ECOLOGICAL INTEGRITY MONITORING PROGRAM EIMP

Parcs Québec Network

RÉSEAU Sépaq

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Preamble

In 2001, the Québec government introduced a number of key amendments to the Parks Act, the primary intent of which was to strengthen the conservation mission for these areas and sites. This led to elimination of the "recreation park" and "conservation park" categories in favour of a single top-priority objective for all parks: conservation and permanent protection of this heritage for the benefit of current and future generations. In order to fulfill this mission, the management of our national parks is primarily intended to maintain or improve the ecological integrity level (EI level) of these areas, while incorporating activities that enable discovery of their natural and cultural richness.

How is “ecological integrity” measured? The answer, while of fundamental importance to park managers, is far from simple. The Ecological Integrity Monitoring Program (EIMP) was therefore implemented in order to develop a system for measuring EI in our national parks. Just as stock market indices evaluate market trends on the basis of economic indicators, the EIMP attempts to detect changes in our parks using environmental indicators reflective of the EI level.

This document is the result of an endeavour that spanned several years and comprised analyses of scientific reports and literature, consultations with specialists, discussions led by an internal committee, comparisons with programs run by Parks Canada and the U.S. National Park Service, and knowledge acquisition in the field. While it may be accessed by any interested reader, the primary target audience is Sépaq managers responsible for implementing the EIMP within Québec’s national parks located south of the 50th parallel.

This document defines the context of the EIMP and its underlying premises, thus enabling a proper understanding of the Program and ensuring it is made operational effectively. Aside from the lists of indicators incorporated into this publication, more than 75 descriptive files – defining each indicator and describing its relevance – have been added to the EIMP content and are also available on the Sépaq website (www.parcsquebec.com/ecologicalintegrity). Rounding out the Program content are a number of detailed methodology files that are available for use by staff members who are either directly responsible for implementing and monitoring indicators, or simply involved in the process.

Since EI monitoring in national parks is a recently adopted practice, development of this type of program represented an innovation. Nonetheless, it occurred concurrently with other similar programs also in the development stage. In 2003, Sépaq chose to implement the EIMP with actual experimentation in the field as its favoured option. A number of potential indicators were identified and defined using simple theoretical bases, and were then measured in the field. Indicators could thus be validated under actual conditions. Some were discarded or amended, and others added. As we established the limitations and the potential of each indicator, its relevance could then be invalidated or confirmed.

This approach yielded multiple benefits: Implementation of the Program was consistent with available resources and effectively incorporated into our base operations. Most of the indicators in place have now been validated: We have been amassing analyzable data since 2003. This consolidation work is ongoing, and will continue for the duration of the Program, which is intended to be vital, active and adaptable.

The results and trends identified through the EIMP serve a dual purpose: as a source of information for park managers on changes in ecological integrity within their respective areas or sites in their charge, and a means of guiding their choices, their actions and the steps they take. These managers are therefore better equipped to maintain the quality of the natural environment for which they are responsible.

Reference Organizations – Definitions

Parcs Québec

The network of national parks within Québec that fall under the Québec government's jurisdiction. As of January 1, 2014, this network comprised 24 national parks and one marine park.

Société des établissements de plein air du Québec (Sépaq)

An organization created by the Québec government for the purpose of managing public infrastructure and land intended for recreational use and tourism. Sépaq manages three networks (Québec's national parks, wildlife refuges and tourist resorts) as well as Sépaq Anticosti. As of January 1, 2014, 22 national parks within Québec were under Sépaq management and two parks, located in Nunavik, were managed by another organization (the Kativik Regional Government). Additionally, Parc marin du Saguenay-Saint-Laurent is co-managed by Sépaq and Parks Canada.

Service des parcs – Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs (MDDEFP) [Parks service – Ministry of Sustainable Development, Environment, Wildlife and Parks]

The Parks service, under the aegis of the MDDEFP's ecological heritage and parks authority, is responsible for planning, creating and developing Québec's network of national parks, as well as providing a framework for their management through the development of park-related policy and companion documents.

Parks Canada

A federal agency responsible for managing Canada's national parks, national historic sites and national marine conservation areas.

U.S. National Park Service (NPS)

A United States federal service responsible for managing various areas and sites designated for preservation of the country's natural, historic and recreational heritage, including national parks, historic sites, natural landmarks and recreation sites.

Table of Contents

Program Objectives, Principles and Approaches

1.1. Rationale for the Ecological Integrity Monitoring Program

1.1.1. Purpose and Objectives

The Parks Act defines a Québec national park and its mission as follows:

> *"The primary purpose [of a national park] is to ensure the conservation and permanent protection of areas representative of the natural regions of Quebec and of natural sites with outstanding features, in particular because of their biological diversity, while providing the public with access to those areas or sites for educational or cross-country recreation purposes."*

Québec's national parks exist primarily to ensure conservation and permanent protection of specific areas, while also keeping them accessible. Compliance with this mandate is a requisite condition of managing the activity and service offering, to ensure fulfillment of this mission. Since these parks are protected areas and conservation issues override development, greater importance is attached to the monitoring of infrastructure, activities and associated impacts than in areas intended for other uses.

Zoning in these parks has been established through legislation that stipulates varying levels of conservation, based on the environmental sensitivity or ecological significance of the habitats present in each one: maximum preservation zone, preservation zone, natural environment zone, services zone and intensive recreation zone. The acceptable level of human impact for each zone will therefore vary based on the designation. As an example, services zones are expected to be more developed, while maximum preservation zones – with some exceptions – must remain untouched by human activity. Park managers are therefore required to use caution when considering any development project or any endeavour that is intended to restore or change the natural or cultural heritage.

Park attendance has risen overall in the past few years, and this keen interest is explained by their protected area status: For outdoor activities, the general public increasingly seeks sites that have, as much as possible, been preserved in their natural state. If this trend were to continue and the various areas or sites were to reach or exceed the limits of their support capacity, park ecosystems would be subject to increased pressure that in turn would produce negative impacts.

The natural heritage quality of Québec's national parks can therefore be preserved through monitoring and adequate management of protected areas or sites. In order to maintain or restore ecological integrity, parks management will increasingly revolve around two sets of factors: knowledge of the components, structures and processes governing the ecosystems within them, and tracking the response of these ecosystems to internal and external anthropogenic pressures. This outlines the underlying rationale for the Ecological Integrity Monitoring Program (EIMP), which is intended to achieve a clearly specified goal:

> ***To monitor changes in EI levels in Québec's national parks.***

This goal is a springboard for three specific objectives, to which the EIMP was intended as a direct response:

> *Evaluate overall efficiency of the conservation mission's management principles.*

> *Detect the onset or presence of undesirable situations and, where applicable, implement corrective actions or mitigation measures.*

> *Communicate information on changes in the health of these parks to government authorities, partners, park visitors and the general public.*

The EIMP will also help us attain the following broad conservation objectives:

> *Building knowledge about our natural heritage in order to help managers make optimal decisions.*

> *Defining thresholds that will enable permanent protection of our natural heritage while maintaining accessibility to the areas in question.*

1.1.2. Starting Point of the Process

1.1.2.1. A World-wide Concern

At the start of the new millennium, Sépaq followed the precedent set by governments and other organizations, making a commitment to an environmental monitoring process for Québec's national parks. A number of authorities in various parts of the world developed environmental assessment programs that could be adapted to the needs of various levels (national, provincial, local) of government. Underpinning all of these programs is the use of indicators that enable management measures to ensure environmental integrity within the area or site. Countries developing monitoring programs of this nature include Tanzania, South Africa, New Zealand, Australia, the United States and Canada. The work done by Parks Canada and the U.S. National Park Service (NPS) generally served as a model for these programs.

1.1.2.2. Parks Canada

Any discussion of ecological integrity in conservation parks must begin with a reference to Parks Canada's role in the implementation of monitoring programs. At the conclusion of a task force mandate to study Bow Valley in Banff National Park, Parks Canada published its *State of the Parks 1997 Report*, which raised the issue of maintaining ecological integrity. Publication of this study led to the creation, in 1998, of the Panel on the Ecological Integrity of Canada's National Parks, which released its report on this issue in 2000. This report attested to the impact of human activity on the ecological integrity of Canada's national parks. Following on the Panel's work, Parks Canada identified its priorities on the basis of maintaining and restoring ecological integrity in federal national parks and, to this end, implemented an ecological integrity monitoring program.

1.1.2.3. Parcs Québec

Drawing on the federal Panel's work on ecological integrity in Canada's national parks and in keeping with the new direction adopted by Parks Canada, the Direction de la planification des parcs de la Société de la faune et des parcs du Québec [Parks planning branch of the Québec wildlife and parks corporation] (FAPAQ[1]) and Sépaq similarly decided to implement an ecological integrity monitoring program (EIMP) for Québec parks located south of the 50th parallel. As early as 2000, the FAPAQ began to contemplate indicators related to the parks conservation mission and the preliminary draft of a specific natural heritage monitoring plan was submitted in 2001. In 2002, discussions between the FAPAQ and Sépaq produced a fixed set of fundamental principles for the EIMP and led to the creation of a committee responsible for ecological integrity (CEI). This committee, under Sépaq's direction, is responsible for development and implementation of the EIMP.

Since other national park management organizations working on similar programs were also at the initial stages of the process, simple emulation of their program(s) was impossible. The EIMP was therefore set up based on initial drafts completed by the FAPAQ, on work then underway at Parks Canada and the NPS, on information derived from various sources available (including some other types of environmental monitoring) and on the development of innovative precepts and methods. It was first tested, as a pilot project, in Parc national du Mont-Mégantic and Parc national du Mont-Saint-Bruno (2003), and subsequently (2004-2005) improved upon and implemented in the other parks comprising the Parcs Québec network managed by Sépaq.

[1] The FAPAQ was disbanded in 2004 and the Direction de la planification des parcs (now called the Service des parcs [Parks service]) has been made a part of the ministère du Développement durable, de l'Environnement,de la Faune et des Parcs.

1.2. Concepts Surrounding Ecological Integrity

1.2.1. Definition of Ecological Integrity

In drafting its Canada National Parks Act, the federal government included a definition of ecological integrity specifically pertaining to parks:

> *With respect to a park, a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes.*

Ecosystem integrity is therefore considered intact when the ecosystem: 1) contains all base components typifying the corresponding natural region (species, habitats, geophysical environments, etc.) and 2) hosts natural processes (growth, reproduction, migration, erosion, etc.) that are subject to controlling factors that exist within nature. Three attributes are used to describe the integrity of an ecosystem: composition, structure and functions (Figure 1.1). Interaction among these three attributes means that any changes in one could produce modifications in the other two. The ecosystem's integrity is considered intact or unchanged when the original characteristics of these three attributes remain present, i.e., they evolve in the absence of significant human influences.

Factors that could change this "natural" state are therefore the result of anthropogenic activity. This raises additional questions, however, regarding the scope of human influence on ecosystem evolution and the appropriate time scale for its assessment. What event should serve as a baseline? The genus *Homo*'s first appearance on this planet 2.5 million years ago? The advent of *Homo sapiens* 200,000 years ago? The worldwide dispersal of this species 30,000 years ago? The discovery of America by Europeans 500 years ago? Or perhaps industrialization in the 19th century?

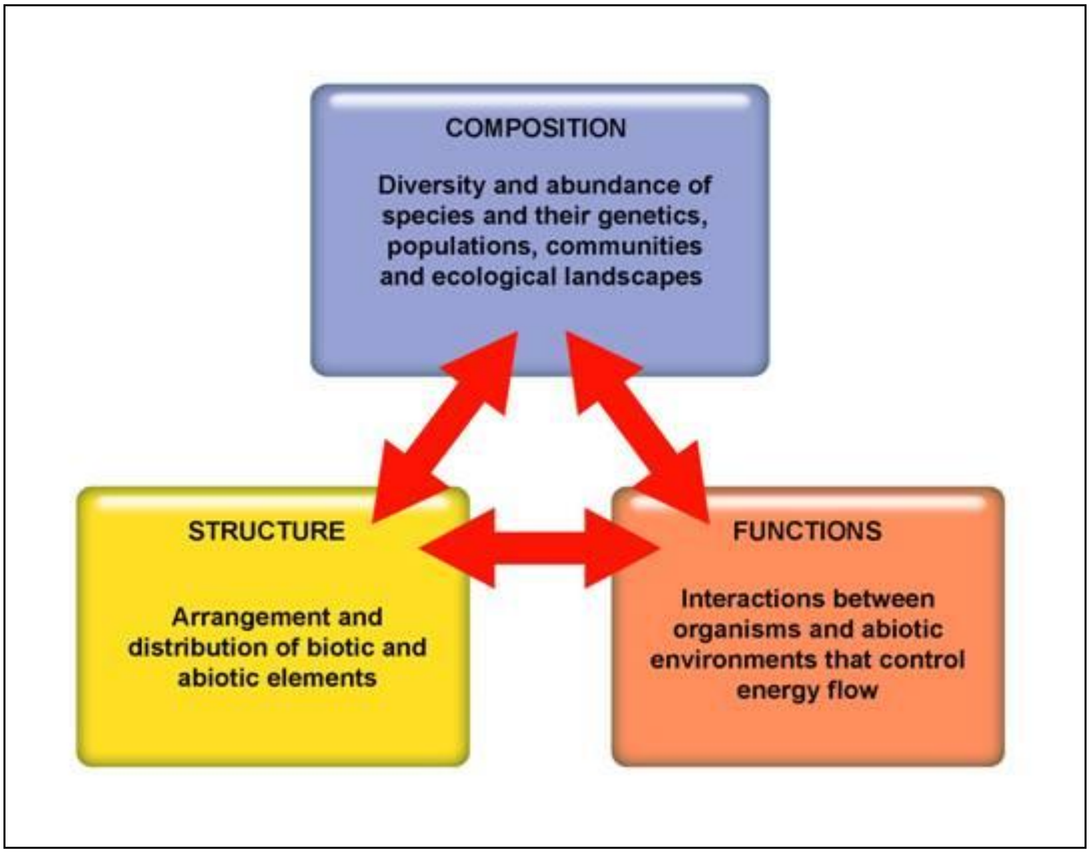


Figure 1.1: Ecosystem attributes

More importantly, to what extent should humans be estranged from nature? Opinions are divided on our place in the ecosystem and the impact of human activity on natural environments. If man is, in fact, a species like any other – one that has evolved within the ecosystems on which he is dependent – what sets him apart is his ability to significantly transform his environment on a large scale while remaining the only species aware of how ecosystems are impacted by his activities. Determining the extent of human impact entails comparison to a baseline state, in which the ecosystem would be deemed unchanged or uninfluenced by humans.

This brings out a complex set of questions: What should be the state of an ecosystem's attributes, for any given area within a specified timeframe, in order that it can be deemed unchanged? What are the baseline conditions? Answering these questions entails in-depth knowledge of the area's requisite primary characteristics and of the natural ecological processes that should (or ought to have) occur(red) there. Knowledge of its history and the effects of anthropogenic activities that led to the ecosystems' current state is also required. These questions, while relevant, cannot be answered – nor a consensus arrived at – easily. The obstacles that these questions create have been eliminated by summarizing the EIMP as a group of measures intended to monitor changes in EI levels in Québec's national parks. This "ecological integrity level" concept forms the basis of the entire Program.

1.2.2. Ecological Integrity Level

Working from this concept, the general belief is that the more an environment is changed by human activity, the lower its EI level. As such, and notwithstanding how much is known about the state of an ecosystem versus an "intact" state, this approach enables positioning of its EI status on a scale ranging from "low" to "high" when assessed against the measurements that comprise an indicator. The EIMP simply verifies the direction (positive or negative) in which the indicator measurements move on a temporal basis, i.e., an upward or downward shift in the EI level as reflected in the indicator.

Moreover, since the parks' mission also states that the public must have access to these areas or sites for educational and recreation purposes, the inevitability of certain anthropogenic pressures on these protected ecosystems is tacitly accepted from both a legal and a social standpoint. The historical backdrop of human occupation of this land before the parks were created is also highly variable, so no area or site can be defined as completely untouched. Parks showing minimal anthropogenic impact will present higher relative EI levels than those in which human activities (agriculture, forestry, etc.) have left their mark. This type of comparison between parks, however, will not be part of the EIMP; its sole usefulness is in helping to properly grasp the EI level concept.

The EIMP was developed as a means for each park, using relevant indicators, to note changes in its own EI level. The challenge in each case lies in striving to attain the highest possible EI level, keeping in mind the park's specific historical context and efforts to improve its heritage for visitors.

