Management of Invasive Species in Novel Ecosystems

T.R. Seastedt, Oct. 26, 2009

Talk goals:

1. Understand the rationale for why invasive species management is part of ecosystem management activities.

2. Understand why ‘natural ecosystems’ are rapidly becoming ‘*novel ecosystems*’ and understand the implications to management

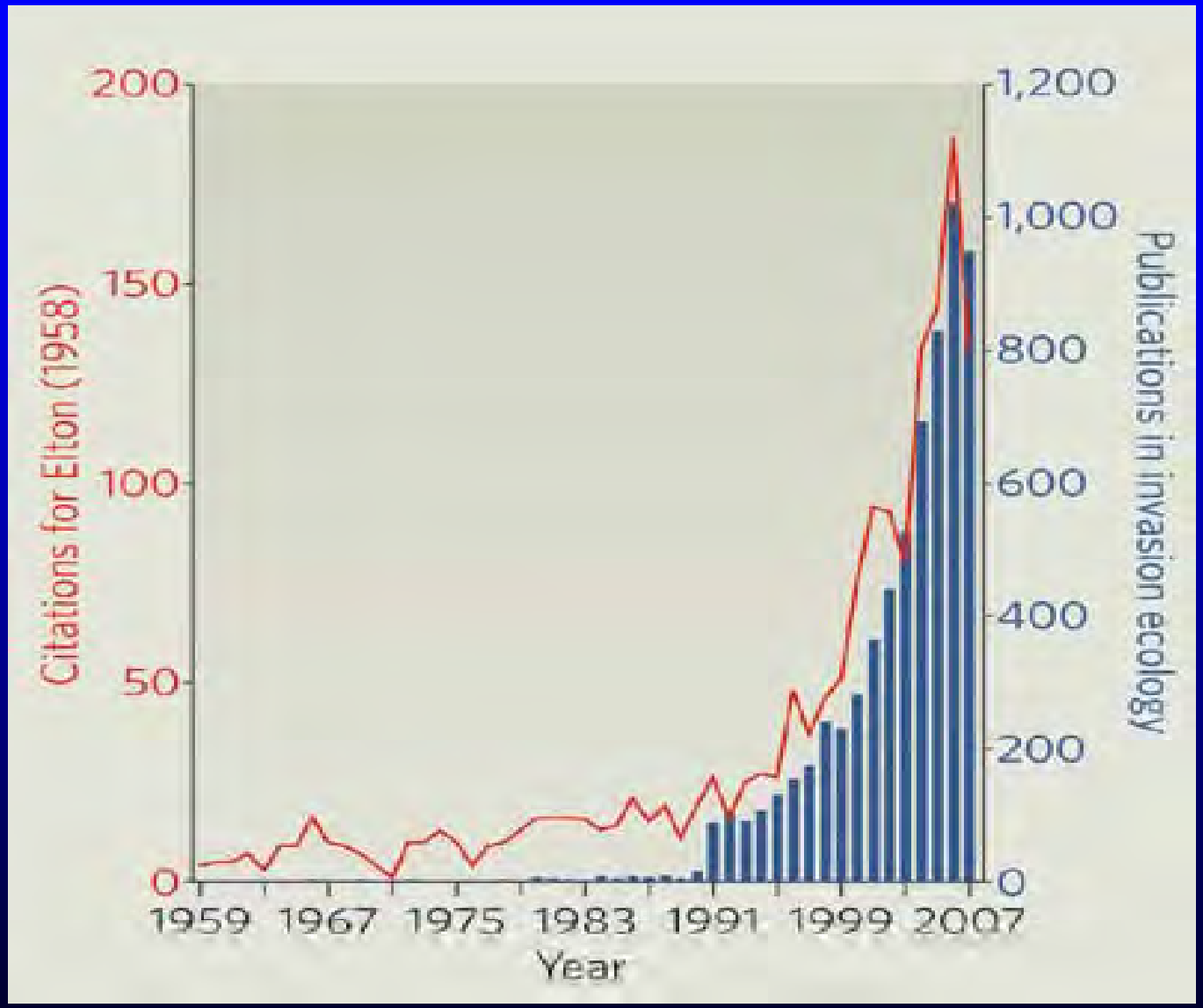
3. Re-assess ‘restoration’ as a forward-looking, goal driven activity.

"…ecologists must now begin the essential task of transforming the study of invasions from a diffuse anecdotal subject to a predictive science."

Mark Davis et al., 2000

And the amount of research suggests that ecologists tried to do just that…

Publications in invasion biology since 1958, the year Elton published “the ecology of invasions by animals and plants.



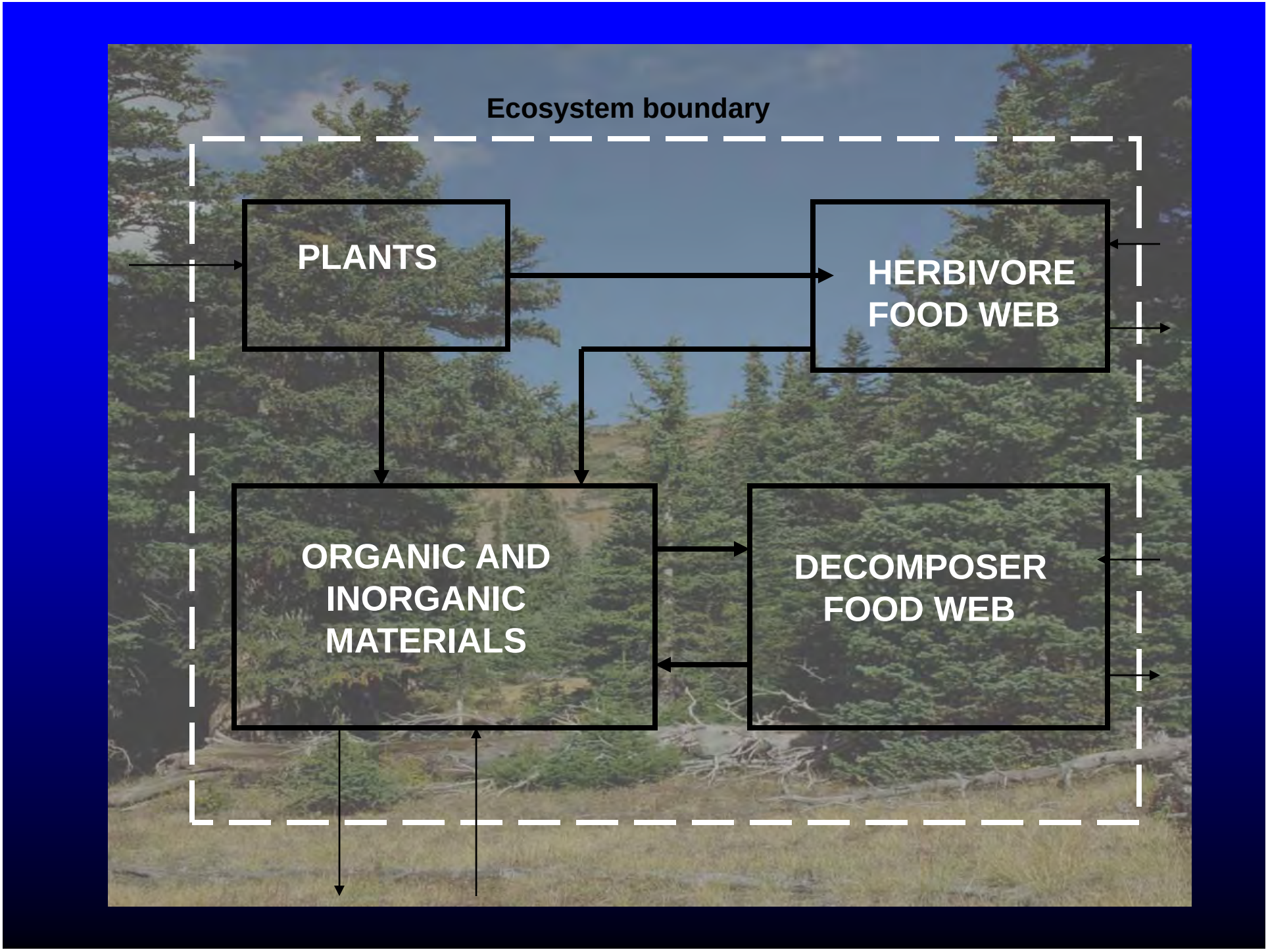
Source:
Ricciardi and MacIssac, Nature 2008

A common lament:

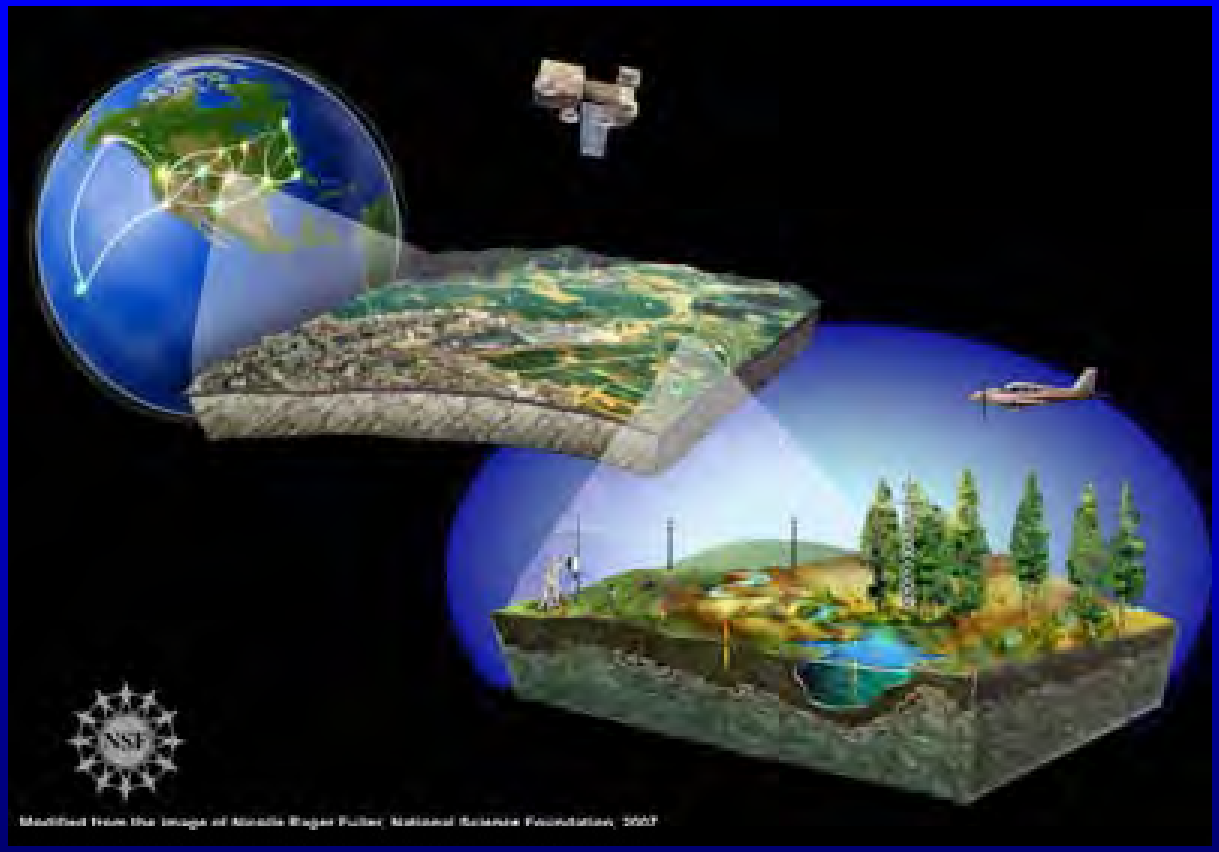
Why ecosystem management?
What's wrong with IPM?

