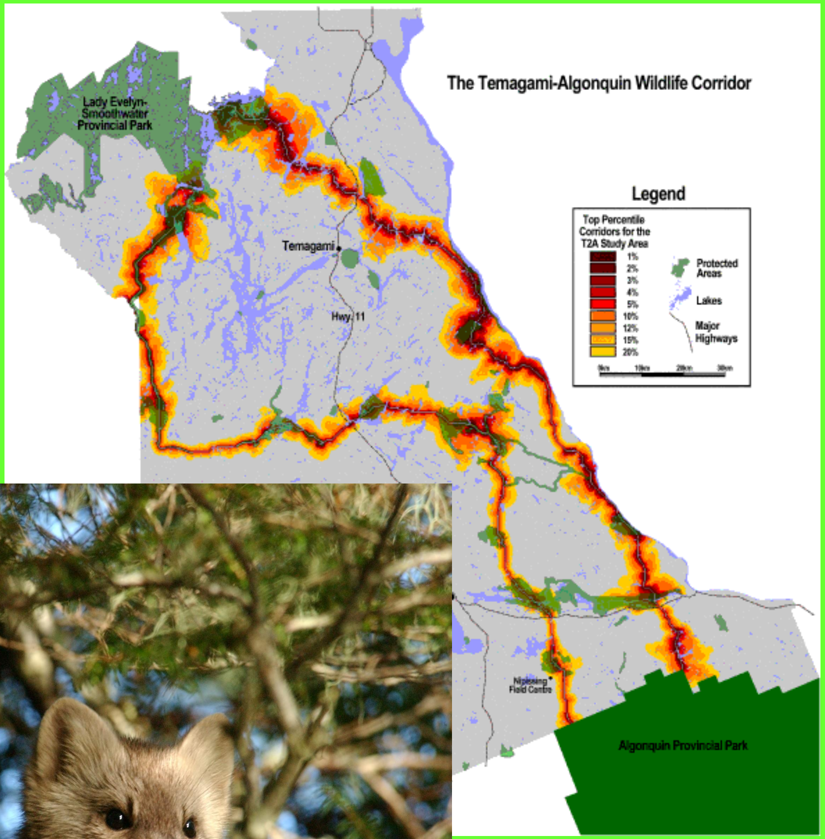
Using GIS and Field Studies to Design a Wildlife Corridor in the Temagami-Algonquin Region of Central Ontario

By Peter Quinby, Ancient Forest Exploration & Research (2003)



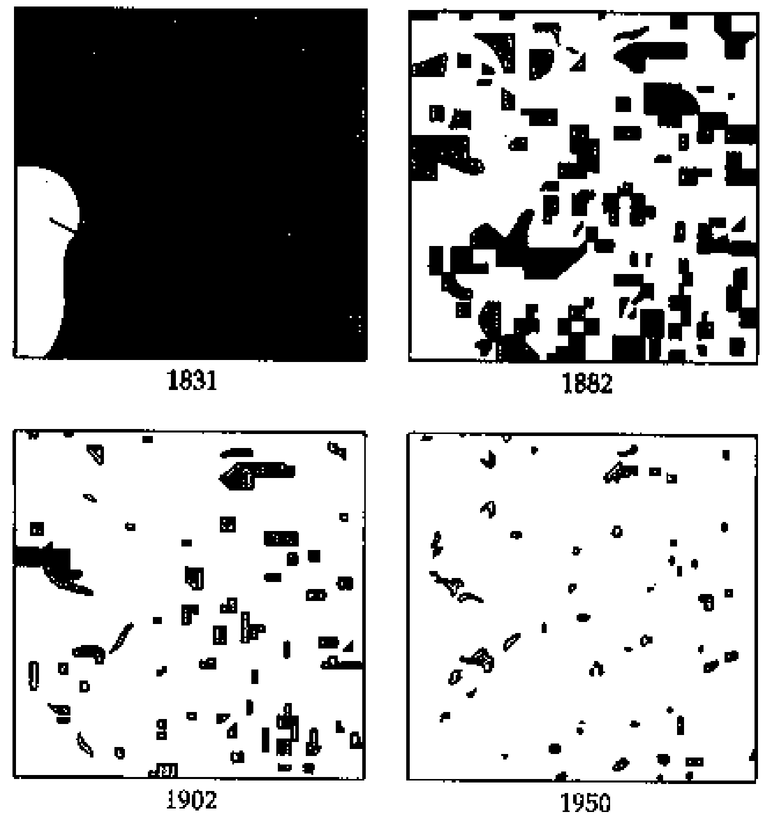
Overview

- Why do We Need More Ecological Connectivity?
- Value of Wildlife Corridors
- The Temagami-Algonquin Region
- Connect LE-SW Park with Algonquin Park
- First Step: Coarse-Scale GIS Analysis to Identify General Corridor Location
- Second Step: Use Maps (mid-scale) and Field Data (fine-scale) to Predict Location of Special Elements – "*Most Healthy Old-Growth White Pine Stands*"
- Future Directions

Why Ecological Connectivity?

Primarily because of:

HABITAT FRAGMENTATION



Changes in wooded area of Cadiz Township, Green County, Wisconsin, during the period of European settlement. Shaded area represents the amount of land in forest in each year. (From Curtis 1956.)

Effects of Habitat Fragmentation

- Ecosystem degradation
- Population decline
- Ecosystem loss
- Species extinction
- Others…

Natural Habitat: A Rare Commodity

We have become experts in resource extraction.

Now we must become experts in habitat management and protection.

But is it too late????

Value of Wildlife Corridors

- No park in N.A. is large enough to provide a complete natural landscape of ecological processes and viable populations of top carnivores
- Reconnect habitat islands
  - Facilitate species migration
  - Facilitate gene flow
- Increase natural habitat
  - Additional protection of natural ecosystems
  - Restore degraded ecosystems
- Provide additional opportunities for education, research, and recreation

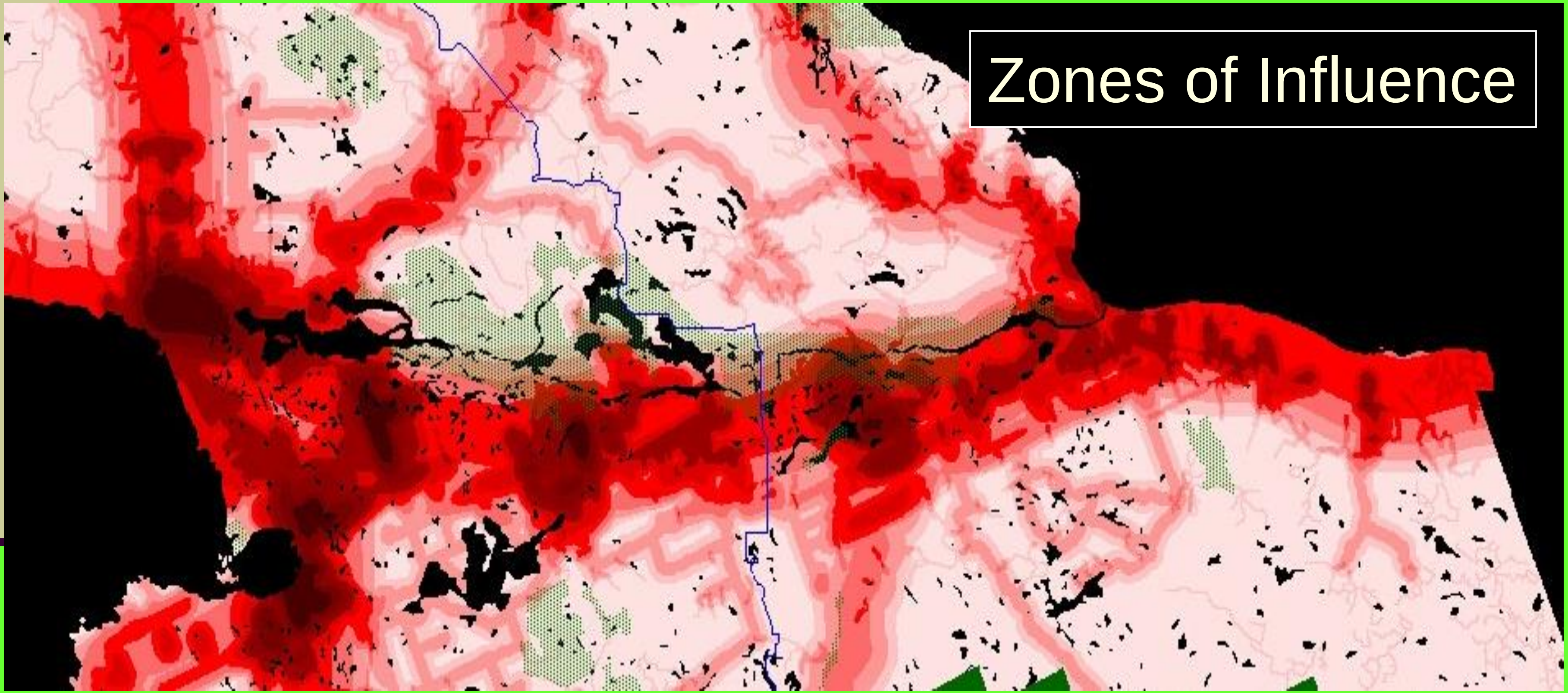
The Temagami-Algonquin Region

- **1.83 million ha study area**
- **Northern edge of the eastern N.A. temperate forest biome – some pockets of boreal forest**
- **Highest concentration of "endangered old-growth white and red pine forest"**
- **Old-growth sugar maple, yellow birch, hemlock, and white cedar also likely "endangered"**

The Temagami-Algonquin Region

- Thousands of lakes & streams
- Healthy populations of top carnivores
  - e.g., wolves
  - e.g., lynx
- Economy: heavily resource dependent – logging, mining, tourism
- Two large parks
  - Algonquin (765,000 ha)
  - LE-SW (72,000 ha)

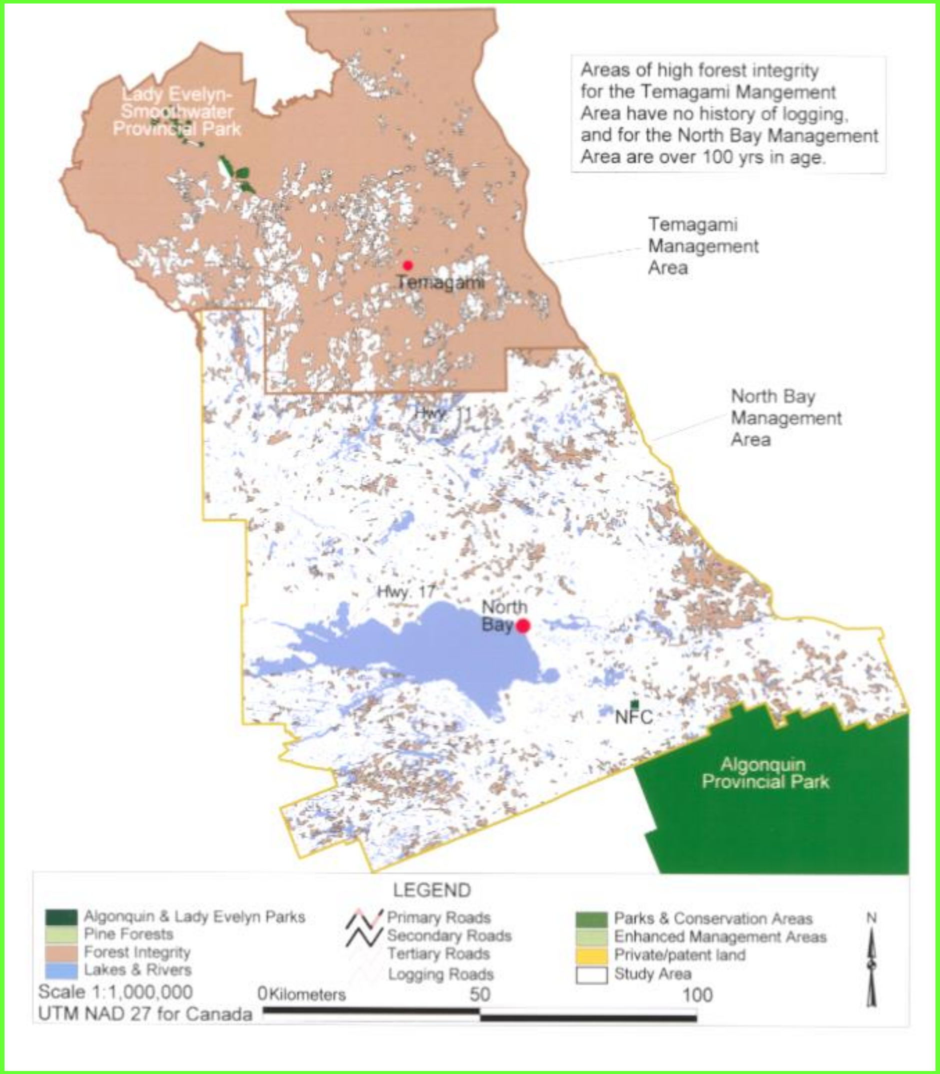
Barriers to Ecological Connectivity: Highways & Other Roads



