Ecological impacts of deer overabundance

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An ecosystem-based perspective

Caughley's (1981) 'value judgments' related to overabundance

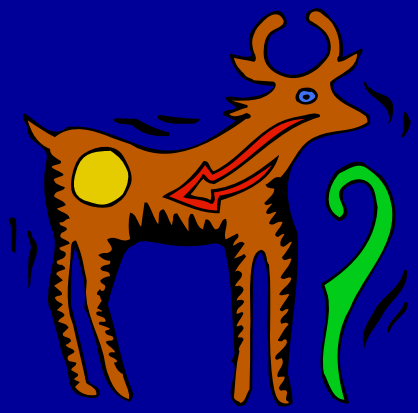
1. threaten human life or livelihood
2. too numerous for their «own good»
3. depress the abundance of «important» species
4. cause ecosystem dysfunctions

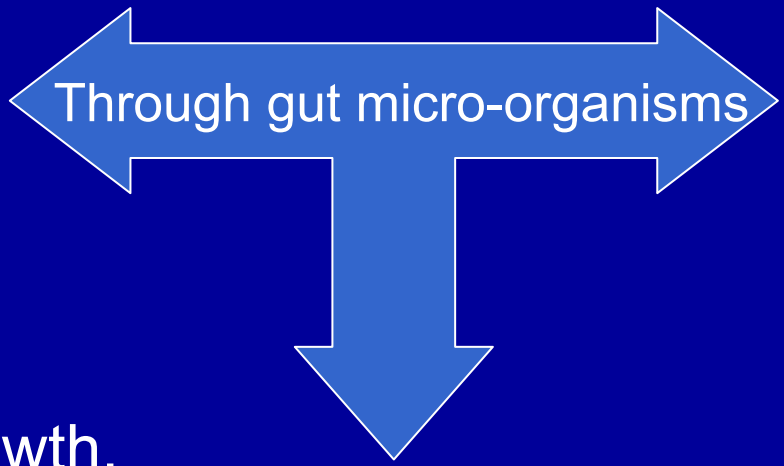
Need to change our management perspective from single species/trophic level-base to ecosystem-base

Ecological impacts of deer overabundance: what's on program

- Plant-herbivore interactions
  - direct impact on individual plant growth strategies
  - indirect impacts on plant community
  - impacts on succession rate and forest structure
  - ecosystem functions
  - cascading effects on other animal species
- Dynamic and reversibility of deer impacts
- Research needs and management issues

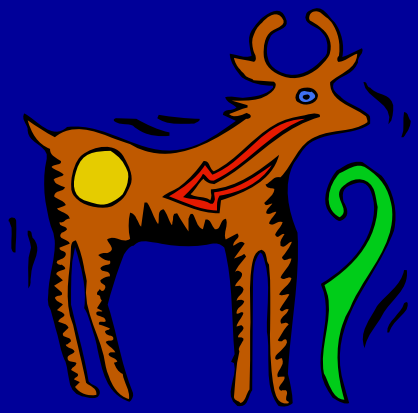
Plant-herbivore interactions: an evolutionary tug-of-war





