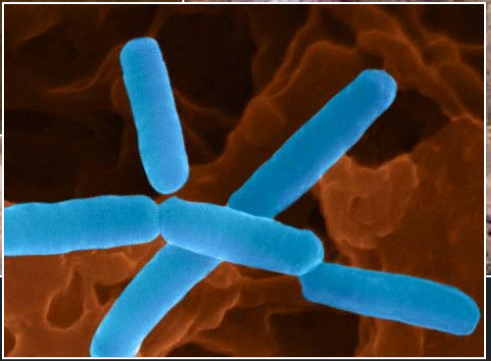
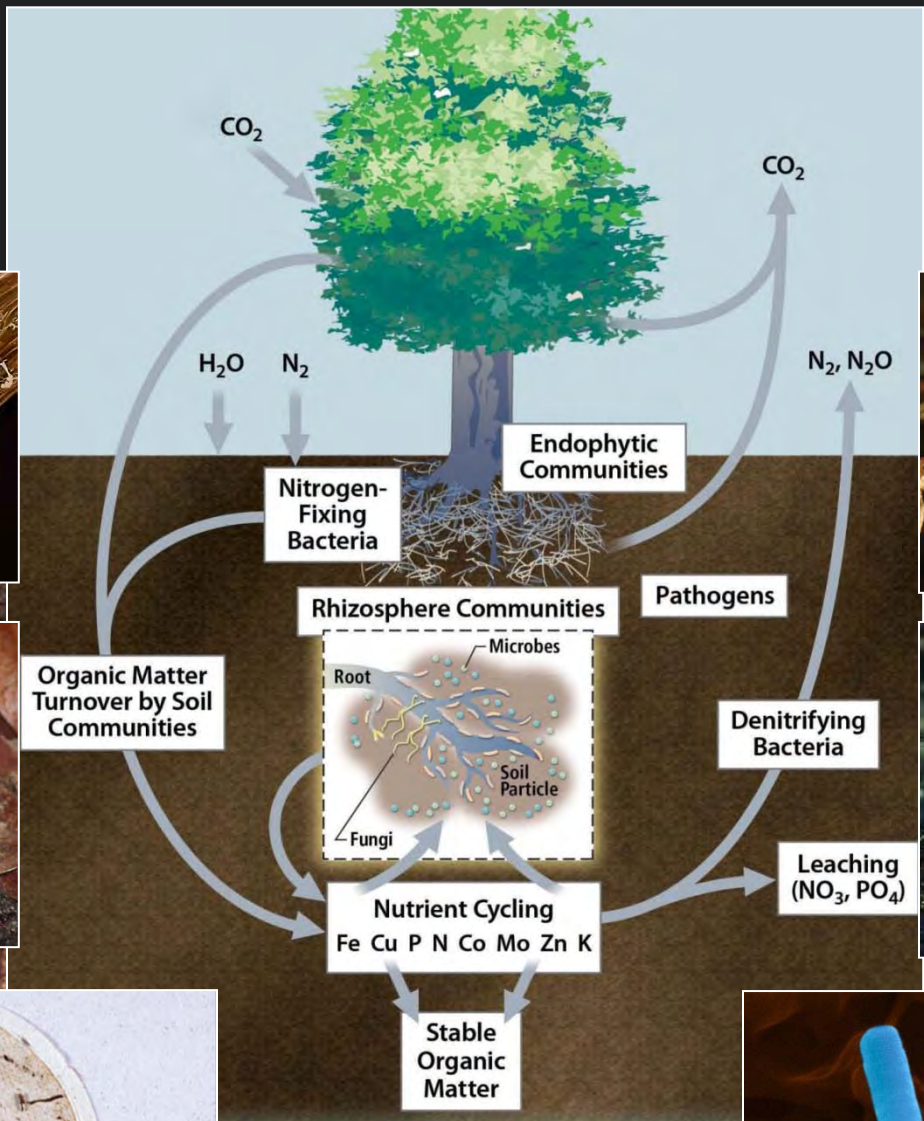