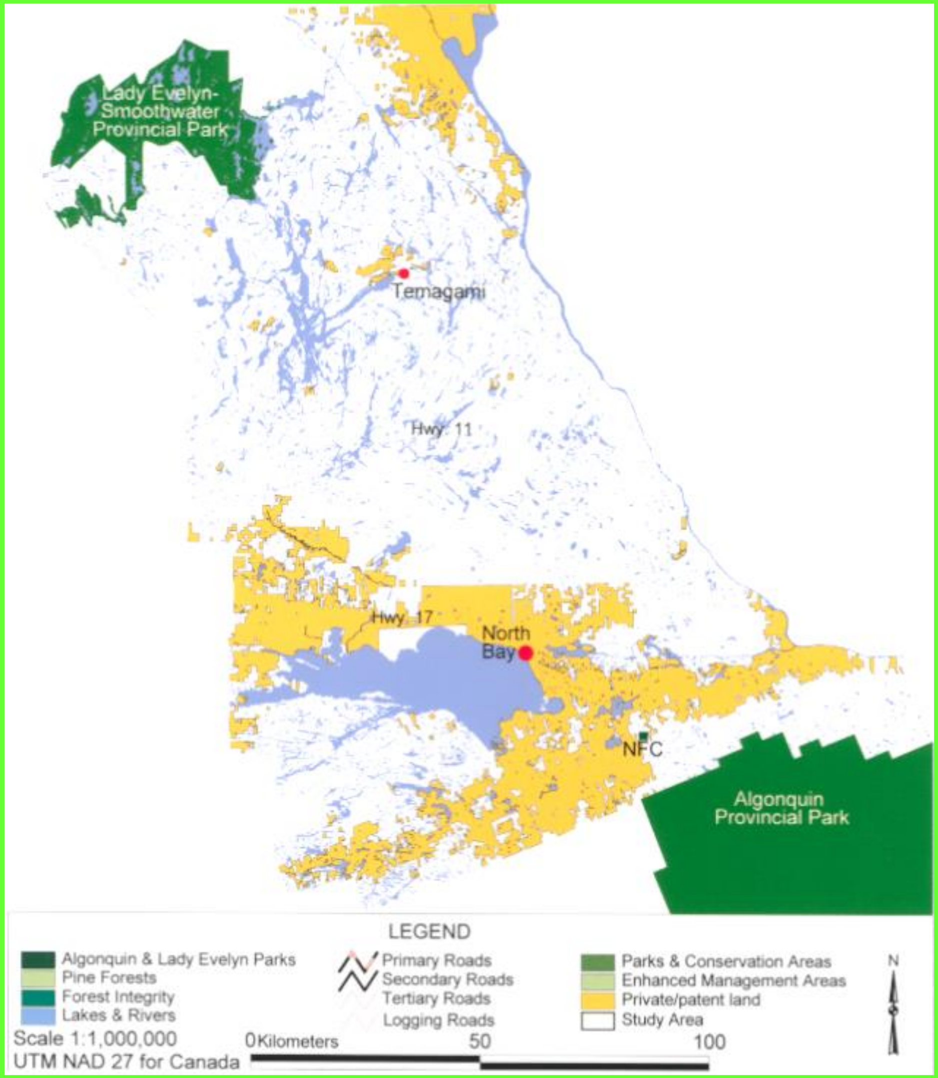
primary: 5,000 m secondary: 3,000 m tertiary: 1,000 m

Conservation Biology 14(1) 2000 "Ecological Effects of Roads"

Barriers to Ecological Connectivity: Intensively Logged Landscape



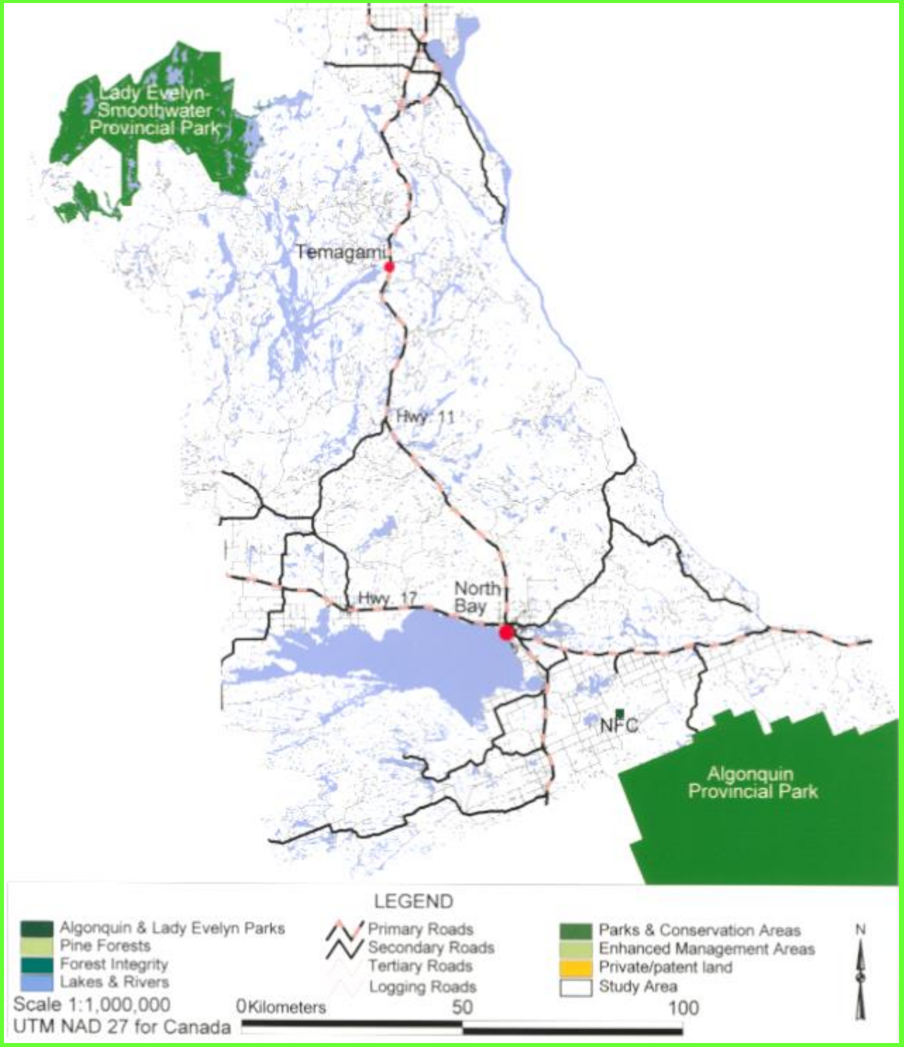
Barriers to Ecological Connectivity: Agriculture & Private Land



Step 1 in Corridor Mapping: Obtain GIS Digital Data Layers

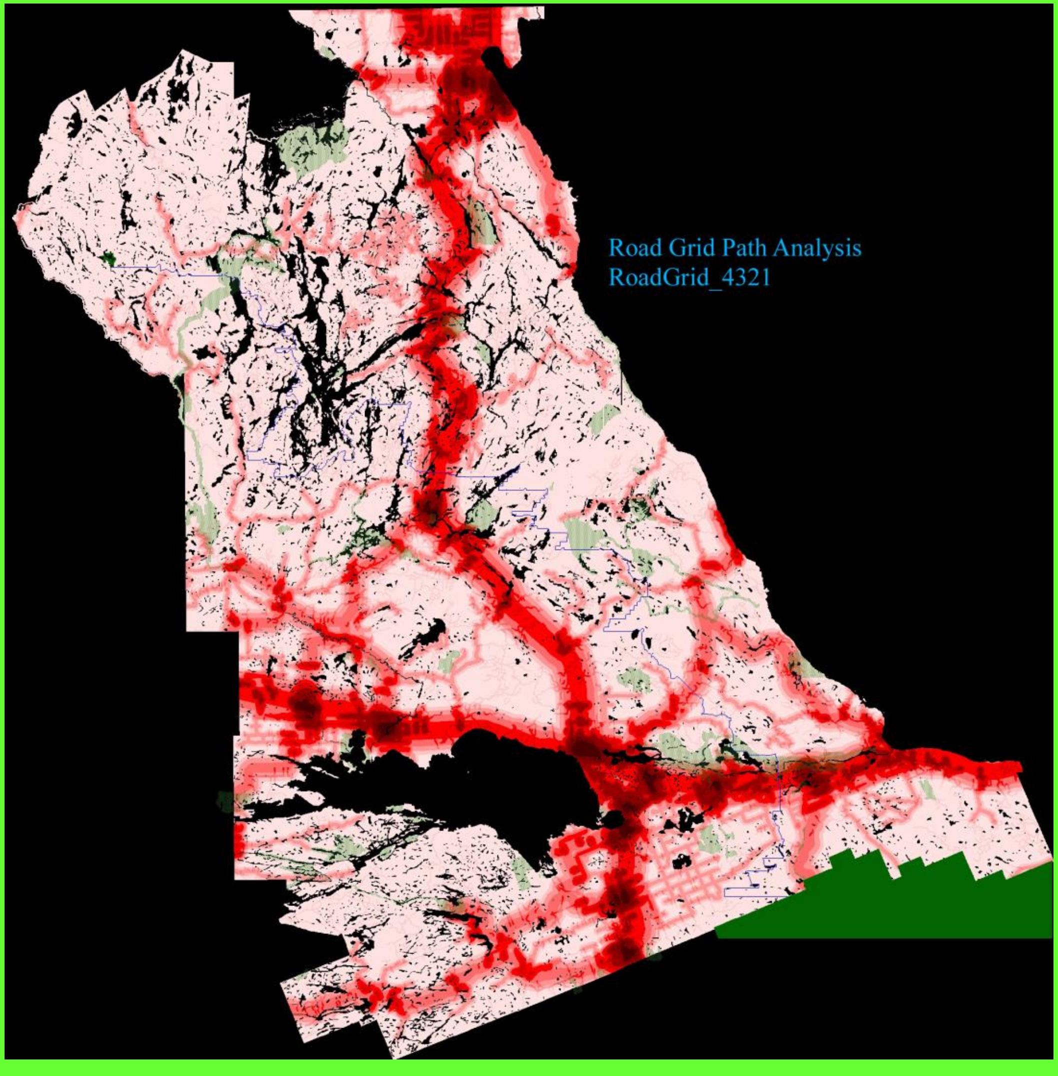
- Three Data Layers Available in Digital Form
  - roads (primary, secondary, tertiary, and logging)
  - lakes and rivers
  - human population density
- Four Data Layers Required Digitizing
  - protected areas (provincial parks, conservation reserves, and enhanced management areas)
  - mature and old-growth forests
  - red and white pine stands (over 50 yrs., min. 10% abundance)
  - private land/crown land
- Cell size: 100 m x 100 m

Roads

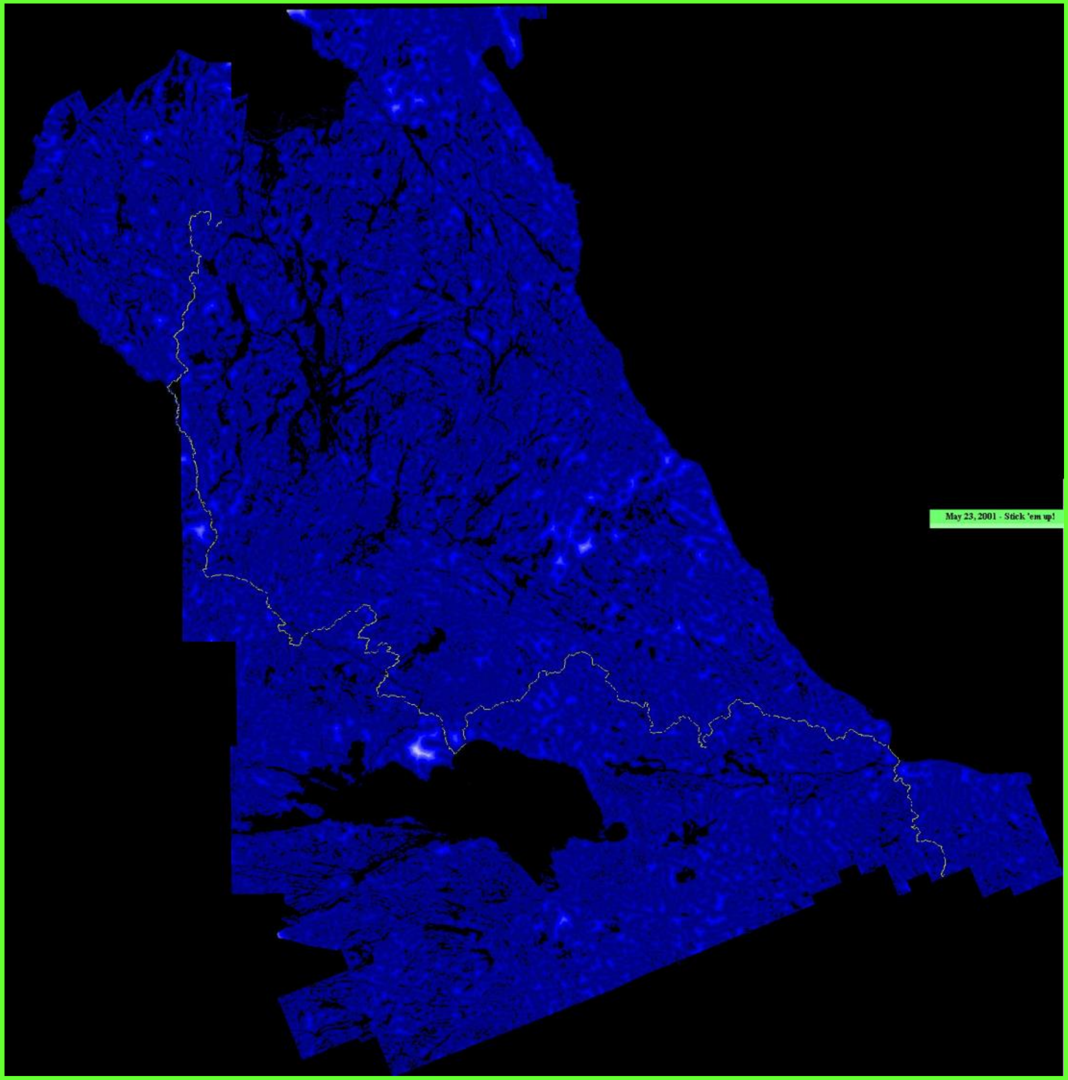


Lady Evelyn-Smoothwater Provincial Park
Temagami
Hwy. 11
Hwy. 17
North Bay
NFC
Algonquin Provincial Park
LEGEND
Algonquin & Lady Evelyn Parks
Pine Forests
Forest Integrity
Lakes & Rivers
Primary Roads
Secondary Roads
Tertiary Roads
Logging Roads
Parks & Conservation Areas
Enhanced Management Areas
Private/patent land
Study Area
N
Scale 1:1,000,000
UTM NAD 27 for Canada
0 Kilometers
50
100

