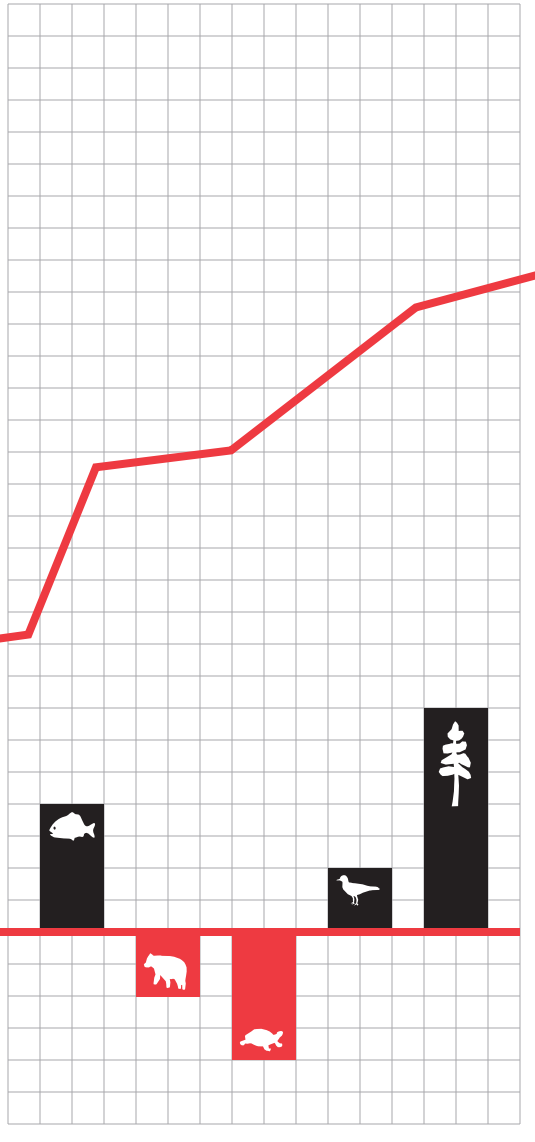
THE NATURE AUDIT



Setting Canada's Conservation Agenda for the 21st Century

REPORT NO. 1 – 2003

WORLD WILDLIFE FUND CANADA

Table of Contents

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The Bottom Line

This first edition of The Nature Audit undertook a regional assessment of species and habitat trends in Canada, examined current pressures on our ecosystems, and assessed Canada's response to current conservation needs in light of its international and domestic commitments to conserve biodiversity. The regional conservation needs of Canada require a multi-faceted strategy emphasizing **protection**, **management** and **restoration/ recovery** in order for commitments to be met on a national scale.

PRIORITIES:

➜ In northern lands and waters, Canada still has opportunities to conserve nature on a grand scale in advance of widespread industrial development, at the same time helping to buffer against the effects of climate change and pollution from toxic chemicals. Time-limited opportunities: northern British Columbia, southern Yukon, southern Northwest Territories, central Quebec and Labrador.

➜ Boreal forests are becoming increasingly impacted from the cumulative pressures of human use. Priority actions: 1) identify and protect intact forests needed to complete protected areas systems; 2) adopt industry best practices (especially forestry, oil and gas) in the surrounding landscape. Priority areas: central and northern Alberta, central Saskatchewan, south-central Quebec and Newfoundland.

➜ Atlantic and Pacific waters are showing significant levels of pressure based on compounding activities such as fisheries, aquaculture, and energy development. Despite this, Canada's Marine Protected Areas (MPAs) system remains among the least developed in the world, and lags significantly behind our land-based system. Priority areas: Bay of Fundy, Gulf of St. Lawrence, the Scotian Shelf and the south coast of British Columbia.

➜ Habitat restoration, in aid of species recovery, must increase significantly. Priority areas: Lower Fraser Valley, BC; mixed grass and tall-grass prairies, aspen parkland in Alberta, Saskatchewan and Manitoba; southern Ontario; the St. Lawrence Valley in Quebec; and Prince Edward Island.

➜ Invasive species – costly, damaging and deadly – continue to arrive in Canada. Priority action: a national prevention plan, which must address the treatment of ballast water and provide adequate inspection of imported goods and their containers, two sources of recent introductions.

➜ Biodiversity-friendly industry standards, such as organic agriculture and Forest Stewardship Council certification, have been adopted on only a fraction of the Canadian landscape. Priority action: more leadership is needed from individuals and companies to voluntarily adopt and support these practices.

➜ Long-lived species with slow reproductive rates, from carnivores and whales, to turtles and yellow cypress trees, are showing declines in almost all regions of Canada. Priority action: Develop and implement regional recovery strategies based on the needs of these species as a group.

➜ The slow pace of review and end-of-pipe approach to regulation of thousands of toxic substances continues to threaten Canada's biodiversity. Reductions in the use of commercial chemicals and synthetic pesticides can best occur with the registration and adoption of alternatives and pollution prevention approaches. Priority areas: southern Ontario and Prince Edward Island.

➜ The biodiversity pressures associated with urban activities, such as pollution and sprawl, are increasingly having far-reaching negative impacts on biodiversity. Priority actions: implement measures to limit sprawl and support public transportation systems.

APRIL 12,1992: THE DATE CANADA RATIFIED THE INTERNATIONAL CONVENTION ON BIOLOGICAL DIVERSITY

Executive Summary

Canada is a diverse country consisting of a variety of regions, primarily due to its enormous size. Different cultures, different politics, different climates and different land and waterscapes create a country characterized by regions. This diversity of place creates some challenges when undertaking a national assessment of how Canada is performing on any given issue. The Nature Audit research team, in putting this report together over the past two years, was repeatedly humbled by the task. Lack of information and/or a lack of access to information, were significant barriers. In the end, we were encouraged by the opportunities to still protect nature and we remain motivated by the urgent need for action to conserve many of our species and spaces.

The Nature Audit's primary objective was to assess how Canada was doing in meeting its major international and domestic commitments to conserve biodiversity. Particular attention was paid to the 1992 United Nations Convention on Biological Diversity and identified areas for action in the 1995 Canadian Biodiversity Strategy.

To assess how Canada was performing against these conservation commitments, it was important to first identify the regional conservation need, which in turn needed to be based on the regional trends observed across Canada for its species and habitats in relation to the human pressures they face. Establishing trends meant starting with a baseline. Based on consultations with conservation biologists, the pre-European state of North America (circa 1500-1600, depending on the location) was chosen as a starting point for the assessment of habitat change and declines or increases in the population status of approximately 1,400 species, from whales to butterflies. The next task was to recreate a template of Canada's landscapes and species distributions as they were 400 to 500 years ago, then fast forward to the present to assess change, and as a result, the type of conservation actions or 'need' required to make progress against Canada's commitments.

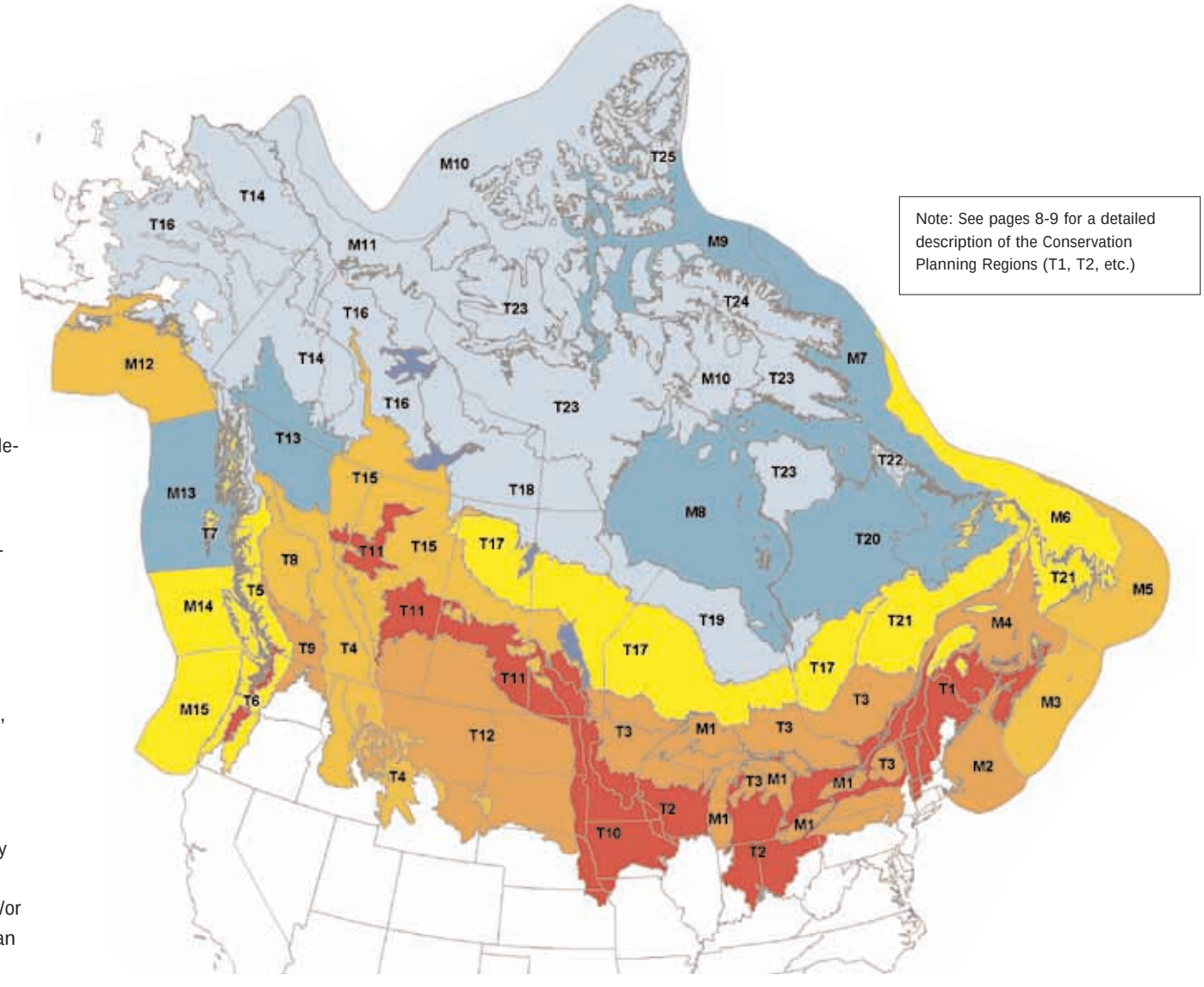
Using the template of Conservation Planning Regions on the map opposite, the story that emerges is one where Canada needs to be equally active on three key conservation fronts to achieve its conservation goals:

- ➔ **Protection;**
- ➔ **Sustainable management of natural resources; and,**
- ➔ **Restoration and recovery of its species and habitats.**

To trade one strategy off for another, or to give more priority to one strategy over another would fail to meet our national conservation commitments. Identifying the best opportunities of where to apply these strategies and being able to establish priority regions that without urgent attention could lose opportunities for conservation action, is key. The map legend provides a signal of broad conservation opportunities across Canada.

The Nature Audit concludes with a broad overview of how Canada is responding to this conservation need by reflecting on specific commitments, activities and successful outcomes regarding development issues that impact nature. Overall, Canada has made significant commitments to conserve nature, often resulting in the creation of programs, committees and discussions to effect change. In the end, however, we are struggling to turn all of this process into on-the-ground success at the scale of intervention required to adequately respond to the conservation need of the nation.

FIGURE 1. REGIONAL CONSERVATION STRATEGIES REQUIRED ACROSS CANADA AND THE ADJACENT UNITED STATES, BY CONSERVATION PLANNING REGION



Note: See pages 8-9 for a detailed description of the Conservation Planning Regions (T1, T2, etc.)

CONSERVATION STRATEGIES

Conservation first: Outstanding opportunities remain to protect intact habitats and species groups.

Time-limited conservation opportunities remain to protect intact habitats and species groups.

Priority conservation actions need to focus on the protection of remaining large habitat blocks and the implementation of regional wildlife management strategies.

Priority conservation actions need to focus on the protection of remaining natural areas with urgent conservation attention directed at the highest-quality sites. Comprehensive management and intervention is required to protect some wildlife populations.

A comprehensive set of conservation actions is required, including protection of remaining natural areas, adoption of best management practices for natural resource-based industries, and significant efforts to restore habitat and recover species.

Significant habitat restoration and species recovery efforts are required but must occur in tandem with the protection of remaining natural areas. Urban growth and/or industry practices must be managed to reduce the human footprint in these regions.

0 500 1,000 1,500 2,000

Kilometres

A Canadian Commitment

Promises, promises… I count no fewer than 28 promises to do a better job of conserving nature in this country, promises made by the Government of Canada alone since 1970. These include everything from proclamation of the Canadian Wildlife Act in the early 1970s, to Canada signing the Ramsar Convention on Wetlands of International Importance in the 1980s, to the national Green Plan announced in 1991.

Probably the best-known of these promises was made, with considerable fanfare, in the international arena at the Earth Summit in Rio de Janeiro. There, Canada was the first industrialized country to sign and subsequently ratify the 1992 United Nations Convention on Biological Diversity. This was followed in 1995 by the Canadian Biodiversity Strategy – a national blueprint promising to implement our international promise.

In addition, business and industry have been coming forward with sustainable development plans, green codes of conduct and certification to international environmental standards.

So we have no shortage of promises and commitments. The real question is, "How well are we doing when it comes to delivering on them?"

The Nature Audit seeks to answer that question, fairly and independently. Its findings also seek to re-focus our collective conservation planning and actions where they are needed most.

But really, how badly are such actions needed in a country as green and pristine as Canada? Read the following pages…I think even the skeptics might be surprised.

To the extent that we still have natural opportunities in Canada, I say that's reason itself for urgency. Let's conserve nature while we can, and not wait until our backs are against the wall.

To the extent that many of our wild species and spaces are threatened, and since Canada officially lists over 400 species at risk, I say that's also reason for urgency. Let's hang on to our last pieces of nature before they are lost permanently, as they have been in so much of the rest of the world.

We have no shortage of promises and commitments. The real question is, "How well are we doing when it comes to delivering on them?"

To the extent that we need to restore nature, I say it's time to pay the price for past neglect. But let's ensure that we don't get into this expensive, last-ditch situation ever again.

"The conservation of biological diver-

©Diana Murphy, PMO Official Photographer Photographe officielle

©UNDPI Photo

Canada was the first industrialized nation to sign and ratify the UN Convention on Biological Diversity – in 1992. Here, (far left) Prime Minister Jean Chrétien and (left) former Prime Minister Brian Mulroney are shown addressing delegates at the World Summit on Sustainable Development (2002) and the Earth Summit (1992).

sity" is definitely not a user-friendly phrase. So, in more plain language, just ask yourself, "Do I want to be one of the last?"

One of the last to dip a paddle into a Canadian lake, and drink cold, clear water as it streams down the blade? One of the last to see a wild bald eagle, or grizzly bear, or white lady's-slipper orchid? One of the last to simply take a walk in a natural area? Or one of the last to earn an honest living from the land, whether it's working in the woods, running a fishing lodge, or relying on "country food" in the case of many Aboriginal communities?

Even urban Canadians use biodiversity products, such as pharmaceutical chemicals (40 per cent of which are still derived from wild plants). Even the venerable Canadian hockey stick is made from ash trees – trees that are increasingly threatened by imported pests and diseases.

I ask you, do you want to be one of the last to have the choice to experience these things, or to at least know they are out there, or to pass that choice on to your children?

These, and many more, are the kinds of living, breathing consequences at stake in The Nature Audit. Ultimately, this report is about the kind of country we want, and what we as Canadians are prepared to do about it. World Wildlife Fund Canada is going to update The Nature Audit every two years, to keep track of how well all of us are doing.

If you and I don't want to be "one of the last," we have promises to keep.

Monte Hummel
President, World Wildlife Fund Canada

Monte Hummel, President
World Wildlife Fund Canada

168: NUMBER OF COUNTRIES THAT HAVE RATIFIED THE INTERNATIONAL CONVENTION ON BIOLOGICAL DIVERSITY

Setting Conservation Priorities in the 21st Century

Canada is a vast country in the enviable position of still having outstanding opportunities to conserve nature. Our country features the world's longest coastline, and encompasses an estimated 20 per cent of the world's remaining natural areas, 25 per cent of the world's wetlands, 20 per cent of the world's freshwater, and more than 10 per cent of its forests – including 30 per cent of the world's boreal forests.

But Canada is also home to widespread, natural resource-based industries and a growing population of more than 31 million people, heavily settled into a narrow band close to the U.S. border. Nature in Canada has changed in order to accommodate our presence and our needs.

Faced with our presence, nature has sometimes adjusted and thrived; in other instances, it has not. For example, when European settlers first arrived on our shores, cod were so plentiful that they literally slowed the passage of small ships. Now, Canada faces significantly depleted cod stocks and continued closure of large parts of the fishing industry. For some ecological systems, our human 'footprint' has been too large, and the result has been species decline, lost habitat and toxic pollution that poisons many species – including our own.

As a nation, it's time we took stock of the 'footprint' we are leaving on nature. This idea – to take stock of Canada's natural assets, expenditures and 'savings' – has resulted in the birth of this new initiative we have called The Nature Audit.

Decision-makers from all levels of government, industry leaders, environmental groups – and ordinary Canadians – all have a role to play in conserving nature. Our goal is to inform and assist efforts to improve the protection of our biodiversity and ecosystem health. To help accomplish this, The Nature Audit includes a list of recommended actions to help set Canada's conservation priorities for the 21st century.

BACKGROUND

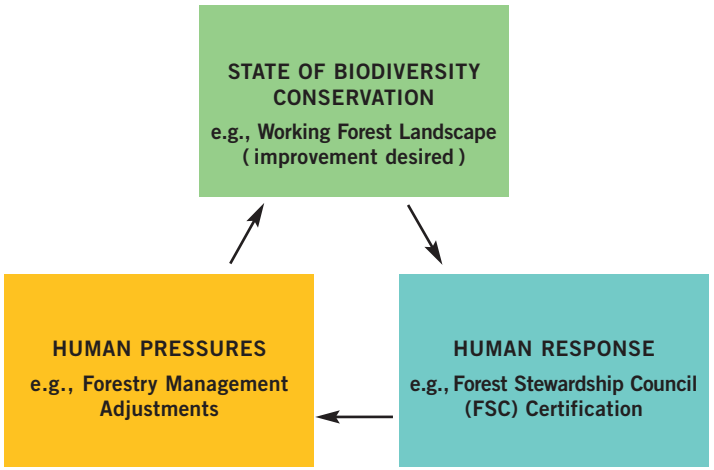
Canada has made international commitments to conserve nature, but are we meeting them? To answer that question, and to enable us to make recommendations for conservation action, The Nature Audit has measured Canada's performance on implementing policies, programs and practices intended to protect and conserve the country's natural capital.

Canada was the first industrialized country to ratify the 1992 Convention on Biological Diversity, setting the stage for the development of a range of commitments and initiatives to address one of the primary objectives of the Convention: namely, to "conserve biological diversity".

In 1995, the federal government released the Canadian Biodiversity Strategy, which "put the commitments of the Convention into a Canadian context and provided planners and policy-makers with guidance on how to better reflect biodiversity conservation and sustainable use considerations in policies, plans, strategies and programs" ("Caring for Canada's Biodiversity, Canada's First National Report to the Conference of the Parties to the Convention on Biodiversity," Government of Canada, 1998). This response set out goals, objectives, and activities necessary to address threats to Canada's biodiversity across a comprehensive breadth of subject matter. We have used much of this to help set the standards for conservation monitoring in The Nature Audit.

The Convention also highlighted the need for regular monitoring and reporting on implementation. To this end, The Nature Audit assessed conservation action to implement the Convention and support conservation commitments. The Nature Audit will also be conducted and released every other year, so that we can continue to measure Canada's conservation efforts and their resulting effectiveness.

FIGURE 2. THE STATE-PRESSURE-RESPONSE MODEL USING FORESTRY AS AN EXAMPLE



OUR APPROACH

The approach used in The Nature Audit is to compare the 'conservation need' of different regions in Canada with the adequacy of conservation 'response'.

It is tempting to suggest that the 'conservation need' will always be highest where species are rapidly declining or habitats have been lost. In The Nature Audit, we take a more comprehensive view of urgent conservation need by suggesting that to succeed in meeting the conservation challenges in Canada, actions are equally needed at both ends of the conservation spectrum. By this, we mean that a species classified as 'abundant' and a species that is 'endangered' will both benefit from the wise application of conservation efforts.

Actively pursuing opportunities to conserve intact nature in advance of development (the Conservation First Principle) makes as much sense as restoring and recovering elements of nature where they have been lost. By looking at the different characteristics of regional conservation need across Canada, we will assess whether current conservation responses are tailored to meet the regional need.

The Nature Audit uses the analogy of a financial audit to summarize: 1) changes to the state of Canada's natural capital with a focus on species and habitats; 2) natural capital 'expenditures' by examining the current distribution of human development pressures on the capital; and, 3) Canada's overall response to reduce any identified natural capital 'debts' and to protect existing balances.

The State-Pressure-Response model is used to monitor and evaluate the success of policy and program implementation. As the working forest example (Figure 2, left) illustrates, the state of any given measure is the result of pressures coming to bear on it. Should the state move in an undesirable direction, then a response that modifies the pressures can be undertaken in the hope that it will lead to an improvement to the state. Further monitoring of the state will determine the effectiveness of the response and whether additional adjustments are needed.

©Karl Sommerer

Horned puffins, a common species of seabird on the Pacific Coast.

60 MILLION: THE ESTIMATED NUMBER OF BIRDS POISONED EACH YEAR IN NORTH AMERICA BY PESTICIDES

Conservation Planning Regions

To address conservation goals that directly impact human interaction with Canada's lands and waters, The Nature Audit has modified existing national and continental ecoregion frameworks to create conservation planning regions (CPRs). These regions, depicted in Figure 3 (right), are ecologically based, but differ slightly from other ecoregion frameworks: each CPR also encompasses areas of similar human development, interest and activity. The importance of this distinction is that, as much as we are an influence on the landscape, the landscape in turn influences the nature of our industrial practices, our prospecting for gold or oil, and even the way in which we lay out our road systems and settlement patterns.

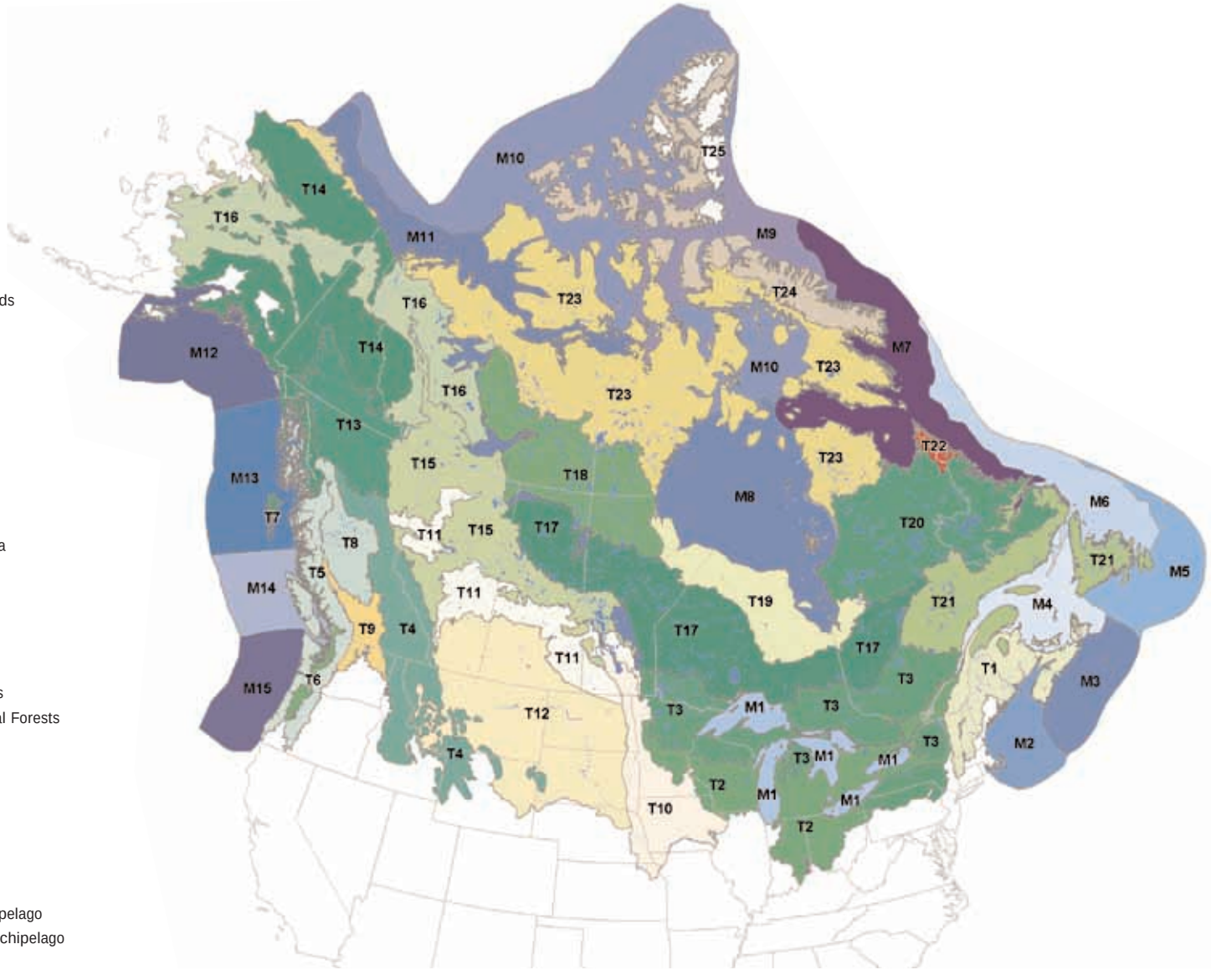
WHY CONSERVATION PLANNING REGIONS?

Framing Canada's lands and waters into these CPRs has enabled The Nature Audit to better evaluate practical, regionally based conservation actions that can lead to new ways of doing business that lessen our impact on ecosystem health.

The CPR framework we have used consists of 25 terrestrial and 15 marine regions. From nature's perspective, the political boundaries of provinces, territories and even countries do not always reflect the best way to assess our biodiversity conservation efforts. Therefore, to better assess the overall status of priority conservation measures as a whole, where CPRs spanned the U.S. border, they were extended into U.S. territory. In this way, the relative status of the Canadian portion of the region can be more accurately portrayed in terms of its importance to regional conservation needs.

Anyone who has traversed Canada knows that it is a vast country spanning a variety of landscapes. This suggests that any given conservation program may be easier to deliver in one region over another. Those differences are important in a report such as The Nature Audit, where the goal is to measure results and focus future conservation effort in areas or regions where our response is still insufficient to meet the need. For conservation purposes, ecological frameworks are helpful in providing a geographical definition of where knowledge and similar conservation strategies can be most successfully shared and applied.

FIGURE 3. CONSERVATION PLANNING REGIONS



LAND-BASED CONSERVATION PLANNING REGIONS

Deciduous and Mixed Forest Regions
- T1 Appalachian Mountains and Maritime Lowlands
- T2 Southern Great Lakes and St. Lawrence Lowlands
- T3 Upper Great Lakes and Laurentians

Temperate Coniferous Forest Regions
- T4 Southern Rocky Mountains
- T5 West Coast Temperate Rainforest
- T6 Puget Sound Lowlands and Willamette Valley
- T7 Queen Charlotte Islands
- T8 Central British Columbia Interior Mountains

Grassland and Parkland Regions
- T9 Southern Interior British Columbia Mountains
- T10 Mid-western Tallgrass Prairie and Oak Savanna
- T11 Aspen Parkland
- T12 Short and Mixed Grass Prairie

Boreal and Northern Transitional Forest Regions
- T13 Northern Rocky Mountains
- T14 Yukon - Alaskan Mountain Ranges
- T15 Western Canadian and Foothills Boreal Forests
- T16 Mackenzie Valley - Central Alaskan Transitional Forests
- T17 Central Canadian Boreal Forests
- T18 Northern Canadian Shield Transitional Forests
- T19 Southern Hudson Bay Lowlands
- T20 Central Quebec-Labrador Transitional Forests
- T21 Quebec North Shore and Newfoundland

Arctic Regions
- T22 Torngat Mountains
- T23 Low Arctic Barrens and Southern Island Archipelago
- T24 High Arctic Mountains and Northern Island Archipelago
- T25 Permanent Snow and Ice

0 500 1,000 1,500 2,000

Kilometres

NEARLY ONE-HALF: AMOUNT OF CANADA COVERED BY FOREST

Setting the Opening Balance

In the financial world, an audit examines an accounting of: 1) increases or decreases of a commodity over a given timeframe (the baseline to present); and, 2) deviations from budgeted predictions (the forecast or 'bottom line').

But in the biological world, it's difficult to examine either of these, especially when trying to estimate changes in biodiversity over a long period of time. Aside from the challenges of characterizing your 'capital', there is often a lack of good information on historical or baseline accounts. This information gap can make it difficult to draw comparisons to the current situation.

In view of this lack of historical accounting, The Nature Audit was left with a choice: we could restrict our analysis to a relatively short time period, where complete data would be more readily available; or we could go back further in time. With the assistance of scientific experts, we could then recreate – to the best of our collective ability – a coarser-scaled version of Canada's natural history accounts that would provide us with an approximate benchmark and still give us a strong signal of the degree of change our ecosystems and species have undergone.

THE VALUE OF THE LONG VIEW

The Nature Audit opted to use the second option, since it offers the possibility of informing Canadians of the full scale of change that has occurred since European explorers first arrived on the continent. Why? In recounting change, too often we can only recall the timeframe of our own lives, or those of our parents and their parents through story-telling. Not knowing the true scale of change can mislead us as to the true extent of long-term cumulative changes. But perhaps more importantly, it can limit our ability to see future possibilities.

Ultimately, the purpose of The Nature Audit is to help set a conservation agenda for Canada in the 21st century, based on our understanding of our history, the patterns of change and the different trajectories of change being experienced regionally across the country.

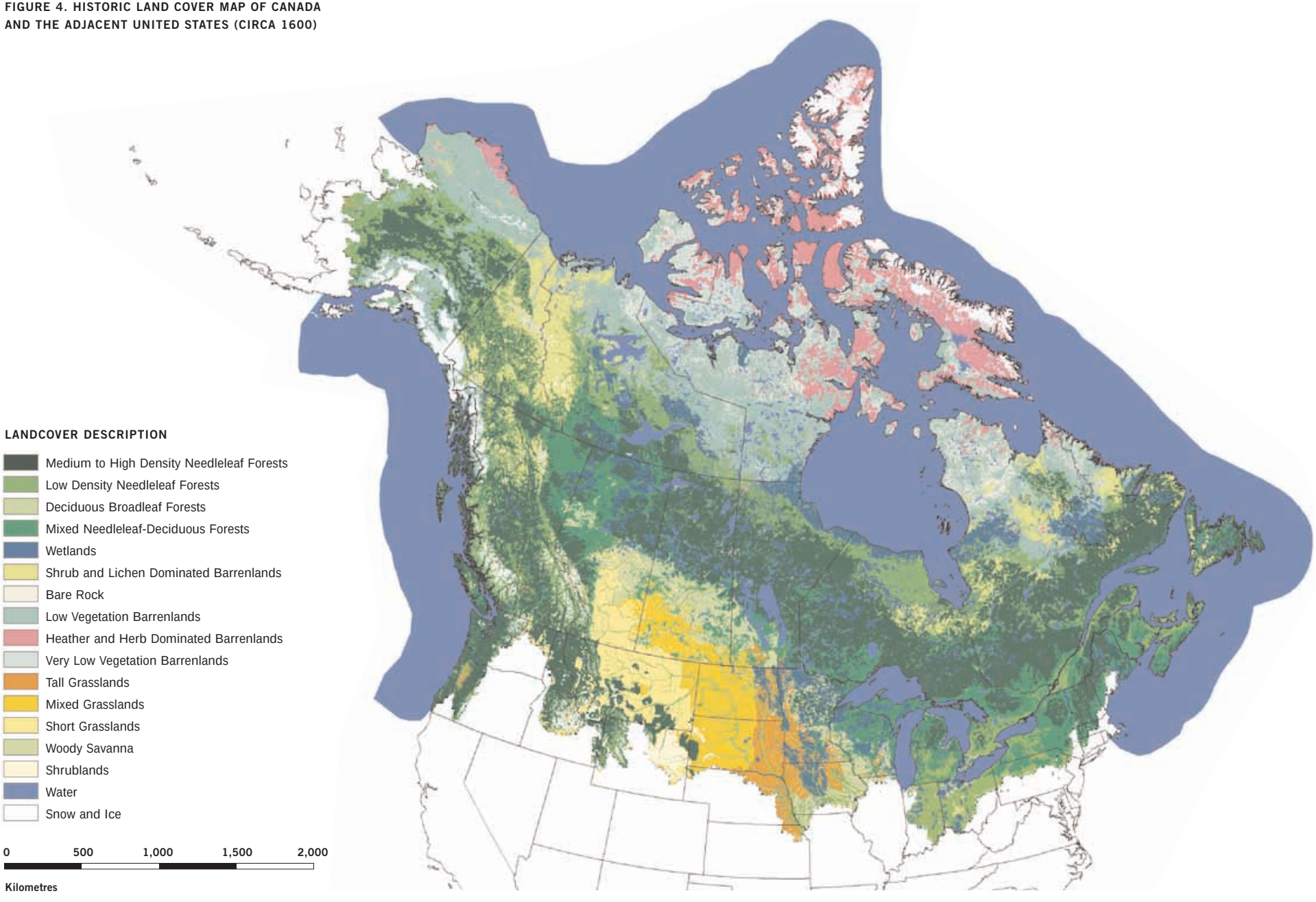
Our starting point or baseline for assessing changes to our land-based habitat accounts is reflected in the map you see on the opposite page. This reconstruction of major habitat types coarsely reflects the general distribution prior to European settlement (circa 1500-1600) of forests, grasslands, major wetlands, Arctic vegetation communities, and more.

The map was constructed by piecing together a combination of current landcover mapping for those parts of Canada believed to be the least disrupted by human activity. Elsewhere, we used existing historical vegetation accounts, topographical modeling and potential vegetation mapping to develop this historical landcover map.

With the opening accounts in place, The Nature Audit has estimated our habitat baseline.

Canada was once home to billions of colourful passenger pigeons. Now extinct, this species was last seen in the wild in the late 1800s.

FIGURE 4. HISTORIC LAND COVER MAP OF CANADA AND THE ADJACENT UNITED STATES (CIRCA 1600)



INTRODUCTION:

Canada's Natural Capital Accounts: Deficit or Surplus?

far left ©J.D. Taylor; left ©Wilf Schurig

Grizzly bears, a top-level predator in some of Canada's ecosystems (far left). Chestnut-collared longspurs can be found in mixed-grass prairies (left).

TABLE 1. NUMBER OF SPECIES COVERED BY THIS REPORT

Species groups	Number of species covered	Approx. percentage of Canada's native species represented
Mammals	100	50%
Birds	437	95%
Reptiles and amphibians	91	100%
Freshwater fish	186	85%
Marine fish	119	12%
Butterflies	288	100%
Trees and large shrubs	124	55%
Orchids	74	100%

Imagine traveling back in time...before Canada was widely settled, when billions of cod filled our east coast waters and millions of bison roamed our vast western grasslands; virgin forests stretched from coast to coast, all the rivers ran free of dams and pollutants and the term 'urban' couldn't be applied. If you could do that, you could experience a richness of biodiversity almost unimaginable today, all set in a stage of intact wilderness.

Now imagine fast-forwarding to the present, and watching the changes in nature as the country is settled, as humans intensify their use of the landscape. What does that change look like? Where has it happened? And what have we lost or gained because of it?

In financial terms, this opening 'Accounts' section of The Nature Audit looks at whether Canada is in a deficit or surplus position by providing results of our time travels, from our baseline of pre-European settlement to present day. It presents broad signals of how the country's natural heritage – our wildlife and natural land and waterscapes – have changed. While some extent of the change is undoubtedly 'natural,' by far the bulk of the biodiversity and habitat change that has occurred since European settlement in Canada has been caused by humans.

The Nature Audit does not suggest that Canada's conservation goal should be to replace every lost bison and forest, to stop farming and fishing and to return to the state of Canada's nature 500 years ago. Rather, our aim is to offer a perspective to help us all understand the biodiversity changes that have already occurred, and to put into better light the value of and current needs for conserving biodiversity today. If we understand where we've come from and the patterns of change as they unfold, we can make better decisions about where we want to go in the future. WWF-Canada feels this perspective is key to helping Canadians set priorities for the conservation of nature in the 21st century.

MEASURING SPECIES CHANGES OVER TIME

The Nature Audit presents information accumulated from scientists (see pp. 102-103), who provided both data and (where no data exists) expert opinion on the changes in species presence, range and abundance in each Conservation Planning Region, and on the threats to species. The result is information about more than 1,400 native species (Table 1), revealing broad trends in their presence, range and abundance among the Conservation Planning Regions (CPRs) of Canada since European settlement.

The following pages reveal the analysis summaries organized by species group: mammals, birds, reptiles and amphibians, freshwater fish, marine fish, butterflies, trees, and orchids. For each species, occurrence, range and abundance trends within each CPR were determined or estimated for time periods between European settlement and present day. 'Regional Disruption Scores' were then determined for each species as the absolute per cent change in range and abundance from pre-European settlement to present day, and were used to compile average Regional Disruption Scores for each species group (see Table 2 for further description).

This effort clearly revealed marked differences both across species groups and within species groups in different regions across the country. It also brought home the fact (Table 3) that a significant amount of work remains to be done to collect basic data on the country's biodiversity – information that is vital to helping us determine how we can put our best foot forward for conservation.

It is our hope to expand this analysis over time to include information about less studied, but no less important groups of species that are an integral part of Canada's biodiversity, including small mammals and additional marine fish, plants and invertebrate groups. By doing so, we will continue to develop an increasingly comprehensive perspective of the patterns of change occurring across Canada.

TABLE 3. DATA AND EXPERT OPINION USED FOR DEVELOPING SPECIES TREND ANALYSIS

	Number of responses	Percentage of responses
Some to adequate data available	48,434	19.2%
Some data available, complemented by expert opinion	159,393	63.1%
Little or no data available – expert opinion used	21,474	8.5%
No data available – noted as unknown	23,117	9.2%
Totals	**252,418**	**100%**

ACCOUNTING FOR HABITAT CHANGE OVER TIME

Since much of the change in species range and abundance has been driven by the loss and degradation of habitat, The Nature Audit opens the natural capital accounts section by examining the cumulative degradation of major habitat types in Canada since European settlement. To do this, the CPRs were grouped into Arctic, Forest, and Grassland habitat types. The major historical land cover types within each of these groups were assessed to determine their circa 1600 relative percentages. Next, using the expenditures data (see pp. 44-69), the amount of each land cover type currently remaining in a relatively undisturbed state was calculated.

TABLE 2. CLASSES OF SPECIES DISRUPTION SCORES AT THE CONSERVATION PLANNING REGION LEVEL. SCORES WERE CALCULATED AS MEAN PER CENT CHANGES, FROM TIME OF PRE-EUROPEAN SETTLEMENT TO PRESENT, IN THE RANGE AND ABUNDANCE OF SPECIES GROUPS. MAP LEGENDS ON PAGES 25-39 ARE BASED ON THESE CLASSIFICATIONS.

Species Disruption Classes	Regional Disruption Score (%)	Description of Species Disruption Classes
No species assessed	Not applicable	No species present or data was unavailable.
Negligible to very low disruption	0 – 4	No known or very low disruption among species within the study group from historical baseline states. Full complement of species present and represented by viable populations.
Low disruption	5 – 19	Some disruption from historical baseline states can be detected for the study group. A few species have declined in population and/or abundance, but most remain stable.
Moderate disruption	20 – 44	Moderate levels of disruption from historical baseline states can be detected for the species group. Some individual species may be heavily impacted in terms of their population and abundance.
High disruption	45 – 69	High levels of disruption from historical baseline state can be detected for the species group. Some species may be extirpated from large parts of their historic range or their populations may be highly reduced in range and/or abundance compared with pre-European conditions.
Severe to critical disruption	70 - 100	Severe to critical levels of disruption from historical baseline states can be detected for the species group. Many species may already be extirpated from large parts of their historic range or their populations may be highly reduced in range and/or abundance compared with pre-European conditions.

Sunset over the barrens, near the headwaters of the Thelon river in the Northwest Territories.

COOL CAPITAL: Arctic Habitat Accounts

The Canadian Arctic is a land of extremes, of endless nights and endless days, of cycles marked by months of cold winter white followed by brief bursts of thaw, flowering and renewal. It is a vast and awe-inspiring place that supports some of the world's largest remaining pristine habitats – rocks and herbs, muskeg and sky, this delicate landscape is an international treasure. The world's largest populations of caribou, muskoxen, and polar bears call the Canadian Arctic home. It is also home to communities of people whose very survival depends on the health of the land and its wildlife.

Note: hatched areas indicate transitional Arctic-taiga habitat

To the eye, the Arctic seems largely pristine. In comparison with landscapes farther south, it is relatively untouched by the human footprint. But this is not the time to be complacent. Human uses of the Arctic's natural capital – oil and gas development and mining among them – are increasing, and must be planned carefully to avoid destroying the delicate balance of life in the north.

One of the greatest pressures acting in the Canadian Arctic today is largely invisible – that of persistent organic pollutants (POPs). POPs are brought by prevailing winds and ocean currents from more industrialised regions, sometimes thousands of kilometres away. Though POPs are invisible, we can see the devastating effects they can have on wildlife: fish and seals with lesions, polar bears with both male and female genitalia, wildlife with weakened immune systems and reproductive failure. Add to this the impacts of climate change, which is resulting in thinner polar bears due to shortened feeding times as the polar ice melts earlier (see page 23), and major ecological pressures on other wildlife, and you can see how global pressures are having major and cumulative impacts on Canadian Arctic wildlife and their habitats.

It is now, while habitat conservation options still exist, that the Arctic is a high priority for conservation action. Now is the time to make sound choices and investments to ensure that we provide protection for Arctic wildlife, Arctic habitats and Arctic peoples so they continue to thrive.

FIGURE 5. RELATIVE BREAKDOWN OF HISTORIC LAND COVER IN THE ARCTIC

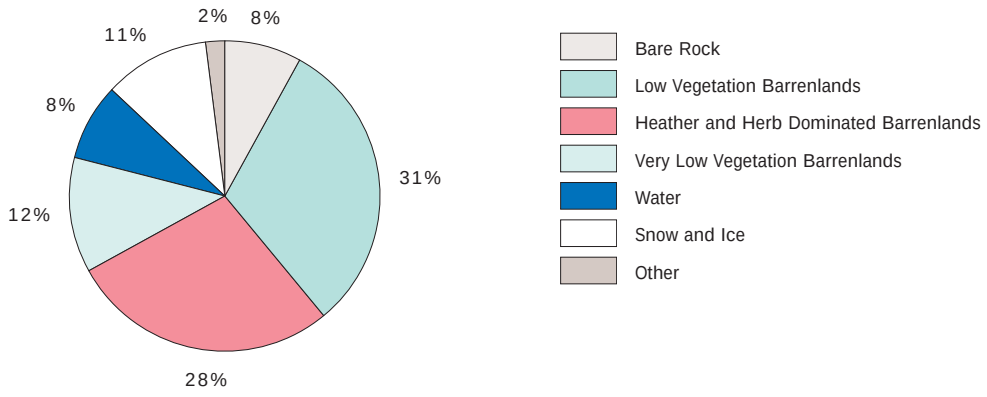


TABLE 4. ARCTIC HABITATS REMAINING WITH A RELATIVELY LOW HUMAN FOOTPRINT

MAJOR LAND COVER (HABITAT) CLASSES WITHIN THE ARCTIC CONSERVATION PLANNING REGIONS	% REMAINING WITH LITTLE OR NO FOOTPRINT
Medium- to High-Density Needleleaf Forests	91.4
Shrub- and Lichen-Dominated Barrenlands	91.6
Low-Density Needleleaf Forests (Taiga)	92.2
Wetlands	93.4
Low-Vegetation Barrenlands	97.0
Water	97.4
Bare Rock	99.7
Heather- and Herb-Dominated Barrenlands	99.9
Snow and Ice	99.9
Very Low-Vegetation Barrenlands	100.0
Total for Arctic CPRs	**96.0**

The Mackenzie River delta.

The Mackenzie Valley: Balancing Habitat Protection with Natural Gas Development

The Mackenzie Valley, in Canada's western Arctic and boreal region, is one of the world's great river systems still in its natural state. It is home to huge breeding populations of migratory ducks, geese and loons and intact predator-prey systems – including caribou, wolves and grizzly bears.

These wildlife and their habitats have supported indigenous people for millennia. But deep beneath the land are large natural gas deposits, and North American energy markets and Aboriginal people in the Northwest Territories (NWT) are keen to have a large gas pipeline from the Mackenzie Delta to northern Alberta.

