Interactions between invasive plants and deer in the herb layer of metropolitan forests :

Effects on invasive recruitment and native trees

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metropolitan forests

metropolitan forests

" **The semi-natural matrix --** Ecological studies often investigate pristine systems, but many organisms now persist in the fringes of habitat around highly disturbed areas (Brauer and Geber 2002). Although much work has been conducted in some of these areas (eg eastern North American old-fields, much of Europe) and despite a growing interest in urban ecology, the semi-natural matrix is still mainly unexplored, its ubiquity notwithstanding."

BIODIVERSITY IN THE BURBS
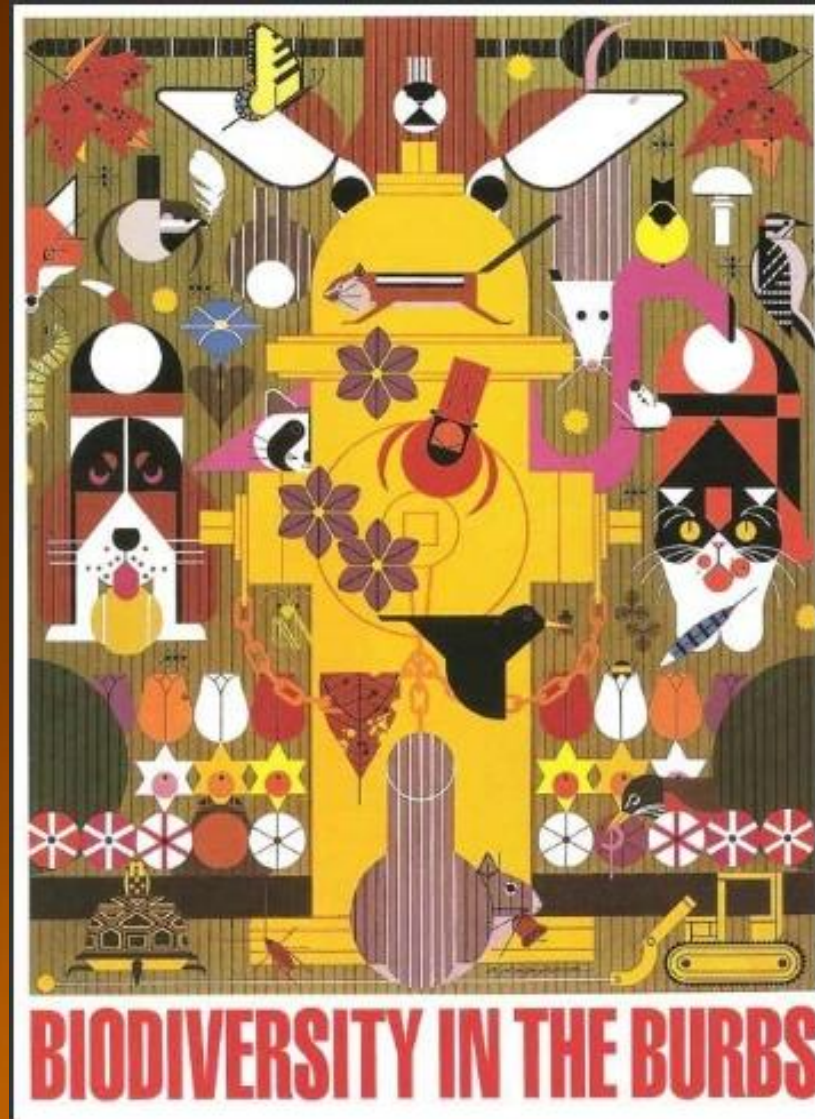
Charley Harper

metropolitan forests

invasive, non-native plants

in metro forests:
- nearby seed sources
- high disturbance rate
- fragmented habitat; increased edge
- multiple, co-occurring species

invasive, non-native plants

. . . and frequent human vectors

invasive, non-native plants

ecological advantage over native plants

- super-competitors
- enemy release
- exploitation of empty niches
- multiple species – 'invasional meltdown'

overabundant deer

Princeton, NJ:
117 deer / square mile

Hopewell, NJ:
54 deer / square mile

overabundant deer

wildnewjersey.tv

Hal Korber/PGC Photo

www.al.com

overabundant deer

www.aces.edu

metropolitan forests

interactions

native plants X invasive plants : competition

native plants X deer : chronic herbivory, trampling

invasive plants X deer :   herbivory? facilitation?

invasive plants X invasive plants :
        competitive hierarchy? facilitation?

multi-way interactions

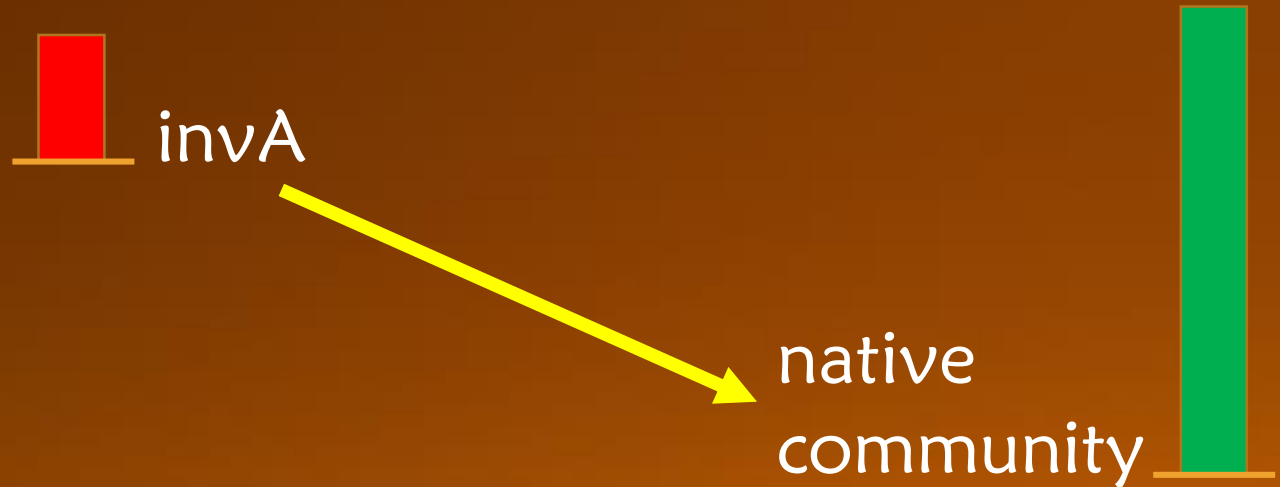deer X invasiveA X invasiveB X natives
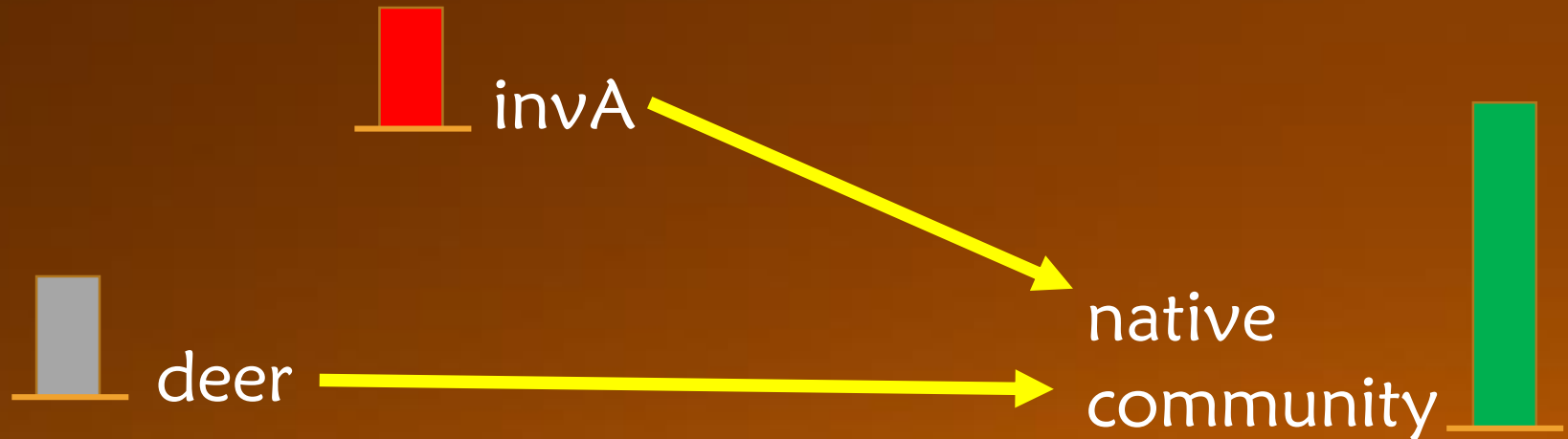
native
community

