

Comparison of the Environmental Monitoring Systems for Protected Areas of Canada and the European Union

by

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Abstract

The global challenges of climate change and declining biodiversity have prompted many countries to develop nature protection strategies, collaborate in international organizations, and set common thresholds and goals. To measure the success of these efforts, effective monitoring systems are essential, but integrating data from different monitoring systems can be challenging. Canada and the European Union have developed advanced monitoring systems under varying circumstances. Both countries joined the Global Biodiversity Framework. To assess and compare these systems and their data, all parties must agree on basic standards. The individuals responsible for operating these systems play a crucial role in ensuring data completeness. Their work must be evaluated based on its complexity, adaptability, and comparability. This thesis compares the monitoring systems at three levels of governmental structure, assessing them against fundamental criteria with the aim of identifying overlapping areas and proposing enhancements. A unified approach could significantly enhance global biodiversity monitoring efforts.

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List of Symbols, Nomenclature, or Abbreviations

COP15	15. Conference of the Parties
COSSAR	Committee on the Status of Species at Risk
EEA	European Environment Agency
EI	Ecological Integrity
EU	European Union
GBF	Global Biodiversity Framework
ICE	Information Centre for Ecosystems
ISPRA	Italian Institute for Environmental Protection and Research
IUCN	International Union for Conservation of Nature and Natural Resources
NB	New Brunswick
UN	United Nations
UNESCO	United Nations Educational, Scientific, and Cultural Organization

Introduction

Global climate change has compelled most governments on the planet to take measures to protect nature. The role of protected nature in the form of protected areas in the maintenance of biodiversity will increase as adjacent lands will be further developed, resulting in the need for refugia for biodiversity, particularly as a coordinated response to climate change. This trend has created a need for a system to validate the success of protected areas in their function as refugia. Monitoring systems are considered the most focused means of assessing change in the state of protected areas.

This report focuses on the efforts of Canada and the European Union to monitor protected areas established to preserve their natural environments. The monitoring systems follow separate guidelines and will be compared to identify opportunities for improvement.

Canada and the European Union have cooperated in many initiatives over the last 50 years (E. U. E. A. European Union, 2021). Over time they have collaborated on several programs; one of them is the Transatlantic Forestry Master study program, which connects several European universities with several Canadian universities (Università degli Studi di Padova, 2024). Students in this program are asked to increase the collaboration and data exchange between the countries and enable the parties to compare data and strategy with the intention of coordinating their future in the best possible way, including facing the challenges of climate change, working as a team instead of working as single parties. Each participant profits from the shared knowledge and contributes its own wisdom. It is hoped that such a collaboration will help to identify best practices.

Protected Areas

A protected area is defined as a landscape with regulated, or limited human intervention. They are commonly used as the primary tool to maintain biodiversity as they typically restrict intensive resource extraction activities, such as farming, mining, forestry, and hydroelectric dams (Dudley, 2008).

Common examples include national parks, which are accessible to the public but often have restrictions on new buildings, roads, and specific human behaviours, such as staying on prepared pathways and removing all refuse. The level of protection in these areas varies from slightly protected from human intervention to strongly protected as a complete set-aside, an area that is closed to the public with little or no intervention to care for it. One globally recognized classification is provided by the International Union for Conservation of Nature and Natural Resources (IUCN). The IUCN classification offers a standard that makes these areas comparable worldwide and gives a rough idea of the applicable rules (Dudley, 2008).

Protected Habitat

Within protected areas are protected habitats, which are the specific environments that various species require to thrive. For example, certain plants may need specific soil and weather conditions. An example is the primula (*Primula hirsuta*), a flower that grows only on steep rocks. It might not be enough to forbid picking it; restricted access to the

rocks and the removal or redirection of climbing routes may be necessary to ensure its protection. Another example is a frog that needs a pond to survive. While the frog itself may not be directly threatened by humans, losing its pond due to construction would result in the loss of its habitat. Thus, the main goal of protected areas is to safeguard these habitats, not just the species within them.

Monitoring Systems

Protected areas that are too small, isolated, or heavily impacted by internal and external stressors may fail to protect biodiversity effectively (Sitzia & Università degli Studi di Padova, 2023). Therefore, it is crucial to monitor the success of protected areas.

Monitoring systems in Canada and the European Union systematically collect data to assess the condition of each habitat and the protected area as a whole. These systems provide various levels of comparison, from regional to national and global scales, using indicators such as:

- Abundance of key species
- Death rates of key species or their prey
- Presence or absence of co-species
- Size of the habitat
- Water quality
- Soil samples
- Air quality

- Watershed distributions
- Habitat fragmentation

These indicators collectively reveal the condition of protected areas.

For example, the abundance of key species might indicate the health of an area, though it doesn't necessarily mean that more is always better. The size of the habitat can also vary under different conditions, such as climate change or increased tourism, affecting its overall health. A habitat might shrink under bad conditions and grow under good ones. A growing habitat might endanger another habitat.

Sampling techniques include counting animals through observation, collecting specimens dead or alive, counting plants in defined areas, and analyzing soil or water pH, among others.

Criteria for Comparison

The conditions of protected habitats can only be compared if there is a consensus on basic definitions. The IUCN provides a global standard, which, while not necessarily perfect for every area, offers a useful model and promotes global dialogue. Clear definitions allow for the comparison of monitoring systems. Each habitat requires different control indicators, and the first step is to assess the condition of the protected area independently of these indicators.

Moreover, the monitoring systems themselves need evaluation. The following recommendations are drawn from the author's experience and can be assessed based on several key factors, including:

- Ease of use in the field - Workflow
- Simplicity in completing surveys
- Understandability
- Presentation of the data in an understandable and intuitive manner
- Ease of Maintenance and Adaption

A user-friendly system is crucial for consistent data collection. The system should be comprehensive, logically covering all monitored objects, making it easy to identify missing data. An easy-to-use system enhances understanding and confidence, leading to reliable data collection. Furthermore, the data must be presented clearly, offering an immediate overview of the situation, such as through the use of color-coded maps (Tarolli & Università degli Studi di Padova, 2023).

Such a system collects reliable data that can be traced back to the source. However, the monitoring system's role does not end there. The collected data must be presented in a clear and comprehensible manner, offering an immediate overview of the situation. The more intuitive the presentation, the better the understanding. An example is the use of colours in maps, as illustrated in Figure 1.

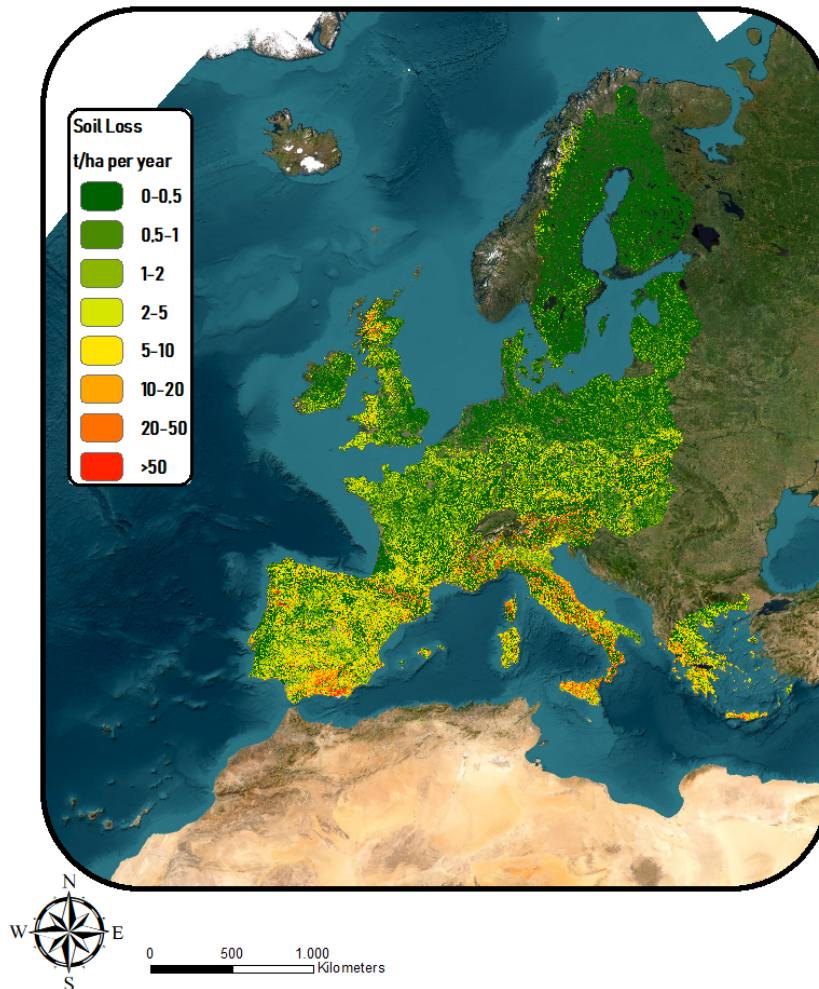


Figure 1: Map of the EU, showing the soil loss in t/ha in color code, map by the author

Coloured maps and graphs are effective tools for presenting data, providing an overview that is accessible even to untrained individuals.

Monitored areas underlie nature's laws and might and will change over time. This forces its managers to change their monitoring system as well: focusing less on the main

structure and more on the details. The main structure still requires evaluation of several habitats, species or threats, but at the same time, the individual habitats, species or threats might have shifted into nothingness, extinct, disappeared or been replaced.

Canada and the European Union

Canada and the European Union represent significant land areas within their respective continents, making them comparable in terms of their biodiversity and the measures they take to protect it. In recent decades, both governments have decided to strengthen their protective systems to conserve existing biodiversity and slow down the loss of species.

To assess their effectiveness, both governments have developed monitoring systems.

These systems survey the condition of selected landscapes and, over time, can assess the effectiveness of the implemented measures.

Objective

This report will compare the monitoring systems of protected areas on the national/Union level and on the regional/national level of Canada and the European Union. The main goal is to identify potential gaps and feasible new options by comparing and combining the systems.

As this report follows the governmental structure, it also follows the three levels of protection according to the rules that apply per level. The first level covers the Canadian national rules and the rules valid for the complete European Union. This applies to Canada's Green Plan and the Natura 2000 network in Europe.

The second level compares the system New Brunswick uses to the system Italy uses. Each country has at least one ministry dedicated to that topic.

The last and the main level is the comparison of the parks. The parks follow all three levels at once, as they are both National Parks, which asks for the first level. At the same time, the parks are situated in a region that lies under the control of the second level and additionally, both parks might add their own features to the monitoring system which opens a third level of rules.

The focus is on the system of control mechanisms, not on the success of the single measurements. Each system has been accomplished by experts and as a condition, the content and the choices of indicators and measurements are regarded as valid, reliable and objective.

By comparing the systems on each level, some gaps might be identified whereas it must be considered that each level of government covers different parts depending on the main structure. Some potential gaps might be covered on another level, which might serve the system as well as interrupt it. The report focuses on the criteria of comparison mentioned in the section "Criteria for Comparison".

Decision Process

Understanding protection requires understanding the administrative structure involved.

Here is a brief introduction of who decides what in which area. Table 1 also gives an overview of what is compared concerning the surrounding conditions:

Table 1: Surrounding conditions of Canada and the European Union (D.-G. for C. European Union, n.d.-a; E. E. A. European Union, 2022b; S. C. Government of Canada, 2018a, 2018b)

Factor	Canada	European Union
System	Constitutional Monarchy	Representative Democracy
Size (km ²)	9,984,670	> 4,000,000
Inhabitants	41,363,811	448,400,000
Population Density (#/km ²)	0.24	112.10
Protected Area in km ²	1,788,387	1,219,416
Protected Area in %	21.8	27.6

Table 1 does not reflect reality as more factors are involved. Canada is approximately the size of the European continent and has large variations in population density. People

gather in larger cities which causes a concentration of pollution. Comparing population densities in total reveals possibilities of decompression of human habitats. On the opposite side of the Atlantic is Europe with a higher population density. Europe has fewer possibilities to spread its human habitats. This comparison offers an exchange of information as both countries have dense areas and relevant solutions. The percentage of protected areas only shows "protected areas" and no areas with lesser criteria. As the restrictions are different and adapt to different circumstances, they might not reflect the total protection but show what falls under the IUCN standards. Standards are crucial to compare data worldwide.

Several factors influence the methods of protection. For example, if two areas have different population densities, the impact of human intervention on nature also varies, calling for stronger or weaker rules to achieve the desired level of protection. For instance, a protected area in a densely populated place may require a fence, while a simple informative sign might suffice in remote areas to prevent trespassing.

Canada

Canada is a constitutional monarchy organized as a parliamentary democracy. It has a parliament with members elected by the people. Responsibility for nature protection is assigned to the Ministry of Environment and Climate Change. This ministry oversees several agencies, including Parks Canada, which is responsible for the national parks (E.

and C. C. Government of Canada, 2020). That includes Fundy Park, which will be discussed later.

New Brunswick

New Brunswick is a province of Canada. Each Canadian province is a federal state and shares the governmental structure with the national government. Some parts of it are regulated nationally whereas other parts are regulated by the local government. Nature protection falls under both jurisdictions.

The New Brunswick government incorporates two departments that are concerned with the natural environment: the Department of Environment and Local Government, and the Department of Natural Resources and Energy Development, the latter focusing on forest conservation (C. Government of New Brunswick, 2012).

Canada's Green Plan

Canada's Green Plan is based on trust. It is a statement formulated in 1990 that outlines key features of Canada that should be protected. The government trusts its citizens to safeguard the future. Several goals and guidelines have been formulated to support the decision-making process, including the United Nations Sustainability Goals (Government of Canada, 1990).

Canada's action plan involves dividing its territory into biodiversity sectors. Each sector must be represented in one or several protected areas, which must be large enough to ensure the conservation of its flora and fauna. Figure 2 shows the protected and conserved areas in 2010 in Canada whereas following the protection plan, these should have increased in size and number. This report focuses on the protected areas as the conserved areas have weaker protection rules which might only regulate the impact of the resource management in that area. Details are available from the regional governments that develop and transform their areas continuously. Information from New Brunswick's government will be discussed later.