Stakeholders are now poised to develop a pipeline, embracing a "Conservation-First" approach, rooted in Aboriginal traditions and settled Land Claims. This well-planned, landscape-level approach will help ensure that key natural and cultural areas are identified and reserved before the pipeline is completed.

Using the community-based NWT Protected Areas Strategy, a network of culturally significant and ecologically representative protected areas is being identified in those natural regions directly intersected by the pipeline and associated developments. This network will be protected by 2008, when the gas is expected to begin flowing.

far left ©Karl Sommerer; left ©Peter Ewins

Canada possesses a wide range of forests from the temperate rainforests of the Queen Charlotte Islands (far left) to the boreal forests across much of Canada (left).

GREEN CAPITAL: Forest Habitat Accounts

From coast to coast, a great swath of forest sweeps across Canada, covering one-half of the nation's land mass: boreal forests from Labrador to Yukon, deciduous woodlands in the Great Lakes region, and coastal temperate rainforest along BC's westernmost fringe. These forests are home to countless caribou, moose, elk and deer; they support packs of wolves, among other predators, and they provide habitat for two-thirds of all of Canada's species of flora and fauna. Naturally abundant in fish, fur-bearing mammals and useful plants, Canada's forested landscapes have also served as the homelands for dozens of First Nations communities across the country.

Half a billion hectares in extent, Canada's forests seem endless. In fact, for most of the last four centuries, we have treated them as such. So much of Canada's forest estate has been cleared entirely or allocated to industry for logging that, in the southern boreal and deciduous forest regions, governments have few, if any, options left to establish adequate protected areas in their natural state. In these regions, populations of some wildlife species, like woodland caribou, are in decline or extirpated. A history of unsustainable use of forests has contributed greatly to the plight of many First Nations communities, and led to over-dependence of many rural communities on wood supply that cannot be sustained at the current rate much longer.

With about half of Canada's forests still wild and intact, and the rest with smaller remnant areas still functioning naturally, there is still time to save forested lands for conservation of their biological diversity.

Though the forest products sector is Canada's largest employer, generating tremendous financial rewards and tax revenues, attitudes are changing rapidly in Canadian society. Canadians do not want to sacrifice long-term forest health for short-term wealth. Attitudes are changing in industry, too, where signs of innovation provide hope for making a smart transition from a focus on only economic bottom-lines to a 'triple-bottom-line' of enduring environmental, social and economic benefits. By encouraging innovation where logging already occurs, and by adopting a Conservation First Principle where forestry has not yet disrupted the landscape, Canada stands to benefit even more from its forests in the future than it has in the past.

FIGURE 6. RELATIVE BREAKDOWN OF HISTORIC LAND COVER IN CANADA'S FORESTED REGIONS

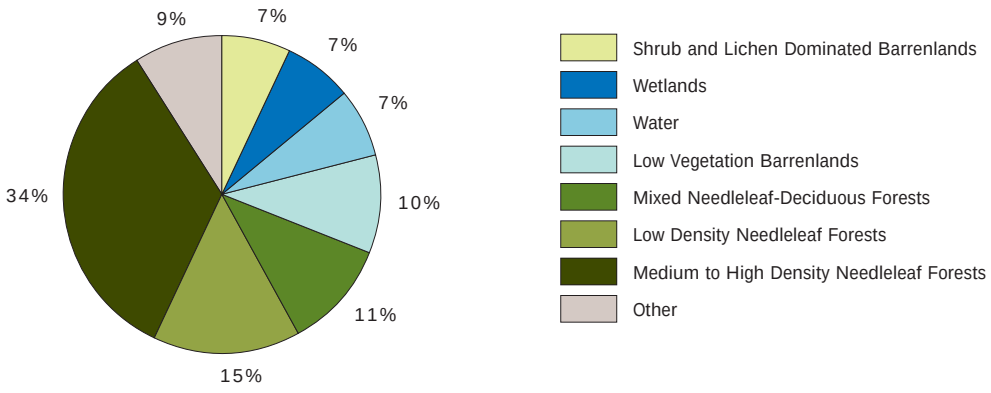


TABLE 5. FOREST HABITATS REMAINING WITH A RELATIVELY LOW HUMAN FOOTPRINT

MAJOR LAND COVER (HABITAT) CLASSES WITHIN FOREST CONSERVATION PLANNING REGIONS	% REMAINING WITH LITTLE OR NO FOOTPRINT
Deciduous Broadleaf Forests	0.7
Woody savanna	2.2
Mixed Needleleaf-Deciduous Forests	10.2
Wetlands	22.0
Medium- to High-Density Needleleaf Forests	28.2
Snow and Ice (High elevation)	44.9
Low-Density Needleleaf Forests (Taiga)	46.0
Water	48.7
Shrub- and Lichen-Dominated Barrenlands	69.0
Total for Forest CPRs	**26.2**

©Karl Sommerer

CURRENT STATUS OF CANADA'S FORESTS
Following the sweep of colonization and exploitation over the last four centuries, southern forests are largely fragmented and degraded and will require restoration. Boreal forests are being logged in some regions unsustainably and in many areas without adequate protection, while northern taiga forests are largely pristine, at least for now.

Future Frontiers for Forestry

Wild forests of Canada's northern boreal and taiga regions offer perhaps the best chance of any in the world to conserve forest wildlife species and natural processes in near-pristine condition. Spared as yet from extensive road networks, logging, mining and other industrial activities, these 'frontier' forests are largely undisturbed, and therefore described as being 'intact.'

Such areas are still subject to the forces of nature as they have acted for millennia, especially fire, which remains the major natural disturbance factor and renewal force in boreal forests from Yukon to Labrador. Canada's combination of large intact, frontier forest and broad societal support for conservation of nature is perhaps the best opportunity to conserve large forest expanses in the entire world. Successful conservation of this vast and largely undeveloped woodland, which can include careful forest use for First Nations communities seeking avenues for cultural preservation and human development, is a unique global challenge and opportunity for Canadians to seize in the 21st century.

10%: THE PERCENTAGE OF THE WORLD'S FORESTS THAT LIE WITHIN CANADA

Once, the prairies of North America were home to around 45 million bison (far left); their numbers have been drastically reduced to only a few thousand. The prairies are home to other species such as the pronghorn antelope (left) which can reach speeds of 100km/hr in short bursts.

GOLDEN CAPITAL: Grassland Habitat Accounts

From lush pothole prairies of central Canada and the eastern U.S. to arid fescue grasslands in the rain shadow of the Rocky Mountains, the central plains are North America's version of East Africa's Serengeti grasslands. Two short centuries ago, the continent's heartland was an endless ocean of grasses, a place teeming with great flocks of waterfowl, millions of bison, pronghorn antelope, deer and elk, complete with great predators from swift fox to wolves and grizzly bears.

Since then, this landscape has felt the heavy hand of human use. Because of its deep, rich soils, the prairie region became the breadbasket of the continent, with agriculture and ranching spanning huge tracts of land. Beneath the prairie roots, large reserves of oil and gas have attracted widespread development. Rivers have been dammed for irrigation, 'pest' species like black-tailed prairie dogs continue to be exterminated, and pesticides applied to crops work their way up the food chain. Since European settlement, fence lines, pipelines, croplands and roads have carved the native grasslands into increasingly smaller fragments and the ecological processes needed to sustain the prairie have been disrupted.

Such intensive use has taken its toll. Some species, including grizzly bear, bison, swift fox and black-footed ferret have been completely or virtually wiped out, and whole groups of species, such as grassland birds, are now in decline. Humans are also a declining species in the prairies; the economies of many communities are in retreat and people are leaving in search of better opportunities to earn a living. The grasslands are at an ecological and economic crossroads. We need to find ways now to conserve the intact grasslands that remain, and to renew both natural and human communities.

In addition to the vast grassland region in the heart of the country, other smaller grassland areas occur, including the tallgrass savannas of Southern Ontario, sagebrush communities in BC's Okanagan Valley, and Garry Oak meadows in southern coastal BC. Only tiny fragments of these habitats remain, the rest swallowed up by intensive urbanization and agriculture. In these grasslands, habitat and species restoration efforts are needed to prevent them from disappearing completely.

FIGURE 7. RELATIVE BREAKDOWN OF HISTORIC LAND COVER IN CANADA'S GRASSLAND AND PARKLAND REGIONS

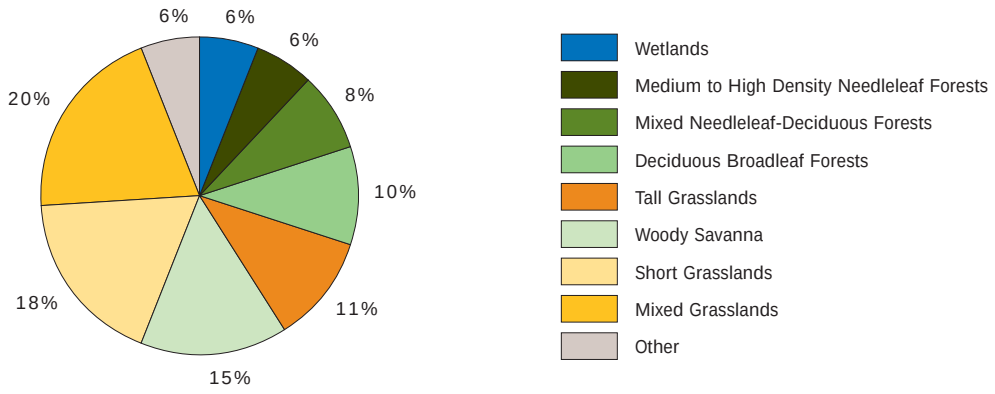
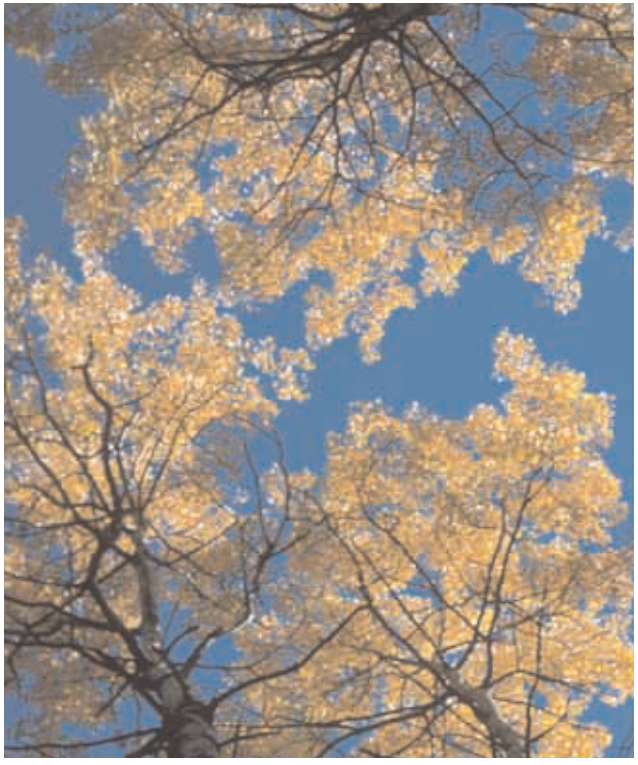


TABLE 6. GRASSLAND AND PARKLAND HABITATS REMAINING WITH A RELATIVELY LOW HUMAN FOOTPRINT

MAJOR LAND COVER (HABITAT) CLASSES WITHIN GRASSLAND CONSERVATION PLANNING REGIONS	% REMAINING WITH LITTLE OR NO FOOTPRINT
Tall grasslands	<0.1
Mixed grasslands	<0.1
Shrublands	<0.1
Short grasslands	0.1
Woody savanna	0.1
Wetlands	0.1
Deciduous Broadleaf Forests	0.1
Mixed Needleleaf Deciduous Forests	1.0
Medium- to High-Density Needleleaf Forests	1.5
Total for Grassland CPRs	**0.9**



©Jason Shafto

Aspen parkland is one of the most altered landscapes in Canada.

Canada's Central Grasslands: One of the Earth's Most Biologically Significant Places

The Northern Great Plains (NGP) is a region of mixed grass prairie that spans over 650,000 km² from southeastern Alberta, across southern Saskatchewan and through parts of the Dakotas, Montana, Nebraska and Wyoming. A region of flat grasslands accented with rugged badlands, meandering rivers and lush prairie wetlands known as potholes, the NGP is a hotspot of biodiversity. In the northernmost portion are found Canada's only watersheds draining through the enormous Missouri-Mississippi basin. In an initiative called 'The Global 200,' WWF has ranked the NGP as one of the most biologically significant and most threatened natural regions on earth.

Worldwide, temperate grasslands are afforded the least protection of all major habitat types – less than one per cent is protected globally. Canada's grasslands are no exception. While some options remain for large protected areas here, the door of opportunity is fast closing. The time for action is now.

45 MILLION: THE NUMBER OF BISON THAT ONCE ROAMED THE NORTH AMERICAN PRAIRIES

far left ©Royal British Columbia Museum; left ©Charles Seaborn

Bull kelp (far left), which makes up the giant kelp forests of the west coast, and (left) sea slugs and soft corals, are some of the many marine species inhabiting Canadian waters.

LIQUID ASSETS: Marine Habitat Accounts

Canada's history and culture is steeped in the sea. Long before forests were harvested or furs were collected commercially, the world was coming to what would eventually be Canadian waters because of the rich natural resources of our seas.

There remains a great wilderness of sea in Canada, perhaps more than in any other country. There are still wild Pacific rivers that teem with the salmon spawns. Millions of seabirds breed on the coasts of Newfoundland, sustained by a bounty of fish in the surrounding waters. Bowhead whales still laze and gorge in the nutrient-rich waters of Igaliqtuuq, on Baffin Island.

As much a part of our marine heritage, but far more mysterious, are the habitats and species that lie out of sight: the centuries-old deep-sea coral forests off the coast of Nova Scotia; the teeming kelp forests in BC; hydrothermal vents in the sea floor, populated by strange species found nowhere else on earth; vast undersea canyons; and towering seamounts rising from the ocean floor nearly to the surface. We understand very little about marine ecosystems, even though Canada's waters make up approximately one-third the size of the country's entire land mass.

The Great Lakes, the largest freshwater system in the world, share much in common with our oceans – indeed, are connected directly through the St. Lawrence Seaway. Like Canada's marine realm, the Great Lakes are huge, extend beyond our jurisdiction, face threats beyond direct Canadian control, and require bi-national and international cooperation to be effectively managed.

Historically, fishing has been the dominant economic use of our marine resources. The growth and industrialization of fishing fleets has outstripped the capacity of the resource and caused serious change to the oceans, including stock collapses, altered community structure and loss of critical habitat for many species of fish, birds, mammals and countless invertebrates.

Over the past half-century, we have seen many new or expanded uses of marine resources, leading to new economic opportunities but also new threats. Offshore oil and gas development, aquaculture, tourism, shipping and coastal development are new or growing uses of the marine environment that, when not done carefully, can and are causing serious and long-term damage to marine ecosystems. Climate change threatens ice cover in the Arctic, and perhaps even the direction of major ocean currents – with the potential for extinction of countless species.

The world is waking up to the need for better conservation of our oceans. In September, 2002, at the World Summit on Sustainable Development, Canada and other participating nations committed to completing representative networks of marine protected areas by 2012, and restoring depleted fish stocks by 2015. Marine protected areas, ocean zoning, and ecosystem-based fisheries management are new ideas that could serve to slow and reverse the accelerating decline in the health of our marine ecosystems. If we are successful, Canada has as much or more to gain than any country in the world – and more to lose if we fail.

©Mike Strong and Maria-Ines Buzeta

Species such as this finger sponge (left) are vulnerable to disturbance by botton trawling.

Seafloor Habitats and Bottom

Just like on land, the ocean bottom is made up of productive and complex habitats, ranging from kelp, seagrass beds and oyster reefs near the shore, to deep-sea coral, sponge and mussel reefs on the deeper continental shelves. Each habitat supports a unique community of fish, invertebrates, and other wildlife that rely on the physical structure for refuge, reproduction and food.

Even though many of these habitats are found in deep waters far from human sight, they are no less susceptible to habitat change and destruction. Some fishing methods, such as bottom trawling, involve dragging heavy gear across the sea floor. This can result in scouring, uprooting, scattering or burying of sea creatures and destruction of seabed habitats. Recovery can take many months, years, and even decades in deep and complex habitats, which have low levels of natural physical disturbance.

Over time, technology has allowed fishing methods to become more efficient and able to access parts of the ocean down to 1,400 m (more than a kilometre!) in depth. This could lead to further destruction of important but little-known habitat structures like deep-sea corals and sponge reefs.

©Mike Strong and Maria-Ines Buzeta

Pollock and other ground fish stocks (left) make the Scotian Shelf one of Canada's richest fishing grounds.

The Undersea World of the Scotian Shelf

Surrounding Nova Scotia and up to 200 nautical miles off its coast, the Scotian Shelf is an undersea world of shallow banks, gullies, and sedimentary basins, providing habitat for species of fish, invertebrates, marine mammals and seabirds. The Sable Gully, the largest underwater canyon on the east coast of North America, is in the eastern Scotian Shelf and supports populations of the endangered northern bottlenose whale.

Economic activity in the Scotian Shelf includes fishing, marine transportation, and increasingly, oil and gas exploration. Intense fishing pressure, both Canadian and international, has reduced populations of many fish stocks, resulting in lower quotas as well as fishing bans. Other threats to the area include oil spills and waste from tankers and production sites, and seismic testing.

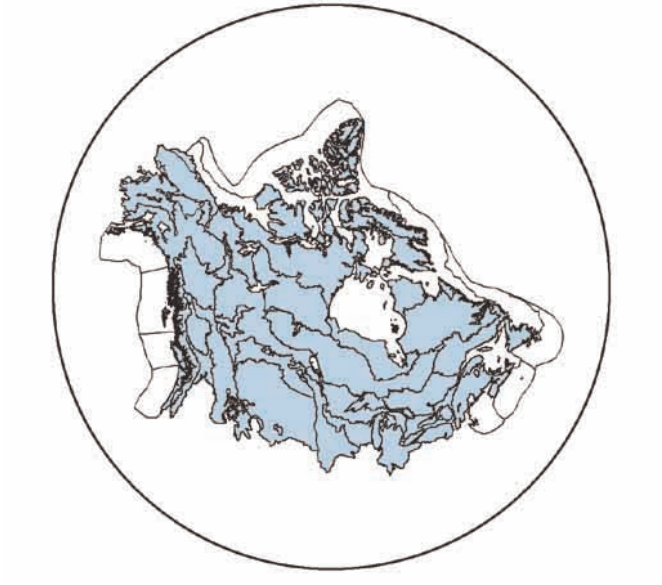
To ensure the ongoing viability of the Scotian Shelf ecosystem, an immediate first step should be for the Eastern Scotian Shelf Integrated Management (ESSIM) initiative to support the federal government's longstanding commitment to establish the Sable Gully as a marine protected area.

The big skies of the Canadian prairies (far left) and the waters of our rivers, are critical to all life on Earth.

Far left ©Wilf Schurig; left ©Gregor G. Beck

QUALITY INVESTMENTS: Clean Air and Water Accounts

Clean air and fresh water: like giant engines working day and night, the water cycle and atmospheric processes provide fundamental life support systems for the planet. For generations, we have taken these life-giving services provided by our ecosystems for granted.



Canada is home to about 20 per cent of the earth's fresh water, essential for the maintenance and functioning of wetlands, rivers and groundwater, to the biological diversity that they directly support, and to human well being. Thankfully, rivers are no longer open sewers, but beaches are still too frequently contaminated for swimming, fish too contaminated to be eaten by pregnant women and children, well water in some communities is not dependably safe, sediments in some rivers and lakes are so contaminated that stirring them up is a pollution problem, and wildlife continue to reveal symptoms resulting from multiple and ongoing exposure to pollution.

The clean air accounts are of similar concern. Efforts have abated, but not eliminated, acid rain and toxic (and in some cases, deadly) smog from tailpipes and smokestacks blankets the most populated and key agricultural regions of the country. In addition to contributions from our southern neighbours, Canadians – on a per capita basis – contribute significantly to the balance sheet. And global warming does not happen by default. Every bit of coal, every litre of oil or gas that humans burn, creates carbon dioxide (CO_2), adding to the load of gases in the atmosphere that trap heat.

Atmospheric levels of CO_2 are now higher than at any time in the past 420,000 years – and they are 30-per-cent higher than before the Industrial Revolution – an increase from approximately 280 to 370 parts per million by volume (ppmv) today. About 97 per cent of the CO_2 emitted by industrialized countries comes from burning coal, oil and gas for energy that adds up to 23 billion tonnes of CO_2 – 700 tonnes per second – into the earth's atmosphere every year.

Global temperature increases are seriously disrupting the delicate and natural balance of the world's climate, and that in turn is causing impacts on local habitats and biodiversity. Here in Canada, the Arctic – our ecosystem that is the most remote from these pollution sources – is already experiencing its disruptive forces. Cleaning these accounts is vital to sustaining much of Canada's biodiversity.

Global Warming Equals Hungry Polar Bears

A symbol of the Canadian Arctic – the polar bear – could be on the path to extinction.

Though well adapted to cold and prolonged fasting, polar bears face declining food supplies and starvation as global warming melts the sea ice earlier. The polar bear depends on sea ice to access its main food source, the ringed seal.

Recently, scientists have noted that the polar bear population in Hudson's Bay has experienced declining health (lower weight, fewer cubs being born). Every 1˚C rise in temperature means a one-week advance in break-up of sea ice in the spring, and possibly an additional one-week delay in its formation in the fall. Some experts estimate a 60 per cent loss of sea ice by 2050.

©Jack Stein Grove / www.JSGrove.com

As winter ice seasons become shorter in places like Hudson Bay due to global warming, polar bears are faced with a shorter feeding season out on the ice.

©Frank Parhizgar

Common loons

The Canary in a Coalmine?

Mercury concentrations in the blood of adult and juvenile loons in Kejimkujik National Park, Nova Scotia are the highest recorded in North America. Current levels of mercury exposure appear to be impairing loon reproduction and adversely affecting the behaviour of young loon chicks. As blood mercury levels rise, so do hormone levels associated with chronic stress, suggesting compromised immune systems. Loons with higher blood mercury levels may leave eggs uncovered more often than usual, forage for food less often, and avoid incubating their eggs.

Loons nesting near industrial sources of mercury pollution occupy few potential territories and lay few eggs. As blood mercury levels of loon chicks rise, they spend less time riding on their parents' backs, less time feeding and more time preening. Riding on their parents' back protects the chicks from predators and excessive preening uses up valuable energy. Mercury concentrations in both adult and juvenile loons in Kejimkujik National Park are closely correlated with mercury concentrations in yellow perch. The mercury contamination of this ecosystem is atmospheric pollution, originating from coal-fired power plants, incinerators, and other industrial concerns. Current mercury levels do not appear to be affecting overall Atlantic loon populations, but reductions in environmental concentrations of mercury are needed to protect local loon populations and throughout the region.

far left ©J.D. Taylor; left ©WWF / J. MacKenzie / www.picaworks.com

The cougar (far left) has disappeared over much of its former range and the American pika (left) may now be threatened by global warming as its alpine habitat shrinks.

NATURAL CAPITAL ACCOUNTS: Mammals

An image of Canada is incomplete without envisioning the awe-inspiring mammal life inhabiting its lands and waters: vast herds of caribou trekking across the tundra, fearsome grizzly bears hunting in a cold salmon stream, and mighty whales breaching off all three coastlines.

With the ultimate goal of examining all native mammal species, The Nature Audit presents here results of trend information for all regularly occurring marine mammals and approximately 50 terrestrial mammals.

Results show that terrestrial mammal populations are facing at least moderate levels of disruption all across southern Canada, from Atlantic Canada to Vancouver Island. Moderate disruption levels range northward up both east and west coastal areas, and up through western Canada, well into northern regions. High disruption levels were detected in the southern Great Lakes and St. Lawrence Lowlands (T2) and the Puget Sound Lowlands (T6), where the effects of high human use and habitat conversion have taken the greatest toll (Figure 8).

Populations of marine mammals have undergone moderate levels of disruption in the vast majority of marine regions, including regions right across Arctic waters. These results illustrate that a number of whale species have yet to fully recover from intensive hunting several centuries ago, as well as the effects of ongoing pressures on marine mammals in Canada's oceans, including toxic chemicals, oil and gas development, and noise pollution.

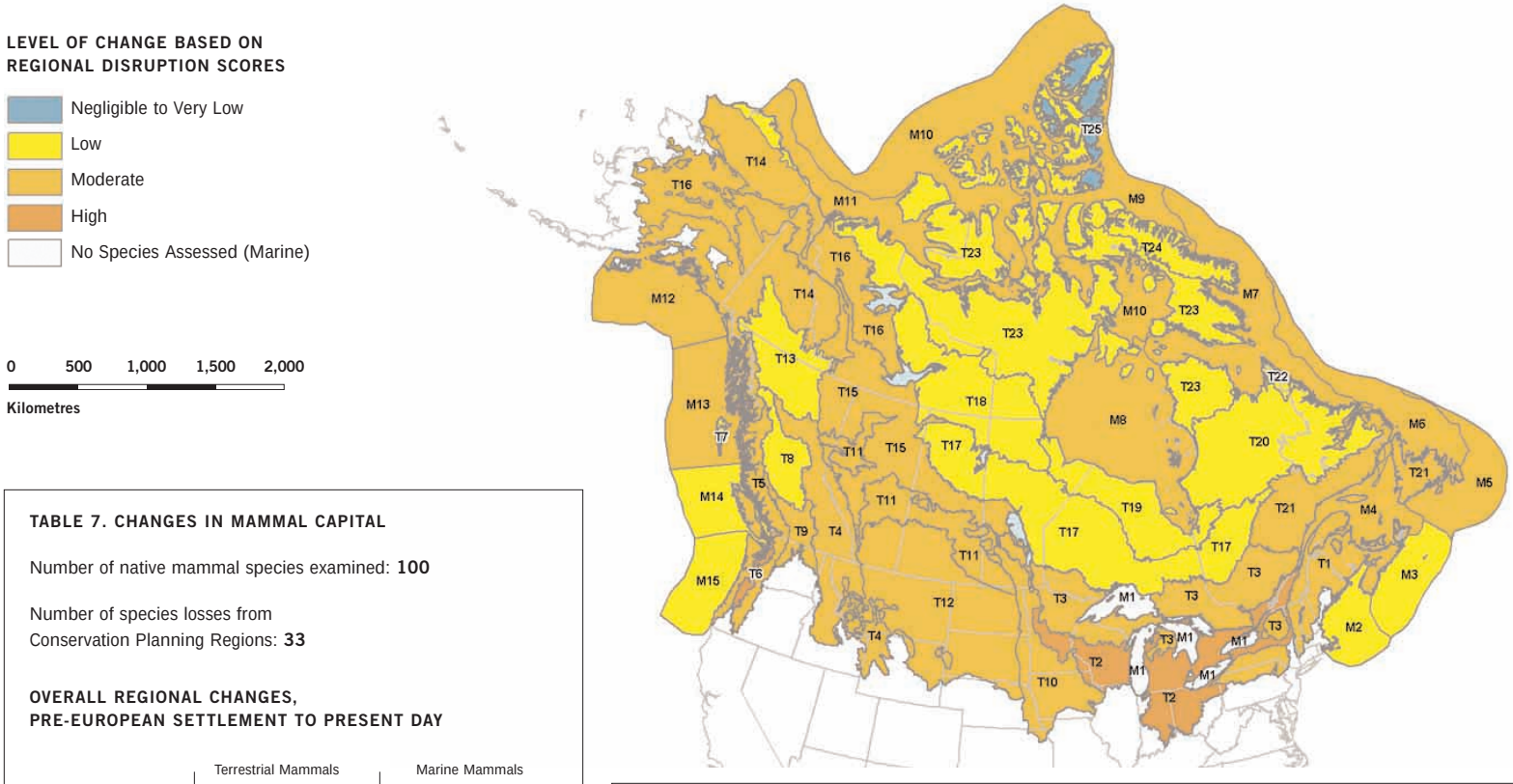
Mammals on land and in the oceans have suffered marked losses in range and abundance since European settlement. Approximately 30 per cent of regional terrestrial mammal occurrences have experienced a 20 per cent or greater loss in abundance, and over 30 per cent of regional occurrences experienced range contractions of 20 per cent or more. Marine mammals have experienced similar regional range contractions, and even greater abundance declines – almost 60 per cent of regional occurrences have experienced a loss of 20 per cent or greater (Table 7).

Of all species groups studied by The Nature Audit, mammals have suffered by far the highest proportion of regional losses. Particularly significant findings include the loss of wolverine, wolf, and grizzly bear, species that once ranged far more extensively than they do today, from four Conservation Planning Regions (CPRs). In general, large mammals needing large, relatively contiguous habitats, especially predators, have been driven from much of southern, more highly populated Canada. Bison has been lost from six entire CPRs. This species, which once numbered in the millions across North America's central grasslands, was nearly annihilated by historic hunting. The grey whale has completely disappeared from Canada's Atlantic marine waters, the Atlantic walrus is no longer found in the Maritimes, and the sea mink, once found from Connecticut to the Maritimes, has gone extinct. All three of these marine species are victims of historic hunting.

Woodland Caribou in Decline

From southern Yukon to Labrador, woodland caribou have roamed most of Canada's northern forests, browsing lichen from trees and the forest floor. Their thick coat and broad hooves help them survive wintry conditions. Larger and darker than their more abundant barren-ground cousins of the tundra, the woodland caribou has declined in number to the point that their official status in the Canadian boreal forest is deemed "Threatened." While there has been intense hunting of caribou, now the loss and degradation of their natural forest habitat probably limits their recovery. Their fate will be determined by whether we establish adequate protected areas and by how carefully we manage the logging, mining, agriculture, roads and pipelines that dissect and fragment much of their woodland home.

FIGURE 8. CHANGE IN RANGE AND ABUNDANCE FROM BASELINE (C. 1600) TO PRESENT: MAMMALS



PRIORITY REGIONS FOR MAMMAL CONSERVATION

Priorities for recovery: all of southern Canada, with a special priority on the southeast (T1, T2, T3, T21), the Puget Sound Lowlands (T6) and the prairies (T10,T12)

Priorities for conservation first: The Scotian Shelf (M3), Ungava Bay, Hudson and Davis Straits (M7), Mackenzie Valley and Western Boreal Forests (T15, T16)

TABLE 7. CHANGES IN MAMMAL CAPITAL

Number of native mammal species examined: **100**

Number of species losses from Conservation Planning Regions: **33**

OVERALL REGIONAL CHANGES, PRE-EUROPEAN SETTLEMENT TO PRESENT DAY

	Terrestrial Mammals		Marine Mammals	
	Regional Abundance Trends (%)	Regional Range Trends (%)	Regional Abundance Trends (%)	Regional Range Trends (%)
Contracted > 50%	20.0	12.5	27.4	8.6
Contracted > 20%	10.5	20.8	30.0	17.8
No Change (+/- 20%)	54.8	58.1	42.2	73.6
Expanded > 20%	6.5	2.2	0.0	0.0
Expanded > 50%	8.3	6.5	0.0	0.0

Mammals, both across Canada's lands and in its waters, have undergone very large regional range retractions and declines in abundance since European settlement. However, some species, including many mid-sized carnivores, have shown promising recovery trends following good management and recovery efforts.

Mammals in 2025?

Recent (1975–2000) trends show that terrestrial mammals continue to decline across most of southern and central Canada. Recovery for many of these species will not occur without sustained efforts, including the protection of most remaining large areas of natural habitat, and habitat restoration on large scales. Unfortunately, opportunities for large-scale habitat protection have already been lost in many parts of southern Canada. In northern Canada, mammals will benefit greatly if planning for new development occurs under the Conservation First Principle, as many species require large areas of intact habitat to maintain viable populations. Not all the news is bad. Some species – such as beaver, marten, fisher and river otter – have shown excellent recovery in some regions in the past 50 years, showing us that recovery is possible with effective management, habitat protection and habitat restoration.

Some marine species are also showing signs of recovery from past declines. Examples include increases in some seal species on both coasts, and in sea otters, grey and humpback whales on the west coast. Conservation measures such as the setting aside of marine protected areas, will be important to help these signs of recovery continue.

CANADIAN WATERS ARE HOME TO THE LONGEST-LIVING MAMMAL ON THE PLANET: THE BOWHEAD WHALE BELIEVED TO LIVE OVER 200 YEARS

far left ©Gregor G. Beck; left ©Wilf Schurig

Common murres and razorbills (far left) gather together to breed in colonies on rocky islands and cliffs. Seabird colonies have undergone historical swings in population levels due to past harvesting pressures. A long billed curlew (left) calls out across the prairie. Some grassland birds have undergone significant declines as habitats have been lost to agriculture.

NATURAL CAPITAL ACCOUNTS: Birds

Birds captivate us – by some estimates, bird watching is the fastest-growing 'sport' in Canada. They return the favour of a well-supplied backyard feeder by providing colour, activity and song on otherwise dull winter days. Their arrivals and departures mark the change of seasons, and some species are hunted for food.

Birds also serve us well as indicators of environmental change. In the 1960s, egg-shell thinning and birth deformities in birds around the Great Lakes demonstrated that DDT was travelling through the food chain and was a health threat to wildlife, in turn raising questions about its impacts on humans. Today, dying birds are being used as an early warning sign for the presence of West Nile virus.

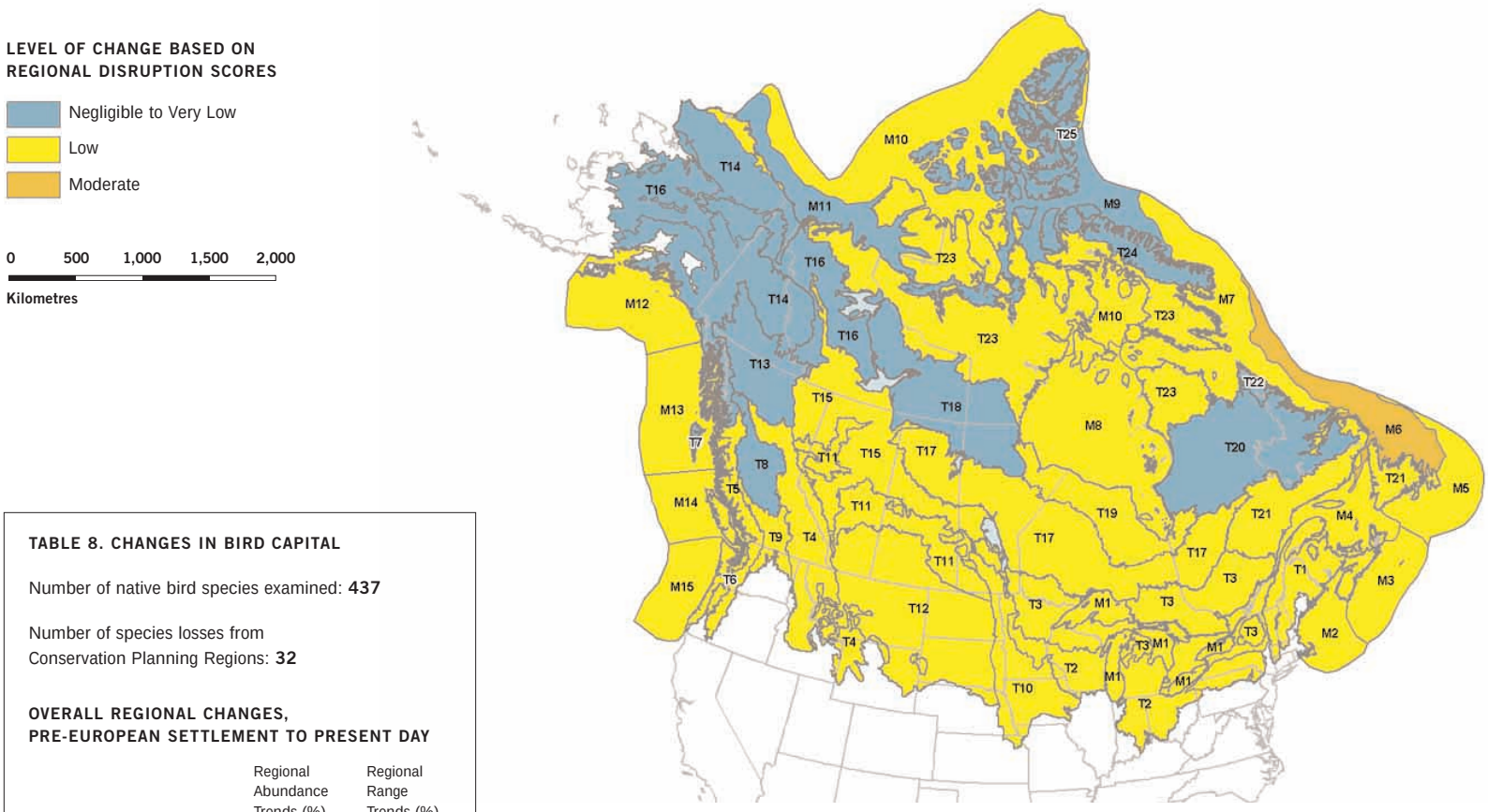
But humans have not always been kind to birds. Slaughtered by the tens of millions for food and sport, the passenger pigeon, thought to be the most numerous species of bird on the continent, disappeared from the wild by 1900 and was extinct a few years later. Plume hunters have killed millions of birds simply to supply feathers to the fashion trade. Seabird colonies were lost due to unsustainable egg harvests for food, and majestic birds of prey had bounties placed on them, having been judged to be vermin worthy of elimination.

Those working to end these unsustainable harvests became the pioneers of the modern conservation movement (e.g., National Audubon Society and Ducks Unlimited). Governments enacted the Migratory Bird Treaty to help co-ordinate bird conservation among the countries they passed through on their migratory cycles. In the past few decades, more groups, like Bird Studies Canada and BirdLife International have emerged to bolster the efforts to monitor, research and protect bird populations.

These bird conservation efforts may help explain the relatively low levels of disruption recorded for birds as a group among most Conservation Planning Regions (CPRs) in The Nature Audit (Table 8). Despite historic dips in populations and abundance, many species have responded to conservation measures and recovered to within 20 per cent of their pre-European settlement status. One marine region – the Newfoundland and Labrador Shelf (M6) – showed a moderate level of disruption (Figure 9). Historic human harvest is likely a key factor here, as numerous bird species and eggs were intensively harvested for food along the coast before the turn of the twentieth century. Two species there went extinct (Labrador Duck and the Great Auk) and others have yet to fully recover.

The Nature Audit's analytical approach, combining all species of a large group such as birds, may mask issues for subsets of birds with specialized habitat requirements. Support for this reasoning can be found in ongoing studies showing evidence of steep declines in birds that depend on interior grassland and forest habitat – especially where these habitats have diminished in size and become fragmented. Trends detected in The Nature Audit were consistent with this pattern – higher bird disruption scores were recorded for CPRs demonstrating greater losses of these habitats (T1, T2, T10). The Nature Audit looks forward to further investigation of subsets of birds to more precisely identify meaningful trends. With individual species – like the piping plover and burrowing owl – still at, or declining to, dangerously low population levels, there is still much bird conservation work to be done.

FIGURE 9. CHANGE IN RANGE AND ABUNDANCE FROM BASELINE (C. 1600) TO PRESENT: BIRDS



PRIORITY REGIONS FOR BIRD CONSERVATION

Atlantic seabird colonies off the coasts of the Atlantic provinces and Quebec (M2, M3, M4, M5, M6)

Eastern deciduous and mixed forest birds in the Great Lakes region, south-central Ontario and Quebec and the Maritime provinces (T1, T2, T3)

Grassland birds in the prairies (T10, T12)

TABLE 8. CHANGES IN BIRD CAPITAL

Number of native bird species examined: **437**

Number of species losses from Conservation Planning Regions: **32**

OVERALL REGIONAL CHANGES, PRE-EUROPEAN SETTLEMENT TO PRESENT DAY

	Regional Abundance Trends (%)	Regional Range Trends (%)
Contracted > 50%	4.3	1.1
Contracted > 20%	4.5	0.6
No Change (+/- 20%)	80.7	94.0
Expanded > 20%	5.1	2.3
Expanded > 50%	5.5	2.0

Birds across Canada have experienced some regional declines in abundance, and numerous regional losses. The majority of the species showing regional increases are those that are able to live in disturbed habitats, such as in urban or agricultural regions.

© P. Allen Woodliffe

Birds in 2025?

With short-term (1975–2000) trend data appearing to show renewed declines in most regions of Canada, this is no time to be complacent when it comes to bird conservation; in fact, this downward trend suggests additional conservation efforts are required. Where habitat loss is a key factor, recovery is unlikely to occur until habitat protection and restoration efforts increase significantly.

The prothonotary warbler (left) is one of the many forest bird species in Canada that is under threat from habitat loss.

AT LEAST 103: THE NUMBER OF BIRD SPECIES THAT HAVE VANISHED FROM THE PLANET SINCE 1800

Reptiles, such as this wood turtle (far left) and fox snake (left) face many threats from humans. The fox snake has a significant part of its global range within Canada.

far left ©Kimberly Barrett; left ©Rob Willson

NATURAL CAPITAL ACCOUNTS: Reptiles and Amphibians

A frog chorus is often our first seasonal reminder that we share our country with approximately 90 species of salamanders, frogs, toads, lizards, snakes and turtles. Increasingly, however, the loss and degradation of habitats, especially wetlands, are causing significant declines for many of Canada's reptile and amphibian species. Characteristically, these species are slow moving on land (e.g., turtles) or like to bask on warm surfaces (e.g., snakes). This makes them highly vulnerable to road traffic as they move seasonally from hibernation to foraging and nesting sites. Illegal collecting for the pet trade, and the persecution of snakes by people who fear or dislike them, further contribute to threats. Amphibians are particularly susceptible to the effects of pollutants due to the porous nature of their skin.

The Nature Audit's regional analysis confirmed a serious situation for this group, with widespread declines in southern Canada where species diversity is highest. Overall, almost 70 per cent of regional reptile and 35 per cent of amphibian occurrences across Canada experienced a 20 per cent or greater loss in population abundance from pre-European settlement to today (Table 9). In some cases, species were lost from a Conservation Planning Region (CPR): the pygmy short-horned lizard and the northern leopard frog both disappeared from the southern interior mountain region of BC. Several species, such as the timber rattlesnake and western pond turtle, have disappeared entirely from the Canadian portion of their ranges. Range contractions accompanied the abundance declines in nearly one-quarter of the regional occurrences for both amphibians and reptiles.

Southern BC overall (T4, T5, T6, T7, T9) emerged as an area of high priority, with most regions showing high disruption in amphibian populations, and several with marked disruptions for reptiles (Figure 10A). Southeastern Canada (T1, T2, T3) and the adjacent tallgrass prairie region (T10) emerged as areas of high national importance for reptile conservation with moderate and increasing levels of disruption to remaining populations (Figure 10B). The situation in the Southern Great Lakes region (T2) is of particular concern, as habitat loss and fragmentation, road mortality, pollution and other threats have caused the dramatic declines of several species, like the Jefferson salamander, Fowler's toad, and Massasauga rattlesnake. Marine regions on both the Pacific (M13, M14, M15) and Atlantic (M2 through M6) coasts also show moderate disruption levels for reptiles. These scores reflect the serious reductions in abundance of several marine turtle species that spend part of the year in Canadian waters but travel to the Caribbean, and Central and South America to lay their eggs each year.

Reptiles and Amphibians in 2025?

The short-term (1975–2000) trend indicators suggest that populations of reptiles and amphibians continue to decline throughout most of southern Canada. In the west, current trends are of greatest concern in southern BC, where habitat loss and other factors, such as introduced bullfrogs (predators of smaller frogs) continue to take a toll on populations. In the east, the southern Great Lakes and St. Lawrence Lowlands region (T2), the situation may be even worse on the Canadian side of the border, where loss and degradation of habitat is the major contributing factor. Focused efforts to recover habitat and lower pollution levels, as well as innovative ideas to reduce traffic mortality are desperately required to stem the decline of reptiles and amphibians in the next 25 years.

FIGURES 10A AND 10B. CHANGE IN RANGE AND ABUNDANCE FROM BASELINE (C. 1600) TO PRESENT: AMPHIBIANS (10A) AND REPTILES (10B)

LEVEL OF CHANGE BASED ON REGIONAL DISRUPTION SCORES

- Negligible to Very Low
- Low
- Moderate
- High
- No Species Assessed (Terrestrial)
- No Species Assessed (Marine)

0 500 1,000 1,500 2,000

Kilometres

TABLE 9. CHANGES IN REPTILE AND AMPHIBIAN CAPITAL

Number of native reptile and amphibian species examined: **91**

Number of species losses from Conservation Planning Regions: **3**

OVERALL REGIONAL CHANGES, PRE-EUROPEAN SETTLEMENT TO PRESENT DAY

	Reptiles		Amphibians	
	Regional Abundance Trends (%)	Regional Range Trends (%)	Regional Abundance Trends (%)	Regional Range Trends (%)
Contracted > 50%	17.0	5.2	3.9	3.5
Contracted > 20%	50.5	22.7	30.6	15.5
No Change (+/- 20%)	31.0	71.1	61.6	77.2
Expanded > 20%	0.5	0.0	1.3	1.3
Expanded > 50%	1.0	1.0	2.6	2.6

Reptiles are thought to have undergone major reductions in abundance since European settlement. Range and abundance declines for amphibians are somewhat lower, but still of concern. All the range and abundance expansions are due to the introduction of species into other parts of Canada, where they are not considered native, such as the introduction of the bullfrog from eastern Canada into BC.