The ecosystem concept may be useful for researchers, but it is too ambiguous to serve as an organizing principle for managers…

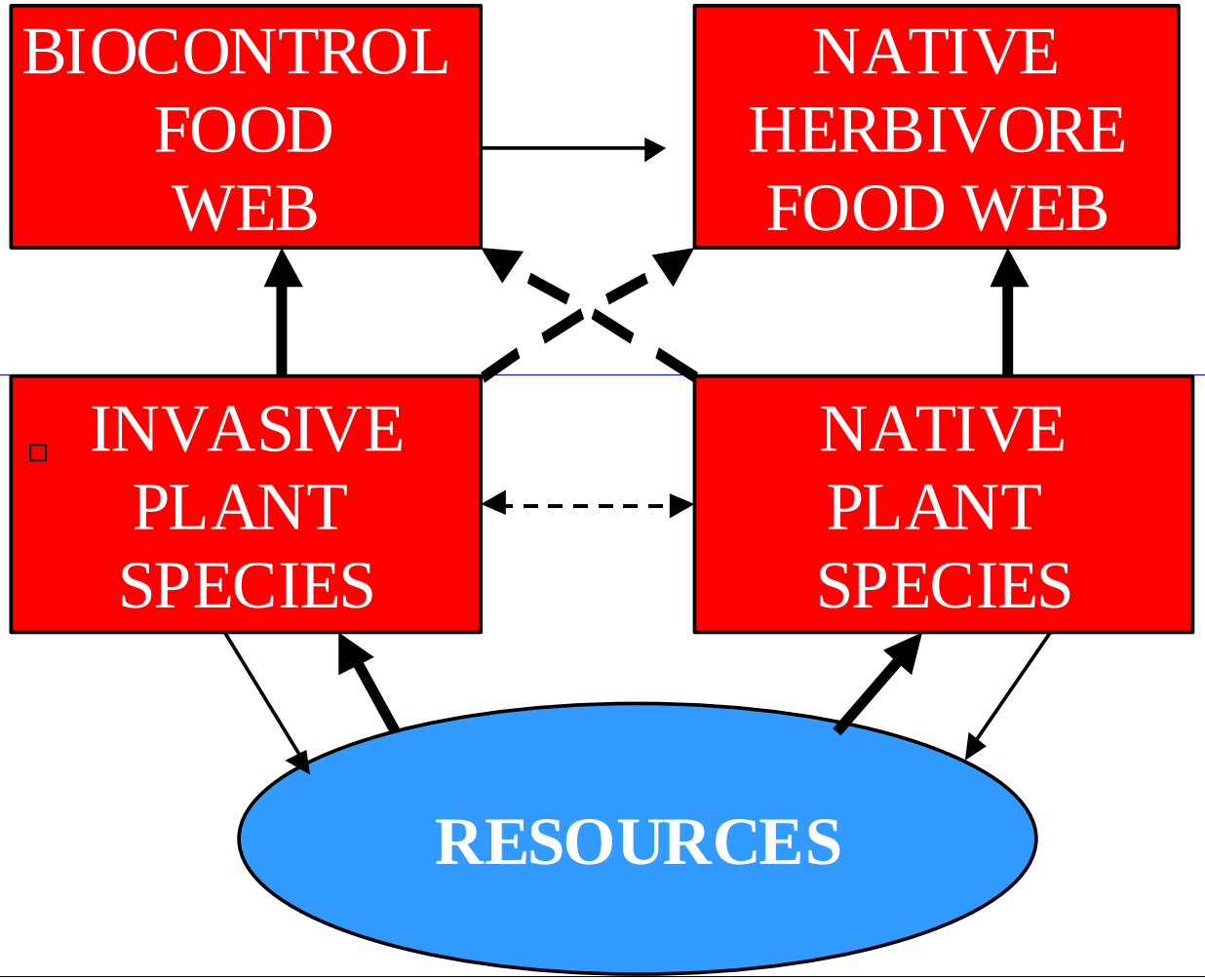

Find the ecosystem in
this picture….

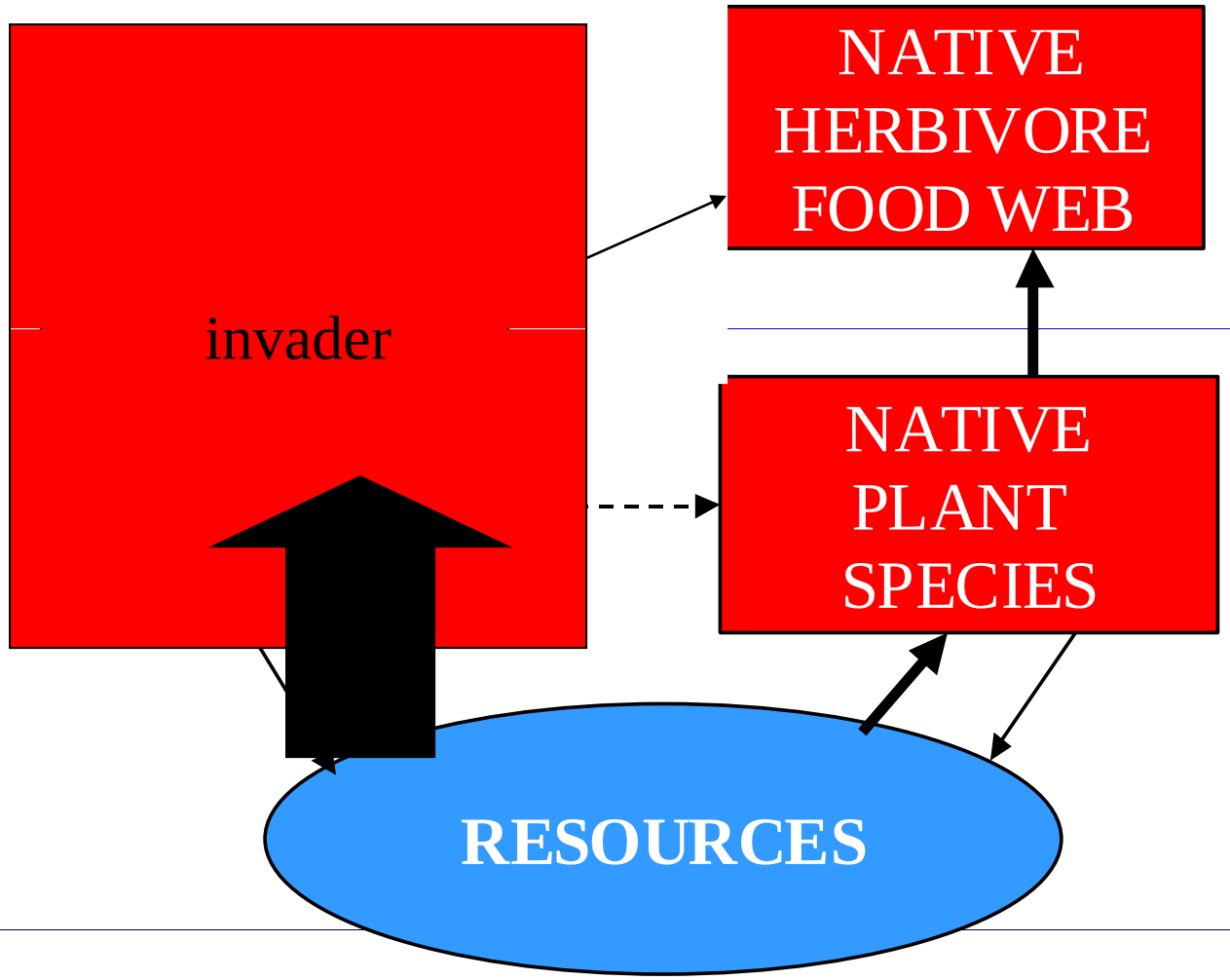

Ecosystem boundary
PLANTS
HERBIVORE FOOD WEB
ORGANIC AND INORGANIC MATERIALS
DECOMPOSER FOOD WEB

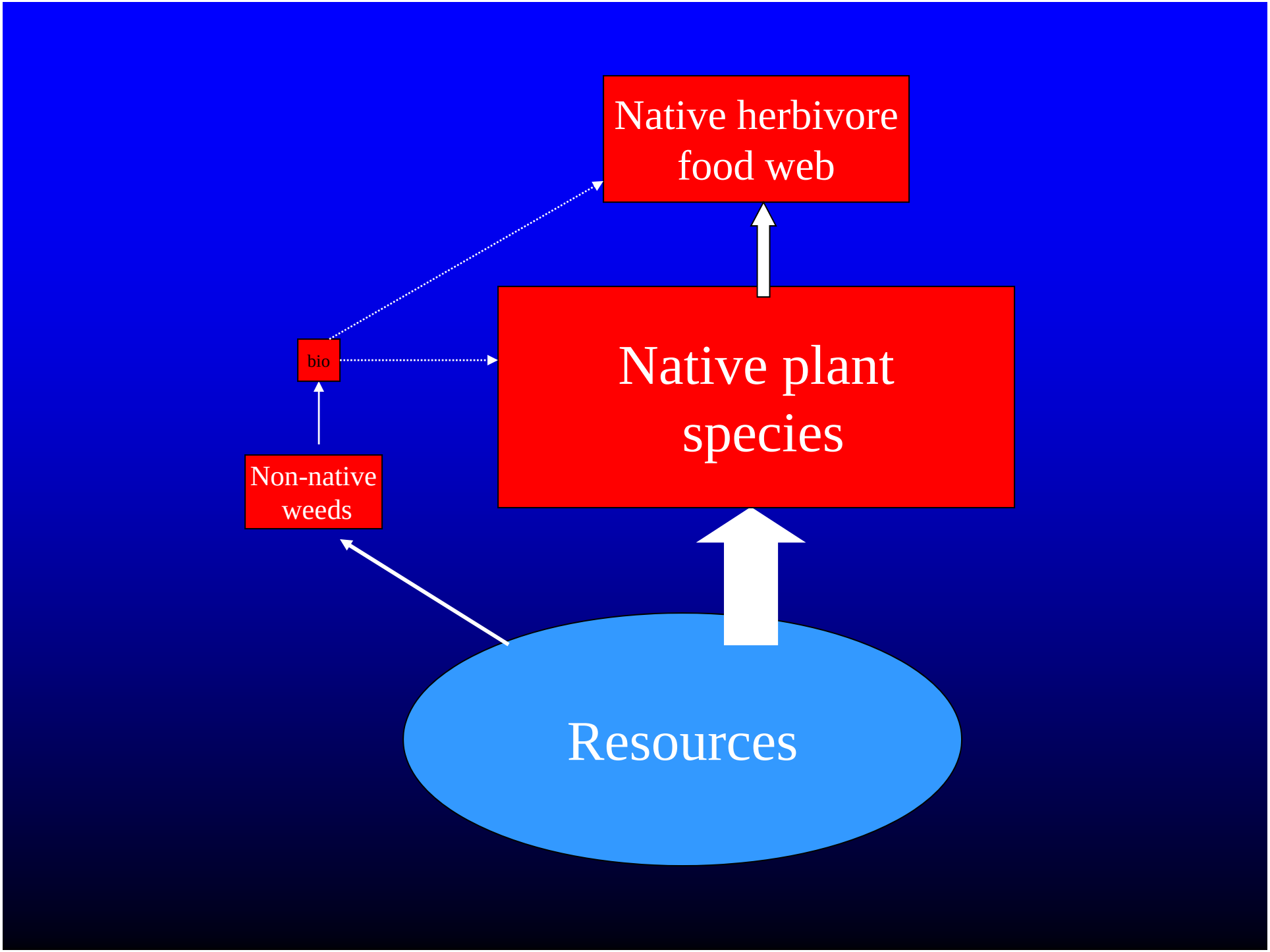
National Ecological Observatory Network (NEON)



The national ecological observatory network will provide information to further our understanding of how land use change, climate change AND INVASIVE SPECIES affect present and future biodiversity and ecosystem services.


