

SUSTAINABLE RECRUITMENT OF COARSE WOODY STRUCTURE ALONG LAKES: AN ASSESSMENT

Pat Wherley
Michael Bozek

Wisconsin Cooperative Fishery Research Unit
College of Natural Resources
University of Wisconsin-Stevens Point

Terminology

- **Riparian Area**: Transition area between the upland and the water (approximately 35+ feet wide).
- **Littoral Zone**: Near shore area where the sunlight penetrates all the way to the bottom, allowing plants to grow.
- **Shoreline Development**: Any land-use activity that removes riparian vegetation (Home/cottage construction, agriculture, etc.)



Coarse Woody Structure (CWS)

Function

- Shoreline Protection
 - Erosion: Wave Action, Ice Scour
- Nutrient Supply to Aquatic Ecosystems
- Habitat Creation
 - Fish, Wildlife, & Aquatic Invertebrates













Land Use in Riparian Areas

- Shoreline disturbance
 - Replacing forest with mowable lawn
 - Visual sight lines
 - Firewood and snag removal
(landowners and fishermen)







Land Use in Riparian Areas

- Littoral zone disturbance
 - Unsightly to landowners
 - Dock, retaining wall, and beach installation
 - Fishermen – Lure retrieval, firewood.
 - Navigation hazard







Current Regulation

Shoreland Management

- Chapter NR 115
 - Broad scope – County regulations
- Chapter NR 117
 - Narrow scope – Cities and Village regulations

Current Regulation

Chapter NR 115

- 115.05 (3)

- (c) Trees and shrubbery. The cutting of trees and shrubbery shall be regulated to protect natural beauty, control erosion and reduce the flow of effluents, sediments, and nutrients from the shoreland area.

1. In the strip of land 35 feet wide inland from the ordinary high-water mark, no more than 30 feet in any 100 feet shall be clear-cut.

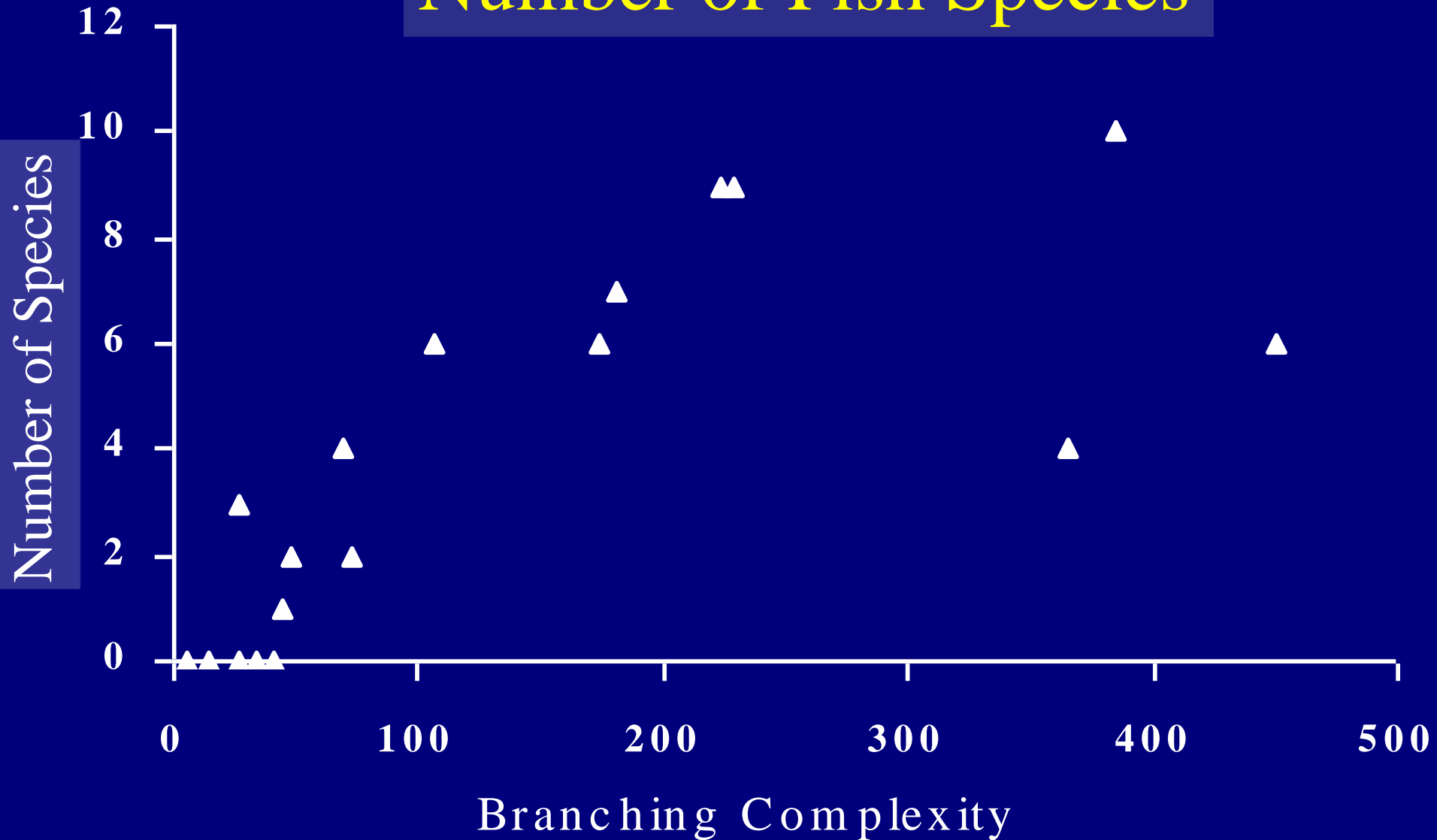
Current Regulation

Chapter NR 115

- 115.05 (3) (c) cont.
 2. In shoreland areas more than 35 feet inland, trees and shrub cutting shall be governed by consideration of the effect on water quality and consideration of sound forestry practices and soil conservation practices.
 3. The tree and shrubbery cutting regulations required by this paragraph shall not apply to the removal of dead, diseased or dying trees and shrubbery.

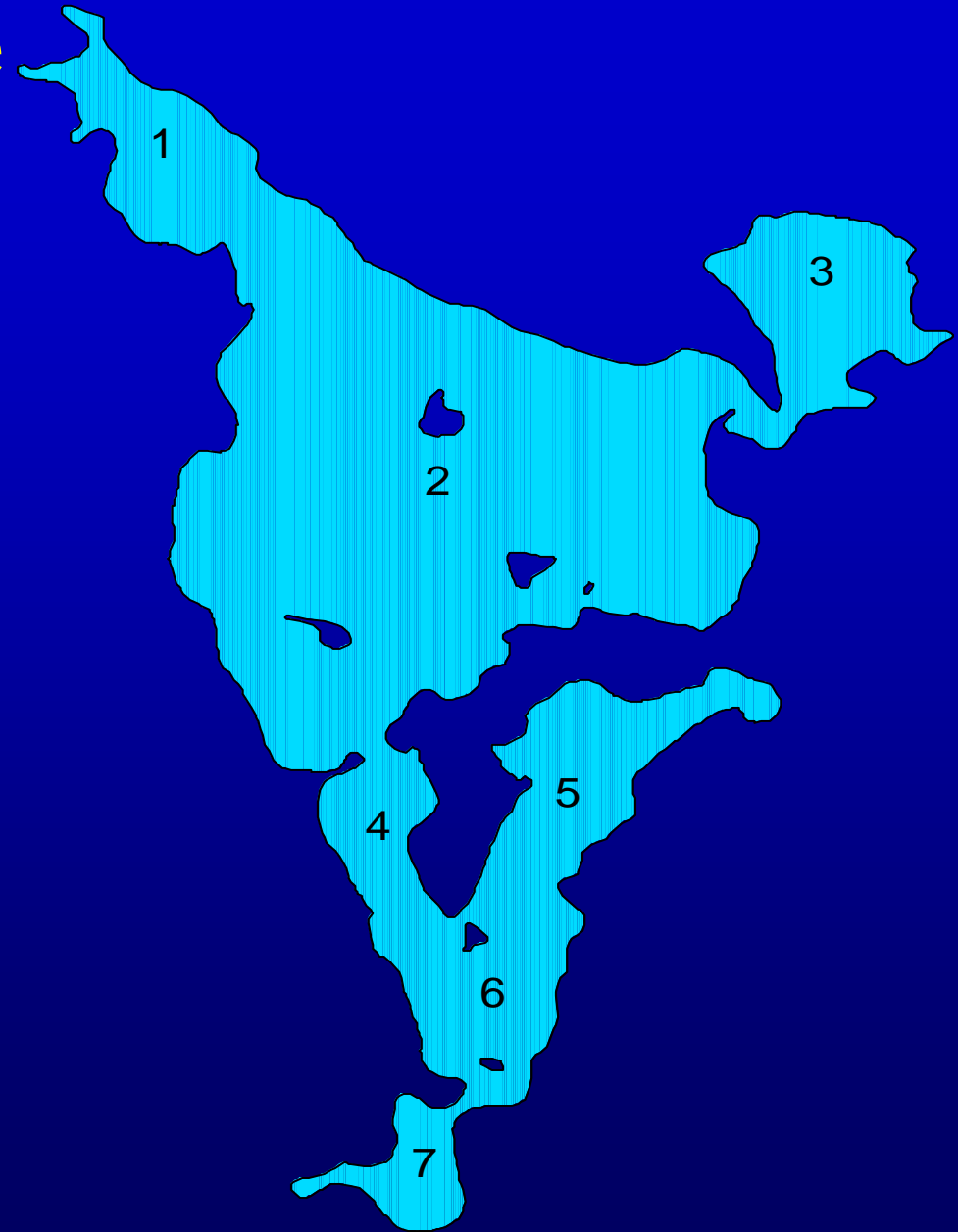
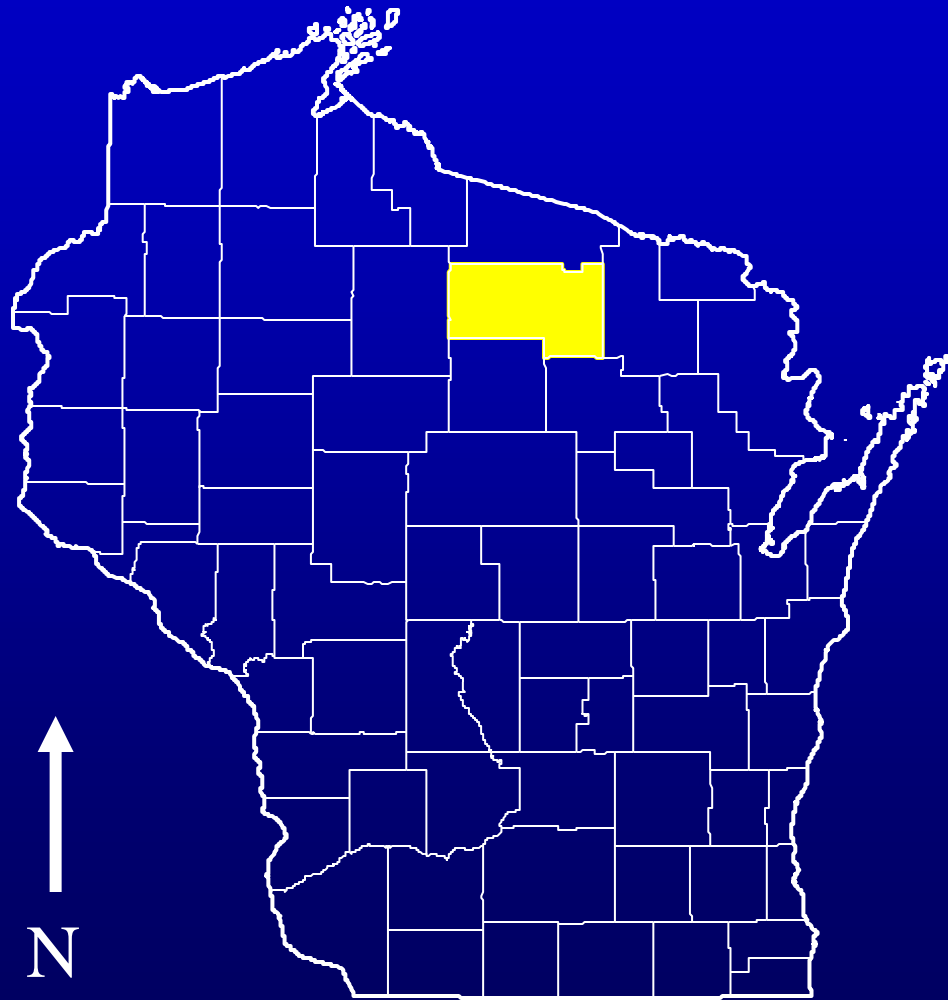