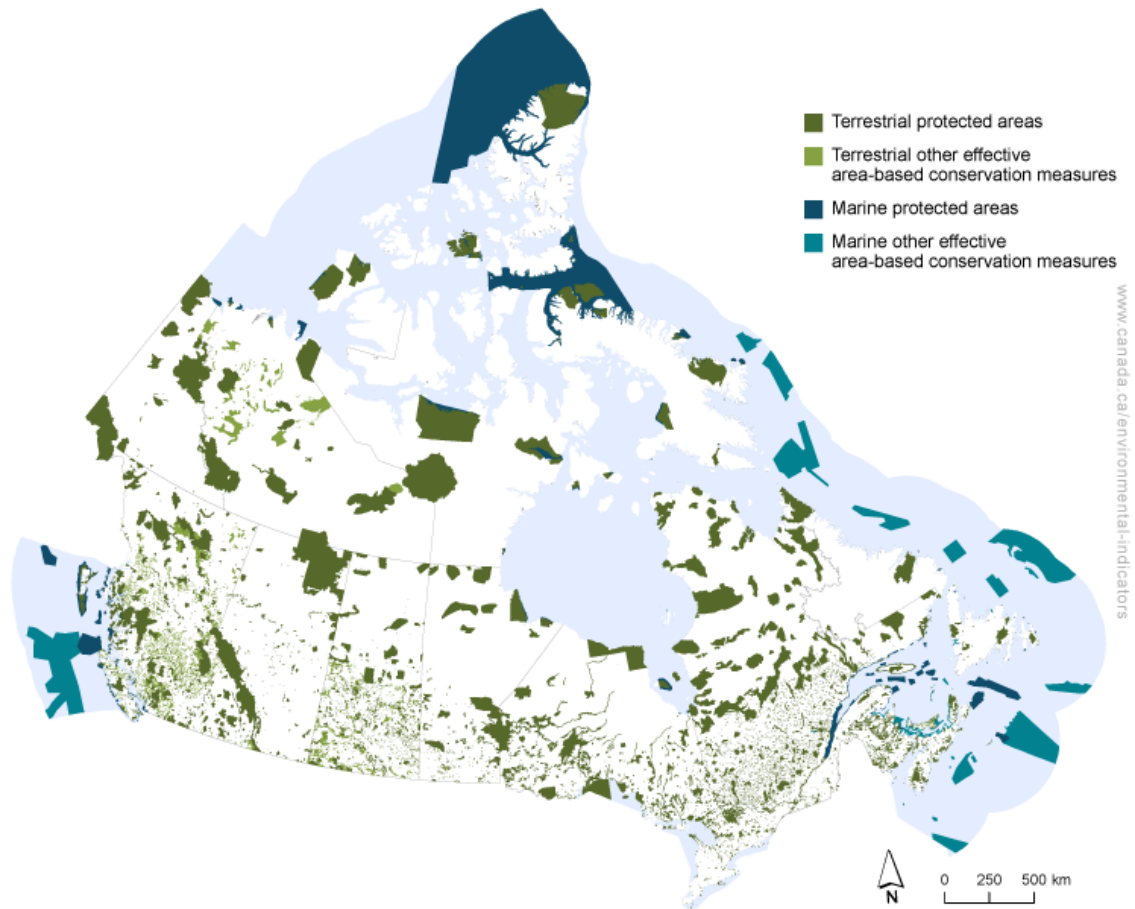


Figure 2: The Canadian government offers a map that shows all the terrestrial and marine protected areas, (E. and C. C. Government of Canada, 2010)

Europe

The European Union (EU) is a representative democracy. The people elect members of the European Parliament, which is only one part of the comprehensive governmental system. Responsible for applied nature protection is the European Commission's Directorate General for the Environment. This directorate drafts new regulations, which must be approved by Parliament, and ensures their execution. The European Commission

verifies whether its members follow these rules. Any new or existing nature protection regulation will be organized and executed by the Directorate General for the Environment.

Each member state has its own national structure, leading to a diversification in the organization of the executive bodies (D.-G. for C. European Commission, n.d.). In case of doubt or contradiction of national law and EU law, the general guideline and past decisions favour the EU law.

Italy

Italy is a member state of the European Union. As a unitary parliamentary republic with a parliament elected by the people, it is the Ministero Ambiente e Sicurezza Energetica (Ministry for Environment and Energy Safety) that regulates nature protection affairs in Italy (M. dell'Ambiente e della S. E. Governo Italiano, 2024).

Natura 2000

Italy takes part in Natura 2000, as does every EU member state (E. E. A. European Union, 2022b, 2023a). Natura 2000 is a network established by the European Union to protect nature with over 27000 sites. It requires each member state to designate sites to ensure biodiversity according to the 233 types of habitats plus the requirements of the Birds Directive that fit their biogeographical region. The system focuses on key species

and their needs. The idea is to provide a habitat for very demanding species thereby also meeting the needs of less demanding species. The key species act as umbrella species, indirectly protecting several related species.

Each Natura 2000 site is defined by a combination of plants and/or animals. Natura 2000 has its roots in the Birds Directive. The EU initially focused on bird protection and created the Birds Directive to identify critical sites and species. This was followed by the Habitat Directive, which included plants and other animals, as birds alone could not safeguard the entire ecosystem. Both directives were integrated to form Natura 2000.

As a result, each site has a list of birds, plants, and animals that define the habitat within the site. The EU developed the system until it seemed robust enough to ensure Europe's biodiversity. Member states can add sites as needed, in agreement with the Union. Once a site is designated, it is not intended to be repurposed.

Global Strategies

Canada and the member states of the European Union are members of the United Nations (UN) and follow their 17 sustainability goals (D. of E. and S. A. United Nations, n.d.).

The UN invented several strategies to protect nature, one of them is the Kunming-Montreal Global Biodiversity Framework (GBF), which will be discussed in the paragraph "United Nations".

IUCN Categories

The IUCN categories can be used as an orientation for protected areas (Dudley, 2008).

The categories unfold as follows:

Class I - Nature Reserve or Wilderness Area

This class allows no public access except by permit from the government for educational and scientific purposes. These sites require complete protection as human activity could irreparably damage the ecologically sensitive features.

Class II - National Park

Class II applies to larger areas of the province's natural ecosystems and landscapes. Low-impact recreational activities and traditional food-gathering activities are permitted. Industrial, commercial, and agricultural uses and development are not permitted. These sites provide an opportunity to study the natural environment as well as the recovery of modified ecosystems. Specific educational and scientific activities, hunting, fishing, harvesting plants and similar activities require a permit. Parks often follow an educational approach to inform visitors about the features of the enclosed area and its nature.

Class III - Natural Monument or Feature

Monuments or features that require protection are often limited in space. Those areas tend to be smaller, and management is mostly concerned to conserve single monuments and function on a smaller scale than the surrounding ecosystem. Such sites often attract tourists and accordingly need protection.

Class IV - Habitat/species Management Area

Class IV areas favour a single species and its habitat. All measurements aim to restore or protect this species. The measurements can be regarded as separated from measurements concerning the ecosystem but are often part of a larger management plan. Such areas can exist on a very small scale and might appear in crowded areas such as cities. An example are stepping stones, resting points for migratory birds or butterflies. Such habitats can be fragmented or visited only twice per year, depending on the species. Still, they can be

crucial for the survival of the species. The Monarch Butterfly (*Danaus plexippus*) in Figure 3 is a migratory butterfly that depends on milkweed as host plant.

Class IV only applies to critically endangered species.



Figure 3: The Monarch butterfly depends on milkweed as host plant, picture by the author

Class V - Protected Landscape/Seascape

Class V regards the intertwined relationship between humans and landscapes. The idea is to ensure the coexisting and the appealing character of a landscape, often formed by traditionally impact of humans. A famous example is Cinque Terre, as shown in Figure 4, a highly trafficked vacation area in north Italy where past generations transformed the

steep coast to terraced gardens. As the tradition is not continued, Italy decided to protect the area by law and support its maintenance.



Figure 4: Cinque Terre, a region in northern Italy, is famous for its terraced coast. The inhabitants formed the steep coast to terraces to form narrow gardens. Picture by the author.

Class VI - Protected Area with Sustainable Use of Natural Resources

This type of area aims to merge a healthy nature with low-impact resource management.

This excludes industrial machineries as the main aim is still to protect nature but

obviously man can not let go of whatever resources hide within the site. It pairs

conservation with sustainable and culture use of the supplies. By default nature should

play the major role in those areas, which means that the resource management should be downleveled to a minimum and leave the bigger part of the area intact. This translates for most countries to a 2/3 to 1/3 use, with two thirds for nature and one third for the highly restricted resource management.

An example for class VI areas are biospheres, as biospheres are meant to harmonize human behaviour and nature protection (UNESCO, n.d.). Naturally such districts contain several stages of protection, including buffer zones that are most likely to be classified as class VI under the IUCN.

The Fundy Biosphere region in Canada, New Brunswick is an example for such a conglomerate of protected areas (Dingman, J., n.d.). This region is a patchwork of differently categorized areas, including the Fundy Park, a national park that falls under IUCN class II. Most biospheres mentioned in this report are acknowledged by the UNESCO and contain several protected areas recognized by the IUCN. Both organisations strive to work cooperatively. The biospheres of Canada are shown in Figure 5, visible as orange areas.



Figure 5: The map shows all the biospheres Canada has in 2024, including Fundy on the east coast, (Canadian Biospheres Reserves Association, 2024)

Italy has similar areas, for example the Po Delta. The Po Delta is recognized by the UNESCO as world heritage and contains several Natura 2000 Sites and other protected areas, including buffer zones, that fall under class VI of the IUCN categories (Ente di gestione per i Parchi e la Biodiversità, 2024; UNESCO, n.d.). Figure 6 shows the Po river with its adjacent biospheres (Commissione Nazionale Italiana per l'Unesco, 2024).

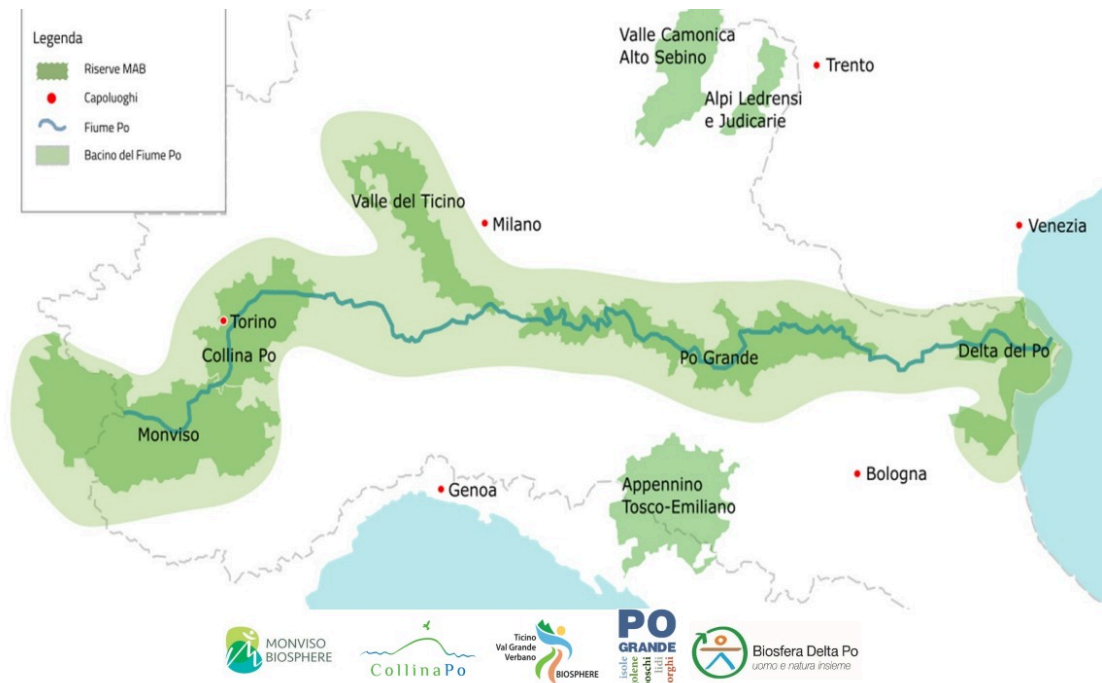


Figure 6: The map shows the Po river in Italy with its adjacent biospheres including the Po Delta which leads to the Mediterranean Sea. Core areas are marked in dark green, buffer zones in light green, (Commissione Nazionale Italiana per l'Unesco, 2024)

United Nations, Canada and Europe

The United Nations, which includes Canada and Europe, committed to the goals of the guidelines formulated in COP15 (Conference of the Parties 15) (Brader, 2023). COP15 was an international conference held by the United Nations on biodiversity in 2022. The international community agreed on the goals of the Kunming-Montreal Global Biodiversity Framework (GBF). This framework sets forth four main goals and 23 targets to be achieved by 2050 (E. United Nations, 2022). The four main goals recap all of the original 23 goals, Table 2 shows an overview which is followed by a description of their details.

Table 2: The four main goals of the Kunming-Montreal Biodiversity Framework

Goal	Title	Measurements
A	Protect and Restore	- enhance protected areas - stop extinction of threatened species - slow down extinction for every species - maintain existing populations
B	Prosper with Nature	- manage biodiversity in a sustainable way

		- protect and enhance the benefits of nature - restore nature where necessary - this development should serve current and future generations
C	Share Benefits Fairly	- genetic resources: maintaining and sharing - protecting of traditional knowledge
D	Invest and Collaborate	- support in several sectors

Goal A - Protect and Restore

Goal A asks for the enlargement of existing protected areas and additional areas. Canada and Europe set its goal to 30% of the land and the marine area. Each year, the regions contribute to this goal.

The Canadian progress is demonstrated in Figure 7, with a significant increase after 2015 and the European progress in Figure 8 with an continuous increase since 1993, the year of the declaration of the Birds Directive (E. E. A. European Union, 2020b; E. and C. C. Government of Canada, 2010).

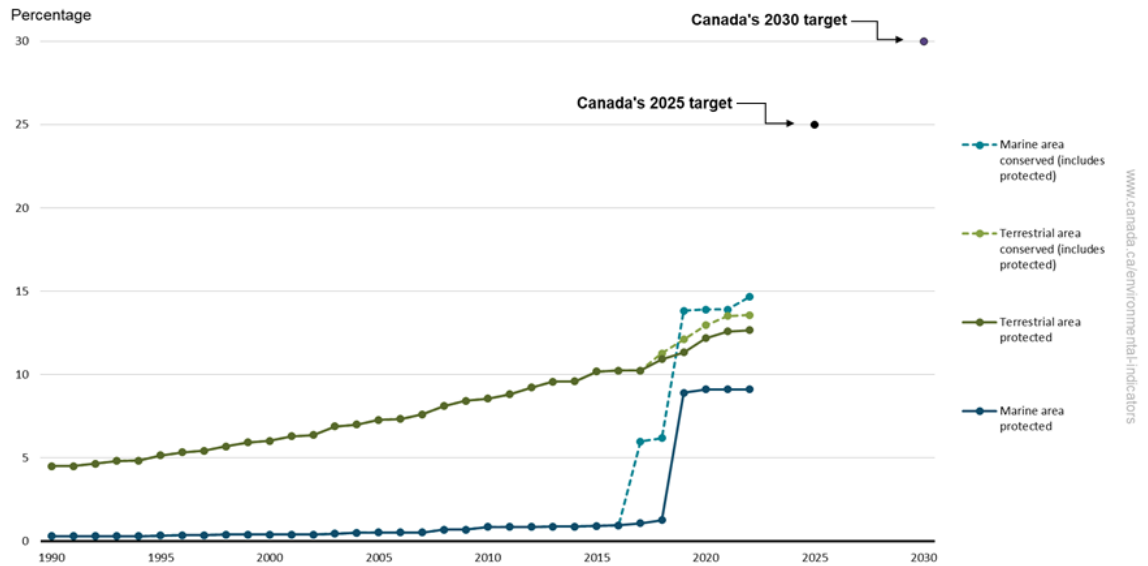


Figure 7: Overview of Canada's enlargement of protected and conserved areas from 1990 to 2022, (E. and C. C. Government of Canada, 2010)

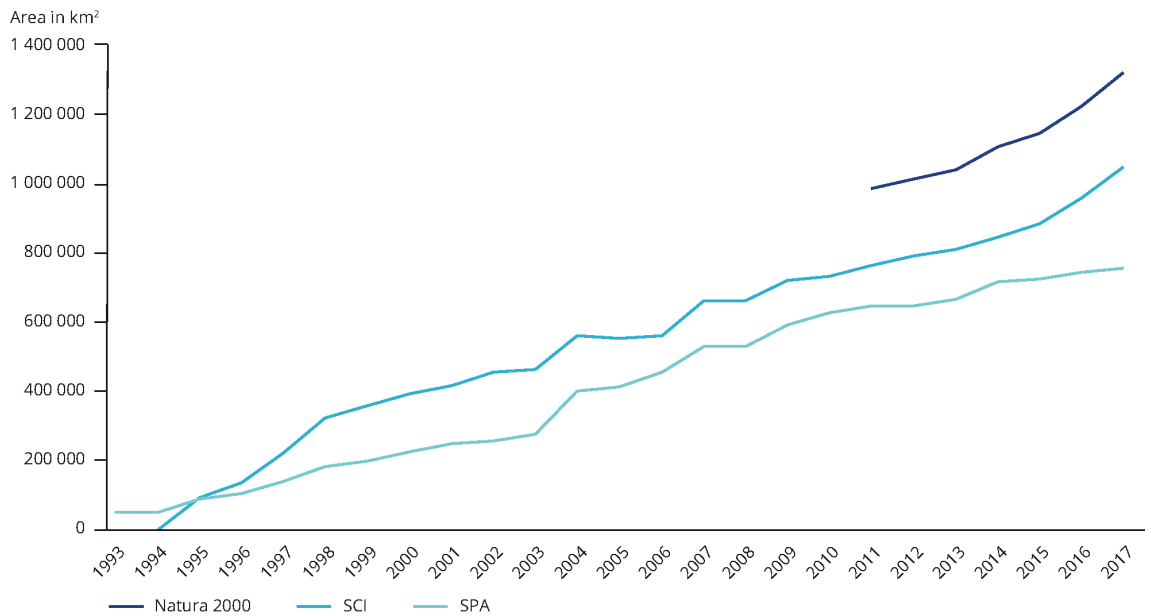


Figure 8: This graph shows the progress of designated sites under the Birds Directive green, the Habitats Directive in blue and the conglomerate of both directives, the Natura 2000 network, in dark blue, (E. E. A. European Union, 2020b)

Goal B - Prosper with Nature

Goal B aims to manage the existing nature by classifying it into worthy parts and ignoring others. Preferred parts refer to biodiversity and services such as water supply, clean air, fertile soil, and more. It promises to keep those benefits at a secure level or enhance them to that level and provide them for the present and the future, with 2050 as a marker for success.

