LIVING PLANET REPORT CANADA

2025 WILDLIFE AT HOME

CONTENTS

WWF-Canada's Living Planet Report Canada 2025: Wildlife at Home could not have been developed without the knowledge, expertise and contributions of several individuals and organizations.

Special thanks for knowledge and perspectives from: Abel Aqqaq, Kianna Bear-Hetherington, Annie Buckle, Jared Davis, Ellen Firth and Ross Hinks, in addition to translation services provided by: Roseanne Clark, Eleanor Firth, Robert Leavitt, Suzie Napayok, Arlene Stevens, and Barbara Sylliboy. Indigenous interviews and narratives were conducted and provided by Haley Lewis and Sophie-Claude Miller.

WWF-Canada is grateful for review and support from: Valentina Marconi (Zoological Society of London), Louise McRae (Zoological Society of London), Sarah Otto (University of British Columbia), Ken Paul (Member of the Wolastoqey Nation at Neqotkuk) and Hannah Puleston (Zoological Society of London).

Sincere thanks to all the individuals and organizations who have contributed data to the Canadian Living Planet Index. Your valuable efforts in monitoring, reporting and sharing biodiversity trends are essential for advancing the understanding of the state of wildlife in Canada and are instrumental in shaping a future where people and wildlife can thrive.

Jessica Currie led the analysis, while James Snider provided senior review. Tina Knezevic edited the report.

Core principles and conceptual design of the Living Planet Index were originally developed by the Zoological Society of London and World Wildlife Fund International.

Citation: WWF-Canada. 2025. Living Planet Report Canada: Wildlife at Home. Currie J. & Snider J. World Wildlife Fund Canada. Toronto, Canada.

WWF-Canada, 410 Adelaide Street West, Suite 400, Toronto, Ontario M5V 1S8

© 1986 Panda symbol WWF-World Wide Fund for Nature (also known as World Wildlife Fund).

® "WWF" is a WWF Registered Trademark.

WWF-Canada is a federally registered charity (No. 11930 4954 RR0001), and an official national organization of World Wildlife Fund for Nature, headquartered in Gland, Switzerland. WWF is known as World Wildlife Fund in Canada and the U.S. Published (September 2025) by WWF-Canada, Toronto, Ontario, Canada. Any reproduction in full or in part of this publication must mention the title and credit the abovementioned publisher as the copyright owner. © Living Planet Report Canada: Wildlife at Home (2025) WWF-Canada. No photographs from this production may be reproduced.

All rights reserved. wwf.ca Living Planet Report® and Living Planet Index® are registered trademarks of WWF International.

Cover photo: Snowy owl © Don Getty

01

02

03

04

05

06

A MESSAGE FROM MEGAN LESLIE

> Nature is not a collection of parts, but a living system with each element working together in harmony. When one piece is pushed to the brink, the effects ripple outward.

From towering coastal rainforests, breathtaking mountain ranges and sandy coastlines to icy northern waters, expansive grasslands and rushing rivers, nature in Canada is vast and beautiful — and deeply interconnected.

Nature is not a collection of parts, but a living system, with each element working together in harmony. When one piece is pushed to the brink, the effects ripple outward: the loss of a keystone species can unravel entire food webs and degraded habitats can no longer support the diverse life they harbour. In an interconnected world, damaging one part of nature puts the species and their habitats we all depend on in jeopardy.

Our Living Planet Report Canada (LPRC) 2025 reveals that monitored populations of vertebrate species in Canada have dropped by an average of 10 per cent since 1970. Notably, more than half of the species we have data for are in decline. This is an early indicator that, despite all the remarkable nature we have in Canada, we risk the potential loss of ecosystems and the extinction of species if we don't reverse our path.

But there is still time. By analyzing trends over the last five decades, the LPRC not only gives us a snapshot of how wildlife in Canada is faring, it also gives us the opportunity to correct our course before tipping points are reached.

To meet the challenges of this unique moment in Canadian history, when both nature and the economy face tremendous headwinds, it's important to remember that the two are also interconnected. Nature's rich biodiversity is at the heart of our communities and the foundation of our economies. The ecosystem services provided by nature, from storing billions of tonnes of carbon to supporting Canada's diverse wildlife, supplying clean freshwater, and ensuring food security in remote and northern communities, are incredibly difficult and costly to replace once lost.

The future of wildlife hangs in the balance we create: between protecting biodiversity and advancing economic prosperity. One does not have to come at the expense of the other. In fact, safeguarding nature is critical to meeting both of these objectives.

To do this, we must actively restore and protect habitats that species at risk depend on and advocate for long-term policies and legislation that support both people and wildlife. And we must also ensure this approach is done in a way that respects Indigenous rights and leadership. Practically, this might look like the creation of Indigenous Protected and Conserved Areas, slowing down ships and avoiding certain shipping routes when whales are on the move, or keeping resource extraction away from critical habitats like the calving grounds of barren-ground caribou.

The trends shown in our most recent LPRC are nature's warning light. WWF-Canada's plan to Regenerate Canada provides a roadmap to repairing the invisible threads that quietly hold life together. Now is the time to act, together, to build a Canada where wildlife, nature and people thrive.

MEGAN LESLIE

President and CEO
World Wildlife Fund Canada

Bison © naturepl.com / Todd Mintz / WWF

A MESSAGE FROM JAMES SNIDER

The latest Canadian Living Planet Index used the most robust dataset yet, giving us the sharpest — and starkest — picture of wildlife loss in Canada to date.

The Living Planet Report Canada (LPRC) 2025, our periodic snapshot of domestic wildlife population trends, comes at an important point in time, a mere five years from the 2030 deadline for targets set in the Kunming-Montreal Global Biodiversity Framework and enshrined in Canada's 2030 Nature Strategy.

While this series of reports is not designed for year-to-year comparison, each snapshot gives us a clearer picture. The latest Canadian Living Planet Index used the most robust dataset yet, giving us the sharpest — and starkest — picture of wildlife loss in Canada to date.

The average size of monitored vertebrate populations declined by 10 per cent from 1970 to 2022. This is the most severe decline we've observed since reporting started.

It's a striking finding that for many in Canada may come as a surprise: not only is wildlife loss happening here, but it's also getting worse. It's happening in a country that prides itself in the vast nature we call home, a country with the longest shorelines and largest tracts of intact forests in the world, with 25 per cent of the world's wetlands and 20 per cent of its freshwater.

Even here, wildlife trends are going in the wrong direction. While the year 1970 is not necessarily a high point for biodiversity in Canada — we know that historical declines occurred before this baseline year of modern recordkeeping — our report finds more than half of the species studied are declining in the 52-year study period.

The average decline is just that, an average, meaning some species are doing better and others are doing far worse. In grassland habitats, wildlife populations declined by 62 per cent on average. In forests, mammal populations have declined 42 per cent on average. For species of global conservation concern, those found on the IUCN Red List of Threatened Species, populations have declined by 43 per cent, on average, in our study.

These findings clearly show that more needs to be done to halt and reverse the loss of biodiversity. But at a time when wildlife and their habitats need more protection, they're getting less.

In response to increasing geopolitical and economic uncertainty, Canada has embarked on a drive to develop more infrastructure, including major new extractive projects that will put more pressure on our forests, wetlands, grasslands, marine and coastal ecosystems. The species that call them home — some of which are already at risk of extinction — are in greater peril as legal protections across the country are systematically weakened by broad exemptions to laws such as the federal Species at Risk Act and changes to Ontario's Endangered Species Act.

As Canada focuses on rapid development, the findings here underscore the importance of creating collaborative strategies that support economic sovereignty and strengthen our resilience, while also protecting and restoring the ecosystems we rely upon. Following five decades of persistent declines in wildlife populations, and with just five years to meet targets set in the Global Biodiversity Framework to a more sustainable future, now is not the time to walk back the protections for wildlife and habitats. Rather, we have a growing responsibility to scale up efforts to restore, protect and steward what remains of the critical habitat that our wildlife calls home.

JAMES SNIDER

Vice-president, Science, Knowledge and Innovation, World Wildlife Fund Canada

REPORT HIGHLIGHTS

WWF-Canada's Living Planet Report Canada found persistent wildlife declines over the last half century. Monitored vertebrate populations in Canada have declined by 10 per cent, on average, since 1970.

The Canadian Living Planet Index is an average — some species are doing better while others are faring far worse, with patterns differing across habitats. On average, monitored populations of grassland species declined by 62 per cent, while forest mammals have declined by 42 per cent over the last five decades.

Monitoring the abundance of wildlife populations over time is important for informing conservation actions and tracking our progress.

Nature is an important part of Canada's economy. Canada must balance economic growth with conservation and use an approach that upholds environmental safeguards, respects Indigenous rights and integrates nature in decision-making.

Pacific leatherback sea turtle © Shutterstock

TRACKING PROGRESS TOWARD BIODIVERSITY GOALS

01

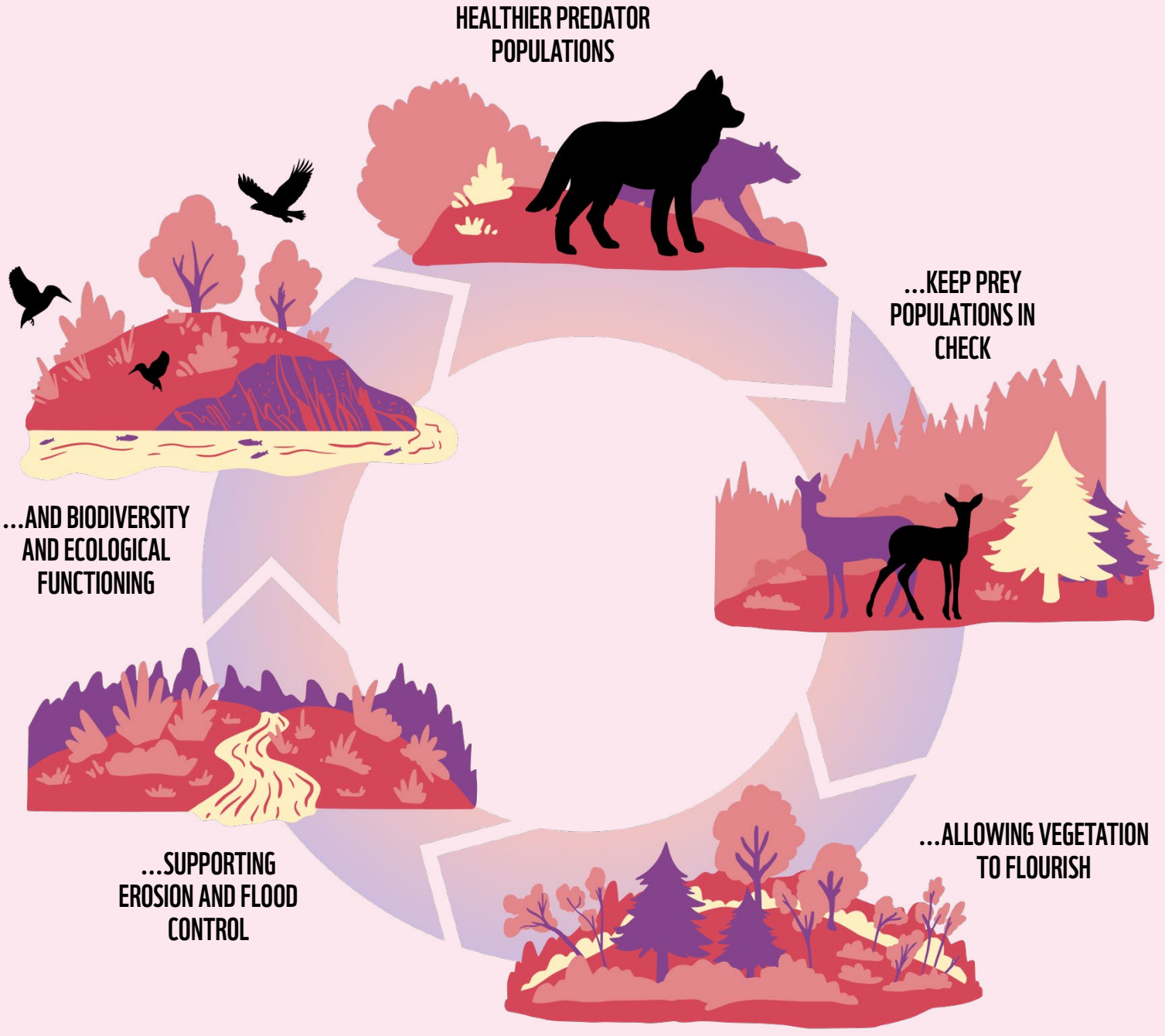
Across Canada's vast boreal forests, grasslands, freshwater, peatlands and marine areas, upwards of 80,000 species of plants, animals and fungi call Canada home.[1] All of this nature — in Canada and around the world — is deeply interconnected, with every species, habitat and ecosystem playing a role in maintaining ecological balance.

Species interact in complex ways to support ecosystem function and services that humans rely on and benefit from. For example, pollinators, such as bumblebees and butterflies, help plants reproduce, strengthening the food web — including our food systems — while also supporting carbon sequestration and air and water purification. Similarly, predator–prey dynamics, such as those between snowy owls and lemmings or sea otters and urchins, highlight species' dependencies on one another for survival. But human activity, such as land use and land-use change (i.e., habitat loss), climate change and overexploitation have disrupted these natural relationships, creating cascading and compounding effects for nature worldwide.

In Canada, 850 species (and/or populations of species) have been assessed as Endangered, Threatened or Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), with an additional 47 already considered Extirpated or Extinct (as of 2025).[2] Not only does this list continue to grow — due to a variety of factors, including broader coverage of species' assessments — but many species on it, including those afforded protections under the Species at Risk Act, also continue to show limited progress toward recovery objectives.[3] While the interconnectedness of nature means that threats can impact nature in complex ways, understanding of these relationships can simultaneously lead to the development of integrated solutions that maximize benefits for multiple species, systems and ecological functions.[4]

INTERCONNECTEDNESS OF NATURE

Inter-species relationships are a cornerstone of all ecosystems. These relationships shape the functioning, stability and dynamics of ecosystems by maintaining biodiversity, energy flow and nutrient cycling. These interactions are vital for ecosystem health and resilience. When an ecosystem is both varied and balanced, it is healthy, and we all benefit.



Atlantic puffin colony © Sarah Pietrkiewicz/ WWF-Canada (Hive)

KEY TERMS

Biodiversity: The variability among living organisms, from plants to animals, as well as the habitats in which they live. Biodiversity includes diversity within the same species (genetic diversity), between different species and between ecosystems.

Converted lands: Lands that have been converted from natural ecosystems (e.g., forest, wetland) into human-dominated landscapes (e.g., agricultural land, urban areas).

Degraded lands: Natural ecosystems that have reduced ecosystem functioning due to human activity, but nevertheless remain categorized as forests, wetlands, grasslands, shrublands, lichen or barren land (e.g., a polluted wetland).

Keystone species: A species that has a disproportionately large effect on the ecosystem. Removal of the species would have drastic impacts for other species.

Living Planet Index: A biodiversity indicator that tracks patterns of vertebrate abundance over time. Trends in abundance indicate how well monitored vertebrates are doing overall.

Population abundance: The number of individuals of a particular species in a defined area.

Population time series: A single species may be made up of many different monitored populations that all contribute to the average national trend for that species. For example, wood turtles are found in Ontario, Quebec, New Brunswick and Nova Scotia, and the population time series in all locations contribute to the species' national trend. "Population time series" refers to the wildlife population data included in the Canadian Living Planet Index database.

Taxonomic groups: In biology, species are grouped together into taxonomic groups based on shared characteristics. For the Canadian Living Planet Index, species are grouped into the four different vertebrate groups: birds, mammals, fish and amphibians/reptiles.

THREATS

- URBAN DEVELOPMENT
- AGRICULTURAL ACTIVITY
- ENERGY PRODUCTION AND MINING
- SYSTEM MODIFICATIONS
- POLLUTION
- CLIMATE CHANGE
- TRANSPORT
- BIOLOGICAL RESOURCE USE
- HUMAN INTRUSIONS AND DISTURBANCE
- INVASIVES AND DISEASE
- NATURAL DISASTERS

KEEP AN EYE OUT FOR

- KEYSTONE SPECIES

LADDERING UP: GLOBAL BIODIVERSITY FRAMEWORK

The Kunming-Montreal Global Biodiversity Framework (GBF) — signed at the 15th Conference of the Parties (COP15) to the UN Convention on Biological Diversity (CBD) in Montreal in December 2022 — is the most recent global framework that aims to halt and reverse nature loss by 2030. This historic commitment to biodiversity involves four goals and 23 targets and was agreed upon by 196 member nations.

The targets focus on a range of priorities, from protection to restoration to financing biodiversity action, while also highlighting the need for a rights-based approach that respects Indigenous rights, title and knowledge. To meet the targets in the GBF, each country is responsible for coming up with a National Biodiversity Strategy and Action Plan (NBSAP). NBSAPs, such as Canada's 2030 Nature Strategy and associated commitments such as the proposed Nature Accountability Act (Bill C-73) introduced in 2024, ensure that a country continues to take action if governments and priorities change. Canada was among only 34 member countries to submit their NBSAP before COP16.

Key components of Canada's 2030 Nature Strategy include protecting 30 per cent of lands and oceans in Canada by 2030 and restoring 30 per cent of degraded lands in the same timeframe. Canada has also committed $200 million to an international biodiversity fund, and Quebec became the first subnational government to contribute funds at $2 million — an important step, given that much of the implementation of NBSAPs will need to be supported by provinces and territories.

Another vital aspect of the GBF is recognizing the importance of Indigenous Peoples and their relationship to biodiversity. Indigenous Peoples have actively stewarded lands and waters, and their biodiversity, for millennia. The international community recognized this at COP16 in Colombia by giving Indigenous Peoples around the world a permanent seat at the negotiating table in the COPs to come.

As we approach 2030, monitoring and reporting on our progress to the global community will become increasingly vital to ensure that the GBF targets are met.

Coachman's Cove, Newfoundland, Canada © Helen Jones/ WWF-Canada

WHAT IS THE CANADIAN LIVING PLANET INDEX?

The Living Planet Index is a biodiversity indicator used to track the state of wildlife at global, national or local scales. It is used to measure ecological health by tracking patterns in vertebrate relative abundance (population size). The Living Planet Index is based on one of the largest repositories of vertebrate abundance data over time. It was adopted by the CBD as a component indicator to track progress toward the Kunming-Montreal GBF,[5] and as a domestic indicator (coined Canadian Species Index) for Canada's 2030 Nature Strategy aimed at halting and reversing biodiversity loss in Canada.[6]

THE C-LPI AND CSI ARE ONE AND THE SAME

Globally, the Living Planet Index was first published in 1998 and has been updated biennially to track average population abundance of monitored vertebrate species over time.[7] A Canadian version of the Living Planet Index was first released by World Wildlife Fund Canada (WWF-Canada) in 2007,[8] with both methodological and data updates published in 2017[9] and 2020.[10] In 2017, both WWF-Canada and Environment and Climate Change Canada (ECCC)[11] adopted separate modified versions of the global Living Planet Index to monitor aggregate trends in vertebrate abundance. These modified versions, titled the Canadian Living Planet Index (C-LPI) and the Canadian Species Index (CSI), respectively, show similar national and system-level results. In 2024, the two organizations aligned their methods and datasets to improve comparability of results. Importantly, differences among the indicators depend only on the inclusion of new data gathered within interim years of publication — ECCC has committed to a triennial publication, while WWF-Canada's publication dates are variable.

Snowy owl © Don Getty

Cape Beale, Barkley Sound, B.C., Canada © Elaine Leung / WWF-Canada

UNDERLYING DATA

The C-LPI relies on quantitative data collected in a form consistent with Western scientific methods of analysis. Data on trends in species populations were obtained from hundreds of sources and included in the calculation of the 2025 C-LPI. Data were retrieved from peer-reviewed scientific literature, public databases and government assessments (for example, Fisheries and Oceans Canada research vessel trawl surveys and The State of Canada's Birds[12]). Approximately half (910 species) of Canada's native vertebrate species were included in the C-LPI. Time series length, spatial coverage and number of distinct populations differed by species and taxonomic group. The data had broad spatial coverage across Canada's political boundaries, particularly for marine fish and birds.

Criteria for the inclusion of species population data in the index followed the approach of previous iterations of the Living Planet Index as developed by the Zoological Society of London,[13] WWF-Canada[14] and ECCC,[15] [16] with slight modifications for the C-LPI, including all of the following:

- Populations must have been consistently monitored in the same location, using the same method over time.
- Data must be numerical (i.e., a population count or another reliable population-size proxy such as population estimates, spawning stock biomass, density, etc.).
- Species must be native to Canada and have applicable conservation status rank according to Canada's Wild Species Report[17] (i.e., exotic species, hybrids and accidental species under the NatureServe rank of "not applicable" were excluded).
- Population data must be available for at least three years between 1970 and 2022.

In cases where there was spatial overlap of population time series for a given species, only one of the overlapping populations was retained to reduce geographic sampling bias. Priority for inclusion was given to higher quality data as determined by time series length, fullness and credibility of the data source. In calculating the C-LPI, population counts of zero — where a species was not observed in a given year — were treated as missing values, as they are more likely to be missing observations than a representation of local population extirpations.[18] [19] This approach was considered appropriate, given that few of the population time series included in the C-LPI had a zero (or trailing zeroes) recorded as the final numeric data point for the trend — and upon examination, none were considered true zeroes reflective of local extirpation. Finally, to align approaches between the C-LPI and the federal government's CSI, bird data were restricted to time series provided by ECCC. As a result, 12 bird species were excluded as they were deemed nuisance species or because their range expanded into Canada after 1970.

See WWF-Canada's Technical Supplement for additional details and methods, including a transparent evaluation of methodological decisions underpinning the calculation of the C-LPI.

HOW TO READ THE INDEX

The C-LPI is assigned a benchmark value of 1.0 in 1970. An increase in the index represents an increase in average monitored wildlife population abundance since 1970 and would be presented as an upward trend in the index value over time. The magnitude of the change in the C-LPI is reported as a percentage — if the index value increases from 1 to 1.2, that's an increase of 20 per cent. The opposite is true for decreases in abundance: A decrease from 1 to 0.8 is a decrease of 20 per cent. Any finding within 5 per cent of the baseline is considered stable.

In addition, an average of population trends is not synonymous with an average of total numbers of animals lost (Table 1). For instance, a loss of 10 individuals in a population of 20 would have the same proportional loss as a decline of 5,000 from a population of 10,000, but the total number of animals lost differs substantially.

The data underlying the C-LPI change with every iteration of the Living Planet Report Canada (LPRC), including the data sources and assemblages of species. Thus, direct comparisons between reports cannot be made. Instead, the relative change in abundance within a C-LPI can be evaluated among years, rather than across reports.

Wood turtle © Shutterstock

Table 1. What the index does and does not tell us

Characteristics of the C-LPI	Addressing Common Misconceptions
The C-LPI reflects changes in relative abundance of monitored vertebrate populations.	The C-LPI does not reflect species extinctions, though some local extirpations may be captured in the underlying data.
Monitored populations and species show increasing, stable or decreasing trends.	Not all monitored species and populations are experiencing similar trends in relative abundance.
The per cent reported indicates the average change in monitored population size.	The per cent reported does not reflect the number of individual animals lost or gained.
The C-LPI is reflective of species and populations for which suitable data is available.	The C-LPI does not necessarily represent trends for other populations, species or biodiversity more broadly and is likely biased by data availability.
The C-LPI only includes data for mammals, fish, birds, amphibians and reptiles.	The C-LPI does not include plants, fungi or invertebrates.
The C-LPI provides a top-down, national-scale, Western science analysis.	The C-LPI itself does not include Indigenous knowledge or local priorities.

MONITORING IN DIFFERENT FORMS

While the C-LPI is useful for tracking progress toward conservation goals, determining trends in biodiversity, ecosystems and threats requires a multifaceted approach not fully captured by a single indicator or knowledge system. Different indicators for species distribution, habitat quality and genetic diversity, for example, can provide unique insights into the status and health of biodiversity from different angles — while the C-LPI reflects relative change in average abundance of populations,[20] other assessments help support conservation actions to more effectively improve ecosystem and species health.

Just as a range of indicators ensures a deeper understanding of biodiversity trends and their interconnectedness, so does including different knowledge systems, weaving Western science and Indigenous knowledge to expand datasets and analytic perspectives. Derived from generations of observation of and interaction with local ecosystems, Indigenous knowledge encompasses not only species and their behaviours but also their intricate relationships with their environments,[21] which are often overlooked by traditional scientific approaches.

> **Indigenous knowledge: An umbrella term for various holistic knowledge systems held by Indigenous Peoples, including a deep, place-based and historically informed understanding of local ecosystems, biodiversity and stewardship that incorporates cultural, spiritual and social dimensions.**

By weaving these different approaches, a more comprehensive understanding of biodiversity — including historical changes, traditional management practices and ecological insights — can enhance conservation efforts and outcomes.

Waterton National Park, Alberta, Canada © Shutterstock

The Luther Marsh, Southern Ontario, Canada © Shutterstock

DATA SOVEREIGNTY

Since long before Canada existed, Indigenous communities have stewarded their traditional territories, providing deep and comprehensive knowledge about local ecosystems and biodiversity. Transmitted through generations and expanded on over time, this Indigenous knowledge is integral to effective conservation efforts.

Western science-based environmental data about these same territories, however, have historically had relatively short observation and data collection periods, and have been controlled by external entities such as governments, academics and industry without sufficient regard for Indigenous values, interest and rights, including consent over how those data will be used. In addition, the era of "big data" and "open data" not only introduces potential risks to Indigenous communities, but any benefits are unlikely to be equitably shared.[22]

Data sovereignty ensures that Indigenous communities have the authority to decide how data about their lands and waters are collected, used and shared. Developed by the First Nations Information Governance Centre, the basic principles are summed up as OCAP® — Ownership, Control, Access and Possession — and align with the broader principle of self-determination.[23] Data sovereignty allows Indigenous Peoples to exercise control over their traditional knowledge and weave that knowledge with scientific research in a way that respects their cultural values and priorities.

Recognizing and implementing data sovereignty is essential for equitable and effective conservation practices and interacts closely with the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) and FPIC (Free, Prior and Informed Consent) to reinforce inherent Indigenous rights over their lands, resources and knowledge.[24]

While this report focuses on the Canadian Living Planet Index, it also includes a series of interviews to further explore ecological changes and expand consideration of other vital ways of knowing.

> **Etuaptmumk | Two-Eyed Seeing: "Learning to see from one eye with the strengths of Indigenous ways of knowing and from the other eye with the strengths of Western ways of knowing and to using both of these eyes together."[25] – Mi'kmaq Elder, Dr. Albert Marshall**

Indigenous knowledge holder insights are vital in a "two-eyed seeing" approach to inform conservation decision-making. Two-eyed seeing also incorporates the opportunity to integrate the methodologies or knowledge paradigms. However, in these areas of integration, knowledge derived from different knowledge systems may sometimes conflict—perhaps due to short-term versus long-term timespans or local versus national contexts. These areas may take significant work to resolve conflicts but also offer opportunities for innovation.

Burrowing owl © Shutterstock

CANADIAN LIVING PLANET INDEX

02

By monitoring changes in the average size of vertebrate populations over time, the C-LPI provides valuable information on the health of nature in Canada.

While the declines reported in Canada are less drastic than those reported at the global scale,[26] they are nevertheless apparent at national, taxonomic and habitat divisions in Canada. Generally, these changes appear small and gradual each year, but their cumulative impact warrants dedicated and strategic responses to safeguard nature long-term.

Explore different divisions of the data in Chapters 2 and 3 below.

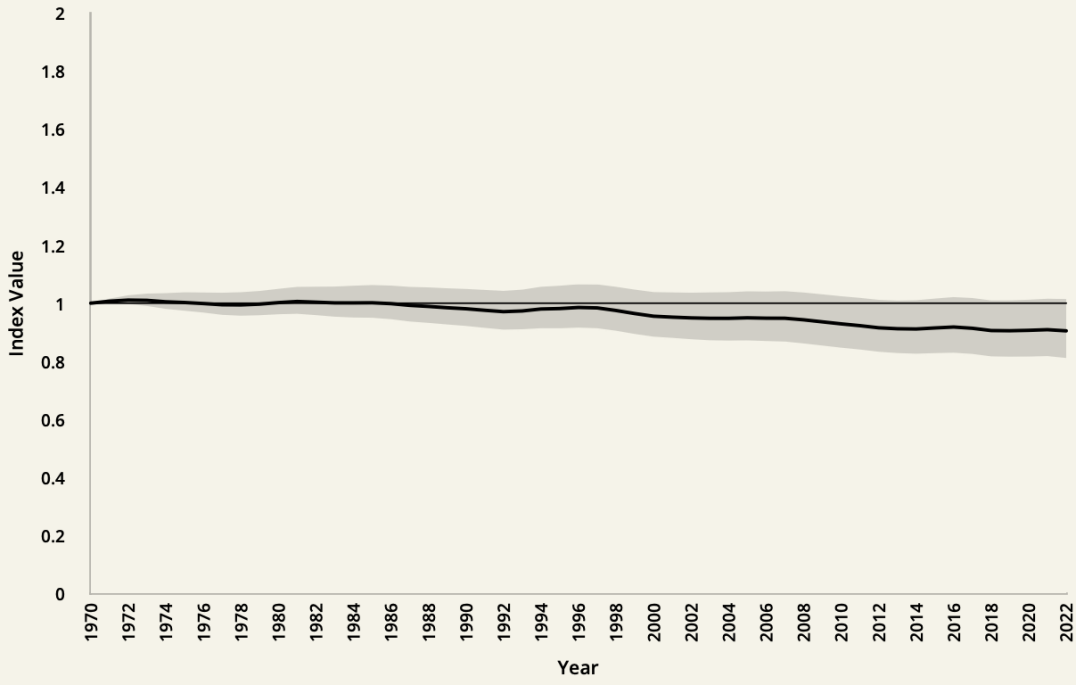
NATIONAL C-LPI

The Canadian Living Planet Index (C-LPI) indicates the average trend in population abundance for 910 native vertebrate species in Canada — more than half of its vertebrate species[27] — and shows an average decline of 10 per cent from 1970–2022 (from 1.0 in 1970 to 0.90 in 2022; Figure 1). The current C-LPI is based on the most extensive dataset to date and therefore represents the most comprehensive picture of biodiversity trends since national reporting began in 2007. Notably, the rate of change from 1970–2010 and 2010–2022 is similar, suggesting that the rate of decline in monitored population abundance isn't necessarily worsening, but that marginal, incremental declines are building over time.

Monitored populations of vertebrate species declined by

▾10%

Figure 1. The C-LPI has declined by 10 per cent (credible interval range: +1 to -19 per cent), on average, from 1970–2022. The index includes 5,099 population time-series for 910 native vertebrate species.



Grey wolf © Shutterstock

THREATS
URBAN DEVELOPMENT, BIOLOGICAL RESOURCE USE

HABITATS
FOREST, ROCKY AREAS

GREY WOLF

(Canis lupus)

The grey wolf is one of the most recognizable animals on the planet, capturing the imagination of people around the world through both stories and science. With its expansive range across Canada, wolves comprise various recognized subspecies, largely identified by a combination of geographic location, genetics, morphological characteristics and ecological role.[28] Stories aside, it is undeniable that the presence or absence of these apex predators has an enormous impact on food webs, in which they play an outsized role as a keystone species.[29] Apex predators bring about changes that have ripple effects in the ecosystem — also known as trophic cascades. As you'll see below, the presence of an apex predator not only impacts its prey and wildlife diversity, but also habitats, soil health, waters and carbon emissions — the ecosystem as a whole. When balanced, biodiversity supports healthy ecosystems.

The history of wolves in North America before European contact is one of reciprocal relationships where these animals played an important role in the cultural, social and ecological fabric of many Inuit, First Nations and Métis groups.[30] After colonization, the relationship between humans and wolves changed, becoming more antagonistic as wolves began to be seen as threats to livestock.[31] It is not difficult to find examples of negative cultural connotations stemming from misperceptions, including in stories such as The Three Little Pigs and Little Red Riding Hood. The mass killing of wolves, paired with the loss of their habitats, resulted in a considerable reduction in their range and abundance.[32]

These losses led to unexpected cascading effects in the ecosystems that they once occupied. With fewer or no wolves controlling the size and behaviour of prey populations, such as elk[33] and beavers,[34] these herbivores over-browsed vegetation, which led to erosion and flooding.[35] Where wolves have been reintroduced, however, such as in Yellowstone National Park, in northwest Wyoming, U.S., they have exerted top-down pressure and helped control the herbivore populations and behaviours, allowing plant species to recover.[36]

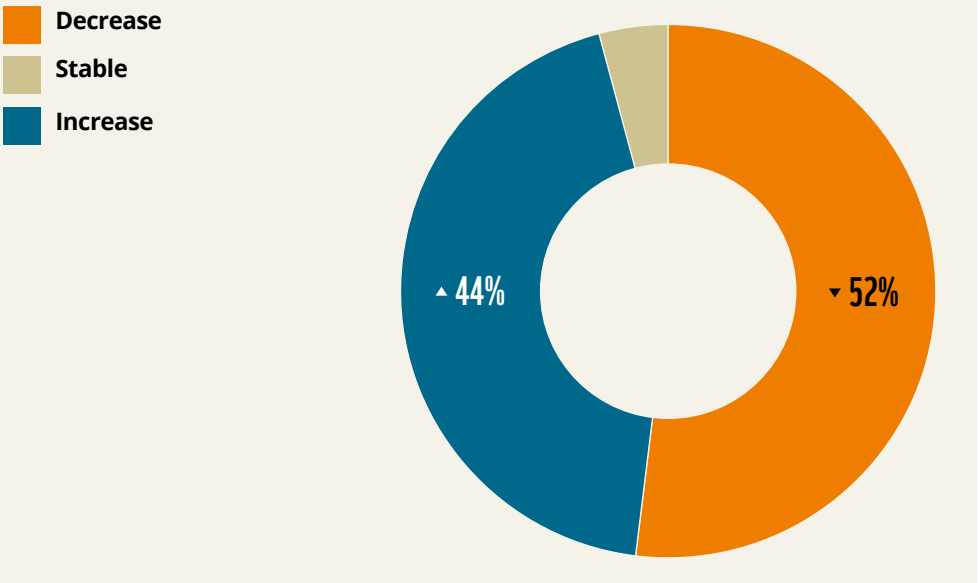
In Canada, trends in wolf populations and the subsequent impacts on ecosystems have varied depending on the region. In urban environments, habitat loss has led to a decrease in wolves and a corresponding increase in species such as white-tailed deer, even when it coincided with an increase in other predators such as coyotes.[37] In more northern regions, wolves have benefitted from linear landscape features created to support human activities, such as roadways and pipelines.[38] These corridors facilitate faster movement and increase access to caribou, which did not previously make up a significant proportion of the wolf's diet.[39] This has led to cascading effects in the ecosystem. While region-specific trends vary, grey wolves still occupy 80 per cent of their original range and are regarded overall as stable.[40 41]

UNDERSTANDING THE NATIONAL TREND

The C-LPI is an average of trends in abundance for monitored vertebrate populations relative to 1970. The aggregated overall trend is a composite of both increasing and decreasing trends in vertebrate populations of varying magnitude and frequency. For example, the Northern leopard frog has a different conservation status depending on where it is found in Canada — three designatable units (DU) are recognized based on genetic distinctions. The Eastern DU, commonly found from Manitoba to Newfoundland, is assessed as Not at Risk. In other parts of the country, habitat loss and degradation, as well as disease, have impacted this species. In B.C., the Rocky Mountain DU has suffered substantial declines in abundance and is considered Endangered, while the Western Boreal/Prairie DU is considered Special Concern.[42]

Closer examination of the C-LPI data reveals that significantly more vertebrate species have declined in abundance on average (475 of the 910; 52 per cent) relative to those that increased (398 of 910; 44 per cent) between 1970 and 2022 (Figure 2). Approximately 4 per cent of species (37 of 910) had stable trends on average (within 5 per cent of the baseline). Variation in trends is anticipated, reflecting asymmetry between increases and declines as a result of anthropogenic change within ecosystems. This is because anthropogenic activity has considerably shifted the natural equilibrium of ecosystems, resulting in both a catastrophic decline in some species in some cases, and significant increases in others. Some wildlife populations have reported declining trends of nearly 100 per cent (e.g., chestnut-collared longspur and Northern myotis), while others have increased by similar or greater proportions (e.g., turkey vulture). It's important to note that within the C-LPI, a species population can only decline to nearly 100 per cent, but can increase boundlessly. For instance, geese and swans have increased by 573 per cent in Canada.[43] Some species whose populations are increasing were the focus of large-scale policy changes such as harvest bans (e.g., bowhead whale), protected area establishment (e.g., whooping crane) or elimination of persistent organic pollutants (e.g., bald eagle); others, such as the Eastern grey squirrel, red fox and raccoon, simply fare well in human-built environments; and still other species benefitted from more targeted conservation action at local scales through, for example, captive breeding and reintroduction as well as habitat restoration (e.g., burrowing owl).

Figure 2: Relative proportion of species with decreasing, increasing and stable trends within the national C-LPI.



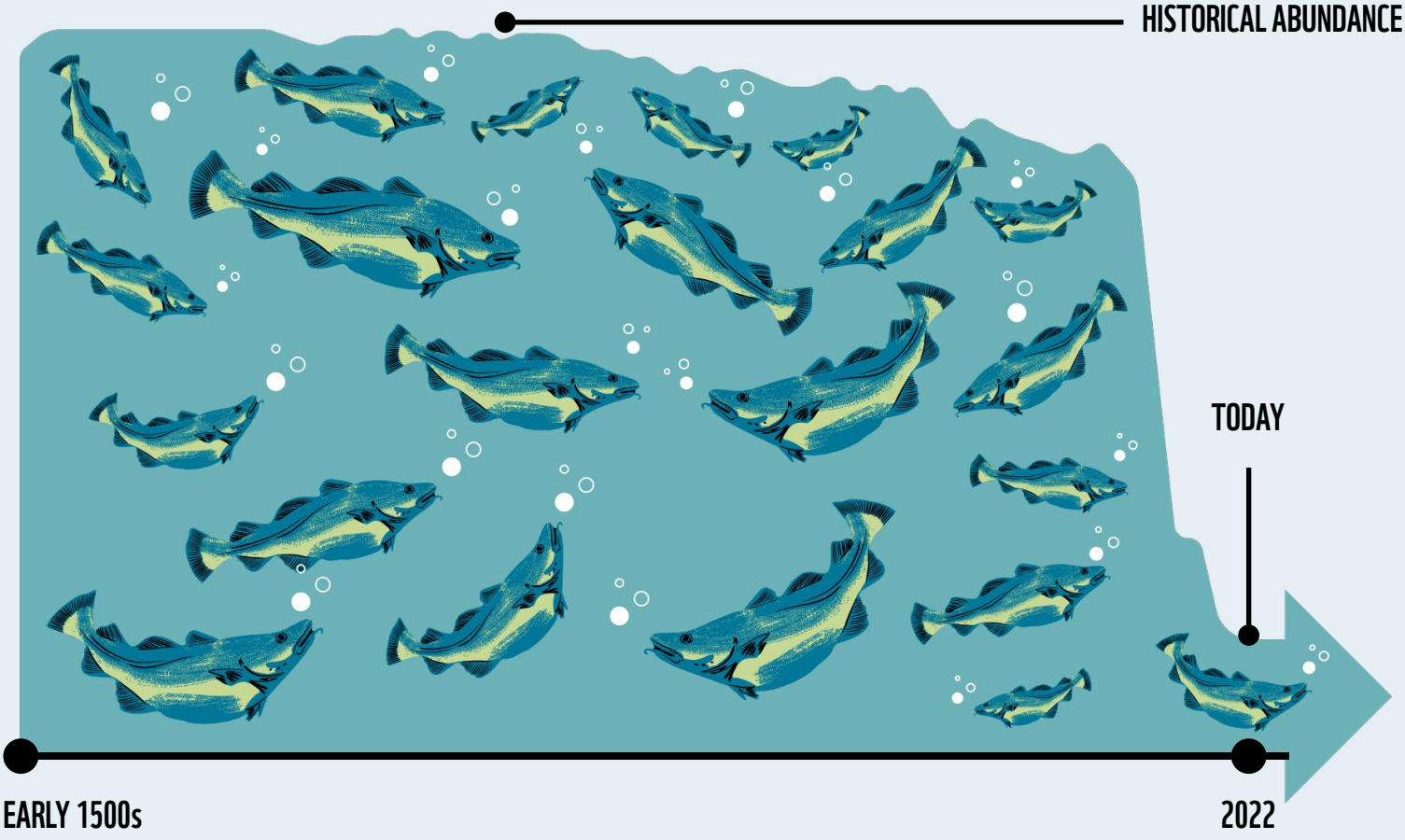
SHIFTING BASELINE SYNDROME

Shifting baseline syndrome (SBS), coined by Daniel Pauly,[44] notes that the baseline by which we judge and determine population trends affects our perception of the current state of ecosystems — in other words, we may believe that populations in the natural world aren't declining at high rates depending on what we consider the baseline to have been. We perceive a loss relative to the standard that we set and consequently lose the knowledge of a less impacted historical state. SBS also highlights the importance of preserving and revitalizing Indigenous knowledge systems and methodologies, where appropriate, and showcasing that knowledge alongside biodiversity indicators to have a clearer picture of historical trends.

In the C-LPI, a benchmark year of 1970 is used as the basis for the analysis of trends in wildlife populations largely due to limited quantitative data before that date. In interpreting the results of the C-LPI, the timeframe of 1970 to 2022 represents a comparatively small and recent analysis of the trends in Canada's wildlife populations. For some of the species included in the C-LPI, a baseline year of 1970 may capture a period of especially low population numbers — an increase from 1970, then, doesn't necessarily mean the population has reached its true historical levels.

SBS was originally applied to fisheries to describe the deterioration of scientists' expectations on marine health and productivity — for example, a fish stock could seem healthy based on recent data, but is actually significantly depleted relative to historic abundance,[45] which has consequences for management (e.g., setting a fishing quota too high). The importance of a long-term view is exemplified by Northern cod (NAFO-delineated Divisions 2J3KL) — formerly one of the world's largest fish stocks.[46] After centuries of overexploitation, the stock had collapsed to such a critical level that the Canadian government declared a moratorium on fishing in the 1990s. A recent study exploring a temporal range of 500 years (1508 to 2019), suggests that, despite variability over five centuries, the Northern cod stock remains at only 2 per cent of what it once was (i.e., its carrying capacity).[47]

The concept extends beyond fisheries. Historically, millions of plains bison (a subspecies of the bison) were once found across the grasslands of central and western Canada. However, they were hunted to extirpation by the late 1880s.[48] Since the 1900s, more than 100 years of bison reintroduction programs have allowed this keystone species to increase in abundance and re-occupy a portion of its former range. These reintroductions happened as recently as 2017, when 16 bison were reintroduced to Banff National Park — after only seven years, the herd had reached 130 individuals.[49] But despite this localized increase in population size, the overall population remains only a fraction of what it once was, occupying a small proportion of its former range. As a whole, plains bison are still considered Threatened in Canada.[50]



WE SHOULD NEVER SEPARATE OURSELVES FROM OUR LANDS AND WATERS

Kianna Bear-Hetherington is a proud Wolastoqey woman from Sitansisk, also known as St. Mary's First Nation, in Fredericton, NB. She grew up swimming and fishing in the lakes and rivers of her community and has always had a deep connection to the land and waters.

Listening to Elders and Knowledge Holders taught her a lot about the sacred relationship with the land and water, such as not to separate ourselves from nature — a teaching that eventually led her to work on fisheries in her community. Through her work with Wolastoqey Nation New Brunswick — the technical advisory body for the six Wolastoqey communities in the province — she has been able to deepen her understanding of her own identity.

Note: The following has been edited for length and clarity.

Bear-Hetherington on the changes she's noticing in the Wolastoq river, the importance of intergenerational knowledge and the value of data

The entire river system and the impact on the whole ecosystem is really clear. I have heard many of our Elders talk about how things used to be — how the river was full of salmon and the land gave us the food and medicine we needed, and how connected we felt to everything around us. And now with the way the river has been altered, that balance has been lost. It's been a real struggle for our communities and for the species that used to thrive here. It's really sad.

I have education in environmental management. I know how this all works. I can't even swim in the waters right in town. And my elders used to talk about how the water used to be so clear. You would be able to see the bottom, and now it's really brown. I know a lot of sewage goes into the water, too, and that is just right up the road from me.

Deterioration of wildlife is a loss of culture

Intergenerational learning is so, so important. And I feel like we've lost that. Changes like colonization and industrial development have had a huge impact on our communities. For generations, our people lived off the land and the river, gathering the foods and medicines from the water.

But now we're seeing a loss of these resources, and many of our people in our community no longer have access to fresh, clean fish, such as salmon. I wouldn't eat the fish that I'm fishing, which used to be a key part of our diet and culture. Now the waters are polluted with chemicals, and it's no longer safe to gather food from the riverbanks like we once did.