FIGURE 10A.

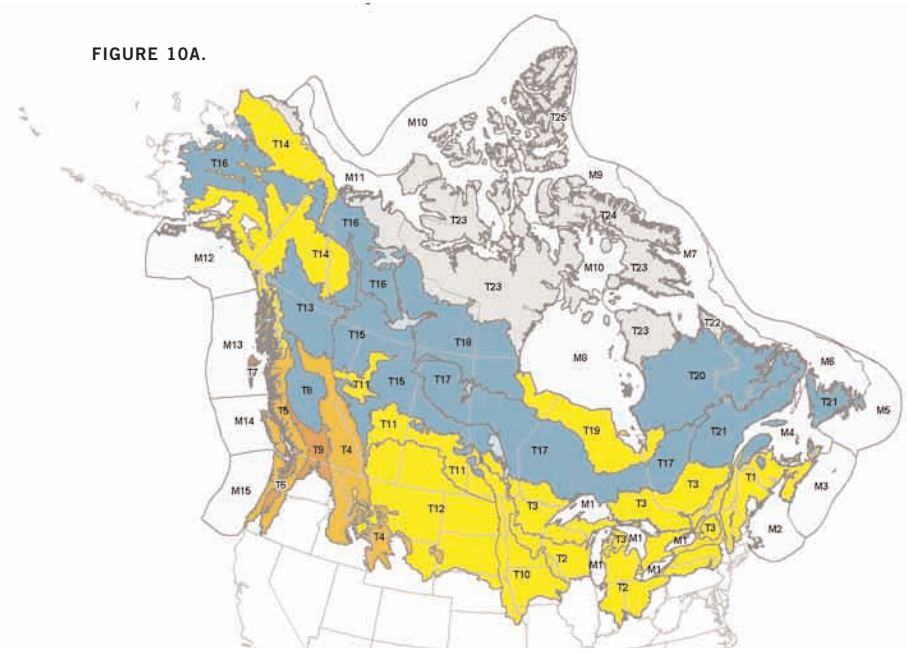
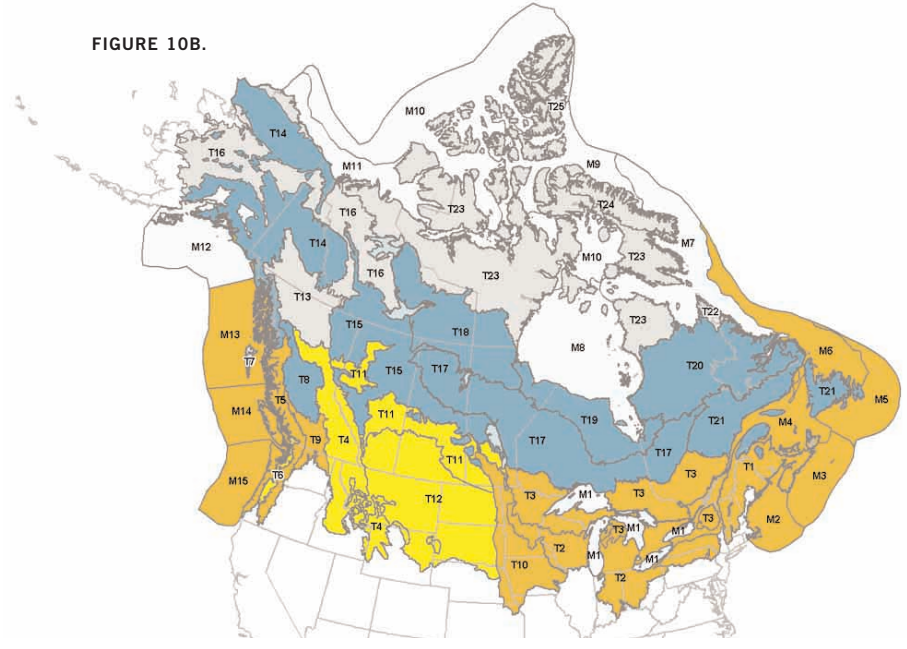


FIGURE 10B.



PRIORITY REGIONS FOR REPTILE AND AMPHIBIAN CONSERVATION

Southern Great Lakes and St. Lawrence Lowlands (T2)

Southern British Columbia (T4, T5, T6, T9)

Leatherback Turtle: The World's Largest Reptile at Risk

The leatherback turtle is the world's largest reptile. It can measure up to 2.4 metres in length and weigh up to 725 kg. Leatherbacks migrate thousands of kilometres each year and are found in the Pacific, Atlantic and Indian Oceans. In the summer, some leatherbacks migrate to cooler waters off the coasts of Atlantic Canada and southern BC in search of jellyfish – their main source of food.

This species is critically endangered worldwide. Major threats include poaching of nesting turtles and eggs for human consumption, incidental capture in fishing gear and human development of nesting beaches. Researchers are currently using satellite transmitters to track their movements and habitat use in order to determine how best to protect this unique species.

10,000+: THE NUMBER OF RED-SIDED GARTER SNAKES KILLED EACH YEAR ALONG A SINGLE 3.2-KILOMETRE SECTION OF HIGHWAY 17 IN MANITOBA

Historically, cod (far left, c. 1920) were larger and much more abundant in our Atlantic waters. Along the Pacific coast, tiger rockfish (left), have also declined significantly, along with many other species of rockfish.

far left ©Courtesy PANL: VA21-18, R. Holloway; left ©Royal British Columbia Museum

NATURAL CAPITAL ACCOUNTS: Marine Fishes

Seven million Canadians live in coastal areas, and many depend on the bounties of our oceans for their food and livelihood. A huge diversity of marine life is found in the waters off Canada's coasts, including approximately 1,000 species of fish. When the stocks of a single species, cod, collapsed, tens of thousands of Canadians were suddenly out of work. Figures like these inextricably link Canada's economic health to marine conservation.

With a long-term goal of looking at trends for all marine fish species in Canadian waters, The Nature Audit took the first step of analyzing abundance and range changes for 119 of Canada's most prominent marine fishes, including most major species that are affected by commercial harvest or by-catch.

Moderate levels of disruption from baseline conditions were noted for coastal and offshore areas all the way down the Pacific coast, from Alaska to Washington State (M12, M13, M14, M15), with the southern regions showing somewhat higher disruption. Severe declines among many species of rockfish contributed significantly to these scores (Figure 11).

In the Atlantic, the Scotian Shelf (M3), Bay of Fundy and Gulf of Maine (M2) showed the highest levels of change from historical conditions. The large number of species indicating declines in these areas could in part be explained by the greater number of fish species, of those analyzed, that are commercially fished there. In the case of the Grand Banks (M5), heavily fished areas beyond Canada's international boundary were not included; hence, the full picture for this region may not be shown by this data. However, those fish in M5 that did show declines showed major declines. Overall in the Atlantic, the results revealed that where species are fished in areas where they are naturally abundant, these species have declined. A few, like cod and American plaice, have undergone catastrophic collapses.

In Arctic waters, marine fish populations showed the least change from estimated historical levels. Currently, most of the fishing in these regions is at subsistence levels, but if stocks continue to dwindle on the east and west coasts, commercial interest in the Arctic is likely to grow.

For all the species examined, The Nature Audit estimated that approximately 50 per cent of regional species occurrences had experienced a 20 per cent or greater loss in abundance levels over the long term – a very sizeable and concerning loss (Table 10).

Canada's Cod: Too Little, Too Late?

Northern cod are marine fish that can grow to more than a metre in length. Found in cold coastal and offshore waters throughout the northwest and northeast Atlantic Ocean, cod have been fished since before the arrival of European settlers.

Between the early 1960s and 2002, cod stocks in Canadian waters along the northeast coasts of Newfoundland and Labrador collapsed by 99.9 per cent – a dramatic decline for a formerly abundant component of the entire region's marine ecosystem and one that affected thousands of people dependent on the fishery.

How did this happen? For many years Canada failed to set sustainable harvest levels and in the end, waited too long to close the northern cod-fishing industry. Breeding-age cod were almost fished out of existence; the result is that the recovery of the small remaining stocks is now uncertain.

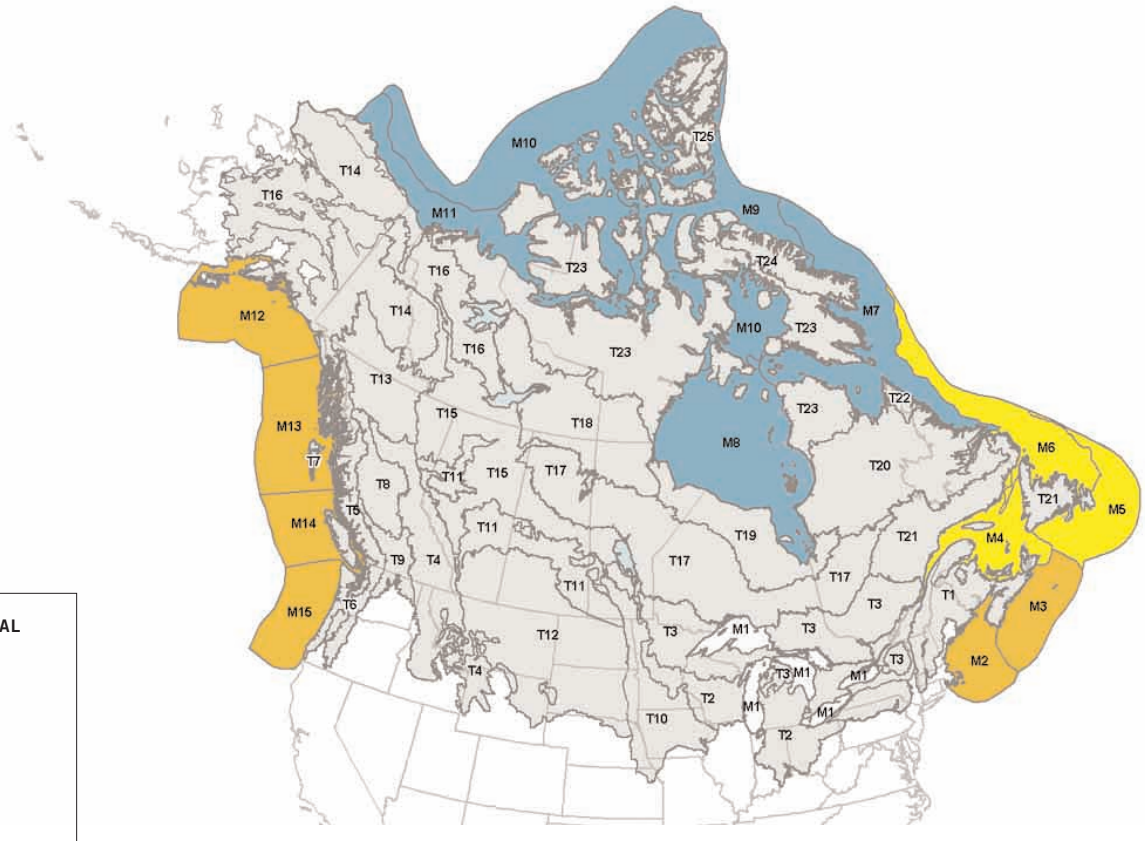
FIGURE 11. CHANGE IN RANGE AND ABUNDANCE FROM BASELINE (C. 1600) TO PRESENT: MARINE FISHES

LEVEL OF CHANGE BASED ON REGIONAL DISRUPTION SCORES

- Negligible to Very Low
- Low
- Moderate
- No Species Assessed (Terrestrial)
- No Species Assessed (Marine)

0 500 1,000 1,500 2,000

Kilometres



PRIORITY REGIONS FOR MARINE FISH CONSERVATION

Marine waters of the West Coast (M12, M13, M14)

Bay of Fundy, Gulf of Maine and Scotian Shelf (M2, M3)

Newfoundland and Labrador Shelf (M6) and the Grand Banks, including heavily fished international waters (M5 and beyond)

Mackenzie Delta and Beaufort Sea (M11)

TABLE 10. CHANGES IN MARINE FISH CAPITAL

Number of native fish species examined: **119**

Number of species losses from Conservation Planning Regions: **0**

OVERALL REGIONAL CHANGES, PRE-EUROPEAN SETTLEMENT TO PRESENT DAY

	Regional Abundance Trends (%)	Regional Range Trends (%)
Contracted > 50%	16.9	4.5
Contracted > 20%	33.8	15.2
No Change (+/- 20%)	43.8	77.6
Expanded > 20%	3.9	2.5
Expanded > 50%	1.6	0.2

The Nature Audit results showed that 50 per cent of commercial marine fish species in Canadian waters have experienced a 20 per cent or greater decline in abundance since European settlement.

Commercial Marine Fish in 2025?

Disturbing recent (1975–2000) trends showed that in all of the Atlantic and Pacific marine regions, commercially valuable fish species as a group have declined in population abundance and range. This includes Pacific cod fished off the west coast, and in the Atlantic, slow-to-reproduce species at the top of the food chain, like porbeagle shark and spiny dogfish. However, some positive signs were detected. Some species, such as pollock and Atlantic and spotted wolffish, with significant declines up to 1994, have begun to show gradual increases in abundance through the late 1990s, likely due to reductions in allowable catch and the ground fish moratorium. Only time – along with careful, long-term fisheries management – will tell whether substantial recovery is possible.

Signals of decline in several fish species in the Mackenzie Delta and Beaufort Sea (M11), including Arctic and toothed cod, raise concerns that fish in Arctic waters are beginning to be impacted. Application of the precautionary principle in managing stocks is a prudent direction.

1,000,000,000: THE NUMBER OF SALMON FRY THAT MIGRATE THROUGH BC'S CENTRAL COAST REGION EACH YEAR

far left ©Ryan Hardie; left ©WWF-Canon / Michel Roggo

Freshwater fish stocks have declined by some 90 per cent in many of the world's rivers. Seen here are two species that have seen declines in Canada: the Atlantic sturgeon (far left) and pink salmon (left).

NATURAL CAPITAL ACCOUNTS: Freshwater Fishes

From the muskeg of the north to the prairie potholes and Great Lakes in the south, Canada is a nation rich in freshwater ecosystems. A wide array of freshwater fish species helps support sizeable commercial freshwater fisheries as well as recreational fisheries that are enjoyed by anglers from coast to coast to coast.

But freshwater fishes also face a number of threats. Mercury and acidity levels in our northern lakes, as well as concentrations of other toxins such as dioxins, remain concerns. Other serious problems include alteration to stream flows and habitat degradation due to damming for hydroelectric power and irrigation, or channelization through populated areas. Approximately 10 per cent of the freshwater fishes found in Canadian waters today are exotic species. While some have arrived by natural migration, most arrived because of human activities, such as stocking, angler and aquarium releases, ballast water release and canal construction. Often these introductions have resulted in changes that negatively impact native species. The round goby, for example, was introduced into the Great Lakes in the mid-1990s. Since that time, this fish has been implicated in the decimation of the mottled sculpin in Lake Erie and interference with other native fish, such as the lake sturgeon and lake trout.

The Nature Audit analyzed range changes and the abundance of 186 freshwater fish species – the majority of the native freshwater fish found in Canadian waters. This was a particularly difficult group of species to analyze, as data in many areas is limited. Thus, these results should be seen as very preliminary, and The Nature Audit looks forward to building partnerships in this area and strengthening the data set accumulated to date.

Results showed that almost all Conservation Planning Regions in Canada have been at least moderately disrupted from their pre-European state (Figure 12). The most intriguing aspect of this dataset is that much of the disruption noted is a result of known or suspected expansions in range and abundance of fish species across the country. Many of these expansions are thought to be as a result of human introductions and habitat alterations, and they can have a significant negative impact, altering the balance amongst other aquatic species within freshwater systems.

Since European settlement, there have been countless alterations to waterways. While some, such as dams, often restrict natural fish movement, others actually remove natural barriers, and have resulted in numerous fish species expanding their range. Sport fish have been moved around and stocked in areas where they did not previously exist or were not naturally abundant. Canals have allowed fish to move upstream and into new water bodies (e.g., between Lake Ontario and Lake Erie, where, before the canal system was developed, Niagara Falls eliminated the possibility of fish traveling upstream into Lake Erie and beyond). Others have, in effect, built bridges of water between what were once entirely unconnected watersheds. The result of human alterations is that freshwater fish abundance and distribution appear far different from 400 years ago.

FIGURE 12. CHANGE IN RANGE AND ABUNDANCE FROM BASELINE (C. 1600) TO PRESENT: FRESHWATER FISHES

LEVEL OF CHANGE BASED ON REGIONAL DISRUPTION SCORES

- Negligible to Very Low
- Low
- Moderate
- High
- No Species Assessed (Terrestrial)
- No Species Assessed (Marine)

0 500 1,000 1,500 2,000

Kilometres

TABLE 11. CHANGES IN FRESHWATER FISH CAPITAL

Number of native fish species examined: **186**

Number of species losses from Conservation Planning Regions: **14**

OVERALL REGIONAL CHANGES, PRE-EUROPEAN SETTLEMENT TO PRESENT DAY

	Regional Abundance Trends (%)	Regional Range Trends (%)
Contracted > 50%	1.5	1.1
Contracted > 20%	1.0	0.9
No Change (+/- 20%)	56.5	55.7
Expanded > 20%	5.5	5.3
Expanded > 50%	36.1	37.0

In this preliminary analysis. The Nature Audit detected numerous instances of regional range and abundance expansions. The expansions are in part a response of fish to the removal of barriers by human activities, such as the building of canals.

Freshwater Fish in 2025?

Human activities have resulted in significant changes to the ranges of many fish species. As these species interact in new environments, they can have negative effects on other species, disrupting established food webs and habitats. If humans continue to facilitate the expansion of fish ranges into new regions, we risk further upsetting the balance of entire aquatic ecosystems.

In some regions, additional pressures posed by air and water pollution and habitat destruction must be addressed, or the state of freshwater fish and their aquatic ecosystems is likely to become even more disrupted in future. More work to inventory, monitor and explain changes to fish populations is needed to better inform conservation action.

PRIORITY REGIONS FOR FRESHWATER FISH CONSERVATION

Findings did not discern priority regions. Conservation effort should be focused on elucidating the causes of trends observed and the elimination of activities that introduce fish outside their natural range, and risk upsetting the natural balance of aquatic systems.

The Uncertain Future of the Fraser Coho

Coho salmon (***Oncorhynchus kisutch***) is one of seven salmon species native to North America. Throughout the 1990s, many of BC's Coho populations drastically declined. The combination of fishing pressures, climate-driven declines, agriculture, urban pollution and other human activities caused an average decline in population of more than 60 per cent. In 1998, the Department of Fisheries and Oceans drastically reduced the allowable catch of Coho salmon, and their numbers appear to have now stabilized.

The future of the Fraser Coho salmon is far from secure, but government action based on good scientific advice, as seen in 1998, will be critical to ensure the continued survival of this and other threatened Canadian species.

far left ©Randy Emmitt; middle left ©Alf Rider; left ©J.D. Taylor

These three butterfly species (left to right) frosted elfin, Karner blue, and monarch, are all listed as 'at risk' in Canada. In the past decade both the frosted elfin and Karner blue have disappeared from their only Canadian range in Ontario.

NATURAL CAPITAL ACCOUNTS: Butterflies

Approximately 300 species of butterflies can be found in Canada. While many are unfamiliar to Canadians, others like the monarch butterfly are well known and their return is eagerly anticipated each summer. The monarch is the world's only butterfly that migrates to tropical latitudes to over-winter. Yet the monarchs that return to Canada are not, in fact, those that flew south the previous autumn to the high-elevation fir forests of Mexico's central mountains. Most are the offspring of two or three subsequent generations of butterflies that have bred as the species follows spring northward across the North American continent.

Butterfly watching is becoming an increasingly popular hobby, but these creatures are more than just pretty to look at. As they move from flower to flower, they fulfill a role as important pollinators; in their larval or caterpillar stage, they can be important prey for a variety of species, including many of our songbirds. Many butterflies have evolved to feed specifically on one or a small group of host plants as caterpillars. Habitat loss and degradation, especially affecting the plant species on which they depend, can lead to species decline or extinction. The use of pesticides and herbicides can also harm populations of these beneficial insects.

The Nature Audit analysis revealed that in much of northern and central Canada, butterfly populations appear to be relatively unchanged from historical levels (Table 12). On the other hand, in southern Canada, moderate levels of population disruption have occurred compared with baseline (pre-European settlement) levels (Figure 13). As expected, these Conservation Planning Regions have had the greatest amount of habitat loss and degradation. This includes the forested regions in eastern Canada (T1, T2, and T3), grassland regions of tallgrass, mixed and shortgrass prairies (T10 and T12) and the aspen parkland (T11) region stretching across the south-central portions of Manitoba, Saskatchewan and Alberta. The populated parts of southern BC, especially in the Lower Fraser Valley (T6) and the southern interior (T9) – also showed a moderately high level of population disruption to butterfly species.

In examining long-term changes to butterfly populations, The Nature Audit estimates that more than one-quarter of regional butterfly occurrences in Canada experienced a 20-per-cent or greater loss of range, most in southern regions of the country. In addition to these decreases, The Nature Audit documented 12 instances where a butterfly has been lost from an entire Conservation Planning Region: in BC, one from the southern interior mountain region (T9), one from the West Coast Rainforest (T5), and four from the Puget Sound lowlands (T6); two species from the aspen parkland in the central prairies (T11); and four species from the southern Great Lakes and St. Lawrence Valley in Ontario (T2).

FIGURE 13. CHANGE IN RANGE AND ABUNDANCE FROM BASELINE (C. 1600) TO PRESENT: BUTTERFLIES

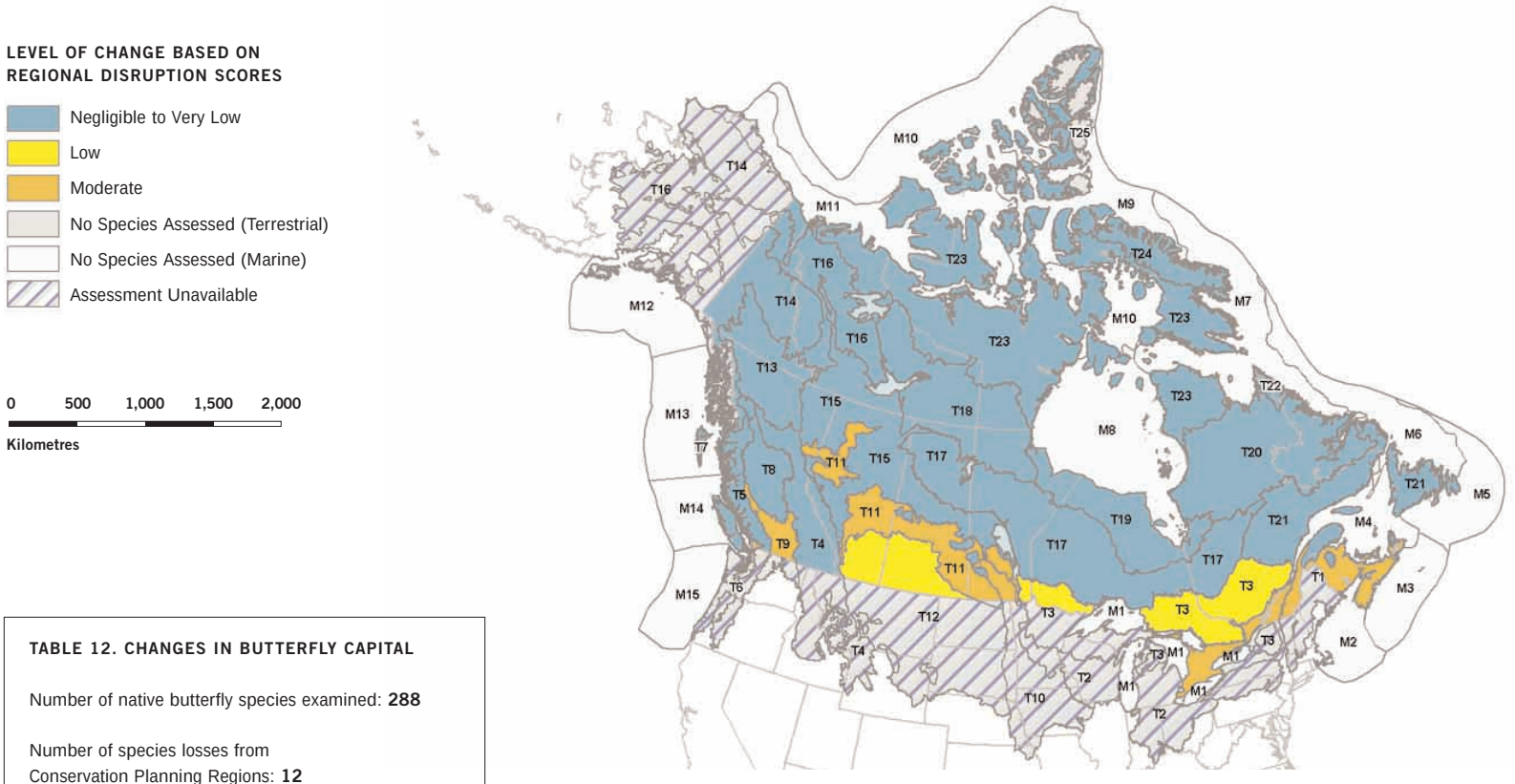


TABLE 12. CHANGES IN BUTTERFLY CAPITAL

Number of native butterfly species examined: **288**

Number of species losses from Conservation Planning Regions: **12**

OVERALL REGIONAL CHANGES, PRE-EUROPEAN SETTLEMENT TO PRESENT DAY

	Regional Abundance Trends (%)	Regional Range Trends (%)
Contracted > 50%	0.8	16.8
Contracted > 20%	0.1	12.2
No Change (+/- 20%)	98.8	62.4
Expanded > 20%	0.0	1.8
Expanded > 50%	0.3	6.9

As a whole, butterflies have shown little decline in range and abundance, although some regional disappearances have been recorded.

©Jim Spottiswood

Butterflies in 2025?

Despite some moderate declines in southern Canada, butterflies are managing to hold their own across much of the rest of the country. The short-term (1975–2000) trend indicators suggest that most regional populations of butterflies are relatively stable or if declining, they are doing so slowly. Two notable exceptions were in the Southern Great Lakes region of Ontario and in the Puget Sound lowlands of BC, where recent trends showed the sharpest regional population declines. These regions are a national priority for butterfly conservation in Canada and key recovery actions must include the restoration and protection of remaining natural habitat.

Monarchs emerge from a chrysalis such as this (left) before travelling over 5,000 kilometers to their wintering site in Mexico.

PRIORITY REGIONS FOR BUTTERFLY CONSERVATION

Southern Great Lakes region of Ontario (T2)

Puget Sound Lowlands of British Columbia (T6)

Tallgrass prairie and parkland regions (T10, T11)

Shrinking Habitats, Disappearing Butterflies

Think how difficult life would be if you could survive only by eating one type of food, and that food became very rare, or worse, totally unavailable. This situation is faced by a number of Canadian moth and butterfly species.

Many moth and butterfly species depend on one or a small group of plants for survival. Larvae of the yucca moth feed exclusively on the developing seeds of the yucca plant (also called soapweed); in Canada, it is found naturally in only two areas of southern Alberta. In turn, the yucca plant relies on its namesake moth for pollination – no other insect can do the job.

Both the karner blue and frosted elfin are butterflies that have disappeared entirely from Canada. As their habitat, oak-pine savannas in southern Ontario, became degraded due to lack of proper management and disappeared due to human land uses, their caterpillars' only food source, perennial wild lupine, became very scarce.

WITH GOOD MANAGEMENT PRACTICES, THE ALFALFA LEAFCUTTER BEE CAN INCREASE ALFALFA SEED YIELDS UP TO 20-FOLD

far left ©Ross Brown; middle left ©Wilf Schurig; left ©Bruce Wakeford

Three of the orchid species found in Canada: the Prairie white-fringed orchid (far left), the yellow lady's slipper (middle) and the small round-leaved orchis (left). Many of the 74 species examined in the Nature Audit were found to be experiencing declines in range and abundance.

NATURAL CAPITAL ACCOUNTS: Orchids

Well known for their exquisite beauty, orchids are found in all regions of Canada except the high Arctic. Most of Canada's 74 native orchids are very slow growing; some species take 10 years or more to grow from seed to flowering, and may lie dormant for years until exact growing conditions are met. Many possess showy, brightly coloured blooms and are a special treat to see in the wild.

Unfortunately, this beauty comes at a price – unscrupulous collecting threatens some species. Even orchid viewing in natural areas can take its toll, as the heavy traffic can damage fragile plants and otherwise disturb the surrounding habitat. And, like many of the other groups examined in The Nature Audit, the biggest threat to these wildflowers is habitat loss and degradation. Many orchids require undisturbed habitats to thrive and may be more susceptible to lower levels of habitat alteration than some other species groups. This is especially true for species inhabiting prairies and wetlands, two key habitats for orchid species that have experienced high levels of disturbance throughout the southern parts of Canada.

The Nature Audit analysis revealed that orchids may be one of the most highly impacted groups of species in Canada. Indications are that the pressures on orchids are taking a great toll; marked changes in range and abundance appear to have occurred in all but the most northerly regions of Canada. For the orchid group overall, more than 80 per cent of regional occurrences showed a contraction of 20 per cent or more in both range and abundance from pre-European settlement to today (Table 13).

Orchid species in the tallgrass and Mixed Grass Prairies (T10 and T12) showed the largest downward trends in range and abundance, corresponding to large losses of prairie and wetland habitats in these regions (Figure 14). Elsewhere, moderate declines were noted for Atlantic Canada (T1), the southern Great Lakes and St. Lawrence Valley (T2), and most regions in southern BC (T4, T6, T9).

One Canadian orchid species, the yellow fringed orchid, is thought to have completely disappeared from this country, while several species have disappeared from entire regions, including small white lady's-slipper from the Mixed Grass Prairie Region (T12) and the small whorled pogonia from the southern Great Lakes-St. Lawrence Region (T2).

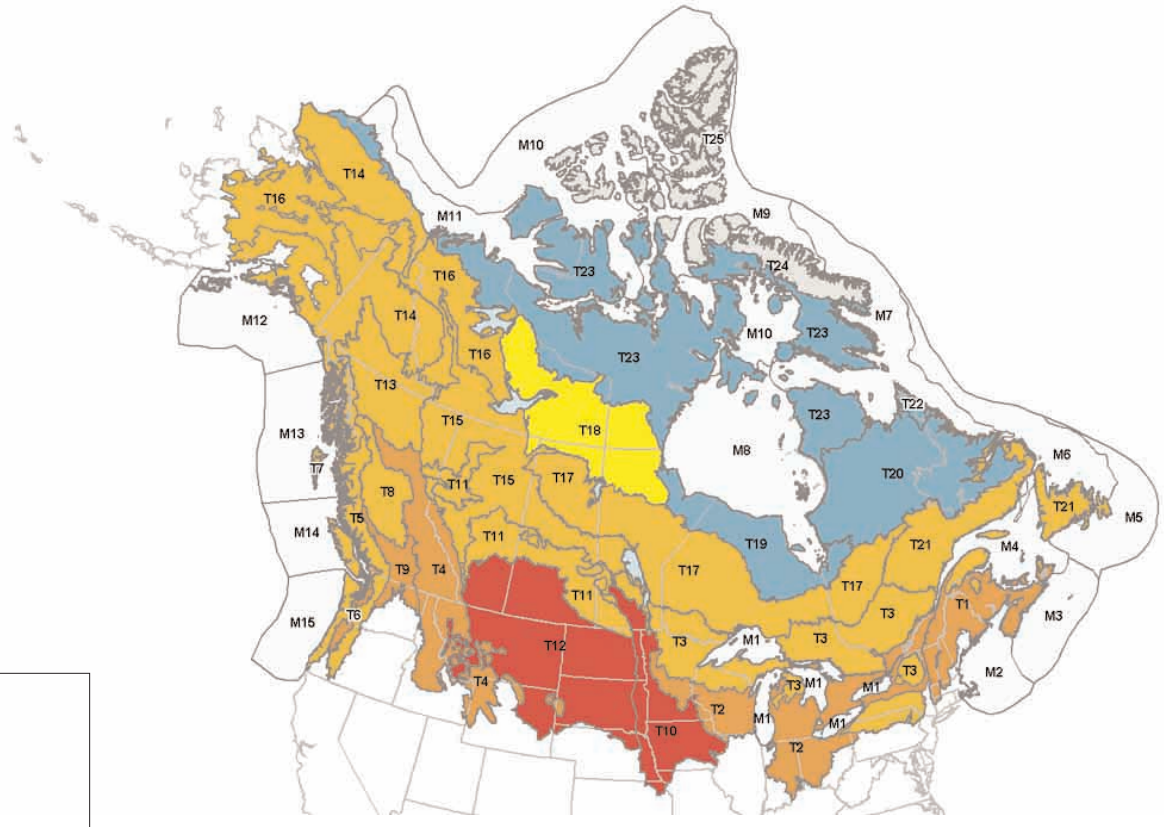
FIGURE 14. CHANGE IN RANGE AND ABUNDANCE FROM BASELINE (C. 1600) TO PRESENT: ORCHIDS

LEVEL OF CHANGE BASED ON REGIONAL DISRUPTION SCORES

- Negligible to Very Low
- Low
- Moderate
- High
- Severe to Critical
- No Species Assessed (Terrestrial)
- No Species Assessed (Marine)

0 500 1,000 1,500 2,000

Kilometres



PRIORITY REGIONS FOR ORCHID CONSERVATION

Mixed and Tallgrass Prairie (T10, T12)

Southern British Columbia (T4, T6, T9)

Southern Great Lakes Region of Ontario (T2)

Atlantic Canada (T1)

Orchids and Water Level Changes Don't Mix

Some orchid species have a modified root system (called a corm) that allows them to survive under some degree of drought conditions. However, many orchids are highly dependent on stable water levels, and perish without them. For example, the beautiful rose pogonia, found in acidic bogs from Ontario to Newfoundland, has only a cluster of fibrous roots, and is the first to perish when its habitat begins to dry out.

Many of our modern-day alterations of water levels – filling in of wetlands, mining peat in bogs, building construction near wetlands, irrigation – have consequences far from the immediate area of the activity, much further than some current buffer zones or environmental assessments evaluate. This sensitivity to changes in water level needs to be better taken into account when assessing the potential environmental damage of development projects.

TABLE 13. CHANGES IN ORCHID CAPITAL

Number of native orchid species examined: **74**

Number of species losses from Conservation Planning Regions: **3**

OVERALL REGIONAL CHANGES, PRE-EUROPEAN SETTLEMENT TO PRESENT DAY

	Regional Abundance Trends (%)	Regional Range Trends (%)
Contracted > 50%	34.1	32.3
Contracted > 20%	47.2	50.9
No Change (+/- 20%)	17.5	15.9
Expanded > 20%	1.3	0.9
Expanded > 50%	0.0	0.0

Orchids have experienced startling declines in range and abundance.

Orchids in 2025?

Will you be treated to seeing orchids growing in the wild on a walk through a natural area in 2025? With expanding disruptions to water levels through continuing land development in southern Canada, and with continuing habitat loss through natural wetland drainage, The Nature Audit predicts that downward trends in orchid range and abundance will continue. These pressures need to be alleviated, and recovery efforts for orchids increased, or we risk the disappearance of native orchids from numerous regions in Canada.

SOME ORCHID SPECIES CAN SIT DORMANT FOR 10 YEARS BETWEEN FLOWERING TIMES

far left ©Mark Hobson; left ©Oliver Maass

Canadians are proud of their forests – from the emblem on our flag to the forests of Clayquot Sound (far left) to the Tobeatic Wilderness in Nova Scotia. (Left), forests define much of the nation's landscapes.

NATURAL CAPITAL ACCOUNTS: Trees

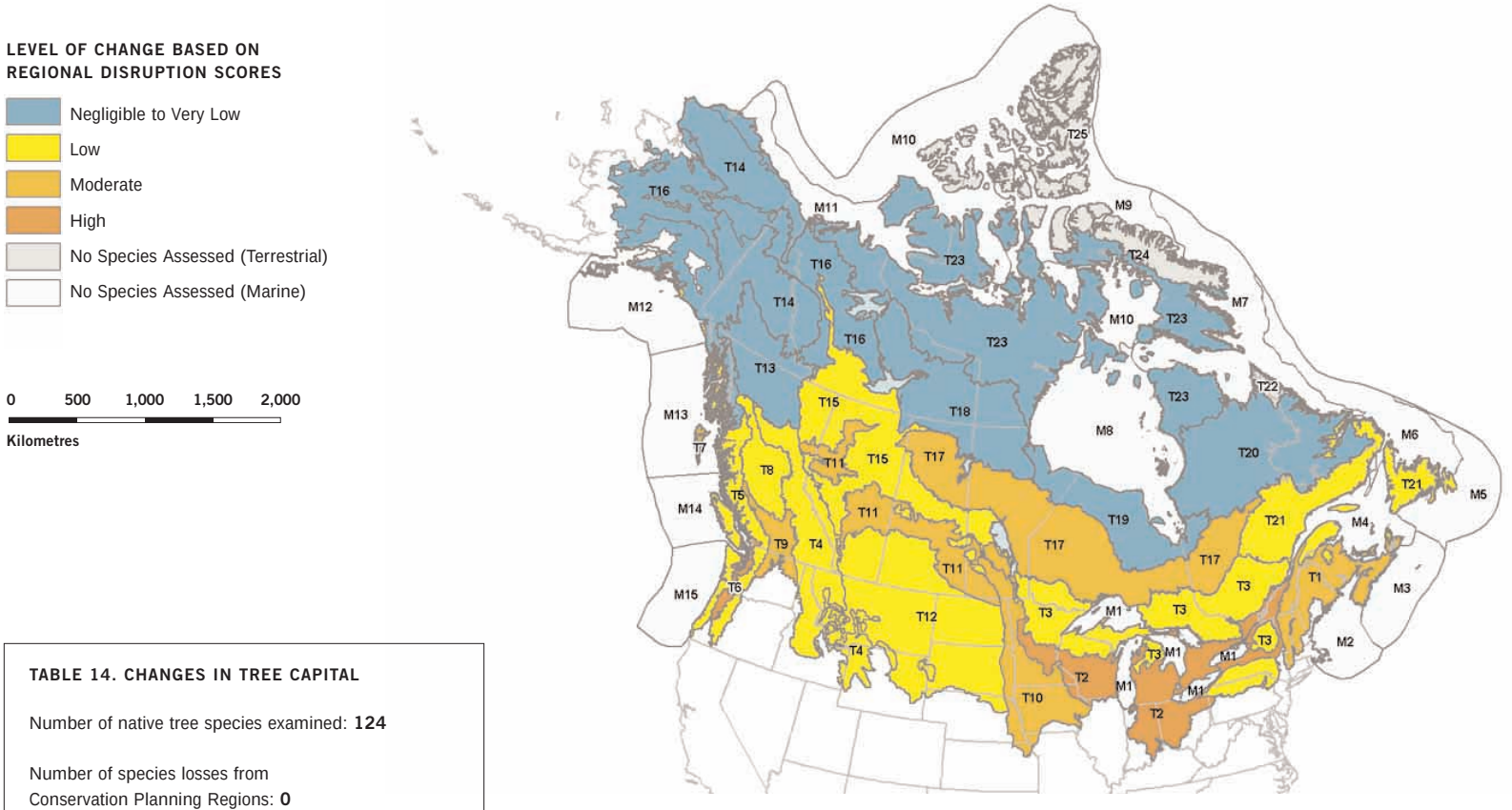
Trees, by their very nature, are indicators of change. Deciduous forests, for example, indicate the change of seasons by the presence or absence and colour or texture of their foliage. Because they are stationary, trees can indicate a great deal about the history of a place – their size and age, often measured in centuries, can be interpreted to tell stories about change on a local level. Associations of trees – forests – can reveal similar clues of change at much larger geographical scales.

While trees have provided a major backbone to the Canadian economy over the centuries, the land on which they thrive is sometimes deemed to be of greater importance for other uses, such as agriculture and urban development. The sedentary nature of trees means that in these situations, range areas immediately decline and become fragmented. Tree planting on a commercial scale can mean the intentional replacement of one group of tree species by another for economic gain. This can lead to non-native tree species disrupting the natural balance across large sections of a region. Where non-native tree species have been introduced, they have sometimes brought with them new diseases that have caused wave after wave of near extinctions to once-common trees in all parts of Canada, but especially to species in the east.

Not surprisingly, therefore, the most significant declines for tree species in Canada are where forest cover has been widely converted to other land uses, especially agriculture and urban development. The Nature Audit has found that the Puget Sound Lowlands and Willamette Valley (T6) recorded the highest disruption rate, closely followed by the southern Great Lakes and St. Lawrence Valley region (T2), where both agriculture and urban sprawl have claimed significant forest habitat (Figure 15). Two other regions demonstrated major disruptions from baseline conditions due to the presence of agriculture: the aspen parkland region of the south-central prairie provinces (T11) and the tallgrass prairie and oak savanna region of southern Manitoba, extending southward to Iowa (T10).

Although overall disruption levels were not as high for trees in other forested regions of Canada, recent disruption trends (1975-2000) indicate that the steepest rates of change for species abundance and range are occurring in five of BC's Conservation Planning Regions (T4, T5, T7, T8 and T9), followed by two regions in the boreal forest (T15 and T17). This appears to reflect the shift in species composition away from a dominance of longer-lived, shade-tolerant conifers to early successional species, such as birch and poplar, as a result of widespread forest harvesting in these regions.

FIGURE 15. CHANGE IN RANGE AND ABUNDANCE FROM BASELINE (C. 1600) TO PRESENT: TREES



PRIORITY REGIONS FOR TREE CONSERVATION

Southern Great Lakes and St. Lawrence Lowlands (T2)

Puget Sound Lowlands (T6)

Wave after Wave...

Eastern North American forests are among the richest in tree species diversity in the temperate world. But in the past century, many of the most common and valuable species have been lost to successive invasions of alien pests and diseases. The first massive wave of decline hit the American chestnut, a grand tree that, according to some estimates, comprised 25 per cent of the deciduous forests east of the Mississippi. An Asian fungal disease, first detected in New York City in 1904, destroyed virtually every chestnut tree by the 1940s.

In the 1930s, Dutch elm disease arrived in North America; by the early 1970s, it had destroyed most stands of American elm. Butternut, eastern hemlock, American beech and eastern flowering dogwood are now disappearing due to recently introduced pathogens. Newly arrived, the emerald ash borer, now threatens species of ash, and unless the Asian long-horned beetle is successfully contained where it has recently been detected in some U.S. city neighborhoods, our maples and oaks will suffer the next major wave of decline.

TABLE 14. CHANGES IN TREE CAPITAL

Number of native tree species examined: **124**

Number of species losses from Conservation Planning Regions: **0**

OVERALL REGIONAL CHANGES, PRE-EUROPEAN SETTLEMENT TO PRESENT DAY

	Regional Abundance Trends (%)	Regional Range Trends (%)
Contracted > 50%	24.0	9.1
Contracted > 20%	18.6	19.0
No Change (+/- 20%)	52.3	48.8
Expanded > 20%	3.4	17.1
Expanded > 50%	1.8	6.0

The Nature Audit revealed trees have experienced marked declines in range and abundance.

Trees in 2025?

Although no species of trees has been completely lost from Canada, the trends indicate that in widespread areas of the country, our tree assemblages are becoming simplified. What remains of deciduous tree species in the east is still threatened by incremental loss. More worrisome, perhaps, is the succession of exotic pests and diseases threatening further range-wide losses. By 2025, many species of ash, maple and oak may have gone the way of the American chestnut, elms and eastern flowering dogwood (see “Wave after Wave”). In the commercial forest zones of Canada, the threat of widespread conversion of natural forest to commercial stands with shorter rotations threatens to further disrupt tree species populations, especially where natural disturbance intervals are measured in centuries, not decades.

Both humpback whales (far left) and lynx (left) are examples of K-strategists.

far left ©PhotoDisc, left ©Howard Buffett

NATURAL CAPITAL ACCOUNTS: r- and K-strategists

The remarkable diversity of life is a result of the various strategies used by each species to grow, survive and reproduce. All of these activities require energy, and – to use a financial analogy – how that energy is used over a lifetime requires budgeting. For example, plants and animals cannot use up all of their energy on growth, since that would mean they have nothing left over for reproduction. Without reproduction, species become extinct. In general, the greatest budgetary difference amongst species occurs in how energy is allocated to reproduction, growth and maintenance.

In 'high-risk' environments, where resource levels are unpredictable, such as in disturbed habitats, it is advantageous for species to allocate most of their energy to quick reproduction of many offspring at the expense of growth and maintenance of their young. This strategy works since in such environments, mortality among offspring is high regardless of the amount of parental care provided. The high number of offspring increases the probability that at least one offspring will survive to maturity. These types of species, classified as **r-strategists**, are typically small, short-lived and have other characteristics adapted to risky habitats (Table 15). Examples of r-strategists, found amongst all forms of life, include rabbits, dandelions, and bacteria.