Distance from Roads



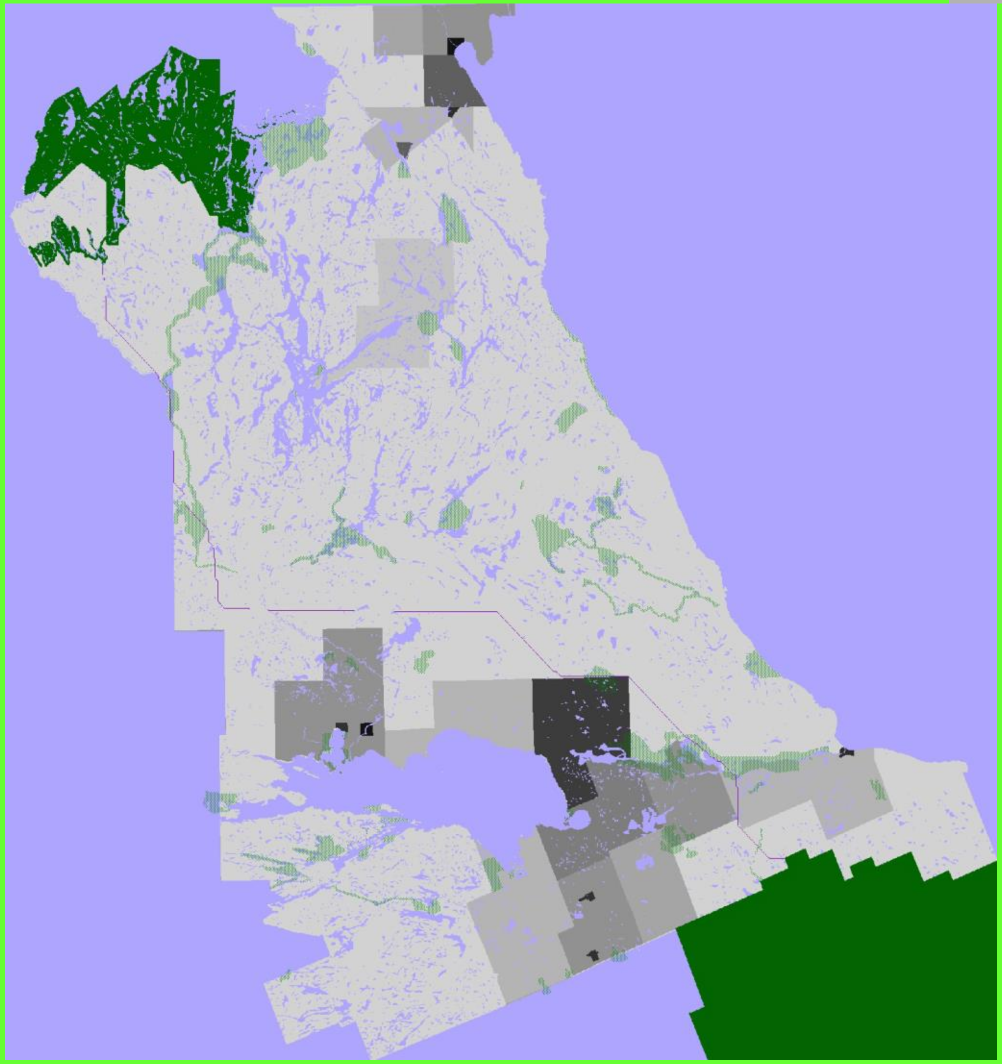
Water Bodies



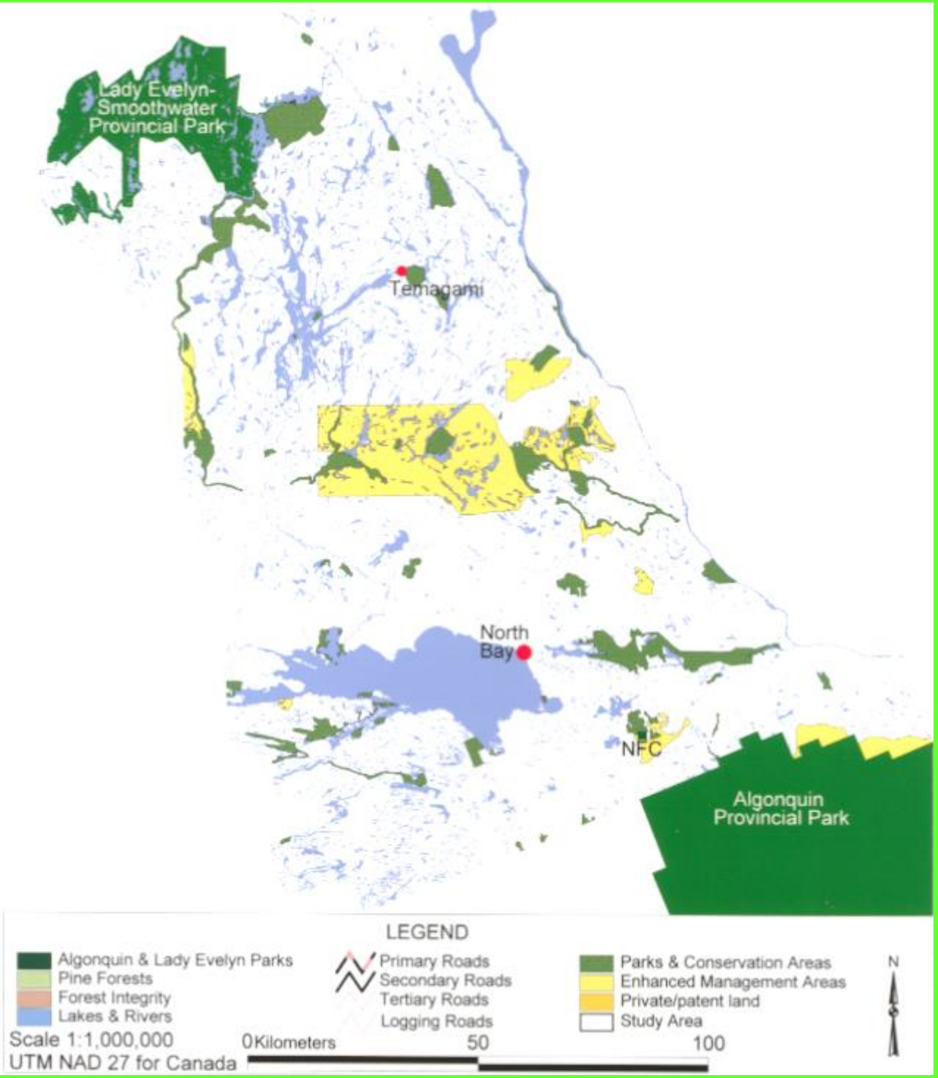
Light colored areas:

Lowest density of water bodies

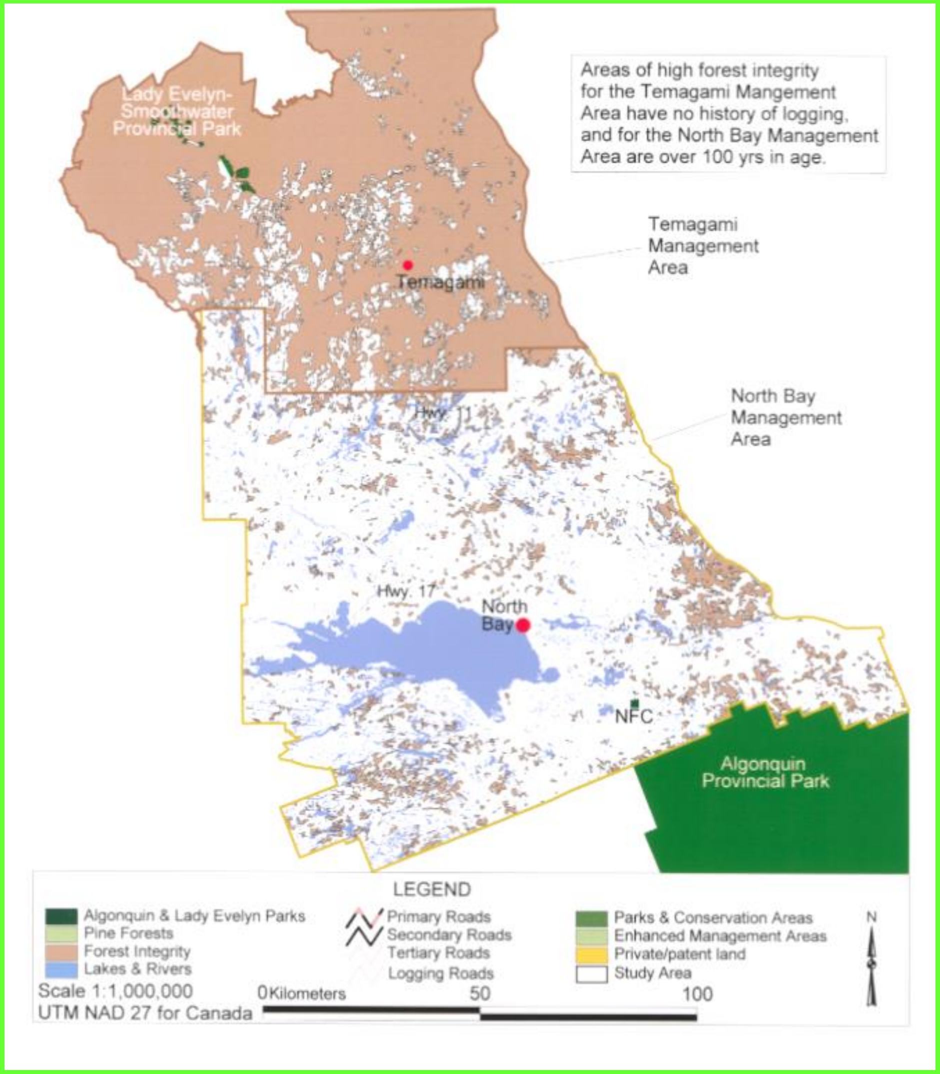
Population Density by Township



Protected Areas

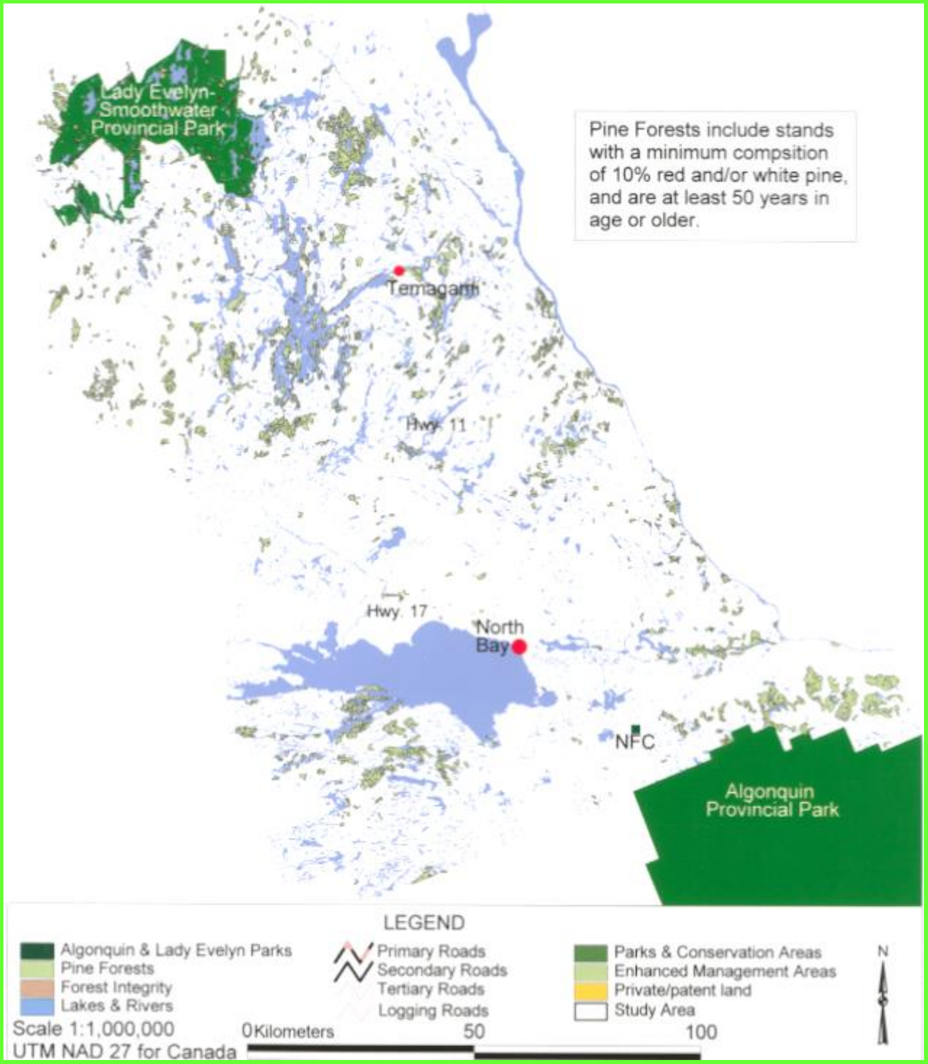


Mature & Old Growth Forests

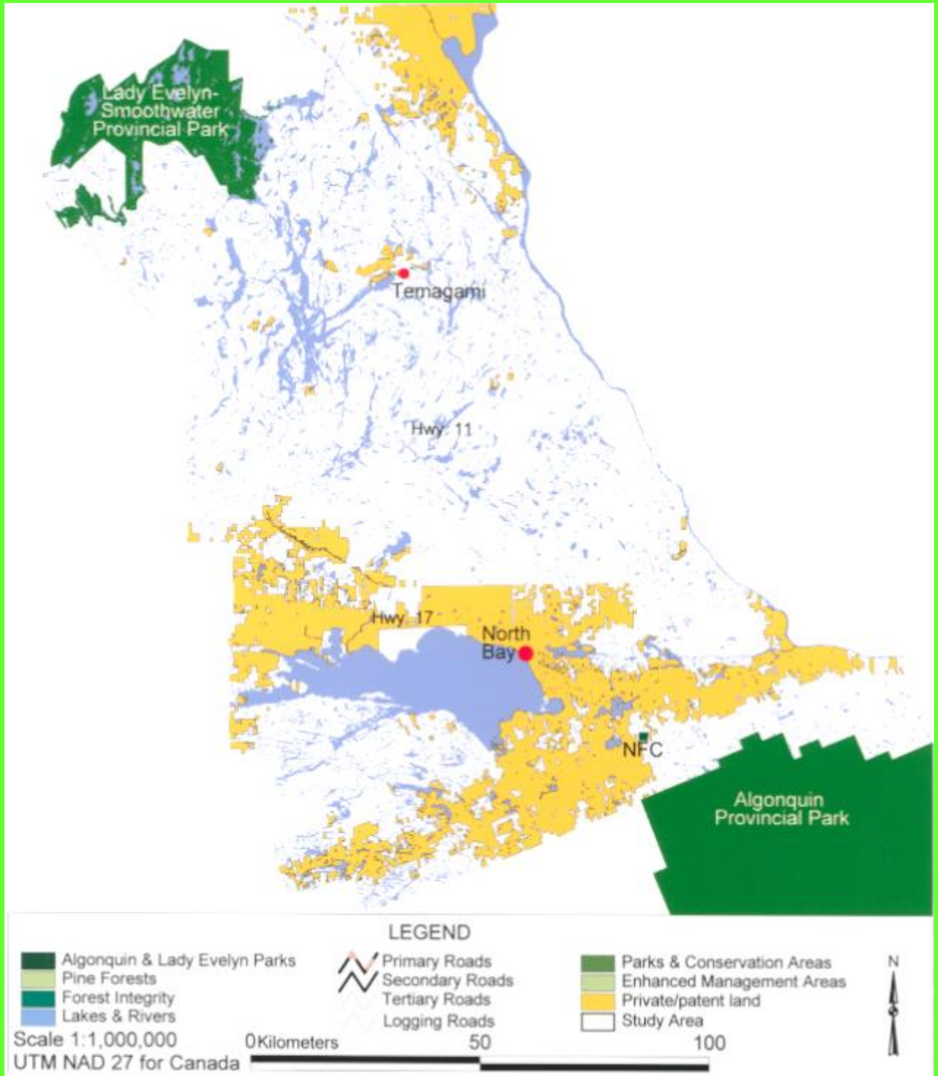


Pine Forest

(red & white pine ›10%, ›50yrs. old)