Goal C - Share Benefits Fairly

All members promise to share their genetic resources on an equitable basis. Traditional knowledge concerning biodiversity, conservation, and genetic resources shall be preserved and heard as long as they fit the Kunming-Montreal framework. The knowledge will be accessible as well as benefit-sharing instruments.

Goal D - Invest and Collaborate

The community offers support for any member who needs it to fulfill these goals, with a focus on developing countries and other states in need. The financial gap of US\$700 should diminish until 2050.

The GBF includes more details and more goals which should all be fulfilled by 2050.

Figure 9 displays them all. Even if several of them sound as if they belong to another political topic than nature protection, the committee considered them necessary for their intentions (E. and C. C. Government of Canada, 2024).

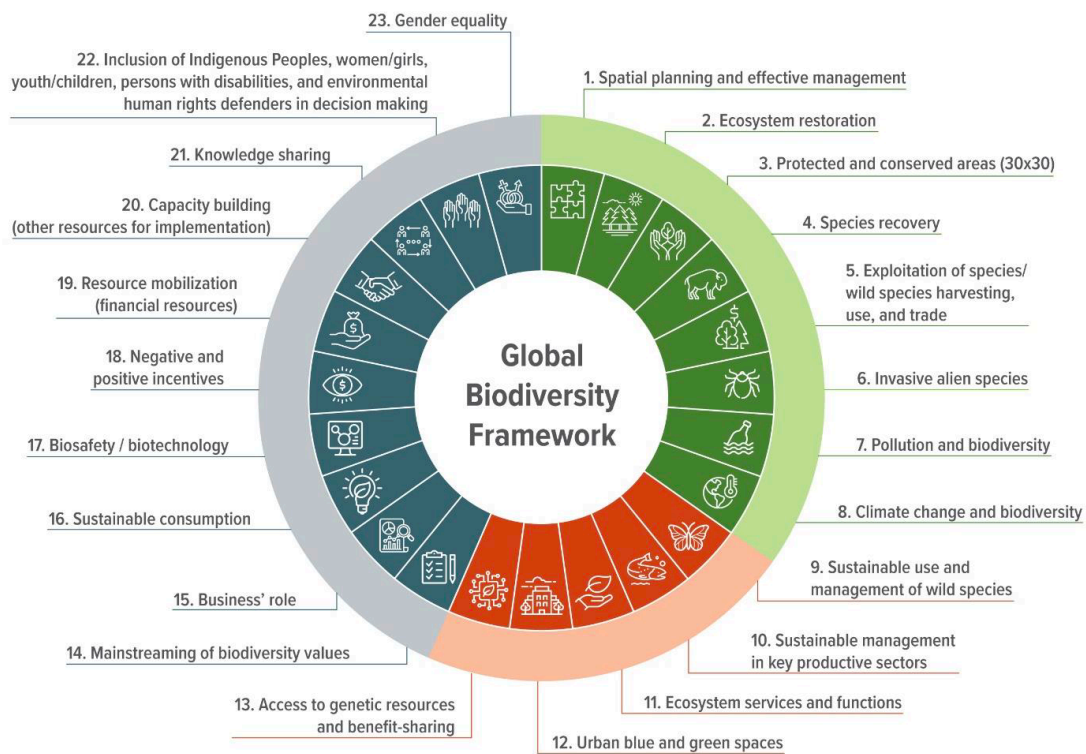


Figure 9: The wheel of Figure 3 shows the goals of the GBF that should all be fulfilled by 2050, (E. and C. C. Government of Canada, 2024)

GBF Monitoring System

Each country that has committed to the GBF is required to submit a national report (Brader, 2023; C. on B. D. United Nations, 2023a, 2023b). These reports are based on the

respective country's monitoring systems. However, at this level, the monitoring discussed does not directly influence local measurements; rather, it pertains to the oversight and governance the GBF exercises over its member states. A critical aspect of this process involves understanding how the GBF collects data and how that data is utilized. Membership in the GBF is a voluntary decision made by each country, but once a country joins, the submission of these reports becomes mandatory.

The primary objective of the monitoring guidelines is to ensure clarity and simplicity (Lefebvre & United Nations, 2022). To minimize the workload for participating countries, the guidelines concentrate on a limited number of key indicators, which can be assembled from detailed measurements that each country selects independently, oriented on the already locally existing monitoring. The report also incorporates yes/no questions on broader topics to facilitate a swift evaluation process.

The reporting cycle was intentionally left undefined, allowing it to align with upcoming meetings, other global frameworks, and conventions. As these meetings generally occur every six years, countries are expected to submit their reports by that time. The availability of updated information is crucial, as future meetings and discussions will rely on these reports to assess progress and guide decision-making.

As of today, the next report is due by February 28 (C. on B. D. United Nations, n.d.). The fifth report was due in 2014. These reports vary significantly, as countries have considerable freedom in determining the level of detail and are not required to follow a strict format (C. on B. D. United Nations, 2023a). For example, Canada included a graph in its fifth report that visually represents progress toward the main goals, as shown in Figure 10 (Government of Canada, 2014). The graph is divided into two sections, with

the left side focusing on nature-related aspects and the right side on human-related aspects. Color-coded symbols with arrows pointing downward or upward offer a straightforward way to understand the outcomes of the measures. This visual approach allows for a quick assessment of progress in relation to the goals.

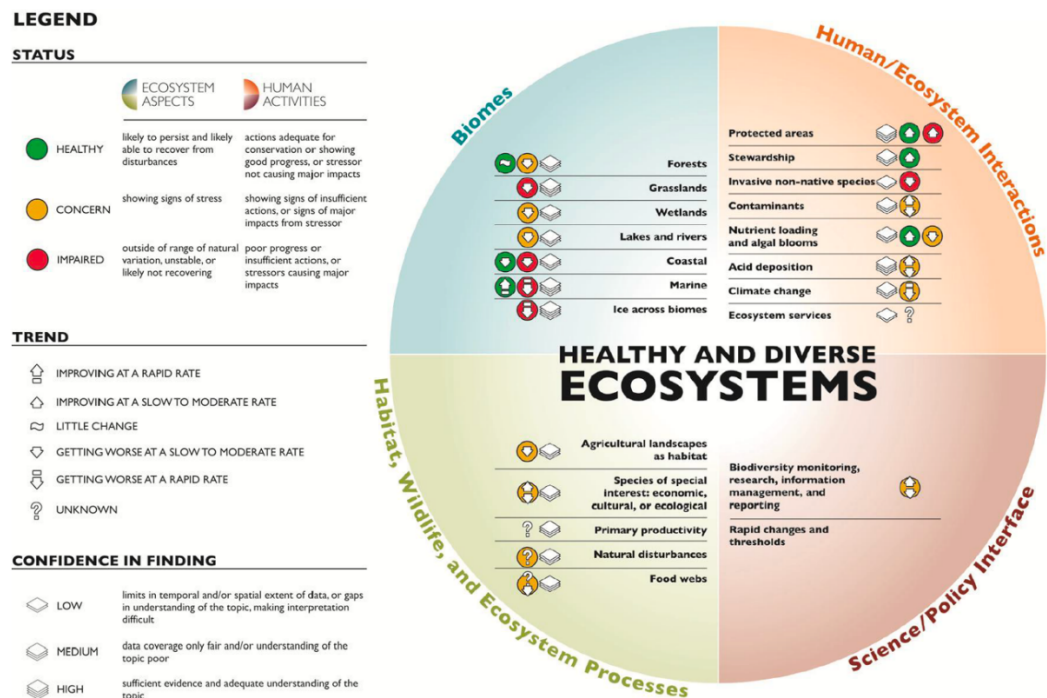


Figure 10: The graph shows the trend of some of the goals of the GBF in Canada, using colours and symbols to enhance immediate understanding (Government of Canada, 2014).

The European Union chose not to include a visual overview in its report, contrary to the style used in the report that has been published on its Natura 2000 websites (European Commission, 2014; E. E. A. European Union, 2020a). Instead, it opted to use text to highlight key features and provided a list detailing each target along with a brief written description of its status.

Italy included a color-coded overview similar to Canada's, using visual elements to illustrate the estate of the measurements of 15 different topics, visible in Figure 11 (M. for the E. Governo Italiano, 2014).

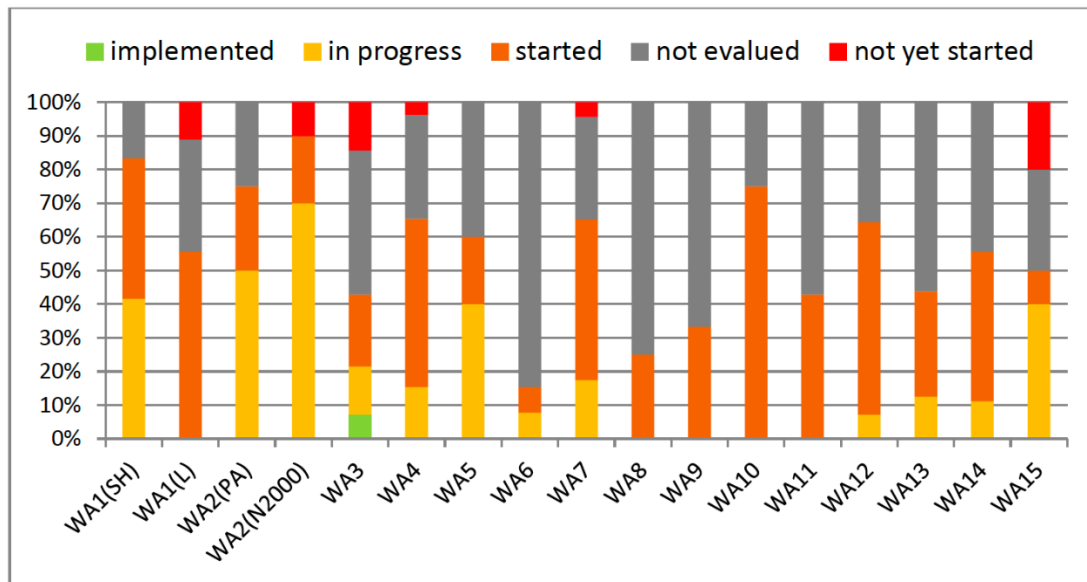


Figure 11: The graphs shows the status of measurements for 15 different topics of the Italian national monitoring, specifically: WA: Working area; 1 SH: Species and habitats; 1L Landscape; 2PA: Protected areas; 2N2000: Natura 2000; 3: Genetic resources; 4: Agriculture; 5: Forests; 6: Inland waters; 7: Marine environment; 8: Infrastructures and transports; 9: Urban areas; 10: Health; 11: Energy; 12: Tourism; 13: Research and innovation; 14: Education, communication, public awareness and participation; 15: Italy and biodiversity in the world, (M. for the E. Governo Italiano, 2014)

These three examples highlight the variety in presentation and interpretation permitted by the GBF guidelines. They illustrate how different countries utilize diverse formats to communicate their progress and measurement capabilities. So far, the reports are not

harmonized displaying global trends but there are several groups working on finding ways to join data (C. on B. D. United Nations, 2021).

National/EU Strategies

The national strategies of Canada and the European Union are shaped by their unique goals, global commitments, and dedication to preserving nature. A comparative analysis is presented in Table 3, highlighting key features between Canada and the European Union. This comparison covers various aspects such as geographical size, nature-protected areas, population, population density, the number of species, and the number of endangered species. The table offers important insights into the distinct contexts that influence the development and implementation of each entity's national strategies. This comparison serves as a foundation for understanding how these diverse conditions influence the formulation and execution of their respective biodiversity strategies.

Table 3: The table compares key features of Canada and the European Union concerning size, population and nature (Cybriwsky, 2013; Encyclopædia Britannica, Inc., n.d.; E. E. A. European Union, 2022a, 2022b, 2022c; Government of Canada, 2014; C. E. S. C. C. Government of Canada, 2022; E. and C. C. Government of Canada, 2010).

	Canada	European Union
Size in mio km²	10	4
Protected land area in km²	1,300,000	770,000
Protected Sea area in km²	500,000	450,000

Population in mio	42	449
Population density in people/km²	4.2	112.25
Protected or Endangered Species #	2200	1400
Species #	80,000	123,000

Canada on the Federal Level

Canada, the second-largest country in the world, is home to over 8,000 species, with 2,253 of them classified as endangered (C. E. S. C. C. Government of Canada, 2022). Protecting nature and addressing climate change are critical priorities for the Canadian government, which is supported by several dedicated governmental bodies.

The Green Plan

In 1990, Canada introduced the Green Plan in response to the growing concerns of its citizens, outlining a set of environmental goals. These goals aligned with those of the United Nations but included a dedicated section for Native Partnerships, emphasizing the

importance of Indigenous knowledge and leadership in environmental stewardship. The primary goals related to protected areas were as follows (Government of Canada, 1990):

- Protect 12% of the country
- Maintain wildlife and plants
- Preserve the historical heritage

Since the plan's inception in 1990, Canada has continuously adapted, improved, and reformulated these goals. As of 2024, Canada now aims to protect 30% of its land and 30% of its marine areas until 2030 (E. and C. C. Government of Canada, 2018). The maintenance of wildlife and plants has become more intertwined with the protected habitats, as many endangered species rely on unique environments that are highly sensitive to disturbances. Additionally, simpler species are attracted by the safe areas, allowing conservation efforts to be concentrated and more effective in these designated zones.

Canada employs two types of designations for its land: protected areas and conserved areas (E. and C. C. Government of Canada, 2010). The country's high standard of living is largely supported by the exploitation of its vast natural resources (Canadian Environmental Advisory Council, 1991). To mitigate the environmental impact of this exploitation, Canada introduced the concept of "conserved areas." These areas have less stringent restrictions compared to protected areas and encompass all protected areas.

Conserved areas are designated for regions where resource extraction and necessary traffic are integral to ongoing business activities. The goal is to manage these areas in a way that balances economic needs with environmental protection. In contrast, protected areas are governed by stricter regulations and serve as true sanctuaries for endangered species, providing them with undisturbed or low-traffic habitats.

To combat species extinction, Canada adopts the IUCN's approach of designating specific areas to represent the biogeographic divisions of the country. These areas are intended to encompass all local species, both animals and plants. This approach ensures that at least one representative part of each region is protected and preserved for the long term, even though biodiversity continues to exist outside these designated areas.