1.3. General Principles

1.3.1. Comparing Approaches: Parcs Québec versus Other Park Networks

Although our program and those of Parks Canada and the NPS were developed concurrently, Parcs Québec did draw upon the others in many respects. These organizations followed the lead of several others worldwide, opting for an approach that examines the EI status of the elements being monitored against an “expected” or a “desirable” state. Establishing this baseline state is a complex process involving analyses, research and detailed studies in order to establish “acceptable” ecological integrity thresholds for the various measurements monitored.

While this approach is at times facilitated by access to a vast body of scientific literature (e.g., for precipitation pH or moose population density), defining thresholds without setting subjective or arbitrary limits is, in most cases, difficult. Stream salamander monitoring amply illustrates the difficulties inherent in this approach. How would acceptable density and “natural” diversity thresholds for these various species be identified, based on limited knowledge, for a given site? How can the presence of species and quantities at the time of the study be determined as being either normal or anomalous? Potentially valid thresholds can only be established through in-depth studies carried out by specialists in the respective fields. Organizations using this approach have therefore devoted considerable resources to meet this challenge.

Since Sépaq’s organization structure is not on a par with those of large federal national park networks, a distinct approach was adopted. Use of the "EI level” referred to above eliminates the need for thresholds at which an ecosystem’s status can be characterized as “intact” or “desirable”. Simply put, the situation that prevailed at the start of the monitoring process became the baseline EI level.

The status of the parameter being measured is not rated “good” or “bad”, since it does not refer to a particular quality threshold. Rather, it reflects how the situation has evolved based on the influence of human activity, which would be assessed and identified as positive or negative. This approach yields multiple benefits: 1) It eliminates the need to be cognizant of the history and past consequences of a human presence in the natural environments monitored. 2) It simply identifies human beings as the stressor whose impacts are being monitored. 3) Finally, less extensive knowledge is needed (chemistry, biology, statistics, etc.) for the parameters monitored (air and water quality, status of biocenosis, etc.).

This approach has enabled efficient identification of the Program’s broad outlines and of potential indicators. The EIMP itself was implemented in the field within a short time. The strategy now encompasses optimization of measurement quality and quantity through adaptation and improvement of indicators. Actual application in the field is effective in separating reliable indicators that are sustainable over the long term from those that ultimately do not prove to be so. Some have been added and others removed.

In addition to the various indicators’ ecological relevance, two other factors need to be considered: the human and financial resources required to carry out the monitoring. Keeping in mind the goal itself – achievement, within a few years, of logistical stability that will optimize the Program’s quality and the ratio of resources to results – the on-site approach enables timely assessment of these tangible aspects.

Since the EIMP was first put into place, a number of changes have been made to both the indicators and methodologies used. The Program can also now draw upon a reliable data bank that will only become more accurate as monitoring is confirmed and protocols become definitive. One aspect, however, must be kept in mind: This approach, which favours simple theoretical concepts and experimentation in the field, is not immune to potential errors. Vigilance and critical thinking are crucial at all times.

The EIMP is therefore primarily intended to measure change. That said, however, “knowledge is the means to understanding”. While an approach based on EI levels delivers monitoring that is easy to analyze, it must also enable better documentation of what could constitute normal or desirable baseline ecosystem conditions. This knowledge, derived from a variety of sources (research projects conducted in parks, work completed by other organizations, literature reviews, etc.), can only help improve understanding and interpretation of the EIMP's results. Managers will therefore build on their knowledge of these baseline conditions, in order to align management practices with them, particularly when carrying out restoration projects on environmentally degraded sites.

1.3.2. Underlying Conditions for a Rigorous Monitoring Program

A monitoring program is a grouping of various tracking endeavours centered on a single goal: to identify changes in natural environments. These endeavours must meet the following conditions:

- Observations or inventories are quantifiable and enable a determination of the state of parameters measured in well identified sites.
- Data are gathered at regular intervals (annual, biennial, etc.) over the long term.
- The project must be replicated – in terms of both geographic location and methodology employed – in each of the periods tracked.

If all of these conditions are met, analysis of the difference in data gathered between periods tracked will serve to determine changes in natural environments or stressors that might have an influence. Changes in the state of an ecosystem can be better detected to the extent that: (1) a number of differing parameters are adequately measured, (2) monitoring occurs periodically and (3) the projects are implemented on a long-term basis.

The objective of monitoring is to detect changes, not to explain them. However, the results of this process can lead to tangible actions:

1) Implementation of a study that facilitates understanding of the cause-and-effect relationship.
2) Intervention to rectify abnormal situations.
3) Modification of management practices.

1.3.3. EIMP Implementation Steps

The EIMP is made up of a number of interconnected elements, as illustrated in Figure 1.2. The success of the Program is founded on a three-pronged strategy: collaboration, coordination and communication. This foundation is essential to smooth functioning of the five implementation steps, each of which also corresponds to one of the five chapters in this report. They all converge on the single goal of the EIMP: monitoring changes in each park's EI level.

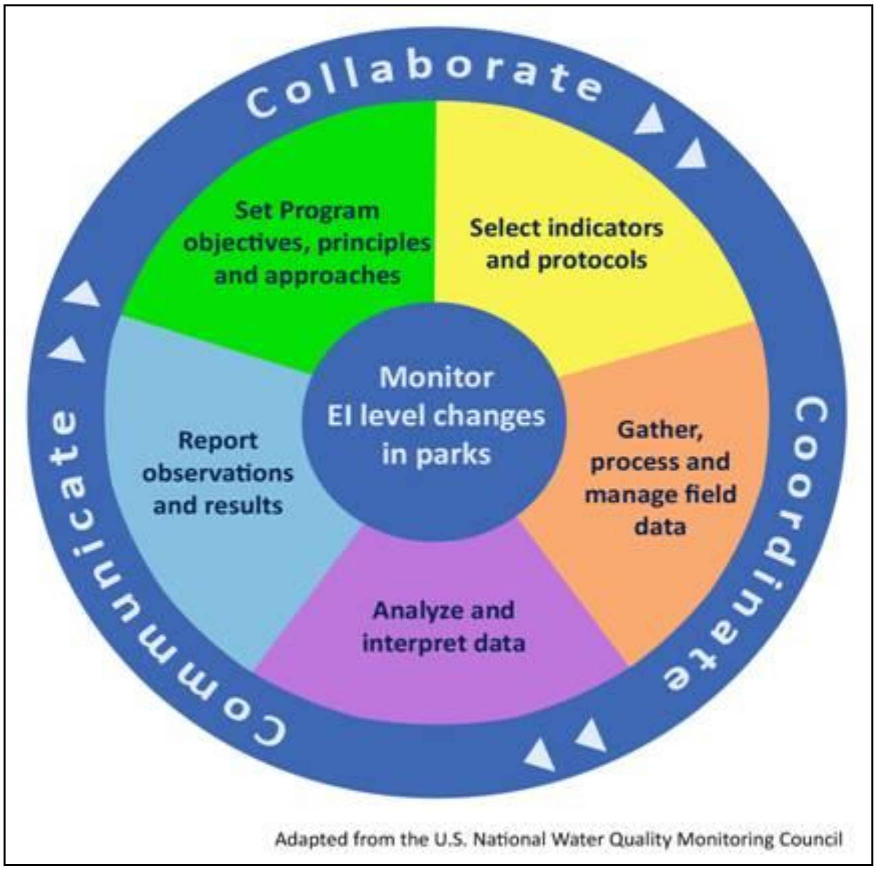


Figure 1.2: EIMP implementation steps

1.3.4. Environmental Indicators

An indicator is a tool used to analyze and assess selected parameters, thus simplifying the information generated from complex phenomena, for easier understanding. Indicators exist in varying forms. They can be used, for example, to study the state of physical or chemical characteristics in a given environment, to monitor a particular species or species group, or to assess the environmental impact of certain elements of infrastructure.

In the ideal monitoring program, a large number of indicators are used to ensure tracking of all components, structures and functions within an ecosystem. This scenario is obviously unrealistic when resources are limited. Relevant indicators then have to be identified and sampling performed on the parameters that are most representative of the ecosystems' overall condition.

Using the information developed from a limited number of indicators, an attempt is made to estimate overall changes in the EI level of a specific area during a given period. A program of this nature could, for example, be compared to the work of a paleontologist who recreates a complete dinosaur (the ecosystem) from a few bone fragments (the indicators). The more bone fragments at his disposal and the more representative they are of the key elements of the animal's anatomy, the better the re-creation.

Not all indicators are equal in scope. Some of them deal with global factors that have a major impact on the entire area (coarse filters). Others, while of more limited scope, can be used to monitor certain attributes that remain undetected by the more general indicators (fine filters). Efforts are therefore focused on maintaining a set of general and specific indicators, as well as various ecological and spatial scales, in order to get the best approximation of the state of the most representative parameters within the park (air and water quality, biocenosis status, etc).

Since the state of natural environments is constantly evolving, what elements should be tracked using these indicators? They are natural and anthropogenic stressors that drive transformation of the ecosystem so that it can adjust to change. This is very easily modeled using the diagram in Figure 1.3. The EIMP's top two priorities are anthropogenic stressors and the state of the natural environment.

Since natural stressors are an integral aspect of how ecosystems function, changes induced by natural processes are not measured for the EIMP. They should, however, be kept in mind when selecting indicators and analyzing and interpreting results. Changes observed through indicators can be the product of entirely anthropogenic causes – or of a blend of two types of stress (this applies particularly to biological indicators). Although these natural stressors do not necessarily have to be measured, their existence, respective roles and impacts on ecosystems must be well known.

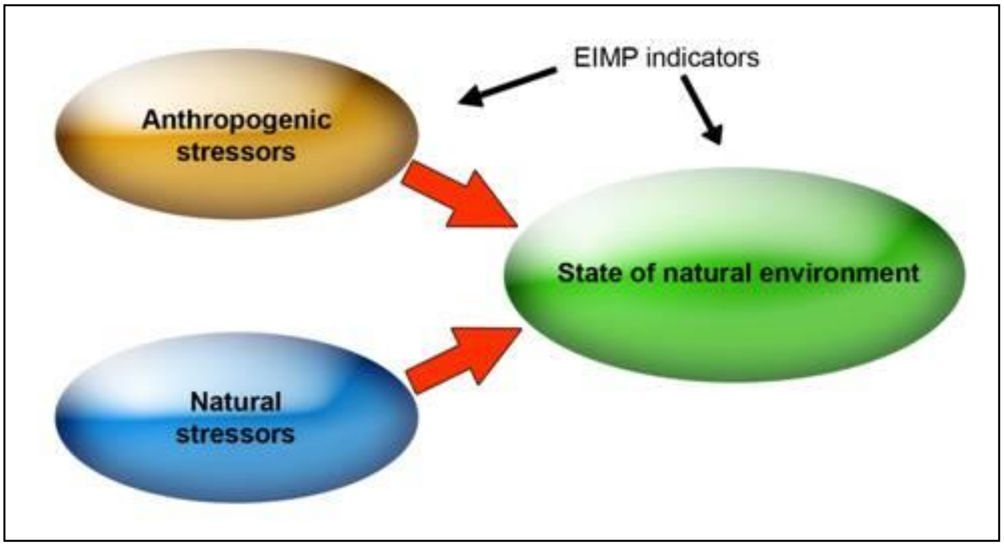


Figure 1.3: Stressors shape the state of the natural environment. This program was structured on the basis of evaluation of the state of the natural environement and onmonitoring anthropogenic stressors.

1.3.5. Base Postulates

Elements tracked using these indicators should measure changes resulting from human activities that influence the EI level. To express this relevance, a base postulate is established in advance for each indicator. A postulate is defined as a "hypothesis [put forth] as an essential presupposition, condition or premise of a train of reasoning"[2] – in other words, a proposition that needs no demonstration and is indisputable that must be acknowledged before reasoning is applied. A postulate is based on generally accepted and recognized theories, studies, observations or principles. The reader's or user's advance acceptance is required.

For EIMP purposes, a postulate is a statement establishing a relationship between the changes measured and human activity. It defines the direction (positive or negative) in which the EI level moves, in part due to these changes. For example, the following postulate would support selection of an indicator used to gauge bacteriological and physicochemical water quality while measuring concentrations of various pollutants:

> *Human activities can increase the pollutant concentration in bodies of water and, consequently, negatively impact aquatic habitat quality.*

This postulate specifies that human beings are the cause of higher pollutant concentrations and qualifies this increase as detrimental to aquatic habitat quality. Analysis of results will therefore serve to verify how concentrations of these pollutants change over the years for the bodies of water monitored and to link these decreased concentrations to an improved EI level.

1.3.6. Baseline EI Level

Since the EIMP's goal is to determine changes in EI levels, measurements taken over time must be compared to baseline circumstances. As described earlier, this relative baseline is simply the prevailing status at the start of the monitoring process. As the data are accumulated, the following statement can be made:

> *The state of this ecosystem, based on an indicator or a group of indicators, has improved/deteriorated/remained stable since monitoring was begun.*

[2] Merriam-Webster dictionary

This simple method of assessing EI level is easy to interpret. One element must, however, be kept in mind: The assessment in question compares a relative state to a previous state, rather than to an absolute state. Comparisons between individual parks are therefore not possible. The benchmark that serves as a point of departure for drawing conclusions can vary greatly from one park to another, since no absolute baselines exist for this process.

For example, the EI level of a park that, in absolute terms, was deemed in a degraded initial state (low baseline level) could be more easily improved once safeguards or restoration measures are implemented. By comparison, a park with a relatively intact absolute state (high baseline level) will tend to present a stable EI level since improvement would be more of a challenge. This is why the baseline state in the first park cannot be deemed worse than in the second, or as having evolved to equivalent or better. Nor is this interpretation conducive to qualifying the state of the first park as poor or that of the second as good. The EIMP is simply intended to verify if the state of each park has improved, deteriorated or remained stable since the monitoring began.

Since the original state of an indicator (at the start of monitoring) is used as a baseline level, the results should be questioned if unusual conditions not reflective of reality are suspected or measured. Monitoring must be repeated the following year (in parks scheduled for monitoring once every two years or less frequently). These suppositions can be confirmed or invalidated using the comparisons derived from the first years of monitoring (specialists' opinions, Dixon's Q test, etc.). Should they prove true, the data will be excluded from the analysis (see Section 4.1.3.).

1.3.7. Ecological Integrity Changes: Score

The EIMP is also intended as a tool for reporting on changes in the state of each park. It should therefore be adequate to the task of synthesizing results for various audiences. To this end, the Program revolves around a scoring system that helps meet this need (see

Chapter 5) and was in turn based on a multimetric index derived from a model developed by NatureServe for the U.S. Environmental Protection Agency.

Using the scoring system, each indicator, group of indicators or park is assigned a score that reflects changes in EI level. A positive score denotes improvement in the EI level, while a negative score reflects deterioration. In no way does this scoring process diminish the importance of the information provided by the raw data for each indicator. Managers directly involved in a park's operations must always use field data to analyze results and, if necessary, to take action.

1.3.8. A Program Tailored Specifically to Each Park

Although the EIMP was developed for, and implemented at, the park network level, each park has – and manages – its own program. While they all share identical underlying principles and several indicators, the EIMP is implemented differently and therefore warrants independent treatment for each park. This is required so that it can be adjusted to reflect natural and historic realities that differ from one area or site to another. Individual parks manage all aspects of monitoring, as well as data collation, analysis and interpretation.

1.3.9. Scope of Program

1.3.9.1. Spatial Dimension

Proper identification of the spatial monitoring scale is an essential aspect of adequately developing the Program and meeting its objectives. EI-related questions can cover topics ranging from a single habitat (e.g., one pond) to the entire planet, with distinct monitoring programs set up for each. That said, however, two spatial monitoring scales would be applicable to Québec's national parks: one network-wide, the other park-specific.

In monitoring the overall park network, the focus is on two elements: 1) landscape spatial organization between parks and versus other types of protected areas, and 2) how closely they are representative of Québec's natural regions. This scale defines the characteristics of the network's structure. Using analysis, the responsible authority – i.e., the MDDEFP Branch responsible for ecological heritage and parks (Direction du patrimoine écologique et des parcs) – is also equipped to build development strategies for park networks and protected areas.

The second level relates directly to individual parks. Concerns are over the state of ecosystems located within the parks' boundaries and on the periphery within close proximity. Since Sépaq's park management mandate encompasses this scale of monitoring, the EIMP takes effect at this level of spatial distribution.

These indicators can be used to draw a portrait of the EI situation in a given park, and serve as a tool for park managers to assess and improve the methods they deploy to fulfill their mandate. That said, however, a park is not a specimen in a bell jar. Its ecosystems are in constant interplay with adjacent environments and even disturbances farther away can have repercussions. Indicators can therefore be greatly influenced by pressures originating from outside the park.

