

# SciencePages

OCTOBER / 2010

## Biodiversity

Biodiversity is essential to current and future human well-being. Despite growing public and government commitment to sustainable development, biodiversity continues to decline.

To raise awareness and to help safeguard this natural wealth, the United Nations declared 2010 the International Year of Biodiversity. This edition of SciencePages focuses on what biodiversity is and how it is under threat. It also examines national and international mechanisms aimed at reducing the rate of biodiversity loss.

### What is biodiversity?

Biodiversity is the variety of genes, species, and ecosystems. The biodiversity we see today is the result of billions of years of evolutionary history, shaped by different combinations of life forms, their interactions with each other and with their environment. Today, life on Earth is increasingly altered by human activity, reshaped on such a large scale that the effects are lasting and difficult to predict.

### Biodiversity is life

Life on Earth depends on biodiversity. It is the source of important goods and services that include *provisioning services* such as food, fibre, fuel, and water; *supporting services* such as nutrient cycling, photosynthesis, and soil formation;

*regulating services* that affect climate, water purification, flood protection, and pollination; and *cultural services* that provide educational, recreational, and aesthetic benefits. Changes to biodiversity can therefore significantly impact our well-being in terms of livelihood, health, security, and economic activity.

### Biodiversity under threat

Human activity exerts many pressures on our environment and is considered to be the main cause of biodiversity loss. Loss of genetic and species diversity has direct effects on the structure and functioning of our ecosystems. Even though species extinction is a natural process, human activity has drastically accelerated biodiversity decline. Direct threats to biodiversity loss include changes in land use and cover, species introduction or removal, resource consumption, pollution, nutrient enrichment, and climate change.

### Measuring biodiversity

A state-pressure-response framework is commonly used to measure impacts on biodiversity. Indicators of *state* include trends in abundance and distribution of species and coverage of protected areas. Indicators of *pressure* include factors responsible for biodiversity loss, such as trends in invasive alien species or habitat fragmentation. Indicators of *response* track environmental and economic efforts that aim to prevent biodiversity loss.

Biodiversity is the variety of genes, species and ecosystems



## Biodiversity trends in Canada

A recent Environment Canada self-assessment demonstrates that some progress has been achieved to date. Positive trends include a fourfold increase in terrestrial and marine protected areas since 1992, and the legal recognition of species at risk of extinction. However, indicators related to the Arctic, such as decreasing seabird and caribou populations, and those related to the Great Lakes, such as invasive alien species and urban land expansion, are moving in a negative direction.

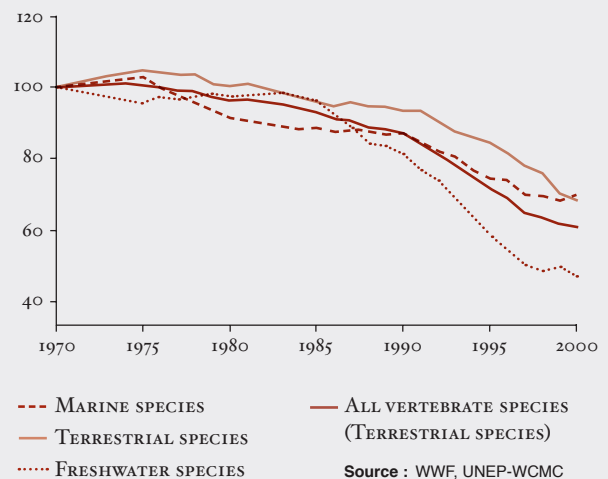
## Invasive alien species

*Invasive alien species* are plants, animals, or micro-organisms introduced and/or spread outside their natural habitat. They can cause a range of negative effects on native biodiversity, including disease, altered ecosystem functioning, and local extinction of species. A striking example is the zebra mussel, introduced into the lower Great Lakes through ballast water from ships. Its introduction devastated native mussel species and has a considerable economic impact. The estimated costs associated with damages from the zebra mussel range from \$3 billion to \$7.5 billion<sup>1</sup>.

## Biodiversity hotspots and areas of special concern

*Biodiversity hotspots* are regions with significant reservoirs of native species under threat by human activity. To date, 34 biodiversity hotspots have been identified worldwide. Regions of special concern in Canada include coastal marine waters, Arctic soils, tall-grass prairie, and boreal forests. Canada's boreal forests provide refuge to migratory birds and northern mammals, and store more carbon in surface vegetation and associated soils than any other terrestrial ecosystem on Earth; almost twice as much as tropical forests.

POPULATION INDEX = 100 IN 1970



**Figure 1.** The Living Planet Index (LPI) is an indicator of the state of biodiversity, based on trends in populations of terrestrial, marine, and freshwater vertebrate species. The global LPI, calculated as an average of the three terrestrial, marine, and freshwater indices, has declined by 27 percent between 1970 and 2005.