At the other end of the spectrum, within stable habitats harboring a more predictable supply of resources, a species will put most of its energy into the growth and maintenance of itself and its offspring at the expense of prolific reproduction. This strategy works since in such environments, offspring are less likely to die from random occurrences, and greater survival will be a result of increased parental care and time taken for development. These types of species – known as **K-strategists** – are typically large, long-lived and have other characteristics adapted to stable habitats (Table 15). Examples of K-strategists include whales, orchids and turtles.

MEASURING THE DIFFERENCES BETWEEN R- AND K-STRATEGISTS

The Nature Audit investigated whether the extent and patterns of human pressures affected r-strategists and K-strategists differently. Species from taxonomic groups examined earlier were categorized as r- or K-strategists based on their individual characteristics. Since in general, human use of and alterations of the land and seascape have been more intensive in the south relative to the north, we grouped the 25 Terrestrial and 15 Marine Conservation Planning Regions into eight Terrestrial Super Regions and four Marine Super Regions along a latitudinal gradient. Disruption scores for r- and K-strategists in each Super Region were calculated using data from a broad assemblage of taxonomic groups.

HOW DOES HUMAN ACTIVITY AFFECT THESE TWO TYPES OF SPECIES?

Reductions in and changes to habitats as a result of human activities alter the stability of habitats and are especially detrimental to K-strategists. The Nature Audit analysis of r- and K-strategists showed a similar trend for most regions. Typically, K-strategists showed a greater level of disruption relative to r-strategists throughout most regions of the country (Figures 16 and 17).

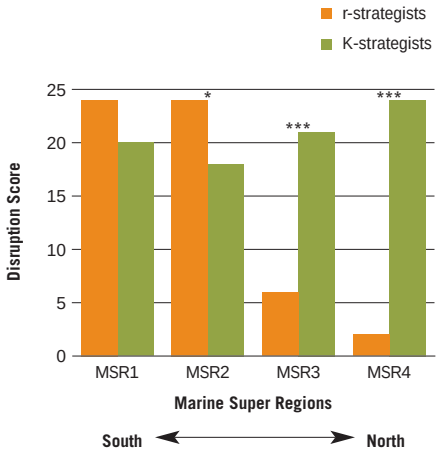
©J.D. Taylor

Cottontail rabbits are classic r-strategists with high reproduction rates.

TABLE 15. CHARACTERISTICS OF R- AND K-STRATEGISTS FROM ACROSS ALL TAXA

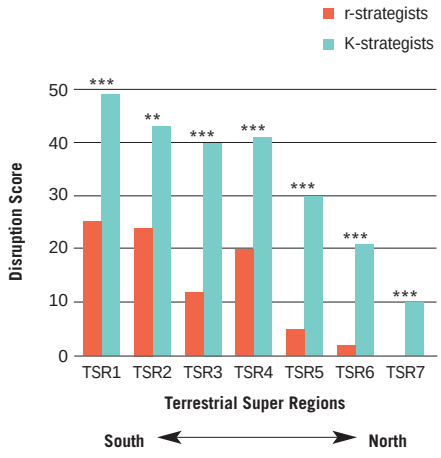
r-Strategists	K-Strategists
short-lived	long-lived
large number of offspring	small number of offspring
small birth size	large birth size
less parental care	more parental care
reaches maturity rapidly	reaches maturity less rapidly
small overall size	large overall size

FIGURE 16. MEAN DISRUPTION SCORES FOR R- AND K-STRATEGISTS WITHIN MARINE REGIONS



Original Conservation Planning Regions were lumped along a latitudinal gradient to produce Marine Super Regions. Mean Disruption scores were calculated using data from all taxa used in the report. Asterisks indicate statistically significant differences (Kruskal–Wallis non–parametric test of group means, * = p < 0.05, *** =p < 0.001).

FIGURE 17. MEAN DISRUPTION SCORES FOR R- AND K-STRATEGISTS WITHIN TERRESTRIAL REGIONS



Original Conservation Planning Regions were lumped along a latitudinal gradient to produce Terrestrial Super Regions. Mean Disruption scores were calculated using data from all taxa used in the report. Asterisks indicate statistically significant differences (Kruskal–Wallis non–parametric test of group means, **=p < 0.01, ***=p < 0.001).

r- and K-strategists in 2025?

While the northern terrestrial areas of the country are relatively undisturbed compared to the south, K-strategists are already showing higher levels of disruption relative to r-strategists. As long-lived species that reproduce less frequently, K-strategists require relatively large stable and intact habitats to survive. If pressure trends continue northward, further disturbance to northern ecosystems will also lead to relatively higher levels of K-strategists disruptions. The problem will be compounded in the Arctic, where the fragility of the ecosystems will mean that any recovery of disturbed habitats will take greater periods of time, if recovery can occur at all. This means that K-strategists, such as the polar bear, that require these northern habitats may be even more vulnerable to future human activities than their counterparts in the south.

From the small and endangered Oregon spotted frog (far left) to the massive Steller sea lion (left), Canada's biodiversity is a treasure we must steward for future generations.

far left ©Russ Haycock, Co-Chair, Oregon Spotted Frog Recovery Team; left ©Charles Seaborn

THE STATE OF SPECIES: Summing it Up

What is the bottom line when it comes to describing the sum total of species change since European settlement? Are we in the black, or in the red? And what does it say about the future for biodiversity in this country?

Table 16 displays the score results from all species groups analyzed – terrestrial and marine mammals, birds, reptiles, amphibians, marine fishes, freshwater fishes, butterflies, orchids and trees. At a glance, one can see a region-by-region perspective, showing which species groups in which regions of Canada have become highly disrupted over time, and which remain relatively intact.

The results are both a cause for concern, and a cause for optimism.

Concern, since except for the very far north, some level of disruption was detected for *every* region in the country. In many southern regions, where the level of human use and change of the landscape has been considerable, the majority of species groups show moderate to severe levels of disruption. Our intense use of the land has had a profound impact on the state of biodiversity in the south. While conservation efforts exist throughout these areas, recent trends indicate that a much larger effort is needed to stop species from sliding deeper into the red. Even in the boreal and Arctic regions, where most of the world believes that Canada is a pristine place, the numbers have taken a downward turn. Human use of the country is much more pervasive, and the impact far greater, than many people realize.

There is also cause for optimism. There are regions in the northern parts of Canada where, by and large, the disruption to biodiversity is still low. These are places where we still have an opportunity to move forward using the Conservation First Principle. Undertaking comprehensive conservation efforts now in these regions will help to prevent biodiversity from sliding into the red as it has in the south.

In sum, the figures show us that we're not bankrupt, but there is much work to be done if we wish to turn the downward trends and keep things in the black. Read on to learn more about the pressures humans are putting on the land and its biodiversity, and the efforts underway to lessen those pressures.

TABLE 16. SUMMARY OF REGIONAL DISRUPTION SCORES FOR ALL SPECIES GROUPS

	DISRUPTION SCORE CATEGORIES				
CPR	**Negligible to Very Low (0 to 4)**	**Low (5 to 19)**	**Moderate (20 to 44)**	**High (45 to 69)**	**Severe to Critical (70 to 100)**
T1		Amphibians, Birds	Butterflies, Freshwater Fishes, Reptiles, Terrestrial Mammals, Trees	Orchids	
T2		Amphibians, Birds	Butterflies, Freshwater Fishes, Reptiles	Orchids, Terrestrial Mammals, Trees	
T3		Amphibians, Birds, Butterflies, Trees	Freshwater Fishes, Orchids, Reptiles, Terrestrial Mammals		
T4	Butterflies	Birds, Reptiles, Trees	Amphibians, Freshwater Fishes, Terrestrial Mammals	Orchids	
T5	Butterflies	Birds, Trees	Amphibians, Freshwater Fishes, Orchids, Reptiles, Terrestrial Mammals		
T6		Birds, Reptiles	Butterflies, Freshwater Fishes	Amphibians, Orchids, Terrestrial Mammals, Trees	
T7	Birds, Butterflies, Freshwater Fishes	Terrestrial Mammals	Orchids, Trees	Amphibians	
T8	Amphibians, Birds, Butterflies, Reptiles	Terrestrial Mammals, Trees	Freshwater Fishes, Orchids		
T9		Birds	Butterflies, Freshwater Fishes, Reptiles, Terrestrial Mammals, Trees	Amphibians, Orchids	
T10		Amphibians, Birds	Butterflies, Freshwater Fishes, Reptiles, Terrestrial Mammals, Trees		Orchids
T11		Amphibians, Birds, Reptiles	Butterflies, Freshwater Fishes, Orchids, Terrestrial Mammals, Trees		
T12		Amphibians, Birds, Butterflies, Reptiles, Trees	Freshwater Fishes, Terrestrial Mammals		Orchids
T13	Amphibians, Birds, Butterflies, Trees	Terrestrial Mammals	Freshwater Fishes, Orchids		
T14	Birds, Butterflies, Reptiles, Trees	Amphibians	Freshwater Fishes, Orchids, Terrestrial Mammals		
T15	Amphibians, Butterflies, Reptiles	Birds, Trees	Freshwater Fishes, Orchids, Terrestrial Mammals		
T16	Amphibians, Birds, Butterflies, Trees	Freshwater Fishes, Terrestrial Mammals	Orchids		
T17	Amphibians, Butterflies, Reptiles	Birds, Terrestrial Mammals	Orchids, Freshwater Fishes, Trees		
T18	Amphibians, Birds, Butterflies, Reptiles, Trees	Orchids, Terrestrial Mammals	Freshwater Fishes		
T19	Butterflies, Orchids, Reptiles, Trees	Amphibians, Birds, Terrestrial Mammals		Freshwater Fishes	
T20	Amphibians, Birds, Butterflies, Orchids, Reptiles, Trees	Terrestrial Mammals	Freshwater Fishes		
T21	Amphibians, Butterflies, Reptiles	Birds, Trees	Freshwater Fishes, Orchids, Terrestrial Mammals		
T22	Birds, Butterflies, Orchids	Terrestrial Mammals	Freshwater Fishes		
T23	Butterflies, Orchids, Trees	Birds, Terrestrial Mammals	Freshwater Fishes		
T24	Birds, Butterflies	Terrestrial Mammals		Freshwater Fishes	
T25	Birds, Terrestrial Mammals				
M1		Birds, Freshwater Fishes			
M2		Birds	Marine Fishes, Marine Mammals, Reptiles		
M3		Birds, Marine Mammals	Marine Fishes, Reptiles		
M4		Birds, Marine Fishes	Marine Mammals, Reptiles		
M5		Birds, Marine Fishes	Marine Mammals, Reptiles		
M6		Marine Fishes	Birds, Marine Mammals, Reptiles		
M7	Marine Fishes	Birds	Marine Mammals		
M8	Marine Fishes	Birds	Marine Mammals		
M9	Birds, Marine Fishes		Marine Mammals		
M10	Marine Fishes	Birds	Marine Mammals		
M11	Birds, Marine Fishes		Marine Mammals		
M12		Birds	Marine Fishes, Marine Mammals		
M13		Birds	Marine Fishes, Marine Mammals, Reptiles		
M14		Birds, Marine Mammals	Marine Fishes, Reptiles		
M15		Birds, Marine Mammals	Marine Fishes, Reptiles		

INTRODUCTION:

Natural Capital Expenditures

© John James Audubon

The Carolina parakeet once inhabited parts of southern Ontario. This colourful bird was hunted to extinction by 1920 because of their attraction to agricultural crops.

Canada is a nation built upon its natural capital. Prior to European settlement, Canada provided bountiful resources to its inhabitants in the form of fish, wood products, fertile soils, precious metals and vast amounts of fresh water. As Canada's population grew, we withdrew natural resources from the land to build the country around us. Yet, while our natural capital was slowly being drawn down, we rarely checked the balance.

From coast to coast, we have covered much of the nation with industries like agriculture, aquaculture, fisheries, forestry, mining, and oil and gas. In addition, people have settled throughout the land, establishing an infrastructure necessary for this development – including roads, cities and dams. Human settlement has also led to the introduction of invasive species and an increase in the number and volumes of pollutants.

The ecological impacts of each of these industries have been studied to varying degrees, though often they are examined locally and in isolation; we tend to look at impacts of only one industry and only in the area in which they are operating. Rarely do we look across borders, view things from a regional perspective or look at what the cumulative impact of many activities are on a single area. What does the picture look like when we add all the different human activities that impact biodiversity together, and evaluate it at a regional level?

This 'Natural Capital Expenditures' section of The Nature Audit provides the results of that picture of human use of and impact on Canada's land- and marine-based resources. It presents broad signals of the pressures or 'footprints' of humans on biodiversity, estimating how our activities and infrastructure have impacted Canada's natural state. While there has been continuing change since pre-European settlement on our lands and waters, this section presents the current development pressures along with current trends – generally attributable to changes over the last 50 years, where data were available.

The Nature Audit is **not** suggesting that these activities should be removed from the landscape. Rather, we are using these results to help identify priority areas where more widespread application of best practices is required. Ultimately, our goal is to examine the cumulative impacts of industry activity in specific areas. This will better inform planning for biodiversity conservation, either in advance of increasing industrial activity or by finding ways to lessen its current impacts. WWF-Canada feels this perspective is essential to helping Canadians set priorities for the conservation of nature in the 21st century. In the end, shifting practices in a manner that conserves biodiversity and ensures the sustainable use of our natural resources is a goal that must be achieved for Canada to meet its commitment to the United Nations Convention on Biological Diversity.

METHODOLOGY USED

The Nature Audit presents pressure or 'footprint' scores based on both spatial and non-spatial information gathered from a variety of sources (see page 102). Using a Geographic Information System (GIS), place-based data on the presence, extent and intensity of human activities (agriculture, aquaculture, fisheries, forestry, large dams, mining, oil and gas, and transportation and urban infrastructure) were examined separately; they were then combined to develop a cumulative impacts assessment. Transportation infrastructure associated with a specific industry (e.g., logging roads) was considered within the transportation and urban infrastructure assessment. Toxic pollution and invasive species were also examined but because of the difficulties in being able to consistently assign or model local, geographically based impacts, they were not incorporated into the cumulative assessment. Instead, sources of toxic emissions were mapped and evaluated by point source and numbers of invasive species were mapped according to their presence in each Conservation Planning Region (CPR). Both pressures pose serious risks to the ecological integrity of ecosystems and habitats and ultimately, to human health.

To assess the individual and cumulative impacts of activities

on biodiversity, scoring systems based on known practices were developed for each industry sector activity and related to known or predicted ecological impacts Table 17. The notion behind this and the scoring of different management systems or practices, is to identify the means by which industry activities can transition towards a lighter footprint on biodiversity. The relative weightings in the scoring system of each industry sector were developed based on personal communications with conservation biologists and review of the scientific literature.

Spatially, the methodology is similar to the GLOBIO Methodology used by the United Nations Environment Programme. Data were processed and analyzed on a 1-km^2 basis. Where data were unavailable, outdated, or of insufficient quality, they were excluded from the analysis. In some cases, this led to an underestimation of the cumulative scores for some areas. Such situations are noted in the methodology of individual thematic coverages, which follow.

The process of building this analysis revealed two significant concerns: that Canada is deficient in tracking most activities on the landscape, and that there is a large gap in our understanding of the spatial impact of different activities on biodiversity. Addressing this lack of data and understanding are crucial to improving and guiding conservation efforts in the 21st century.

This analysis is a first iteration in developing an increasingly comprehensive perspective of the patterns of biodiversity change that have, and continue, to occur across Canada. While we are confident in the broad trends that are visible, there are still many improvements that can be made. The Nature Audit welcomes feedback on our methodology in order to help us expand and refine this analysis over time, and to improve the accuracy of the results. In particular, further refinement of the pressures scoring system for specific habitat types is sought and we hope to be able to incorporate more accurate accounting of company-specific best practices being applied in the field. Within the following pages you will note a series of ranked tables; the tables list the five heaviest 'footprints' by jurisdiction and CPR. 'Avg.' is the average score within a region (area dependent) while 'Total' is the cumulative footprint within a region (area independent).

TABLE 17.
This table describes the classes of industry pressure on biodiversity used to assess the level of disruption to ecosystems and habitats. This table is the basis of the map legends on pages 47 – 69.

LEVEL OF HABITAT DISRUPTION ATTRIBUTED TO INDUSTRY ACTIVITY IN THE CONSERVATION PLANNING REGIONS	DESCRIPTION OF CHANGE TO BASELINE HABITAT CONDITIONS AND ECOSYSTEM INTEGRITY PRIOR TO EUROPEAN SETTLEMENT AS A RESULT OF INDUSTRY ACTIVITY
No industry activity	No impact.
Very low disruption	Industrial presence generally causing little or no long-term impact to habitats. Some local areas in close proximity to concentrated areas of activity may be experiencing higher levels of disruption.
Low disruption	Industrial activity causing some ecosystem disruption but structure and function remain essentially intact. Some local areas in close proximity to concentrated areas of activity may be experiencing higher levels of disruption.
Moderate disruption	Industrial activity is leading to some simplification of ecosystem structure; evolutionary processes begin to be compromised.
High disruption	Industrial activity is causing considerable habitat disruption as a result of increased alteration or conversion. Ecosystem structure is noticeably simplified and evolutionary processes are significantly compromised.
Severe disruption	Industrial activity is causing significant levels of ecosystem disruption as a result of widespread alteration or conversion. Ecosystem structure is simplified and evolutionary processes are severely compromised. Few blocks of intact, baseline habitat remain.
Critical disruption	Industrial activity is leading to critical disruption of habitats and ecosystems. Only small fragments of baseline habitat remain.

far left ©Gregor G. Beck; left ©Courtesy Jim Brown / The Journal-Pioneer

Large areas of southern Ontario wetlands have been drained for agriculture, such as in the Holland Marsh (far left). Potato farming in PEI, which uses high inputs of pesticides, has caused fish kills in waterways.

NATURAL CAPITAL EXPENDITURES: Agriculture

With fertile soils and suitable climates, some regions of Canada are ideal for farming. In the east, forests were felled to make way for croplands while in the prairies, sod was broken to make way for extensive grain cropping. Agriculture closely paralleled the settlement patterns of Canada and largely remains so today. Agriculture is most often the principal use of the landscape immediately outside of our major urban centres.

Agricultural activities can have a significant negative impact on biodiversity, although with careful attention to farming practices and farming systems, impacts can be minimized and farm profitability maintained or improved. Pressures on biodiversity can result from the use and overuse of agricultural inputs (synthetic pesticides and fertilizers, inadequately treated manure), the simplification of cropping systems, and the loss and poor management of native habitat.

The Nature Audit results indicate that the greatest impact is being caused by intensive farming practices throughout the American Midwest which are exerting the greatest pressure on the tallgrass prairie and savanna Conservation Planning Regions (CPR) (T10), followed by the southern Great Lakes and St. Lawrence Lowlands (T2). Aspen Parkland (T11) has also been highly impacted as has the short and mixed grass prairie region (T12), especially in Canada (Figure 18). The Puget Sound lowlands and Willamette Valley (T6) has been intensively farmed outside of where urban development has occurred.

CPR T9 (which includes the Okanogan Valley of BC) scored more favourably than expected, likely due to the high adoption rate of Integrated Pest Management (IPM) practices, and the fact that more acreage is under permanent cover (orchards and rangeland) than in other CPRs. Even in regions with lower scores, there are often localized areas where agriculture exerts a considerable impact on biodiversity. This is particularly true where synthetic pesticides and fertilizers are intensively used, and a limited numbers of crops are grown repeatedly on the same land. Intensive potato farming on Prince Edward Island (T1) is a case in point.

Some Highlights of Historical Trends

- Major reductions in natural habitat on farms continued from 1900 to 2000. In 1900, many regions of the country still had extensive natural habitat on agricultural land.
- Significant agricultural pressures on biodiversity were already visible in T10 and T2 by 1900, particularly due to loss of forest cover, and an early trend away from cereal and hay towards, first corn, and later soybeans. These trends are particularly pronounced in the U.S. parts of T2 and T10.
- There has been a huge increase in the negative impacts of synthetic pesticides and fertilizers since 1900, when their use was just beginning.
- Cropping in Canadian portions of T11 and T12 is now significantly more diverse than in 1900, which generally benefits biodiversity.

FIGURE 18. INDUSTRY FOOTPRINT SCORE: AGRICULTURE

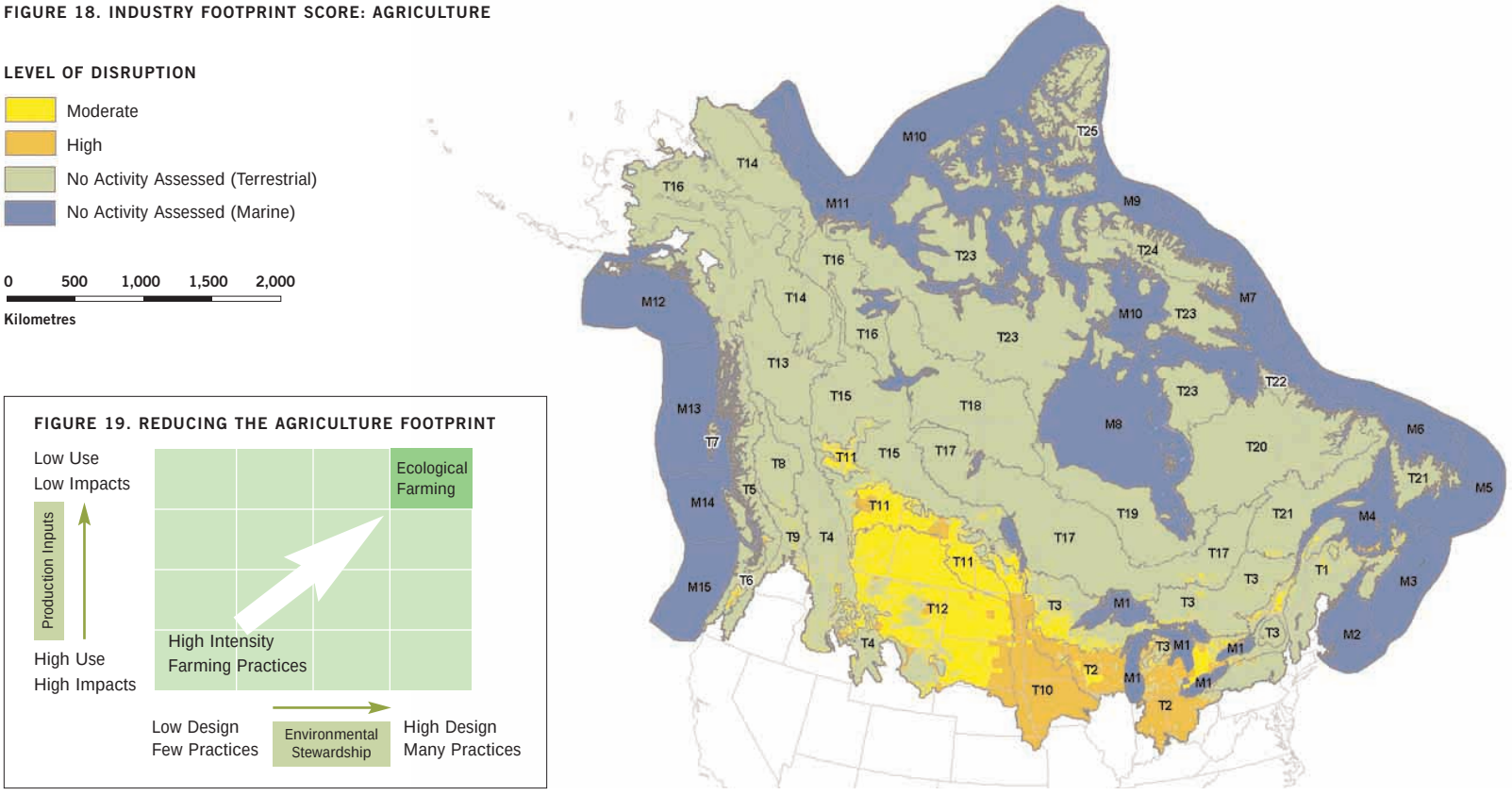


FIGURE 19. REDUCING THE AGRICULTURE FOOTPRINT

TABLE 18. HEAVIEST FOOTPRINT: AGRICULTURE

	Jurisdiction		CPR	
Rank	Avg	Total	Avg	Total
1	PE	SK	T10	T12
2	SK	AB	T2	T2
3	AB	MB	T12	T10
4	MB	ON	T11	T11
5	NB	QC	T6	T3

METHODOLOGY USED

- Data were derived from the 1901/ 1900 and 2001/1997 Census of Agriculture from Canada and the U.S., respectively, farm environmental management surveys, pesticide use surveys, and extension specialist estimates of farm practices.
- Scores were assigned out of a total of 10 for each of 10 components.
- Production inputs and practices included the consideration of pesticide use and toxicity, fertilizer management and use, manure management and quantity, farm pollution, diversity of cropping systems.
- Habitat quantity and management considered the management of ponds and riparian areas, ditches and watercourses, woodlots and forested areas, margins and corridors, and rangeland quantity and complexity.
- Generally, data on agricultural impacts on biodiversity are limited as is the spatial resolution of the data due to U.S. and Canadian federal confidentiality requirements. As a result, satellite imagery was used to limit the assessment only to agricultural lands.

© PhotoDisc

Bee Biodiversity: Canada's Food Supply Depends On It

Bees are active from early spring to late autumn and can be found in every part of Canada, including our urban gardens. Bees are highly seasonal creatures; for many species, only one generation emerges each year, timed to coincide with the peak flowering of their preferred food plants. Canada is home to as many as 977 native species of bees.

Bees are susceptible to many of the pressures that impact other wildlife species. The use of pesticides in agriculture and urban areas and the effects of habitat loss both have an impact on populations of bees. This should be a serious concern for Canadians, as up to one-third of Canada's food supply is dependent on insect-pollinated plants. Recent estimates of the value of services that bees provide to our agricultural industry range up to an estimated $1.2 billion per year.

85%: AMOUNT OF SOUTHERN CANADIAN WETLANDS LOST TO AGRICULTURE

Aquaculture, the farming of aquatic species, often takes place in pens like these open-net cages seen in BC's Broughton Archipelago.

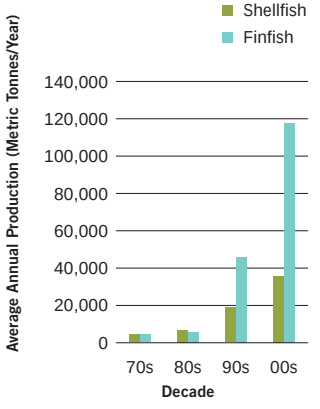
NATURAL CAPITAL EXPENDITURES: Aquaculture

In a world of decreasing fish stocks, aquaculture has been hailed by some as a way of meeting the world demand for marine protein sources. Aquaculture has seen tremendous growth since the 1970s; in Canada, the average annual growth rate has been over 15 per cent (Figure 20). While generating jobs and millions of dollars of revenue, there are numerous concerns with respect to aquaculture's impacts on biodiversity: it may cause disease outbreaks in wild fish stocks, result in discharge of untreated waste and antibiotics, and allow alien species to escape. Recently, scientists have raised concerns over the amounts of wild fish taken to meet demands for fish feed (see Aquaculture: A Growing Business, A Serious Cost).

Presently, the impact of aquaculture is fairly localized in Canada along coastal areas, but where it occurs, it can have a significant footprint on biodiversity. The two highest-scoring regions, the Broughton Archipelago in British Columbia and the Bay of Fundy in New Brunswick (M14 and M2, Figures 21a and 21c), have heavy concentrations of open-cage salmon farms. These two areas collectively produced almost 90 per cent of the farmed salmon in Canada in 2001. While the impacts of shellfish aquaculture are usually far less than finfish (mostly salmon) aquaculture, PEI produces nearly 60 per cent of the nation's shellfish, which accounts for the impact noted in M4.

Experts predict that the industry in Canada will continue to expand rapidly in established areas, as well as the Gulf of the St. Lawrence (M4), the Great Lakes (M1), and the central and north coasts of BC (M14, M13). In the coming years, aquaculture has the potential to play an important role in conserving biodiversity by reducing pressures on wild stocks and capture fisheries (Figure 22). To date, however, this potential has not been realized. Sustainable management practices are essential to a clean environment – something on which both biodiversity and fish farms depend.

FIGURE 20: EXPANSION OF AQUACULTURE INDUSTRY, 1970s TO 2001



The Canadian aquaculture industry has increased its production by approximately 15 per cent annually since 1970.

Source: FAO, 2003 & DFO, 2003

FIGURE 21A – 21C. INDUSTRY FOOTPRINT SCORE: AQUACULTURE

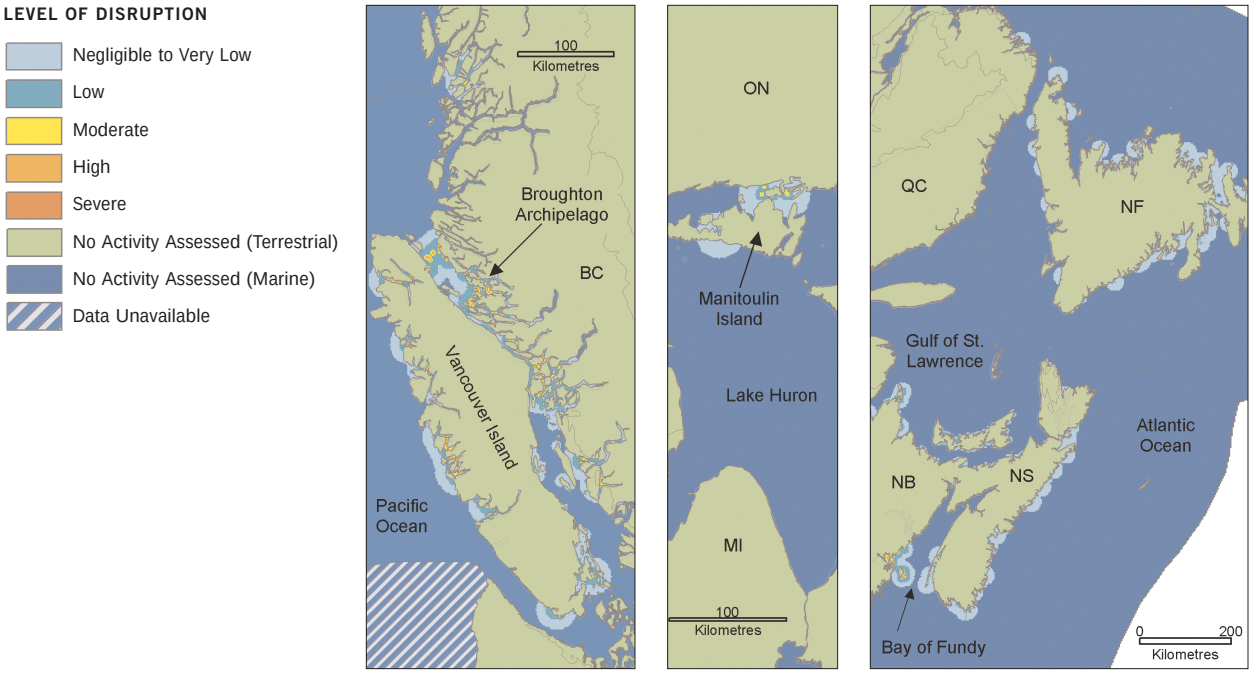
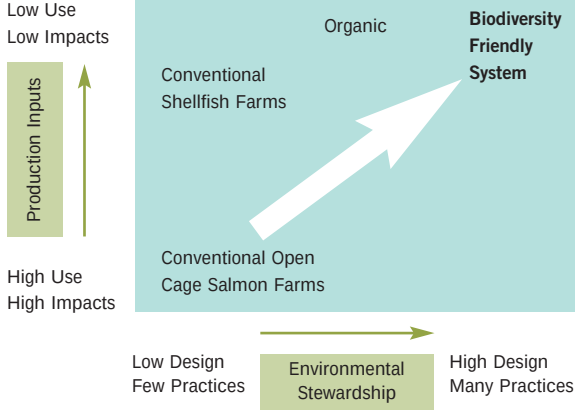


TABLE 19. HEAVIEST FOOTPRINT: AQUACULTURE

	Jurisdiction		CPR	
Rank	Avg	Total	Avg	Total
1	N/A	N/A	M14	M14
2	N/A	N/A	M2	M2
3	N/A	N/A	M4	M4
4	N/A	N/A	M5	M6
5	N/A	N/A	M6	M5

N/A: Not Available

FIGURE 22. REDUCING THE AQUACULTURE FOOTPRINT



Aquaculture: A Growing Business, A Serious Cost

Aquaculture is a growing business with a serious cost. Global production of farmed fish and shellfish doubled during the 1990s to about 45 million tons in 2000; by comparison, wild fisheries reached a total of 96 million tons in 2000.

Aquaculture is thought to decrease the current fishing pressure on commercial stocks, such as salmon and trout, and give wild populations a chance to rebound. However, new data show that certain wild stocks, used to make fish feed, are being severely impacted by aquaculture. Of the 96 millions tons of annual global catch, a third is used to produce fishmeal and fish oil. To produce 1 kg of farmed salmon, 4 kg of wild caught fish are needed to create fishmeal for the salmon. As global demand for seafood increases, aquaculture is expected to grow dramatically.

Wild fish stocks impacted include anchovies, pilchards, mackerel and herring. They are important parts of the marine food chain, and their decline could have repercussions up the chain – on commercial fish species and on dolphins and seabirds.

METHODOLOGY USED

- The Nature Audit looked only at coastal marine and Great Lakes aquaculture sites.
- Finfish and shellfish farms were scored separately.
- "Footprint" or pressure scores were applied to a distance of 20 km out from an aquaculture site based on impacts cited in scientific studies.
- Considerations included: effects of inputs (such as antibiotics and pesticides), outputs (such as nitrogen and phosphorus), diseases (such as sea lice), predator control devices (such as high-powered acoustic harassment devices), and pen infrastructure (a consideration for escaped alien species).
- Fish farm intensity was assessed using the average annual production of shellfish (clams, oysters, mussels, scallops and others including marine plants) and finfish (e.g., salmon) by province.
- Estimates of ecosystem impact are likely conservative. For example, finfish aquaculture risks escapes of non-native fish and the transfer of diseases to wild stocks. This can contribute to ecosystem impacts far beyond the 20 km from aquaculture sites assessed in this analysis.

4 KG: THE AMOUNT OF WILD CAUGHT FISH REQUIRED TO FEED AND PRODUCE 1 KG OF FARMED SALMON

far left, ©Mike Strong and Maria-Ines Buzeta; left ©NEFSC Photo Archives / www.nefsc.noaa.gov

Bottom-trawling practices often damage sea floor coral beds, home to species like the northern red soft coral (far left). Canada's cod industry (left) is at a critical point, with recovery in question.

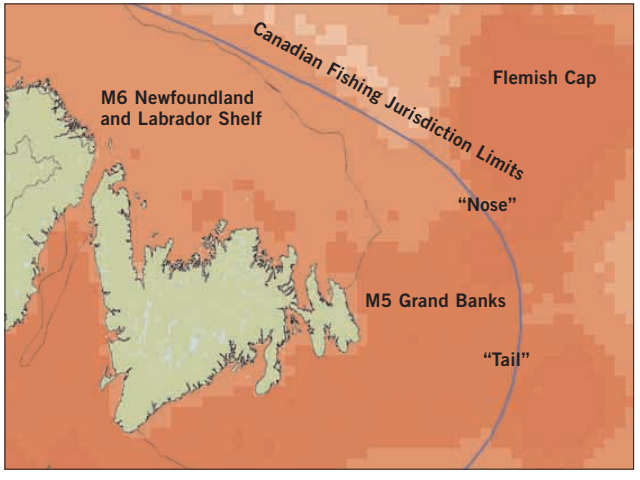
NATURAL CAPITAL EXPENDITURES: Fisheries

Being a terrestrial species, humans rarely appreciate what goes on in our waters. Yet beneath the surface of blue, our fishing activities have caused dramatic change to the biodiversity of our oceans. John Cabot described the Grand Banks in 1497 as so "swarming with fish [that they] could be taken not only with a net but in baskets let down [and weighted] with a stone" (Safina, C. 'Song for the Blue Ocean', 1997). From the mountains of bycatch (the 'waste' species that are trapped in nets when fishing), to the damage to the ocean floor caused by bottom trawling, fishing has considerably impacted biodiversity. The collapse of the cod fishery on the east coast stands as a globally renowned example of unsustainable practices. If our oceans and Great Lakes are to recover, we must include reforms to fisheries practices (Figure 25).

Not surprisingly, the results of research carried out for The Nature Audit indicate a number of areas of intense fishing activity, including the Gulf of Maine (M2), the Scotian Shelf (M3), and the Gulf of St. Lawrence (M4). The western coast of the Olympic Peninsula (M15) in Washington, with its massive and localized bottom trawling activities, had the greatest fisheries footprint (Figure 24).

The Grand Banks present a unique challenge. With a moratorium on groundfish in place in Canadian waters, the pressure on Canada's portion of the Grand Banks has been reduced in recent years, despite offsetting growth in crab and shrimp fisheries. Yet just beyond Canadian waters, international fishing vessels land huge catches of fish and shrimp from the famous 'nose' and 'tail' of the Banks, and on the Flemish Cap (Figure 23). This emphasizes that international cooperation will be crucial to restoring the health of the Canadian portion of this marine ecosystem.

FIGURE 23. FISHERIES FOOTPRINT ON THE GRAND BANKS



The intensity of the fisheries is indicated by the colour of red with the darkest areas representing the highest fisheries footprint on biodiversity. The blue line represents the 200 nautical mile limit of Canadian jurisdiction.

FIGURE 24. INDUSTRY FOOTPRINT SCORE: FISHERIES

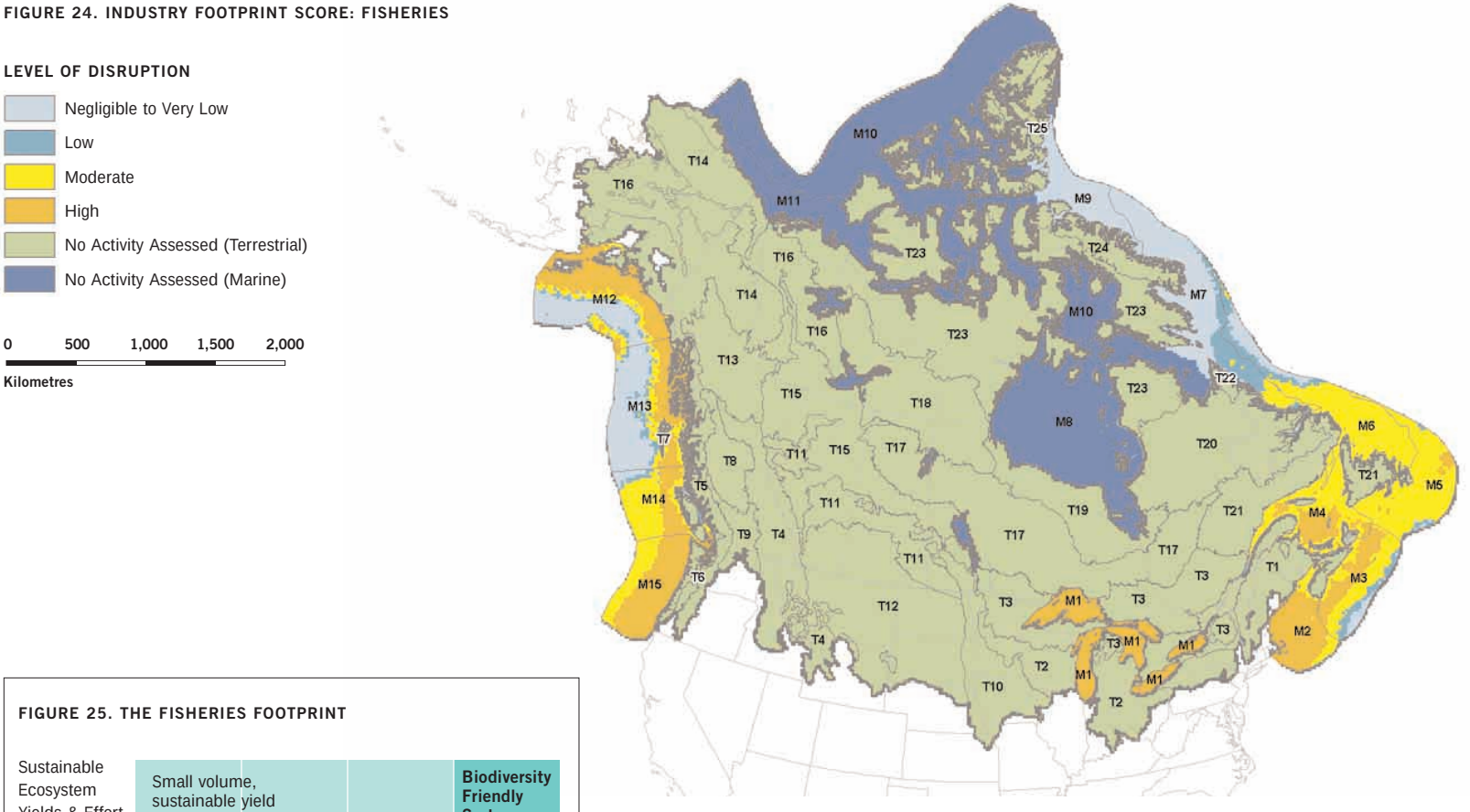
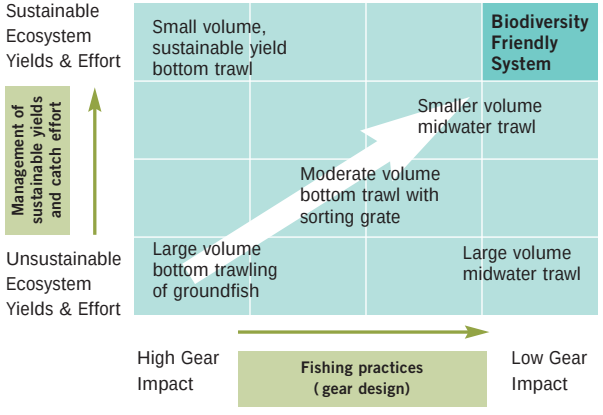


TABLE 20. HEAVIEST FOOTPRINT: FISHERIES

	Jurisdiction		CPR	
Rank	Avg	Total	Avg	Total
1	N/A	N/A	M2	M12
2	N/A	N/A	M15	M15
3	N/A	N/A	M4	M5
4	N/A	N/A	M1	M13
5	N/A	N/A	M14	M1

N/A: Not Available

FIGURE 25. THE FISHERIES FOOTPRINT



As practices shift from the lower left to the upper right corner of the diagram, the overall impact of fisheries activities on biodiversity lessens.

Fishing Down the Food Chain

Studies have shown over-fishing leads to a more rapid decrease of larger predator fish species compared to smaller fish varieties. This phenomenon occurs because larger, long-lived fish take many years to mature and breed. Consequently, a lengthy period of time is required to replenish over-fished populations of large fish. The worldwide declines in the populations of large, commercially valuable fish species has led to the exploitation of smaller and smaller fish species and invertebrates, found further down the food chain. Without sustainable fisheries practices, larger predator fish will not be able to recover, since they must now compete with humans for the smaller prey fish. At current catch levels, the smaller fish are suffering the same fate as their larger cousins.

METHODOLOGY USED

- Despite many models and estimates, Canadians still lack good data on our impacts on marine life.
- Data were provided from the University of British Columbia's Fisheries Centre (Sea Around Us Project - http://saup.fisheries.ubc.ca/). These were re-interpolated using a 20-km grid and fishing gear types were assigned to species groups as the principal means of catch.
- Relative impacts of gear types were based on a recent study on the biodiversity impacts of varying fishing gear types by L. Morgan (Marine Conservation Biology Institute) and R. Chuenpagdee (Virginia Institute of Marine Science).
- Fisheries footprint scores were generated based on a combination of catch volumes (to approximate fishing effort) and ecological impact of the gear type.
- UBC data were not available for the Great Lakes, and therefore they were scored independently using Great Lakes Fishery Commission catch data.

MALE COD GRUNT TO ATTRACT FEMALES DURING SPAWNING

far left ©Greg Stott; left ©Lara Ellis

Far left: an aerial view of logging roads and a close-up (left) of a logging road in Ontario. Fragmentation of forests by remote access roads can lead to significant impacts on wildlife.

NATURAL CAPITAL EXPENDITURES: Forestry

The likely impact of forestry operations on biological diversity in different regions of Canada can be assessed by evaluating provincial forest management policies and guidelines. To accomplish this, a set of 32 indicators was used to assess the forest management requirements on Crown land in each of Canada's provinces where timber harvesting takes place. The indicators cover four major aspects of forest management: 1) landscape-level planning; 2) reserves and protected areas; 3) stand-scale prescriptions; and, 4) harvest-rate calculation.