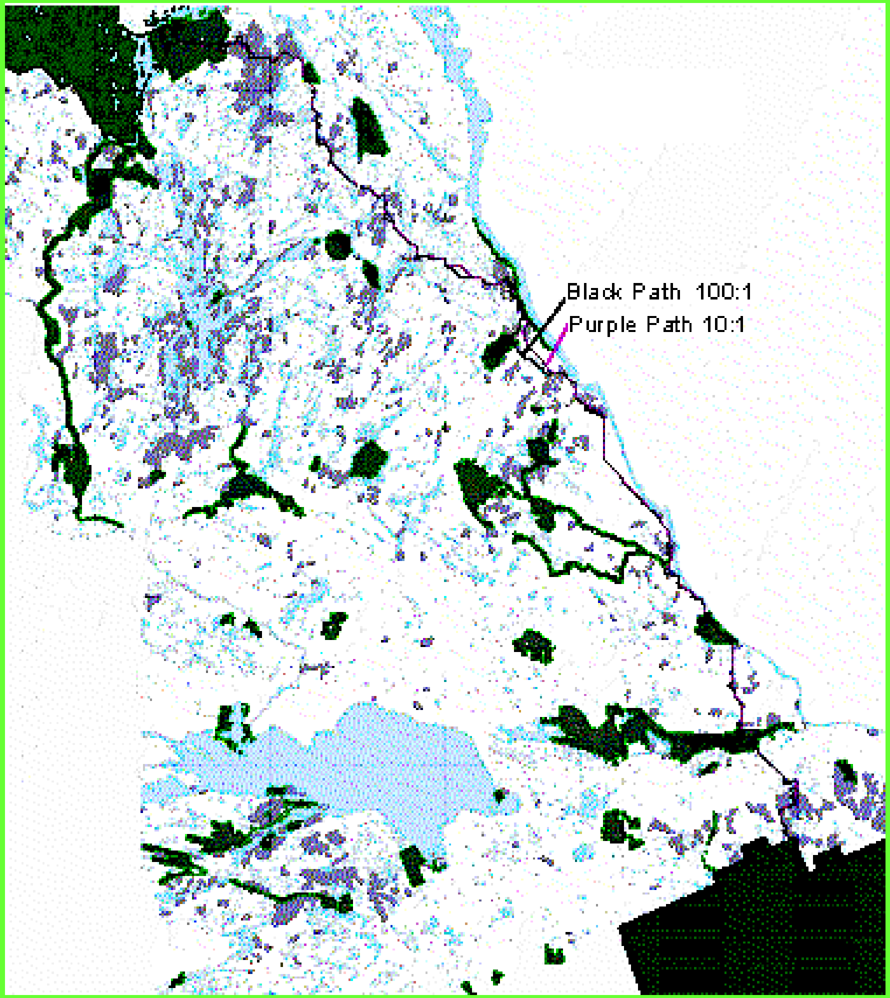


Private & Crown Land



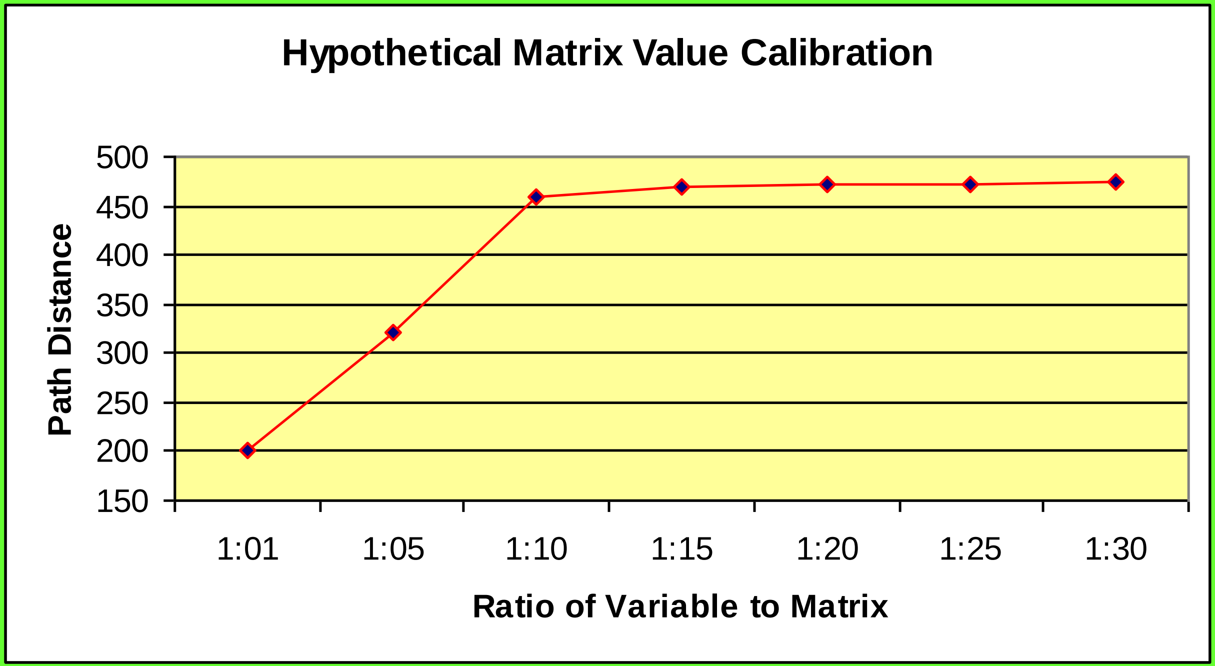
Step 2 in Corridor Mapping:
Calibration for Matrix Values (a)

- **Use "least-cost path analysis"**
- **Best wildlife habitat = lowest values; poorest habitat = highest values**
- **Pathway is one cell wide**
- **Nearest neighbor analysis to choose lowest cost cell**
- **Start at Algonquin north boundary; end at Lady Evelyn-Smoothwater southern boundary**
- **Best data variable linkage (pathway) = lowest total path cost**



Step 2 in Corridor Mapping:
Calibration for Matrix Values (b)

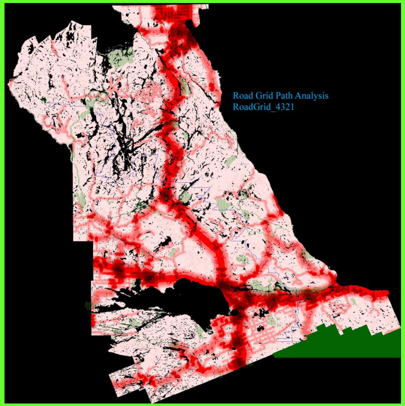
- **Variable = low value; Matrix = high value – BUT HOW HIGH???**
- **Must avoid high cost cells and maximize connection of variable occurrences**
- **Matrix value = point where curve approaches zero slope – very little additional path distance or connection of variable occurrences thereafter**



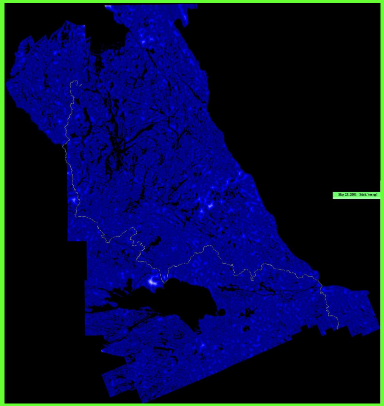
Step 3 in Corridor Mapping:

Examine Results of Calibration & Least-Cost Path Analysis for Each Data Layer

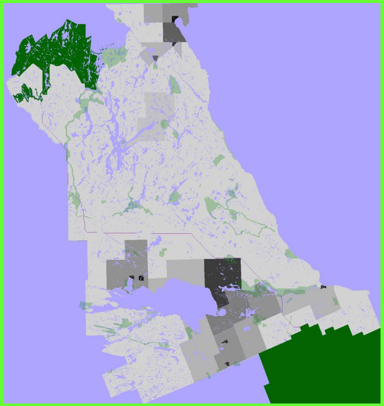
Roads



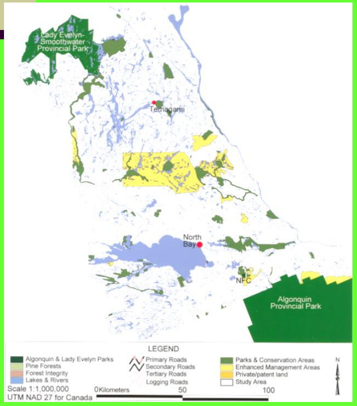
Water Bodies



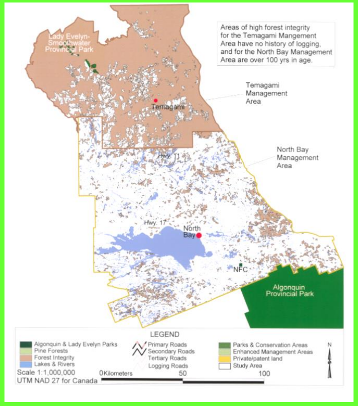
Human Population



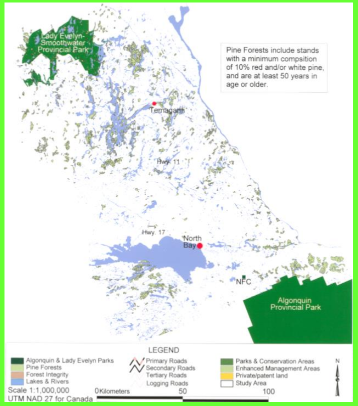
Protected Areas



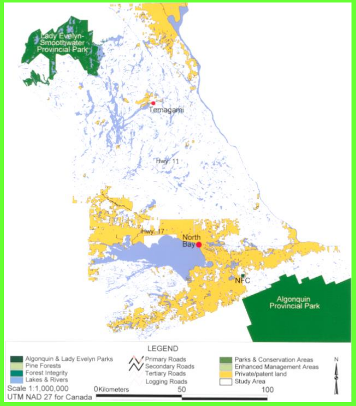
Mature & Old Growth Forests



Pine Forest



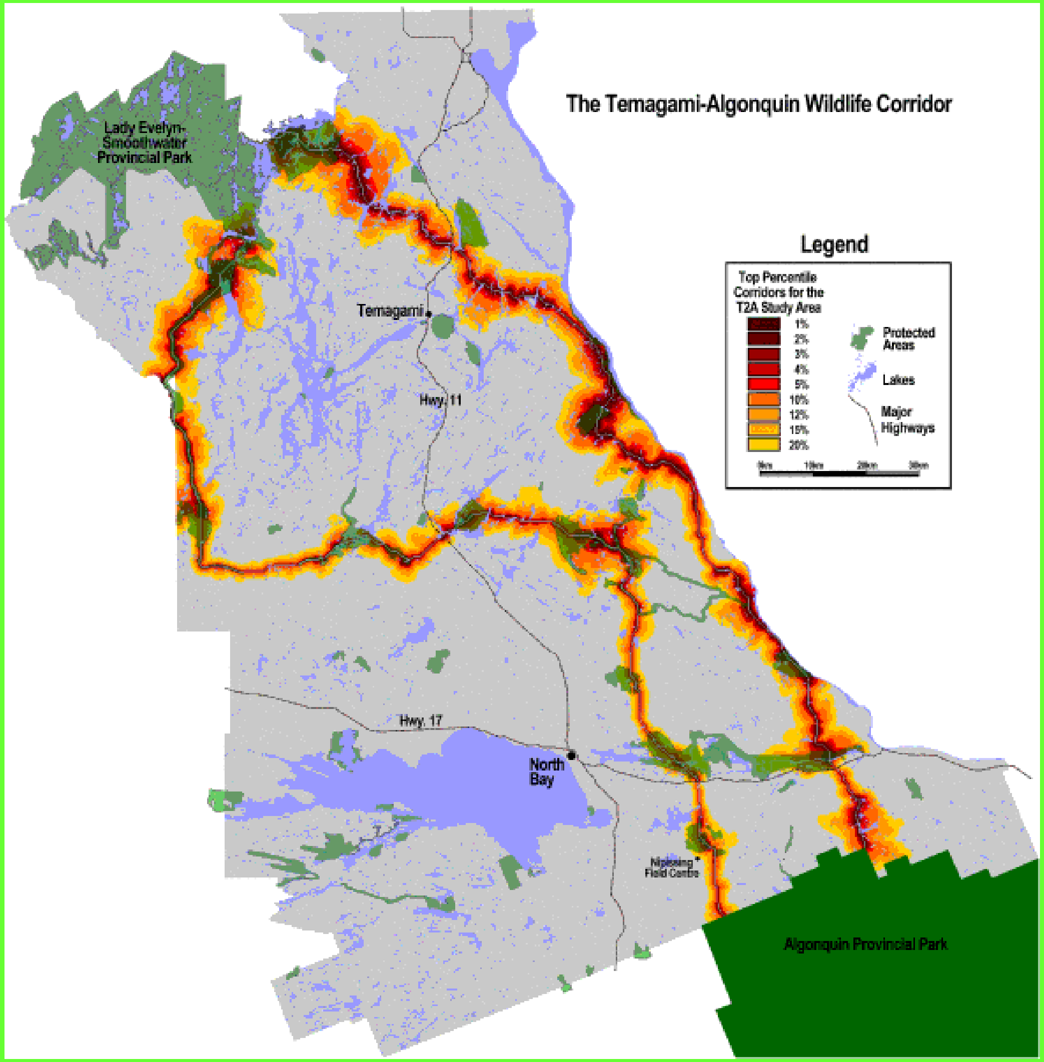
Private Land



Step 4 in Corridor Mapping:
Choose Most Logical Pathways

<u>West Arm</u> – best connection of existing ***protected areas***

<u>East Arm</u> – maximizes linkage of ***mature & old-growth forest***, ***pine forest***, *and* ***roadless areas***