On land, you also find the moose with glyphosate — an herbicide that is commonly sprayed in our forests. It's not really safe to eat. We don't really have full transparency of what chemicals are being polluted there and how they have affected our communities' well-being.

Monitoring helps guide decisions and advocacy

Wildlife monitoring and data collection are central to everything that we do. The more information we have, the better equipped we are to protect the land and wildlife. It guides our decisions and ensures we're taking the right actions to protect our territory.

This data also gives us the ability to advocate for stronger protections and to push for policies that align with our values. The data is a tool we used to make sure that our voice is heard, and that our traditional knowledge is being respected alongside that scientific data as well.

Ensuring future generations thrive

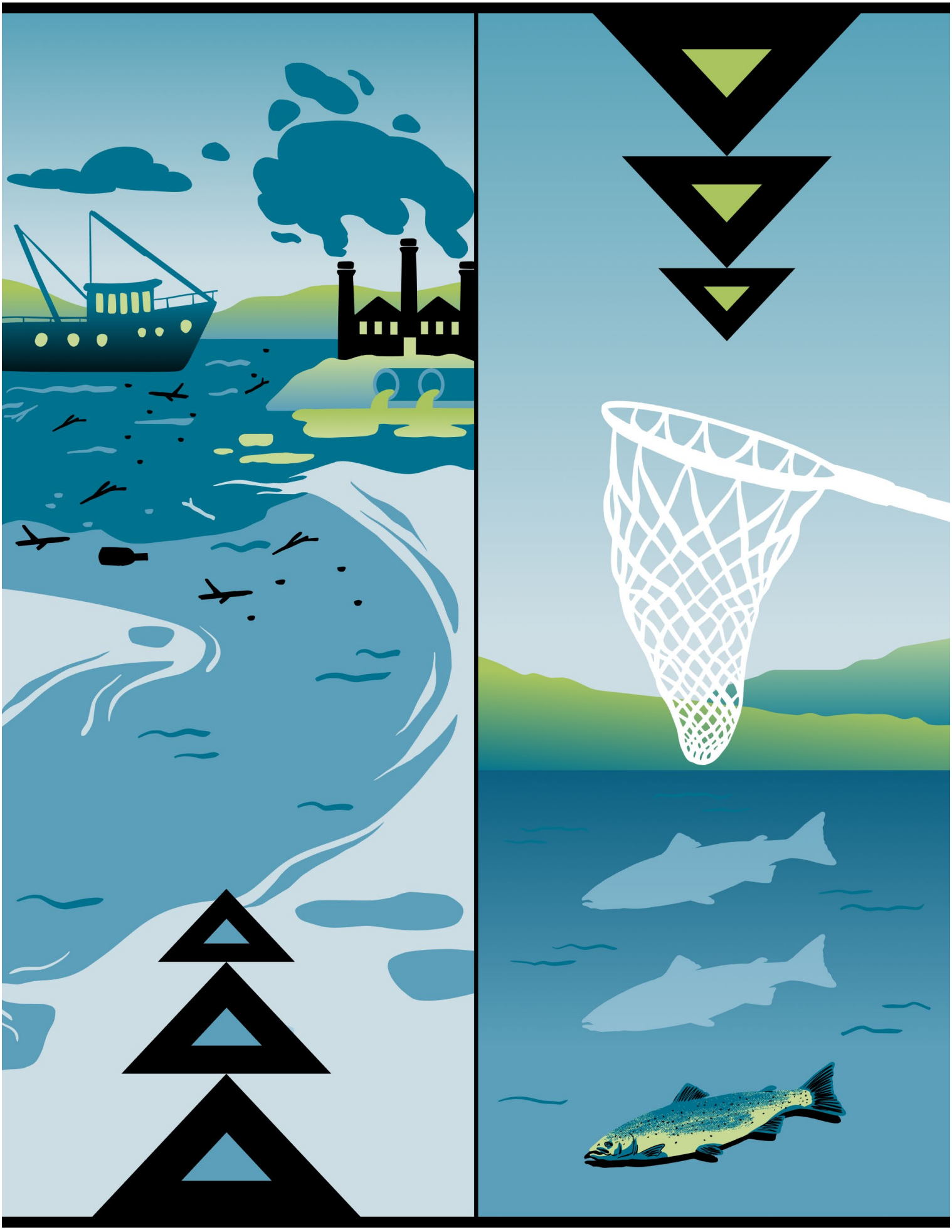
I know that these animals and medicines are a part of the balance in our ecosystem, and also deeply tied to our way of life. I am worried about how climate change and all these industrial activities and the continued disruption of our land and waters will really affect their populations in the future.

When we work to heal the waters, we're not only healing the land but also our communities. My role is about ensuring that future generations will be able to connect with the land and waters and wildlife the way we always have. How much we've gone through as people and how much we're still fighting for our inherent and treaty rights is what keeps me going in the work that I do for my nation.

Translation provided by Robert Leavitt and Roseanne Clark
Language: Wolastoqey

KIANNA BEAR-HETHERINGTON

Water Guardian, Wolastoqey Nation



MECIMI-TEHC KTAHCUWI-POMAWSULTIPON WICIW KIHTAHKOMIKUMONUL NAKA KNOSSAMAQANNUL

Kianna Bear-Hetherington not palitahasit Wolastoqewi-ehpit ’cey Sitansisk. Qeni-macekit, naci-tkahsomuhpon naka natamehpon qospemihkuk naka sipuwihkuk nit ewikit. Mecimi-te-na ’koseltomon ktahkomiq naka ’samaqanol.

Etoli-tpostuwat kehcikotonelici naka kcicihtuwinu, ’tokehkimsin ’kihcitomitahatomon ktahkomiq naka ’samaqan naka weci skat ’cepehlosihq. Nit weci-maceluhkatok etolamhotimok ewikit. Nit qenoluhket Wolastokuk, qeni-kinuwikemit ihik kamahcin Wolastoqewi-neqtuhkomikkil, wicuhkemkun eli-aqami-nonasit.

Bear-Hetherington weskuhutok tan kisi-acehtasik Wolastoq, elokimqahk kehsi-kcicihtuhtit kehcikotonecik, elawotik wen weli-papehtapotok ktahkomiq naka psi-te keq nit pemawsuwik, naka psi-te kotokil kcicihtuwakonol.

Woli-kcicihtasu eli-kisi-acehtasik Wolastoq naka psi-te ktahkomiq yut ewikultiyek. Nil-ote nkisi-tpostuwak kehcikotonecik etolakonutomuhtit tan pihce eleyikpon: psonte-te sip polamok, naka ktahkomiq nmilkunennul micuwakonol naka ’pisunol ehcuwi-iyultiyekil, naka eci-woli-mawapekhasik psi-keq wiwonahsukotuwinomok. Mecimi-te nwikultipon wiciw weyossisok, etolikkil, ktahkomiq, naka ’samaqanol. Toke, kisi-acehtasik sip, nkisi-ksihkahtunen nit eli-tetpahtekpon. Ntahcuwi-matonahkatomonen ntutenemonul naka ntihkalanen weyossisok yut wisokeluhtihtitponik. Komac ktomakitahamqot nit.

Nkisokehkimsin eli-woli-tpinasik ktahkomiq. Nkocicihtun psi-keq tan-op kisessik. Ma-te toke nkisi-tkahsomiw ’samaqanihkuk yut-te utenek. Kenuk-ote itomuponik kehcikotonecik eli-sapinaqokpon ’samaqan. Woli-nomihtasuhpon-ote psahkoniw lampekuk, kenuk toke mocopekot. Kis wawikiye-na sukayewotikon yut qihiw nil ewiki.

Tokec ksihkassultihtit weyossisok, nkoskahtunen eli-pomawsultiyek

Komac nit okimqot ktankuwi-miltultinen kcicihtuwakon. Nit nkisi-ksihkahtunen. Npiluwi-pomawsultipon neket ’ci-maciw kisi-petapasihtit okamonuhkewiyik naka nuci-tpeltomuhticik. Psi-te keq mace-piluwessu Skicinuwihkuk. Mecimi-te nutawsultiponuhpon ktahkomiq naka sip, nmaqenomonennul micuwakonol naka ’pisunol ’samaqanihkuk.

On toke nomihtunen tan toli-ksihkahtasu psi-te yuhtol pemawsikhinomokil naka elinaqsitn pomawsuwinuwok ma-te nokomasi-ptahawa pilomeq, pehkikilit, tahalu polam. Ma-tehp ntotolomawiyik yuktok nomehsuwok kisi-ptuhukik, apeq mecimiw nkisapemanen weci-kisahsomosultiyek, nit eli-pomawsultiyek. Toke-olu mocopekotul ’samaqanol, naka ma-tehp nkisi-maqenomuwonewin micuwakon sonuciw, tahalu pihce kisolukhotiyek.

Kmoskuwak-ona enahkatahacik eyihtit glyphosate wiyuhsomuwak, yut nehpahtikewik ’ciw etolikkil kcihkuk. Ma-te kisi-micasiw. Ma-te wen ntiyukuwonewin tan yuhtol nehpahtikewikil toli-wehkasuwol kosona tan-otehp ntoli-’sikiyukenen nsakolomolsuwakononnuk.

Nuli-tpinomuhtipon weci-woli-kisolutomahtiyek tan-op kisi-wicuhketomek ktahkomiq

Ntahcuwi-woli-tpinomuhtipon ’ciw weyossisok naka nmaqenomonen kcicihtuwakonol weci-kisi-wollukhotiyek. Elomi-te kcicihtuwek, olomi-te-na nkisi-ihkatomonen ktahkomiq naka weyossisok. Yut oloqiw nkisi-woli-kisolutomahtipon, naka-tehc nkocicihtunen eli nilun wewolukhotiyek weci-ihkatasik nkihtahkomikumon.

Psi-te yuhtol kcicihtuwakonol ewehkiyekil, nkisi-aqami-wicuhketomonen weci-aqami-ihkatasik nkihtahkomikumon, naka nkisi-wihkutomonen ihkatasuwakonol tahalu nilun eli-wolamsotomuhtiyek naka ellukhotiyek, wiciw kotokil kcicihtuwakonol.

Weci-woli-pomawsultihtit nicannuk naka nqenosso-nuk

Nkocicihtun eli psi-te weyossisok naka psi-te yuhtol ’pisunol woli-tetpokimqotul yut ewikultiyek; yuktok ewehkehek, nuli-pomawsultipon nilun. Nutomitahatomon etoli-atokiskahk naka eli nuci-tpeltomucik cileyutomuwinomok nkihtahkomikumon naka nossamaqanomol. Komac ’koti-’sikonomahtuhtuwok pomawsuwinuwok weckuwikotok.

Etoli-qeci-kikehtuwek ’samaqanol, nkikehtunen-ona ktahkomiq naka skicinuwihkul. Nil-oc ntoqeci-wicuhkemak pomawsuwinuwok weckuwi-nomihqosultihtit weci-kisi-witawsultihtit wiciw ktahkomiq, ’samaqanol, naka weyossisok, tahalu nilun mecimi-te nkisawsultipon. Psi-keq kisi-’sikonomahtuhtiyek naka psi-keq ahtoli-matonahkatomek, pciliw elokimqosikil lakutuwakonihkuk, nihtol nit ntahtoli-nihkaskuwit qeni-wicuhkemuk npomawsuwinumok.

BREAKING DOWN THE NATIONAL TREND

The national C-LPI includes data for monitored vertebrates including birds, fish, mammals, amphibians and reptiles. The index weighs each species equally, so disaggregating the trend into taxonomic groups can help uncover patterns that may not be evident at the national level (Figure 3). On average, populations of mammals declined by 14 per cent, birds by 12 per cent and fish by 6 per cent from 1970–2022. A lack of amphibian and reptile data means that the C-LPI for these species ranges from 1975–2022, and shows a decline of 14 per cent, on average. While the bird and fish trends display temporal consistency, there is substantial variability within average trends for mammals and amphibians and reptiles.

Fish and birds are the primary taxonomic groups in the C-LPI, accounting for 43 per cent and 41 per cent of species in the analysis, respectively (Figure 4). The relative proportion of mammals (12 per cent) and amphibians and reptiles (4 per cent) is smaller. This is expected, given that there are comparatively fewer species in these taxonomic groups in Canada (Table 2). Taxonomic biases also exist in the broader context of conservation, with data on fish, amphibians and reptiles often underrepresented relative to the number of species in these groups.[51] The proportion of species increasing in abundance and decreasing in abundance differs by taxonomic group (Figure 5).

Figure 3. The C-LPI shows an average decline of 10 per cent (credible interval range: +1 to -19 per cent) between 1970 and 2022. The national index includes 5,099 population time-series for 910 native vertebrate species. Birds, fish, mammals, and amphibians and reptiles show differing patterns. The trend for amphibians and reptiles begins in 1975 due to insufficient data.

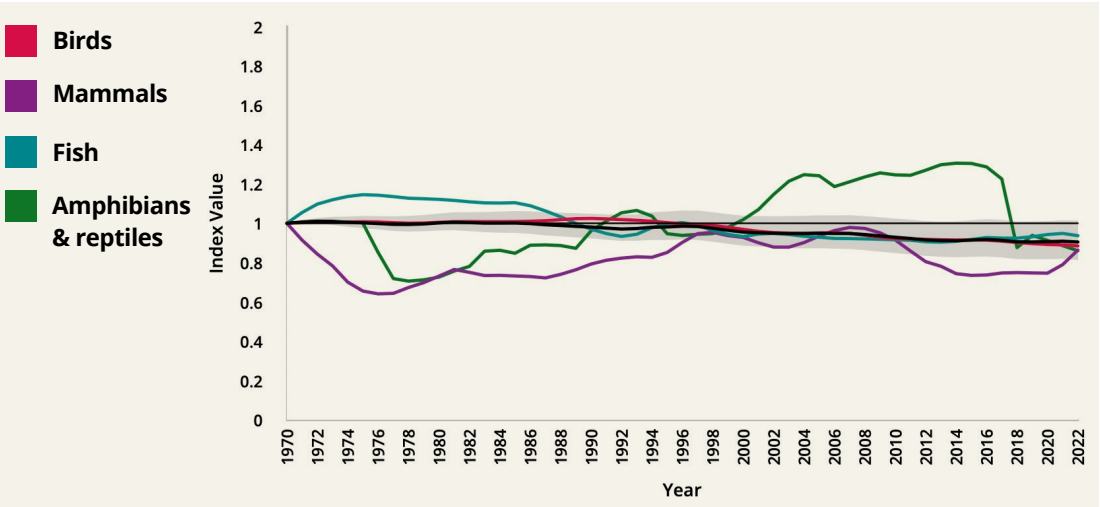
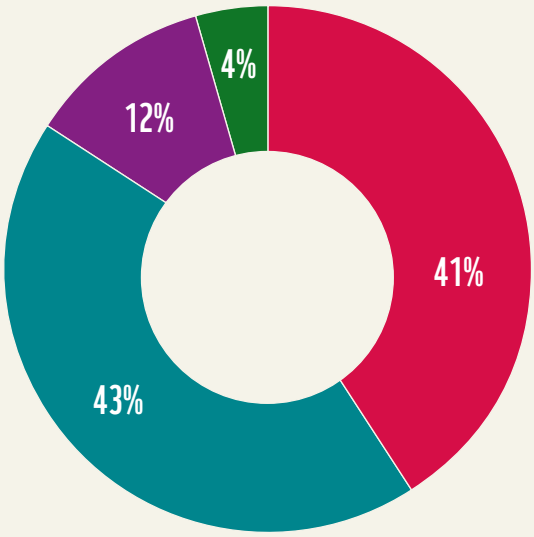


Figure 4. Relative proportion of birds, fish, mammals, and amphibians and reptiles included in the index.



Trends

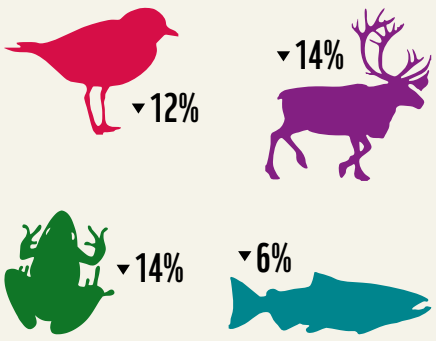


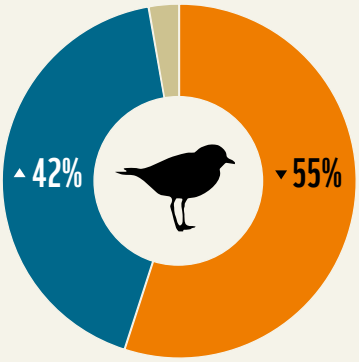
Table 2. Representation of native vertebrate species included in the analysis.

Taxonomic Group	Number in C-LPI	Percentage Included
Birds	374	83%
Fish	394	38%
Mammals	104	53%
Amphibians & Reptiles	38	44%
Total	910	51%

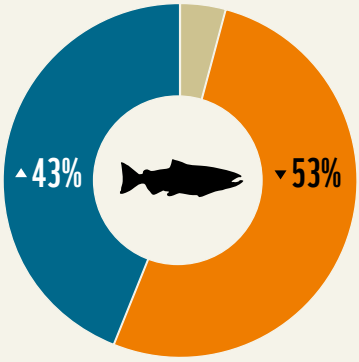
Figure 5. Relative proportion of species with decreasing, increasing and stable trends within the national C-LPI, by taxonomic group.

Decrease **Stable** **Increase**

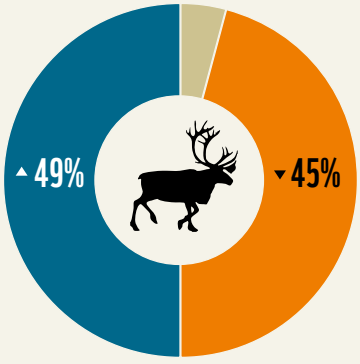
The C-LPI for monitored bird populations has declined by 12 per cent, on average, from 1970–2022 (from 1.0 in 1970 to 0.88 in 2022). The index includes 374 population time series for 374 species. More bird species have declined in abundance (202 of 374; 55 per cent) relative to those that have increased (158 of 374; 42 per cent). Twelve bird species (3 per cent) are considered stable.



The C-LPI for monitored fish populations has declined by 6 per cent, on average, from 1970–2022 (from 1.0 in 1970 to 0.94 in 2022). The index includes 3,949 population time series for 394 species. More fish species have declined in abundance (207 of 394; 53 per cent) relative to those that have increased (172 of 394; 43 per cent). Fifteen fish species (4 per cent) are considered stable.

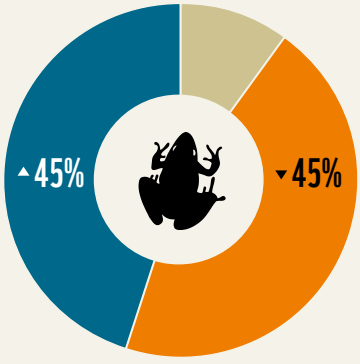


The C-LPI for monitored mammal populations has declined by 14 per cent, on average, from 1970–2022 (from 1.0 in 1970 to 0.86 in 2022). The index includes 599 population time series for 104 species. More mammal species have increased in abundance (51 of 104; 49 per cent) relative to those that have declined (47 of 104; 45 per cent). Six mammal species (6 per cent) are considered stable.



The C-LPI for monitored amphibian and reptile populations has declined by 14 per cent, on average, from 1975–2022 (from 1.0 in 1975 to 0.86 in 2022). The index includes 177 population time series for 38 species. An equal number of amphibians and reptiles have increased (17 of 38; 45 per cent) and declined (17 of 38; 45 per cent) in abundance. Four amphibian and reptile species (10 per cent) are considered stable.

Note that there is considerably less data contributing to the trend from 2018–2022.



SITUATING TRENDS WITHIN THE GLOBAL CONTEXT

The International Union for Conservation of Nature (IUCN) Red List of Threatened Species — often referred to as the "Barometer of Life" — assesses population trends, geographic range, habitat availability and current and emerging threats to determine the status of a species globally. IUCN categorizes threatened species in order of extinction risk from Vulnerable to Critically Endangered — the latter are species of greatest conservation concern from a global perspective, and include species such as the North Atlantic right whale and leatherback sea turtle.[52] Because the IUCN Red List of Threatened Species is global, trends in abundance and extinction risk of the same species can be different at the national or local level. Species that are classified as Threatened on the IUCN Red List may be faring well in Canada, but poorly around the globe (such as the Atlantic puffin), and vice versa.

The C-LPI for globally assessed at-risk species that are present in Canada shows that monitored populations in the country have declined by 43 per cent, on average, from 1970–2022. Canada has a national and shared global responsibility to contribute to the protection and recovery of globally at-risk species.

St. John River, Canada © Shutterstock

Atlantic herring © Shutterstock

THREATS
BIOLOGICAL RESOURCE USE, CLIMATE CHANGE

HABITATS
MARINE AND COASTAL

ATLANTIC HERRING

(Clupea harengus)

Forage fish are the backbone of marine ecosystems, providing an important link between microscopic zooplankton at the bottom of the food web (which they eat) and large marine mammals at the top (which eat them). From the blue-grey iridescence of Atlantic and Pacific herring to the smooth, silvery metallic sheen of capelin and the dizzying zigzag coloration of mackerel, these tiny species span all three oceans in Canada and make up in numbers and importance what they lack in size. Species such as Atlantic herring are critical to the functioning of marine ecosystems on the Atlantic coasts from an ecological, cultural and economic standpoint.[53]

While these fish have natural "boom and bust" cycles, the impact of external factors such as overfishing, sea use change and climate change can throw their population dynamics off balance. In Atlantic Canada, herring stocks are generally considered unhealthy (i.e., categorized within Cautious or Critical Zones)[54] [55] and, in some cases, have declined[56] to levels where moratoria on fishing are required.[57] [58] Unsustainable fishing practices can directly and indirectly disrupt the entire ecosystem through overfishing, bycatch and removal of prey for predators. While there is limited information on many of the thousands of populations of forage fish across Canadian waters,[59] we do know that they are vital in ensuring the health of our marine ecosystems.

OUR NEW GENERATION WILL PROBABLY NEVER KNOW WHAT A WILD SALMON LOOKS LIKE

Ross Hinks has spent most of his life living on Miawpukek First Nation. A small Mi'kmaq community in Conne River, Nfld. Hinks grew up fishing on the river with his father — their livelihood depended on what they could get from the land and sea. He's worked for the Nation for roughly 45 years and now serves as the community's director of natural resources, where he advocates for Miawpukek's involvement in development projects.

A Mi'kmaq man, Hinks holds vast knowledge of the land and the species that occupy it. He's spent his life accumulating knowledge and beliefs about the relationships between the species in his region and how to respectfully coexist with them. This knowledge he's inherited has been passed down from generation to generation and is built on thousands of people's direct contact with the environment.

Note: The following has been edited for length and clarity.

Hinks on the changes he's noticing in Miawpukek, the decline in regional salmon, capelin, cod and mackerel, and what needs to be done to ensure species stability

I've been on this earth for 62 years now and, during that short period of time, I certainly have seen dramatic changes — and a lot is because of development.

The fish in our area have been in decline over the last 30 years. We used to be able to catch capelin right below my house, catch cod anywhere in the bay, mackerel, all of that. Now there's nothing coming near us. The salmon have dropped off since industry came in and we're very concerned that the stock will get on the endangered list if nothing is done. Right now, we have to travel far out to sea in order to get any type of fish.

We have a few other species at risk in our area, the American marten and the boreal felt lichen, so we're concerned.

Decline in species is a loss of livelihood

Loss of species is a loss of tradition, loss of livelihood, loss of everything we stand for. I'm not a religious man, but it's like going to church. It gives you that feeling, you're out there on the land where your ancestors have always been.

Being out there is learning why the community came about — because of this location, near the river, a fjord that was teeming with fish, that's why we came here. And now, basically that is gone; our livelihood, as we exercised it back then, is basically gone.

Our new generation will probably never know what a wild salmon looks like. The only one they'll probably see is in a grocery store, not in our rivers.

Our community knows the species trend, and that's monitoring

About 15 years ago, I was fishing up the Conne River next to an Elder, and he said, "Ross, this river is dead." Up until that point, I was thinking it was in a bit of a state but he saw an even bigger picture — how much it was depleted. And it's just been continually following that trend.

We have Elders everywhere and it isn't "monitoring" in a formalized manner, but it's recognized. We're told to talk to Elders about what it was like back then. It might not be numerical data, but they know the trends and what's happening to the species we depend on.

So, it's monitoring as far as I'm concerned, but certainly not monitoring as far as Western science is concerned, I suppose.

We need co-management from the beginning

In addition to funding and training, we need to be at the table with the government and other agencies from the get-go for resource extraction projects, and we need to be compensated for providing input. It needs to be easier to incorporate the knowledge that our Elders have.

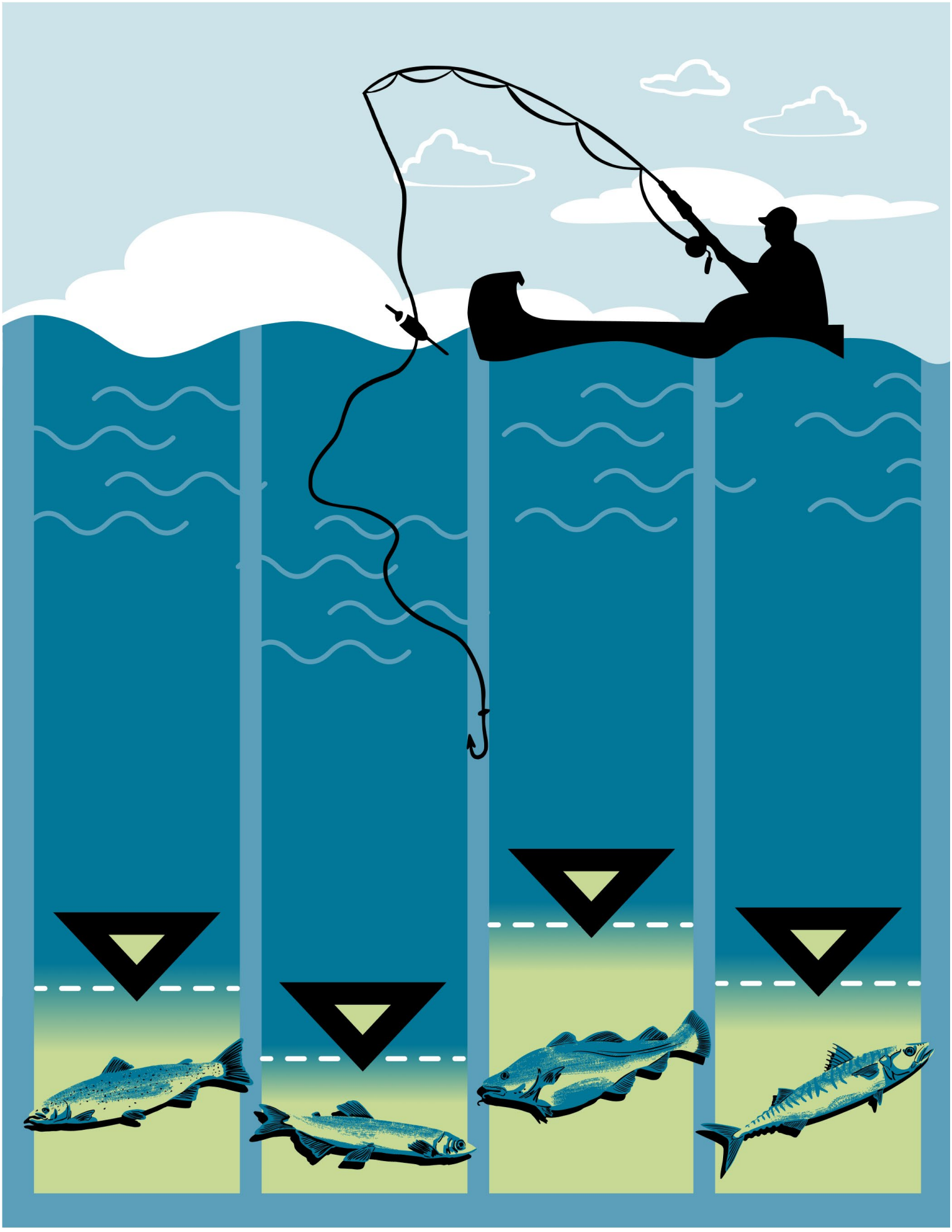
We need total access in co-managing the resource itself. We've developed a consultation protocol when it comes to industry development and that needs to be listened to. We need people that can get behind us and rebut or interpret what people are saying — sometimes it's not made for a layperson, it's for the people that work in the industry.

We need all of that to ensure more healthy wildlife populations, and we need our voices heard. We can't just be there for someone to put a check in the box.

Translation provided by Arlene Stevens and Barbara Sylliboy
Language: Mi'kmaq

ROSS HINKS

Director of Natural Resources, Miawpukek First Nation



WEJKWIKUTIJIK MA' ETUK ELAM KJI-JIA'TIKL PLAMU'L TELI-ANKAMKUSILIJ

Ross Hinks suel teli-pkitawsit wikit Miawpukek L'nue'kati. Apje'jk l'nue'kati etek Conne River, Ktaqamkuk, wejkwikwetjek Hinks ekitamepnik wujjl ula sipuk – mimajuaqnmuew wejiaq ta'n koqoey weja'tu'tij maqamikew-iktuk aqq apaqtuk. Elukewaji Miawpukwek natamiaw 45 te'sipunqekl aqq nike' nikanus tel-maliaptmumk koqoey wejiaq maqamikew- iktuk aqq nutaknutk wjit Miawpukek teli-wiaqa'luj eltumk mtmo'taqney lukwaqn.

Mita nekm L'nu, Hinks pikweli-kjijitoq wjit wskitqamuey aqq koqoey etlikwek ta'n eyk. Teli-pkitawsit ekina'masit kjijitaqn aqq tel-nenuj tel-milamuksultiliji mimajultiliji aqq tel-milamu'k sqaliaqnn ula eymumk aqq ta'n menaqaj toqo'ltiten. Ula kjijitaqn wejiaq te's ankuie'tij mimajuinu'k wejkwa'taqnik, aqq wejiaq pituimtlnaqn te'sunemiksitjik weji-kina'masultijik wsksitqamuey.

Mikuite'te'n: Ula ewikasik kisi-iltunkatasik wjit ta'n tel-pittaq aqq tli-nsitten.

Ta'n Hinks nemitoq tel-pilua'sik Miawpukek, pemi-aji-tkle'jijik pla'mu'k, peju'jk, peju'k aqq amalamaq, aqq koqoey nu'ta'q tla'sin kulaman apaji'sitaq:

Mimaji ula wskitqamu'k ki's 62 te'sipunqekl aqq, ula teli-pkije'k, nemitu kesi-pilua'sik koqoey – aqq pikwelk tela'tekek eltumk mtmo'taqney lukwaqn.

Pemi-aji-tkle'jijik nme'jk ta'n eymu'k ki's nesiskekipunqekl pemiaql. I'ne'pe'kitipni peju'jk pkewe'k wikiek, ne'pe'kitipni peju'k walne'k, amalamaq, aqq me' piluey koqoey.

Nike' mu eymu'k kikjiw eymu'k. Plamu'k pemi-aji-tkle'jijik tujiw ajelk mtmotaqney lukwaqn ika'qek aqq sespeta'sultiek pemi-ktmaqsenenew mu na'tala'taqatiwk. Nike' amujpa knekk apaqtuk elta'mk ktu' ne'pe'j ta'n pasik telamuksit nme'j.

Eykik elt pilue'k mimajultiliji pemi-ktmaqsenenujik ula eymu'k, nkutey apistane'wj aqq oqwatnukewe'l pisaqnatkl,ketloqo sespeta'sultiek.

Pemi-ktmaqsenejik tel-milamuksultiliji mimajultiliji na weji-kska'q teli-pkwatekemk.

Ketmaqsenej tel-milamuksultiliji mimajultiliji wiaqi-ksika'q ta'n telo'ltimk, aqq keska'q ta'n weni'k. Mu melki-ktlamsitasiw, katu nkutey teko'tmumk alame's. We'tukwask, ala'sin wksitqamu ta'n kniskamijinaqi'k ne'kaw eymu'tipni'k.

Ala'sin na'te'l ekina'masin ta'n wutanminu wettaqne'wasik – mita tett etek kikjiw sipuk, paqtapa'q waju'epnik nme'jk, na wjit petqatmu'ti'kip. Toqo nike', kaqia'q, teli-ktantu'kip mimajuaqnminu, aqq ta'n tel-lukuti'kip, kaqia'q.

Wejkwikutijik ma' etuk nenua'tikl pla'mu'l. Na'msit nmia'tita na epiliji malsano'kuo'mk, mu sipuk.

Wutanminu kejitu'tij ta'n nuta'q tla'luksinew tel-mi-lamuksultiliji mimajultiliji, amuj pa jikeyujik.

Na'tamiaw 15 te'sipunqekl ki's pmiaql, etl-kwitameyekip kisiku pi'tawk Miawpukek, na telimit, "Ross, nepk ula sipu." Mi'soqo tujiw kejituap pemi-ewle'jk katu nekm nemitoqip ta'n telitpiaq – pemi-ktmaqseta'sik. Aqq me' ne'kaw pem-tla'sik.

Ala'lu'kik Kisiku'k msit tami kejitu'tij tela'sik koqoey aqq tluenes "jiko'tekemk" mu na ta'n sa'q i'ta'taqatimk, katu keknuite'tasik. Teluemk tlewistuk Kisiku'k wjit ta'n i'tliaqsip. Jiptuk ma' we'wmi'tik kiskukewey tel-mawo'tumk kinua'taqn katu kejitu'tij ta'n tela'sik koqoey wksitqamu'k aqq ta'n telitpia'tilij tel-milamuksultiliji mimajultiliji elita'sualu'kik.

Ta'n ni'n telte'tm jiko'taqatijik, katu mu tel-jiko'taqati'k staqa kiskukewey kjijitaqn.

Nuta'q meltamtuk maw-maliaptaqatinew.

Mu tepianuk pasik suliewey aqq kina'masuti, nutaik meltamtuk wiaqpultinew kaplno'l aqq pilue'l mtmo'taqne'l ta'n tujiw wesku'tasik lukwaqney ketalqa'tumk koqoey wejiaq maqamikew-iktuk, aqq apankituksinenew wjit teli-wsku'tmu'k ketu'-tl-lukutimk. Tepias aji-nqamasian tel-wiaqa'tumk L'nui-kjijitaqn nenmi'tij Kisiku'k.

Nutaik kisi-puktaqi-maliaptmnenew koqoey wejiaq maqamikew-iktuk. Kisa'tu'kipn wije'wmumkl wjit tel-mawaknutmamk wesku'tasik lukwaqney eltasik aqq nuta'q wije'wasiktn. Nutaikik wenik apoqnmuksinenew aqq e'tmatmnew kisna nestmalsewuksinew wjit ta'n telua'ti'tij wenik – jijuaqa na koqoey wesku'tasik ma' nsitmuk ta'n pasik wen, amujpa etl-lukwen.

Nutaik ula msit kulaman kelewa'tesnu naji-tajiko'ltinew wisqisultijik aqq nuta'q nutuksinenew. Ma' pasik l'ta'wk kulaman kis-tlua'titaq eymu'tipnik.

Eastern tiger swallowtail © Shutterstock

INVERTEBRATES

Wild indigo duskywing © Shutterstock

WHY AREN'T INVERTEBRATES INCLUDED?

The Canadian Living Planet Index (C-LPI) measures the average change in relative population abundance of vertebrate species, including fish, birds, mammals, amphibians and reptiles. To date, Canadian invertebrates have not been included in the C-LPI for several reasons.

Invertebrates are more numerous, diverse[60] and generally smaller than vertebrates, which often makes tracking and monitoring their population abundance more labour-intensive and resource demanding, compounding already constrained biodiversity funding. Thus, only a small fraction of native invertebrate species has publicly available, long-term monitoring data that fit the criteria for inclusion in the index[61] [62] — including them would mean that invertebrates would be poorly represented. Even if sufficient data were available, the index itself may not be the best indicator to evaluate trends over time, given large fluctuations in abundance that may further obscure the mathematical calculation of the index. For most — though not all — invertebrate groups, alternative measures related to distribution, such as changes in occurrence and occupancy,[63] [64] rather than counts, are often used (see What's the buzz: Bees and butterflies).[a]

In contrast, relative vertebrate abundance is comparatively well monitored in Canada, with 51 per cent of native vertebrate species currently represented in the C-LPI, boasting impressive taxonomic, spatial[65] and life history representation,[66] and reinforcing the value of the C-LPI as a useful indicator when appropriately framed by its biodiversity constraints.

Yet, vertebrates represent a small proportion (just over 2 per cent) of the 80,000 known species in Canada,[67] and thus a more comprehensive assessment of biodiversity is needed to detect change across taxa, especially given recent studies of dramatic rates of invertebrate decline.[68] While invertebrates may not be appropriate for inclusion in the current version of the C-LPI, there has been extensive monitoring work conducted by researchers in Canada and around the world, providing invaluable insights into patterns for temporal comparison. For instance, data collected can be used to inform trends in distributions, ranges and, in some cases, abundance for individual species or groups of invertebrates at local, national or international scales. While the C-LPI is a useful indicator to measure average change in relative abundance for large assemblages of vertebrates, other species, data and indicators can help build out a broader narrative to more comprehensively assess the status of wildlife in Canada.

[a] Occupancy refers to the probability that a species is present within a given location.

WHAT'S THE BUZZ: BEES AND BUTTERFLIES

Pollinators help maintain biodiversity and ensure the production of a wide range of plants. They're essential for food security and ecosystem health.

BUMBLE BEES

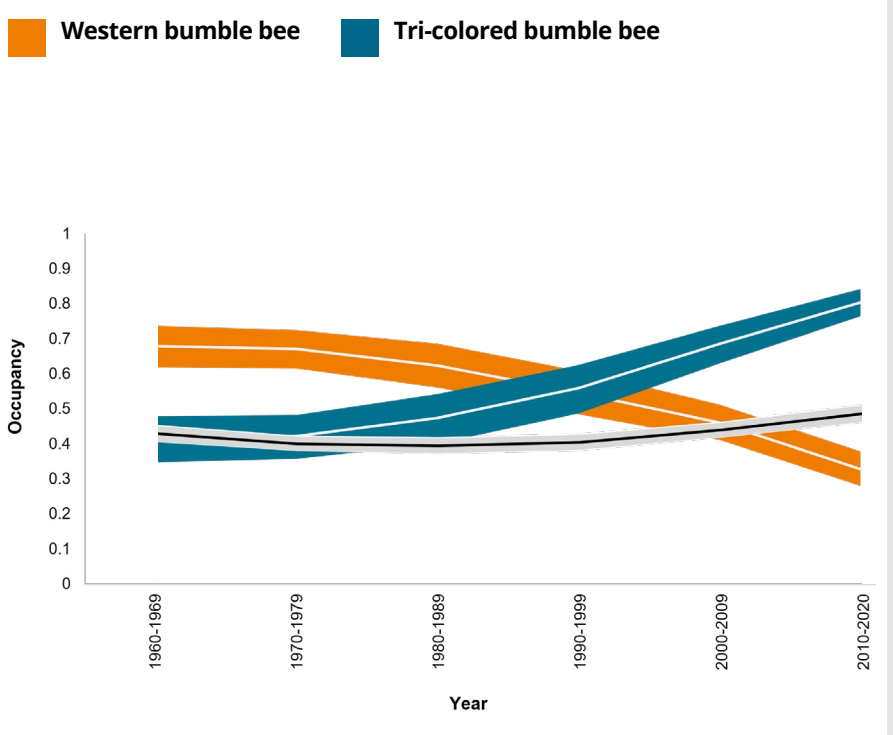
There are roughly 900 known species of bees native to Canada,[69] 5 per cent of which are bumble bees (*Bombus spp.*). Bumble bees are well-recognized as efficient pollinators, and we rely on them for pollination of our food crops. However, declines in bumble bee populations have been reported in Canada and around the world. To date, seven bumble bee taxa have been assessed as at risk of extinction in Canada by COSEWIC. Bumble bees are found across the country, occupying habitats from the Arctic tundra to rocky areas and forests, with ranges extending from coast to coast to coast.

Despite major declines for some species in Canada, the average[b] occupancy of bumble bees has increased slightly from 1960 to 2020 (6 per cent), with minor declines in the 1970s, but increases in recent decades, with different species displaying differing patterns (Figure 6). Occupancy has increased for the tri-colored bumble bee (*Bombus ternarius*; shown in blue in Figure 6) but declined for the at-risk Western bumble bee (*Bombus occidentalis*; shown in orange in Figure 6).[c]

[b] Occupancy across all sites in each species' range was averaged to obtain species occupancy. The average of those values was then used to obtain an overall average across species, where species were weighted equally. This was done for each time point to get the average trend through time.

[c] Analysis contributed by Jayme Lewthwaite, Teagan Baiotto, Hanna Jackson and Laura Melissa Guzman [see Technical Supplement]

Figure 6. Trends in occupancy of bumble bees in Canada from 1960–2020. The average trend has increased slightly (6 per cent) and includes data for 38 bumble bees. Note that occupancy (i.e., spatial extent of occurrence) is a different metric from the C-LPI (i.e., relative population abundance) and cannot be directly compared. The overall trend for all species is in black (grey) with colours representing two different species with contrasting trends: tri-colored bumble bee *(Bombus ternarius)* and the at-risk Western bumble bee *(Bombus occidentalis)*. The intercept of the y-axis represents the baseline or average probability of occupancy of a species at a site. Therefore a species with a low value in 1960 would be less prevalent on the landscape.