Browsing directly influence plant growth, reproduction and survival

Plant-herbivore interactions: an evolutionary tug-of-war



Through gut micro-organisms

Browsing directly influence plant growth, reproduction and survival

Defense against herbivory

↓ selection
↓ intake rate
} resistance$

tolerance to defoliation

reallocation of resources

Plant-herbivore interactions: an evolutionary tug-of-war

Through gut micro-organisms

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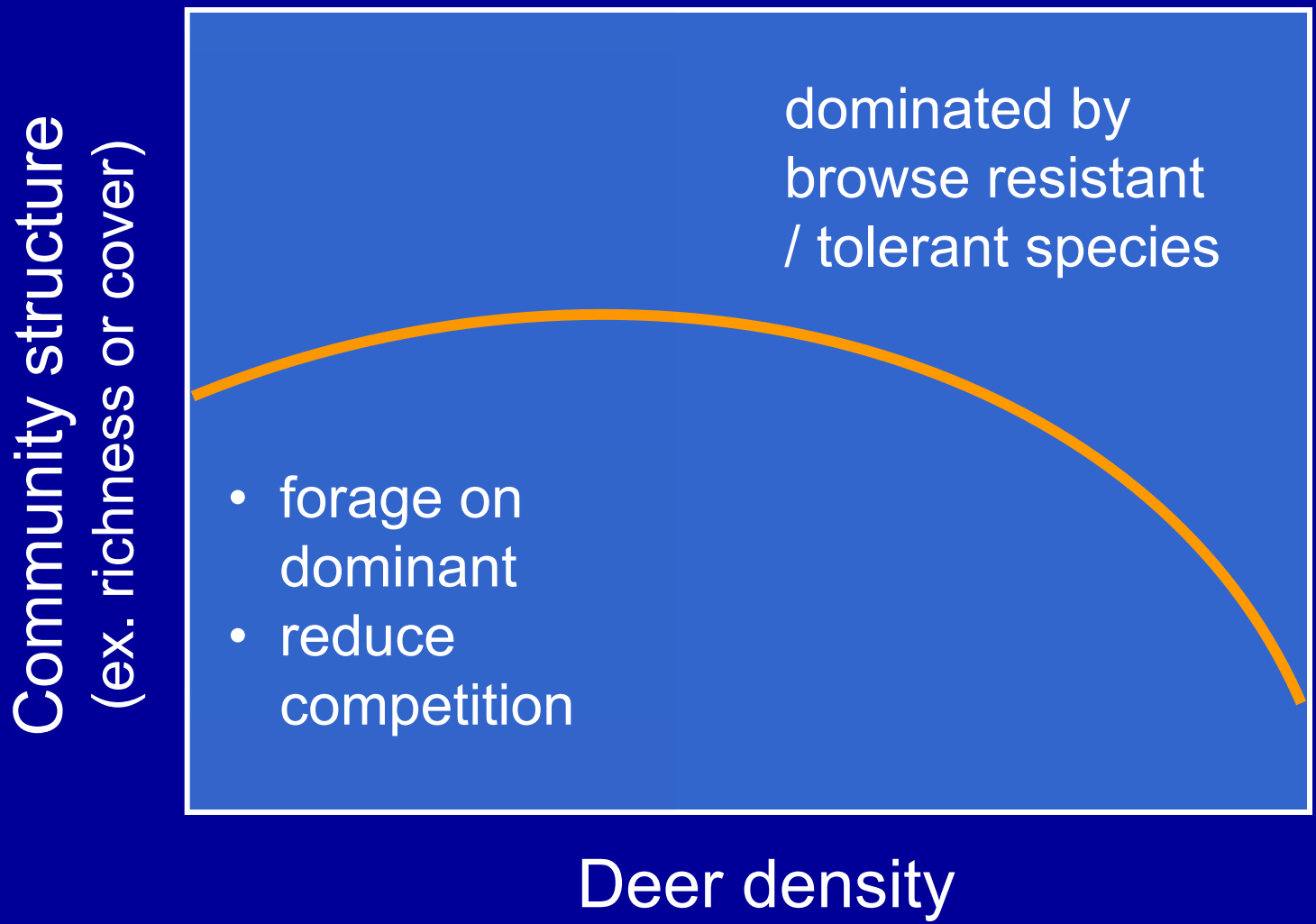
reallocation of resources

? which plants are selected, how plant and deer respond and ultimately how ecosystems functions are affected

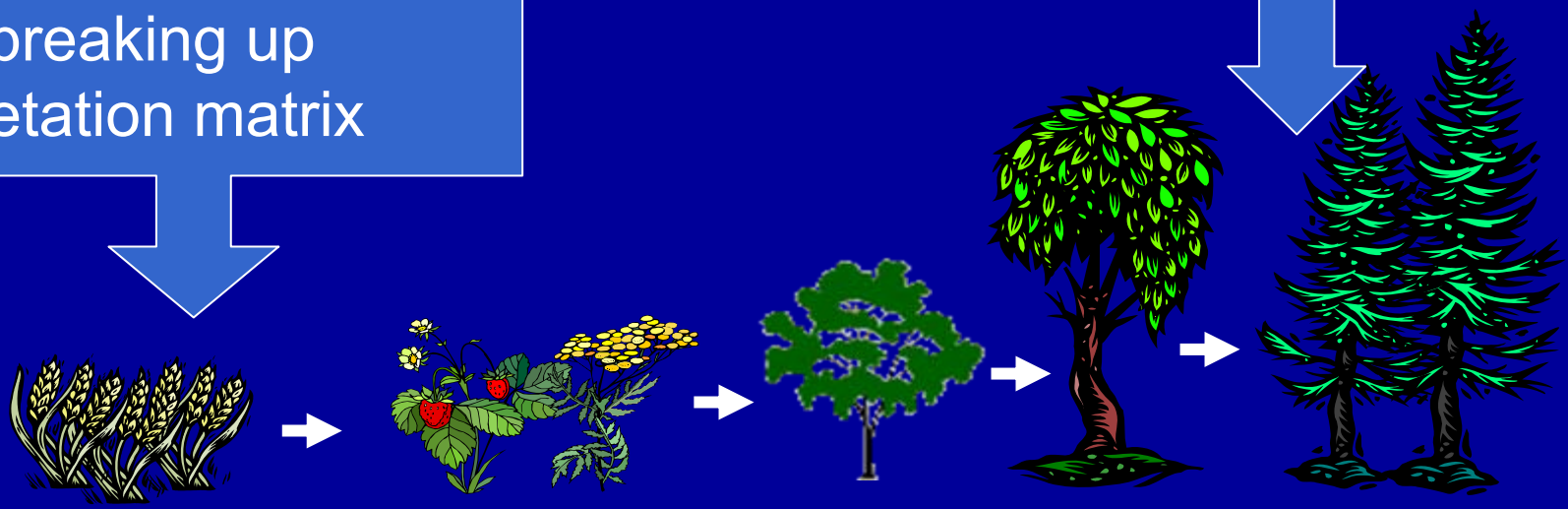
Indirect impacts: modulation of plant-plant interactions