BIOCONTROL FOOD WEB
NATIVE HERBIVORE FOOD WEB
INVASIVE PLANT SPECIES
NATIVE PLANT SPECIES
RESOURCES

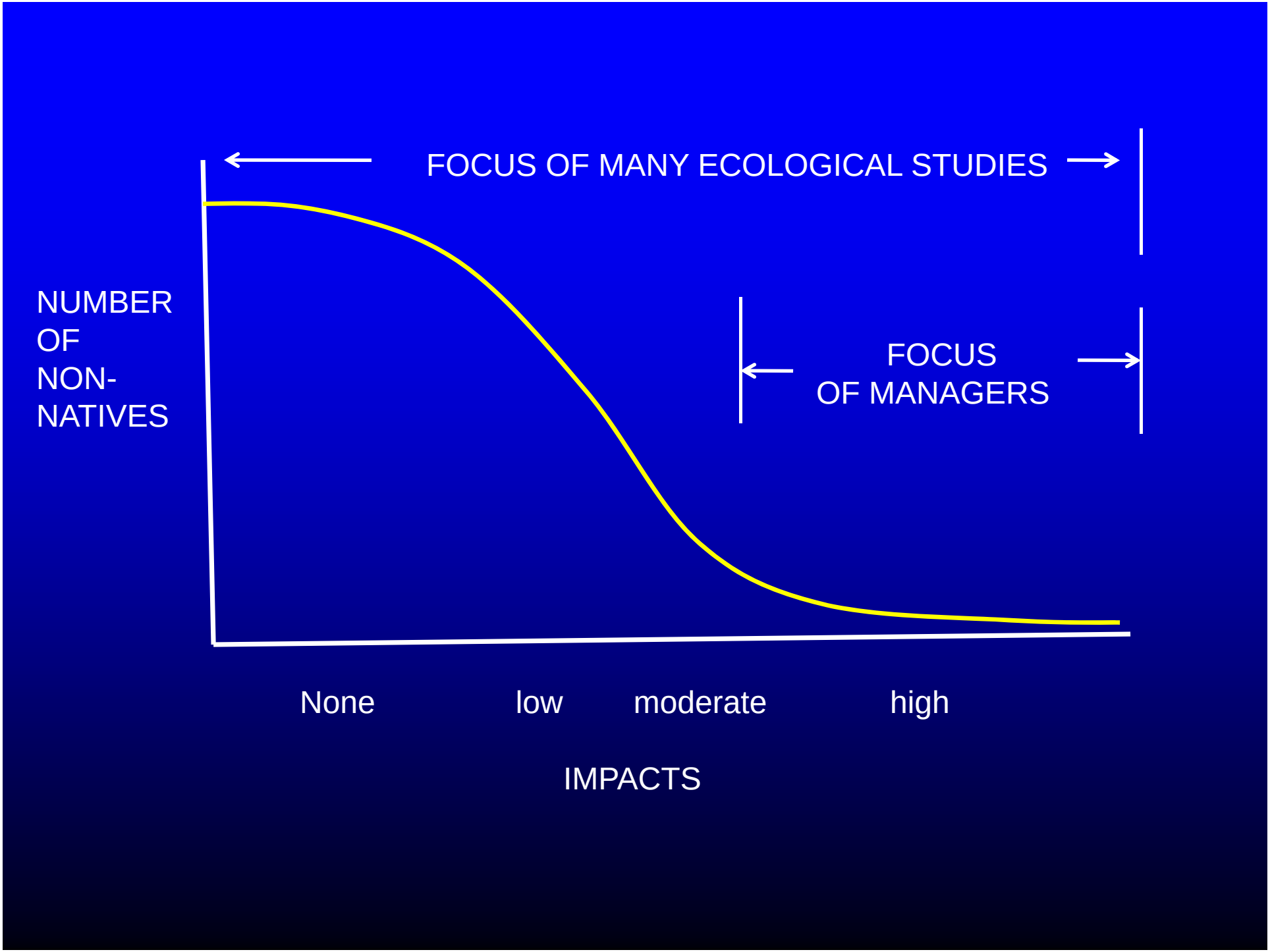

NATIVE
HERBIVORE
FOOD WEB
invader
NATIVE
PLANT
SPECIES
RESOURCES

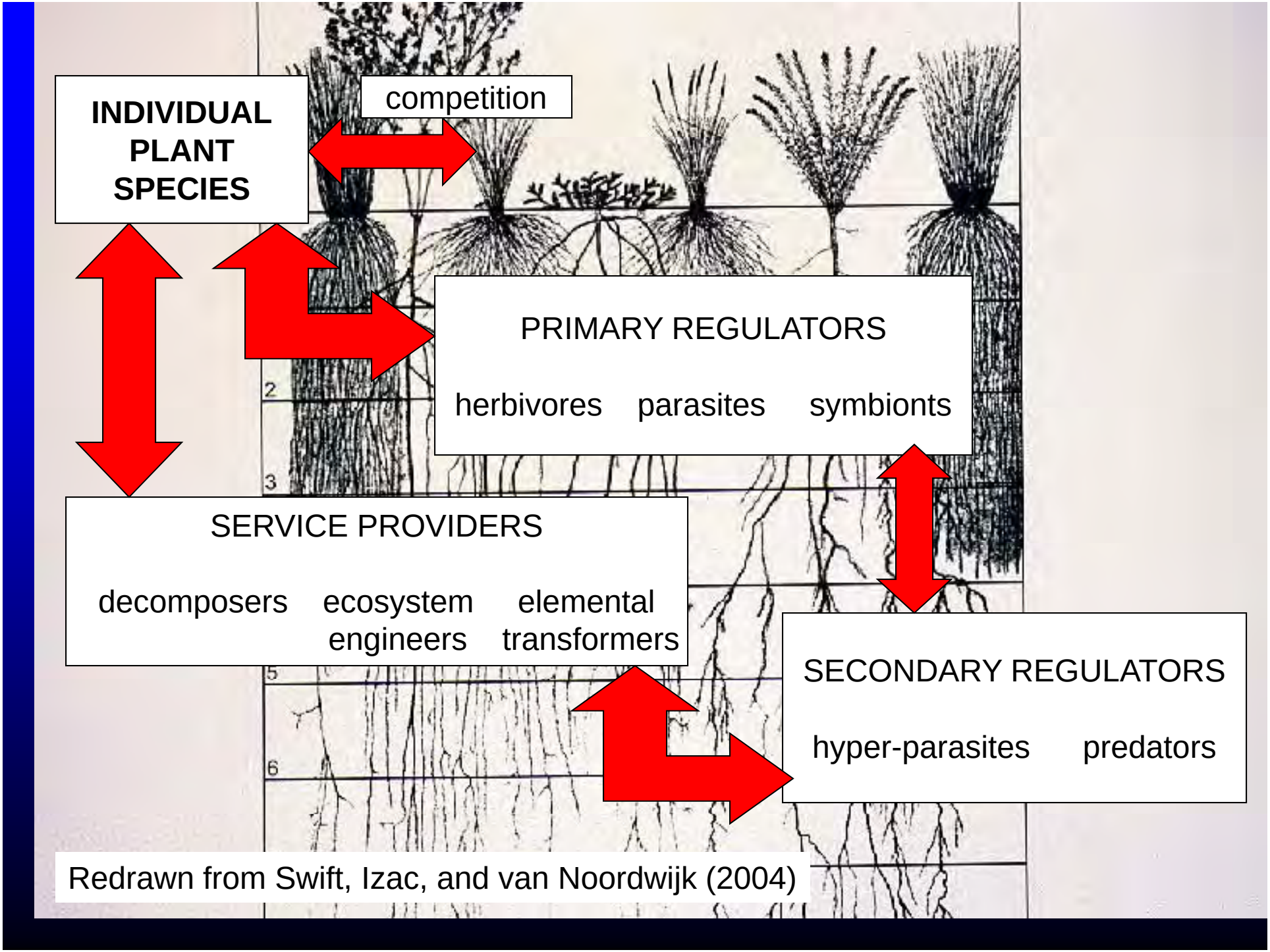

Native herbivore food web
bio
Native plant species
Non-native weeds
Resources

The presence and abundance of invasive species can be explained by the same factors that explain the abundance and distribution of native species.

However…

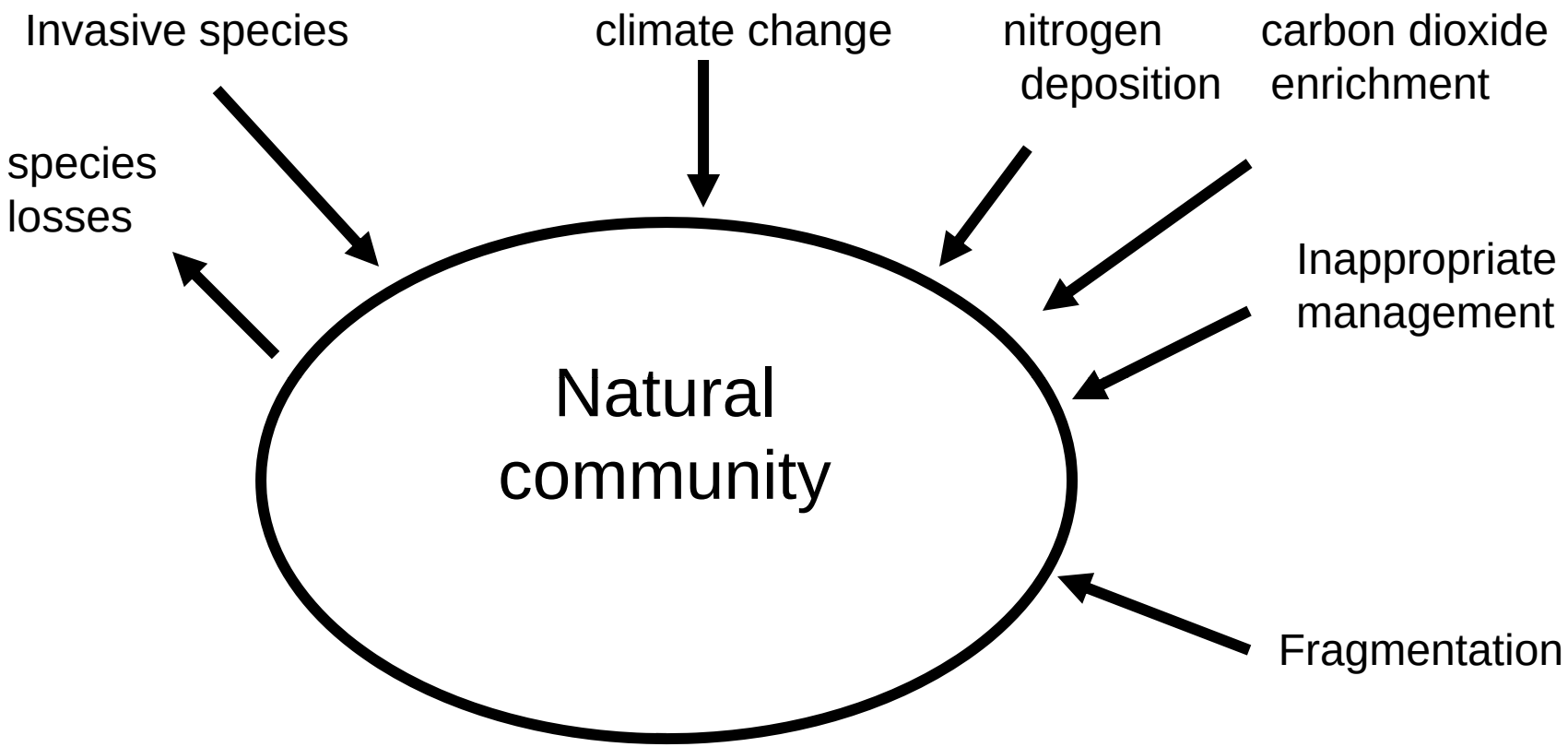
Our interests are only on a subset of non-native species that become dominants.