Parks Canada

Parks Canada employs the concept of Ecological Integrity (EI) as a key measure for monitoring its national parks (P. C. A. Government of Canada, 2007, 2011). An ecosystem is considered to have EI if the living species present are those expected for the climate, and if the ecosystem functions as anticipated. This does not necessarily mean the ecosystem must function entirely independently; human intervention may be required. For instance, a park adjacent to a port may face the risk of invasive species, and preventative measures against such invasions are considered part of human support for maintaining EI.

Parks Canada developed guidelines for reporting on national parks using EI as a framework. The main goal of these guidelines is to provide a self-guidance tool centered on core values. Parks Canada recognizes that each park is unique, shaped by its biogeographical characteristics, external factors, sampling costs, and public pressure from nearby residents. These factors, along with varying public interests, such as quick transit across the park or recreational use and the preservation of historical traditions, determine the specific indicators, triggers, and methods each park uses to assess the state of nature.

Those unique situations dictate the specific indicators, triggers, and methods the park uses to identify the state of nature. Despite these differences, all parks are expected to follow a basic structure to ensure comparability of results. Comparability is essential for Parks Canada, as all reports are stored in a standardized data format within a shared database. This database has no public access, but is meant to facilitate the exchange of methods and results across Canada within the Parks.

In 2007, Parks Canada established a working group to develop metadata standards, which led to an update of the guidelines. This working group operates without a public profile and, as such, is not accessible to the public.

However, it is noted on the Parks Canada website that the framework is still under construction, particularly concerning core EI indicators.

First Nations

Canada has occupied a land that has already been populated by Indigenous groups. To acknowledge their rights, Canada signed several treaties and anchored their rights in the Constitution Act (C.-I. R. and N. A. Government of Canada, 2012; Government of Canada; Indigenous and Northern Affairs Canada, 2008). This leads to the duty to consult the First Nations whenever something might impact topics that are covered by the treaties. This includes the treatment of nature and the protected areas.

The First Nations took a leadership in protection and climate change which follows a different approach (Assembly of First Nations, 2023):

The First Nations treat climate change as an emergency that asks for urgent actions. Their Knowledge Keepers tried to attract attention to that for decades. The Elders go one step further: “We therefore insist on an immediate end to the destruction and desecration of the sacred elements of life based on the human obligation to care for the Land and for future generations.”

As they were unheard for such a long time and are still ignored by local governments, they started to act on their own and developed several strategies and declared an emergency.

The National Climate Strategy focuses on seven priorities, as shown in Figure 12. The first step is to ensure their rights and culture as it is the foundation to respond to crises. More legal power will enable them to guide actions and fulfill their role as climate leaders. This involves their participation in the formulation of new guidelines and programs.

Finally, the First Nations are within the first to be called for future emergencies, they are the first to ask and develop new solutions.



Figure 12: The First Nations formulated seven priorities to structure the approach to climate change, (Assembly of First Nations, 2023)

The First Nations find themselves in a world influenced by history and other cultures. To position themselves and climate change in it, they developed the Climate Lens, as seen in Figure 13. It consists of four circles:

The Inner Circle

The first and inner one represents the Natural Law. We should follow the Natural Law to balance how we interact with natural resources. Natural resources and more-than-human, in fact, the whole ecosystem, including us, should stay functioning and should reciprocate. Balance is the condition to keep everything in flow.

The Second Circle

The second circle represents the First Nation's worldview. The consideration is the union of Mother Earth and humans. Everything is connected and with that comes connected responsibility. Responsibility is seen as a positive value, even sacred. To respect Mother Earth offers at the same time guidance.

The Third Circle

The third circle focuses on interruptions that impacted the first two circles. Indigenous people have been ripped out of their culture and lost their connection. Those acts had consequences that continue to have serious effects which are often disregarded in climate change discussions. The loss of connection is accompanied by a different lifestyle and the attempt to regain the proper way of life. Such behaviour impacts nature in unforeseen ways and does not follow the rules of the first two cycles.

The Outer Circle

The fourth and most outer circle pairs up the Indigenous culture with the Canadian culture, specifically the legislative. The First Nations claim their rights of self-governance which includes land, territory, water and more. Both governments work together to overcome the past and build a new future together.

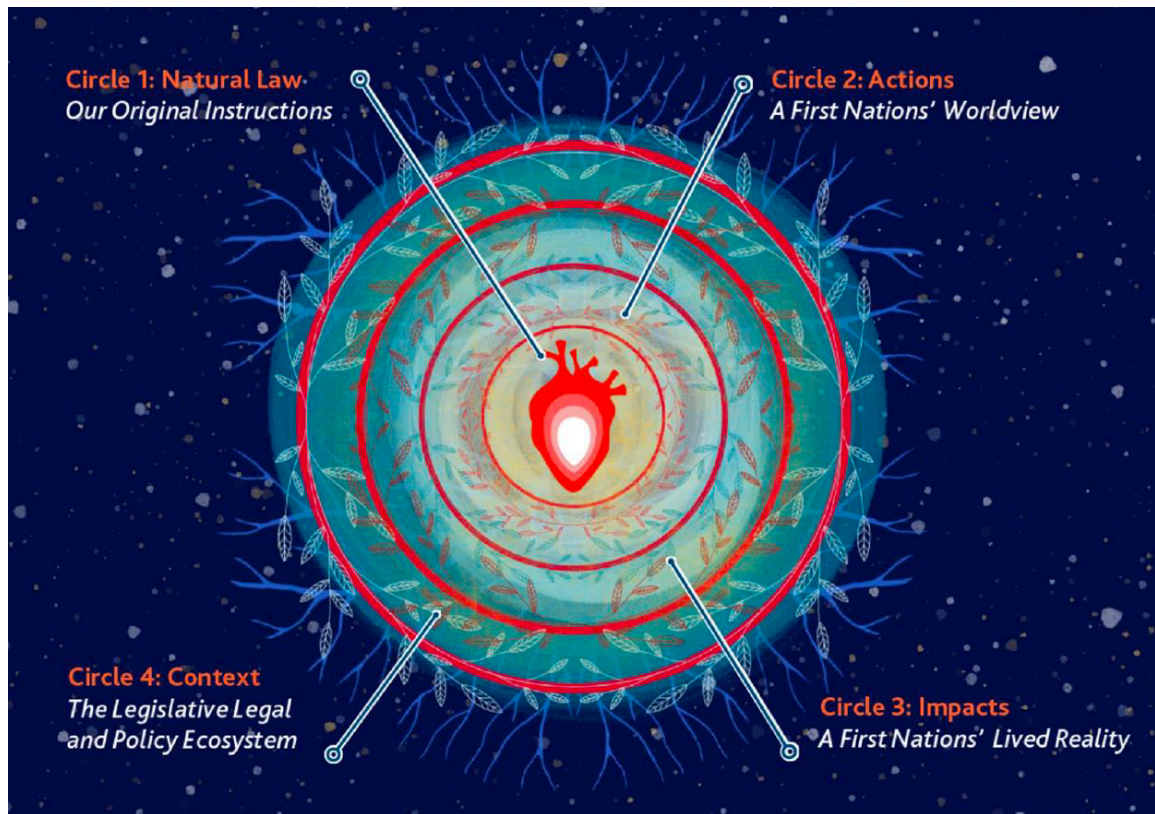


Figure 13: "First Nations Climate Lens. The visual work of the First Nations Climate Lens was curated by Atikamekw", (Assembly of First Nations, 2023; E. and C. C. Government of Canada, 2024)

EU on the Union Level

The European Union is compared to Canada just a fraction of the size but has a significant higher population. The region is densely populated, with numerous large cities, and therefore adopts a completely different approach to ensuring nature's protection.

Natura 2000

Natura 2000 is a network of protected sites within the European Union, formed through the integration of two key directives: the Birds Directive, established in 1979, and the Habitats Directive from 1992 (E. E. A. European Union, 2023a).

The Habitats Directive unified these directives to create Natura 2000, a Union-wide network of protected habitats that has been updated multiple times, including revisions to the Birds Directive (E. European Commission Climate Change, Environment, 2024b; E. E. A. European Union, 2022a)

Each member state is obligated to announce core areas, both on land and sea, favouring endangered species listed in the directives. New areas can be proposed to the Commission and must be agreed on by the community. If a member state fails to identify a core area, nominations can be made by other entities, following the standard process. Currently, the Natura 2000 network encompasses approximately 27,000 sites, covering over 1,200,000 square kilometers.

After each reporting cycle, which lasts 6 years, the EU government publishes a *State of Nature* report (E. E. A. European Union, 2020a). The most recent report, covering the 2013-2018 cycle, features numerous color-coded graphics.

One of these graphics, titled "The State of Nature Report in a Nutshell," appears at the very beginning of the report, as shown in Figure 14. This graphic shows a landscape illustration with statements corresponding to various elements of the landscape. For example, a statement next to the dolphin indicates the percentage of sea area that is part of the Natura 2000 network.

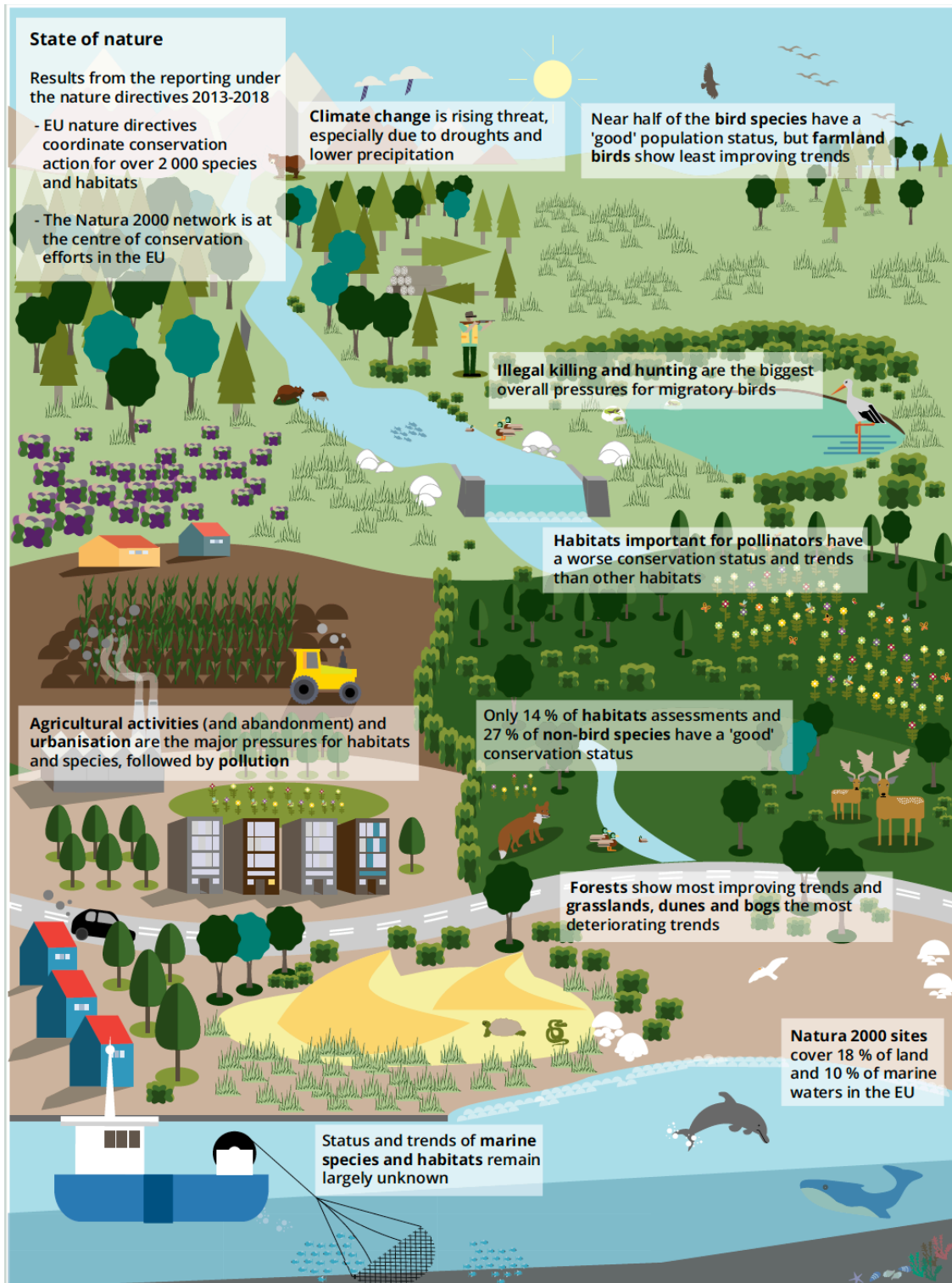


Figure 14: This is the first graphic that appears in the *State of Nature* report from the EU for the cycle 2013-2018. The graphic gives a short statement about each type of habitat or core topic that is illustrated in the background (E. E. A. European Union, 2020a).

In summary, the European Union has designated over 27,000 protected sites, encompassing more than 230 different habitats (E. European Commission Climate Change, Environment, 2024a; B. European Union, n.d.-a). It protects 26.4% of its land mass and 12.1% of the sea area. As the EU is a member of the UN, it also pursues the 17 UN Sustainable Development Goals, similar to Canada (D. of E. and S. A. United Nations, n.d.). One of these goals aims for 30% of protected areas on land and at sea, a target reflected in the EU Biodiversity Strategy, which aims to achieve this by 2030, as illustrated in Figure 15 (J. R. C. European Commission, 2023). The area of protected land has expanded by over 900,000 km² from 1993 to 2010, and further growth is needed to meet the target percentages (E. E. A. European Union, 2020a). The European Environment Agency (EEA) hosts data about Europe, including an overview of all Natura 2000 sites as shown in Figure 12 (E. E. A. European Union, 2022a).

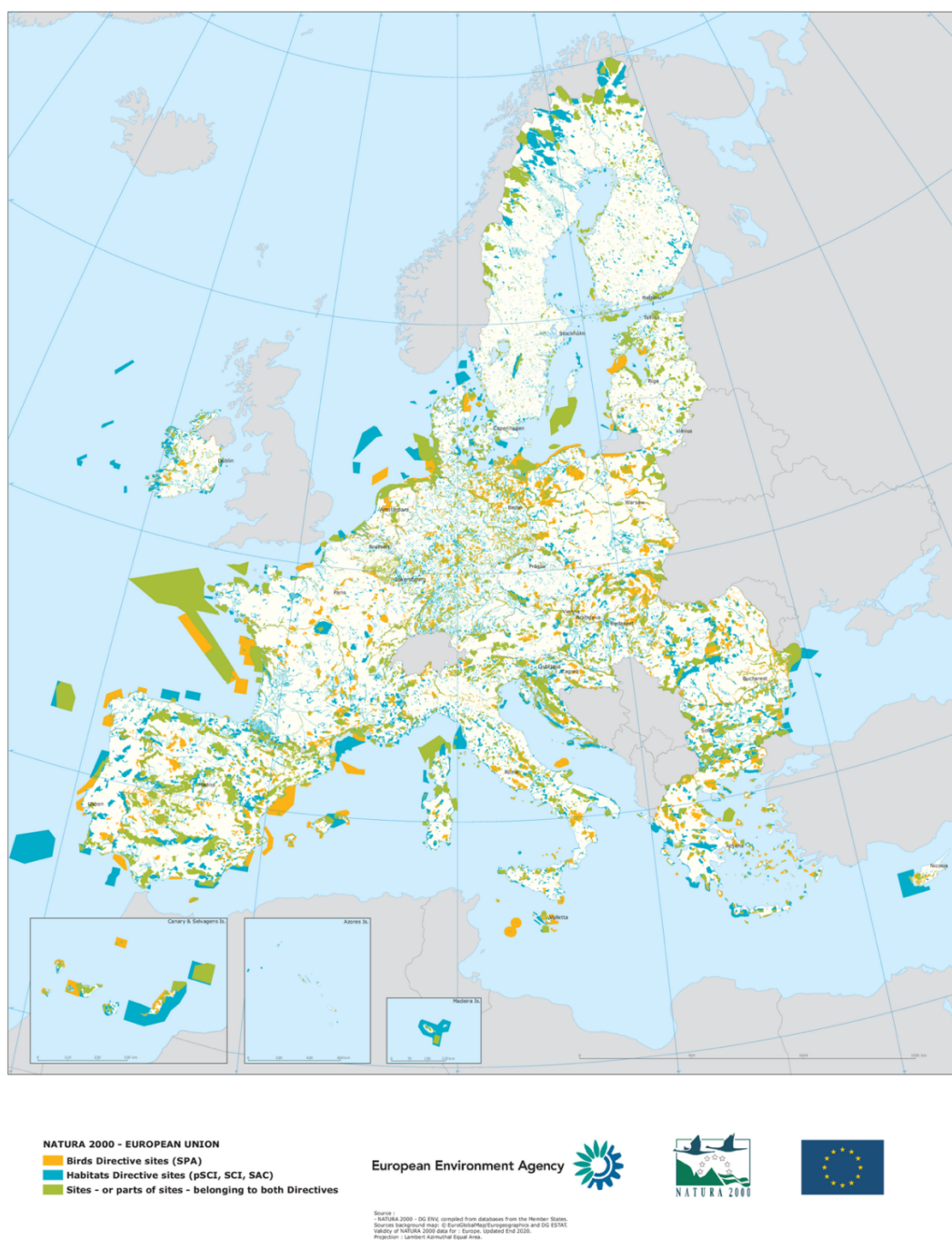


Figure 15: the map shows all Natura 2000 sites, with the sites under the Birds Directive in orange, sites under the Habitats Directive in blue and sites belonging to both directives in green (E. E. A. European Union, 2022a).

