

Earth Observations Technology: Ecological Integrity Monitoring & Reporting

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Major Focus

- Utilization of EO-technology at an operational level
- Transfer of technology oriented research partnerships

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EO Technology Utilization

- National Park System Characteristics
- Legislative mandate for the Ecological Integrity (EI) Monitoring & Reporting for each National Park

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Parks Canada Highlights

- 42 National parks
- Land withdrawn
- 3 National marine conservation areas

Total National Parks Area
• 276 182 km²
• 2.7% of Canada

+ 153 historic sites managed by Parks Canada

Range in person-visits per year from Auyuittuq, 300 to Banff: 5 million

Largest is Wood Buffalo 44 802 km²

Smallest is Point Pelee 8.3 km²

Gwaii Haanas

Fathom Five

Saguenay

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Completing Canada's National Park System



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A Science Vision for National Parks

National parks are known as "Centres of ecological understanding,"

- where science knowledge is incorporated into park management

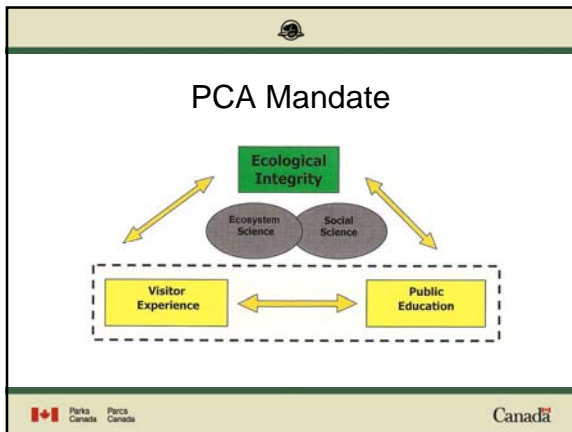
Parks are viewed as living laboratories - knowledge of natural ecosystems

- active partnerships with Aboriginal peoples, social and natural scientists from universities and other science-based agencies, industry, provincial and territorial authorities, and regional and local communities.

National parks have become benchmarks

- can understand human impacts on an ecosystem scale
- cross-country system of benchmarks that monitor such things as the persistence of species at risk, changes in biodiversity, and the impact of climate change.

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Ecological Integrity (EI)

"...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."

Ecological Integrity Program...

"Maintenance or restoration of ecological integrity through the protection of natural resources and natural processes, shall be the first priority of the Minister when considering all aspects of the management of parks"

(Canada National Parks Act, 2000)

- ### EI Monitoring and Reporting
- National EI Monitoring and Reporting Programme (2003)
 - State of the Park Report every 5 year for each Park
 - EI in the context of Greater Park Ecosystem (GPE)
 - Progress made towards achieving the goals of previous park management plan
 - State of the Protected Heritage Areas Reports every 2 years at National Level

Fundamental Monitoring Questions

1. What is our vision of EI for our park?
2. What is the present state of park EI?
3. How has overall park EI changed over the last 5 years?
4. Are we approaching or departing from our vision?

THE INFORMATION ICEBERG
Finding Common Language

INDICATORS or INDICES

Public Environment

Scientific Environment

STATISTICS

DATA

MEASUREMENTS

Ecological integrity assessment framework

BIODIVERSITY	ECOSYSTEM FUNCTION	STRESSORS
<u>Species Richness</u> Changes Number, extent of exotics <u>Population dynamics of indicator species</u> Mortality/birth rates Immigration/emigration Population viability <u>Trophic structure</u> Size class distribution of all taxa Predation levels	<u>Succession/ Retrogression</u> Disturbance frequency size - fire, insects, flooding Vegetation age class <u>Productivity</u> Landscape or by site <u>Decomposition</u> By site <u>Nutrient retention</u> Ca, N by site	<u>Land use patterns</u> Land use, road density Population density Population density <u>Habitat fragmentation</u> Patch size Interpatch distance Forest interior <u>Pollutants</u> Long-range transportation <u>Climate</u> Weather data Frequency of extreme events

EI Monitoring Framework

Term	Definition	Examples
Field measurements	the fundamental data collected through a monitoring project and which contribute to the suite of EI measures that make up an EI indicator.	fish condition assessment, creel census data, game fish population estimates, electro-fishing, pH, BOD, nutrients, heavy metals, phytoplankton
EI Measure	monitoring data that contribute to an EI indicator, that are collected over time following a strict protocol, to measure present conditions and change since the last measurement. An EI measure may be a single ecological field measurement, or may combine field measurements into an index. All EI measures will have targets and thresholds	fish population measure (an index developed from a small suite of fish field measurements such as fish condition index, game fish population estimates, creel census data, electro-fishing sampling); water quality measure (a water quality index developed from a suite of water quality field measurements such as pH, metals, nutrients, dissolved oxygen)
EI Indicator	one of 0-5 indices, comprised of an internal suite of EI monitoring measures, that are combined through semi-quantitative models to provide a clear message on a key park EI element. All EI indicators will have targets and thresholds	Lake EI Indicator (LEI): in this example, values of the indicator range along a gradient derived from an index that ranges from 0-30
Threshold	levels of an EI indicator or EI measure that represent high, medium and low ecological integrity; trends that cross thresholds invoke a pre-described management response	lake EI = 22 = high EI; LEI 11-22 = medium EI; LEI = 11 = low EI for the lake EI indicator (EI measures will also have thresholds)
Target	desired condition of the EI indicator or EI measure, i.e., the level of the EI indicator or EI measure that represents high EI	target lake EI = 24-29 for the lake EI indicator (EI measures will also have targets)
Baseline	level of an EI indicator or EI measure at the start of monitoring measurement	lake EI = 25 for the Lake EI Indicator (EI measures will also have a baseline)