Impacts on succession rate and forest structure

deer ↑ succession rate by breaking up vegetation matrix

deer ↓ succession rate by killing seedlings and reducing growth



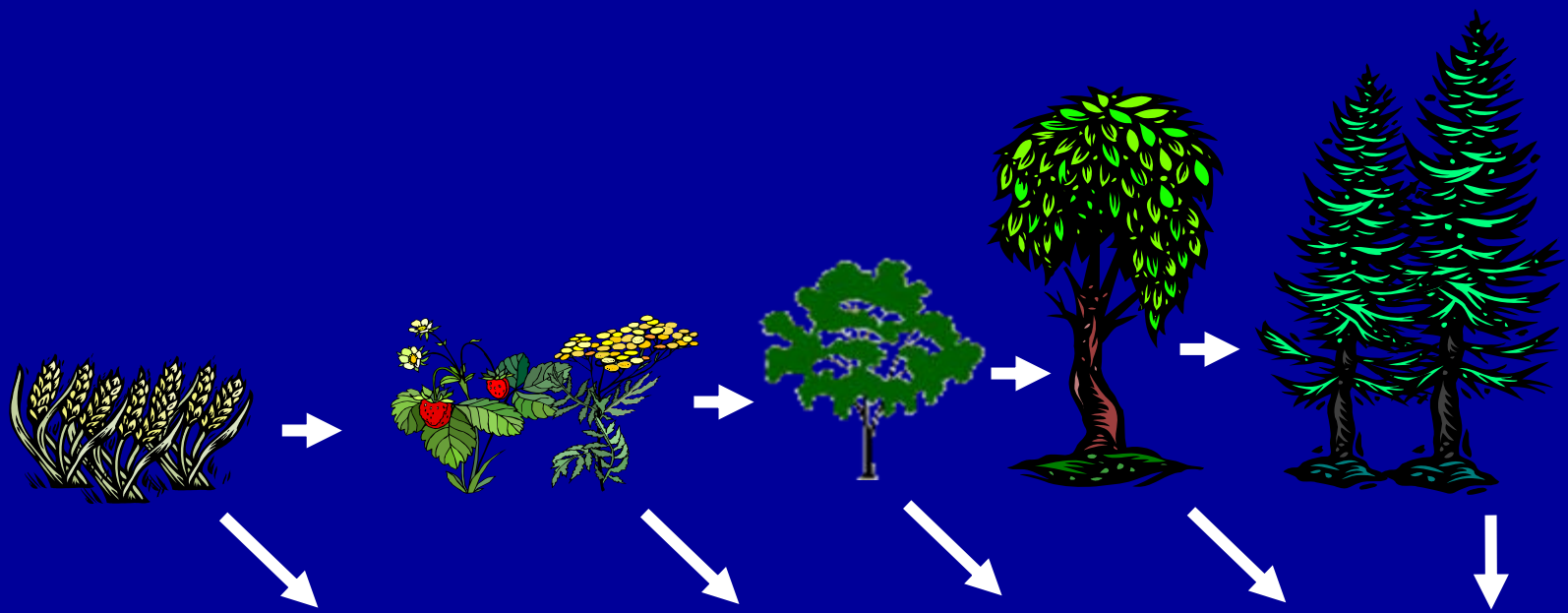
invasion of grassland by shrubs

↓ vertical structure
- biais toward med and large stems

↓ stand density

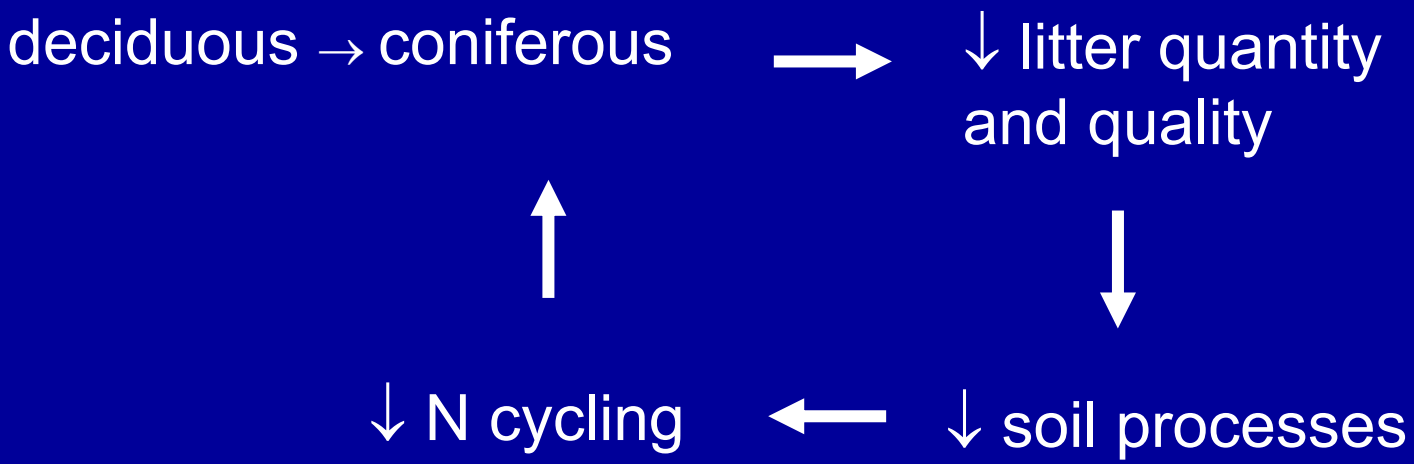
↑ stand rotation

Impacts on succession rate and forest structure



Alternate successional pathways and compositional shifts

Impacts on ecosystem functions: nitrogen cycling

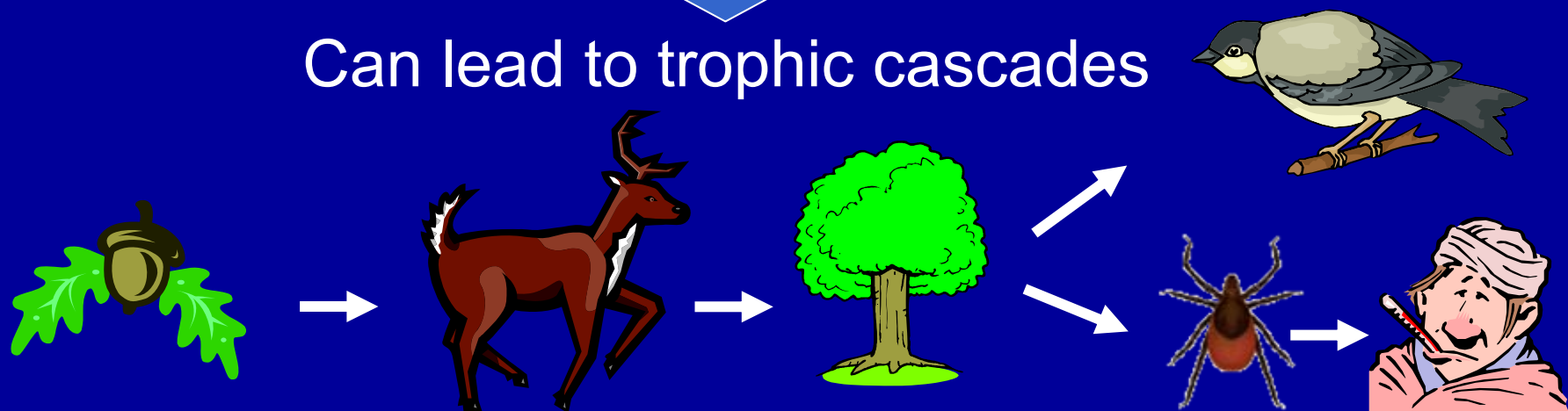