multi-way interactions
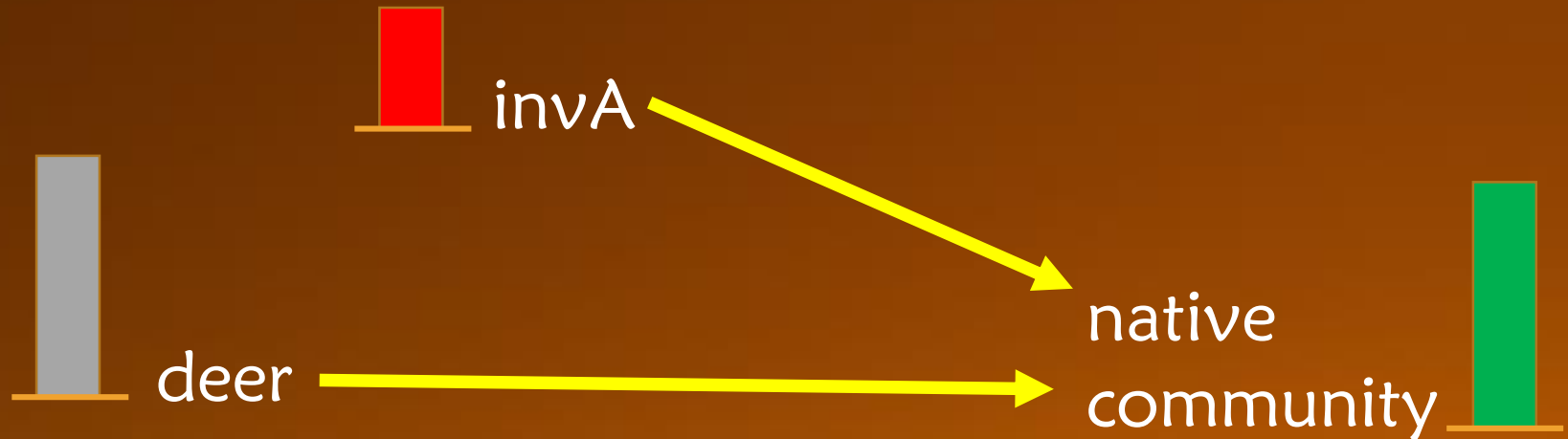
deer X invasiveA X invasiveB X natives

invA

native
community

multi-way interactions

deer X invasiveA X invasiveB X natives

invA

deer

native community

multi-way interactions

deer X invasiveA X invasiveB X natives

invA

deer

native community

multi-way interactions

deer X invasiveA X invasiveB X natives

invA

deer

native
community

more free niche space

multi-way interactions

deer X invasiveA X invasiveB X natives

multi-way interactions

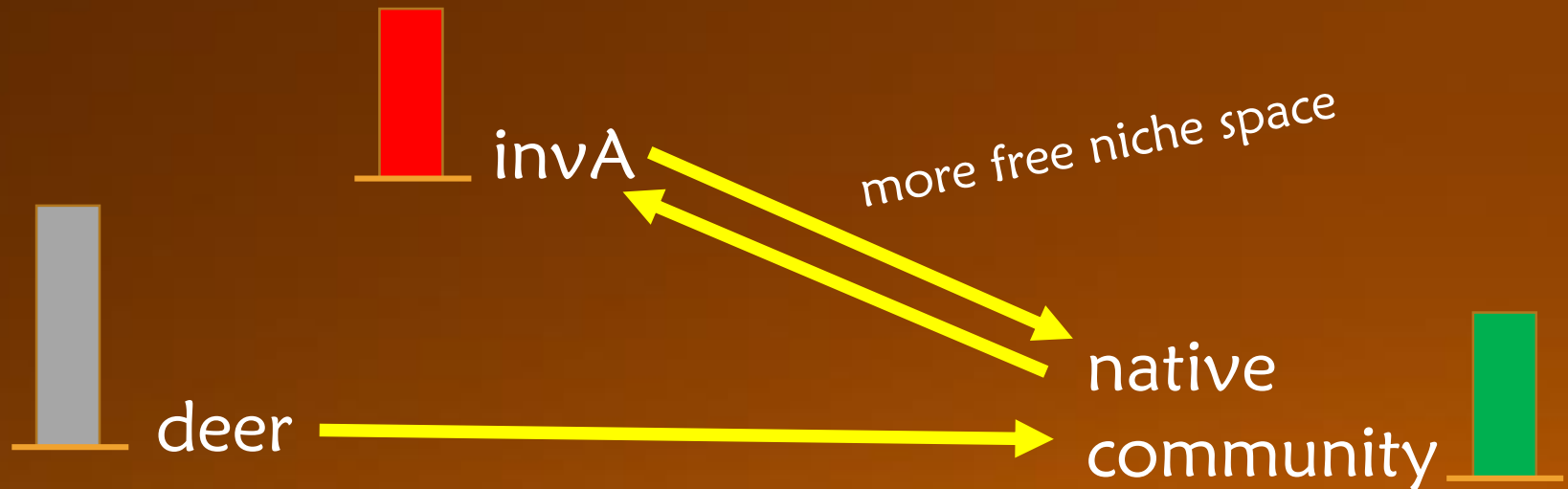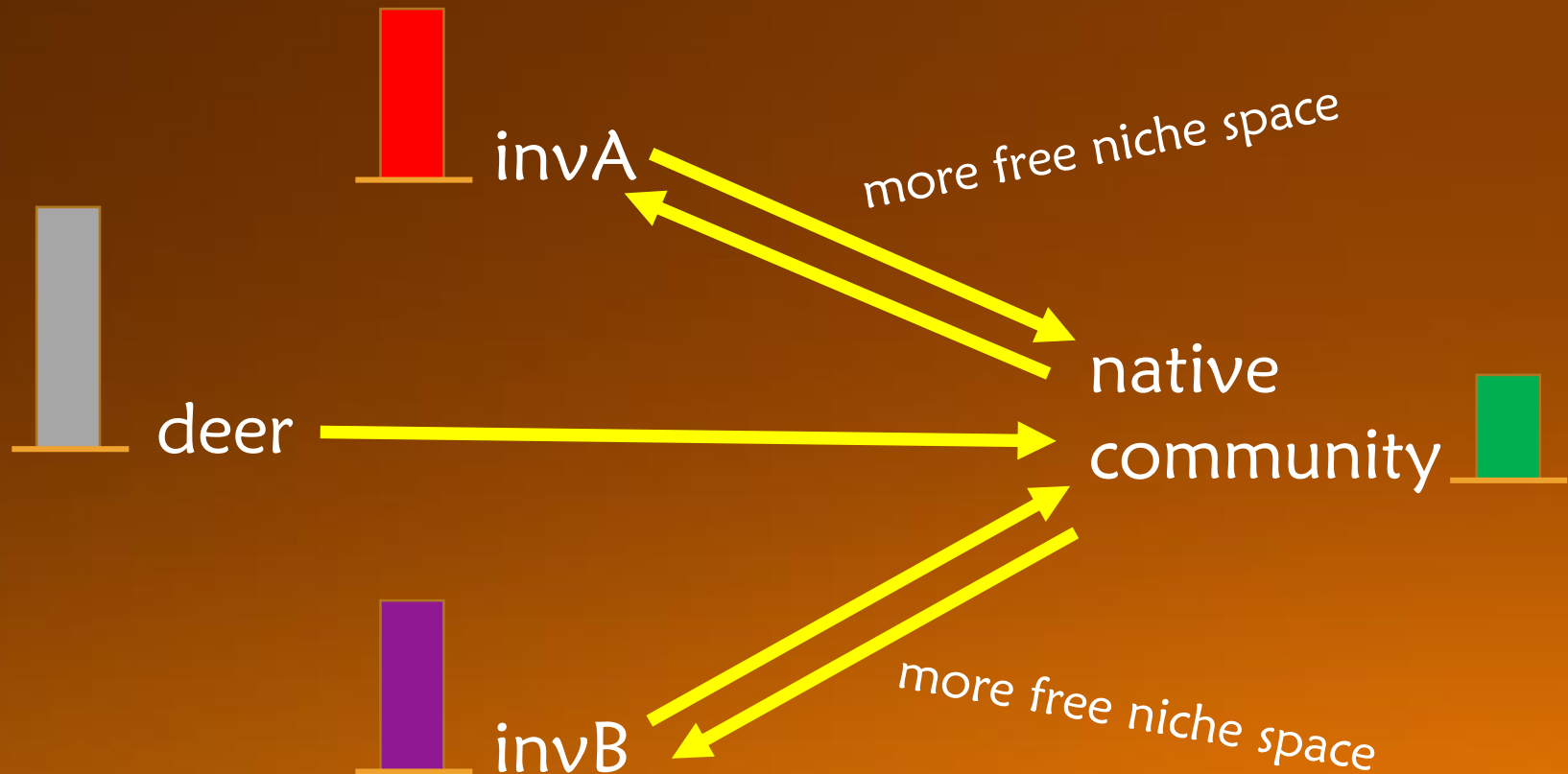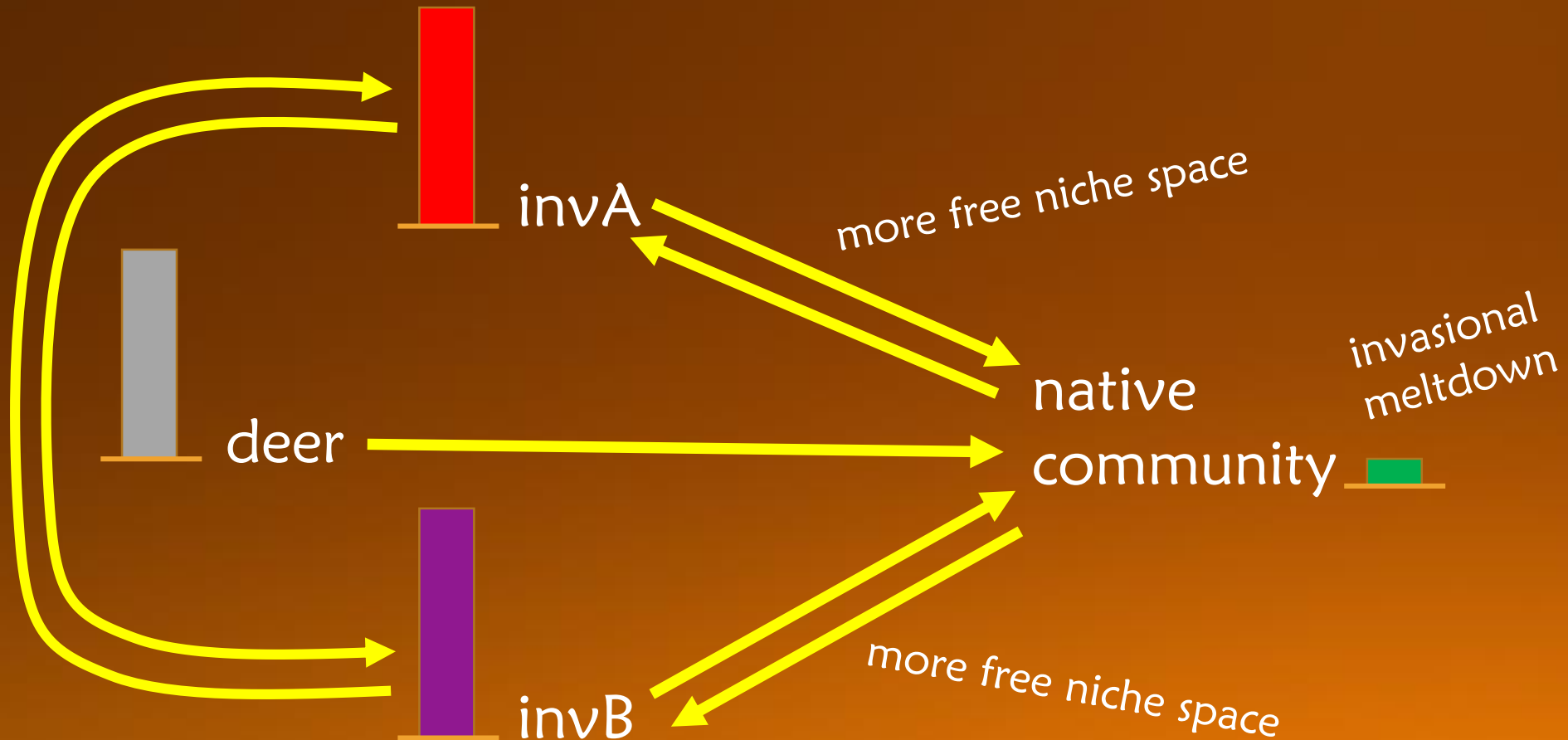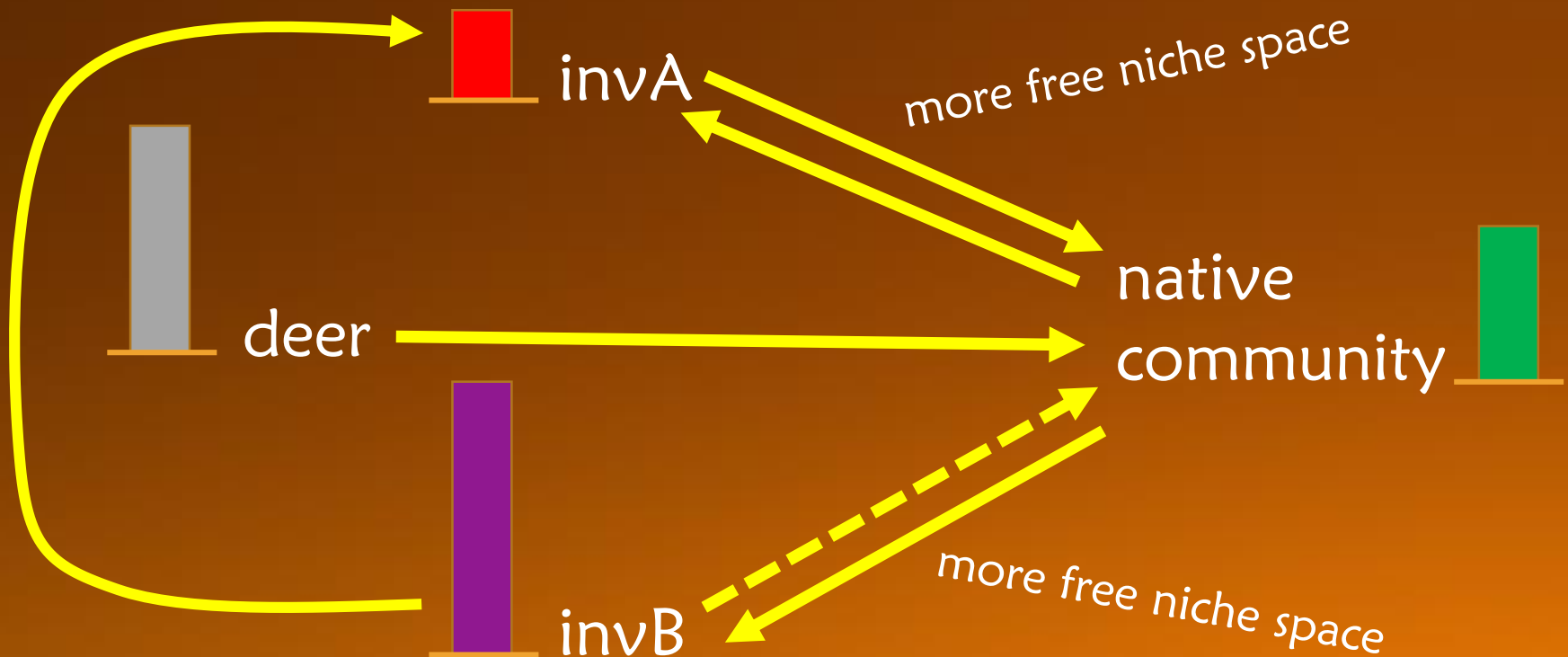deer X invasiveA X invasiveB X natives