Tri-colored bumble bee © Shutterstock

TRI-COLORED BUMBLE BEE

(Bombus ternarius)

The bright orange backside of the tri-colored bumble bee (also known as the orange-belted bumble bee) is impossible to miss among a stand of vibrant, sunshine-coloured goldenrod in eastern Canada. These busy pollinators can be found in open meadows collecting nectar and pollen from wildflowers. Once queen bumble bees establish their nests in the spring (often in abandoned rodent burrows), they build their colonies by feeding larvae a small nutrient-rich mixture of pollen and nectar (somewhat similar to honey). Populations of the tri-colored bumble bee have increased in some regions, including southern Ontario, but varying patterns exist geographically.[70]

THREATS

POLLUTION, CLIMATE CHANGE, INVASIVES AND DISEASE

HABITATS

GRASSLAND, FOREST

Western bumble bee © Shutterstock

WESTERN BUMBLE BEE

(Bombus occidentalis)

COSEWIC Status: Special Concern – Threatened

An unassuming bee with black, yellow and white patterning, this species was once common across Western Canada, but its two subspecies are now considered at risk of extinction.[71] Like other bumble bees, Western bumble bees have the ability to buzz pollinate: this is when bees can use their wing muscles to vigorously shake a flower and dislodge trapped pollen grains. This type of pollination is required for plants like tomatoes and peppers, which means that commercial greenhouses use colonies of Western bumble bees (or common Eastern bumble bees) for production.[72] However, the transmission of pathogens and disease from exotic bumble bees or those introduced for pollination in commercial greenhouses is threatening native populations of the Western bumble bee, particularly in the Yukon [73] [74] Additional factors such as intensive agricultural practices, pesticides — including neonicotinoids — and habitat change are also prominent threats.[75]

Monarch butterfly © Sarah Pietrkiewicz

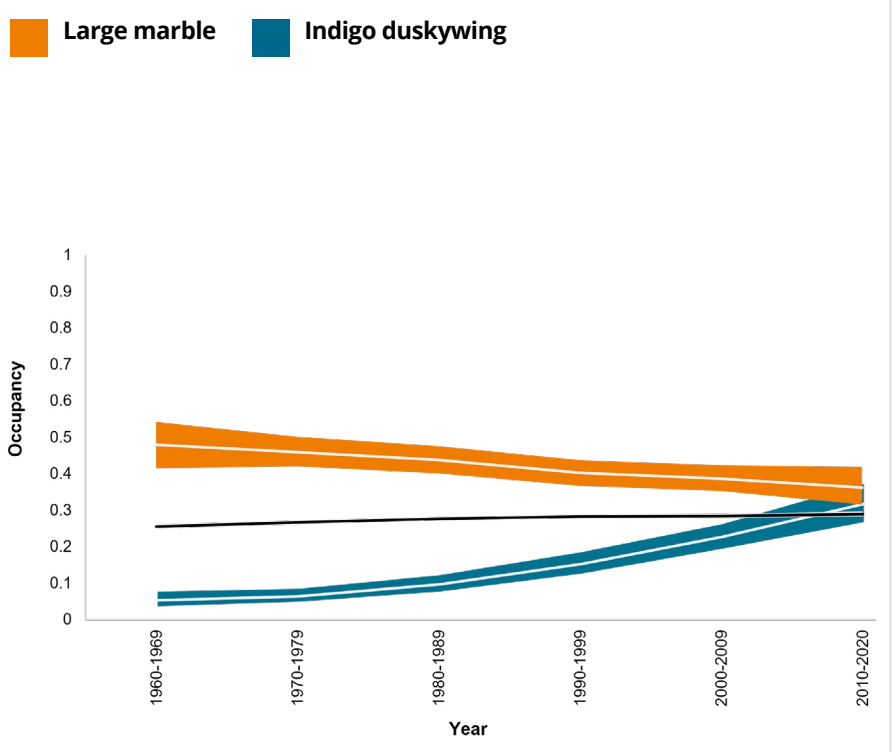
BUTTERFLIES

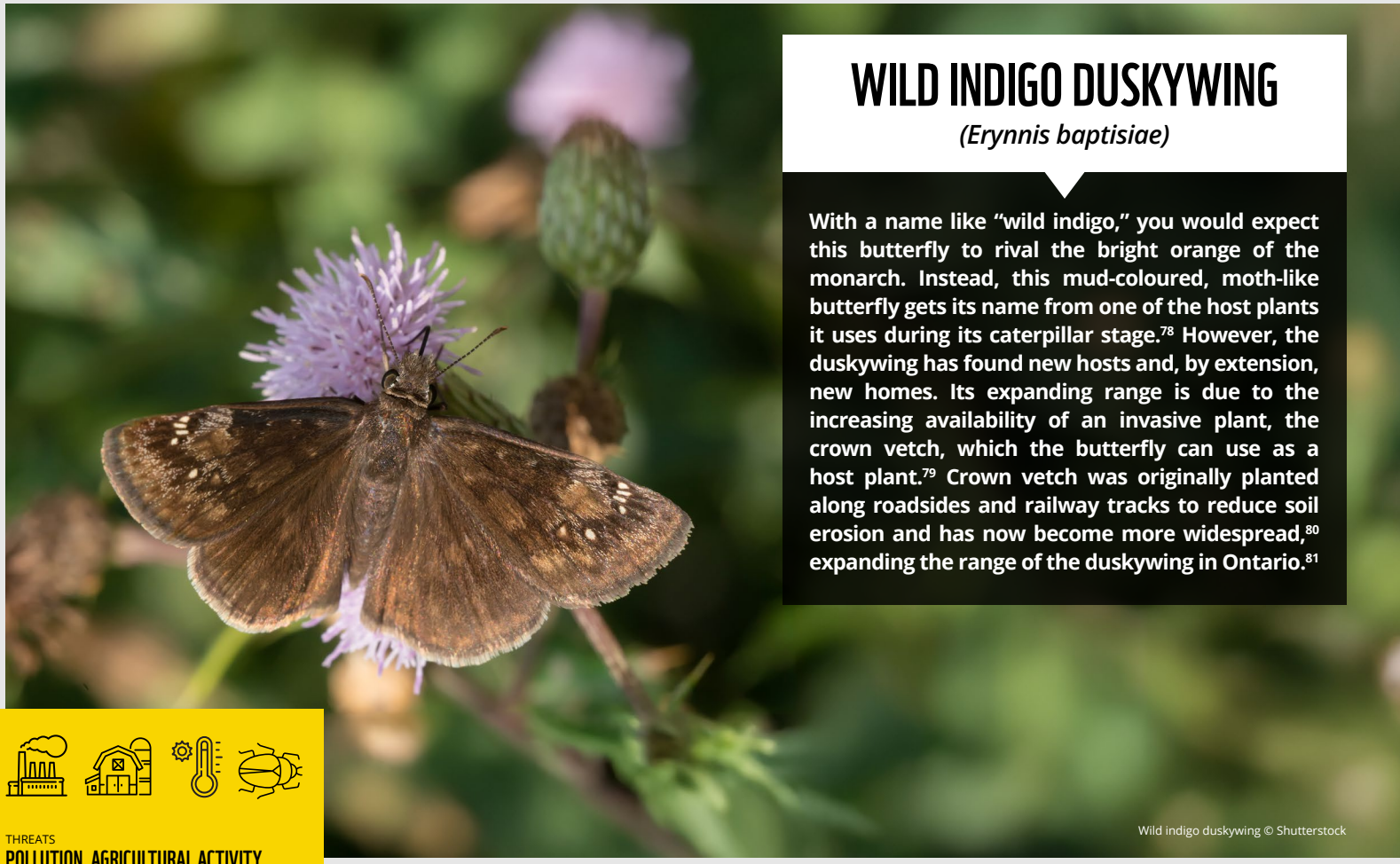
Butterflies in Canada are diverse, with approximately 300 native species. They transform from caterpillars to recognizable butterflies through metamorphosis. Some Canadian species are migratory, and this migratory behaviour may be best exemplified by the monarch butterfly. Each fall, monarchs set out on an incredible 4,000–5,000-kilometre journey from southern Canada to their wintering sites in the mountain forests of Mexico, one of the world's longest insect migrations. A monarch's lifespan lasts anywhere from weeks to less than a year, so the same individual does not fly from Canada to Mexico and back. Instead, successive generations stop along the journey to breed another generation that can continue on.[76] The area of occupancy of monarch butterflies hibernating in Mexico has declined over the last three decades.[77]

In Canada, the average occupancy across butterflies has been relatively stable from 1960 to 2020 (less than 5 per cent increase), with minor increases since 1960, though there is species-specific variation (Figure 7).[d] Occupancy has increased for the wild indigo duskywing (*Erynnis baptisiae*; shown in blue in Figure 7) but declined for the large marble (*Euchloe ausonides*; shown in orange in Figure 7).

[d] Analysis contributed by Jayme Lewthwaite, Teagan Baiotto, Hanna Jackson and Laura Melissa Guzman [see Technical Supplement]

Figure 7. Trends in occupancy of butterflies in Canada from 1960–2020. The average trend is relatively stable (3 per cent) and includes data for 282 butterflies. Note that occupancy (i.e., spatial extent of occurrence) is a different metric from the C-LPI (i.e., relative population abundance) and cannot be directly compared. The overall trend across all species is in black, with colours representing two different species with contrasting trends: wild indigo duskywing (*Erynnis baptisiae*) and large marble (*Euchloe ausonides*). The intercept of the y-axis represents the baseline or average probability of occupancy of a species at a site. Therefore, a species with a low value in 1960 would be less prevalent on the landscape.





WILD INDIGO DUSKYWING

(Erynnis baptisiae)

With a name like "wild indigo," you would expect this butterfly to rival the bright orange of the monarch. Instead, this mud-coloured, moth-like butterfly gets its name from one of the host plants it uses during its caterpillar stage.[78] However, the duskywing has found new hosts and, by extension, new homes. Its expanding range is due to the increasing availability of an invasive plant, the crown vetch, which the butterfly can use as a host plant.[79] Crown vetch was originally planted along roadsides and railway tracks to reduce soil erosion and has now become more widespread,[80] expanding the range of the duskywing in Ontario.[81]

Wild indigo duskywing © Shutterstock

THREATS

POLLUTION, AGRICULTURAL ACTIVITY, CLIMATE CHANGE, INVASIVES AND DISEASE

HABITATS

GRASSLANDS, HUMAN-DOMINATED LANDSCAPES, ROCKY AREAS

Large marble © Shutterstock

LARGE MARBLE

(Euchloe ausonides)

The large marble lives up to its name with a complex and stunning green marble pattern on its milky white hindwings. These butterflies are typically found in open areas such as grasslands and meadows, often with mustard plants, one of their larval host plants. The large marble is relatively widespread across Canada, from B.C. through Ontario, and even extending north into the territories.[82] While the species is currently considered Secure in Canada (but Vulnerable in Ontario),[83] long-term monitoring data from the U.S. show a stark decline, with habitat loss, climate change and pesticide use impacting butterflies more broadly.[84] There are seven subspecies found in North America, though one, the island marble, once found on islands off the West Coast of Canada, was extirpated in the early 1900s. Despite considerable effort devoted to butterfly surveys since the turn of the century, the island marble has not been detected within its historic range.[85]

Mountain bluebird © WWF-US / Clay Bolt

HABITATS

03

Canada is home to a diverse range of habitats — from grasslands and forests to wetlands and marine areas — and each plays a role in supporting biodiversity and ecological function.

The trends in this chapter are based on the relationship between a species and the specific habitats where they are most commonly found or on which they rely. Note that taiga and tundra habitats are not included due to limited C-LPI data; these areas are home to species such as the Arctic fox and northern collared lemming.

Some species are confined to one habitat (e.g., whales can only occupy marine habitats) while others migrate between habitats (e.g., salmon use both marine and freshwater habitats). Consequently, some species are included in one or more of the following trends. Exploring trends between habitats allows us to better understand the status of biodiversity in Canada across its iconic land- and seascapes.

GRASSLANDS

Grasslands are expansive open spaces dominated by a diversity of grasses and wildflowers. They feature fertile soils and a semi-arid climate, and they support a variety of wildlife, including pronghorn and burrowing owl. Grassland habitats in Canada span the Prairie provinces (Alberta, Saskatchewan and Manitoba). This is also where land conversion for human uses has been highest.[86] [87] As a result, temperate native grasslands are among the world's most imperiled and least protected terrestrial ecosystems,[88] occupying approximately 20 per cent of their former area in Canada (since the 1800s).[89] While the majority of grassland conversion occurred in decades past,[90] grasslands are still being lost at a rate of 361.4 hectares per year in Canada,[91] and the legacy of these impacts impedes biodiversity recovery.

Once a species is in decline, trends become more difficult to reverse because populations are more vulnerable to threats and environmental changes, given their reduced genetic diversity, size and isolation. This can lead to feedback loops that can accelerate population declines.

HABITAT HIGHLIGHTS

- Climate change mitigation: In Canada, grasslands store 19,085 megatonnes of carbon in their soils — an average of 360.7 tonnes per hectare.[92]
- Climate change adaptation: Grasslands retain water in their soils to help endure droughts.
- Nature-based climate solutions: Providing farmers with sufficient financial resources and other supports to restore marginal croplands to native grasslands promotes balance between ecosystem health and food security.

C-LPI: GRASSLANDS

The C-LPI for monitored populations of species occurring in grassland habitats shows a decline of 62 per cent, on average, since 1970 (from 1.0 in 1970 to 0.38 in 2022; Figure 8). The trend includes 300 population time series of 85 species that occupy grassland habitats. It includes species such as Sprague's pipit, swift fox and prairie rattlesnake. While most species (58 per cent) are in decline on average, approximately 38 per cent are increasing in abundance (Figure 9). Mammals contribute the greatest proportion of species (51 per cent) to the average trend (Figure 10) and, combined, show large variability. Monitored birds show significant population declines relative to 1970.

Figure 8. The C-LPI (black) for monitored populations of species occurring in grassland habitats has declined by 62 per cent (credible interval range: -35 to -77 per cent), on average from 1970–2022. The index includes 300 population time-series for 85 native vertebrate species. A trend for amphibians and reptiles is not displayed due to insufficient data.

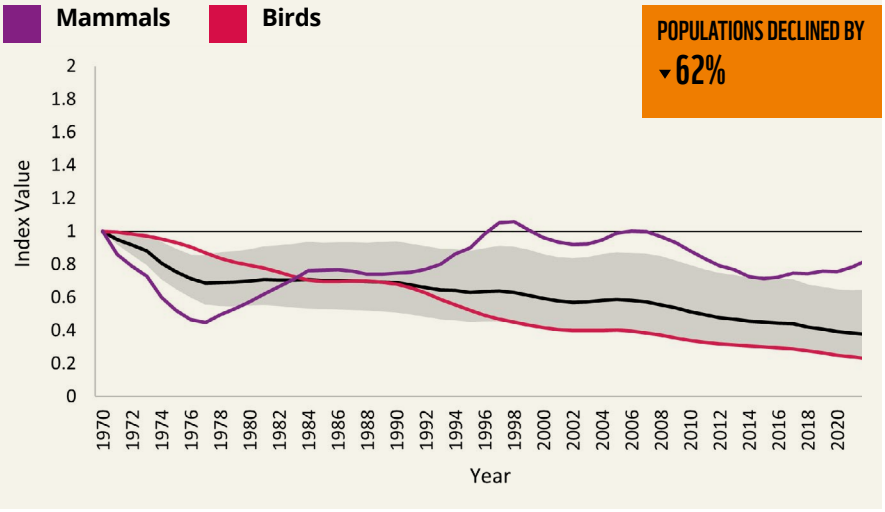


Figure 9. Relative proportion of grassland species with decreasing, increasing and stable trends within the index.

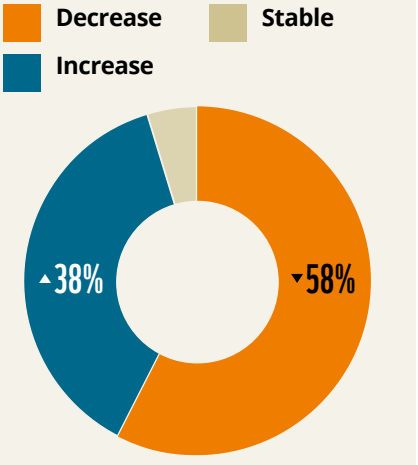
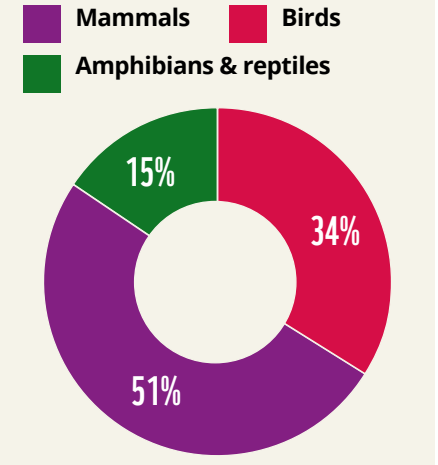
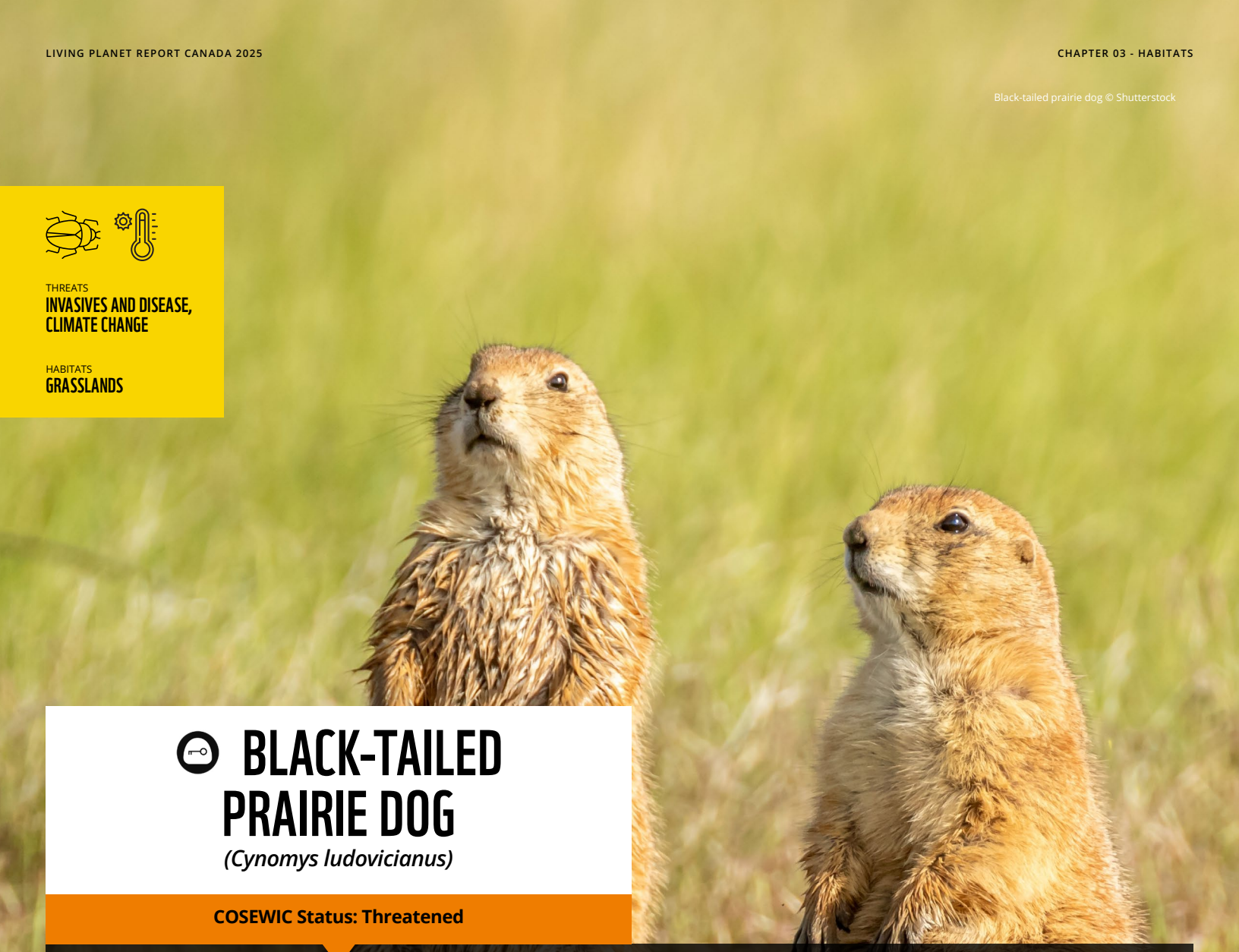


Figure 10. Relative proportion of birds, mammals and amphibians and reptiles included in the index.





Black-tailed prairie dog © Shutterstock

THREATS
INVASIVES AND DISEASE, CLIMATE CHANGE

HABITATS
GRASSLANDS

BLACK-TAILED PRAIRIE DOG

(Cynomys ludovicianus)

COSEWIC Status: Threatened

The silent, rolling hills of southern Saskatchewan were once filled with a repertoire of vocalizations made by black-tailed prairie dogs. A large, sandy-coloured squirrel with a black-tipped tail, prairie dogs — which, surprisingly enough given their common name, are a member of the squirrel family — are almost never found alone. They "jump-yip" at every passerby to alert their colony to any possible threats.

Wildlife in North America's Central Grasslands once rivalled that of Africa's Serengeti.[93] But, like many other grassland species, black-tailed prairie dog populations have suffered in part due to the ongoing conversion of productive grassland habitats into agricultural fields, in addition to increased drought and sylvatic plague (a bacterial disease).[94] Across the Great Plains of North America, the species only occupies 2 per cent of the global range it once did.[95] With a small range in Canada, isolated from other populations in the United States,[96] the species is Threatened under the federal Species at Risk Act.

Black-tailed prairie dogs are an integral part of the ecosystem since they are prey for other at-risk species, including swift foxes, prairie rattlesnakes and Swainson's hawks. If the beaver is one of the world's greatest aquatic ecosystem engineers, the black-tailed prairie dog measures up as its terrestrial keystone counterpart. By digging wide-ranging burrow systems, building large mounds and extensively grazing nearby vegetation, these mammals also influence plant community compositions while providing habitat for other species. Some evidence suggests that colony sites boast greater densities of large-bodied avian carnivores[97] in addition to plant diversity and richness.[98] Their digging and grazing activities also create conditions that support some rare native plants that occur almost exclusively in prairie dog colonies.[99] In addition, some animals use the black-tailed prairie dog's burrows during key parts of their own life cycle, such as the aptly named burrowing owl, which uses the tunnels as a nesting and resting place.

Addressing threats to grassland ecosystems and supporting their regeneration would allow colonies of black-tailed prairie dogs to recover.[100] As a keystone species, their survival will support a diversity of wildlife, like the Extirpated black-footed ferret, which is a prairie dog specialist and depends on it for both food and shelter.

ROCKY AREAS

Rocky habitats include caves, inland cliffs and mountain peaks — they are characterized by sandy, stony or rocky substrate and can be found at any elevation, in any geography. Plant cover is typically quite sparse in rocky habitats, but precipitation can vary depending on the habitat type. Rocky habitats make up a relatively small proportion of the Canadian landscape. Despite perceptions of a seemingly more permanent landscape, habitat loss of rocky areas is an ongoing issue — for instance, removal for gravel (i.e., exploitation).

HABITAT HIGHLIGHTS

- Climate change adaptation: Rocky areas include mountain tops, which are regions of high elevation, recognized for containing comparatively high concentrations of climate refugia (areas with unique climate conditions anticipated to remain relatively stable despite future climate change).
- Nature-based climate solutions: While the protection, restoration and sustainable management of rocky areas themselves are unlikely to meaningfully contribute to greater ecosystem carbon sequestration, protection of these areas is vital to safeguarding wildlife now and into the future, particularly under a warming climate.

C-LPI: ROCKY AREAS

The C-LPI for monitored populations of species occurring in rocky habitats (i.e., caves and mountains) shows a decline of 31 per cent, on average, since 1970 (from 1.0 in 1970 to 0.69 in 2022; Figure 11). The trend includes 352 population time series of 90 species that occupy rocky habitats. The trend includes wildlife such as bats, mountain goats and foxes. More than half of the species included in the trend (58 per cent) have experienced average populations declines, while 37 per cent increased in abundance (Figure 12). Five per cent have stable population trends. The trend is evenly influenced by birds (48 per cent) and mammals (45 per cent), with amphibians and reptiles contributing 7 per cent of species (Figure 13).

Figure 11. The C-LPI for monitored populations of species occurring in rocky habitats declined by 31 per cent (credible interval range: -5 to -49 per cent), on average, from 1970–2022. The index includes 352 population time-series for 90 native vertebrate species. A trend for amphibians and reptiles is not displayed due to insufficient data.

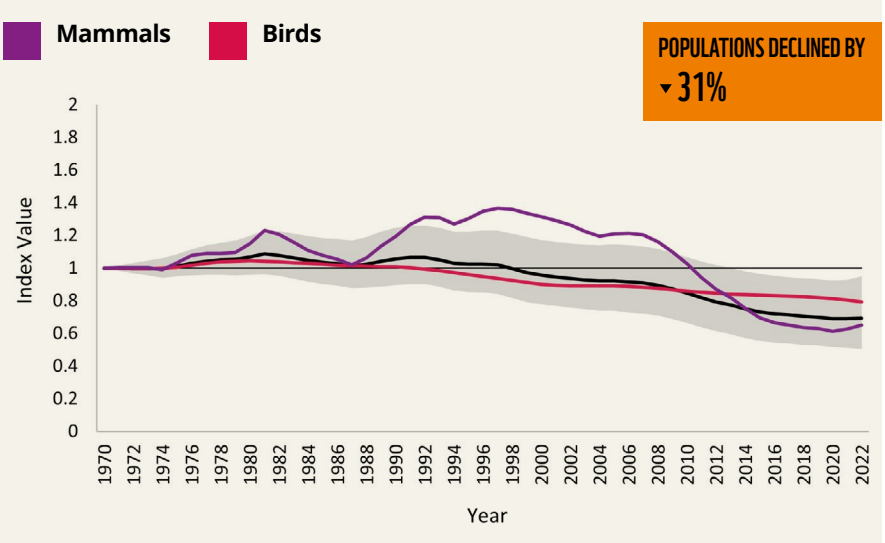


Figure 12. Relative proportion of species with decreasing, increasing and stable trends within the index.

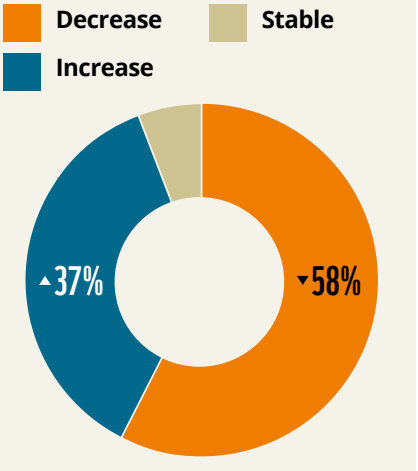
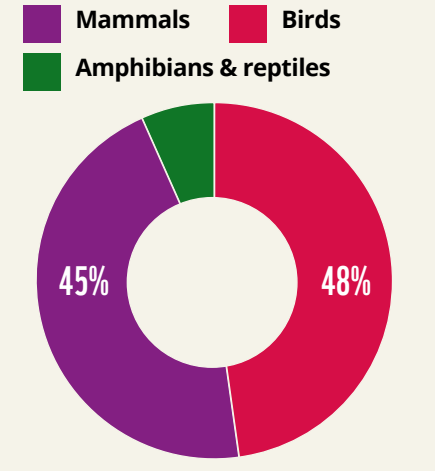


Figure 13. Relative proportion of birds, mammals and amphibians and reptiles included in the index.



Common five-lined skink © Shutterstock

THREATS
URBAN DEVELOPMENT, TRANSPORT, CLIMATE CHANGE

HABITATS
ROCKY AREAS, FOREST

COMMON FIVE-LINED SKINK

(Plestiodon fasciatus)

COSEWIC Status: Special Concern – Endangered

As eastern Canada's only lizard, the common five-lined skink, identifiable by its electric blue tail, is secretive as it slinks away for shelter behind cover objects.[101] These reptiles are often found close to shrubs, which are the perfect hiding spots from threats that loom nearby [102] Snakes and small mammals prey on skinks, though the skink can employ the common lizard defense tactic of losing its bright blue tail to distract any predators.

Land use and land-use change — including urban development, agricultural expansion and road networks — have contributed to habitat loss and created physical barriers to skink movement by limiting the skink's dispersal ability.[103] The vast road networks within Southern Ontario are also a source of road mortality. These threats are compounded by shifts in food web dynamics, where declines in large-bodied predators (e.g., wolves) have resulted in an increased abundance of small-bodied predators, such as raccoons and skunks, that prey on skinks.[104] Climate change and rising water levels have also reduced available habitat by altering the sandy habitats these animals prefer.[105]

There are actions we can take to ensure that this reptile recovers. Encouraging proper garbage disposal in protected areas, including national parks, can discourage the presence of small predators and help alleviate some pressure on skink populations.[106] Lower speed limits and the installation of speedbumps, especially near wetlands, can greatly reduce road mortality[107] and local skink populations also respond well to restoration projects that increase the quality of habitats — for example, actions such as adding woody debris creates more hiding spots.[108]

Mountain bluebird © Shutterstock

THREATS
AGRICULTURAL ACTIVITY, URBAN DEVELOPMENT, BIOLOGICAL RESOURCE USE, CLIMATE CHANGE

HABITATS
ROCKY AREAS, GRASSLANDS, FOREST

MOUNTAIN BLUEBIRD

(Sialia currucoides)

The shocking cerulean of a mountain bluebird is a treat to the eyes. A robin-sized bird, it frequents backyards in central and western Canada, using nest boxes put up by nature enthusiasts. Mountain bluebirds are secondary cavity nesters, meaning they do not create holes in trees but use existing cavities to build their nests, such as those made by woodpeckers in the wild, or conservation nest boxes. Because of this, they are limited by a lack of suitable nest sites, combined with a loss of breeding habitat.[109] In Canada, mountain bluebird populations have experienced decadal fluctuations in abundance, leading to an overall decline of 60 per cent since 1970.[110]

As their name suggests, mountain bluebirds prefer higher elevations and can be found breeding at elevations up to 2,700 metres.[111] However, they also mix with species in flocks numbering over hundreds of individuals at lower elevations. Insects are the primary food source for mountain bluebirds, especially during the breeding season.[112] Their dependence on insects means that heavy applications of insecticides impact the quantity and quality of food available for chicks during the nesting season. Extreme weather events such as unpredictable, heavy rainfall or early-season storms due to climate change also impact mountain bluebirds at all life stages,[113] in addition to ongoing threats driven by forestry and agricultural practices.[114]

MARINE & COASTAL

Canada's expansive coastline — the longest in the world — supports diverse ecosystems, including salt marshes, eelgrass beds and kelp forests.[115] These ecosystems provide habitat for wildlife and have supported and protected coastal communities for millennia. Moreover, extending beyond the coast is Canada's exclusive economic zone (EEZ) — an area of the ocean that extends out to up to 200 nautical miles (370 kilometres) and over which Canada exercises authority.[116] When the EEZ is included, Canada encompasses roughly 7.1M km² of jurisdictional marine waters, which equates to approximately 70 per cent of its landmass.[117]

HABITAT HIGHLIGHTS

- Climate change mitigation: Blue carbon habitats, such as salt marshes and eelgrass beds, mitigate climate change by drawing down carbon dioxide from the atmosphere and storing the carbon long term in their sediments.
- Climate change adaptation: In addition to naturally sequestering and storing carbon, blue carbon ecosystems support climate adaptation through shoreline stabilization, wave attenuation, and storm surge and flood mitigation.
- Nature-based climate solutions: Stewardship of blue carbon habitats including the establishment of marine protected areas, restoration of degraded shorelines and subtidal habitats, and improved coastal management may deliver disproportionately large climate and biodiversity benefits per unit area.

C-LPI: MARINE & COASTAL

The C-LPI for monitored populations of species occurring in marine and coastal habitats (i.e., coastal, intertidal, pelagic and deep waters) shows a stable trend of -4 per cent, on average, since 1970 (from 1.0 in 1970 to 0.96 in 2022; Figure 14). The trend includes 2,563 population time series of 432 species that occupy marine habitats, including wildlife such as sea turtles, whales and fish. Half of the species included in the trend (51 per cent) experienced average populations declines, while 45 per cent increased in abundance (Figure 15) and 4 per cent have stable population trends. The trend is significantly influenced by fish (72 per cent), followed by birds (22 per cent; Figure 16). While marine mammals have experienced large population increases, on average, relative to 1970 (with some species benefitting from conservation interventions including bans on whaling), their influence on the trend is comparatively small given they make up only 6 per cent of species.

Figure 14. The C-LPI for monitored populations of species occurring in marine and coastal habitats has been stable (-4 per cent; credible interval range: +17 to -21 per cent), on average, from 1970–2022. The index includes 2,563 population time-series for 432 native vertebrate species. A trend for amphibians and reptiles is not displayed due to insufficient data.

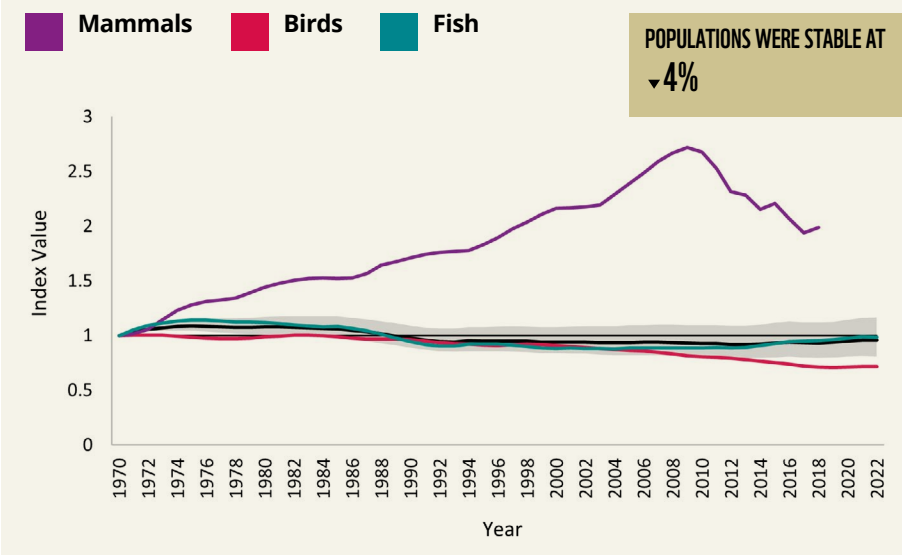


Figure 15. Relative proportion of species with decreasing, increasing and stable trends within the index.

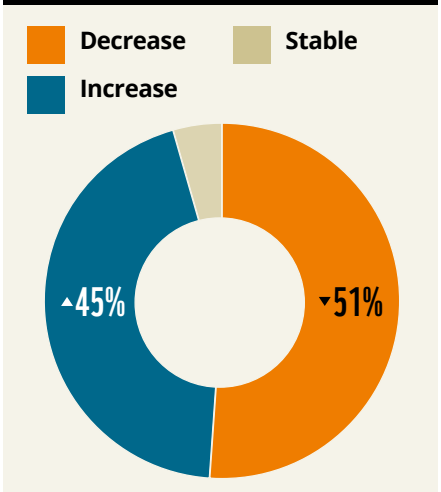
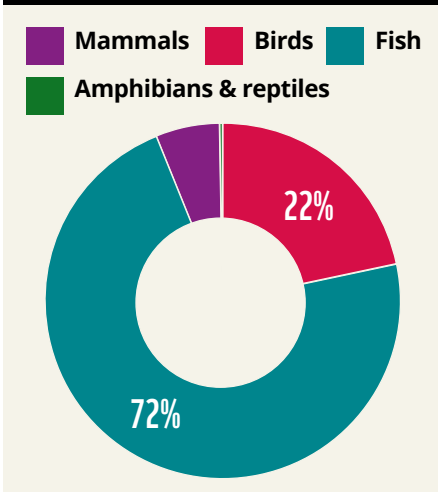


Figure 16. Relative proportion of birds, fish, mammals and amphibians and reptiles included in the index.



Blue whale © Shutterstock / WWF-UK

THREATS

POLLUTION, CLIMATE CHANGE, TRANSPORT

HABITATS

MARINE AND COASTAL

BLUE WHALE

(Balaenoptera musculus)

COSEWIC Status: Endangered

The biggest animal on Earth had all but disappeared from Canadian waters because of high levels of commercial overexploitation prior to Canada's commercial whaling ban in 1972.[118] In the Atlantic Ocean, commercial overexploitation reduced the population by approximately 70 per cent.[119] Though other whale species have shown evidence of recovery since the ban on commercial whaling, the legacy effects of whaling on blue whale populations in Canadian waters are not fully understood. There has been limited recovery in blue whales despite decades of protection afforded through legal instruments (e.g., Species at Risk Act; commercial whale ban)[120] Yet, there is evidence of recovery outside Canadian waters,[121] [122] [123] providing hope for the iconic marine mammal.

It is imperative to continue addressing the ongoing threats throughout the entirety of the blue whale's range, including high-risk threats such as noise from ships.[124] In the darkness of the marine realm, whales and other marine species use sound to sense their environment. But the songs, clicks and whistles that they rely on to search for food, care for their young, socialize and mate are being drowned out by a rising human-made racket. Protection from underwater noise will be critical for blue whale long-term recovery as they are a vocal species that use sounds to locate feeding grounds, navigate the seascape and communicate with whales up to 1,600 kilometres away.[125]

FORESTS

Over one-third (36 per cent) of Canada is covered by forest, stretching across all provinces and territories.[126] From the coastal and montane forests of the west to the Acadian forests in the east, Canada's forests are as diverse as the animals they support. The boreal forest is the largest, making up 77 per cent of forested areas in Canada and representing 28 per cent of the global boreal zone.[127] Natural disturbances (such as disease and fire) affect forest ecosystems, as do anthropogenic activities like harvesting, road construction and conversion of land to other uses (e.g., agriculture, infrastructure, industrial and urban development).

HABITAT HIGHLIGHTS

- Climate change mitigation: In Canada, forests store 19,922 megatonnes of carbon in their biomass — an average of 56.7 tonnes per hectare — and significantly more in their soils.[128]
- Climate change adaptation: Healthy forests help to stabilize land, prevent erosion and improve water absorption during severe weather events.
- Nature-based climate solutions: Planting a diversity of native trees not only sequesters atmospheric carbon, but also provides shade, food and habitat.

C-LPI: FORESTS

The C-LPI for monitored populations of species occurring in forest habitats (i.e., boreal, temperate and mixed wood) shows a decline of 6 per cent, on average, since 1970 (from 1.0 in 1970 to 0.94 in 2022; Figure 17). The trend includes 686 population time series of 186 species that occupy forest habitats. The trend includes salamanders, owls and large mammals such as the iconic Canada lynx and boreal caribou. Approximately 46 per cent of species included in the trend have experienced average population declines, while 48 per cent increased in abundance (Figure 18). Six per cent have stable population trends. The trend is dominated by birds (60 per cent) and is thus influenced by their average trends — which includes, for instance, the exponential increases of some birds of prey relative to the 1970 baseline (Figure 19). Within forested habitats, mammals exhibit large population declines (42 per cent on average), while birds are stable (3 per cent).

Figure 17. The C-LPI for monitored populations of species occurring in forested habitats has declined by 6 per cent (credible interval range: +14 to -22 per cent), on average, from 1970–2022. The index includes 686 population time-series for 186 native vertebrate species. A trend for amphibians and reptiles is not displayed due to insufficient data.

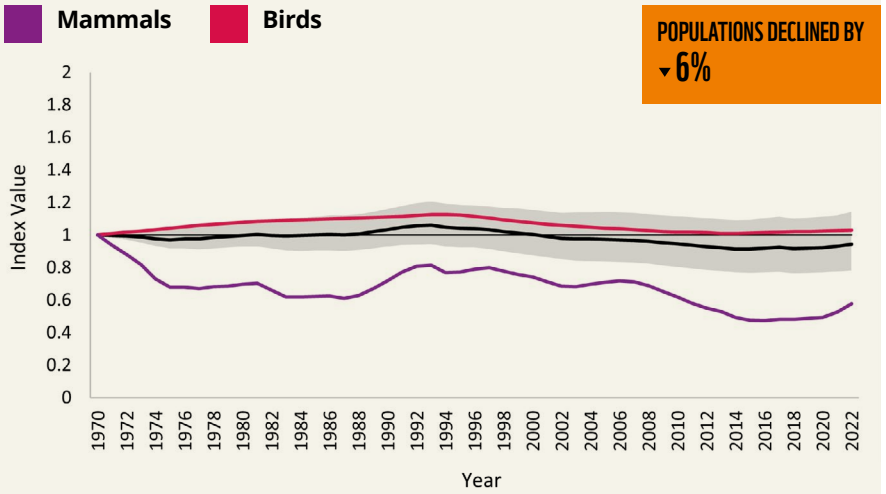


Figure 18. Relative proportion of species with decreasing, increasing and stable trends within the index.

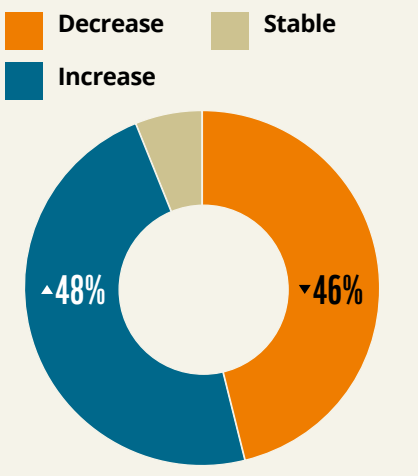
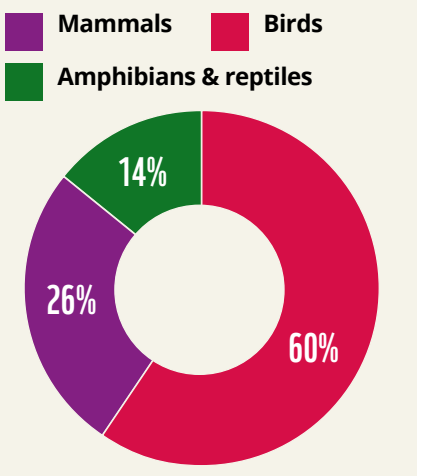


Figure 19. Relative proportion of birds, mammals and amphibians and reptiles included in the index.



Grizzly bear © Doug Kliewer

THREATS
TRANSPORT, BIOLOGICAL RESOURCE USE, ENERGY PRODUCTION AND MINING

HABITATS
FORESTS, GRASSLANDS, ROCKY AREAS

GRIZZLY BEAR

(Ursus arctos)

COSEWIC Status: Special Concern

Animals — and their roles in the food web — have evolved over hundreds of years to reach impressive and confounding levels of complexity that researchers dedicate entire careers to studying. A perfect example is the grizzly bear, a keystone species that plays an important role in maintaining ecosystem health. Grizzlies are apex predators, at the top of the food web and therefore impact prey populations such as ungulates and salmon as well as flora and associated geochemical processes such as nutrient cycles.[129]

Starting from the base of the food web, bears eat roots and tubers by digging them up in meadows with their powerful claws. The removal of selective plants impacts how much nitrogen is available for nearby vegetation.[130] Berries are the preferred food of grizzlies, with one individual capable of eating thousands of berries a day.[131] With this level of consumption, however, there is indirect competition with other animals, such as elk, which also depend on this food source.[132] Once berries pass through the bear's gut, the seeds are dispersed across the landscape providing a natural replanting of berry shrubs.[133]

One of the most iconic grizzly relationships is with salmon on the West Coast. Salmon are anadromous, meaning they live in the sea and migrate to freshwater to spawn. Anadromous salmon have tissues that absorb oceanic nutrients and minerals, transporting them as they migrate from marine to freshwater environments. When grizzlies eat salmon, they further distribute those nutrients to terrestrial environments where they are absorbed by soils, acting as fertilizer for plants. This nutrient influx that happens because of the interspecific interactions among grizzlies and salmon showcases the links between species and their influence on ecosystems.[134]

Western populations of grizzlies — those in Yukon, Northwest Territories, Nunavut, B.C., Alberta, Saskatchewan and Manitoba — are categorized as Special Concern in Canada, with variation among regional trends and distributions.[135]

FRESHWATER

Canada is synonymous with an abundance of freshwater, with its lakes, rivers, streams and wetlands comprising 20 per cent of the world's total surface freshwater.[136] While the overall area of freshwater ebbs and flows with the seasons and weather,[137] the sheer size and extent of Canada's freshwater is renowned, from the country's largest lake (Great Bear Lake), deepest lake (Great Slave Lake) and longest river (Mackenzie River). As an ecologically and geographically diverse assemblage of habitats, the threats to Canada's freshwater habitats are equally varied — from wetland draining to peatland harvest, to pollution and the spread of invasives.

HABITAT HIGHLIGHTS

- Climate change mitigation: Peatlands in particular store more carbon than any other ecosystem, encompassing a third of carbon stored in soils in Canada (when measured up to 1 metre depth).
- Climate change adaptation: Healthy freshwater habitats can absorb excess water to support climate adaptation to floods and droughts.
- Nature-based climate solutions: Protecting Canada's critical carbon stores — such as peatlands — are essential for preventing the release of significant amounts of carbon.

C-LPI: FRESHWATER

The C-LPI for monitored populations of species occurring in freshwater habitats (i.e., wetlands, lakes and rivers) shows a stable trend of 5 per cent, on average, since 1970 (from 1.0 in 1970 to 1.05 in 2022; Figure 20). The trend includes 2,405 population time series of 243 species that occupy freshwater habitats. It includes wildlife such as sturgeon, ducks and turtles. More than half of the species included in the trend (52 per cent) have experienced average populations declines, while 43 per cent increased in abundance (Figure 21). Five per cent have stable population trends. The trend is predominantly influenced by fish (48 per cent) and birds (33 per cent), with amphibians and reptiles contributing 14 per cent of species (Figure 22). Freshwater birds exhibit the largest increases, due mainly to the exponential increases in waterfowl such as swans. Mammals show substantial temporal variability. The data for freshwater fish, specifically, is geographically biased, and reinforces the calls for additional data collection and sharing.

Figure 20. The C-LPI for monitored populations of species occurring in freshwater habitats has been stable (+5 per cent; credible interval range: +32 to -17 per cent), on average, from 1970–2022. The index includes 2,405 population time-series for 243 native vertebrate species. The trend for amphibians and reptiles begins in 1975 due to insufficient data.

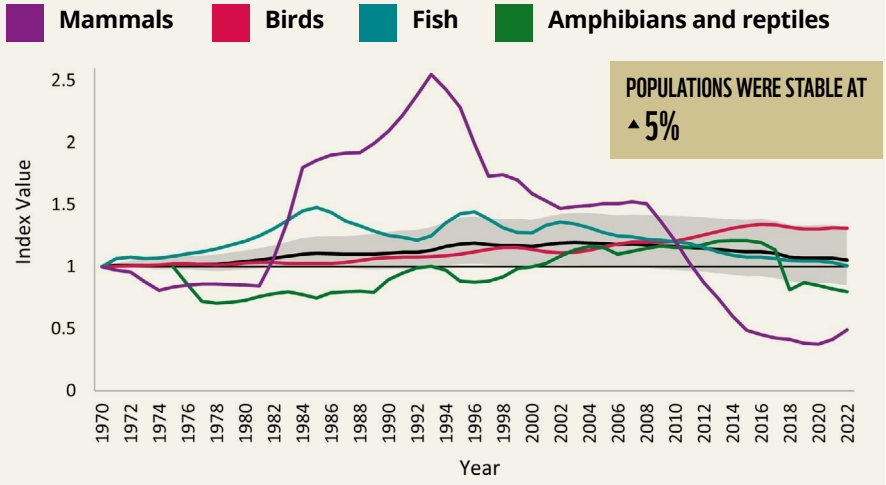


Figure 21. Relative proportion of species with decreasing, increasing and stable trends within the index.