Number of Fish Species

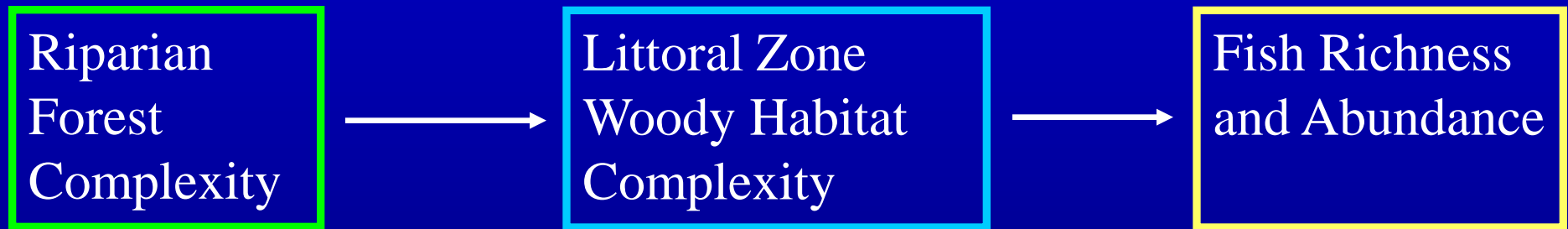


Lake Katherine Study Site

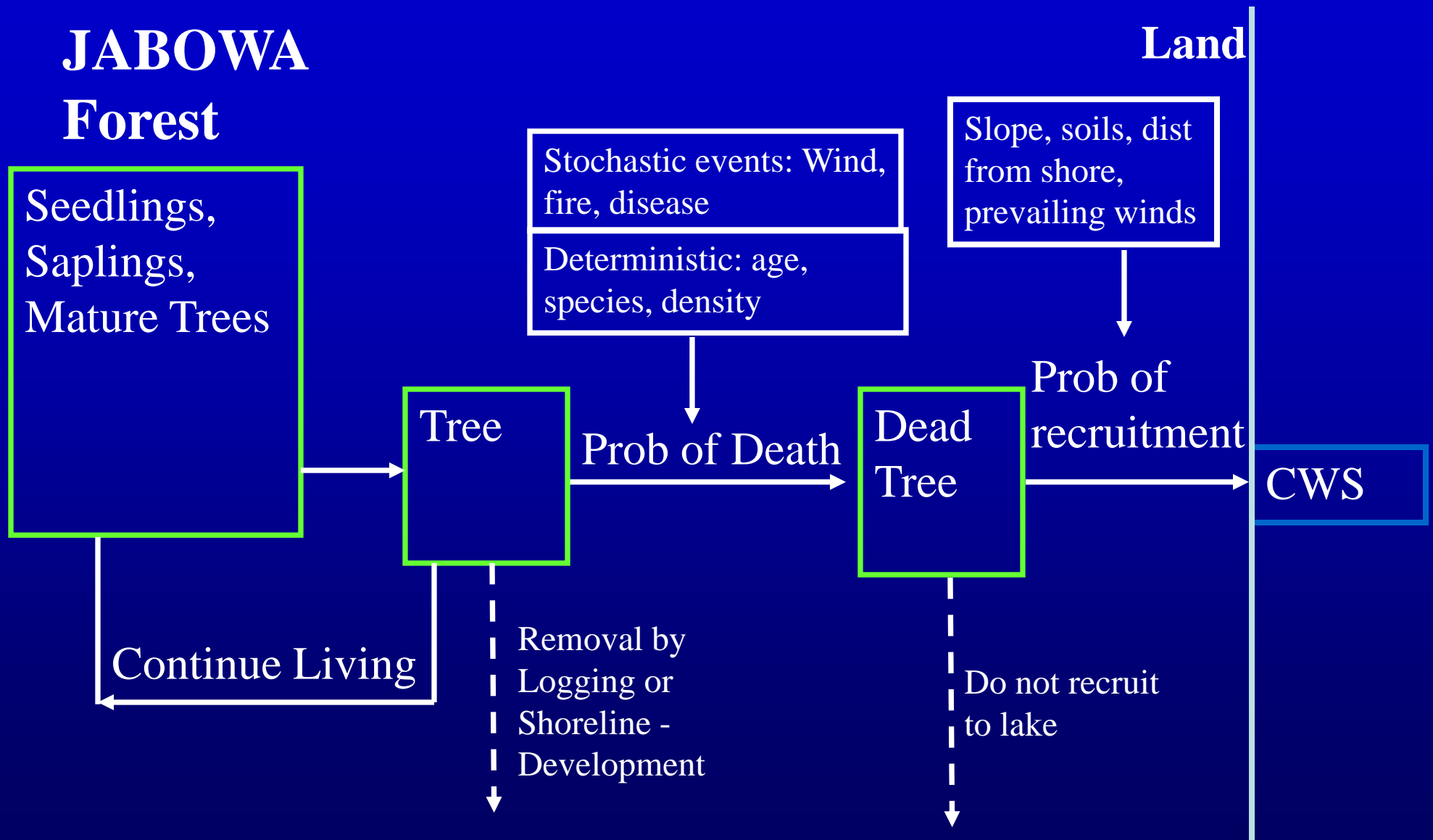
Oneida County, Wisconsin



Tree/Fish Linkage



Conceptual Dynamic Model: Riparian



Study Design

Riparian Land Uses

- a) Natural succession
- b) Understory removal
- c) Total forest removal
- d) Clearcut logging