- Positive feedback mechanism
- Long lasting effects

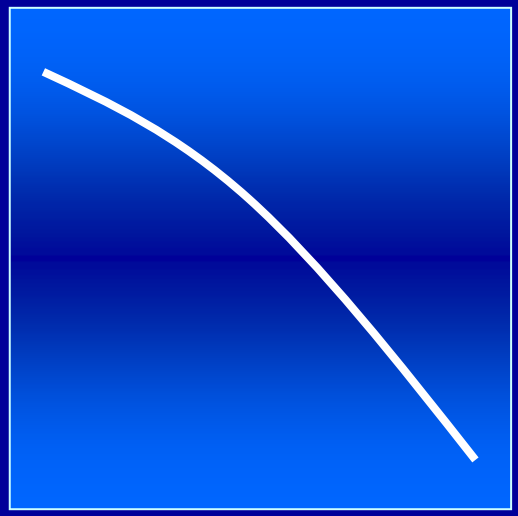
Cascading effects on animal species

- Direct competition for resources
- Modification to the composition and structure of habitats
- Nonlinear relationships between diversity and deer density
  - ↑ diversity at intermediate density level
  - as with plants, some wining species in insects + birds
  - small mammals usually ↓

Can lead to trophic cascades



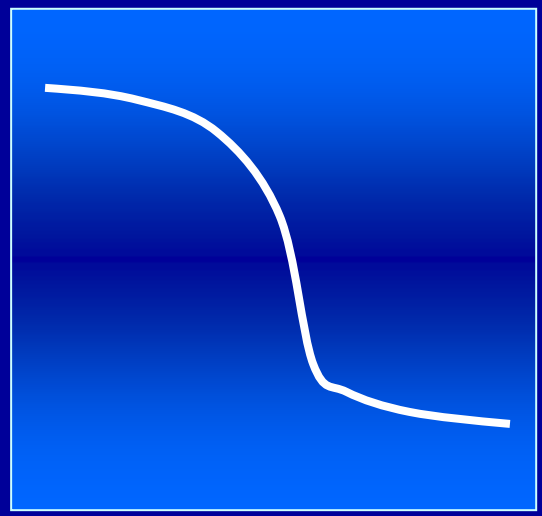
Dynamic and reversibility of impacts: deer as a biological switch