FOCUS OF MANY ECOLOGICAL STUDIES
NUMBER OF NON-NATIVES
FOCUS OF MANAGERS
None
low
moderate
high
IMPACTS



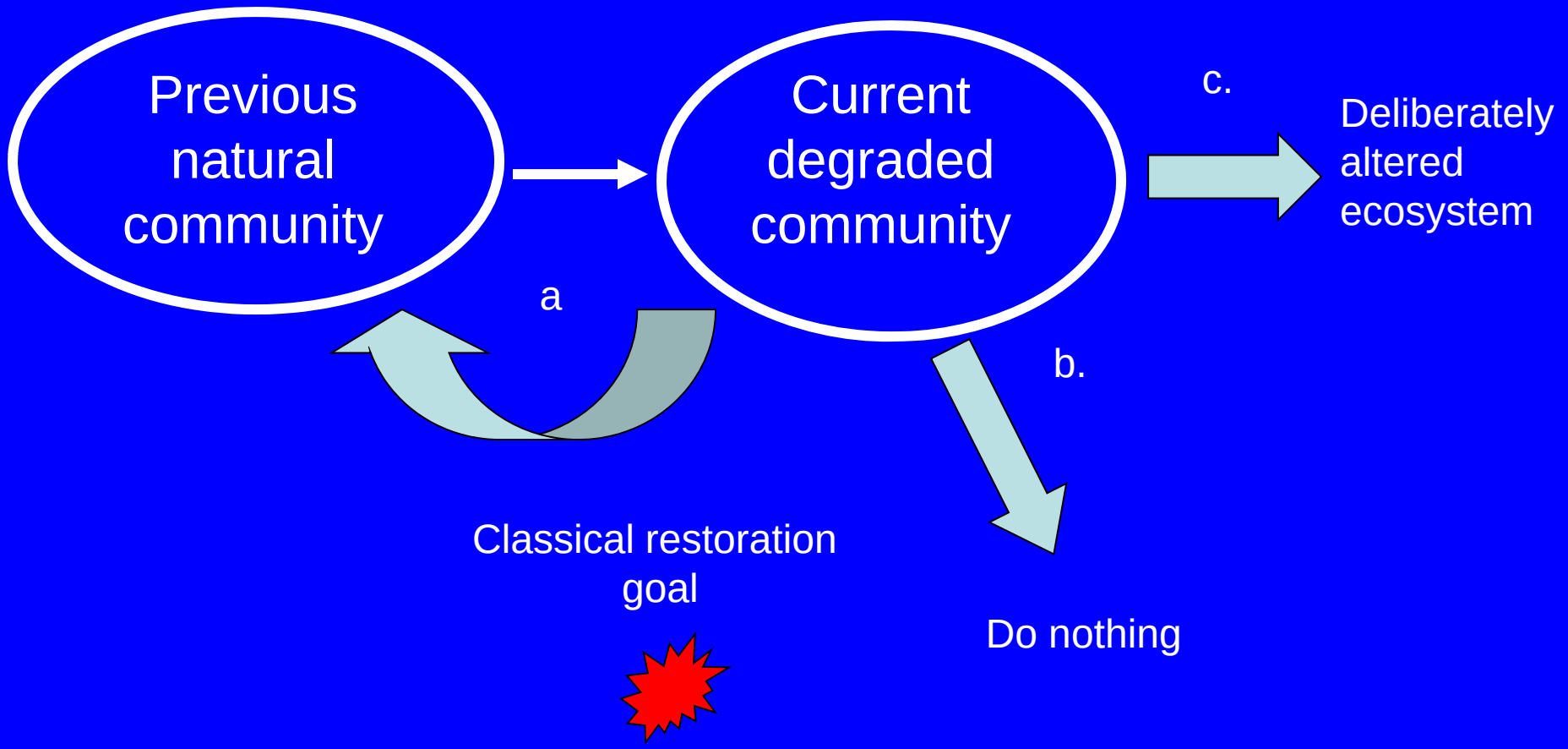
Redrawn from Swift, Izac, and van Noordwijk (2004)

Factors affecting natural ecosystems

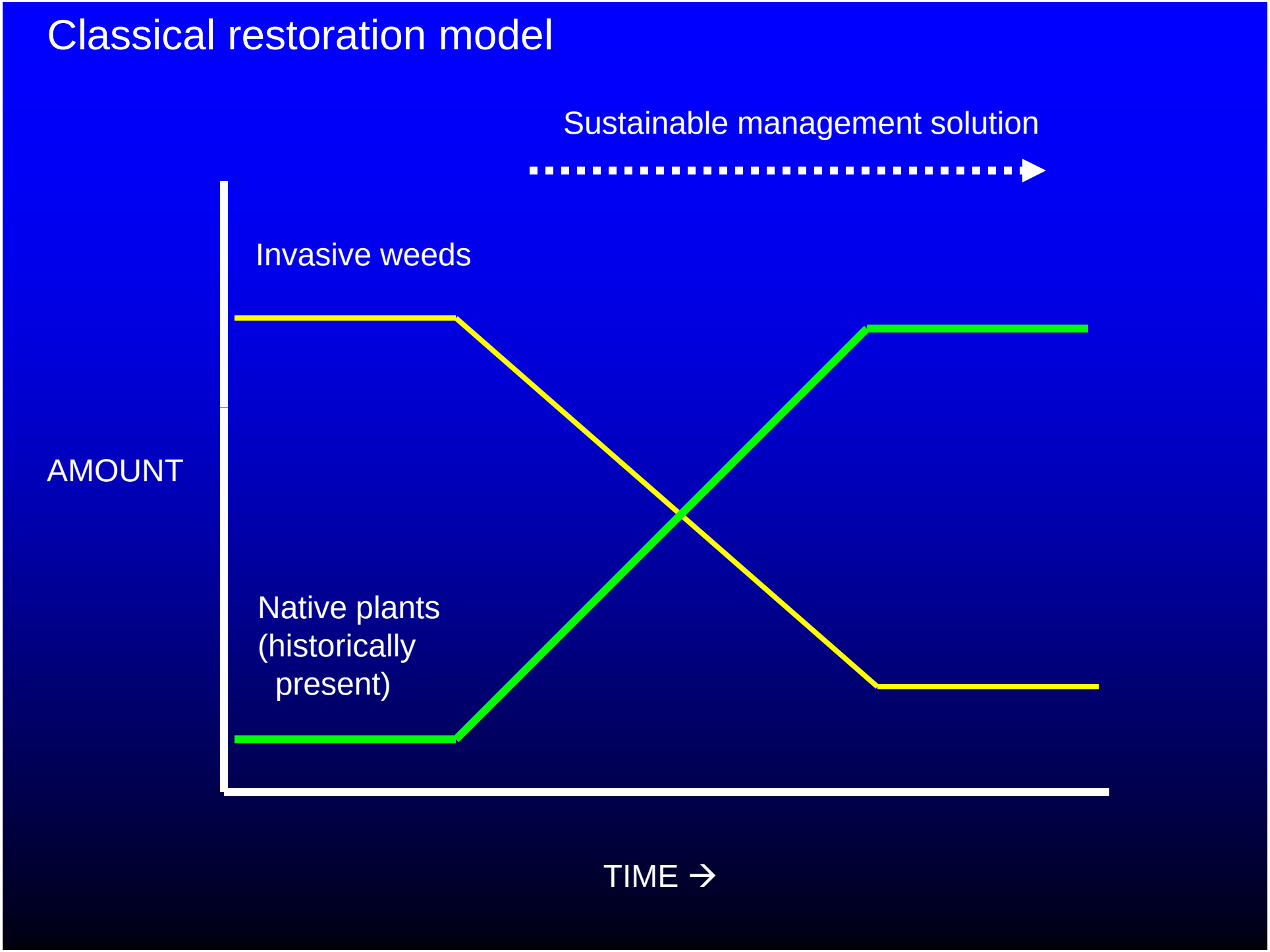


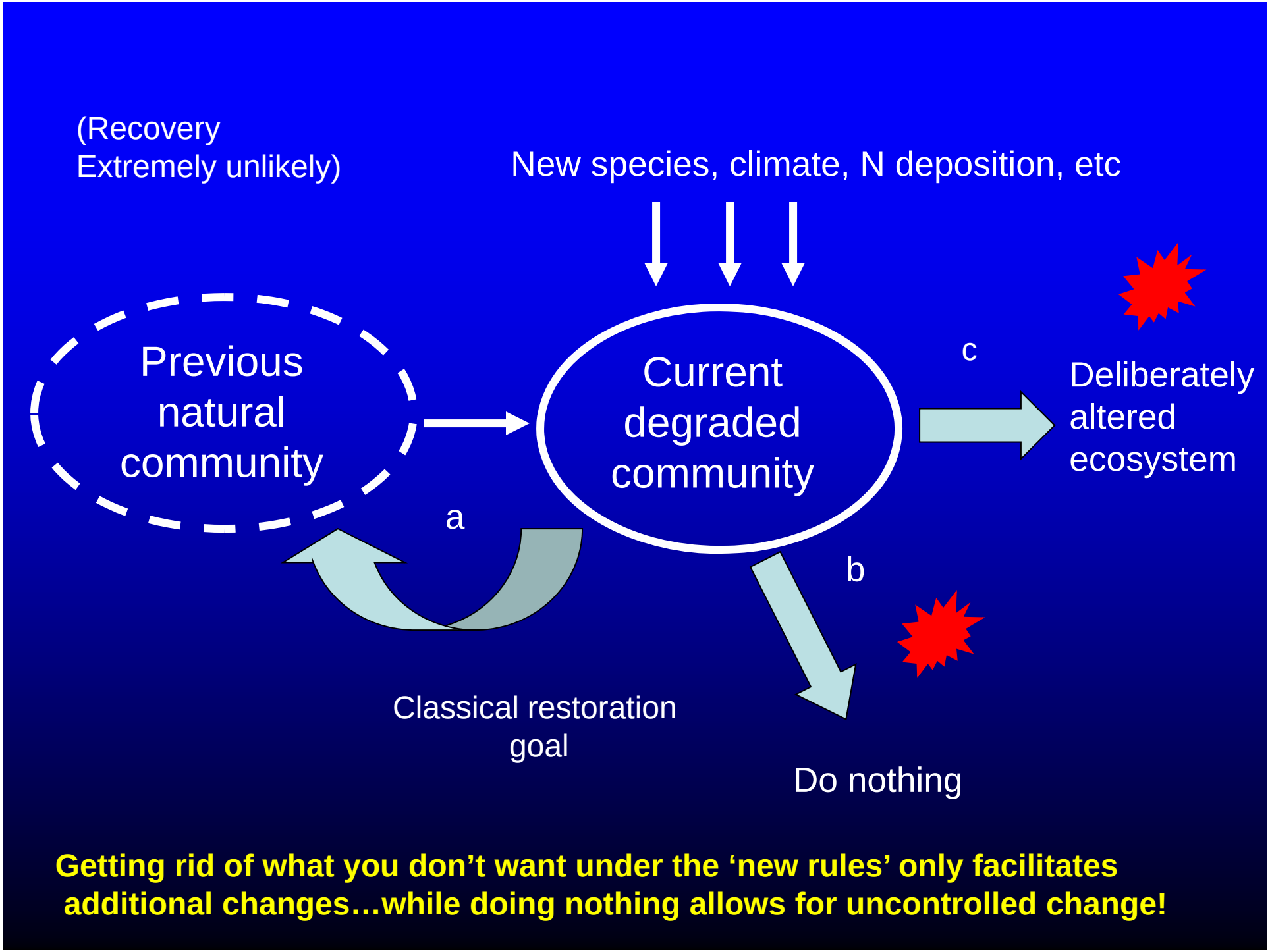
"Pristine" communities have been influenced by a number of 'unnatural' factors for multiple decades.