Natural Succession



Understory Removal



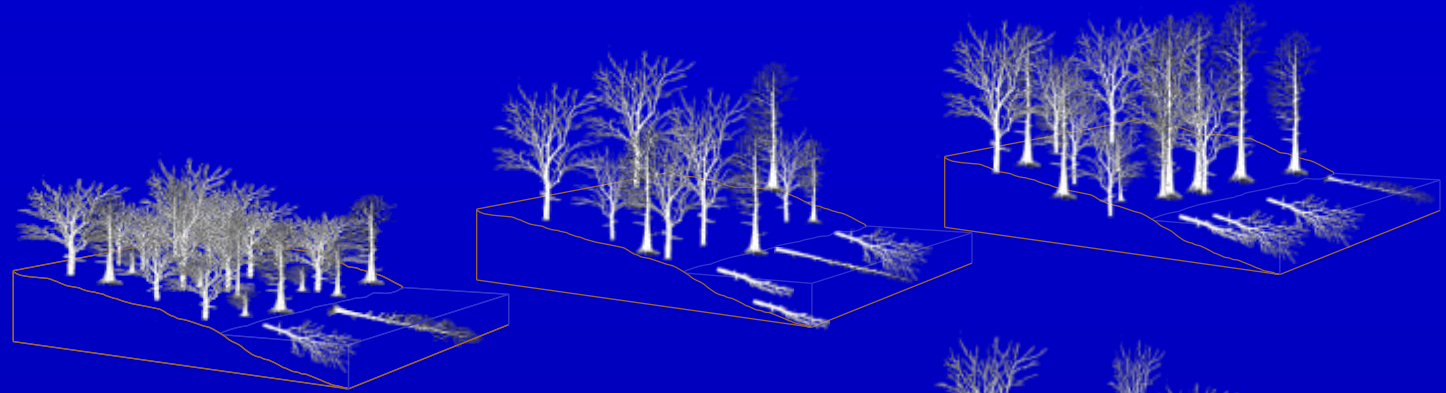
Total Removal



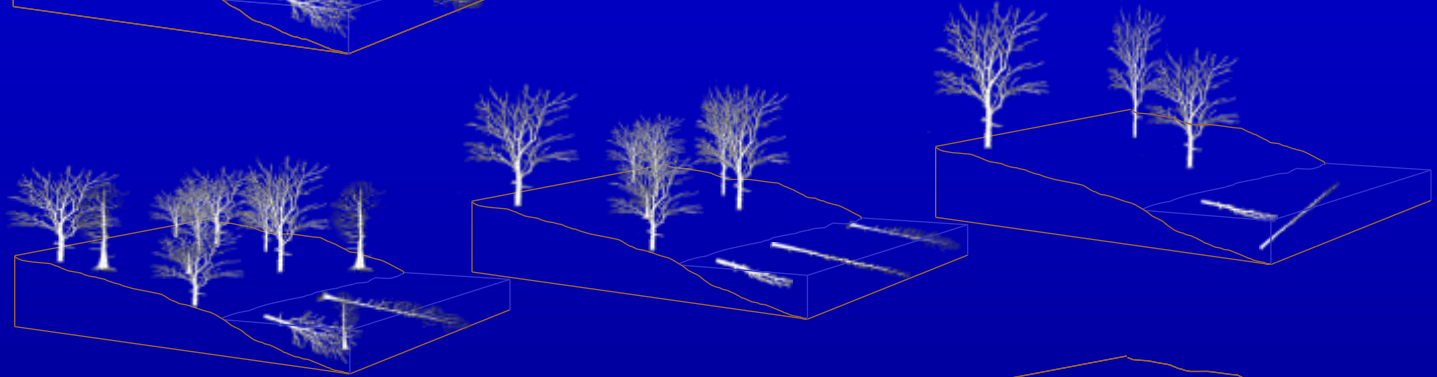
Clearcut Logging



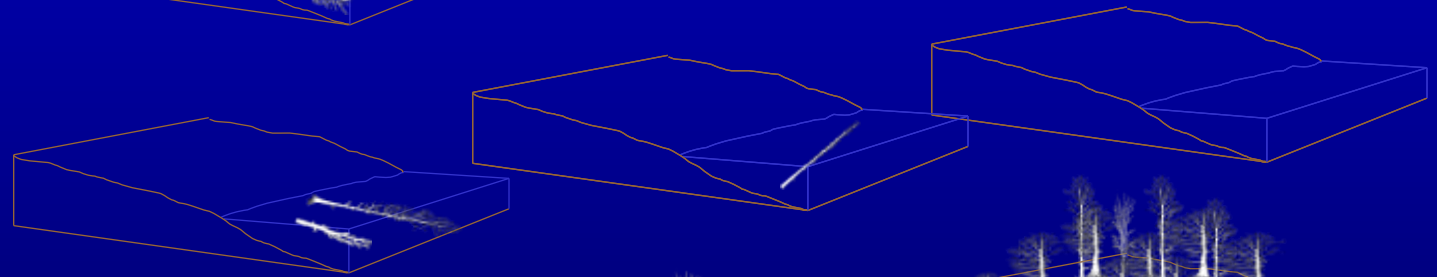
**Natural
succession**



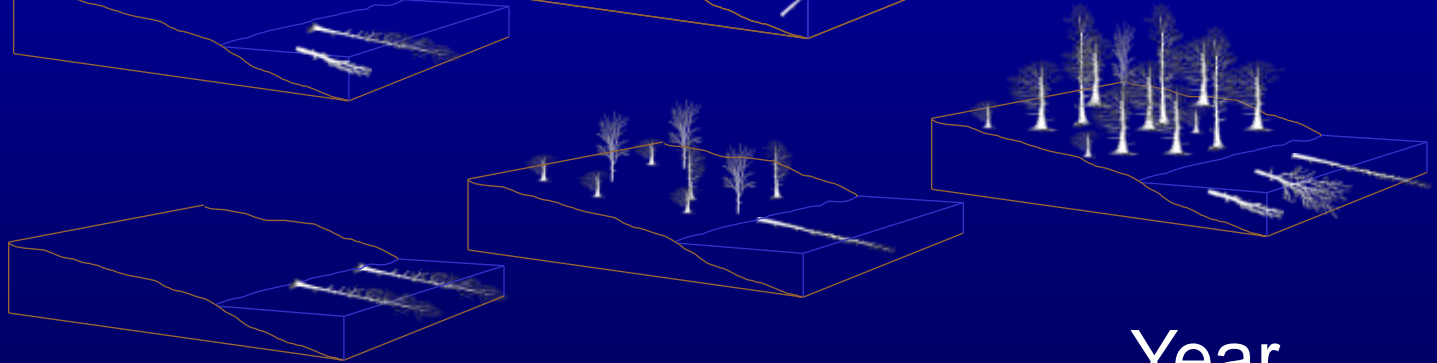
**Understory
removal**



Total removal



**Clear-cut
regeneration**

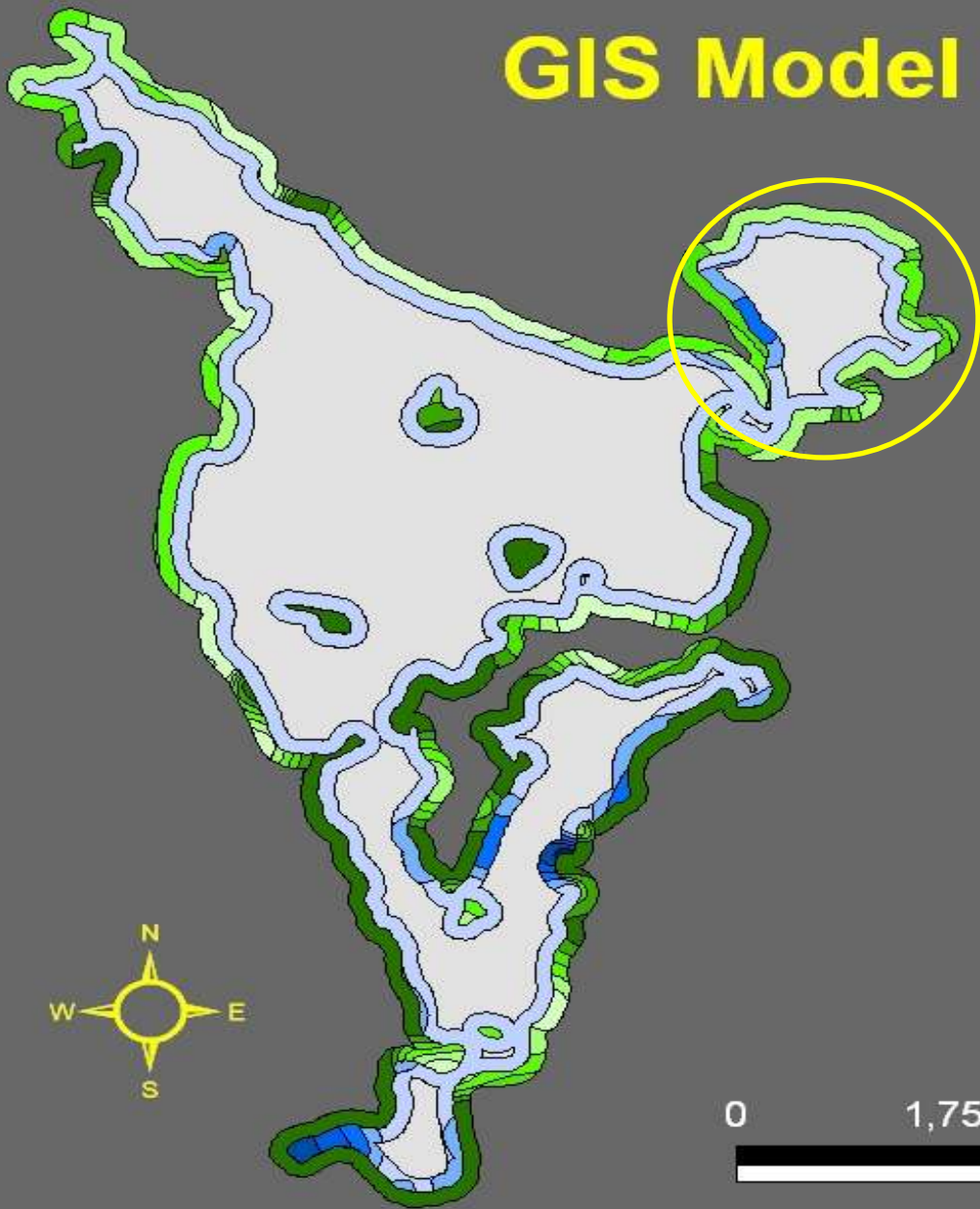


Trees That Fall Into Lakes

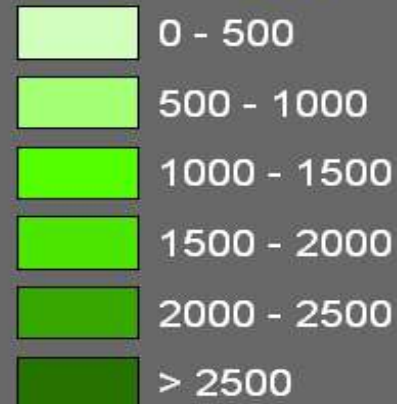
(trees/20 years/100 ft. site)

<u>Year</u>	<u>Natural Succession</u>	<u>Understory Removed</u>	<u>Clear cut regeneration</u>
2015	31	9	—
2035	25	7	—
2055	24	5	41
2075	20	4	34
2095	20	3	32
2115	18	2	27
2135	16	2	21
2155	17	1	20

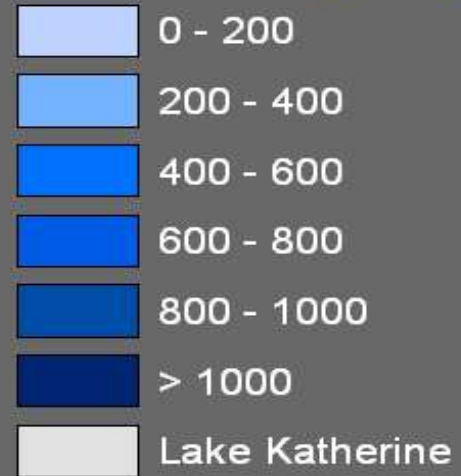
GIS Model



2005 Density (trees/ha)

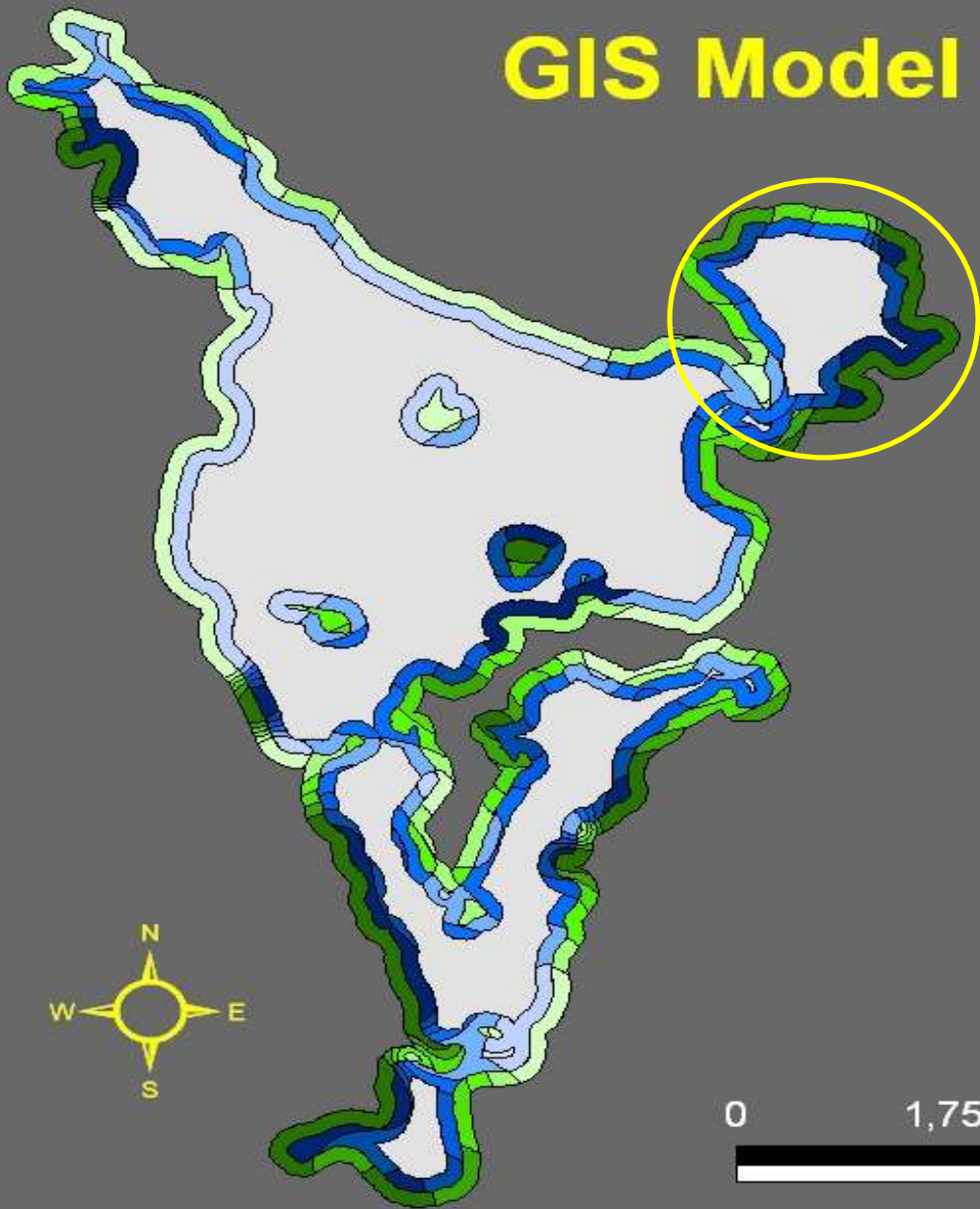


2005 Branching Complexity

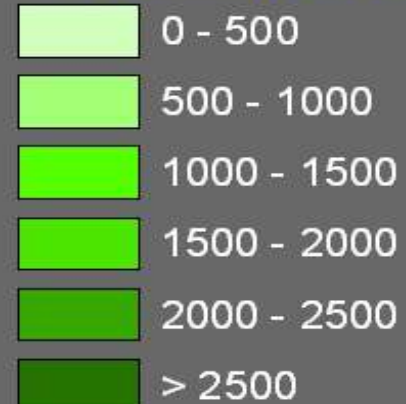


(Scribner 2006)

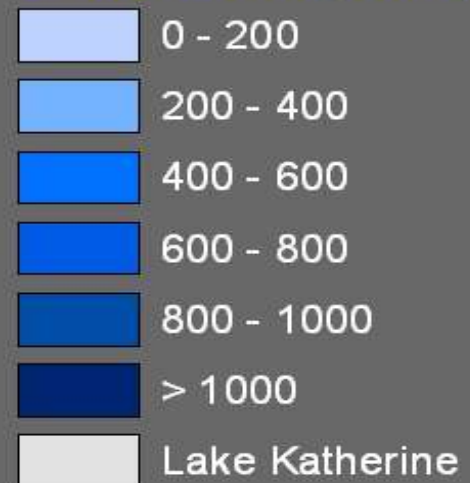
GIS Model



2055 Density (trees/ha)

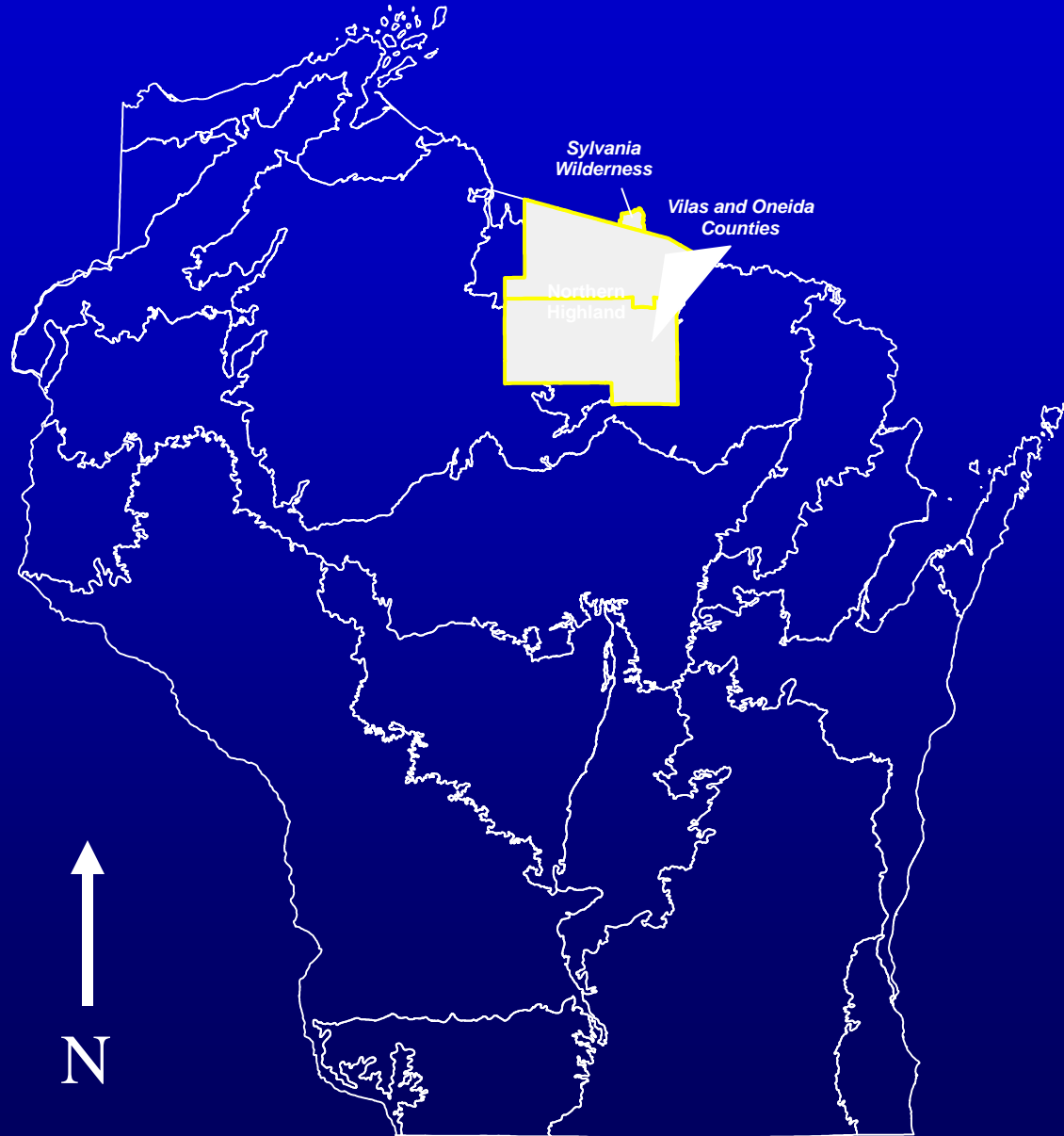


2055 Branching Complexity



(Scribner 2006)

Study Area



Study Area

Broad Scale (Northern Highland Ecoregion)

- Use Scribner (2006) model: Katherine Lake, Oneida County, WI
- JABOWA (Forest Succession Model)

Objectives

1. Compare current and future recruitment of CWS into lakes as a function of different land-use patterns within shoreline riparian areas and among lakes in northern Wisconsin.
2. Create a shoreline riparian-littoral zone index based on the amount of sustainable CWS recruitment into lakes across land-use conditions over a 150 year time period.