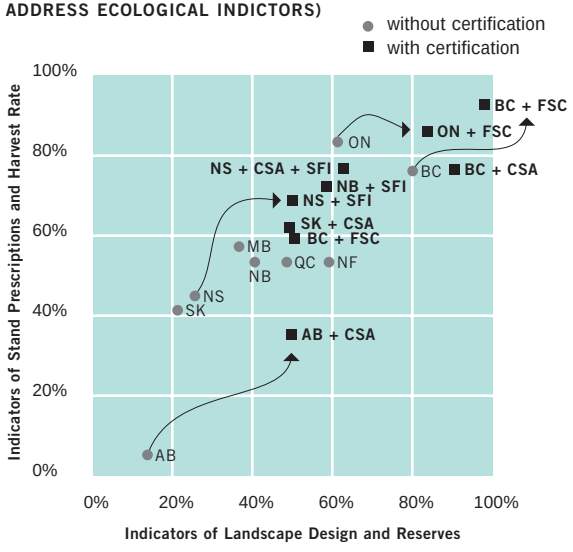
In addition to evaluating each jurisdiction's potential forestry footprint, which provides a base value for each province, the three major voluntary certification systems for forest management (FSC – Forest Stewardship Council; CSA – Canadian Standards Association; and SFI – Sustainable Forestry Initiative) were assessed to reveal the additional value of certifying voluntarily on top of the base value of each jurisdiction's mandatory regulations.

It is very important to note that the regional forestry pressure map and the analysis of forestry's footprint are based on the *potential* for existing policies, guidelines and voluntary certification systems to provide for sustainable forest management. Good policies mean very little if they are not enforced. In this first edition of The Nature Audit, no field assessments in real forestry operations were undertaken to verify how well the indicators reflect actual on-the-ground forestry practices.

Managing the Stand and Wider Landscapes

Figure 26 at right shows the degree to which forest management guidelines and certification standards address a set of 32 indicators of sustainable forest management (SFM). Two groups of indicators are shown in the graph: 1) indicators addressing stand-level regulations and harvest rate calculations; and, 2) indicators addressing landscape-scale design and the establishment of reserves.

FIGURE 26. REDUCING THE FORESTRY FOOTPRINT (DEGREE TO WHICH FOREST MANAGEMENT GUIDELINES ADDRESS ECOLOGICAL INDICTORS)



Forestry regulations, policies and guidelines vary widely among provinces, in the degree to which they specifically address 32 indicators of sustainable forestry assessed. The proportions met of landscape-level versus stand-level indicators are displayed here – each province's ability to address sustainable forestry would be greatly enhanced by adoption of voluntary certification systems.

FIGURE 27. INDUSTRY FOOTPRINT SCORE: FORESTRY

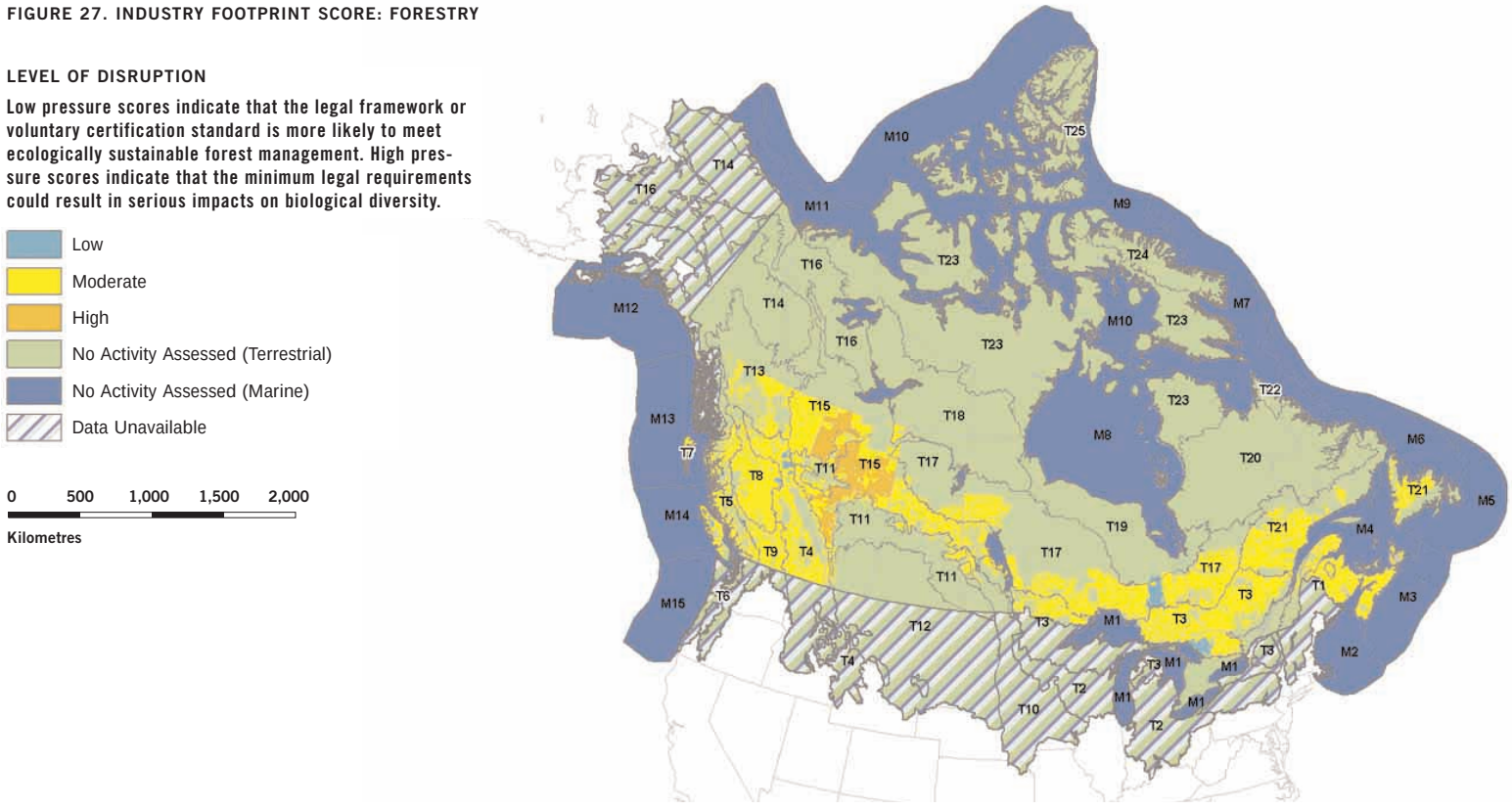


TABLE 21. HEAVIEST FOOTPRINT: FORESTRY

	Jurisdiction		CPR	
Rank	Avg	Total	Avg	Total
1	NB	BC	T15	T15
2	NS	AB	T3	T17
3	AB	QC	T1	T3
4	BC	ON	T8	T21
5	ON	MB	T9	T4

MAJOR FINDINGS INCLUDE:

- Of nine provinces assessed, six address less than 60 per cent of the SFM policy indicators, whether stand-level or landscape-level.
- Ontario and BC addressed the highest percentage of SFM indicators (Ontario – 80 per cent stand / 60 per cent landscape; BC – 80 per cent for both stand and landscape).
- Alberta scored the lowest, since its forest policy framework is not very prescriptive (though the performance of forestry companies relative to the SFM indicators varies widely).
- All jurisdictions, and especially those with the lowest SFM policy scores, would enjoy greatly improved scores with the adoption of certification.
- Only when combined with FSC standards did two jurisdictions (BC and Ontario) meet more than 80 per cent of SFM policy indicators, thus having the potential for lowest impact on biodiversity.

Forest Access: The Hidden Pressure

Road networks are built to allow access for forestry operations and oil and gas exploration. Incontrovertible evidence exists that roads magnify the detrimental impacts of logging and have cumulative effects that persist as long as the roadbed is in place. The capillary-like network they form offers human access into previously remote forest areas. Trucks, snowmobiles, ATVs and motorcycles carry hunters, fishers and other recreational users deep into areas which previously enjoyed little hunting and fishing pressure. Within a very short time, the unique remote character is eroded, with increased rates of human access inviting poaching and stressing formerly wild lakes and forests. Roads encourage increased unnatural access by predator species such as wolves, foxes and raccoons; increased risk of diseases these mammals can carry, such as rabies; invasions of weedy plants like purple loosestrife; and other unnatural threats to interior forest species, such as access for nest parasites like cowbirds, who lay eggs in other birds' nests.

Though often intended to be only temporary, roads (once opened) are usually kept open by continued use. Forestry company officials who would otherwise arrange for closing and rehabilitation of the road network are pressured to permit access by local users they are reluctant to deny. Sometimes, government policy prevents sound conservation measures, e.g., Quebec law prohibits the closure of roads once they are built.

far left ©Claude Beaudoin; left ©Gregor G. Beck

(Far left The James Bay hydro-electric development and the Robertson Lake hydro-electric development (left) in Quebec.

NATURAL CAPITAL EXPENDITURES: Large Dams

Large dams have impacted significant portions of many watersheds in Canada and virtually all in the adjacent portions of the Conservation Planning Regions (CPRs) in the U.S. The Nature Audit accounted for 4,482 dams larger than 10m throughout the CPRs, 934 of which reside within Canada. The majority of the Canadian dams are part of large hydroelectric projects that produce about two-thirds of Canada's electricity. Construction of large dams peaked in the 1970s (with 155 in Canada), but nonetheless, has continued at a considerable pace for the past 25 years (Figure 28).

Large dams can have significant consequences for biodiversity. Alteration of a river's flow impacts aquatic species throughout a watershed by changing water temperature, sediment and nutrient levels, while dams themselves act as a barrier to wildlife migration. Flooding behind dams has resulted in a loss of habitat and an increase in both the release of greenhouse gasses and increases in toxic mercury levels.

The Nature Audit results suggest that the three watersheds with the greatest ecological footprint created by large dam construction are: La Grande Rivière (T20) and La Rivière Manicouagan (T21), both in Quebec, and the Upper Missouri River near Sioux City, Iowa (T10) (Figure 29). The two Canadian systems listed have some of the largest reservoirs ever constructed, while the Upper Missouri has some 585 large dams concentrated in an area half the size of Vancouver Island. So disrupted is the Upper Missouri that there are sections of the river that 50 years ago flowed north-south but now flow east-west. In addition to these areas, several other large hydroelectric projects do bear note: the watersheds of the Churchill-Nelson Rivers in Northern Manitoba (T17), the Peace River in eastern BC (T4/T15), Labrador's Churchill River (T21) and the lower reaches of the Columbia watershed in western Oregon all have major dam complexes that have likely had significant impacts on their upstream and downstream ecology and biodiversity.

FIGURE 28: THE NUMBER OF CANADIAN LARGE DAMS IN EXISTENCE BY 25 YEAR CLASSES: 1900 - 2000

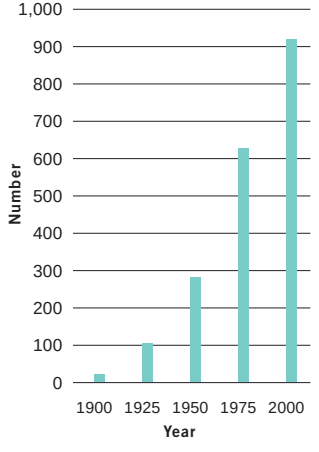


FIGURE 29. INDUSTRY FOOTPRINT SCORE: LARGE DAMS

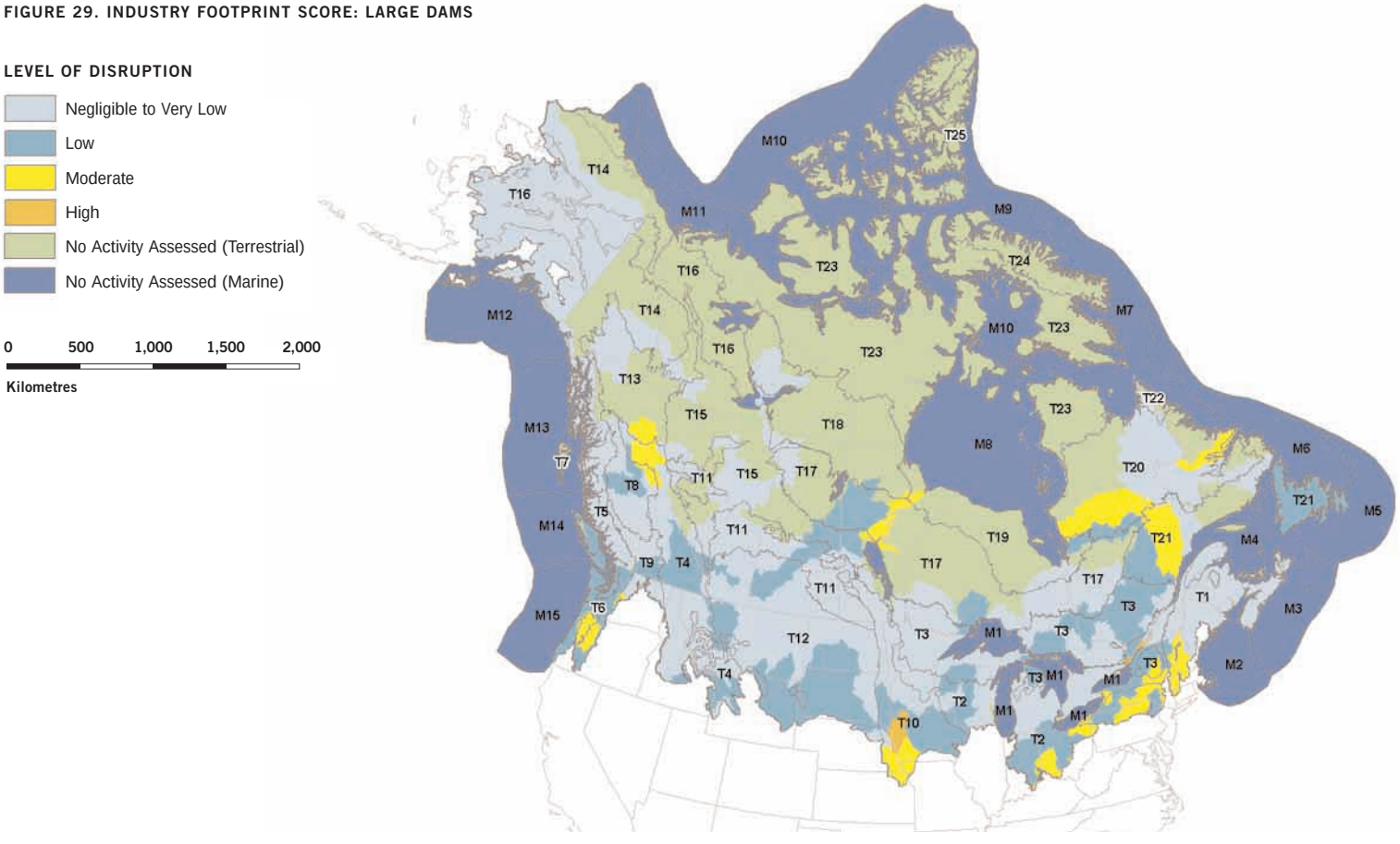


TABLE 22. HEAVIEST FOOTPRINT: LARGE DAMS

	Jurisdiction		CPR	
Rank	Avg	Total	Avg	Total
1	NF	QC	T20	T20
2	QC	BC	T10	T12
3	BC	NF	T21	T3
4	MB	MB	T6	T21
5	SK	ON	T3	T2

METHODOLOGY USED

- The Nature Audit defined large dams as those over 10m.
- Scoring system for the impact of large dam activity was based largely upon the World Commission on Dams report "Dams and Development".
- Biodiversity impacts considered in developing a footprint score included: loss of habitat (due to flooding and downstream riparian habitat), risk of mercury contamination, habitat disturbance from human presence and noise, dams as a barrier to species migration, and habitat degradation (from sediment and flow changes).
- Regional road infrastructure required to access dams and transmission line corridors were accounted for in the transportation and urban development layer.
- After assigning each dam to a watershed, footprint scores were developed for watersheds based on the sum of the volume of all reservoirs (a proxy for the amount of habitat flooded) and the total number of large dams (an indication of general hydrological alteration).
- Smaller dams were not considered in this work, due to a lack of data.
- For this first estimate of large dam pressure on biodiversity, no differentiation of scores was made based on individual site-based environmental management practices (such as fish ladders). Future releases of The Nature Audit hope to differentiate regional scores based on an evaluation of corporate best practices in the field.

Fish Ladders: Lowering the Pressures on Biodiversity

The American eel (*Anguilla rostrata*) is one of the many species that migrates huge distances throughout the course of its life. The trip from the Great Lakes to the Sargasso Sea in the Atlantic Ocean requires a journey of more than 2,000 km and takes the eels down the St. Lawrence Seaway. With the creation of the RH Saunders/Moses Dam in the mid-1950s, this migration became threatened. In the mid-1970s, Ontario Hydro and the Ontario Ministry of Natural Resources undertook a project to establish a 'fish ladder' for the eels. This trough that slowly goes up and over the dam take the eels some 24 hours to climb and is the only eel ladder in North America and the highest in the world. While recent years have seen some debate over eel numbers and trends as a result of fishing, pollution and other human pressures, fish ladders are a positive step towards reducing the pressures on fish species.

The Hemlo Gold Mine in Ontario (far left) and the Whitehorse Copper Mine in Yukon (left).

far left ©GaryAndJoanieMcGuffin.com; left ©Angela Walkley

NATURAL CAPITAL EXPENDITURES: Mining

Of Canada's industries, none is more widely distributed across the landscape than mining. From the active and abandoned mine sites in the far North, to those in Conservation Planning Regions (CPRs) that drop down into the United States and from the Pacific to Atlantic coasts, mining activity is present in nearly every corner of the nation.

Canada is a significant global player when it comes to mining and its domestic revenues were estimated at $36 billion for 2001. It is not surprising, therefore, that Canada houses some of the largest mining operations in the world including the Syncrude oil sands in Alberta, the MacArthur uranium mine in Saskatchewan, the Voisey's Bay nickel mine in Labrador, and the BHP diamond mine in the Northwest Territories.

Despite their size and distribution, mining operations do not cover vast tracts of land relative to other industries. Nevertheless, they do have the potential to cause significant localized damage through direct habitat removal and the degradation of local water bodies. Mining operations also require infrastructure such as roads, and are always preceded by exploration activities that can cause habitat fragmentation resulting in biodiversity disturbance. Furthermore, acid-draining mines have the potential to damage aquatic systems, a process which can continue for years after their abandonment.

The Nature Audit found some level of mining activity in all 25 terrestrial CPRs (Figure 30). Mining activity was most pronounced in the l'Abitibi-Témiscamingue area flanking both sides of the Ontario-Quebec border and in eastern Manitoba, all within CPR T17. Other areas of concentrated activity included the Nickel belt around Sudbury, Ontario (T3) and much of northern Newfoundland (T21). A large number of advanced exploration sites in the central part of the Yukon (T16) and north of Yellowknife to the Nunavut border (T18/T23) reflect the rapid expansion of new mining activity into Canada's northern territories.

Out of Service, Out of Mind

In the vast expanses of our Arctic lie time bombs that nobody wants: abandoned mine sites with hundreds of thousands of tons of highly toxic chemicals that pose a threat to both humans and many other species. The Report of the Commissioner of the Environment and Sustainable Development noted in September 2002 that to clean up these sites (which include such chemicals as arsenic and cyanide) will cost the Canadian taxpayers some $555 million. With the mining companies claiming that Canadian citizens have benefited from profits made by these mines, and government willing to only apply small band-aid solutions to the problem, these sites remain as potent point sources of ongoing biodiversity damage.

FIGURE 30. INDUSTRY FOOTPRINT SCORE: MINING

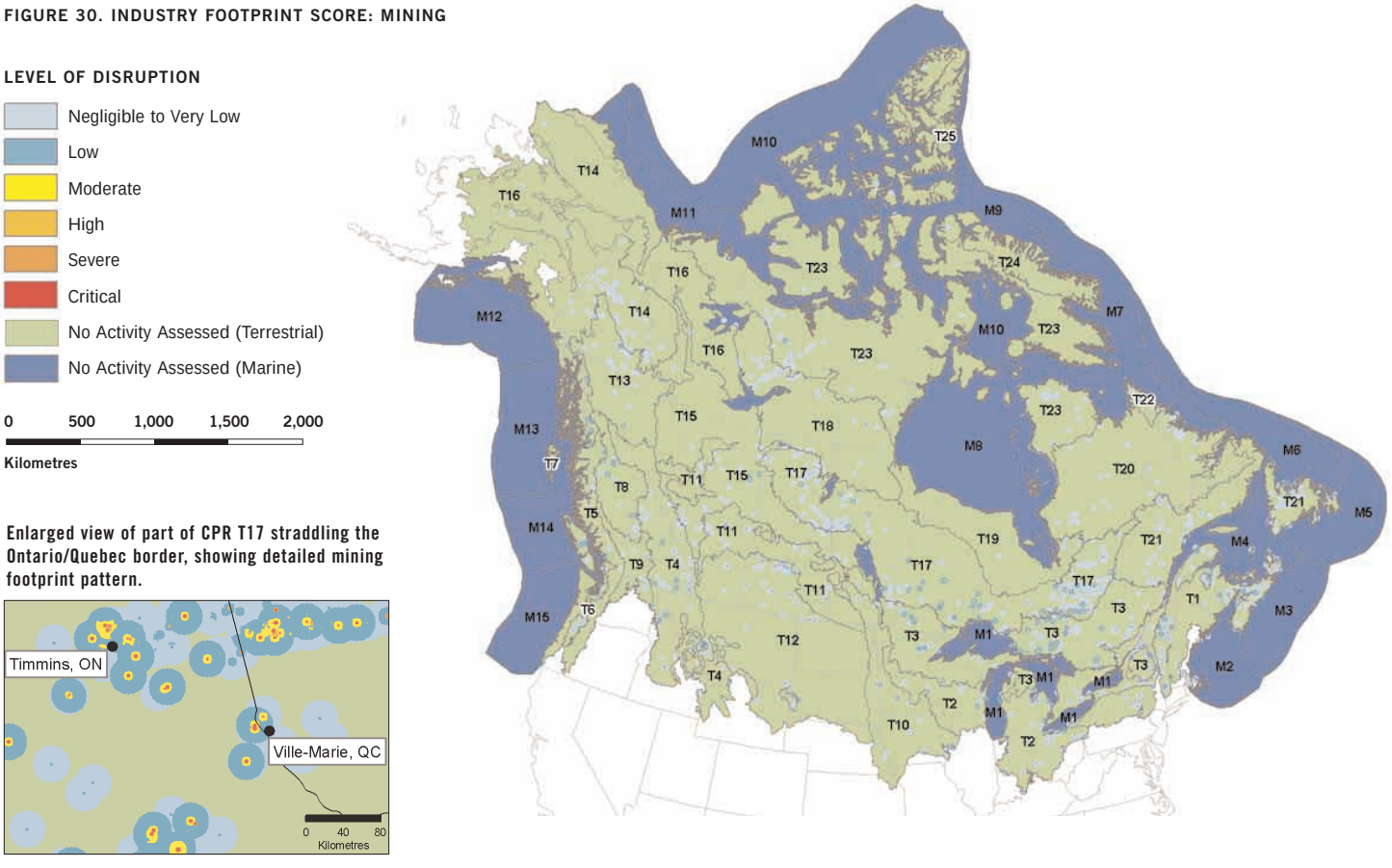


TABLE 23. HEAVIEST FOOTPRINT: MINING

	Jurisdiction		CPR	
Rank	Avg	Total	Avg	Total
1	NS	ON	T6	T17
2	NB	QC	T1	T3
3	ON	BC	T17	T2
4	SK	SK	T3	T1
5	BC	AB	T2	T4

METHODOLOGY USED

- Scoring system for mining activity was based upon studies examining the spatial and ecological impacts of mining.
- Considerations for scoring included: the loss of habitat, localized environmental contamination, disturbance from human presence and noise, and acid drainage.
- Regional road infrastructure required to access mines and other infrastructure (such as large dams and transmission lines) were considered in other layers.
- Scores were applied to all of the nearly 200 active mines in Canada as well as those in the adjacent United States out to a distance of 20 km.
- Data on the type of facility (e.g. open pit) and the production volumes were unavailable on a mine-by-mine basis; therefore, the material being mined was used as a proxy to identify the basic type of facility (underground or open pit) and a rough size (large or small).
- A consistent pressure score was applied to all advanced exploration sites.
- Available mine sites that were not noted as being active in 2002 were assumed to be abandoned and were scored accordingly, whether acid draining or not.
- Mining claims were not considered in this work, nor were a number of abandoned mines, both due to a lack of national data on location or former activity.
- For this first estimate of mining pressure on biodiversity, no differentiation of scores was made based on individual site-based environmental management practices. Future releases of The Nature Audit hope to differentiate regional scores based on an evaluation of corporate best practices in the field.

Mining and Canada's Protected Areas Network

Protected areas are essential for the preservation of biodiversity. In 1992, the mining industry in Canada agreed to the Whitehorse Mining Initiative Leadership Council Accord, which stated that mining companies would help ensure a completed network of protected areas. In the intervening years, however, this has largely failed to happen. In many places throughout Canada, the mining sector seems unable to meet its commitments. Mineral stakes and claims remain in areas where protection is both necessary and possible.

While land access remains a thorny issue, there are a few groups that are in the process of living up to their commitments. For example, the mining companies in Manitoba the Northern Bathurst Island National Park, where the Canadian Nature Federation, local people and the Mining Association of Canada came to an agreement on park boundaries. More of these collaborative agreements will be necessary in the coming years if both the Canadian governments and the Canadian mining industry are to meet their commitments on protected areas in Canada.

ALBERTA'S SYNCRUDE OIL SANDS MINE HAS MOVED MORE EARTH THAN WAS USED IN THE COMBINED CONSTRUCTION OF THE GREAT WALL OF CHINA, THE SUEZ CANAL, THE GREAT PYRAMID OF CHEOPS AND THE WORLD'S 10 LARGEST DAMS

far left ©Wilf Schuring; left ©Linda Weilgart

(Far left) This Alberta oilwell, surrounded by canola fields, is one of roughly 425,000 in Canada. (Left) A Northern bottlenose whale is one of several species vulnerable to the loud noises made by seismic testing in undersea oil and gas exploration.

NATURAL CAPITAL EXPENDITURES: Oil and Gas

Since the discovery of oil in North America in the 1800s, the oil and gas sector has expanded from coast to coast to coast in Canada, and has a current annual value of $65 billion. There are nearly 650,000 oil and gas wells within the land-based and marine Conservation Planning Regions (CPRs) examined in The Nature Audit.

The Nature Audit analysis scored oil and gas wells as having mostly localized impacts on biodiversity as a result of habitat alteration and the associated risks of spillage, leaks or off-gassing emissions at the well site. The combined pressure scores of well sites in close proximity to one another resulted in much higher scores for well fields, especially where densities exceeded five wells/km^2.

Another biodiversity impact from oil and gas activities happens during the exploration phase. The use of seismic lines – grid systems used to pinpoint oil and gas reserves – can damage biodiversity in a number of ways. On land, seismic lines have traditionally involved the clearing of vegetation in corridors running tens to hundreds of kilometres in length. These corridors, often cut or bulldozed across the landscape, fragment habitats and can open up remote areas allowing increased human access, which in turn increases pressures on wildlife species. Underwater (see "The Gully", page 59), seismic exploration using detonations has the potential to interfere with species, such as dolphins and whales, that use sound for communication.

Of course, climate change caused largely by the burning of fossil fuels, is widely recognized to have major consequences for biodiversity.

Though widespread in Alberta (T12, T11, T15), oil and gas activity is most heavily concentrated in southern Alberta and Saskatchewan (T12 and T11). A second concentration is found around the Great Lakes (T2/M1) – especially in and around Lake Erie, which has over 2,000 wells (primarily natural gas) in the lake on the Canadian side alone. Regions in Canada where oil and gas exploration and development is expanding include the Mackenzie Delta and Valley in the Northwest Territories (T16 and T23), the Beaufort Sea (M11) in the western Canadian Arctic, and the Scotian Shelf (M3) and Grand Banks (M5) on the east coast.

FIGURE 31: THE NUMBER OF CANADIAN OIL AND GAS WELLS BY 25-YEAR CLASSES: 1900 – 2000

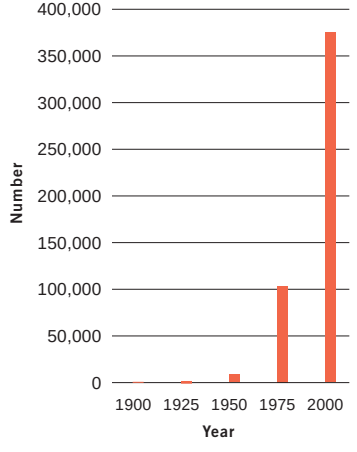
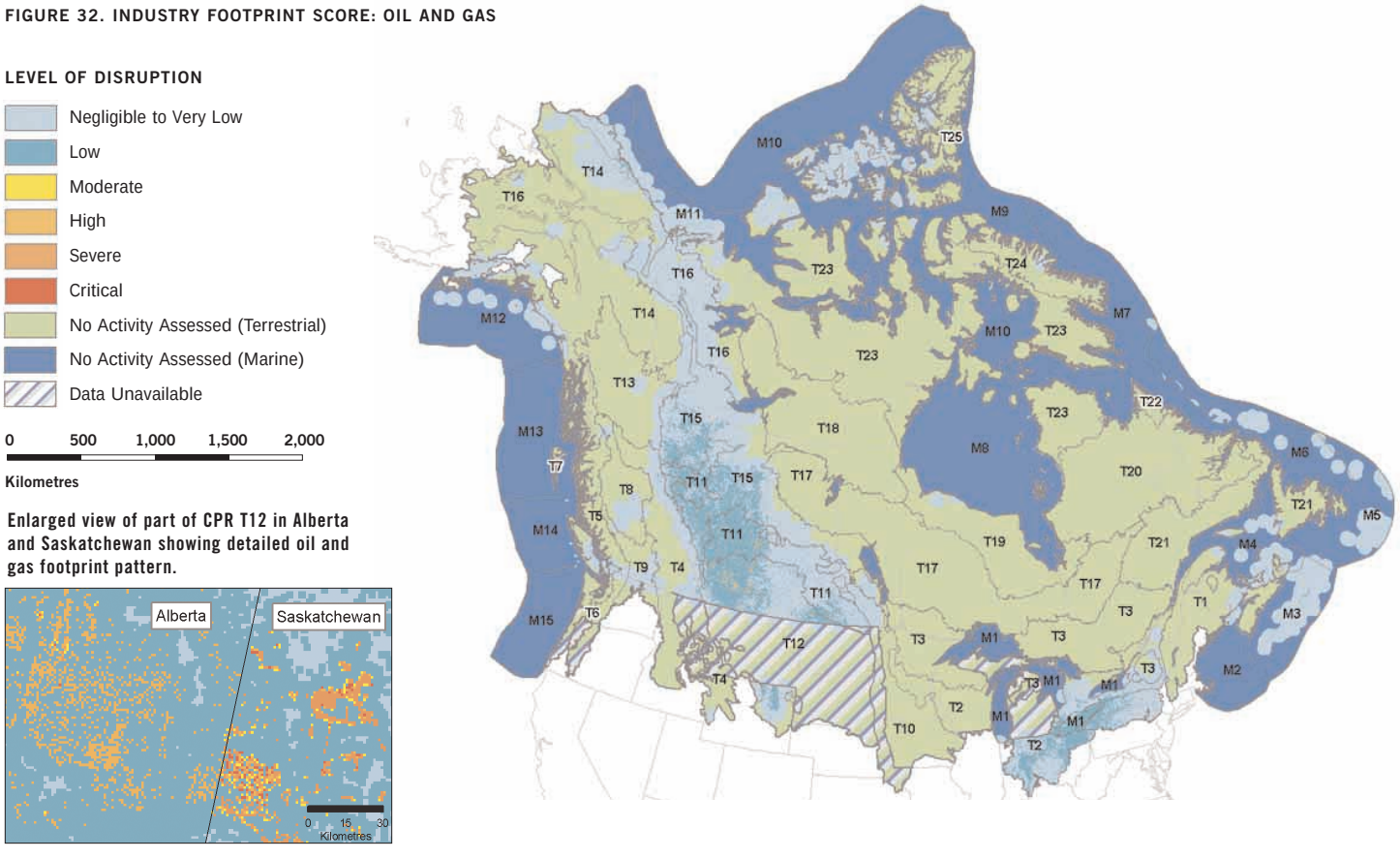


FIGURE 32. INDUSTRY FOOTPRINT SCORE: OIL AND GAS



The Gully: Petroleum Exploration, Development Threaten This Unique Habitat

The Gully is a deep sea canyon 260 km off the coast of Nova Scotia (M3), established as a candidate Marine Protected Area (MPA) by the Department of Fisheries and Oceans in 1997. Unique conditions support high productivity and biodiversity, including ancient deep-sea corals and the endangered northern bottlenose whale. These whales are among the most vulnerable to loud noises, such as those produced by the petroleum industry during seismic testing. The noise can damage hearing and even kill these whales if exposure is severe. A number of seismic tests are planned near the Gully starting in May 2003, up to one kilometre off the proposed Gully MPA boundary.

To reduce the threat, The Gully must be designated as an MPA. Enhanced monitoring and research into the effects of seismic testing on endangered species and on unique environments should address the immediate threats and provide industry standards for other sensitive marine environments.

TABLE 24. HEAVIEST FOOTPRINT: OIL AND GAS

	Jurisdiction		CPR	
Rank	Avg	Total	Avg	Total
1	AB	AB	T12	T15
2	SK	SK	T11	T11
3	PE	NT	T15	T12
4	BC	BC	T2	T2
5	NT	MB	M3	T16

METHODOLOGY USED

- The analysis accounted for more than 427,000 wells in Canada and an additional 214,000 wells in the U.S.
- Regional summaries of footprint scores may be conservative, as mapped information was unavailable for an additional 15,000 wells in southern Ontario and an unknown number of wells in the U.S. portion of the CPRs in the U.S.
- Considerations for measuring our human footprint included: the loss of habitat at drill sites, localized environmental contamination and damage to habitat and species from seismic detonations in the exploration phase.
- The current status of wells (active, suspended or abandoned) was used as a proxy for the amount of activity and degree of disturbance at any given site. Active sites are visited more frequently for repairs, maintenance, and kept clear of overgrowth, and hence, were given higher footprint scores.
- A lack of national data on the mapped locations of seismic lines resulted in The Nature Audit applying a 'seismic exploration pressure score' to a 50-km zone around well sites as a rough proxy for the impacts of seismic activity.
- Regional road infrastructure required to access mines as well as other infrastructure (such as pipelines and transmission lines) were considered in other layers.
- For this first estimate of oil/gas industry pressure on biodiversity, no differentiation of scores was made based on individual site-based environmental management practices. Future releases of The Nature Audit hope to differentiate regional scores based on an evaluation of corporate best practices in the field.

450,000: ESTIMATED NUMBER OF OIL WELLS IN CANADA

High road densities, intensive land use and pollution result in high impacts on biodiversity within urban areas such as Toronto, pictured here.

NATURAL CAPITAL EXPENDITURES: Transportation and Urban Development

Humans, just like other species, have their preferred habitats in which to settle. We have tended to gravitate to landscapes that have moderate climates with fertile soils and abundant natural resources. With the arrival of Europeans, a dense network of settlements began to form across southern Canada in close proximity to arable farmland and an adequate water supply. The introduction of the automobile then increased our ability to travel among settlements and to transport goods. Paved roads were rare prior to 1900 in North America, but since then our road network has expanded exponentially (see Figure 34). In addition to roads, rail lines and shipping lanes, we now also have extensive corridors to 'transport' commodities such as electricity, oil and natural gas.

Human settlement has caused significant biodiversity loss; sprawling neighbourhoods permanently replace natural habitat, and roads and other transport corridors cause habitat fragmentation, increase wildlife mortality and provide access to habitats that were formally remote from human disturbance. As a secondary impact, these networks alter predator-prey interactions, and provide pathways for both pollution and the introduction of invasive and competing species.

Transportation and urban pressures, due in part to their cumulative nature, have had by far the greatest impact on biodiversity in southern Canada and the adjacent U.S. territory of any of the development activities examined in this report. In The Nature Audit, the Puget Sound Lowlands and Willamette Valley (T6) emerge as one of the two most impacted regions from this pressure (Figure 33). This relatively small and narrow Conservation Planning Region is home to major cities such as Vancouver, Victoria, Seattle and Portland. The region formerly consisted of forests of Garry oak, Douglas fir and western red cedar, yet few large areas of this forest now remain. On a larger scale, the Great Lakes and St. Lawrence Lowlands region (T2) hosts the largest number of urban centres and overall, suffers the greatest impacts. It includes Canadian cities such as Montreal, Toronto, Hamilton, Ottawa, London and Windsor (overall, hosting approximately 40 per cent of the Canadian population) and U.S. cities such as Detroit, Buffalo, Syracuse, Cleveland, Albany, Indianapolis, Milwaukee, Madison and Minneapolis-St. Paul.

Roads constructed to provide access to industry operations also contribute to transportation pressure scores. This includes the dense road network throughout the farming regions of the prairies (T10, T11 and T12), logging roads in the forested regions of Canada (e.g. T3, T13, T15 and T17) and access roads to remote hydro-electric mega-projects such as La Grande and Churchill Falls (T20).

FIGURE 33. INDUSTRY FOOTPRINT SCORE: TRANSPORTATION AND URBAN DEVELOPMENT

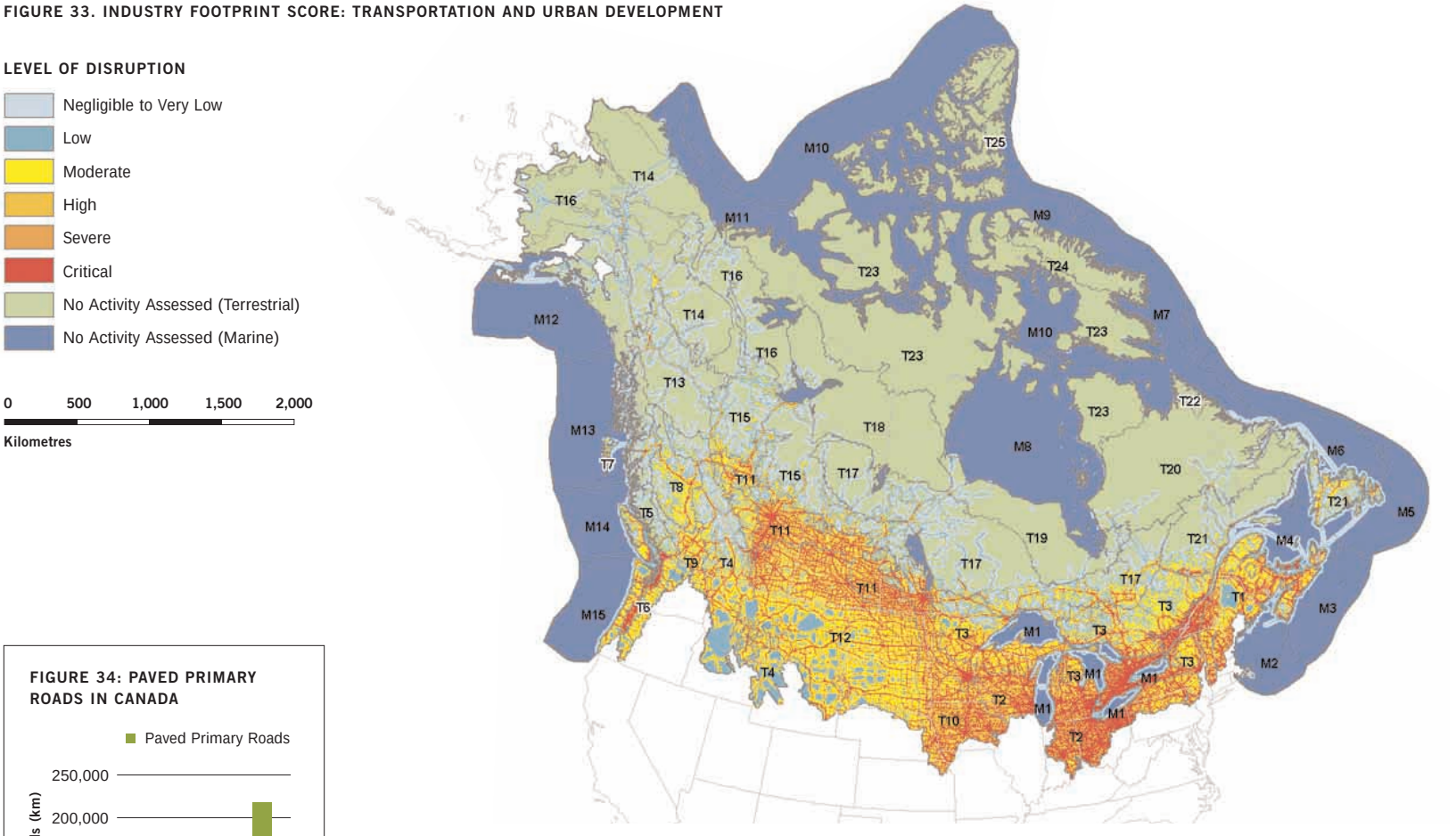
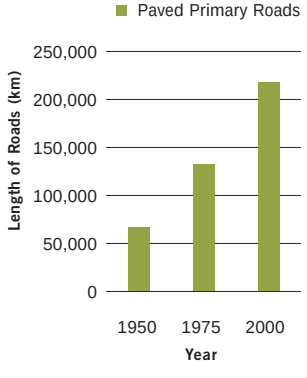


FIGURE 34: PAVED PRIMARY ROADS IN CANADA



The expansion of the road network throughout Canada in the latter twentieth century.

Conservation First: The Principle in Action in Southern Ontario

The Oak Ridges Moraine Conservation Plan, announced in April, 2002, is a successful example of the Conservation First Principle being brought to bear in an area under intense pressure from urban sprawl that spreads northward from Toronto.

The plan began with the identification and evaluation of important natural areas. This formed a basis to further classify remaining lands on the moraine into three other designations: natural linkage (green corridors), countryside, and settlement areas where urban development was to be contained within current borders. The plan resulted in protection of important wildlife corridors and natural areas totaling 62 per cent of the Oak Ridges Moraine and increased focus on protecting watersheds, groundwater and farmlands.

TABLE 25. HEAVIEST FOOTPRINT: TRANSPORTATION AND URBAN DEVELOPMENT

	Jurisdiction		CPR	
Rank	Avg	Total	Avg	Total
1	PE	SK	T2	T12
2	NB	AB	T6	T2
3	NS	ON	T10	T3
4	SK	QC	T1	T11
5	AB	BC	T11	T10

METHODOLOGY USED

- Pressure scores were based on studies documenting biodiversity impacts from different types of transportation and urban infrastructure.
- A detailed road network was used to establish both road and settlement patterns for Canada.
- A similar road network was used for the U.S., though it did not contain local (generally secondary or tertiary rural) roads. To compensate for this difference from Canadian data, a baseline rural transportation score was developed and applied to all settled areas of the U.S. portions of the Conservation Planning Regions.
- Transmission lines, ferry routes and ice roads were inserted where possible along with pipeline data for Canada and parts of the U.S.
- Due to a lack of available data, shipping routes, urban land use and logging roads are not comprehensively accounted for within the analysis. Some areas (especially the marine and boreal regions) are currently believed to be underestimated with respect to their pressure scores.

79.4%: THE RELATIVE NUMBER OF CANADIANS LIVING IN URBAN CENTRES OF 10,000 PEOPLE OR MORE

All polar bear (far left) fat and milk, and some marine mammals like the narwhal (left) are contaminated by persistent synthetic toxins that, while never used in the Arctic, are carried in the air from southern industrial and agricultural regions and deposited in the Arctic.

far left ©Frank Parhizgar; left ©John Ford

NATURAL CAPITAL EXPENDITURES: Air and Water Pollution

Air and water pollutants result in some of the most widespread pressures on biodiversity. Yet, they often remain difficult to detect, especially as distances increase from their point of origin. Manufactured chemicals and pollutants are known to contribute to a variety of health issues in wildlife including cancer, hormone disruption, birth defects, behavioural abnormalities, and chronic illness. While accidental spills, both at industrial sites or in agricultural fields when pesticides are being used, can lead to large wildlife kills, the impact of continual low-level exposure to a mix of toxic chemicals in air and water may be more detrimental to wildlife populations.

In an attempt to quantify toxic releases from industrial facilities that pose a particularly serious risk to biodiversity and habitat, The Nature Audit developed a toxicity score or weighting (see 'Methodology Used'), opposite for 64 chemicals tracked in the National Pollutant Release Inventory (Canada) and the Toxic Release Inventory (U.S.). Based on the kinds and volume of substances released by each facility, The Nature Audit assigned a cumulative toxic score for each point source and mapped them (Figure 35) to examine their locations within the Conservation Planning Regions (CPRs).