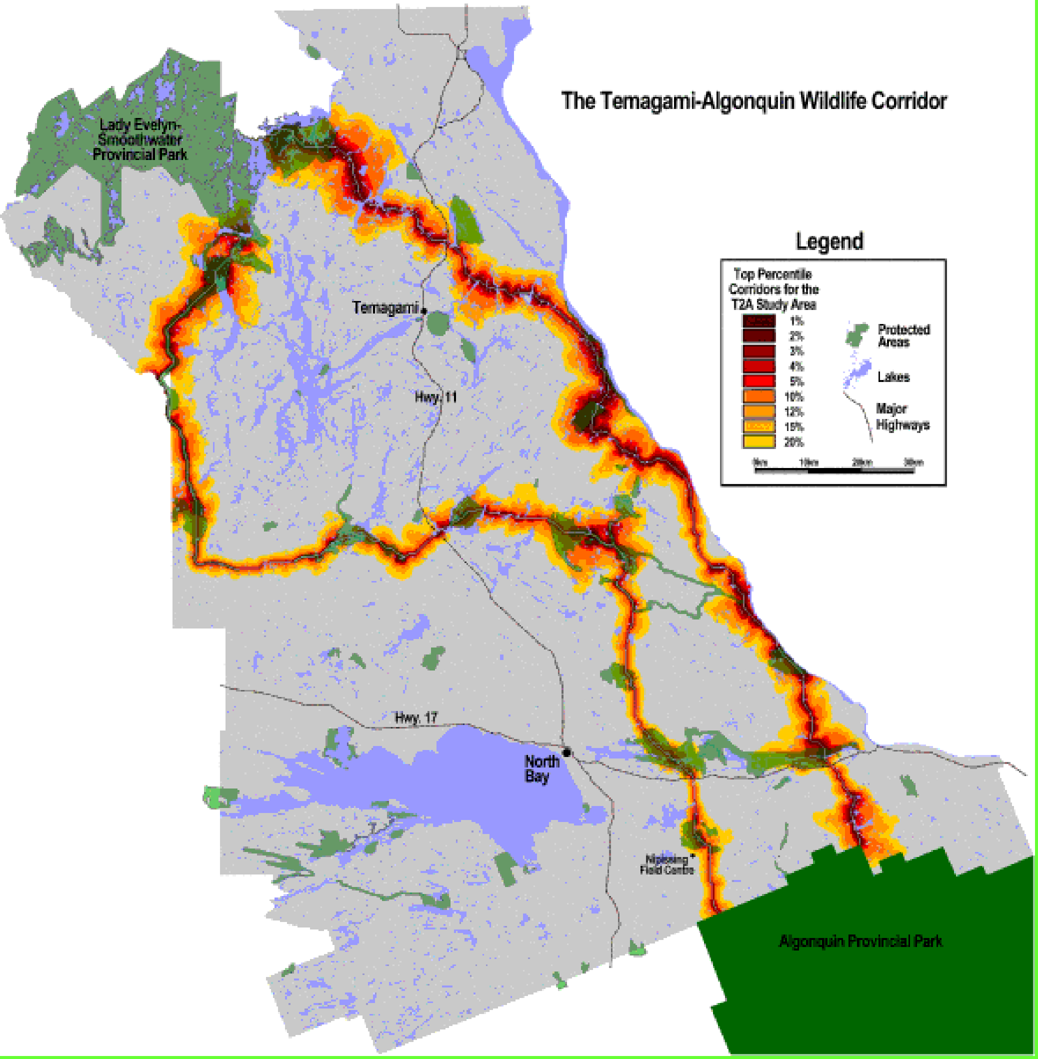
Step 5 in Corridor Mapping:
Add Width (a)

Heavily weighted (x7):

- **Roadless Areas**
- **Mature & OG Forests**
- **Pine Forest**
- **Protected Areas**

Unweighted (x1):

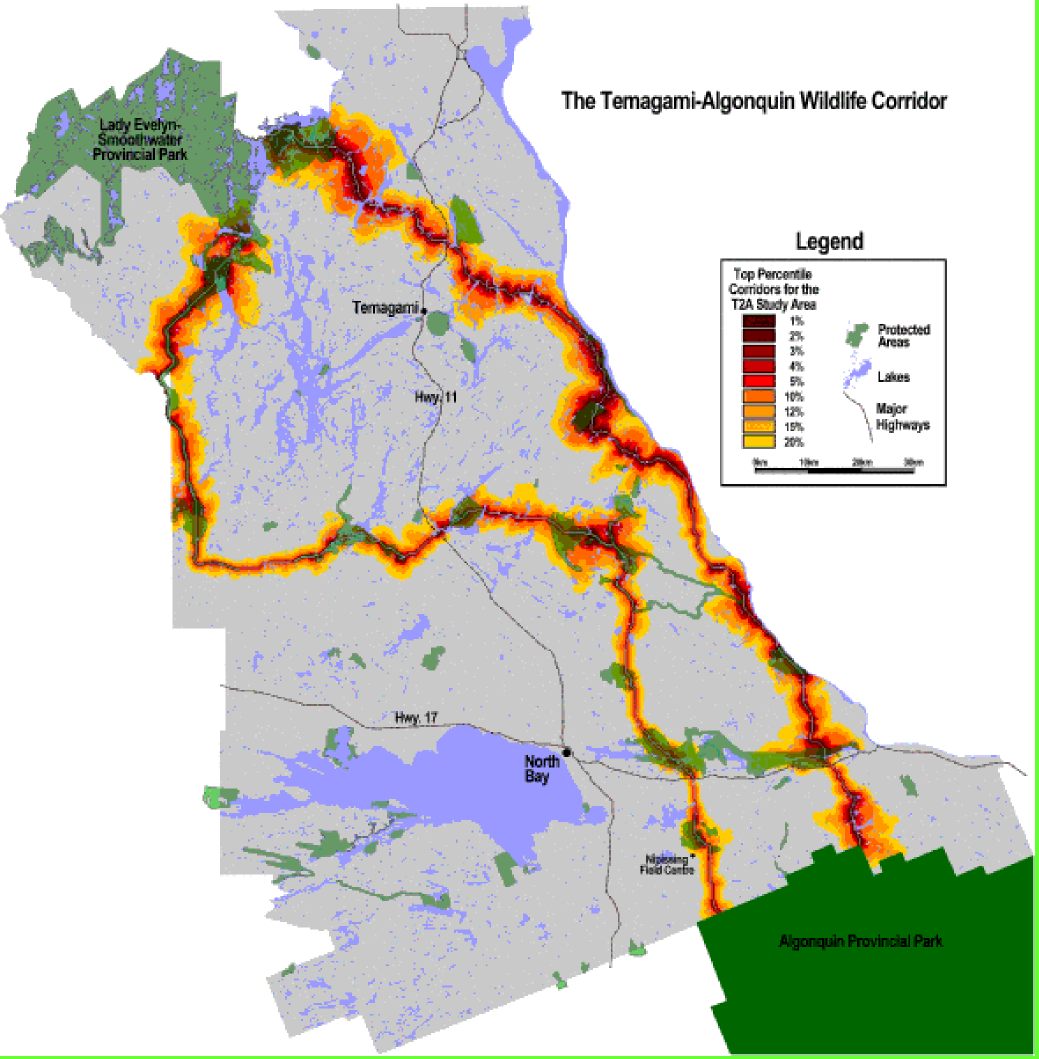
- **Human Population**
- **Water Bodies**
- **Private Land**



Step 5 in Corridor Mapping:
Add Width (b)

Least Cost Surface Analysis

- produce new data layer
- square of the 7:1 model (recognized significant features); use reciprocal
- use all three paths as the origin
- cost surface grid = cumulative cost from the paths to all other points
- query highest values until 20% of the study area accounted for



Establishing Corridor Boundaries

- Coarse-scale GIS mapping can only provide general corridor location
- Need more detailed species & ecosystem information to identify and advocate for specific boundaries
- Three-pronged approach: *ecological representation, focal species & special elements*
- Most significant special element: "*ENDANGERED OLD-GROWTH RED & WHITE PINE FORESTS*"
  - Partial legal protection, public interest & experience
  - Identify and promote protection of the healthiest stands – least expensive to maintain

Healthy Stands = Abundant Regeneration = Sustainability = Least Expensive

A Problem of Scale

GIS Data Layer

(thousands of hectares)

Forest Resource Inventory Maps

(hundreds of hectares)

Field Plots

(portions of a hectare)

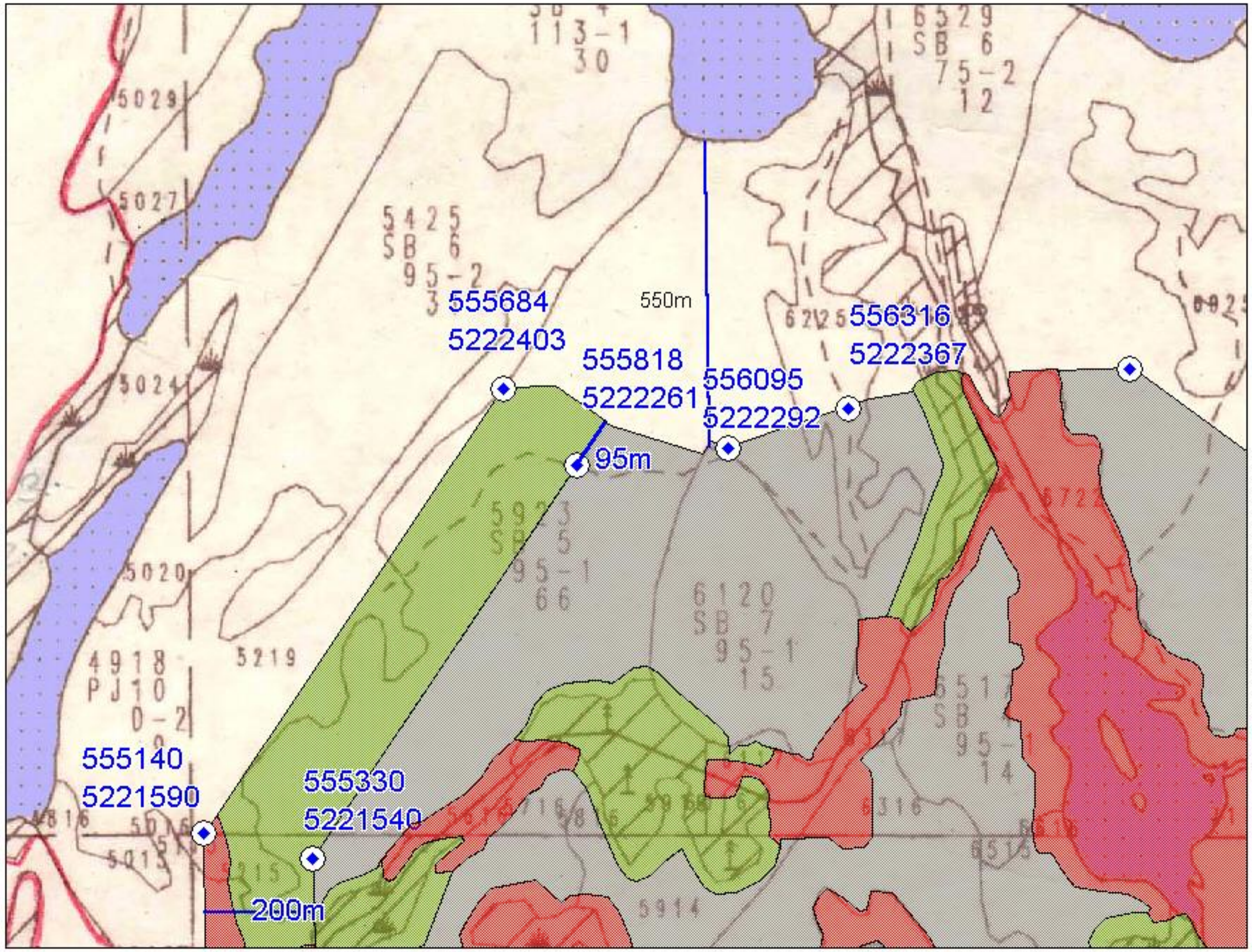
Objective of the White Pine Regeneration Field Study

- Identify relationships between existing map variables and white pine regeneration
- Use map-regeneration relationships to predict location of healthiest white pine stands = highest regeneration
- Future
  - Test predictions
  - Convert FRI map data to digital GIS data layer

Map Variables

FRI Maps:

- Size
- Age
- Stocking
- Species (%)
- Site Class
- Height



Topo Maps:

- Aspect
- Slope Position

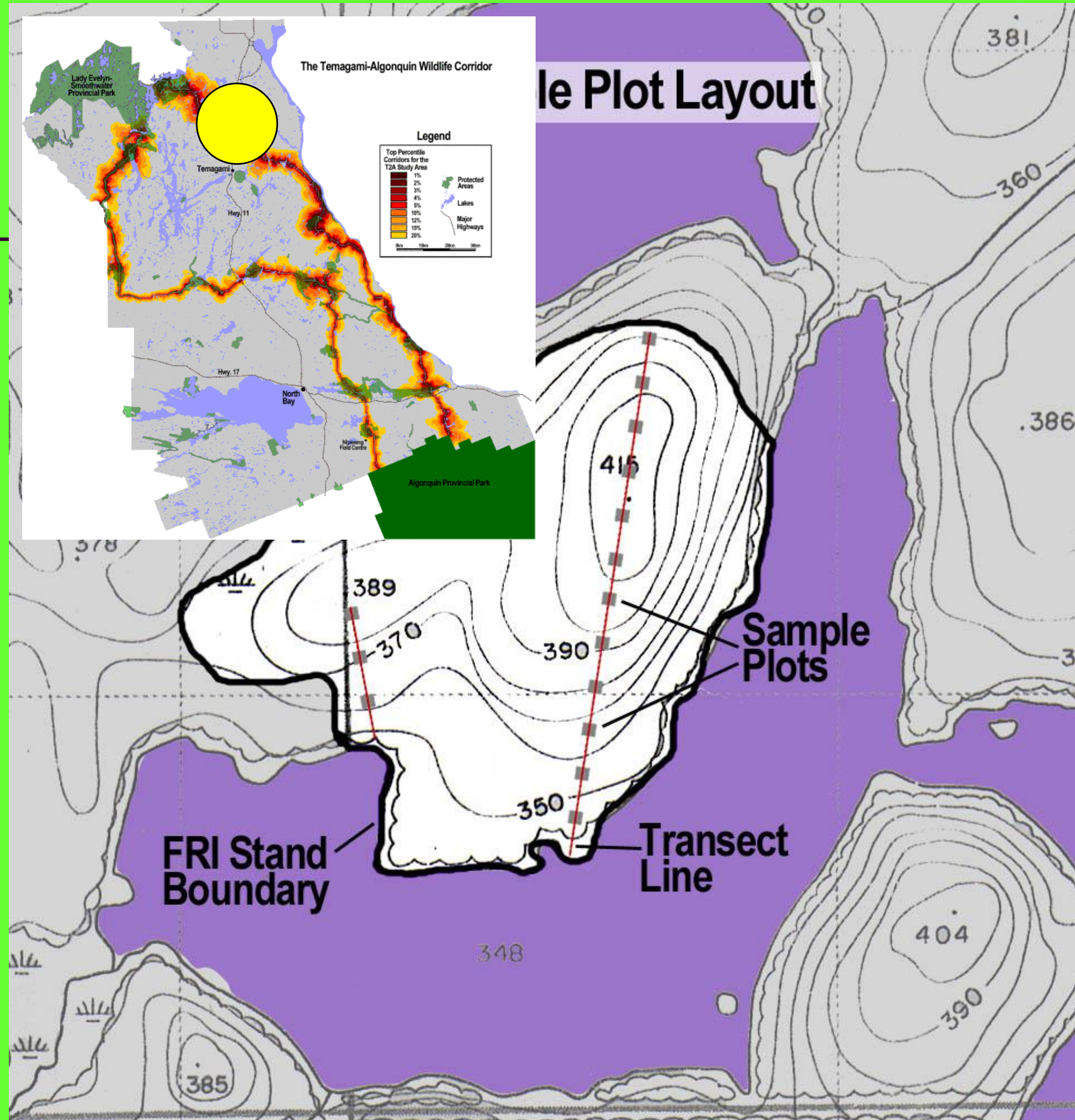
Field Methods

Stands with 10, 20, 30, 40, 50, 60 & 70% Pw

Transects with sample plots

Follow greatest topographic (environmental) variation

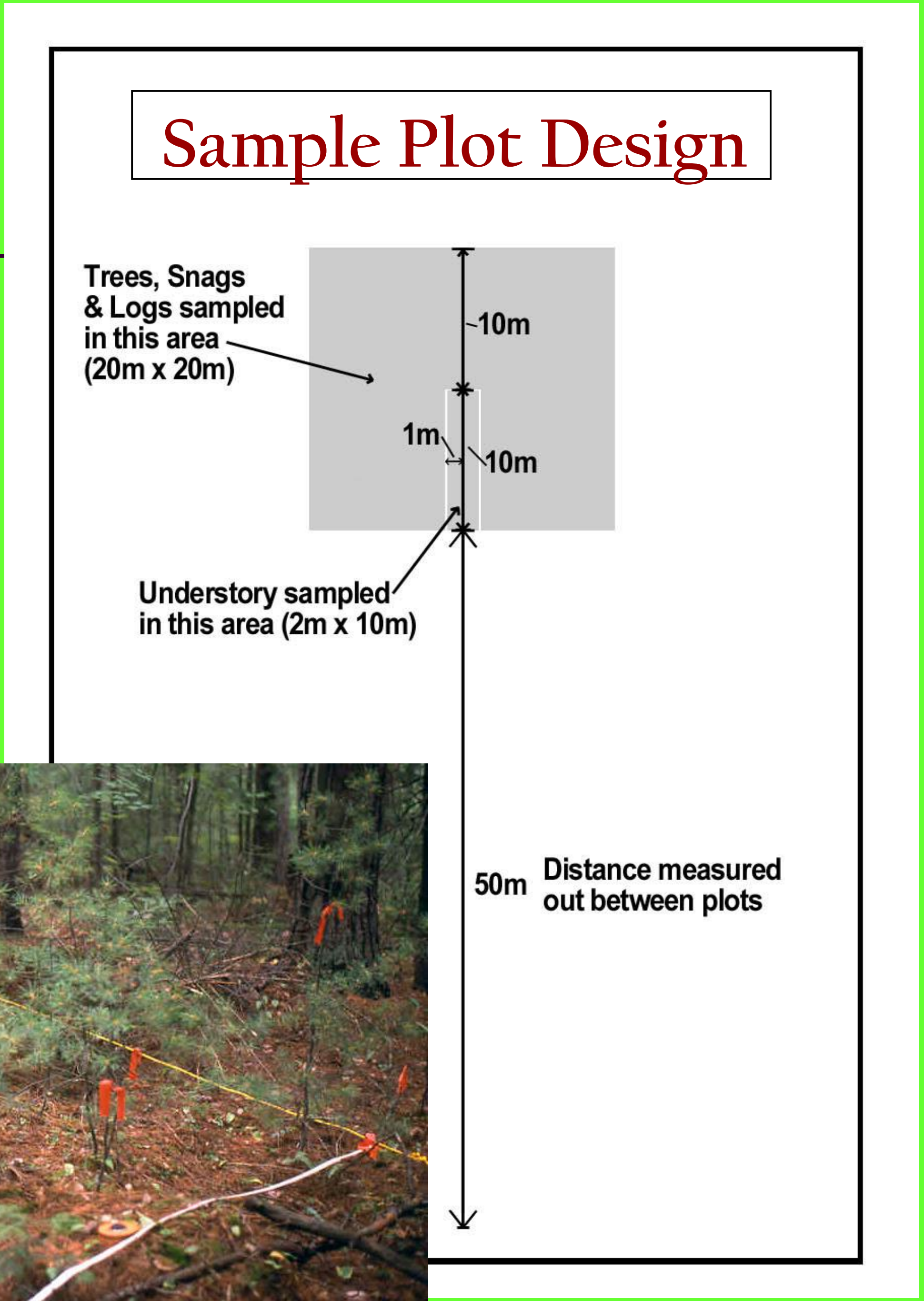
North-south & east-west when possible



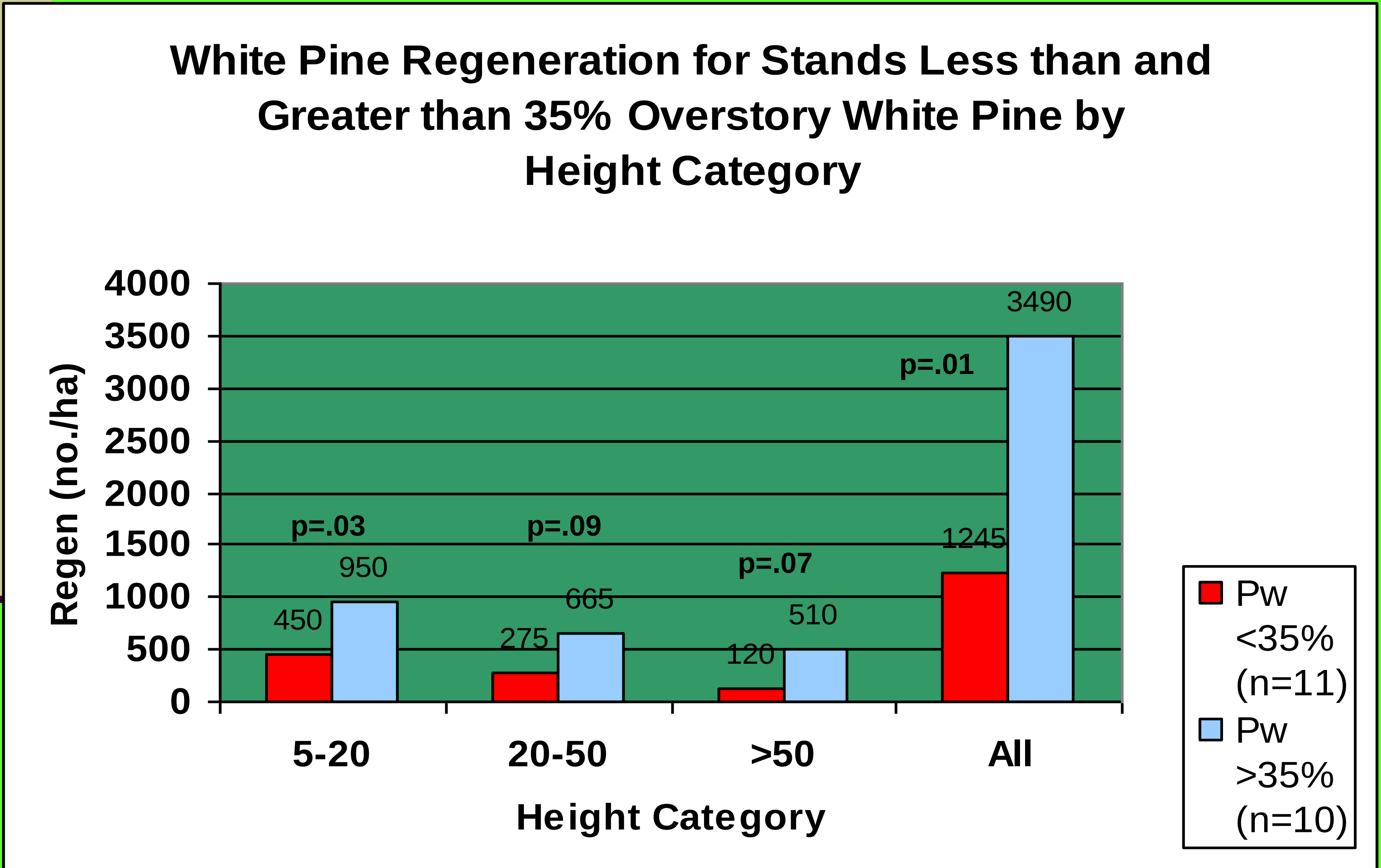
Field Methods

Five Pw regeneration classes

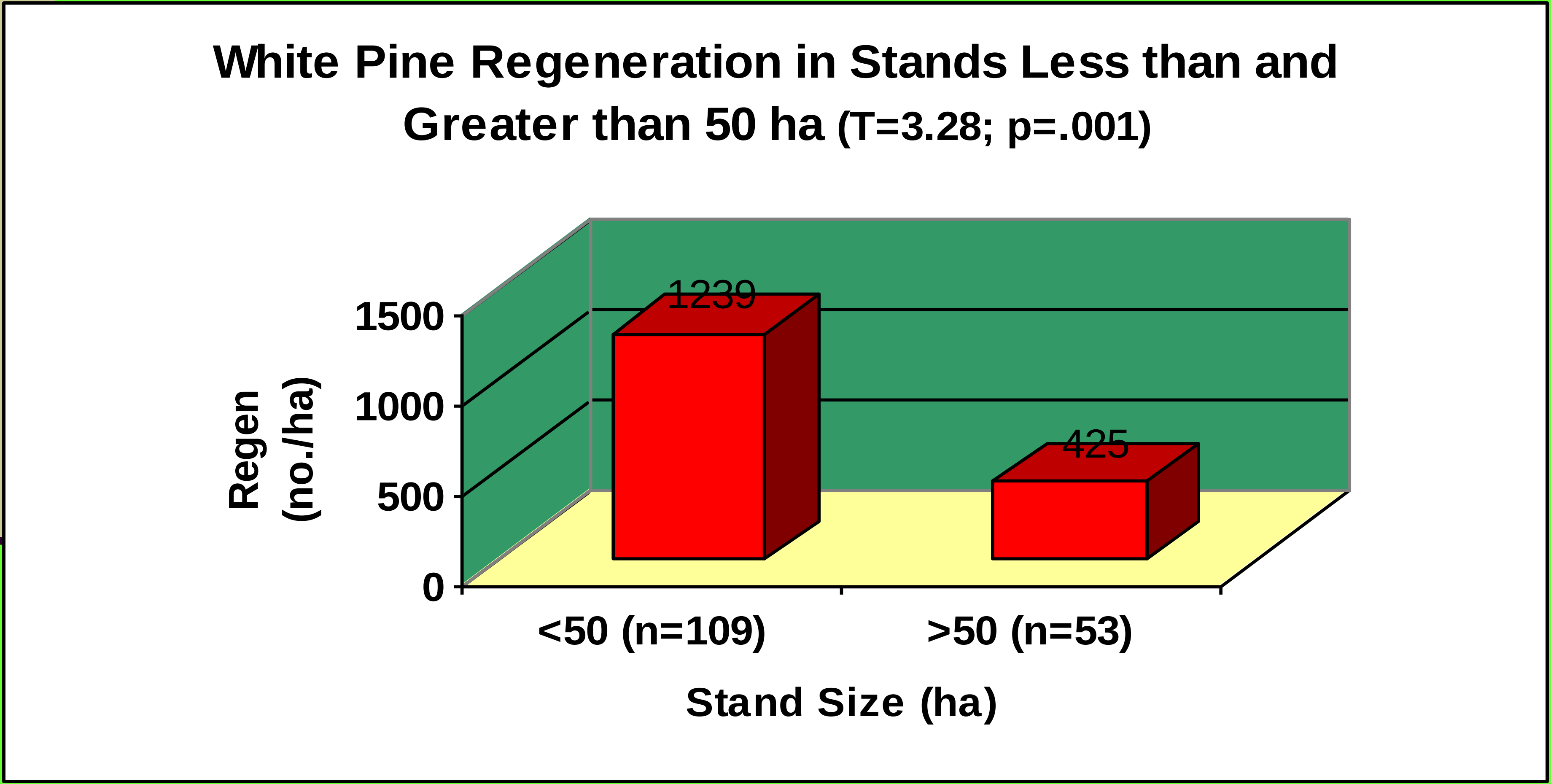
- 0 – 5 cm (height)
- 5 – 20 cm
- 20 – 50 cm
- 50 cm – 10 cm dbh
- all combined



