Maintaining and promoting compositional and structural diversity for forest resilience

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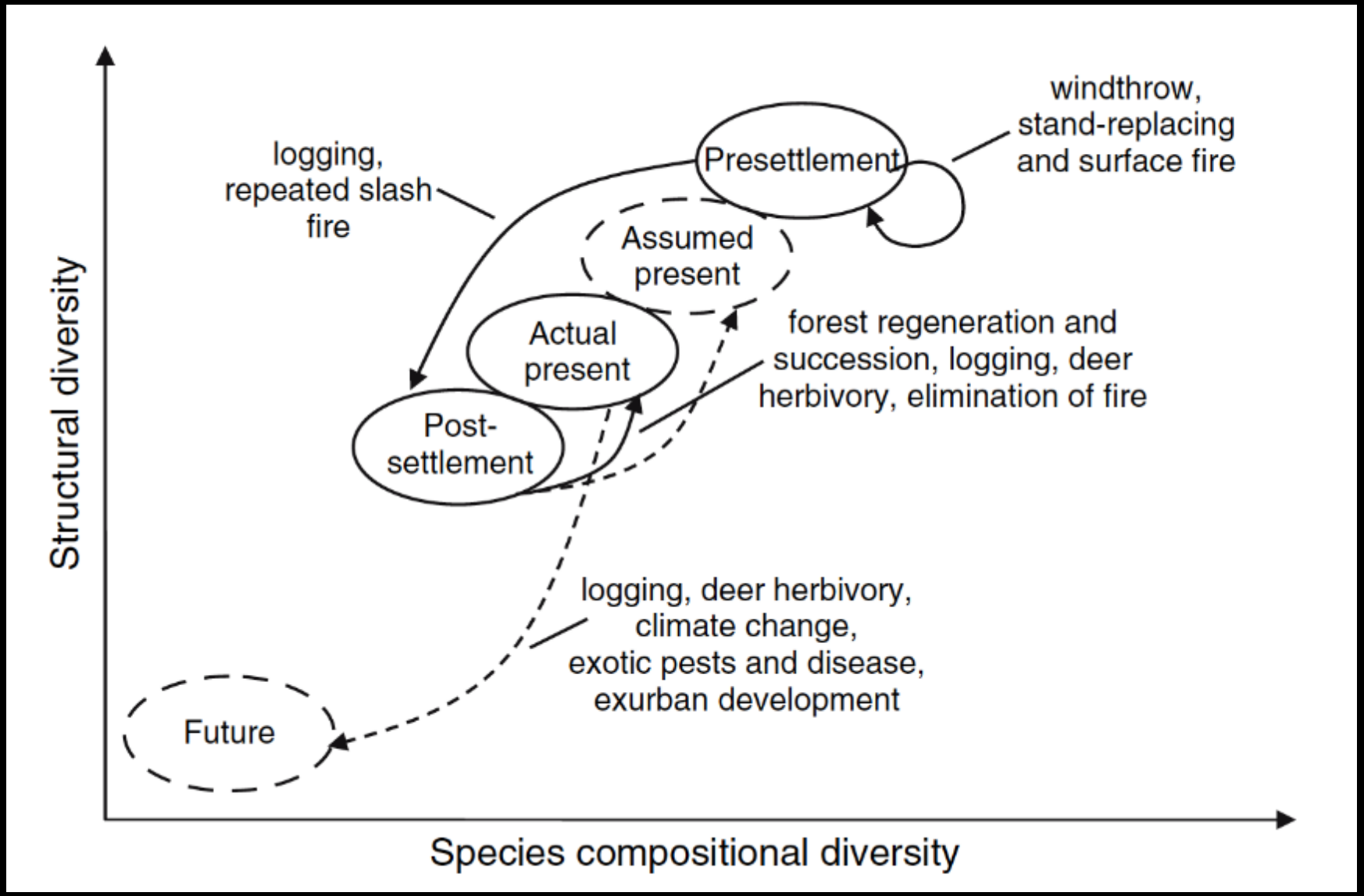
http://www.gannett-cdn.com/