As an example, a decrease in the natural biodiversity of breeding birds is not necessarily linked to habitat degradation in the parks. It could be the result of problems associated with wintering grounds or migration corridors. Other indicators are essentially contingent on management choices and user presence in the parks, especially when it comes to infrastructure quality. Conversely, some of the items measured are entirely beyond the scope of the parks management mandate, but their influence on the quality of our natural heritage is considerable. Examples are precipitation acidity, the quality of water bodies upstream of the park and periphery land use.

As such, while the EIMP's main focus is ecosystems and their components located both within park boundaries and in the adjacent periphery, potential stressors – both external and internal – must be taken into account when interpreting results. The causes of changes measured are often difficult to identify or assess. When making management decisions based on interpretation of results, managers must always apply the precautionary principle.

1.3.9.2. Scientific Scope

The top priority when conducting a monitoring program is obtaining reliable data that can form the basis for interpretation. These field data, which can be developed from species or physical elements, quantitative data on infrastructure or various statistics, are representative of the actual situation that prevailed when they were collected. Well-defined and properly executed protocols enable consistent and timely gathering of data, which in turn ensures that we are able to track changes in the parameters measured.

The methodologies put in place are generally existing, proven protocols that can also be adapted to better meet the needs of the monitoring process. In some cases, protocols have been developed specifically for the EIMP. The methodologies used at these times are based on recognized scientific foundations and principles, which taken together enable collection of reliable, comparable field data representative of a specific point in time. Whatever method is used thereafter for information processing, the ongoing reliability of the raw data forms the underpinnings of the entire approach.

The EIMP also remains a valuable source of information on our natural heritage. While it does not replace inventories and fundamental research, the information developed from it must be taken into consideration while gathering parks-related knowledge. The parks have put into place a vast array of inventory and research projects intended to meet specific needs related to knowledge acquisition. This work is conducted independently of the EIMP, which has its own objectives. A number of indicators have, in fact, been selected from these existing projects. Other studies – either upcoming or currently underway – could also potentially be used to develop or improve EIMP indicators.

1.3.10. Long-term Vision

The EIMP's reason for being hinges on its implementation in terms of a long-term vision. Although some indicators change quickly, they can only be used to draw a general portrait of the ecosystem over time. This type of program will only see a favourable outcome if all involved managers have the will to ensure its success and continuation by efficiently building it into the annual park planning process. The EIMP must become a familiar part of standard operations and a tool that enables better decision-making. It must be communicated effectively to employees in order that they grasp its importance and take ownership of and disseminate it. This sense of ownership must be strongly felt, in order that it can be easily passed on to new employees who will eventually become the next generation of EIMP managers.

The EIMP can always be improved upon and perfected, which is why remaining current on developments in similar programs elsewhere in the world and on advances in the environmental sciences is essential. Research opportunities must always be sought out. Finally, the effects of various local or global factors that could influence its results, such as global warming, must also be understood and, as needed, fully integrated into the EIMP.

1.4. Program Coordination

1.4.1. Park Level

1.4.1.1. Program Responsibility

EIMP implementation, tracking and management are coordinated by team leaders in each park who are responsible for its conservation and education functions. They are accountable to the network and must remain current at all times on the EIMP status of their park. Conservation and education managers (CEMs) are responsible for planning the allocation of required human and financial resources. They also delegate duties to the park wardens and other employees selected for this role, and supervise all EI monitoring. They compile results and ensure that these are forwarded to the network coordinator within the set timelines. Finally, CEMs keep their management committee and all park staff apprised, on a regular basis, of the park's EIMP status and results.

CEMs are also responsible for data archiving, and must complete a simplified annual report that is incorporated into the annual status report produced by the EIMP network coordinator.

1.4.1.2. Selection of Monitoring Indicators

Network-level indicators should essentially be monitored in every park; however, they do not necessarily apply across the network. Each CEM is therefore responsible for validating the relevance of each indicator for his/her park. CEMs must explain to the network CEI why they might have decided to set aside certain indicators that are deemed non-applicable or irrelevant. When a particular indicator is not retained in its original form for a specific park, the EIMP network coordinator and the CEMs will attempt to rectify the situation, either by adjusting the proposed methodology or developing a new indicator. CEMs are also responsible for keeping methodology files for monitoring indicators within their respective parks up-to-date.

CEMs are also strongly encouraged to develop local indicators that will speak to problems that are specific to their respective parks. They should also be able to leverage monitoring results from various sources (e.g., government programs and studies, academic research, monitoring already underway or in development) that are deemed relevant for their own parks. In all of these cases, CEMs are required to prepare a specific methodology file that must then be validated by the CEI or the network coordinator.

1.4.2. Network Level

1.4.2.1. Program Responsibility

Network-level responsibility for the EIMP lies with the Sépaq's park Vice-Presidency. The committee responsible for ecological integrity (CEI) was formed with this mandate in mind. Its work forms the basis of EIMP development. The CEI is made up of five individuals: the director of conservation, education and joint development, the conservation coordinator, a park director and two CEMs, along with a representative of the MDDEFP Parks service. Additional members, such as Parks Canada representatives or others with park management responsibility, may be invited to serve on the committee on an occasional or a temporary basis. The CEI receives and assesses all EIMP-related proposals and decides on future directions, approves park-specific indicators (based on relevance and feasibility) and methodologies selected, and also assists the network coordinator in performing his/her duties.

The EIMP network coordinator, part of the Parcs Québec operations team, ensures that the Program is running smoothly. Based on decisions made by the CEI, the network coordinator:

- provides parks with direction and assistance in implementing and tracking their program
- develops and assesses methodologies applied across the network
- develops and makes improvements to EIMP management tools

- sets up connections among parks that work on the same indicators and validates the development of shared methodologies
- ensures effective communication between the CEI and CEMs
- is responsible for compiling and distributing results.

This individual must watch for developments in EI monitoring and closely follow any aspects that could be made part of the EIMP. He/She must maintain an ongoing self-critical stance with respect to the Program and be receptive to whatever changes and proposals are required. As part of the CEI, he/she is called upon to provide fellow members with as much information as possible to help them define directions and closely follow changes in the Program and its results.

1.4.2.2. Annual Status Reports

Once a year, the Program coordinator will file an internal report intended to keep the organization apprised of the Program's status within each park and across the network, as well as of problems brought to light and changes made. This report will also outline the CEI's activities. Results analysis, on the other hand, will be included in the five-year reports.

Indicators

2.1. Indicators: General Structure

Figure 2.1 depicts the structure of EIMP monitoring. The selected indicators are grouped into two main categories: 1) the Ecosystemic component, made up of indicators that measure changes directly within the habitat, using bio-indicators or physico-chemical tests conducted within the specific environment, and 2) the Human component, which comprises indicators that measure variables directly linked to a human presence in the area. These components are sub-divided into their constituent parameters, and a few indicators generally measure the state of each parameter. Finally, one or more monitoring methodologies are defined for each indicator.

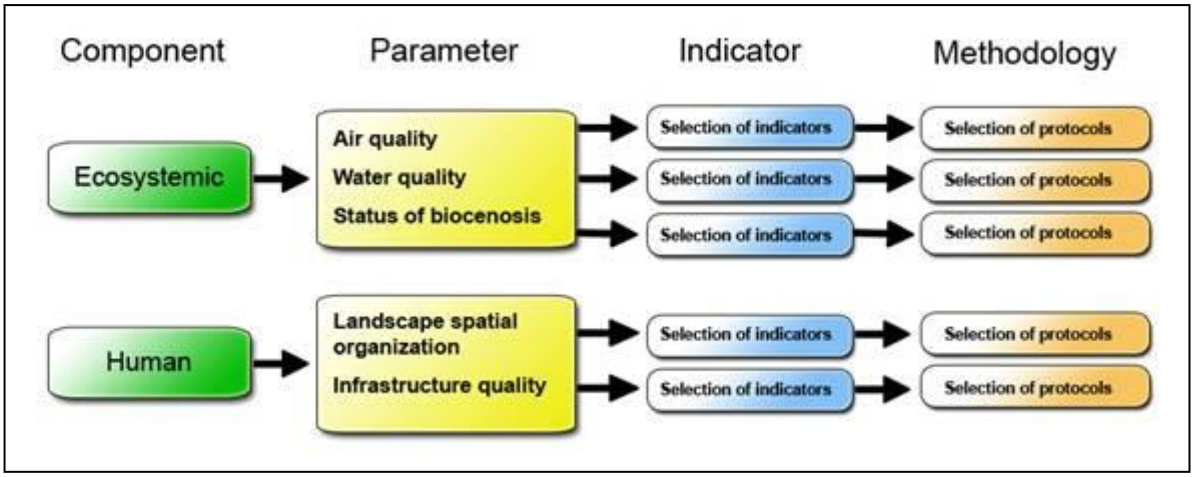


Figure 2.1: Arrangement of items tracked through the EIMP

Using the above structure, indicators or groups of indicators can be aligned together and, collectively, express the overall condition of the parameter(s) being measured. This structure is similar to that of the NPS Ecological Monitoring Framework, which was based on modeling of the various ecosystems developed by identifying the nature of interactions between species, physical environments and stressors. The above indicator structure enables coverage of all aspects that represent or influence ecological integrity in a given area.

The two components monitored are also linked to the parks' dual mission. Using the indicators that fall within the Ecosystemic component, a connection can be established to natural heritage protection, a priority mission. Indicators in the Human component are tied to the accessibility mission, since they enable observation of artificial elements put in place to facilitate visitors' discovery of the park's natural heritage.

2.2. Components and Parameters Monitored

2.2.1. The Ecosystemic Component

Indicators in this category directly measure the physical and biological parameters of natural environments. The aspects they cover include, primarily, the state of ecosystem components (water, air, wildlife, plant life, etc.), as well as some environmental stressors (air and water pollution, invasive exotic species, etc.). In some cases, a single indicator can play both roles. An example is the bacterial and physico-chemical water quality index (IQBP), which can be used to make judgments about water quality (the state of the water) as well as the level of pollution (a stressor) and its potential impacts on wildlife and plant life, which depend on water quality.

The three parameters retained (air and water quality, status of biocenosis) are meant to be representative of the various habitats' components and the species that inhabit them. They cover biotopes (physical elements) and the biocenosis (living beings).

The "soil and geology" parameter, however, is not part of the EIMP. Geology is an extremely stable natural parameter. Since Québec national parks are protected and therefore exempt from any mining activity, it would not be a relevant parameter for the EIMP. No soil-related indicators are currently included because no protocols were judged relevant; however, this could change as more information on this issue becomes available.

2.2.1.1. Parameter: Air Quality

Air is a basic element, essential to all forms of life, and its composition greatly influences environmental quality. Many of the contaminants emitted as a result of human activity are displaced through air circulation. The sources of air pollutants in Québec generally originate in Ontario and the United States. These pollutants, which originate far away, cause stress to the parks' ecosystems.

Despite its importance, studying air quality at the local level is neither easy nor affordable. Air quality varies greatly based on climate conditions, and measurement of this parameter calls for complex methodologies and facilities. Permanent government-run weather stations equipped to assess air quality parameters, including pH, low-level ozone, particulate matter and nitrogen dioxide, are located close to some parks, however.

Although the potential effects of poor air quality are significant, park managers have little control over this parameter. While air quality could be a major stressor, the information gathered provides indices that could prove useful in understanding subtle changes in ecosystems or interpreting certain other parameters being monitored.

2.2.1.2. Parameter: Water Quality

Aquatic habitat quality is of prime importance to a number of aquatic species groups, such as fish and amphibians, and is also essential for several terrestrial species. The park visitor's recreational experience is also strongly tied to the quality of water and aquatic environments.

Water quality is determined on the basis of the various substances it contains. Concentrations of these substances will also determine their effects on the ecosystem and on humans. Even the water in rivers and lakes that undergo little or no impact from human activities is impure. It contains a certain quantity of organic matter or mineral substances, either dissolved or in suspension, that are commonly found in nature (e.g., bicarbonates, sulfates, sodium, calcium, magnesium, potassium, nitrogen, phosphorus, aluminum, iron). These elements originate in the soil and sub-soil, in vegetation and wildlife, in precipitation and run-off from the drainage basin as well as in biological, physical and chemical processes that occur in the body of water itself. In addition to these naturally occurring substances, other products, resulting from the presence of humans (phosphorus, nitrogen and micro-organisms in domestic wastewater) or industrial and farming activities (toxic substances, metals, pesticides, fecal coliforms), might also be found.

Parks may vary greatly in size and based on the types of water systems they contain. The existence of these changes mandates the use of several specific indicators to monitor water quality throughout the network. These indicators are therefore relevant for water bodies of varying sizes, ranging from small streams to the St. Lawrence River, or from ponds to large lakes.

2.2.1.3. Parameter: Status of Biocenosis

The status of wildlife and plant life is an essential parameter in assessing the state of ecosystems. A biocenosis in good condition means that the attributes characterizing the ecosystem are functional. Changes in vegetation will impact directly on habitat structure and, consequently, on the status of wildlife. The appearance of invasive exotic species could dramatically transform the natural biodiversity in an ecosystem, in that it affects distribution of the various indigenous species.

Stress resulting from human activities, such as climate change, air pollution and trampling, hampers vegetative growth and survival. In addition to stresses on habitats that wildlife populations depend on, these species can also be affected by direct stresses (e.g., development, on-road mortality, disturbances). Taken together, the effects of human activities can lead to geographic redistribution of animals and change population demographics, which could in turn lead to species disappearance on a local or regional scale, or, conversely, to overpopulation issues.

Biocenosis status is especially diversified and multiple indicators are required to present a portrait of this parameter. In the case of plant life, certain methodologies that can be applied to the entire network, including indicators for exotic species, have been developed. When monitoring the “Situation of selected fauna species”, parks are required to use specific methodologies according to the species selected. A number of parks, however, use the same methodology when monitoring the same species.

The Parks Act forbids any use of national park resources for commercial purposes. While hunting is not allowed, recreational fishing is sometimes authorized, subject to strict conditions. Although not a primary activity in these parks, fishing is no less popular, hence the development of the “Fish resource quality” indicator. It measures various biometrical items in order to verify adherence, in the ongoing management of this activity, to maintenance standards for this resource.

A number of these parks are home to species that are rare or threatened, or could be thus designated, and also feature natural environments with specific and unusual biophysical or environmental characteristics. The precarious status of these habitats and of species with specific characteristics makes them effective indicators of a park’s ecological integrity. This precariousness is often a product of their sensitivity to changes in the environment or their position at the edge of their ecological niche. When an ecosystem is impacted by anthropogenic stress, these species are often the first to disappear and their loss represents a tangible decrease in an area’s or a site’s ecological integrity.

Two indicators will be used to monitor these key elements: the “Rare and endangered species situation” and “Exceptional or fragile habitat quality”. In both cases, a number of specific methodologies have been developed since these species and habitats can exist in varying forms. Since many parks harbour exceptional forest ecosystems (EFEs) legally defined by the ministère des Ressources naturelles (MRN)[3], a network-level methodology has been developed, as part of the “Exceptional or fragile habitat quality” indicator, for use in monitoring these specific forest segments.

Since the administrative boundaries defined for these parks do not coincide with their natural ecosystems, monitoring certain elements beyond these boundaries is a sound practice. This aspect is part of the landscape spatial organization parameter (see Section 2.2.2.1.).

[3] Natural Resources ~~and Wildlife~~ Ministry

2.2.2. The Human Component

A park area is exposed to various forms of both internal and external anthropogenic pressures. Unlike most indicators in the Ecosystemic component, which focus on environmental effects, the indicators in the Human component measure an opposite set of stressors, i.e., the characteristics of human presence.

2.2.2.1. Parameter: Landscape spatial organization

The general state of the ecological landscape is likely mostly shaped by landscape spatial organization, both within the park and on its periphery. The habitat and species potential for preservation is closely tied to the spatial mosaic of natural and stressed environments, the infrastructure and the activities carried out in these areas. Ongoing changes to spatial organization will result in multiple impacts: reduced potential for species dispersal and movement (physical and genetic), ecosystem fragmentation (so habitats are no longer able to support certain species), loss of natural biodiversity, ease of infiltration by invasive species and disturbance caused by human presence, among others. In order to determine the extent of these potential effects on ecosystems, two complementary indicators are used to verify infrastructure density in parks and the resultant fragmentation.

Another indicator focuses on periphery land use, since phenomena within the park's boundaries are greatly influenced by activities in the area surrounding the park. Whatever its form – be it pollutants released into a body of water upstream from the park, certain farming practices, forestry, mining or urbanization – human activity in the surrounding area directly defines regional ecosystem quality. Although park managers have no direct leverage over activities carried out in surrounding areas, acquiring thorough knowledge of these activities and of their actual or potential impacts on a park means that they can raise local stakeholders' awareness of this situation.