Forest integrity

Deer density

- 1 equilibrium



Deer density

- nonlinear
- threshold
- 1 equilibrium

Deer density

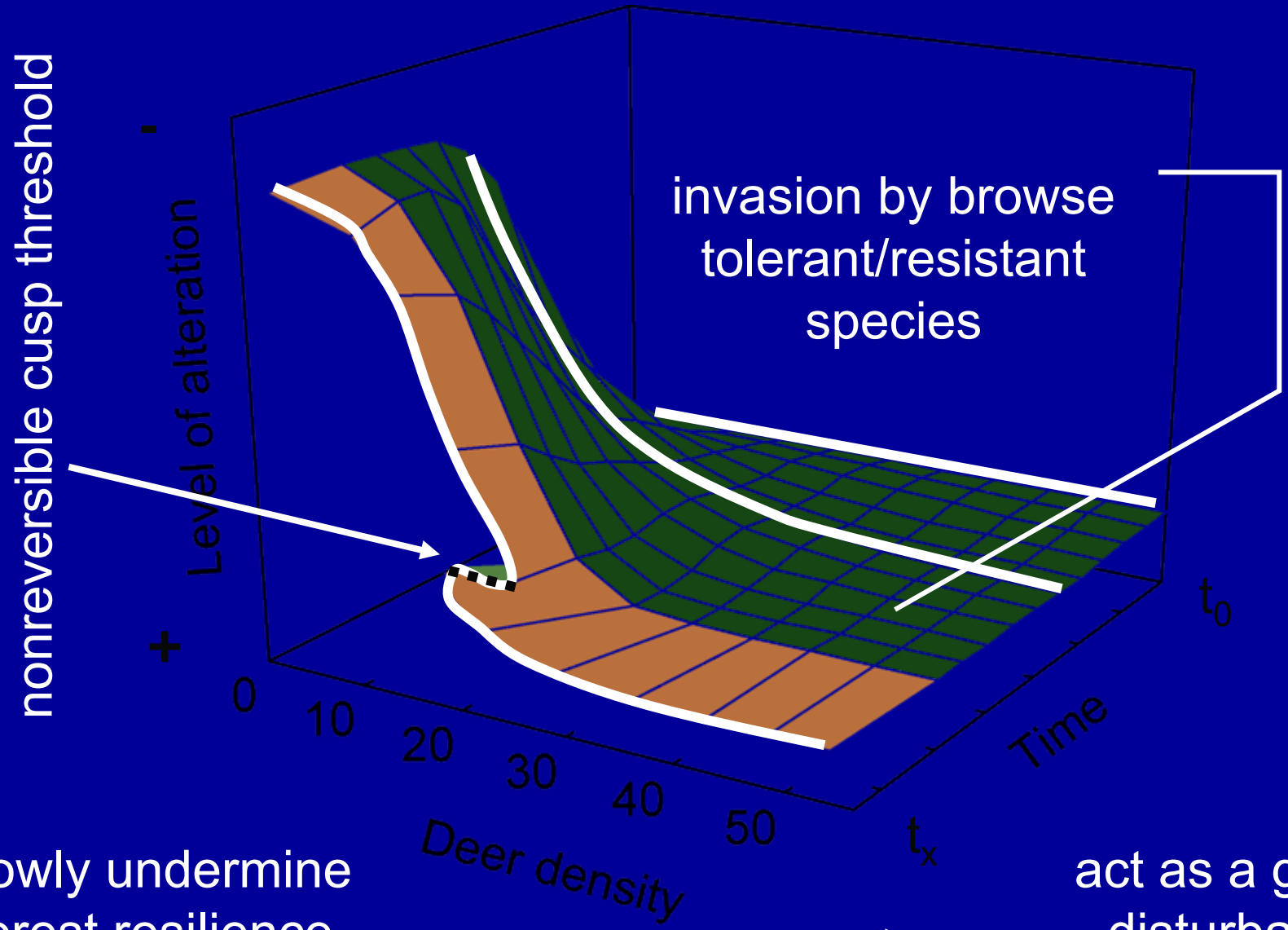
- threshold
- discontinuous
- nonlinear
- 2 equilibriums

Research needs and management issues

- identify thresholds density, recovery paths and time to recovery through control experiments in different forest ecosystems
- continue to improve estimation methods
  - impact-based (early-warnings indices) estimators
- adopt an ecosystem-based manage. perspective
  - call for better links between forest and wildlife manage.
- seek to reduce uncertainty → adaptive manage.
  - call for better link between research and management
- precautionary approach

