

# **Chapter 3: Ecosystems are Dynamic**

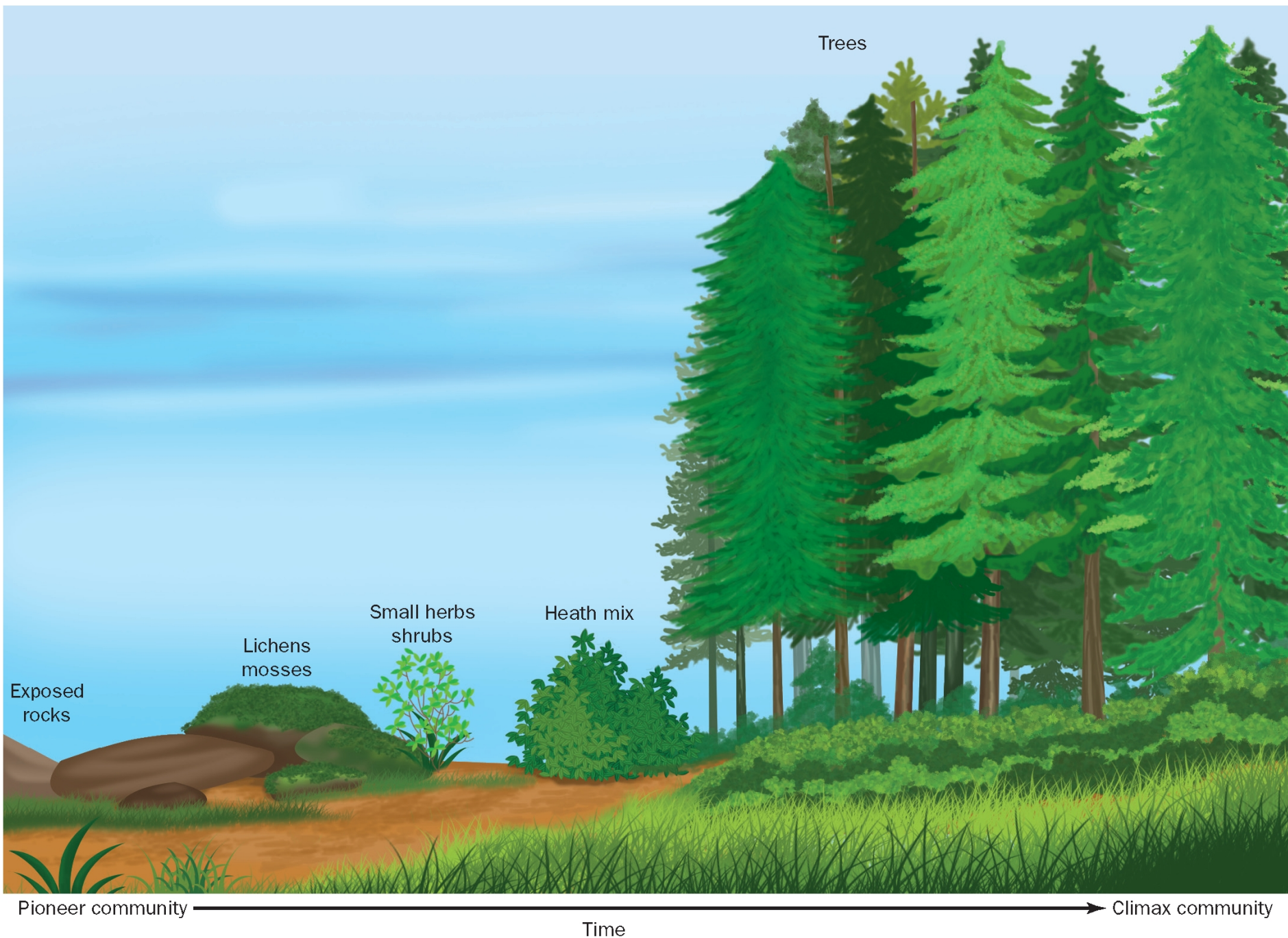


# Introduction

- Ecosystems and communities change over time
- Change is driven by many factors including abiotic conditions and species' tolerances
- Change can be rapid or slow
- Species will have to respond to climate change

# Ecological Succession

- Ecological succession is the gradual replacement of one assemblage of species by another as conditions change over time
- There are two basic types of succession:
  - Primary succession
  - Secondary succession