Study Design

Total of 12 lakes in study

- (9) Developed – Different ranges and types of development (treatment lakes)
 - (3) Low – 1-33% development
 - (3) Moderate – 34-66% development
 - (3) High – 67+% development
- (3) Undeveloped – Wilderness lakes (reference lakes)

Tree Habitat Recruitment Index

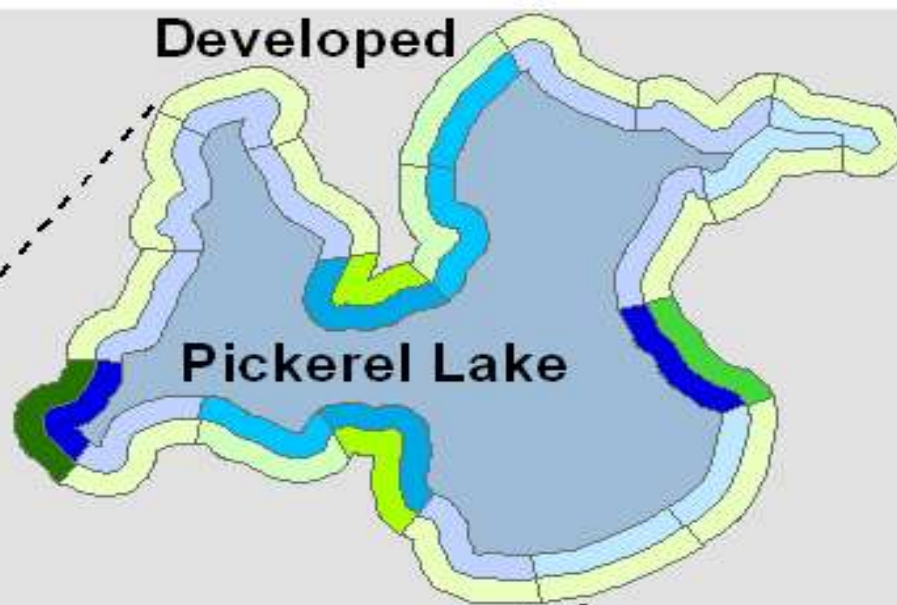
(trees/25 yrs./site)

Lake	% Development	Present	2035	2060	2085	2110	2135	2160
Pickerel	92	*Low	*Low	*Low	*Low	*Poor	*Poor	*Poor
Muskellunge	54	*Low	*Low	Med.	Med.	*Low	*Low	*Low
Snipe	0	High	High	Med.	Med.	High	High	Med.
Boot	29	Med.	Med.	Med.	Med.	*Low	*Low	*Low

Recruitment Categories:

- Poor (0 trees/25 yrs/site)
- Low (1-10 trees/25 yrs/site)
- Medium (11-20 trees/25 yrs/site)
- High (21+ trees/25 yrs/site)

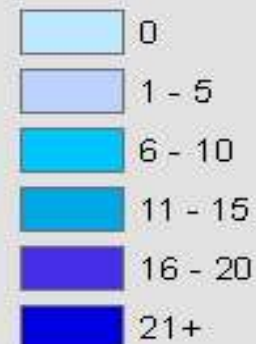
Developed



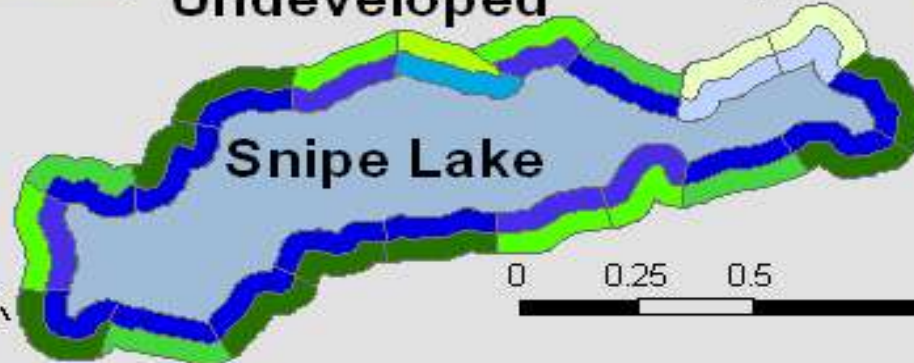
2010 Density (trees/ha)



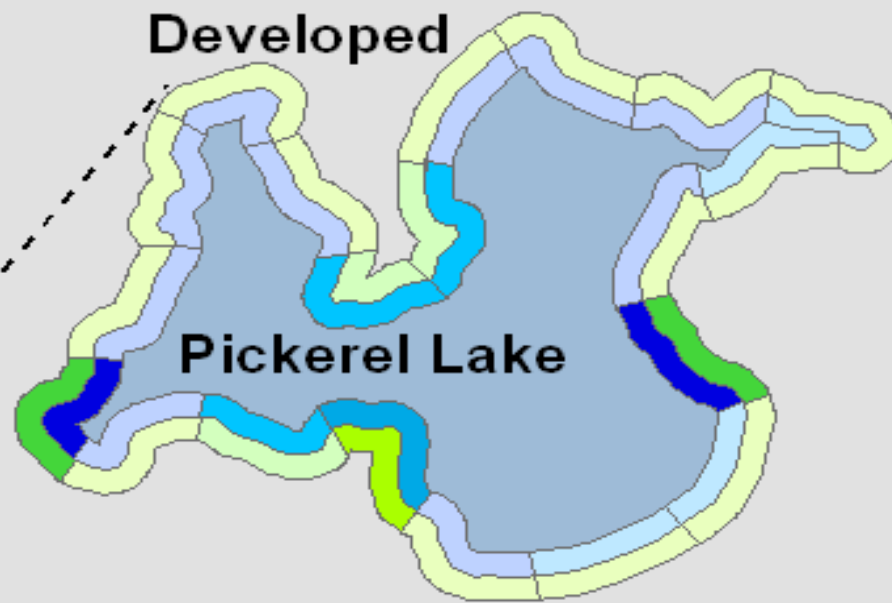
2010 Recruitment (trees/25 yrs./site)



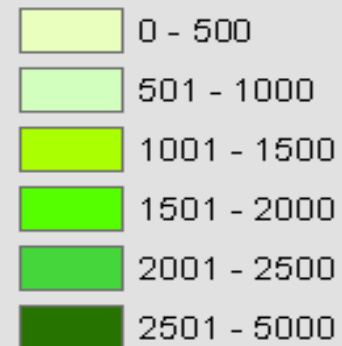
Undeveloped



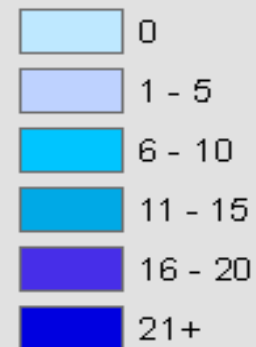
Developed



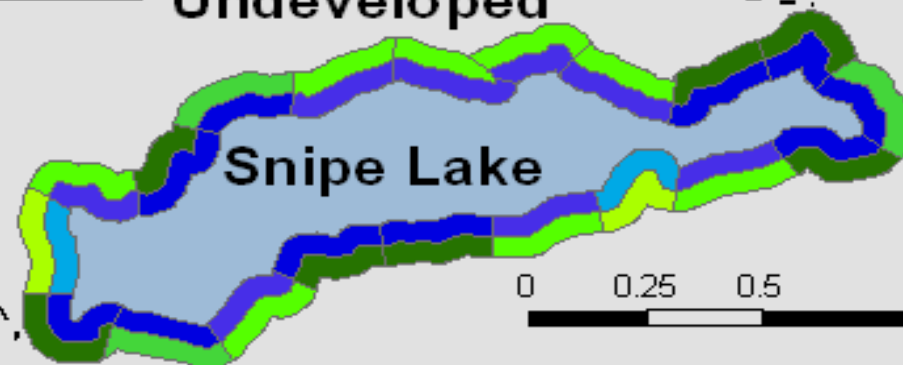
2160 Density (trees/ha)



2160 Recruitment (trees/25 yrs./site)



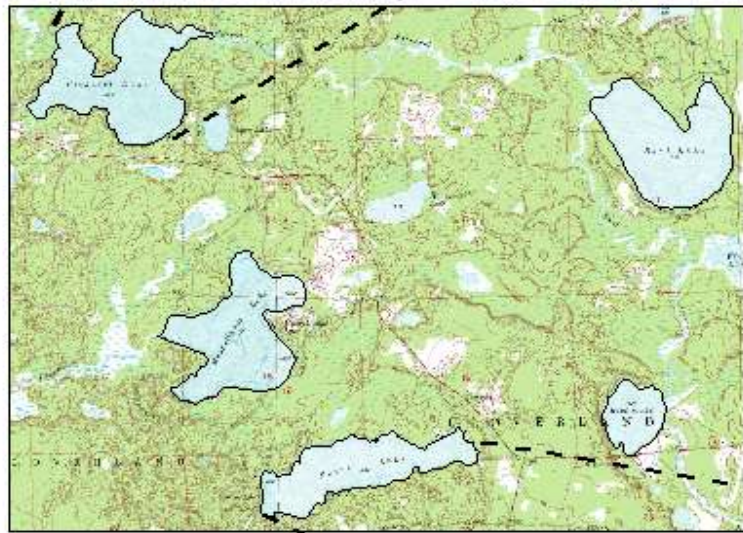
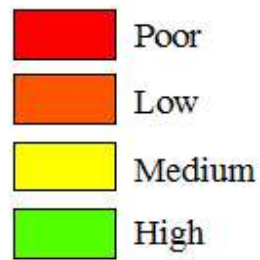
Undeveloped



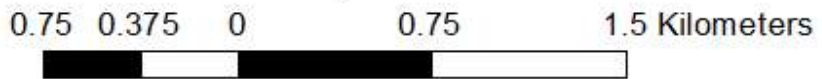
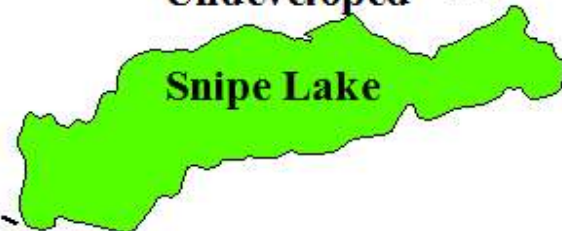
Developed