Declines in structural and compositional diversity

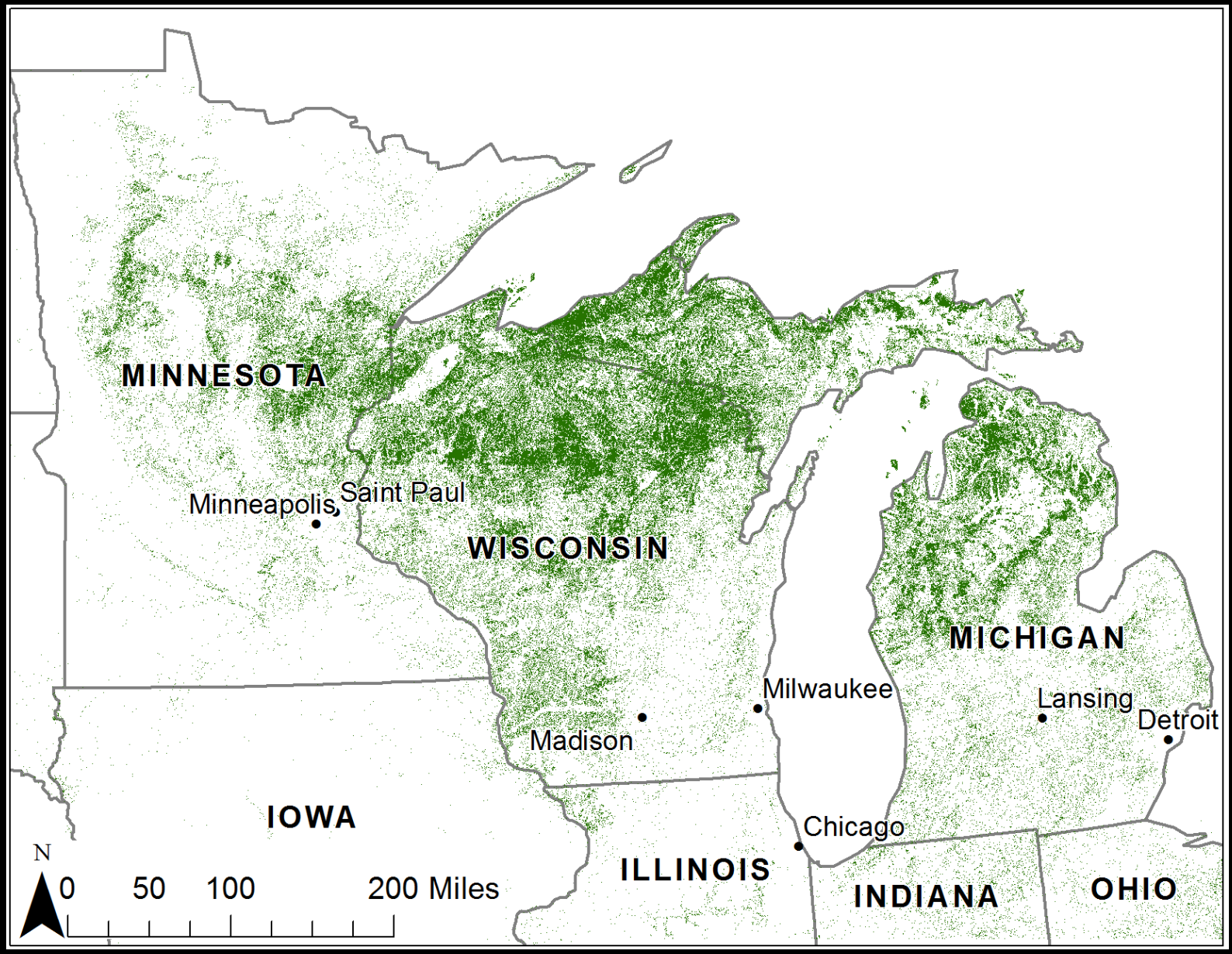
- Regional homogenization of Lake States (Schulte et al. 2007)
  - Decline in conifers
  - Increase in maple and aspen.
  - Decline in large trees and diversity of tree sizes