**Figure 3.1** | A general model of primary succession over time, from a bare rock surface to a forest community.

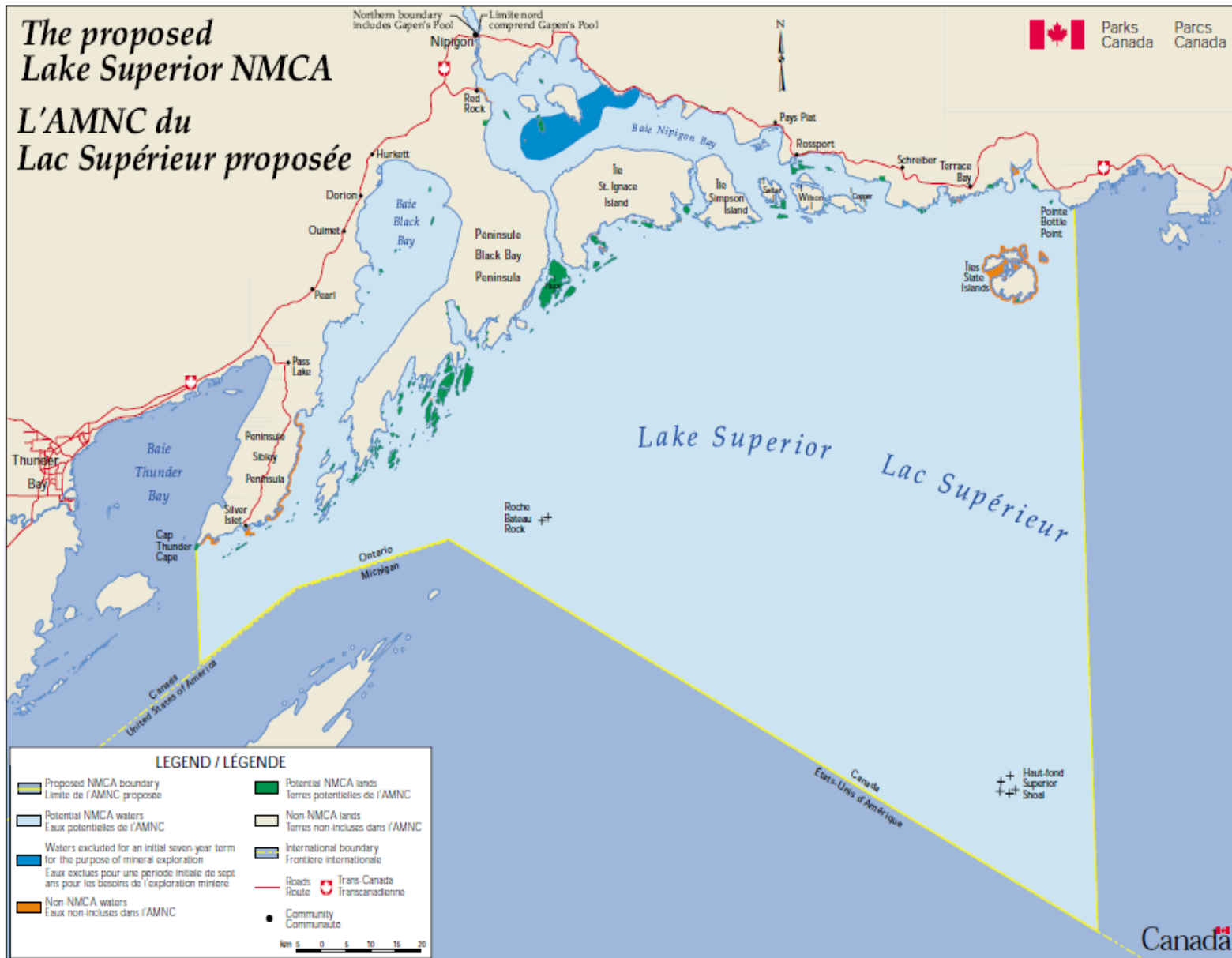
# **An Assessment of Coastal Sensitivity to Human Disturbance on the Black Bay Peninsula Archipelago, Lake Superior.**



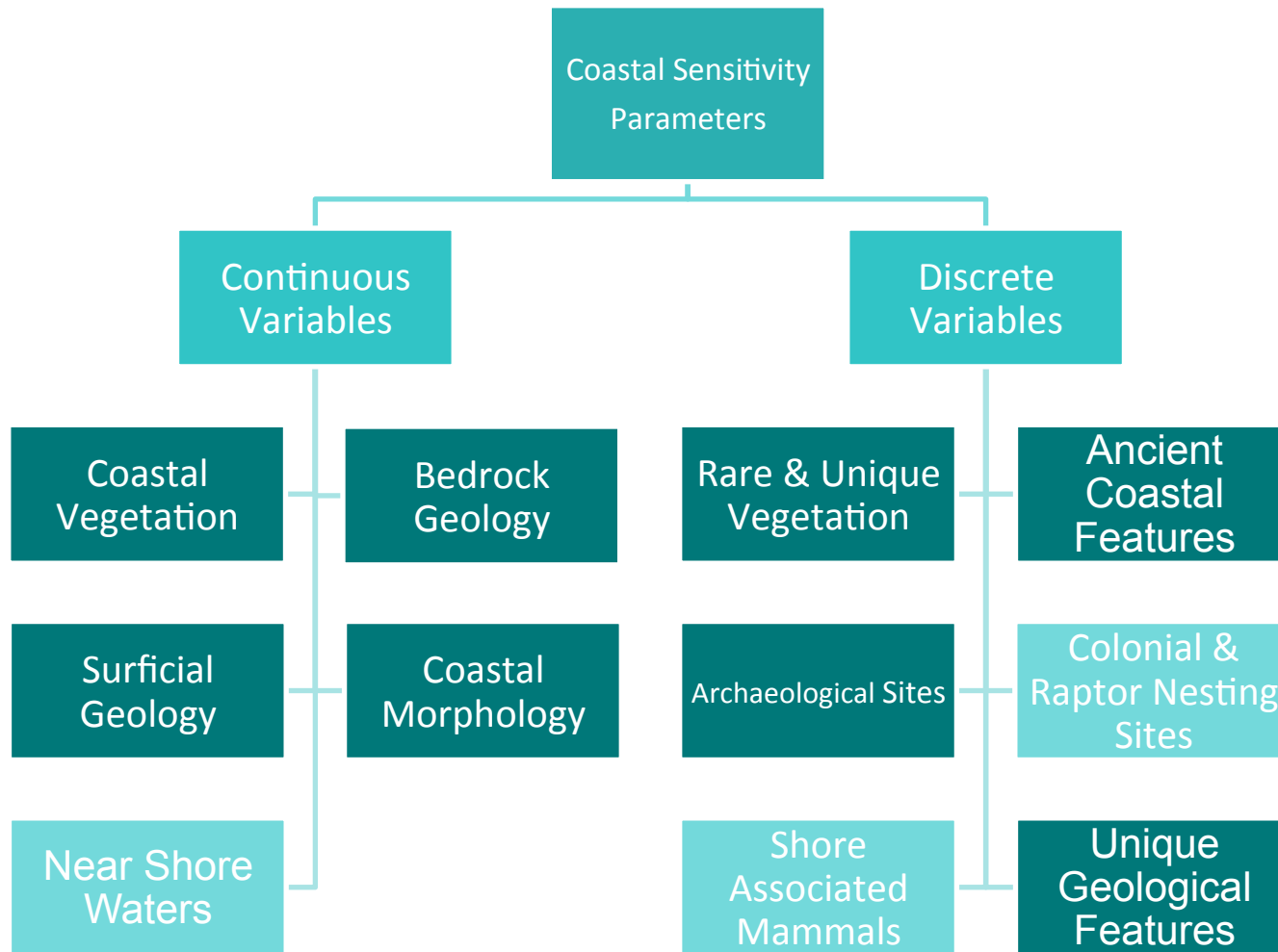
# Research Questions?