2.2.2.2. Parameter: Infrastructure Quality

The natural environment is impacted by the installation of any type of artificial infrastructure. As specified in the Québec national parks mission, however, the public must enjoy access to these parks. These two elements must therefore be reconciled by creating facilities that can enable public discovery of these areas without hampering the conservation mission.

“Infrastructure" is taken to mean any artificial structure or development of anthropogenic origin. As such, buildings, campsites, power lines, roads and trails are all considered to be elements of infrastructure. Their presence and their use will impact the EI level of an area. Aside from spatial distribution (see previous section), infrastructure quality is also important. The impact of these structures will be minimized if they are well designed, properly set up and adequately maintained. The focus of these indicators is paths, campsites and facilities that enable access to bodies of water.

2.3. Indicator Selection

2.3.1. Step 1: Potential Indicators

Selecting a limited number of indicators that can properly represent the quality of the parks' complete natural heritage is a complex process. Figure 2.2 presents, in diagram form, the broad outlines of the selection process used to create the EIMP. The first step is developing a list of potential indicators by plumbing various sources for information. These include searches for scientific literature and existing protocols, the work of various ministries (MRNF, MDDEP, Environment Canada), studies already underway in parks, and the expertise of both researchers and internal resources. This step consists in retaining all

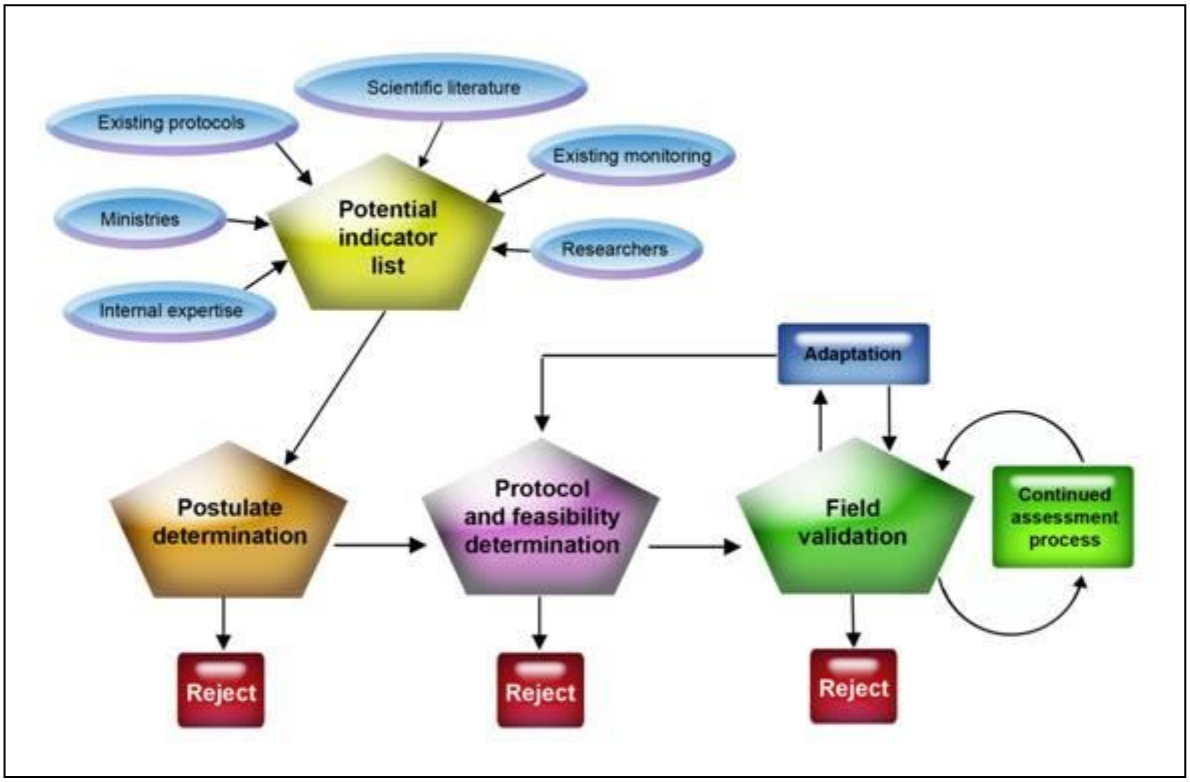


Figure 2.2: Indicator selection process – step-by-step breakdown

proposed indicators that might provide information on parameters to be tracked. Whenever new information is available or opportunities for collaboration present themselves, some indicators can be re-assessed, added or revisited at any time.

2.3.2. Step 2: Determining the Base Postulate

The first filter comprises determining the base postulate for a potential indicator. As explained in Section 1.3.5., the postulate must establish a causal relationship between human activities and their impacts on ecosystem components, structures and functions. Setting out a postulate requires knowledge of enough elements pertaining to the proposed indicator to demonstrate a relationship between the changes measured and the anthropogenic activity. The postulate must identify what is measured by the indicator and the significance, for the EI level, of an increase or a decrease in these measurements.

An indicator will provide a "yes" answer to Questions 1 and 2 below and make a response to a third question possible:

> *1. Is the theoretical and practical knowledge of this indicator sufficient?* In order to arrive at a valid postulate, the underlying knowledge must be strong enough to enable an understanding of what is being measured. This knowledge is usually developed from studies and research on the subject. An indicator based on the moose, for example, would be highly useful since the biology of this species is well documented. Conversely, since little is known about the status of the cougar in Québec, this would not be an adequate indicator.

> *2. Do the values measured by the indicator change in response to human activity?* Drawing a potential connection between variations measured and the impact of human activities must be possible. In general terms, indicators that fall in the "Human Component" category measure elements that vary solely because of human activities and decisions (e.g., infrastructure density, periphery land use).

This link, on the other hand, is more difficult to characterize for indicators in the "Ecosystemic Component" category. For instance, is a lower bird population the result of anthropogenic pressure or a natural phenomenon? In such cases, even if the extent of the human causal connection is not precisely known, knowledge of the elements measured must serve to establish the existence of a potential relationship between anthropogenic activity and the status of the bird population. This knowledge must also suffice to demonstrate that the link is not negligible.

> *3. Do the changes measured bespeak an increase or a decrease in EI level?* If the answer to the previous two questions is "yes", the response here will be no more than a formality. The question is, nonetheless, an important one that must be asked, since the results of this indicator will be interpreted on the basis of the answer provided.

The postulate for an indicator will therefore be a statement derived from the above three questions, set out in the following general form:

The increased/decreased value of the element measured is overall/partially attributable to the effects of human activities and produces negative/positive impacts on the EI level of a habitat/an ecosystem.

The postulate for an indicator may carry additional nuances that specify the role of human beings in the changes seen, as well as the nature, scale and extent of the impacts. If a postulate producing this type of synthesis cannot be developed, the indicator should be excluded.

2.3.3. Step 3: Protocol Selection and Determination of Feasibility

The next step in the selection process (see Figure 2.2) is choosing the protocol and determining its feasibility. This is a significant challenge, requiring a proper balance between the objectives set, the selection of a relevant protocol and the resources required for its implementation. It can be summarized in a single premise: The greater the number of indicators monitored and the more scientifically proven the methodologies, the better the depiction of the state of ecological integrity.

An ideal program would therefore comprise a large number of indicators that would all be monitored as rigorously as possible from a scientific standpoint. This exercise would produce a fully representative image of all aspects of the area in question and yield undeniable statistical power. In practical terms, however, limited human and financial resources restrict the scope and depth of a monitoring program. Choices and compromises are required.

The existing indices, methodologies or protocols that enable measurement of the indicator must first be determined. New tools of this nature may have to be developed or the ones identified adapted. The resources generally required for implementation and subsequent monitoring must then be estimated, keeping in mind the park-specific context. If a potential indicator meets all of the theoretical criteria but the monitoring would pose an overly onerous logistical and financial burden, it may not be retained in its original form. To ensure it is sustainable, an indicator must be established based on available resources, while generating an adequate quantity of useful information.

A standardized but logistically complex methodology is, quite commonly, adapted or simplified in order to improve its feasibility. In some cases, an assessment is required to determine if the sampling intensity can be reduced without compromising the quality of the information obtained. Innovative methodologies, developed to monitor a specific indicator that is deemed important, but is difficult to measure, can be based on standardized protocols or specific studies. What’s important is that the methodology adopted and the amount of information produced are adequate to meeting EIMP objectives as well as particular goals.

Feasibility restrictions can also compel indicator monitoring at a less desirable frequency. As an example, the “Monitoring Bats” protocol should, ideally, be handled once a year;

however, the human and financial resources this would entail make it an unrealistic target. Rather than discard this protocol, the monitoring interval was set at once every three years. While this decision reduces this indicator's effectiveness in detecting short-term variations, fluctuations will still be monitored over the long term.

Monitoring frequency can also be contingent on the indicator's sensitivity (speed) in reacting to anthropogenic pressures. This is why a number of indicators are measured at fixed intervals, ranging from two to five years, that may vary from one park to another. The "Non-indigenous plant propagation" indicator, for example, is monitored once every two years in parks in the southern region and once every four years in boreal forest parks. The issue of introduced plants arises less frequently in the latter group, and they propagate at a slower rate.

2.3.4. Step 4: Field Validation

The final step in selecting or discarding an indicator is field validation and tracking the results of this process. The process – an empirical test – leads to acceptance, elimination or adaptation of the indicator or its associated methodology. This step is performed in conjunction with the EIMP network coordinator, who works with those responsible for monitoring to assess the strengths and weaknesses of the various indicators. This assessment is based on actual field experience and analysis of results. Exchange of information is essential when examining both network-level indicators and those implemented in more than one park.

Should any doubts, complications or unexpected logistical difficulties arise, the methodology is re-assessed and, if possible, adapted in order to eliminate or mitigate the problems raised. Should a change in methodology preclude comparison of pre- and post-change results, the data previously gathered will no longer be valid. In these cases, monitoring must begin all over again with more solid, proven fundamentals. If, despite these improvements, the problem is too large to enable verification of the underlying postulate, the indicator is discarded once and for all.

2.4. Selected indicators

2.4.1. Network-level Indicators

Approximately 20 indicators have been selected (Appendix 1) for monitoring in all parks. However, the diversity of environments within Québec's national parks network, coupled with various other restrictions, means that measurement of every indicator in all parks is irrelevant, unnecessary or impossible. As an example, MDDEFP stations that measure air quality are not necessarily located near every park. This parameter can therefore only be monitored in parks that fall within the range of an MDDEFP station.

A detailed network-level methodology has not been developed for certain indicators, since they would be applied differently from one park to another. These indicators are used to verify a common global element; however, specific monitoring topics will not be the same. Indicators in this group are:

> Situation of selected fauna species (3 species or species groups per park)

> Rare and endangered species situation (2 species or species groups per park)

> Exceptional or fragile habitat quality (2 habitats or environments per park)

To measure the above three indicators, each park is allowed to implement whatever projects it deems relevant and feasible. For the first two, however, species selected must be significant to the ecosystem and responsive to anthropogenic changes – specifically, keystone species, umbrella species and species that fall in a defined ecological niche. For the "Exceptional or fragile habitat quality" indicator, habitats selected have usually been granted protected status under law.

Some forms of monitoring are nonetheless recommended for these indicators, through implementation of a standardized network-wide protocol. The anuran listening route and bat monitoring are examples of the "Situation of selected fauna species" indicator. Monitoring of exceptional forest ecosystems (EFEs) is also recommended as part of the "Exceptional or fragile habitat quality" indicator. Some parks can also select a common parameter for monitoring and work together to develop a joint methodology. In all cases, monitoring must be confirmed by the program coordinator.

2.4.2. Local Indicators

Parks wishing to develop new area-specific indicators are encouraged to do so. If the network-level indicators do not cover a local issue, the park can develop a specific indicator and an appropriate methodology. The program coordinator will have information about this indicator circulated in order to encourage future joint endeavours with parks encountering a similar issue.

2.4.3. List of Indicators Grouped by Park

This exercise has produced a list of indicators monitored in each park. Each list combines: 1) common network-level indicators, 2) network-level indicators with customized methodologies and 3) local indicators. Appendix 2 presents a list of indicators for each park. Since EIMP development is a dynamic, adaptable process, some monitoring projects will ultimately be discarded, changed or added on, and these lists of indicators will have to be updated.

2.4.4. Descriptive Files

A descriptive file (see template, Appendix 3) is completed for each methodology retained (several may be implemented for each indicator). Listed in this file are the classification (components and parameters monitored), the broad outlines of the selected methodology (units measured, frequency, protocol), the base postulate, the rationale for indicator selection, ecological power, the level of control as well as theoretical and methodological references that enabled validation of indicator selection and methodology.

These files have not been incorporated into this document because of their number and the possibility of modification at any time, e.g., when an improvement is made to a particular indicator. They will, however, be available on the Sépaq website (http://www.parcsquebec.com/ecologicalintegrity).

2.5. Ecological Power

2.5.1. Definition

Ecological Power (EP) is a parameter used to determine an indicator's relative importance, based on its capacity to answer the following question:

To what extent do the changes measured by the indicator in question reflect actual changes in the EI level of one or more of the park's ecosystems?

This question is particularly useful for the following reasons:

> A comparison of all indicators could reveal that some might be less relevant than others, and these could then be eliminated from the EIMP.

> Indicators deemed more important are prioritized when implementing projects, which will help improve the Program.

> Should certain indicators point to a decrease in EI level, defining their relative importance will help managers prioritize their action steps.

> EP is an essential element in the scoring table, since it serves to establish changes in the parks' EI score, as described in Chapter 5.

The EP of a given indicator is determined on the basis of three criteria:

A) Ecological scope of the changes measured

B) The strength of the anthropogenic relationship to the changes measured

C) The spatial coverage of the measurements

These three criteria are described in the paragraphs below, and the process used to determine the indicators' EP is explained in Section 2.5.2.

A) Ecological Scope of Changes Measured

The base postulate for an indicator asserts that human activities impact the EI level of the item being measured. Of what significance, however, are these impacts on the park itself? Do they affect the key elements of multiple ecosystems? Are the repercussions felt in more than one trophic level or in different habitats? The changes measured by a particular indicator are reflected, to varying degrees, in the three attributes of a park's ecosystems: the components, the structure and the functions. The greater the likelihood of these three elements being affected by the changes measured, the higher the indicator's declared EP for that criterion.

B) Strength of the Anthropogenic Relationship to the Changes Measured

The base postulate affirms the existence of a relationship between the change being measured and the effect of anthropogenic activities. What is the scope of this relationship? What is the relative importance of anthropogenic stressors versus natural disturbances in a change being measured? The stronger the potential for correlating the changes measured to an anthropogenic cause, the higher the indicator's EP.

Landscape fragmentation, for example, is determined by the amount and distribution of infrastructure within the park. Any change in fragmentation level is, of necessity, linked to some form of human intervention, hence the high EP for this indicator. Conversely, the status of a given wildlife species can of course be governed by human factors (loss of habitat, pollution, etc.) as well as by entirely natural factors such as the predator-prey cycle and disease, among others. If the significance of the anthropogenic connection becomes the underlying criterion, the EP for these indicators will be lower since changes measured will not necessarily reflect an altered EI level.

C) Spatial Coverage of Measurements

When measuring a particular parameter, does the indicator encompass all of its elements throughout the park? Or is the monitoring conducted on a single site, in which case the results cannot be extrapolated to cover the rest of the park? The higher the percentage of park area for which information is collected using a methodological protocol, the more effective this protocol will be in reflecting changes in the park's EI.

The indicator's spatial coverage will be largely determined by the sampling work done, as well as by the spatial magnitude of the information measured.

Fragmentation, for example, is analyzed for the entire area. This is a full enumeration that does not limit EP. Anuran monitoring, on the other hand, is restricted to a single listening route and therefore represents no more than a segment of the park, yet it is more representative of the park itself than single-site tracking of a plant would be.

In other cases, one sampling site can represent significant spatial coverage. For example, a single MDDEFP air quality station provides information for an entire region. Sampling for the standardized global biological index (benthic fauna IBGN) on a single site will be representative of the entire drainage basin upstream.

The "entire area" referred to above encompasses all applicable environments. As an example, if only one lake falls within a park's boundaries but that lake is monitored, coverage for this parameter is deemed to be 100% since it includes all of the lakes in the park. If, however, dozens of lakes fall within the park but only one is monitored, representativeness for this area will be lower. This reasoning also applies to other habitats, an example of which would be monitoring a bird that uses a specific habitat. Should every location of this habitat be monitored, or only a single one?