## Convention on Biological Diversity

In 1992, Canada was the first industrial nation to sign the Convention on Biological Diversity (CBD); a milestone global agreement on biodiversity.<sup>2</sup> The CBD has three main objectives: the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilization of genetic resources. A decade later, Canada joined 192 nations in a commitment to achieve a “significant reduction” in the rate of biodiversity loss by 2010.<sup>3</sup> The CBD reports that although progress has been made in certain areas, this overall target has not been met.<sup>4</sup>

## Canadian biodiversity policy

Biodiversity includes all life forms, and its protection involves many federal departments and all levels of government. The publication of the *Canadian Biodiversity Strategy* by federal, provincial and territorial officials in 1995 fulfilled a key requirement of Canada’s commitment to the CBD. This Strategy provided a framework for the conservation of biodiversity and sustainable use of biological resources.<sup>5</sup> Provinces and territories are important partners, due to their role as primary custodians of their own natural resources, and have developed their own strategies.

The boreal forest occupies 35% of the total Canadian land area



## SARA

The *Species at Risk Act* (SARA) is currently undergoing a required parliamentary review by the House of Commons Standing Committee on Environment and Sustainable Development. Issues being considered include the timing and relative importance of scientific and socio-economic considerations, Aboriginal involvement, and the time lines for recovery strategies and action plans. SARA was adopted in 2002 to honour Canada’s legal commitments under the CBD to protect endangered and threatened species and their

habitats. SARA mandates the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to advise the federal government on the conservation status of species at risk. The provision of legal protection to these species is at the discretion of cabinet. If granted, recovery strategies must also be implemented for these species and their habitats.

SARA is just one of many pieces of federal legislation which aim to protect biodiversity.



## A compelling economic case

Economic considerations are often seen to be in conflict with conserving biodiversity. Given this, an increasing number of initiatives aim to mobilize industry and policymakers by highlighting the value of ecosystem goods and services. *The Economics of Ecosystems and Biodiversity* (TEEB), an international effort endorsed by the European Commission and the G8, seeks to provide a “compelling economic case for the conservation of biodiversity.” TEEB has published evidence that ecosystem restoration can provide significant positive social returns and help sustain various market sectors (see Table 1).

One emerging market is a carbon financing system based on Reducing Emissions from Deforestation and forest Degradation (REDD).<sup>6</sup> This initiative would see carbon emitters fund the sustainable development of forest resources and biodiversity conservation in developing nations. There is potential that REDD+, which includes the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks, can concurrently tackle the two global environmental challenges of sustaining forest biodiversity and mitigating the effects of climate change.

## Towards a renewed global effort

There is consensus among world governments that policy decisions addressing biodiversity and ecosystem services need to be based on the best available scientific information. A new United Nations science body called the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is being created in a renewed global effort to protect the natural world. Supported by the G8, it will learn from the Intergovernmental Panel on Climate Change (IPCC) and provide regular, non-prescriptive assessments on the state of biodiversity and ecosystem services around the world.<sup>7</sup>

**Table 1**

ESTIMATES OF COSTS AND BENEFITS OF RESTORATION PROJECTS IN DIFFERENT BIOMES

BIOME/ ECOSYSTEM	COST OF RESTORATION (US\$/HA)	BENEFITS OVER 40 YEARS (US\$/HA)	RATE OF RETURN
COASTAL	232,700	935,400	11%
INLAND WETLANDS	33,000	86,900	12%
LAKES/ RIVERS	4,000	69,700	27%
WOODLAND/ SHRUBLAND	990	32,180	42%
GRASSLANDS	260	22,600	79%

**Note:** Costs are based on an analysis of appropriate case studies. Benefits are determined according to Net Present Value. The rate of return is an internal rate of return. As the TEEB database and value-analysis are still under development, this table is for illustrative purposes only.

**Source:** TEEB (2009) TEEB Climate Issues Update, [www.teebweb.org](http://www.teebweb.org)

## Endnotes

- 1 An Invasive Alien Species Strategy for Canada, Environment Canada, <http://www.ec.gc.ca/eee-ias/default.asp?lang=En&n=F695900C-1>
- 2 List of Parties, Convention on Biological Diversity, <http://www.cbd.int/convention/parties/list/>
- 3 2010 Biodiversity Target, Convention on Biological Diversity, <http://www.cbd.int/2010-target/>
- 4 See *Global Biodiversity Outlook 3*, <http://gbo3.cbd.int/>
- 5 Canadian Biodiversity Strategy, <http://www.cbin.ec.gc.ca/strategie-strategy/default.cfm?lang=eng>
- 6 The Forest Carbon Partnership Facility, <http://www.forestcarbonpartnership.org/>
- 7 Science-Policy Platform on Biodiversity and Ecosystem Services, <http://ipbes.net/>

## About SciencePages

*SciencePages* ([www.sciencepages.ca](http://www.sciencepages.ca)) is an initiative of the Partnership Group for Science and Engineering ([www.pagse.org](http://www.pagse.org)). *SciencePages* aims to increase discussion on topical issues that have science and engineering at their core, by summarizing the current state of knowledge and policy

landscape. Each issue is prepared and reviewed by a multi-disciplinary team and is published quarterly, free of charge.

This pilot issue is made possible thanks to the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Canadian

Foundation for Innovation (CFI) and was prepared by Tomasz Kasprzycki, Barbara Kubica, and Edith Lamoureux.

For more information please write to us at: [info@sciencepages.ca](mailto:info@sciencepages.ca)