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1. What aspects of the Black Bay Peninsula Archipelago are sensitive to human disturbance?
2. What is the spatial distribution of these sensitive features in relation to areas of human-use?



Source: Parks Canada, 2007.



**Figure 3.1: Coastal Sensitivity Parameters (adapted from Gneiser, 2000). Coloured boxes indicate variables included within the scope of this project.**



# Results

- 1. They were identified by the literature/in the field as experiencing significant degradation caused by human disturbance.
- 2. They show a stronger resistance to abiotic factors of change than they do to human induced change.
- 3. They experience a high level of human interaction with the specific type of Land use identified within the archipelago.

# Raised Cobble Beaches

- preserve a record of past lake levels and significant storm events

- formed an unconsolidated material that can be easily altered by human activity.

- Show a relationship with the human use that occurs in this area.



# Pukaskwa Pits

-ancient rock structures found on raised cobble beaches along Lake Superior's north shore.

-a unique form of aboriginal architecture

-attributed to the Blackduck peoples 900 to 400 B.P.

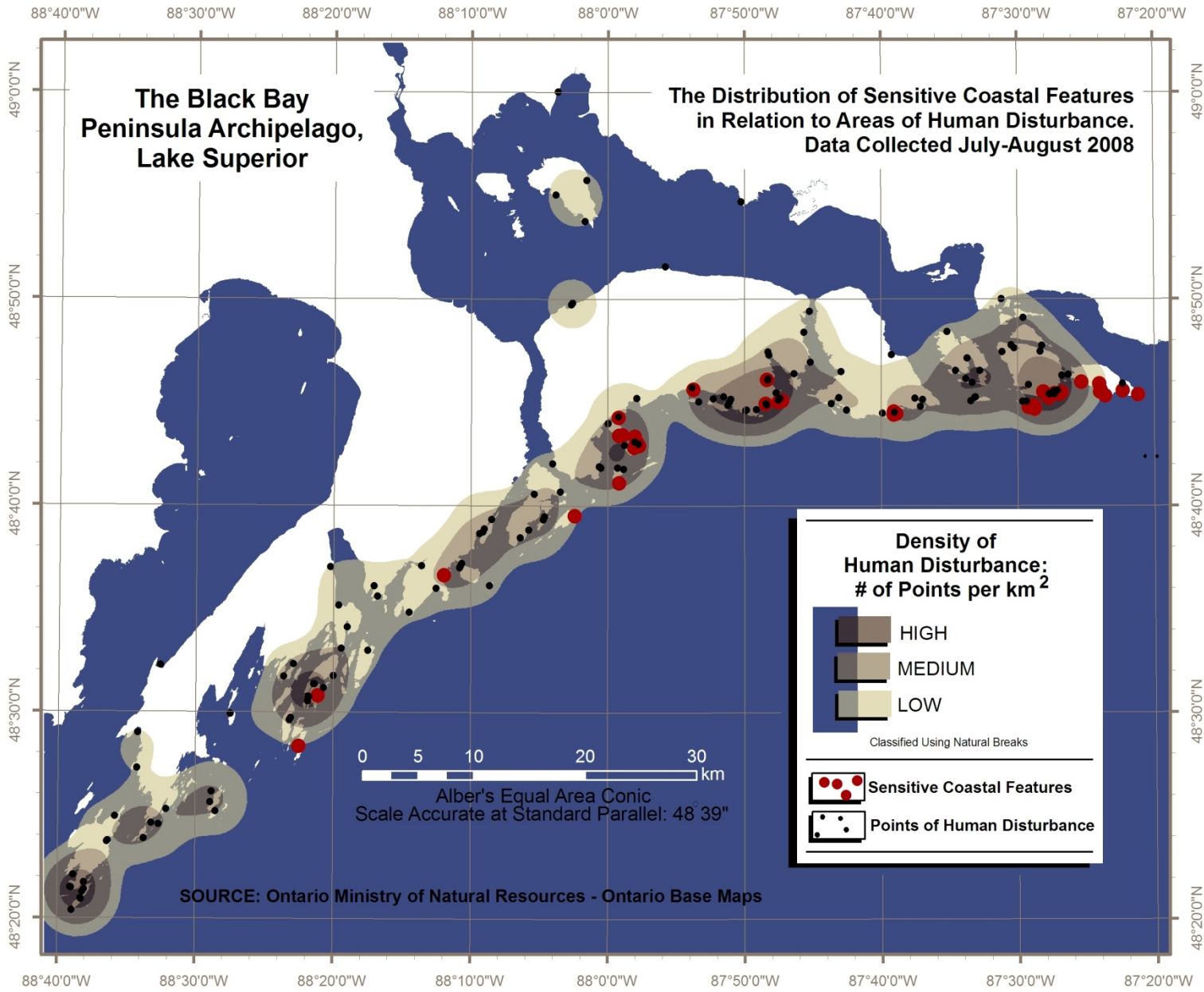
-Documented as significantly disturbed by human use.