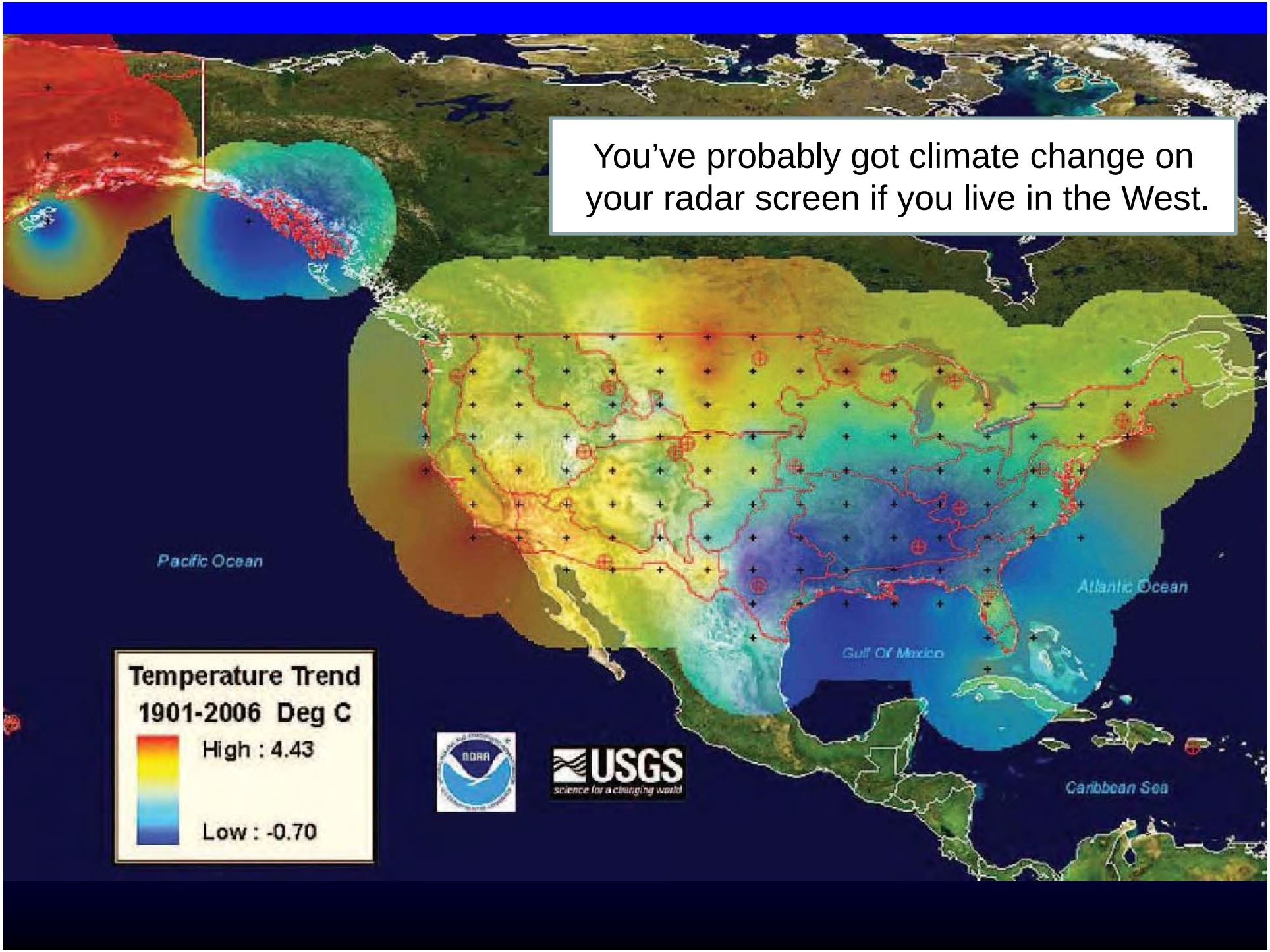
Restoration and Ecosystem Services Management:



Classical restoration model

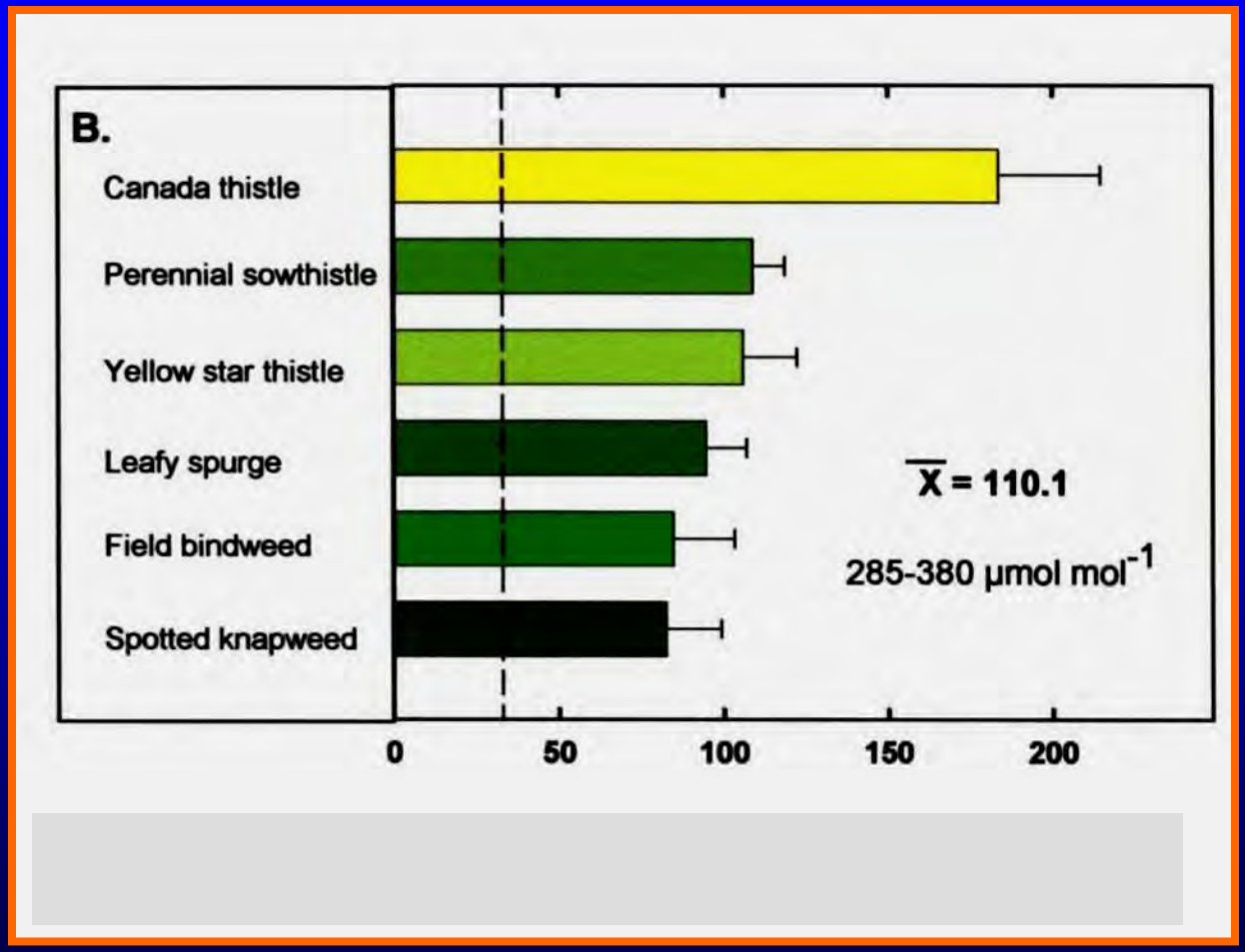



(Recovery
Extremely unlikely)
New species, climate, N deposition, etc
Previous natural community
Current degraded community
c
Deliberately altered ecosystem
a
b
Classical restoration goal
Do nothing
Getting rid of what you don't want under the 'new rules' only facilitates additional changes…while doing nothing allows for uncontrolled change!


You've probably got climate change on your radar screen if you live in the West.
Pacific Ocean
Atlantic Ocean
Gulf Of Mexico
Caribbean Sea
Temperature Trend
1901-2006 Deg C
High : 4.43
Low : -0.70
NOAA
USGS
science for a changing world

CARBON DIOXIDE FERTILIZATION EFFECTS

(dashed line is average increase shown by native plant studies.)



Percent increase in biomass of six invaders to last 100 yrs of increased CO_2 (Ziska 2003)

Elevated atmospheric CO_2 in a forest ecosystem increases population biomass of **poison ivy**.

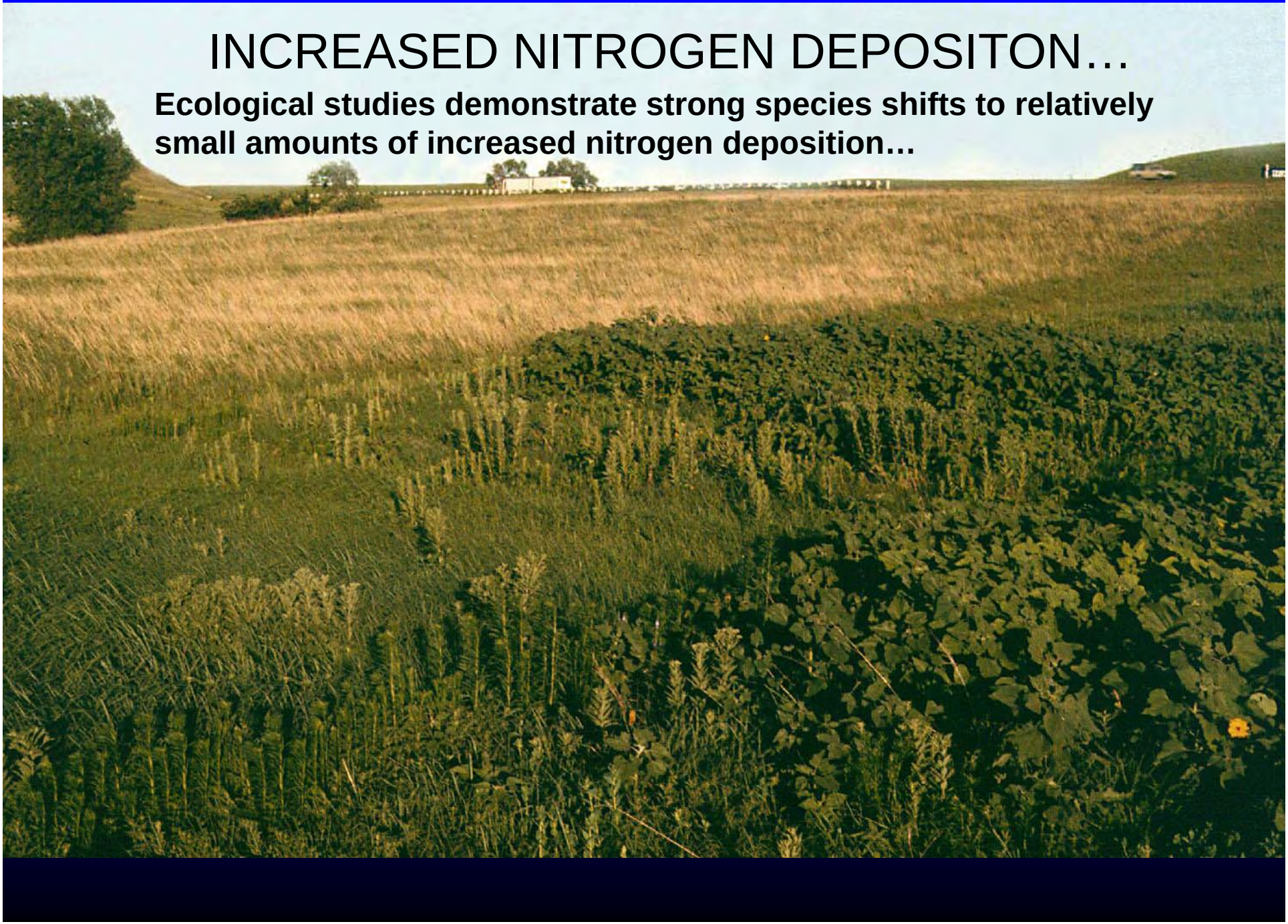
The CO_2 growth stimulation exceeds that of most other woody species.