Schulte et al. (2007) Landscape Ecol 22:1089–1103

Northern hardwoods

- Maple-Beech-Birch USFS FIA data, Michigan 1980 *cf.* 2015



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Northern hardwoods

- Maple-Beech-Birch USFS FIA data, Michigan 1980 *cf.* 2015
  - Declines in mid-tolerant and intolerant species, particularly 1-13” DBH
    - yellow birch -36% TPA
    - basswood -44% TPA
    - white pine & red pine -33% TPA
    - *Populus* spp. -19%

Northern hardwoods

- yellow birch declines widely reported
  - Woods 2000; Zhang et al. 2000; Erdman and Oberg 1973; Crow et al 2002; Webster and Lorimer 2005; Anger et al 2005; Webster and Jensen 2007; Schulte et al. 2007
- basswood declines also reported
  - Woods 2000

Northern hardwoods

- Maple-Beech-Birch USFS FIA data, Michigan 1980 *cf.* 2015
  - Declines in mid-tolerant and intolerant species, particularly 1-13” DBH
  - Increases in shade tolerant
    - Spruce & balsam fir + 125% TPA
    - But decline in sugar maple (-25% TPA), particularly 1-7” DBH

Northern hardwoods

- Maple-Beech-Birch USFS FIA data, Michigan 1980 *cf.* 2015
  - Declines in mid-tolerant and intolerant species, particularly 1-13” DBH
  - Increases in shade tolerant
  - Also, changes due to exotic invasives?
    - beech +84% TPA, increase <7” DBH and decline >7” DBH
    - ash -22% TPA

Challenges

- Exotic invasive species

Challenges

- Exotic invasive species
- Climate change

Uncertain future climate

- Possible decline in suitable habitat:
  balsam fir, black spruce, jack pine, Northern white cedar, paper birch, quaking aspen, white spruce, eastern white pine
- Possible increase in suitable habitat:
  a number of oaks and hickories, black walnut, elms, yellow-poplar
- Uncertain forest responses:
  yellow birch, sugar maple, basswood

(Handler et al. 2013; Janowiak et al. 2014)

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- Exotic invasive species
- Climate change
- Balancing multiple ecosystem services: provisioning, regulating, supporting and cultural
- Uncertain future biomaterial markets and societal needs

Diversity is one approach to mitigate many of these challenges

Greater species richness:

- ensures stability of ecosystem production
  - functional redundancy
  - Greater richness needed as variability increases with temporal and spatial scale
- may increase productivity through complementarity
- generally reduces susceptibility to invasion
- will preserve management options

Hooper et al. (2005)

Diversity is one approach to mitigate many of these challenges

- Structural diversity may also confer ecological resilience and resistance
  - Variations in susceptibility
  - Survivors promote recovery e.g. advance regeneration and seed banks

Yellow birch

- Hard mast for birds and rodents
- Catkins, buds and leaves for grouse and hares
- Browse for ungulates
- Rough bark – habitat for insects, birds and bats
- Cavities

http://www.arboristsite.com/

Basswood

http://www.botany.wisc.edu/

- Important nectar source
- Mast for rodents
- Cavities
- Improves soil condition linked with reduced sugar maple decline (Cote et al. 1999)
- “Trap crop” Asian Longhorn Beetle ? (Turgeon et al. 2016; Smith et al. 2009)

What can we do?

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- Continue to focus on promoting and maintaining diversity within stands and across landscape
- Actively manage landscapes to retain and promote a diversity of stand ages and structures
- Avoid prescriptions that target the removal of specific species
  - Retain potentially resistant individuals during salvage
  - Retain future management options

What can we do?

- Mimic the full range of natural disturbances
  - Vary silvicultural prescriptions across the landscape