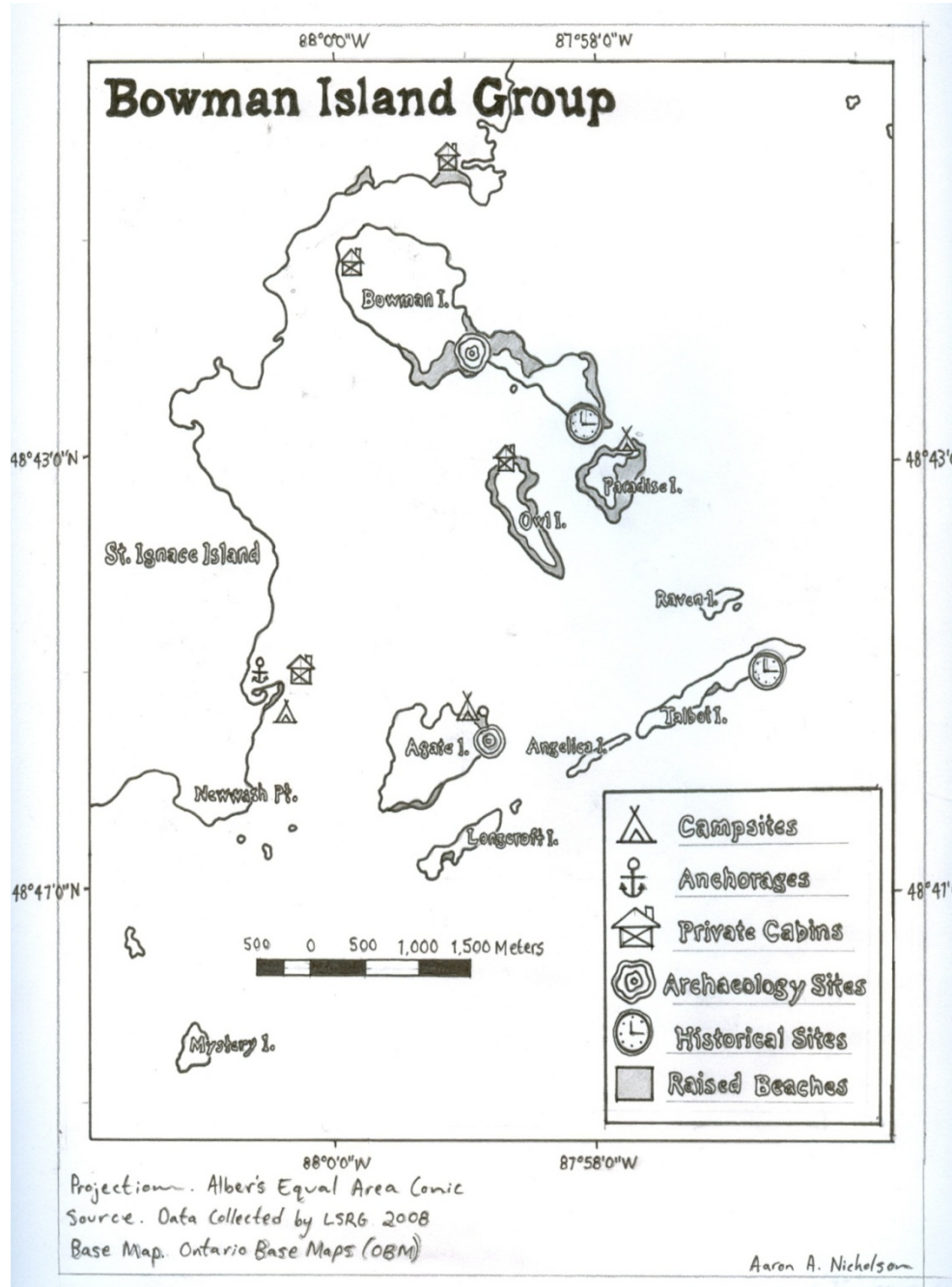


# Lichen Heath Communities

- Tundra like floral communities
- support regionally rare arctic/ alpine vascular plants.
- Found on smooth, gently sloping, volcanic shorelines and also on raised cobble beaches.
- If disturbance is constant and repeated, the lichen mats become quickly degraded or eliminated.







# Ecological Succession

- **Disturbance:** an event that alters ecosystem structure and function
  - Mountain Pine Beetle invasion in Western Canada
- Many disturbances are natural and integral parts of healthy ecosystem functioning
- Recovery patterns following disturbance depend on many factors
- Ecosystems and landscapes are dynamic, interacting in complex ways, often unpredictably, and over large spatial and time scales.

# Ecological Succession

- Communities do not always reach a stable climax community, however the species assemblage that is more constant over time is characteristic of a **mature community**.
- ‘Climax’ vegetation is strongly influenced by climate (**climax climate**)
- Soil can be more important than climate in determining community composition (**edaphic climaxes**)