Figure 16 shows the distribution of Natura 2000 sites and sites of the Emerald network as well as other protected sites in 2024 per country (D.-G. for C. European Union, n.d.-a; E. A. European Union, n.d.-d). The Emerald Network is the pan-European network of protected sites, which includes the Natura 2000 network as the contribution from the EU-members (B. C. Council of Europe, 2023).

Several countries reached the 30% threshold for protection, a goal that has been mentioned in the GBF, as well as in national strategies; with outstanding percentages from Luxembourg and Liechtenstein, likely connected to their small size.

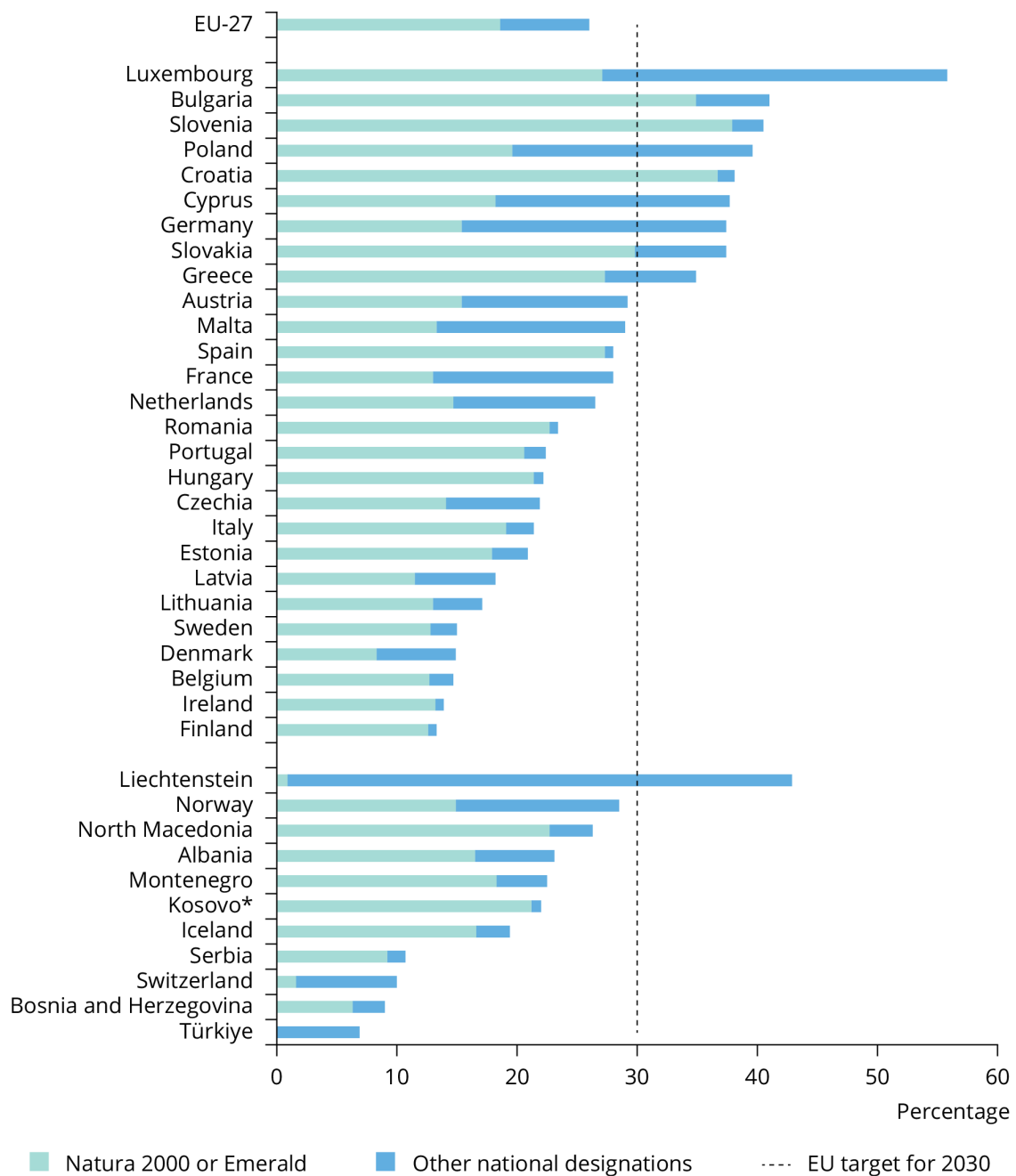


Figure 16: The graph shows the percentage of protected areas per EU-country in percentage, with the Natura2000 or Emerald areas in green and other protected areas in blue. The goal is to protect 30% of each country by 2030, (E. E. A. European Union, 2023b). The Emerald network is an equivalent of Natura 2000, including non-EU countries like Switzerland, Norway, and England (E. E. A. European Union, n.d.-d, 2024).

Comparison of the Monitoring Systems

The European Union uses Natura 2000 as main reference about the state of nature (E. E. A. European Union, 2020a). The European Environment Agency (EEA) displays the data on its website.

According to EU regulations, Natura 2000 sites and their core areas must be maintained and reported on (E. European Union, 2017). The reporting cycle lasts six years, with the next cycle concluding in 2024, meaning reports should be submitted in 2025. These reports will be presented to the community and are expected to be accessible to the public.

The data will be analyzed and transformed into various graphs, varying in detail and specificity. The EEA compiles reports from member countries to present an overview, the Natura 2000 Barometer. The EEA provides a comprehensive database filled with charts, reports, and links, which can be searched using specific keywords, making it more suited for professional use than for public access.

The *State of Nature* report provides a clear overview of the situation but lacks connections that would place the information in a broader international context (E. E. A. European Union, 2020a). Much of the data is presented as percentages, particularly in relation to the Natura 2000 network. However, the absence of concrete figures with comparable units, such as square kilometers or species abundance, limits the report's ability to be referenced alongside similar reports from other countries, making it a stand-alone document without external benchmarks.

It is important to note that this report includes data from the United Kingdom, as it covers the period 2013-2018, prior to Brexit, which was completed in 2020.

Canada chose a different approach from a strict reporting cycle for each topic (P. C. A. Government of Canada, 2011). Instead, the country left the specifics to the managers of individual areas and encouraged the collection of data based on topics rather than fixed periods. One possible reason for this flexibility could be the vastness of Canada's territory, which would be challenging to cover within a rigid time schedule.

The report Canada submitted under the UN follows a similar approach to using percentages but also provides clear units in the text and some graphs (Government of Canada, 2014). This report offers a broader context compared to the European report or the *State of Nature* report, including political issues related to nature, such as access to traditional food and connections to other organizations and their work.

Both governments have produced detailed reports that are accessible to the public and contain comparable information. However, all reports lack a comprehensive overview, such as a table with absolute figures, yet they significantly enhance understanding of each country's situation, challenges, and next steps.

Regional/National Strategies

Canada is divided into several regions, with New Brunswick being the third-largest province on the east coast. This province borders the Atlantic Ocean, resulting in diverse climate zones that range from moderate along the coast to more extreme conditions in the mountainous inland areas. Geographically, New Brunswick is about a third of the size of Italy.

Italy, situated in Mediterranean Europe, is nearly completely surrounded by the Mediterranean Sea, giving it a vast coastline and a variety of climate zones, from Mediterranean to Alpine. Both New Brunswick and Italy have designated protected areas, as listed in Table 3. These protected sites encompass various levels of protection, but they don't always align with the national definitions in Canada or those of the Natura 2000 network in the European Union.

When comparing the extent of protected areas, as shown among other features in Table 4, Italy nearly meets the GBF target, although the listed areas might not fulfill all the required conditions. The population difference between Italy and New Brunswick is significant, but more crucially, their population densities are vastly different, leading to distinct political approaches to conservation.

Italy is a key region for biodiversity, hosting a wide array of species, while New Brunswick is also renowned for its species richness within Canada. This makes both regions essential as current and future habitats. New Brunswick has a higher number of

protected species than Italy, which may indicate differing interpretations and implementations of what qualifies as "protected" in each region.

Table 4: The table compares basic data from New Brunswick and Italy, (D.-G. for C. European Union, n.d.-b; C. E. S. C. C. Government of Canada, 2022; C. Government of New Brunswick, 2010, 2024a; I. N. di S. Governo Italiano, 2020; I. S. per la P. e la R. A. Governo Italiano, 2023)

	New Brunswick	Italy
Size in km²	73,000	300,000
Protected area in km²	8220	104,500
Protected area in %	10	32.9
Population	750,000	59 mio
Population density in people/km²	10.17	201.3
Protected Species #	8000	637
Species #	30,000	134,000

New Brunswick

New Brunswick is one of the smaller regions in Canada, yet its species density is the third highest (C. E. S. C. C. Government of Canada, 2022). The province hosts over

30,000 species, with around 13,000 of them having been assessed so far. Of those assessed, nearly 8,000 species are currently endangered (C. E. S. C. C. Government of Canada, 2022; C. Government of New Brunswick, 2024a).

New Brunswick's plans to preserve biodiversity are fairly new, as they had not yet been developed in 2009 (Government of New Brunswick, 2009). The provincial government declared the Protected Natural Areas Act in 2003, which defines two classes of protected areas (C. Government of New Brunswick, 2003):

Class I areas are strictly off-limits to the public, functioning as set-asides with the highest level of protection.

Class II areas, while still shielded from industrial and resource-based activities, permit public access and visitation.

Figure 17 provides an overview of New Brunswick, highlighting the distribution of these protected areas. Collectively, they span 1,500 square kilometers. At first glance, it may appear that there are no Class I areas; however, six such areas do exist (C. Government of New Brunswick, 2011). The 196 Class II areas are more widely distributed, and together, both classes account for 10% of the region's land area (C. Government of New Brunswick, n.d.-b).

Comparing the size of classified protected areas to the total protected areas reveals several thousand square kilometers unaccounted for. These remaining areas may fall under federal protection or include sites like the Fundy Biosphere, which, while protected, does not receive the same stringent safeguarding as Class I or II areas.

As part of Canada's commitment to the GBF, New Brunswick has pledged to protect an additional 20% of its natural areas by 2030. This commitment includes an equal percentage of protection for both terrestrial and marine environments.

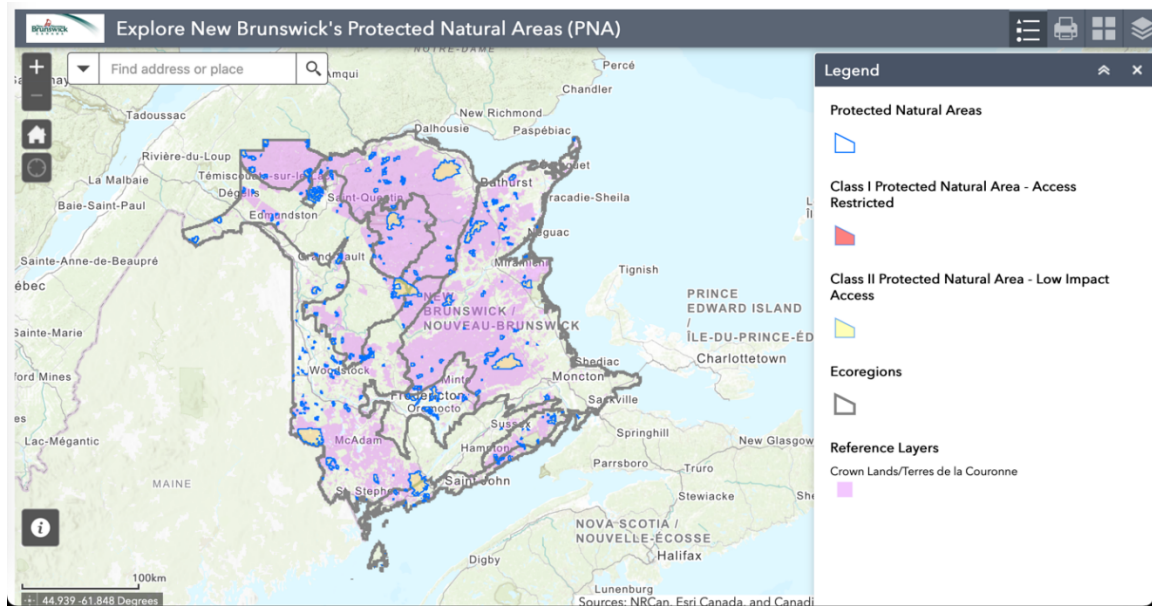


Figure 17: The map shows New Brunswick, with its Crown Land in purple and protected areas surrounded by a blue border (C. Government of New Brunswick, n.d.-a).

Classifying 10% as protected is a sharp contrast to the Italian 32%. The reason for that could be that New Brunswick follows a stricter approach and only classifies areas under strict protection whereas Italy counts all areas even with low protection.

New Brunswick's approach reflects a more stringent criterion, classifying only those areas under strict protection. Plus, New Brunswick only values the regional protected areas, excluding national protected areas, a fact that is misleading concerning the real size of protected areas. In contrast, Italy's higher percentage includes all areas designated as

protected, regardless of the level of protection. This distinction highlights the variations in how protection levels are defined and reported in different regions.

The government of New Brunswick does not currently provide a comprehensive report on the status of its biodiversity apart from a listing of ten specific animals from the report of Committee on the Status of Species at Risk, which is cited in Table 5 (C.

Government of New Brunswick, 2021; NB Department of Natural Resources and Energy Development, 2024). The committee on the Status of Species at Risk must report on an annual basis. The list of endangered species reported may appear in sharp contrast to contrast with the actual number of 8000 of protected species in Canada. This discrepancy may appear thanks to the monitoring guidelines established by the federal government, which allow for longer reporting cycles and may affect how current data on endangered species is reflected in the reports.

There is no centralized databank summarizing biodiversity results. Citizens have the option to report their observations of species to the Public Registry or the Atlantic Canada Conservation Centre (D. of N. R. Government of New Brunswick, n.d.). The Atlantic Canada Conservation Centre only provides its data to individuals who meet specific criteria or legal rights, offering information on species abundance and sightings to those who qualify.