invA

deer

invB

native
community

more free niche space

more free niche space

invasional
meltdown

multi-way interactions

deer X invasiveA X invasiveB X natives

approach

herb layer : where the action is

two important co-invaders: Japanese stiltgrass
garlic mustard

manipulative experiment
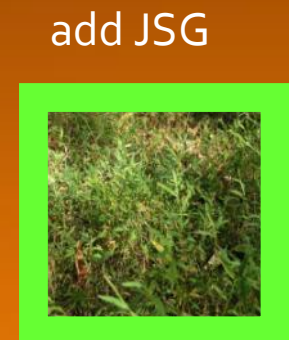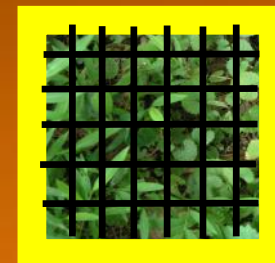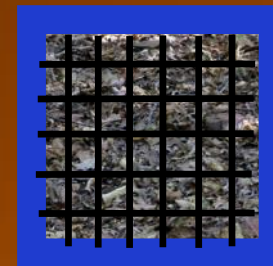staging novel invasions*
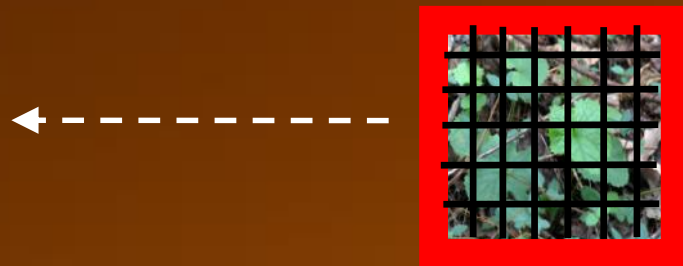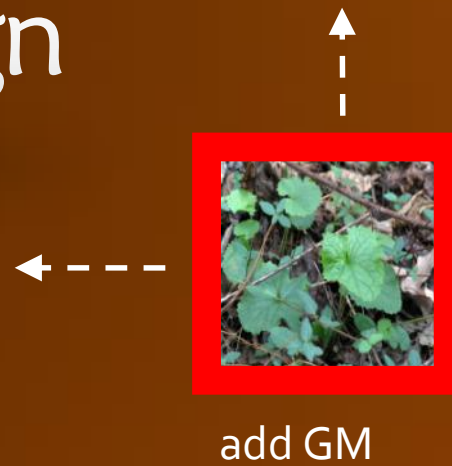deer exclosures
factorial design
highly replicated