2.5.2. Determination of Ecological Power

2.5.2.1. Analytic Hierarchy Process (AHP)

Establishing the various indicators' relative importance is not a simple process. Ecosystems are complex systems in which a considerable number of factors come into play. Objective quantification of these connections can be time-consuming, and the process will always, to a large extent, involve the use of personal judgment. To accommodate this, an analytic hierarchy process (AHP) technique is being used to define the EP for various indicators. The AHP is a tool designed for making decisions on the basis of complex, subjective variables. In the absence of “THE” perfect response, the AHP is used to identify the one(s) that appear(s) optimal.

When applying the AHP, indicators are paired and comparatively assessed to identify which of the two in each case best meets the EP criteria. A particular indicator is thus compared in turn to all other indicators based on the expertise and judgment of skilled assessors. The results are entered into a matrix that prioritizes the indicators based on their order of importance. The final hierarchy is established by summarizing all of the assessors’ results. Details of the Analytic Hierarchy Process used for the EIMP are found in a stand-alone technical guide that explains the process itself and helps assessors perform their role.

The assessors bring together researchers who specialize in fields related to ecological monitoring and biologists (or other professionals) who are directly involved in making the EIMP operational – specifically, park staff responsible for conservation and education (CEMs). Their mandate is to answer the following question for each pair of indicators:

Is Indicator Y generally superior to Indicator X
in demonstrating potential changes in EI levels?

The five possible answers to this question are set out in Table 1. A score is assigned, based on the appropriate response, and indicated in a scoring system matrix (Table 2) at the point where the two indicators in question intersect. Total scores appear in the far right column of the matrix. The higher the score, the better the indicator’s EP. In the example given in Table 2, Indicator 1 would be considered the best one and Indicator 7 the least effective. The matrices produced by each assessor using this process are then compiled to establish a final classification for the indicators.

Table 1: Scores to be Assigned when Comparing Paired Indicators

Response	Score
The y-axis indicator is **significantly superior** to the x-axis indicator.	+2
The y-axis indicator is **superior** to the x-axis indicator.	+1
The y-axis indicator is **similar** to the x-axis indicator.	0
The y-axis indicator is **less relevant** than the x-axis indicator.	-1
The y-axis indicator is **significantly less relevant** than the x-axis indicator.	-2

Table 2: Sample EP Assessment Matrix for a Combination of Ten Indicators

	Indicator 1	Indicator 2	Indicator 3	Indicator 4	Indicator 5	Indicator 6	Indicator 7	Indicator 8	Indicator 9	Indicator 10	Total
Indicator 1	0	0	2	1	2	1	2	1	1	0	10
Indicator 2	0	0	1	1	2	1	2	1	1	0	9
Indicator 3	-2	-1	0	0	0	0	0	-1	-1	-2	-7
Indicator 4	-1	-1	0	0	1	0	1	0	-1	-1	-2
Indicator 5	-2	-2	0	-1	0	-1	2	-2	-2	0	-8
Indicator 6	-1	-1	0	0	1	0	1	-1	-1	-1	-3
Indicator 7	-2	-2	0	-1	-2	-1	0	-1	-2	-2	-13
Indicator 8	-1	-1	1	0	2	1	1	0	0	-1	2
Indicator 9	-1	-1	1	1	2	1	2	0	0	0	5
Indicator 10	0	0	2	1	0	1	2	1	0	0	7

2.5.2.2. Ecological Power (EP) Ranking

Based on the final ranking obtained, indicators are grouped into three categories (Levels 1 to 3) in descending order of importance: Level 1 reflects the top-scoring indicators and Level 3 the lowest scores. Indicators are hierarchically rearranged based on these categories, using statistical analysis with scores plotted on a distribution curve. All indicators within a single category must have the most consistent scores possible. The details of this analysis can also be found in the AHP technical guide. An indicator's classification is entered in its descriptive file; this information is required to establish scores for changes in the indicators' EI. The process used to calculate these scores is described in Chapter 5.

2.5.2.3. Distinctive Nature of the Measures' Spatial Coverage

An indicator's EP is established based on its ability to meet the three above-defined criteria (ecological scope, strength of the anthropogenic relationship and spatial coverage). The AHP is inadequate, however, to assessing network-wide spatial coverage for an indicator since the sampling characteristics can vary from one park to another for a number of reasons: the park's area, access to the area or site, and various logistical restrictions, among others.

This criterion should therefore be assessed individually whenever an indicator is monitored in each park – an exercise that lies beyond the scope of the AHP. To avoid this restriction, assessors will need to base their AHP on the hypothesis that this criterion is always optimal for the criterion in question, i.e., assume, while conducting their assessment, that the methodology chosen for that particular indicator will always enable monitoring that is representative of the entire park and the ecosystems targeted.

The CEMs and the network coordinator then evaluate spatial coverage on a local level, at which time spatial characteristics developed during the monitoring process are verified. If the information developed during the monitoring process is not representative of the entire area or site, a restrictive multiplication factor is applied to the EP to reduce its importance (these multiplicative factors are discussed in Chapter 5). Levels of spatial coverage used for individual classification of indicators – ranging from the most to the least representative – are listed in Table 3.

Managers directly involved in making the EIMP operational are able to use this categorization, when analyzing and interpreting results, to adjust the ecological power calculated during the monitoring process. Consequently, an indicator with minimally representative sampling and a low EP (Level 3) could be rejected, or improvement of its spatial coverage become a requirement. This category-based ranking is also important for establishing the EP multiplicative factor required to calculate scores for EI changes (Chapter 5).

Table 3: Levels of Spatial Coverage

Level	Description
The entire park or targeted ecosystems	The information is representative of the entire park area or of all targeted ecosystems.
More than half the park or targeted ecosystems	The information is representative of more than half the park area or more than half of the targeted ecosystems.
Monitoring routes/Multiple sites	The information is gathered from monitoring routes or multiple sampling sites, but is representative of no more than half the area or half of the targeted ecosystems.
A single site	The information is representative of a single site in the park or in the targeted habitat.

Data Gathering and Processing

3.1. Data Gathering

3.1.1. Monitoring Protocols

Protocols should be relatively simple, in order to keep them feasible and reproducible, but, at the same time, rigorous enough to maintain adequacy of their scientific value for the program objectives. Protocol selection is a key aspect of the process, since the quality of results analysis and interpretation will correlate with that of the raw data.

Protocols that are standardized, recognized and commonly used when conducting scientific studies are, of course, preferred. They can be used in their original form or modified according to our logistical restrictions or to better meet our needs. Some EIMP - specific protocols have been developed jointly with researchers, educational institutions or government ministries. In some cases, simple protocols were developed internally.

3.1.2. Methodology Files

A methodology file has been developed for each indicator (see the template in Appendix 4). These files provide instructions for the various indicators and contain the details of methodology-based protocols. For each network-level indicator, one or more general methodology files describing the protocol to be followed has/have been created. Each park must adapt its files so that its own specific monitoring circumstances are defined (site location, dates of specific accomplishments, changes to base protocol, etc.).

The function of these methodology files is to ensure the project's long-term reproducibility. This role is essential, especially when the data are gathered from field sampling or assessment, since these monitoring processes can be carried out by different people each year. What's important is that these methodology files be clear, well structured and complete, to help maintain consistency over the years. The data developed can therefore be compared since they will have been gathered in a uniformly rigorous fashion.

3.1.3. Record Sheet

Record sheets will vary greatly from one monitoring to another. They can be incorporated into the protocols used, developed specifically for the EIMP or designed locally at the park level. Whatever form they take and whatever their origin, they are used to record the raw data. The record sheet provides information about a given parameter and specifies the exact location and time at which the datum in question was gathered.

The information recorded in these record sheets is of the utmost importance. The EIMP is only relevant to the extent that the raw data gathered are valid. Whatever the mathematical or statistical processing applied to these data, the base information must always be available for consultation. Record sheets are archived on site at each park.

3.2. Data Processing

3.2.1. Use of Indices

Presenting indicator results by means of indices can sometimes prove useful. Indices group together the information collected from different measurements, for the same indicator, into a single relative value. These tools are of interest to decision-makers since they summarize measurements or phenomena that are not easily understood without a minimum level of expertise into a comprehensible form. These indices – whether adapted, developed or used in their existing form – demonstrate the relative changes observed in an indicator based on measurements that vary greatly at times.

The objective remains the same in all cases: to ensure that the raw data underpinning these indices are, as much as possible, uninfluenced by: a) subjectivity, b) the observer's level of expertise or c) phenomena outside of our control. While this objective is usually attainable, compromises may sometimes be required in order to facilitate monitoring of a specific indicator or ensure that it can be monitored. Staff involved in making the EIMP operational, as well as managers, must carry out the analyses and make their decisions with these compromises in mind.

3.2.2. Data Compilation Tool

Each park maintains an Excel file in which all annual data are compiled from the information found in the record sheets. The Excel file is the basic tool used by park staff to analyze and interpret changes in EI level in the area for which they are responsible.

The file is identified by the acronym FACIL (automated file for compilation of local information). Excel was chosen, rather than a standard database software, since it is commonly used by all CEMs and is a perfect fit for EIMP-related needs. With no more than a minimum of training, CEMs are functionally capable of using the file.

FACIL comprises a series of spreadsheets – one for each indicator monitored by the park – and other sheets on which the results are compiled and presented. The user is simply required to enter the raw data obtained during the monitoring process as and when they become available, and all graphs, statistics and EI scores are automatically generated.

The network coordinator, with the CEMs' assistance, adapts the file to the context of each park. The CEMs are responsible for updating the data. All format modifications are made by the network coordinator, at the CEMs' request, or when mandated by methodology changes. The most current version of each park's FACIL spreadsheets is maintained on a server that can be accessed remotely by both CEMs and the network coordinator. The CEMs are also responsible for maintaining back-up copies of this file.

3.2.3. Information Archiving

Each park is required to maintain a document or a folder containing the raw field data for EIMP support purposes. Any comments regarding methodology or results must also be included in this document. While CEMs are free to decide what form (hard copy, digital, etc.) this document should take, they must also ensure that it is easy to understand and access. The existence of this document in a usable form is essential. Back-up copies must be created in order to ensure that this document or file is secure.

This document should be consulted by all staff members assigned to a specific monitoring function, e.g., park wardens. It contains information, such as methodology-related problems and sampling or monitoring recommendations, that will help them do the following monitoring properly. CEMs or the network coordinator can also review previous data, change aspects of methodology or perform quality control on results. Stakeholders outside of the organization may even wish to access these data for research purposes. In all of these cases, understanding where the information originated is essential to making proper use of the raw data.

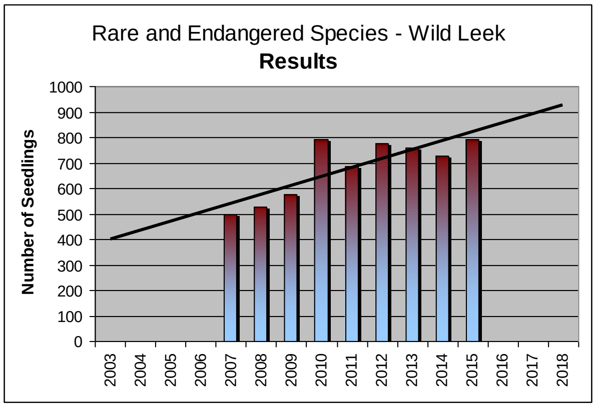
Results Analysis and Interpretation

4.1. Interpreting Change

4.1.1. Linear Regression

The primary goal of the EIMP is to track changes in a park's ecological integrity level. This requires analysis of the raw data to see if changes have occurred since baseline monitoring. Linear regressions aid in verifying the existence of any changes and their significance and direction (positive or negative).

Linear regression is a widely used statistical tool defining the equation of a straight line that most closely approaches the distribution of a data series. For EIMP purposes, this regression line serves to model the relationship between two variables: measured indicator data and the years in which monitoring was done. Trends in changes can therefore be established from the time monitoring began. Two examples are depicted in Figure 4.1. As indicated, general trends in raw data are modeled using the regression lines (shown in black).



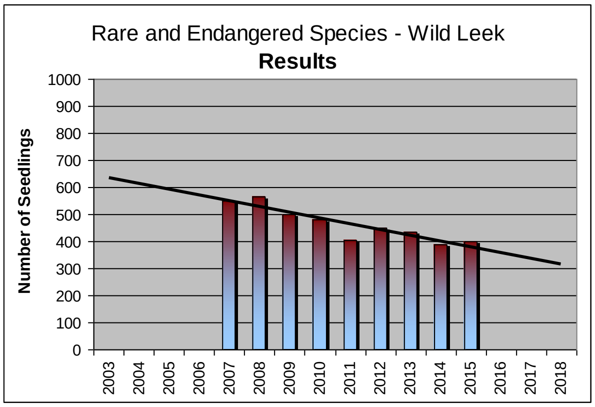


Figure 4.1: Two examples of raw data series and their respective regression lines.

4.1.1.1. Positive/Negative Change

Depending on the linear regression slope (upward or downward), the change can be defined as positive or negative. One aspect must, however, be known in advance: Does a rise in the values measured reflect an improvement or a deterioration in EI level? This information is provided by the base postulate. If this postulate characterizes a rise in wild leek seedling populations as a desirable change, the examples in Figure 4.1 could be said to depict an increase and a decrease, respectively, in ecological integrity in the left- and right-hand graphs. If the base postulate stipulates that such a rise would be a negative factor, the opposite conclusions would be drawn from these two examples.

4.1.1.2. Extent of Change

The extent of the change is expressed by the linear regression slope, which depicts the average annual change measured by an indicator. Use of a relative slope is preferable, however, to better express the actual extent of the change. As an example, an annual average rise of 10 plants is less significant in an initial population of 1,000 than in an initial population of 100. In both examples, graphs would depict an absolute slope of 10% versus a relative slope of 1%. In Figure 4.1, the absolute value of the slope is greater in the graph on the left than on the right, pointing to a higher rate of change.

Drawing a distinction between a stable state, change and significant change is desirable, since managers directly involved in making the EIMP operational can use this as a guide for results analysis and interpretation. The information on the various indicators can also thus be synthesized and a multimetric index created, which assigns scores to each parameter as well as a global score to the park, thus facilitating results reporting (Chapter 5).

To distinguish the significance of the various changes, classifications (or ranges) must be established based on the linear regression slopes. Establishing class limits that are representative of all indicators under all circumstances would likely be impossible.

Moreover, the accuracy required to guide managers as they perform their analyses is relatively flexible since these indicators are essentially parsed individually based on raw data. The various disciplines that assess rates of change over the long term (economics, demographics, etc.) generally record annual figures ranging between 0% and 10% (at a 5% annual rate of growth, the initial value of a datum doubles in as little as 32 years).

Several indicators have been tested on this basis, using available raw data and the hypotheses related to changes observed. Percentages retained as preliminary class limits for relative linear regression slopes vary between 2% and 5%. Consequently, an indicator with measurements forming a linear regression slope between -2% and 2% will be considered stable. Change is deemed to have occurred when the slope extends beyond these limits. A negative or positive slope of 5% or more will be deemed to represent significant change.

These class limits serve as a general basis for interpreting changes reflected in indicator measurements. These thresholds could, however, be adjusted to more closely represent the specifics of the indicator in question on the basis of existing or potential studies, or as new data become available. Specialists in the relevant areas of monitoring could perform qualitative and statistical analyses on these new data.

4.1.2. Determination Coefficient

The determination coefficient (R^2) is used to verify the strength of the correlation between a regression line and the raw data it is intended to model. This coefficient is determined by the distance between the actual data and the regression line. The graphs in Figure 4.2 depict two data series presenting an identical slope, -3.5%. In the graph on the left, the regression line is in proximity to the actual data, whereas actual values in the other graph vary so greatly that many of them are some distance away from the line. The R^2 values are 77% and 9% respectively. The high R^2 value in the graph on the left therefore shows that this regression line produces better modeling of the raw data than does the line in the graph on the right. The R^2 value helps establish how reliably the relative slope can be interpreted, i.e. the change reflected in the indicator measurements. In the natural sciences, an R^2 value exceeding 50% is generally acknowledged to demonstrate a strong correlation between variables and the regression line is thus seen as reflective of the actual situation. R^2 classes and their respective interpretations are listed in Table 4.