Table 5: The animals assessed in 2023 by the Committee on the Status of Species at Risk (New Brunswick). The list includes animals as well as plants and shows an alarming trend for most species, whereas the ranking of the classifications remains unclear as the report lacks a legend, (NB Department of Natural Resources and Energy Development, 2024)

Species Name	Previous Classification	New Classification
Wolverine	Extirpated	Extirpated
Eastern Wolf	Extirpated	Extirpated
Canada Lynx	Endangered	Special Concern
Anticosti Aster	Endangered	Special Concern
Cobblestone Tiger Beetle	Endangered	Special Concern
Eastern Waterfan	No classification	Threatened
Furbish's Lousewort	Endangered	Endangered
Eastern Painted Turtle	No classification	Special concern
Skillet Clubtail	Endangered	Data Deficient
Black-foam Lichen	No classification	Endangered

Wolastoqey Nation in New Brunswick

The Wolastoqey is an aboriginal tribe that lives in New Brunswick. According to the First Nation Climate Strategy, they should fulfil a leadership in the local actions for climate change.

An interview with a Wolastoqiyik member, who wishes to remain anonymous, added further complexity to the topic (*Interview with a Wolastoqiyik*, personal communication, August 2024).

The Wolastoqiyik should, following the First Nation Climate Strategy, have a monitoring plan for New Brunswick. This is not the case, as the tribe lacks land to monitor. The population has been diminished to the point that they occupy only 0.02% of their traditional territory. Their members have been excluded from the decision process and are still excluded.

In fact, New Brunswick currently faces the tribe in the court system, in the context of "The Wolastoqey Aboriginal Title Claim". The Wolastoqiyik claim about 60% of New Brunswick's area as their territory.

Apart from that is the community open for cooperation and recently started several projects and partnerships.

The first step should be to enhance the monitoring by distancing from the idea of numbers defining limits, thresholds, and minimum viable populations. This way of monitoring does not reflect their beliefs. It is necessary to identify the natural state and

use it as a base for new criteria and indicators. The aim is to correct for shifting baseline syndrome.

The Wolastoqiyik are currently locked in legal battles, fighting for essential needs, unable to gain the strength needed to fulfill their duties even if they wanted to and were prepared to do so.

The nation feels unheard by the authorities but supported by friends.

The First Nations Climate Strategy demands to be informed with high priority about any incidents. According to the Wolastoqiyik, any relevance is decided above their heads and gives an impression of dishonesty.

In summary, the Wolastoqiyik do not feel valued in New Brunswick and are unable to fulfill their duty to the land, due to personal issues and due to the lack of cooperation from the New Brunswick government. This is not a state of coexistence Canada can perpetuate in the future.

Italy

Italy is more densely populated than New Brunswick, with highly concentrated urban areas such as Rome, Milan, and Naples. Despite this, Italy is recognized as a key advocate for biodiversity thanks to its rich variety of species (I. S. per la P. e la R. A. Governo Italiano, n.d.).

Italy is part of the Natura 2000 network and has implemented specific national and regional regulations to protect additional areas. Additionally, Italy signed the Landscape Contract, which requires the identification of areas dedicated to this initiative (T. O. Council of Europe, n.d.). These landscape areas receive a certain level of protection and may overlap with Natura 2000 sites, though they do not fall under the highest IUCN standard of protected areas. This is similar to Canada's conserved area system, which also permits resource extraction. The goal of the Landscape Contract is to foster a peaceful coexistence between human culture and nature while preserving landscapes formed by human activity.

Italy has designated 2,600 protected sites as part of the Natura 2000 network, shown in Figure 18 (B. European Union, n.d.-b) and approximately 900 national protected sites, some of which may overlap with Natura 2000 areas (I. S. per la P. e la R. A. Governo Italiano, 2023).

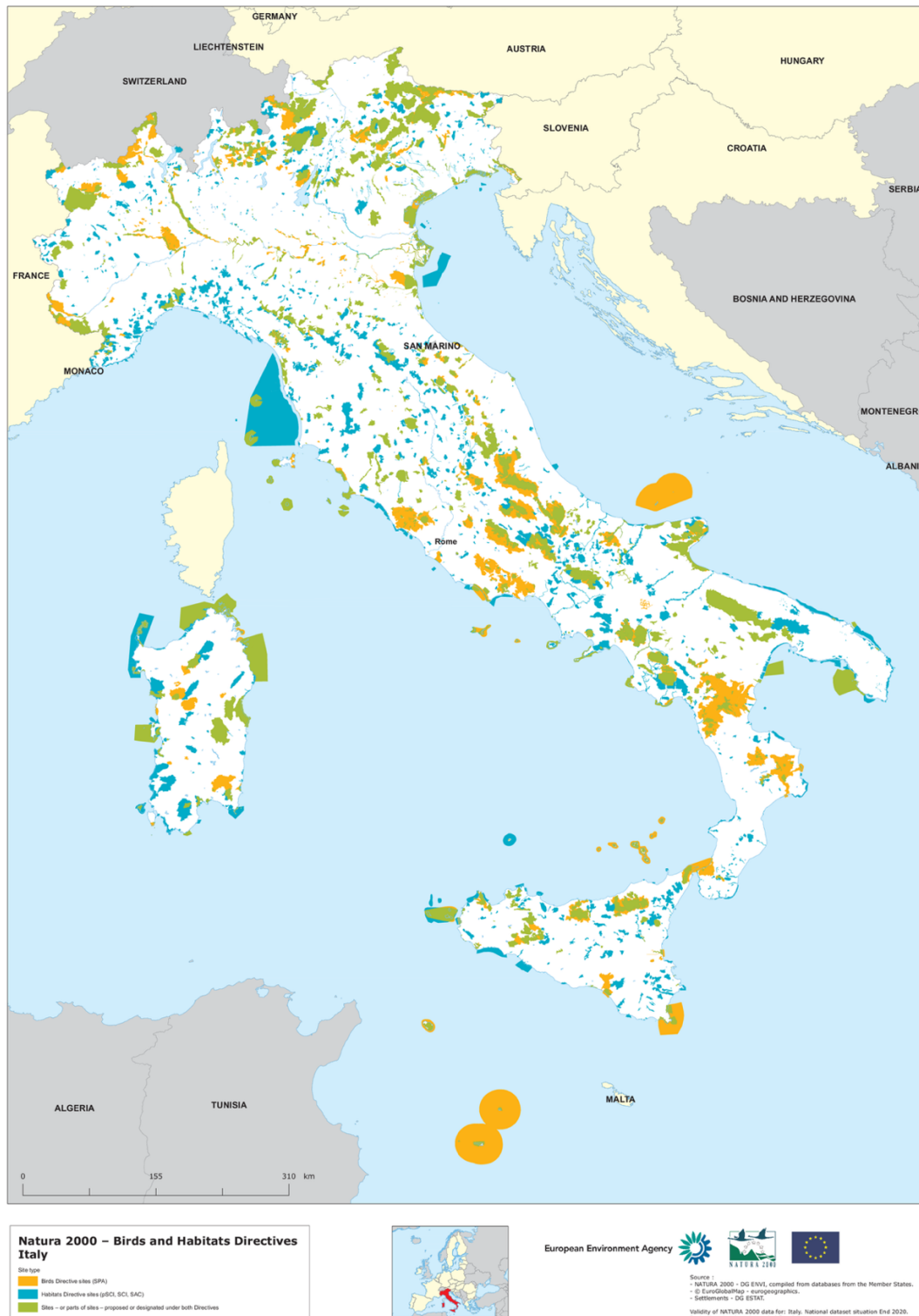


Figure 18: This map shows all Italian Natura 2000 sites, with the sites under the Bird Directive in orange, sites under the habitats Directive in blue, and sites under proposal in green, (E. E. A. European Union, n.d.-f)

Italy is currently far from reaching the 30% protection threshold within the Natura 2000 network (as seen in Figure 16), which is concerning given Italy's status as a key biodiversity area due to its rich variety of species (I. S. per la P. e la R. A. Governo Italiano, n.d.). Referring to the Italian government, Italy already protects 32% of its area which is above the threshold. The discrepancy between those numbers arises in the definition of "protected area." The Italian standards seem to be less stringent than the standards of the Natura 2000 network, leading to a broader classification of protected areas.

As explained in the report *Ambiente in Italia*, the 32% figure is a combined total of protected terrestrial and marine areas, as illustrated in Figure 19.

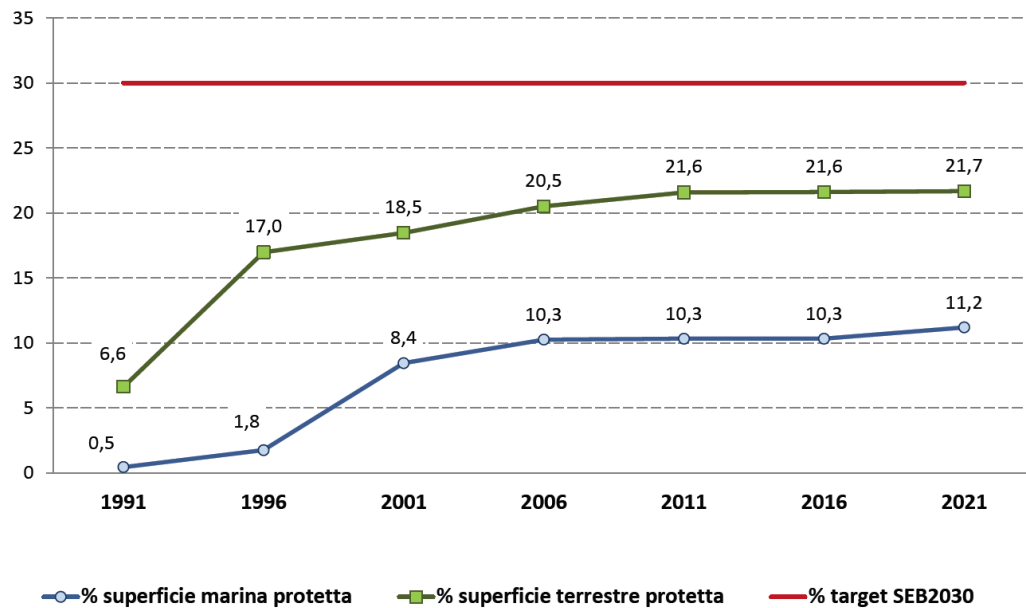


Figure 19: The graph shows the growth of protected areas in Italy in percent over the time period from 1991 to 2021, the blue line represents marine areas, the green line terrestrial

areas and the red line is the target of 30% that should be reached with both lines (I. S. per la P. e la R. A. Governo Italiano, n.d.)

Comparison of the Monitoring Systems

Italy is committed to reporting to the Natura 2000 network on the status of its protected sites in a 6-year cycle. On top of that, Italy's Higher Institute for Protection and for Environmental Protection and Research (Istituto Superiore per la Protezione e la Ricerca Ambientale, or ISPRA) produces an annual report on various environmental topics, including the state of nature, pollution, tourism, traffic, and more (I. S. per la P. e la R. A. Governo Italiano, n.d.). Additional reports about details of the system are available, such as reports about water quality or air pollution (W. European Union, n.d.-g).

Some of these reports are published in English, while others are in Italian. All reports feature graphs, abstracts and summaries. As Italy is part of the European Union, these reports include comparative details that place Italy's data in a broader European context, enhancing comparability. Since the reports are sometimes interconnected and sometimes not, comparisons can be challenging. This is due to inconsistencies in units of measurement or gaps in essential information across different reports. Despite these challenges, Italy provides a wealth of information, increasing the likelihood of finding matching data for meaningful analysis.

New Brunswick provides a single public report on biodiversity, issued by the Committee on the Status of Species at Risk. This report is six pages long, including the title page,

and lacks any graphs. While the regional government may produce additional reports on specific areas, such as the *State of the Forest* report, these often focus on economic aspects rather than biodiversity (D. of N. R. and E. D. Government of New Brunswick, 2023b, 2023a). The *State of the Forest* report, for example, centers more on the economic value of forestry and the distribution of tree species, rather than on biodiversity.

Sustainable Forestry is mentioned, but lacks broader information and details. The newest report from 2023, the Forest Management Strategy, promises an annual report and an online map about forest activities concerning Crown Land and expresses the willingness to respect the First Nations and their rights.

Other environmental information is not accessible to the public, and requests for access can only be made by qualified individuals.

In contrast to Italy, New Brunswick is not a formal state but a province within Canada. Although it has its own government, New Brunswick relies heavily on the Pan-Canadian structure for environmental governance. This is similar to the regions in Italy, which must adhere to national guidelines. While Italy's regions operate within the framework of national and EU regulations, New Brunswick aligns its environmental efforts with broader national strategies set by the Canadian federal government.

National Parks

Fundy Park and Stelvio Park are both classified under the IUCN Category II, designating them as national parks with protected status. These parks are open to the public, but with strict regulations to preserve their natural environments. Human activities within these parks are guided by established infrastructure and a set of rules.

Fundy Park

- **Camping:** Several designated camping sites are available, and camping is only allowed within these areas (P. C. A. Government of Canada, 2022b).
- **Activities:** Visitors can enjoy activities like canoeing, swimming, and mountain biking, but each activity is restricted to specific areas or trails

Stelvio Park

- **Community Living:** Unlike Fundy Park, Stelvio Park is home to residents living within its boundaries (U. per il P. N. dello S. Governo Italiano, n.d.-a, n.d.-b). Building new houses within the park is tightly controlled, requiring permission, and is generally discouraged to maintain a stable human footprint.
- **Activities:** Similar to Fundy Park, Stelvio Park offers holiday activities, all regulated to specific locations within the park.

- Cultural Preservation: The park features several museums dedicated to showcasing the history and biodiversity of the area (U. per il P. N. dello S. Governo Italiano, n.d.-c).

National Parks in the category IUCN II are usually open to the public. The primary objective is to educate visitors and foster a connection with nature while offering recreational opportunities that do not harm the environment. Education is a key focus, often delivered through infographics, interactive exhibits, and museums that provide information about the local flora and fauna.

While these parks are typically accessible, there are circumstances under which they may be temporarily closed:

- Environmental Recovery: In the event of a natural disaster, the park may be closed to allow the ecosystem to recover without human interference or if the area becomes too dangerous for visitors.
- Wildlife Protection: Temporary closures might also occur during sensitive periods such as bird nesting seasons, when quiet and undisturbed environments are crucial for breeding.
- Visitor Safety: The park could be closed to protect visitors from potential dangers, such as the presence of harmful species like the oak processionary moth (*Thaumetopoea processione*), whose poisonous hairs can pose a health risk.

Table 5 presents an overview of the main features of both parks. Stelvio Park is notably larger, being more than six times the size of Fundy Park. Both Parks host protected species, though the number of species remains uncertain, as they tend to highlight larger

animals without providing a complete overview of all species. While Fundy Park has controlled access and tracks visitor numbers, Stelvio Park does not charge an entrance fee and is open to the public, making it difficult to estimate how many people visit each year. In contrast to Fundy Park, Stelvio has inhabitants who live permanently inside the protected area. Both Parks were established around the same time, so that both conservation measures had a similar timeframe to develop.

Table 5: The table compares the profiles of Fundy Park and Stelvio Park, (B. European Union, 2021; E. E. A. European Union, n.d.-e; P. C. A. Government of Canada, 2022a, 2024; A. für den N. S. Governo Italiano, n.d.; U. per il P. N. dello S. Governo Italiano, n.d.-a)

	Fundy Park	Stelvio Park
Size in km²	207	1307
Species #	315+	116+
# visitors/year	300,000	unknown
inhabitants	0	64,000
established in	1948	1935

Fundy National Park

Fundy National Park adheres to the monitoring guidelines (EI-guidelines) guidelines that all Canadian national parks are required to follow (P. C. A. Government of Canada,

2011). The monitoring process is extensive and can span several years, depending on the species being observed. While the guidelines provide a framework, each national park, including Fundy, has the flexibility to interpret and apply them as necessary to fulfill their mission of safeguarding and monitoring Canada's biodiversity.