2010 CWS Recruitment Overall Rating

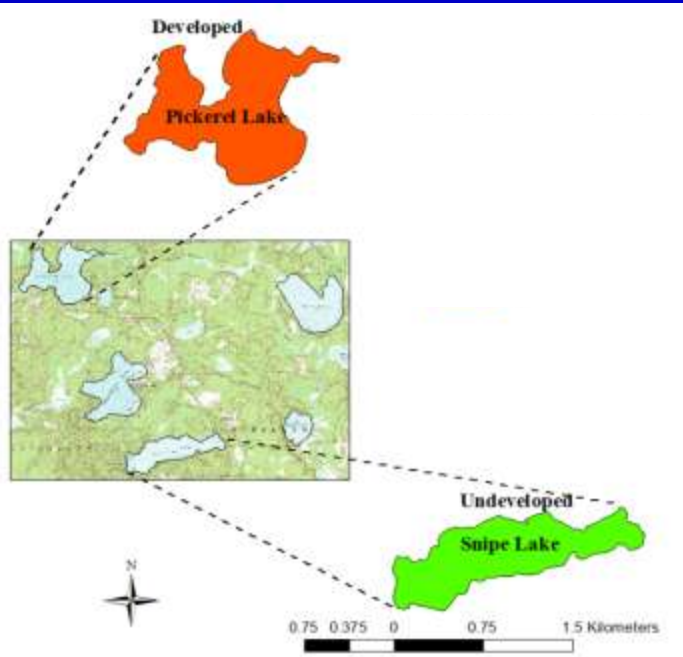


Undeveloped



Current Land Use Projection

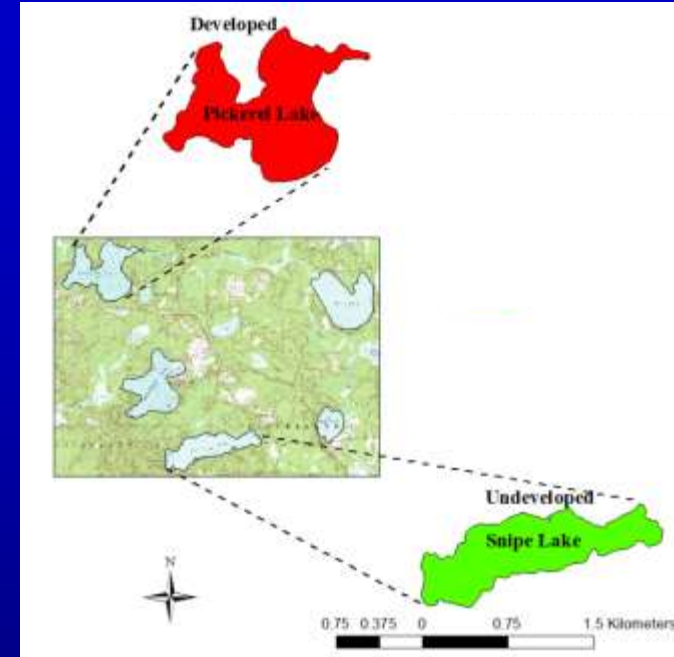
2010



2035



2060



Recruitment Rating

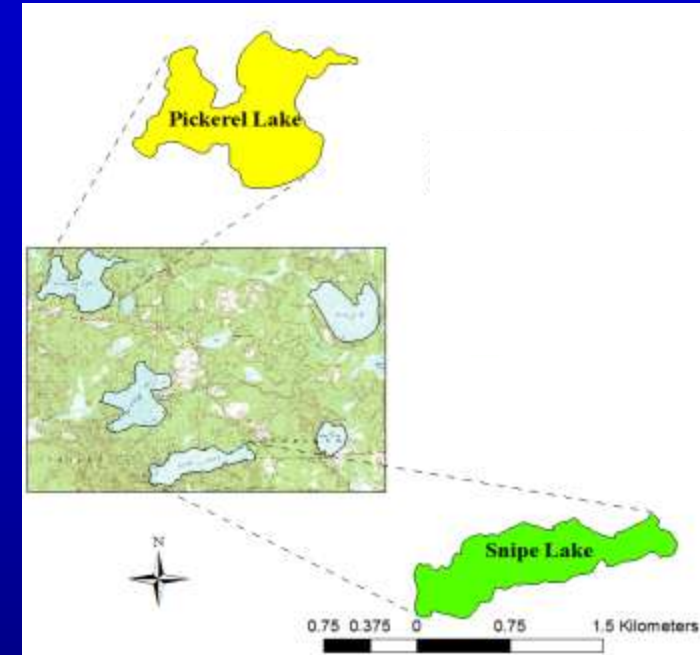
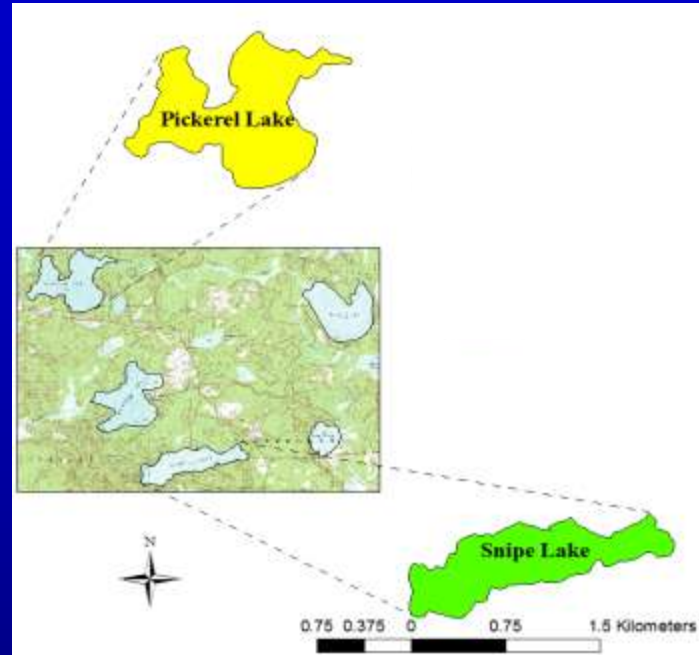
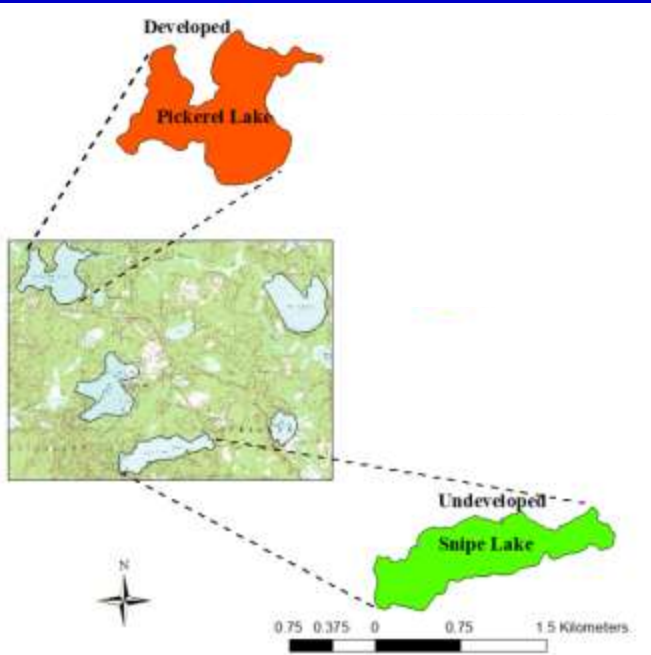


Sustainable Land Use Projection

2010

2035

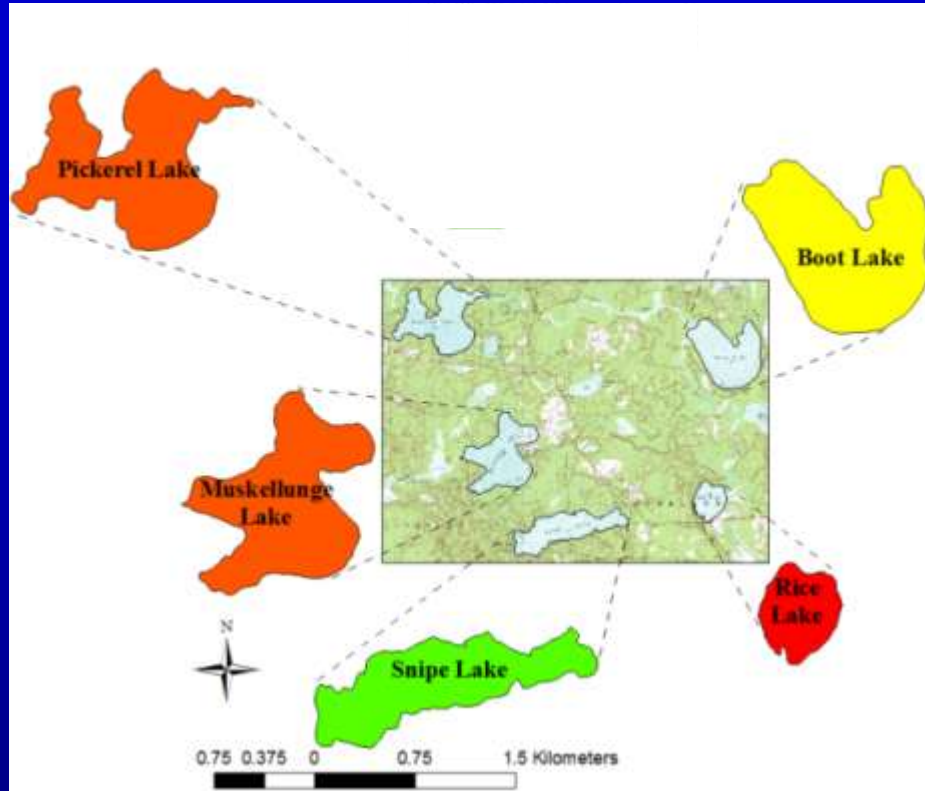
2060



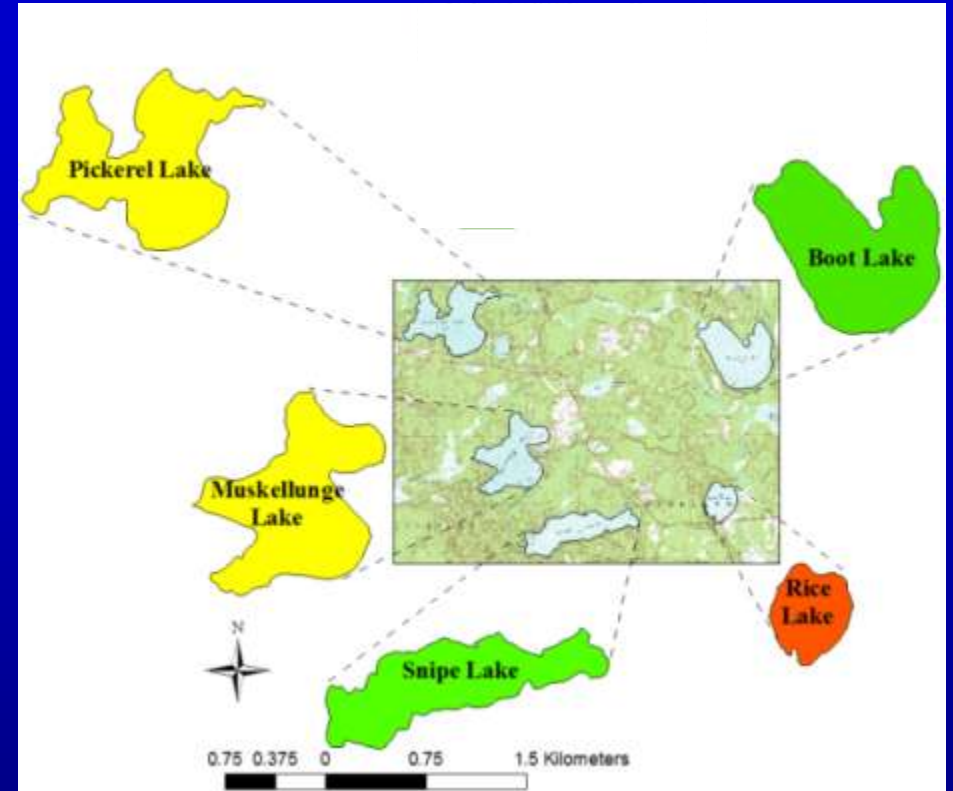
Recruitment Rating



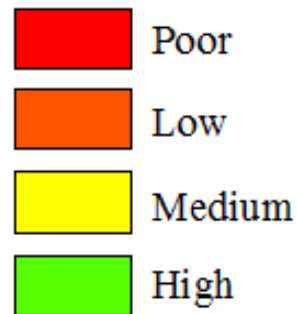
2010



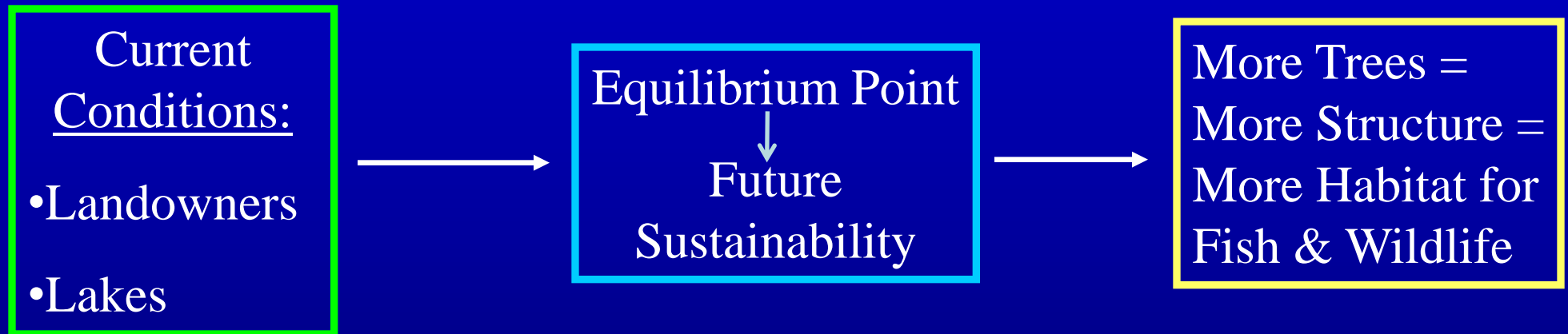
2060



Recruitment Rating



Conclusion



Potential Landowner Options

- Lake Associations: Best Management Practices & Educating Public
- Riparian buffer strips
- Maintain trees in the riparian area
- Leave trees that have fallen into the lake
- Fisherman – find alternative sources of firewood
- Stricter enforcement of current laws