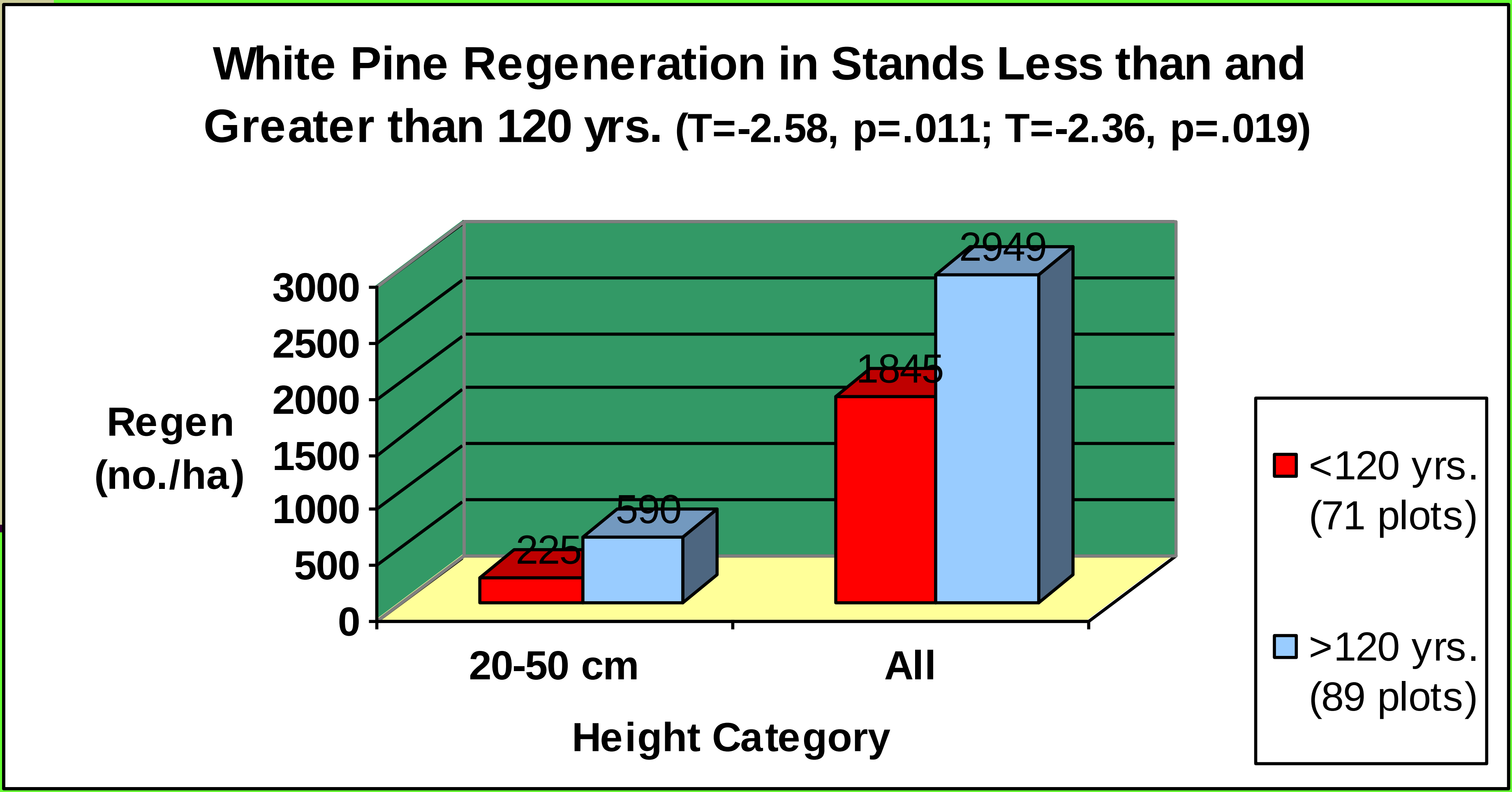
Results: FRI White Pine Abundance



Results: FRI Stand Size

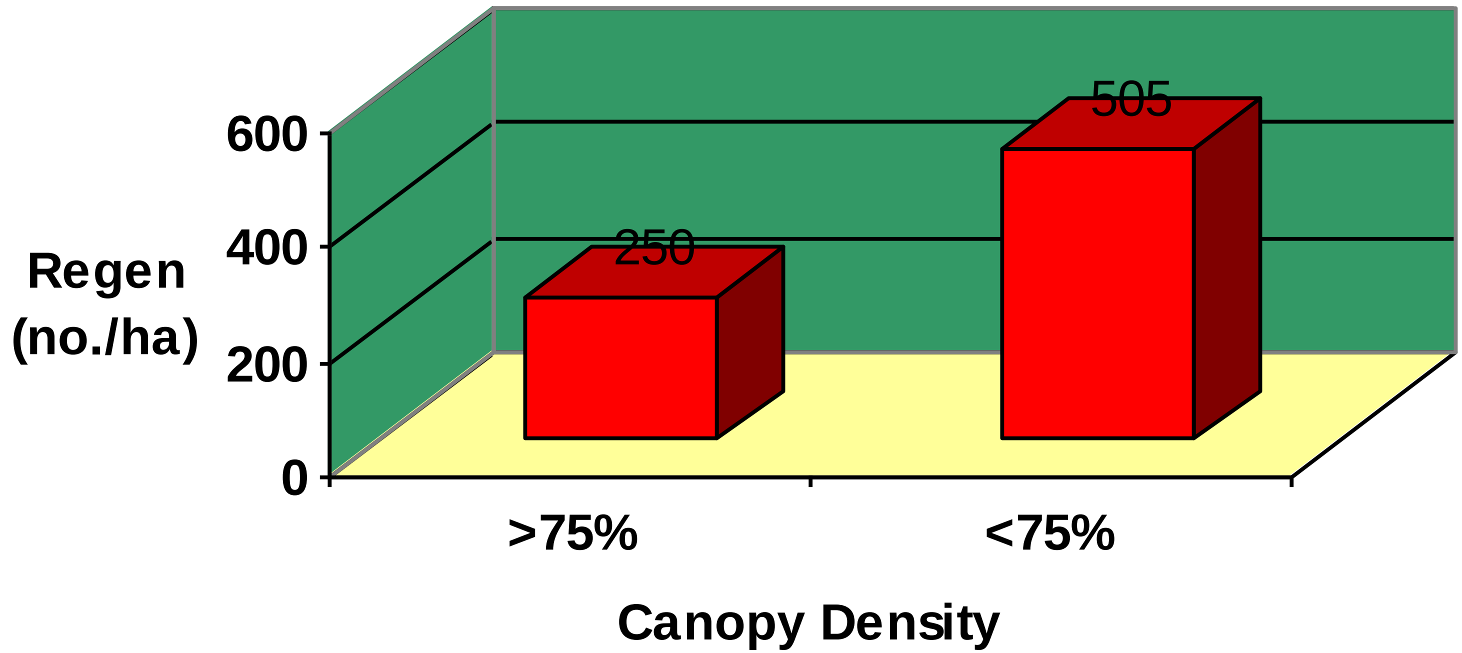


Results: FRI Stand Age

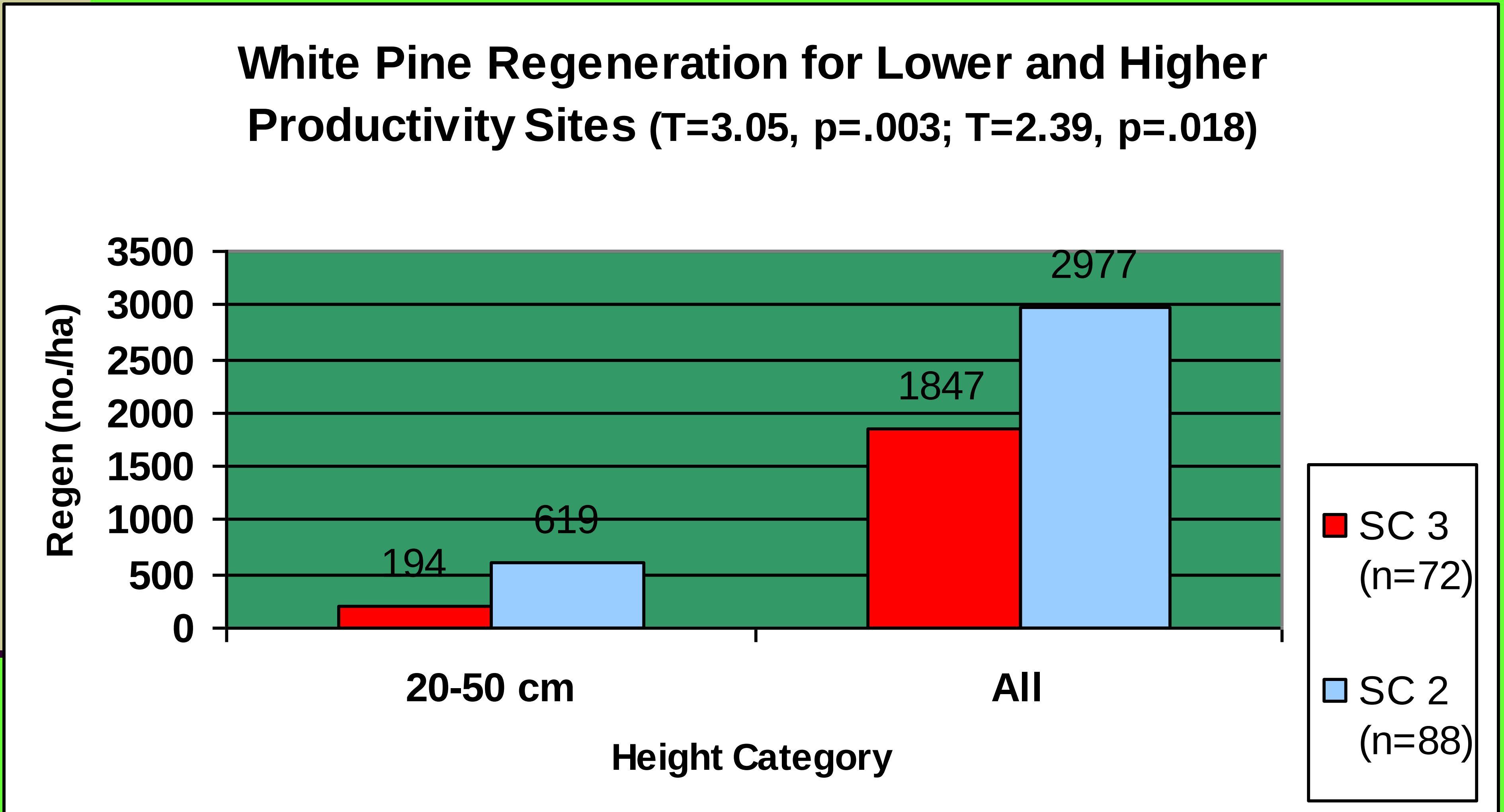


Results: FRI Stocking

White Pine Regeneration (20-50 cm Height) for Stands Greater than (n=52) and Less than (n=110) 75% Canopy Density (T=2.06, p=.041)



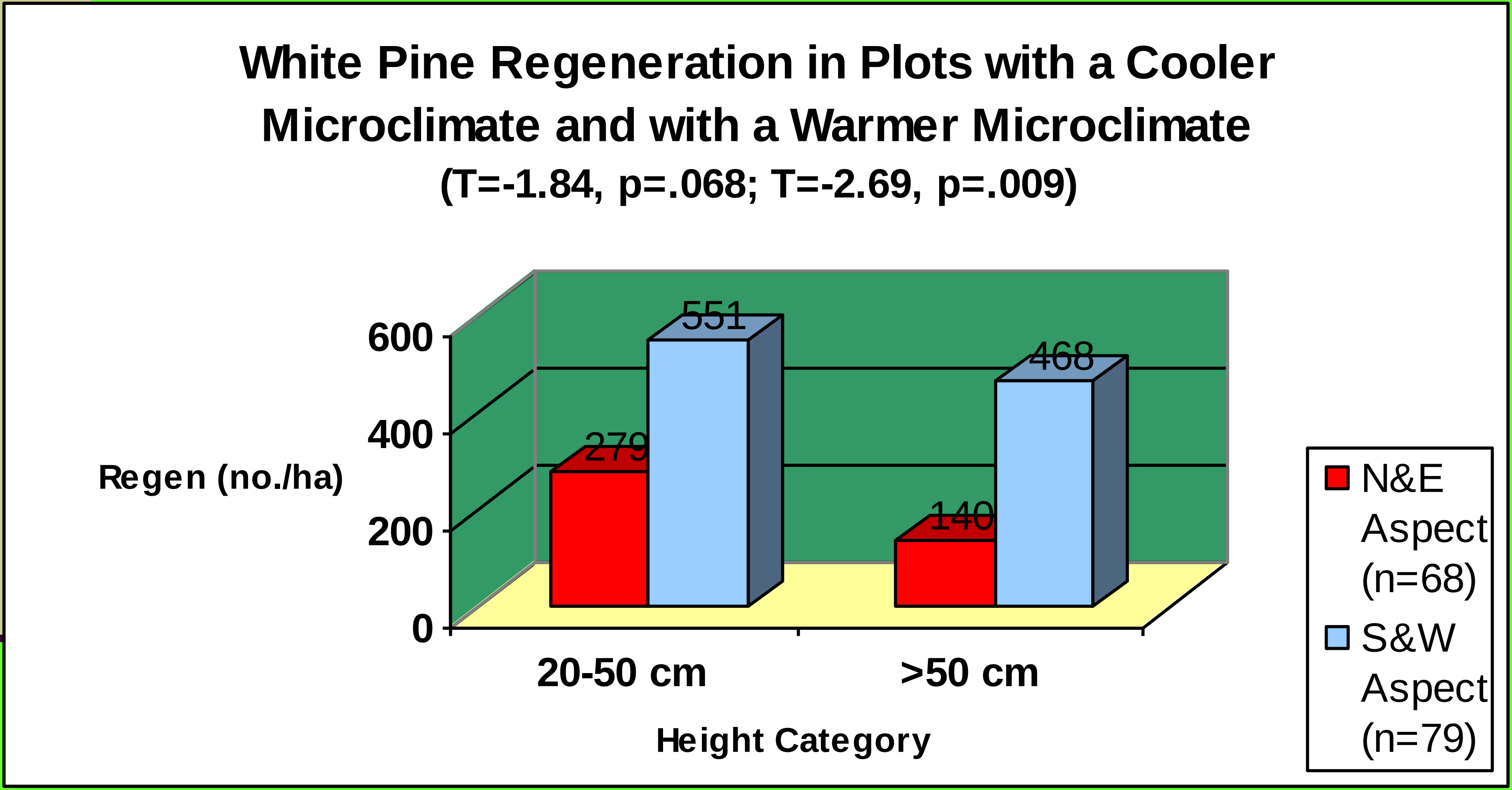
Results: FRI Site Class



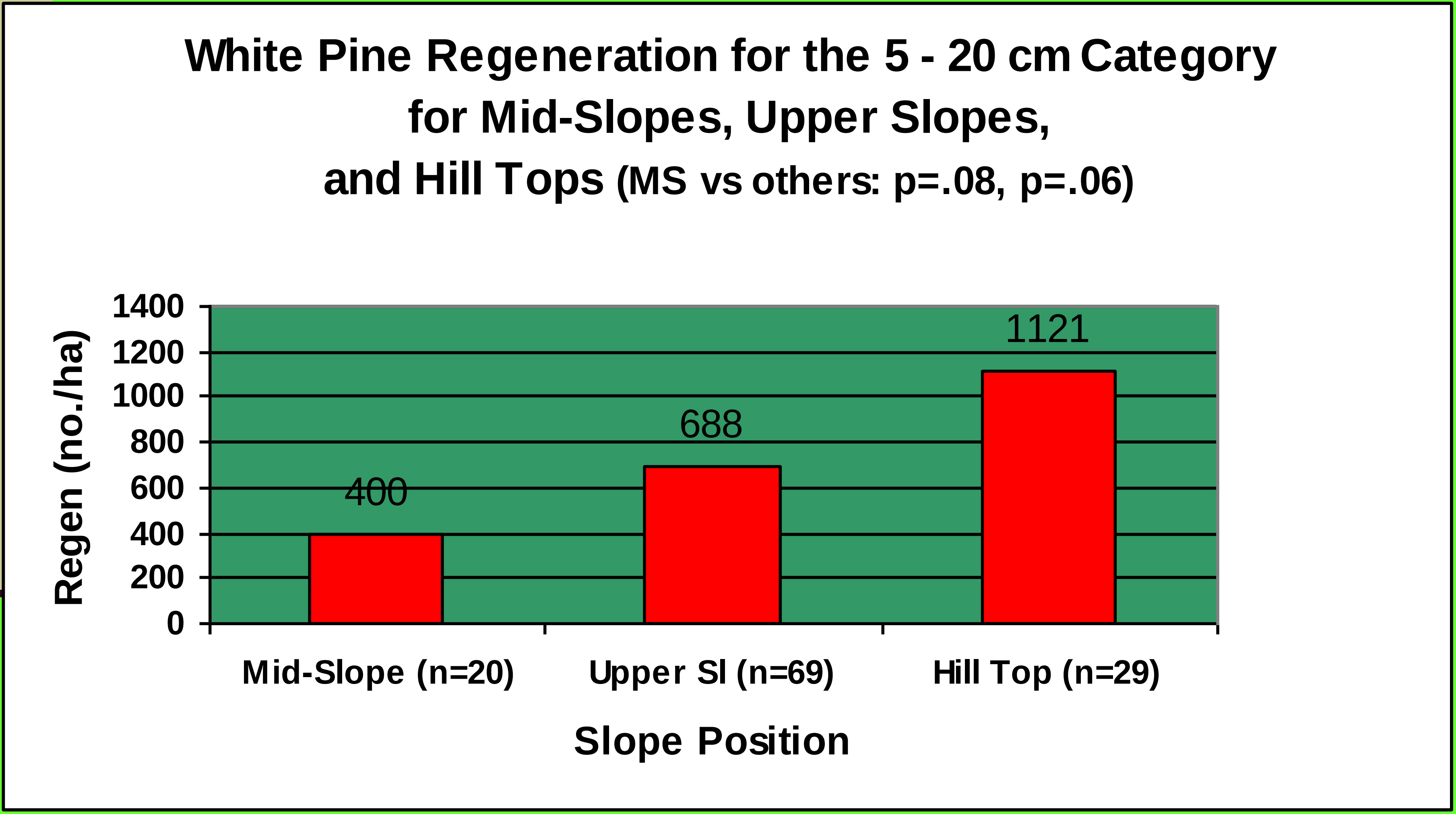
Results: FRI Tree Height

No Differences

Results: Aspect (field & topo maps)