An Interview with Sarah Van de Reep, an employee at Fundy Park, offered some insights concerning the criteria for comparison (S. Van de Reep, personal communication, August 2024):

About the Ease of Use in the Field:

"Depending on the measure, specific site location and more, data collection can be extremely straightforward and easy to highly complex or laborious. "

As Fundy Park consists of different geographical zones, it can be challenging to reach measuring points or tiring to fulfill. The staff relies on technical solutions for all kinds of measurements, from permanently installed devices as well as a helicopter.

Thanks to the freedom the EI-guidelines offer, Fundy Park can take several years to collect data, depending upon costs and behaviour of the species.

" There [are] unique challenges to data collection for most measures."

About Simplicity and Understandability:

The EI-guidelines leave some room for interpretation, as it is needed to provide a guideline for such a diverse and vast country as Canada. To implement a monitoring system based on the guidelines for a specific area can be challenging.

Fundy Park employs an Ecological Monitoring team, consisting of 4 people, to tackle this exercise. The team has to coordinate and interact about several decisions, such as conducting field work, site locations, thresholds and additional optional information.

So yes, it needs a team to fulfill the expectations and experts to understand the requested measurements.

About Presentation of the data in an understandable and intuitive manner:

The results of each report should be implemented in the ICE-system, a databank that connects all national parks and provides insides into each park, a platform for comparison and progress. The ICE-system is not available to the public.

Sarah Van de Reep is quite confident with the ICE system. According to her, it is easy to use, easy to understand and displays the state of each park at first glance.

Such a simplification of data sacrifices on the context. The way the data is compressed into a simple overview lacks context and lacks weighing each component according to its importance for each park. Some details in the colour-coded system might lead to a misinterpretation.

"This simplicity is also its downside, as it fundamentally over-generalizes entire ecosystems into trends and statuses."

Fundy National Park of Canada

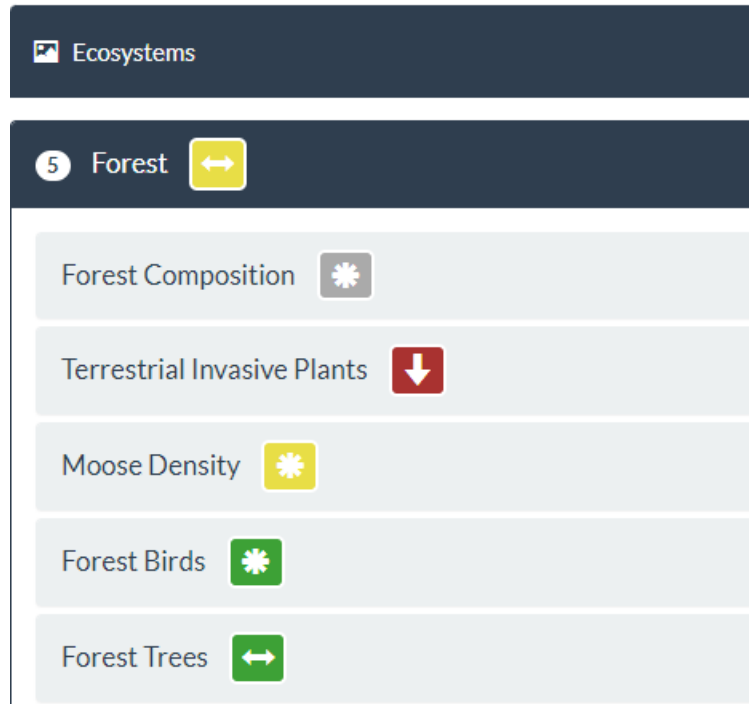


Figure 20: The screenshot shows a detail of the ICE entry of Fundy Park. The overall status of the Forest does not represent properly the status of the trees, but is falsified by other measurements which are not weighted according to their importance. (S. Van de Reep, personal communication, August 2024)

Figure 20 shows an example of such a misleading colour-code. The overall status of the forest in Figure 17 is marked in yellow (fair) which does not represent the status of trees (green = good), but is affected by the 4 other measurements.

About Ease of Maintenance and Adaption:

The monitoring framework that Canada uses is open to changes. If the protected area changes, so must its measurements. In order to change them, the park has to

contact the national office ecological team to align it with the purpose of the initiative.

" Of course, the goal of most ecological monitoring is creating a long-term dataset to detect change, so decisions to add/remove/replace measures are not taken lightly."

About enhancing the monitoring system:

The ICE-system is, as demonstrated in Figure 17, unweighted. As each park has unique features, it would be useful to adapt the system according to the importance of each measurement. Such an implementation needs quantification, which seems to be a barrier.

"I personally think the way the monitoring program and reporting is structured gives it more influence on the forest ecosystem than exists in reality."

Overall seems the monitoring system to satisfy the expectations of the experts. There is still room for improvement as well as the publication of the reports to the public.

Stelvio Park - Parco Nazionale dello Stelvio - Nationalpark Stilfserjoch

Stelvio Park lies in several municipalities, who have to work together to form this national park. One part of the park lies in South Tyrol. The park itself will report to the

government about its total area, but here is the focus on Natura 2000 in south Tyrol. This part of the park contains six Natura 2000 sites, three of which double as sites of the Birds Directive. As the main language in South Tyrol is German, the original interview and the report for Natura 2000 is in German and any citations have been translated by the author.

The report for Natura 2000 is an interlocking document of official regulations that are cited to put the report into context and the list of habitats or species to be reported on.

The complete report is in written form, lacks graphs or colour-coding but uses an acronym to describe the status of each topic.

At first glance, the report does not reveal the status of the park. To gain any insight about that, the user has to read the text. The text, on the other hand, offers a full picture and describes not only the status but also the next goal for each habitat.

To understand more about the difficulties Stelvio Park has to face, the author asked for an interview (S. Winkler, personal communication, August 2024). The answers revealed the following:

About Ease of Use in the Field and Simplicity in Completing Survey:

Stelvio Park uses technologies and adequate measurements for each species. To enhance education, the park opens its door to universities and their students and relies on their help to complete the monitoring. Social Media, in this case iNaturalist is another tool for Stelvio to complete the surveys, the idea is to appeal to the public to detect biodiversity. iNaturalist is an app for mobile phones and a

website that identifies species by photos. The community has to agree three times before a picture is certified as a certain species.

About Ease of Maintenance and Adaption:

Similar to Fundy Park is Stelvio Park obligated to contact higher entities if any changes to the measurements should be made. The form of the report (art. 17 of the Habitats Directive) gives a rigid structure, stricter than the EI-guidelines for Canadian national parks, that can not be changed without appropriate reasoning.

The monitoring process of Stevio Park is still under maintenance and the park strives to be better in multiple ways at the same.

"This is a duty that will keep us busy over the next years."



Figure 21: Renato grassi, Bartgeier, bearded vulture. This bird is the success of a cooperation between three countries: Italy, Austria, and Switzerland. The species has successfully reintroduced to Stelvio Park and its surroundings. (Platter & Governo Italiano, 2019)

Stelvio Park is especially proud to host a bird species that has been extincted in the Alps, the bearded vulture (*Gypaetus barbatus*), as shown in Figure 21, (Platter & Governo Italiano, 2019). To revive that species, three countries (Italy, Austria and Switzerland) had to cooperate and guarantee for the safety of its habitats. The bearded vulture is mentioned in the Natura 2000 report. The project has been a success so far.

Comparison of the Monitoring Systems

Table 7 compares basic facts from Fundy Park and Stelvio Park and in addition a keyword for each category of the criteria for comparison.

	Fundy Park	Stelvio Park
Reporting Cycle in years	1	6
Grading	good/fair/poor	written text
Public Access	none	differs
Ease of Use in the Field	complex	complex
Simplicity in Completing Surveys	complex	complex
Understandability	complex	complex
Presentation of the Data	colour-coded	written
Ease of Maintenance and Adaption	difficult	difficult

Parks Canada asks for annual reports, with possible variance in less populated and used regions, such as the Northern Territories. The guidelines offer an orientation about the

colour-coding that should be used and how to implement the accompanying thresholds on the data.

The Italian report has a specific format, following the guidelines of Article 17 of the Habitats Directive which dictates the content and the order of the topics (E. European Union, n.d.-c). The report asks, among other things, for a list of habitats, the condition of the habitat and the next measurements. The complete report is in written form, no colour code, the freedom of writing applies to every descriptive part. The reports are due every 6 years with the next due date in 2025.

Both monitoring systems follow national/union wide guidelines that force them to present the data in a certain way. For Canada that means a colour-coded overview that loses a certain amount of context and detail; for Italy and Natura 2000, the results are only in written form, but rich in details.

Canada does not allow the public to access the reports, whereas Stelvio Park reports to the Italian government, and is accessible, and Natura 2000 which should also be accessible, but the specific website has been down during the duration of this report. Stelvio Park was so kind to send the report after request. As long as it remains unclear whether the European Union allows the download of the reports, it is the individual decision of the parks to send the report out or not.

The Ease of Use in the field seems to depend on the monitored species or measurement. Both parks use technologies such as apps on the phone to support the collection of data. It

seems to be a lengthy process to find all the necessary data. Fundy Park uses the tolerance of its guidelines to concede several years to it if necessary. Stelvio Park instead is forced to deliver a judgement every six years. If Stelvio Park is unable to gather the data within one cycle, there is still the option to mark the relevant entry as uncertain due to the lack of data. The guidelines of the Habitats Directive are strict, so that such a statement must be reasoned within a certain time.

Both areas contain difficult to access areas, and similar difficult species, so that the measurements themselves are equally difficult. These make completing a survey a challenge for both parks.

Each survey requires experts who know how to interpret the measurements and the data.

The presentation of the reports has several levels. The colour-coded ICE-system that the Canadian National Parks use offer an immediate but potentially misleading impression. The written report for Natura 2000 sites lacks any graphs or colours but offers a real insight in the status and problems of each protected site.

Both parks rely on experts and further experience to fulfill their duty and deliver future reports.

Conclusion

Overall Impression

This report has examined the hierarchical structure of biodiversity monitoring, starting at the global level, which relies on national efforts in Canada and the European Union, and narrowing down to the regional level for New Brunswick and the national level for Italy, ultimately focusing on specific aspects within National Parks. At each level, authorities have established reporting requirements and implemented monitoring systems to track biodiversity.

A vast number of people contribute to this process, developing metadata, regulations, measurements, and other details to ensure continuous monitoring of the planet's biodiversity. Despite the complexity, there are ongoing efforts to coordinate and harmonize data across all levels.

Key Differences in Strategies

Canada and Europe employ different strategies for safeguarding biodiversity.

In Europe, the approach begins with identifying endangered or desired species. Protected areas are then established wherever these species are found, comparable to class III

monuments or class IV species/habitat in the IUCN classification. The next logical step is to ensure the protection of these specific habitats.

Canada starts with selecting sites and focuses on offering or regenerating habitats within these areas. While the presence of species is monitored, the approach also emphasizes bioregional specifications. This strategy allows for larger areas to be dedicated to conservation, supporting biodiversity within extensive tracts of land.

Each approach has its advantages. Europe's method ensures the survival of specific species through targeted protection, while Canada's strategy involves setting aside large areas for conservation, concentrating biodiversity within these zones. The differing motives behind these strategies may relate to population density: Europe's high population density makes it challenging to dedicate large areas for conservation, leading to a pattern of smaller, interconnected protected areas. In contrast, Canada's lower population density allows for the allocation of vast areas to nature, where ecosystems can develop more freely. Canadian conservation efforts also rely on sustainable resource management and other protective regulations rather than a grid of protected areas.

The reports for each country seem to be similar in content, but public interaction is opposite.

Canada dictates the whole setup for measurements, indicators, and thresholds within its national parks. It even asks for a colour code. But the whole report is closed, allowing no access for the public, nor even for universities. Canada's government offers some general data about their environment but nothing specific for their parks.

Europe relies on the skills of its foresters and park managers. Each report follows a strict setting but there is no colour code, and the development of each threshold, indicator and measurement lies in the hands of the local responsible person. The reports are uploaded to a European Union databank. The EU government offers extensive access to data on other websites, including detailed information per country; however, the reports themselves are not available.

The European Environment Agency edits the data, concatenating the information to create an overview. The Italian report cited was sent to the author upon a personal request.

The procedure for gathering information on Stelvio Park is quite the opposite to the Canadian approach. Stelvio Park invites universities and students, it even prompts the public and the internet-community to participate in the monitoring. This is the most public approach imaginable.

The benefits of this approach are in the public interest. Stelvio Park combines education with work. Both parties benefit from their collaboration and public interest in protecting the area will increase as people tend to value that which they participate in. Participating in Stelvio Park means building a connection with it. The more valuable and successful each participant feels, the more connected is the person to the project.

In contrast to that Canada offers far less public participation. Parks in Canada, national or regional, are not free to enter. New Brunswick recently offered free cards to access their regional parks (C. Government of New Brunswick, 2024b). Parks Canada runs a program for new residents and offers free cards as well. Sponsoring such events seems somewhat contradictory.

As Canada keeps the reports a secret, the public has little idea of how well biodiversity is developing even in their local area. The data on the governmental website for the pan-Canadian biodiversity is limited compared to the data richness of the European Environment Agency.

However, the European Environment Agency focuses on its successes; there is no mention of a species loss on the website.

Future Cooperation

Both countries' monitoring systems offer connection points, such as online databases or comparable forms, where other systems could be integrated. Given that most parties already have extensively developed systems, there is a strong potential for identifying commonalities that can serve as starting points for collaboration.

Recommendations

The idea of protected areas potentially delivers a false sense of protection. While claiming an area as a nature reserve, no matter if it is highly protected or not, it also means at the same time that there are boundaries. Beyond the boundaries, human activity continues to destroy biodiversity and environmental integrity.

Protecting certain areas is valuable, but one step beyond such zones, nature is treated as not worth protecting (depending on the local basic protection rules).

Integrating the local inhabitants or visitors in the monitoring is a way to raise awareness. The more people who understand what biodiversity is, the more monitored it will be.

Canada

As Canada is the second largest country in the world, it is difficult to find an approach common to all provinces and territories. Canada adopted a prudent approach in allowing leeway for interpretation of their guidelines.

The governmental website representing the data is, compared to the European site, relatively incomplete. This creates the impression of disregarding citizens by not revealing what is the current state of Canada's nature. The data pool should be increased drastically.

The results of the provinces should be collected there as well. As far as I understood, the guidelines apply only to federal areas. The provinces have the freedom to create their own standards.

For a topic as important as saving the future, this is not appropriate. Nature protection and accompanying guidelines should be streamlined, organized, and controlled by the federal government.

Moreover, transparency is key to cooperation; all results should be accessible to the public.

New Brunswick

New Brunswick decided to set a low priority on preserving the natural environment. The government, the universities, and even the primary schools are dominated by the industry. UNB has a building, sponsored by one of the biggest lumber producers of the province; the same sponsor is allowed to present lectures in Forestry at the universities; even more, the company is invited to do so. Other forestry companies are similarly invited to make presentations. The local public primary school has a partnership with a supermarket. Schools in New Brunswick are officially free, but the freedom ends when parents have to pay an annual fee and again, there is a lack of transparency. A government-funded school should be free of industrial sponsors. The university, providing knowledge and education, should remain neutral instead of teaming up with a biased company.

The government of New Brunswick is said to be influenced by the same company, as many members of the government have worked for it before. This is a common problem all over the world. But nonetheless it should be acknowledged and prevented wherever possible.

Dividing governmental responsibilities appropriately is the basic step to prevent abuse. Currently several ministers are responsible for two or more different departments. A structure like this invites conflicts and self-contradictions and makes the system vulnerable to manipulation. In fact, it is surprising to see such a cavalier approach in operation. Dividing power and maintaining neutrality are basic principles.

