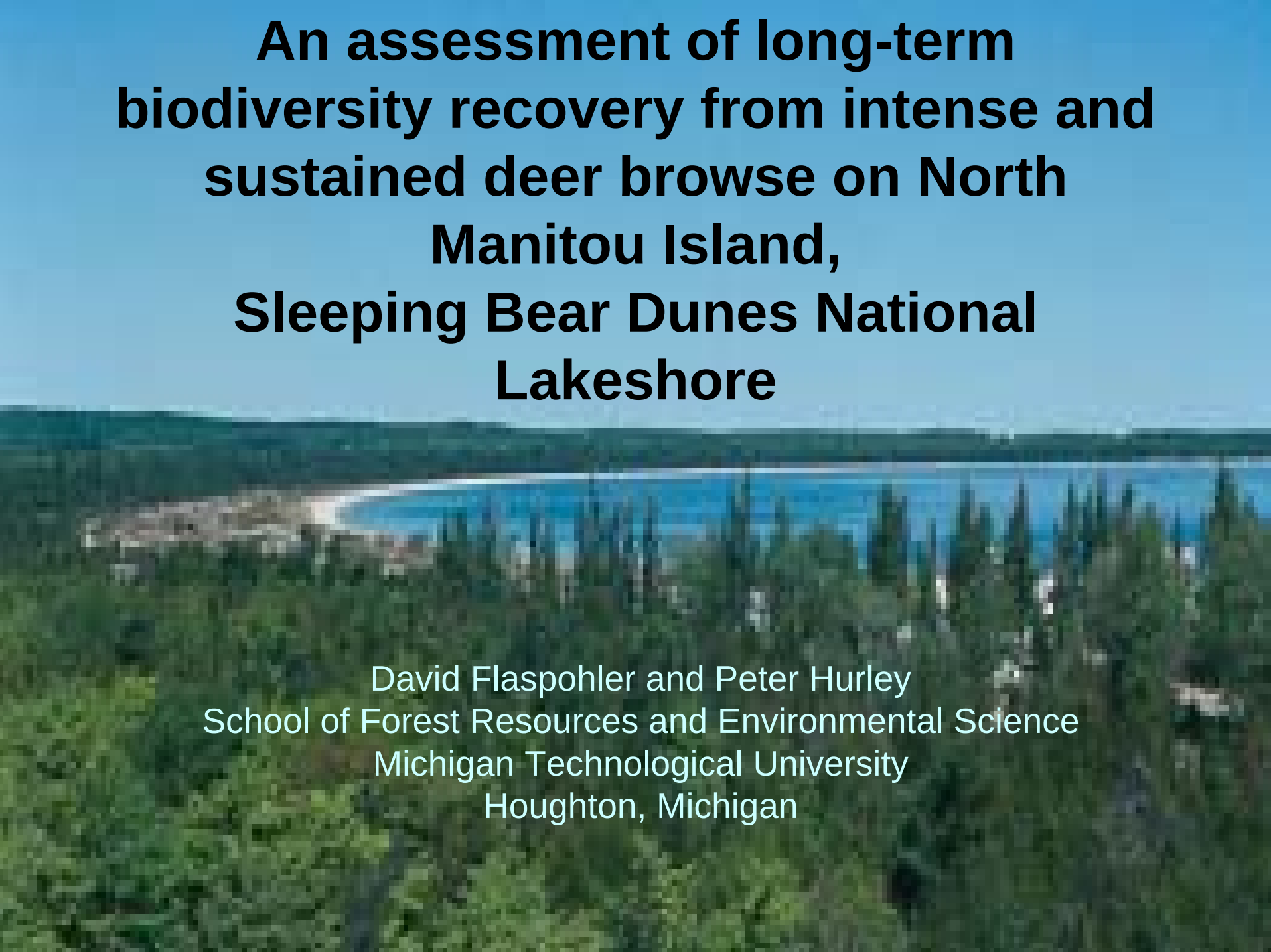
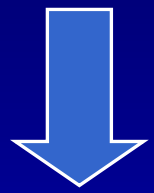
An assessment of long-term biodiversity recovery from intense and sustained deer browse on North Manitou Island, Sleeping Bear Dunes National Lakeshore



David Flaspohler and Peter Hurley
School of Forest Resources and Environmental Science
Michigan Technological University
Houghton, Michigan

Influence of deer browse on ecosystems:

Deer Browse



Changes in veg. structure & spp. composition

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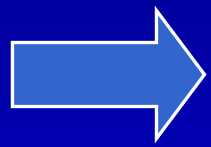

Associated indirect changes in faunal abundance, demog., etc.

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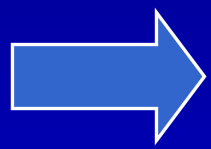

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?

?

?

Influence of deer browse on ecosystems:

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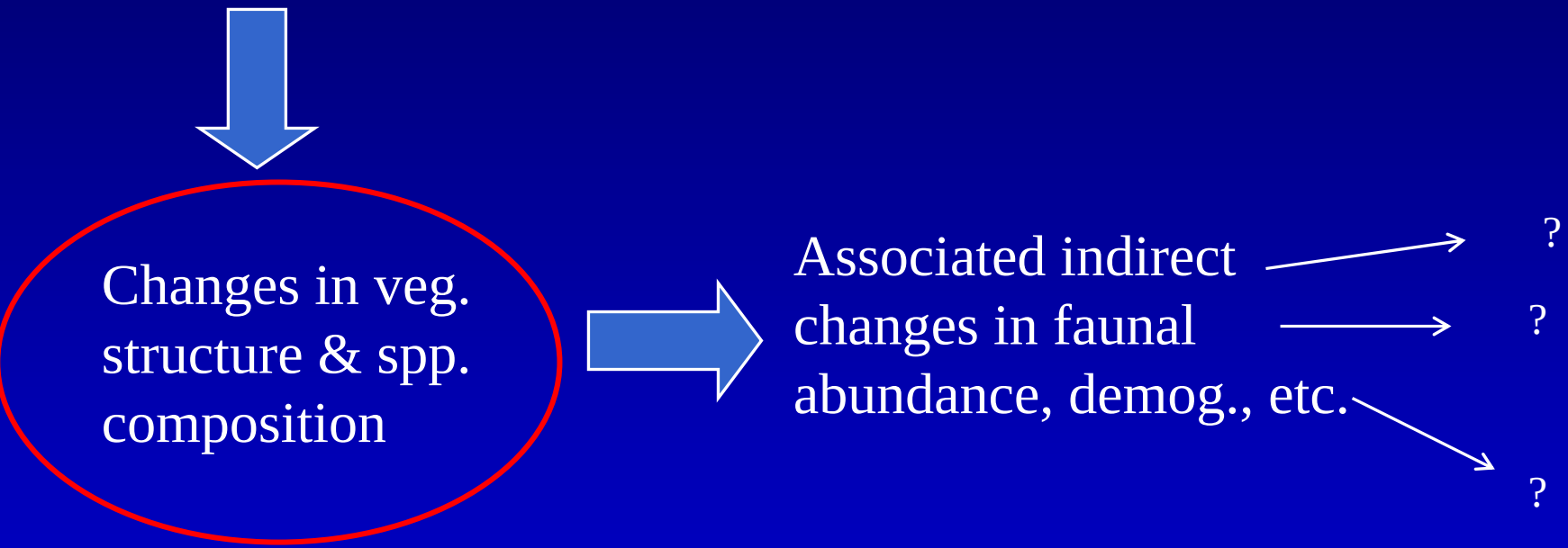

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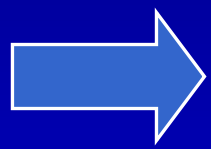

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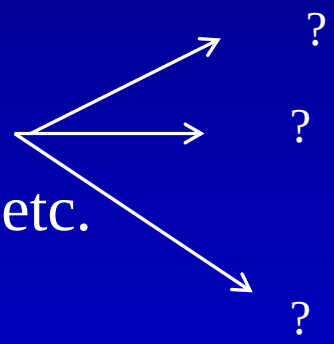


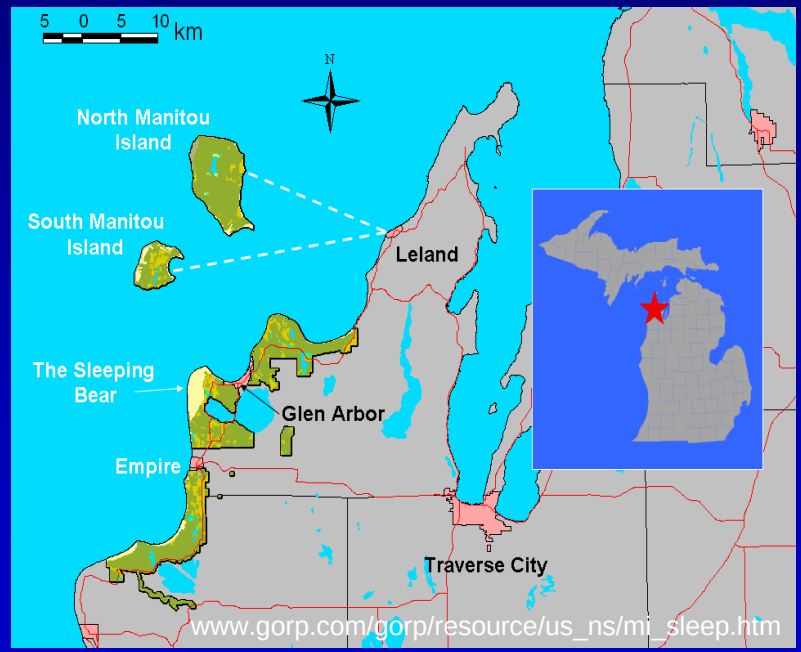
How long do the effects of sustained heavy deer browse persist?

Project Goal:

To present an assessment of the current condition of 2 island ecosystems that differ greatly in their history of deer browse.