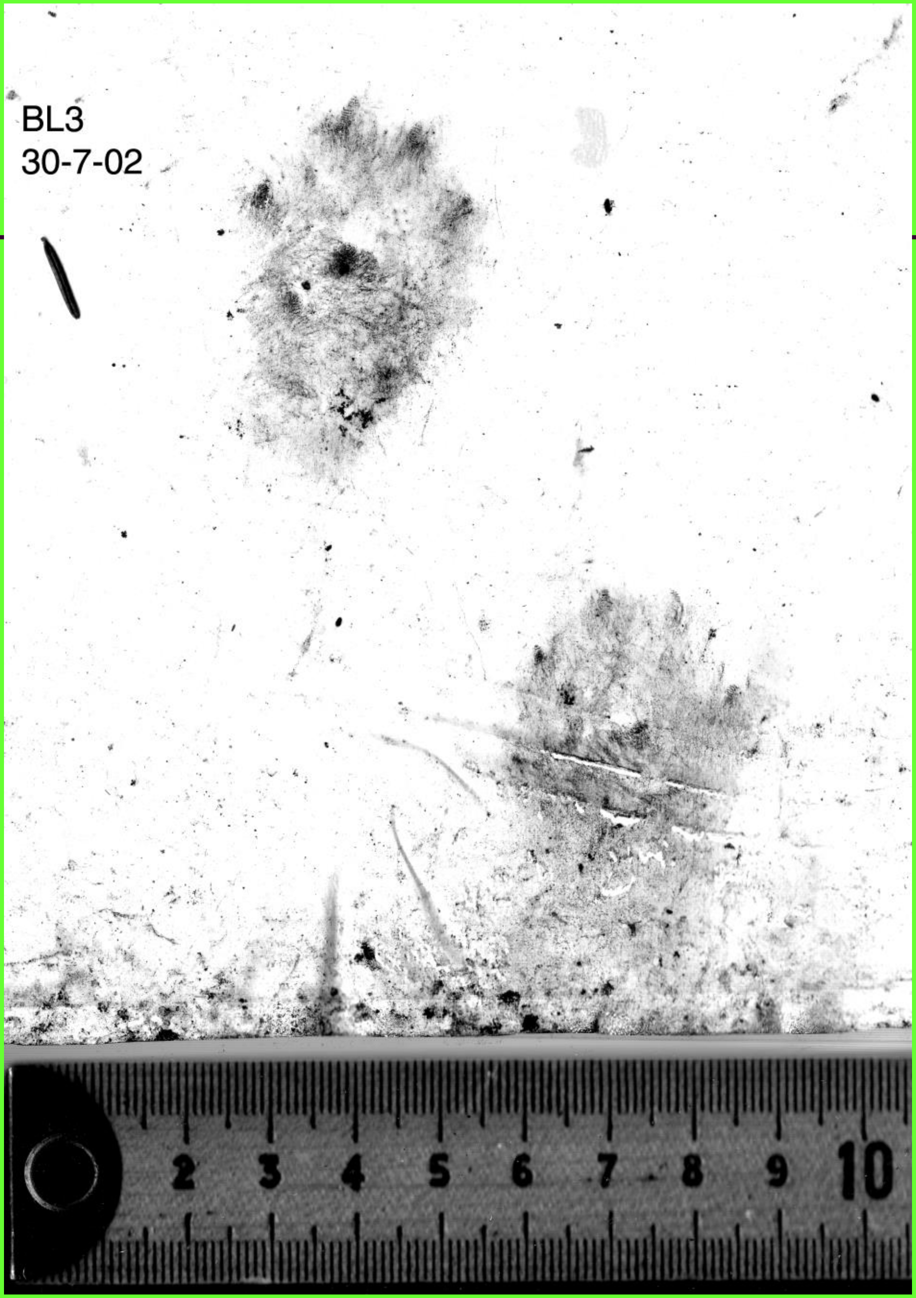


Results: Slope Position (field & topo maps)

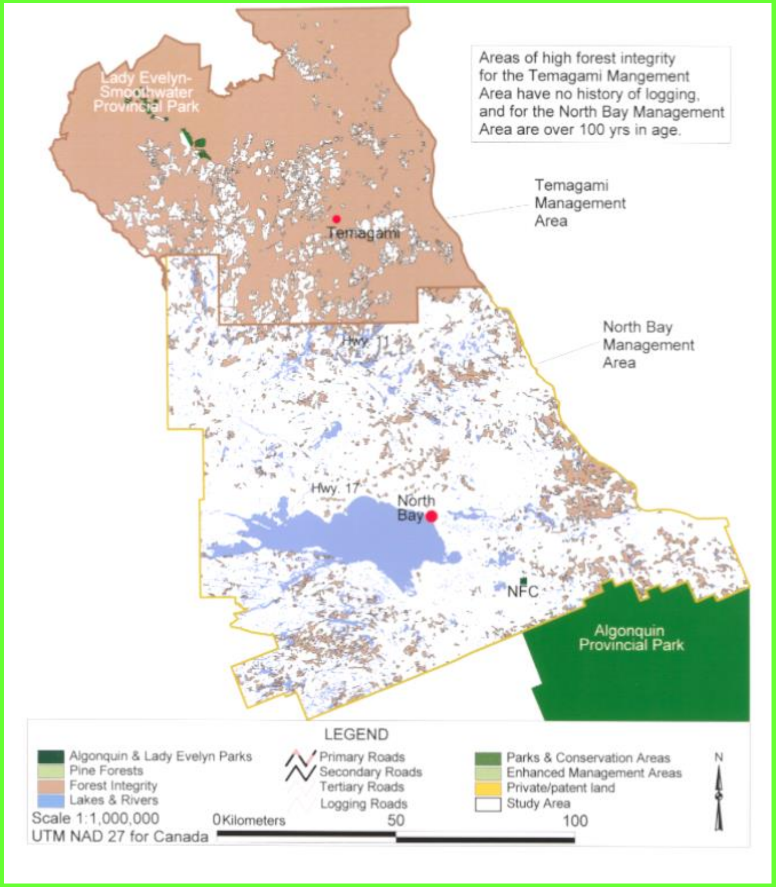


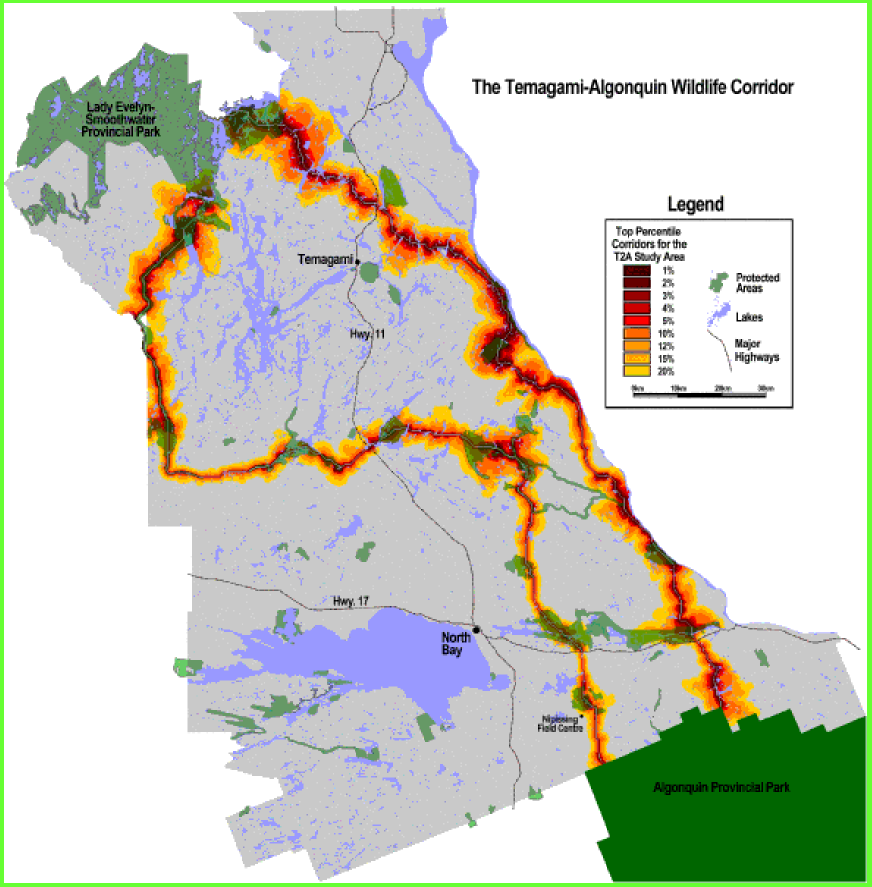
Regeneration:
Key Stand Features from Maps

- FRI Maps
  - >35% overstory white pine
  - >120 years old
  - <75% stocking (canopy density)
  - Site class 2 (more productive sites)
- Topographic Maps
  - South & west aspects
  - Hill tops & upper slopes
- Predict using maps; field test; digital data

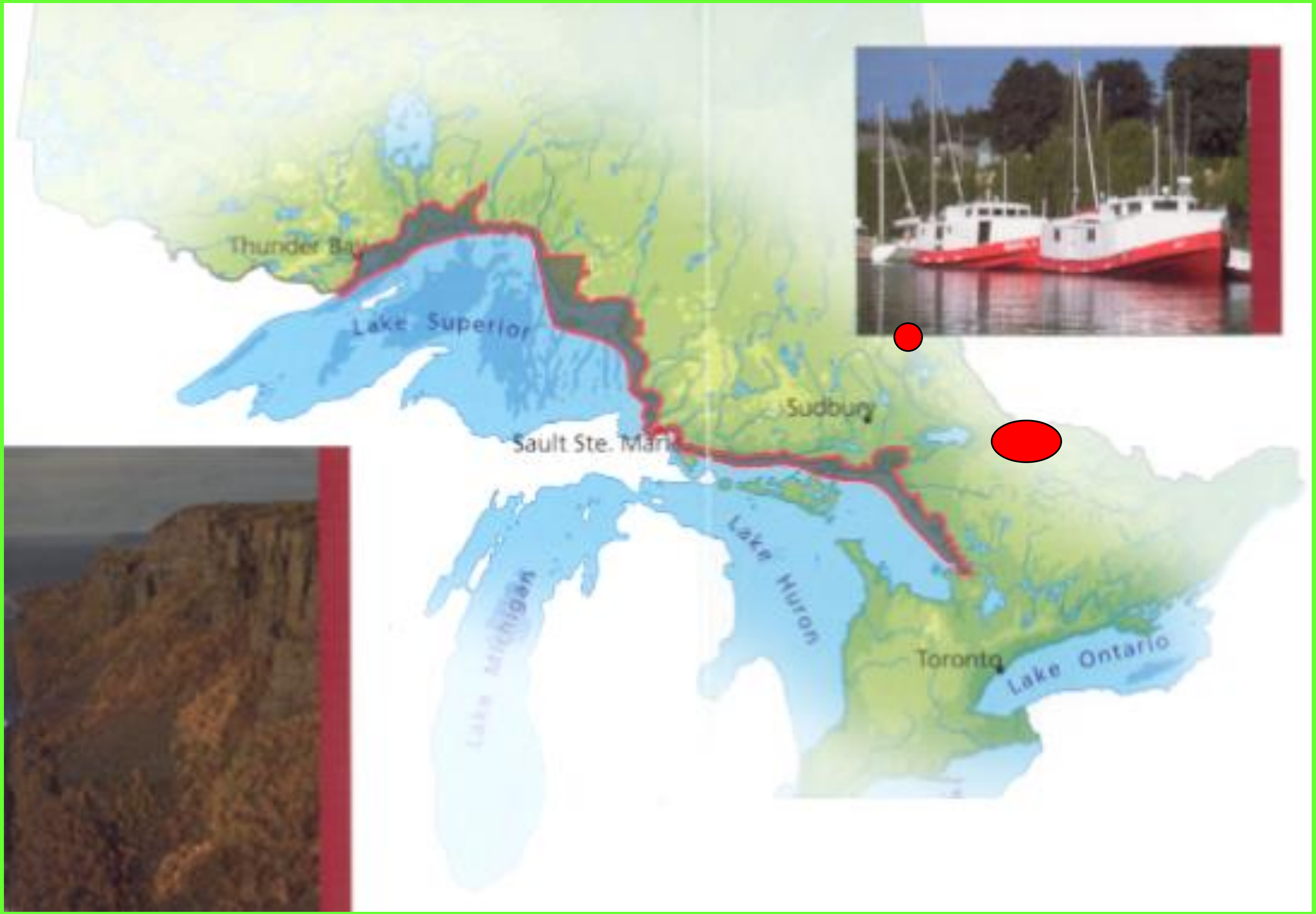

BL3
30-7-02
2 3 4 5 6 7 8 9 10

Corridor Boundaries for Marten Habitat Connectivity





Great Lakes Heritage Coast: Ontario Government



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