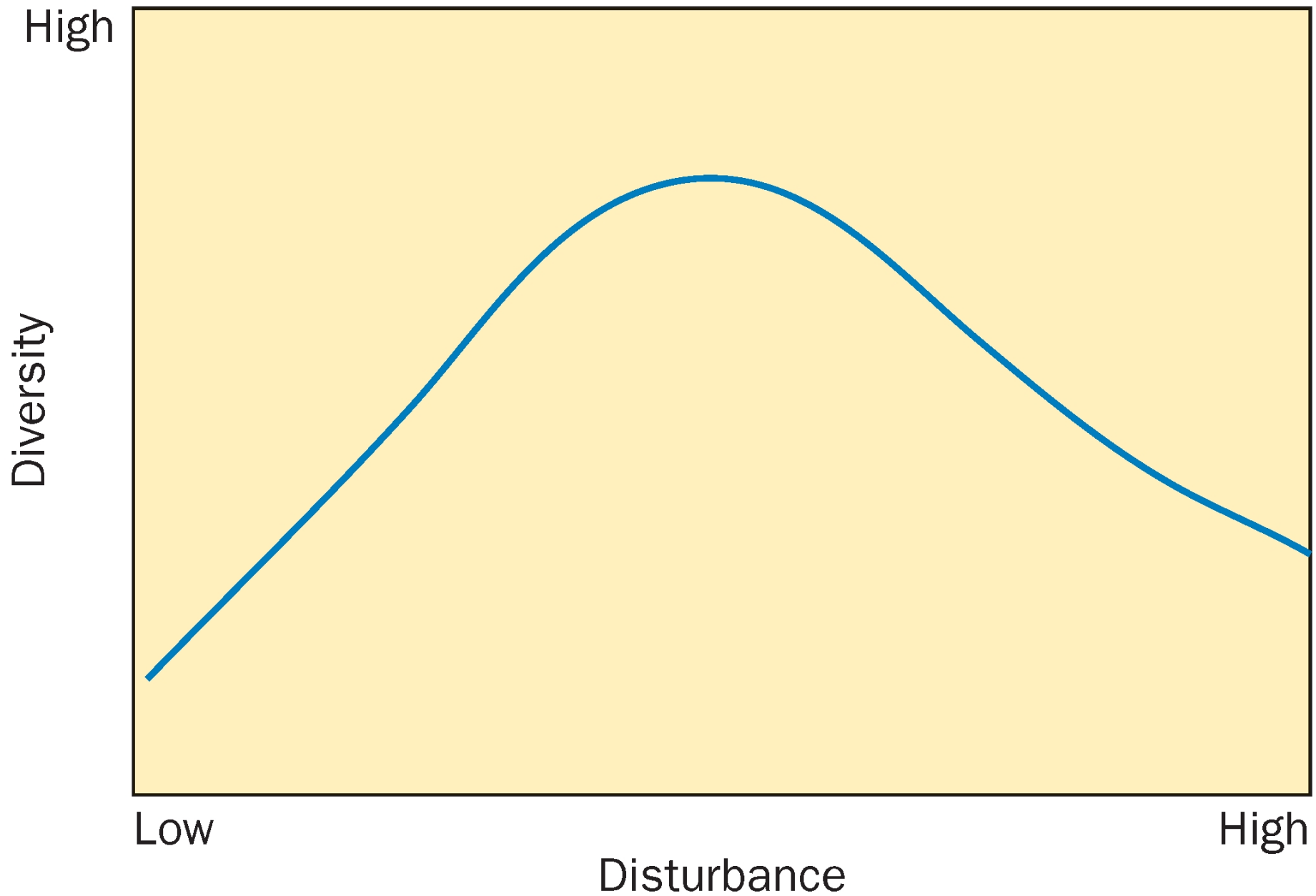
# Ecological Succession

- **Secondary succession** is the sequential development of biotic communities on previously vegetated surfaces that have soil cover, and that have been disturbed, e.g., abandoned farm fields
- Faster than primary succession, and initiated by invading species such as annual ‘weeds’
  - Similar processes also occur in aquatic environments; the natural aging process is called eutrophication
- Can be a challenge for farmers and resource managers

# Ecological Succession

## Indicators of Immature and Mature Ecosystems

- As succession occurs, several trends emerge:
  - NPP declines
  - Biodiversity increases
- The **Intermediate Diversity Hypothesis** suggests that diversity will not increase indefinitely; and that moderately disturbed ecosystems have higher biodiversity than those that experience either high or low disturbance



**Figure 3.5** | The intermediate disturbance hypothesis.

# Ecological Succession

## Effects of Human Activities

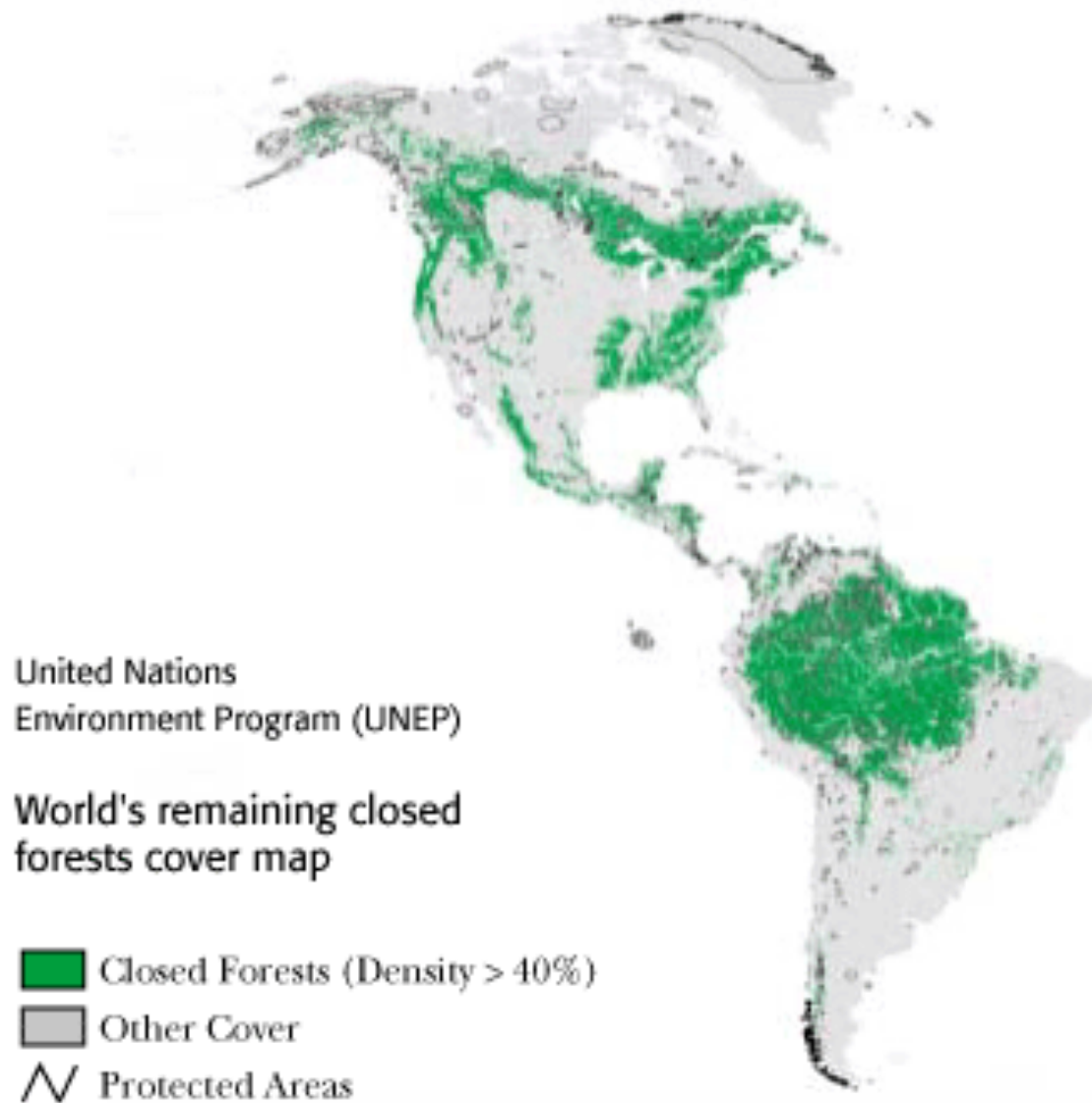
- Humans influence ecological succession
- We often keep ecosystems in an early stage
  - Agriculture, forestry
- Increased productivity
- Faster nutrient and water cycling, with greater losses
- Reduced biodiversity, especially at higher trophic levels, and an increase in pioneer species