Acknowledgments

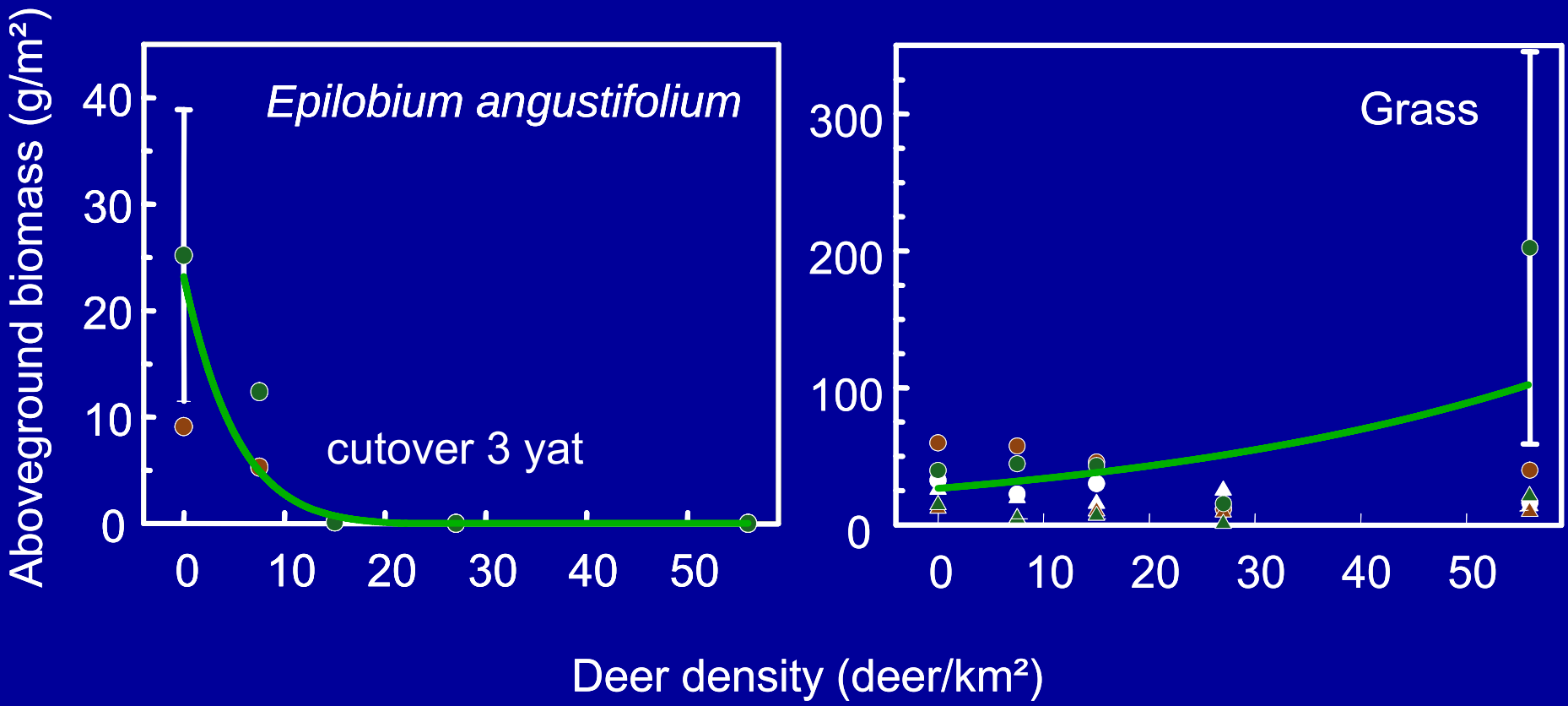
An ecosystem-based restoration framework