A brief history of Sleeping Bear Dunes National Lakeshore (SLBE)

- Early and intensive history of human utilization
- Nearly complete cutting of forest and replacement by agriculture and/or pasture
- Post-European settlement decline in human population...then recreation
- Introduction of white-tailed deer to NMI - 1926
- Acquired by NPS in early 1970s



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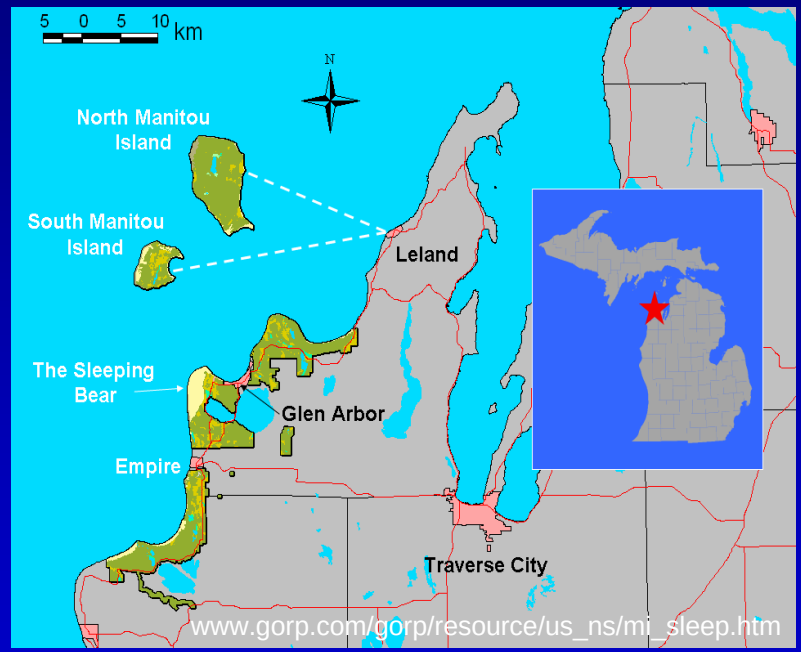
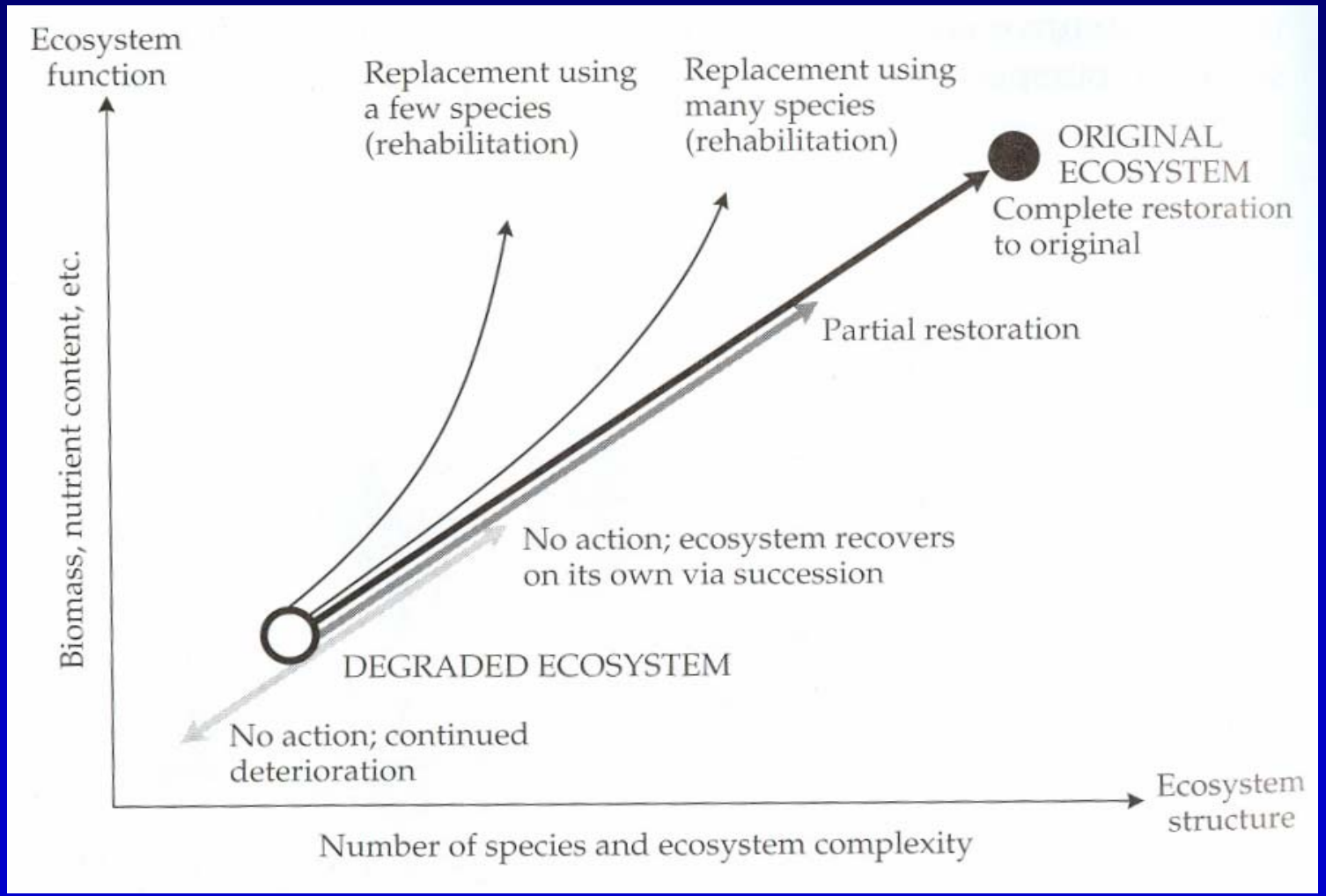


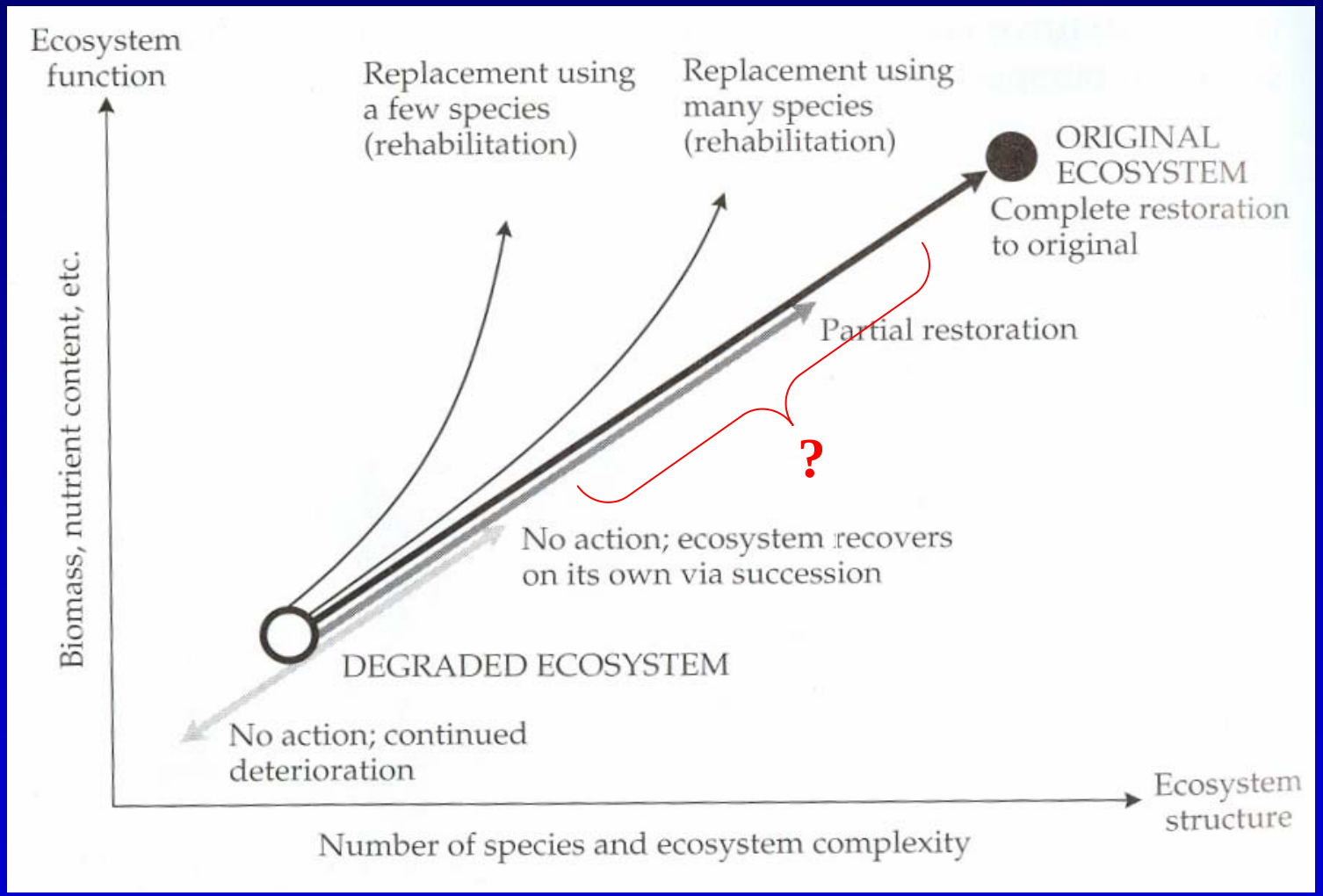
Priority for NPS: Assessment of current conditions and restoration need/potential