* in invaded forests; long-term removal & management plan

experimental design

- 6 forests: 3 lower & 3 higher deer pressure
- 8 treatments
- 5 replicates/treatment/forest
- 16 m² plots
- 40 plots per forest

add GM

add GM + JSG

add JSG

add none

data collection

herb layer community census
pre-treatment spring 2012, fall 2012

stiltgrass and garlic mustard seed added Nov 2012
fences installed March 2013

herb layer community census
spring 2013, fall 2013, spring 2014, fall 2014

other variables measured: shrub cover, browse, woody heights, earthworms, light, leaf litter mass, soil compaction, soil water potential

plots

16 m²

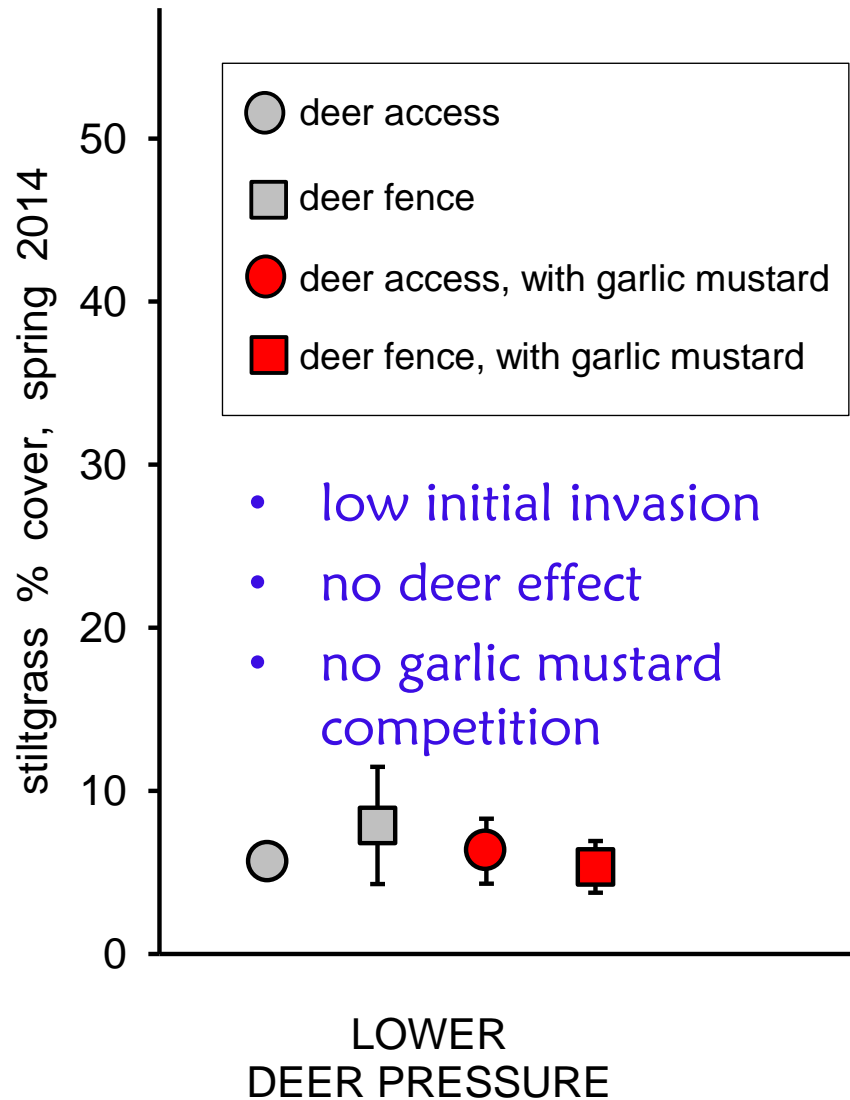# fences

herb layer community census

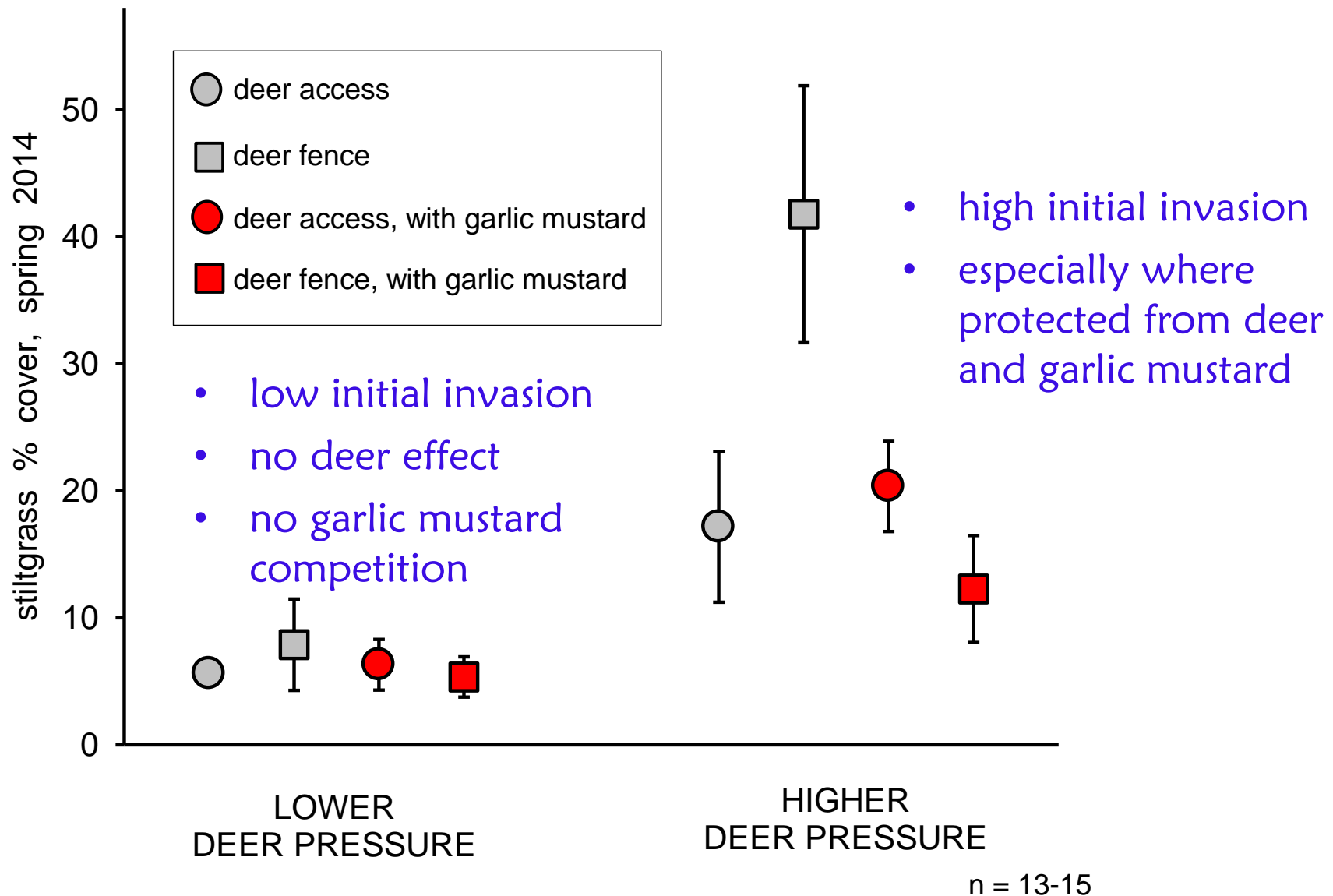16 ¼ m² quadrats / plot

Score cover of each species in 10% intervals

Convert to interval midpoints, average across the 16 quadrats

Initial invasion of Japanese stilt-grass

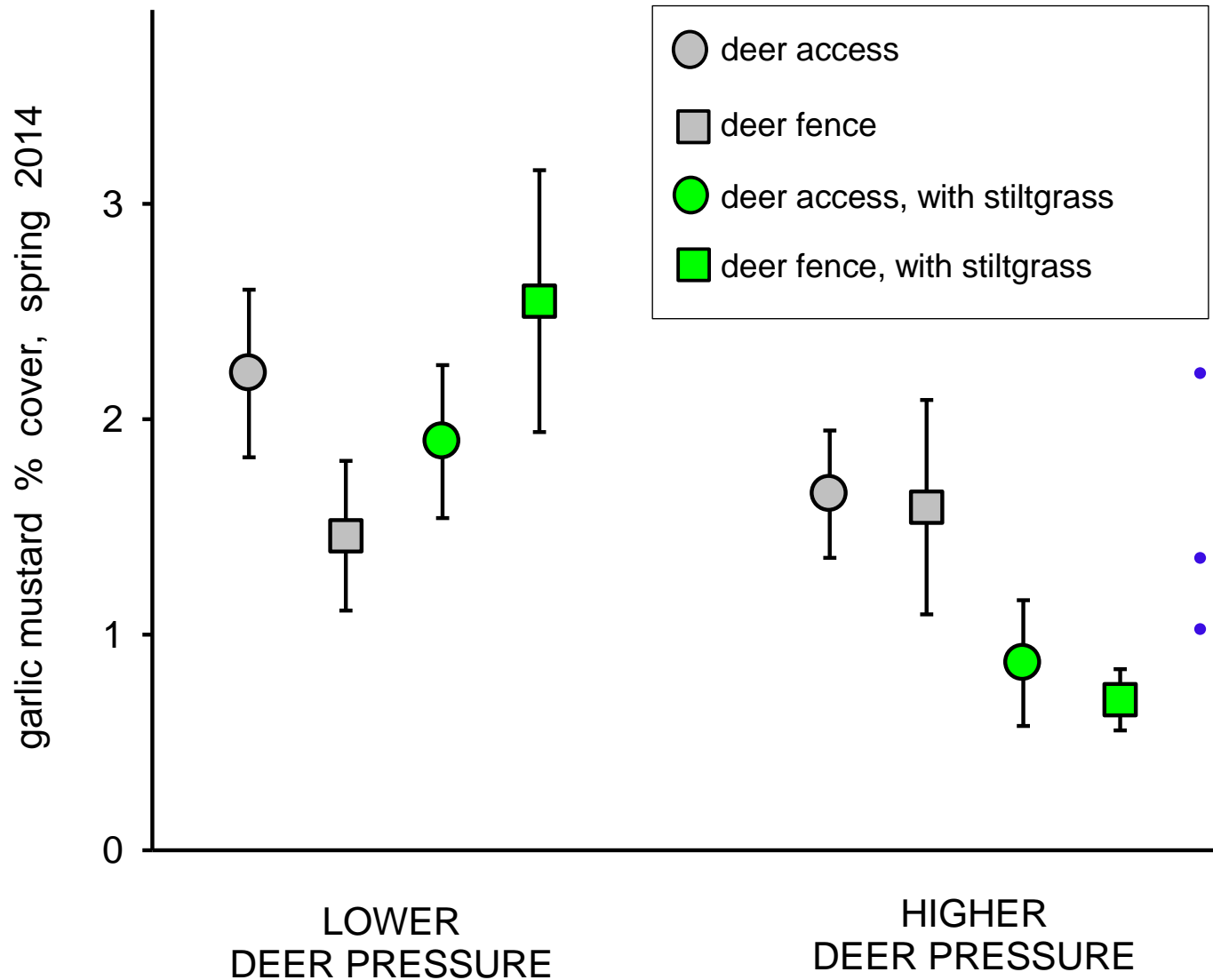Legend:
- ⬤ (gray circle) deer access
- ◼ (gray square) deer fence
- ⬤ (red circle) deer access, with garlic mustard
- ◼ (red square) deer fence, with garlic mustard

y-axis: stiltgrass % cover, spring 2014

- low initial invasion
- no deer effect
- no garlic mustard competition

LOWER
DEER PRESSURE

n = 13-15

Initial invasion of Japanese stilt-grass

- **high initial invasion**
- **especially where protected from deer and garlic mustard**

- **low initial invasion**
- **no deer effect**
- **no garlic mustard competition**

Legend:
- deer access
- deer fence
- deer access, with garlic mustard
- deer fence, with garlic mustard

y-axis: stiltgrass % cover, spring 2014

x-axis: LOWER DEER PRESSURE, HIGHER DEER PRESSURE

n = 13-15

stiltgrass invasion
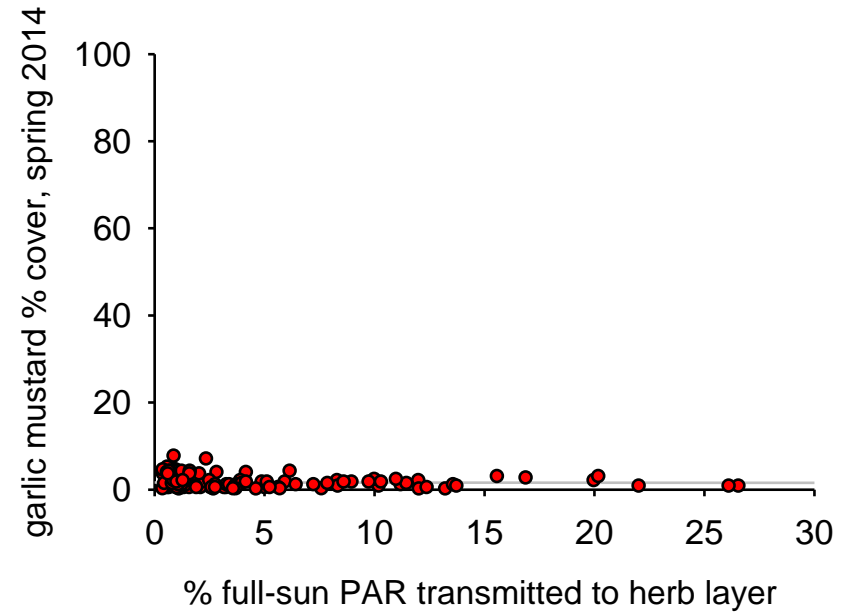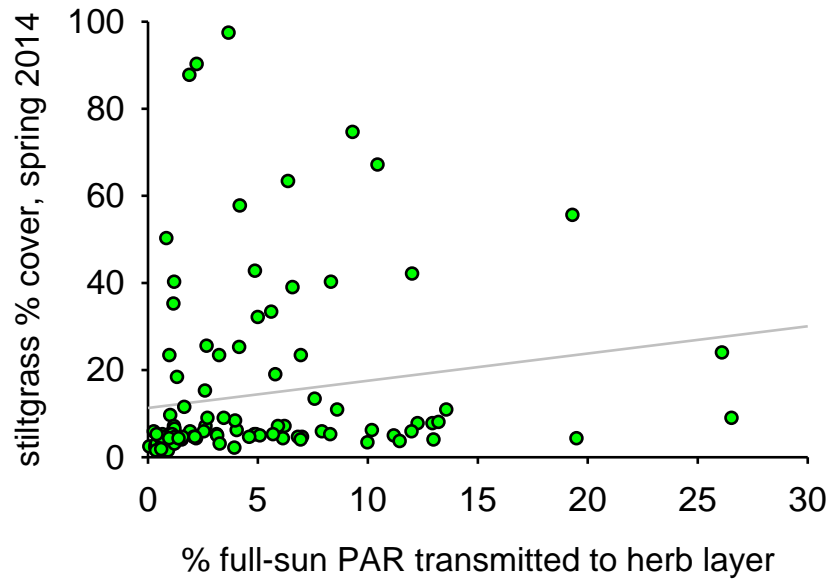
Initial invasion of garlic mustard

- much lower invasion than stiltgrass
- no deer effect
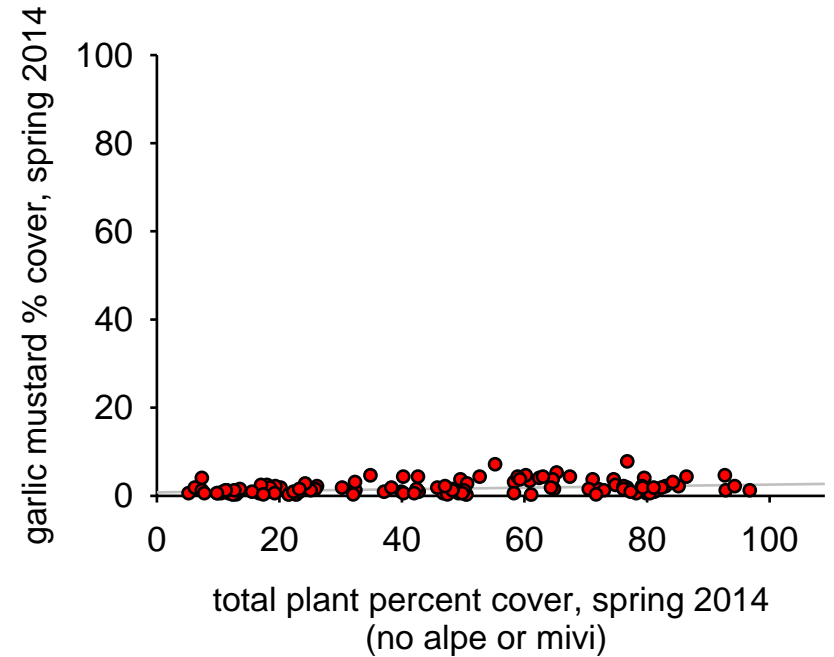- competition from stiltgrass only under high deer pressure
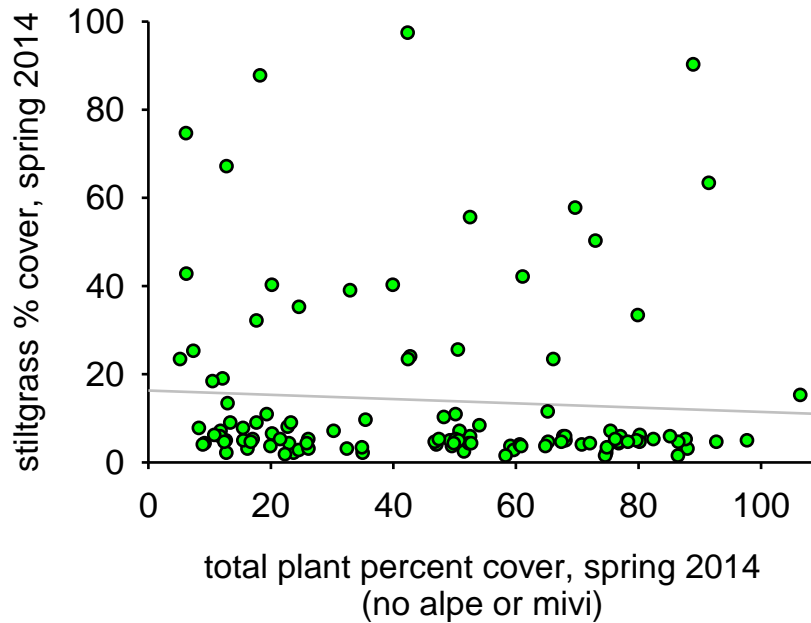
n = 13-15

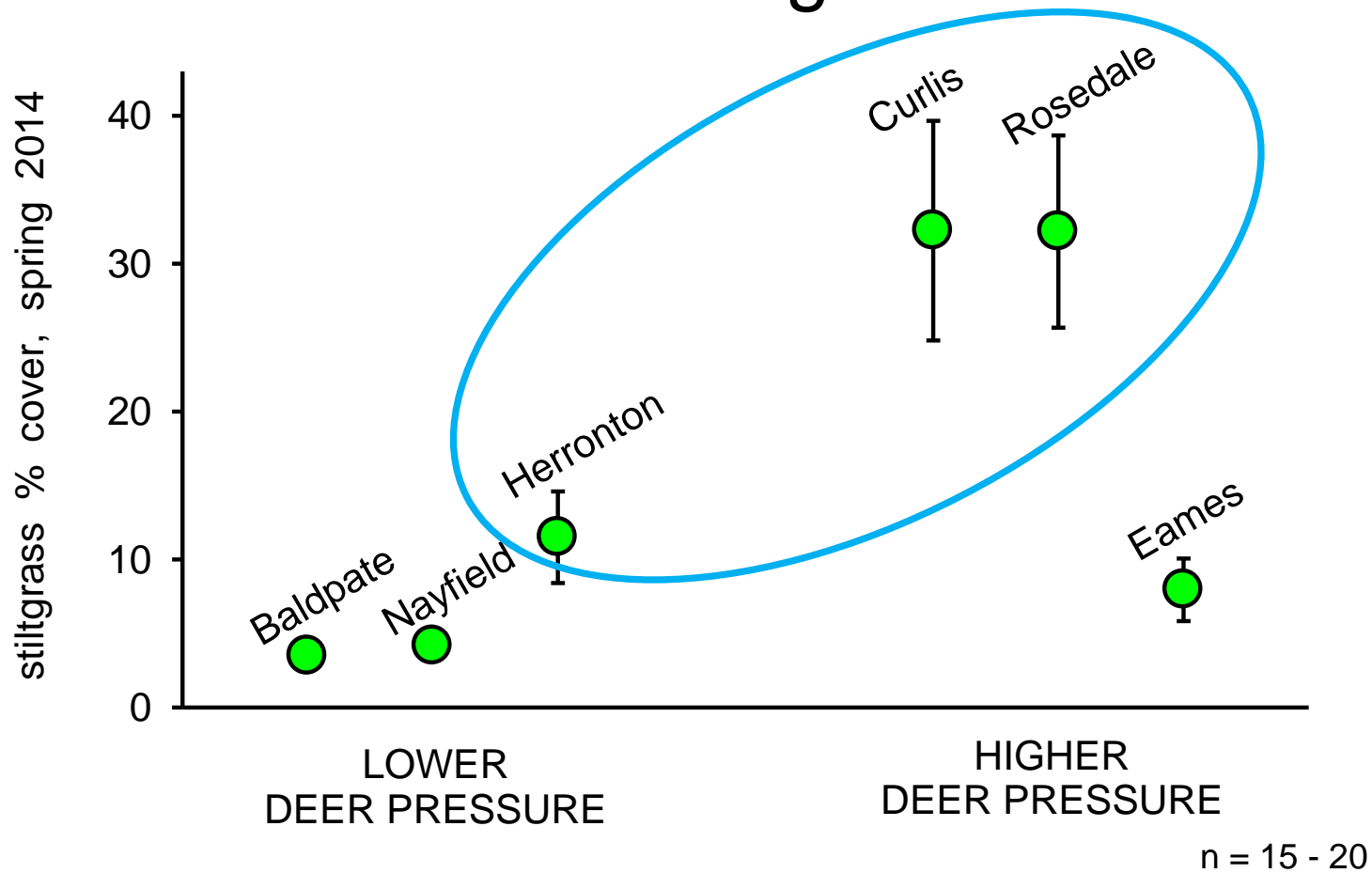# Effect of leaf litter mass on initial invasions of stiltgrass and garlic mustard
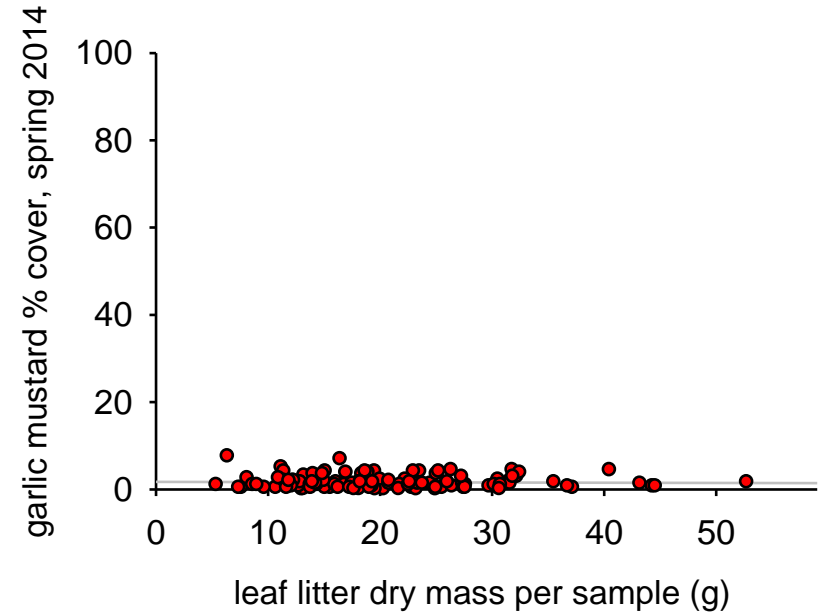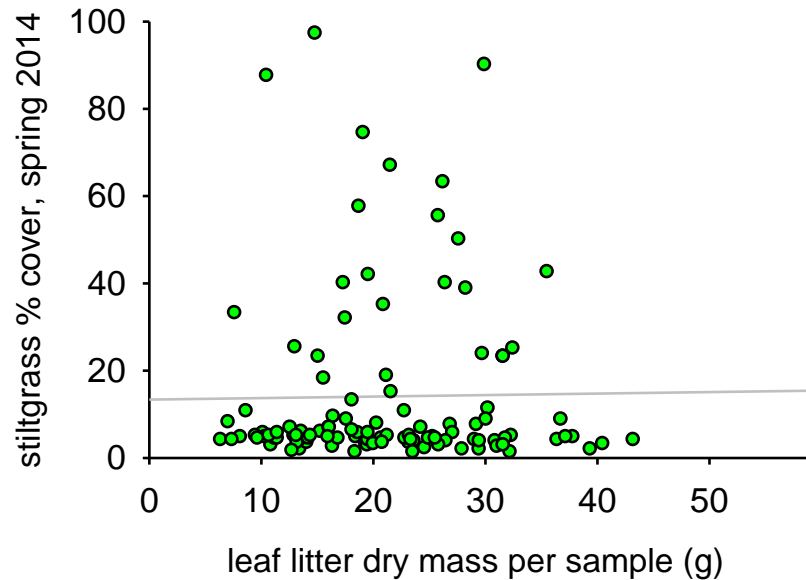
Effect of light level on initial invasions of stiltgrass and garlic mustard

Effect of total plant community percent cover on initial invasions of stiltgrass and garlic mustard
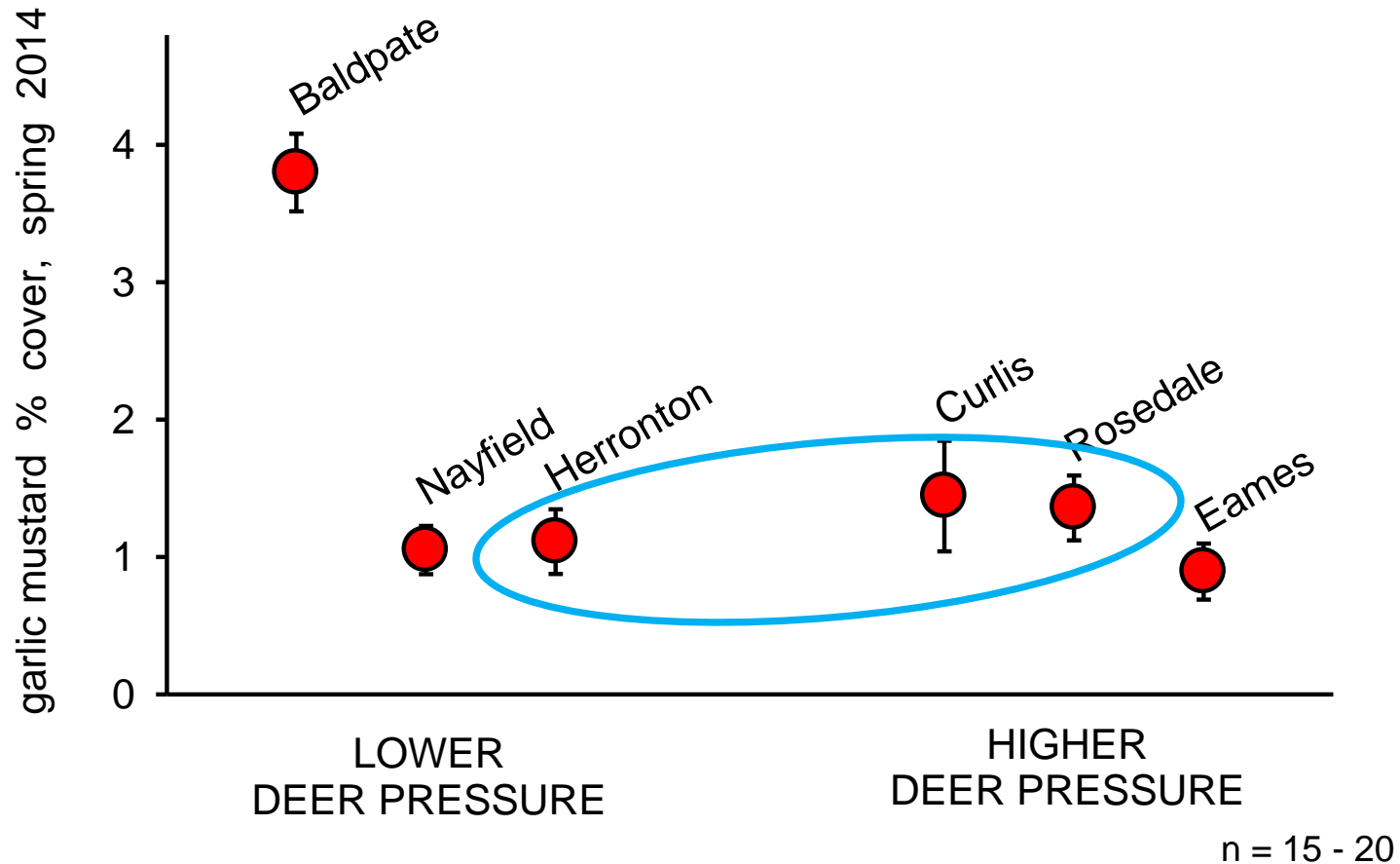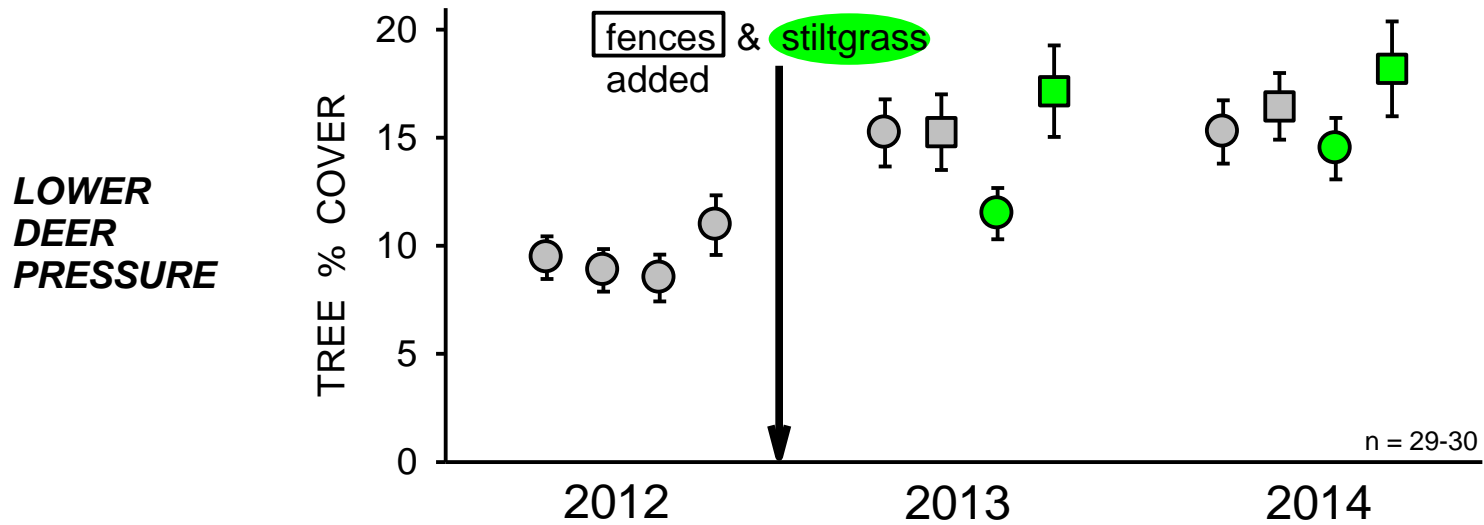
Initial invasion of stiltgrass

n = 15 - 20

hurricane Sandy

Initial invasion of garlic mustard

garlic mustard % cover, spring 2014

Baldpate

Nayfield   Herronton   Curlis   Rosedale   Eames

4

3

2

1

0

LOWER
DEER PRESSURE

HIGHER
DEER PRESSURE

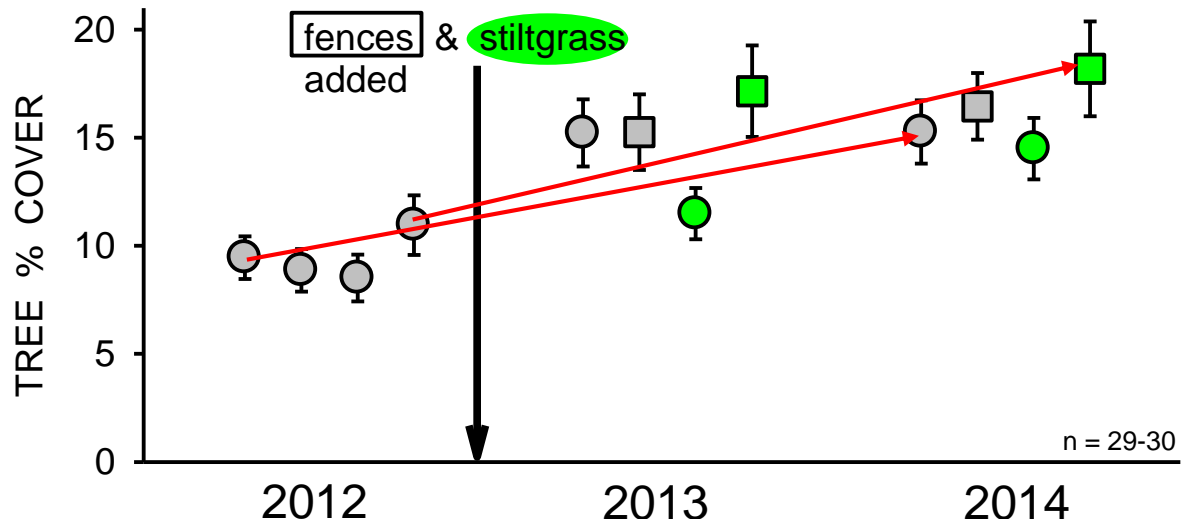n = 15 - 20

native trees in the herb layer

Percent cover of native trees in the herb layer 2012 - 2013 - 2014 (spring census)