While it is not easy to map the direct 'fallout' of toxic emissions, evidence suggests that for many chemicals, areas in close proximity to emission sources are subject to higher risk of exposure. In this regard, habitats and species in CPR T2 are most directly at risk from exposure to toxic emissions, particularly in the heavily industrialized parts of southwestern Ontario, the St. Lawrence Valley in Quebec and in the adjacent states of Ohio, Michigan and Indiana. This region has within it some of the most significant Canadian point sources, including a hazardous waste incinerator near Sarnia, Ontario with the highest Canadian emissions of lead and mercury. Nearby, a major U.S. facility near Detroit is one of North America's largest emitters of hexachlorobenzene – a known developmental toxin, probable human carcinogen and an imunu-toxicant, HCB is considered one of the most hazardous compounds to ecosystems and human health. Additional clusters are present in southwestern and central Alberta (T11 and T12) where the oil and gas industry is concentrated.

Northern Canada is relatively free from industrial point sources of pollutants; the exception is when the pollutants emitted are persistent. Nevertheless, many toxic chemicals are subject to long-range transport and may impact wildlife thousands of kilometres from the point source. As an example, organochlorines, a group of persistent and bioaccumulative chemicals, have the tendency to go up in warm air and float north until they permanently settle where the air is coldest: in the Arctic.

As recently documented in Environment Canada's 2003 National Environmental Indicator report, while there have been some notable reductions in releases of some important pollutants (for example, atmospheric releases of mercury) due to recent actions, emissions of others (including cadmium and lead) have strongly increased. If a report card were to evaluate Canadian action on cleaning up pollutants, the teacher's notes might indicate that, while work habits are improving and progress is being made, there is still a vast amount of work to do.

FIGURE 35. TOXIC POINT SOURCES WITHIN CONSERVATION PLANNING REGIONS

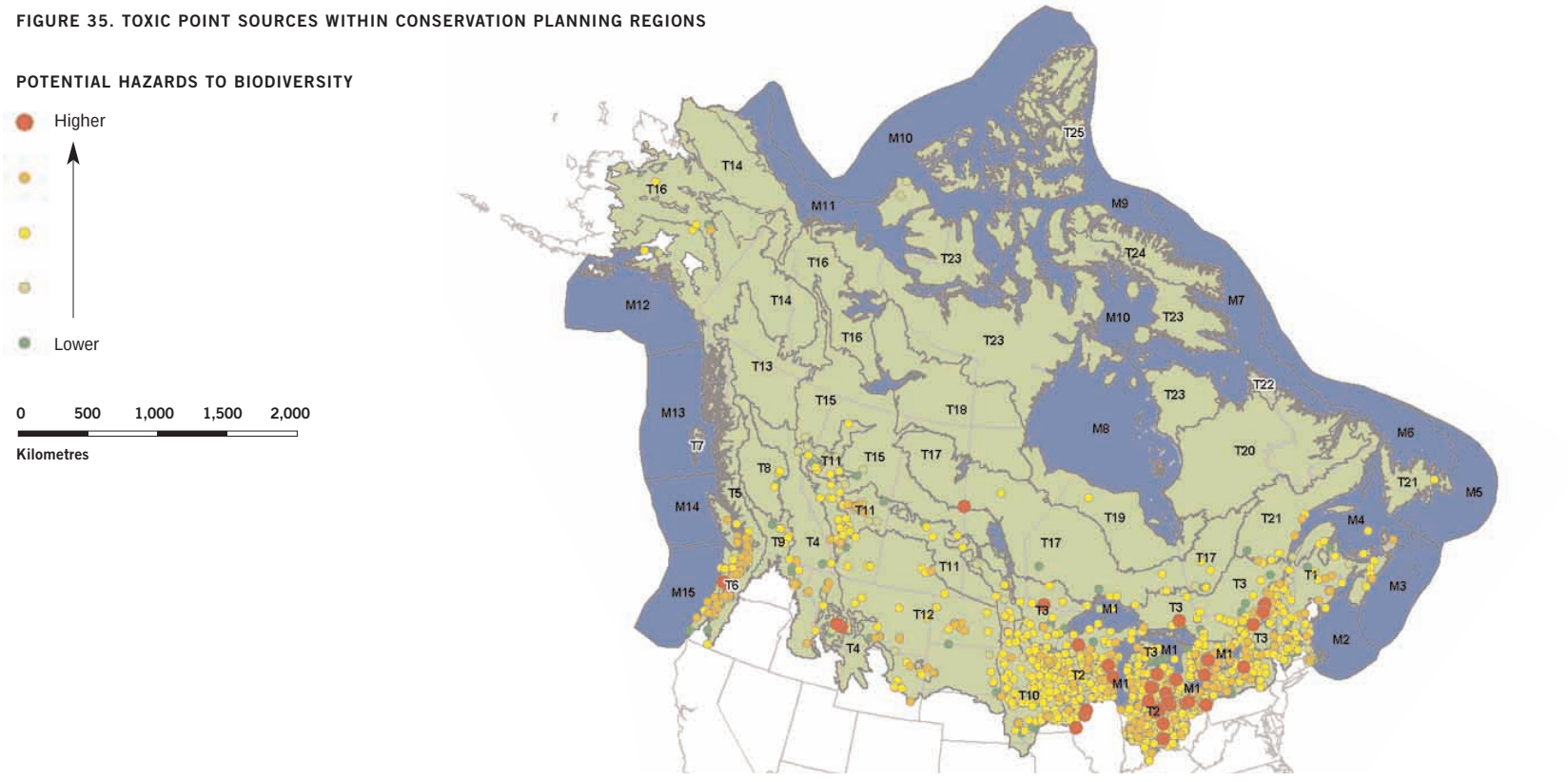


TABLE 26. HEAVIEST FOOTPRINT: AIR AND WATER POLLUTION

	Jurisdiction		CPR	
Rank	Avg	Total	Avg	Total
1	NB	ON	T4	T2
2	ON	QC	T12	T12
3	NS	AB	T16	T10
4	AB	NB	T2	T3
5	QC	BC	T10	T4

METHODOLOGY USED

- Scoring system assessed 64 toxic chemicals used in Canada that pose a risk to biodiversity.
- Chemicals were scored against a series of factors that contribute to their potential impacts on biodiversity.
- Scores were developed based on a chemical's ability to bio-accumulate, disrupt hormonal systems or produce cancers in wildlife species.
- Point sources for land, air and water emissions were then individually scored based on their annual outputs of the chemicals examined in this report. These were derived from the 2000 Canadian National Pollutant Release Inventory (NPRI) and the 1998 Toxic Release Inventory (TRI).


©PhotoDisc

From Computers to Mother's Milk: PBDEs

Polybrominated diphenyl ethers (PBDEs) are persistent, bioaccumulative and toxic chemicals used as flame retardants in a wide variety of consumer products, including computers. Some PBDEs are persistent in water, air and sediment, and are subject to long-range atmospheric transport. Being found in increasing concentrations in the Arctic, and tend to bioaccumulate in aquatic species. Concentrations in blue heron eggs from Vancouver increased by a factor of more than 150 between 1983 and 2000. Concentrations in St. Lawrence belugas have doubled every two years for the last decade.

PBDEs also bioaccumulate in human tissue. One study showed that workers at an electronics manufacturing facility had up to 70 times the levels of one PBDE in their blood than a control group. Levels of PBDEs in breast milk in the Vancouver area increased by a factor of 15 between 1992 and 2002. Some PBDEs interfere with normal thyroid functioning, are toxic to the nervous and immune systems and disrupt the endocrine system. While the European Union has taken steps to phase out PBDEs, North America has yet to restrict their use.

far left ©Gregor G. Beck; left ©Dean Morewood, Pennsylvania State University

From the infamous zebra mussel (far left) to the Asian longhorned beetle (left), Canada's biodiversity faces serious threats from invasive species.

FOREIGN CURRENCY: Invasive Species

Invasive exotic species (invasive species) present one of the most serious threats to biodiversity today. They are plants, animals or other organisms that didn't exist in Canada before European settlement, but are now established – often to the detriment of native species. Many were brought here intentionally by settlers for food, or for their medicinal or ornamental value. Others have come as stowaways on ships or in ballast water, hitching rides on trucks and planes, or hiding in packing crates and imported goods.

At least 1,500 invasive species are established in Canada; the number is likely higher, and likely increasing. Once an invasive species is established, it is difficult – if not impossible – to eradicate.

While some are benign, others are harmful to native species. Some directly attack native species as new diseases; others compete for food and space or radically change the habitat conditions that native species need to survive.

The results can be dramatic. For example, chestnut blight – a disease accidentally imported in the 1920s – wiped out virtually all of the estimated two million chestnut trees native to Canada in less than 25 years.

Since its North American arrival only four years ago, West Nile virus has spread across the continent, from New York City to the Rocky Mountains. In its wake, local populations of some bird species appear to have plummeted. Health officials are confronted with the spread of this disease among Canadians.

Invasive species also take a huge economic toll. Zebra mussels, implicated in the disappearance of at least 10 native mussel species in western Lake Erie and Lake St. Clair, can shut down electrical utilities by clogging water intake pipes and fouling beaches with drifts of washed-up shells. The U.S. Fish and Wildlife Service estimates that between 2000 and 2010, the economic impact from zebra mussels to U.S. and Canadian water users within the Great Lakes region alone may reach $5 billion U.S.

The Nature Audit collected information on the presence and timing of arrival of 150 invasive species that scientists suspect are impacting biodiversity (Tables 27 and 29). The results show that:

- once established in Canada, it is inevitable that an invasive species will spread;
- new species continue to invade (Figure 36) as global trade and tourism continue to grow, and invasion rates are likely increasing as natural systems become more disrupted;
- few regions in Canada remain untouched by their effects (Figure 37).

FIGURE 36. RATE OF INVASION OF 150 EXOTIC SPECIES IN FOUR CONSERVATION PLANNING REGIONS

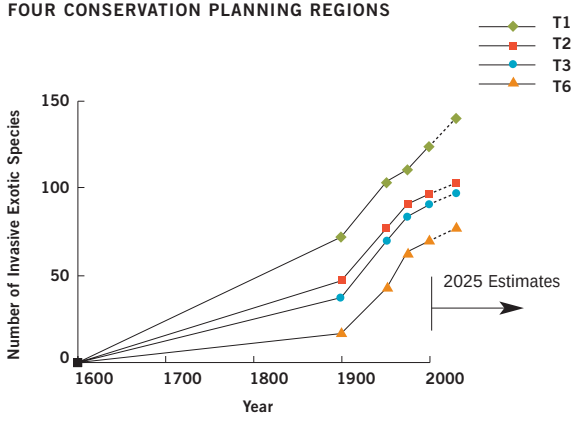
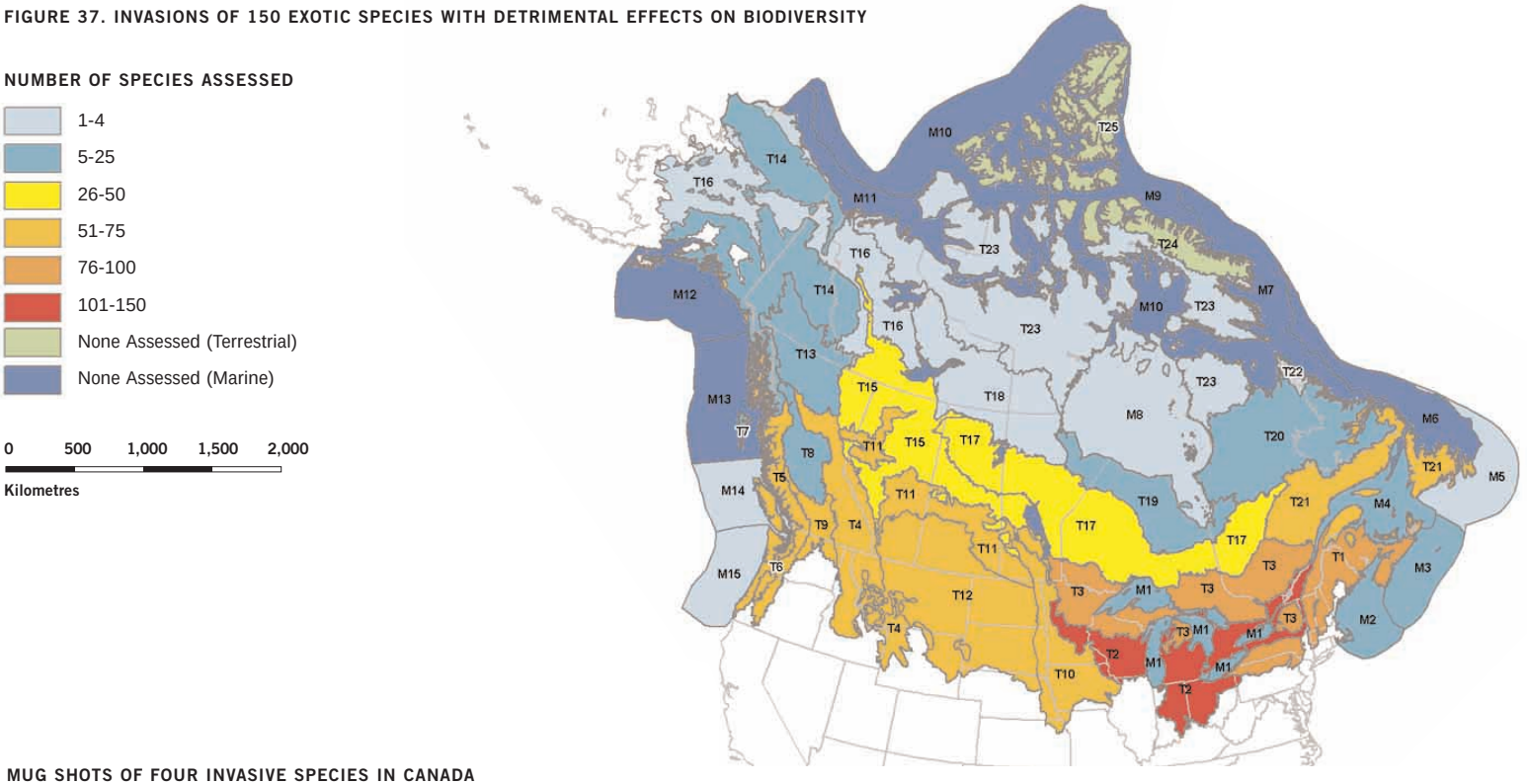


TABLE 27. ESTIMATED SEVERITY AND RANGE OF IMPACT OF 150 INVASIVE EXOTIC SPECIES

Suspected impact on biodiversity	Current Range of Impact				Totals
	Very local	Local	Wide-spread	Very Widespread	
Severe	2	4	14	20	**40**
Moderate	9	14	18	9	**50**
Slight	27	18	9	6	**60**
Totals	**38**	**36**	**41**	**35**	**150**

FIGURE 37. INVASIONS OF 150 EXOTIC SPECIES WITH DETRIMENTAL EFFECTS ON BIODIVERSITY



MUG SHOTS OF FOUR INVASIVE SPECIES IN CANADA

Leafy spurge
(Euphorbia esula)

Origin: Eurasia
Impact on biodiversity: Displaces native vegetation by shading, removing available water and nutrients and through plant toxins that prevent the growth of other plants underneath it. A major threat to endangered species in Manitoba sand hills.
Range in Canada:
From Ontario west to BC

European green crab
(Carcinus maenas)

Origin: Europe
Impact on biodiversity: Heavy predator of clams; may also significantly reduce food sources (invertebrates) for various native species.
Range in Canada: Atlantic Ocean, from the Gulf of St. Lawrence to the Gulf of Maine, and Vancouver Island area

West Nile virus
(*Flavivirus* Japanese Encephalitis Antigenic Complex)

Origin: First found in the West Nile region of Uganda in 1937.
Impact on biodiversity: May be fatal to many bird species, including jays, bald eagles, Canada geese, various owls, most hawks. Mammals are also vulnerable, including humans.
Range in Canada: Atlantic provinces, QC, ON, west to southern BC

Round goby
(Neogobius melanostomus)

Origin: Black, Caspian Seas
Impact on biodiversity: Competes with native fish, preys on eggs and juveniles of other fish, crustaceans.
Range in Canada: Widespread in all Great Lakes; found as far east in the St. Lawrence River as Quebec City

From left to right: ©Norman E. Rees, USDA ARS; ©Paul G. Olin, University of California Sea Grant (Michigan Sea Grant Graphics); ©James Gathany; ©David Jude, University of Michigan

AT LEAST 110: THE NUMBER OF BIRD SPECIES KNOWN TO HAVE BEEN INFECTED BY WEST NILE VIRUS

TABLE 28. HEAVIEST FOOT-PRINT: INVASIVE SPECIES

	Jurisdiction		CPR	
Rank	Avg	Total	Avg	Total
1	N/A	N/A	N/A	T2
2	N/A	N/A	N/A	T1
3	N/A	N/A	N/A	T3
4	N/A	N/A	N/A	T6
5	N/A	N/A	N/A	T5

REGIONS MOST SEVERELY AFFECTED BY INVASIVE EXOTIC SPECIES
(based on numbers present out of 150 exotic species assessed)

Terrestrial Regions:

Southern Great Lakes and St. Lawrence Lowlands (T2)

The Maritimes (T1)

Upper Great Lakes and Laurentians (T3)

Coastal British Columbia, Vancouver Island (T5, T6)

Marine Regions:

The Great Lakes (M1)

The Eastern Seaboard, from the Gulf of St. Lawrence to the Gulf of Maine (M2, M3, M4)

Invaders at Canada's Doorstep

These are just a few of the invasive species that are sitting on Canada's doorstep. They bring with them the potential to severely affect native biodiversity and create serious economic impacts. Can we stop them, or is it already too late?

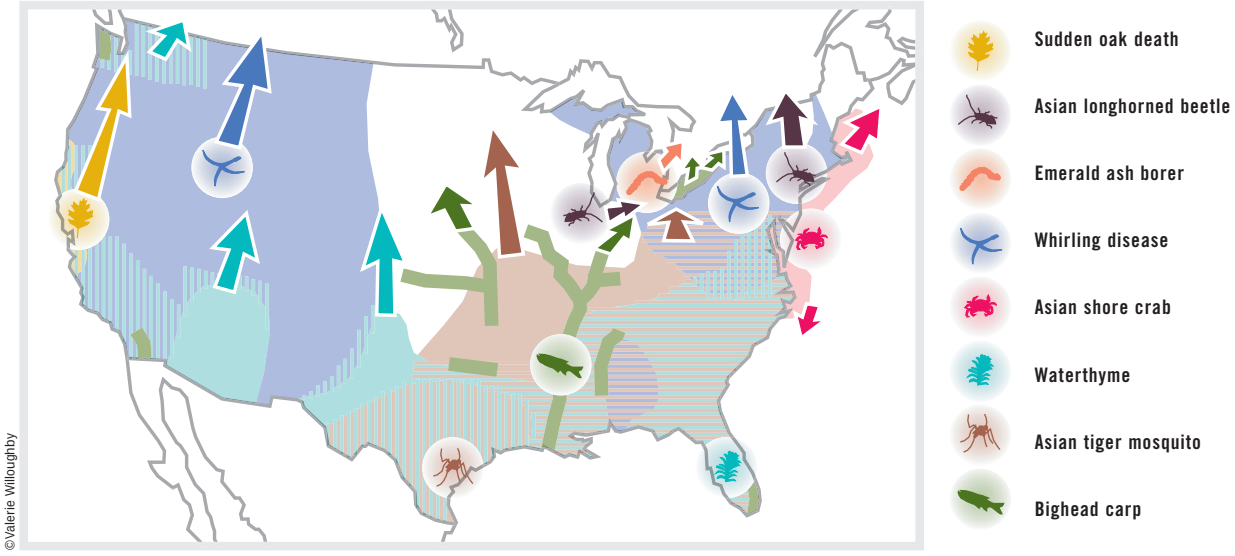


FIGURE 38: This map shows the current approximate distribution of eight invasive species that threaten to spread into Canada.

Invading our lands:

Sudden oak death: This is a plant disease that attacks and kills many tree species, including oaks, maples and Douglas fir. First detected in California in 1995 and more recently reported from southern Oregon, this fungus-like pathogen could have a huge ecological and economic impact if it continues to spread northward and enters Canadian forests.

Asian longhorned beetle: This beetle is finding its way to North America in wood used to construct containers for goods shipped from its native Asia. It has been intercepted by authorities in Vancouver and southern Ontario, and has been found and eradicated in warehouses in numerous U.S. states. It prefers to bore into maple trees, but also attacks many other forest and ornamental trees; the infested trees weaken and eventually die. Affected trees must be cut down, chipped and burned to prevent the spread of this exotic pest. Eradication efforts are underway in New York and Chicago, where serious infestations have recently been discovered.

Emerald ash borer: This beetle from Asia is currently found in southeast Michigan, neighbouring northwest Ohio and in the city of Windsor, Ontario. It is reported to have killed or damaged millions of ash trees in these areas. The Canadian Food Inspection Agency has placed an area around Windsor in quarantine, prohibiting ash trees and wood from leaving the infected region in an attempt to stop its spread in Ontario. Ash trees are a major component of forests from Manitoba to the Maritimes; their wood is used to produce Canadian hockey sticks.

Invading our air:

Asian tiger mosquito: Originally from southeast Asia, this large mosquito was first found in North America near Houston, Texas in 1985, and has since spread aggressively. It is now in at least 26 states, and has been seen in Southern Ontario. The mosquito is the carrier of several diseases such as yellow fever, dengue fever and encephalitis. It can also harbour West Nile virus, but it is not yet known whether it can be transferred to other animals.

Invading our waters:

Waterthyme (hydrilla): Discovered in Florida in 1960, this wetland plant from Asia has quickly spread northward and is likely to invade the southern Great Lakes and southern BC in the near future. Waterthyme forms virtually impenetrable mats in surface waters that block sunlight and displace native vegetation, changes the physical and chemical characteristics of lakes, and seriously impedes water flow and water use – it obstructs boating, swimming and fishing in lakes and rivers, and prevents the withdrawal of water for use in power generation and agricultural irrigation. Its presence has also been linked to reductions in the size of sport fish.

Whirling disease: Named for the erratic whirling behaviour of infected fish, this Eurasian parasite is now present in 22 states and is within 100 km of the Alberta-Montana border. It is thought to have been introduced to North America in frozen rainbow trout shipped to Pennsylvania, where the

parasite made its way inadvertently into local streams and then to fish hatcheries. The disease infects the head and spine of juvenile fish, leading to severe deformities, which reduces the fish's ability to feed and avoid predators. It affects many members of the trout and salmon family, but especially native rainbow trout.

Bighead carp (Asian carp): Imported from China in 1972 by Arkansas catfish farmers to reduce phytoplankton blooms in aquaculture ponds, this fish escaped and has spread through the Mississippi River basin. It is now found in 18 states, and in 2000 was found on the Canadian side of Lake Erie. This fish, which can grow to 50 kg, is a voracious plankton eater and has already replaced most native commercial fishes in some pools in the Mississippi River, with the result that commercial fishing has been abandoned in some areas. In 2002, an electric shock barrier was put in place across the Chicago Ship and Sanitary Canal to prevent entry to Lake Michigan.

This is an Asian food fish. There is concern that humans may introduce it to new areas, since it is thought to bring good luck to release a live fish for each fish eaten. A live fish has already been found in a fountain in Toronto near the shore of Lake Ontario.

Asian Shore crab: Originally from the western Pacific, it was introduced at Townsend Inlet, New Jersey, in 1988; it is now established from Maine to North Carolina. It is an opportunistic omnivore that is highly reproductive, and commonly found in oyster and mussel beds. It is now the most common intertidal crab in New England; it crowds out native crabs. This species will likely invade Atlantic Canada in the next 10 years.

TABLE 29 150 Invasive Exotic Species Impacting Biodiversity in Canada

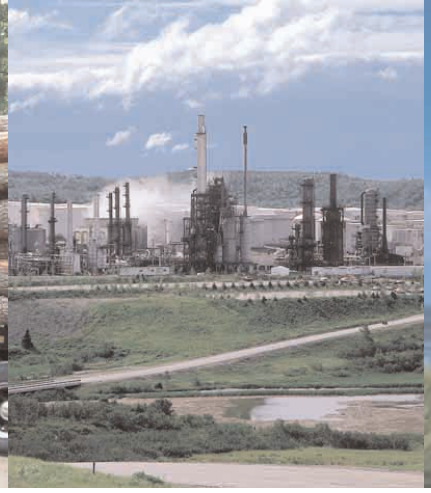
The Nature Audit compiled this list of 150 exotic species, established in Canada, with known or suspected impacts on native biodiversity. Undoubtedly, this list is incomplete, but it provides a good start from which to identify and eventually develop plans to control these invaders, if possible.

Mammals
black rat
cat
European wild boar
Norway rat
Birds
European starling
house sparrow
mute swan
Reptiles and amphibians
bullfrog*
red-eared slider
Fishes
alewife*
brown trout
common carp
goldfish
rainbow smelt*
rainbow trout*
round goby
rudd
ruffe
sea lamprey*
tench
tubenose goby
white perch
Insects
Asian lady beetle
balsam woolly adelgid
brown spruce longhorn beetle
emerald ash borer
European gypsy moth
European spruce sawfly
hemlock woolly adelgid
introduced pine sawfly
pine false webworm
pine shoot beetle
satin moth
Crustaceans
chameleon shrimp
European green crab
fishhook waterflea
Lumholtz water flea
opossum shrimp*
rusty crayfish
spiny waterflea
Molluscs
Asian clam
Chinese mystery snail
common periwinkle
quagga mussel
zebra mussel
Other invertebrates
clubbed tunicate
a flatworm species
freshwater jellyfish
lacy-crust bryozoan
Vascular plants
amur maple
autumn olive
bird's-foot trefoil
bittersweet nightshade
black locust
black medic
bouncing-bet
butter-and-eggs
Canada bluegrass
Canada thistle
coltsfoot
common buckthorn
common reed*
common St.John's-wort
common tansy
common wormwood
crack willow
crested wheatgrass
crown vetch
curly pondweed
cypress spurge
dalmatian toadflax
dame's rocket
diffuse knapweed
downy brome
English hawthorn
English ivy
Eurasian watermilfoil
European frog-bit
European spindletree
European water chestnut
fanwort
flowering-rush
garlic mustard
giant hogweed
glossy buckthorn
gorse
goutweed
ground-ivy
Himalayan balsam
Himalayan blackberry
hoary alyssum
hound's-tongue
Japanese barberry
Japanese knotweed
jimsonweed
Kentucky bluegrass*
leafy spurge
Manitoba maple*
Mezer's daphne
moneywort
Morrow's honeysuckle
mother-of-thyme
multiflora rose
nodding thistle
Norway maple
orange hawkweed
orange-eye butterflybush
orchard grass
oriental bittersweet
periwinkle
privet
purple loosestrife
quack grass
reed canary grass*
rough manna grass
rush-skeletonweed
Russian knapweed
Russian olive
scentless chamomile
Scotch broom
sea-buckthorn
Siberian peashrub
smooth brome
spotted knapweed
spurge-laurel
sulphur cinquefoil
swallow-wort
sweet vernalgrass
tansy ragwort
Tartarian honeysuckle
tree of heaven
velvet-grass
white mulberry
white poplar
white sweet clover
wild parsnip
winged spindletree
yellow bedstraw
yellow flag
yellow starthistle
yellow sweet clover
Algae
oyster thief
serrated wrack
Animal diseases
West Nile virus
Plant diseases
beech bark disease
butternut canker
chestnut blight
dogwood anthracnose
Dutch elm disease
white pine blister rust

* Species considered native to some parts of Canada, but introduced into other regions where they are having harmful effects on native wildlife.

This list of 150 species complete with scientific names is available on request from WWF-Canada.

0 TO 383,000/M²: THE CHANGE IN THE DENSITY OF ZEBRA MUSSELS ALONG A SECTION OF THE RIDEAU RIVER, ONTARIO WITHIN THREE YEARS


far left ©Deborah Freeman; middle left ©Karen A. Rosborough; left ©Gregor G. Beck

Canadians need to be made explicitly aware that their cumulative activities are having a costly impact on biodiversity.

NATURAL CAPITAL EXPENDITURES: Cumulative Impact

When evaluating changes to biodiversity, assessing the level of **cumulative** impact on species and habitats – not just one pressure, but all – is key. While ecosystems may have some capacity to buffer themselves from the effects of one impact, many impacts interacting together, may cause a more rapid decline in ecosystem health than examination of single activities can reveal.

This section of The Nature Audit brings together eight of the individual 'natural capital expenditures' previously discussed and provides an estimate of the combined pressure being placed on Canadian biodiversity from a Conservation Planning Region (CPR) perspective. It does not include the additional pressures of manufactured pollutants or invasive species – both of which can have devastating effects on biodiversity, but whose relative pressures are even more challenging to model and quantify.

The results reflect massive changes to many of Canada's ecosystems brought about by our activities on the land and in the water. The extent of our footprint may surprise some; it does not just hug our southern border with the U.S., but has now widely penetrated the boreal forest regions and is creeping into some of Canada's northernmost regions. Nonetheless, the longer history of European settlement, and more intense use of the lands and waters in the south, have delivered the heaviest footprint in these regions. Eastern forested regions from the Maritime provinces through southern Quebec to the Great Lakes basin (T1, T2 and T3), the Great Lakes waters (M1), our prairies and parklands (T10, T11 and T12), lowland areas of the west coast around Vancouver and Victoria (T6) and coastal and offshore areas in both the Pacific and Atlantic oceans (e.g. M14, M2 and M4) have been highly altered (Figure 39). While the dense road networks, sprawling cities and vast agricultural lands in these areas drive much of the impact, these regions also receive locally significant pressure from dams, oil and gas drilling and mining.

The western boreal forest of Alberta (T15) emerged as the highest disrupted region among the boreal forest CPRs, due to the combination of roads, extensive forestry, and intensive oil and gas. Fortunately, Canada still retains large areas where, even cumulatively, the footprint is low and conservation can proceed in advance of development. Opportunities to act, however, are becoming increasingly time-limited, especially in T13 in northern BC and southern Yukon and T20 stretching across central Quebec and Labrador.

FIGURE 39. INDUSTRY FOOTPRINT SCORE: CUMULATIVE

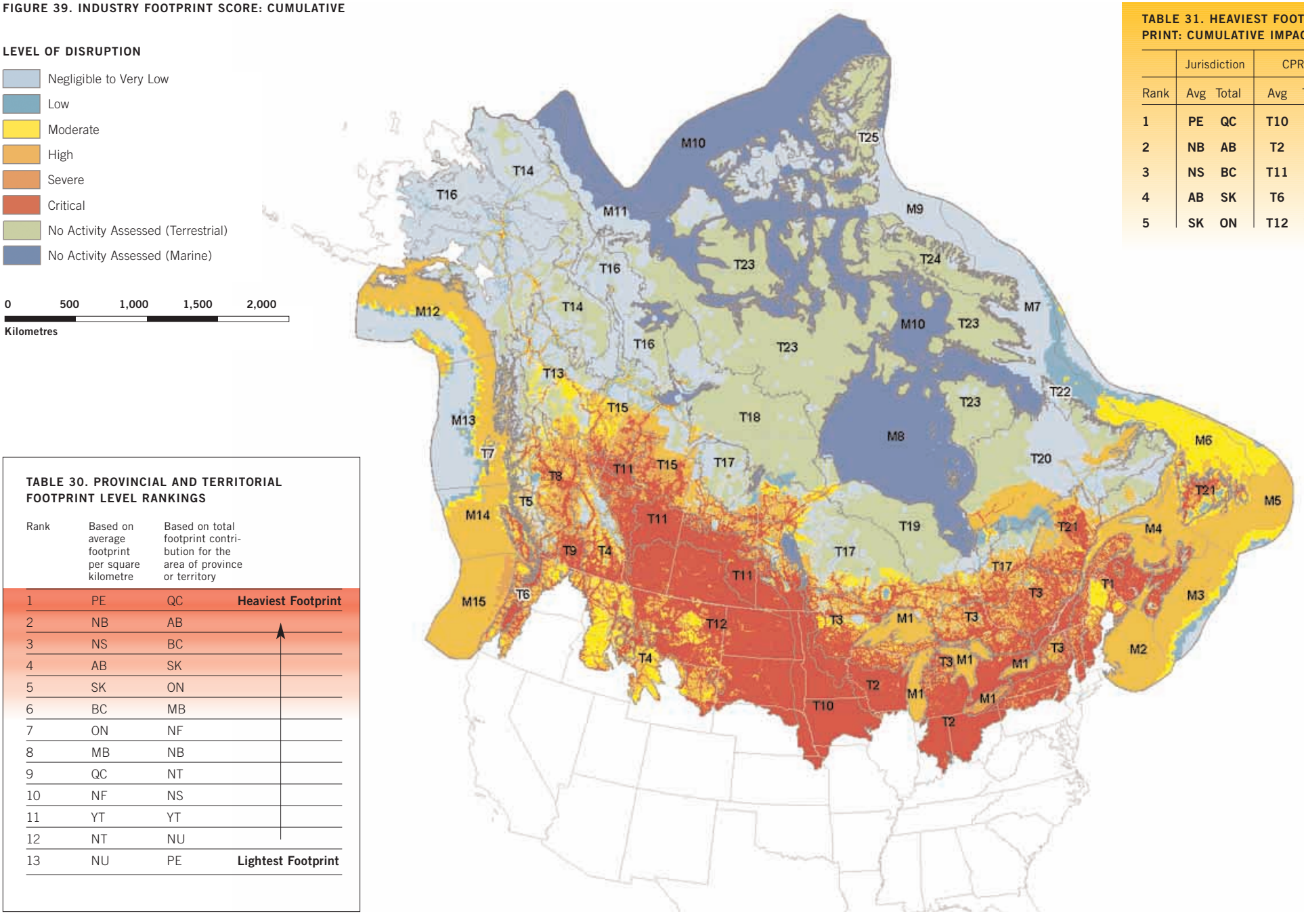


TABLE 31. HEAVIEST FOOTPRINT: CUMULATIVE IMPACT

	Jurisdiction		CPR	
Rank	Avg	Total	Avg	Total
1	PE	QC	T10	T12
2	NB	AB	T2	T2
3	NS	BC	T11	T3
4	AB	SK	T6	T15
5	SK	ON	T12	T11

TABLE 30. PROVINCIAL AND TERRITORIAL FOOTPRINT LEVEL RANKINGS

Rank	Based on average footprint per square kilometre	Based on total footprint contribution for the area of province or territory	
1	PE	QC	**Heaviest Footprint**
2	NB	AB	
3	NS	BC	
4	AB	SK	
5	SK	ON	
6	BC	MB	
7	ON	NF	
8	MB	NB	
9	QC	NT	
10	NF	NS	
11	YT	YT	
12	NT	NU	
13	NU	PE	**Lightest Footprint**

Strategically Addressing Canada's Conservation Need

Nature's connections across our land and waterscapes mean that for a national conservation commitment to be met, actions must be taken in all parts of the country. Natural systems, by their very nature, require the health of all parts for the whole to survive. Ultimately, pursuing conservation in one region but not another, recovering one species while another disappears, will not achieve the goal, no matter how practical or attractive focussing only on the rarest species or the most disturbed habitat may seem. But choices do need to be made, not so much on where to be involved, but on how to be involved. The current state of Canada's biodiversity dictates that we need to make choices about the best strategic approaches to take in conservation planning at a regional level. The bottom line is that for Canada to meet its United Nations' commitment, a multi-faceted, national approach to biodiversity conservation is required.

To provide an overview of conservation opportunities and options, Table 1 provides a regionalized conservation template for Canada. The rows classify The Nature Audit's Conservation Planning Regions (CPRs) into six broad categories, reflecting their conservation need. This assess-

TABLE 32. PRIORITY STRATEGIC APPROACH REQUIRED TO MEET THE REGIONAL CONSERVATION NEED.	NEWFOUNDLAND AND LABRADOR	NOVA SCOTIA	PRINCE EDWARD ISLAND	NEW BRUNSWICK	QUEBEC
Conservation First: Outstanding opportunities remain to protect intact habitats and species groups: Opportunities remain throughout the Conservation Planning Region to apply the Conservation First Principle to protect ecosystems and species in advance of widespread industrial development.	Terrestrial: Northern tip of Labrador, although widespread protection already in place (T22)				Marine: Davis Strait and Ungava Bay (M7); Terrestrial: only in extreme northern parts of province (T22, T23)
Time-limited conservation opportunities remain to protect intact habitats and species groups: Opportunities remain throughout the Conservation Planning Region to apply the Conservation First Principle to protect ecosystems and species in advance of widespread industrial development, but human pressures are increasing and some species groups are showing increasing disruption from baseline conditions or have yet to recover from historical declines.	Marine: Northern and central coasts of Labrador (M7); Terrestrial: Most parts of Labrador (T13)				Marine: Davis Strait and Ungava Bay (M7), Hudson and James Bay (M8); Terrestrial: Northern and central parts of province (T20)
Priority conservation actions need to focus on the protection of remaining large habitat blocks and the implementation of regional wildlife management strategies. Widespread adoption of industry best practices is needed outside of protected areas to stem some regional species declines and to prevent further habitat degradation. Some species groups may require monitoring and active recovery intervention.	Marine: Southern Labrador coast and northeastern coast of Newfoundland (M6) Terrestrial: Most of the commercial boreal forest zone (T21)	Terrestrial: Highland areas in Cape Breton (T21)		Terrestrial: Highland areas around Christmas Mountains (T21)	Terrestrial: Most of the commercial boreal forest zone (T17, T21)
Priority conservation actions need to focus on the protection of remaining natural areas with urgent conservation attention directed at the highest quality sites. Comprehensive management and intervention is required to protect some wildlife populations. Widespread adoption of industry best practices along with some restoration efforts are required outside of protected areas to address species declines and habitat degradation. Active recovery efforts will be required for some species groups.	Marine: Grand Banks (M5)	Marine: Scotian Shelf (M3)			
A comprehensive set of conservation actions are required, including protection of remaining natural areas, adoption of best management practices for natural resource-based industries, and significant efforts to restore habitat and recover species. Conservation efforts need to place a high priority on conservation of any significant natural areas remaining. Widespread adoption of industry best practices is needed in conjunction with effective monitoring and enforcement in order to help stem habitat degradation. Significant habitat restoration and species recovery efforts need to be undertaken, preferably in conjunction with one another.	Marine: Gulf of St. Lawrence (M4)	Marine: Gulf of St. Lawrence (M4)	Marine: Gulf of St. Lawrence (M4)	Marine: Gulf of St. Lawrence (M4)	Marine: Gulf of St. Lawrence (M4); Terrestrial:The mixed forest region in the Laurentians.(T3)
Significant habitat restoration and species recovery efforts are required but must occur in tandem with the protection of remaining natural areas. Urban growth and/or industry practices must be managed to reduce the human footprint in these regions. Comprehensive and intense local efforts are needed to rehabilitate habitats and species populations in these regions. These efforts will need to be sustained over the long term to ensure their success.		Marine: Bay of Fundy/Gulf of Maine (M2); Terrestrial: All of the province outside of Cape Breton Highlands (T1)	Terrestrial: All of Prince Edward Island (T1)	Marine: Bay of Fundy/ Gulf of Maine (M2); Terrestrial: All of the province outside of Christmas Mountains (T1)	Terrestrial: Appalachian Mountains (T1) and St. Lawrence Valley (T2)

ment of the CPRs was based on their overall ecological footprint as determined by the cumulative pressure scores presented on page 69, with adjustments made to better reflect the overall abundance and range trends of species groups examined in the Natural Capital Accounts section (pages 42-43). In other words, the cumulative impact scores provided a base estimate of the degree of ecosystem disruption and the species provided a fine tuning of that measure, since their population trends would reflect additional pressures such as commercial harvesting, climate change and exposure to toxic chemicals. Together, the cumulative ecological pressure and species disruption scores provide a relative assessment among regions as to their current conservation need.

When the CPR conservation need is sliced by the provinces and territories (see table columns), the range of conservation strategies needing to be delivered in any one province or territory becomes apparent and examples are described. Most striking are the extraordinary opportunities still remaining for some jurisdictions to protect large functioning ecosystems, an opportunity that is becoming globally rare. Nonetheless, such opportunities have been lost in more than half the country, and there are other conservation approaches that must be engaged to protect natural areas that remain, transition industries to highest environmental standards of operation and finally, to restore degraded habitats and ensure the recovery of wildlife species.

ONTARIO	MANITOBA	SASKATCHEWAN	ALBERTA	BRITISH COLUMBIA	YUKON	NORTHWEST TERRITORIES	NUNAVUT
Terrestrial: Only in northern parts of the province (T19, possibly some adjacent parts of T17)	Terrestrial: Last opportunities are in the northern parts of the province (T18, T19; possibly parts of T17)	Terrestrial: Last opportunities are in the extreme northern parts of the province (T18, possibly parts of T17)		Terrestrial: Limited to extreme northern parts of province (T14, possibly parts of T13)	Marine: Arctic waters in Beaufort Sea (M10, M11) Terrestrial: Northern and central regions (T14, T16, T23)	Marine and Terrestrial: most regions of the territory (M10, M11, T16, T18, T23, T24)	Western marine and all terrestrial regions of the territory (M10, M11, T18, T19, T23, T24, T25)
Marine: Hudson and James Bay (M8)	Marine: Hudson Bay (M8)			Marine: Northern coast and waters around Queen Charlotte Islands (M13); Terrestrial: Northern parts of province (T13)	Terrestrial: Southern parts of territory (T13)		Marine: Eastern Arctic waters and Hudson and James Bay (M7, M8, M9)
Terrestrial: Most of the commercial boreal forest zone (T17)	Terrestrial: Most of the commercial boreal forest zone (T17)	Terrestrial: Most of the northern commercial boreal forest zone (T17)		Marine: Central and south coast; waters surrounding Vancouver Island (M14); Terrestrial: Coastal Rainforest (T5) and Queen Charlotte Islands (T7)			
	Terrestrial: Interlake, Duck Mountains area of boreal forest zone (T15)	Terrestrial: Southern boreal forest zone (T15)	Terrestrial: All commercial forest zones in the province (T15), Rocky Mountains (T4)	Terrestrial: Northeastern part of province (T15), Rocky Mountains and central interior valleys (T4, T8)		Terrestrial: Southern boreal forest zone stretching northward along the Mackenzie Valley. Most intact part of (T15)	
Great Lakes Waters: (M1); Terrestrial: Mixed forest zone of central and northwestern Ontario (T3)	Terrestrial: Mixed forest zone of extreme southeastern part of the province (T3)	Terrestrial: The southwestern part of the province (T12)	Terrestrial: The southeastern part of the province (T12)	Terrestrial: Southern interior valleys and Okanagan region (T9)			
Terrestrial: Southwestern Ontario, St. Lawrence and Ottawa valleys (T2)	Terrestrial: Southern agricultural areas (T10, T11)	Terrestrial: Former parkland areas in south-central regions (T11)	Terrestrial: Former parkland areas in central and northern regions now dominated by agriculture (T11)	Terrestrial: The Lower Fraser Valley in the Puget Sound Lowlands (T6)			

MORE WATER IS DIVERTED BY DAMS IN CANADA THAN IN ANY OTHER COUNTRY IN THE WORLD

ADDRESSING CONSERVATION NEED:

Canada's Response: Protecting Our Investments?

©Karl Sommerer

Recovery efforts have succeeded in preventing wood bison from disappearing in Canada, but populations are still under threat from habitat loss and disease. Efforts to recover the Plains bison are sorely needed.

The Nature Audit's regional assessments of 'conservation need' confirm that for Canada to be in compliance with its commitments to conserve biodiversity, a broad spectrum of conservation actions is required. These range from habitat and species protection, to the sustainable management of resources, to the recovery of species and restoration of habitat.

This range of conservation approaches and strategic directions are embedded within the 1995 Canadian Biodiversity Strategy (CBS) as key measures required to deliver the United Nations commitment. To help ascertain whether the range of activities is producing the desired conservation outcomes, The Nature Audit sought to establish overall levels of progress among governments and industry sectors on CBS-identified issues where actions were needed in order to deliver its goal, "to conserve biodiversity and use biological resources in a sustainable manner".

The Nature Audit used these issues as the basis to create a number of parallel 'standards' that define the kinds of conservation actions needed to ensure a comprehensive national response. These standards are listed on page 73.

To broadly evaluate the nation on its current level of activity to conserve nature, we undertook an information-gathering exercise with conservation stakeholders, industry and governments. The discussions and information we received was informative, forthcoming, and at times thought provoking. We'd like to express our gratitude to all those who assisted The Nature Audit team in providing information.

We have used the information provided to develop an overview of progress related to making commitments, developing programs and actions to deliver the commitments and finally, to determine if outcomes are evident and sufficient to ensure that conservation goals are achieved. Federal, provincial and municipal governments, business, industry and all Canadians have a role to play in conserving the country's biodiversity. In commenting on how Canada is doing, The Nature Audit is, in essence, commenting on how we are all doing.

STANDARDS

The Nature Audit used the following standards to assess progress towards implementation of the United Nations Convention on Biodiversity:

Sustainable Wildlife Management: The maintenance of viable populations of native flora and fauna and other wild organisms in their natural habitats, functioning ecosystems, landscapes and waterscapes.

Terrestrial Protected Areas Systems Completion: The completion of permanent, ecologically representative terrestrial networks of protected areas and their long-term management free of industrial uses.

Marine Protected Areas Systems Completion: The completion by 2012 of permanent, ecologically representative networks of marine protected areas (MPAs) and their long-term management, free of large-scale habitat destruction

Species at Risk Recovery: The recovery of individual species at risk and the restoration of their degraded habitats.

Agriculture Best Practices: The development and implementation of integrated resource use policies, plans, legislation, programs and corporate best practices for agricultural areas to prevent adverse impacts on native biodiversity within the working landscape, to support the conservation of native species and to restore degraded lands.

Aquaculture Best Practices: The development and implementation of integrated resource use policies, plans, legislation, programs and corporate best practices regarding aquaculture activities to prevent adverse impacts on the full range of native biodiversity, and ensure the sustainable use of biological resources for the long term.

Fisheries Best Practices: The development and implementation of integrated resource use policies, plans, legislation, programs and corporate best practices for commercially and recreationally fished areas that ensure the protection, management and restoration of the full range of native biodiversity and the sustainable use of biological resources for the long term.

Forestry Best Practices: The development and implementation of integrated resource use policies, plans, legislation, programs and corporate best practices for forested areas to ensure biodiversity conservation through the right combination of permanent protection, management and restoration of the land base where planned, monitored and evaluated at a landscape level, while generating sustainable social and economic benefits.

Greenhouse Gas Emissions: The development and implementation of policies, plans, legislation, programs and practices to reduce levels of CO_2 emissions by 10 per cent below 1990 levels by 2010.

Air and Water Pollution: The development and implementation of policies, plans, legislation, programs and practices: 1) to reduce other human-caused air pollutants (besides CO_2 emissions) that threaten biodiversity; and 2) that prevent adverse impacts of water pollution on native species and habitats.

Invasive Species Control: The development and implementation of policies, plans, legislation, programs and practices to prevent exotic organisms from adversely affecting native biodiversity.

Transportation and Urban Development: The development and implementation of policies, plans, legislation, programs and corporate best practices to reduce the adverse impacts of residential and commercial development and transportation infrastructure on native species and plants, and their habitats.

far left ©J.D. Taylor; left ©Bruce Petersen

The golden eagle (far left) and the woodland caribou (left) are two species for which management guidelines have been put in place to ensure their long term recovery and survival.

THE RESPONSE: Sustainable Wildlife Management

SUMMARY

The health of wildlife is essential to many social and economic activities within Canada; Canadians spend billions of dollars each year pursuing wildlife-related activities. There are numerous acts, policies and associated programs that address issues pertaining to the management of Canadian wildlife species (e.g., The Migratory Birds Convention Act), many of which are administered by the Canadian Wildlife Service, an agency of Environment Canada.

Canada is also a party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), along with 160 other countries. Currently, Canada's inability to accurately monitor the level of wildlife trade into, out of, and within the country means that the size of the footprint Canada makes on the world's global biodiversity cannot be accurately measured.

For wildlife populations to be sustained, industry practices and economic initiatives must address wildlife goals. The Northwest Territories, for example, has implemented programs on the sustainable use of terrestrial and aquatic wildlife that fall under their Sustainable Development Policy. Some individual companies within the forest sector are also striving to improve the management of forests to accommodate the needs of a broad range of wildlife species.

Wildlife management efforts, however, often end up targeting single species, such as moose, wild salmon or predator management. This approach fails to recognize and address the ecological relationships among species. While it is encouraging that programs are in place to deal with these species, many ecologically important but less charismatic and/or non-game species, are largely neglected. This problem was reflected in the lack of data available for The Nature Audit analyses, and a lack of information about management practices to conserve species such as small mammals, invertebrates and plants.

While management policies relating to wildlife are becoming more comprehensive and in many cases, helping to deliver on their targets, widespread concern was expressed among wildlife managers that program funding and enforcement of wildlife regulations are still greatly inadequate to meet current challenges.

MOVING IN THE RIGHT DIRECTION

- In 1986, Canada signed the North American Waterfowl Management Plan, an international action plan to conserve migratory birds throughout the continent. It is a partnership of federal, provincial/state and municipal governments, non-governmental organizations, private companies and many individuals, all working towards achieving wetland habitat conservation.

- In some provinces (e.g. the Maritimes, Quebec, Ontario, and Alberta), non-governmental organizations and government agencies have been teaming up to conduct surveys of breeding birds. Known as 'breeding bird atlases', the goal of these ambitious projects is to gather, at regular 20-year intervals, data on the changing distribution and abundance of breeding birds to help monitor population trends.

- The Northwest Territories Biodiversity Team administers programs that manage a wide range of species, including: polar and grizzly bears, moose, caribou, waterfowl, shorebirds, frogs and plants.

- Provincial governments, in conjunction with NatureServe Canada and other partners, have established a series of conservation data centres with the goal of providing accurate and objective information on wildlife, including species and communities. They are essential in providing information for the management of sustainable wildlife populations.

CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
Many commitments exist, but are not always supported by ecological targets, goals, measures or timelines – often focussed on day-to-day management. Industry commitments are slowly improving with the forestry sector generally leading the way.	No shortage of wildlife activities, highly focussed on commercially important species. Greater financial and human resources need to be dedicated to less well known species groups, such as plants and invertebrates, and non-game species.	Improving, but wildlife management is still too often being addressed in a piecemeal fashion by individual government departments and companies. Few integrated approaches apply ecosystem-wide plans that also address social and economic factors.

POTENTIAL BARRIERS TO SUCCESS

- Overall, program emphasis remains too focussed on a relatively small number of commercially valued species. While these programs are important, the emphasis needs to shift towards managing species in a more integrated fashion and at ecosystem based scales.

- In regions of the country where much of the landscape is in private ownership, government assistance to help promote sustainable wildlife management and habitat stewardship on private lands is seriously lacking.

- Environment Canada is not providing comprehensive and consistent training on CITES, permit validation, and species and product identification. The impact of this lack of training is exacerbated by the loss of experienced biologists from within the inspection staff. These issues are diluting both Environment Canada's capability to meet its most fundamental responsibility, and ultimately, its credibility for providing advice and training to other government departments and agencies.

- Lack of financial and human resources, and in some cases political will, to enforce existing policies and legislation (e.g. failure of Canada to enforce adequately the Migratory Birds Convention Act, as exemplified through a current NAFTA Commission for Environmental Cooperation review regarding forestry practices and violations of the Act in Ontario).

The Mystery of PEI Fish Kills

Prince Edward Island has experienced a spate of fish kills over the past several years. More than 100,000 fish have died in two dozen rivers or ponds since 1994. Calling these incidents "fish kills" is something of a euphemism – it's likely that a wide range of aquatic organisms were killed or injured.

Some fish kills have caused significant losses of aquatic life, with streams appearing "dead" for some time. Many of these incidents have been related to run-off of pesticides from intensively farmed potato fields. The reality is that the pre-conditions for mass poisoning of aquatic species exist throughout the island. Soil in PEI is sandy and highly erodable and the climate is rainy with frequent heavy summer storms. Although improving, the regulatory regime and enforcement practices are insufficiently protective of aquatic habitats. Finally, there is an intensive agricultural system which has expanded into marginal and sometimes sloping land, which remains dependent on chemicals which are highly toxic to aquatic life.

2005 Recommended Actions

1. **All governments and industry sectors:** integrate single species policies and practices to more effectively encompass landscape/watershed-level planning approaches to address overall ecosystem integrity and the conservation of all species. Put into place recommendations from the Report of the Panel on the Ecological Integrity of Canada's National Parks.

2. **All governments and the private sector:** provide financial support for the continued operation of Canada's network of provincial Conservation Data Centres and assist with the establishment of new centres in Canada's north.

3. **National Round Table on the Environment and the Economy:** deliver a set of natural capital indicators that can provide linkages to Canada's economic indicators.

4. **Environment Canada:** develop and institute a comprehensive training programme on CITES and on the biological and taxonomic expertise required for the identification of wildlife products. The former should be mandatory for all officers involved with CITES enforcement and the latter should be required for all officers actively involved in conducting inspections and making species identifications.

5. **All governments:** develop regulations restricting the introduction of non-native species, such as Ring-necked Pheasants and Brown Trout. Do not introduce native species into parts of the country where they did not naturally occur (e.g., Wild Turkey and Rainbow Trout outside of their natural range)

THE WOOD FROG, BOREAL CHORUS FROG, SPRING PEEPER, AND PAINTED TURTLE ARE SOME EXAMPLES OF AMPHIBIANS AND REPTILES CAPABLE OF FREEZING SOLID DURING THE CANADIAN WINTER AND THEN 'WAKING UP' IN SPRING.

far left ©Gregor G. Beck; left ©Jason Shafto

Though there has been considerable progress since 1990, neither Canada's boreal forests (far left) nor grasslands (left) have a completed system of protected areas.

THE RESPONSE: Terrestrial Protected Areas

TABLE 33: RANK OF JURISDICTIONS BASED ON THE LEVEL OF ECOLOGICAL REPRESENTATION ACHIEVED PRE-APRIL 17, 2003 THROUGH THE ESTABLISHMENT OF PROTECTED AREAS SYSTEMS AND SOME INTERIM PROTECTED SITES.

Ranked Jurisdictions	% of ecological representation targets achieved	% of jurisdiction permanently protected from industrial activity*	Area protected (hectares)*
1. BC	41	13.0	12,017,617
2. ON	40	9.2	9,142,039
3. NS	36	8.2	465,363
4. PEI	35	2.6	14,780
5. MB	34	8.5	5,402,416
6. AB	33	12.3	8,009,229
7. NF & Labrador	30	4.3	1,701,412
8. NWT	25	12.3	16,318,158
9. YK	25	12.0	5,678,119
10. NU	25	7.4	15,434,457
11. SK	24	3.5	2,243,230
12. QC	22	3.5	5,217,586
13. NB	21	3.1	233,443
CAN	**29**	**8.4**	**81,877,848**
U.S.-Shared Portions of CPRs	**20**	**18.2**	**46,357,334**

NOTES: Jurisdictions were scored based on the representation assessment of natural regions depicted in Figure 40. Total area covered by regions assessed as 'adequately represented' received a score of 100 per cent (i.e. job complete for major habitat features), moderate – a score of 75 per cent; partial – a score of 35 per cent; and little or no representation – a score of 0 per cent. Total area covered by each of these categories was summarized and averaged to determine an overall jurisdictional mean value. Natural region representation levels are based on WWF-Canada methodology. For details, please go to www.wwf.ca

* Only considers areas contributing to ecological representation

SUMMARY

The federal, provincial and territorial governments of Canada have been committed to completing their terrestrial protected areas systems since 1992, when they signed "A Statement of Commitment to Complete Canada's Networks of Protected Areas". While the original target date for systems completion – 2000 – was not met by any jurisdiction, considerable progress and planning was achieved in expanding protected areas systems by all governments through the 1990s.

Over the past two years, however, the pace of new protected areas designations has slowed significantly in many regions of the country. This is of concern as no government in Canada (see Table 33) has yet achieved even 50 per cent of the ecological representation targets for their protected areas systems. British Columbia leads the country with approximately 41 per cent of the representation task achieved, followed closely by Ontario at 40 per cent. The least complete systems from a representation standpoint are currently New Brunswick (21 per cent) and Quebec (22 per cent). Progress is now being made in two of these jurisdictions: Quebec and the Northwest Territories (NWT) which recently announced the protection of some large new sites. The Prime Minister's recent promise to provide funding to establish 10 new national parks is also welcome news.

In some parts of the country where industries are licenced to operate on crown lands, some companies are stepping up to the plate and working with stakeholders to ensure that significant areas, such as high conservation value forests, receive protection. Examples of areas where industry is supporting protected areas efforts include northern Ontario and Quebec (e.g., Tembec Inc.), northeastern Alberta (e.g., Alberta-Pacific Forest Industries Inc.), the Mackenzie Valley in NWT (oil and gas sector) and Manitoba (mining sector).

In southern Canada, where most of the landscape is privately owned, progress on protecting high-priority sites continues, led by private conservation organizations and land trusts, such as the Nature Conservancy of Canada, Ducks Unlimited Canada, and the Federation of Ontario Naturalists. In addition, the use of conservation easements is becoming increasingly common as a means for private landowners to ensure the long-term protection of their land.

MOVING IN THE RIGHT DIRECTION

- **The federal government has publicly announced five-year funding** to create 10 new national parks, five new national marine conservation areas, and to improve the ecological integrity of the existing 39 national parks.

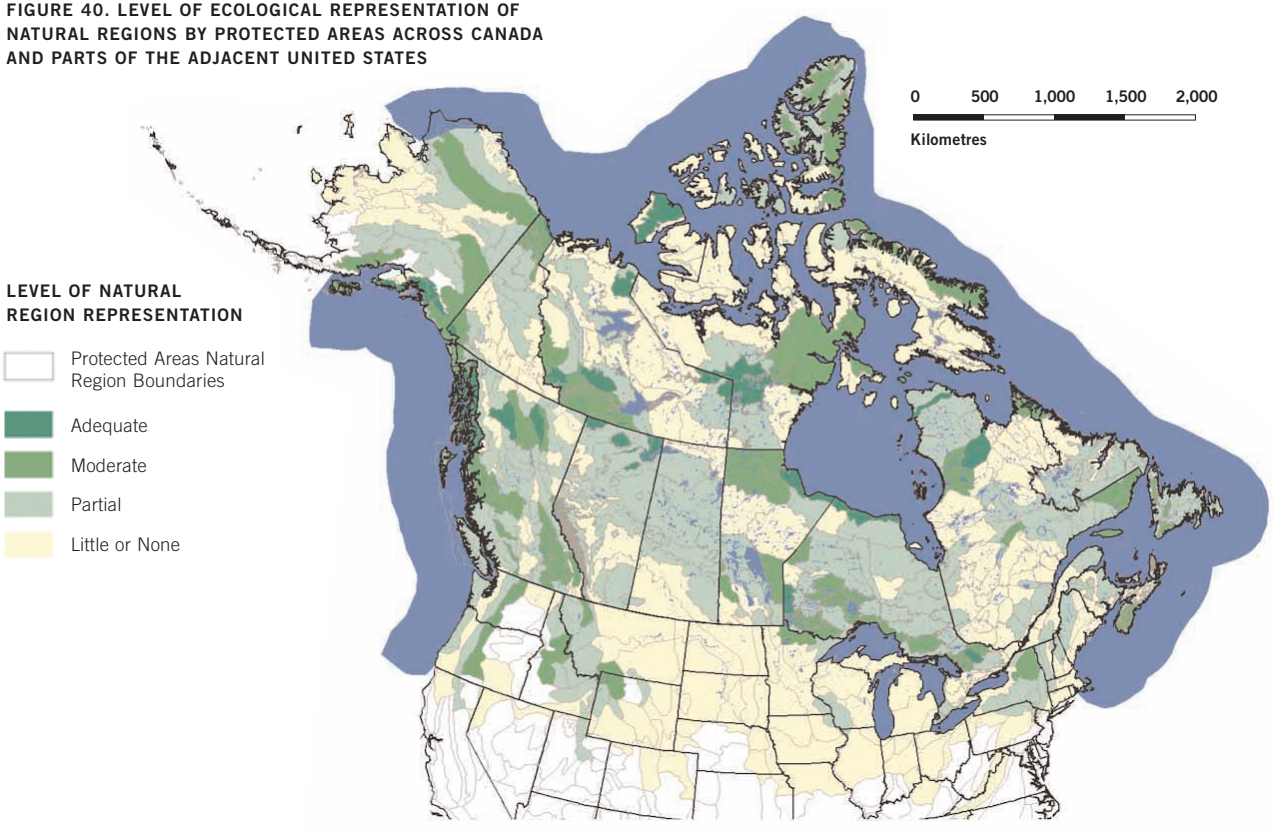
- The **province of Nova Scotia has established a Private Land Conservation Enhancement Committee**, to identify barriers and develop solutions to private land conservation.

- The **Province of Ontario's Room to Grow Framework** is being developed to address gaps in representation, such as developed/converted landscape in southern areas of

CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
Long-standing commitments remain at senior political levels and in some industry sectors, but they lack updated measurable targets or timelines. Political will is slipping in many jurisdictions.	Government programs becoming chronically underfunded and often bogged down in stakeholder consultations. Programs and decision-making processes need to be streamlined.	Overall, the pace of new protected area designations is declining across Canada, with NWT and Quebec being notable exceptions.

FIGURE 40. LEVEL OF ECOLOGICAL REPRESENTATION OF NATURAL REGIONS BY PROTECTED AREAS ACROSS CANADA AND PARTS OF THE ADJACENT UNITED STATES



the province, and the Northern Boreal Initiative is establishing a dialogue with First Nations for protection of northern regions of the Province.

- The **NWT's Protected Areas Strategy Draft Action Plan to 2008**, when implemented, will see a network of key cultural and ecological areas reserved in the Mackenzie Valley prior to completion of the major gas pipeline.

2005 Recommended Actions

1. **The federal government and the governments of Northwest Territories, Yukon, Nunavut, Quebec and Newfoundland and Labrador** should apply the Conservation First Principle to continue and/or increase efforts to identify and advance a roster of new protected areas, targeted at under-represented parts of Conservation Planning Regions T16, T18, T20 and T23 before any major new industrial development forecloses conservation options.

2. **The Ontario and Quebec governments** should provide financial incentives for conservation and restoration of privately-owned remnant woodlands of regional significance in highly degraded deciduous and mixed-wood forests of the Southern Great Lakes and St. Lawrence lowlands (T2).

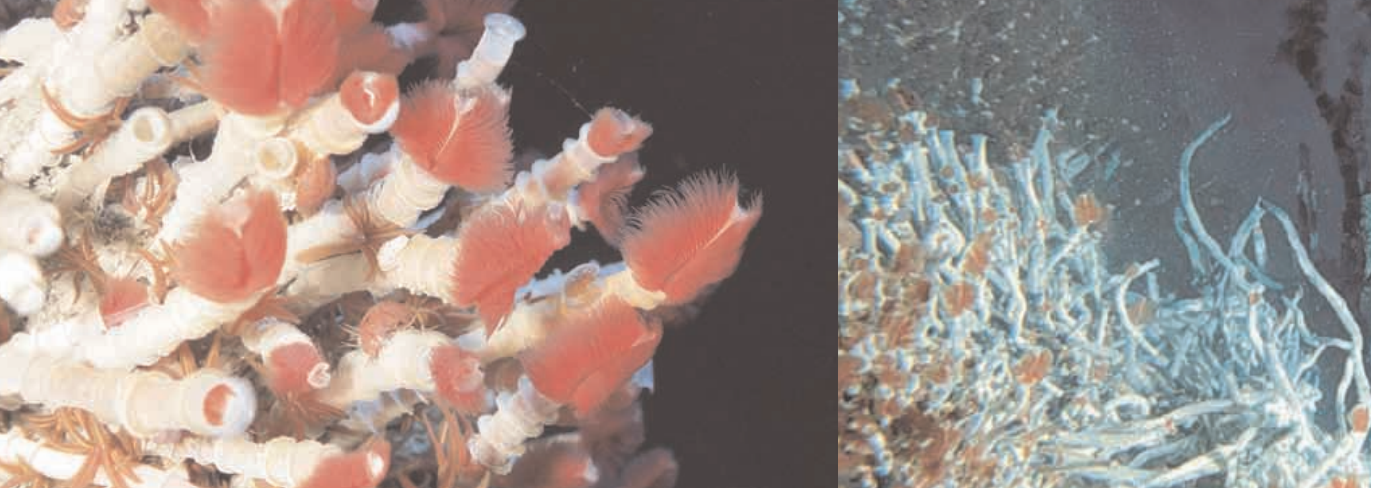
3. **All governments** should follow the Conservation First Principle instead of the 'development-first' principle, by identifying and reserving candidates for an ecologically representative protected area network before any new exploration or extraction licences are granted.

POTENTIAL BARRIERS TO PROGRESS

- The Province of New Brunswick has **placed a cap of 5,000 hectares in total** for new protected areas on Crown Land.

- The Yukon government has placed '**on hold**' further work on its territorial protected areas system.

- The BC Mining Association is trying to **reduce and remove protected land** status from provincial parks so that they can expand mining activities in the province.



(Far left) The brilliant red gills of vestimentiferan worms extend into warmed waters in proximity to 8-metre high chimneys (left) at Endeavor Hot Vents, 2,200 metres under the ocean.

THE RESPONSE: Marine Protected Areas

SUMMARY

Canada, with the longest coastline and most freshwater in the world, presently has no network of marine protected areas that will contribute to biodiversity conservation.

In 1992, Canada's federal, provincial and territorial ministers of the environment, parks and wildlife signed "A Statement of Commitment To Complete Canada's Networks of Protected Areas". In the 10 years since that commitment was made, only two new marine protected areas (MPAs) have been established: the Saguenay-St. Lawrence Marine Park in Quebec (Parks Canada) and the Endeavour Hydrothermal Vents (Fisheries and Oceans Canada).

This is a significant under-representation of Canada's marine environments, and the Great Lakes (Figure 41). Most of the country's marine ecological regions lack any MPAs at all. At the World Summit on Sustainable Development in 2002, Canada, along with other participating countries, committed to completing representative networks of marine protected areas by 2012.

MOVING IN THE RIGHT DIRECTION

- The federal government has publicly announced **five-year funding** to include the creation of five new National Marine Conservation Areas.

- In Ontario, a commitment has been made to **establish a National Marine Conservation Area (NMCA)** in western Lake Superior, protecting 10,000 km^2 of sparkling, freshwater habitat, the largest such reserve in the world.

POTENTIAL BARRIERS TO PROGRESS

- **Lack of adequate funding** is frequently cited, from within and outside government, as the greatest impediment to implementing this standard.

- **Lack of support** for MPAs within and among some provincial and federal government agencies leads to slow decision-making and poor coordination of government programs.

- Oil and gas exploration and development on Canada's east coast and in the Beaufort Sea, and proposed exploration on Canada's west coast, **threatens to foreclose options** to establish a network of marine protected areas.

- **Lack of federal/provincial agreements**, such as the disputed jurisdiction between the federal and provincial governments over ownership of the seabed, continues to slow protected areas development, although some excellent cooperative arrangements have emerged (e.g., resolution of seabed issues in the Gwaii Haanas NMCA reserve, BC and the Saguenay-St Lawrence Marine Park, Quebec).

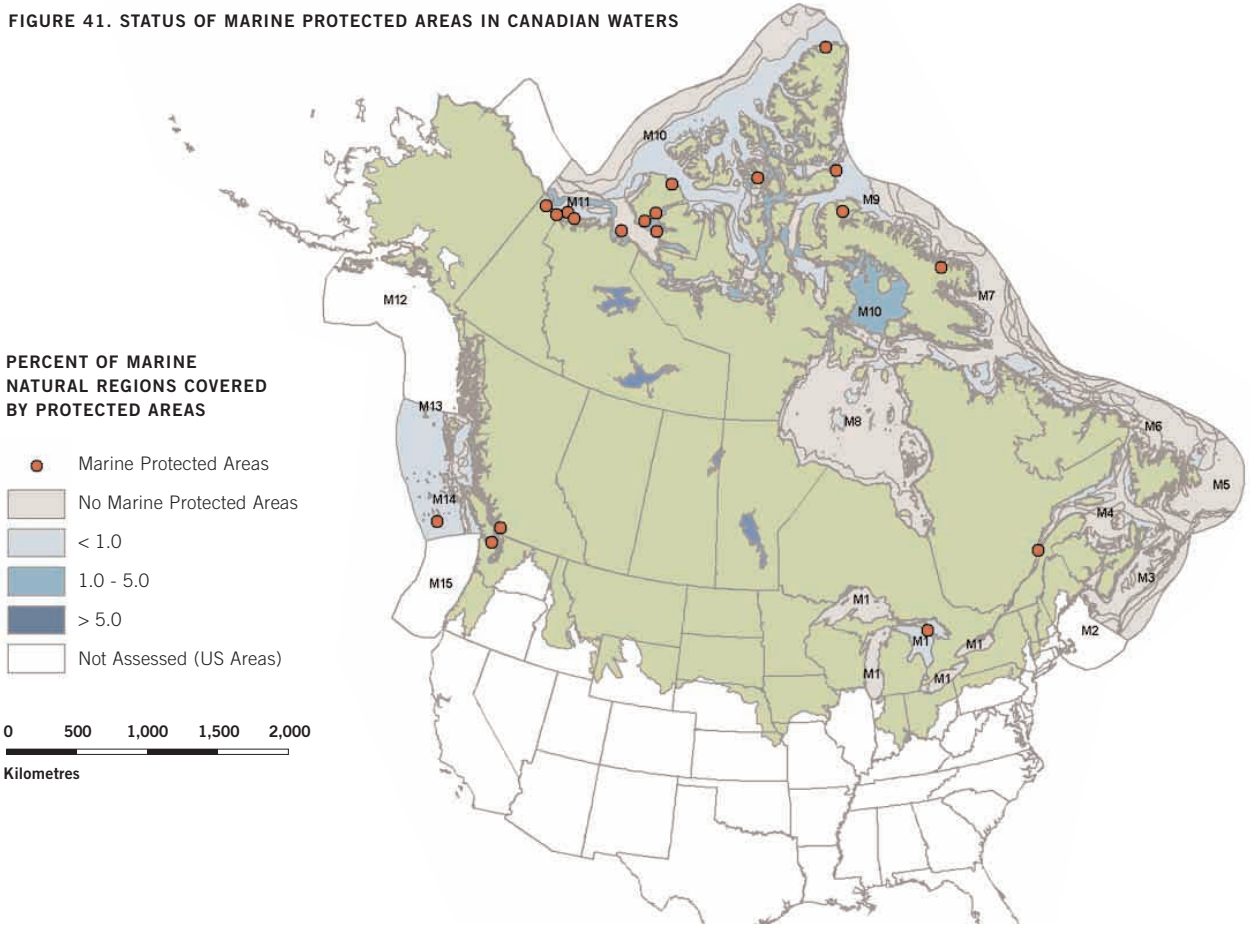
Hydrothermal Vents are Home to 12 Unique Species

Twelve unique species – existing nowhere else in the world – make their home in one of Canada's new marine protected areas. The Endeavour Hydrothermal Vents, located off Vancouver Island, BC, is an active seafloor-spreading zone. The area consists of large, hot black smokers that form when dissolved minerals and metallic ions are carried upward and make contact with the surrounding lower-temperature water. Temperature variances around the vents range from two to 300 degrees Celsius over distances of less than two metres. Hydrothermal venting systems host one of the highest levels of microbial diversity and animal abundance on earth.

CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
Despite high-level political commitments (such as the 1992 Tri-Council Agreement on Protected Areas), government programs on MPAs lack funding, targets, timelines, or all of the above.	Parks Canada has committed to five new NMCAs within five years, and Fisheries and Oceans Canada has identified several "Areas of Interest" for possible protection.	Rate of new MPA establishment is much too slow. To meet Canada's 2012 commitment, there must be new funding to implement the 1997 Oceans Act. Identification of MPAs must be a part of new or expanded development decisions by government and industry.

FIGURE 41. STATUS OF MARINE PROTECTED AREAS IN CANADIAN WATERS



2005 Recommended Actions

1. **The Federal Government** must develop a plan, with specific goals and timelines, to implement the 2002 World Summit on Sustainable Development's Agreement on Oceans, in which governments committed to completing representative networks of MPAs by 2012.

2. **Parks Canada** must complete at least three new National Marine Conservation Areas.

3. **The Federal Government** must complete existing protected areas candidates, such as Igaliqtuuq on Baffin Island (Canadian Wildlife Service), the Sable Gully off the coast of Nova Scotia (Fisheries and Oceans Canada) and Bowie Seamount (Fisheries and Oceans Canada) off the coast of Haida Gwaii (Queen Charlotte Islands); some of these have been proposed for more than 10 years.

4. **All governments** should follow the Conservation First Principle in Canada's lakes and oceans by identifying MPAs in affected regions before or concurrent with decisions on new marine and coastal development.

5. **Identify and reserve the suite of MPAs** necessary for representation as part of integrated coastal zone management both at the provincial and federal levels, such as the Fisheries and Oceans Canada-led Eastern Scotian Shelf Integrated Management Initiative.

55KM/HR: THE SPEED OF THE FASTEST MAMMAL IN THE WATER, THE KILLER WHALE (ORCINUS ORCA)

With only 15 left in the wild by 1941, efforts to bring back the whooping crane (left) from the brink of extinction appear to be working. Pictured here, an ultra-light aircraft teaches young cranes a new migration route.

THE RESPONSE: Species at Risk Recovery

SUMMARY

As pressures on Canadian biodiversity increase, the effects weigh on our plants and animals. More than 430 species are currently listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as nationally at risk of extinction. As more species are assessed, this number has grown steadily. Hundreds more species are considered rare and at risk provincially or regionally.

Since the mid 1970s, when COSEWIC was first formed to identify species at risk in Canada, significant progress has been made in developing policy, legislative and programmatic tools to address the growing concern over species declines and loss. In 1996, the provincial, territorial and federal governments signed the National Accord for the Protection of Species at Risk, agreeing to establish complementary legislation and programs that would provide for effective protection of Canadian species at risk.

Recently, some jurisdictions have improved efforts to conserve species at risk, either by introducing or strengthening legislation, or bolstering programs. On December 12, 2002, the Federal Species at Risk Act (SARA) received Royal Assent, although at the time of writing this report, it had yet to come into force. This act is a step forward in getting recovery teams and plans in place for nationally threatened and endangered species.

While SARA offers protection to species under federal jurisdiction, it will largely be left to the provinces to protect species on provincial crown and private lands. Recent progress in this regard includes new acts in Nova Scotia and Newfoundland; the Northwest Territories is currently drafting legislation, and the Yukon is considering changes to its Wildlife Act to address species at risk. At the same time, several provinces have yet to pass their own species at risk legislation, notably BC which is home to 125 of the 415 species at risk currently listed by COSEWIC. Concerns have been raised at the slow speed by which species at risk are regulated for protection under provincial legislation (e.g., PEI, Ontario). The lack of provisions for habitat protection in legislation and lack of enforcement in some jurisdictions mean that these legal tools are not as helpful as they could be.

The responsibility to protect and recover species under federal jurisdiction is different in Canada's oceans. All Canadian marine waters fall under the jurisdiction of the Department of Fisheries and Oceans (DFO); it has an important role to play in the recovery of many marine species – commercial and non-commercial species alike. DFO is beginning to take a strong role in the development of species recovery plans, but will face a serious challenge in identifying and protecting critical habitat of species at risk.

Programs that spearhead and assist research, recovery action and voluntary stewardship efforts are also vital tools. Widely shared concerns persist regarding the level of program resources allocated to address the current and growing need for such efforts. In some areas, much time and effort is being used to build recovery processes and programs, but resources for on-the-ground-actions remain sparse. The dominant approach to species at risk recovery in Canada is not proactive; we wait until species are in such a dire situation that an enormous effort – and an enormous amount of resources – is required to make a positive difference.

CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
A relatively strong commitment from most jurisdictions across Canada, and some commitment from a few industrial leaders.	Numerous, and increasing in recent years. A relatively comprehensive set of tools has been developed; however, insufficient resources are available to implement these tools on the scale needed to make a real difference.	Low level of success to date; relatively few instances of species recoveries compared with the growing need. More of the focus on critical habitat protection and pro-active species conservation initiatives.

MOVING IN THE RIGHT DIRECTION

- The Government of Newfoundland and Labrador passed an Endangered Species Act in 2001 and promptly moved to list all nationally endangered and threatened plants and animals that occur in that jurisdiction for protection under the law.

- Nova Scotians wanting to "drive home" the importance of protecting endangered plants and animals can do just that. Special licence plates recognizing species at risk are now available for sale to vehicle owners, with proceeds going to the province's Species at Risk Conservation Fund.

- Transport Canada, Department of Fisheries and Oceans, fishermen's associations in the Bay of Fundy, and members of the shipping industry, in conjunction with WWF came together and made changes to shipping lanes in the Bay of Fundy to aid in the recovery of the north Atlantic right whale.

- Environment Canada has increased its support of recovery and habitat protection for species at risk, through the Habitat Stewardship Program.

- Ontario is developing a recovery strategy for the woodland caribou by a provincial recovery team that works in collaboration with a multi-stakeholder advisory group.

POTENTIAL BARRIERS TO PROGRESS

- Current policies and legislation tend to be reactive and not proactive. Species recovery, habitat protection and restoration efforts usually get underway only after the species is in a critical state, resulting in the need for greater resources to protect the species.

- Habitat protection and restoration, a key species at risk recovery activity, is not being operationalized in a way and on a scale that is necessary. Recovery approaches that are more proactive and habitat-based are needed in addition to the species-by-species efforts to make more significant progress on the ground. This approach, especially in southern Canada, will necessitate much greater participation from municipal governments.

- More inter- and intra-government cooperation is needed; while governments and land users argue over who has authority over a particular species or place on the ground, species continue to decline.

2005 Recommended Actions

1. **The Federal Government** should ensure that the Species at Risk Act (SARA) comes into force with no delays, that the discretionary critical habitat protection clause is well used wherever critical habitat occurs and that the Act is adequately enforced.

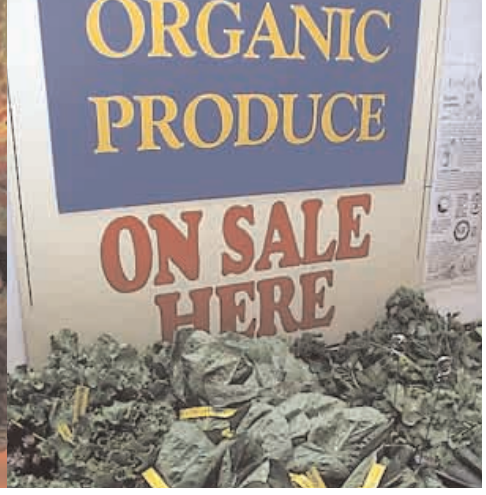
2. **Provinces and territories** without species at risk legislation should enact laws that protect all species at risk and their critical habitats.

3. **All governments** should list all species at risk under wildlife or species at risk legislation and identify critical habitat for protection and restoration as part of their recovery actions. In addition, look for opportunities to implement more habitat-based recovery plans.

4. **All governments** should resolve disagreements over jurisdiction and leadership of species at risk affairs. Better collaboration is needed to ensure that an intact safety net is in effect across Canada for species at risk. Find more constructive ways to work cooperatively with industries, conservation organizations and private landowners, who can assist with finding the most effective ways to recover species at risk.

5. **Municipal governments** should become more involved in assisting with species at risk recovery, such as by amending official plans to better ensure the protection of critical habitats for species at risk within municipal boundaries.

1,200: THE NUMBER OF PEREGRINE FALCONS THAT HAVE BEEN SUCCESSFULLY FLEDGED IN CANADA SINCE 1976



far left ©Frank Parhizgar; left ©Michael Lee

By buying locally produced food such as the grapes from Niagara (far left) and certified organic products, YOU can help support more sustainable agricultural practices.

©Denise Sturmwind

THE RESPONSE: Agriculture

SUMMARY

Governments and farmers, supported by good research, have taken some positive preliminary steps to conserve biodiversity. Sometimes, these steps have been taken directly in response to biodiversity pressures, other times when solving economic or agronomic problems that conserve biodiversity as a co-benefit. For instance, in the first category, many government-farmer collaborations have restored natural habitat on farms or reintroduced endangered species to farm landscapes. In the second, significant reductions in soil degradation have resulted from changes to cropping and tillage practices, and these have improved soil biodiversity and reduced water pollution. Some farmers have also reduced their use of synthetic fertilizer and pesticide inputs to cut costs, with associated beneficial impacts on waterways and other wildlife habitats. Many improvements are now associated with Environmental Farm Plans and agri-environmental clubs.

Still, many habitat and farm practice initiatives are too small, localized and fragmented to have a significant positive impact at a landscape level. Because programs are voluntary, the biggest problems are not necessarily addressed. Coverage is also hit-and-miss since much of the direct support provided by governments is via grants rather than a comprehensive or targeted set of program supports. In many provinces, reductions in government research and extension staff have compromised program delivery, and monitoring of effectiveness is poor or non-existent.

A major shortcoming in Canada's response to the impact of agriculture on ecosystems is the lack of a broad and integrative approach. Governments and farm organizations are reluctant to embrace farming systems that are biodiversity-friendly (see Matrix), focusing instead on incremental modifications to specific practices. While the new Agricultural Policy Framework sets out specific targets to improve environmental stewardship, the challenge will be to design and implement new programs that actually produce improvements and enhance the economic and ecological viability of Canada's agricultural sector.

MOVING IN THE RIGHT DIRECTION

- Some 30,000 Canadian farmers have **participated in Environmental Farm Plans or agri-environmental clubs**. Ontario and Quebec have the largest programs, but new programs are beginning in many provinces and existing ones are expanding.
- Results of The Nature Audit suggest that **government crop diversification programs on the Prairies** have paid dividends, as Saskatchewan and Manitoba now have the most diverse cropping patterns in Canada, which improves above- and below-ground habitats for many organisms.
- **Alberta's Cows and Fish program**, designed to improve riparian areas on farms while maintaining or improving farm profitability, has been presented to 22,000 farmers, ranchers, land managers and the public since 1992.
- Apple growers in BC, ON, QC, and the Maritimes are all **significantly reducing pesticide use**, as part of a program directed by the Canadian Horticultural Council and supported by WWF-Canada.
- The government of **PEI is implementing a new legislative program** to reduce farm pollution that includes regulating some farming practices, and providing financial incentives to adopt more environmentally-friendly farming systems.

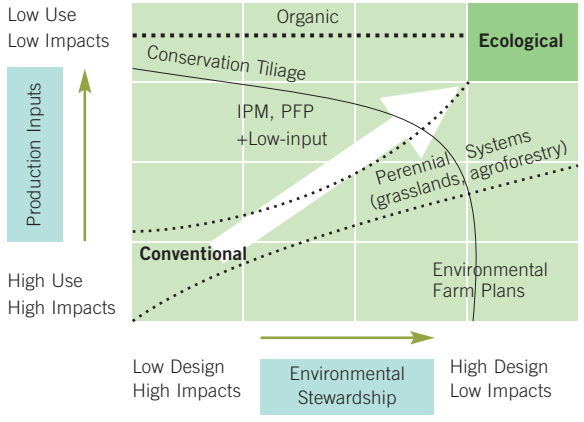
CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
Governments have broad commitments, and the new Agricultural Policy Framework (APF) has specific targets for air, water, land, climate change, and biodiversity protection to be implemented through federal/provincial agreements and partnerships with farm organizations and commodity groups.	There are some environment and biodiversity-specific programs supported by federal and provincial agencies, farm groups, academics, and others. However, there's rarely a central or integrated ecological theme in core programs and a predominant/excessive focus on incremental practices rather than integrated systems. Most of the relatively small investment is sporadically located since programs are largely voluntary, and not clear how effective given minimal monitoring of impacts.	Some significant national improvements in soil erosion and pollutant control over the past few decades. Regional and local improvements in habitat restoration and protection. Too early to evaluate effectiveness of new APF programs and research at reducing pressure on ecosystems.

POTENTIAL BARRIERS TO PROGRESS

- Governments and farm organizations are **reluctant to target programs and policies** to the most problematic regions, farmers and farm practices. Until they do, significant biodiversity improvements are unlikely.
- Many **provincial extension programs have been drastically cut** over past 10 years, leaving farmers without adequate field-level support to adopt environmentally friendly farming systems.
- The food processing and retailing sectors have **yet to fully embrace consumer interest** in buying foods with environmental attributes, thereby restricting market opportunities for farmers practicing environmental stewardship.
- Farmers are more than food producers. They provide environmental services and rural amenities. Since **the marketplace is not yet rewarding farmers financially** for providing such services to society, governments must provide payments, something they remain reluctant to do.

FIGURE 42. REDUCING THE FARM FOOTPRINT ON BIODIVERSITY



Governments, farm organizations and food businesses must support the movement towards more environmentally friendly farming systems. With the right supports in place, farmers will adopt systems that are increasingly ecological, with positive results for biodiversity. With proper financial and market incentives, farmers can maintain or improve farm profitability at the same time.

2005 Recommended Actions

1. **The Federal Government** should set ambitious goals for adoption of integrated pest management and organic farming systems, and begin implementing programs that support such a transition on at least half the country's farming acreage.
2. **Technical, extension, financial and research support must be available** to prepare and implement strategies that reduce risk from and reliance on pesticides, using the platform offered by the Agricultural Policy Framework.
3. **Provincial governments** across the country must ensure full region-by-region implementation of nutrient management plans that improve farm performance and reduce agricultural pollution.
4. Building on successful initiatives in several provinces, **all provinces** should require Environmental Farm Plans, with specific attention to sub-sectors with the greatest need for improvements, incentives for farm-level implementation and monitoring to track progress against environmental targets.
5. **All provinces** must have crop diversification programs for the main regions where field crops are grown, e.g., grain regions of Alberta, corn and soybean areas of Ontario, potato production in New Brunswick and Prince Edward Island.
6. **The application of sludge** contaminated with persistent pollutants and metals to agricultural lands should be strictly controlled/prohibited.

WITH GOOD MANAGEMENT PRACTICES, THE ALFALFA LEAFCUTTER BEE CAN INCREASE ALFALFA SEED YIELDS UP TO 20-FOLD

Aquaculture has come to play an important role in the Canadian seafood industry. Canada's top four exports by species were lobster, crab, farmed Atlantic salmon and shrimp.

THE RESPONSE: Aquaculture

SUMMARY

Finfish aquaculture production in Canada has grown at a rapid rate, from 13,000 tonnes to 120,000 tonnes in less than 15 years. The bulk of federal and industry investment in research during this period has been focused on increasing competitiveness but has not addressed the large-scale effects of the expansion of intensive aquaculture. The drive for international competitiveness has resulted in several improvements in environmental performance and the development of improved farming practices. These include more efficient use of feed (and therefore less waste generated in the surrounding waters), reduction in fish escapees, and antibiotics/pesticide use reduction.

However, rapid industry growth, a lack of designated control areas (areas with no aquaculture facilities) to serve as baselines for monitoring, low levels of ecosystem-level impact monitoring (ie., monitoring for effluent discharges, nutrient loading, the depletion of wild fish for use as feed), and inadequate levels of research on environmental effects (ie., toxic chemicals, antibiotics, habitat impacts and genetic contamination) make it very difficult to accurately assess and monitor ecosystem impacts – especially cumulative effects.

Furthermore, intensive finfish aquaculture expansion is proceeding in advance of integrated management planning processes that would co-ordinate multiple uses and plans for marine protected areas, in concert with industry development.

Fisheries and Oceans Canada, and the provincial agencies with jurisdiction on licensing activities currently have dual roles – as both regulators and promoters of aquaculture – particularly in salmon farming. This makes it more challenging to ensure that adequate effort is being devoted to monitoring industry compliance with existing environmental regulations, let alone being able to dedicate significant attention to developing improved environmental practices.

MOVING IN THE RIGHT DIRECTION

- In May 2001, the Office of the Commissioner for Aquaculture Development released a report, entitled "Legislative and Regulator Review of Aquaculture in Canada" that made **recommendations for enacting an aquaculture act.**
- In June 2001, Environment Canada released reports outlining their recommendations for marine and freshwater finfish aquaculture activities.

POTENTIAL BARRIERS TO PROGRESS

- In December 2000, the Auditor General's report gave Fisheries and Oceans Canada a **failing grade in carrying out its regulatory responsibilities to enforce the Fisheries Act** with respect to BC salmon farming.
- There is **growing evidence of disease transmission** from open-cage, farmed fish to wild stocks, such as sea lice in the Broughton Archipelago, BC.
- There are several documented cases of **escaped open-cage farmed Atlantic salmon** surviving and successfully breeding in native Pacific salmon habitat and a growing concern over escapees of non-native genetic stocks in the Atlantic.
- A national **aquaculture act to regulate activity still does not exist for Canada.**

CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
All responsible authorities and industry have clear policy commitments to sustainable aquaculture, but they are usually lacking measurable ecosystem-based targets based on marine environmental quality.	Canadian agencies are increasingly involved in the promotion of sustainable aquaculture. While many reports have been produced that outline good principles and protocols, industry research remains primarily focused on efficiency and technology, rather than on ecosystem impacts.	Industry development remains focused on sustaining or growing production rather than on sustaining environmental quality.

©Laurie Murison

Noise devices, placed near aquaculture facilities to deter seals from predating on caged salmon, may disrupt whale behaviour several kilometres away due to the loud underwater sounds they emit.

2005 Recommended Actions

1. **The Federal Government** should pass aquaculture legislation with national and regional regulatory standards that address where facilities may be located and husbandry practices – particularly stocking densities – to prevent escapes and reduce disease spread, parasites, and the amount of effluent discharged into surrounding waters.

2. **All governments** should restrict finfish aquaculture farms from operating within or near existing or proposed marine protected areas. They should also identify representative marine protected areas in affected regions before allocating new aquaculture sites.

3. **Industry** should reduce the dependence on wild species for finfish feed through the efficient use of by-catch and waste from other fisheries/fish plants, sustainably managed stocks and/or plant-based alternatives.

4. **Government and industry** should invest in research regarding the cumulative environmental impacts of aquaculture, including: the acute and chronic long-term impacts of using antibiotics and pesticides; the long-term impacts of acoustic devices on animals; and the impacts of aquaculture activities on migratory species. Investment should also be made to advance land-based re-circulating tank technologies.

CURRENT AQUACULTURE PRACTICES CAN LEAD TO FARMED SALMON BEING FED MORE ANTIBIOTICS PER POUND OF 'LIVESTOCK' THAN ANY OTHER FARMED ANIMAL

From the traditional harvesting of Arctic char (far left) to the commercial catch of capelin (left), fisheries are an important resource for Canadians.

THE RESPONSE: Fisheries

SUMMARY

While there are examples of well-managed fisheries, overall fisheries as a resource is declining in Canada, as it is globally. There are many well-documented cases of major stock collapses in Canada. In some cases, like the Pacific coho and herring fisheries, the stocks have returned to pre-collapse numbers. In other cases, such as Atlantic salmon and cod, they have not – and may never – despite long-term fishing moratoria. A disconcerting possibility follows: severe depletions in keystone species may precede an irreversible shift in the fundamental trophic structure of the ecosystem, preventing the recovery of collapsed stocks. This challenges long-held fisheries management assumptions that depleted fish stocks could recover when fishing pressure is removed.

Recent studies have shown that around the world, high trophic level (top predator) species, such as sharks and salmon have been overfished, leading to a shift in fishing effort to lower and lower trophic-level species (species lower in the food chain). For example, since the collapse of the Atlantic groundfisheries, fishing effort in Newfoundland has focused on exploiting lower trophic level invertebrate species such as shrimp and snow crab.

Canada's legislative framework is sufficient to enable sustainable fisheries management. The federal Fisheries Act is one of the strongest examples of fisheries legislation in the world, giving broad regulatory powers and a mandate for sustainability. For example, the Act includes a provision for "no net loss" of fisheries habitat; this provision is meant to ensure that any activity that damages fisheries habitat must offset the loss by the creation or restoration of similar fish habitat elsewhere.

Why then, with such strong legislation, have fish stock declines been so commonplace in Canada? There is a multitude of complex, interacting factors. First, Canada's Fisheries Act is not adequately enforced. There are insufficient funds committed to enforcement, resulting in too few Fishery Observers and Conservation Officers to monitor illegal fishing activities.

Second, it can sometimes be difficult to accurately estimate fish stocks via monitoring and modeling particularly in light of ecosystem interactions. This can be problematic for setting quotas on how many fish can be harvested without causing stock declines.

Third, fishing commonly takes place in coastal areas that are traditionally economically depressed, often with few employment options beyond the fishery. These factors lead to a dangerous cycle: governments historically have subsidized fisheries and encouraged overcapacity, entrenching dependency on the fishery and, inevitably, causing excessive fishing pressure on stocks. Politicians and managers are left with a difficult choice: reduce quotas and cause economic hardship based on uncertain scientific numbers, or maintain quotas (or reduce by less than advised by scientists) and hope for the best. Too often, we have hoped for the best, and ended up with the worst.

MOVING IN THE RIGHT DIRECTION

- In light of the cod collapse of the early 1990s, both fishers and government officials became more aware of the importance of sustainable fishing. As a result, the political will to place complete moratoria on fisheries has increased.

- Emergence, in policy and legislation, of **ecosystem-based management principles** (e.g., Oceans Act, 1997).

CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
Canada's Fisheries Act is one of the strongest examples of fisheries legislation in the world. All jurisdictions officially committed to sustainable fishing and the precautionary approach.	Comprehensive enforcement of key provisions has been lacking. Stock assessments and quotas often still set based on single-species analysis rather than an ecosystem-based approach.	Impacts of fishing the top end trophic species still evident. Shift of fishing effort to lower trophic levels persists. Many stocks not recovering, others continue to decline.

- Emergence of marine protected areas as bet-hedging against uncertainty (e.g., National Marine Conservation Areas – Parks Canada).

- Commitment to the preservation of biodiversity – (e.g., Species At Risk Act)

POTENTIAL BARRIERS TO PROGRESS

- Overall, the **fisheries resource is declining in Canada** – and globally.

- Canada's Fisheries Act is **not adequately enforced**.

- Key marine **habitats continue to be degraded or lost** by activities such as bottom trawling, aquaculture, coastal development, offshore oil and gas development and land-based pollution sources.

- Marine habitats important to fisheries have been **damaged**, such as deep-sea coral beds, nutrient-rich estuaries, kelp forests and sea grass beds.

A Whale of a Dilemma: Solving the Net Entanglement Problem

It's rarely a fishing net that entangles whales – it's more often the vertical lines that connect gear to the surface of the water or lines that connect individual gear like lobster traps.

In the Bay of Fundy, some fishermen are testing innovative means of reducing the risk of entangling whales, especially endangered North Atlantic right whales.

Lobster fishermen are experimenting with reducing the amount of rope between traps, which can ensnare whales as they swim near the ocean bottom. Gillnetters are testing "weak links" gear designed to sever lines if a whale becomes caught.

These important efforts contribute to the challenge at hand: reducing the risk to whales while maintaining sustainable fisheries.

2005 Recommended Actions

Canada's priorities for fisheries management should include reducing the depletion of fish stocks by taking a precautionary approach to setting fishing quotas, protecting essential fish habitats, establishing unfinished marine protected areas for management, and encouraging sustainable fishing practices that minimize by-catch and seafloor damage. Specific actions include:

1. **The federal government** must provide incentives to the fishing industry to encourage selective and less-destructive fishing gears over operations using unselective and destructive gears. For example, studies have shown that switching from prawn trawls to prawn traps reduces the rate of bycatch from approximately 10-20:1 to nearly 1:1.

2. **The federal government** must conduct an environmental assessment of mobile fishing gears (such as bottom trawling), with the explicit goal of restricting their use to appropriate, less sensitive bottom types. For example, trawl use could be restricted in areas of known or suspected coral concentrations.

3. **The federal, provincial and territorial governments** must implement a network of MPAs in all three oceans, with high protection standards (fully protected core, zoned areas with limited use around core) to serve as unfished areas, a recruitment source for rebuilding depleted stocks, and a hedge against environmental change.

STUDIES HAVE INDICATED THAT FISHING PRODUCTIVITY INCREASES WITH THE ESTABLISHMENT OF MARINE PROTECTED AREAS

You do not need to be a Hollywood celebrity to change forestry practices. By supporting FSC products you will be sending a clear message to the forestry industry to help biodiversity.

centre ©Mark Hobson

THE RESPONSE: Forestry

SUMMARY

In 1992, Canada published a national forest strategy, *Sustainable Forests: A Canadian Commitment*, providing a national framework for provincially administered forestry. Yet a decade later, harvest rates still capture nearly every cubic metre of nature's ability to grow wood, logging roads fragment forests undermining ecosystem health, and a protected areas network covering all forest types in Canada remains uncompleted. Exceptional corporate leadership is changing forestry practice in the absence of strong government leadership, sometimes in the face of threatened boycotts of forest products. For example, voluntary independent certification of forest management is expanding to meet marketplace demands and secure market share.

Overall in Canada, there remains a pervading sense that forestry considerations are dominated by the needs of industry – a 'timber-first' approach. Forests need to be understood for their wider ecological and social value, not just economic worth, especially if worth means only wood.

MOVING IN THE RIGHT DIRECTION

- **Protection proposal for 600,000 hectares of BC coastal temperate rainforest** – an area larger than PEI – following unique negotiations among forestry companies, First Nations, environmental organizations, labour, communities and government.

- **Certification of more than three million hectares of forest lands to the high environmental standards of the Forest Stewardship Council:** in BC, Iisaak Forest Resources on Vancouver Island, and in Ontario, Westwind Forest Stewardship and the Tembec-managed Gordon Cosens Forest (see sidebar).

- Joint mapping by the **Algonquins of Barrière Lake** and WWF of key cultural and environmental zones that require protection from logging, in their traditional territory in western Québec.

- **Mapping of high conservation value forest** by two companies, Alberta-Pacific in northeastern Alberta and Lignum in central BC, to help identify which portions of their logging tenures are most important for wildlife conservation.

POTENTIAL BARRIERS TO PROGRESS

- **Cumulative pressure of forestry and oil and gas exploration**, especially in northern Saskatchewan, Alberta and northeastern BC (CPR T15 – Western Boreal Forest) and inadequate co-operation between the two sectors to reduce road-building. **Ray of hope**: Alberta-Pacific's forestry pilot project with the petroleum sector on road minimization.

- **Wood harvest rates determined as an expectation or right**, based on economic needs rather than ecological capability of the forest. Annual allowable cuts should be a residual output of total landscape planning intended to sustain a full range of forest values, such as old-growth forest and protected area networks. For example, in

CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
Commitments to sustainable forest management lack a primary focus on ecosystem health and ecological sustainability. Timetables and targets mostly lacking.	Some innovative practices in place by industry leaders, suggesting the sector can shift to true sustainability, in some cases only in response to threats of consumer boycotts.	Recent positive trends hopeful, but more widespread shift to sustainability needed to adequately address all forest values: First Nation cultures, wilderness, non-timber forest products, protected areas.

Quebec's commercial boreal forest (T3, T17 and T21), there are very few adequate protected areas, and wood supply is so highly allocated that there is little room to establish new ones.

- **Government rollbacks on forest management.** In BC, simplification of the Forest Practices Code and reduction in government staff for monitoring will place more emphasis on corporations to meet high environmental standards. In Ontario, wavering government support for the innovative Room-to-Grow policy, tying new wood supply to new park creation.

- **Insufficient forest management capacity within First Nations**, whose threatened cultures and future development are so closely tied to Canada's forests, especially in most ecoregions of the boreal, taiga and BC forest zones.

Leading the Way

In the boreal forest of northeastern Ontario, Tembec Inc. has revolutionized Canadian forest management. Once, enormous clear-cutting dominated the two-million-hectare Gordon Cosens Forest, but today new patterns of logging prevail. Now, considerable clumps of trees are left standing, serving as wildlife habitat today while alive, as well as tomorrow when dead and later fallen. But beyond these more careful logging practices, large tracts of old-growth forest will be maintained, and a selection of all forest types will never be logged, serving biodiversity conservation by filling gaps in the province's uncompleted network of protected areas. This combination of increased protection and better harvesting has earned Tembec the coveted Forest Stewardship Council logo for voluntarily meeting FSC's high standards of forest management, setting a tremendous precedent for forest management in Canada: the first boreal forest and the largest forest to be FSC-certified in North America, and the first step toward Tembec's pledge to certify all 13-million hectares of its woodlands in Canada to FSC standards by 2005.

2005 Recommended Actions

1. **Companies** should identify high conservation-value forests by 2005, leading to deferral of logging in forest types not currently well-represented in protected area systems (especially in CPRs T15, T17 and T2, adjacent to the forest frontier).

2. **Environment Canada** should amend regulations stemming from the Migratory Birds Convention Act by 2004, ensuring that regional conservation targets are set for bird populations in Canada, and thereby establish a framework for forest companies to manage habitats and monitor bird species in their woodlands.

3. **Provincial forestry ministries** should ensure ecologically sustainable harvest rates that respect non-timber values, whether economic (e.g., tourism), cultural (e.g., First Nations hunting and spiritual grounds) or ecological (e.g., old-growth forests and large unroaded areas).

4. **Recreational forest users and provincial organizations** for hunting and fishing should support road closure on public forest land, as well as restriction of snowmobile and ATV access on logging roads, to help ensure long-term survival of wild forests, as well as fish and wildlife populations in Canada.

5. **The Canadian Forest Service** should develop and champion a 'best-practice manual' for forestry in Canada, adopting recommendations from the 2002 Review of the National Forest Sector Strategy.

6. **Individual and business consumers** should purchase FSC-certified products when buying wood and paper, to reward those companies that voluntarily practice better forest management.

CURRENTLY, AN AREA ALMOST TWICE THE SIZE OF PRINCE EDWARD ISLAND IS HARVESTED EACH YEAR IN CANADA

Cause and effect: (left) Lakeview Generating Station is a Toronto-area coal-fired electricity plant that releases CO_2.

THE RESPONSE: Greenhouse Gas Emissions

SUMMARY

Canada has ratified the Kyoto Protocol, signaling a commitment to reduce national greenhouse gas (GHG) emissions by 6 per cent by 2012. While not considered stringent enough to adequately protect biodiversity, this is still an important first step for a country with the world's highest per-capita emission of CO_2.

Following years of consultation between all levels of government and industry, there is still no national consensus on a strategy to achieve greenhouse gas reductions. As demonstrated in the lead-up debate to Kyoto ratification, there is not even national consensus on the need to address the problem of climate change. So far, the multi-year consultative process to establish a national reduction strategy – the Climate Change Plan for Canada – has only resulted in positioning and forceful lobbying, forcing the federal government to hold further consultations. With the 2003 federal budget allocation of $1.7 billion over five years to address climate change and an international commitment as incentives, the focus should be on tangible initiatives by all levels of government, key sectors and individual Canadians in a national effort to reduce greenhouse gas emissions.

MOVING IN THE RIGHT DIRECTION

- The average Canadian produces five tonnes of greenhouse gas emissions per year by driving, heating their home, using appliances, and other daily activities. The federal government is asking every Canadian to set and meet a personal goal of **reducing their annual greenhouse gas emissions by one tonne.** Many Canadians are joining in by taking advantage of government-sponsored energy audits that help to improve the energy-efficiency of their homes.

- Many large industries have demonstrated that **reducing greenhouse gas emissions through energy efficiency and co-generation also produces financial benefits**. For instance, Alberta-Pacific Forest Industries Inc. recently won the national award for doing the most to reduce its greenhouse gas emissions in the forest sector, and Inco Ltd. reduced its absolute GHG emissions by 8 per cent between 1990 and 2001.

- Ontario will be **phasing out coal-fired electricity generating stations** by 2015 or sooner. Their closure will reduce life-threatening smog and cut the province's CO_2 emissions by almost 50 per cent.

POTENTIAL BARRIERS TO PROGRESS

- Although cost-effective technologies and techniques exist, Canada has a major investment in and structural dependence on fossil fuels; these are politically difficult to break and require visionary capital investment.

- With oil, gas and coal prices not reflecting their real cost to society and biodiversity, and the federal and provincial/territorial governments subsidizing energy-intensive activities, there is no financial incentive to conserve or shift to sustainable alternatives.

- The second-highest emitter of greenhouse gases by province – Ontario – acknowledges that emissions need to be reduced but has yet to develop a strategy.

CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
Commitment is high at the federal level for the Kyoto goal. Exemplary response by some industry leaders and a high level of commitment by municipalities.	Isolated activities to improve energy efficiency underway with leadership potential, but inadequate to meet the Kyoto reduction target, much less the swifter, deeper greenhouse gas reduction target needed to protect nature.	Canada's greenhouse gas emissions have been steadily rising, contributing to the global climate change problem and making the task of reducing GHGs ever-more pressing. A small dip in 2001 may be a turning point.

TABLE 34. CLIMATE CHANGE PLANS: STATUS OF DEVELOPMENT BY PROVINCE*

HAVE DEVELOPED A CLIMATE CHANGE PLAN	CLIMATE CHANGE PLAN IN DEVELOPMENT	NO CLIMATE CHANGE PLAN IN DEVELOPMENT
Alberta	New Brunswick	Newfoundland & Labrador
British Columbia	Nunavut	Ontario
Manitoba	Yukon	
Northwest Territories		
Nova Scotia		
Prince Edward Island		
Quebec		
Saskatchewan		

*This addresses the adoption of strategic *plans*, and may not reflect some reduction targets adopted by provinces.

Ride the Wind in Calgary

In 2001, the City of Calgary launched Ride the Wind™, the first North American wind-powered public transit train fleet. Winners of numerous international and national environmental awards, the City's C-Train light rail transit system is using power from 12 wind-powered turbines as its source of electricity. This makes the C-Train 100% emissions free, and credited with 20,000 tonnes of avoided greenhouse gas emissions due to the selection of wind-generated electricity over coal-fired and natural gas-generated electricity as the power source.

2005 Recommended Actions

1. **The federal government**, with participation of the provinces, should finalize and begin implementing Canada's Climate Change Action Plan in 2003; it must include specific reduction targets and requirements, education and incentives that address the major sources of GHG emissions.

2. **Set legally enforceable standards** to reduce GHG emissions, including: provincially set renewable energy portfolio standards; federal appliance and vehicle fuel-efficiency standards; and tax measures that reduce dependence on fossil fuels and promote renewable energy sources and co-generation.

3. **Deploy federal, provincial and other incentives** to leverage adoption of and investment in energy efficiency in industry and by individual Canadians.

4. **Eliminate direct and indirect incentives/subsidies** for processes/choices that produce greenhouse gas emissions.

106: THE NUMBER OF CANADIAN CITIES THAT HAVE COMMITTED TO IMPLEMENTING CLIMATE CHANGE ACTION PLANS TO REDUCE GREENHOUSE GAS EMISSIONS

(Far left) Without proper action, water pollution, such as E.coli, can affect both biodiversity and human health. (Left) Wind turbine in Toronto.

far left ©Gregor G. Beck; left ©Michael Lee

THE RESPONSE: Air and Water Pollution

SUMMARY

Over the decades, Canada has addressed – on a case-by-case basis – some of the most egregious pollutants. For instance: ozone-depleting chemicals are being phased out under the Montreal Protocol; a handful of persistent chemicals like DDT and PCBs have been banned, and Canada was the first country to sign the treaty banning them worldwide; major emitters of acid rain pollution have complied with provincial regulations; Lake Erie recovered from acute eutrophication when rules limiting phosphates forced major investment in sewage treatment; pulp and paper mills are generally in compliance with regulations limiting highly toxic discharges; and a smattering of pesticides have been banned or restricted because of their demonstrated hazard.

Yet contamination of Canada's freshwater systems – by industrial emissions, municipal waste, runoff from agriculture – persists, often at levels which affects biodiversity. Air quality has deteriorated with increased smog-causing pollution from industrial operations, electricity generation and vehicles, and this also contaminates large lakes and the Arctic. While diminished, acid rain is still a problem for forests, fish and waterfowl, especially given its links to mercury contamination. In addition to hazardous wastes from domestic facilities, tightening of U.S. laws has resulted in enormous trans-border shipments to landfills and incinerators.

Management of air and water resources is a shared responsibility among municipal, provincial/territorial, and federal governments, requiring multiple actions to ensure biodiversity and health is protected. The development of national water quality guidelines, crises such as water contamination in Walkerton, fish kills in PEI, deadly smog events, and contaminants in food may help challenge further action from governments, industries, farmers and individuals. Recent amendments to key federal laws hold promise for addressing the backlog of chemicals and pesticides in commerce for which little or inadequate hazard information is available.

MOVING IN THE RIGHT DIRECTION

- Daimler Chrysler Canada Inc.'s Windsor, Ontario assembly plant switched to a water-based, lead-free primer on their vehicles, eliminating the use of 25 tonnes of lead per year, reducing hazardous lead-contaminated waste by 2.6 tonnes and eliminating lead compounds from the wastewater.

- The Cape Breton District Health Authority is following a pollution prevention plan, which includes new procurement rules aimed at reducing energy and water use, air pollution, and waste, with a special emphasis on mercury.

- Apple growers in Norfolk County, Ontario who adopted advanced integrated pest management techniques, eliminated several highly toxic pesticides and lowered their pesticide use overall. The effort is going national with leadership from the Canadian Horticultural Council.

POTENTIAL BARRIERS TO PROGRESS

- End-of-pipe controls are still the legal and operational approach to pollution, despite lip service to pollution prevention.

- With 23,000 chemicals on the Domestic Substances List and 6,000 registered pesticides, most of which came into commercial use decades ago and have not been formally re-evaluated, analysis paralysis prevails under an 'innocent until proven' guilty regime.

CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
Standard chemical control laws in place in all jurisdictions, addressing some pollutants and some key sources/industries, but no overall commitment to pollution prevention.	Various and varied but neither adequate response for the sheer number of products needing regulation nor addressing root causes.	Improvement in some sectors/contaminants but contamination of freshwater systems, urban air pollution, and emission of persistent contaminants continue to pose a threat to ecosystem health.

- Experience indicates that clear and enforceable environmental targets are needed to drive innovation and progress, and mechanisms are needed to ensure a minimum standard. Efforts to remove 'red tape' and over-reliance on voluntary initiatives can hamper air and water protection.

The Great Toxic Chemical Lake Clean Up

Cleaning up toxic chemicals in the Great Lakes has benefited many species. Levels of many substances, including polychlorinated biphenyls (PCBs) and DDT, have declined over the last 20 years. Herring gull and double-crested cormorant eggs, lake trout, coho salmon and bald eagles all show significantly lower concentrations of these and other toxic chemicals. Phosphorus loadings have also decreased significantly since the early 1980s.

Contaminant reductions throughout the food chain have had many benefits for biodiversity. Populations of *Hexagenia* mayflies, an important link in the aquatic food chain, have recovered. Populations of breeding double-crested cormorants on Lake Ontario increased 400-fold from 1979 to 2000. In Lake Superior, there has been a resurgence in wild lake trout. Still there remain advisories against eating Great Lakes fish because of toxic contaminants.

2005 Recommended Actions

1. **Incorporate pollution prevention/clean production requirements** – not simply controls on specific chemicals – in all relevant federal, provincial and municipal laws. Federal and provincial incentives, tax laws and other financial mechanisms should support and leverage investment in pollution prevention planning, skills and technology.

2. **Using a precautionary approach, relevant federal agencies** should re-evaluate the backlog of industrial and agricultural chemicals against modern standards and with consideration to alternative approaches.

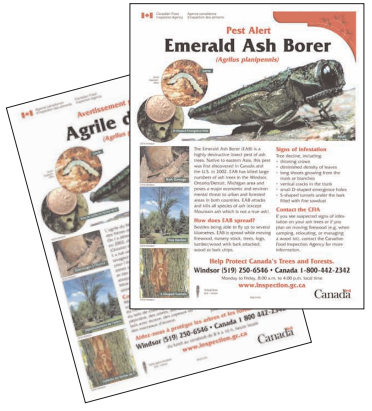
3. **Enforce the legally binding water quality requirements** in provincial and federal (e.g. Fisheries Act) legislation, and comply with all international pollution prevention treaties.

4. **The federal government** should improve monitoring and enforcement of illegal bilge oil discharges from ships.

50,000,000 KG: THE AMOUNT OF PESTICIDE USED IN CANADA EACH YEAR

far left ©William Kalbfleisch; left ©David Cappaert, Michigan State University

Without adequate response, invasive species, from house cats (far left) to the emerald ash borer (left), can have a devastating effect on native species. Recent notices (right) have been circulated in southern Ontario to notify the public about this new pest.



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THE RESPONSE: Invasive Species Control

Invasive species – organisms that are accidentally or intentionally transplanted from one ecosystem to another – are a major cause of native species decline. All of Canada's provinces and territories have ecosystems threatened by invasive species. In 2002, the federal Environmental Commissioner noted that, "studies to date indicate that they cause billions of dollars of damage to Canada's economy every year".

Only recently, it seems, is Canada beginning to acknowledge the huge ecological and economic cost of invasive species. This was a widespread theme in the response we received from both governments and industry in many parts of the country. Although attempts are being made to address invasive species through specific legislation and policies, they generally admitted that these efforts were not comprehensive enough to address all invasive species in their regions or provinces. There was also a sense of futility conveyed by many contacted by The Nature Audit about the complexity of the problem of invasive species, and the (real or perceived) difficulty in eliminating invasive species completely.

These sentiments are well reflected in the December 2002 report by the federal Environmental Commissioner's Report to the Auditor General of Canada. The Commissioner provided the following summation with which The Nature Audit is in full agreement and would extend to most provinces and territories:

"The federal government has not responded effectively to invasive species that threaten Canada's ecosystems, habitats, and other species. Ten years after the federal commitment to prevent their introduction or to control or eradicate them, the number of invasive species in Canada continues to grow. We found that neither the United Nations Convention on Biological Diversity nor the Canadian Biodiversity Strategy has triggered an identifiable change in the government's approach:

- *The federal government has not identified the invasive species that threaten Canada's ecosystems or the pathways by which they arrive.*
- *There is no consensus on priorities and no clear understanding among federal departments or between the federal government and other jurisdictions of who will do what to respond.*
- *The federal government has not established the capability to gauge progress on its commitment to deal with invasive species.*

No federal department sees the big picture. There is a bias toward continuing dialogue and consensus building and a lack of practical action to prevent invasive species from harming Canada's ecosystems, habitats, or native species."

MOVING IN THE RIGHT DIRECTION

- Environment Canada is **co-ordinating the development of a national plan** to address the threat of invasive alien species on behalf of the Wildlife Ministers' Council of Canada, the Canadian Council of Forest Ministers, and the Canadian Council of Fisheries and Aquaculture Ministers. A draft plan will be put before these councils for approval by the end of 2003.

CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
Commitments to control invasive species are not yet well established or widespread. Focus is often on control as opposed to prevention and targets only a few invasive species.	By necessity, actions are growing and engaging more sectors. Evidence the threat of the West Nile virus. However, while actions are 'addressing' particular invasive species, they are not effectively 'eradicating' the problem. Efforts are also fragmented among agencies.	Programs and practices have not been effective. Numbers of invasive species continue to grow. Canada appears ill-equipped to deal with putting in place adequate prevention measures. Instead, there is a focus on costly rear-guard actions to control invasive species after they have become established.

- **BC has established an Alien Species Working Group** that is responsible for developing a preliminary Invasive Species Strategy. This will be an integral part of the Province's overall Biodiversity Strategy, for completion in 2004.

- **At some individual parks in Ontario, staff are working on management policies** to identify and address issues related to specific invasive species.

- **The Canadian Food Inspection Agency** is using extensive monitoring to determine whether some **tree-cutting** may be necessary to contain one of the newest alien arrivals – the emerald ash borer in the Windsor area.

POTENTIAL BARRIERS TO PROGRESS

- "Both Transport Canada and Fisheries and Oceans Canada recognize that ballast water and sediment are major pathways for invading organisms, and both departments have participated in national and international discussions on the ballast water issue for more than a decade. Yet **neither has developed or proposed a ballast water quality standard** or criteria for testing ballast water for the presence of alien organisms to ensure that the risk of unintentional introductions of alien species is eliminated or reduced to acceptable levels." (2002 Federal Environmental Commissioner's Report)

- **1,074**: number of interceptions of alien pests made by the Canadian Food Inspection Agency (CFIA) in 2000. Average number of incoming shipments to Canada the CFIA can inspect: only **1 to 2 per cent**.

2005 Recommended Actions

1. **Environment Canada** should complete the national invasive species action plan to which provinces provided input in 2001; produce a draft national plan to address the threat of invasive exotic species for approval in the fall of 2003 by the Wildlife Ministers' Council of Canada, the Canadian Council of Forest Ministers, and the Canadian Council of Fisheries and Aquaculture Ministers. The plan should provide direction on how to deliver a coordinated process for the identification and assessment of invasive species and pathways of invasion, set priorities for action based on risk assessment, and include measures to be taken to address these priorities.

2. **The Federal Government** should provide sufficient resources to develop appropriate inspection protocols and deliver effective inspection and screening of goods being shipped into Canada. This will require, in part, collaborative efforts with the U.S. to develop effective laws and policies to deal with transboundary threats. As noted by the federal Environmental Commissioner, prevention is recognized as the best response. Preventative measures would not be cost-free or stop all invaders, but they are generally considered more practical than reacting to a succession of crises and repairing damage after invaders have become established.

3. **All Canadians** should: not release unwanted pets; research the plant material in their gardens and remove known invasives; not transport firewood long distances to campgrounds and cottages; not transfer bilge water and ensure boat hulls are washed between lakes; put a bell on your house cat's collar.

$30 MILLION: THE ESTIMATED COST CAUSED BY A US BAN ON PEI POTATOES DUE TO THE INVASIVE FUNGUS THAT CAUSES POTATO WARTS

The Garry Oak ecosystem of the west coast, along with its native flora such as the winter dance seen here, is amongst the most at risk ecosystem from urban development in all of North America.

THE RESPONSE: Transportation and Urban Development

SUMMARY

The Nature Audit recognizes that urban infrastructure contributes to biodiversity loss in a variety of ways. However, this section deals principally with transportation and land development issues.

Much of our urban infrastructure is a shared responsibility. At the federal level, Canada has the goal to develop sustainable communities and to reduce greenhouse gas emissions through transportation efficiency. In some cases, there is provincial/territorial legislation and/or developing policies supporting this national goal. It is at the municipal government level where many programs are implemented, as much urban development and transportation infrastructure and decisions fall under local government management.

As a result of this complex governance model, the response across Canada to issues pertaining to urban development varies considerably. Two key issues that continue to threaten biodiversity however, are applicable across Canada. The first pertains to the constantly increasing area under development pressure. While there has been long-term discussion of greenbelts to contain the sprawl of major centres, few cities in Canada have successfully implemented these strategies. As a result, within our southern Conservation Planning Regions, Canada continues to sprawl over both natural areas and rural agricultural landscapes. Unfortunately, many of the areas facing the greatest pressure from urban sprawl are also the areas with high agricultural productivity, high biodiversity and, frequently, areas with large concentrations of species at risk. With few exceptions, governments have generally failed to successfully deal with the need to contain urban growth within fixed boundaries.

The second issue pertains to the rapid proliferation of roads, both in the north – where, for example, logging roads provide new and often permanent access to formally remote areas – and in urban areas, where the desire and funding to build new and expanded roads vastly exceeds investment in public transit. Both of these elements will need political leadership to restrict urban and rural sprawl and shift transportation priorities to public transit.

Recently, there has been interest in some provinces in 'Smart Growth' principles, notably Ontario and BC, but few concrete examples of these principles are apparent on the ground. In Canada, non-government organizations, some municipalities and progressive developers are leading the way in tackling the issue, leaving provincial and federal governments to play catch up with meaningful actions.

MOVING IN THE RIGHT DIRECTION

- To help present solutions to this complex issue, the Federation of Ontario Naturalists recently published a book, entitled **"A Smart Future for Ontario: How to Protect Nature and Curb Urban Sprawl in Your Community"** (available at www.ontarionature.org).

- In December 2001, **Ontario passed The Oak Ridges Moraine Conservation Act** (which received unanimous support of the legislature) and approved the associated conservation plan in April 2002. The Oak Ridges Moraine case became the litmus test for Ontario in dealing with sprawl, and helped to launch a province-wide government initiative on 'Smart Growth' which is currently underway.

- In its effort to sustainably manage travel between Vancouver to Whistler, the City of Vancouver's bid to host the 2010 Winter Olympic Games plans to optimally **utilize the existing transportation network** through traffic flow management, dedicated routes, the elimination of parking, and a heavy reliance on present rail, surface and sea transit vehicles. The Games will also be an

CANADA'S OVERALL RESPONSE

COMMITMENTS	ACTIVITIES	OUTCOMES
Traditional lack of provincial/federal support for municipalities, municipal planning and public transit; historically, provincial and federal governments have deferred planning decisions to municipalities, which frequently failed to address ecosystem protection and sustainability issues.	Some progressive developments and planning exist locally/regionally; recent political interest in some jurisdictions in ecosystem-based planning and greater support for public transit; rapidly growing public concern about impact of sprawl is leading to greater political awareness and actions.	With few exceptions, and now with close to 80 per cent of the Canadian population living in urban centres, governments of all levels are only just beginning to respond to environmental impacts of sprawl and proliferating road networks.

opportunity to showcase leading-edge clean technologies in transit vehicles.

- In recent months, three levels of government in Ontario have been announcing more funding for public transit, related in part to the federal Climate Change Action Plan.

POTENTIAL BARRIERS TO PROGRESS

- **The fall 2002 Report of the Prime Minister's Caucus Task Force on Urban Issues** called for a national strategy prioritizing affordable housing, infrastructure and transportation. There was general disappointment when the federal 2003 budget **did not provide adequate funding to these priority areas.**

- **Continued lack of cooperation between different levels of government** to provide meaningful protection for natural areas, agricultural lands and sustainability concepts.

- **Continued public demand for large vehicles and houses**, distant from work places, and lack of awareness of the connection between human health and ecosystem health.

Biodiversity in Our Backyards

While many urban areas are classified in The Nature Audit as critically disrupted, some species have hung on and even returned to remaining green spaces scattered throughout our cities. Though the scale of our analysis did not allow for the finer-scale contributions of biodiversity-friendly gardens, community parks, restored wetlands and streams, citizens in many urban areas have begun to take steps to reducing the footprint within our urban areas. Canada's largest city, Toronto, stands as an example of these sorts of grassroots initiatives. From gardens filled with native species to the formation of task forces to bring back our rivers, the citizens of Toronto have actively begun to try to reduce their pressures on biodiversity.

2005 Recommended Actions

1. By 2005, **implement ecosystem-based land-use plans** in southern Ontario, Quebec, British Columbia and Alberta that identify and protect systems of core and corridor natural areas across the regions, and promote ecosystem sustainability. Three key actions to be employed in implementing such plans include: i) immediately freeze urban boundaries and direct growth to within existing urban areas; ii) impose a moratorium on new or expanded multi-lane highways or equivalent municipal roads until 'big-picture' plans are in place to (a) protect natural and agricultural areas; and (b) support increased public transit systems; and, iii) provide support and incentives to private landowners in high-value natural areas threatened by urban sprawl to participate effectively in stewardship actions, and encourage the acquisition of high-priority sites.

2. **Effectively restrict public access to transportation corridors** such as seismic lines, industry access roads, and pipeline and energy corridors. Widespread access via these corridors leads to increased human presence in remote areas, causing added pressure on biodiversity.

THE RESPONSE:

Summing it Up

This first edition of The Nature Audit has sought to detect how Canada is performing regarding its commitments to conserve nature. Overall, three important conservation strategies have emerged; these can be summarized as "protect, manage and restore," and in most regions of Canada, they need to be used in varying combinations to address differing conservation needs.

1. PROTECTION FIRST: Opportunities to protect intact landscapes and wildlife populations before widespread development occurs.

Most opportunities to protect nature on a large scale are in Canada's northern terrestrial and marine Conservation Planning Regions (CPRs), where the overall signal is one of cautious optimism. Aboriginal organizations and communities (Table 35) are playing leadership roles and sometimes stepping ahead of federal or territorial governments to identify and reserve large areas for protection, in advance of development. Recent protected areas announcements by the Deh Cho First Nations in the Mackenzie Valley are testimony to this conservation-first principle. Quebec, too, has recently moved to create new northern protected areas, and Parks Canada is negotiating some new northern national parks. These actions contrast with recent statements by the Yukon Government to place protected areas planning 'on hold'.

TABLE 35. PROTECTING NATURAL CAPITAL: OPTIONS TO APPLY THE CONSERVATION FIRST PRINCIPLE

Recent actions	More effort required in	Involvement required from these sectors
Federal: Parks Canada	Yukon	Oil and gas
Northwest Territories	Labrador	Mining
Deh Cho First Nations		Hydro-electric development
Province of Quebec		

©Lu Carbyn

A swift response: continued recovery actions are needed to ensure the long-term survival of species in Canada like swift fox, seen here in its native prairie habitat.

The qualifier to this optimism is that species groups in most of these regions are showing early signs of decline. As well, in parts of the Yukon, Northwest Territories, Quebec, Labrador and northern British Columbia, options to protect intact natural habitat are foreclosing as oil, gas and mining developments expand. With climate change impacts already detected and toxic chemicals entering northern food chains, increased conservation attention in the country's north is warranted. Fortunately, most areas still remain in a relatively healthy state, but as these trends indicate, conservation will not be well served by complacency, even in remote areas.

2. MANAGEMENT: Areas where protection of remaining natural habitat is urgent and where sustainable best management practices need widespread adoption.

Sizeable areas of intact natural habitat remain across central Canada's forested regions and offshore in rich Atlantic and Pacific fishing grounds. However, in some regions, protection options are disappearing as industrial activity expands. It will be vital for governments to find ways to direct incentives towards higher, more sustainable standards – especially where cumulative impacts are high as the result of multiple industries operating on the same land base. Particularly worrisome, few new large marine or terrestrial protected areas were established in the past two years in this vast area, excepting a few Quebec forest reserves (Table 36).

Sustainable management practices are needed in areas surrounding protected areas; without them, ecological integrity will almost certainly continue to decline. At the time of publication, two significant developments

highlighted both the challenges and opportunities for implementing sustainable practices. In the first case, the federal government closed most remaining commercial cod fisheries, as stocks in the Gulf of St. Lawrence and northern Newfoundland showed continued collapse. With each successive closure, the same questions arise: is the response too little, too late? Lack of political will to implement strong restrictions has long been a challenge confronting conservation biologists and local communities trying to persuade governments to invoke the precautionary principle and to avert subsequent crisis management.

TABLE 36. MANAGING NATURAL CAPITAL SUSTAINABLY ALONGSIDE PROTECTED AREAS

Recent actions	More effort required in	Involvement required from these sectors
Province of Quebec	Atlantic waters, especially on the Scotian Shelf (M3)	Forestry
Federal: Parks Canada	Pacific waters (especially M13)	Fisheries
Tembec's FSC Certification in Ontario	Boreal forests in Alberta and Saskatchewan (T15)	Oil and gas Mining Hydro-electric development

TABLE 37. RESTORING AND RECOVERING NATURAL CAPITAL

Recent actions	More effort required in	Involvement required from these sectors
Most examples are local, community-based initiatives	Great Lakes waters	Agriculture
	Bay of Fundy, Gulf of Maine	Transportation
Examples of regional Initiatives include: • Oak Ridges Moraine Conservation Plan and Act • Smart Growth BC • Backyard and schoolyard naturalization programs (e.g., Evergreen Foundation)	Broughton Archipelago, BC	Urban development
	Fraser Valley, BC	Aquaculture
	Regina Plain, Saskatchewan	Fisheries
	Southwestern Ontario	Oil and gas
	St. Lawrence Lowlands, Quebec	Mining
	Prince Edward Island	Hydro-electric development

In contrast, some companies, notably in the forest sector, are adopting voluntary management standards that surpass government guidelines and are expected to produce a lower forestry footprint. In April, 2003 Tembec Inc. announced that it had been awarded a certificate by the independent Forest Stewardship Council for sustainable management of its Gordon-Cosen's forest – a two-million-hectare licence in Ontario's boreal forest. This is testimony to the sizable contribution that voluntary implementation of best practices can make on the landscape. Tembec has further committed to certifying all 13 million hectares of its woodlands in Canada by 2005.

3. RESTORATION AND RECOVERY: Areas where opportunities to protect unaltered habitats are rare; restoration and recovery are needed in conjunction with sustainable best management practices (Table 37).

The terrestrial, marine and coastal landscapes of southern Canada – the Fraser Valley of BC, the prairies, the Great Lakes-St Lawrence region, and the Maritimes – are the most altered areas in the country. Overall, the conservation response here is weak relative to the challenges – in most cases, agencies and industry are only just beginning to identify practices and regulations that can soften our footprint on nature.

For example, few national or other effective measures exist to: monitor the rapid growth of the aquaculture industry, prevent new species invasions from entering Canada, or to review and regulate toxic substances. Signals may be improving for species recovery, but the need to protect and/or restore their habitats – a critical element of any recovery strategy – has rarely been adequately addressed. Urban issues have become conservation issues, especially with respect to the pervasive problem of sprawl – one of the major threats to nature in southern Canada. Agriculture, the dominant land use in these regions, is still highly dependent on synthetic pesticides and fertilizers. Despite the growth of the organic market share, organic farming practices are not widely applied in Canada and governments are not stepping forward with incentives or policies to help farmers and consumers transition to them.

Conservation issues are undeniably complex in the south; however, the urgency remains high as species groups continue to decline, and in many places human presence on these lands and waters is intensifying. While Canada shares many of these regions with the United States, they are rarely better off south of the border - in fact, for some shared CPRs, the best conservation opportunities are found in Canada.

Cross-Cutting Actions for 2005

This section of The Nature Audit outlines individual actions that governments, industry and Canadians need to undertake for Canada to make further progress towards meeting its stated conservation commitments. In preparing these actions, a number of common themes and cross-cutting issues emerged. These in turn indicate a need to re-think and challenge how conservation programs are delivered and the proper sequencing of actions taken, especially where species and pressure indicators provide evidence that current conservation efforts are not sufficient to meet the need. The following cross-cutting actions need to be completed by 2005:

Biodiversity information in Canada needs improvement. The process of producing The Nature Audit unearthed a widespread concern for the inadequacy of information of both historical and current information regarding wildlife, habitats and human activities in Canada. Environment Canada, in its own recent 'Environmental Signals' Report (2003), stated that *"Canada does not have a reliable baseline against which to measure habitat loss…Little is known about most of Canada's species. In many cases, the status of species is at best an educated guess."* Key initiatives needing political support among the governments of Canada include support for training taxonomists, resources for field surveys for both well-studied and lesser known species groups (especially plants and invertebrates), and development of shared and accessible databases which incorporate traditional knowledge.

Canada needs to do a better job of setting standards and monitoring progress. In ratifying the United Nations Convention on Biological Diversity, Canada committed to setting conservation goals and standards, against which it would then monitor and report on progress. To date, measurable conservation standards are lacking in relation to stated goals, which has led to a poor framework for effective implementation and monitoring. Canada needs to improve its record in setting clear and quantifiable standards supported by timelines, and must follow up by monitoring outcomes.

Financing for biodiversity conservation must increase…creatively. There is unquestionably a need for additional resources to be directed to biodiversity conservation, including for protected areas, wildlife management and pollution reduction. But the cumulative pressures outlined in The Nature Audit cannot be addressed by simply throwing more money at the problem. Indeed, when the problem is that economic measures actually cause biodiversity degradation, the cost-effective approach is to eliminate the disincentives to conservation (such as outright subsidies, tax breaks, and international marketing support). Similarly, opportunities should be grasped to make current financial resources do double-duty and promote biodiversity benefits. In the long-term, investing properly in conservation gives us all the best chance of leaving a healthy legacy for our grandchildren, rather than an impossible bill for clean-up, ecosystem restoration and artificially providing the basic services that nature provides – our own life support system.

We'll be watching: World Wildlife Fund Canada will be on the lookout to ensure that species, such as this great horned owl, get the protection they require and that Canada is meeting its commitments to protect biodiversity.

The precautionary principle should be built into all wildlife management strategies. Continued decline or even collapse of wildlife populations and habitats usually results from hesitation by governments and society to restrict or limit the exploitation of resources, control the use of toxic chemicals or take prompt preventative actions to limit the introduction of new invasive species. Accepting the counsel of biologists and a greater willingness to show political leadership on biodiversity conservation are both needed. The financial costs alone of ignoring the precautionary approach are mounting rapidly.

New initiatives by industry to adopt higher voluntary standards of practice are needed. The greening of the market place provides the consumer with an opportunity to support better conservation practices in the field through the purchase of "green" products. Where independent, certified standards are present that result in the delivery of a softer footprint by that industry sector, Canada needs more industry leaders stepping forward to promote wider adoption of the standards. Examples of such standards include organic agriculture, the Forest Stewardship Council and the Marine Stewardship Council. By 2005, much higher adoption rates of these certified standards are needed.

A greater emphasis is needed on enforcement of existing regulations. Industrial compliance with regulations and management practices, as well as operations in the field, are coming under less public scrutiny. As governments cut back on auditing services, voluntary reporting is not sufficient to ensure that minimum standards are being met. Resources to support field investigations, spot audits and review of management plans need to be at least maintained, or increased.

The pace of establishing new protected areas must increase. In the 1990s, while Canada's land-based protected areas systems added or expanded more than 1000 new parks and reserves, only one marine protected area was designated. Simply put, the pace of designating MPAs has been abysmal. Governments have failed to meet the 1992 commitment to 'accelerate the protection of areas representative of Canada's marine natural regions,' let alone make progress on Canada's 2002 commitment to complete a representative system of marine protected areas by 2012. The pace of protection must significantly increase. On land, despite some excellent progress in northern regions of Canada, few protected areas of any size were established in the past two years. Options to move forward are being lost with each year of delay, especially in the boreal forests of Canada (notably T15, T17 and T21).

Conservation is an urban issue. More attention needs to be directed at urban municipalities with regard to land-use planning, transportation, major sources of air and water pollution, greenhouse gas emissions and entry points for invasive species. In addition, with close to 80% of Canadians now living in urban centers, there is a great need to increase consumer support for purchasing "green" or certified products in the urban market place. Such buying power can help drive the adoption of more sustainable practices in the field.

NEXT STEPS FOR THE NATURE AUDIT:

The second edition of The Nature Audit is scheduled to be produced in May, 2005. Over the next two years, the 2005 action points presented throughout the response section of this report will be the focus for monitoring by WWF-Canada, as The Nature Audit continues to measure progress towards completing Canada's conservation commitments.

SPERM WHALES CAN STAY SUBMERGED FOR UP TO TWO HOURS, DESCENDING OVER 1,500 M BELOW THE SURFACE

Partners and Contributors

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The Spicebush Swallowtail is a spectacular species in southern Ontario. As its name suggests, as a caterpillar, it feeds on the leaves of spicebush, a shrubby understorey plant of now rare Carolinian forests.

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The leatherback turtle is showing declines in both the Pacific and Atlantic Oceans. As a group, sea turtles are among the most endangered reptiles on Earth.

©Nova Scotia Leatherback Turtle Working Group

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