THE GHOST OF INVASIONS PAST: soil legacies of invasive plant species

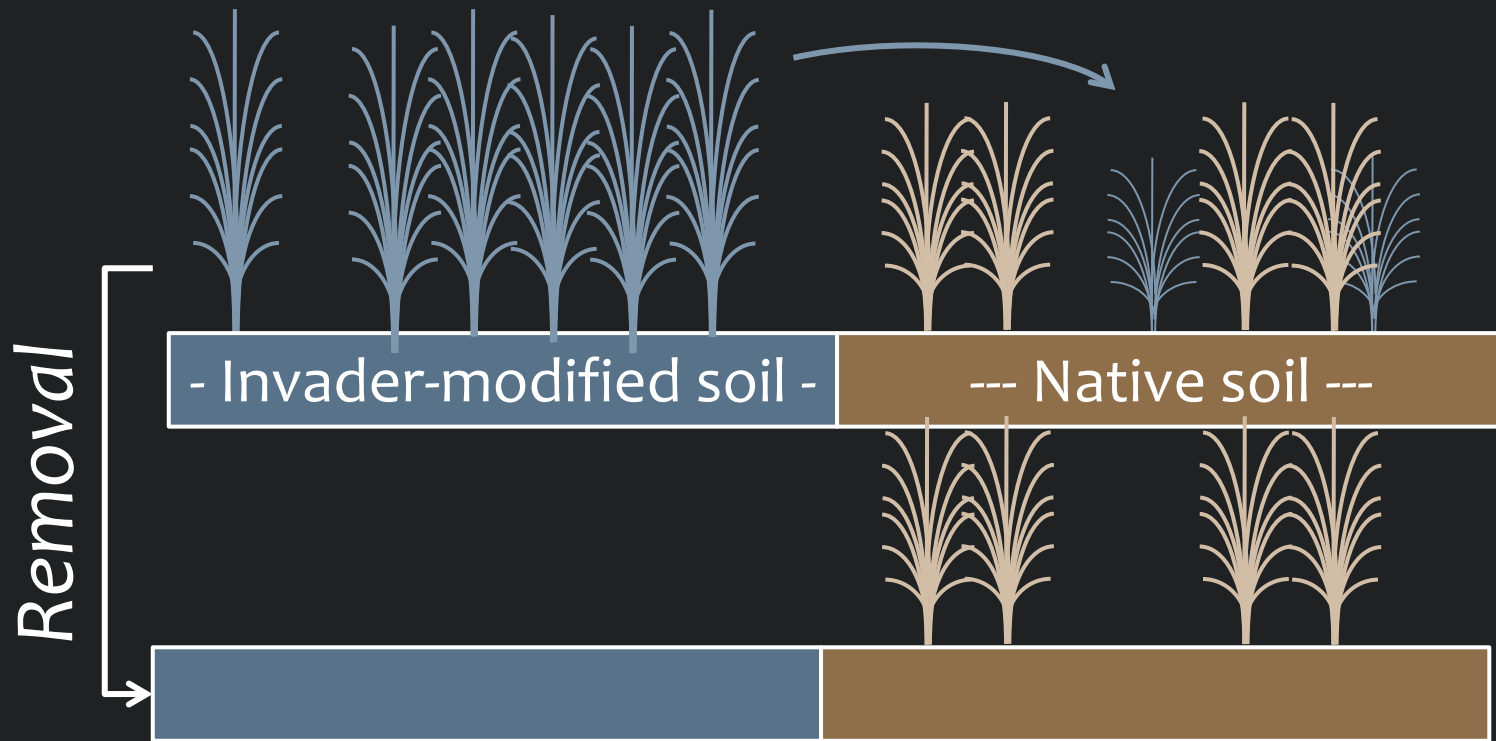
Katharine Suding

University of California Berkeley,
Environmental Science, Policy and
Management

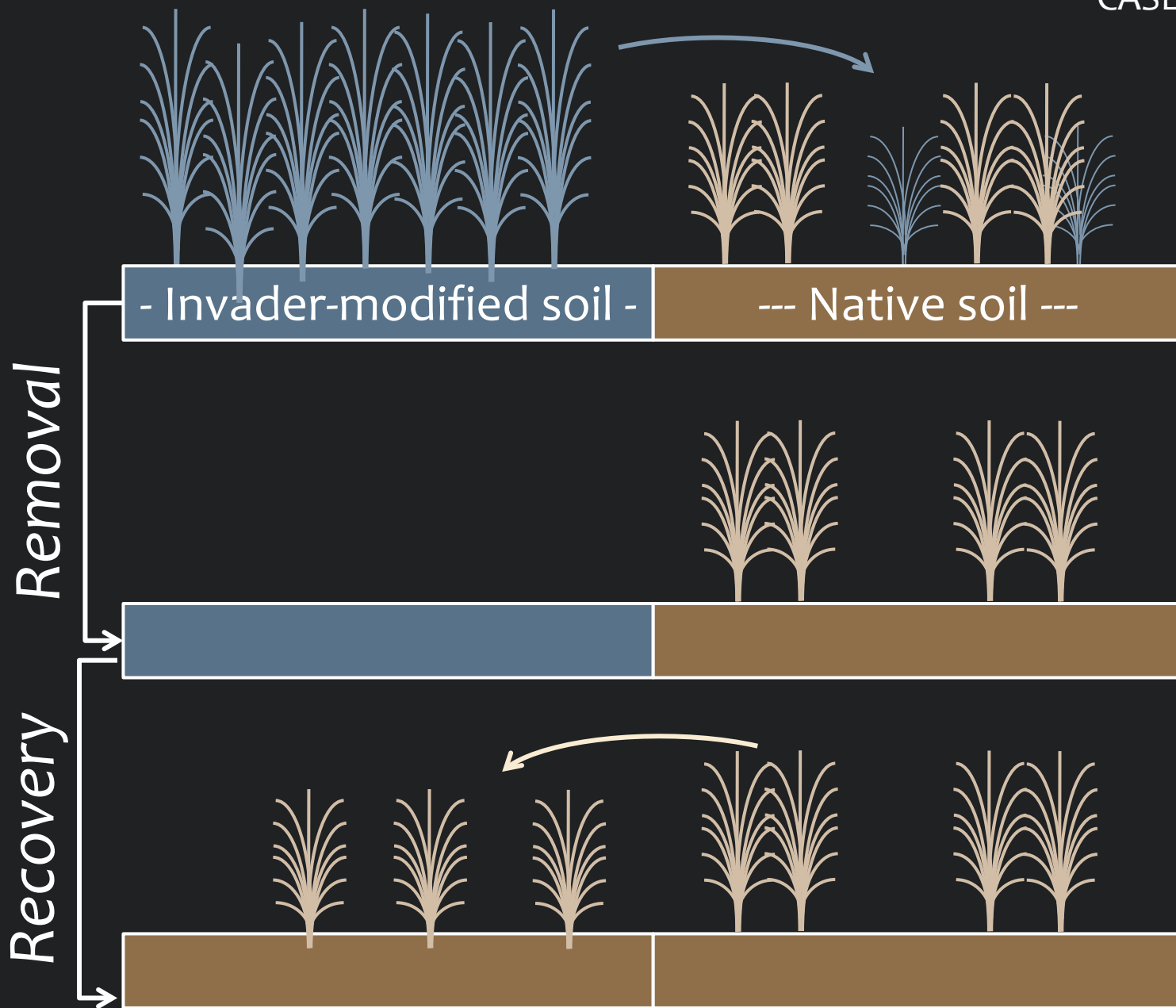




Consequences of soil impacts: FOUR CASES



CASE 1: RECOVERY



CASE 1: RECOVERY
Suding and Royale, 2008
Komatsu et al, 2008
Artichoke thistle, Orange County