**Table 3.1 | Characteristics of Immature and Mature Ecosystems**

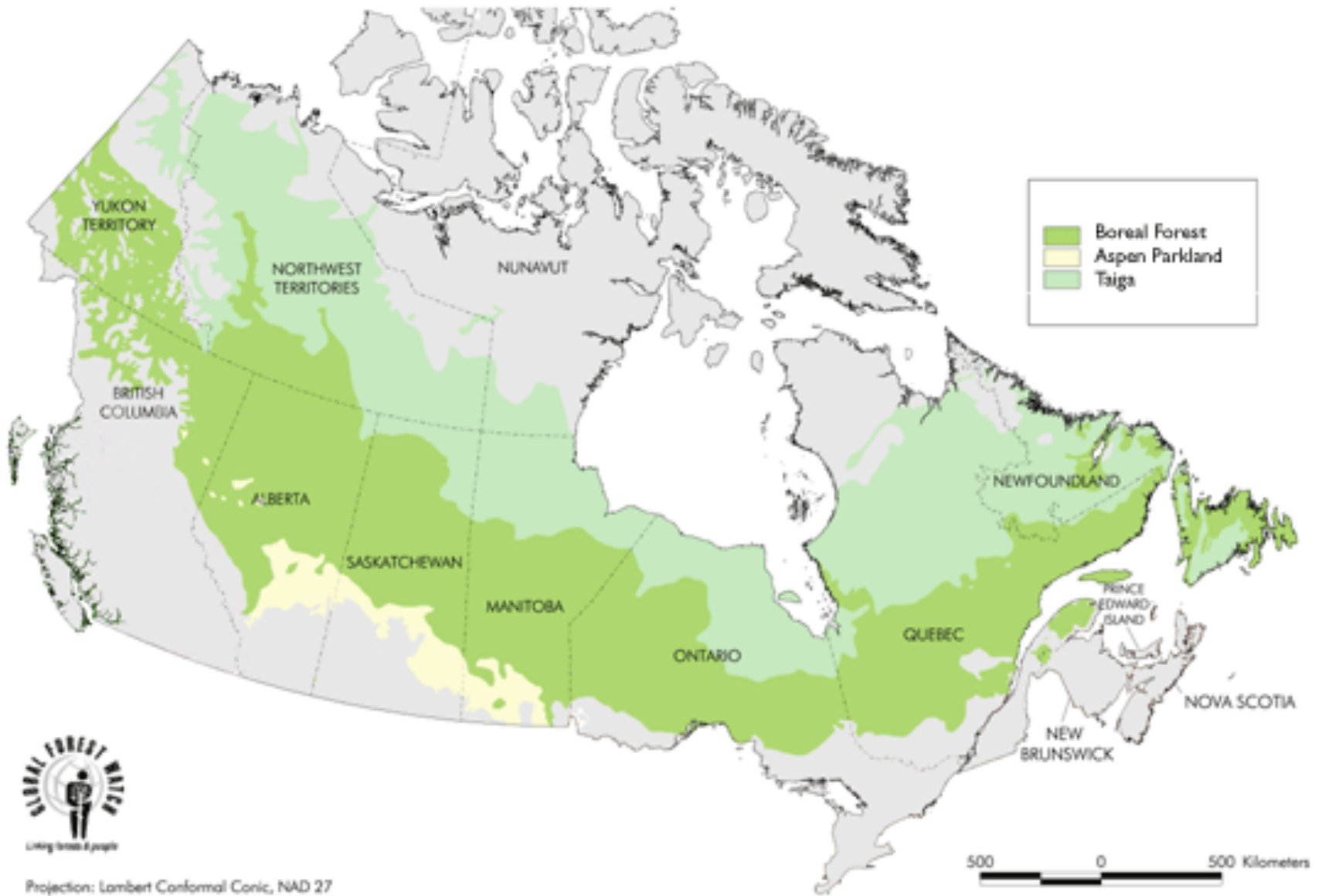
<b>Characteristic</b>	<b>Immature Ecosystem</b>	<b>Mature Ecosystem</b>
Food chains	Linear, predominantly grazer	Web-like, predominantly detritus
Net productivity	High	Low
Species diversity	Low	High
Niche specialization	Broad	Narrow
Nutrient cycles	Open	Closed
Nutrient conservation	Poor	Good
Stability	Low	Higher

Source: Modified from Odum (1969). Copyright © 1969 by the American Association for the Advancement of Science.

# World's Remaining Closed Forests



# Canada's Boreal Forest



Projection: Lambert Conformal Conic, NAD 27

Adapted from J.S. Rowe, Forest Regions of Canada, (Ottawa: Canadian Forestry Service, Dept. of Fisheries and Environment, 1977).