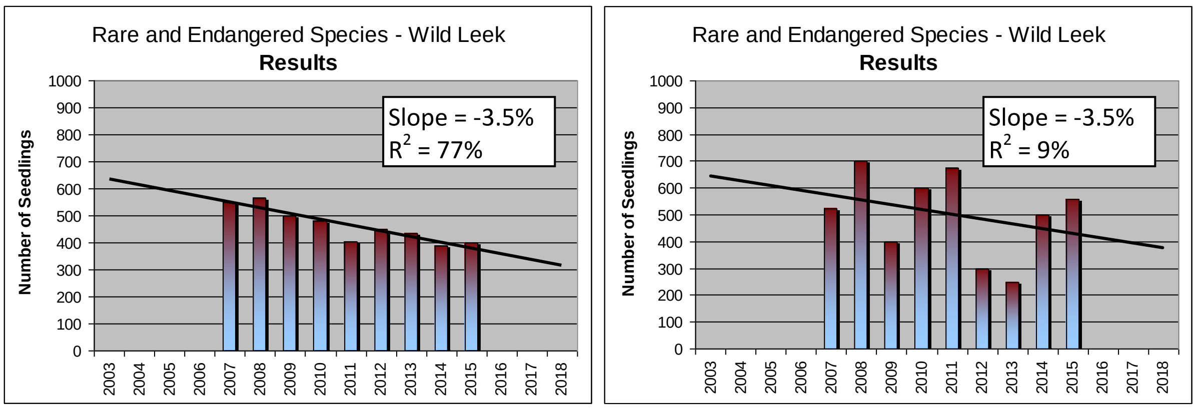


Figure 4.2: Two sample graphs with the same relative slope but varying determination coefficients (R^2).

Table 4: Extent of Correlation between Determination Coefficient (R^2) and Regression Line

R^2	Correlation
90% or more	Very high
50% to 89%	High
25% to 49%	Moderate
10% to 24%	Low
Less than 10%	Very low to nil

An R^2 value of less than 10% denotes a significant variation in the raw data. As a result, determining the existence of actual changes or if the item measured is naturally irregular becomes more difficult and those making judgments about the change should be more cautious. Class limits used in these cases are more conservative and amended to 4% and 10% rather than to 2% and 5%.

4.1.3. Treatment of Outliers

Some of the data gathered during fieldwork could be outliers. CEMs need to explore the possible causes of these in order to establish if: 1) the datum in question is in fact beyond standard range and 2) it reflects actual reality or points to methodology-related problems.

The recommendation is that, at the first sign of suspicious data quality, Dixon's Q test be performed on the complete raw data set for the indicator in question. The intent is to verify the datum mathematically to establish if it is truly an outlier. If it is, the next step would be an in-depth review of sampling conditions or of the methodology used. If adverse sampling conditions or potentially bias-inducing errors are identified, the data should be discarded. If suspect data remain a possibility (for reasons such as time of year or logistics, for example), the sampling must be redone. Otherwise, the monitoring is repeated the following year even if it had not been scheduled.

If data-gathering quality does not appear to be an issue, the datum will be retained. When a datum or data from subsequent years is/are available, Dixon's Q test can be repeated to confirm that the datum remains an outlier and should be excluded from the analysis, or to determine if these outliers do in fact reflect an abrupt change in the parameter measured.

When outliers are confirmed, they should be excluded from the analysis to avoid skewing of linear regression and R^2 calculations. These data, however, are only excluded from the analysis, not erased. If outliers for a particular indicator are found repeatedly over time but cannot be linked to methodology errors, they probably point to an actual behaviour of the item measured. Dixon's Q test allows for these situations and the excluded data should become part of the analysis once again.

4.2. Interpretation of Trend

4.2.1. Trend versus Change

For the EIMP's purposes, the distinction between trend and change is a function of the time span covered. Change (covered in the previous section) is interpreted on the basis of all available data. This meets the EIMP's primary goal, since it assesses the current situation against the one in place at the start of monitoring. Trend, however, focuses on the most recent years in which monitoring was carried out. An indicator may, for instance, show an overall rise in EI level versus initial monitoring after 10 years, but a downward trend could be observed for the last few times it was tracked (Figure 4.3).

Trend is a tool primarily intended for managers' use. The information it conveys provides a rationale for preventive or corrective actions, and enables assessment of the effectiveness and relevance of previous interventions. It can also prove useful when drawing up five-year reports, since it enables a clear distinction between actual changes since monitoring was begun versus trends that have developed since the last report was written.

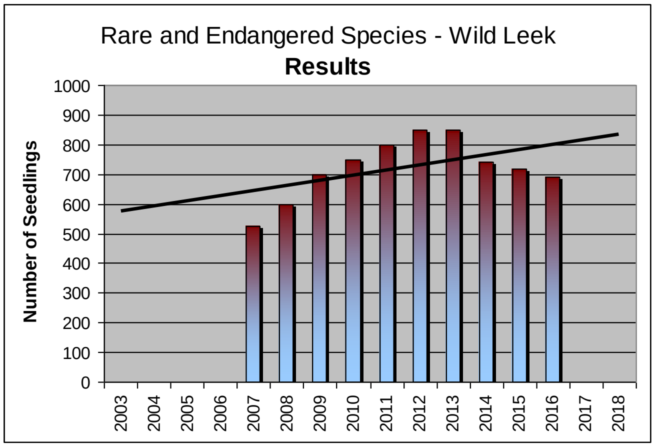


Figure 4.3: Example of an indicator showing an overall improved situation but a downward-shifting trend.

4.2.2. Trend Determination

Trend interpretation is a qualitative assessment process that is repeated with each new datum measured for a given indicator. The process requires CEMs to remain in monitoring mode at all times, always ready to act when negative trends are confirmed or apparent, or if previous actions do not produce the anticipated results. The CEMs can evaluate

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tendency by reviewing the most recent results surveyed. In some cases, this can be difficult to determine. In these cases the CEMs must determine the tendency using the precautionary principle.

4.3. Indicators and Park Management

4.3.1. Indicator Control Levels

Park managers do not enjoy the same degree of control over all items measured by indicators. While the results for some indicators are entirely dependent on management choices (e.g., infrastructure density), others vary based on factors beyond the managers' control (e.g., precipitation acidity). For several others, the level of control is mixed. Rare plants, for example, can be affected equally by both natural and anthropogenic pressures. However, managers can implement safeguards to help protect these species.

Control levels for any given indicator can also differ from one park to the next. An example is benthic fauna monitoring. If the drainage basin under study is located mostly upstream of park boundaries, the managers have no control over the results obtained. All they can do is record changes. On the other hand, if the drainage basin for another park falls entirely within the area or site, managers can be viewed as exercising more – but still partial – control over results, since these can also be influenced by a number of natural factors.

This distinction is important since an objective of the EIMP is to attempt to verify the overall adequacy of park management principles. Indicators are therefore grouped into three control levels: no control, partial control and complete control. This information, which is built into the scoring table described in Chapter 5, enables attribution of a separate management score (distinct from the overall score) that serves as a gauge of this specific aspect. The CEM and network coordinator determine indicator control levels for each individual park.

4.3.2. Statistical confidence

The statistical confidence for each indicator is determined so as to be able to evaluate the trustworthiness of the results obtained. This is established in relation to the coefficient of determination (R^2) and the statistical power which is associated with it (table 5). The calculation of statistical power is based on a 10 year reporting period, a 20% risk threshold, and a +/- 5% change in detection interval. However, the methodology used for the survey of certain indicators is not usable for the calculation of statistical power. In these cases, only the coefficient of determination is used. For some of the other indicators, the statistical confidence is inconclusive, for the raw data cannot be used to determine either the statistical power or the coefficient of determination.

In summary, the statistical confidence is a qualitative measure of the level of uncertainty in the results. The number of surveys completed and the size of an animal population are examples of factors that may influence to a greater or lesser extent the accuracy of the obtained results and therefore how reliable are the results shown by a given indicator.

Table 5: Determination of level of confidence for an indicator in relation to the intervals of statistical power and the coefficient of determination (R^2)

	Statistical Confidence			
Coefficient R^2 / Statistical Power	**0% - 9%**	**10% - 24%**	**25% - 49%**	**50% et +**
No analysis	Very low	Low	Average	Good
0% - 9%	Very low	Very low	Low	Low
10% - 24%	Very low	Low	Low	Average
25% - 49%	Low	Low	Average	Good
50% et +	Low	Average	Good	Good

4.3.3. Park Managers' Ownership of Results

When an indicator points to downward change that is either recent or can be traced back to the start of monitoring, the CEM is required to look into the situation and convey his/her findings to park management. Managers must first attempt to understand the causes and consequences of a situation. If these factors are unclear or unknown, more in-depth or more frequent monitoring – similar to development of a more thorough research project – must be planned in conjunction with specialists whose expertise is related to the targeted parameters.

The objective is to outline, as much as possible, the cause(s) of this decrease and the attendant ecological ramifications. This will also enable planning and implementation of methods to rectify or mitigate the situation, in the form of direct action in the field, adaptation of management practices or awareness-building among users or external stakeholders.

Reporting Results

5.1. Scoring Table

5.1.1. Guiding Principle and Target Audience

Québec's national parks are public areas, managed for the benefit of the general population. As the organization responsible for managing these areas, Sépaq is expected to report on its activities to government authorities and the general public. The EIMP is a tool that helps meet one aspect of this need: fulfillment of its conservation mission.

As indicated repeatedly in this document, managers who are directly involved in park operations will always draw upon raw data as their primary source of information. They have the expertise to analyze all the data, but deciphering this information can quickly become a complex process for audiences at other levels. The communication pyramid below (Figure 5.1) demonstrates the need to disseminate information differently, depending on the type of environment associated with each target audience.

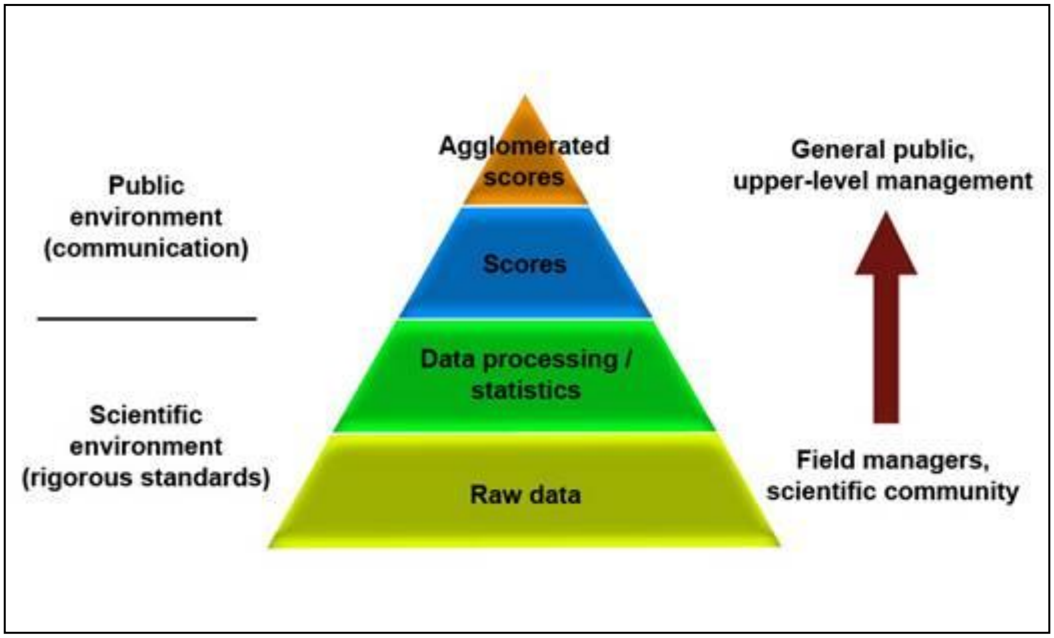

Figure 5.1: Communication pyramid to be used in an ecosystem monitoring program

To this end, a scoring table encompassing all indicators has been adopted since it meets the full range of communication needs, reaching upper-level management, government authorities, park visitors and the general public. This table was adapted from the model developed by NatureServe for the United States Environmental Protection Agency (EPA). It is set up as a multimetric index with colour symbols denoting changes measured by indicator and by parameter at the park level, and within the entire park. Perusal of this table therefore yields an overall view of changes in EI levels without any loss of the information provided by each indicator.

The scoring system process is summarized in Figure 5.2 and a sample scoring table is reproduced in Table 6. The process is detailed in subsequent sections, as are the various items listed in the table and the method of interpreting the information it contains.

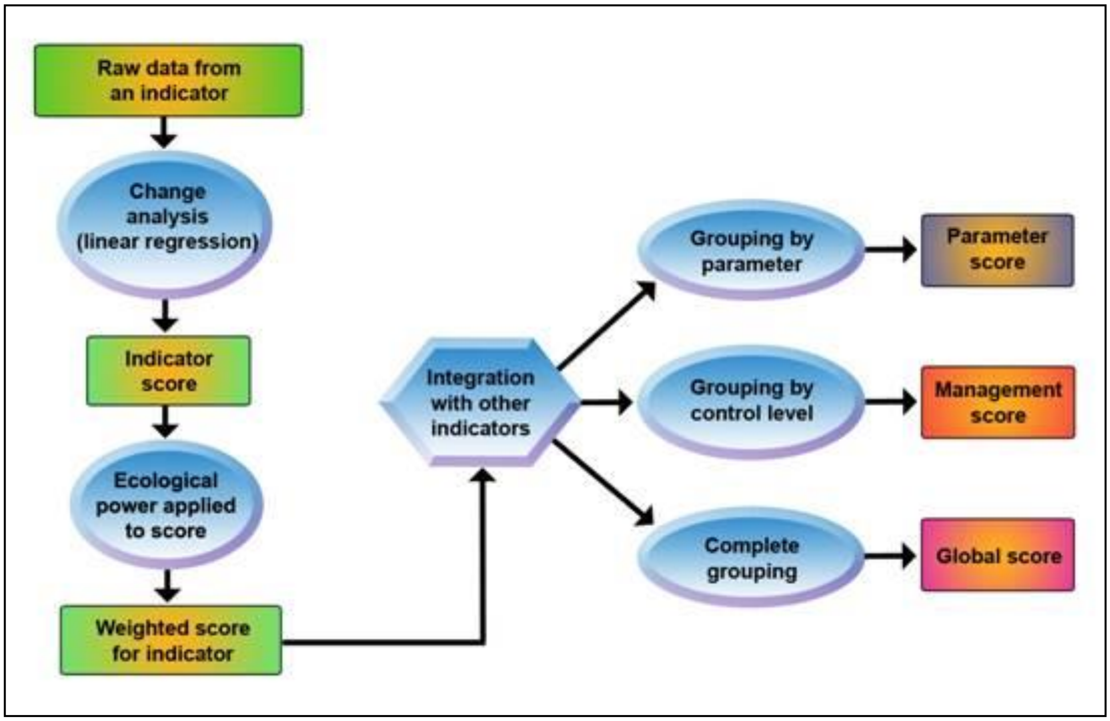

Figure 5.2: Summary of scoring system process, from raw data to agglomerated scores

Table 5: Example of a Scoring Table Listing EIMP Information for a Given Park, in Synthesized Form

Parc national de la Haute-Montagne

Scoring Table – Changes in EI Scores

	EP (mf)	Change – Weighted Score		Correlation	Trend	Control Level	Parameter Score / Correlation
AIR QUALITY							**0.33**
Precipitation acidity	1	H	1	Moderate	Improvement	None	S
Atmospheric pollutants	0.5	B	-0.5	High	Stable	None	Moderate
WATER QUALITY							**0.50**
Benthic fauna quality	1	H	1	Moderate	Stable	Partial	H
Lake acidity level	1	S	0	High	Deterioration	None	High
Lake trophic level	1	S	0	High	N/C	Partial	
Bact. & phys.-chem. stream water quality	1	H	1	High	Stable	Partial	
STATUS OF BIOCENOSIS							**-0.06**
Non-indigenous plant propagation	1	H	1	Moderate	Stable	Partial	S
Invasive exotic species	1	B	-1	Low – N/C	Deterioration	None	High
Environmental disturbances	0.5	S	0	Low – N/C	N/C	Partial	
Restoration of degraded sites	2	H	2	High	Improvement	Complete	
Importance of human and wildlife interactions	1	HS	2	High	Improvement	Partial	
Monitoring breeding birds	1	B	1	High	Stable	Partial	
Monitoring bats	1	B	-1	High	N/C	None	
Anuran listening route	1	BS	-2	High	Deterioration	None	
Monitoring Bicknell's thrush	2	S	0	High	N/C	Partial	
Monitoring a rare plant	2	S	0	Moderate	Stable	Partial	
EFE	1	H	1	High	Stable	None	
Fish resource quality	2	B	-2	Low – N/C	Stable	Partial	
LANDSCAPE SPATIAL ORGANIZATION							**0.40**
Infrastructure density	1	S	0	Low – N/C	N/C	Complete	H
Fragmentation	2	S	0	Low – N/C	Stable	Complete	Low – N/C
Periphery land use	2	H	2	Low – N/C	Improvement	None	
INFRASTRUCTURE QUALITY							**-0.67**
Hiking trail quality	0.5	S	0	Moderate	Deterioration	Complete	B
Campsite quality	0.5	B	-0.5	Moderate	N/C	Complete	Moderate
Water bank infrastructure quality	0.5	B	-0.5	High	N/C	Complete	

N/C = Inconclusive
HS = Significant increase
H = Increase
S = Stable
B = Decrease
BS = Significant decrease

Management score	0.11
	S
Correlation ▶	Moderate

Global score for park	0.09
	S
Correlation ▶	Moderate

5.1.2. EI Change: Scoring and Symbol Attribution

The scoring table model developed by NatureServe can be used to assess the state of an ecosystem by comparing it to a so-called “natural” baseline state. This model is based on a five-point scoring system (where 1 = "very poor" and 5 = "excellent") that defines the position of each measurement with respect to this baseline state. A weighted score is then arrived at by multiplying the score by a factor assigned to the indicators based on their significance (equivalent to ecological power in the EIMP).

The score was adjusted, for the EIMP, to reflect the change represented by measurements taken at baseline (in this case, conditions at the inception of monitoring). The score for any given indicator will therefore range between -2 and +2. A negative score represents a decrease in EI level, while a positive score denotes a rise. Table 7 lists all scores and colour codes that could be assigned to an indicator based on the changes it reflects.

Table 6: Symbols and Score to be Assigned to an Indicator Based on Change Depicted by the Relative Linear Regression Slope of the Associated Raw Data

	Classification of Linear Regression Slope (Relative Slope)	Significance	Colour	Symbol Assigned	Score
When the determination coefficient (R^2) **exceeds** 10%	> 5%	Significant increase	Green	HS	+2
	> 2%	Increase	Green	H	+1
	Between -2% and 2%	Stable	Blue	S	0
	< -2%	Decrease	Yellow	B	-1
	< -5%	Significant decrease	Red	BS	-2
When the determination coefficient (R^2) **falls below** 10%	> 10%	Significant increase	Green	HS	+2
	> 4%	Increase	Green	H	+1
	Between -4% and 4%	Stable	Blue	S	0
	< -4%	Decrease	Yellow	B	-1
	< -10%	Significant decrease	Red	BS	-2

5.1.3. Grouped Scores

The scoring table is useful since it groups the indicators' individual scores and develops agglomerated scores that integrate the information provided by all indicators. Changes in the parameters monitored or the state of the entire park can be reviewed more easily, without any loss of the detailed information from which these integrated scores were developed. The individual scores for each indicator (previous section) and its ecological power form the basis for these calculations.

5.1.3.1. Ecological Power

In the scoring table, ecological power (EP) is a multiplicative factor applied to the individual score assigned to an indicator in order to weight its significance within an agglomerated score. Multiplicative factors by EP level are listed in Table 8. The base score of an EP Level 1 indicator will be doubled, thus assuming greater significance in an agglomerated score. For an EP Level 3 indicator, the score – and, therefore, its significance in an agglomerated score – will be halved.

Table 7: Multiplicative Factors by EP Level

EP Level	Multiplicative Factor
1	2
2	1
3	0.5

As stated in Section 2.5., spatial coverage is assessed individually for each monitoring since logistics and the sampling exercise can vary greatly from one park to another. The assessment is performed, in each park, by the EIMP coordinator and the CEM. Spatial coverage is a multiplicative factor added onto that of EP. When a sampling (or an enumeration) is defined as representative of the entire park, a multiplicative factor of 1 is assigned, indicating that EP is not restricted by the methodology in place. As the spatial coverage of a sampling diminishes (see Table 3, Section 2.5.), the multiplicative factor also drops. Markers used to define this multiplicative factor are arrived at using a statistical analysis tool (in development as of this writing) devised as part of a specific research project dealing with the issue of indicator representativeness.

5.1.3.2. Weighted Score by Indicator

Two items are required to establish an indicator's weighted score: the score it was assigned and the EP multiplicative factor. This weighted score is then used to work out agglomerated scores. The weighted score for an indicator is calculated using the following formula:

Score X Ecological Power = Weighted Score

This score will range between -2 and +2 (see Table 7), and the ecological power is the product of:

1) AHP assessment, which defines a level (1, 2 or 3) to which a multiplicative factor is then assigned (see Table 8)

2) a multiplicative factor of 1 or less, based on the conclusions of a statistical analysis tool used to track the representativeness of the monitoring process.

The first column in the scoring table (see Table 6) indicates the final multiplicative factor for the EP in question, i.e., the product of the two multiplicative factors described above. Column 2 provides the following information: the change measured by the indicator, coded by colour and assigned a letter symbol, and the weighted score in numeric form.

5.1.3.3. Parameter Score

The score for a single parameter is calculated by combining the results of indicators for that parameter (air quality, water quality, status of biocenosis, landscape spatial organization, infrastructure quality). This process involves the use of the indicators' individual weighted scores, which are combined into a weighted average by applying the formula set out below:

$$\frac{\sum \textit{Weighted scores for parameter indicators}}{\sum \textit{EP of all parameter indicators}}$$

This weighted average, the parameter's EI score, varies between -2 and +2 based on the reasoning applied when working out an indicator's individual score. Since this is an average, however, the score is no longer a whole number and will be interpreted according to the classification in Table 9. The span for these score groupings is 0.8, since five different interpretations exist for a possible range of four values (-2 to +2).

Table 8: Score Classifications by Parameter and Symbol Attribution for Scores

Score Grouping Span	Significance	Colour	Symbol Assigned
1.2 to 2	Significant increase	Green	HS
0.4 to 1.2	Increase	Green	H
-0.4 to 0.4	Stable	Blue	S
-1.2 to -0.4	Decrease	Yellow	B
-2 to -1.2	Significant decrease	Red	BS

In the scoring table (see Table 6), changes in EI scores by parameter – score and symbol assigned – are listed in the final column. Using these scores, the park's status can be worked out based on each structuring parameter for EI in the area or site, so the reader is able to compare parameters and analyze those that show positive change and those presenting problems. The influence of each indicator can be determined at a glance, since all of the results are listed in this table.

5.1.3.4. Global Score for Park

Using the same reasoning as that applied to the parameters, the change in global EI score for a given park is a combination of weighted individual scores for all indicators monitored within the park. This score is also interpreted based on the classifications listed in Table 9. The formula used for the calculation is:

$$\frac{\sum \textit{Weighted score of all indicators monitored}}{\sum \textit{EP of all indicators monitored}}$$

The score and symbols that identify the global picture in this park are listed at the end of the scoring table (see Table 6). This table summarizes, under a single score and colour, all EI information measured in the park. This table is equivalent to the topmost level of the communication pyramid and conveys a clear, comprehensible message to the audience targeted.

5.1.3.5. Management Score

The "control level" concept discussed in Section 4.3. is also built into the scoring table, so that the score obtained more closely reflects the quality of general management principles. The calculations are based on the same reasoning as that applied to the previous scores, with a multiplicative factor based on control level added to the individual weighted score for the indicator. These multiplicative factors are listed in Table 10.

Table 9: Multiplicative Factors, Tied to Indicator Control Levels

Control Level	Multiplicative Factor (mf)
Complete	1
Partial	0.5
None	0

As such, indicators are excluded from the analysis (multiplicative factor = 0) if their results are beyond the manager's control, and the significance is halved if control is deemed partial. Interpretation of this score is also based on the classifications set out in Table 9. The following formula is used when performing the calculations:

$$\frac{\Sigma\left(\textit{single indicator weighted score X control level mf}\right)}{\Sigma\ \textit{EP of "complete" and "partial" indicators}}$$

The management score and symbol attributed appear at the end of the scoring table (see Table 6). This management score will be higher than the park's global score if the indicators over which managers have complete or partial control generally fare better than do indicators beyond their control. Conversely, the management score will be lower if indicators beyond the managers' control show better overall EI change.

5.1.4. Correlation Symbols

The correlation between changes in these data and the time elapsed since the start of monitoring can be verified by applying the determination coefficient (R^2) of the linear regression line for a raw data string. The R^2 value simply expresses the strength of this correlation and, therefore, the reliability of any assumption that the direction and slope of the regression line do in fact bespeak the existence and significance of a change in EI level. Table 4 (Section 4.1.2.) lists the R^2 classifications and their interpretation. In the scoring table, correlation classifications are broken down into three levels and colour-coded as shown in Table 11 below.

Table 10: Correlation Classifications and Symbol Attribution

R^2	Correlation	Colour	Symbol Attribution
50% and over	High	Green	High
25% to 49%	Moderate	Yellow	Moderate
0% to 24%	Low or inconclusive	Orange	Low – N/C

In the scoring table (see Table 6), the colour coding shown is not used to correlate individual indicators in order to avoid information overload. Colours are used solely to classify the correlation levels of agglomerated scores.

Correlation of agglomerated scores is based on that of indicators used to determine the score. Individual indicator correlations are converted to numbers, where High = 2, Moderate = 1 and Low or N/C = 0. The average is calculated and the correlation for the agglomerated score selected based on the classifications in Table 12.

Table 11: Classifications Used to Determine Correlations for Agglomerated Scores

Average Calculated	Correlation
1.33 to 2.0	High
0.67 to 1.33	Moderate
0 to 0.67	Low or inconclusive

Combined with the details of EI level change, this information gives the reader an additional tool for interpreting, more realistically and cautiously, the significance attributed to changes reflected in these indicators.

5.1.5. Symbol Attribution: Trend

The scoring table only shows the trend established, through analysis of the most recent raw data, for individual indicators. This tool, primarily for use by managers, also provides additional interesting information about recent changes in EI. Symbol attribution for this is set out in Table 13.

In order to avoid information overload in the scoring table, only cases of improvement and deterioration are colour-coded.

Table 12: Trend Symbol Attribution

Trend	Colour	Symbol Attribution
Improvement	Green	Improvement
Stable	White	Stable
Deterioration	Orange	Deterioration
Inconclusive	White	N/C

5.2. Five-year Reports

After 10 years of preparation, 2014 marks the first publication of the EIMP report. It contains the survey results gathered from 2003 to 2012. It details the changes in ecological integrity within the parks managed by the Sépaq under Parks Quebec. This report presents the analysis and interpretation of each park's result and highlights the most important details. Henceforth, a new report will be produced every five years.

The 2003-2012 report can be accessed from the Sépaq website at the following address:
www.parcsquebec.com/ecologicalintegrity

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Appendices

1- List of network indicators
2- Indicator lists by national park
    A. Parc national d'Aiguebelle
    B. Parc national d'Anticosti
    C. Parc national du Bic
    D. Parc national du Fjord-du-Saguenay
    E. Parc national de Frontenac
    F. Parc national de la Gaspésie
    G. Parc national des Grands-Jardins
    H. Parc national des Hautes-Gorges-de-la-Rivière-Malbaie
    I. Parc national de l'Île-Bonaventure-et-du-Rocher-Percé
    J. Parc national des Îles-de-Boucherville
    K. Parc national de la Jacques-Cartier
    L. Parc national du Lac-Témiscouata
    M. Parc national de Miguasha
    N. Parc national du Mont-Mégantic
    O. Parc national du Mont-Orford
    P. Parc national du Mont-Saint-Bruno
    Q. Parc national des Monts-Valin
    R. Parc national du Mont-Tremblant
    S. Parc national d'Oka
    T. Parc national de Plaisance
    U. Parc national de la Pointe-Taillon
    V. Parc national de la Yamaska
    W. Parc marin du Saguenay–Saint-Laurent
3- Template: descriptive file
4- Template: methodology file

APPENDIX 1 – List of Network Indicators

	Parameter	Indicator	Methodology
Ecosystem components	Air quality	Precipitation acidity	• Precipitation pH – MDDEFP stations
		Atmospheric pollutants	• Air quality index – MDDEFP stations
	Water quality	Benthic fauna quality	• SurVol Benthos (replacing IBGN from 2013)
		Lake acidity level	• pH of selected lakes
		Lake trophic level	• Voluntary lake surveillance network
		Bacterial and physicochemical stream water quality	• Bacterial and physicochemical water quality index
	Status of biocenosis	Non-indigenous plant propagation	• Quadra sampling
		Invasive exotic species	• Species list
		Influence of anthropogenic events on natural processes	• Disturbance/restoration index
		Significance of human and wildlife interactions	• Depredation index
		Situation of selected fauna species	• Monitoring of diverse indicator species or indicator species groups
		Rare and endangered species situation	• Monitoring of diverse rare and endangered species
		Exceptional or fragile habitat quality	• Monitoring of exceptional or fragile habitats
		Fish resource quality	• Fishing quality index
Human components	Landscape spatial organization	Infrastructure density	• Infrastructure density index
		Fragmentation	• Landscape dissection index
		Periphery land use	• Land use index
	Infrastructure quality	Hiking trail quality	• Hiking trail width
		Campsite quality	• Degradation index
		Water bank infrastructure quality	• External impact degradation index

APPENDIX 2 – Indicator Lists by Park

(As of March 2014)

A — Parc national d'AIGUEBELLE

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring Small mammals	1-3-05-107
			Monitoring the Pine Marten	1-3-05-104
		Rare and endangered species situation	Monitoring the Northern Oak Fern	1-3-06-505
		Exceptional or fragile habitat quality	Monitoring heron nesting sites	1-3-07-004
			Monitoring cliff vegetation	1-3-07-014
		Fish resource quality	Fishing quality index	1-3-08-001
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation index	2-2-03-001

B — Parc national d'ANTICOSTI

	Parameter	Indicator	Methodology	Code
Ecosystem components	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
		Lake acidity level	PH of selected lakes	1-2-02-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring bats	1-3-05-101
		Rare and endangered species situation	Monitoring the Bald Eagle	1-3-06-004
			Monitoring Atlantic Salmon – 1	1-3-06-302
			Monitoring the Fairy Slipper	1-3-06-506
		Exceptional or fragile habitat quality	Monitoring EFEs – Fir forest, White Spruce and White Pine	1-3-07-001A
			Monitoring EFEs – lac Wickenden old growth forest	1-3-07-001B
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001

C – Parc national du BIC

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
		Bacterial and physicochemical stream water quality	Bacterial and physicochemical water quality index	1-2-04-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring bats	1-3-05-101
			Anuran listening route	1-3-05-201
		Rare and endangered species situation	Monitoring the Cutleaf Fleabane	1-3-06-507
		Exceptional or fragile habitat quality	Monitoring EFEs – White Spruce forest, lichen and Arctostaphylos	1-3-07-001A
			Monitoring EFEs – Red Pine forest	1-3-07-001B
			Marsh monitoring program	1-3-07-005
		Fish resource quality	Quahog harvest	1-3-08-004
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation percentage	2-2-03-002

D – Parc national du FJORD-DU-SAGUENAY

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
		Lake trophic level	Trophic rating measurement	1-2-03-003
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Anuran listening route	1-3-05-201
			Monitoring stream salamanders	1-3-05-202
			Monitoring ground beetles and snout beetles	1-3-05-401
		Rare and endangered species situation	Monitoring the Peregrine Falcon	1-3-06-001
			Monitoring the Striated Coral-root	1-3-06-521
		Exceptional or fragile habitat quality	Monitoring EFEs – Red Pine and White Pine forest	1-3-07-001
			Monitoring marine terraces	1-3-07-512
		Fish resource quality	Fishing quality index	1-3-08-001
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation index	2-2-03-001

E – Parc national de FRONTENAC

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
		Atmospheric pollutants	Air quality index – MDDEFP stations	1-1-02-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
		Lake trophic level	Water clarity	1-2-03-002
		Bacterial and physicochemical stream water quality	Phosphorus concentration	1-2-04-003
			Fecal coliform concentration	1-2-04-004
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
			Monitoring Common Reed	1-3-02-002
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Avian monitoring	1-3-05-005
			Anuran listening route	1-3-05-201
			Ichthyological quality index	1-3-05-302
		Rare and endangered species situation	Monitoring the Bald Eagle	1-3-06-003
			Monitoring Peatland Orchids	1-3-06-508
		Exceptional or fragile habitat quality	Monitoring a lacustrine habitat	1-3-07-002
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
		Periphery activities	Pressures of adjacent activities	2-1-05-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation percentage	2-2-03-002

F – Parc national de la GASPÉSIE

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Winter monitoring – Mustelidae	1-3-05-109
			Anuran listening route	1-3-05-201
		Rare and endangered species situation	Monitoring Caribou	1-3-06-101
			Monitoring the Greenscale Willow	1-3-06-514
		Exceptional or fragile habitat quality	Monitoring EFEs – old-growth fir forest	1-3-07-001
			Monitoring arctic-alpine vegetation	1-3-07-006
		Fish resource quality	Fishing quality	1-3-08-001
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation index	2-2-03-001