Ecological restoration: many options



From: R. Primack, Conservation Biology, 2002

Ecological restoration: many options



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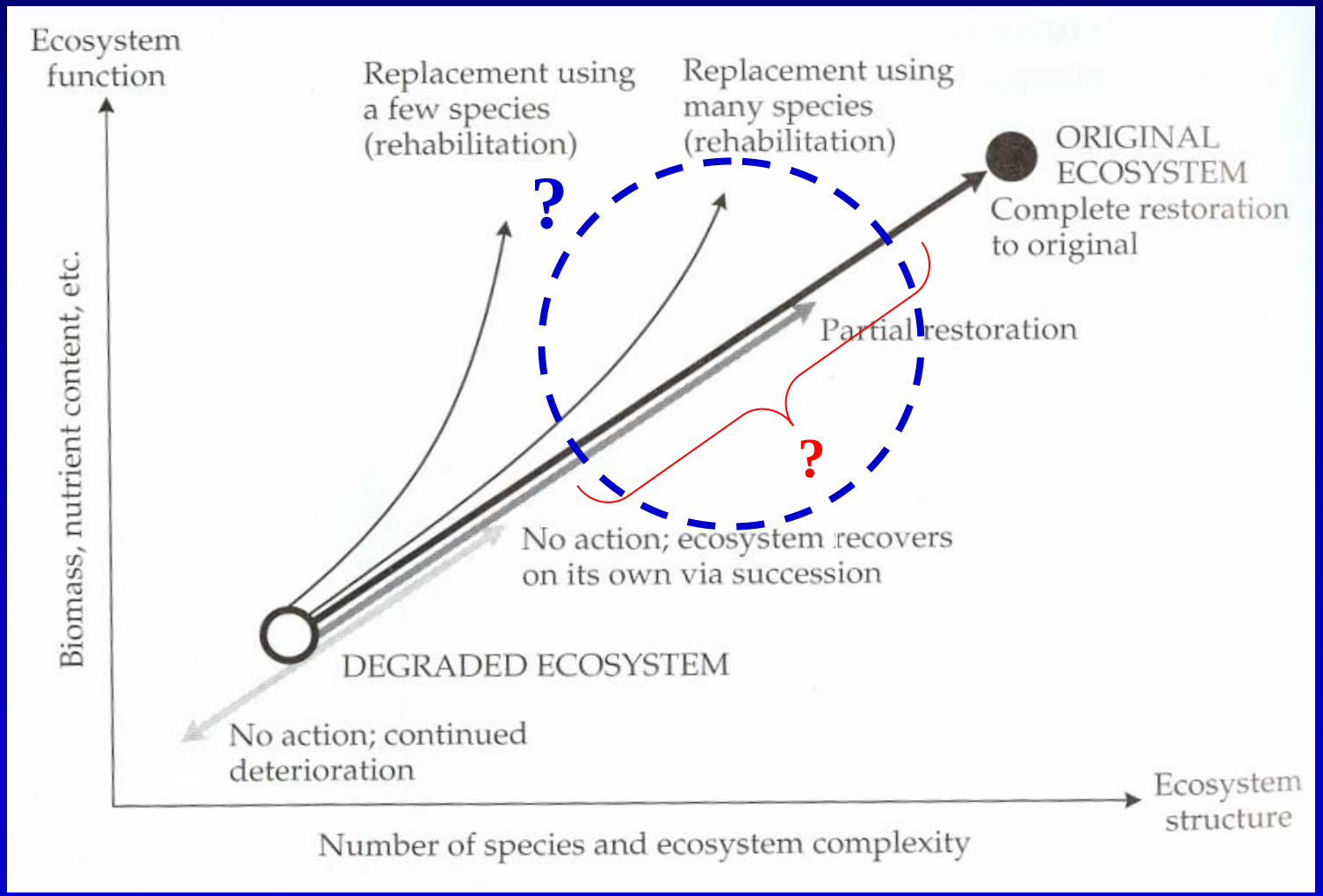
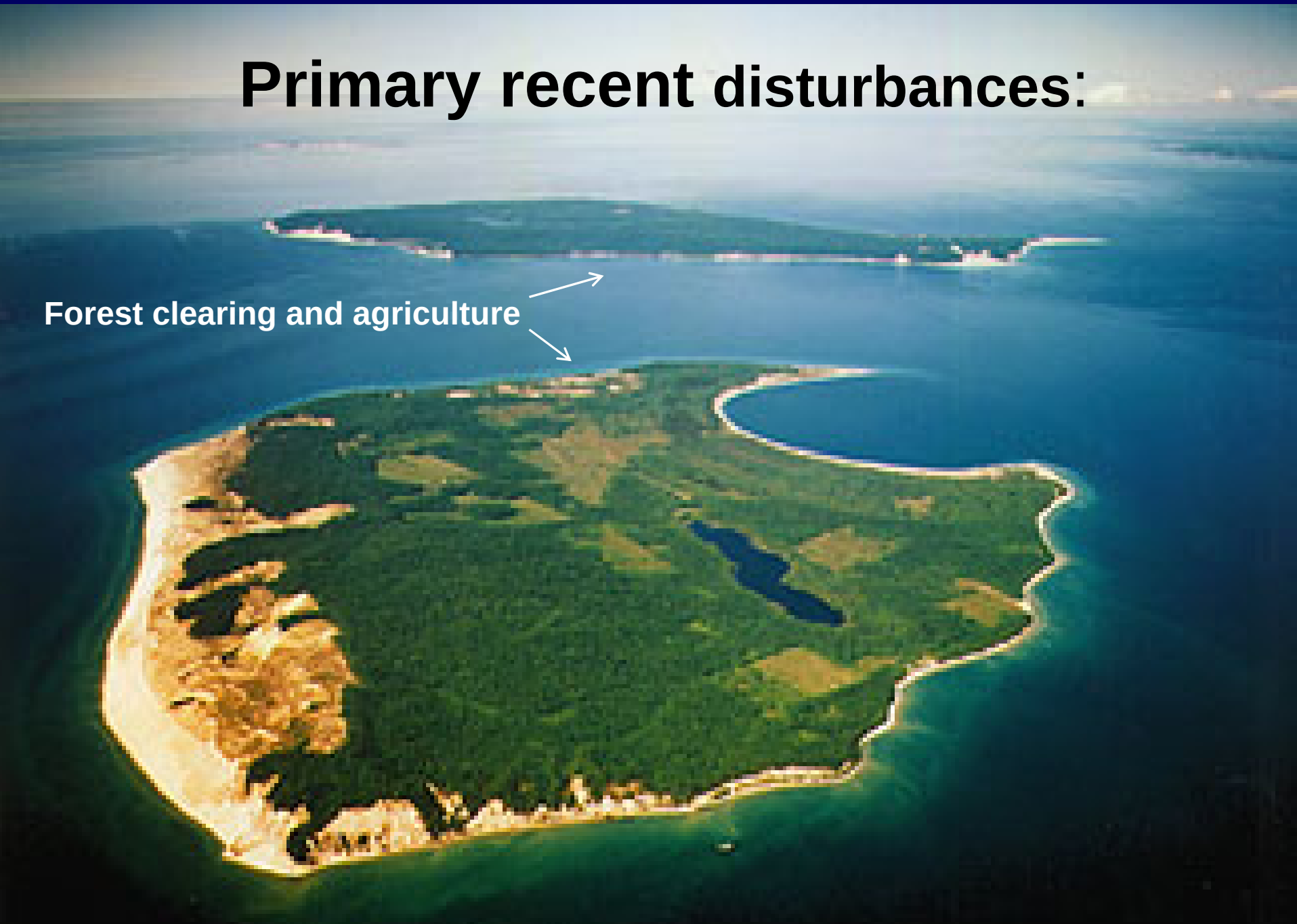


From: R. Primack, Conservation Biology, 2002


NMI
N
SMI

Recent (last 150 yrs.) disturbances:

Primary recent disturbances:



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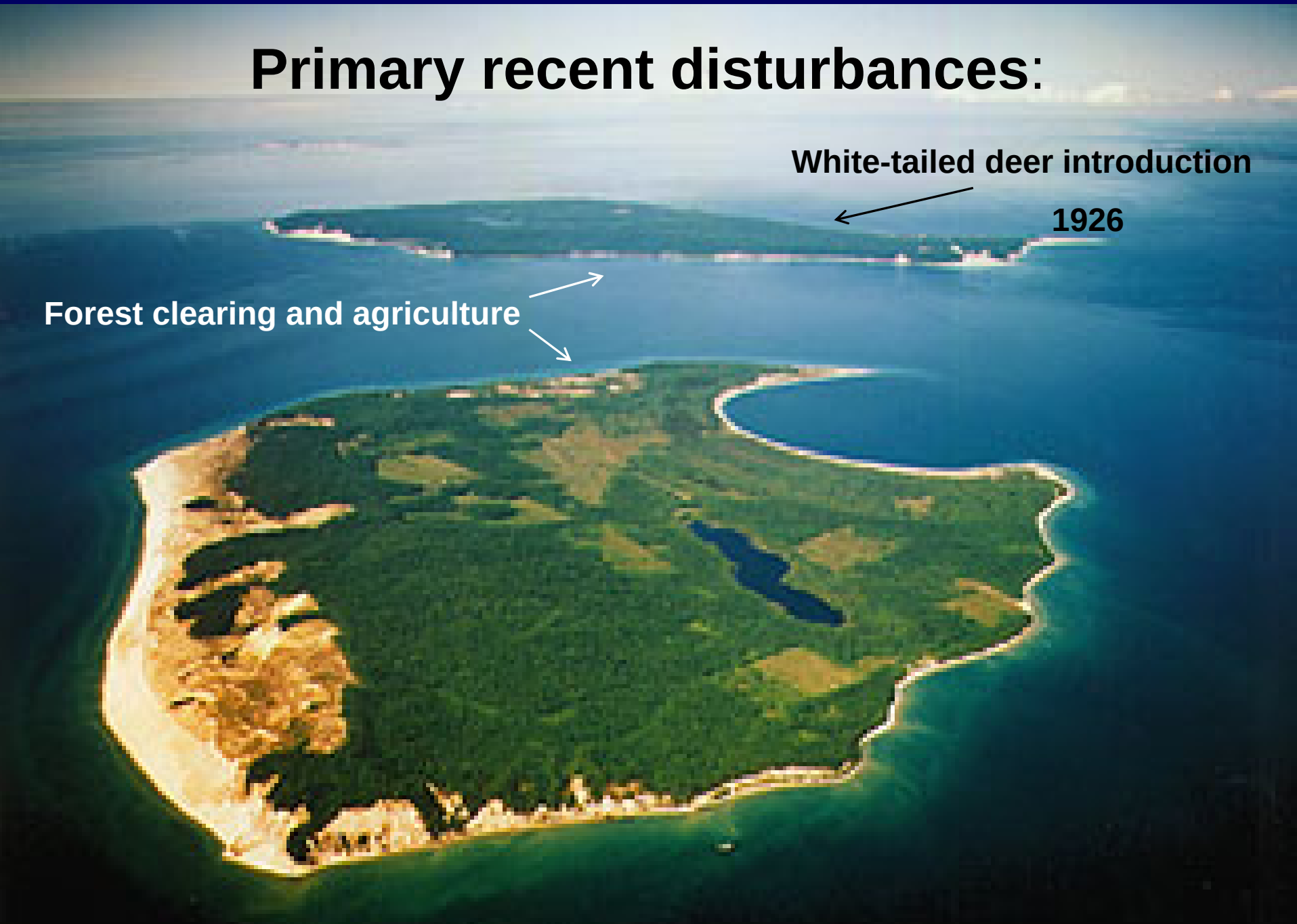
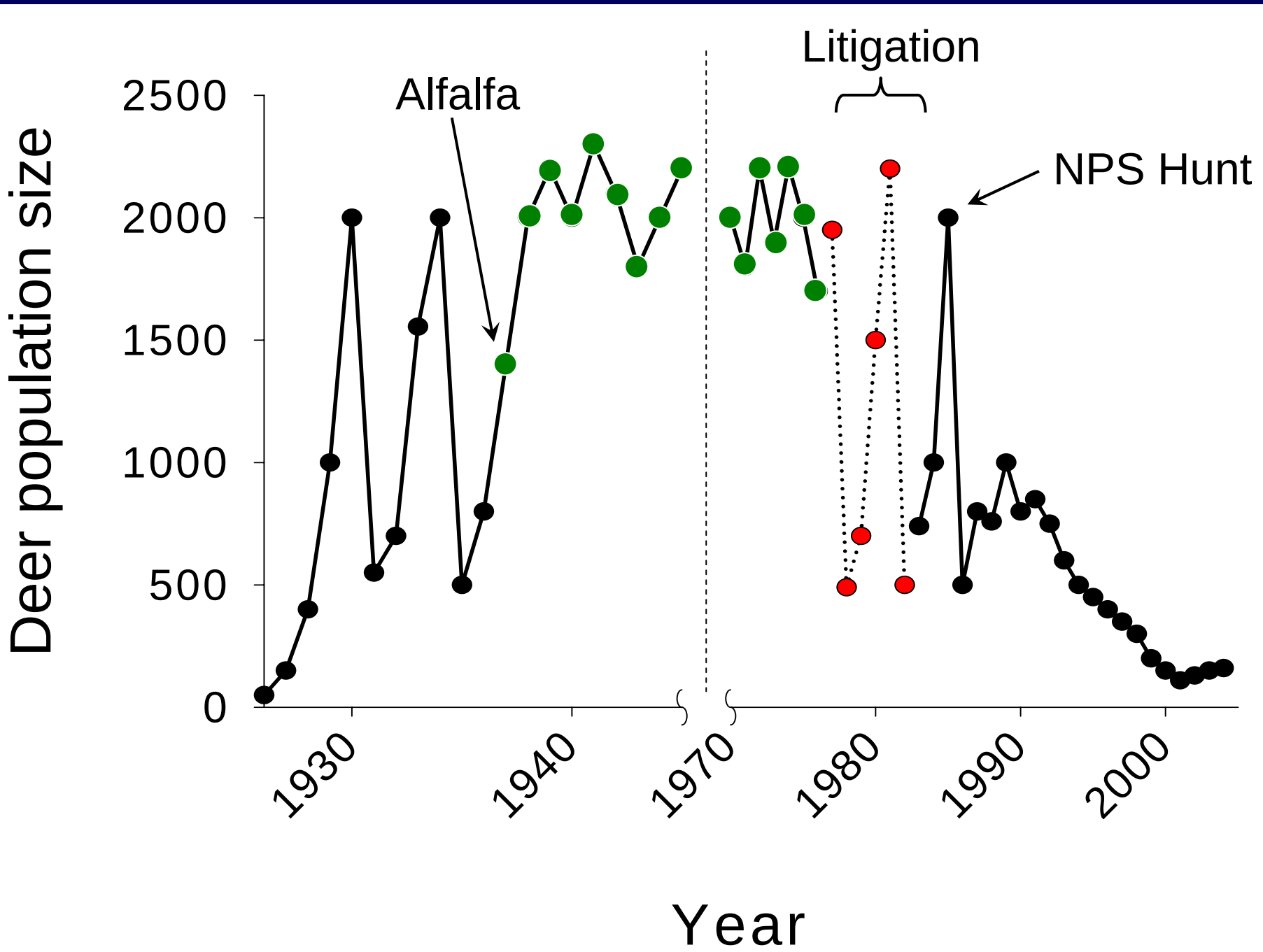