Further adapted by CPAWS from GFW's Canada's Forest Heritage map

500 0 500 Kilometers

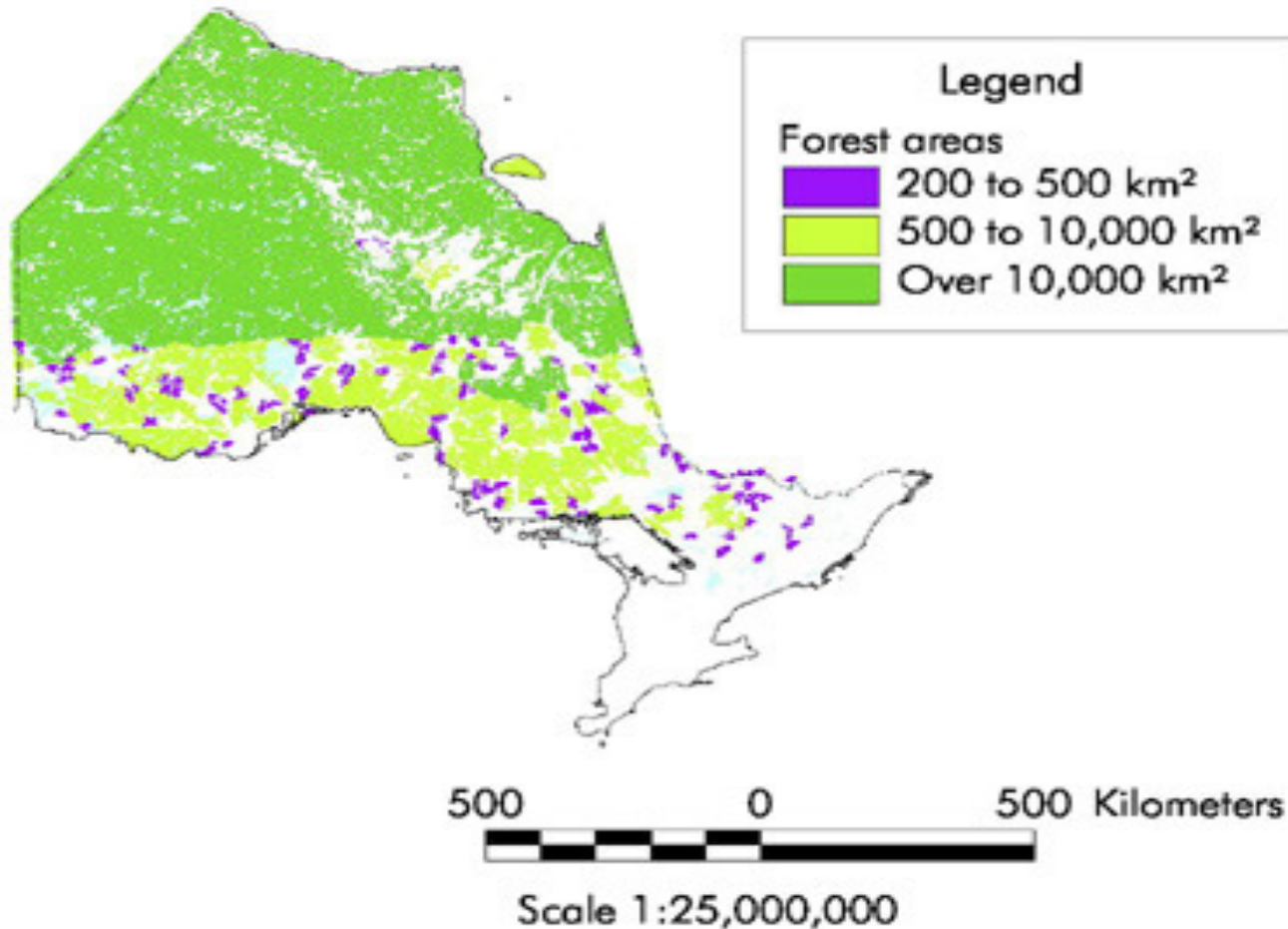
Scale 1:20,000,000

# Ontario's Boreal Forest

ONTARIO: Large Remaining Forested Areas

Based on 1:50,000 Road Data

August 8, 2000





# Guide for Natural Disturbance Pattern Emulation

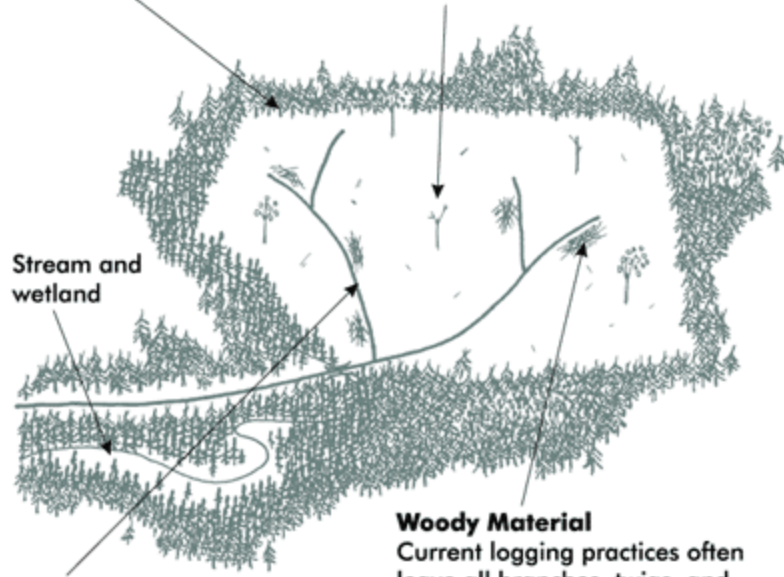
## Clearcutting today

### Boundaries:

In the past, logging has tended to create clearcuts with straight boundaries. These unnatural patterns ignore habitat complexity and have a negative impact on wildlife.

### Biological legacy (standing/residual trees):

Current logging rules require a minimum of only 6 standing trees per hectare for wildlife in a clearcut, too few for many species.



Stream and wetland

### Woody Material

Current logging practices often leave all branches, twigs, and leaves in piles at the side of the road, effectively removing nutrients and ground level habitat structure that would otherwise be available to the soil and wildlife.

### Roads

Most roads are left open to public access following harvest. This can lead to impacts on wildlife and the environment from overhunting and fishing and motorized access.