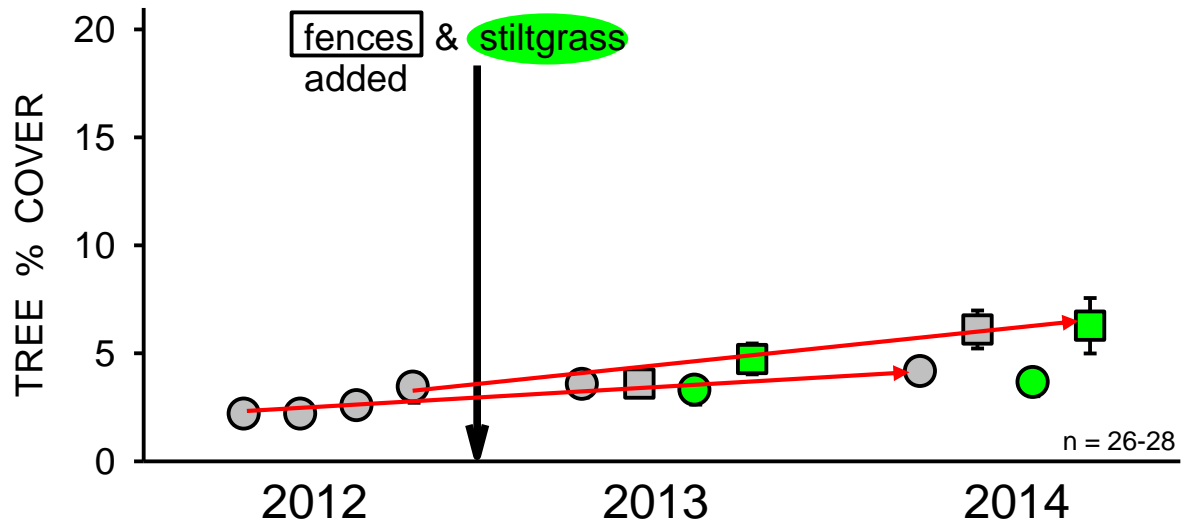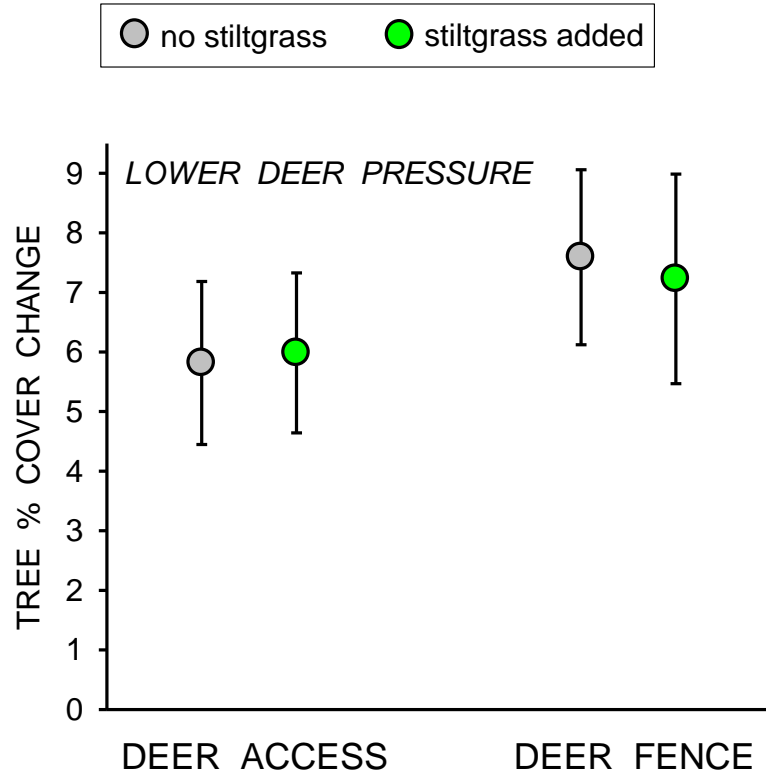# Percent cover of native trees in the herb layer 2012 - 2013 - 2014 (spring census)

2012 to 2014 change in percent cover of native trees in the herb layer (spring census)

Legend: ○ no stiltgrass   ● stiltgrass added

LOWER DEER PRESSURE

Y-axis: TREE % COVER CHANGE (0 to 9)

X-axis categories: DEER ACCESS, DEER FENCE

- No significant increase when protected from deer
- no competition from stiltgrass

2012 to 2014 change in percent cover of native trees in the herb layer (spring census)

Legend: ● no stiltgrass ● stiltgrass added

LOWER DEER PRESSURE

TREE % COVER CHANGE vs. DEER ACCESS / DEER FENCE

HIGHER DEER PRESSURE

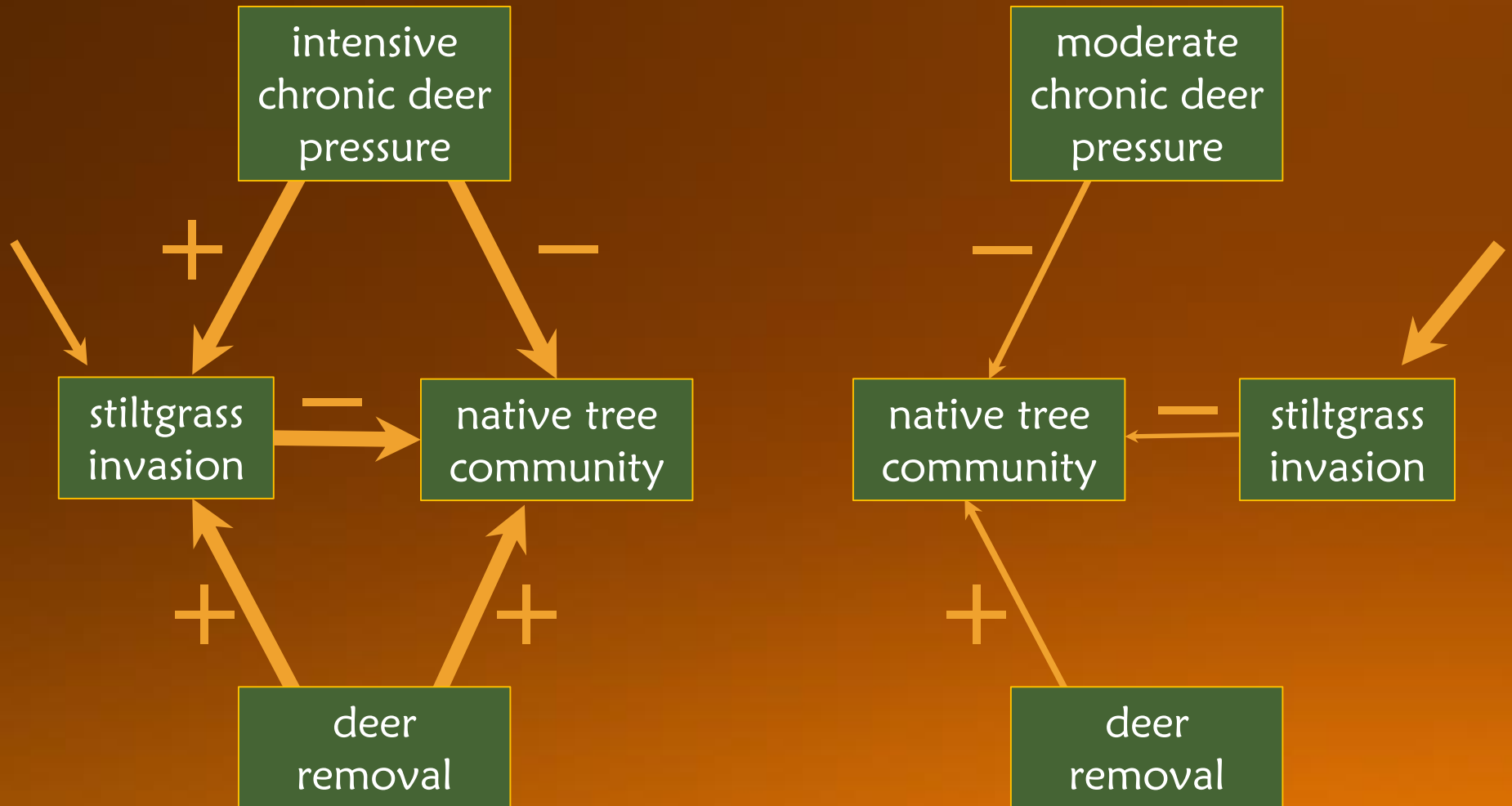TREE % COVER CHANGE vs. DEER ACCESS / DEER FENCE

- no significant increase when protected from deer

- no competition from stiltgrass
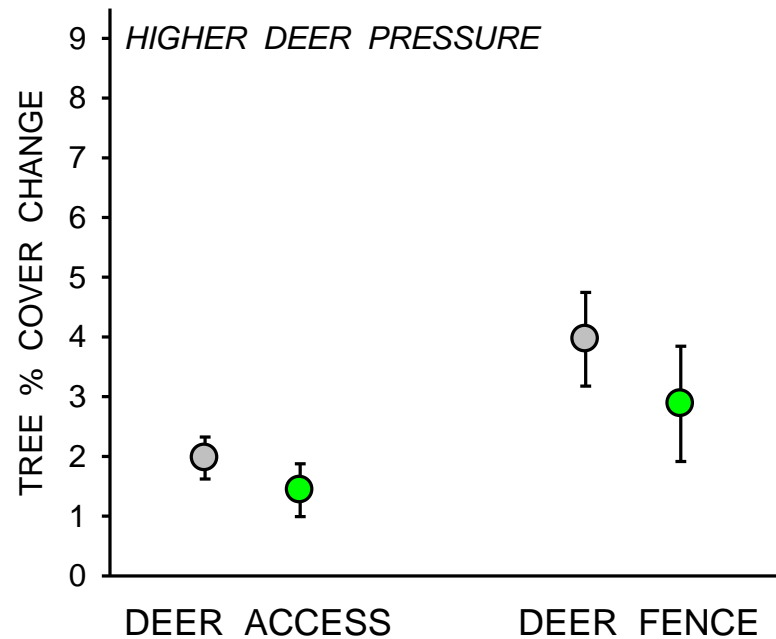
- significant increase when protected from deer

- competition from stiltgrass

conceptual models

intensive chronic deer pressure

+

−

stiltgrass invasion

−

native tree community

+

+

deer removal

moderate chronic deer pressure

−

native tree community

−

stiltgrass invasion

+

deer removal

Acknowledgements

Effect of initial stiltgrass invasion on 2012 to 2014 change in percent cover of native trees in the herb layer

Effect of initial stiltgrass invasion on 2012 to 2014 change in percent cover of native trees in the herb layer