Management Implications

- Better guidelines on maintaining or replacing riparian vegetation
- More research forecasting trends in recruitment of woody structure along a gradient of lake development

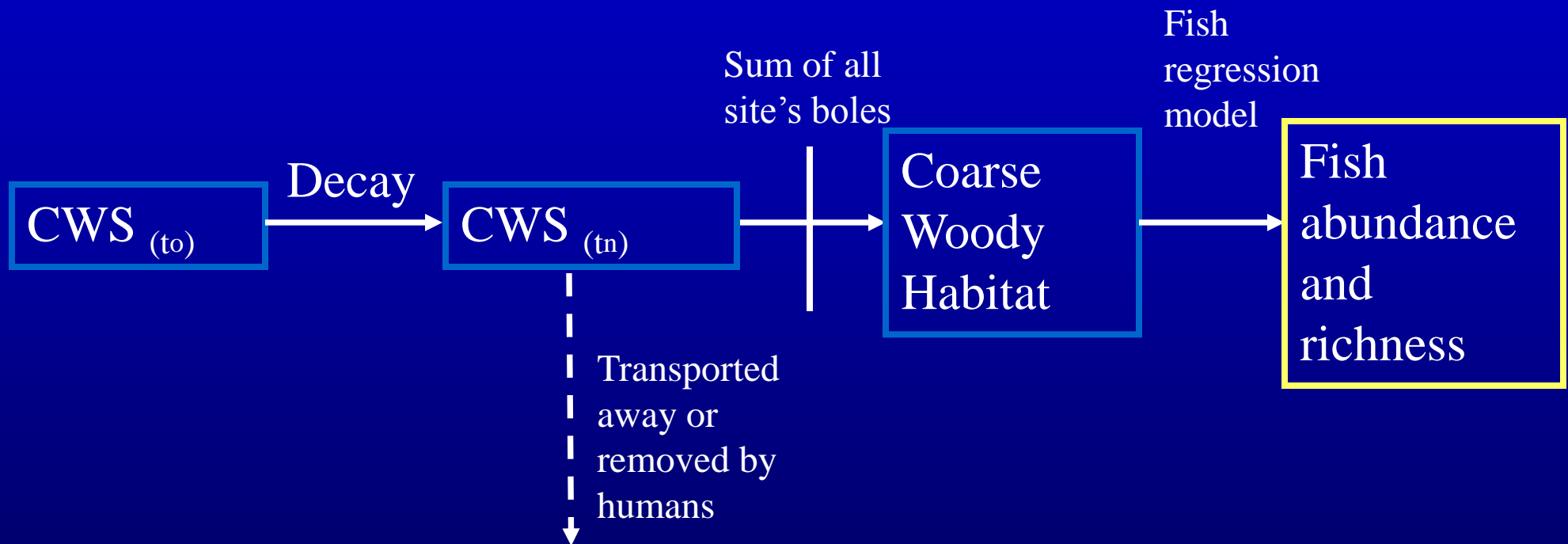
Acknowledgements

- Carolyn Scholl – Vilas Co. Land and Water Conservation Dept.
(*Lake Assn. Advisor*)
- Pat Goggin – UW Extension
- Vilas and Oneida County Law Enforcement
- USFS – Ottawa N.F.
- UWSP Advisors: James Cook & Keith Rice
- Lake Associations and Landowners of the Following Lakes:
 - Big Bearskin ○ Crescent ○ George
 - High ○ Ballard ○ Razorback
 - White Sand ○ Lynx ○ Boulder



Conceptual Dynamic Model: Littoral

Water



Natural Succession



Understory Removal



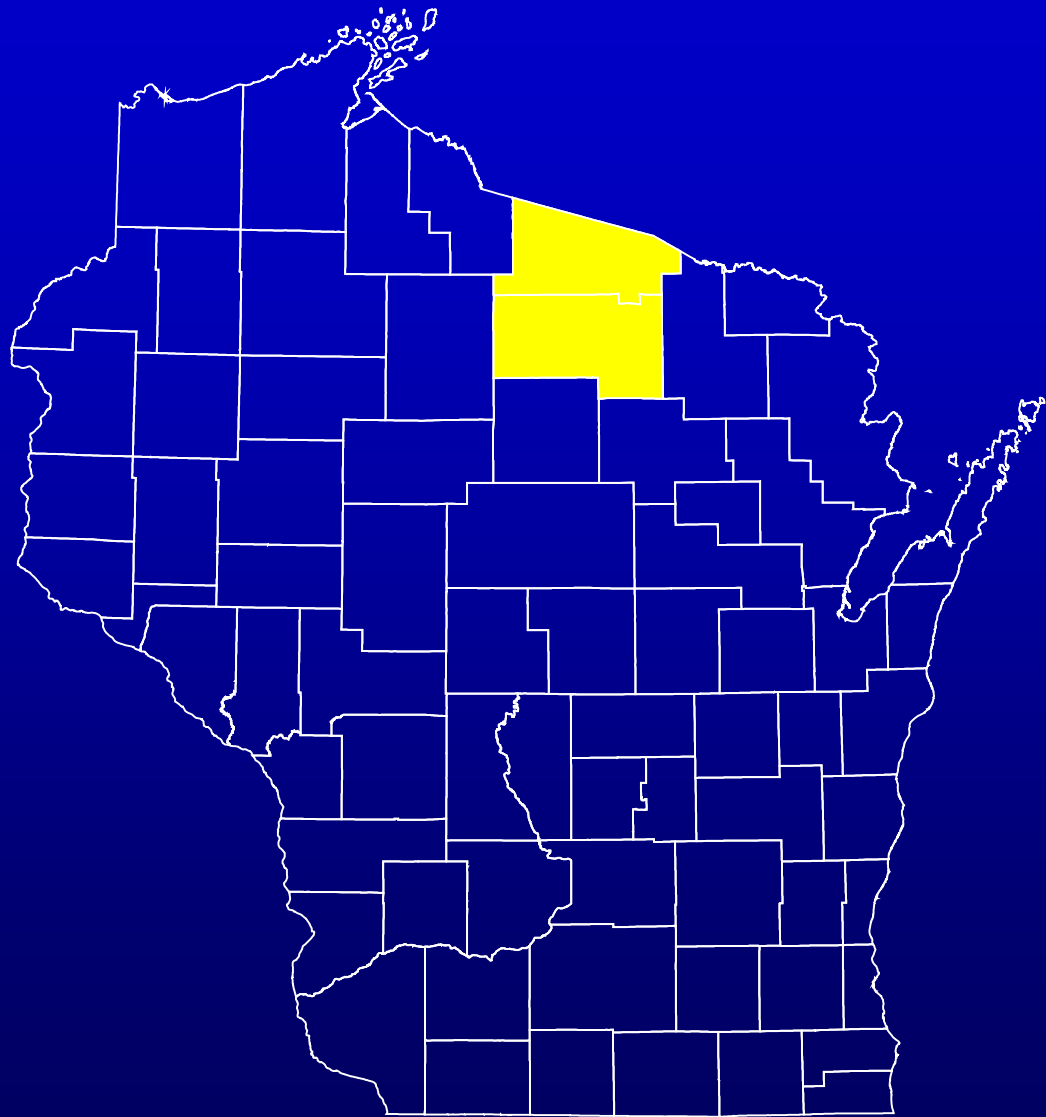
Total Removal



Study Design

Lakes will range in degree of development

- Undeveloped – Wilderness lakes
(reference lakes)
- Developed – Different ranges and types of
development (treatment lakes)



Null Hypotheses

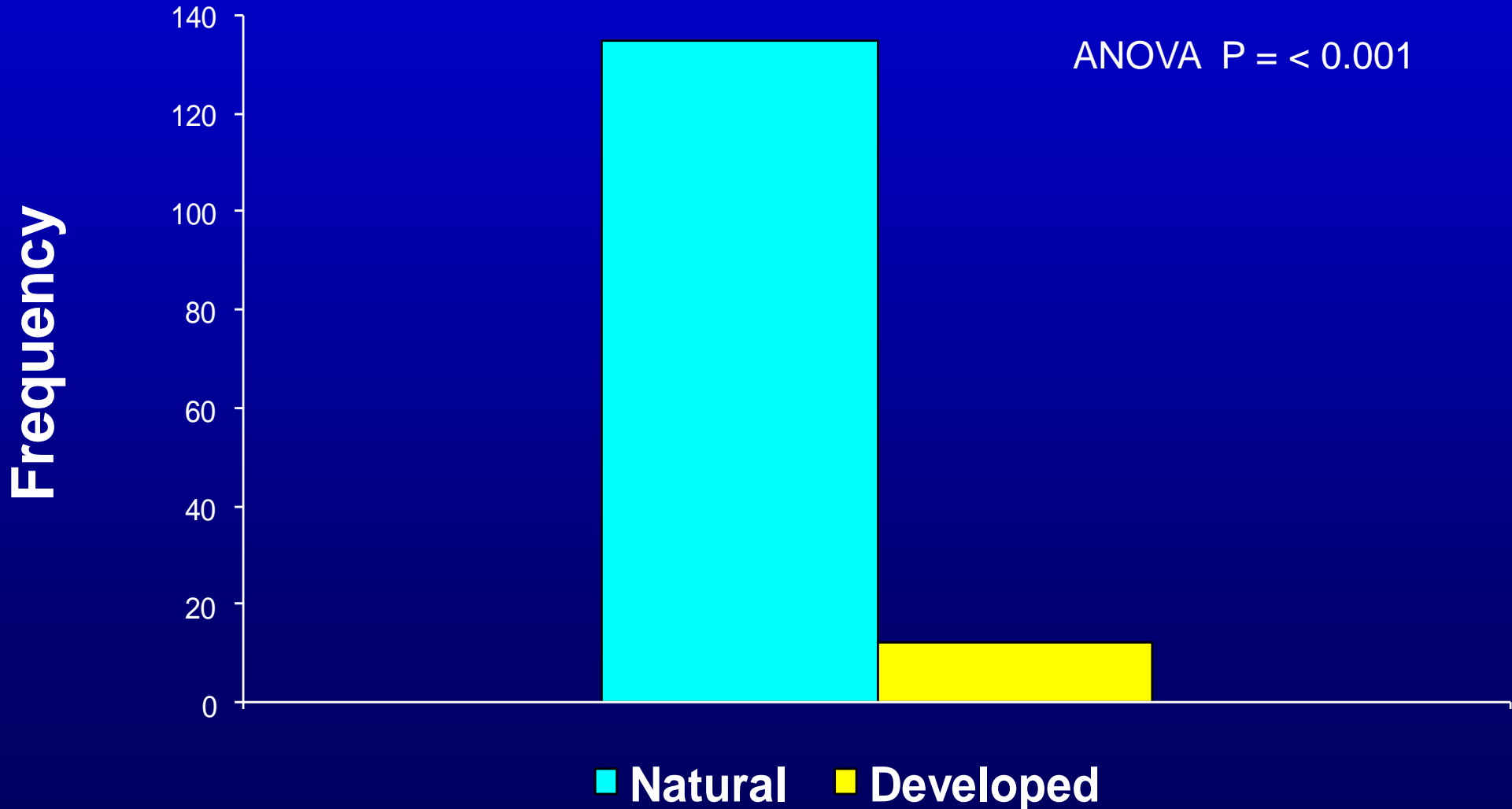
H_{01} – CWS recruitment will not differ among different land uses.

H_{02} – Sustainable coarse woody structure recruitment index will not differ across land use conditions over the 150 year time period.

Conceptual Modeling

- Use of GIS to delineate land use and vegetation types/conditions
- Ground truth until consistency is reached
- Use of JABOWA to run models across each lake.
- Combination of JABOWA and Scribner's model to evaluate recruitment based on land use.
- Comparison of developed lakes to reference lakes
- Forecast into the future
- Create an index for managers.

Coarse Woody Structure

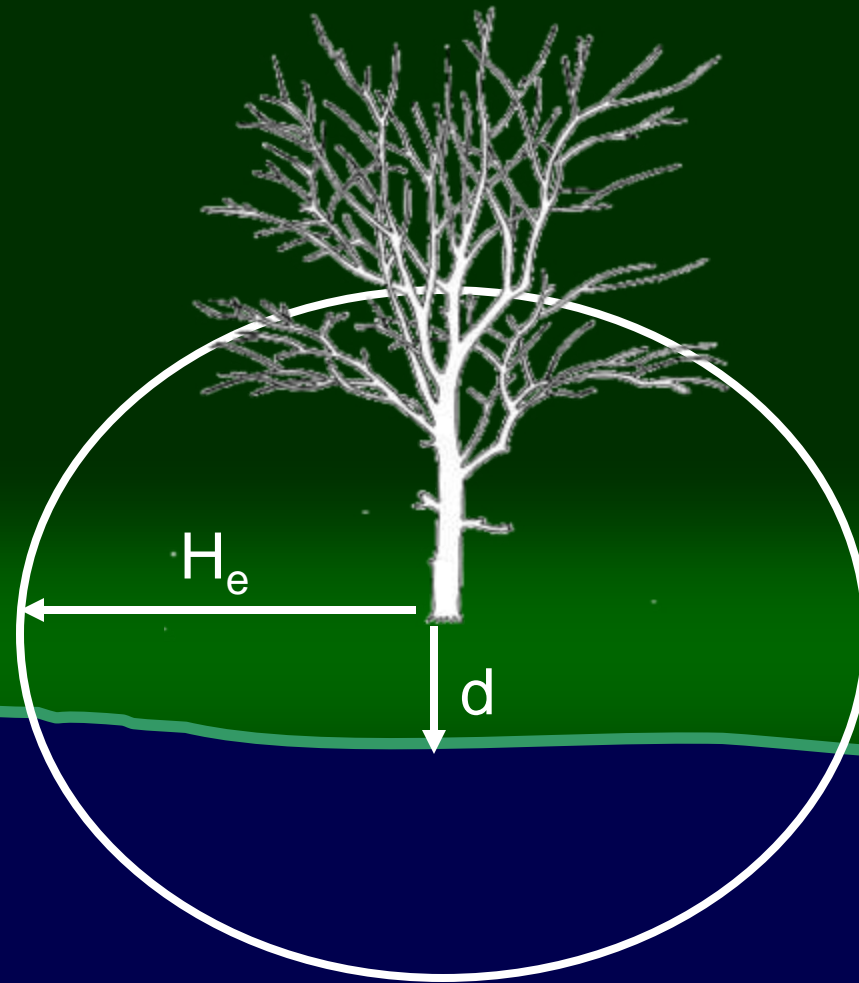


(Courtesy N. Scribner, WY Game & Fish)

Recruitment Model

ASSUMPTIONS

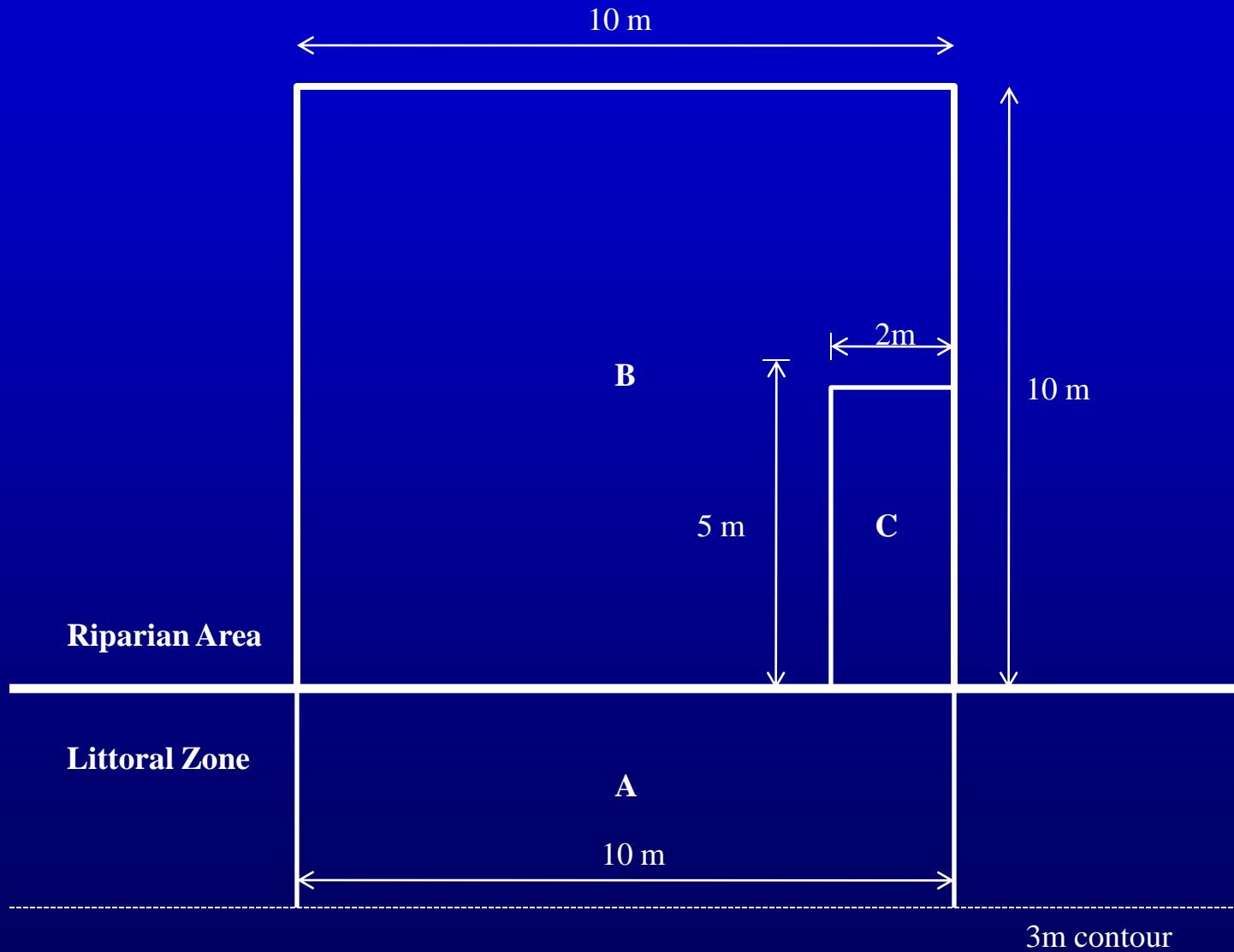
- Spatial distribution
 - Distance from lake (d)
 - Tree height (H_e)
 - Arc of fall
 - Mortality rate
- (Buchman 1983)



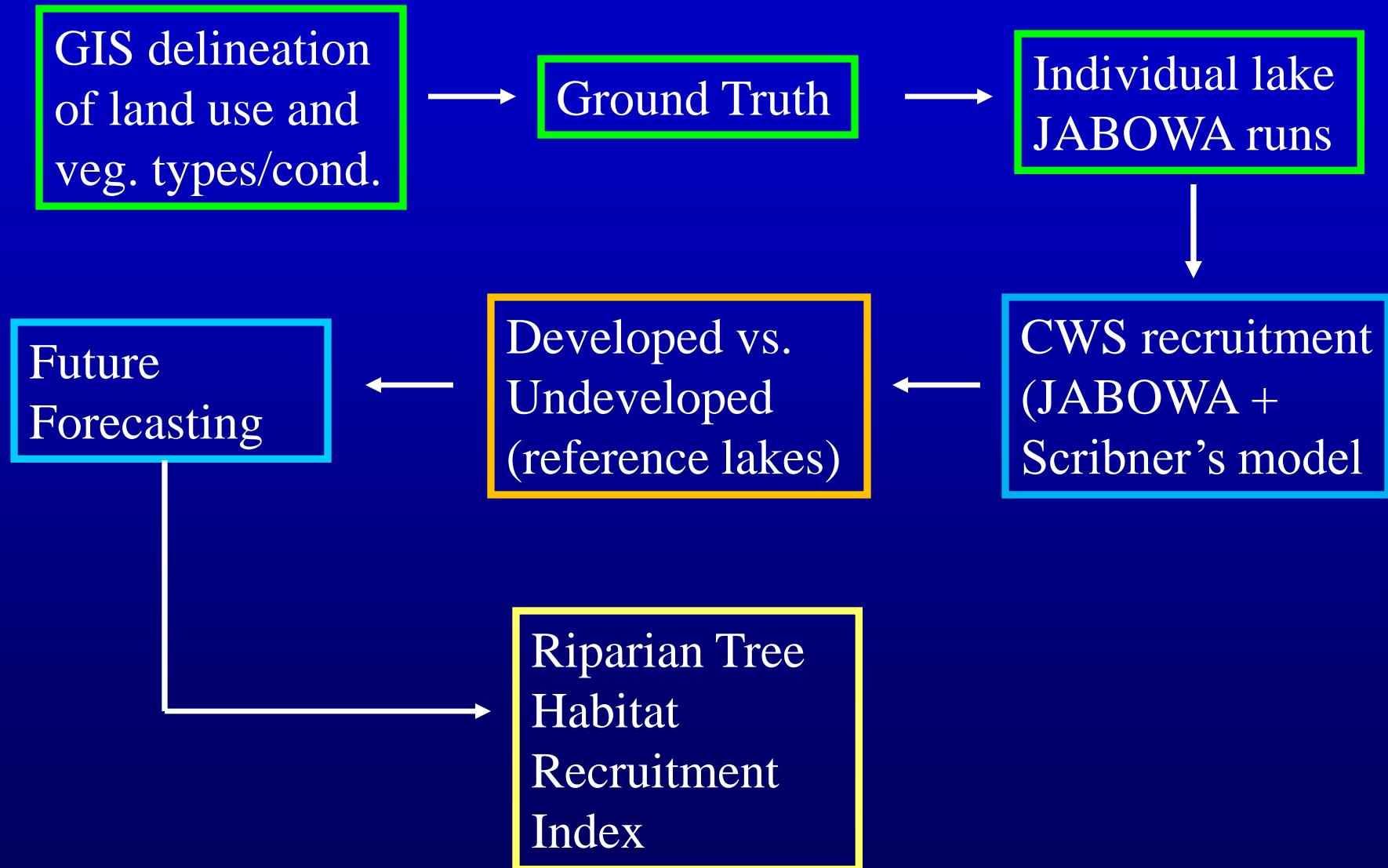
Riparian
Area

Littoral Zone

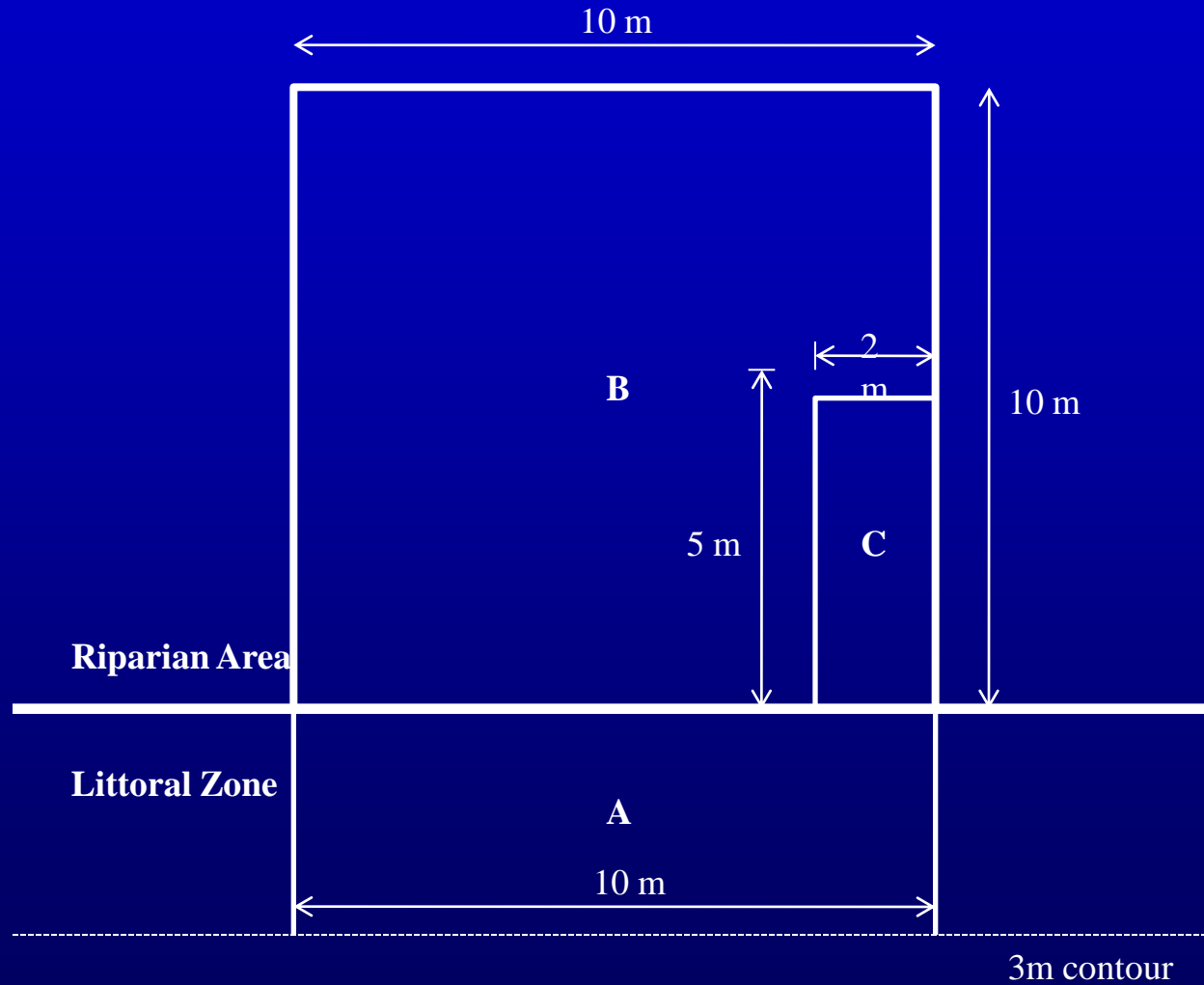
Study Design



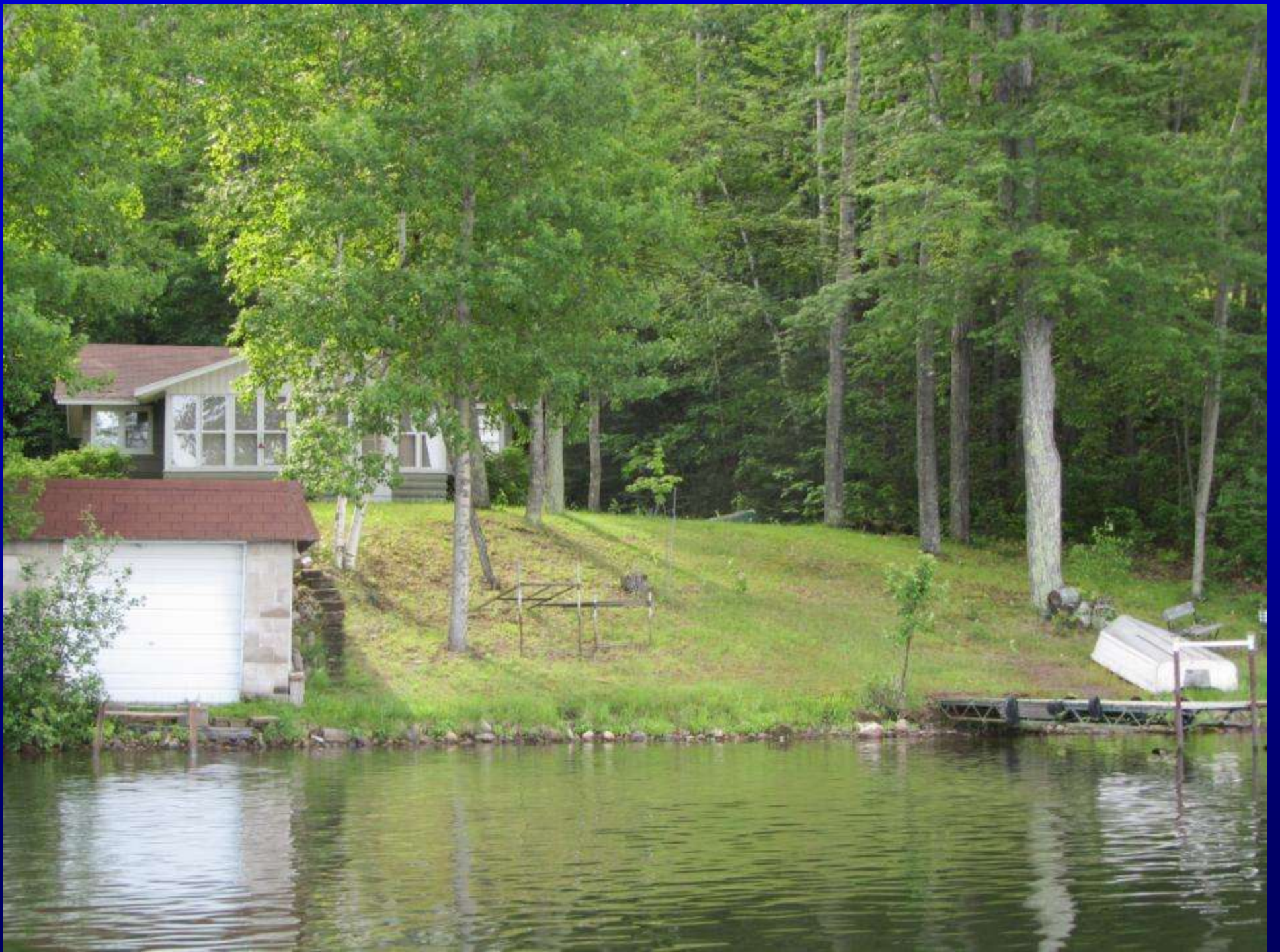
Conceptual Modeling



Study Design



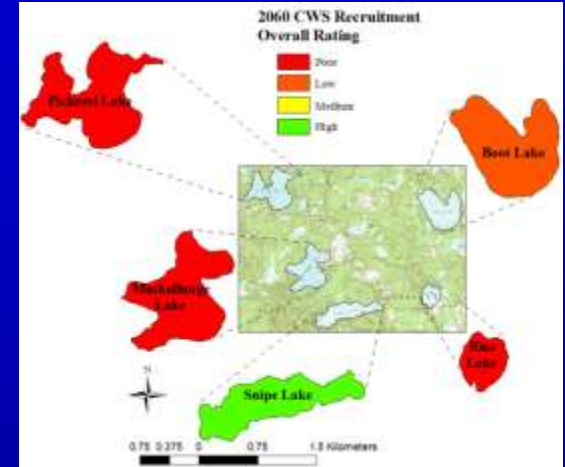
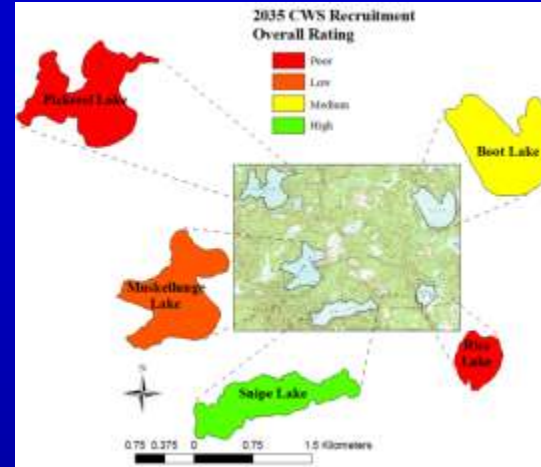
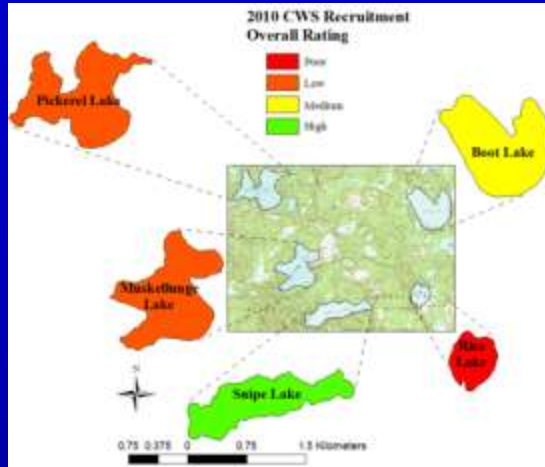




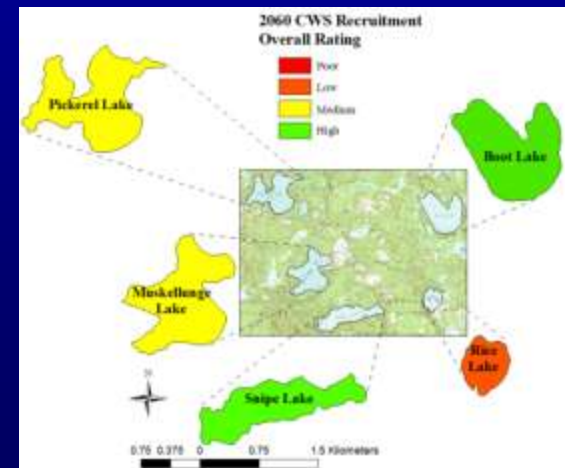
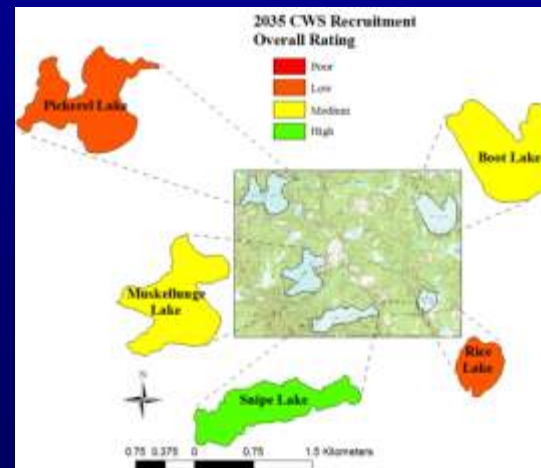
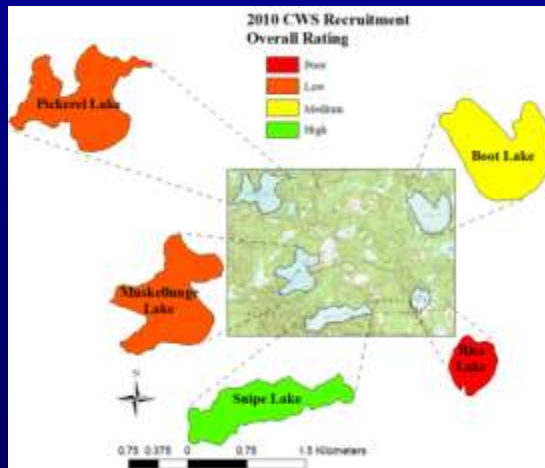




Bad Scenario



Good Scenario



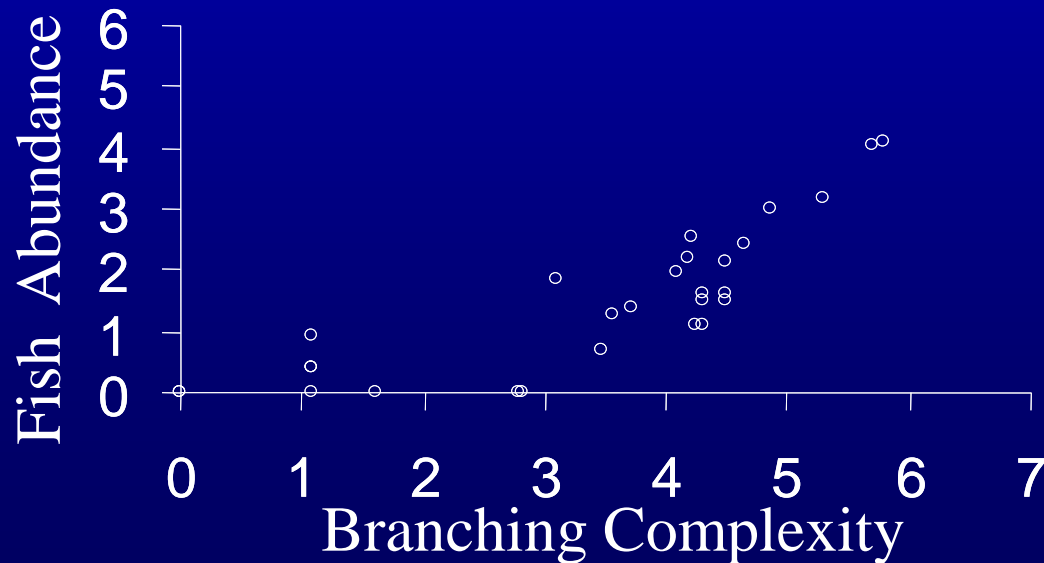
Branching Complexity-Fish Abundance



Coniferous

$r^2 = 0.789$

$P = <0.001$



Deciduous

$r^2 = 0.722$

$P = <0.001$

- Lower songbird density (Lindsey et al. 2001)
- Lower green from density (Woodford and Meyer 2002)
- Loss or disturbance of fish spawning, feeding and rearing
- Loss of wood structure from tree fall
- Lower diversity of fish species in developed shoreline areas (Brazner1997)
- Reduction in vegetation abundance (66% Radomski2005)