Results indicate that poison ivy will become more abundant and more "toxic" in the future, potentially affecting global forest dynamics and human health.

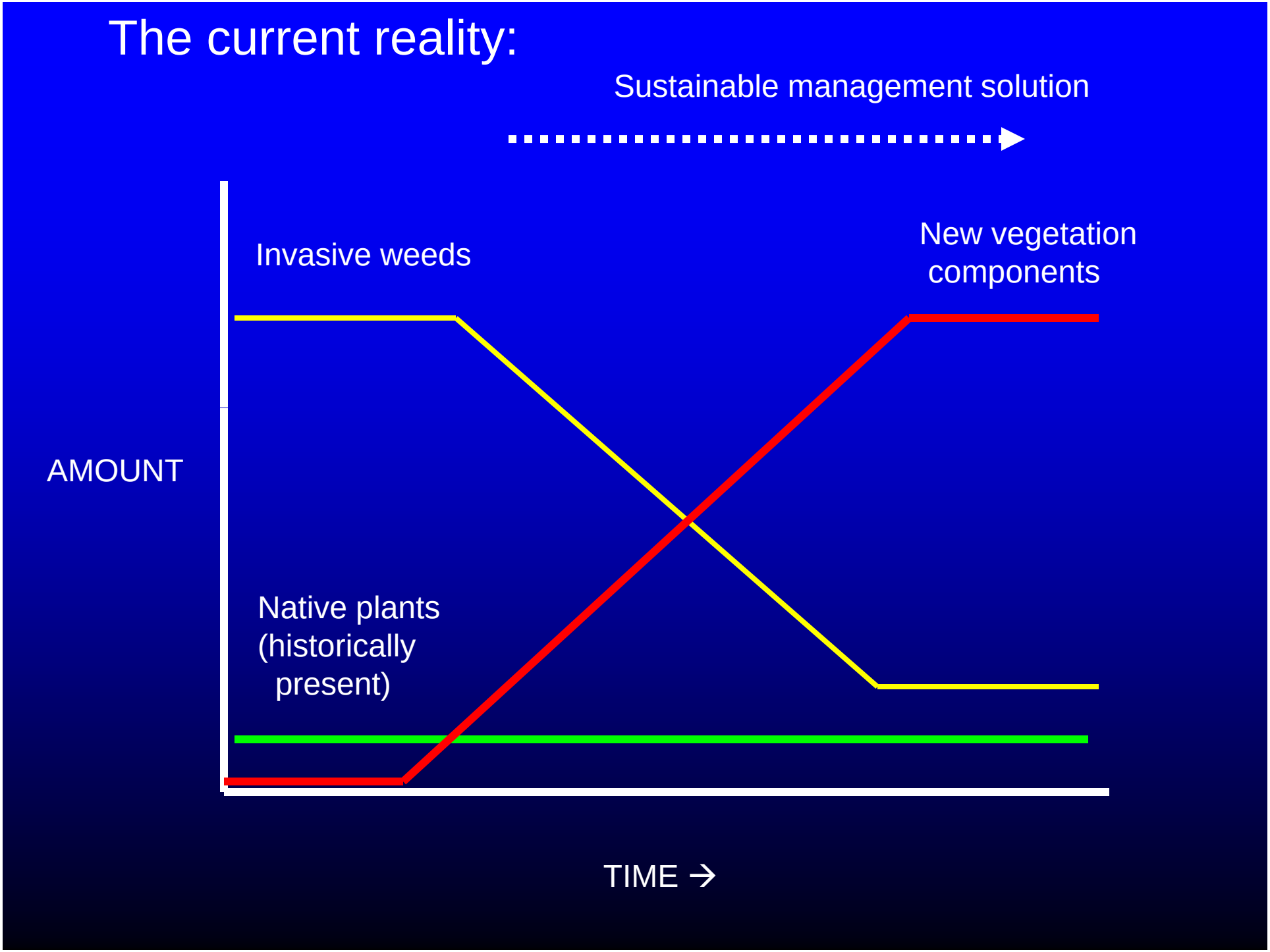
Mohen et al. 2006

INCREASED NITROGEN DEPOSITON…

Ecological studies demonstrate strong species shifts to relatively small amounts of increased nitrogen deposition…

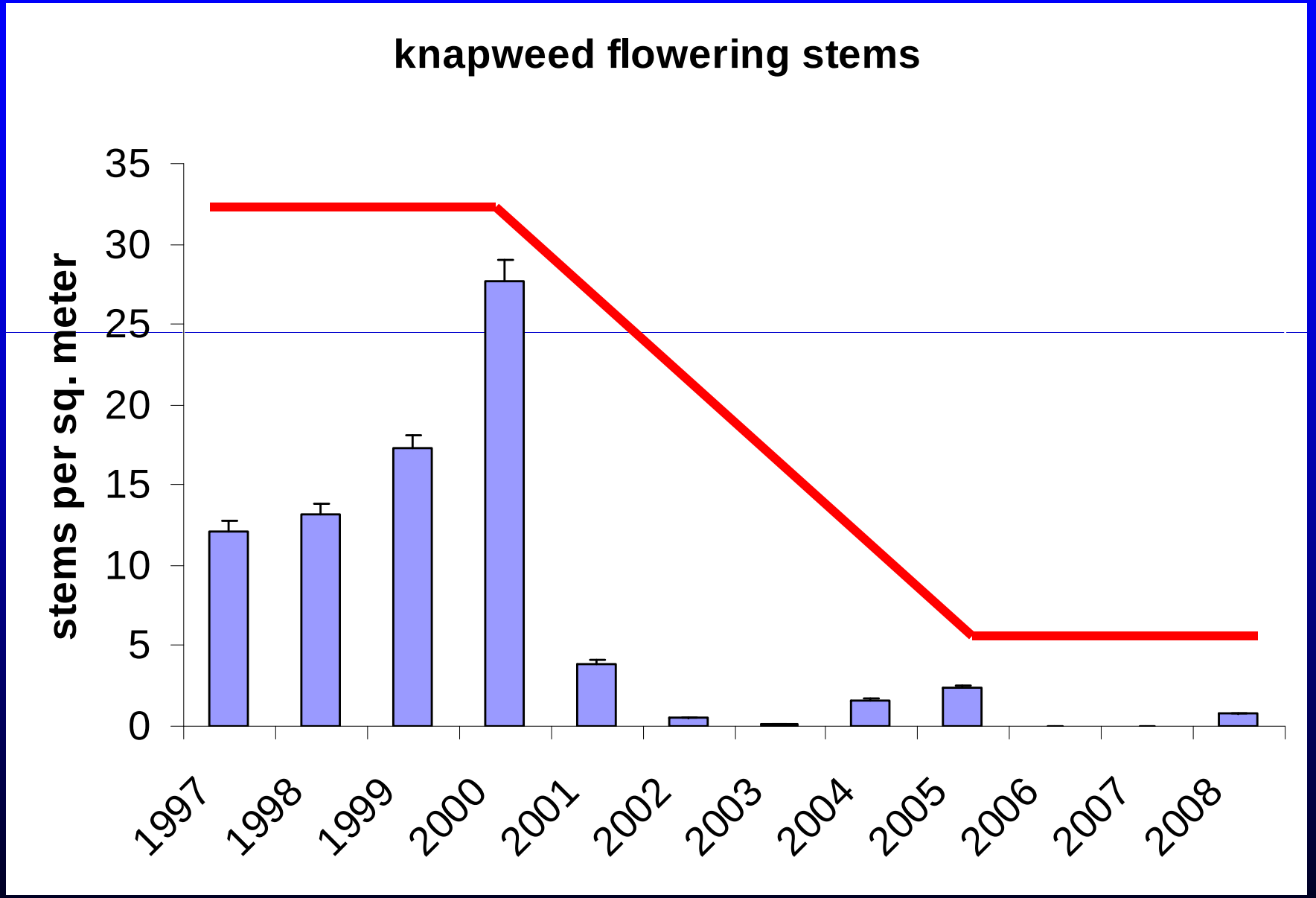


The current reality:

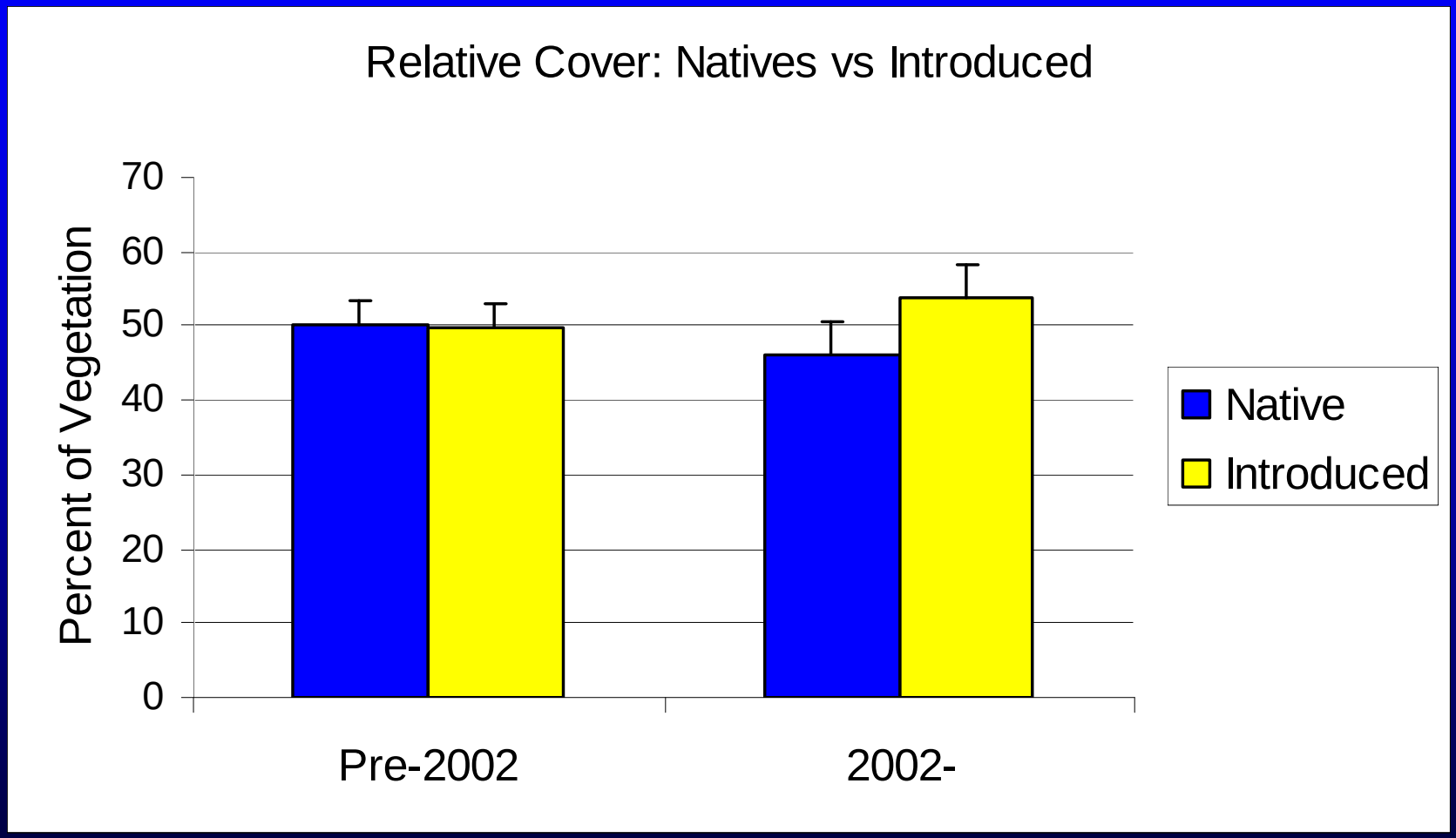


The local/regional textbook example:
Control of diffuse knapweed:

Demise of knapweed on eastern Boulder grassland:



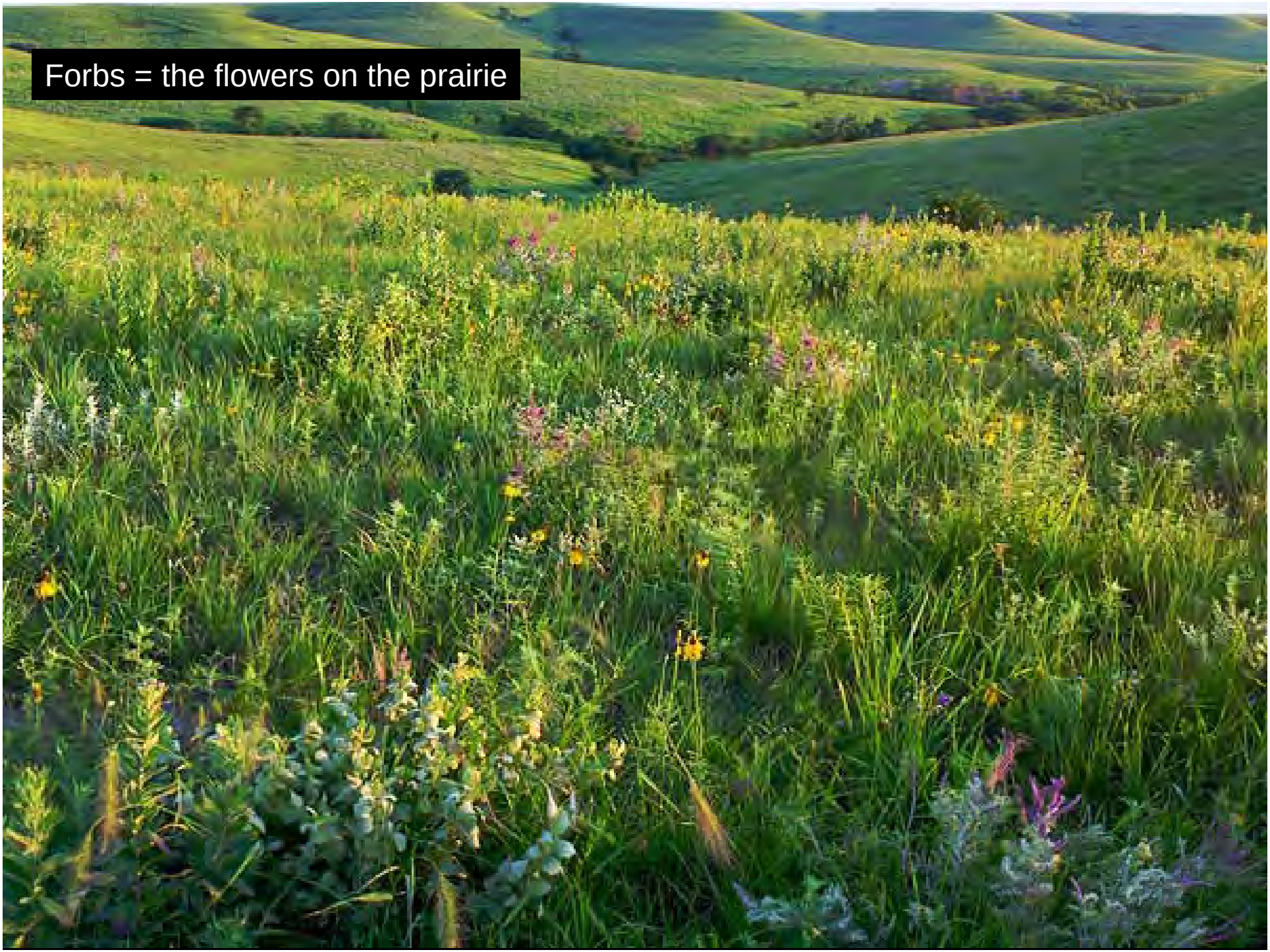
But the demise of knapweed was exploited by other non-native species… Why?



Hypothesis:

Classical restoration efforts produce new systems in the Colorado Front Range because:

a) Longer growing season
b) Wetter winters but no overall increase in precipitation
c) Higher CO_2 and atmospheric nitrogen deposition
d) Regionally abundant non-native species
e) Altered fire regimes
f) Fragmentation effects on movements
g) Predator-prey interactions have been altered


Forbs = the flowers on the prairie

Where have all the flowers gone?