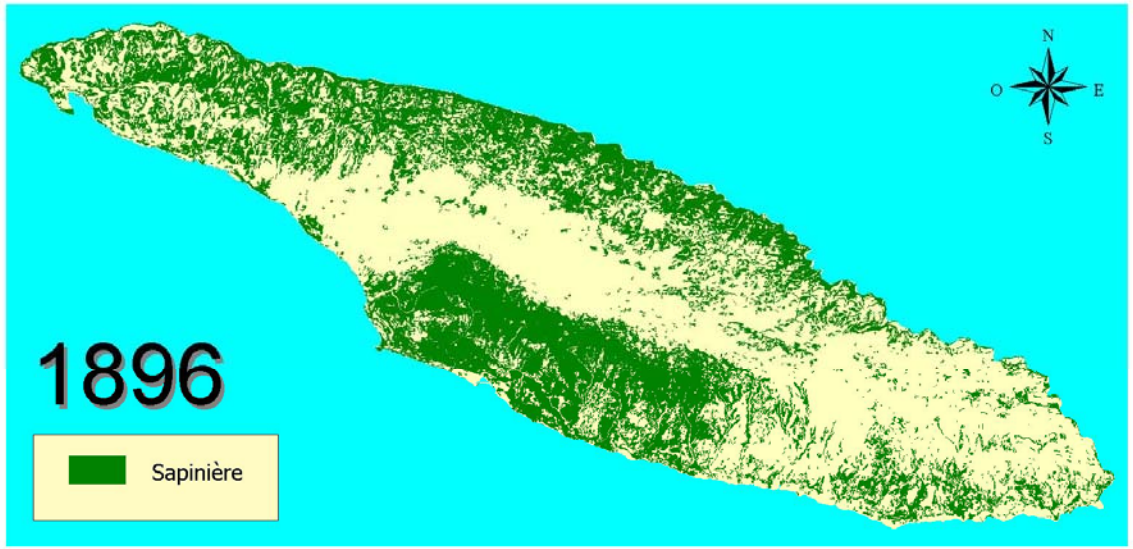
slowly undermine forest resilience

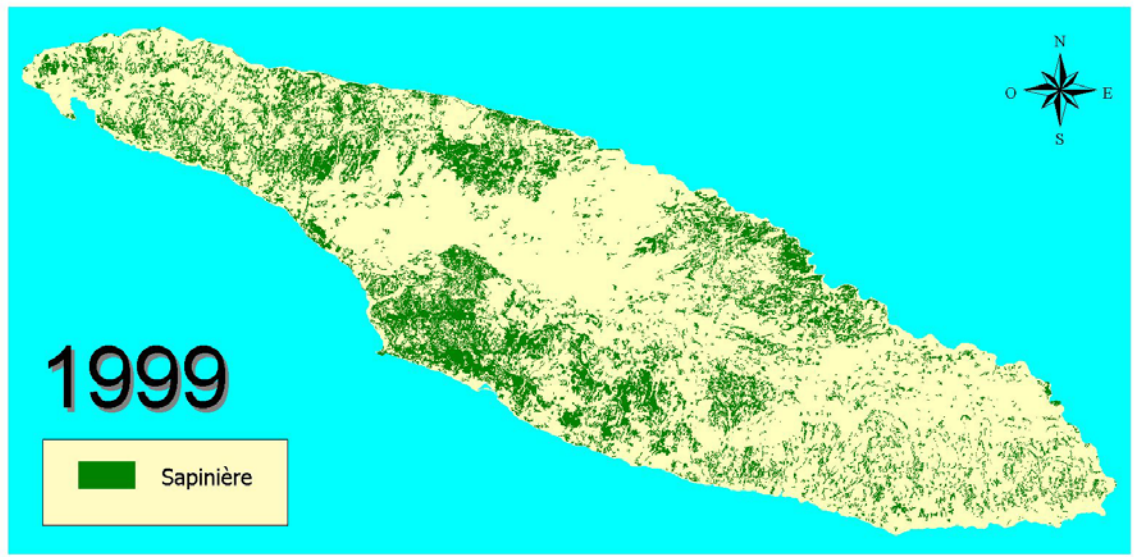
act as a global disturbance

Fireweeds vs. grasses



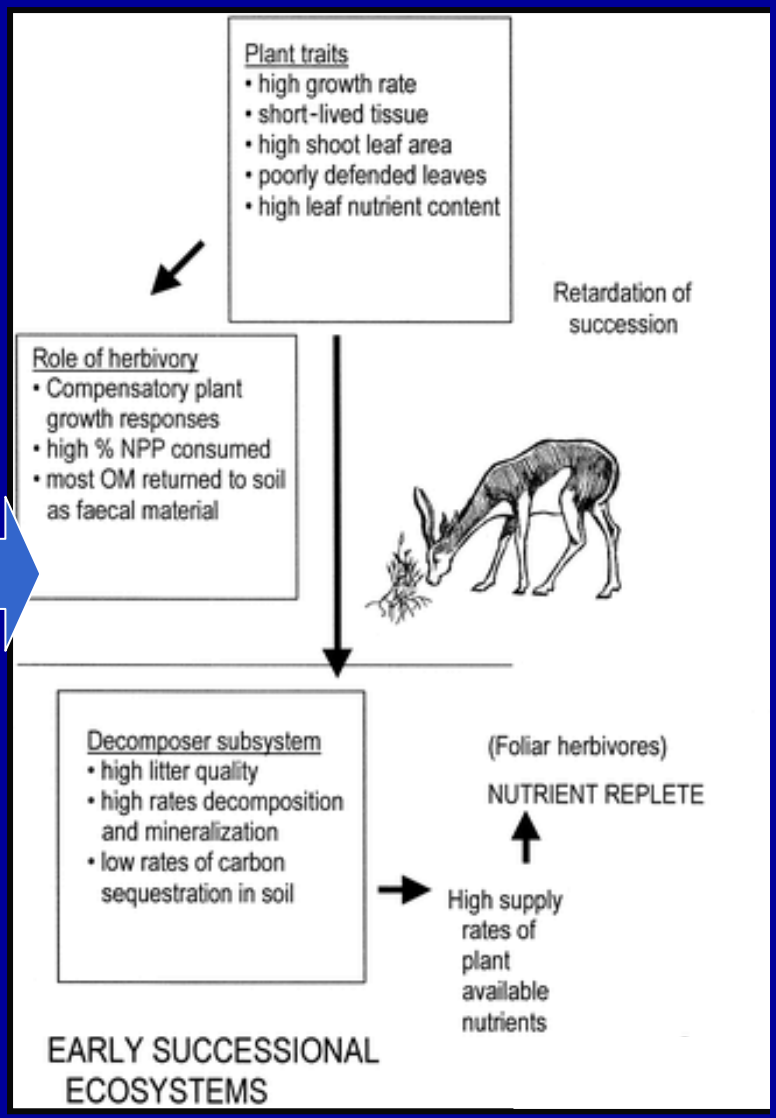
Effects of white-tailed deer on Anticosti forest