Invaded areas, rhizosphere:
4-100X Carbon-
processing microbial
enzymes


Four yrs after herbicide:
1/4-2X further increase

4X Needlegrass (*Nassella
pulchra*) cover (to 5%)

When native species don't recover → legacies?



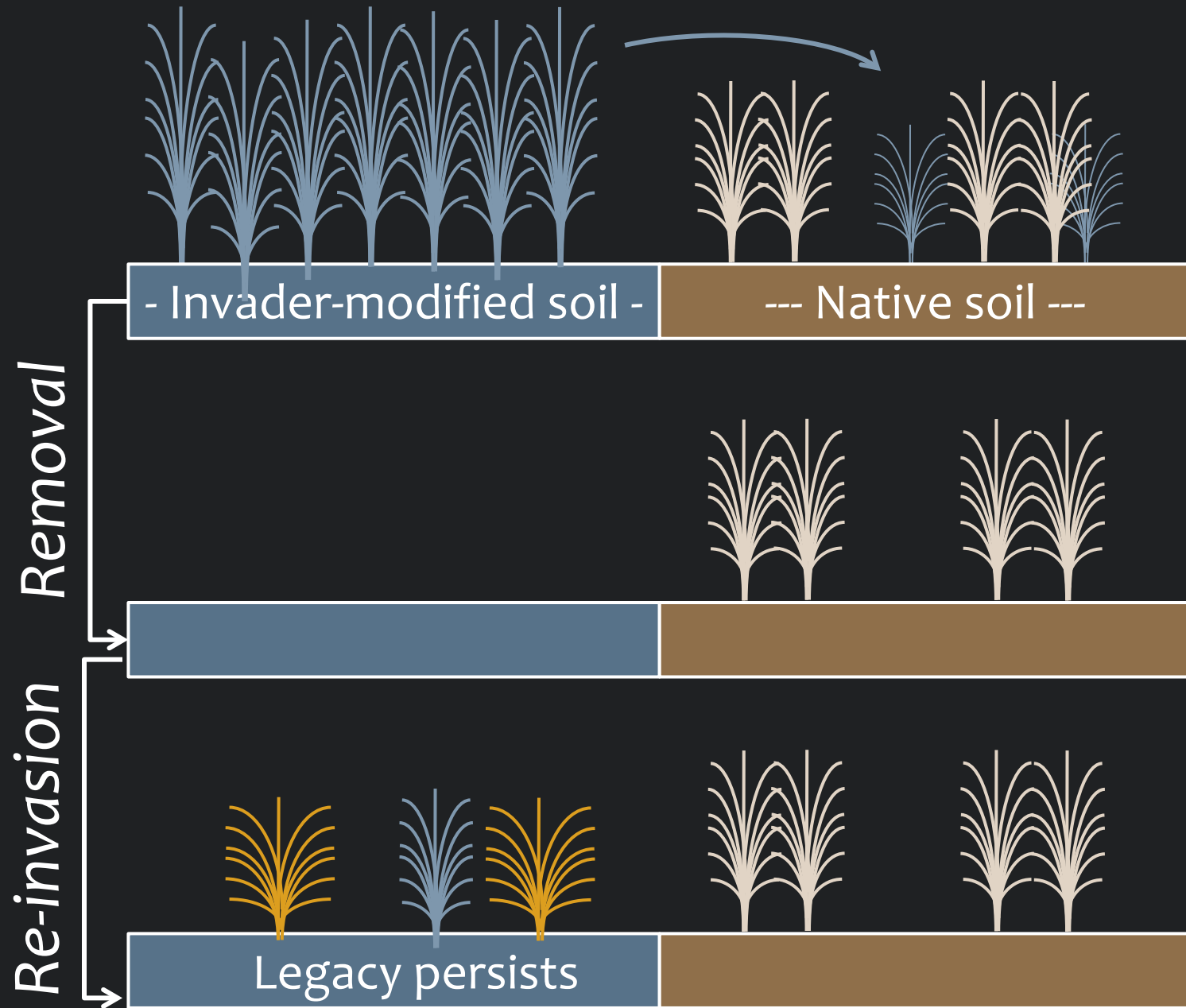
-70% (-60 to -95%) Invasive



+9% (+20 to -17%) Natives

Mean change in abundance (95% CI), herbicide control
355 invasive species removal projects (n= 45, 18)