Influence of deer on vegetation

- Browse on herbaceous and woody plants
- Species-specific reduction in recruitment
  - change in relative abundance of plant species

North Manitou Island (NMI) Deer history:

- 5,968 ha
- 11 km from shore
- Deer not previously present on NMI
- Introduced in 1926,managed as hunt club
- 54.3 metric tons of food /winter
- South Manitou Island has never had a significant deer population


Litigation
Alfalfa
NPS Hunt
Deer population size
2500
2000
1500
1000
500
0
1930
1940
1970
1980
1990
2000
Year

Documented effects of deer on NMI focused on woody species:

- 58% of island had pronounced browse line
- "…regeneration of northern hardwood trees other than by the unpalatable beech (*Fagus grandifolia*) was essentially eliminated." Case 1982, Case and McCullough 1987
- Exclosures:
  - Deer browse favored beech recruitment over sugar maple in short-term

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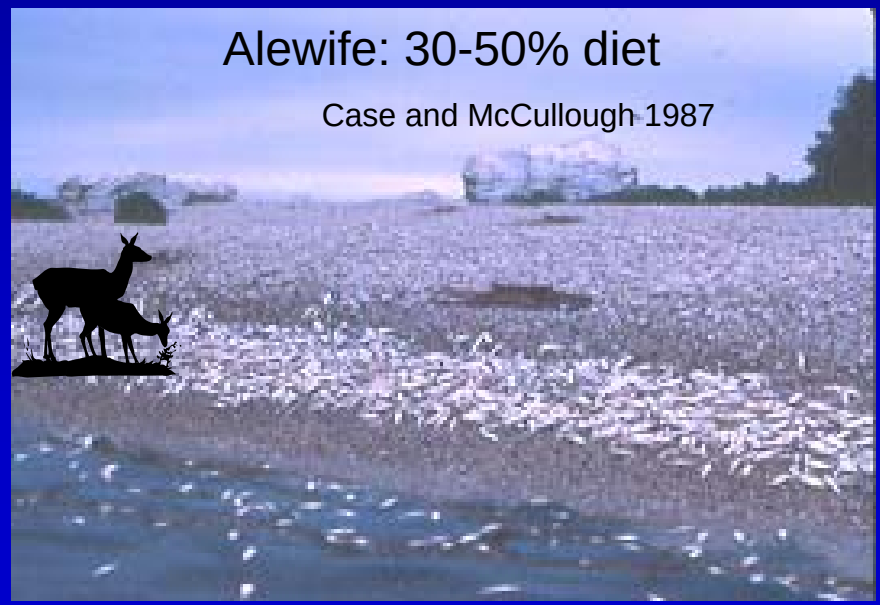
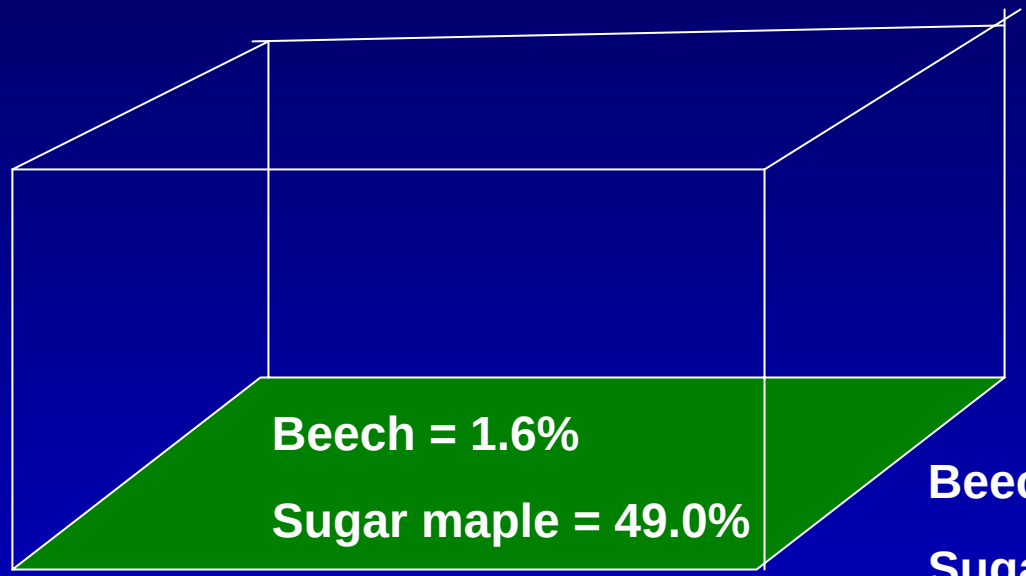


Deer exclosures
- leaf biomass

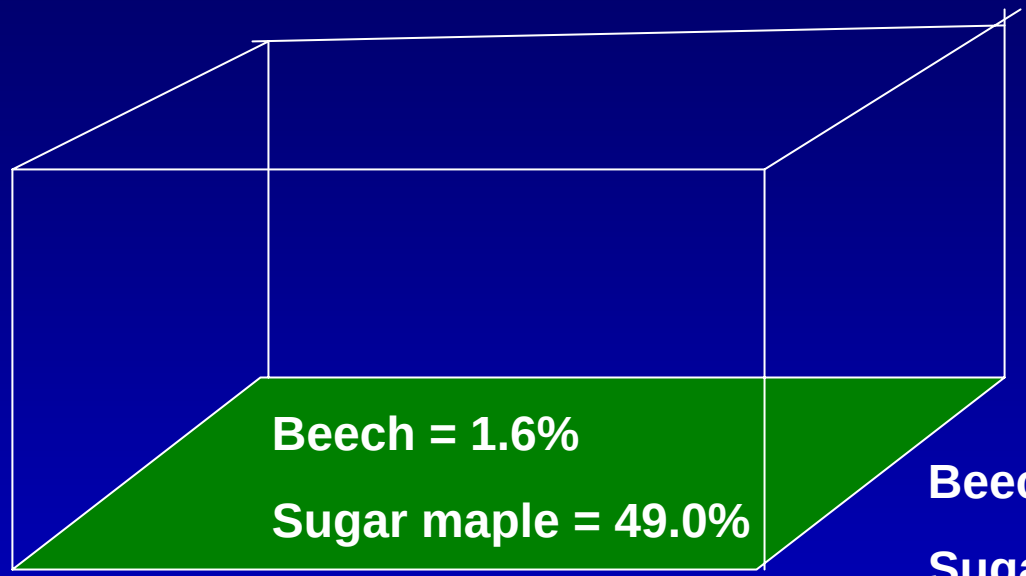


Beech = 98.5%

Sugar maple = 0.5%

Scharf and Jorae 1980,
Case and McCullough 1987

Deer exclosures
- leaf biomass



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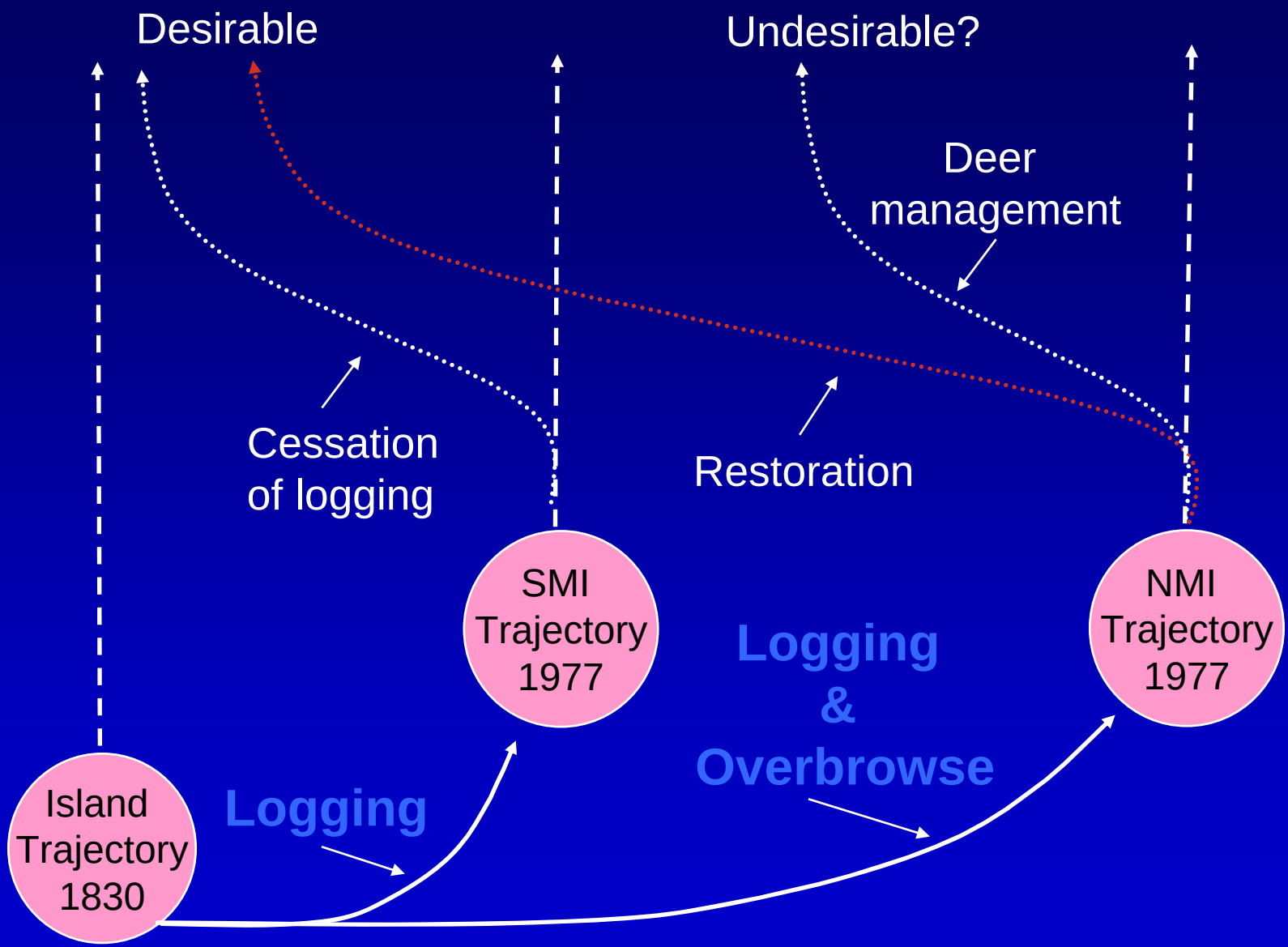
North Manitou Island (NMI)


South Manitou Island (SMI)


Desirable
Undesirable?
Deer management
Cessation of logging
Restoration
SMI Trajectory 1977
NMI Trajectory 1977
Logging & Overbrowse
Island Trajectory 1830
Logging

Goals

- Assess forest recovery on North Manitou Island (NMI)
  - What is the current condition of forest on NMI? How does this affect birds?
  - Will forest return to a desirable structure and function on its own?
  - Will recovery take place within an acceptable time frame?