© Wildlands League 2000

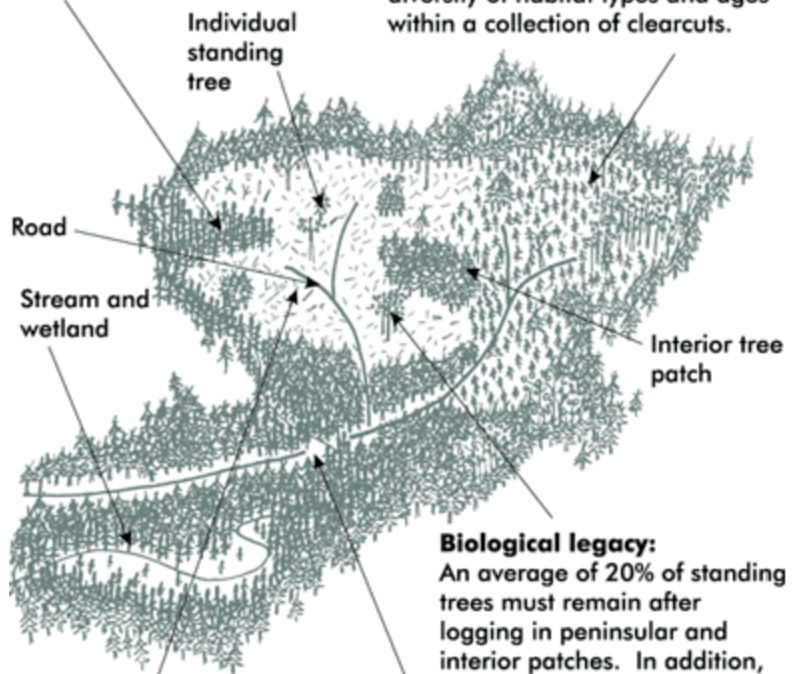
## Proposed New Guidelines

### Boundaries:

Follow natural features and retain peninsulas of standing trees.

### Regrowth requirements for adjacent clearcuts

An old clearcut must have young trees at a height of 3 metres before a new clearcut can be located next to it. This allows for a diversity of habitat types and ages within a collection of clearcuts.



Road

Stream and wetland

Individual standing tree

Interior tree patch

### Biological legacy:

An average of 20% of standing trees must remain after logging in peninsular and interior patches. In addition, 25 individual trees per hectare must be left for wildlife.

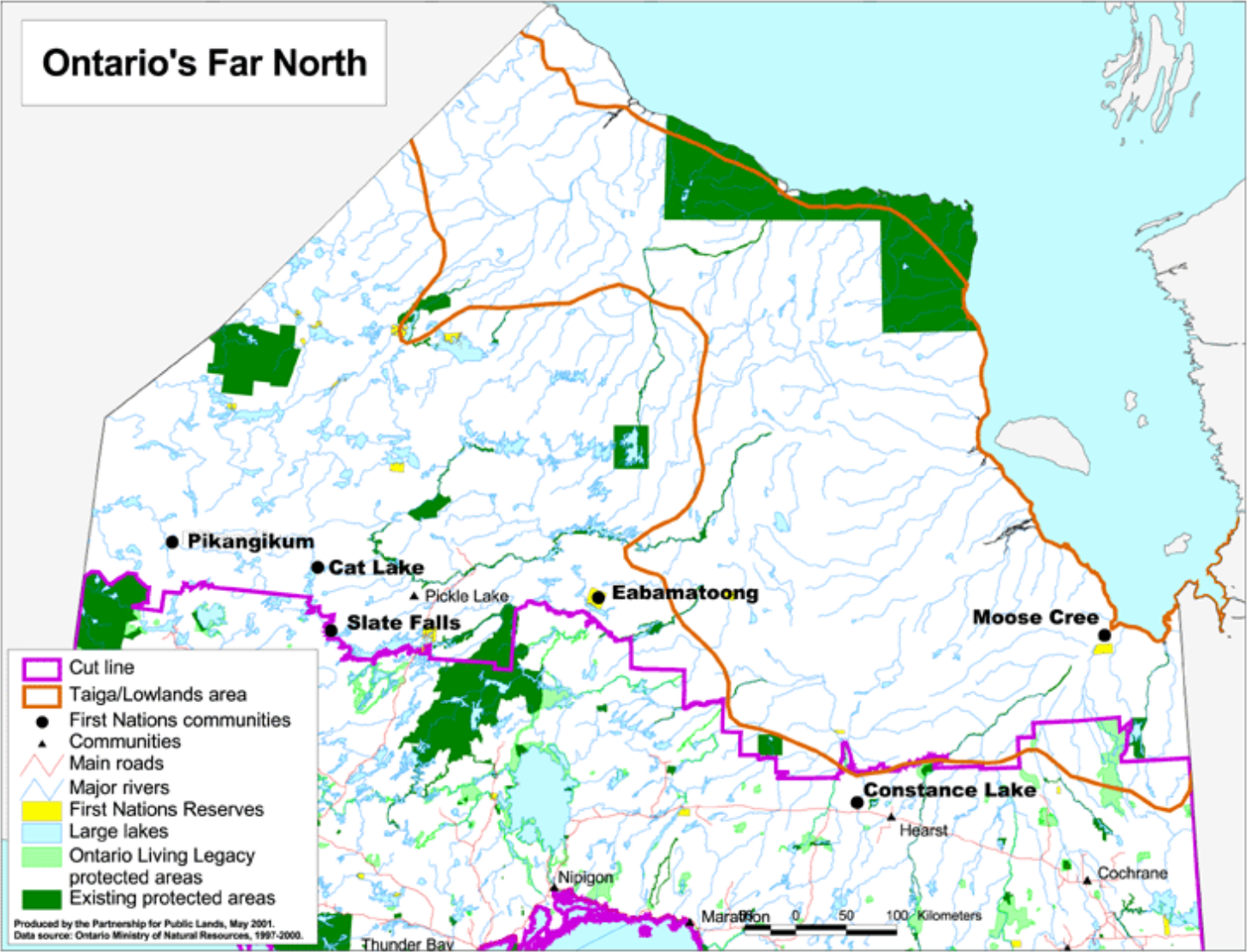
### Woody Material

On sensitive sites, branches, twigs and leaves must either be left at the stump or redistributed across the area to provide nutrients to the soil and ground level habitat structure for wildlife.

### Road Closure

Road closure is required to prevent impacts from overhunting, overfishing and motorized recreation.

# Forestry Encroaching Native Lands



**The Northern Boreal Initiative**

# Implications

- Ecosystems are dynamic entities and change over time
- We should accept and understand the nature of these changes, and distinguish between those that are the result of natural processes, and those that are the result of human activities
- The temporal and spatial scales of ecosystem change are often so great that they are very difficult to observe in the human lifespan
- There are complicated feedback loops and synergistic relations

# Implications

- Global climate change will place considerable stress on many species in terms of their limits of tolerance. This will lead to changes in range and abundance, and some species will become extinct
- When faced with such dynamic ecosystem changes, we must use equally dynamic thinking to confront the challenges of the future