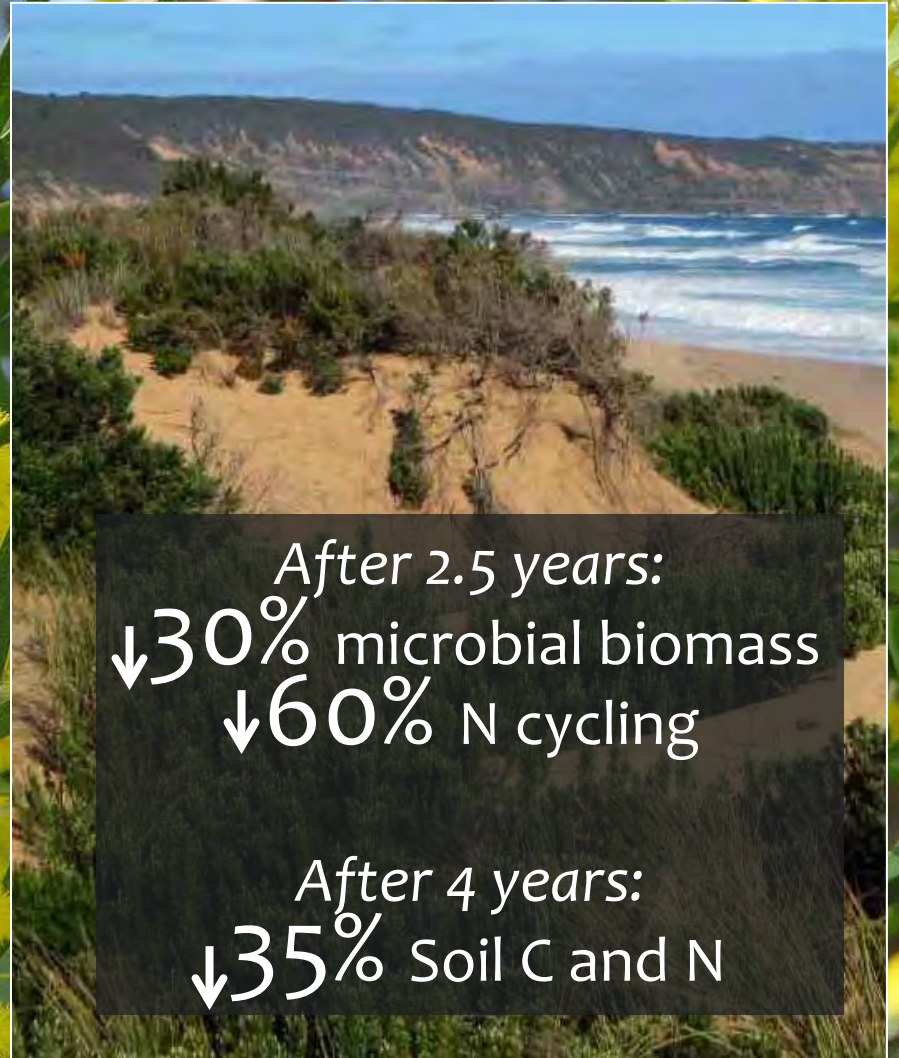
CASE 2: LEGACIES



CASE 2: LEGACIES
Nutrient pools



CASE 2: LEGACIES
Marchante et al, 2008
Acacia longifolia, Portugal



After 2.5 years:
↓30% microbial biomass
↓60% N cycling

After 4 years:
↓35% Soil C and N

CASE 2: LEGACIES
Microbial community



CASE 2: LEGACIES

Vogelsang and Bever 2009

Planted mesocosms, Orange County



Native (*Gnaphalium*):

↓30% nonnative-
conditioned soil

Invasive Italian thistle

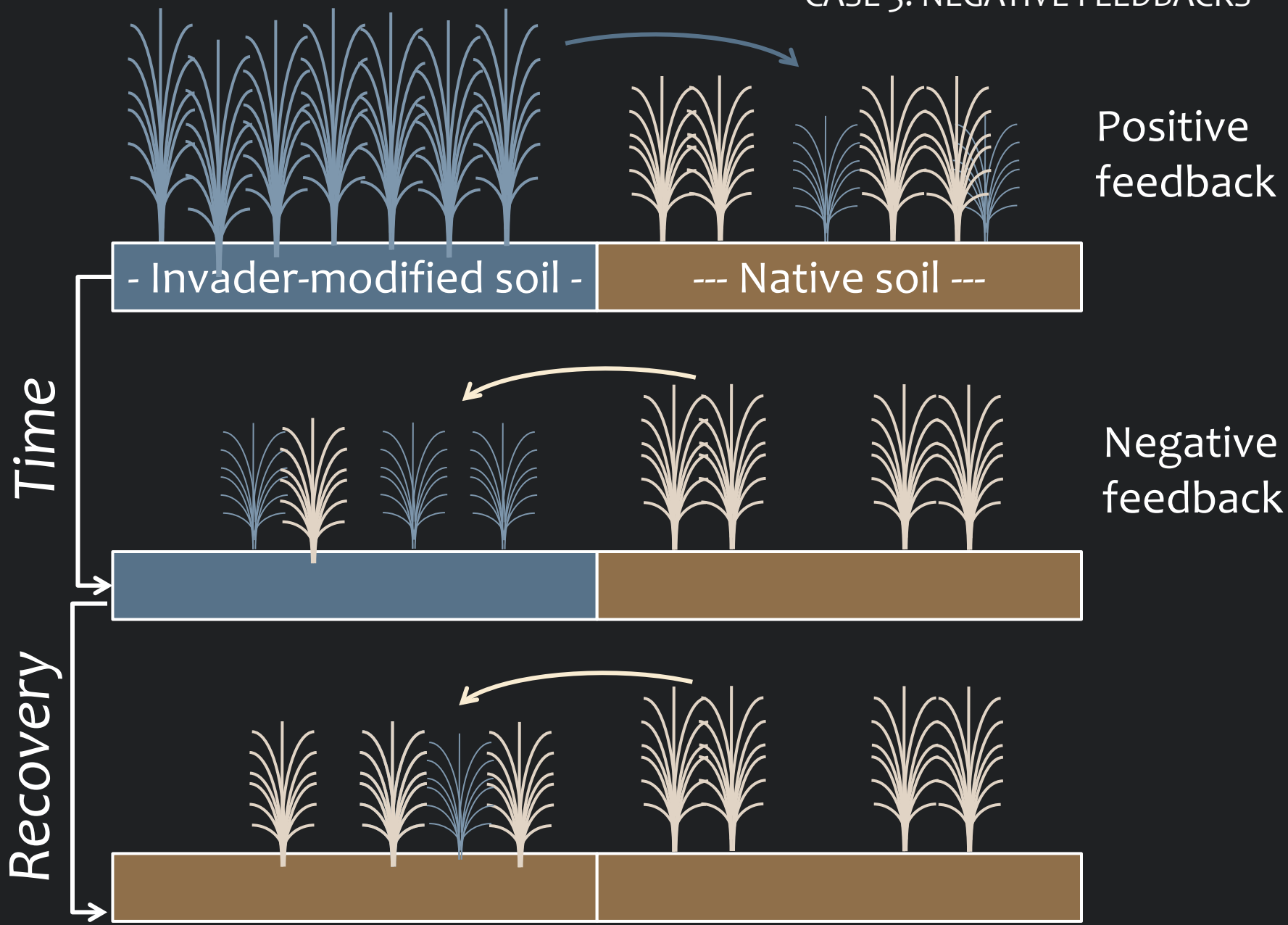
(*Carduus*):

↓8% native soil communities

Nonnative-conditioned soil:

↓33% mycorrhizal density

CASE 3: NEGATIVE FEEDBACKS



CASE 3: NEGATIVE FEEDBACKS

Nijer et al 2007

Chinese tallow, Texas

Invaded (own) soil inoculum:
↓42% biomass (vs native
soil)

↑48% fungi-killed soil



CASE 3: NEGATIVE FEEDBACKS
Stein et al, in prep
Medusahead, Sierra Foothills



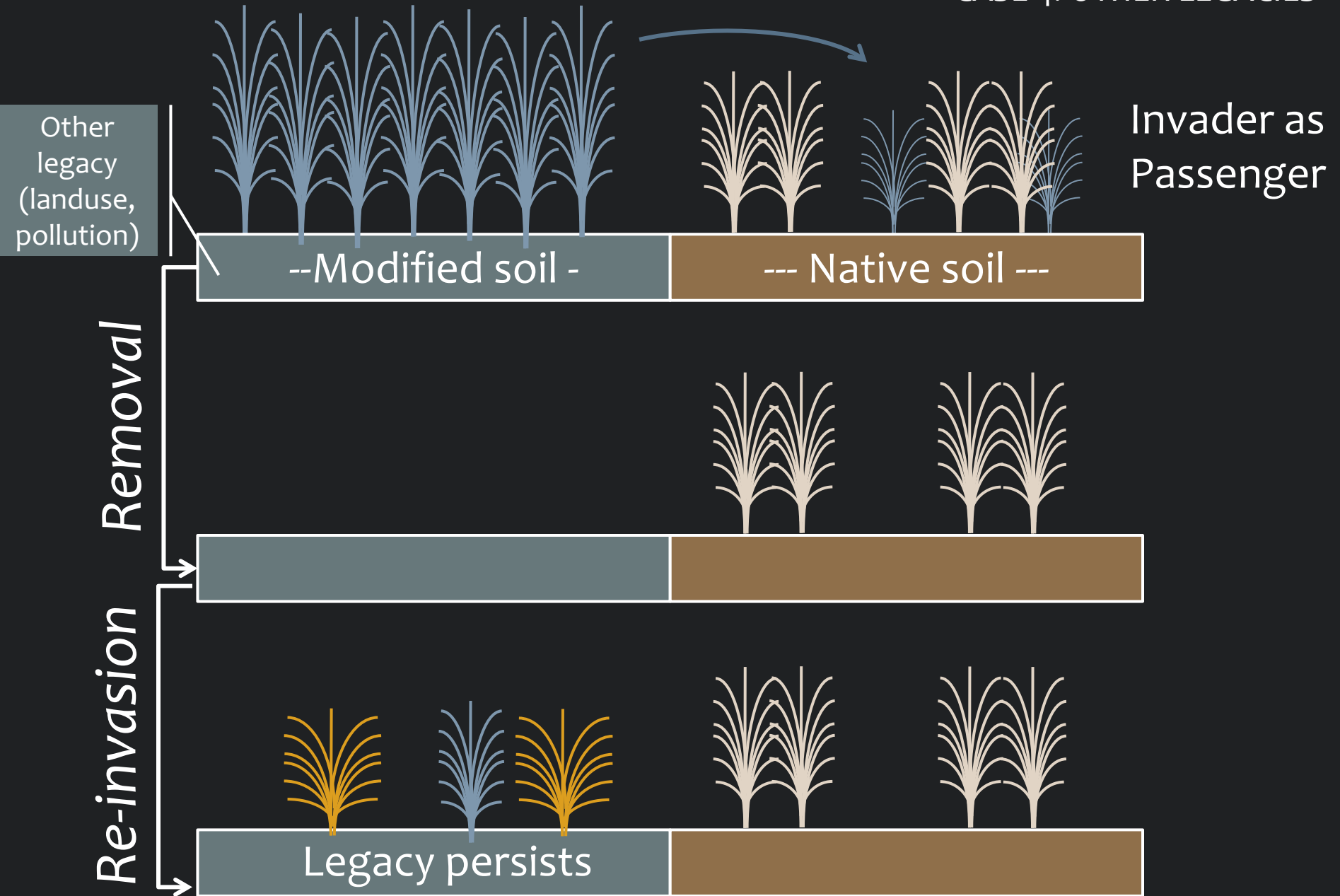
Medusahead:
↓33% MH-conditioned soil

Needlegrass (*Nassella*):
↓51% MH-conditioned soil

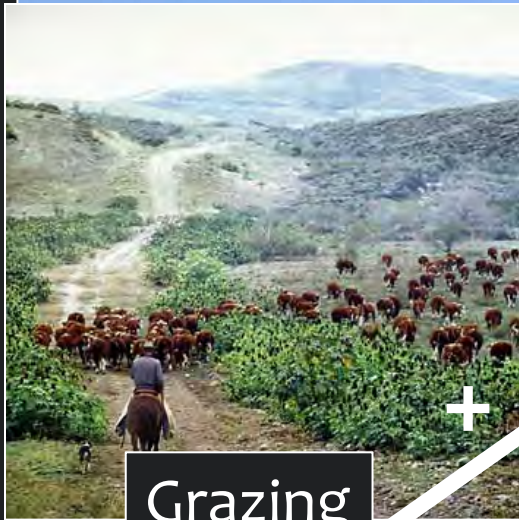
Avena fatua:
↓12% MH-conditioned soil



CASE 4: OTHER LEGACIES



CASE 4: OTHER LEGACIES
Mangla et al, in prep
Artichoke thistle, Orange County



Grazing
Erosion

+



Artichoke thistle₁₉₉₈



Herbicide
Control

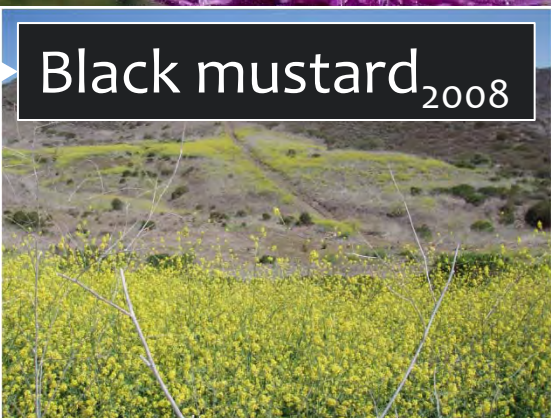
+



Needlegrass₂₀₀₈

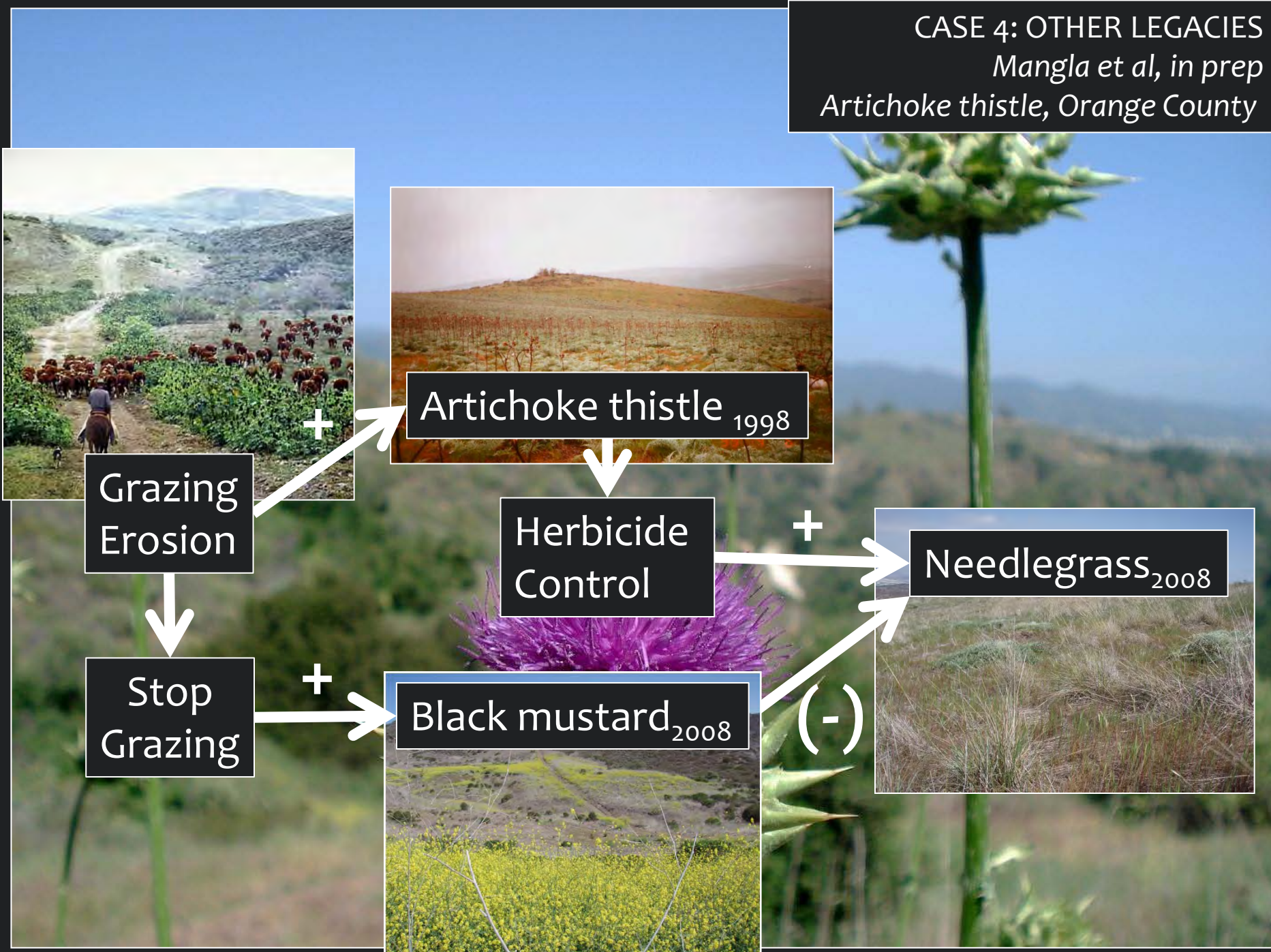
Stop
Grazing

+



Black mustard₂₀₀₈

(-)





Dispersal

Native seed limitation
Invasive propagule pressure

Restoration in the face of soil legacies



Transitional plantings
(Herron et al 2001)



Less susceptible
natives
(Jordon et al 2008)

Topsoil removal (Holzel and
Otte 2003)



Host-specific
mycorrhizae
(Klironomos et al
2011)

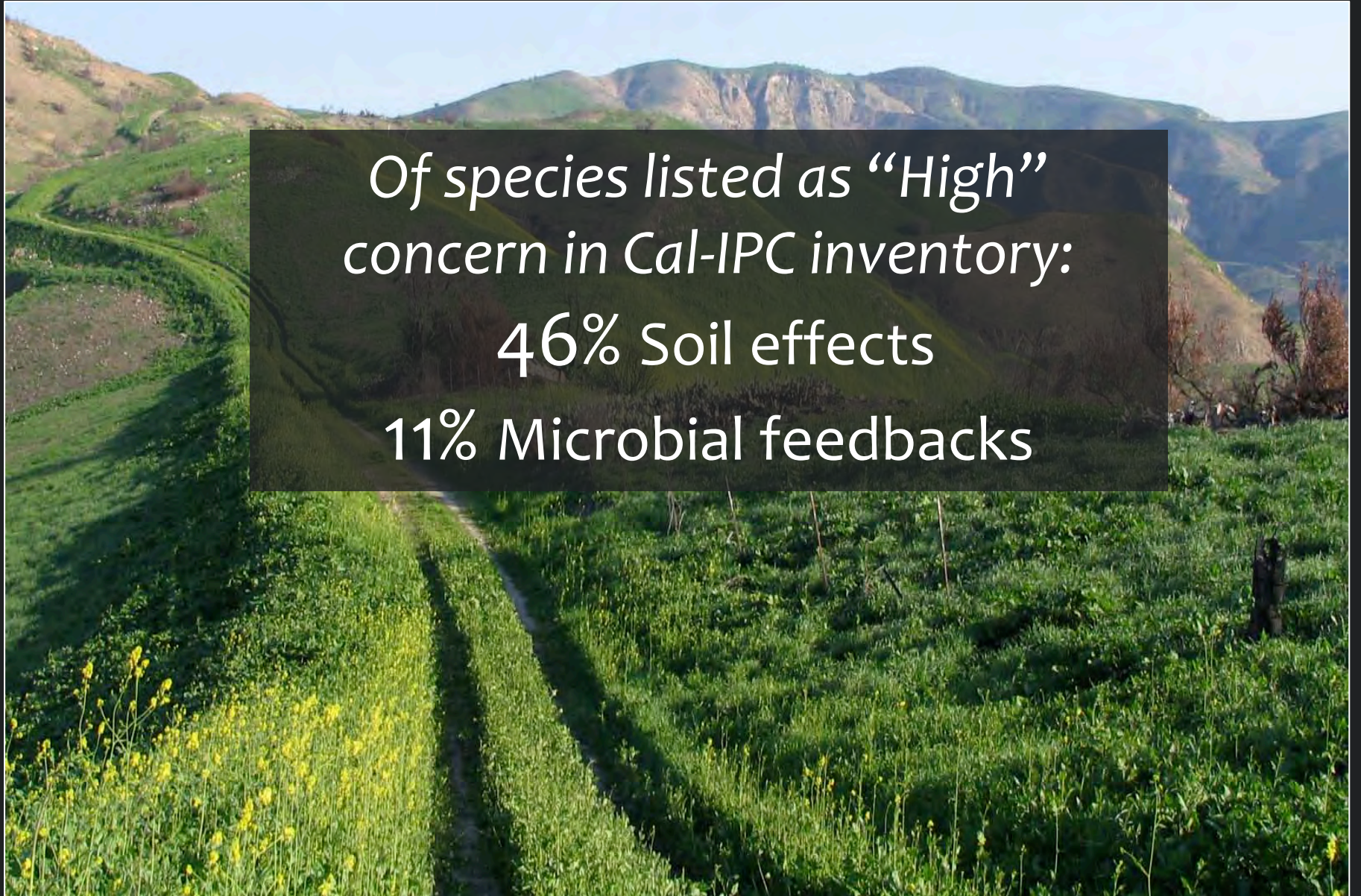


Many unknowns

*Of species listed as “High”
concern in Cal-IPC inventory:*

46% Soil effects

11% Microbial feedbacks



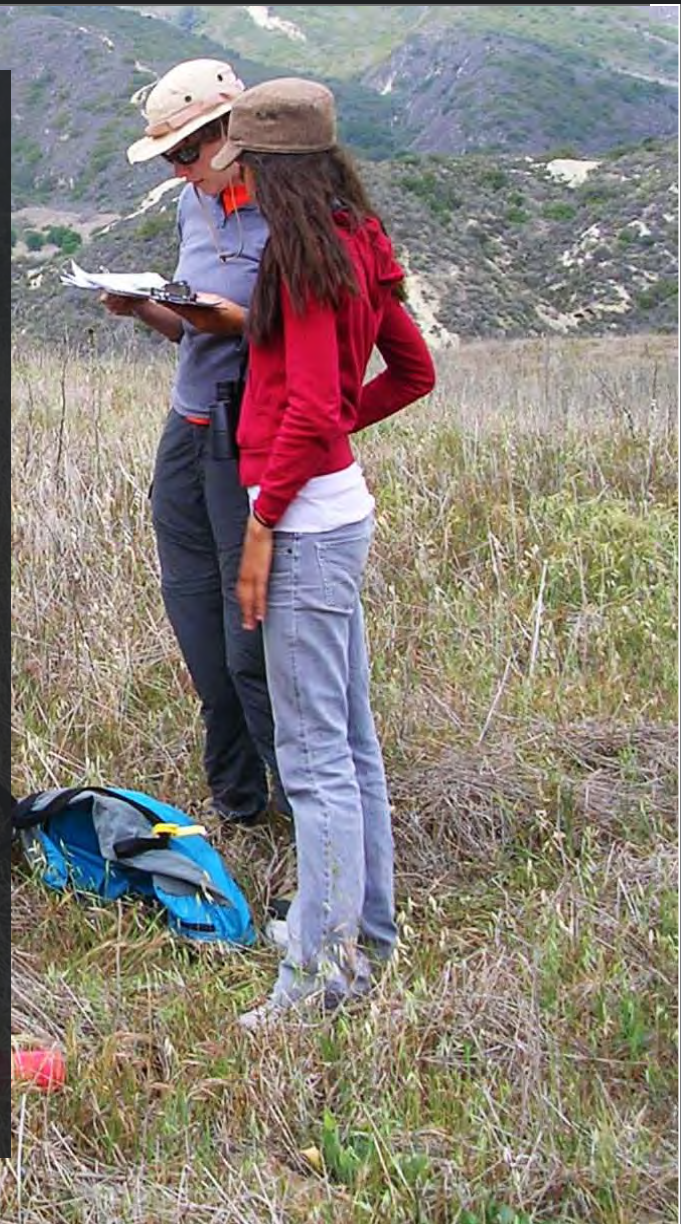
Generalities

Time and invader density increase severity: get them early!

Species that impact nutrient pools and microbial composition likely to have longer-lasting legacies.

Positive feedbacks likely the exception rather than rule.

View in the larger context of other constraints: land-use, climate change, seed limitation.



Thanks