EI INDICATORS

The North	Pacific Coastal	Interior Plains	Great Lakes	Quebec Atlantic	Montane Cordilleran
Forest	Forests and woodlands	Forest	Forest	Forest	Terrestrial Ecosystems
Tundra	Non-forest	Grasslands	Non-forest	Barrens	
Wetlands	Lakes and wetlands	Wetlands	Wetlands	Wetlands	Aquatic Ecosystems
Freshwater	Streams and rivers	Lakes	Lakes	Freshwater (Lakes)	Native Biodiversity
Glaciers	Islets/shorelines	Streams	Streams	Freshwater (Streams)	Geology and landscapes
Coastal	Inter-tidal		Great Lakes Shore	Coast	Climate and atmosphere
Marine	Sub-tidal			Marine	support for EI

Example: State and Trends of EI Indicators, Gros Morne NP

Indicator: Ecosystem Type	Percentage of Park Area	Condition and Trend	Rationale
Forest	44	↓	High moose density - regeneration affected. Habitat loss from forestry. High percentage non-native mammals
Barrens	35	↓	Woodland caribou decline, increasing human use, increasing non-native species
Wetland	11	↓	Damage from snowmobiles. Woodland caribou declines.
Freshwater	8.8	↔	Healthy fish and invertebrate populations. Atlantic salmon, brook trout concerns
Seacoast	0.2	↔	Recovering from historic grazing, farming and human use. Seabird populations healthy.
Marine	1	↓	Over-exploitation of fish species, pollution, garbage

Research Support

- Canadian Space Agency
 - Government Related Initiatives Programme (GRIP)
 - Phase-I (2004 - 2008)
 - Phase-II (2008 - 2011)
 - Earth Observation Application Development Programme (EOADP)
- In-House Research

GRIP – Phase i

Using Satellite Remote Sensing Technology to Monitor and Assess Ecosystem Integrity and Climate Change in Canada's National Parks

- Make optimum use of RS-Earth observation for 'Ecological Integrity' Monitoring;
- Contribution in the development of national EI indicators
- Standards approaches for monitoring landscape changes in and around national parks;
- Integration of RS-EO data and derived environmental parameters into geospatial information

GRIP Phase -ii

"ParkSPACE Arctic: Towards an Operational Satellite – based System for Monitoring Ecological Integrity of Arctic National Parks"

- Land cover change
- Plant growth and seasonality changes
- Permafrost change
- Changes in wetlands and lakes

(Object-based methods, special focus)

GRIP-I Pilot sites

GRIP Pilot Sites

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Satellite Images

1994 Classified Satellite Vegetation Map

Application types...

- Glacier margins mapping
- Anyuttuq NP
- Fire Severity Analysis
- Predictive Pine Beetle Habitat

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National Research Needs

1. Transboundary impact of adjacent water
2. Landscape-level strategies
3. Introduced and emergent species – TB, CWD
4. Minimum park size
5. Sustained management (e.g., fishing, and trapping)
6. Marine ecosystems and function
7. Species diversity characteristics
8. Potential for species and GMO to be invasive
9. Hypothesis of wildlife – definition and prediction
10. Climate change - adaptation and planning
11. human use impacts – models by activity type
12. Cumulative impact assessments
13. Kinds of park experiences sought by Canadians

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PCA EO Capacities

- Distributed across Field Units, Service Centres (5), National Office
- < 5 staff devoted near full time to EO;
- Some land managers, scientists & technicians use some aspect of EO in their work;
- Often same individual performs work in the RS/GIS/GPS/DBMS fields;
- Rely on Academia and Private Sector

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Some Challenges (1 of 2)...

- Culture shift in terms of EO-RS applications
- Potential for high profile stories and reporting
- Partnerships (CSA, NRCan, US NPS, NASA...)
- Consistent protocols / accessibility / data collection, data management, metadata, etc.

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Some Challenges (2 of 2)...

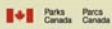
- "Operational" by the end of year 2008
- Better linkages to other GRIP projects executed by (EC,NRCan, CFS, AAFC) International Polar Year (IPY) Program
- Radarsat-2
- Manage expectations !

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Our Requirements

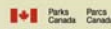
- Development of EO-based methods followed by Transfer of Technology
 - Details of Methods / User Manuals
 - Tutorials / Hands on training
 - Workshops



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Thank You



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