Our approach:

Our approach:

Canopy

Saplings

Ground layer
(seedlings and herbs)

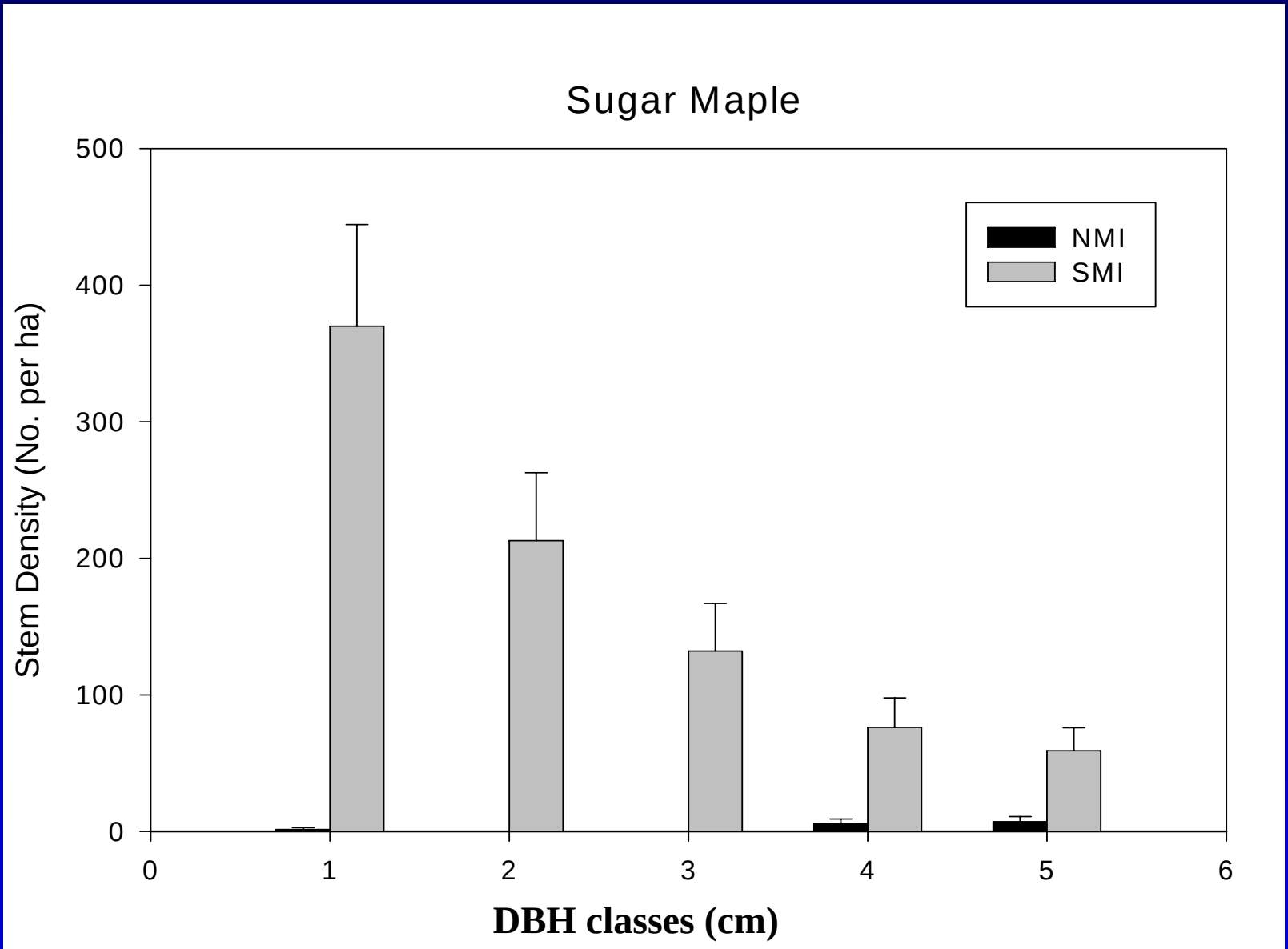
2 questions:

1. Do saplings of the dominant tree species show differences in abundance between NMI and SMI?
2. Do the herbaceous plant communities differ between NMI and SMI?

1. Do saplings of the dominant tree species show differences in abundance between NMI and SMI?

Data used: Modified FIA plots

Sapling densities on North and South Manitou Islands



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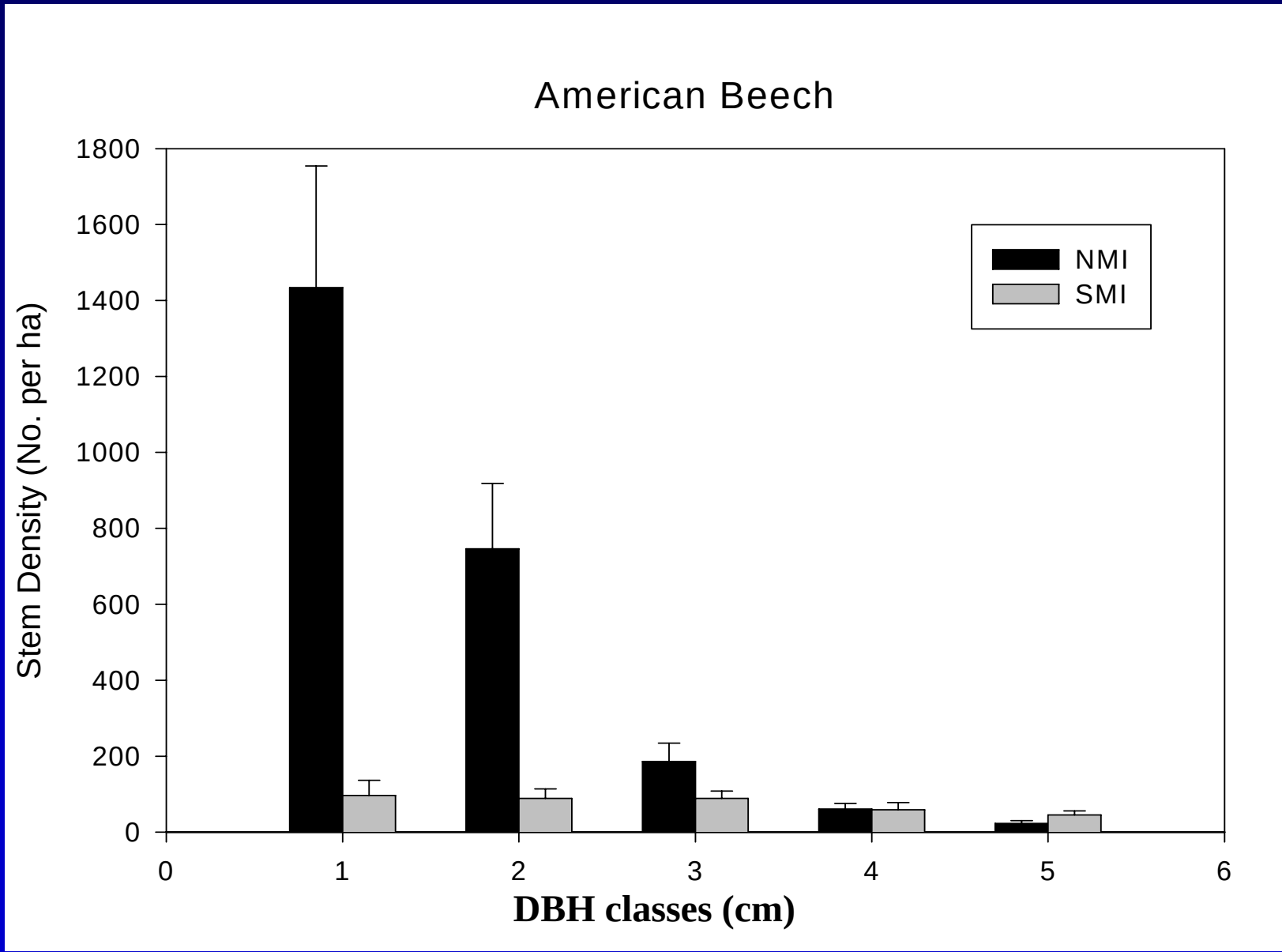
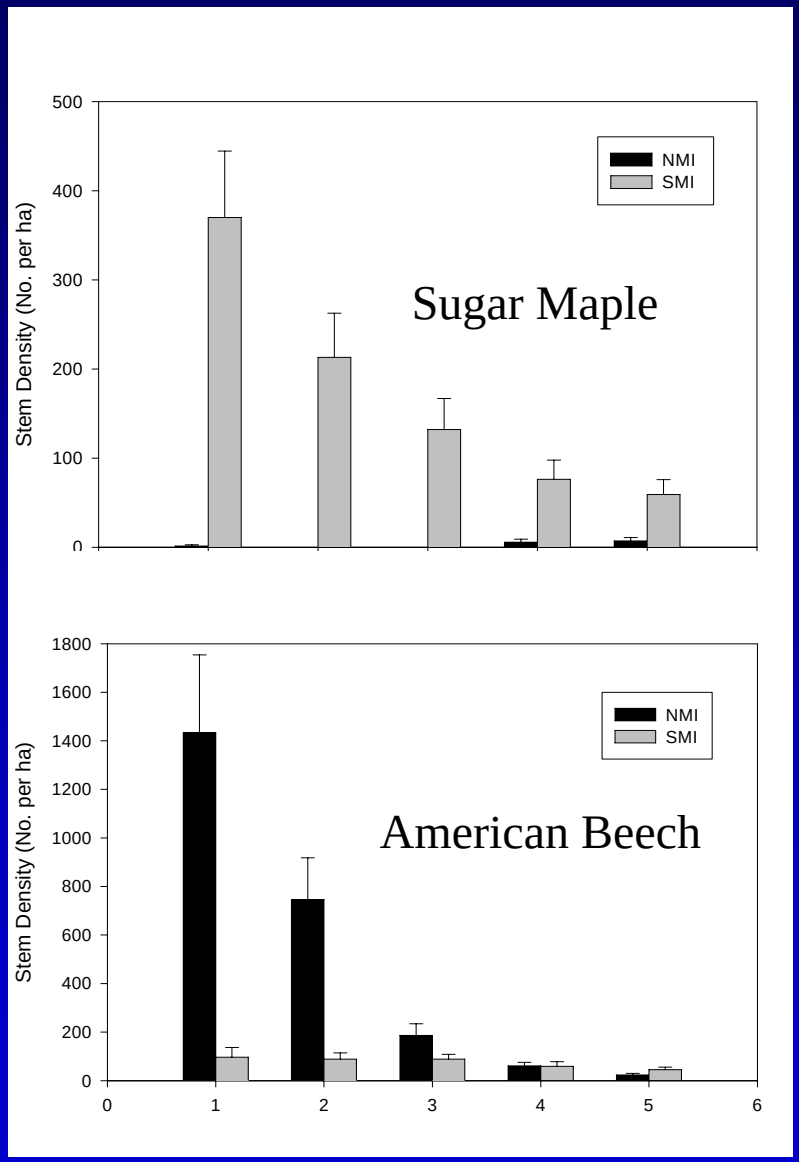
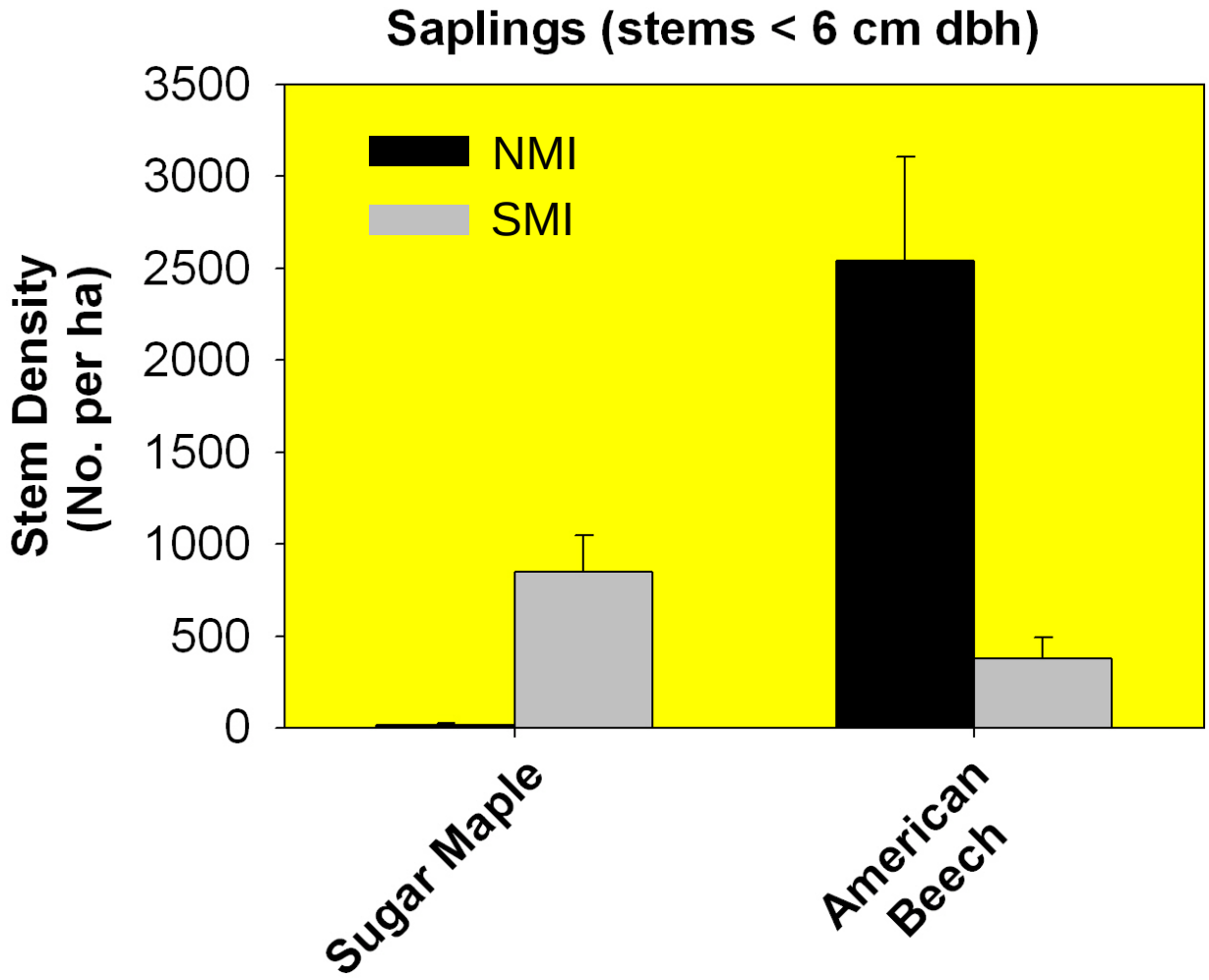
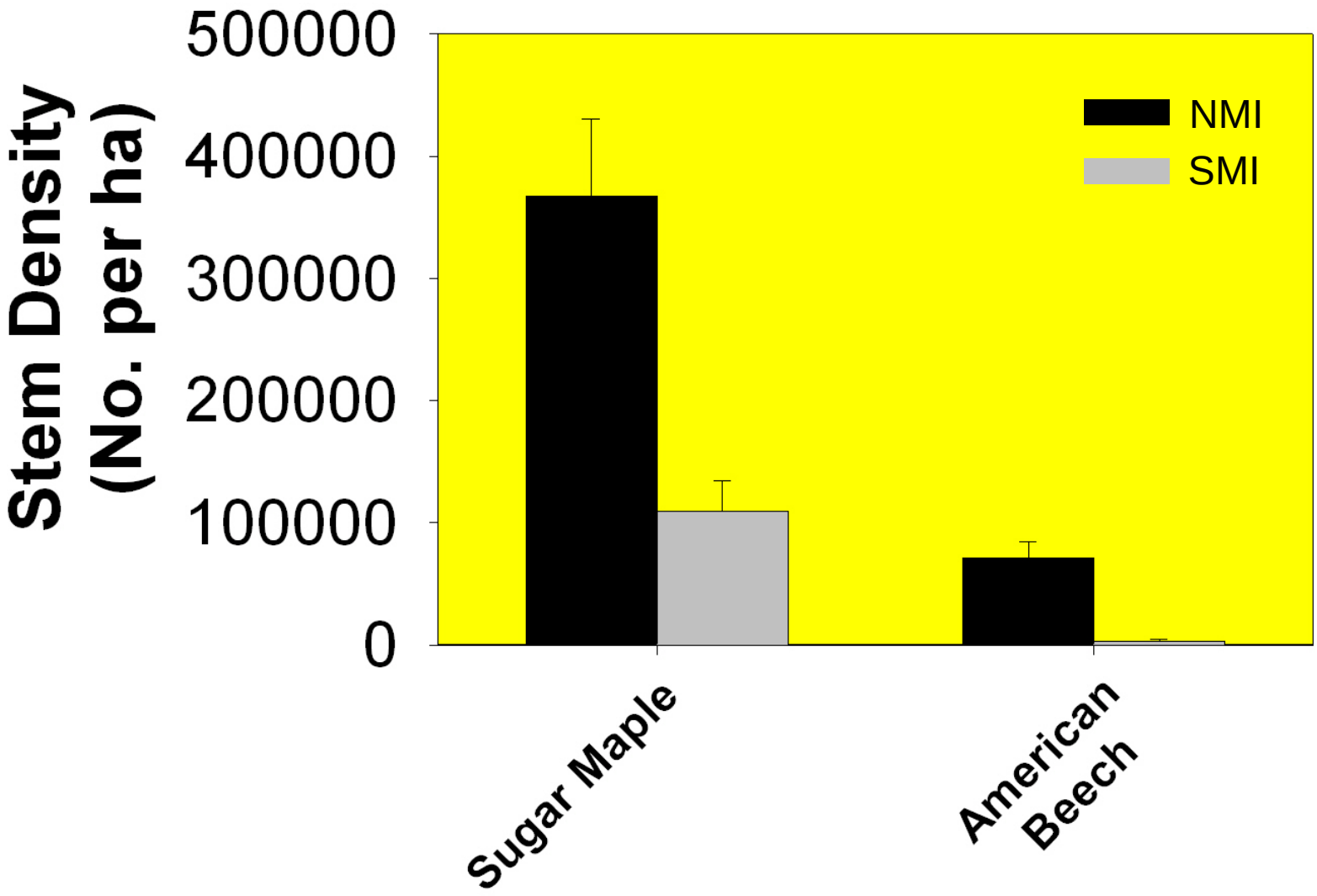




Saplings from 1-5 cm in diameter show dramatic differences in abundance on NMI and SMI with maple dominating on SMI and beech dominating on NMI


Saplings (stems < 6 cm dbh)
Stem Density (No. per ha)
3500
3000
2500
2000
1500
1000
500
0
NMI
SMI
Sugar Maple
American Beech

Seedlings (stems < 1.4 m tall)

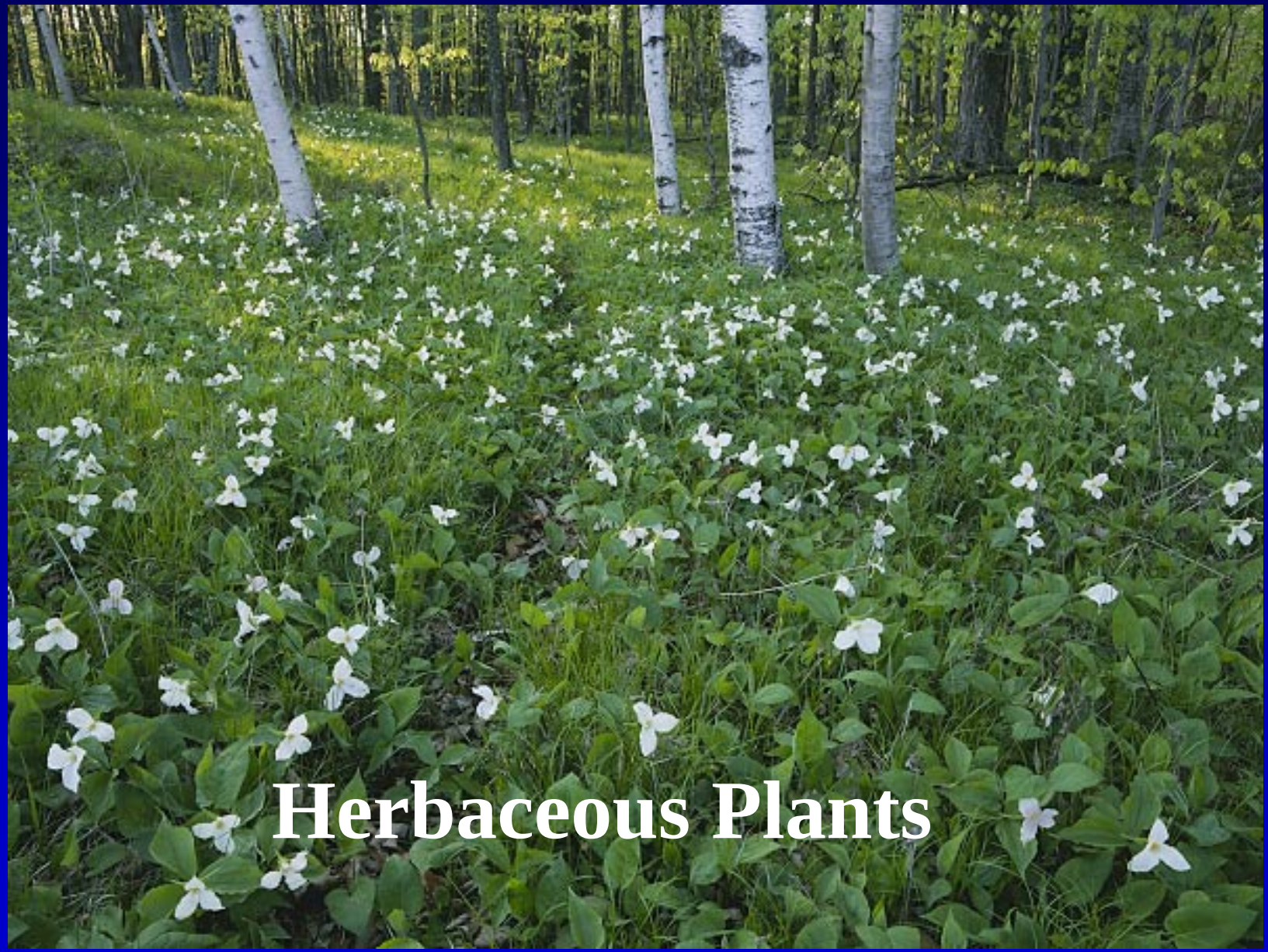



NMI

2. Do the herbaceous plant communities differ between NMI and SMI?

Data used: Modified FIA plots and subplots

- 35 plots on NMI and 32 on SMI randomly selected controlling for forest type, soils, slope, and buffered from edge
- Three 1m subplots in each 8 m plot for herbaceous species


Herbaceous Plants


South Manitou, May 2004
North Manitou, May 2004

C. Webster

Cades Cove, Great Smoky Mountains National Park

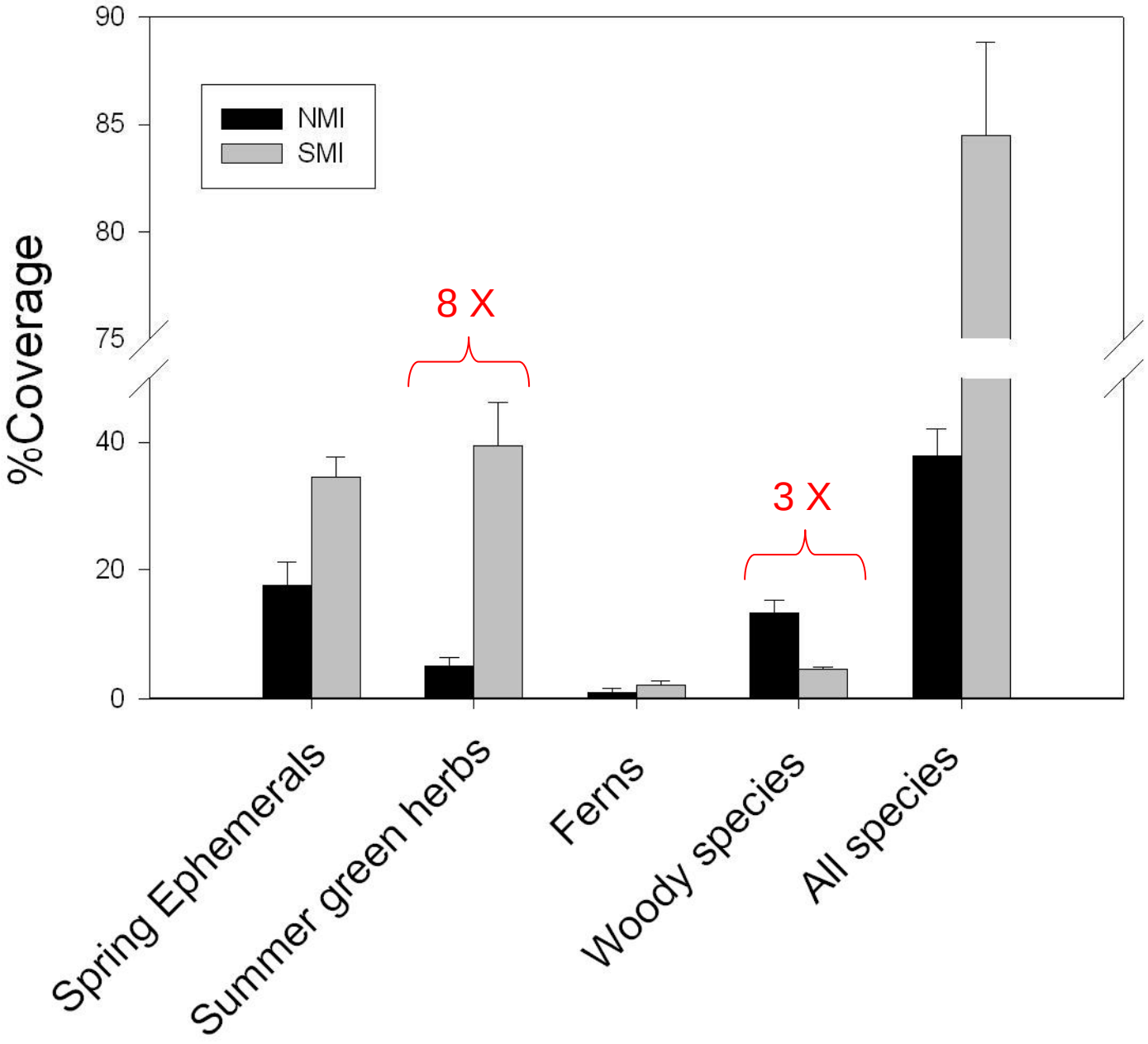
Site Selection Criterion

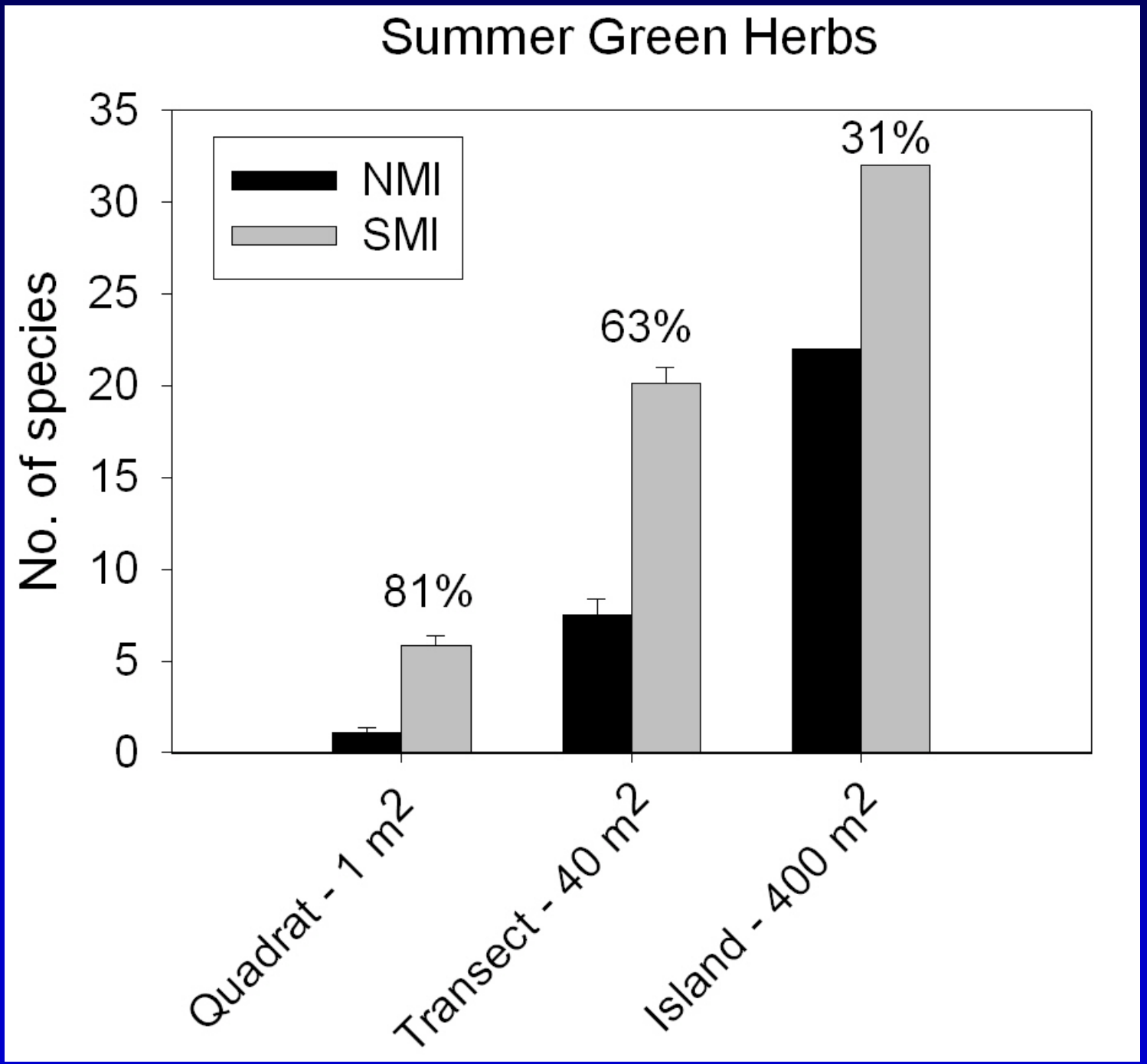
- Randomly selected, at least 300 meters apart
- Forest type
  - mature northern hardwoods forest
  - no evidence of recent cutting
- Slope – less than 15%
- Soils – loamy sands or sandy loams


South Manitou Island
Mist net plots
2003 forest sampling plots
2004 herb layer transects
Sampled forest
Non-sampled forest
Non-forest
Open Water
N
1 0 1 2 Kilometers


North Manitou Island
N
Mist net plots
2003 forest sampling plots
2004 herb layer transects
Sampled forest
Non-sampled forest
Non-forest
Open Water
2
0
2
4 Kilometers

Coverage in the Herbaceous Layer




Summer Green Herbs
No. of species
35
30
25
20
15
10
5
0
NMI
SMI
81%
63%
31%
Quadrat - 1 m2
Transect - 40 m2
Island - 400 m2

Summer green herbs differed greatly in % coverage and % frequency.

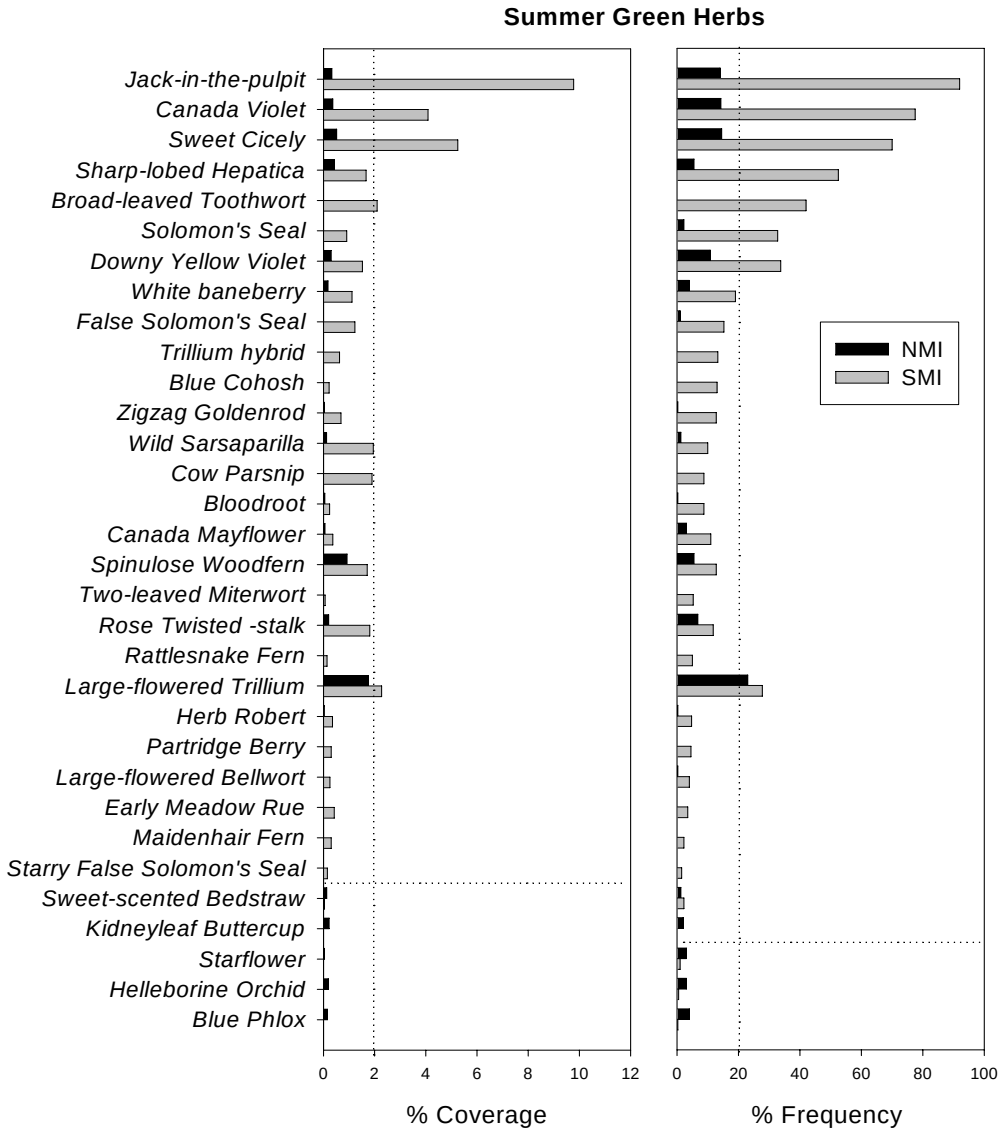
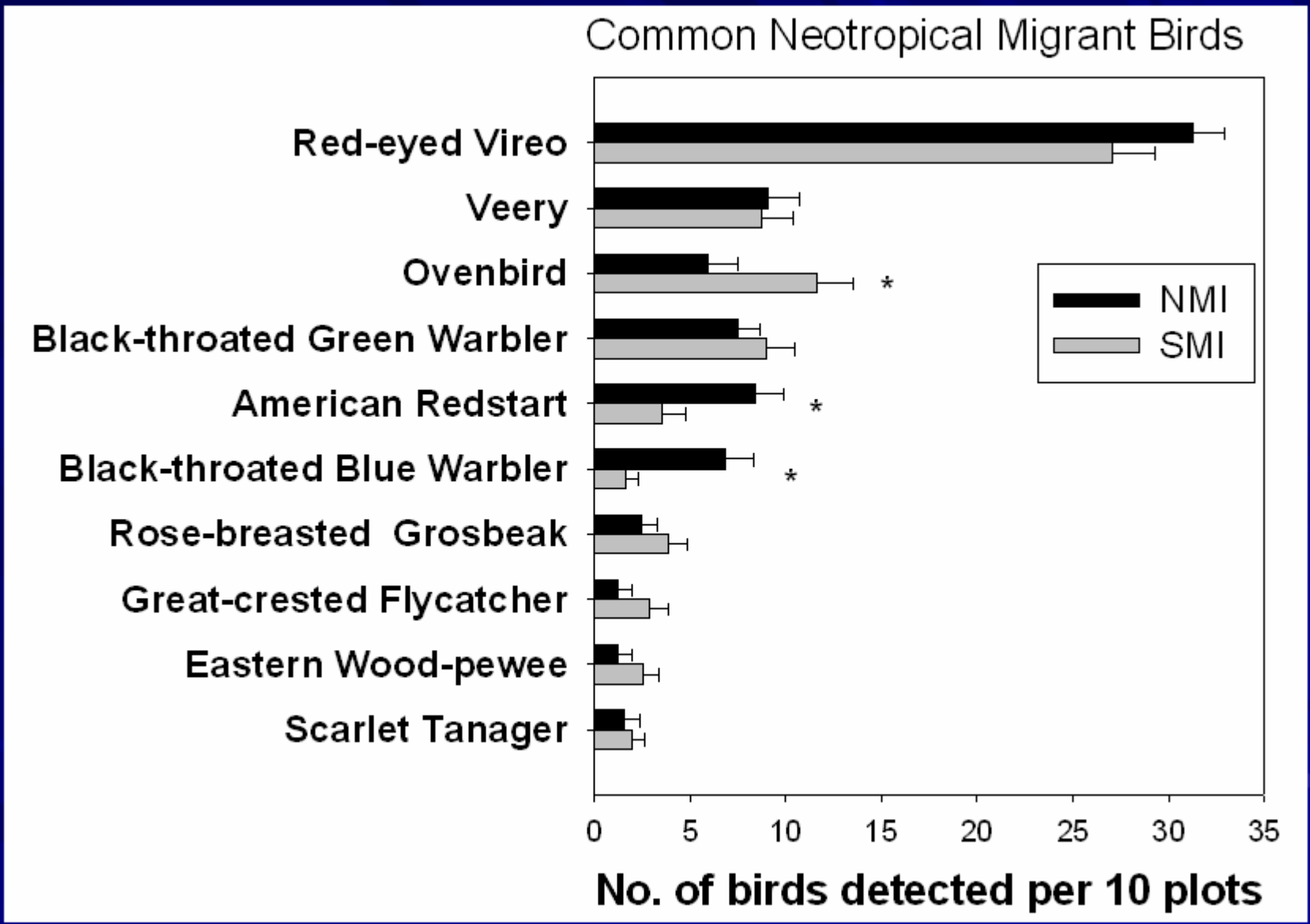


Figure 2.10. Summer green forest herb percent coverage and percent frequency (quadrat level) on North and South Manitou Islands, Sleeping Bear Dunes National Lakeshore, Michigan. Species are ranked by mean difference in quadrat level frequency between the two islands for 33 species that occurred in at least one percent of quadrats.

1. Are there patterns of differences in the bird communities on SMI and NMI?


Common Neotropical Migrant Birds
Red-eyed Vireo
Veery
Ovenbird
Black-throated Green Warbler
American Redstart
Black-throated Blue Warbler
Rose-breasted Grosbeak
Great-crested Flycatcher
Eastern Wood-pewee
Scarlet Tanager
*
*
*
NMI
SMI
0
5
10
15
20
25
30
35
No. of birds detected per 10 plots

Why have herbs shown so little recovery in last 20 years?

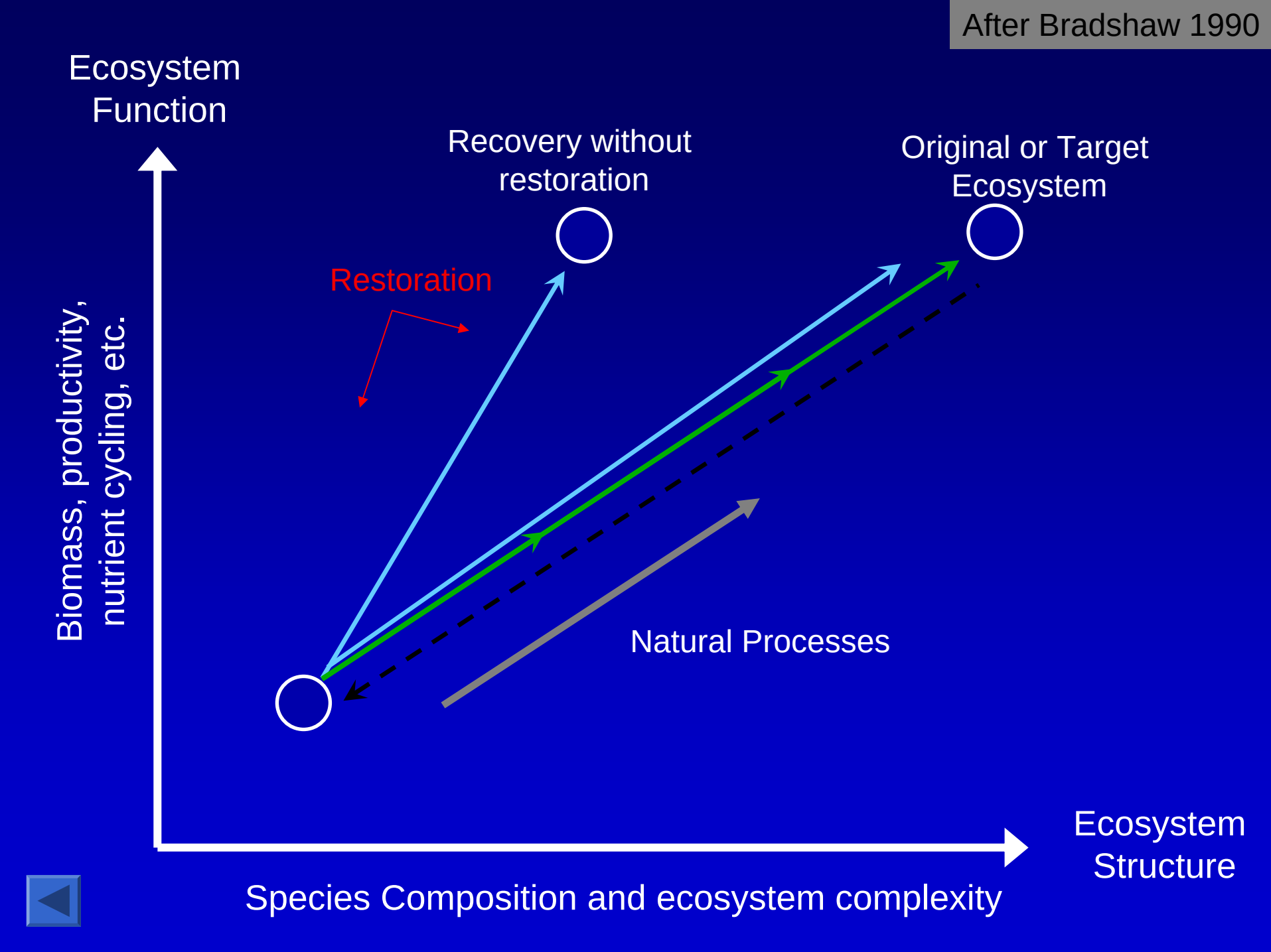
- Competition with woody plants in the understory may have altered successional trajectory?
- Current herbivory from smaller deer herd on NMI?
- Inability to re-colonize the island (for extirpated species such as blue cohosh, Canada yew)? - nearest source population 5 km away
- Herbs tend to be good competitors for space and resources, but poor colonizers of unoccupied growing space

Summary

- Deer may have altered beech vs. maple competition on NMI, favoring beech.
- Deer have functionally extirpated many species from NMI.
- Woody recovery on NMI has proceeded but may be slowing herb recovery.
- Some evidence for response of ground and understory bird relative abundance

Is Restoration Necessary?

- Is recovery of desirable ecosystem trajectory likely?
- Is recovery too slow?


After Bradshaw 1990
Ecosystem Function
Recovery without restoration
Original or Target Ecosystem
Restoration
Biomass, productivity, nutrient cycling, etc.
Natural Processes
Ecosystem Structure
Species Composition and ecosystem complexity

Is Restoration Necessary?

- Is recovery of desirable ecosystem trajectory likely? Is recovery too slow?
- What do National Park Service legal and regulatory guidelines say?


“Identify, acquire, and interpret inventory, monitoring and research” in order to “maintain – and, where necessary, restore – the integrity of natural systems”
- NPS *Management Policies* (2001).

Acknowledgements

- U.S. Dept. of Interior, National Park Service (NRPP Project 247)
- Steve Yancho and NPS Staff
- MTU School of Forest Resources and Environmental Science
- Audra Bassett, Mark Fogg, Kat Nelson, Melinda Scott, Craig Flanick, others