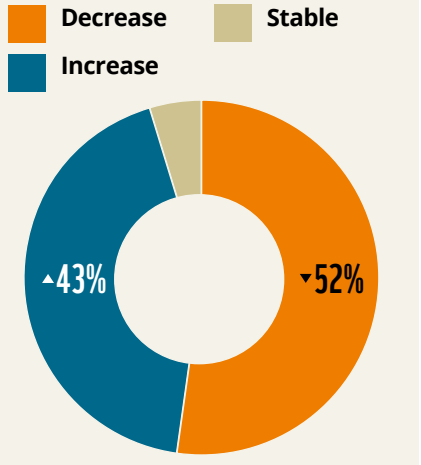
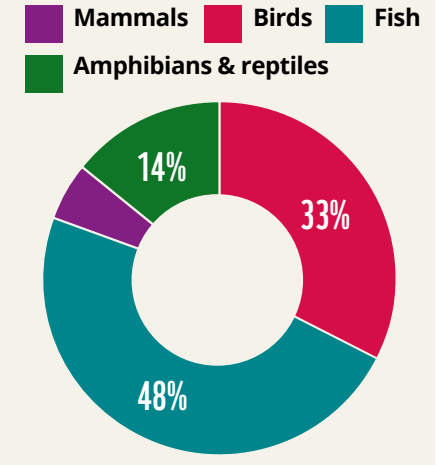


Figure 22. Relative proportion of birds, fish, mammals and amphibians and reptiles included in the index.



Beaver © Tina Hurd

THREATS
HUMAN INTRUSION AND DISTURBANCE, BIOLOGICAL RESOURCE USE, SYSTEM MODIFICATIONS

HABITATS
FRESHWATER, FORESTS

NORTH AMERICAN BEAVER

(Castor canadensis)

Beavers are Canada's largest rodent, but their claim to fame is their role as ecosystem engineers. They have the ability to substantially alter their environments, particularly due to their dam-building activities. When constructing dams in streams and rivers, beavers slow the flow of water, creating ponds or wetlands that, on average, support more species-rich and biodiverse freshwater ecosystems.[138] [139] [140] These habitat modifications can facilitate additional hydrological, geomorphological and ecological habitat alterations, including flood mitigation, carbon sequestration, climate resiliency and water quality improvement through enhanced filtration.[141] [142]

Although beavers themselves are considered keystone species (more specifically, keystone modifiers), their range expansion and influence has also been tied to other keystone species — compounding the ecological influence of particular fauna, which have disproportionately large impacts on ecosystems. For instance, the decline of wolves led to overgrazing of vegetation by herbivores — their main prey. The resulting reduced riparian vegetation is associated with a destabilization of streambanks which reduces channel width, wood debris and the conditions necessary for beaver habitat.[143] Likewise, the existence or reintroduction of wolves positively correlates with riparian vegetation, stimulating beaver distribution that alter freshwater dynamics and facilitate more biodiverse landscapes.[144]

The fur trade from the 17th to 19th centuries caused a dramatic decline in beaver populations, rendering the species nearly extinct.[145] Beavers have since rebounded, largely due to changes in management practices, hunting regulations and habitat protection, and are currently considered Secure in Canada.[146]

WHEN WE TAKE CARE OF THE HABITAT, WE TAKE CARE OF THE WILDLIFE

Jared Davis, a member of Blueberry River First Nation in northeastern B.C., is the Cultural Protection Manager with his community's Lands Department.

After earning a degree in Native Studies from the University of Alberta, he realized "there is only so much you can learn from a book and how important it is to reconnect with community and be on the land." He moved back after he graduated.

Working as a cultural protection manager, he gained an understanding of the land and hunting and fishing regulations while engaging in geographical familiarization with the area's wildlife and habitat.

Note: The following has been edited for length and clarity.

Davis on the changes he's noticing in Blueberry River and the cumulative effects of development

I started a community trapping subsidy program to help break down the financial barriers and get members back to hunting and trapping. My work as a cultural protection manager gets me connected on a deeper level with the people and to the land. I get to see reports on what they're doing, what wildlife they see and all the pictures of the areas that really matter to them.

The amount of oil and gas, forestry and industry that's taking place in the Fort St. John area (close to the border with Alberta), and the cumulative effects of it all has definitely affected our treaty rights to hunt, fish and trap.

It's not just one threat

I talked to my Elders and my dad, and they said the moose and elk populations definitely declined from when they were younger. Before, you could walk out into trails nearby and you would find large bull moose and elk. They would be everywhere, and they would be much healthier than they are now.

Now, they are maintaining their populations but they are not growing, they are not thriving. The cumulative effects of more roads and development not only cause roadkill, but have changed their habitat and calving grounds, which affects their populations and how healthy they are.

Climate change is also a problem. This past winter was really bad. It didn't get cold enough to kill all the ticks and a lot of the moose were covered. They were ghost moose that were either all white or had huge patches of missing hair because of the ticks.

Unfortunately, they don't look healthy. They look skinny, and they don't have a shiny coat. They don't look appealing, and the meat isn't as good.

Death by a thousand cuts

We recently won a huge court case against the province. The British Columbia Supreme Court found that the cumulative effects of industrial development in our traditional territory have resulted in significant adverse impacts on the lands, waters, fish and wildlife. And that's impacted how we can exercise our Treaty 8 rights.

Because of this, we created an implementation agreement with the province. It outlines the cumulative effects on the wildlife populations that have declined, and how we can work together for land stewardship in the region.

Monitoring change together

Through the subsidy program, we make sure that our trappers and hunters are reporting any wildlife — taking pictures and detailing where they see it. They also note which roads are being used and what areas they're in. We also have multiple wildlife camera projects underway to help us understand what animals are out there, and how many.

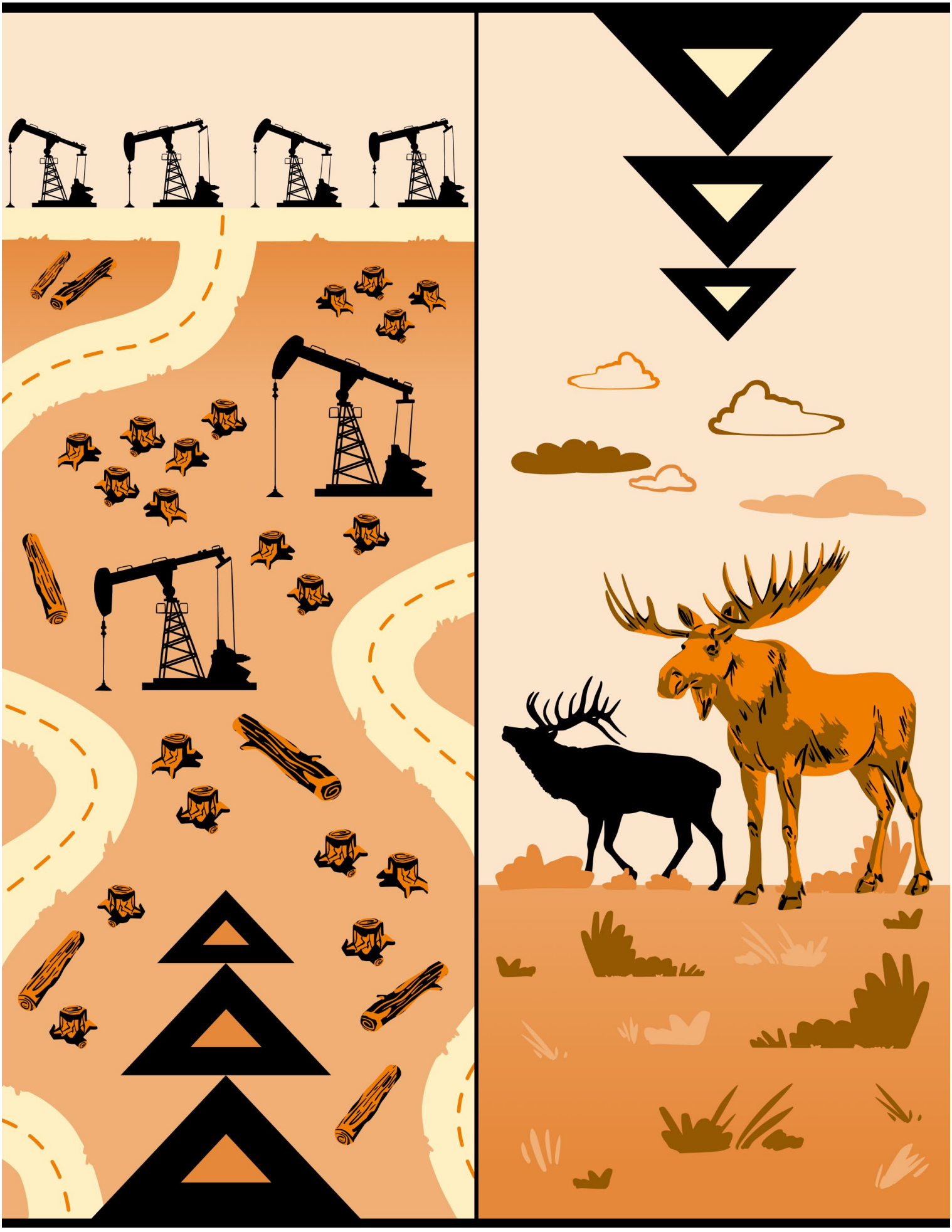
We would like to eventually develop more partnerships with the province, possibly to do some collaring projects that will allow us to better understand wildlife movements and calving areas.

Wildlife are integral to us

The stability of wildlife is important to our people on multiple points. It is our connection to the land base that helps us ground ourselves and who we are as those people who have always hunted, trapped and fished on these traditional territories. That is a part of our stories and our connections.

JARED DAVIS

Cultural Protection Manager, Blueberry River First Nation



HUMAN-DOMINATED LANDSCAPES

Human-dominated landscapes are natural habitats converted to human use. They are prevalent in the south of Canada,[147] where population density, roads, croplands and other infrastructure are highly concentrated spatially.[148] Urban areas make up 0.65 per cent of Canada, while agricultural areas constitute an additional 4.58 per cent.[149] While some species thrive in human-dominated landscapes, others are negatively impacted by their influence. The way urban areas, agricultural landscapes and other human-dominated infrastructure are designed and managed can significantly impact the biodiversity they support.

HABITAT HIGHLIGHTS

- Climate change mitigation: Vegetation plays an important role in the urban carbon cycle, contributing to nature-based carbon sequestration in landscapes dominated by carbon emissions.
- Climate change adaptation: Urban trees contribute climate change adaptation benefits by providing shade to reduce local temperatures. They also reduce local flood risks by absorbing excess water.
- Nature-based climate solutions: Planting native gardens is an accessible action that provides pollinator habitat for a diversity of wildlife while removing carbon from the atmosphere.

C-LPI: HUMAN-DOMINATED LANDSCAPES

The C-LPI for monitored populations of species occurring in human-dominated landscapes (e.g., urban areas, agricultural lands) shows a decline of 17 per cent, on average, since 1970 (from 1.0 in 1970 to 0.83 in 2022; Figure 23). The trend includes 539 population time series of 242 terrestrial species that occupy human-dominated terrestrial landscapes. The trend includes species such as peregrine falcon, racoon and red fox. More than half of the species included in the trend (53 per cent) exhibit declines, while 44 per cent are increasing in abundance (Figure 24). The rest exhibit stable trends. The trend is heavily influenced by birds, which represent 84 per cent of species (Figure 25). When disaggregating into taxonomic groups, birds, mammals and amphibians and reptiles all show declines, on average, with amphibians and reptiles exhibiting more dramatic declines relative to the national trend.

Figure 23. The C-LPI for monitored populations of species occurring in human-dominated landscapes has declined by 17 per cent (credible interval range: -3 to -30 per cent), on average, from 1970–2022. for the index includes 539 population time-series for 242 native vertebrate species. The trend for amphibians and reptiles begins in 1975 due to insufficient data.

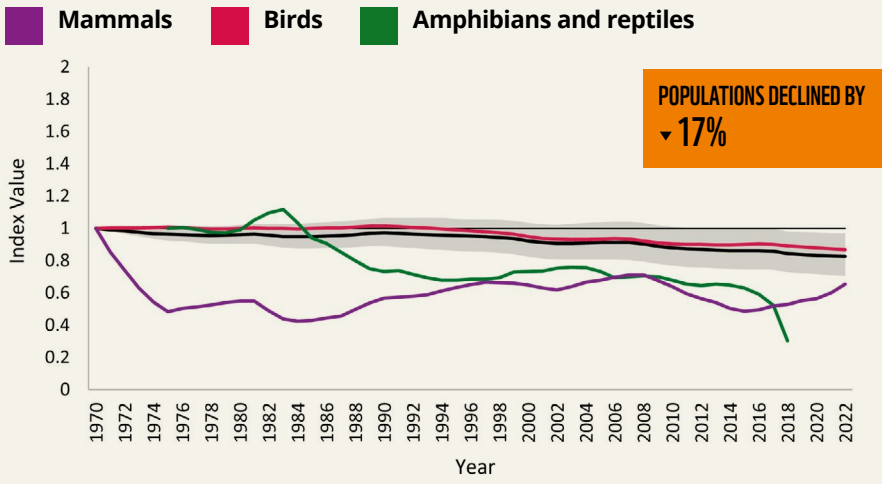


Figure 24. Relative proportion of species with decreasing, increasing and stable trends within the index.

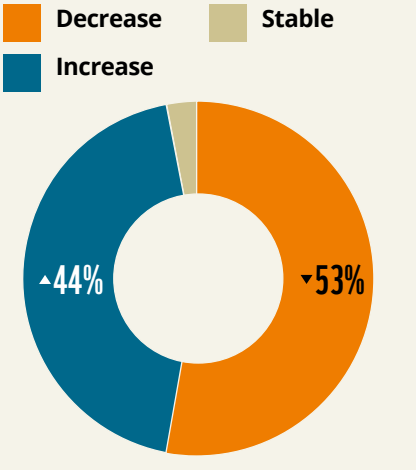
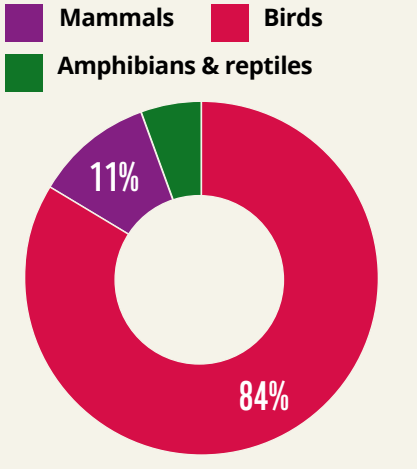


Figure 25. Relative proportion of birds, mammals and reptiles and amphibians included in the index.



Chimney swift © Shutterstock

THREATS
URBAN DEVELOPMENT, AGRICULTURAL ACTIVITY, BIOLOGICAL RESOURCE USE

HABITATS
HUMAN-DOMINATED LANDSCAPES, FORESTS, GRASSLANDS

CHIMNEY SWIFT

(Chaetura pelagica)

COSEWIC Status: Threatened

As their name suggests, chimney swifts use dark and semi-enclosed areas like chimneys for roosting and nesting. This behaviour originates from occupying caves or snags in mature forests: snags are dead, semi-hollow tree trunks with an opening at the top where chimney swifts can enter to build a nest and lay eggs.[150] These hollow trees declined with logging in forests, so the birds adapted to using chimneys. However, the artificial habitats that once replaced the natural snags are now themselves dwindling due to the demolition and modification of chimneys and similar urban structures.[151]

Data suggest that chimney swift populations have declined by 90 per cent relative to 1970.[152] While loss of nesting and roosting habitat may be one factor, there are multiple drivers contributing to this massive downward trend.[153] As insectivores, these species depend on flying insects, including multiple species of beetles, mayflies, wasps and bees, for food.[154] Their role in the ecosystem, alongside other aerial insectivores such as swallows and flycatchers, is to provide natural pest control and ensure that insect populations remain stable at healthy levels. However, agricultural intensification and pesticide use have contributed to insect population declines, which in turn has had direct consequences for insect-feeding birds.[155] [156]

DATA GAPS

Ideally, the C-LPI would be based on species and population time series that are wholly representative of the diversity of Canadian vertebrates. Yet, despite acclaim as the most representative population abundance dataset at a national scale,[157] 49 per cent of native vertebrate species are not included within the C-LPI. Among those that are, many have inconsistent spatial and temporal coverage.

This lack of data may be due in part to insufficient biodiversity monitoring, absence of publicly available data and/or data that do not meet the criteria for inclusion within the index. Moreover, the data that are included in the index are spatially, taxonomically[158] and biologically[159] biased. For instance, Canadian birds are substantially better represented relative to other taxonomic groups, owing to volunteer-led annual monitoring and status evaluations by Environment and Climate Change Canada. Population time series for carnivorous reptiles (e.g., snakes and lizards) are considerably lacking[160] — both in terms of species and spatial extent. In addition, C-LPI data is biased toward large, commercially important marine fish because of an abundance of data from Fisheries and Oceans Canada research vessel trawl surveys, the primary purpose of which is to contribute to stock assessments for management of marine fisheries. These and other underlying biases in the C-LPI are also reflected in biodiversity research even at a global scale.[161] [162]

These limitations have been accompanied by recommendations for enhanced monitoring to address data gaps and improve the representation of species within biodiversity indicators.[163] [164] The importance of monitoring cannot be overstated,[165] and additional population time series data is critical to analyzing accurate trends in Canadian vertebrate species. By continually evaluating, comparing and prioritizing the distribution of biotic species traits (e.g., body size, trophic level) and abiotic influences (e.g., geography, protection) on population time series included within the C-LPI, data gaps can be targeted and underlying data biases can be recognized to more accurately estimate the direction and magnitude of average trends in population abundance nationwide.

Ontario, Canada © Karen Rosborough / WWF-Canada

White shark © naturepl.com / Mark Carwardine / WWF

THREATS
BIOLOGICAL RESOURCE USE, POLLUTION

HABITATS
MARINE AND COASTAL

WHITE SHARK

(Carcharodon carcharias)

COSEWIC Status: Data Deficient - Endangered

Historically, white sharks visited Canadian waters — the northern periphery of their range — infrequently and were once considered rare. Previous assessments in Canada were based on relatively few records over several decades and, thus, reliable trend estimates were difficult to obtain.[166] However, sightings and telemetry data of this apex predator have indicated a substantial increase in recent years.[167] [168]

There are various factors that could be at play, the simplest being better technology and more frequent reporting. However, a northward expansion of white sharks in the Northwest Atlantic may be a result of climate change-induced warming waters and/or an increase in the availability of prey such as seals.[169] Despite an increase in sightings in Atlantic Canada, the broader Northwest Atlantic population (beyond Canada) is estimated to have declined by over 70 per cent since the 1960s, with the primary threat being bycatch in fisheries. Since the 1990s, however, the population has remained stable.[170]

Continued and expanded research will be critical to evaluating the status and impact of this apex predator as it continues to move into Canadian waters.

Canadian Arctic © Shutterstock

GEOGRAPHICAL DATA GAPS: ARCTIC HABITATS

The Arctic region extends throughout Nunavut, Northwest Territories, Yukon, northern Quebec and Labrador and comprises predominantly tundra and taiga habitats — cold biomes with sparse vegetation. Biodiversity monitoring in this region presents significant challenges due to the Arctic's harsh and remote environment, yielding a much higher cost per effort. Extreme temperatures, limited accessibility and a short field season complicate efforts to collect and analyze data on its diverse flora and fauna. For instance, harsh weather conditions can not only damage equipment and reduce the reliability of data collected but can also make fieldwork physically challenging — and sometimes dangerous. In addition, the remoteness of the region adds logistical complexity, as specialized equipment and/or transportation may be required.

Despite these — and other — challenges, monitoring Arctic biodiversity is crucial given the region's sensitivity to climate change and its outsized role in global ecological processes. The Arctic's average temperature has already risen at a rate of almost four times the global average,[171] correlating with large increases in shipping traffic.[172] Thankfully, knowledge holders and scientists in the Arctic have successfully documented landscape and wildlife population changes despite these challenges, and ongoing efforts are underway to collect a diversity of data to support multiple initiatives, including, for instance, data to support community land-use plans. While those initiatives may not directly contribute to the C-LPI, the information is vital for monitoring wildlife and informing conservation action.

NORTH SLAVE MÉTIS PERSPECTIVES, EXPERIENCES, KNOWLEDGE AND STORIES TO INFORM THE FUTURE OF LAND USE PLANNING

The North Slave Métis Alliance (NSMA) area spans roughly 700,000 km^2, predominantly situated in the Northwest Territories, and extending beyond administration boundaries into Nunavut, Alberta and B.C. Community members have noticed human-induced and natural changes on the landscape evolving each year. It's those changes, combined with funding availability, that have prompted the NSMA to take action through the creation of a Traditional Land Use Plan.

Over the past five years, with the support of the Government of the Northwest Territories, the NSMA has created a Community Advisory Committee (CAC) that primarily supports land-use planning, though its responsibilities extend to additional projects. When wildfires swept through the territory in 2023, the CAC reinvigorated an interest in developing a fully functional traditional knowledge archive and database — one that could be periodically updated and used to support land-use planning and the transmission of knowledge.

While a traditional knowledge archive and database did exist, the NSMA assessed deficiencies within it, including data gaps and limited documentation, in addition to poor uptake. The CAC is working to identify those gaps and document traditional knowledge in specific regions and topics. Applying a more systematic approach helps to fill in data gaps and ensure the database is thematically tagged for quicker reference. For instance, "environmental change" could be indicated by phrases such as "it's not like it once was" or "when I was young" — using different terminology to discuss similar concepts.

The systematic documentation of past interviews with community members, dating back to the 1970s, may allow for assessments of cumulative effects over time as well as documenting adaptation strategies. This form of data is qualitative and incorporates both the experiences and observations of Métis peoples, which are irreplaceable. This information, combined with current and future input, may subsequently be used to ensure that Métis perspectives, experiences, knowledge and stories are shared more broadly with the community to support generational knowledge, in addition to supporting community land-use planning and federal and territorial decision making.

> "As part of maintaining our distinct identity, it is important that we share our knowledge and understanding of our ways. And today's world transmission of knowledge does not so much happen around the campfire or over shared cups of tea, but particularly with young people happens more in the interconnected digital space on social media and the internet. It has been increasingly important to ensure that those in our community who have knowledge are free to share what they know by all available means back to our community. Such sharing enables more cohesion and strengthens the vision into the future by extension. This comprises the significant aspect of the rationale for sovereign land based in our home region.
>
> – Adrian D'Hont, North Slave Métis Elder

Snowy owl © Don Getty

THREATS
CLIMATE CHANGE, TRANSPORT

HABITATS
ROCKY AREAS, FORESTS

SNOWY OWL

(Bubo scandiacus)

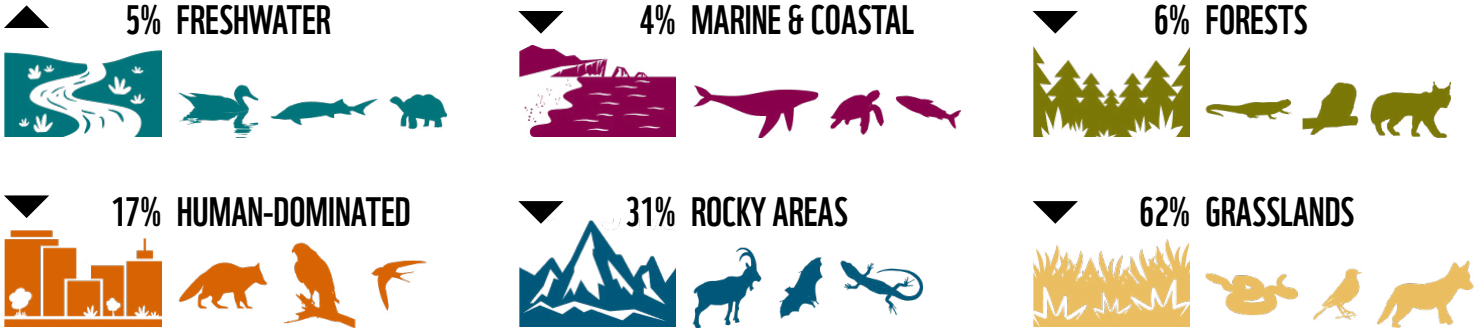
COSEWIC Status: Threatened

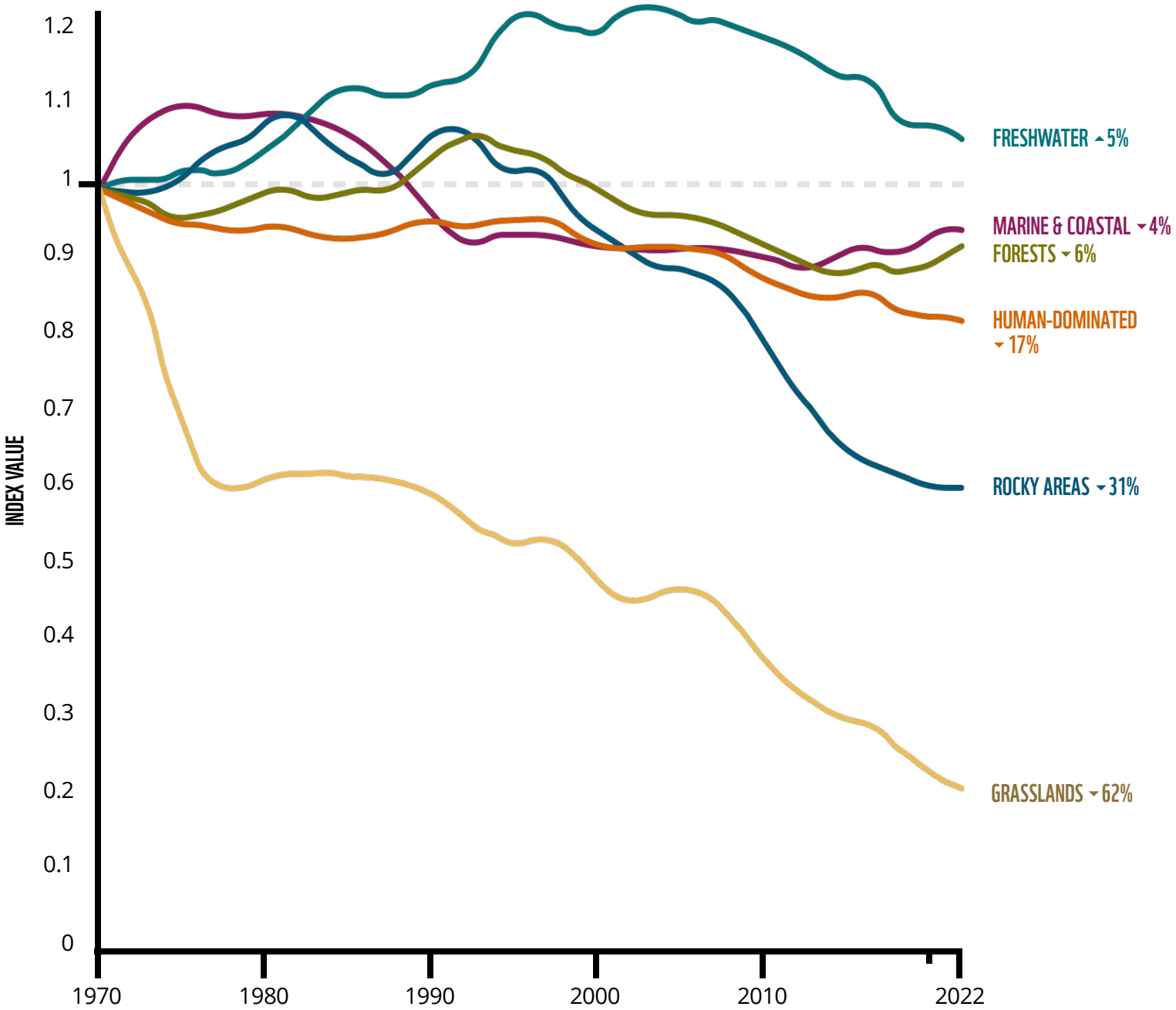
With binocular vision, acute hearing and a wing structure that absorbs sound and makes flight noiseless,[173] snowy owls are noteworthy predators. They are active both day and night, taking advantage of 24-hour summer Arctic light[174] to opportunistically hunt a diversity of prey including snowshoe hares, ptarmigans and seabirds — they do, however, have a preference for lemmings.[175] In regions where owls depend on lemmings, prey availability and breeding success are intimately related.[176] [177] [178] When there is a high density of snowy owls, a large number of young owls fly south for the winter to avoid competition for resources — a well-documented unpredictable movement called an irruption migration.[179]

One of the main threats to snowy owls is climate change, particularly as the global Arctic is warming at four times the rate of the rest of the planet.[180] Climate change may affect the abundance of prey, which is particularly critical for birds in their first year of life. Additional threats include anthropogenic development, collisions and exposure to environmental contaminants.[181]

Over half of the global population breeds in or migrates through and to Canada, putting a high degree of responsibility on the country. Since 1970, the snowy owl population in Canada has declined by approximately 56 per cent, though there is large interannual variability reflecting both changes in abundance and distribution.[182]

HABITAT TRENDS





Open pit mine for gold ore extraction © Shutterstock

THREATS TO WILDLIFE

04

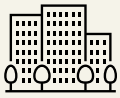
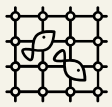
Successful recovery of biodiversity relies on the effective mitigation of threats — the factors that are responsible for population declines.[183] Despite a depth of knowledge on the major drivers of species decline, many of them remain pervasive and have even accelerated since 1970.[184] [185]

Given that biodiversity and human pressures are unevenly distributed across Canada, spatially identifying and quantifying threats can help guide conservation actions that maximize species recovery.

Some threats — such as climate change — are accelerating rapidly and pushing ecosystems toward irreversible tipping points.

In 2008, the International Union for the Conservation of Nature (IUCN) released a common threat classification to systematically identify the direct drivers of species declines.[186] Direct threats are the activities that cause nature decline, rather than the outcome. For instance, "energy production and mining" and "biological resource use" in the form of logging are direct threats — their outcome is habitat loss. Since 2008, the classification has been periodically updated, with the newest version (4.0) released this past year.[187] Within the following spatial threats analysis there are 9 high-level IUCN threat classifications grouped under three categories (Table 3).

Table 3. Direct threats to wildlife as depicted by the IUCN's Classification of Direct Threats to Ecosystems and Species version 4.0, and associated data layers included in the spatial threat analysis by Currie *et al*. 2025

	Direct Threat (IUCN)	Description	Data Layer(s) Included in Analysis
Use of Lands and Waters	 Urban development	Human settlements (e.g., housing, offices, schools, etc.), factories and other commercial centres, and tourism and recreational sites	Urban cover Population density
	 Agricultural activity	Agricultural expansion and intensification due to farming, ranching, and annual and perennial crops	Cropland and pastureland Cattle density
	 Energy production and mining	Exploration, development and production of minerals and rocks (mining and quarrying), petroleum and other liquid hydrocarbons (oil and gas drilling)	Oil, gas and mining production Oil rigs (marine)
	 Transport	Transportation and service corridors and the vehicles that use them, including roads, railroads and shipping lanes	Roads Railways Shipping
Use / Management of Species and Ecosystems	 Biological resource use	Exploitation of biological resources at unsustainable levels, including both deliberate (e.g., logging) and unintentional (e.g., bycatch) harvesting effects. Includes unsustainable fishing, in addition to unsustainable logging and wood harvesting that contribute to habitat loss. Forest loss encompasses conversion due to industry, fires and pest outbreaks	Forest loss (conversion)[e] Commercial fishing Recreational fishing
	 System modifications	Modification of natural systems through dams, water management and use, fire and fire suppression	Dams
Additional Sources of Stress	 Invasives and disease	Invasive and other problematic species, genes and diseases	Invasives
	 Pollution	Threats from the introduction of materials or energy from both point and non-point sources, including domestic and urban wastewater, industrial and military effluents, agricultural and forestry effluents, garbage and solid waste, air-borne pollutants and excess energy (e.g., light)	Fertilizers Pesticides Light pollution Coastal pollution Ocean-based pollution
	 Climate change	Linked to global warming and other severe climatic events including droughts, floods, sea-level rise and tundra thawing	Temperature Precipitation UV anomalies Ocean acidification Ocean surface temperature anomalies Sea-level rise

[e] Forest loss encompasses conversion due to industry, fires and pest outbreaks.

HIGH-INTENSITY CUMULATIVE THREATS

Canada is renowned for its vast and diverse natural landscapes — ranging from the rugged Rocky Mountains to the expansive boreal forests and extensive coastline, with temperatures that can span a 100°C range. However, the country's natural landscapes contrast sharply with areas that face direct human pressures,[188] many of which are prevalent in the south.[189] [190] Threats are not only high in intensity, but are also overlapping, particularly in the Mixedwood Plains, Prairie and Atlantic Maritime ecozones (Figure 26), which comprise many of Canada's crisis ecoregions.[191] In marine ecosystems, high-intensity cumulative threats decrease with distance from the coast, suggesting that anthropogenic activity on land can have an impact on other ecosystems.

While the biodiversity crisis reflects global declines,[192] [193] [194] changes can be less obvious or even contrary to expectations in specific geographies such as Canada. It is this local heterogeneity in both biodiversity trends and associated drivers that can support more directed conservation action.[195] In Canada, despite consistently stable or negative C-LPIs across habitats, we find evidence of heterogeneity in trends of different species from 1970–2022. Monitored populations in human-dominated landscapes showed an average decline of 17 per cent relative to 1970, likely owing to the net negative effects of habitat loss and associated threats on biodiversity.[196] Notably, this trend is less dire relative to natural habitats, which are being continually lost or degraded. In addition, some species, such as the peregrine falcon, actually thrive in human-built environments.[197]

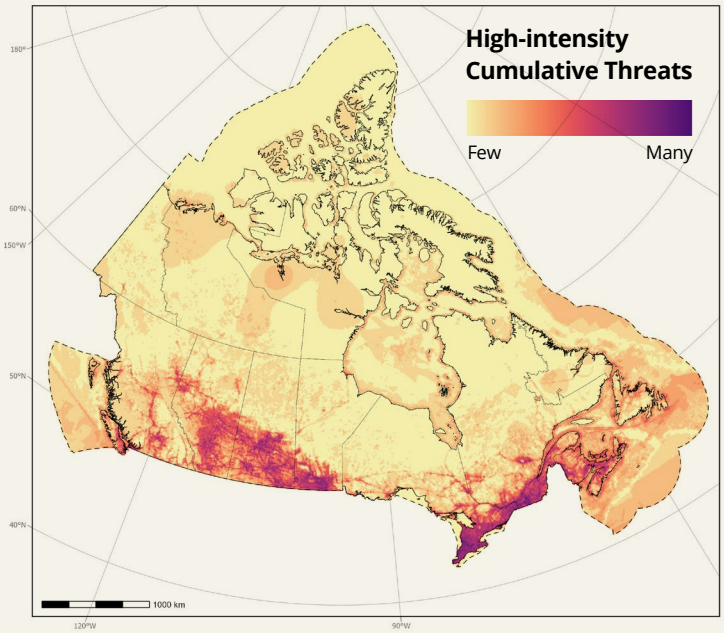
Agricultural activity is the leading cause of land conversion in Canada,[198] with significant historical impacts on grassland ecosystems contributing to the average 62 per cent decline for monitored populations of species occupying grassland habitats. Today, agriculture is the reason for nearly half of deforestation (i.e., conversion from forests),[199] while industrial logging practices can lead to forest degradation.[200] [201] The loss and degradation of these habitats have cascading effects on ecosystem services such as climate change mitigation, water filtration and wildlife habitat.

Harvested fields, Longview Alberta, Canada © Shutterstock

When threats are introduced and then magnified, the inherent interconnectedness of nature means that there can be a variety of compounding and cascading effects.

Average population declines in Canada are found to be associated with (i) the number of habitats a species occupies and (ii) high-intensity cumulative threats, both of which have implications for conservation action.[202] Cumulative threats can contribute to extinction debts — the idea that species are already destined to extinction in the future based on threats they've already faced.[203] For instance, habitat fragmentation can reduce the size and movement of populations, and when impacted by additional pressures, these small, isolated populations will be less likely to recover. Likewise, climate change is creating a mismatch between species' thermal tolerances and geographies, further constricting their potential habitat until, in some cases, none remains.[204] By definition, species populations must first decline before becoming extinct. Thus, while stable or marginally declining average population trends might not seem particularly alarming, these trends, combined with information on threat intensity in Canada, provide early detection signals to reinforce the need for conservation action across the country.

Figure 26. Spatial distribution of high-intensity cumulative threats in Canada. Threats include urban cover, population density, cropland and pastureland, cattle density, oil, gas and mining (terrestrial), oil rigs (marine), roads, railways, shipping, forest loss (conversion), commercial fishing, recreational fishing, dams, invasives, fertilizers, pesticides, light pollution, coastal pollution, ocean-based pollution, temperature anomalies, precipitation anomalies, UV anomalies, ocean acidification, ocean surface temperature anomalies and sea-level rise. From Currie *et al*. 2025.

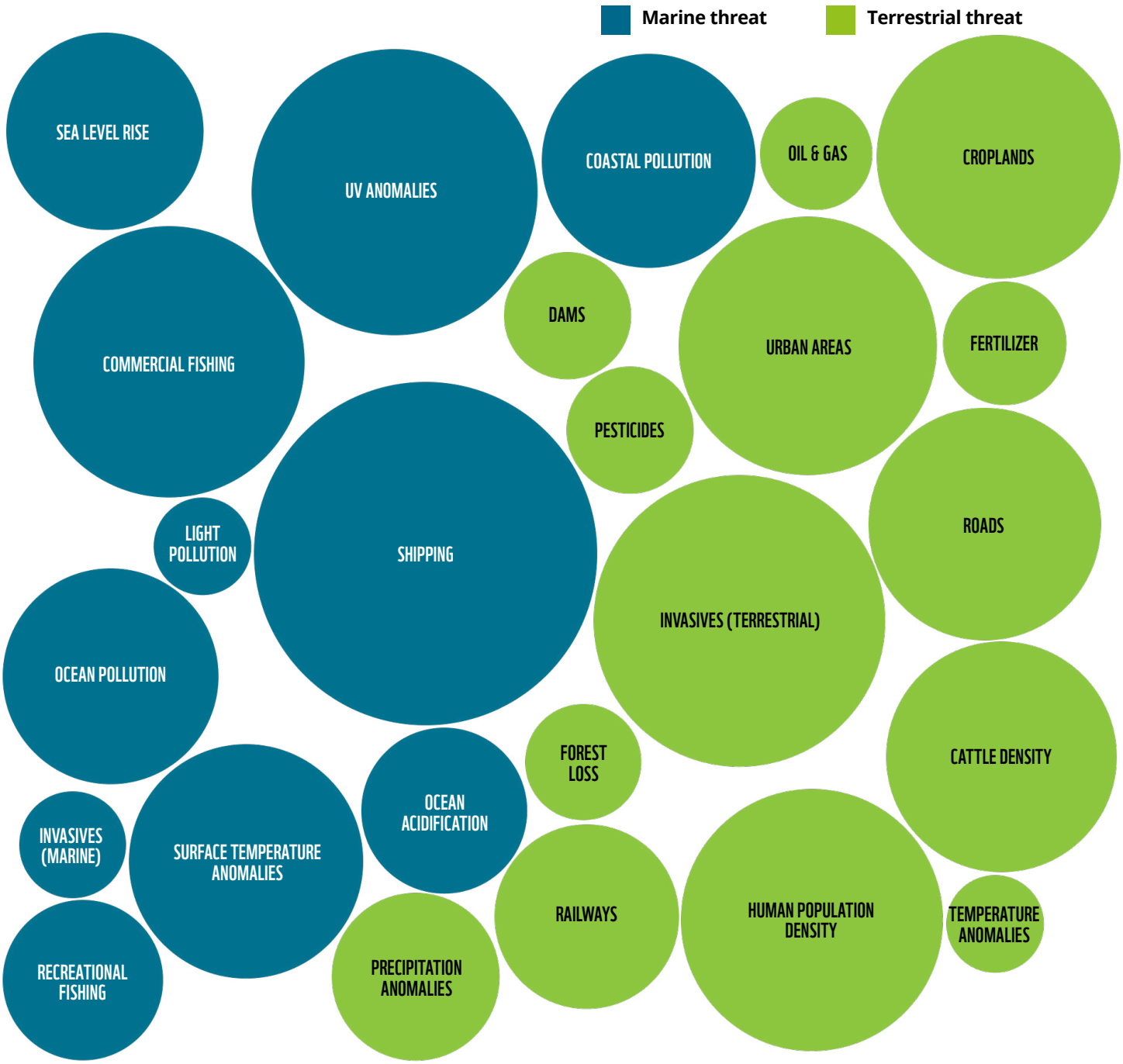


EVALUATING INFORMATION FROM MULTIPLE STUDIES

A diversity of analyses have documented threats and outcomes to wildlife, each with different variables, species, scopes and approaches. While there is nuance to each method and its associated results, the main take-away remains clear: Biodiversity is threatened by multiple, compounding and cumulative pressures. Depending on the study, one threat may be more prevalent than another. For instance, many non-spatial analyses that aggregate threat outcomes into high-level categories suggest that habitat loss is the most dominant.[205] [206] This aligns with humanity's growing footprint – covering more than three-quarters of Earth's land (excluding Antarctica) and 87 per cent of oceans.[207] [208] [209] However, when threats are categorized by their direct source of stress (e.g., transportation, pesticides), such as through the IUCN classification of threats[210] — rather than their outcome — biological resource use (the deliberate and/or unintentional harvesting of biological resources at unsustainable levels) often becomes a leading threat, particularly for species at risk.[211] [212] Notably, however, broad-scale analyses relying on quantitative and spatial data should be accompanied by local knowledge and priorities to more appropriately support biodiversity recovery objectives and associated conservation actions.

LINKING THREATS TO POPULATION TRENDS

Within terrestrial systems in Canada, urban development, agricultural activity, transport (i.e., roads), and invasives and disease are the most prevalent spatial threats for populations within the C-LPI (see Table 3 for data layers included in the analysis). By contrast, marine populations in the C-LPI predominantly co-occur with transport (i.e., shipping), biological resource use and pollution.[f 213] There are, however, taxonomic differences. For instance, biological resource use (i.e., commercial fishing) is one of the top threats to fish, while coastal pollution overlaps with mammal, amphibian and reptile data.[214] Monitored populations are rarely threatened by just one pressure, with species often impacted by multiple, compounding pressures.



[f] *Note: Based on broader C-LPI dataset that retains ten of thousands of population time series for greater spatial solution.*

LAGGING BEHIND: WHY RECOVERY — AND ITS INFLUENCE ON BIODIVERSITY INDICATORS — TAKES TIME

Lags between threats and recovery are common in biodiversity indicators because nature takes time to respond to both harm and conservation efforts. These "lags" or delayed responses to environmental change occur as a result of complex ecological processes and may vary across taxonomic groups and drivers.[215] For instance, in some cases, a threat might have an immediate impact (e.g., overexploitation of a species), while others could take time (e.g., climate change or the accumulation of pollutants that affect brood size). Moreover, physically larger species may display longer ecological lags relative to smaller ones,[216] due to often being longer-lived and thus having longer generation lengths before impacts can be seen. The variation in temporal response to anthropogenic threats has consequences for biodiversity monitoring and indicator interpretation, particularly because the impacts of threats may continue to accumulate decades following the initial disturbance.[217]

The LPI (and C-LPI) is a direct measure of changes in relative population abundance and can thus detect early signals of decline or increase.[218] [219] This is in contrast to other indicators that evaluate metrics that are slower to respond, such as extinction risk (e.g., IUCN's Red List Index) and/or rely on indirect measures of change such as habitat loss or species distributions (e.g., Species Habitat Index; Biodiversity Habitat Index). While the LPI (and C-LPI) is valuable for its sensitivity and responsiveness to changes in the short term relative to other indicators, [220] [221] [222] [223] it is nevertheless a lagging indicator of abundance change, given the delay between data collection and incorporation into the LPI.[224] Consequently, ecological delays may be further compounded by monitoring and indicator lags.

Athabasca River, Fort McMurray, Alberta, Canada © Shutterstock

WE NEED THE WORLD TO BE SERIOUS ABOUT TOMORROW

Annie Buckle has spent most of her life calling what we now know as the Northwest Territories home. The Gwich'in Elder was taught to live culturally and traditionally — being on the land is in her blood. Spending time at various family members' cabins growing up, she now lives just outside of Aklavik in a cabin of her own.

A Gwich'in Elder, Buckle's knowledge of the land and species that occupy it is vast. She's spent her life accumulating knowledge and beliefs about the relationships between the species in her region and how to respectfully coexist. This knowledge she's inherited has been passed down from generation to generation and is built on thousands of people's direct contact with the environment.

Note: The following has been edited for length and clarity.

Buckle on the changes she's noticing in Gwich'in Territory, the impact of climate change and the importance of spending time at camp

I was brought up living a cultural and traditional life in my territory and going on the land was always in my blood. Over the years I've noticed a lot of change; what I'm seeing most right now is the char not running like it used to. It used to run at a certain time, but nowadays we don't know when it's coming and so people get nets out, but they're just getting bits.

I've also noticed an increase in beavers; there are too many making dams all over that are impacting the water levels. Plus there's a bunch more wolf packs and animals coming close to town. Two or three years ago there was 11 bears at the garbage, but this year, they said there's only two. So, something's happening

The fires and climate change are affecting our way of life

Climate change is an issue with harvesting by the seasons here, the changes make animals confused. They're coming closer to town and farther north.

I'm also noticing more impact from the fires down south; we're having to breathe in the smoke and the heat is hard to tolerate. What we need to do is protect, protest and start growing our own veggies, harvest more fish and meat to get people and the planet healthy again. I think the land is the key to a better, longer life.

Everything we need is on the land

For us up north, spending time on the land at camp is really important. My fish camp was passed on to my mom and dad from one of their friends, and as they got older and hardly came up, they told us, "Never leave that camp abandoned."

So, my nephew got a house, and I got my own house and we built everything up. Now my family all come and enjoy each other's company when we can – there's about 10 of us up at camp.

We have everything we need here: fish and berries; the cranberries I need are right in my backyard. I'm one of those people that dream up all this deadly stuff with cranberries. I make trifle sauces for desserts, I try spices with different fruits, a bit of everything — all my nieces and nephews love my food!

Monitoring for us is just people talking to each other

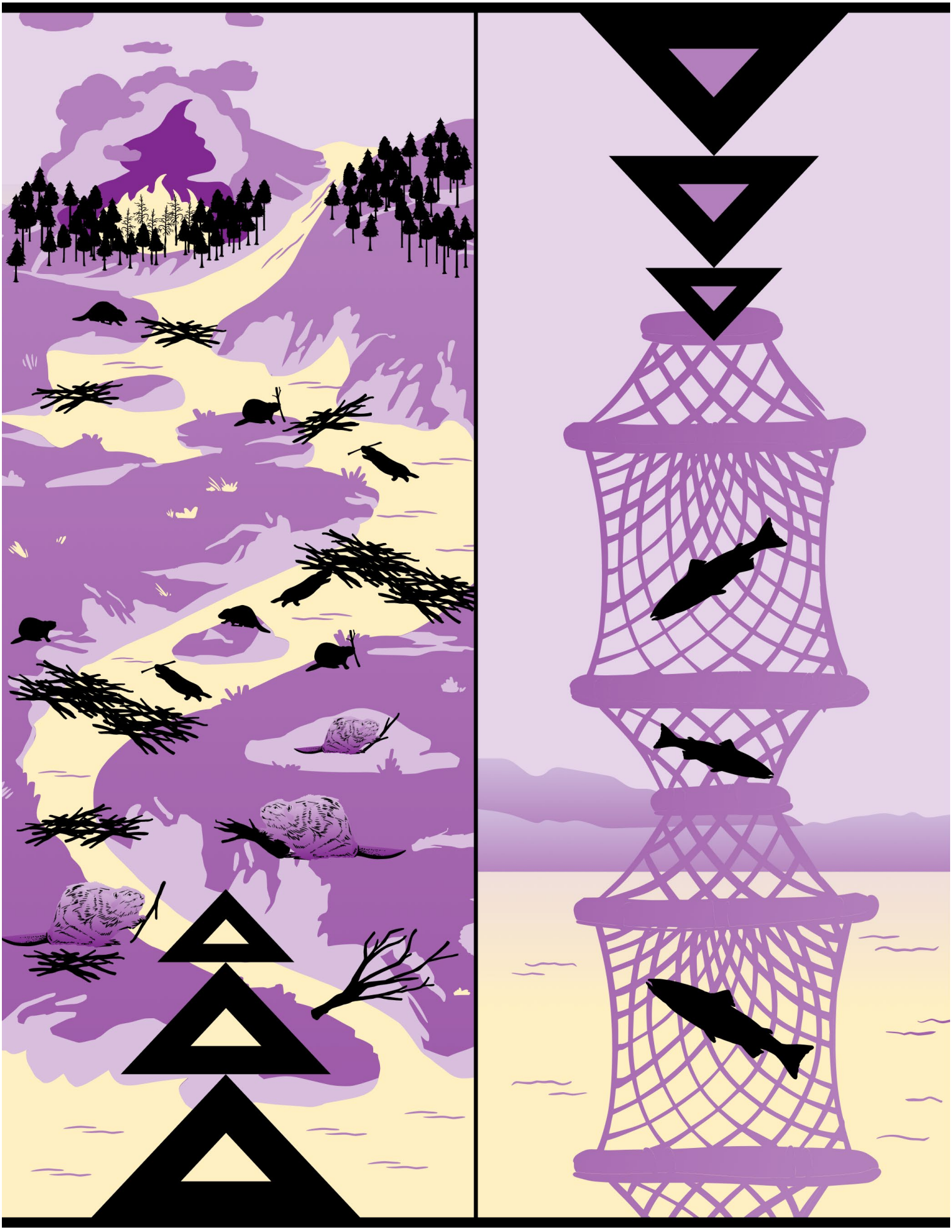
In the past, leadership had people that would watch to know what's going on around the lands. But as leadership changes, things change, and now they have no one. So, the community talks, and we share what's happening over Facebook.

I got a really genius nephew, Dwayne, and on a recent trip to Aklavik he was telling me that he saw this orange stuff along the river, that it seems like rust or iron coming out of the creeks. Then some young people were driving around after hearing about what Dwayne found and they're looking for a reason why it's there. So, we don't have people formally investigating but at least there's interest and some people are looking into it.

Really what we need is unity, for people to go into environmental work and for opportunities to be created for them. We need more people to get involved, to care and the world to be serious about tomorrow.

Translation provided by Eleanor Firth
Language: Gwich'in (Teetl'it Gwich'in dialect)

ANNIE BUCKLE
Gwich'in Tribal Counci



NÀNH KAK TTHAK T'ANIINCH'UU KAT YEENDOO GEEN-JIT GWIIYEENDOO GANIINJI' GIHEEDHAT DIINJIIDIZHIT

Annie Buckle gwindaii tthak jii Northwest Territories danh gwiindài'. Anjoo nilii ts'àt nits'oo Dinjii Zhuh gwindaii vayuunìltinh – gwatat gwindaii vidaa zhit diinch'uh. Diink'iinzhit guuzhik vizhehk'oo nihłinehch'i' gwatat guukaiik'it guuvah t'iinich'u', jùk Aklavik ehghee zheh di'in ts'àt ezhik gwich'inh.

Anjoo nilii, nan ts'àt nin dagoonch'oo Buckle gwiiyeendoo gahdandaih. Gwindaii tthak nin geenjit gik'iniljik ts'àt nits'oo gwiinzii nihàh tr'igwiheendaii ahdandaih. Nits'oo gwatat tr'igwindaii yeenoo tthak gahgweedandai' ts'àt yeendoo łagweeda'aa k'iighè' nits'òo gwatat gwiheendaii ahdandaih.

Gahgwiheedandaih: Jii gwiyeezhak nigwan ts'àt gwindoo gahtr'iheedandaii tr'ałtsaih.

Gwich'in nànhkak ejuk t'igwinjik ts'àt gwatat tr'igwich'in łi'hàh gwijiinchii goonlii, Buckle geenjit gịịkhih:

Diik'iishit guuzhik shinànhkak gwihch'inh, gwatat nachihdik shidàa zhìt diinch'uh. Nagwidadhat guuzhik ejuk t'igoonch'uu gwinł'inh; dhik'ii nits'oo han gwinjik k'adivik ejuk diinch'uu gwinił'inh. Yeenoo nijuk dài' jii han zhìt t'iheech'aa gahgweedandài', jùk ejuk goonlih, dinjii kat guuchihvyaa hàh tr'iilee giinlii gòo' leii kagidi'inh kwàh.
Aii gehghee ts'àt tsèe' leii goonlii gwinił'inh; gwindoo leii giinlii ts'àt nanii'ol gahtsii k'iighe chuu ejuk diinch'uh.

Aii gehghee zhoh ts'àt nin ezhii kaiik'it gwits'àt nyahgwan t'igiinch'uh. Nagwidadhat neekaii goo tik gwinoo shoh ihłak juutin ts'àt ihłak agwahłeii tsijiinch'ii uu'an tr'ihilii deek'it danh giinlii, juk nagwidhat neekaii zraih ezhik giinlih. Jii k'iighè' ejuk t'igoonch'uu gahgwidandaih.

Nan kak guk'an ts'àt nikhwinagoo'ee ejuk t'igwinjik k'iighè' nits'oo gwiidandaii ejùk gòonlih

Nikhwinagoo'ee ejuk t'igwinjik k'iighè' nin katr'idi'in geenjit gwiizuu, ejuk t'igwinjik k'iighè' nin kat dagiheedya'aa gahgidandaih kwàh. Kaiik'it gwits'àt nyahgwan t'igiinch'uu ts'àt north gwa'àn gwiiyeendoo t'igiinch'uh.

Yeenji' guk'an k'iighè' nikhwah ejuk goonlii chan gwinił'inh; juukan' gwilàt hàh iidizhak ts'àt gwiiyeendoo gwiniidhaa k'iighè' gugoontrih. Guk'andeh hanahtyaa, geenjit gikhiidikhyaa, kheenjit gwinzhih hanaazhii, gwiiyeendoo łuk ts'àt nin katr'iheedya'aa k'iighè' dinjii kat tthak gwiiyeendoo srìi gugwiheendaii ts'àt nan tthak srìi gwihee'ah. Gwatat tr'igwindaii jì' gwiiyeendoo niinzhuk srìi tr'igwinheendaii nihthanh.

Jidii t'ajaach'uh nan kak tthak goo'aih

Jii north gwa'àn t'iidich'uu kat gwatat nikhwikaiik'it goo'aih danh t'iidichuu łi'hàh gwijiinchii goonlih. Shiłuk deek'it shiyuughwan guujaa kat guutsan giłtsaih, anjoo giinlii tł'ee gwits'ee geehdah kwaa ts'àt, 'Ezhik eghè'uudohnuh srò',' nikhwigahnuh.

Shuu zheh di'in ts'àt shii chan shi'in ts'àt tthak dhaatsaih. Jùk nijin nikhweenjit goo'aii shizhehk'oo tthak nikhwikaiik'it neeniidi'oh ts'àt nihàh srigoonch'uu daatsih – ihlak juutin agwahłeii gwatat nikhwikaiik't danh t'iidich'uh.

Jidii t'ajaach'uh tthak zhat danh iidi'inh; łuk ts'àt jak, natłat t'adilch'uh shizheh gwintii goonlih. Natłat gwiinlit geenjit t'adilch'uh. Nihłinehch'i' vàh ełtsih, desert geenjit trifle sauces, spice ts'àt jak nihłinehch'i' vitat naihjah – shuu kat jidii vikè'ełch'uu tthak gat'igiiniindhanh!

Gukandehtr'inahtii dài' geenjit nihàh giniidikhii k'it nikhweenjit diinch'uh

Niinzhit dài' gwanoo chit kat nan dagoonch'uu gwiiyeendoo gwiinzii gàhgeedandai'. Jùk nikhwichit kat ejuk giinlih ts'àt tthak ejuk t'igoonch'uh, jùk jii geenjit nadhat gidi'inh kwàh. Kaiik'it gwizhit geenjit nihàh tr'igịịkhii ts'àt Facebook kak chan geenjit giniidikhih.

Shuu Dwayne gwiiyeendoo vigwizhi' goonlih. Ihłat Aklavik gwits'àt chuuzhih dài' han gwinjik ejiichii ditsik chuu zhìt diinch'uu nah'ìn' shàhnuh, chehtsùu' k'it vigwideech'in ts'àt teechik gwats'àt niinlaii k'it gugwideech'inh nùh. Aii tł'ee Dwayne jidii nah'in k'eejit kat gijiith'ak ts'àt jaghadee jùu dagoonch'uu gwizhit gugwinah'inh. Jii geenjit gwitr'it t'agwah'in kat gwizhit gugwinah'inh kwaa gòo' zhat gwats'àt dinjii kat geenjit gik'igaanjii kagintih. Tthak nihàh nikhwinagoo'ee geenjit gwitr'it gwahaatsaa k'iighè' gwindoo diiyeenjit gwitr'it gwiheelah. Dinjii kat gwindoo diiyah gwizhit giheelyaa, geenjit guk'agahnahtyaa ts'àt nan kak tthak t'aniinch'uu kat yeendoo geenjit gwiiyeendoo ganiinji' giheedhat jì' gwiteezah.

Swift fox © Gerrit Vyn / WWF

SOLUTIONS FOR RECOVERY

05

Halting and reversing wildlife loss will depend on finding ways to meet human needs without further overexploitation of species and the degradation and destruction of their habitats.

There is no single solution to this problem, and we will need concerted actions from communities, industry and government, among others. While many different approaches are needed to address environmental crises[225] [226] — such as a rapid reduction in the use of fossil fuels and improved management of natural resources — nature itself also provides opportunities to address biodiversity loss and climate change simultaneously.[227]

The following solutions and recommendations should be carried out in partnership between Indigenous and non-Indigenous governments and actors based on shared governance and decision making, and in accordance with Free, Prior and Informed Consent (FPIC).[228]

We know, we have to:

- Support Indigenous leadership and advance reconciliation in conservation.
- Collect and share (where appropriate) knowledge and better data on wildlife populations and ecosystem health.
- Meaningfully expand and strengthen Canada's network of protected and conserved areas.
- Restore ecosystems to increase the amount and quality of wildlife habitats.
- Improve the sustainability of renewable resource use and ensure any non-renewable resource development is done responsibly where no alternatives exist.
- Build sustainable conservation-based economies that benefit people and nature.
- Create and enforce policies and regulations that measurably improve the health of ecosystems and the species that depend on them.

This report is largely driven by metrics — data of a specific kind that can help inform top-down approaches to conservation action. As applied to national-scale analyses and systematic and spatial conservation planning tools, top-down conservation involves using broad, high-level information and strategies to guide conservation efforts.

But for efforts to be successful, these actions must be co-developed and co-implemented with — and in some cases, led by — Indigenous Peoples and also recognize their knowledge and priorities and the rights and title of the lands on which such actions are taken. These bottom-up, local approaches to conservation are equally, if not more, important because they also consider local economies and community health and well-being.

Although the following are examples of top-down scientific analyses to support national conservation prioritization, local voices, perspectives and priorities remain paramount in order to ensure that wildlife and people are able to thrive together now and into the future.

Barren ground caribou © John E. Marriott

RECONCILIATION IN CONSERVATION

Crawford Lake Conservation Area, Ontario, Canada © Shutterstock

In Canada, reconciliation in conservation is the process of acknowledging and addressing the historical and ongoing impacts of colonialism on Indigenous Peoples while promoting Indigenous-led conservation of the territories that they have successfully stewarded for millennia. Reconciliation recognizes Indigenous rights, knowledge systems and stewardship practices as essential for the long-term care of lands and waters. Reconciliation also acknowledges the importance of partnerships between Indigenous Peoples, governments, NGOs, academia, industry and other organizations to ensure conservation initiatives respect Indigenous sovereignty, rights and title and cultural values. It also seeks to redress past harms — such as the exclusion of Indigenous Peoples from their traditional territories for the creation of protected and conserved areas — and supports Indigenous leadership to advance effective stewardship alongside social and economic justice. [229] [230] [231]

It's important to note that nature conservation and the resurgence of Indigenous autonomies are congruent, but their aims require transformation in both conservation and re-Indigenization, a concept that encompasses decolonization, inclusion, resurgence and reconciliation.[232] [233] The path to reconciliation in conservation involves reaffirming Indigenous land rights and supporting Indigenous-led initiatives, including Indigenous Protected and Conserved Areas (IPCAs),[234] [235] in addition to fostering co-development, co-governance and co-management frameworks. Meaningful reconciliation depends on sustained commitment from governments and organizations, financial resourcing and legal reforms that prioritize and affirm Indigenous consent.

By working together, we can protect and recover nature while helping to restore cultural connections, develop conservation economies,[236] build trust and uphold Indigenous leadership.

The leadership and sovereignty of Indigenous Peoples must be the foundation of advancing nature-based climate solutions (NbCS) in Canada.

Patrica Lake, Jasper National Park, Alberta, Canada © Don Getty

RECOMMENDATIONS

01 Advance data sovereignty in Canada by providing education on FPIC, OCAP and ethical data-collection practices to individuals and organizations interested in partnering with Indigenous governments and organizations on wildlife monitoring and conservation activities.

02 Co-develop wildlife monitoring frameworks with Indigenous Peoples to support etuaptmumk or the two-eyed seeing approach.

03 Ensure adequate and long-term funding and supports for Indigenous Guardians programs across Canada.

04 To address the lack of legal recognition, Crown governments must recognize and support terrestrial and marine IPCAs when declared and asserted by Indigenous Peoples in acknowledgment of self-determination and self-governance.

MONITORING PROGRESS

The Monitoring Framework underpinning the Kunming-Montreal Global Biodiversity Framework (GBF) includes a series of headline indicators used to monitor progress toward individual targets. These global headline indicators are also recommended for use in domestic reporting,[237] [238] including as part of National Biodiversity Strategies and Action Plans (NBSAPs), such as Canada's 2030 Nature Strategy, which addresses all 23 of the GBF targets.[239] Each 2030 target also includes component and complementary indicators, which provide greater detail on the progress of key elements under each target.

Indicators provide a measure of progress, based on available data, to reveal status or trends. They help monitor progress toward biodiversity targets and goals and thereby inform conservation action.

The C-LPI (known domestically as the Canadian Species Index[g]) is a domestic indicator that can help track progress toward Target 4 of Canada's 2030 Nature Strategy. Canada has some of the best temporal population abundance data in the world, and the application of the LPI at a national level can provide valuable insights into the relative abundance of native vertebrate populations within the country.

[g] Note that there are minor methodological differences between C-LPI and CSI regarding the criteria of inclusion for data. Efforts are underway to harmonize approaches and results.

Wildlife biologist setting a camera trap in the forest © Shutterstock

> **CANADA'S NATURE STRATEGY | KUNMING-MONTREAL GLOBAL BIODIVERSITY FRAMEWORK TARGET 4**
>
> **Ensure urgent management actions to halt human induced extinction of known threatened species and for the recovery and conservation of species, in particular threatened species, to significantly reduce extinction risk, as well as to maintain and restore the genetic diversity within and between populations of native, wild and domesticated species to maintain their adaptive potential, including through in situ and ex situ conservation and sustainable management practices, and effectively manage human-wildlife interactions to minimize human-wildlife conflict for coexistence.**

Despite boasting some of the best temporal abundance data in terms of species representation, the C-LPI still lacks data for roughly half of the known native vertebrate species in the country. There are also gaps in the geographic coverage of many of the species already included.[240] Indicators are only as useful as the data underpinning them, and experts have called for greater monitoring to address data gaps and ensure that biodiversity is more fully represented in trends.[241] [242] In Canada, targeted data monitoring and collection to support adequate representation of vertebrates could be targeted toward small fishes and mammals, as well as carnivorous reptiles.[243] Spatially, data that fit the criteria of the C-LPI are also limited in the Arctic.[244]

Side view of bird watching in the forest © Shutterstock

People birdwatching with binoculars in a tower © Shutterstock

RECOMMENDATIONS

01 **Implement a systematically designed and openly accessible monitoring framework for tracking biodiversity across the country so that declines in wildlife species in Canada can be prevented. This should include systematic sampling to ensure representation of regions, ecosystems and taxonomic groups.**

02 **Invest in new technologies like environmental DNA, camera traps, AI applications, sensors and bioacoustic technologies to help scale data collection for monitoring wildlife populations across Canada. Support Indigenous Guardians programs, Indigenous Peoples and communities in furthering environmental monitoring.**

PROTECTION

CANADA'S NATURE STRATEGY | KUNMING-MONTREAL GLOBAL BIODIVERSITY FRAMEWORK TARGET 3

Ensure and enable that by 2030 at least 30 per cent of terrestrial and inland water areas, and of marine and coastal areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures, recognizing Indigenous and traditional territories, where applicable, and integrated into wider landscapes, seascapes and the ocean, while ensuring that any sustainable use, where appropriate in such areas, is fully consistent with conservation outcomes, recognizing and respecting the rights of Indigenous peoples and local communities, including over their traditional territories.

Indigenous Protected and Conserved Areas: Areas actively being protected and stewarded by Indigenous communities. IPCAs comprise "lands and waters where Indigenous governments have the primary role in protecting and conserving ecosystems through Indigenous laws, governance and knowledge systems."[245]

Canada boasts more than 7 million km² of the world's remaining intact areas[246] [247] and thus holds a disproportionate global responsibility — and opportunity — to protect and sustainably manage its landscapes. Without intervention, these intact ecosystems are vulnerable to degradation and disruption from major human and industrial stressors and their associated impacts.

Protected and conserved areas (PCAs) are a cornerstone of wildlife conservation and, as such, have expanded both geographically and conceptually since their inception.[248] They include a variety of management regimes and types, such as national parks, wildlife refuges and IPCAs.[h] More recently, the value of protected and conserved areas in simultaneously allowing for mitigation and adaptation to climate change has been amplified through the emergence of nature-based climate solutions, particularly as land use and land-use change are primary drivers of global biodiversity loss[249] and land-based greenhouse gas emissions.[250] Likewise, multiple international agreements and frameworks (e.g., COP26 Glasgow Climate Pact; Global Biodiversity Framework) have set PCA targets. The GBF adopted a target to protect 30 per cent of lands and waters by 2030 (known as "30x30"), aiming to nearly double the 17 per cent target of a decade prior amidst calls for increases in coverage.[251] [252] [253] [254] Domestically, Canada matched the 30x30 target under the 2030 Nature Strategy.

As of 2023, 13.7 per cent of Canada's land and freshwater had been reported as conserved through both formal protected areas and Other Effective Conservation Measures (OECMs) — still well under the intended target.[255] Consequently, the government's heightened ambition must be complemented by rapid implementation to effectively deliver meaningful protection. To do so, the Government of Canada will require the support of provincial, territorial, municipal and Indigenous governments, along with private landowners.

A collaborative effort is needed from federal, provincial, territorial and Indigenous governments and Nations to meaningfully protect land- and seascapes and achieve Target 3.

[h] Indigenous Protected and Conserved Areas is one of many terms used to describe these areas.

SPATIAL OPTIMIZATION: CHOOSING THE RIGHT LOCATION WHEN CONSIDERING PROTECTION

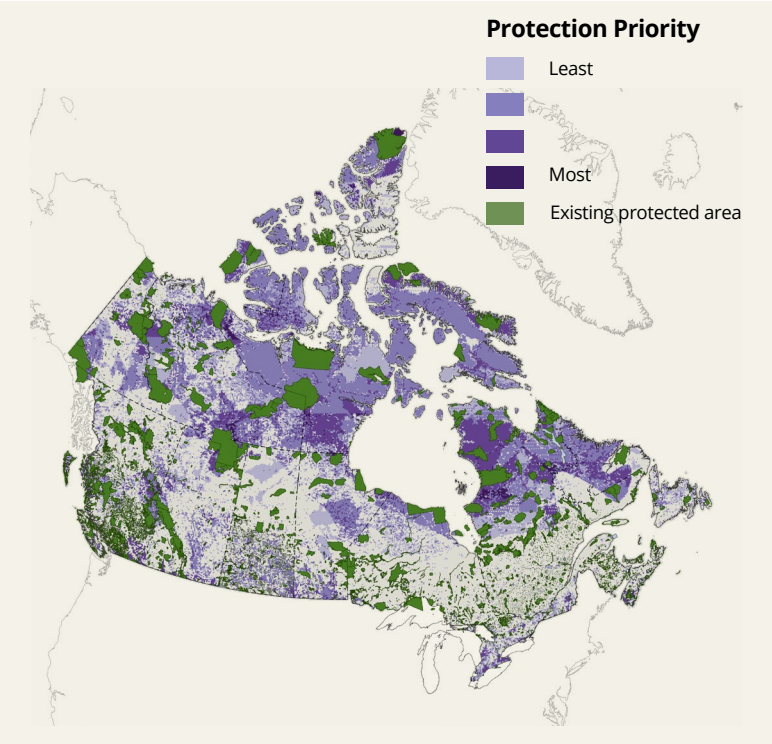
While targets associated with protected area coverage have driven PCA establishment to date,[256] [257] [258] past and current targets under the Convention on Biology Diversity (and its associated domestic targets) have also included criteria for strategically establishing PCAs to ensure representative and well-connected networks.[259] [260] However, focusing on area-based expansions has, in some cases, undermined the strategic establishment of PCAs,[261] [262] [263] leading to biases on where they are established[264] [265] [266] and limitations on their size and connectivity.[267] [268] Simply put, where PCAs are located matters.

For instance, in considering location, species at risk have been inadequately represented,[269] [270] [271] there is a lack of connectivity among PCAs[272] [273] and gaps in representation are prevalent[274] [275] — all of this is without considering the potential co-benefits of thinking strategically when establishing a PCA, such as the contribution of PCAs to climate change mitigation and adaptation. Critically, some formerly established PCAs have been reduced in size, altered to accommodate less stringent protections and/or eliminated entirely through what's known as protected area downgrading, downsizing and/or degazettement (PADDD) events.[276] In Canada, from 2010–2022, over 2,000 km2 of PCAs were fully degazetted — representing an area larger than Gros Morne National Park.[277]

A recent analysis detailed spatial priorities for PCA establishment in Canada that help to advance multiple components under Target 3 of the GBF — those that enhance PCA coverage, species habitat, Key Biodiversity Areas and connectivity. Priority areas for protection were focused in northern latitudes, including the Taiga Shield and Arctic (Artic Cordillera, Northern and Southern Arctic) ecozones (Figure 27).[278] While priorities for protection were strongly influenced by connectivity and Key Biodiversity Areas in the north, species-specific targets highlight regions such as the Mixedwood Plains, Montane Cordillera and Prairies as importance ecozones for new protected areas.[279]

Critically, spatial analyses serve as valuable resources to inform conservation action but contribute merely one component of a multi-faceted approach needed to conserve nature in Canada. While spatial prioritization can support Indigenous-led conservation, Indigenous priorities should supersede top-down scientific exercises where rights and title are incompatible with conservation targets.[280] [281]

Figure 27. Spatial priorities for new protected areas to reach targets under the Kunming-Montreal Global Biodiversity Framework. From Currie *et al*. 2025.



MARINE PROTECTED AND CONSERVED AREAS MUST EXIST AS NETWORKS

As of 2023, a total of 842,849 km2 — representing 14.7 per cent of Canada's national marine area[282] — has been protected through protected areas or OECMs, with exponential increases in coverage over the last decade.[283] Like terrestrial landscapes in Canada, large marine conserved areas are often located where human use is less intensive, including northern Canada or offshore areas. By contrast, smaller conserved areas have been established in areas with more competing uses.[284] Improving the scale and connectivity of marine protected and conserved areas will be paramount to ensure that they are effective, as marine species move freely through waters. Recently, the governments of Canada and Quebec jointly committed to expanding the Saguenay-St. Lawrence Marine Park to nearly 4,500 km2 — a move that will strengthen protections for the St. Lawrence beluga, capturing the population's entire critical summer habitat.[285]

Beluga whale © David Merron / WWF-US

RECOMMENDATIONS

Great Bear Rainforest, B.C., Canada © Andrew S. Wright / WWF-Canada

01 Despite its commitments, Canada has failed to meet its previous PCA targets, including the 17 per cent terrestrial and freshwater protection target for 2020. The 30x30 ambition must be matched by rapid and strategic action.

02 PCAs that maximize potential environmental benefits and deliver on multiple GBF targets (and components) should be prioritized.

03 New financial tools that account for the establishment, management and long-term stewardship of protected areas must be created so that they can provide prolonged benefits for biodiversity and climate in the centuries to come.

04 To address the lack of legal recognition, Crown governments must recognize and support IPCAs when declared and asserted by Indigenous Nations in acknowledgment of self-determination and self-governance.

RESTORATION

> **CANADA'S NATURE STRATEGY | KUNMING-MONTREAL GLOBAL BIODIVERSITY FRAMEWORK TARGET 2**
>
> **Ensure that by 2030 at least 30 per cent of areas of degraded terrestrial, inland water, and marine and coastal ecosystems are under effective restoration, in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity.**

Ecosystem Restoration: The process of supporting the recovery of ecosystems that have been degraded, damaged or converted due to human activities.

Human-induced land- and sea-use change, whether for food, timber or energy, has resulted in a loss of natural ecosystems and biodiversity and has diminished Earth's ability to effectively store carbon, causing it to occasionally act as a source, rather than a sink, of greenhouse gas emissions.[286] Canada's natural landscapes are juxtaposed against areas under immense human pressure[287] where multiple, compounding pressures to wildlife are pervasive in both magnitude and scale.[288] Ecological restoration serves to repair the damage that humans have caused to terrestrial and coastal ecosystems and can serve as a dual solution to address both biodiversity loss and climate change by enhancing natural carbon sequestration and storage potential through the creation and enhancement of healthy ecosystems.[289] [290] Restoration can have immediate benefits or can take decades to achieve recovery of an ecosystem.[291] What's critical is that threats are removed from restored ecosystems and that they remain undisturbed so they can effectively support the long-term viability of wildlife and ecosystem services[292] [293] (e.g., cultural benefits, water purification, pollination, and climate change mitigation and adaptation).

Ecosystem restoration is fundamental to conserving biodiversity and recovering ecosystem services and functions — so much so that the United Nations General Assembly proclaimed the current decade (2021–2030) as the Decade on Ecosystem Restoration. Canada has also committed to restoration through multiple international endeavours including the Kunming-Montreal GBF, the Bonn Challenge, which is focused on forested ecosystems, and the Freshwater Challenge.[294] Domestically, Canada launched the 2 Billion Trees program — aptly named for its goal to plant two billion trees over 10 years[295] — in addition to funding under the broader umbrella of NbCS.[296] Given global goals and national commitments to ecosystem restoration, spatial optimization and prioritization can provide decision-makers with helpful information to maximize biodiversity and carbon storage benefits. Essentially, targeting restoration activities at ecosystems with greater potential benefits can enhance conservation gains while reducing costs.[297] However, strategies and goals should be adapted to Indigenous priorities, in addition to local ecological and socioeconomic environments to optimize their success.[298]

SPATIAL OPTIMIZATION: LOCATION MATTERS WHEN MAXIMIZING RESTORATION BENEFITS

In Canada, land that has been converted to human use, which may benefit most from ecosystem restoration, is located in southern Canada (Figure 28),[299] where the human footprint — roads, croplands and population density — is highly concentrated.[300] Converted landscapes cover more than 5 per cent of the country,[301] [302] with agricultural expansion continuing to be the primary driver of land conversion in Canada.[303] The greatest spatial extent of disturbance is concentrated in the croplands of the Prairies, Boreal Plains (southern Alberta, Saskatchewan and Manitoba) and Mixedwood Plains (southern Ontario and Quebec) ecozones.[304] Among these, forest and grassland restoration represent the greatest opportunities for ecosystem revitalization of converted landscapes.

The interconnectedness of biodiversity loss and climate change reinforces the need to address multiple environmental crises simultaneously.[305] [306] Spatial optimization of converted lands, when combined with the potential biodiversity and carbon benefits of restoration, reveal priority areas for restoration in southern Quebec, Ontario, Manitoba and British Columbia (Figure 29).[307] More specifically, many of Canada's "crisis ecoregions,"[308] such as the Lake Erie and St. Lawrence Lowlands, Manitoulin-Lake Simcoe and Aspen Parkland, are consistently a priority for restoration.[309] Although spatial optimization exercises can support conservation planning, knowledge and priorities from local and Indigenous communities should inform the objectives, types of restoration needed and approaches to more effectively advance collaborations among top-down and bottom-up initiatives.

Figure 28. Converted lands in Canada that would benefit from restoration. Darker shades show areas of higher conversion. From Currie *et al*. 2023.

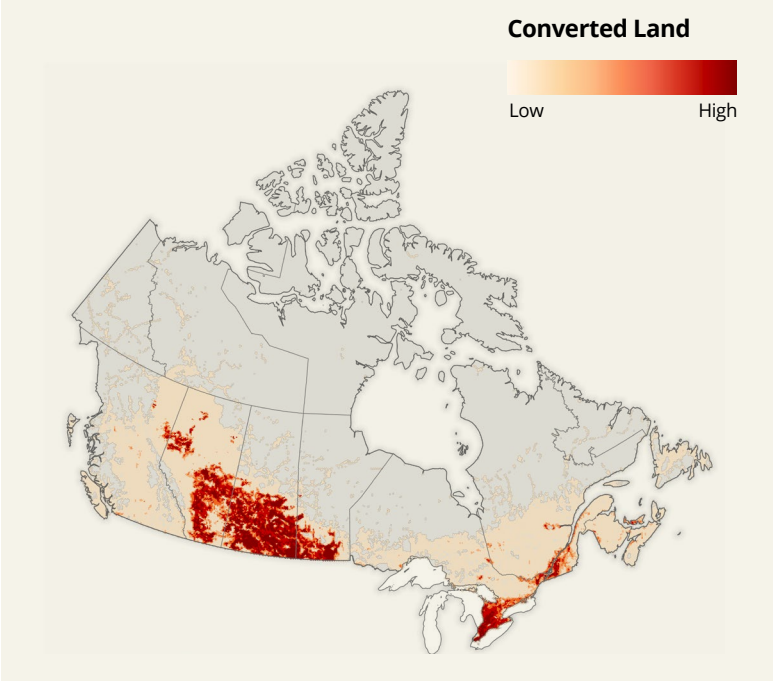
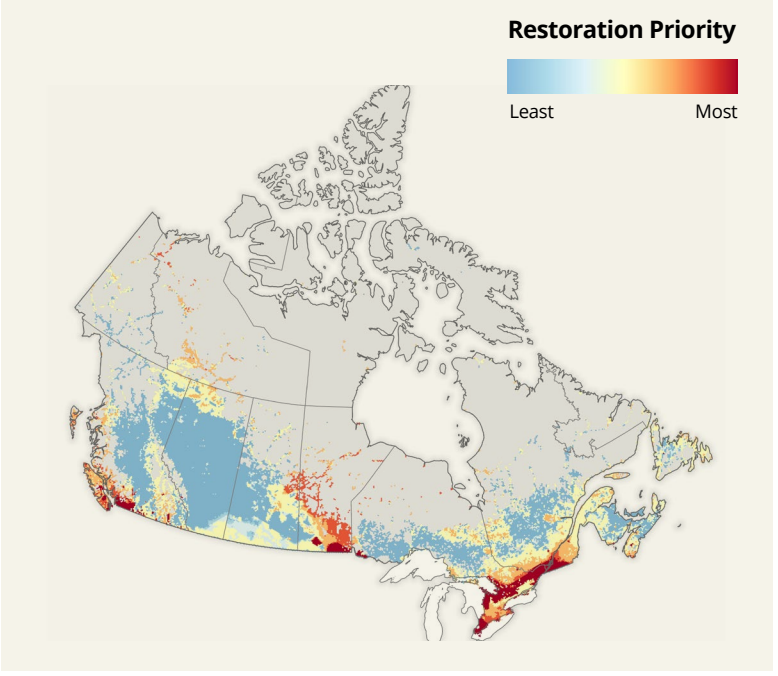


Figure 29. Spatial priorities for restoration of converted lands in Canada. From Currie *et al*. 2023.



Gardener planting wild strawberry seedling © Shutterstock

RECOMMENDATIONS

01 **Define and take action on a national target for complex ecosystem restoration in Canada.**

02 **Invest in Indigenous- and community-led restoration initiatives to ensure just and effective conservation outcomes.**

03 **Ensure restoration efforts align with and support the goals of other regulatory and policy commitments toward climate change mitigation and the conservation of biodiversity.**

04 **Develop and implement financial mechanisms to incentivize land- and rights-holders to implement restoration activities on converted and degraded lands.**

05 **Invest in research and analysis to measure and report on changes in degraded ecosystems.**

06 **Develop private and public partnerships to increase employment opportunities for restoring natural infrastructure across the country.**

Eastern tiger swallowtail © Shutterstock

THREATS
URBAN DEVELOPMENT, INVASIVE SPECIES AND DISEASE

HABITATS
FORESTS, HUMAN-DOMINATED LANDSCAPES

EASTERN TIGER SWALLOWTAIL AND TULIP TREE

(Papilio glaucus and *Liriodendron tulipifera)*

The connection between milkweed and the monarch butterfly is well established, but this type of relationship is not unique. All butterflies require specific host plants where the female insects lay the eggs and the larvae (caterpillar) hatch and feed. Often, these plant–insect relationships have existed for hundreds of years and are specific to a region's habitat and climate.[310] It's worth noting that the relationship to a host-providing plant is distinct from relationships to nectar-providing plants, though those are also essential since these plants provide nutrient-rich food for insects.

Called "tiger" because of the four black stripes on the top of each yellow forewing, the vibrant Eastern tiger swallowtail is often seen fluttering across southern Ontario during the summer months. To lay its green eggs, this species selects plants such as the native tulip tree, which has iconic flowers shaped like their namesake. In Canada, this tree, which grows up to 35 metres in height,[311] is found in the Carolinian Zone in southern Ontario. Given their size, tulip trees require a lot of space to grow, which is difficult because of the urban landscape in which it is found. However, when planted and allowed to reach maturity (>15 years), every part of the tree — from its leaves and flowers to its seeds — provides important resources for invertebrates, birds and mammals.[312] These interwoven relationships not only span seasons but centuries, given that tulip trees can live for hundreds of years.

With milder temperatures and a unique topography, the diversity of flora and fauna in the Carolinian Zone is outstanding. However, this area is also experiencing a rapidly growing human population, which increases the pressure on surrounding habitats.[313] Restoration of these converted habitats is necessary to ensure the survival of local ecosystems. Luckily, especially as this zone is densely residential, action can be implemented even in backyards, by planting native vegetation, including the tulip tree, which contributes to the success of urban forests and resulting ecological benefits.[314]

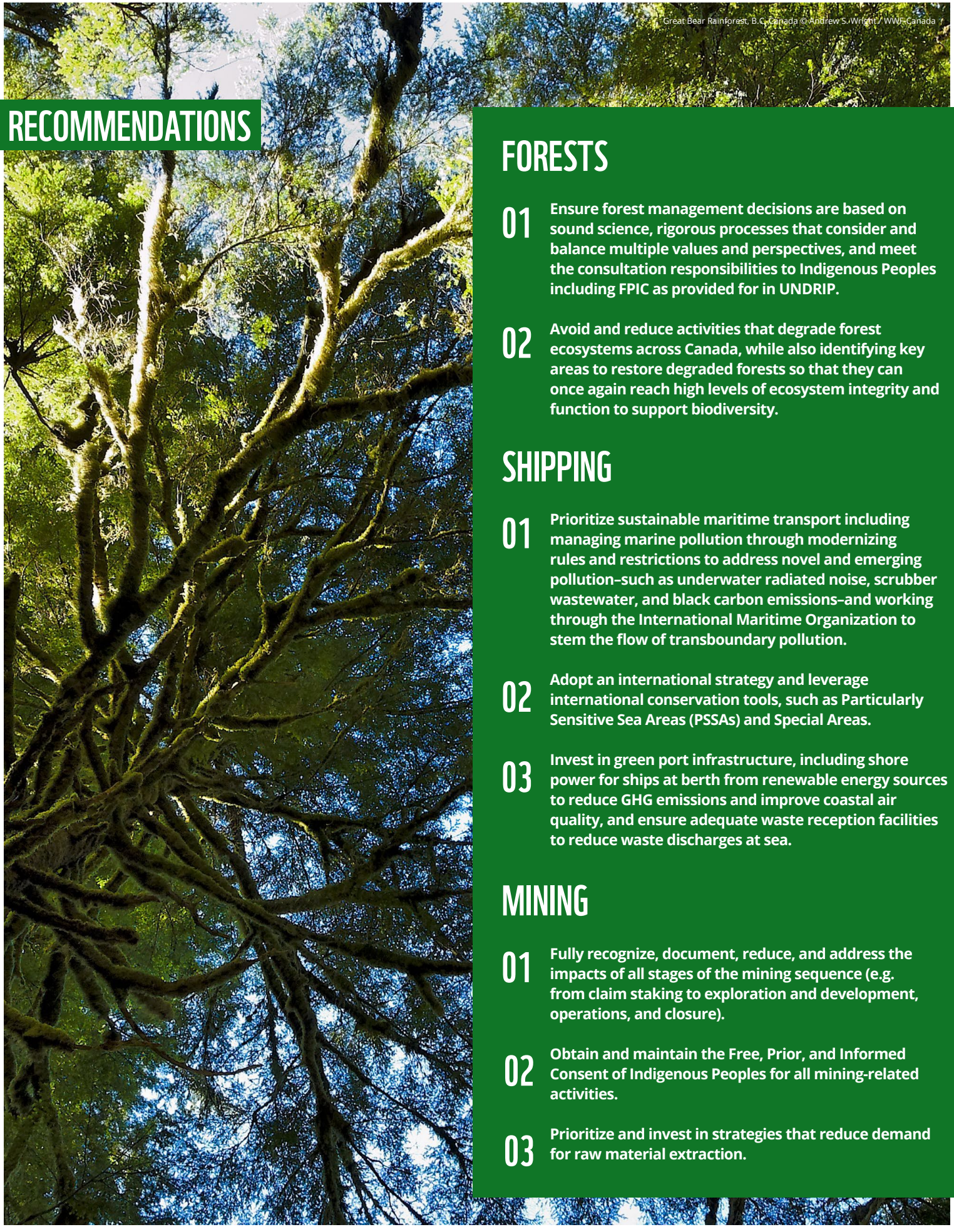
SUPPORT SUSTAINABLE AND RESPONSIBLE DEVELOPMENT OF INDUSTRIAL SECTORS

There are several targets under the Canada's 2030 Nature Strategy and the Kunming-Montreal Global Biodiversity Framework that relate to the sustainable and responsible development of industrial sectors. GBF Target 10 specifically calls for the sustainable management of four major global sectors: agriculture, aquaculture, fisheries and forestry. GFB Target 7 prompts the reduction of pollution risks and the negative impact of pollution from all sources. Other GBF targets are also relevant, including Target 5 (harvesting and trade of wild species), Target 8 (minimizing climate change impacts), and Target 15 (disclosure and reduction of biodiversity-related risks and impacts), demonstrating the wide array of impacts and solutions associated with industry activities.

Human pressures on land and seascapes are widespread.[315] [316] [317] While the degree of impact varies across regions, both land and marine ecosystems are profoundly shaped by human influence. Some of the most potentially harmful activities in Canada, and around the world, occur in areas regulated for industrial use — for example, agriculture, fisheries, forestry, mining, and shipping. But despite their importance for food, housing and economic stability, the sustainable management of these sectors could be vastly improved from an ecological perspective. For instance, one quarter of Canada's fish stocks are in the Critical or Cautious zone, with another 42 per cent that cannot be classified because they have uncertain statuses.[318] Canada does not fulsomely account for rates of forest degradation or carbon emissions in its reporting, thereby undermining monitoring and strategic conservation action.[319] And agricultural expansion is the leading cause of land conversion within the country.[320]

Similarly, Canada produces over 60 minerals at nearly 200 mine sites and 6,500 quarries, supporting thousands of jobs.[321] However, the extraction of minerals and metals, as well as the activities associated with site exploration, development and associated infrastructure have significant negative consequences for land, water, wildlife, and people. Canada is also an ocean nation whose wellbeing depends on healthy marine ecosystems. Shipping is an important industry sector, with over 80 per cent of all goods being transported via ship,[322] yet increasing ship traffic threatens the ocean, wildlife, and climate.

Canada's rich natural assets are also the foundation of its economy. That said, it's imperative to improve the sustainability of renewable resource use and ensure any non-renewable resource development is done responsibly, where no alternatives exist. At the heart of this work must be the protection of lands and waters, the mitigation of harm, and the return and healing of these places once projects end, so they can continue to support our communities, cultures and future generations.



Great Bear Rainforest, B.C. Canada © Andrew S. Wright / WWF-Canada

RECOMMENDATIONS

FORESTS

01 Ensure forest management decisions are based on sound science, rigorous processes that consider and balance multiple values and perspectives, and meet the consultation responsibilities to Indigenous Peoples including FPIC as provided for in UNDRIP.

02 Avoid and reduce activities that degrade forest ecosystems across Canada, while also identifying key areas to restore degraded forests so that they can once again reach high levels of ecosystem integrity and function to support biodiversity.

SHIPPING

01 Prioritize sustainable maritime transport including managing marine pollution through modernizing rules and restrictions to address novel and emerging pollution–such as underwater radiated noise, scrubber wastewater, and black carbon emissions–and working through the International Maritime Organization to stem the flow of transboundary pollution.

02 Adopt an international strategy and leverage international conservation tools, such as Particularly Sensitive Sea Areas (PSSAs) and Special Areas.

03 Invest in green port infrastructure, including shore power for ships at berth from renewable energy sources to reduce GHG emissions and improve coastal air quality, and ensure adequate waste reception facilities to reduce waste discharges at sea.

MINING

01 Fully recognize, document, reduce, and address the impacts of all stages of the mining sequence (e.g. from claim staking to exploration and development, operations, and closure).

02 Obtain and maintain the Free, Prior, and Informed Consent of Indigenous Peoples for all mining-related activities.

03 Prioritize and invest in strategies that reduce demand for raw material extraction.

Southern sea otter © Shutterstock

THREATS
ENERGY PRODUCTION AND MINING, POLLUTION, TRANSPORT, BIOLOGICAL RESOURCE USE

HABITATS
MARINE AND COASTAL

SEA OTTER

(Enhydra lutris)

COSEWIC Status: Special Concern

The sea otter is among the most well-documented examples of the removal and reintroduction of a keystone species. Once abundant along the Pacific coast, sea otters were extirpated by the early 1900s because of an intensive maritime fur trade that spanned hundreds of years. Their absence in coastal ecosystems led to cascading effects — without a predator to keep invertebrate populations in balance, prey populations exploded, leading to subsequent overgrazing of underwater kelp forests.[323]

Eighty-nine sea otters were reintroduced to British Columbia from Alaska between 1969 and 1972. Within a few decades, their range had expanded, covering one-quarter to one-third of the species' historic distribution in Canada.[324] Their presence shifted the population dynamics of the coastal ecosystem. Sea otters exerted top-down control of sea urchin populations, permitting the regrowth of iconic kelp forests, which in turn led to increased populations of various other species — such as copper rockfish — that occupy these habitats.[325] The return of sea otters is seen by some as a positive step[326] toward kelp forest restoration, delivering biodiversity and carbon sequestration benefits.[327]

Low numbers relative to historic abundance, combined with the species' susceptibility to oil spills among major tanker routes, mean that this species is categorized as Special Concern in Canada.

THE LAND HOLDS THE ANSWERS

Ellen Firth comes from a big family in Inuvik, in the northwestern corner of the Northwest Territories, where she was raised on the land until she was nine years old, when she was forced to come into town and attend residential school. With a home base in the city, she now spends as much time as she can with her family out on the land at their cabin and hopes to educate the Gwich'in community's youth on the value of respecting the territory around them.

Note: The following has been edited for length and clarity.

Firth on the changes she's noticing in Gwich'in Territory

Every time we go fishing now in June and July, it's getting hotter and hotter. The other day it was 34, and I'm standing in it, gutting fish in the heat and, oh my goodness, it was hot! The number of fish we're seeing is also changing; you used to have one net and get 60 to 70 fish. Now we have three nets and the other day we got four fish.

The water is also really low this year, with lots of sandbars, and it's making the water warm. One of the things we noticed was a lot of beavers damming up all the creeks, so the water is not coming. There has to be another bounty on these beavers — there was one a few years ago, $100 a beaver — that would help keep the population at bay.

The species movements are changing, too. Near Tuktoyaktuk, for a couple years in a row, the whales have been coming into the delta and when they come in, it's muddy and shallow. A few years ago, they said it was 40 whales, but it looked like a hundred, and it happened again this year.

What happens is the males and the females get killed and the children get confused, lost, and don't know where to go. So, they come into the delta and their lungs get sick. You know what's scary? When people got some of the whales, they'd bring them to Aklavik, cut them up and everybody was told to throw it away — always check the liver and heart, anything with a spot on it, give it to the dogs.

I think it's our warmer climate and infrastructure changes that are impacting the species and their habitats, causing them to move north and impacting their behaviour.

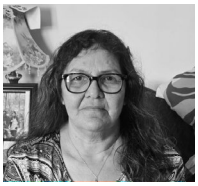
Living out on the land and learning our traditional ways can help keep our territory healthy

Usually, we go to the cabin in May, come back to town sometime in June, and right from June to about the end of September, I do fishing. A lot of fishing. I raised several of my children out on the land. I have 14 grandkids now, and four of them are eight years old and two have done everything on the land.

Over the years, I've mostly been out at the cabin and it's a good life for us. If we had it our way, we'd live out on the land year-round, but because of my grandchildren in school, we can't.

I'm hoping to do some work at a school in Aklavik to help teach kids the value of living on the land because when my granddaughter tells them now, they are all interested and ask her lots of questions. They don't know we have everything out there — TV, skidoos. But the land holds the answers, so that's what I want to do this year, if they approve it, for kindergarten to grade 12. I think that can make a difference.

Translation provided by Eleanor Firth
Language: Gwich'in (Teetl'it Gwich'in dialect)



ELLEN FIRTH
Gwich'in Tribal Counci

‘IDÌI GAHGWIHEEDANDAII GWII-NIINDHAN NAN KAK GOO’AIH

Ellen Firth vizhehk’oo zhit giinleih, Inuvik, Northwest Territories gwats’àt diinchuh, gwatat diik’iindhat, vaghaii vanchoh nak’oh zhàk dhitin dài’ zheh danh gè’tr’oonahtan gwizhìt heelyaa geenit tr’oonjik. Kaiik’it gwizhit zheh di’in ts’àt jùk gweendoo gwatat dachan zheh di’in danh dizhehk’oo hàh shìk diinch’uh ts’àt Gwich’in kaiik’it gukeejit kat nan nits’òo chidhaa’ee gaguuhanahchyaa gadiindizhit.

Gahgwiheedandaih: Jii gwiyeezhak nigwan ts’àt gwindoo gahtr’iheedandaii tr’ałtsaih

Gwich’in nànhkak ejuk nigwijaazhii Firth gwinah’inh

Vananh Adaghoo ts’àt Vananh Yidichuu guuzhik łuk kaiidi’ii dài’ gwiiyeendoo gwiniidhah. K’eejit drin gwinoo gwidhah 34 gwiinli’ guuzhik łuk hàh dhii’aih, zhaagah li’hah gwiiniidhah! Łuk dagwahłeii naa’in chan ejùk diinch’uh, chihvyah ihłak zhìt luk 60 goo 70 gwizhit gwiinli’. Jùk chihvyah tik chaachuh ts’àt drin ihłat łuk daankat zraih gwats’àt iidi’ìn’.

Jùk nagwidhat chuu gwiiyeendoo zhàk diinch’uh ts’àt tł’eedik leii goonlih, jii k’iighè’ chuu nįįgwan’. Tsèe kat teechik gwizhìt nanii’ol gahtsii k’iighè’ chuu niinlaih kwàh, jii nyaa’inh. Tsèe nitr’ahaazrii tr’igwahtsii jì’ gwiteezah – yeenoo nagwidadhat akòo digweedi’in’, tsèe ihłak geenjit $100 tr’oovįįkat, jii gwik’it digidi’in jì’ tsèe’ gwiiyeendoo leii gwiheelah kwàh.

Nin kat nits’oo nagitaa’oh chan ejùk diinch’uh. Nagwidhat neekaii guuzhik Tuktoyaktuk gwa’àn chuu zhit kaleeluk nahdivik aii guuzhik chuu vee ts’àt te’jahgwanh. Yeenoo nagwiniidhat kaleeluk 40 agwahłeii jùu digeedi’ìn’ ginuu gòo’ 100 agwahłeii k’it gugwideech’ìn’, jùk nagwidadhat chan gwik’it digeedi’ìn’.

Kaleeluk gughan dài’ guugii dagiheedya’aa gahgidandaih kwaa, nijin t’igiinch’uu gahgidandaih kwaa ts’àt nijin gwits’àt geedaa gahgidandaih kwàh. Aii k’iighè’ ehdiitat gwi’ee geedaa ts’àt guudrihdok hàh giłts’ik nigijaanaih. Jidii andaih gwijahch’uh lèe gahnidandaih? Aklavik gwits’àt kaleeluk k’eetr’aazhik ts’àt tr’iintu’ tł’ee uu’àn tr’ihilii diitr’ahnuh, vadhat ts’àt vidrii shìk tr’ahnahnah, gwakak tsinjahch’uu goo’aii jì’ łaii zhii t’iheech’ah.

Gwindoo nikhwinagoo’ee gwiniidhaa ts’àt ejuk t’igwinjik k’iighè’ nijin nin gwindaii ejuk diinch’uh, jii k’iighè’ gweenoo geedaa ts’àt dagidi’ii ejuk goonlih.

Gwatat tr’igwindaii ts’àt nits’oo yi’eenoo tr’igwiindài’ gwik’it gadiitr’oonahtan jì’ gwiiyeendoo jii nikhwinành kak srìi tr’igwiheendaih

Gwilyuu Zrìi’ dài’ gwatat nikhwizheh gwits’àt naiididah, Vananh Adaghoo dài’ zheh naiidi’oh aii tł’ee Vananh Adaghoo, Vananh Di’iilii gwats’àt tthak łuk kashi’inh. Łuk leii kashi’inh. Khaiinjii shitr’iinin kat tthak gwatat diik’iizhit. Jùk shicheii 14 agwahłeii goonlih, daankat guughaii nihk’ii daan goonlih ts’àt neekanh nits’oo gwatat tr’igwindaii gahgidandaih.

Nagwidadhat leii gwatat gwihdaii, gwatat gwiidandaii nikhweenjit gwiinzih. Nagwidadhat tthak gwatat gwihiidandaii niidadhan gòo nikhwich’eii kat gè’tr’oonahtan gwizhìt t’igiinch’uu geh’an zheh t’iidich’uh.

Aklavik danh gè’tr’oonahtan zheh gwitr’it t’igwił’in gadiinjishizhit, k’eejit kat gwatat tr’igwindaii gwiiyeendoo gwichil’ee gaguuhanalchyaa nihthanh, shicheii gwatat gwindaii geenjit guuvah gwaandak dai’ gwiiyeendoo geenjit gahvidandai’ giiniindhan ts’àt gwindoo giiyuudahkat. Jidii tthak gwatat iidi’in gahgidandaih kwàh – TV, iitsii khał tsal gwatat iidi’inh. Jidii gahgwiheednaii gwiiniindhan nan kak goo’aih, jùk khaii akoo dihiishi’aa nihthanh, gwik’it giiniindhan jì’ kindergarten, grade 12 gwits’àt gaguuhanałchah. Aii k’iighè’ ejuk gwiheelaa nihthanh.

FINANCING NATURE AND BUILDING SUSTAINABLE CONSERVATION ECONOMIES

A commitment to nature requires financial investment. Purchasing lands, funding restoration work and changing management practices all come at a financial cost. The financial targets set out under the Kunming-Montreal GBF are two-fold: a US$500 billion reduction in harmful subsidies across sectors, complemented by the mobilization of an additional US$200 billion per year for biodiversity. If fully implemented, this two-fold approach would help to close the estimated annual US$700 billion biodiversity gap.[328] By shifting from harmful incentives — those that lead to overexploitation or deterioration of nature — to fund actions that support positive outcomes for nature and public well-being, governments can support a more sustainable economy.[329]

Domestically, Canada has created an assessment framework[330] and associated guidelines[331] to support the decarbonization of the country's oil and gas sector, supporting federal commitments to eliminate inefficient fossil fuel subsidies. Canada is the first G20 country to fulfill its commitment ahead of the 2025 deadline. The guidelines, however, apply to federal departments and agencies. By contrast, phasing out public financing of the fossil fuel sector more broadly has been limited.[332]

Canada has also rolled out several funding programs since 2020 to recover biodiversity and support NbCS more broadly, in addition to ongoing contributions to legacy initiatives such as the North American Waterfowl Management Plan and the Ramsar Convention on Wetlands.[333] While the investment and attention on NbCS is applauded at the federal level, additional funding and implementation of NbCS from all sectors of society will be critical for achieving biodiversity and climate goals.

> **CANADA'S NATURE STRATEGY | KUNMING-MONTREAL GLOBAL BIODIVERSITY FRAMEWORK TARGET 18**
>
> **Identify by 2025, and eliminate, phase out or reform incentives, including subsidies, harmful for biodiversity, in a proportionate, just, fair, effective and equitable way, while substantially and progressively reducing them by at least US$500 billion per year by 2030[i], starting with the most harmful incentives, and scale up positive incentives for the conservation and sustainable use of biodiversity.**

[i] This is a numerical value representative of a global target. Domestic contributions vary.

CANADA'S NATURE STRATEGY | KUNMING-MONTREAL GLOBAL BIODIVERSITY FRAMEWORK TARGET 19

Substantially and progressively increase the level of financial resources from all sources, in an effective, timely and easily accessible manner, including domestic, international, public and private resources, in accordance with Article 20 of the Convention, to implement national biodiversity strategies and action plans, by 2030 mobilizing at least US$200 billion per year.

CONSERVATION ECONOMIES

A conservation economy centres around acknowledging environmental, social and economic issues and embracing long-term outcomes over short-term economic gains by conserving and restoring resources, rather than depleting them.

Forests, waters and agricultural lands sustain livelihoods across the country. Realigning priorities to better consider and acknowledge economic, social and environmental outcomes underpins conservation economies, which are a way to generate wealth by meeting the needs of a local community while conserving and restoring (rather than removing) natural resources.

To be viable, conservation economies require long-term, durable solutions that emphasize equitable access to the economy, equitable distribution of benefits, strong governance, community-based and community-led designs and an alignment with ecosystem stewardship and regeneration.[334] As a result, the best examples are often place-based, emphasizing bottom-up approaches, emphasizing community priorities, co-development and governance. Conservation economies and the mechanisms that enable them (e.g., IPCAs) are being increasingly implemented — particularly for Indigenous communities in Canada.[335] [336] [337]

We find a great example of this in Nunavut, which is home to the fastest growing economy in Canada — Inuit Guardians programs are estimated to be generating a return on investment of $27 million. The territory's growing blue conservation economy includes land-based activities like hunting, trapping, fishing, arts and crafts, and nature-related tourism. There are also numerous co-benefits, including the transfer of Inuit knowledge, culture and language, and the approach ensures that local economic prosperity is rooted in traditional values and food sovereignty.[338] [339]

Wolastoq (Saint John River), New Brunswick © Terry Kelly / WWF-Canada

EXAMPLES OF RELEVANT DOMESTIC PROGRAMMING:

2 Billion Trees Program: A 10-year restoration initiative that provides financial support to organizations to plant two billion trees over 10 years, led by Natural Resources Canada.

Nature Smart Climate Solutions Fund: A 10-year fund administered by Environment and Climate Change Canada to reduce annual greenhouse gas emissions by up to 7 megatonnes through protection, restoration and improved management of ecosystems.

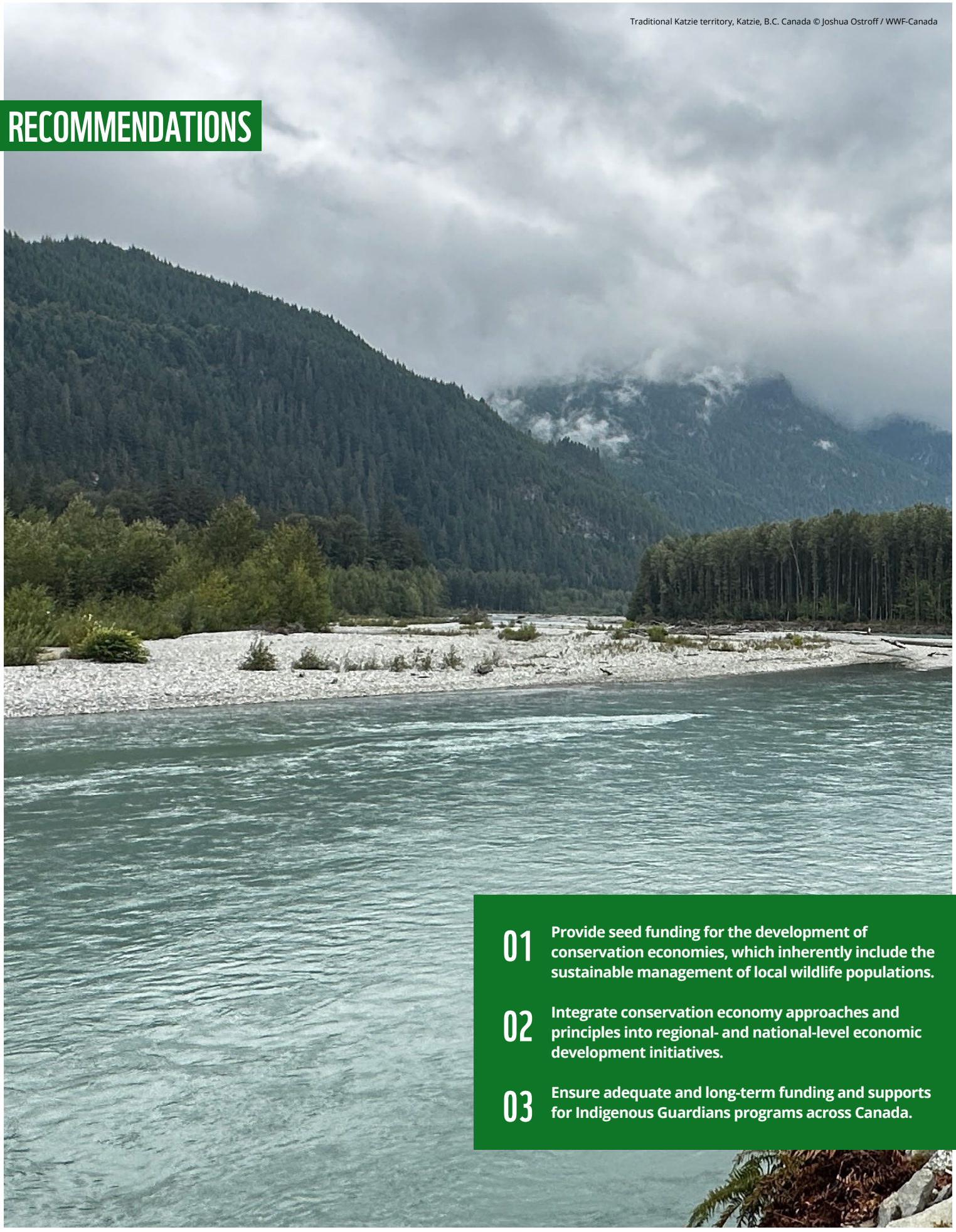
Agricultural Climate Solutions: A sector-specific 10-year program administered by Agriculture and Agrifood Canada to support the development and implementation of farming practices that tackle climate change and enhance climate resiliency.

Enhanced Nature Legacy: A multi-stream program to advance protected and conserved areas, safeguard species, advance reconciliation with Indigenous Peoples and connect people with nature.

Project Finance for Permanence: An innovative investment model that leverages government and private funding to support larger-scale, long-term conservation.

Grasslands National Park, Saskatchewan, Canada © WWF / Troy Fleece

RECOMMENDATIONS



Traditional Katzie territory, Katzie, B.C. Canada © Joshua Ostroff / WWF-Canada

01 Provide seed funding for the development of conservation economies, which inherently include the sustainable management of local wildlife populations.

02 Integrate conservation economy approaches and principles into regional- and national-level economic development initiatives.

03 Ensure adequate and long-term funding and supports for Indigenous Guardians programs across Canada.

WILDLIFE IS VERY IMPORTANT FOR US UP HERE, IT'S OUR ONLY GARDEN

Abel Aqqaq has spent his entire life in the small hamlet of Taloyoak, Nunavut, the northernmost community on the Canadian mainland. Nestled between the Gulf of Boothia and the M'Clintock Channel, Aqqaq grew up on the land with his father, where he learned to hunt seal and caribou and trap Arctic foxes. Now he's working as the community's lead Indigenous Guardian and with ArctiConnexion to ensure the preservation of his territory.

An Inuk man, Aqqaq's knowledge of the land and the species that occupy it is vast. He has spent his entire life accumulating understandings about the relationships between the species in his region and how to respectfully coexist with them. The knowledge he's inherited, Inuit Qaujimajatuqangit, has been passed down from generation to generation, and is built on thousands of people's direct contact with the environment.

Note: The following has been edited for length and clarity.

Aqqaq on the changes he's noticing in Taloyoak, wildlife migratory routes and why his community is prioritizing protection

Growing up, when I was old enough to go out on the land, my dad would take me out hunting, and that's where I learned my skills.

Back then, there was plenty of ring seals on the south side of the M'Clintock Channel but, over the years, the numbers have declined, and we don't know the reason. On the land side, caribou was very hard to find; we'd have to go a long distance to look for them. But today, the number of caribou migrating through the community has increased, and we don't have to travel as far.

We never used to have brown bears up here, or see any tracks, but they're slowly moving up north. We have more wolves up here, too, especially on the Gulf of Boothia, but our neighbouring communities, Gjoa Haven and Kugaaruk, tend to see a lot more of the wildlife.

So, there are some changes we're seeing, but it's still stable. What helps is we have a local radio station here and the Elders go on air talking about wildlife, especially during the migration of the caribou. Sometimes they say, "We have plenty of caribou today, respect the animal, just get what you need and don't waste it. If you're not going to eat it, or if you're not going to share it, don't get what you're not going to use." That knowledge has been passed on and it's very strong.

For the changes in our species, it might be the mining that is going on farther south in Baker Lake or Rankin Inlet that's bothering the animals, pushing them north, changing their migratory routes. We're also seeing more helicopters flying low, people looking for minerals, so that might be part of it too.

Taloyoak has started environmental monitoring to keep an eye on species health

We do marine sampling, and last year we started using a hydrophone — we recorded ring seals, bearded seals, narwhals, beluga and, I think, a walrus, but we're not too sure.

We also set cameras and have to change them every couple of weeks. We haven't really looked into the footage yet, but eventually it will help the Hunters and Trappers Organization. Even without the cameras, as a hunter who grew up here, I know the numbers of caribou are healthy. It's just the migrating route that has changed.

The community prioritizes wildlife for survival

Wildlife is very important for us up here, it's our only garden. We don't have vegetables growing in our community, so it's very important that we take good care of what we have.

We need to take care of our wildlife, take care of our land, and that includes protecting it from mining. Taloyoak is very small and if somebody starts mining up here, our wildlife, migrating routes and calving grounds would be destroyed, just like that.

We don't want any mining up here; we've seen what's happening on the Baffin side where there's a mine. It has done a lot of damage to the land, the wildlife has changed, and we don't want that to happen here.

Translation provided by Suzie Napayok, Tusaajiit Translations
Language: Inuktitut

ABEL AQQAQ

Lead Guardian,
Taloyoak Umaruliriqut Association

“ ᐆᒪᔪᐃᑦ ᐱᒻᒪᕆᐋᓘᕐᒪᑕ ᐅᓐᑉᑎᓐᓄᑦ ᑕᒫᓂ, ᓂᕿᒃᓴᖅᑖᕐᕕᒋᓐᑲᑐᐊᕆᒐᑉᑎᒍᑦ

ᐋᐳᑦ ᐊᖅᑲᖅ ᐃᓅᓯᓕᒫᖅ ᓄᓇᓕᖕᒥᐅᑕᐅᒐᖅ Hᐊᒻᒪᓚᑦᑯᑦᓂ ᑕᓗᕿᐊᕐᓂ, ᓄᓇᕗᒻᒥ, ᐅᐊᖕᓇᖅᐸᓯᐅᓂᖅᐹᖕᖓᓂ ᓄᓇᓕᖕᓂ ᑲᓇᑕᒥᐅᑦ ᓄᓇᖃᐱᖕᒥᐅᑕᐅᓂᖕᒋᓐᓂ. ᐃᓂᓕᒃ ᐊᑯᓐᓂᖕᖓᓂ ᐃᑦᑐᐊᖅᑐᕐᕕᐅᑉ ᐊᒻᒪᓗ ᖃᖏᐅᔭᐅᓪᓗ ᑕᐃᔭᐅᔪᒥ ᐊᕐᕕᖅᑑᕐᒥ. ᐊᖅᑲᖅ ᓄᓇᒥ ᐱᕈᖅᓴᓂᑯ ᐊᑖᑖᒥᓂᓗ ᐃᓕᓐᓂᐊᖅᓯᒪᓪᓗᓂ ᓇᑦᓯᖅᓯᐅᕈᓐᓇᕐᓂᕐᒥᒃ, ᑐᒃᑐᓯᐅᕈᓐᓇᕐᓂᕐᒥᒡᓗ ᐊᒻᒪᓗ ᑎᕆᒐᓂᐊᕐᓂᒃ ᒥᕿᕆᐊᕐᓂᐊᖅᑕᕐᓂᕐᒥᒃ. ᒫᓐᓇᐅᓕᖅᑐᖅ ᐱᓕᕆᔾᔪᓕᖅᑐᖅ ᑖᒻᓇ ᓯᕗᓪᓕᕆᔭᐅᕙᖕᓂᖅ ᓄᓇᓕᑐᖅᑲᕐᓂ Hᐊᐳᒻᒥᔾᔪᓂᖕᒋᓐᓂ ᑖᒃᑯᓂᖕᖓᓗ ᐃᓚᖅᑲᖅᓱᑎᒃ ArctiConnexion-ᑯᓐᓂᒃ Hᐊᐳᒻᒥᔭᐅᖅᑯᓪᓗᒋᑦ ᐱᑕᖅᑲᐃᓐᓇᖅᑯᔭᖕᒋᑦ ᑕᒫᓂ ᐊᕕᒃᑐᖅᓯᒪᓂᖕᖓᓂ.

ᐃᓄᓪᓚᕆᐅᔪᖅ ᑖᓐᓇ, ᐋᖅᑲᖅ ᖃᐅᔨᒪᓂᖕᖓ ᓄᓇᒥᓂᒃ ᐆᒪᔪᖅᑲᖅᕕᐅᔪᓂᒡᓗ ᐊᖕᒋᔪᐊᓘᕗᖅ. ᐃᓅᓯᓕᒫᖅ ᑐᑭᓯᓂᐊᖅᑕᐃᓐᓇᖅᒥ ᐃᓚᒌᖕᓂᖕᒋᓐᓂ ᐆᒪᔪᐃᑦ ᑕᒫᓂ ᐊᕕᒃᑐᖅᓯᒪᓂᖕᒋᓐᓂ, ᐊᒻᒪᓗ ᖃᓄᖅ ᐃᑕᕆᓗᕆᑦ ᐱᑕᖅᑲᖅᑐᐃᓐᓇᐅᔪᓐᓇᖅᓂᖕᒋᓐᓂ ᐃᓄᐃᓪᓗ ᐆᒪᔪᐃᓪᓗ. ᑕᒪᒃᑯᐊ ᖃᐅᔨᒪᓂᖕᒋᑦ ᑎᒍᒥᐊᖅᑕᖕᒋᑦ ᐊᑐᖅᐳᕆᑦ, ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖅᑲᖕᒋᑦ, ᑲᔪᓯᑎᑕᐅᓯᒪᒐᑦ ᑭᖑᕙᕇᒃᑐᓄᑦ ᑕᐃᒪᖕᖓᑦ, ᑐᖕᖓᕕᖅᑲᖅᓱᑎᒃ ᑕᐅᓴᖕᒋᓐᓂᒃ ᐊᕐᕌᖑᓂᒃ ᐃᓄᐃᑦ ᐊᕙᑎᒥᐅᑕᐅᑕᖅᑲᐃᓐᓇᖅᓂᖕᒋᓐᓂᒃ.

ᖃᐅᔨᒪᔭᐅᓂᐊᖅᐸᖅ: ᐅᑯᐊ ᐊᑕᐆᑦᑐᑦ ᓇᑲᑎᖅᑕᐅᓯᒪᔪᑦ ᑕᑭᓂᖕᒋᑦ ᓈᒻᒪᖅᑯᓪᓗᒋᑦ ᐊᒻᒪᓗ ᑐᑭᓯᓇᑦᑎᐊᖅᑯᓪᓗᒋᑦ.

ᐊᖅᑲᖅ ᐱᔾᔪᑎᖃᖅᑐᓂᒃ ᐊᓯᙶᖅᓯᒪᓂᖕᒋᓐᓂᒃ ᖃᐅᔨᖃᑦᑕᖅᓯᒪᔭᖕᒋᓐᓂᒃ ᑕᓗᕿᐊᕐᓂ, ᐆᒪᔪᐃᓪᓗ ᓇᐅᒃᑯᖃᑦᑕᕐᓂᖕᒋᓐᓂᒃ, ᐊᒻᒪᓗ ᓱᖅ ᓄᓇᓕᖕᒥᓂ ᓯᕗᓪᓚᐅᑎᑦᑎᓂᖕᒋᓐᓂᒃ Hᐊᐳᒻᒥᒥᕆᐊᕐᓂᕐᒥᒃ:

ᐱᕈᖅᐸᓪᓚᐊᓂᓐᓂ, ᐊᖏᓪᓕᑐᐊᕋᒪ ᐃᓚᐅᔪᓐᐱᕈᖅᐸᓪᓚᐊᓂᓐᓂ, ᐊᖏᓪᓕᑐᐊᕋᒪ ᐃᓚᐅᔪᓐᓇᖅᓯᓪᓗᖕᖓ ᓄᓇᒨᖕᖓᐅᕙᒃᑐᓂᒃ, ᐊᑖᑕᒪ ᐃᓚᐅᑎᑉᐸᓚᐅᖅᑖᖕᖓ ᐊᖑᓇᓱᑭᐊᓂᐊᕐᓚᕝᖕᖓᒥ, ᑕᖅᑮᓂ ᑕᒡᕙ ᐃᓕᓐᓂᐊᕐᓂᑰᕗᖕᖓ.

ᑕᐃᔅᓱᒪᓂᓚ, ᐊᒥᓱᐊᓘᕙᓚᐅᕐᒪᑕ ᓇᑦᑏᑦ ᑕᐅᕙᓂ ᓂᕆᖅᐸᓯᐊᓂ ᖃᑦᕿᐅᕋᐅᑉ ᓄᓇᖕᖓᓂ ᑭᓯᐊᓂᓚ, ᐊᕐᕌᒍᓂ ᑲᔪᓯᕙᓪᓚᐊᔪᓂ, ᐊᒥᓱᔪᓐᖅᓯᒪᖕᒪᑕ, ᐊᒻᒪᓗ ᓱᓕ ᖃᐅᔨᒪᖕᒋᑦᑐᒍᑦ ᓱᖅ ᑕᐃᒪᐃᓕᖕᖓᓕᕐᓂᖕᒋᓐᓄᑦ. ᓄᓇᖅᐱᐅᓂᕐᒥᑕᐅᖅ, ᑐᒃᑐᐃᑦ ᑕᑯᔭᐅᖓᔪᐃᑦᑑᓕᖅᑐᑦ, ᐅᖕᖓᓯᒃᑐᐊᓗᖕᒑᕆᐊᖅᑲᖅᑐᒍᑦ ᑐᒃᑐᓂᒃ ᓇᓂᓯᓇᓱᖕᓂᕐᒍᑦ. ᐅᓪᓗᒥᐅᓕᖅᑐᖅ, ᑐᒃᑐᐃᑦ ᑕᒪᐅᓈᖅᐸᓚᐅᖅᑐᑦ ᓄᓇᑎᓄᑦ, ᐊᒥᓱᕈᕆᐊᖅᓯᒪᓕᖅᑐᑦ ᑭᓯᐊᓂ ᑕᐅᕗᖕᖓ ᐅᖕᖓᓯᒃᑐᒍᑦ ᐊᐅᓛᕋᔪᐃᓕᖅᑐᒍᑦ.

ᑕᑯᕙᓚᐅᖅᑎᑦᑎᐊᖅᑐᒍᑦ ᐊᒃᓴᖕᓂᒃ, ᑐᒥᖕᒋᓐᓂᓪᓗᓐᓂᑦ, ᑭᓯᐊᓂ ᐅᐊᖕᓇᖅᐸᓯᐅᓂᕐᒍᑦ ᑎᑭᐸᓪᓚᐊᖅᑕᓕᕆᕗᑦ. ᐊᒥᓲᓂᖅᓴᐅᕙᓕᕐᒥᔪᑦ ᐊᓚᕈᐃᑦ, ᐱᓗᐊᖅᑐᒥᒃ ᑕᐅᕙᓂ ᐃᑦᑎᐊᖅᑐᕐᕕᖕᒥ, ᐊᒻᒪᓗ ᓴᓂᓕᕆᔭᑦᑕ ᓄᓇᓕᖕᖓᓂ, ᐅᖅᓱᖅᑑᕐᒥ ᐊᒻᒪᓗ ᑯᓴᕿᖕᒥ, ᑕᑯᔭᐅᓴᖅᓯᔪᑦ ᑕᒪᒃᑯᐊ.

ᐃᓚᖕᒋᓐᓂᒃ ᐊᓯᙳᖅᓯᒪᔪᓂᒃ ᑕᑯᖃᑦᑕᕐᒥᔪᑦ, ᑭᓯᐊᓂ ᓯᓚ ᖃᓄᐃᓗᐊᖕᒋᑦᑐᑦ. ᐃᑲᔪᖃᑦᑕᖅᑕᑦᑕ ᓄᓇᓕᖕᓂ ᓈᓚᐅᑎᓕᑦ ᑕᒫᓂ ᐊᒻᒪᓗ ᐃᓐᓇᑐᖃᐃᑦ ᓈᓚᐅᑎᒃᑰᔫᒡᓗᑎᒃ ᐅᖃᐅᓯᕐᐊᕆᐊᖅᑐᓂᒃ ᐆᒪᔪᓚᕆᓂᖅᒥᒃ, ᐋᓗᐊᖅᑐᒥᒃ ᓇᐅᒃᑯᖅᑕᕐᓂᕐᒥ ᑐᒃᑐᐃᑦ. ᐃᑮᓂᒃᑯᑦ ᐅᖅᑲᖅᑕᖅᑕᖅᑕᖅ, “ᐊᒥᓲᓂᒃ ᑐᒃᑐᖃᓕᖅᑕᖅ, ᐃᒃᐱᒋᔭᐅᑎᐊᖅᑕᖅᓂᐊᖅᐳᑦ, ᐱᖃᑦᑕᖅᑐᓯᓗ ᑭᓯᐊᓂ ᐱᔭᕆᖅᖃᑕᐃᓐᓇᕆᔭᔾᔨᓐᓂᒃ, ᐃᒋᑕᐅᑐᐃᓐᓇᖅᑕᐃᓕᓗᑎᒃ. ᓂᕿᒃᓴᕆᔾᔮᖕᒋᒃᑯᑉᓯᐅᒃ, ᐅᕝᕙᓗᓐᓃᑦ ᐃᓄᖕᓄᑦ ᐊᐃᑦᑑᓯᐊᖅᑖᖅᑎᑦᑎᓂᐊᖕᒋᒃᑯᓯ, ᐱᑦᑕᐃᓕᕚᓪᓗᓯ ᐊᑐᔾᔮᖕᒋᑕᔅᓯᓐᓂᒃ.” ᑕᒪᑉᑯᐊ ᖃᐅᔨᒪᔭᐅᔪᑐᖅᑲᐃᑦ ᑲᔪᓯᑎᑕᐅᖕᒋᓐᓇᖅᒪᑕ ᓴᖕᒋᔪᐊᓘᖕᒋᓐᓇᖅᐳᑦ.

ᐊᓯᙳᖅᓯᒪᓂᖕᒋᓐᓂ ᐆᒪᔪᐃᑦ ᑕᒫᓂ, ᐱᔾᔪᑕᐅᔪᓐᓇᖅᑐᑦ ᐅᔭᕋᖕᓂᐊᖅᕕᑦ ᓂᕆᖅᐸᓯᑎᓐᓅᑦᑐᑦ, ᑕᐅᓇᓂ ᖃᒪᓂ’ᑐᐊᕐᒥ, ᑲᖕᒋᖅᓴᓂᕐᒥᓗᓐᓂᑦ ᐸᒡᕕᓴᒃᑕᐅᖅᑕᖅᓂᖕᒋᓐᓄᑦ ᐆᒪᔪᐃᑦ ᓅᖅᑕᓕᖅᑕ ᐅᐊᖕᓇᖅᐸᓯᖕᒨᖅᐸᖕᖓᓄᑦ, ᐊᓯᙳᖅᓯᒪᓪᓗᑎᒃ ᑕᕝᕗᓇ ᓇᐅᒃᑯᖅᕕᒋᕙᒃᑐᖅᑲᓗᐊᖕᒋᓐᓂᒃ. ᑕᑯᕙᓪᓚᐊᓕᖅᑕᔪᑦ ᐊᒥᔅᓱᓂᖅᓴᓂᒃ ᖁᓕᒥᒨᓕᖕᓂᒃ ᐊᑦᑕᓈᓗᐊᖅᑕᖅᑐᓂᒃ, ᑭᓇᒃᑯᑐᐃᓐᓇᐃᓪᓗ ᐅᔾᔨᖕᓂᐊᓚᒃᓴᖅᓯᐅᖅᑐᑦ, ᑕᒪᒃᑯᐊᑦᑕᐅᖅ ᐱᔾᔪᑕᐅᔪᓐᓇᖅᑐᔪᑦ.

ᑕᓗᖅᔪᐊᑦ ᐊᕙᑎᖕᖓᓂ ᓇᐅᑦᑎᖅᑐᐃᕙᓪᓚᐊᓕᖅᑐᑦ Hᐊᐳᒥᔭᐅᖅᑯᓪᓗᒋᑦ ᐆᒪᔪᐃᑦ ᓈᒻᒪᒍᓃᖅᐸᓪᓚᐊᔪᓐᓇᖅᓂᖕᒋᓐᓄᑦ

ᑕᕆᐅᖅ ᐃᒪᖅᓂᒃ ᖃᐅᔨᓴᐅᒃᓴᓂᒃ ᐱᓕᕆᕙᓕᖅᑕᔪᑦ, ᐊᒻᒪᓗ ᐊᖅᕿᓂᐅᓚᐅᖅᑐᖅ, ᐊᑐᖅᑲᕆᐊᓕᓚᐅᖅᑐᑦ ᐃᒪᖅᒥᒃ ᑐᓴᕐᔪᑎᓂᒃ – ᓂᐱᓕᐅᖅᑕᐅᕝᕙᒃᓯᑎᒃ ᓇᑦᑏᑦ, ᐅᒡᔪᐃᑦ, ᑑᒑᓖᑦ, ᕿᓇᓗᒐᐃᑦ ᐊᒻᒪᓗ ᐃᒻᒪᖄ ᐊᐃᕖᑦ ᑖᒃᑯᐊᓕᐊᐃᕖᑦ ᐃᖅᑲᐅᒪᑦᑎᐊᖏᑦᑕᖅᑐᐊᒃᑲ.

ᐋᕿᐅᒪᑎᑦᑎᕙᓕᖅᑕᔪᑦ ᐊᔾᔨᓕᐅᕈᑎᓂᒃ, ᐊᓯᙳᖅᑎᑕᐅᖅᑕᐅᓇᐊᓖᖕᓂᒃ ᒪᕿᖕᓂᒃ ᐱᓇᓱᐊᕈᓯᑕᒪᖅ. ᑕᑯᓯᒪᖕᒋᑕᕗᑦ ᓱᓕ ᐊᔾᔨᓕᐅᖅᑕᐅᓯᒪᓂᖕᒋᑦ ᑕᕿᓴᐅᑏᑦ ᑭᓯᐊᓂ ᐃᑲᔪᕐᓂᖅᑲᕐᓂᐊᖅᑐᑦ ᐊᖑᓇᓱᒃᑏᑦ ᑲᑐᔾᔨᖅᑲᑎᕇᖕᒋᓐᓂᒃ ᑕᒪᒃᑯᐊ. ᐊᔾᔨᓕᐅᕈᑎᖅᑲᖕᒋᑲᓗᐊᖅᑎᓪᓗᑕ, ᐊᖑᓇᓱᒃᑎᑐᖅᑲᐅᓪᓗᑕ ᐱᕈᖅᓴᓃᑦᑐᑕᓗ ᑕᐅᕙᓂ. ᖃᐅᔨᒪᔪᒍᑦ ᑐᒃᑐᐃᑦ ᐊᒥᓱᓂᖕᒋᑦ ᖃᓄᐃᖕᒋᑦᑎᐊᖅᑐᑦ. ᐊᓯᙳᖅᓯᒪᑐᐃᓐᓇᖅᑐᑦ ᓇᐅᒃᑯᐸᓕᖅᓂᖕᒋᑦ ᑎᑭᐸᓪᓚᐊᓂᖕᒋᓐᓂ.

ᓄᓇᓖᑦ ᓯᕗᓪᓕᐅᔾᔨᕙᒃᑐᑦ ᐆᒪᔪᓂᒃ ᐃᓅᔾᔪᑎᒃᓴᕆᔭᐅᕙᖕᓂᖕᒋᓐᓄᑦ

ᐆᒪᔪᐃᑦ ᐱᒻᒪᕆᐊᓘᕐᒪᑕ ᐅᕙᑦᑎᓐᓂᒃ ᑕᒫᓂᕐᒥᐅᑕᐅᔪᒍᑦ, ᓂᕿᒃᓴᖅᑖᕐᕕᒋᐊᓗᐊᕆᒐᑉᑎᒍᑦ. ᐱᕈᖅᑐᖅᑲᔅᓲᖑᕆᓪᓚᑦ ᓄᓇᑦᑎᓐᓂ, ᑕᐃᒪᐃᓂᖕᖓᓄᑦ ᐱᒻᒪᕆᐊᓘᕗᖅ ᐅᕙᒍᑦ ᒥᐊᓂᖅᓯᑦᑎᐊᖅᑕᕆᐊᖅᑲᖅᓂᖅ ᐱᕙᕆᔪᓐᓇᖅᑕᑦᑎᓐᓂᒃ.

ᐸᕿᔭᐅᑦᑎᐊᖅᑕᕆᐊᖅᑲᖅᑕ ᐆᒪᔪᐃᑦ, ᑲᒪᒋᔭᐅᑦᑎᐊᖅᑐᓂᒃ ᓄᓇᖅᑯᑎᕗᑦ, Hᐊᐳᒻᒥᔭᐅᓗᑎᓪᓗ ᐅᔭᕋᖕᓂᐊᕐᕕᐅᔪᓐᓇᖅᓂᖅᒥᒃ. ᑕᓗᖅᔪᐊᑉ ᓄᓇᖕᖓ ᒥᕿᔫᖕᒪᑦ, ᐊᒻᒪᓗ ᑭᓇᑐᐃᓐᓇᖅ ᐅᔭᕋᖕᓂᐊᕐᔭᕈᓂ ᑕᒫᓂ, ᓄᓇᖅᑯᑎᕗᑦ, ᐆᒪᔪᐃᑦᑕ ᓇᐅᒃᑯᖅᕕᒋᕙᒃᑕᖕᒋᑦ ᐊᒻᒪᓗ ᓄᕿᓇᕝᕙᐅᕙᖕᓂᖕᒋᑦ ᓱᕋᒃᑎᖅᑕᐅᓇᔭᖅᑐᑦ, ᑕᐅᕙᒃᑲᐅᑎᒋ.

ᐅᔭᕋᖕᓂᐊᖅᑕᐅᖅᑯᔾᔨᖕᒋᑦᑐᒍᑦ ᑕᒫᓂ, ᑕᑯᓯᒪᓕᕋᑦᑕ ᖃᓄᐃᓕᖕᖓᓕᖅᓂᖕᒋᓐᓂ ᕿᑭᖅᑖᓗᖕᒥ ᐅᔭᕋᖕᓂᐊᕐᕕᓕᖕᓂᒃ. ᐊᖏᔪᐊᓗᖕᒥᒃ ᓱᕋᒃᑎᖅᑕᐅᓯᒪᔪᖅ ᓄᓇᖕᖓᑦ, ᐆᒪᔪᖅᑯᑎᖕᒋᑦᑐ ᐊᓯᔾᔨᖅᓯᒪᓗᑎᒃ, ᑕᐃᒪᐃᓕᖕᖓᖅᑯᔾᔨᖕᒋᓐᓇᖅᑕᑦᑕ ᑕᒫᓂ.

INTEGRATING BIODIVERSITY IN DECISION-MAKING

Integrating biodiversity into decision-making is essential for ensuring the long-term health, resilience and sustainability of Canada's ecosystems, economies and communities. As pressures from economic development, resource extraction and climate change intensify, decisions made in silos risk compounding biodiversity loss.

Governments must also be held accountable for their commitments to nature, especially as leaders, parties and priorities change. Previous goals and targets associated with nature conservation have rarely been achieved[340] — for example, none of the previous 20 Aichi Biodiversity Targets (from 2011–2020) under the Convention on Biological Diversity were fully accomplished.[341] In 2024, the federal Minister for Environment and Climate Change introduced into parliament Bill C-73, the Nature Accountability Act, to provide a transparency and accountability framework for the federal government on progress toward a subset of nature and biodiversity commitments under the GBF.[342] [343] While the creation of the bill was an important step, it was not passed in the House of Commons. Conservation targets are not yet enshrined into law, and there remain no legally enshrined repercussions for Canada's failure to meet nature targets and commitments.[344]
Species at risk legislation provides a legal framework to protect and recover species that are threatened with extinction, providing a vital and direct mechanism for embedding biodiversity considerations into decision-making. While species at risk legislation are not without flaws in Canada,[345] and some provinces and territories lack legislation altogether, additional issues have arisen within the last year — namely weakening environmental protections in the name of economic development.

For instance, Ontario's dangerous move to dismantle provincial environmental protections through the Protect Ontario by Unleashing Our Economy Act (which received Royal Asset on June 5, 2025) — an enabling omnibus legislation that included changes to several other Acts — puts wildlife and nature at greater risk by removing science-based decision-making, harmfully redefining "habitat" and giving the government the power to exempt certain developments from any regulation.[346] This is just one example of many where policy is increasingly decoupled from environmental impacts.

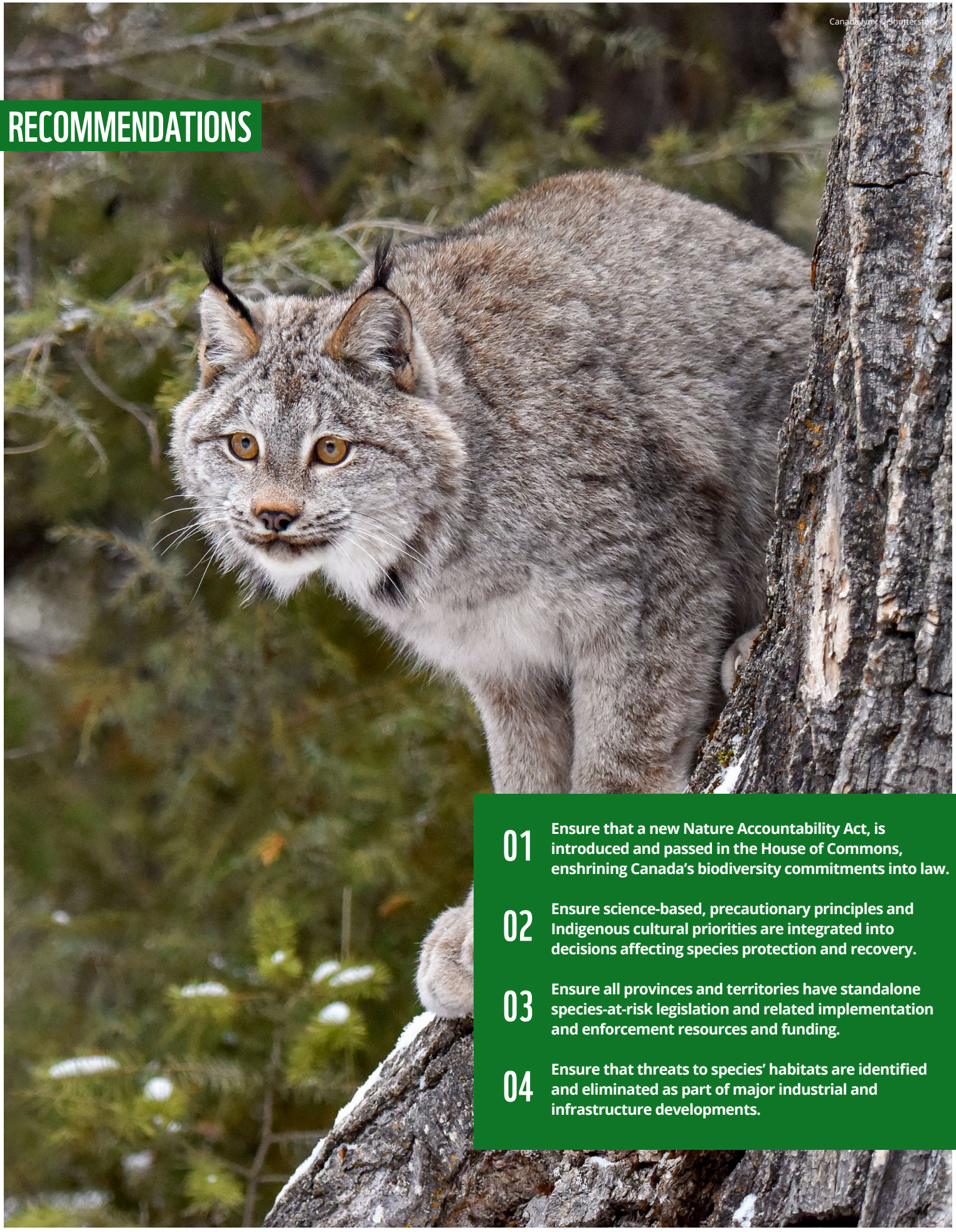
Across Canada, deregulation is on the rise. B.C. recently passed its Infrastructure Projects Act (Bill 15) which gives the provincial cabinet expanded powers to bypass the current environmental review process for projects deemed "provincially significant."[347] The importance of mining to Canada's economy is widely acknowledged. But we must also acknowledge — and take action to eliminate or minimize — the risks to nature, communities and the economy when the regulations that manage those risks are stripped away.

Not only do we need legislation specifically designed to protect biodiversity, but biodiversity must also be integrated into all types of legislation where it may be impacted, including environmental assessments related to infrastructure and mining.

Co-ordinated action across jurisdictions, accompanied by a whole-of-government approach, may help mainstream biodiversity considerations in decision making, while simultaneously supporting Indigenous-led conservation and advancing Canada's international commitments to the Convention on Biological Diversity.[348] By thoughtfully embedding biodiversity in planning, policy and investment decisions, Canada can build a more nature-positive future.

> **CANADA'S NATURE STRATEGY | KUNMING-MONTREAL GLOBAL BIODIVERSITY FRAMEWORK TARGET 14**
>
> Ensure the full integration of biodiversity and its multiple values into policies, regulations, planning and development processes, poverty eradication strategies, strategic environmental assessments, environmental impact assessments and, as appropriate, national accounting, within and across all levels of government and across all sectors, in particular those with significant impacts on biodiversity, progressively aligning all relevant public and private activities, and fiscal and financial flows with the goals and targets of this framework.

RECOMMENDATIONS



Canada lynx © Shutterstock

01 Ensure that a new Nature Accountability Act, is introduced and passed in the House of Commons, enshrining Canada's biodiversity commitments into law.

02 Ensure science-based, precautionary principles and Indigenous cultural priorities are integrated into decisions affecting species protection and recovery.

03 Ensure all provinces and territories have standalone species-at-risk legislation and related implementation and enforcement resources and funding.

04 Ensure that threats to species' habitats are identified and eliminated as part of major industrial and infrastructure developments.

Sea otter © naturepl.com / Pascal Kobeh / WWF

Peyto Lake, Banff National Park, Alberta, Canada. © Don Getty

MOVING FORWARD AT WWF-CANADA

06

The latest results of this report show that even in a country like Canada, where nature abounds, wildlife is in decline. Habitat loss and the effects of climate change — such as heat waves, wildfires, floods and storms — are causing a devastating loss of biodiversity.

The good news is that we already know what works. Protection, restoration, Indigenous-led conservation and sustainable and responsible industry practices are some of the targeted actions we can take. We also need comprehensive, integrated and inclusive conservation strategies that effectively tackle multiple threats at once. By using nature to fight biodiversity loss and climate change, we can reverse what seems irreversible. The following are some of the initiatives that WWF-Canada is undertaking.

THE RESTORATION AGENDA

Restoration is key to providing more habitat for wildlife and for increasing the potential for carbon storage and sequestration. In collaboration with land and rightsholders as well as other stakeholders across the country, WWF-Canada is working to restore one million hectares of lost or degraded habitats for wildlife by 2030. The first step for this work was identifying, through systematic analysis, the regions with the greatest need and potential for restoration, such as the Wolastoq watershed in New Brunswick, the Lower Fraser River and the interior of B.C. Some of this restoration work is being supported through the Nature and Climate Grant Program, which helps local groups and Indigenous communities restore degraded lands and shorelines to improve habitats and capture carbon. In high-density areas, we're engaging people through schools, campuses and re:grow, a program that helps people plant native species in any environment. Finally, we're also working with like-minded organizations to build momentum for large-scale restoration and to track restoration activities in the country through Mission Restoration.

Volunteering group in a park for sustainable environment initiatives © Shutterstock

IPCA SUPPORT FUND

Indigenous Protected and Conserved Areas (IPCAs) are defined and managed by Indigenous communities, with stewardship drawing from Indigenous governance, laws and knowledge systems. In 2022, WWF-Canada launched the IPCA Support Fund, a commitment to provide funding of between $50,000 and $100,000 to support Indigenous communities in early-stage IPCA ideation and implementation and is currently funding seven Indigenous-led initiatives. IPCAs are critical in addressing biodiversity loss and securing the climate-regulating benefits of healthy ecosystems, while elevating Indigenous rights and upholding the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). Guided by feedback from the inaugural recipients and Indigenous advisors, the IPCA Support Fund will continue to grow in impact and evolve in the years to come.

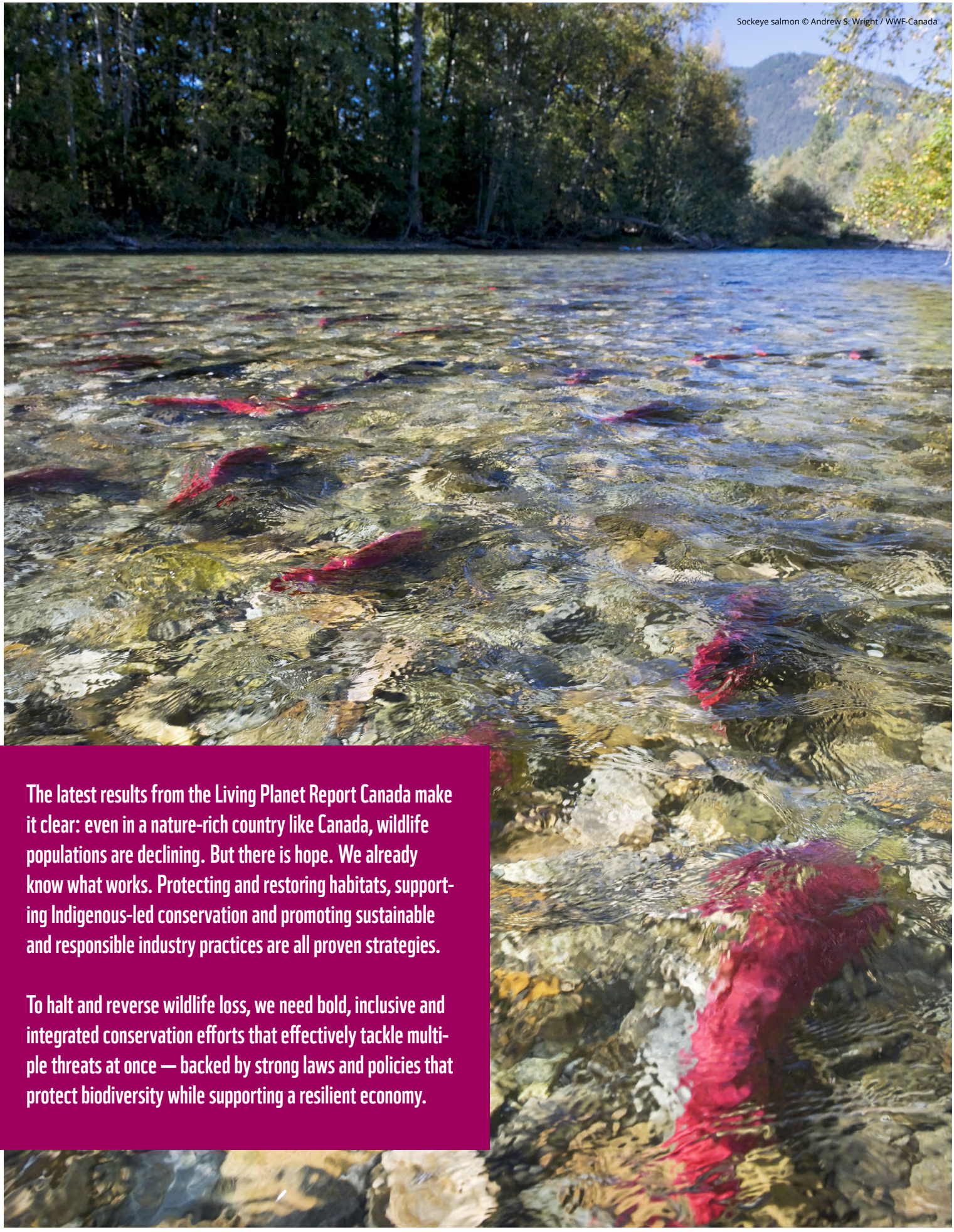
SUSTAINABLE SHIPPING

Reducing threats to wildlife decline includes working with industries to reduce their impacts on wildlife and habitat. Marine shipping is the most prominent threat to marine populations and WWF-Canada's work seeks to demonstrate how sustainable shipping practices can slow and reverse biodiversity loss, fight climate change and support community wellbeing.

A core part of our strategy includes supporting Indigenous rights and conservation priorities in ocean governance through research, data sharing and knowledge mobilization. We advocate for reducing the risk of fuel spills, ship strikes, underwater noise, harmful air emissions including black carbon, and the elimination of polluting discharges such as greywater, sewage and scrubber washwater.

We collaborate with industry, governments and communities to develop and implement marine mammal management plans, advocate for protection of important habitats, and ensure that shipping routes and operations are developed, managed and monitored in ways that prioritize ecological integrity, Indigenous rights and community values.

Recognizing that shipping is a transboundary industry governed by both Canadian and international law, we also advance our goals internationally through ongoing engagement and thought leadership at the United Nations International Maritime Organization and at the Arctic Council.



Sockeye salmon © Andrew S. Wright / WWF-Canada

The latest results from the Living Planet Report Canada make it clear: even in a nature-rich country like Canada, wildlife populations are declining. But there is hope. We already know what works. Protecting and restoring habitats, supporting Indigenous-led conservation and promoting sustainable and responsible industry practices are all proven strategies.

To halt and reverse wildlife loss, we need bold, inclusive and integrated conservation efforts that effectively tackle multiple threats at once — backed by strong laws and policies that protect biodiversity while supporting a resilient economy.

REFERENCES

1 CESCC. 2022. Wild Species 2020: The general status of species in Canada. National General Status Working Group, Canadian Endangered Species Conservation Council. Retrieved [online] from: https://www.wildspecies.ca.

2 ECCC. 2025. Species at Risk public registry. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

3 ECCC. 2024. Canadian Environmental Sustainability Indicators: Species at risk population trends. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

4 IPBES. 2024. The thematic assessment report on interlinkages among biodiversity, water, food and health. – Summary for policymakers. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Retrieved [online] from: https://ipbes.canto.de.

5 CBD. 2022. Kunming-Montreal Global biodiversity framework. CBD/COP/DEC/15/4. Convention on Biological Diversity. Retrieved [online] from: https://www.cbd.int.

6 ECCC. 2024. Canada's 2030 Nature Strategy: Halting and reversing biodiversity loss in Canada. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

7 WWF. 2024. 2024 Living Planet Report: A system in peril. World Wildlife Fund. Retrieved [online] from: https://livingplanet.panda.org.

8 WWF-Canada, ZSL and GFN. 2007. Canadian living planet report 2007. World Wildlife Fund Canada, Zoological Society of London and Global Footprint Network. Retrieved [online] from: https://www.footprintnetwork.org.

9 WWF-Canada. 2017. Living planet report Canada: A national look at wildlife loss. World Wildlife Fund Canada. Retrieved [online] from: https://wwf.ca

10 WWF-Canada. 2020. Living planet report Canada: Wildlife at risk. World Wildlife Fund Canada. Retrieved [online] from: : https://wwf.ca.

11 ECCC. 2023. Canadian Environmental Sustainability Indicators: Canadian Species Index. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

12 Birds Canada and ECCC. 2024. The State of Canada's Birds Report. Nature Counts. Birds Canada and Environment and Climate Change Canada. Retrieved [online] from: https://naturecounts.ca.

13 Collen B. Loh J. Whitmee S. McRae L. Amin R. & Baillie JEM. 2009. Monitoring change in vertebrate abundance: the Living Planet Index. Conservation Biology, 23(2): 317-327. DOI: 10.1111/j.1523-1739.2008.01117.x.

14 WWF-Canada. 2020. Living planet report Canada: Wildlife at risk. World Wildlife Fund Canada. Retrieved [online] from: https://wwf.ca.

15 ECCC. 2023. Canadian Environmental Sustainability Indicators: Canadian Species Index. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

16 Marconi V. McRae L. Müller H. Currie J. Whitmee S. Gadallah F. & Freeman R. 2021. Population declines among Canadian vertebrates: But data of different quality show diverging trends. Ecological Indicators, 130, 108022. DOI: 10.1016/j.ecolind.2021.108022.

17 CESCC. 2022. Wild Species 2020: The general status of species in Canada. National General Status Working Group, Canadian Endangered Species Conservation Council. Retrieved [online] from: https://www.wildspecies.ca.

18 Marconi V. McRae L. Müller H. Currie J. Whitmee S. Gadallah F. & Freeman R. 2021. Population declines among Canadian vertebrates: But data of different quality show diverging trends. Ecological Indicators, 130, 108022. DOI: 10.1016/j.ecolind.2021.108022.

19 Currie J. Ravoth S. Marconi V. McRae L. Arce-Plata M. Emry S. Freeman R. et al. 2025. Navigating methodological decisions: Balancing rigor and data volume of the Canadian Living Planet Index. Submitted.

20 Collen B. Loh J. Whitmee S. McRae L. Amin R. & Baillie JEM. 2009. Monitoring change in vertebrate abundance: the Living Planet Index. Conservation Biology. 23(2): 317-327. DOI: 10.1111/j.1523-1739.2008.01117.x.

21 Jessen TD. Ban NC. Claxton NX. & Dairmont CT. 2021. Contributions of Indigenous Knowledge to ecological and evolutionary understanding. Frontiers in Ecology and the Environment, 20(2), 93-101. DOI: 10.1002/fee.2435.

22 Walter M. Lovett R. Maher B. Williamson B. Prehn J. Bodkin-Andrews G. & Lee V. 2020. Indigenous data sovereignty in the era of big data and open data. Australian Journal of Social Issues, 56(2), 143-156. DOI: 10.1002/ajs4.141.

23 FNIGC. 2025. OCAP® is a registered trademark of the First Nations Information Governance Centre (FNIGC). First Nations Information Governance Center. Retrieved [online] from: https://fnigc.ca/.

24 United Nations (General Assembly). 2007. United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). Resolution 61/295 (A/RES/61/295). Retrieved [online] from: https://www.un.org.

25 Bartlett C. Marshall M. & Marshall A. 2012. Two-Eyed Seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. Journal of Environmental Studies and Sciences, 2, 331-340. DOI: 10.1007/s13412-012-0086-8.

26 WWF. 2024. 2024 Living Planet Report: A system in peril. World Wildlife Fund. Retrieved [online] from: https://livingplanet.panda.org.

27 CESCC. 2022. Wild Species 2020: The general status of species in Canada. National General Status Working Group, Canadian Endangered Species Conservation Council. Retrieved [online] from: https://www.wildspecies.ca.

28 COSEWIC. 2015. COSEWIC assessment and status report on the Eastern Wolf *Canis sp. cf. lycaon* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://publications.gc.ca.

29 Hoy SR. Hedrick PW. Peterson RO. Vucetich LM. Brzeski KE. & Vucetich, JA. 2023. The far-reaching effects of genetic process in a keystone predator species, grey wolves. Science Advances, 9(34), eadc8724. DOI: 10.1126/sciadv.adc8724.

30 Fogg BR. Howe N. & Pierotti R. 2015. Relationships between indigenous American peoples and wolves 1: Wolves as teachers and guides. Journal of Ethnobiology, 35(2), 262-285. DOI: 10.2993/etbi-35-02-262-285.1.

31 Musiani M. & Paquet PC. The practices of wolfp ersecution, protection, and restoration in Canada and the United States. BioScience, 54(1), 50-60. DOI: 10.1641/000 6-3568(2004) 054[0050:TPOWPP]2.0.CO;2.

32 Musiani M. & Paquet PC. The practices of wolf persecution, protection, and restoration in Canada and the United States. BioScience, 54(1), 50-60. DOI: 10.1641/0006-3568(2004)054 [0050:TPOWPP]2.0.CO;2.

33 Ripple WJ. & Beschta RL. 2012. Trophic cascades in Yellowstone: The first 15 years after wolf reintroduction. Biological Conservation, 145(1), 205-213. DOI: 10.1016/j. biocon.2011.11.005.

34 Gable TD. Johnson-Bice SM. Homkes AT. Windels SK. & Bump JK. 2020. Outsized effect of predation: Wolves alter wetland creation and recolonization by killing ecosystem engineers. Science Advances, 6(46), eabc5439. DOI: 10.1126/sciadv. abc5439.

35 Ripple WJ. Rooney TP. & Beschta RL. 2010. Chapter 9: Large predators, deer, and trophic cascades in boreal and temperate ecosystems. Trophic cascades: predators, prey, and the changing dynamics of nature, 141-161. Retrieved [online] from: https://www.researchgate.net.

36 Ripple WJ. & Beschta RL. 2012. Trophic cascades in Yellowstone: The first 15 years after wolf reintroduction. Biological Conservation, 145(1), 205-213. DOI: 10.1016/j. biocon.2011.11.005.

37 McShea WJ. 2012. Ecology and management of white tailed deer in a changing world. Annals of the New York Academy of Sciences, 1249(1), 45-56. DOI: 10.1111/j.1749-6632.2011.06376.x.

38 Dickie M. Serrouya R. McNay RS. & Boutin S. 2017. Faster and farther: wolf movement on linear features and implications for hunting behaviour. Journal of Applied Ecology, 54(1), 253-263. DOI: 10.1111/1365-2664.12732.

39 Whittington J. Hebblewhite M. DeCesare NJ. Neufeld L. Bradley M. Wilmshurst J. & Musiani M. 2011. Caribou encounters with wolves increase near roads and trails: a time to event approach. Journal of Applied Ecology, 48(6), 1535-1542. DOI: 10.1111/j.1365-2664.2011.02043.x.

40 ECCC. 2014. Grey wolf: non-detriment finding. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

41 CESCC. 2022. Wild Species 2020: The general status of species in Canada. National General Status Working Group, Canadian Endangered Species Conservation Council. Retrieved [online] from: https://www.wildspecies.ca.

42 COSEWIC. 2009. COSEWIC assessment and update status report on the Northern Leopard Frog *Lithobates pipiens*, Rocky Mountain population, Western Boreal/Prairie populations and Eastern populations in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

43 Birds Canada and ECCC. 2024. The State of Canada's Birds Report. Nature Counts. Birds Canada and Environment and Climate Change Canada.Retrieved [online] from: https:// naturecounts.ca.

44 Pauly D. 1995. Anecdotes and the shifting baseline syndrome of fisheries. Trends in Ecology and Evolution, 10, 430. DOI:

10.1016/s0169-5347(00)89171-5.

45 Alleway HK. Klein ES. Cameron L. Douglass K. Govia I. Guell C. Lim M. Robin L. et al. 2023. The shifting baseline syndrome as a connective concept for more informed and just responses to global environmental change. People and Nature, 5(3), 885-896. DOI: 10.1002/pan3.10473.

46 Hutchings JA. & Rangeley RW. 2011. Correlates of recovery for Canadian Atlantic cod *(Gadus morhua)*. Canadian Journal of Zoology, 89, 386-400. DOI: 10.1139/z11-022.

47 Schijns R. Froese R. Hutchings JA. & Pauly D. 2021. Five centuries of cod catches in Eastern Canada. ICES Journal of Marine Science, 78(8), 2675-2683. DOI: 10.1093/icesjms/fsab153.

48 COSEWIC. 2004. COSEWIC assessment and status report on the plains bison *Bison bison bison* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

49 Parks Canada. 2024. Plains bison reintroduction. Retrieved [online] from: https://parks.canada.ca.

50 COSEWIC. 2013. COSEWIC assessment and status report on the Plains Bison *Bison bison bison* and the Wood Bison *Bison bison bison athabascae* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net

51 Di Marco M. Chapman S. Althor G. Kearney S. Besancon C. Butt N. et al. 2017. Changing trends and persisting biases in three decades of conservation science. Global Ecology and Conservation, 10: 32-42. DOI: 10.1016/j.gecco.2017.01.008.

52 IUCN. 2024. The IUCN Red List of Threatened Species. International Union for the Conservation of Nature. Retrieved [online] from: https://www.iucnredlist.org/.

53 Calder RSD. McDermid JL. & Boudreau. 2023. Drivers of Atlantic herring decline and evidence basis for fisheries closures and rebuilding plans. Canadian Journal of Fisheries and Aquatic Sciences, 80(4), 663-675. DOI: 10.1139/cjfas-2022-0169.

54 DFO. 2021. Atlantic herring in the Maritimes region. Fisheries and Oceans Canada. Retrieved [online] from: https://www.dfo-mpo.gc.ca.

55 DFO. 2022. Science Advisory Report 2022/021: Assessment of the southern Gulf of St. Lawrence (NAFO Division 4TVn) spring and fall spawner components of Atlantic Herring *(Clupea harengus)* with advice for the 2022 and 2023 fisheries. Fisheries and Oceans Canada. Retrieved [online] from: https://www.dfo-mpo.gc.ca.

56 Calder RSD. McDermid JL. & Boudreau. 2023. Drivers of Atlantic herring decline and evidence basis for fisheries closures and rebuilding plans. Canadian Journal of Fisheries and Aquatic Sciences, 80(4), 663-675. DOI: 10.1139/cjfas-2022-0169.

57 DFO. 2025. Notice to fish harvesters – herring. Retrieved [online] from: https://www.glf.dfo-mpo.gc.ca.

58 Calder RSD. McDermid JL. & Boudreau. 2023. Drivers of Atlantic herring decline and evidence basis for fisheries closures and rebuilding plans. Canadian Journal of Fisheries and Aquatic Sciences, 80(4), 663-675. DOI: 10.1139/cjfas-2022-0169.

59 Boldt JL. Murphy HM. Chamberland J-M. Debertin A. Gauthier S. Hackett B. Hagel PS. et al. 2022. Canada's forage fish: an important but poorly understood component of marine ecosystems. Canadian Journal of Fisheries and Aquatic Sciences, 79, 1911-1933. DOI: 10.1139/cjfas-2022-0060.

60 Eisenhauer N. & Hines J. 2021. Invertebrate biodiversity and conservation. Current Biology, 31(19), R1214-R1218. DOI: 10.1016/j.cub.2021.06.058.

61 Ledger SEH. Loh J. Almond R. Böhm M. Clements CF. Currie J. Deinet S. et al. 2023. Past, present, and future of the Living Planet Index. npj biodiversity, 2(12). DOI: 10.1038/s44185-023-00017-3.

62 Hochkirch A. Samways MJ. Gerlach J. Böhm M. Williams P. Cardoso P. Cumberlidge N. et al. 2020. A strategy for the next decade to address data deficiency in neglected biodiversity. Conservation Practice and Policy, 35(2), 502-509. DOI: 10.1111/cobi.13589.

63 Otto CRV. Woodard SH. & Bailey LL. 2025. A case for occupancy as a state variable for wild bee monitoring. Biological Conservation, 302, 110932. DOI: 10.1016/j.biocon.2024.110932.

64 Mancini F. Cooke R. Woodcock BA. Greenop A. Johnson AC. & Isaac NJB. 2023. Invertebrate biodiversity continues to decline in cropland. Proceedings of the Royal Society B, 290(2000), DOI: 10.1098/rspb.2023.0897.

65 Marconi V. McRae L. Müller H. Currie J. Whitmee S. Gadallah F. & Freeman R. 2021. Population declines among Canadian vertebrates: But data of different quality show diverging trends. Ecological Indicators, 130, 108022. DOI: 10.1016/j.ecolind.2021.108022.

66 Currie J. Burant JB. Marconi V. Blain SA. Emry S. Hébert K. Xie G. et al. 2022. Assessing the representation of species included within the Canadian Living Planet Index. FACETS, 7(1), 1121-1141. DOI: 10.1139/facets-2022-0063.

67 CESCC. 2022. Wild Species 2020: The general status of species

in Canada. National General Status Working Group, Canadian Endangered Species Conservation Council. Retrieved [online] from: https://www.wildspecies.ca.

68 Hallmann CA. Sorg M. Jongejans E. Siepel H. Hofland N. Schwan H. Stenmans W. et al. 2017. More than 75 percent decline over 27 years in total flying insect biomass in protected areas. PLoS ONE, 12(10), e0185809. DOI: 10.1371/journal.pone.0185809.

69 CESCC. 2022. Wild Species 2020: The general status of species in Canada. National General Status Working Group, Canadian Endangered Species Conservation Council. Retrieved [online] from: https://www.wildspecies.ca.

70 Jacobson MM. Tucker EM. Mathiasson ME & Rehan SM. 2018. Decline of bumble bees in northeastern North America, with special focus on *Bombus terricola*. Biological Conservation, 217, 437-445. DOI: 10.1016/j.biocon.2017.11.026.

71 COSEWIC. 2014. COSEWIC assessment and status report on the Western Bumble Bee *Bombus occidentalis*, occidentalis subspecies *(Bombus occidentalis occidentalis)* and the mckayi subspecies *(Bombus occidentalis mckayi)* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

72 COSEWIC. 2014. COSEWIC assessment and status report on the Western Bumble Bee *Bombus occidentalis*, occidentalis subspecies *(Bombus occidentalis occidentalis)* and the mckayi subspecies *(Bombus occidentalis mckayi)* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net

73 Cameron SA. Lim HC. Lozier JD. Duennes MA. & Thorp R. 2016. Test of the invasive pathogen hypothesis of bumble bee decline in North America. Proceedings of the National Academy of Sciences, 113(16), 4386-4391. DOI: 10.1073/pnas.1525266113.

74 COSEWIC. 2014. COSEWIC assessment and status report on the Western Bumble Bee *Bombus occidentalis*, occidentalis subspecies *(Bombus occidentalis occidentalis)* and the mckayi subspecies *(Bombus occidentalis mckayi)* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

75 COSEWIC. 2014. COSEWIC assessment and status report on the Western Bumble Bee *Bombus occidentalis*, occidentalis subspecies *(Bombus occidentalis occidentalis)* and the mckayi subspecies *(Bombus occidentalis mckayi)* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

76 Reppert SM. & de Roode. 2018. Demystifying monarch butterfly migration. Current Biology, 28(17), pR1009-R1022. DOI: 10.1016/j.cub.2018.02.067.

77 WWF. 2025. Eastern monarch butterfly population nearly doubles in 2025. World Wildlife Fund. Retrieved [online] from: https://www.worldwildlife.org.

78 Scott JA. 1986. The butterflies of North America: A natural history and field guide. Stanford University Press.

79 Shapiro AM. 1979. *Erynnis baptisiae* (Hesperiidae) on crown vetch (Leguminosae). Journal of the Lepdopterists' Society, 33(4), 258.

80 Shapiro AM. 1979. *Erynnis baptisiae* (Hesperiidae) on crown vetch (Leguminosae). Journal of the Lepdopterists' Society, 33(4), 258.

81 CESCC. 2022. Wild Species 2020: The general status of species in Canada. National General Status Working Group, Canadian Endangered Species Conservation Council. Retrieved [online] from: https://www.wildspecies.ca.

82 CESCC. 2022. Wild Species 2020: The general status of species in Canada. National General Status Working Group, Canadian Endangered Species Conservation Council. Retrieved [online] from: https://www.wildspecies.ca.

83 CESCC. 2022. Wild Species 2020: The general status of species in Canada. National General Status Working Group, Canadian Endangered Species Conservation Council. Retrieved [online] from: https://www.wildspecies.ca.

84 Edwards CB. Zipkin EF. Henry EH. Haddad NM. Forister ML. Burls KJ. Et al. 2025. Rapid butterfly declines across the United States during the 21st century. Science, 387(6738), 1090-1094. DOI: 10.1126/science.adp4671.

85 COSEWIC. 2000. COSEWIC assessment and update status report on the Island Marble *Euchloe ausonides* insulanus in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

86 Currie J. Merritt W. Liang C. Sothe C. Beatty CR. Shackelford N. Hirsh-Pearson K. et al. 2023. Prioritizing ecological restoration of converted lands in Canada by spatially integrating organic carbon storage and biodiversity benefits. Conservation Science and Practice, 5(6), e12924. DOI: 10.1111/csp2.12924.

87 Scholtz R. & Twidwell D. 2022. The last continuous grasslands on Earth: Identification and conservation importance. Conservation Science & Practice, 4(3), e626. DOI: 10.1111/csp2.626.

88 Carbutt C. Henwood WD. & Glifedder LA. 2017. Global plight of native temperate grasslands: going, going, gone?

Biodiversity & Conservation, 26, 2911-2932. DOI: 10.1007/s10531-017-1398-5.

89 AAFC. 2010. Management of Canadian prairie rangeland. Agriculture & Agri-Food Canada. Retrieved [online] from: https://publications.gc.ca.

90 AAFC. 2010. Management of Canadian prairie rangeland. Agriculture & Agri-Food Canada. Retrieved [online] from: https://publications.gc.ca.

91 CEC. 2020. Land cover change 30m, 2015-2020 (Landsat). Commission for Environmental Cooperation. Retrieved [online] from: https://www.cec.org. *conversion from grassland to crop or urban landcover

92 Sothe C. Gonsamo A. Arabian J. Kurz WA. Finkelstein S. & Snider J. 2022. Soil organic carbon stock and uncertainties, 30cm and 1m depth, at 250m spatial resolution in Canada, version 3.0. 4TU.ResearchData. dataset. DOI: 10.4121/16686154.v3.

93 Davidson AD. Fink M. Menefee M. Sterling-Krank L. Van Pelt W. & Augustine DJ. 2023. Present and future suitable habitat for the black-tailed prairie dog ecosystem. Biological Conservation, 286, 110241. DOI: 10.1016/j.biocon.2023.110241.

94 COSEWIC. 2011. COSEWIC assessment and status report on the Black-tailed Prairie Dog *Cynomys ludovicianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://www.registrelep-sararegistry.gc.ca.

95 COSEWIC. 2011. COSEWIC assessment and status report on the Black-tailed Prairie Dog *Cynomys ludovicianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://www.registrelep-sararegistry.gc.ca.

96 COSEWIC. 2011. COSEWIC assessment and status report on the Black-tailed Prairie Dog *Cynomys ludovicianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://www.registrelep-sararegistry.gc.ca.

97 Augustine DJ. & Baker BW. 2012. Associations of grassland bird communities with black-tailed prairie dogs in the North American Great Plains. Conservation Biology, 27(2), 324-334. DOI: 10.1111/cobi.12013

98 COSEWIC. 2011. COSEWIC assessment and status report on the Black-tailed Prairie Dog *Cynomys ludovicianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://www.registrelep-sararegistry.gc.ca.

99 COSEWIC. 2011. COSEWIC assessment and status report on the Black-tailed Prairie Dog *Cynomys ludovicianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://www.registrelep-sararegistry.gc.ca.

100 Parks Canada Agency. 2021. Recovery Strategy and Action Plan for the Black-tailed Prairie Dog *(Cynomys ludovicianus)* in Canada. Parks Canada Agency. Retrieved [online] from: https://wildlife-species.az.ec.gc.ca.

101 COSEWIC. 2021. COSEWIC assessment and status report on the Common Five-lined Skink *Plestiodon fasciatus*, Carolinian population and Great Lakes/St. Lawrence population in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

102 COSEWIC. 2021. COSEWIC assessment and status report on the Common Five-lined Skink *Plestiodon fasciatus*, Carolinian population and Great Lakes/St. Lawrence population in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

103 COSEWIC. 2021. COSEWIC assessment and status report on the Common Five-lined Skink *Plestiodon fasciatus*, Carolinian population and Great Lakes/St. Lawrence population in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

104 COSEWIC. 2021. COSEWIC assessment and status report on the Common Five-lined Skink *Plestiodon fasciatus*, Carolinian population and Great Lakes/St. Lawrence population in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

105 COSEWIC. 2021. COSEWIC assessment and status report on the Common Five-lined Skink *Plestiodon fasciatus*, Carolinian population and Great Lakes/St. Lawrence population in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

106 Seburn DC. 2010. Recovery strategy for the Common Five-lined Skink *(Plestiodon fasciatus)* – Carolinian and Southern Shield populations in Ontario. Prepared for the Ontario Ministry of Natural Resources. Retrieved [online] from: https://www.ontario.ca

107 Farmer RG. & Brooks RJ. 2012. Integrated risk factors for vertebrate roadkill in southern Ontario. The Journal of Wildlife Management, 76(6), 1215-1224. DOI: 10.1002/jwmg.358.

108 COSEWIC. 2021. COSEWIC assessment and status report on the Common Five-lined Skink *Plestiodon fasciatus*, Carolinian population and Great Lakes/St. Lawrence population in

Canada. Committee on the Status of Endangered

109 Wiggins D. 2006. Mountain Bluebird *(Sialia currucoides)*: a technical conservation assessment. Retrieved [online] from: http://www.fs.fed.us.

110 ECCC & Birds Canada. 2024. The State of Canada's Birds – Mountain bluebird. NatureCounts, Environment and Climate Change Canada and Birds Canada. DOI: 10.71842/by4n-7p65.

111 Wiggins D. 2006. Mountain Bluebird *(Sialia currucoides)*: a technical conservation assessment. Retrieved [online] from: http://www.fs.fed.us.

112 Wiggins D. 2006. Mountain Bluebird *(Sialia currucoides)*: a technical conservation assessment. Retrieved [online] from: http://www.fs.fed.us.

113 McArthur SL. McKellar AE. Flood NJ. & Reudink MW. 2017. Local weather and regional climate influence breeding dynamics of Mountain Bluebirds *(Sialia currucoides)* and Tree Swallows *(Tachycineta bicolor)*: a 35-year study. Canadian Journal of Zoology, 95, 271-277. DOI: 10.1139/cjz-2016-0184.

114 Wiggins D. 2006. Mountain Bluebird *(Sialia currucoides)*: a technical conservation assessment. Retrieved [online] from: http://www.fs.fed.us.

115 Statistics Canada. 2011. Chapter 15: Geography. Retrieved [online] from: https://www150.statcan.gc.ca.

116 Statistics Canada. 2021. Human activity and the environment 2021: Accounting for ecosystem change in Canada. Statistics Canada. Retrieved [online] from: https://www150.statcan.gc.ca.

117 Statistics Canada. 2021. Human activity and the environment 2021: Accounting for ecosystem change in Canada. Statistics Canada. Retrieved [online] from: https://www150.statcan.gc.ca.

118 COSEWIC. 2012. COSEWIC status appraisal summary on the Blue Whale *Balaenoptera musculus*, Atlantic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

119 Fisheries and Oceans Canada. 2020. Action Plan for the Blue Whale *(Balaenoptera musculus)*, Northwest Atlantic Population, in Canada. Fisheries and Oceans Canada. Retrieved [online] from: https://wildlife-species.canada.ca.

120 COSEWIC. 2012. COSEWIC status appraisal summary on the Blue Whale *Balaenoptera musculus*, Atlantic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

121 Fisheries and Oceans Canada. 2017. Action Plan for Blue, Fin, Sei and North Pacific Right Whales *(Balaenoptera musculus, B. physalus, B. borealis*, and *Eubalaena japonica*) in Canadian Pacific Waters. Fisheries and Oceans Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

122 COSEWIC. 2012. COSEWIC status appraisal summary on the Blue Whale *Balaenoptera musculus*, Atlantic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

123 Cooke JG. 2018. *Balaenoptera musculus* (errata version published in 2019). IUCN Red List of Threatened Species. e.T2477A156923585. DOI: 10.2305/IUCN.UK.2018-2.RLTS.T2477A156923585.en.

124 COSEWIC. 2012. COSEWIC status appraisal summary on the Blue Whale *Balaenoptera musculus*, Atlantic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

125 NOAA Fisheries. 2023. Blue whale. Retrieved [online] from: https://www.fisheries.noaa.gov

126 Statistics Canada. 2021. Human activity and the environment 2021: Accounting for ecosystem change in Canada. Statistics Canada. Retrieved [online] from: https://www150.statcan.gc.ca.

127 Natural Resources Canada. 2022. The State of Canada's Forests – Annual report 2022. Natural Resources Canada. Retrieved [online] from: https://natural-resources.canada.ca.

128 Sothe C. Gonsamu A. Snider J. Arabian J. Kurz WA. & Finkelstein S. 2022. Carbon stock map and uncertainty in plants of forested areas of Canada, 250m spatial resolution. 4TU.ResearchData. dataset. DOI: 10.4121/14572929.v2.

129 Tardiff SE. & Stanford JA. 1998. Grizzly bear digging: effects on subalpine meadow plants in relation to mineral nitrogen availability. Ecology, 79(7), 2219-2228. DOI: 10.1890/0012-9658(1998)079[2219:GBDEOS]2.0.CO;2.

130 Tardiff SE. & Stanford JA. 1998. Grizzly bear digging: effects on subalpine meadow plants in relation to mineral nitrogen availability. Ecology, 79(7), 2219-2228. DOI: 10.1890/0012-9658(1998)079[2219:GBDEOS]2.0.CO;2.

131 Rode KD. & Robbins CT. 2000. Why bears consume mixed diets during fruit abundance. Canadian Journal of Zoology, 78(9), 1640-1645. DOI: 10.1139/z00-082.

132 Ripple WJ. Beschta RL. Fortin JK. & Robbins CT. 2014. Trophic cascades from wolves to grizzly bears in Yellowstone. Journal of Animal Ecology, 83(1), 223-233. DOI: 10.1111/

1365-2656.12123.

133 Kuijt AF. Burton C. & Lamb CT. 2024. Effects of bear endozoochory on germination and dispersal of huckleberry in the Canadian Rocky Mountains. PloS ONE, 19(11), e0311809. DOI: 10.1371/journal.pone.0311809.

134 Helfield JM. & Naiman RJ. 2006. Keystone interactions: salmon and bear in riparian forests of Alaska. Ecosystems, 9, 167-180. DOI: 10.1007/s10021-004-0063-5.

135 COSEWIC. 2012. COSEWIC assessment and status report on the Grizzly Bear *Ursus arctos* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

136 Statistics Canada. 2011. Canada year book. Statistics Canada. Retrieved [online] from: https://www150.statcan.gc.ca.

137 Statistics Canada. 2021. Human activity and the environment 2021: Accounting for ecosystem change in Canada. Statistics Canada. Retrieved [online] from: https://www150.statcan.gc.ca.

138 Nummi P. Liao W. Huet P. Scarpulla E. & Sundell J. 2019. The beaver facilitates species richness and abundance of terrestrial and semi-aquatic mammals. Global Ecology and Conservation, 20, e00701. DOI: 10.1016/j.gecco.2019.e00701.

139 Brazier RE. Puttock A. Graham HA. Auster RE. Davies KH. & Brown CML. 2020. Beaver: Nature's ecosystem engineers. Wires Water, 8(1), e1494. DOI: 10.1002/wat2.1494.

140 Hossack BR. Gould WR. Patla DA. Muths E. Daley R. Legg K. & Corn PS. 2015. Trends in Rocky Mountain amphibians and the role of beaver as a keystone species. Biological Conservation, 187, 260-269. DOI: 10.1016/j.biocon.2015.05.005.

141 Brazier RE. Puttock A. Graham HA. Auster RE. Davies KH. & Brown CML. 2020. Beaver: Nature's ecosystem engineers. Wires Water, 8(1), e1494. DOI: 10.1002/wat2.1494.

142 Fairfax E. & Whittle A. 2020. Smokey the Beaver: beaver-dammed riparian corridors stay green during wildfire throughout the western United States. Ecological Applications, 30(8), e02225. DOI: 10.1002/eap.2225.

143 Wolf EC. Cooper DJ. & Hobbs NT. 2007. Hydrologic regime and herbivory stabilize an alternative state in Yellowstone National Park. Ecological Applications, 17(6), 1572-1587. DOI: 10.1890/06-2042.1.

144 Ripple WJ. & Beschta RL. 2012. Trophic cascades in Yellowstone: The first 15 years after wolf reintroduction. Biological Conservation, 145(1), 205-213. DOI: 10.1016/j.biocon.2011.11.005

145 Government of Canada. 2024. Official symbols of Canada. Retrieved [online] from: https://www.canada.ca.

146 CESCC. 2022. Wild Species 2020: The general status of species in Canada. National General Status Working Group, Canadian Endangered Species Conservation Council. Retrieved [online] from: https://www.wildspecies.ca.

147 Currie J. Merritt W. Liang C. Sothe C. Beatty CR. Shackelford N. Hirsh-Pearson K. et al. 2023. Prioritizing ecological restoration of converted lands in Canada by spatially integrating organic carbon storage and biodiversity benefits. Conservation Science and Practice, 5(6), e12924. DOI: 10.1111/csp2.12924.

148 Hirsh-Pearson K. Johnson CJ. Schuster R. Wheate RD. & Venter O. 2022. Canada's human footprint reveals large intact areas juxtaposed against areas under immense anthropogenic pressure. FACETS, 7(1), 398-419. DOI: 10.1139/facets2021-0063.

149 CEC. 2020. North American land change monitoring system. Commission for Environmental Cooperation. Retrieved [online] from: http://www.cec.org.

150 COSEWIC. 2018. COSEWIC assessment and status report on the Chimney Swift *Chaetura pelagica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://publications.gc.ca.

151 COSEWIC. 2018. COSEWIC assessment and status report on the Chimney Swift *Chaetura pelagica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://publications.gc.ca.

152 ECCC & Birds Canada. 2024. The State of Canada's Birds – Chimney swift. NatureCounts, Environment and Climate Change Canada and Birds Canada. DOI: 10.71842/t8rw-fn23.

153 Spiller K. J. & Dettmers R. 2019. Evidence for multiple drivers of aerial insectivore declines in North America. The Condor, 121(2), 1-13. DOI: 10.1093/condor/duz010.

154 COSEWIC. 2018. COSEWIC assessment and status report on the Chimney Swift *Chaetura pelagica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://publications.gc.ca.

155 COSEWIC. 2018. COSEWIC assessment and status report on the Chimney Swift *Chaetura pelagica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://publications.gc.ca.

156 Spiller K. J. & Dettmers R. 2019. Evidence for multiple drivers of aerial insectivore declines in North America. The Condor, 121(2), 1-13. DOI: 10.1093/condor/duz010.

157 WWF-Canada. 2020. Living planet report Canada: Wildlife at risk. World Wildlife Fund Canada. Retrieved [online] from: https://wwf.ca.

158 Marconi V. McRae L. Müller H. Currie J. Whitmee S. Gadallah F. & Freeman R. 2021. Population declines among Canadian vertebrates: But data of different quality show diverging trends. Ecological Indicators, 130, 108022. DOI: 10.1016/j.ecolind.2021.108022.

159 Currie J. Burant JB. Marconi V. Blain SA. Emry S. Hébert K. Xie G. et al. 2022. Assessing the representation of species included within the Canadian Living Planet Index. FACETS, 7(1), 1121-1141. DOI:10.1139/facets-2022-0063.

160 Currie J. Burant JB. Marconi V. Blain SA. Emry S. Hébert K. Xie G. et al. 2022. Assessing the representation of species included within the Canadian Living Planet Index. FACETS, 7(1), 1121-1141. DOI:10.1139/facets-2022-0063.

161 Donaldson MR. Burnett NL. Braun DC. Suski CD. Hinch SG. Cooke SJ. & Kerr JT. 2016. Taxonomic bias and international biodiversity conservation research. FACETS, 1, 105-113. DOI: 10.1139/facets-2016-0011.

162 Troudet J. Grandcolas P. Blin A. Vignes-Lebbe R. & Legendre F. 2017. Taxonomic bias in biodiversity data and societal preferences. Scientific Reports, 7, 9132. DOI: 10.1038/s41598-017-09084-6.

163 Leung B. Hargreaves AL. Greenberg DA. McGill B. Dornelas M. & Freeman R. 2022b. Reply to: emphasizing declining populations in the Living Planet Report. Nature, 601, E25-E26. DOI: 10.1038/s41586-021-04166-y.

164 Murali G. de Oliveira Caetano GH. Barki G. Meiri S. & Roll U. 2022. Emphasizing declining populations in the Living Planet Report. Nature, 601, E20-E24. DOI: 10.1038/s41586-021-04165-z.

165 Tittensor DP. Walpole M. Hill SLL. Boyce DG. Britten GL. Burgess ND. Butchart SHM. et al. 2014. A mid-term analysis of progress toward international biodiversity targets. Science, 346(6206), 241-244. DOI: 10.1126/science.1257484.

166 COSEWIC 2006. COSEWIC assessment and status report on the White Shark *Carcharodon carcharias* (Atlantic and Pacific populations) in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

167 COSEWIC. 2021. COSEWIC assessment and status report on the White Shark *Carcharodon carcharias*, Atlantic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net

168 Bastien G. Barkley J. Chappus J. Heath V. Popov S. Smith R. Tran T. et al. 2020. Inconspicuous, recovering, or northward shift: status and management of the white shark *(Carcharodon carcharias)* in Atlantic Canada. Canadian Journal of Fisheries and Aquatic Sciences, 77(10), 1666-1677. DOI: 10.1139/cjfas-2020-0055.

169 Bastien G. Barkley J. Chappus J. Heath V. Popov S. Smith R. Tran T. et al. 2020. Inconspicuous, recovering, or northward shift: status and management of the white shark *(Carcharodon carcharias)* in Atlantic Canada. Canadian Journal of Fisheries and Aquatic Sciences, 77(10), 1666-1677. DOI: 10.1139/cjfas-2020-0055.

170 COSEWIC. 2021. COSEWIC assessment and status report on the White Shark *Carcharodon carcharias*, Atlantic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

171 Rantanen M. Karpechko AY. Lipponen A. Nordling K. Hyvärinen O. Ruosteenoja K. Vihma T. et al. 2022. The Arctic has warmed nearly four times faster than the globe since 1979. Communications Earth & Environment, 3, 168. DOI: 10.1038/s43247-022-00498-3.

172 PAME. 2025. The increase in Arctic shipping: 2013-2024. Protection of the Arctic Marine Environment – Arctic Council Working Group. Retrieved [online] from: https://oaarchive.arctic-council.org.

173 Wagner H. Weger M. Klaas M. & Schröder W. 2017. Features of owl wings that promote silent flight. Interface focus, 7(1), 20160078. DOI: 10.1098/rsfs.2016.0078.

174 ECCC. 1991. Snowy owl. Environment and Climate Change Canada. Retrieved [online] from: https://publications.gc.ca.

175 ECCC. 1991. Snowy owl. Environment and Climate Change Canada. Retrieved [online] from: https://publications.gc.ca.

176 Holt DW. Larson MD. Seidensticker MT. & Hiro SP. 2024. A worldwide review of snowy owl feeding ecology: The importance of lemmings and voles in a changing climate. Birds, 5(3), 341-351. DOI: 10.3390/birds5030022.

177 ECCC. 1991. Snowy owl. Environment and Climate Change Canada. Retrieved [online] from: https://publications.gc.ca.

178 McCabe RA. Aarvak T. Aebischer A. Bates K. Bety J. Bollache L. Brinker D. et al. 2024. Status assessment and conservation priorities for a circumpolar raptor: the Snowy Owl Bubo scandiacus. Bird Conservation International, 34, e41. DOI: 10.1017/S0959270924000248.

179 McCabe RA. Aarvak T. Aebischer A. Bates K. Bety J. Bollache L. Brinker D. et al. 2024. Status assessment and conservation priorities for a circumpolar raptor: the Snowy Owl Bubo scandiacus. Bird Conservation International, 34, e41. DOI: 10.1017/S0959270924000248.

180 Rantanen M. Karpechko AY. Lipponen A. Nordling K. Hyvärinen O. Ruosteenoja K. Vihma T. et al. 2022. The Arctic

has warmed nearly four times faster than the globe since 1979. Communications Earth & Environment, 3, 168. DOI: 10.1038/s43247-022-00498-3.

181 McCabe RA. Aarvak T. Aebischer A. Bates K. Bety J. Bollache L. Brinker D. et al. 2024. Status assessment and conservation priorities for a circumpolar raptor: the Snowy Owl Bubo scandiacus. Bird Conservation International, 34, e41. DOI: 10.1017/S0959270924000248.

182 ECCC & Birds Canada. 2024. The State of Canada's Birds – Snowy owl. NatureCounts, Environment and Climate Change Canada and Birds Canada. DOI: 10.71842/zdk2-3k19.

183 Dirzo R. Young HS. Galetti M. Ceballos G. Isaac NJB. & Collen B. 2014. Defaunation in the Anthropocene. Science, 345(6195), 401-406. DOI: 10.1126/science.1251817.

184 Butchart SHM. Walpole M. Collen B. van Strien A. Scharlemann JP Almond REA. Baillie JEM. et al. 2010. Global biodiversity: Indicators of recent declines. Science, 328, 1164-1168. DOI: 10.1126/science.1187512.

185 IPBES. 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Secretariat. Retrieved [online] from: https://ipbes.net/global-assessment.

186 Salafsky N. Salzer D. Stattersfield AJ. Hilton-Taylor C. Neugarten R. Butchart SHM. Collen B. et al. 2008. A standard lexicon for biodiversity conservation: Unified classifications of threats and actions. Conservation Biology, 22(4), 897-911. DOI: 10.1111/j.1523-1739.2008.00937.x.

187 Salafsky N. Relton C. Young BE. Lamarre P. Böhm M. Chénier M. Cochrane E. et al. 2024. Classification of direct threats to the conservation of ecosystems and species 4.0. Conservation Biology, [early view], e14434. DOI: .1111/cobi.14434.

188 Hirsh-Pearson K. Johnson CJ. Schuster R. Wheate RD. & Venter O. 2022. Canada's human footprint reveals large intact areas juxtaposed against areas under immense anthropogenic pressure. FACETS, 7(1), 398-419. DOI: 10.1139/facets2021-0063.

189 Currie J. Puleston H. Marconi V. Liang C. Deinet S. Smith AC. McRae L. et al. 2025. Under pressure: The relationship between vertebrate populations and high-intensity cumulative threats in habitats across Canada. DOI: 10.1139/facets-2024-0340.

190 Kraus D. & Hebb A. 2020. Southern Canada's crisis ecoregions: identifying the most significant and threatened places for biodiversity conservation. Biodiversity & Conservation, 29, 3573-3590. DOI: 10.1007/s10531-020-02038-x.

191 Kraus D. & Hebb A. 2020. Southern Canada's crisis ecoregions: identifying the most significant and threatened places for biodiversity conservation. Biodiversity & Conservation, 29, 3573-3590. DOI: 10.1007/s10531-020-02038-x.

192 Johnson CN. Balmford A. Brook BW. Buettel JC. Galetti M. Guangchun L. & Wilmshurst JM. 2017. Biodiversity losses and conservation responses in the Anthropocene. Science, 356(6335), 270-275. DOI: 10.1126/science.aam9317

193 Dirzo R. Young HS. Galetti M. Ceballos G. Isaac NJB. & Collen B. 2014. Defaunation in the Anthropocene. Science, 345(6195), 401-406. DOI: 10.1126/science.1251817.

194 IPBES. 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Secretariat. Retrieved [online] from: https://ipbes.net.

195 Pilotto F. Kühn I. Adrian R. Alber R. Alignier A. Andrews C. Bäck J. et al. 2020. Meta-analysis of multidecadal biodiversity trends in Europe. Nature Communications, 11, 3486. DOI: 10.1038/s41467-020-17171-y.

196 Newbold T. Hudson LN. Hill SLL. Contu S. Lysenko I. Senior RA. et al. 2015. Global effects of land use on local terrestrial biodiversity. Nature, 520, 45-50. DOI: 10.1038/nature14324.

197 Kettel EF. Gentle LK. Quinn JL. & Yarnell RW. 2018. The breeding performance of raptors in urban landscapes: a review and meta-analysis. Journal of Ornithology, 159, 1-18. DOI: 10.1007/s10336-017-1497-9.

198 ECCC. 2021. Canadian Environmental Sustainability Indicators: Land-use change. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

199 NRCan. 2022. The state of Canada's forests: Annual report 2022. Natural Resources Canada. Retrieved [online] from: https://natural-resources.canada.ca.

200 Mackey B. Campbell C. Norman P. Hugh S. DellaSala DA. Malcolm JR. Desrochers M. et al. 2024. Assessing the cumulative impacts of forest management on forest age structure development and woodland caribou habitat in boreal landscapes: A case study from two Canadian provinces. Land, 13(1), 6. DOI: 10.3390/land13010006.

201 The State of the Forest in Canada. 2024. The State of the Forest in Canada: Seeing through the spin. Canopy, David Suzuki Foundation, Nature Canada, Natural Resources Defense Council, Sierra Club BC, Sierra Club Canada, STAND.earth, Wilderness Committee. Available [online] from: https://static1.squarespace.com.

202 Currie J. Puleston H. Marconi V. Liang C. Deinet S. Smith AC. McRae L. et al. 2025. Under pressure: The relationship between vertebrate populations and high-intensity cumulative threats in habitats across Canada. DOI: 10.1139/facets-2024-0340.

203 Tilman D. May RM. Lehman CL. & Nowak MA. 1994. Habitat destruction and the extinction debt. Nature, 371, 65-66. DOI: 10.1038/371065a0.

204 Isbell F. Gonzalez A. Loreau M. Cowles J. Díaz S. Hector A. Mace GM. et al. 2017. Linking the influence and dependence of people on biodiversity across scales. Nature, 546, 65-72. DOI: 10.1038/nature22899.

205 IPBES. 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Secretariat. Retrieved [online] from: https://ipbes.net.

206 Venter O. Brodeur NN. Nemiroff L. Belland B. Dolinsek IJ. & Grant JWA. 2006. Threats to endangered species in Canada. BioScience, 56(11), 903-910. DOI: 10.1641/0006-3568(2006)56[903:TTESIC]2.0.CO;2.

207 Watson JEM. Venter O. Lee J. Jones KR. Robinson JG. Possingham HP. & Allan JR. 2018. Protect the last of the wild. Nature, 563(7729), 27-30. DOI: 10.1038/d41586-018-07183-6.

208 Allan JR. Venter O. & Watson JEM. 2017. Temporally inter-comparable maps of terrestrial wilderness and the Last of the Wild. Scientific Data, 4, 170187. DOI: 10.1038/sdata.2017.187.

209 Jones KR. Klein CJ. Halpern BS. Venter O. Grantham H. Kuempel CD. Shumway N. et al. 2018. The location and protection status of Earth's diminishing marine wilderness. Current Biology, 28(15), 2506-2512.e3. DOI: 10.1016/j.cub.2018.06.010.

210 Salafsky N. Salzer D. Stattersfield AJ. Hilton-Taylor C. Neugarten R. Butchart SHM. Collen B. et al. 2008. A standard lexicon for biodiversity conservation: Unified classifications of threats and actions. Conservation Biology, 22(4), 897-911. DOI: 10.1111/j.1523-1739.2008.00937.x.

211 Maxwell SL. Fuller RA. Brooks TM. & Watson JEM. 2016. The ravages of guns, nets and bulldozers. Nature, 536, 143-145. DOI: 10.1038/536143a.

212 Currie J. Puleston H. Marconi V. Liang C. Deinet S. Smith AC. McRae L. et al. 2025. Under pressure: The relationship between vertebrate populations and high-intensity cumulative threats in habitats across Canada. DOI: 10.1139/facets-2024-0340.

213 Currie J. Puleston H. Marconi V. Liang C. Deinet S. Smith AC. McRae L. et al. 2025. Under pressure: The relationship between vertebrate populations and high-intensity cumulative threats in habitats across Canada. DOI: 10.1139/facets-2024-0340.

214 Currie J. Puleston H. Marconi V. Liang C. Deinet S. Smith AC. McRae L. et al. 2025. Under pressure: The relationship between vertebrate populations and high-intensity cumulative threats in habitats across Canada. DOI: 10.1139/facets-2024-0340.

215 Cornford R. Spooner F. McRae L. Purvis A. & Freeman R. 2023. Ongoing over-exploitation and delayed responses to environmental change highlight the urgency for action to promote vertebrate recoveries by 2030. Proceedings of the Royal Society B, 290(1997), 20230464. DOI: 10.1098/rspb.2023.0464.

216 Cornford R. Spooner F. McRae L. Purvis A. & Freeman R. 2023. Ongoing over-exploitation and delayed responses to environmental change highlight the urgency for action to promote vertebrate recoveries by 2030. Proceedings of the Royal Society B, 290(1997), 20230464. DOI: 10.1098/rspb.2023.0464.

217 Isbell F. Gonzalez A. Loreau M. Cowles J. Diaz S. Hector A. et al. 2017. Linking the influence and dependence of people on biodiversity across scales. Nature, 546, 65-72. DOI; 10.1038/nature22899.

218 McRae L. Cornford R. Marconi V. Puleston H. Ledger SHE. Deinet S. Oppenheimer P. et al. 2025. The utility of the Living Planet Index as a policy tool and for measuring nature recovery. Philosophical Transactions of the Royal Society B, 380(1917), 20230207. DOI: 10.1098/rstb.2023.0207.

219 Ledger SHE. Loh J. Almond R. Böhm M. Clements CF. Currie J. Deinet S. et al. 2023. Past, present, and future of the Living Planet Index. npj biodiversity, 2, 12. DOI: 10.1038/s44185-023-00017-3.

220 Butchart SHM. Akçakaya HR. Berryman AJ. Brooks TM. Burfield IJ. Chanson J. 2025. Measuring trends in extinction risk: a review of two decades of development and application of the Red List Index. Philosophical Transactions of the Royal Society B, 380(1917): 20230206. DOI: 10.1098/rstb.2023.0206.

221 Ledger SHE. Loh J. Almond R. Böhm M. Clements CF. Currie J. Deinet S. et al. 2023. Past, present, and future of the Living Planet Index. npj biodiversity, 2, 12. DOI: 10.1038/s44185-023-00017-3.

222 Costelloe B. Collen B. Milner-Gulland EJ. Craigie ID. McRae L. Rondinini C. & Nicholson E. 2015. Global biodiversity indicators reflect the modeled impacts of protected area policy change. Conservation Letters, 9(1): 14-20. DOI: 10.1111/conl.12163.

223 Buckland ST. Studeny AC. Magurran AE. Illian JB. & Newson SE. 2011. The geometric mean of relative abundance indices: a biodiversity measure with a difference. Ecosphere, 2(9): 1-15. DOI: 10.1890/ES11-00186.1.

224 Dove S. Böhm M. Freeman R. McRae L. & Murrell DJ. 2023. Quantifying reliability and data deficiency in global vertebrate population trends using the Living Planet Index. Global Change Biology, 29(17), 4966-4982. DOI: 10.1111/gcb.16841.

225 IPCC. 2018. Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Intergovernmental Panel on Climate Change. Retrieved [online] from: https://www.ipcc.ch.

226 IPBES. 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Secretariat. Retrieved [online] from: https://ipbes.net.

227 Seddon N. Chausson A. Berry P. Girardin CAJ. Smith A. & Turner B. 2020. Understanding the values and limits of nature-based solutions to climate change and other global challenges. Philosophical Transactions of the Royal Society Publishing B, 375 (1794), 20190120. DOI: 10.1098/rstb.2019.0120.

228 United Nations (General Assembly). 2007. United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). Resolution 61/295 (A/ RES/61/295). Retrieved [online] from: https://www.un.org.

229 Truth and Reconciliation Commission. 2015. Truth and Reconciliation Commission of Canada: Calls to Action. Truth and Reconciliation Commission of Canada. Retrieved [online] from: https://ehprnh2mwo3.exactdn.com

230 Tamufor NE. Roth R. MacDonald DB. 2025. Biodiversity conservation policy reform and reconciliation in Canada: an analysis of the pathway to Canada target 1 through the policy cycle model. Frontiers in Environmental Science, 12. DOI: 10.3389/fenvs.2024.1434731.

231 Jones R. Doubleday N. Bailey M. Paul K. Taylor F. and Pulsifer P. 2024. Chapter 2. Status of reconciliation and Indigenous ocean management in Canada. In Sea Change: Charting a sustainable future for oceans in Canada. Sumaila UR. Armitage D. Bailey M. and Cheung WWL. UBC Press.

232 M's-it No'kmaq. Marshall A. Beazley KF. Hum J. Joudry S. Papadopoulos A. Pictou S. et al. 2021. "Awakening the sleeping giant" re-Indigenization principles for transforming biodiversity conservation in Canada and beyond. FACETS, 6, 839-869. DOI: 10.1139/facets-2020-0083

233 Beazley KF. & Olive A. 2021. Transforming conservation in Canada: shifting policies and paradigms. FACETS. 6, 1714-1727. DOI: 10.1139/facets-2021-0144.

234 Zurba M. Beazley KF. English E. & Buchmann-Duck J. 2019. Indigenous Protected and Conserved Areas (IPCAs), Aichi Target 11 and Canada's Pathway to Target 1: Focusing conservation on reconciliation. Land, 8(1), 10. DOI: 10.3390/land8010010.

235 Moola F. & Roth R. 2018. Moving beyond colonial conservation models: Indigenous Protected and Conserved Areas offer hope for biodiversity and advancing reconciliation in the Canadian boreal forest. Environmental Reviews, 27(2), 200-201. DOI: 10.1139/er-2018-0091.

236 Nitah S. 2021. Indigenous peoples proven to sustain biodiversity and address climate change: Now it's time to recognize and support this leadership. One Earth, 4(7), 90-909. DOI: 10.1016/j.oneear.2021.06.015.

237 CBD. 2022. CBD/COP/DEC/15/5. Retrieved [online] from: https://www.cbd.int.

238 CBD. 2022. CBD/COP/16/L.26/Rev.1. Retrieved [online] from: https://www.cbd.int.

239 ECCC. 2024. Canada's 2030 Nature Strategy: Halting and reversing biodiversity loss in Canada. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca

240 Marconi V. McRae L. Müller H. Currie J. Whitmee S. Gadallah F. & Freeman R. 2021. Population declines among Canadian vertebrates: But data of different quality show diverging trends. Ecological Indicators, 130, 108022. DOI: 10.1016/j.ecolind.2021.108022.

241 Murali G. de Oliveira Caetano GH. Barki G. Meiri S. & Roll U. 2022. Emphasizing declining populations in the Living Planet Report. Nature, 601, E20-E24. DOI: 10.1038/s41586-021-04165-z.

242 Leung B. Hargreaves AL. Greenberg DA. McGill B. Dornelas M. & Freeman R. 2022b. Reply to: emphasizing declining populations in the Living Planet Report. Nature, 601, E25–E26. DOI: 10.1038/s41586-021-04166-y.

243 Currie J. Burant JB. Marconi V. Blain SA. Emry S. Hébert K. Xie G. et al. 2022. Assessing the representation of species included within the Canadian Living Planet Index. FACETS, 7(1), 1121-1141. DOI:10.1139/facets-2022-0063.

244 Marconi V. McRae L. Müller H. Currie J. Whitmee S. Gadallah F. & Freeman R. 2021. Population declines among Canadian

vertebrates: But data of different quality show diverging trends. Ecological Indicators, 130, 108022. DOI: 10.1016/j.ecolind.2021.108022.

245 ICE. 2018. We rise together: Achieving Pathway to Canada Target 1 through the creation of Indigenous Protected and Conserved Areas in the spirit and practice of reconciliation. Indigenous Circle of Experts. Retrieved [online] from: https://www.conservation2020canada.ca.

246 Allan JR. Venter O. & Watson JEM. 2017. Temporally inter-comparable maps of terrestrial wilderness and the Last of the Wild. Scientific Data, 4, 170187. DOI: 10.1038/sdata.2017.187.

247 Watson JEM. Venter O. Lee J. Jones KR. Robinson JG. Possingham HP. & Allan JR. 2018. Protect the last of the wild. Nature, 563, 27-30. DOI: 10.1038/d41586-018-07183-6.

248 Watson JEM. Dudley N. Segan DB. & Hockings M. 2014. The performance and potential of protected areas. Nature, 515, 67-73. DOI: 10.1038/nature13947.

249 IPBES. 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Secretariat. Retrieved [online] from: https://ipbes.net.

250 IPCC. 2019. Climate change and land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Intergovernmental Panel on Climate Change. Retrieved [online] from: https://www.ipcc.ch.

251 Noss RF. Dobson AP. Balwin R. Beier P. Davis CR. Dellasala DA. Francis J. et al. (2012). Bolder thinking for conservation. Conservation Biology, 26(1). 1-4. DOI: 10.1111/j.1523-1739.2011.01738.x.

252 Wilson EO. 2016. Half-Earth: Our planet's fight for life. Liverlight. New York, United States of America.

253 Dinerstein E. Olson D. Joshi A. Vynne C. Burgess ND. Wikramanayake E. Hahn N. et al. 2017. An ecoregion-based approach to protecting half the terrestrial realm. BioScience, 67(6), 534-545. DOI: 10.1093/biosci/bix014.

254 Allan JR. Possingham HP. Atikinson SC. Waldron A. Di Marco M. Butchart SHM. Adam VM. et al. 2022. The minimum land area requiring conservation attention to safeguard biodiversity. Science, 376(6597), 1094-1101. DOI: 10.1126/science.abl9127.

255 ECCC. 2025. Canadian Protected and Conserved Areas Database. Environmental and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

256 Barnes D. Glew L. Wyborn C. & Craigie ID. 2018. Prevent perverse outcomes from global protected area policy. Nature Ecology & Evolution, 2, 759-762. DOI: 10.1038/s41559-018-0501-y.

257 Watson JEM. Darling ES. Venter O. Maron M. Walston J. Possingham HP. Dudley N. et al. 2015. Bolder science needed now for protected areas. Conservation Biology, 30(2), 243-248. DOI: 10.1111/cobi.12645.

258 MacKinnon K. Smith R. Dudley N. Figgis P. Hockings M. Keenleyside K. Laffoley D. et al. 2020. Strengthening the global system of protected areas post-2020: A perspective from the IUCN World Commission on Protected Areas. Parks Stewardship Forum, 36(2), 281-296. DOI: 10.5070/P536248273.

259 CBD. 2010. The Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets. Convention on Biological Diversity. Retrieved [online] from: https://www.cbd.int.

260 CBD. 2022. Kunming-Montreal Global Biodiversity Framework. Convention on Biological Diversity. Retrieved [online] from: https://www.cbd.int.

261 Barnes M. 2015. Protect biodiversity, not just area. Nature, 526, 195. DOI: 10.1038/526195e.

262 Butchart SHM. Clarke M. Smith RJ. Sykes RE. Scharlemann JPW. Harfoot M. Buchanan GM. et al. 2015. Shortfalls and solutions for meeting national and global conservation area targets. Conservation Letters, 8(5), 329-337. DOI: 10.1111/conl.12158.

263 Barnes D. Glew L. Wyborn C. & Craigie ID. 2018. Prevent perverse outcomes from global protected area policy. Nature Ecology & Evolution, 2, 759-762. DOI: 10.1038/s41559-018-0501-y.

264 Venter O. Magrach A. Outram N. Klein CJ. Possingham HP. Di Marco M. & Watson KEM. 2018. Bias in protected-area location and its effects on long-term aspirations of biodiversity conventions. Conservation Biology, 32(1), 127-134. DOI: 10.1111/cobi.12970.

265 Joppa LN. & Pfaff A. 2009. High and far: Biases in the location of protected areas. PLoS One, 4(12), e8273. DOI: 10.1371/journal.pone.0008273.

266 Anthamatten P. & Hazen H. 2015. Changes in the global distribution of protected areas, 2003-2012. The Professional Geographer, 67(2), 195-203. DOI: 10.1080/00330124.2014.921014.

267 Williams DR. Rondinini C. & Tilman D. 2022. Global protected areas seem insufficient to safeguard half of the world's mammals from human-induced extinction. Proceedings of

the National Academy of Sciences, 119(24): e2200118119. DOI: 10.1073/pnas.2200118119.

268 Brennan A. Naidoo R. Greenstreet L. Mehrabi Z. Ramankutty N. & Kremen C. 2022. Functional connectivity of the world's protected areas. Science, 376(6597), 1101-1104. DOI: 10.1126/science.abl8974.

269 Eckert I. Brown A. Caron D. Riva F. & Pollock LJ. 2023. 30x30 biodiversity gains rely on national coordination. Nature Communications. 14(1), 7113. DOI: 10.1038/s41467-023-42737-x.

270 Venter O. Fuller RA. Segan DB. Carwardine J. Brooks T. Butchart SHM. Di Marco M. et al. (2014). Targeting global protected area expansion for imperiled biodiversity. PLoS Biology, 12(6), e1001891. DOI: 10.1371/journal.pbio.1001891.

271 Venter O. Magrach A. Outram N. Klein CJ. Possingham HP. Di Marco M. & Watson KEM. 2018. Bias in protected-area location and its effects on long-term aspirations of biodiversity conventions. Conservation Biology, 32(1), 127-134. DOI: 10.1111/cobi.12970.

272 Belote RT. Dietz MS. McRae BH. Theobald DM. McClure ML. Irwin GH. McKinley PS. et al. 2016. Identifying corridors among large protected areas in the United States. PLoS ONE, 11(4), e0154223. DOI: 10.1371/journal.pone.0154223.

273 Brennan A. Naidoo R. Greenstreet L. Mehrabi Z. Ramankutty N. & Kremen C. 2022. Functional connectivity of the world's protected areas. Science, 376(6597), 1101-1104. DOI: 10.1126/science.abl8974.

274 Butchart SHM. Clarke M. Smith RJ. Sykes RE. Scharlemann JPW. Harfoot M. Buchanan GM. et al. 2015. Shortfalls and solutions for meeting national and global conservation area targets. Conservation Letters, 8(5), 329-337. DOI: 10.1111/conl.12158.

275 Belote RT. Dietz MS. Jenkins CN. McKinley PS. Irwin GH. Fullman TJ. et al. 2017. Wild, connected, and diverse: building a more resilient system of protected areas. Ecological Applications, 27(4), 1050-1056. DOI: 10.1002/eap.1527.

276 Mascia MB. & Pailler S. 2010. Protected area downgrading, downsizing, and degazettement (PADDD) and its conservation implications. Conservation Letters, 4(1), 9-20. DOI: 10.1111/j.1755-263X.2010.00147.x.

277 Currie J. Liang C. & Snider J.2025. Protected area targets: Spatially evaluating progress and prioritizing areas to reach 30 × 30 in Canada. Conservation Science and Practice, e70087. DOI: 10.1111/csp2.70087.

278 Currie J. Liang C. & Snider J.2025. Protected area targets: Spatially evaluating progress and prioritizing areas to reach 30 × 30 in Canada. Conservation Science and Practice, e70087. DOI: 10.1111/csp2.70087.

279 Currie J. Liang C. & Snider J.2025. Protected area targets: Spatially evaluating progress and prioritizing areas to reach 30 × 30 in Canada. Conservation Science and Practice, e70087. DOI: 10.1111/csp2.70087.

280 Witter R. & Satterfield T. 2018. The ebb and flow of Indigenous rights and recognitions in conservation policy. Development and Change, 50(4), 1083-1108. DOI: 10.1111/dech.12456.

281 Artelle, KA. Zurba, M. Bhattacharyya, J. Chan, DE. Brown, K. Housty, J. & Moola, F. 2019. Supporting resurgent Indigenous-led governance: A nascent mechanism for just and effective conservation. Biological Conservation, 240, 108284. DOI: 10.1016/j.biocon.2019.108284.

282 ECCC. 2025. Canadian Protected and Conserved Areas Database. Environmental and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

283 ECCC. 2024. Canadian Environmental Sustainability Indicators: Canada's conserved areas. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

284 ECCC. 2024. Canadian Environmental Sustainability Indicators: Canada's conserved areas. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca/content/dam/eccc/documents/pdf/cesindicators/canada-conserved-areas/2024/conserved-areas.pdf.

285 Parks Canada. 2024. Saguenay–St. Lawrence Marine Park expansion project. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

286 IPCC. 2019. Climate change and land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Intergovernmental Panel on Climate Change. https://www.ipcc.ch.

287 Hirsh-Pearson K. Johnson CJ. Schuster R. Wheate RD. & Venter O. 2022. Canada's human footprint reveals large intact areas juxtaposed against areas under immense anthropogenic pressure. FACETS, 7(1), 398-419. DOI: 10.1139/facets2021-0063.

288 Currie J. Puleston H. Marconi V. Liang C. Deinet S. Smith AC. McRae L. et al. 2025. Under pressure: The relationship between vertebrate populations and high-intensity cumulative threats in habitats across Canada. DOI: 10.1139/facets-2024-0340.

289 Seddon N. Chausson A. Berry P. Girardin CAJ. Smith A. & Turner B. 2020. Understanding the value and limits of nature-based solutions to climate change and other global challenges. Philosophical Transactions of the Royal Society B,

375(1794), 20190120. DOI: 10.1098/rstb.2019.0120.

290 IPCC. 2019. Climate change and land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Intergovernmental Panel on Climate Change. https://www.ipcc.ch.

291 IPCC. 2019. Climate change and land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Intergovernmental Panel on Climate Change. https://www.ipcc.ch.

292 IPBES. 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Secretariat. Retrieved [online] from: https://ipbes.net.

293 IPCC. 2019. Climate change and land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Intergovernmental Panel on Climate Change. https://www.ipcc.ch.

294 NRCan. 2022. Canada pledges to join the Bonn challenge for landscape restoration at COP15. Natural Resources Canada. Retrieved [online] from: https://www.canada.ca.

295 NRCan. 2020. Minister O'Regan launches Canada's plant to plant two billion trees. Natural Resources Canada. Retrieved [online] from: https://www.canada.ca.

296 ECCC. 2024. Natural Climate Solutions Fund. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

297 Strassburg BBN. Beyer HL. Crouzeilles R. Iribarrem A. Barros F. de Siqueira MF. Sánchez-Tapia A. et al. 2019. Strategic approaches to restoring ecosystems can triple conservation gains and halve costs. Nature Ecology and Evolution, 3, 62-70. DOI: 10.1038/s41559-018-0743-8.

298 Jones HP. Jones PC. Barbier EB. Blackburn RC. Benayas JMR. Holl KD. McCrackin M. et al. 2018. Restoration and repair of Earth's damaged ecosystems. Proceedings of the Royal Society B: Biological Sciences, 285, 20172577. DOI: 10.1098/rspb.2017.2577.

299 Currie J. Merritt W. Liang C. Sothe C. Beatty CR. Shackelford N. Hirsh-Pearson K. et al. 2023. Prioritizing ecological restoration of converted lands in Canada by spatially integrating organic carbon storage and biodiversity benefits. Conservation Science and Practice, 5(6), e12924. DOI: 10.1111/csp2.12924.

300 Hirsh-Pearson K. Johnson CJ. Schuster R. Wheate RD. & Venter O. 2022. Canada's human footprint reveals large intact areas juxtaposed against areas under immense anthropogenic pressure. FACETS, 7(1), 398-419. DOI: 10.1139/facets2021-0063.

301 AAFC. 2019. Annual crop inventory. Agriculture and Agri-Food Canada. Retrieved [online] from: https://open.canada.ca.

302 CEC. 2015. North American land change monitoring system. Commission for Environmental Cooperation. Retrieved [online] from: http://www.cec.org.

303 ECCC. 2021. Canadian environmental sustainability indicators: Land-use change. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

304 Currie J. Merritt W. Liang C. Sothe C. Beatty CR. Shackelford N. Hirsh-Pearson K. et al. 2023. Prioritizing ecological restoration of converted lands in Canada by spatially integrating organic carbon storage and biodiversity benefits. Conservation Science and Practice, 5(6), e12924. DOI: 10.1111/csp2.12924.

305 IPBES. 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Secretariat. Retrieved [online] from: https://ipbes.net.

306 Turney C. Ausseil A.-G. & Broadhurst L. 2020. Urgent need for an integrated policy framework for biodiversity loss and climate change. Nature Ecology & Evolution, 4, 996. DOI: 10.1038/s41559-020-1242-2.

307 Currie J. Merritt W. Liang C. Sothe C. Beatty CR. Shackelford N. Hirsh-Pearson K. et al. 2023. Prioritizing ecological restoration of converted lands in Canada by spatially integrating organic carbon storage and biodiversity benefits. Conservation Science and Practice, 5(6), e12924. DOI: 10.1111/csp2.12924.

308 Kraus D. & Hebb A. 2020. Southern Canada's crisis ecoregions: identifying the most significant and threatened places for biodiversity conservation. Biodiversity & Conservation, 29, 3573-3590. DOI: 10.1007/s10531-020-02038-x.

309 Currie J. Merritt W. Liang C. Sothe C. Beatty CR. Shackelford N. Hirsh-Pearson K. et al. 2023. Prioritizing ecological restoration of converted lands in Canada by spatially integrating organic carbon storage and biodiversity benefits. Conservation Science and Practice, 5(6), e12924. DOI: 10.1111/csp2.12924.

310 Carrasco D. Larsson MC. & Anderson P. 2015. Insect host plant selection in complex environments. Current Opinion in Insect Science, 8, 1-7. DOI: 10.1016/j.cois.2015.01.014.

311 MNR. 2024. Tulip tree. Ontario Ministry of Natural Resources. Retrieved [online] from: https://www.ontario.ca.

312 MNR. 2024. Tulip tree. Ontario Ministry of Natural Resources. Retrieved [online] from: https://www.ontario.ca.

313 ECCC. 2014. Conserve Ontario's Carolinian forests – Preserve songbird Species at Risk. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

314 Almas AD. & Conway TM. 2016. The role of native species in urban forest planning and practice: A case study of Carolinian Canada. Urban forestry & urban greening, 17(1), 54-62. DOI: 10.1016/j.ufug.2016.01.015.

315 Watson JEM. Venter O. Lee J. Jones KR. Robinson JG. Possingham HP. Allan JR. 2018. Protect the last of the wild. Nature, 563(7729), 27-30. DOI: 10.1038/d41586-018-07183-6.

316 Allan JR. Venter O. & Watson JEM. 2017. Temporally inter-comparable maps of terrestrial wilderness and the Last of the Wild. Scientific Data, 4, 170187. DOI: 10.1038/sdata.2017.187.

317 Jones KR. Klein CJ. Halpern BS. Venter O. Grantham H. Kuempel CD. Shumway N. et al. 2018. The location and protection status of Earth's diminishing marine wilderness. Current Biology, 28(15), 2506-2512.e3. DOI: 10.1016/j.cub.2018.06.010.

318 ECCC. 2024. Canadian Environmental Sustainability Indicators: Status of key fish stocks. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

319 The State of the Forest in Canada. 2024. The State of the Forest in Canada: Seeing through the spin. Canopy, David Suzuki Foundation, Nature Canada, Natural Resources Defense Council, Sierra Club BC, Sierra Club Canada, STAND.earth, Wilderness Committee. Retrieved [online] from: https://static1.squarespace.com.

320 ECCC. 2021. Canadian Environmental Sustainability Indicators: Land-use change. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

321 NRCan. 2025. Minerals and the economy. Natural Resources Canada. Retrieved [online] from: https://natural-resources.canada.ca.

322 UNTAD. 2024. Review of maritime transport 2024. UN Trade & Development. Retrieved [online] from: https://unctad.org

323 Sea Otter Recovery Team. 2007. Recovery Strategy for the Sea Otter *(Enhydra lutris*) in Canada. Fisheries and Oceans Canada. Retrieved [online] from: https://www.sararegistry.gc.ca.

324 COSEWIC. 2007. COSEWIC assessment and update status report on the sea otter *Enhydra lutris* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

325 Markel RW. & Shurin JB. 2015. Indirect effects of sea otters on rockfish (Sebastes spp.) in giant kelp forests. Ecology, 96(11), 2877-2890. DOI: 10.1890/14-0492.1.

326 COSEWIC. 2007. COSEWIC assessment and update status report on the sea otter *Enhydra lutris* in Canada. Committee on the Status of Endangered Wildlife in Canada. Retrieved [online] from: https://ecprccsarstacct.z9.web.core.windows.net.

327 Wilmers CC. Estes JA. Edwards M. Laidre KL. & Konar B. 2012. Do trophic cascades affect the storage and flux of atmospheric carbon? An analysis of sea otters and kelp forests. Frontiers in Ecology and the Environment, 10(8), 409-415. DOI: 10.1890/110176.

328 Deutz A. Heal GM. Niu R. Swanson E. Townshend T. Zhu L. Delmar A. et al. 2020. Financing nature: Closing the global biodiversity financing gap. The Palson Institute, The Nature Conservancy, and the Cornell Atkinson Center for Sustainability. Retrieved [online] from: https://www.paulsoninstitute.org.

329 ECCC. 2024. Canada's 2030 Nature Strategy: Halting and reversing biodiversity loss in Canada. Environment and Climate Change Canada. Retrieved [online] from: https:// www.canada.ca.

330 ECCC. 2023. Inefficient fossil fuel subsidies: Government of Canada self-review assessment framework. Environment and Climate Change Canada. Retrieved online from: https://www.canada.ca.

331 ECCC. 2023. Inefficient fossil fuel subsidies: Government of Canada guidelines. Environment and Climate Change Canada. Retrieved online from: https://www.canada.ca.

332 ECCC. 2023. Government of Canada delivers on key climate commitment to phase out inefficient fossil fuel subsidies. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca.

333 ECCC. 2024. Canada's 2030 Nature Strategy: Halting and reversing biodiversity loss in Canada. Environment and Climate Change Canada. Retrieved [online] from: https://www.canada.ca/en/environment-climate-change/services/biodiversity/canada-2030-nature-strategy.html#toc37.

334 Mansuy N. Staley D. Alook S. Parless B. Thomson A. Littlechild DB. Munson M. et al. 2023. Indigenous protected and conserved areas (IPCAs): Canada's new path forward for biological and cultural conservation and Indigenous well-being. FACETS, 8, 1-6. DOI: 10.1139/facets-2022-0118

335 Mansuy N. Staley D. Alook S. Parless B. Thomson A. Littlechild DB. Munson M. et al. 2023. Indigenous protected and conserved areas (IPCAs): Canada's new path forward for biological and cultural conservation and Indigenous well-being. FACETS, 8, 1-6. DOI: 10.1139/facets-2022-0118

336 Powell L. Quakegesic A. McCulloch E. Allen I. & Bradshaw B. 2024. Rooting natural climate solutions in Wahkohtowin through Indigenous guardianship: insights from a youth-led initiative in Northern Ontario, Canada. FACETS, 9, 1-17. DOI: 10.1139/facets-2023-0104.

337 Awan T. & Twigg M. 2023. Conservation economies in Nunavut: Aviqtuqq case study. Smart Prosperity Institute. Retrieved [online] from: https://institute.smartprosperity.ca.

338 Awan T. & Twigg M. 2023. Conservation economies in Nunavut: Aviqtuqq case study. Smart Prosperity Institute. Retrieved [online] from: https://institute.smartprosperity.ca.

339 Awan T. Twigg M. Sushant & Desrochers C. 2023. Inuit-led economic development: An overview of Nunavut's Blue Conservation Economy. Smart Prosperity Institute. Retrieved [online] from: https://institute.smartprosperity.ca.

340 Tittensor DP. Walpole M. Hill SLL. Boyce DG. Britten GL. Burgess ND. Butchart SHM. et al. 2014. A mid-term analysis of progress toward international biodiversity targets. Science, 346(6206), 241-244. DOI: 10.1126/science.1257484.

341 Secretariat of the Convention on Biological Diversity. 2020. Global Biodiversity Outlook 5 – Summary for Policy Makers. Secretariat of the Convention on Biological Diversity. Retrieved [online] from: https://www.cbd.int.

342 Parliament of Canada. 2025. C-73 - An Act respecting transparency and accountability in relation to certain commitments Canada has made under the Convention on Biological Diversity. Parliament of Canada. Retrieved [online] from: https://www.parl.ca.

343 ECCC. 2024. Canada's 2030 Nature Strategy and the Nature Accountability Bill. Environment and Cliamte Change Canada. Retrieved [online] from: https://www.canada.ca.

344 Ecojustice et al. 2024. Letter to House Leaders and Members of the House of Commons Standing Committee on Environment and Sustainable Development; Re: Bill C-73, Nature Accountability Act. Ecojustice, David Suzuki Foundation, Canadian Parks and Wilderness Society (CPAWS), The ChariTree Foundation, East Coast Environmental Law, Environmental Defence, Greenpeace Canada, Nature Canada, SeaBlue Canada, and WWF-Canada. Retrieved [online] from: https://ecojustice.ca.

345 Creighton MJA. Bennett JR. 2019. Taxonomic biases persist from listing to management for Canadian species at risk. Écoscience. 26(4), 315-321. DOI: 10.1080/11956860.2019.1613752.

346 Legislative Assembly of Ontario. 2025. Bill 5 - Protect Ontario by Unleashing our Economy Act, 2025. Legislative Assembly of Ontario. Retrieved [online] from: https://www.ola.org.

347 Legislative Assembly of the Province of British Columbia. 2025. Bill 15 – 2025 Infrastructure Projects Act. Legislative Assembly of the Province of British Columbia. Retrieved [online] from: https://www.bclaws.gov.bc.ca.

348 Ray JC. Grimm J. & Olive A. 2021. The biodiversity crisis in Canada: failures and challenges of federal and sub-national strategic and legal frameworks. FACETS, 6(1), 1044-1068. DOI: 10.1139/facets-2020-0075

A Canada with abundant wildlife, where nature and people thrive.

wwf.ca

WWF-Canada
410 Adelaide St. West, Suite 400
Toronto, Ontario M5V 1S8, Canada
Toll-Free: **1-800-267-2632**
Email: **ca-panda@wwfcanada.org**
Website: **wwf.ca** Donate: **wwf.ca/donate**

Cover photo: Snowy owl © **Don Getty** / Black-tailed prairie dog © **Shutterstock** symbol WWF-World Wide Fund For Nature (also known as World Wildlife Fund) ® "WWF" and "Living Planet" are WWF Registered Trademarks. WWF-Canada is a federally registered charity (No. 11930 4954 RR0001) and an official national organization of World Wide Fund For Nature, headquartered in Gland, Switzerland. WWF is known as World Wildlife Fund in Canada and the U.S. Published (2025) by WWF-Canada, Toronto, Ontario, Canada. Any reproduction in full or in part of this publication must mention the title and credit the above-mentioned publisher as the copyright owner. © WWF-Canada (2025). No photographs from this production may be reproduced. All rights reserved.