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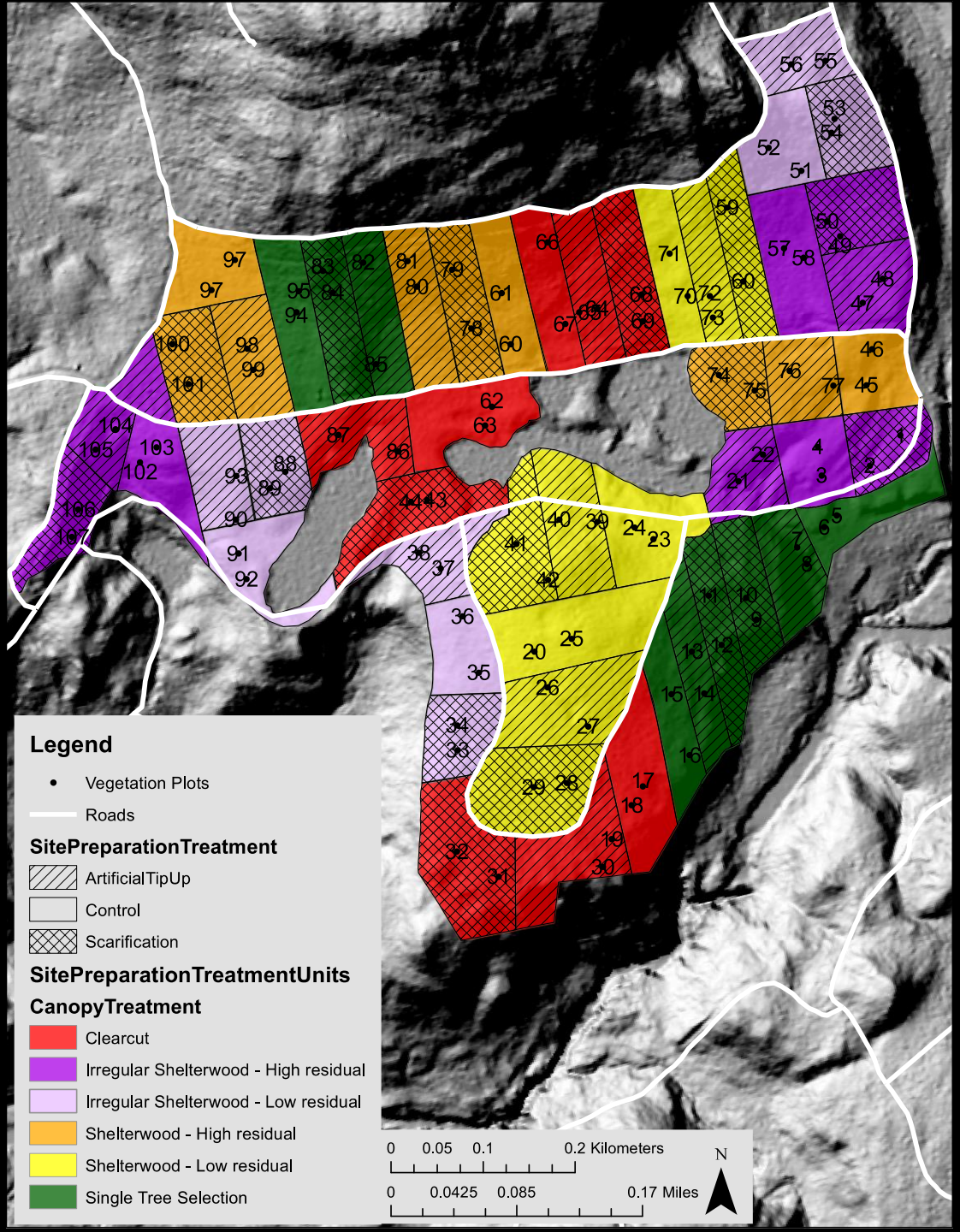
- Mimic the full range of natural disturbances
  - Vary silvicultural prescriptions across the landscape
  - Use existing silviculture recommendations to promote yellow birch (MI DNR)
    - Range of gap sizes (25-167ft diameter)
      - Deer and competition control (Walters et al. 2016, Kern et al. 2016)
      - Leave vigorous seed trees (Poznanovic et al. 2013)
    - Expose mineral soil
    - Even-aged regeneration methods e.g. shelterwood
      - Likely to also favor basswood

Continue to focus on promoting and maintaining diversity within stands and across landscape

- Continue to investigate new silvicultural systems

NHSEED: Northern Hardwood Silviculture Experiment to Enhance Diversity



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Take home messages

- Continued decline of mid-tolerant and intolerant species in the northern hardwoods over the last 35 years
- Continue to focus on promoting and retaining diversity in forest stands
  - Including previously “uneconomic” species?
- Use a diversity of silvicultural approaches (within reason) and active adaptive management