I strongly recommend the appointment of more ministers and curtailing the role of industry in education. Every aspect of education should be financed solely by the government. Independence from industry is vital to unbiased development.

First Nations

The treatment of the First Nations here is inappropriate for a developed country. Canada is in the middle of restitution for its past mistakes, still fighting old practices and it seems to have lost its orientation during the process. An external review could be of use, as every Canadian seems to be very moved by the topic, in one way or another.

The First Nations lack of an effective political structure; the settlers in their own political structure have failed to include First Nations. Progress is slow and painful.

Their point of view should be included in the monitoring, as fundamental as they claim.

European Union

The European Union took some promising steps with the two directives, but missed the call to update them. The Birds Directive was a great idea at that time; the Habitats Directive was an even better one. It is time to eliminate the Birds Directive as it only complicates monitoring. Foresters and employees are lost in regulations when it comes to identifying the sites and following the corresponding rules. The Habitats Directive already contains some references to the Birds Directive or even includes it indirectly but still, they remain two different directives. The Birds Directive should be incorporated within the Habitats Directive as soon as possible.

Apart from the structure, which is great in my opinion, the data presentation is overwhelming and mainly unorganized. The EEA and every other department that is touched by the topic should provide a fuller overview, as the current version lacks some basic information. Organizing the data in categories instead of a long open list, that is sorted by the date it has been published, would be easier to search through. The search algorithm is too focused on details, but copying the internet's most used search engine is too complicated, and relying on it directly again makes the public vulnerable to private interests. Categories as filters provide ease of use here.

Italy

Italy has an overwhelming amount of data and a remarkable motivation to protect its nature that should be honored. ISPRA is the coordinating institution for Italy's guidelines. Italy as well as Canada is divided into regions and like Canada, the European government has different rules, comparable to the federal government in Canada, the presence of different regulations and guidelines is confusing. Streamlining this will make it easier for all employees, regardless of their level. The reports ISPRA collects on its website are not only from governmental institutions but also from other independent organizations. Their reports do not always adhere to the guidelines perfectly, as they cannot always afford to fund high quality monitoring and sampling. Similar to Canada, a streamlined guideline would benefit all, as well as sponsoring some of the monitoring to enhance the quality. Sponsoring is not restricted to money, but a useful addition could be sharing of instruments, donating used instruments, and providing expertise, free of charge. Cooperation is key. Money will always remain an issue as every matter might consume an endless amount of it, as there is always room for improvement.

As Italy is aware of other environmental issue that do not show up on the guidelines of the protected areas, such as flood risks or other human impacted effects, anticipating them promises to enrich the protection and predictions for protected areas. My Masters course work in Padua included a lecture about flood risks, so that I would say, first steps are taken to combine such information as the future foresters know about the issue and might ask for cooperation in their future practice, which is exactly what is needed.

Again similar to Canada and the European Union, the data presentation on the website needs improvement. So far, it was difficult to find, but the real misery is the title of the files online. The files are probably named according to their organizing system, which

leads to completely unreadable names. Every file was a mystery until it was opened.

Proper names enhance the orientation remarkably. As for the European Union, I advise using standardized terminology in naming files and divisions of web sites.

Technical Solutions

A cellphone is a tool that everybody uses in his daily life and carries around nearly 24/7. It is an obvious choice to implement working tools as cellphone applications. Both parks reported using such applications (apps) to simplify their work. Fundy Park reports using mapping apps; Stelvio Park uses an app for the identification of species.

A phone app provides easy access, is handy to use, and is small and easy to transport. Of course, as it tends to be small, it is not the best tool for longer textual descriptions; but it does not have to be the only tool to assess the site.

Europe developed a complicated system with two overlapping directives that have slightly different regulations. To distinguish between those directives can be challenging. An app could solve some of those problems by combining the GPS-data with the demands of each directive. To identify the site and to follow the correct regulations would simplify the maintenance of European sites.

An app can be used in the field, operating it by simply tapping on it, with a user-friendly, easy-to-operate and visually appealing design. The app should transfer the data to the

local databank, interpret it, and translate it into graphs and other overviews. The more work the app takes over, the easier it is to assess the sites which leads to more detailed and more frequent check-ups. Using programs and the internet or intranet to identify risks and status is overdue.

Some apps use pictograms instead of text, as these are more readily processed than text.

Our will to protect should take advantage of the technologies of our time and use them to simplify and enhance our profession. Connecting the locally used apps in a global databank is the logical next step.

Global

Overall, the attempts to build a global network are incomplete. For example, the United Nations remains a respected organization throughout Europe. In Canada, the United Nations are disregarded, called unimportant, and have the reputation of offering low salaries. The motivation to cooperate with such an organization is low.

Canada seems too big a country to see the need of cooperation. As Canada is in a forced relationship with its neighbor, the United States, cooperation and conflicts are mainly restricted to a single partner. Europe on the opposite is used to neighbours, to conflicts, to friendships, and, to different languages. The need for conversation is clear, as in the past, wars have shaken the continent, peace and treaties were crucial, conversation was crucial, and translation was inevitable.

Europe is used to misunderstandings due to differences in languages and culture; a situation that cannot be reflected in the Canadian lifestyle: The country is too big to easily touch the borders, even if most neighbours speak the same language. To be fair, Canada contains Quebec, a province where the official language is French, insists on its own culture. Quebec is therefore somewhat isolated. The only other province that has French as an official language, is New Brunswick. New Brunswick fosters a double language program, so that every official text is written in both languages, which extends so far as to the products on the shelves of the supermarkets which have labels in both languages. New Brunswick is outstanding with that cooperation and offering an outstretched hand to its neighbour Quebec.

That means that Canada is forced to rely on external impacts from other continents to inspire innovations in policy and culture. As a university town, Fredericton is an entry point to Canada for a wide range of immigrants, and its inhabitants are more open to welcoming strangers than any place in which I have lived in Europe.

Independent from the limited number of opinions that I heard, Canada joined several global networks, showing a good example, same as Europe.

The GBF is an example of global cooperation, but it is a serious shortcoming that it does not provide clear guidelines for its reports. Implementing guidelines and requiring common data would make merging data possible. Ideal would be the combination of both strategies, the Canadian and the European: a colour-coded report, accessible to the public. Hiding data or saving it in an unshareable format prevents cooperation on each level and reduces citizen engagement.

Every country should join a global monitoring organization with clear guidelines, not only to monitor environmental risks but also to discuss solutions. Coordinated measurements are decades overdue.

Finding Common Ground in Monitoring Strategies

To make data comparable, the participants of the monitoring systems have to agree on a common format or at least agree on a minimum of unified data to create a platform for comparison and to enhance the chance to make a common statement. It is also essential to listen and to include different approaches, such as the First Nations offer. The current way of dealing with climate change is not different from the way that caused it. It can be the solution, like walking backwards to reach the starting point. Based on the author's experience, other cultures often present a surprising richness of new ideas, and innovation is critical in the present situation.

Such agreements are already achieved on governmental levels. But on a global level, the countries lack a common vision; each one seems to operate independently, including in the presentation of data. It is obvious that organizations such as the UNO or the Arctic Circle, that rely on the voluntary service of their members, have constraints limiting the pressure they exert on their members. However, the goals that the GBF (and therefore the UNO) formulates are not optional. The members agreed to work towards the goals, so that it should not be challenging to impose a common format for data exchange.

What the world needs is a common data format. Climate Change is a global phenomenon, the extinction of biodiversity a global problem, it requires a minimum level of cooperation and formating should be the least of our problems.

As this report demonstrates, bringing together monitoring systems from around the world could be a game-changer. It is essential that countries consider the unification of the monitoring systems, getting one step closer to understanding and protecting.

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Appendix A: Fundy Park Interview

How easy is it to gather the data in the field?

Depending on the measure, specific site location and more, data collection can be extremely straightforward and easy to highly complex or laborious. For example, our Stream Flow Index measure requires no field data collection at all—only a computer analysis of data collected at Environment Canada’s hydrometric station on the Point Wolfe River. Our Moose Density measure, on the other hand, requires coordination of an entire helicopter survey in ideal winter conditions—this is probably our most logistically challenging measure. Many of our measures, such as Forest Trees, Benthic Invertebrates and Water Quality, have sites in locations that require several hours of challenging hiking on and off trails. Our Forest Bird measure requires two members of our team to be at work at 5:00 AM or earlier for 10 field days. There unique challenges to data collection for most measures.

How long do you need to complete the data set for one report? I saw several report deadlines, from yearly to every second year—correct?

Each measure is on its own cycle. The number of years it takes to complete an analysis depends on resources and ecologically appropriate timelines for the monitoring in question. For example, growth and condition of forest trees does not generally change so quickly as to warrant annual measurements of all our plots—we complete this measure fully every 5 years. The terrestrial invasive plant measure was recently moved to be completed every 5 years because it was too laborious. The helicopter moose survey takes

a lot of resources, so that is completed every 3 years. Measures that are either simpler to complete annually (i.e., water quality, benthic invertebrates, bog water level and quality) or have more of a need to show changes on an annual basis (returning Atlantic salmon adults, forest birds) are prioritized for annual updates.

How easy is it to understand what you have to do to complete one report: Is it ok for a single person or do you need a team just to find out what to do and when to do it?

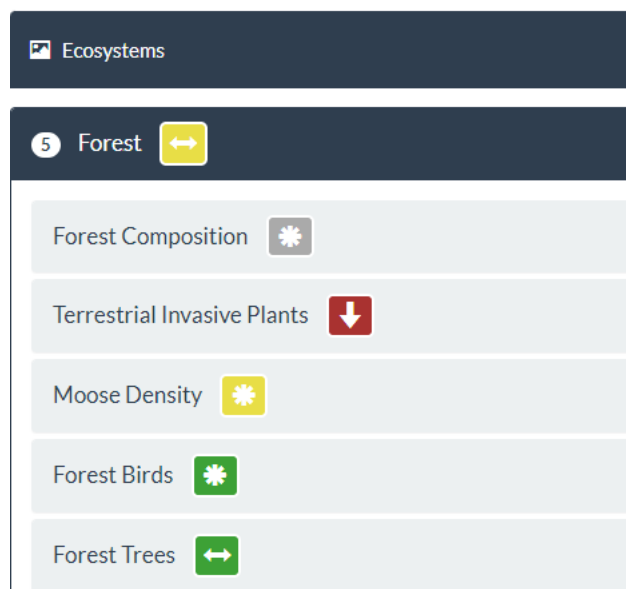
Our measures are divided between our Ecological Monitoring team (generally 3 Resource Management Officers + 1 ecologist) for the responsibility of leading the field work, entering and analysing the data. We will collaborate on any decisions that need to be made about conducting field work, changes to site locations, thresholds for the measures and anything else the lead would like input on, but for the most part they are the expert on that measure and have put considerable time and energy into developing/learning the protocol for the measure. We all help each other to conduct the field work, so we are fairly familiar with each other's measures.

How about the report in your ICE system: Do you feel like you understand it just by looking at it or do you need several hours to judge if your park is in a good state or not? What happens if you want to judge another park by looking at its report? Does each park get an overall grade? What is Fundy's?

One of the benefits of ICE is its ability to input large amounts of ecological monitoring data and display it in a way that gives you a general idea of the ecological condition of a park and its ecosystems very easily. Even new users of ICE can view any park in Canada and quickly gauge how its ecosystems are faring. All data is available to see between parks.

This simplicity is also its downside, as it fundamentally over-generalizes entire ecosystems into trends and statuses. For example, Fundy's Forest ecosystem is currently Fair (yellow) with a stable trend- someone might glance at this and think forest trees were not doing well in Fundy, for example. Upon expanding the Forest ecosystem, you see that the measures lowering the condition of the ecosystem are specifically moose density, and especially invasive plants, which are poor and declining.

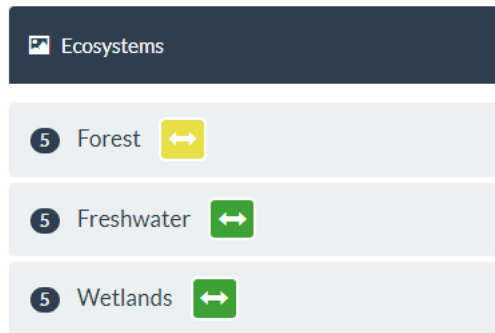
Fundy National Park of Canada



ICE does not combine the three ecosystems into a single score or status, but the score, status and trend of each of the 5 measures in the ecosystem affects the overall status and

trend of the 3 ecosystems. Fundy's forest ecosystem is fair and stable, while the freshwater and wetland ecosystems are good and stable.

Fundy National Park of Canada



Assume you have to change some measurements, for example, you lost a species, the park has suddenly a different ecosystem in one sport or something similar: You are forced to change your monitoring method. How easy is it to implement changes in your report system? Will this be notified to distinguish it from previous reports?

The environmental monitoring framework is relatively flexible. With guidance from the national office ecological monitoring team, we are able to make decisions about whether new measures should be incorporated and/or existing ones removed. Whatever configuration of measures best reflects the state of the park's ecological integrity is the best approach. Of course, the goal of most ecological monitoring is creating a long-term dataset to detect change, so decisions to add/remove/replace measures are not taken lightly.

Do you use your phones or an app? How and which one?

Phones with apps such as Avenza and ArcGIS FieldMaps have become our go-to way to navigate and collect data in the field for some measures. Our invasive plant and moose surveys are conducted on FieldMaps.

If you could change the way you handle data and the report: What are your wishes? Feel free to be unrealistic!

I sometimes wish that there was a way to assign different weights to measures within the ecosystem instead of all 5 measures being weighted equally, although this would be very difficult to quantify. For example, over 95% of Fundy is forested, and forest trees, the backbone of the forest, have a very high score and stable trend. But as the ecosystem is currently assessed, the ever-growing presence and detection of invasive plants in primarily disturbed areas like ditches is being equally weighted with forest trees. I certainly agree that invasive plants are a large threat to the park, but I personally think the way the monitoring program and reporting is structured gives it more influence on the forest ecosystem than exists in reality.

Appendix B: Stelvio Park Interview

Wir im Nationalpark Stilfserjoch haben, wie sie aus den Standarddatenbögen gesehen haben, 6 Natura 2000 Gebiete die besondere Schutzgebiete laut Flora Fauna Habitat Richtlinie darstellen. Gleichzeitig sind 3 davon auch Schutzgebiete laut Vogelschutzrichtlinie. Zu diesen Natura 2000 Gebiete im Südtiroler Teil des Nationalparks Stilfserjoch gibt es weitere im lombardischen sowie im Trentiner Teil des Nationalparks. Wir können uns in diesem Fall nur zum Südtiroler Teil äußern.

Das Monitoring ist abhängig von der Art der Daten, die wir erfassen möchten und entsprechend wählen wir die Methoden aus. Sofern möglich werden dazu auch Smartphones und Apps verwendet. Vorwiegend arbeiten wir mit Universitäten zusammen, die im Rahmen von gemeinsamen Projekten Monitorings durchführen. Wir versuchen aber auch die Besucher des Nationalparks zu involvieren, zum Beispiel über iNaturalist-Projektseiten.

Aufgrund der erfassten Daten entscheidet nicht eine einzelne Person über die notwendigen Maßnahmen, sondern es ist vielmehr ein Prozess, in den mehrere Mitarbeiter miteingebunden sind.

Die Anpassung der Standarddatenbögen kann nicht einfach durchgeführt werden, sondern es ist notwendig, die erfolgten Änderungen zu begründen und eventuell Maßnahmen dazu vorzuschlagen.

Wir arbeiten noch an der optimalen Vorgangsweise, um Monitorings durchzuführen und die gewonnen Erkenntnisse in konkrete Maßnahmen umzusetzen. Dies ist eine Aufgabe, die uns in den nächsten Jahren beschäftigen wird.

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