Impacts on ecosystem functions: nitrogen cycling

conifers → hardwoods



From Bardgett, R. D., and D. A. Wardle. 2003. Ecology 84: 2258-68

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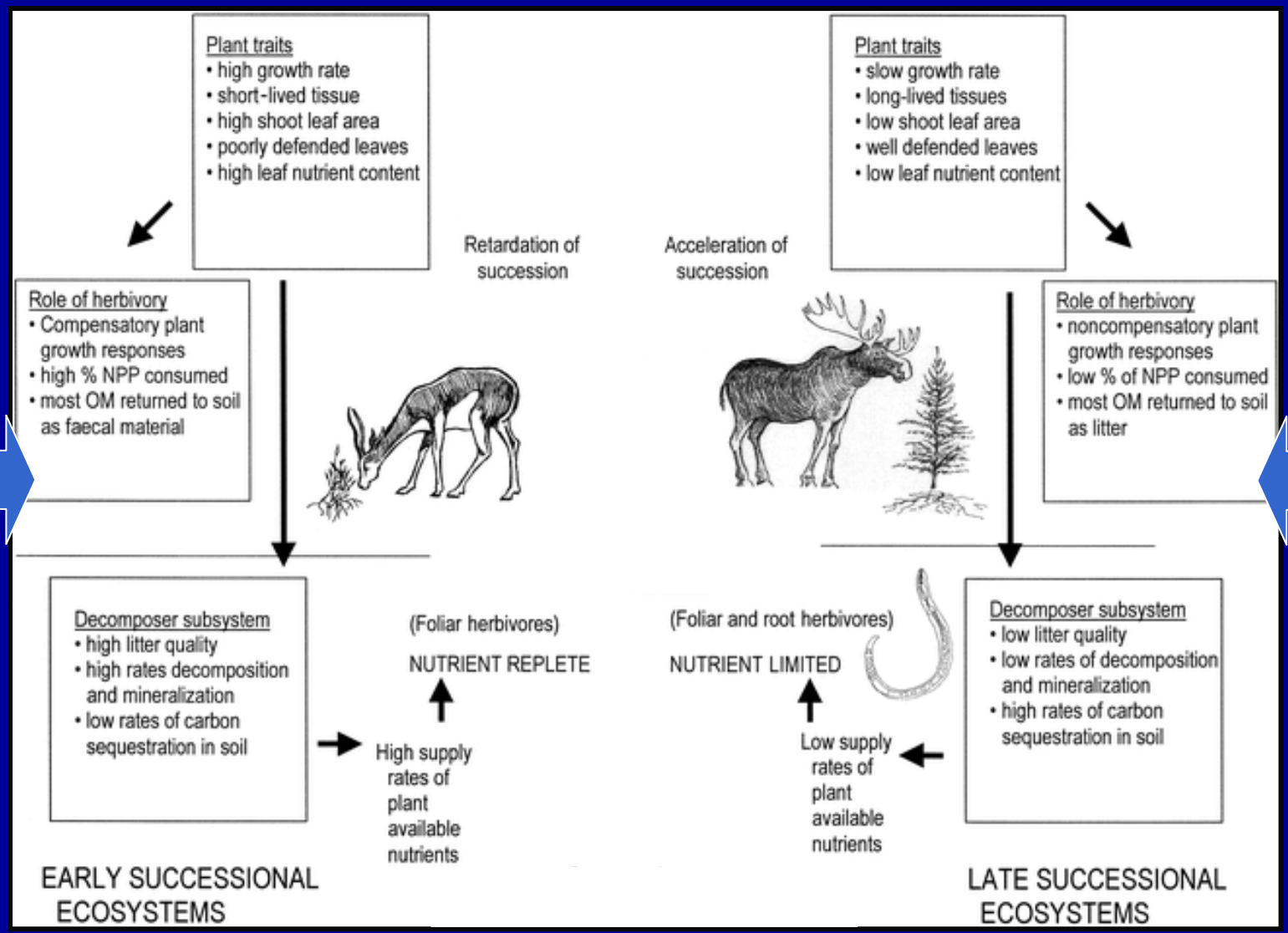
hardwoods → conifers



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