G – Parc national des GRANDS-JARDINS

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
		Lake acidity level	pH of selected lakes	1-2-02-001
		Lake trophic level	Voluntary lake surveillance network	1-2-03-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring the Common Loon	1-3-05-002
			Monitoring birds in a lacustrian environment	1-3-05-004
			Anuran listening route	1-3-05-201
			Monitoring Brook Trout habitat	1-3-05-303
		Rare and endangered species situation	Monitoring Common Nighthawk	1-3-06-006
			Monitoring Arctic Char	1-3-06-301
		Exceptional or fragile habitat quality	Monitoring EFEs – boreal forest	1-3-07-001
			Monitoring arctic-alpine vegetation	1-3-07-006
		Fish resource quality	Fishing quality index	1-3-08-001
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation index	2-2-03-001

H – Parc national des HAUTES-GORGES-DE-LA-RIVIÈRE-MALBAIE

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN form 2013)	1-2-01-001
		Lake trophic level	Voluntary lake surveillance network	1-2-03-001
		Bacterial and physicochemical stream water quality	Bacterial and physicochemical water quality index	1-2-04-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring the Pine Marten	1-3-05-104
			Anuran listening route	1-3-05-201
			Monitoring Stream Salamanders	1-3-05-202
		Rare and endangered species situation	Monitoring Bicknell's Thrush	1-3-06-002
			Monitoring Arctic Char	1-3-06-301
		Exceptional or fragile habitat quality	Monitoring EFEs – Maple forest, Elm and Ash	1-3-07-001
			Monitoring arctic-alpine vegetation	1-3-07-006
		Fish resource quality	Fishing quality index	1-3-08-001
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation index	2-2-03-001

I – Parc national de l'ÎLE-BONAVENTURE-ET-DU-ROCHER-PERCÉ

	Parameter	Indicator	Methodology	Code
Ecosystem components	Water quality	Bacterial and physicochemical stream water quality	Mercury content in Northern gannet eggs	1-2-04-005
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring seabirds	1-3-05-003
			Monitoring bats	1-3-05-101
			Monitoring ground beetles and snout beetles	1-3-05-401
		Rare and endangered species situation	Monitoring the Dense Whitlowgrass	1-3-06-512
		Exceptional or fragile habitat quality	Monitoring net productivity in Northern Gannet colony	1-3-07-010
		Fish resource quality	Status of lobster stocks	1-3-08-005
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001

J – Parc national des ÎLES-DE-BOUCHERVILLE

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
		Atmospheric pollutants	Air quality index – MDDEFP stations	1-1-02-001
	Water quality	Bacterial and physicochemical stream water quality	Bacterial and physicochemical water quality index	1-2-04-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring bats	1-3-05-101
			Anuran listening route	1-3-05-201
		Rare and endangered species situation	Monitoring the Brown Snake	1-3-06-201
			Monitoring the Eastern Spring Beauty	1-3-06-513
		Exceptional or fragile habitat quality	Monitoring EFEs – Basswood, Red Ash	1-3-07-001A
			Monitoring EFEs – Red Oak, Sllver Maple	1-3-07-001B
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Water bank infrastructure quality	External impact degradation index	2-2-03-001

K – Parc national de la JACQUES-CARTIER

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
		Lake acidity level	PH of selected lakes	1-2-02-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring bats	1-3-05-101
			Habitat suitability index of moose	1-3-05-108
			Anuran listening route	1-3-05-201
		Rare and endangered species situation	Monitoring Arctic Char	1-3-06-301
			Monitoring Atlantic Salmon	1-3-06-303
		Exceptional or fragile habitat quality	Monitoring EFEs – Yellow Birch, Fir, Elm, Ash	1-3-07-001
		Fish resource quality	Fishing quality index	1-3-08-001
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation index	2-2-03-001

L – Parc national du LAC-TÉMISCOUATA

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
		Atmospheric pollutants	Air quality index – MDDEFP stations	1-1-01-002
	Water quality	Benthic fauna quality	SurVol Benthos	1-2-01-002
		Lake acidity level	PH of selected lakes	1-2-02-001
		Lake trophic level	Voluntary lake surveillance network	1-2-03-001
		Bacterial and physicochemical stream water quality	Bacterial and physicochemical water quality index	1-2-04-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring bats	1-3-05-101
			Anuran listening route	1-3-05-201
			Monitoring Lake whitefish	1-3-05-301
		Rare and endangered species situation	Monitoring the Bald Eagle	1-3-06-003
			Monitoring the Fairy Slipper	1-6-06-506
			Monitoring Leiberg's Waterlily	1-3-06-505
		Exceptional or fragile habitat quality	Monitoring EFEs – Red Pine forest, Eastern White Pine	1-3-07-001
			Monitoring Clinton's Club-rush	1-3-07-009
		Fish resource quality	Fishing quality index	1-3-08-001
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation percentage	2-2-03-002

M – Parc national de MIGUASHA

	Parameter	Indicator	Methodology	Code
Ecosystem components	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
Ecosystem components	Status of biocenosis	Invasive exotic species	Species list	1-3-02-001
Ecosystem components	Status of biocenosis	Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
Ecosystem components	Status of biocenosis	Significance of human and wildlife interactions	Depredation index	1-3-04-001
Ecosystem components	Status of biocenosis	Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
Ecosystem components	Status of biocenosis	Situation of selected fauna species	Monitoring bats	1-3-05-101
Ecosystem components	Status of biocenosis	Situation of selected fauna species	Monitoring stream salamanders	1-3-05-202
Ecosystem components	Status of biocenosis	Rare and endangered species situation	Monitoring orchids	1-3-06-509
Ecosystem components	Status of biocenosis	Exceptional or fragile habitat quality	Monitoring cliff retreat	1-3-07-008
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
Human components	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001

N – Parc national du MONT-MÉGANTIC

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
		Atmospheric pollutants	Air quality index – MDDEFP stations	1-1-02-001
		Light pollution	Celestial spectrophotometry	1-1-04-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring bats	1-3-05-101
			Monitoring Moose yarding areas	1-3-05-102
			Anuran listening route	1-3-05-201
		Rare and endangered species situation	Monitoring Bicknell's Thrush	1-3-06-002
			Monitoring Wild Leek – 1	1-3-06-501
		Exceptional or fragile habitat quality	Monitoring EFEs – Fir forest, Mountain Woodsorrel	1-3-07-001
			Monitoring arctic-alpine plants – Northern Gentian	1-3-07-007A
			Monitoring arctic-alpine plants – Highland Rush	1-3-07-007B
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001

O – Parc national du MONT-ORFORD

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
		Atmospheric pollutants	Air quality index – MDDEFP stations	1-1-02-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
		Lake trophic level	Voluntary lake surveillance network	1-2-03-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring the Common Loon	1-3-05-002
			Monitoring Moose yarding areas	1-3-05-106
			Anuran listening route	1-3-05-201
			Monitoring stream salamanders	1-3-05-202
		Rare and endangered species situation	Monitoring Wild Leek – 2	1-3-06-502
			Monitoring a threatened plant	1-3-06-517
		Exceptional or fragile habitat quality	Monitoring EFEs – Red Oak	1-3-07-001
			Monitoring peat bogs	1-3-07-003
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	Degradation index	2-2-03-001

P – Parc national du MONT-SAINT-BRUNO

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Atmospheric pollutants	Air quality index – MDDEFP station	1-1-02-001
	Water quality	Lake acidity level	PH of selected lakes	1-2-02-001
		Lake trophic level	Voluntary lake surveillance network	1-2-03-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring bats	1-3-05-101
			Anuran listening route	1-3-05-201
		Rare and endangered species situation	Monitoring Showy Orchis	1-3-06-503
			Monitoring Broad Beech-fern	1-3-06-515
		Exceptional or fragile habitat quality	Monitoring EFEs – Sugar Maple-Hickory Stand	1-3-07-001A
			Monitoring EFEs – Red Oak, Sugar Maple	1-3-07-001B
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Water bank infrastructure quality	Degradation index	2-2-03-001

Q – Parc national des MONTS-VALIN

	Parameter	Indicator	Methodology	Code
Ecosystem components	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
		Lake acidity level	PH of selected lakes	1-2-02-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring bats	1-3-05-101
			Anuran listening route	1-3-05-201
		Rare and endangered species situation	Monitoring Bicknell's Thrush	1-3-06-002
			Monitoring Robinson's Hawkweed	1-3-06-504
		Exceptional or fragile habitat quality	Monitoring arctic-alpine vegetation	1-3-07-006
		Fish resource quality	Fishing quality index	1-3-08-001
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation percentage	2-2-03-002

R – Parc national du MONT-TREMBLANT

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
		Atmospheric pollutants	Air quality index – MDDEFP stations	1-1-02-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
		Bacterial and physicochemical stream water quality	Bacterial and physicochemical water quality index	1-2-04-001
			MDDEFP bathing water monitoring	1-2-04-002
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring the Common Loon	1-3-05-002
			Monitoring bats	1-3-05-101
			Anuran listening route	1-3-05-201
		Rare and endangered species situation	Monitoring Bicknell's Thrush	1-3-06-002
			Monitoring Robinson's Hawkweed	1-3-06-504
		Exceptional or fragile habitat quality	Monitoring EFEs – Red Oak	1-3-07-001
			Monitoring heron nesting sites	1-3-07-004
		Fish resource quality	Fishing quality index	1-3-08-001
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation index	2-2-03-001

S – Parc national d'OKA

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
Ecosystem components	Air quality	Atmospheric pollutants	Air quality index – MDDEFP stations	1-1-02-001
Ecosystem components	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
Ecosystem components	Water quality	Lake acidity level	PH of selected lakes	1-2-02-001
Ecosystem components	Water quality	Bacterial and physicochemical stream water quality	MDDEFP bathing water monitoring	1-2-04-002
Ecosystem components	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
Ecosystem components	Status of biocenosis	Invasive exotic species	Species list	1-3-02-001
Ecosystem components	Status of biocenosis	Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
Ecosystem components	Status of biocenosis	Significance of human and wildlife interactions	Depredation index	1-3-04-001
Ecosystem components	Status of biocenosis	Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
Ecosystem components	Status of biocenosis	Situation of selected fauna species	Monitoring bats	1-3-05-101
Ecosystem components	Status of biocenosis	Situation of selected fauna species	Anuran listening route	1-3-05-201
Ecosystem components	Status of biocenosis	Rare and endangered species situation	Situation of rare and endangered plant species	1-3-06-516
Ecosystem components	Status of biocenosis	Rare and endangered species situation	Monitoring a threatened plant	1-3-06-517
Ecosystem components	Status of biocenosis	Exceptional or fragile habitat quality	Monitoring EFEs – Sugar Maple-Hickory Stand	1-3-07-001A
Ecosystem components	Status of biocenosis	Exceptional or fragile habitat quality	Monitoring EFEs – White Oak	1-3-07-001B
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
Human components	Landscape spatial organization	Fragmentation	Landscape dissection index	2-1-02-001
Human components	Landscape spatial organization	Periphery land use	Land use index	2-1-03-001
Human components	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
Human components	Infrastructure quality	Campsite quality	Degradation index	2-2-02-001

T – Parc national de PLAISANCE

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
	Water quality	Bacterial and physicochemical stream water quality	Bacterial and physicochemical water quality index	1-2-04-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring bats	1-3-05-101
			Anuran listening route	1-3-05-201
		Rare and endangered species situation	Monitoring the Four-toed Salamander	1-3-06-203
			Monitoring the Common Hackberry	1-3-06-518
		Exceptional or fragile habitat quality	Monitoring EFEs – Maple Grove, Red Oak	1-3-07-001A
			Monitoring EFEs – Silver Maple, Black Ash	1-3-07-001B
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
		Periphery activities	Pressure—water game hunt	2-1-05-002
			Illegal snowmobile traffic	2-1-05-003
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation index	2-2-03-001
			External impact degradation percentage	2-2-03-002

U – Parc national de la POINTE-TAILLON

	Parameter	Indicator	Methodology	Code
	Water quality	Lake acidity level	pH of selected lakes	1-2-02-001
		Bacterial and physicochemical stream water quality	MDDEFP bathing water monitoring	1-2-04-002
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring moose	1-3-05-102
			Anuran listening route	1-3-05-201
		Rare and endangered species situation	Monitoring relict plants	1-3-06-519
			Monitoring Dragon's Mouth	1-3-06-520
		Exceptional or fragile habitat quality	Monitoring coastal dune	1-3-07-011
			Monitoring shoreline erosion	1-3-07-013
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation percentage	2-2-03-002

V – Parc national de la YAMASKA

	Parameter	Indicator	Methodology	Code
Ecosystem components	Air quality	Precipitation acidity	Precipitation pH – MDDEFP stations	1-1-01-001
		Atmospheric pollutants	Air quality index – MDDEFP stations	1-1-02-001
	Water quality	Benthic fauna quality	SurVol Benthos (replacing IBGN from 2013)	1-2-01-001
		Lake acidity level	pH of selected lakes	1-2-02-001
		Lake trophic level	Voluntary lake surveillance network	1-2-03-001
		Bacterial and physicochemical stream water quality	Bacterial and physicochemical water quality index	1-2-04-001
	Status of biocenosis	Non-indigenous plant propagation	Quadra sampling	1-3-01-001
		Invasive exotic species	Species list	1-3-02-001
		Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Significance of human and wildlife interactions	Depredation index	1-3-04-001
		Situation of selected fauna species	Monitoring breeding birds	1-3-05-001
			Monitoring bats	1-3-05-101
			Monitoring small mammals	1-3-05-107
			Anuran listening route	1-3-05-201
		Rare and endangered species situation	Monitoring the Red-shouldered Hawk	1-3-06-005
			Monitoring Wild Leek	1-3-06-502
		Fish resource quality	Monitoring – ice fishing	1-3-08-006
Human components	Landscape spatial organization	Infrastructure density	Infrastructure density index	2-1-01-001
		Fragmentation	Landscape dissection index	2-1-02-001
		Periphery land use	Land use index	2-1-03-001
	Infrastructure quality	Hiking trail quality	Hiking trail width	2-2-01-001
		Campsite quality	Degradation index	2-2-02-001
		Water bank infrastructure quality	External impact degradation index	2-2-03-001

W – Parc marin du SAGUENAY–SAINT-LAURENT

	Parameter	Indicator	Methodology	Code
Ecosystem components	Water quality	Eutrophication survey	Toxic algae monitoring	1-2-03-004
			Primary production monitoring	1-2-03-005
			Quantity of fertilizer used in agricultural areas	1-2-03-006
		Bacterial and physicochemical stream water quality	Quality of water treatment systems	1-2-04-006
			Chemical contamination of soft shell clams	1-2-04-007
		Contamination by hydrocarbons and other toxic substances	Accidental spill survey	1-2-05-001
	Status of biocenosis	Influence of anthropogenic events on natural processes	Disturbance/restoration index	1-3-03-001
		Situation of selected fauna species	Sea bird monitoring	1-3-05-006
			Harbour seal monitoring	1-3-05-110
		Rare and endangered species situation	Barrow's goldeneye monitoring	1-3-06-007
			Beluga monitoring	1-3-06-102
			Large rorquals monitoring	1-3-06-103
		Exceptional or fragile habitat quality	Marine prey monitoring	1-3-07-015
			Herbaceous littoral zone monitoring	1-3-07-016
		Fish resource quality	Ice fishing monitoring	1-3-08-006
			Rainbow smelt monitoring	1-3-08-007
			Sea-run brook trout monitoring	1-3-08-008
			Green sea urchin monitoring	1-3-08-009
Human components	Landscape spatial organization	Periphery land use	Land use index	2-1-03-001
		Disturbance due to human activity	Number of vessels at observation points	2-1-04-001
			Number of recreational vessel passages	2-1-04-002
			Number of commercial vessel passages	2-1-04-003

Appendix 3 – Template: Descriptive File

Component		**Parameter**	
Indicator			
Methodology			
Item(s) measured			
Recommended frequency			
Postulate			
Justification			
Protocol			
Unit of measurement			

Ecological power	
Control level	

References	

Appendix 4 – Template: Methodology File

Park	**Parc national…**
Indicator	
Methodology	
Frequency	

Description

Short description of monitoring performed

Unit of measurement

What is measured and unit of measurement used

Performed by

Individual(s), job class(es) or department(s) responsible for carrying out the monitoring

Methodology

Details of protocol to be followed or link to existing protocol

Completion date(s)

Exact point in time at which the various steps of the monitoring process were completed

Contact(s)

External specialist(s) or internal resource(s) who can help implement monitoring

Reference documents

Original protocol or other document(s) that may prove useful in implementing and carrying out the monitoring process

Cartography and site description(s)

Specific location and detailed description of monitoring site(s)

EIMP ECOLOGICAL INTEGRITY MONITORING PROGRAM
Parcs Québec Network

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