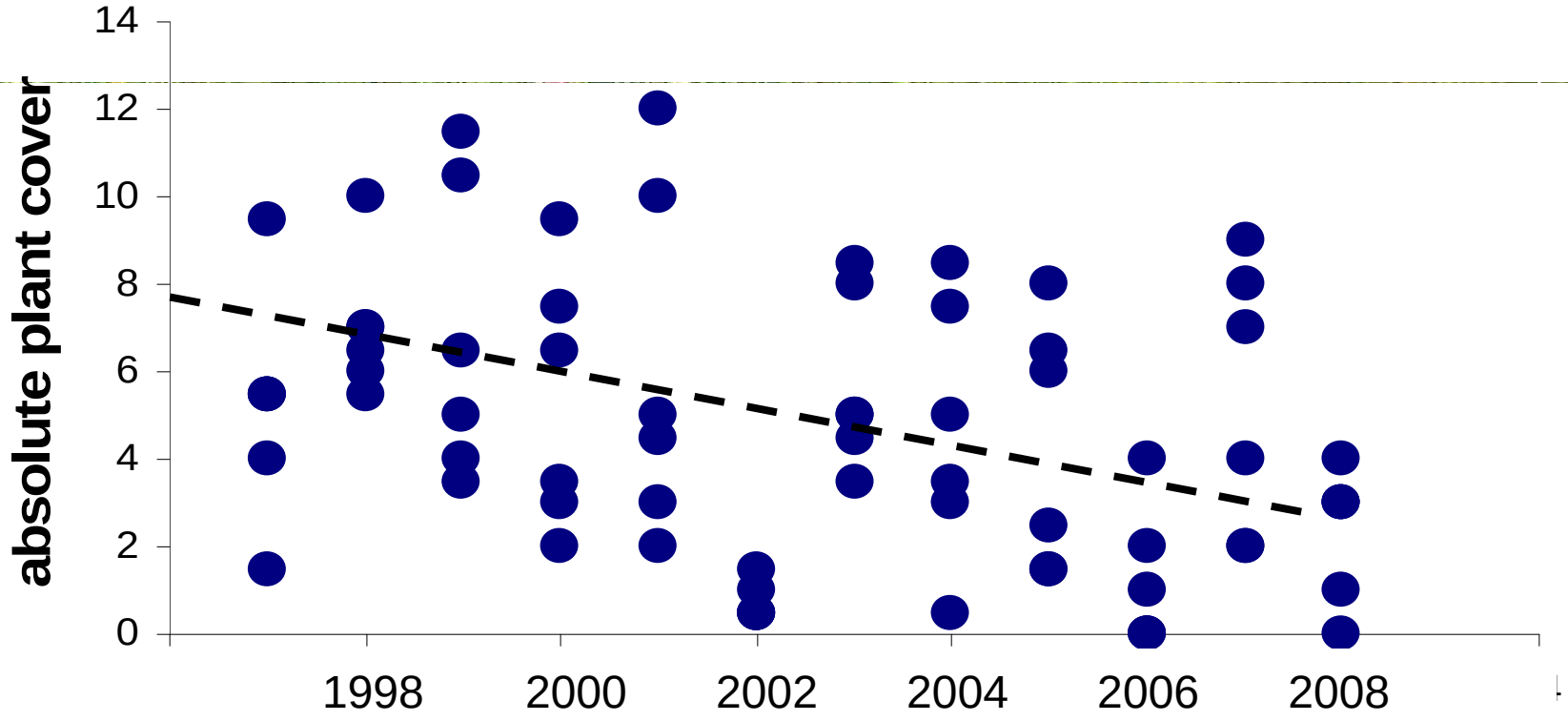
Native forbs

Year: P=.001

Temperature: P=.002

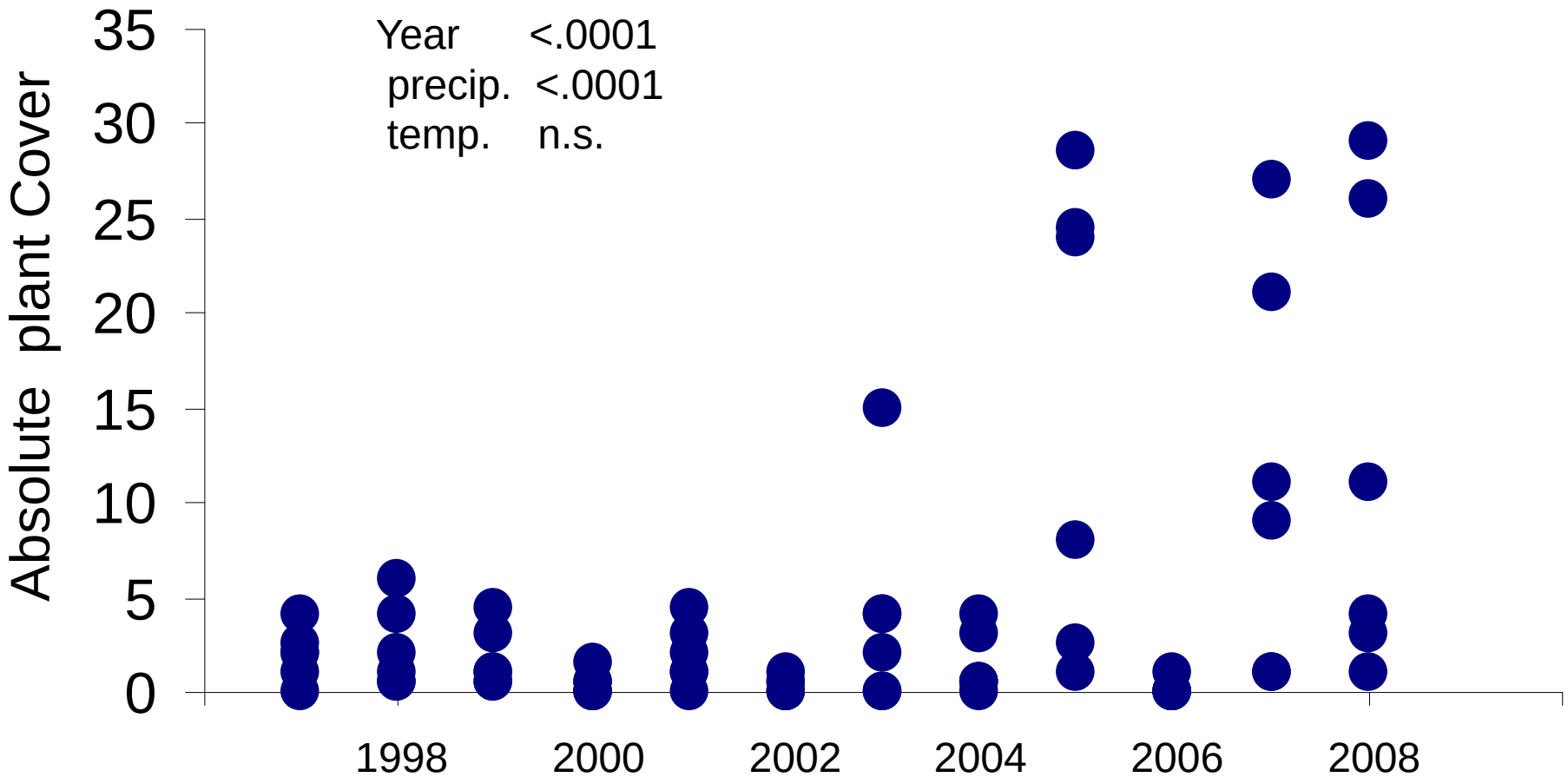
Precipitation: ns

Absolute cover declined by ~50% during interval



A dry-down from the gay 90s? (Lawton et al., in review)

Annual plants (often called ‘winter annual plants’) have become much more abundant through time at this site



Alyssum, annual peppergrass

Erodium, storksbill

cheatgrass
and
Japanese
brome

The historical growing season, dominated by a mix of cool and warm season perennial plant species

The new grassland environment:

1. growing season longer, with more precipitation occurring in the non-growing season
2. a much higher % composition by winter annuals

Jan. 7, 2009
Dust from prairie dog town at Highway 93-Colo. 128.

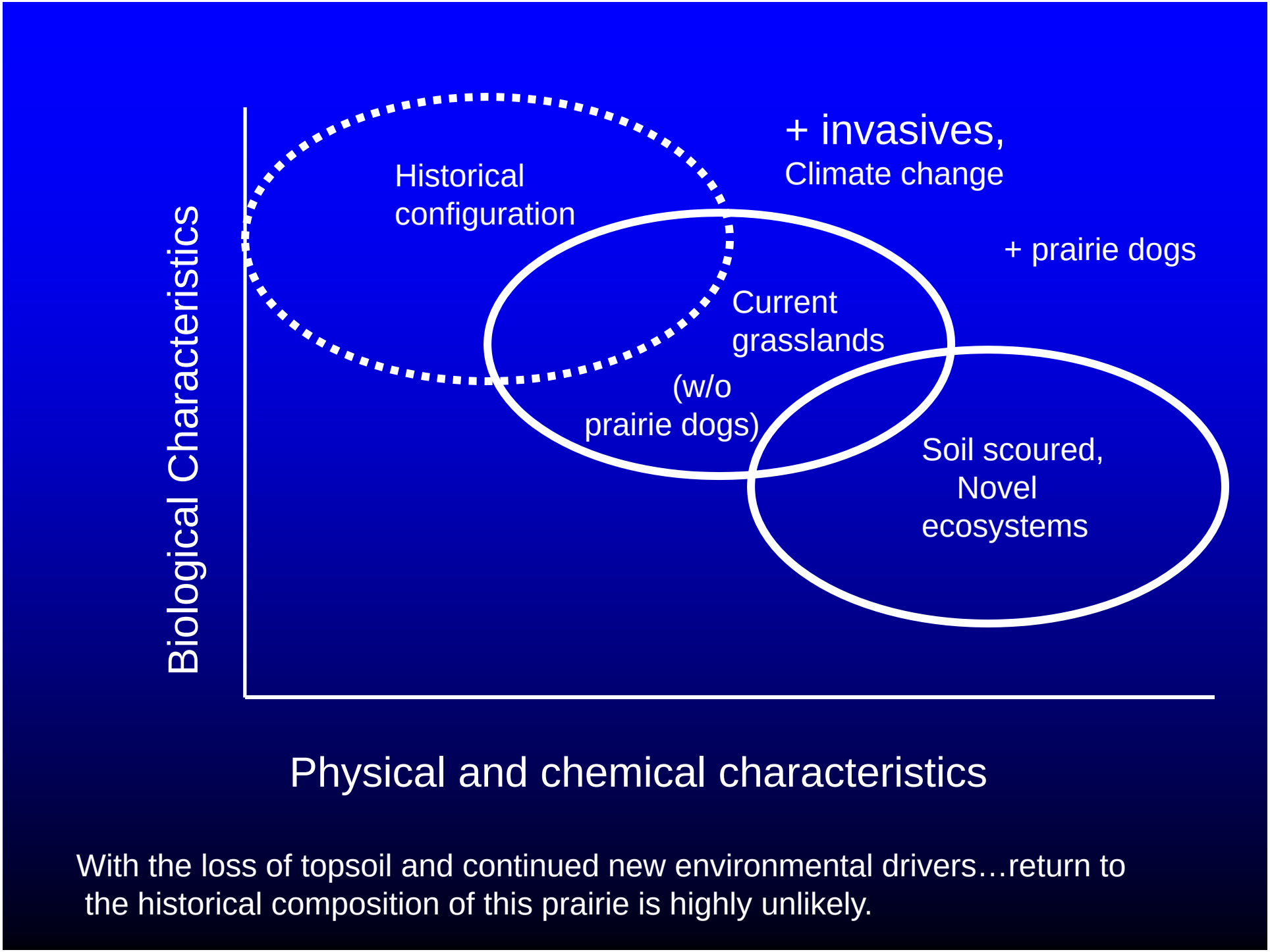
Photo by Richard Reynolds


Jan. 7, 2009
Photo by Richard Reynolds

A 2001 prairie, freed of knapweed, but soon to be colonized by prairie dogs.

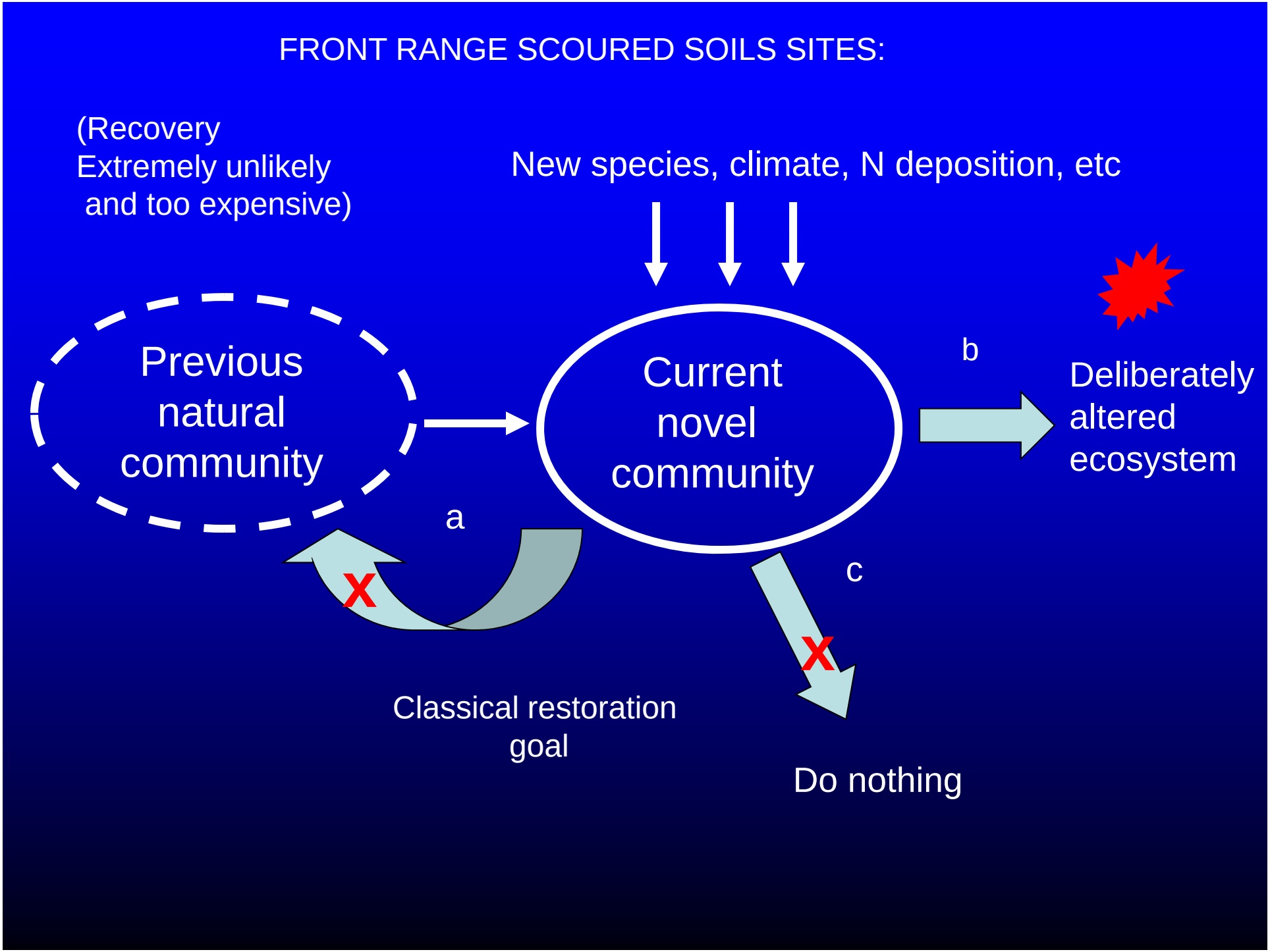
Photo by Jody Nelson


March 14, 2009

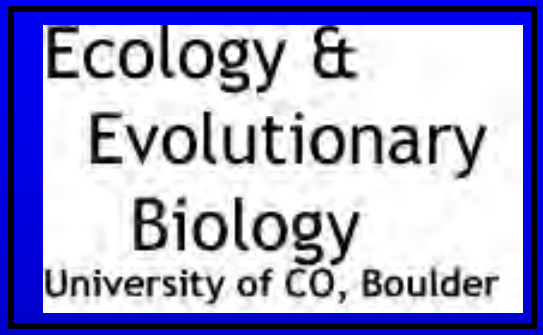


With the loss of topsoil and continued new environmental drivers…return to the historical composition of this prairie is highly unlikely.

We’ve experienced climate-human land use change interactions before…


FRONT RANGE SCOURED SOILS SITES:
(Recovery
Extremely unlikely
and too expensive)
New species, climate, N deposition, etc
Previous
natural
community
Current
novel
community
b
Deliberately
altered
ecosystem
a
X
c
X
Classical restoration
goal
Do nothing

Support for Seastedt's research is from:



And ability to participate in this meeting from: