Positive feedback loops of invasive grasses: breaking the cycle

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Cal-IPC Symposium

Acknowledgements

- D’Antonio VEG Lab
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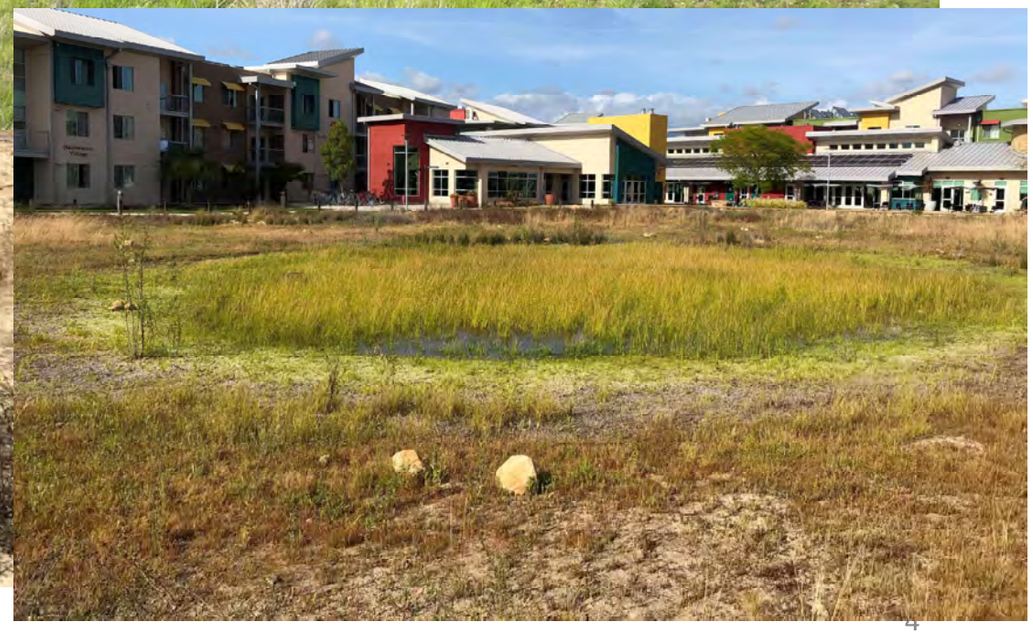
- Valerie Olson
- D’Antonio Lab
- & all staff, student workers, & interns!

What are vernal pools?

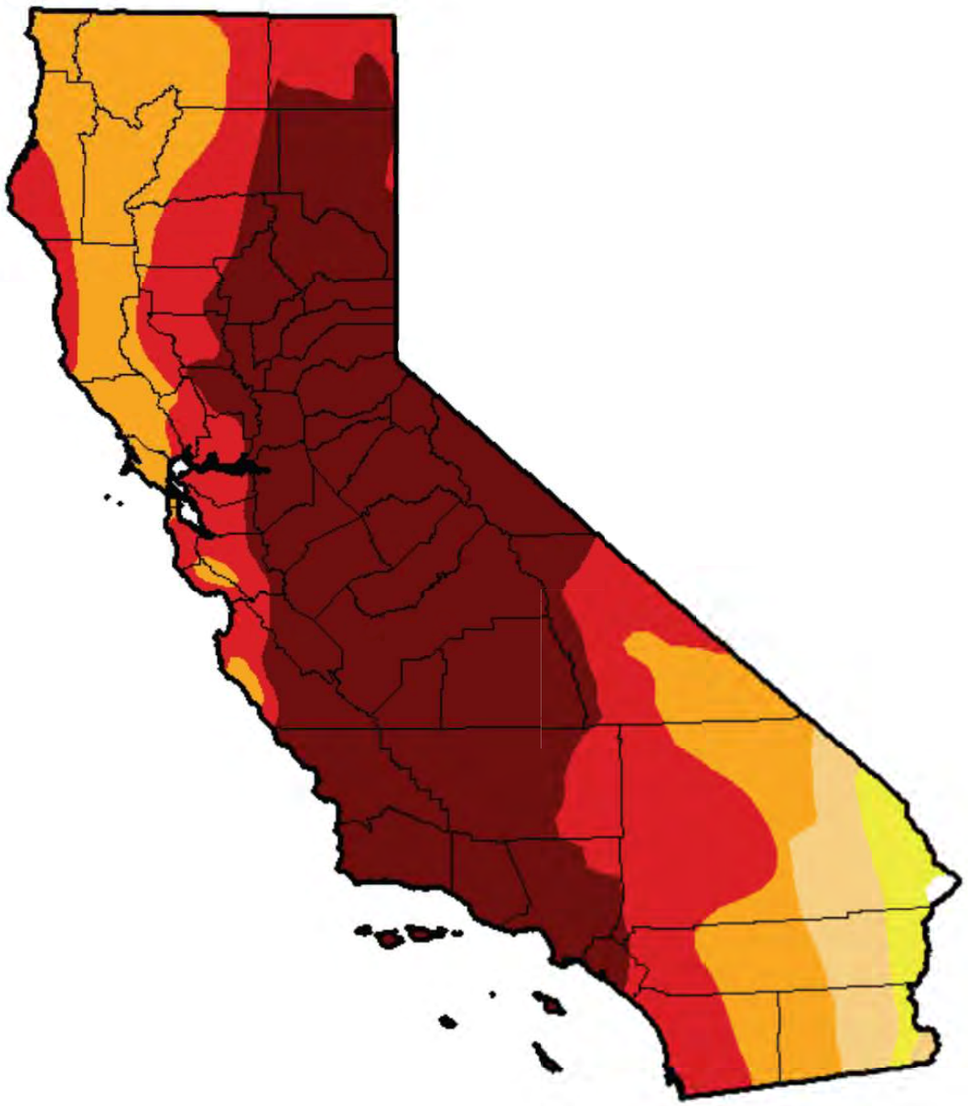
- Seasonally-flooded, rainfed wetlands



What are vernal pools?

- Seasonally-flooded, rainfed wetlands
- High biodiversity & endemism
- **Endangered ecosystem**: <5% of historic range remains

U.S. Drought Monitor
California



September 15, 2015

(Released Thursday, Sep. 17, 2015)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.14	99.86	97.33	92.36	71.08	46.00
Last Week 9/8/2015	0.14	99.86	97.35	92.36	71.08	46.00
3 Months Ago 6/16/2015	0.14	99.86	98.71	94.59	71.08	46.73
Start of Calendar Year 12/30/2014	0.00	100.00	98.12	94.34	77.94	32.21
Start of Water Year 9/30/2014	0.00	100.00	100.00	95.04	81.92	58.41
One Year Ago 9/16/2014	0.00	100.00	100.00	95.42	81.92	58.41

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:

Chris Fenimore

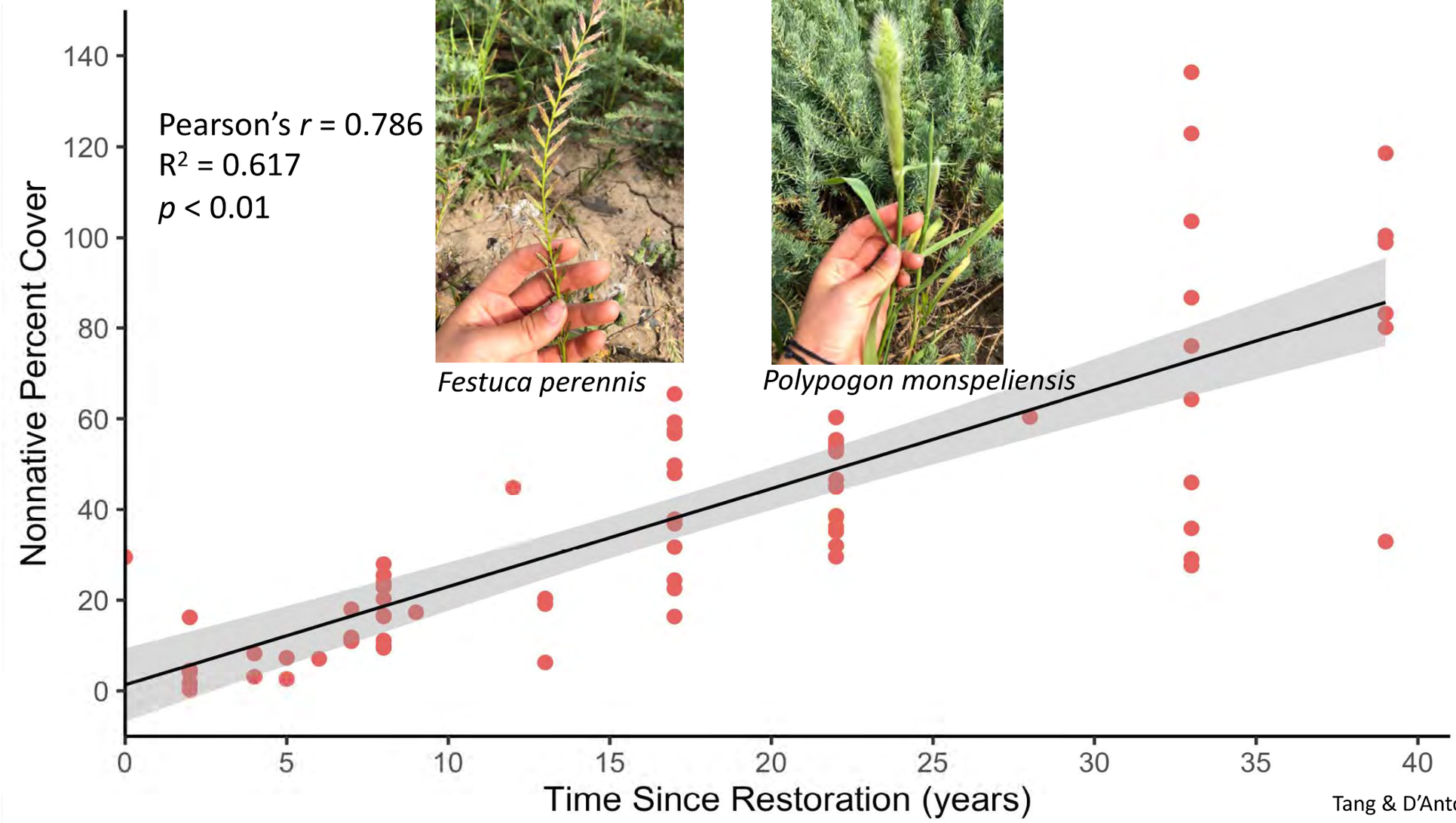
NOAA/NESDIS/NCEI

http://droughtmonitor.unl.edu/

Nonnative cover increases over time

Festuca perennis

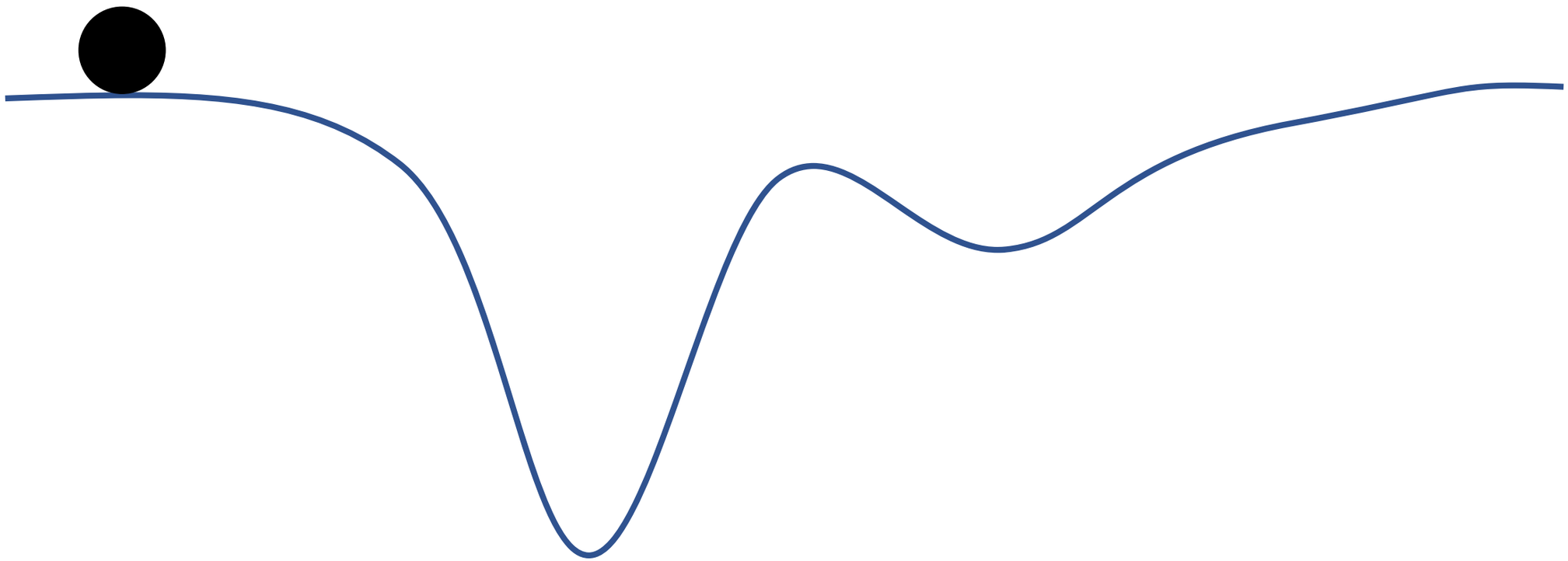
Polypogon monspeliensis



Tang & D'Antonio, *unpublished data*

Alternative Stable States

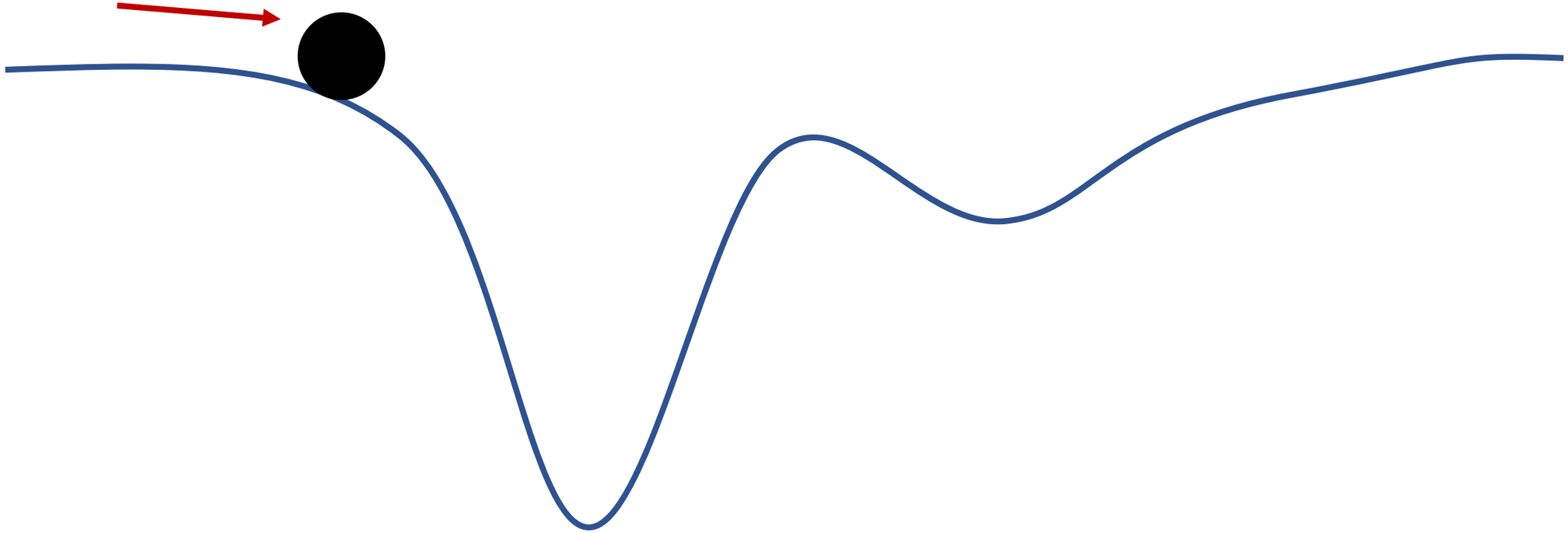
In-tact ecosystem



Alternative Stable States

In-tact ecosystem

Degradation



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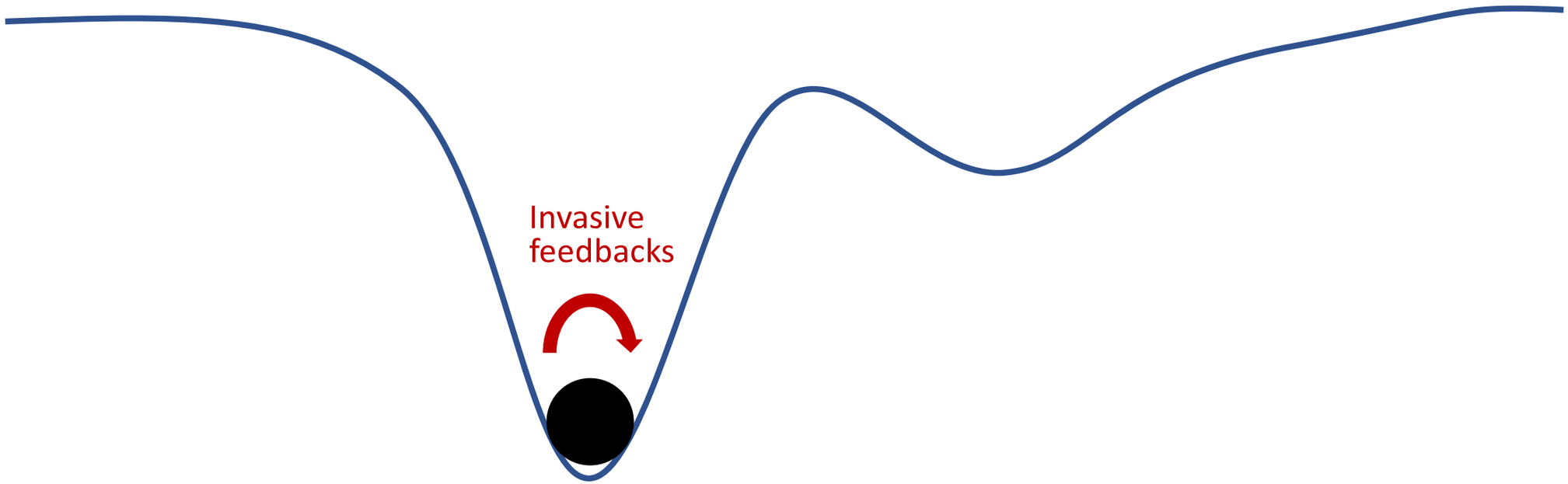

Invaded ecosystem

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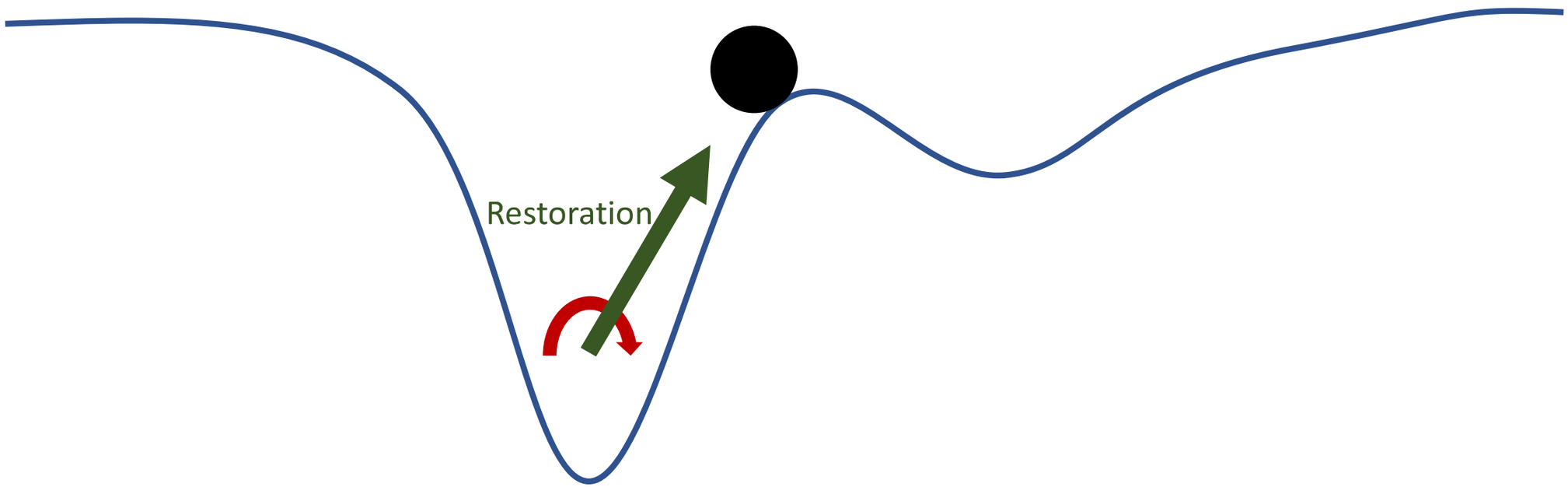
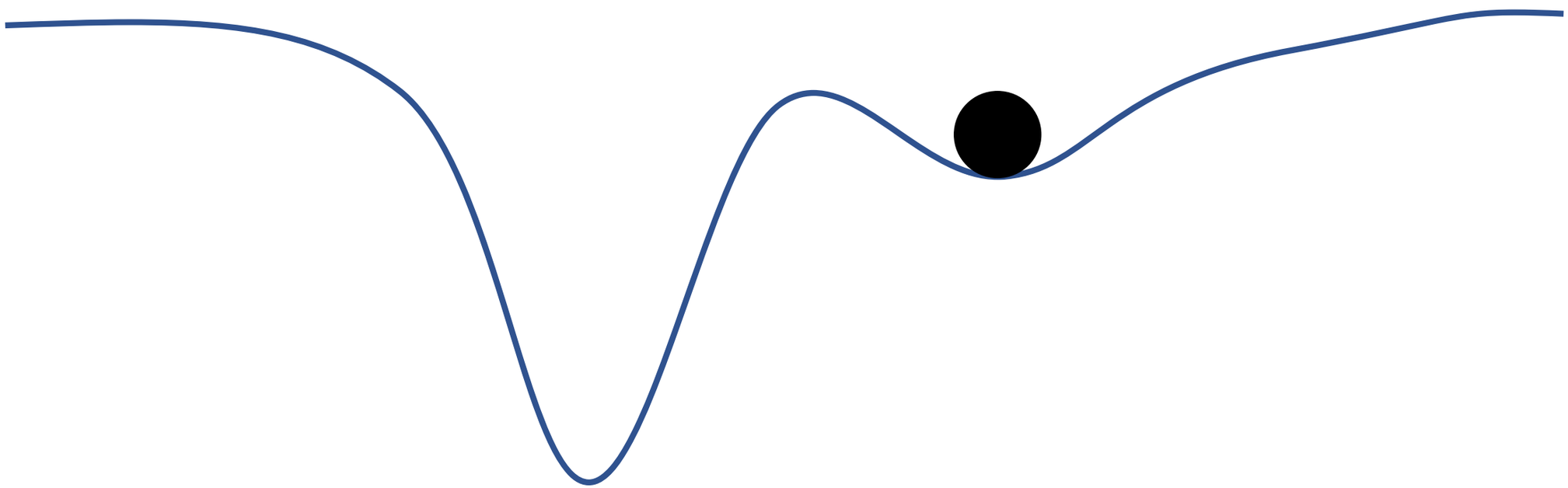


Invaded ecosystem

Alternative Stable States

In-tact ecosystem

Restored ecosystem



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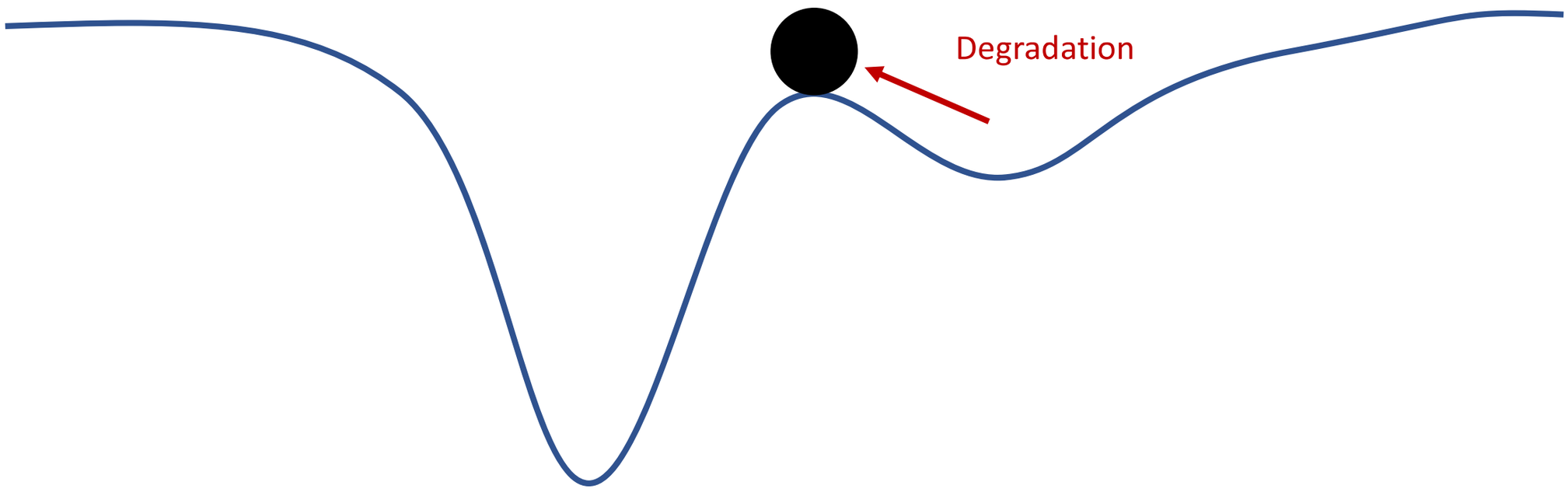

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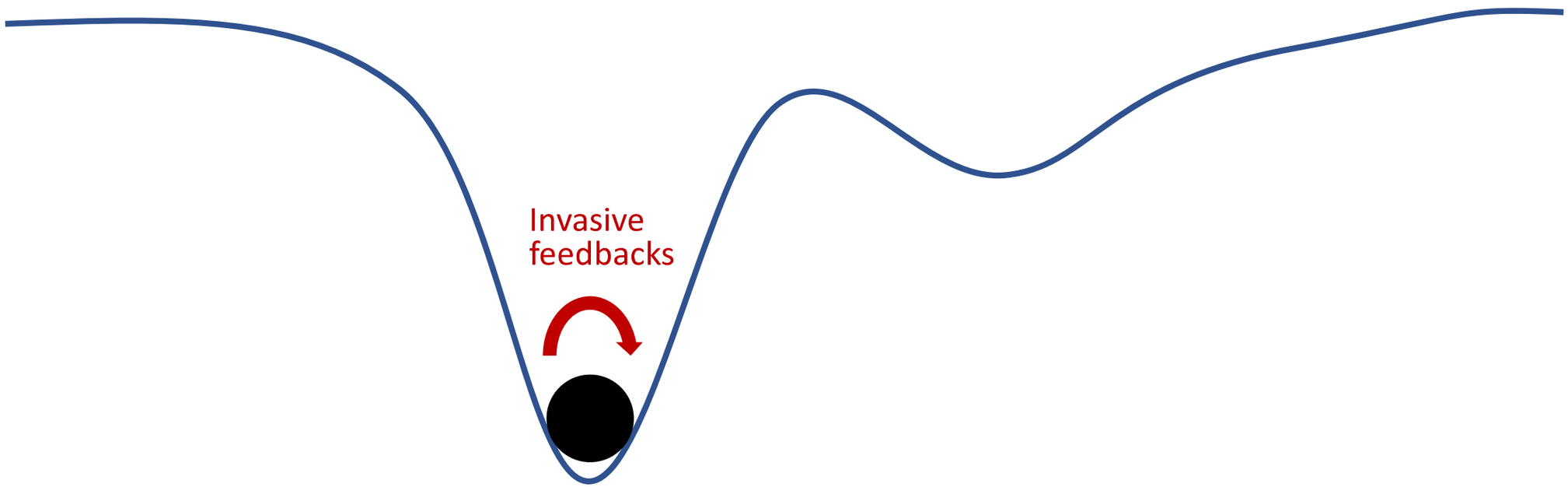

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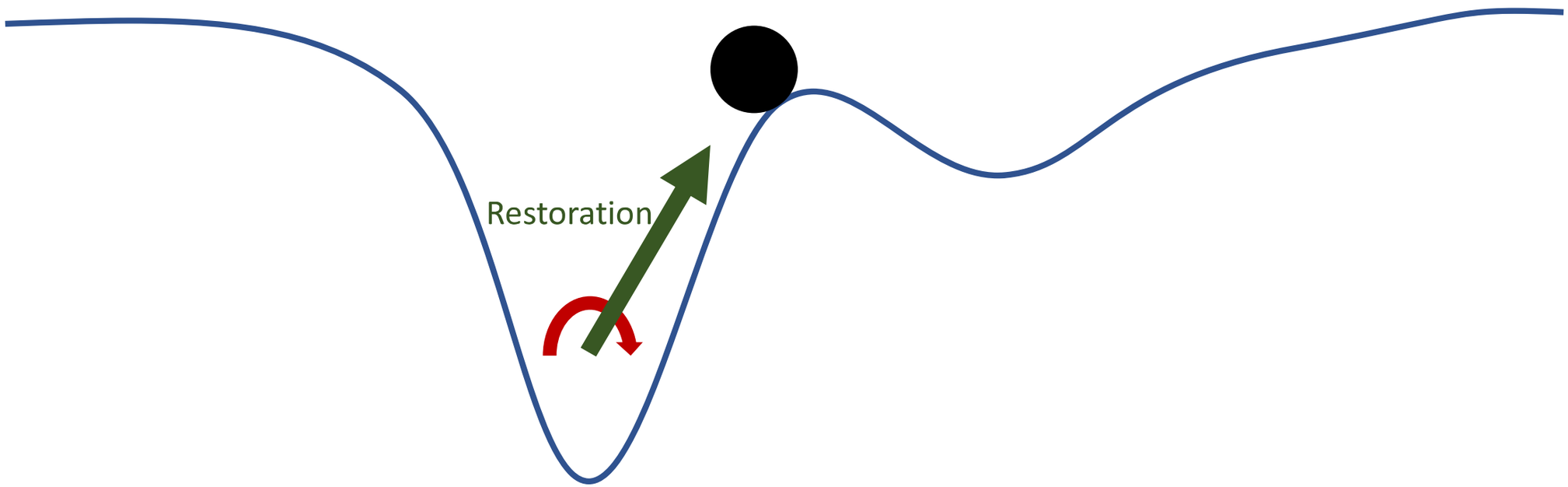

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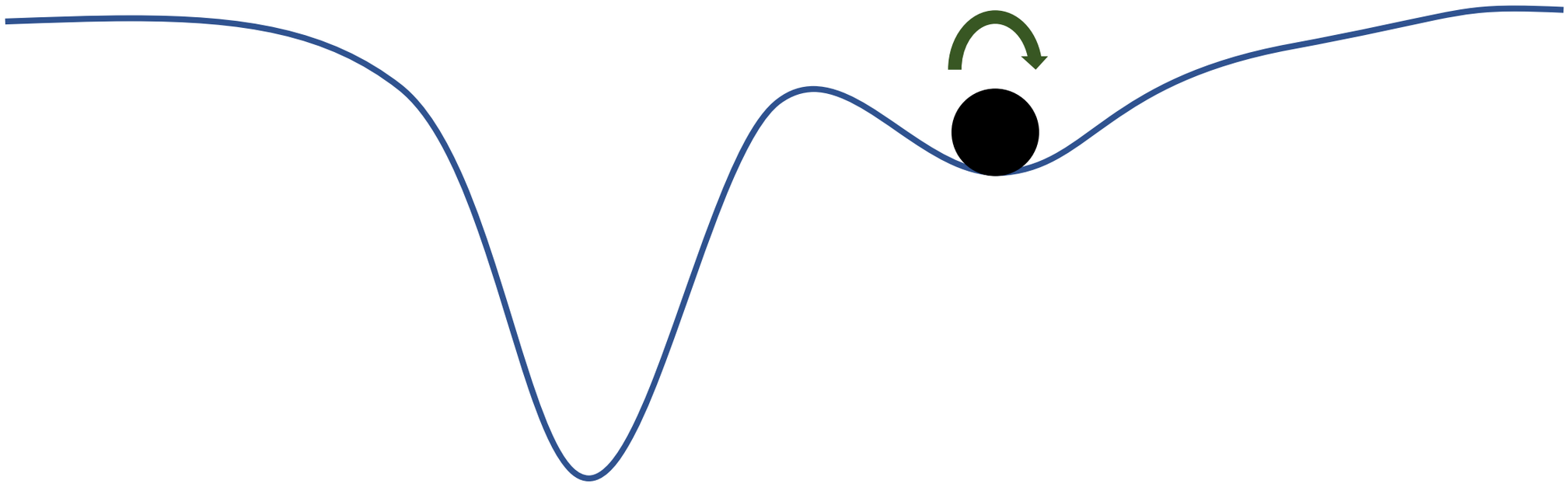
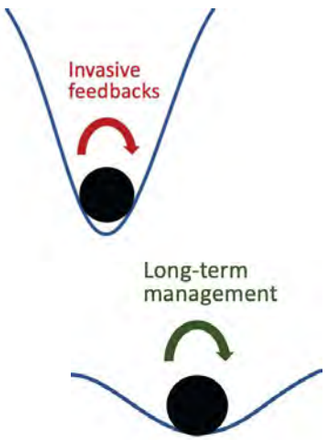
Long-term management



Invaded ecosystem

How can invasive feedbacks be overcome to sustain a stable restored ecosystem?



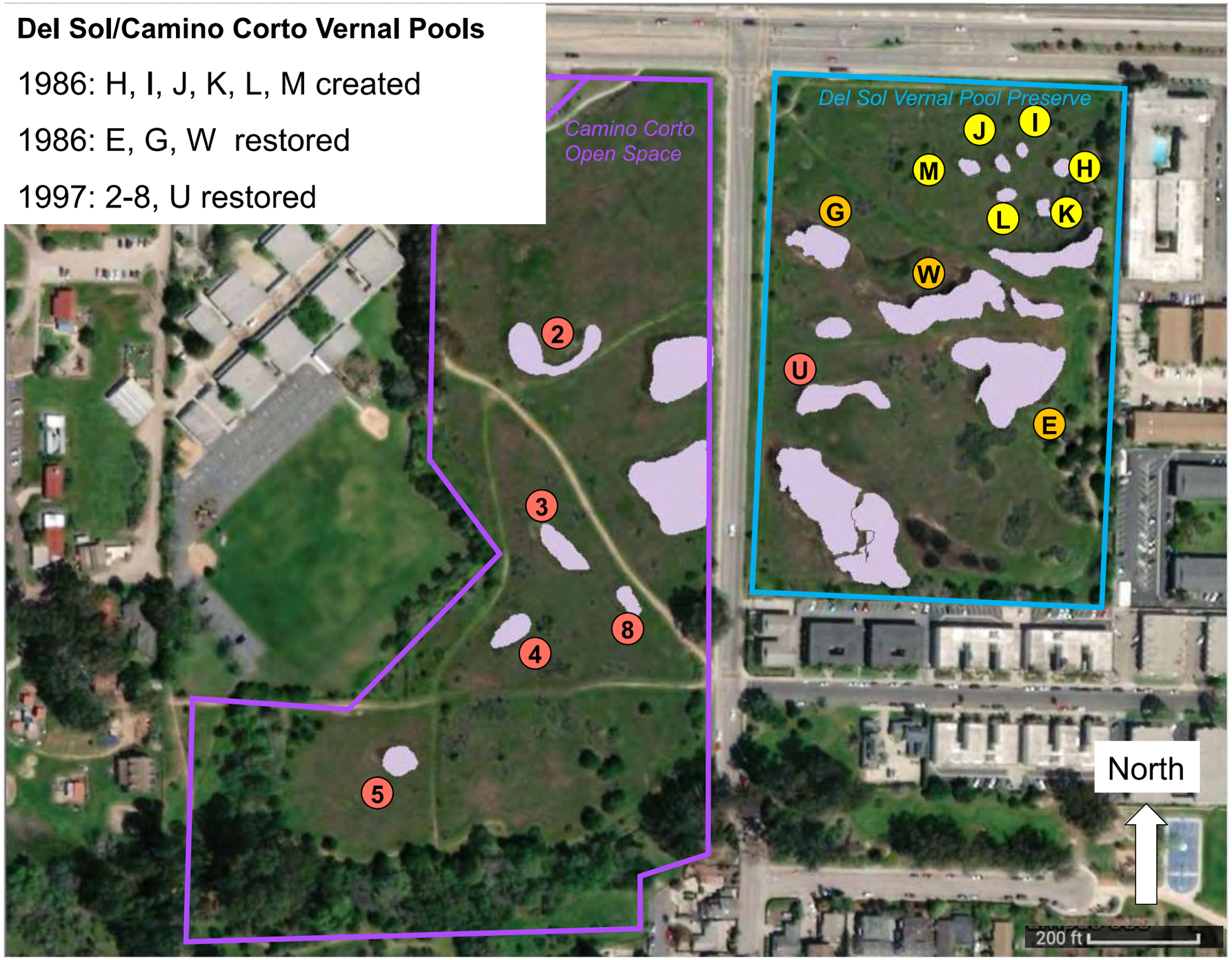
- **H1:** Layer of built-up thatch promotes nonnative germination but suppresses native germination
  → Annual summer removal of thatch will decrease nonnative cover & increase native cover
- **H2:** Build-up of thatch prevents native seed rain from contributing to the seed bank
  → Annual addition of native seed will further increase native diversity

Del Sol/Camino Corto Vernal Pools

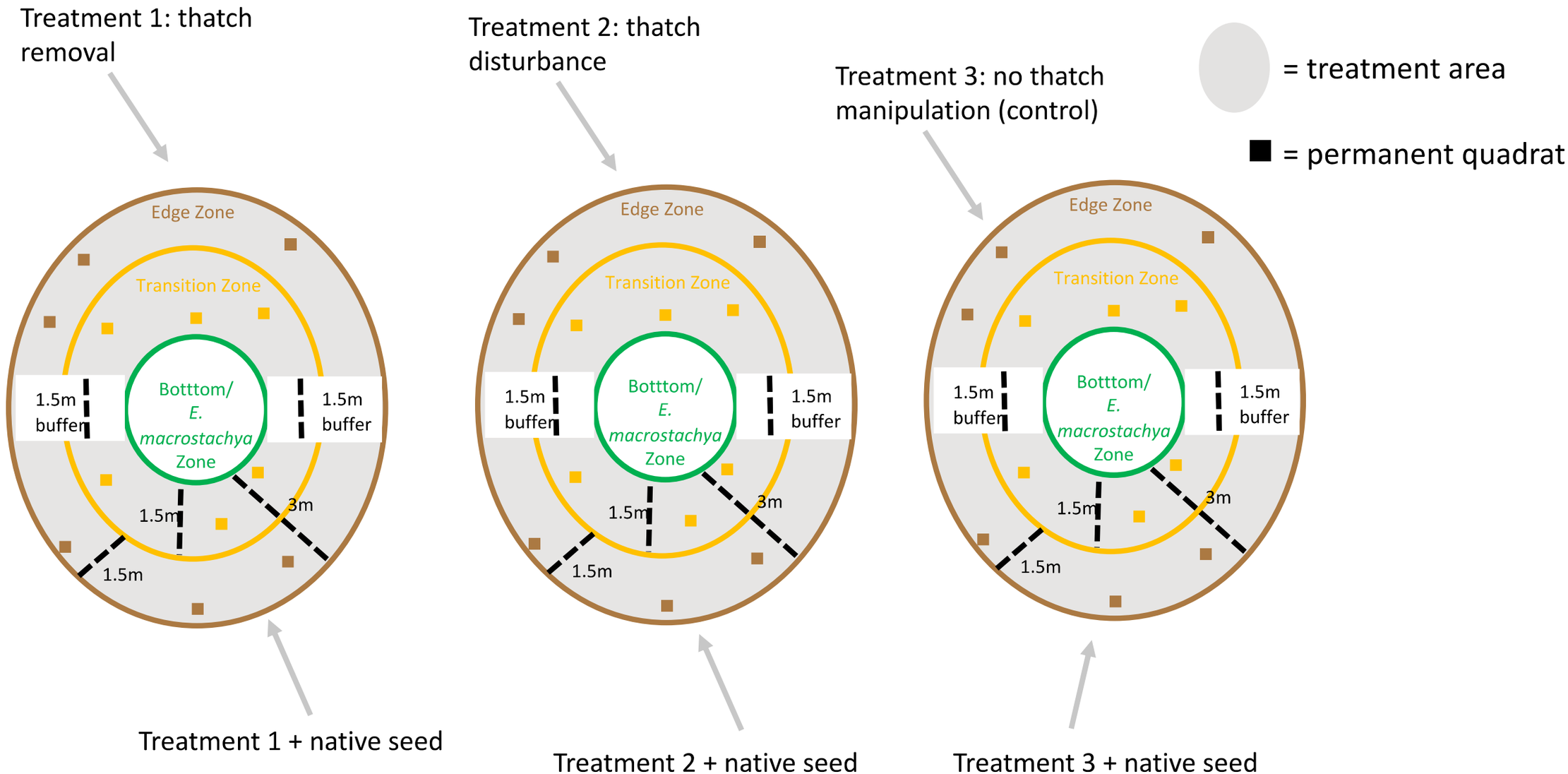
1986: H, I, J, K, L, M created

1986: E, G, W restored

1997: 2-8, U restored



Blocked experimental design: 1 block = 3 pools



Blocked experimental design: 1 block = 3 pools

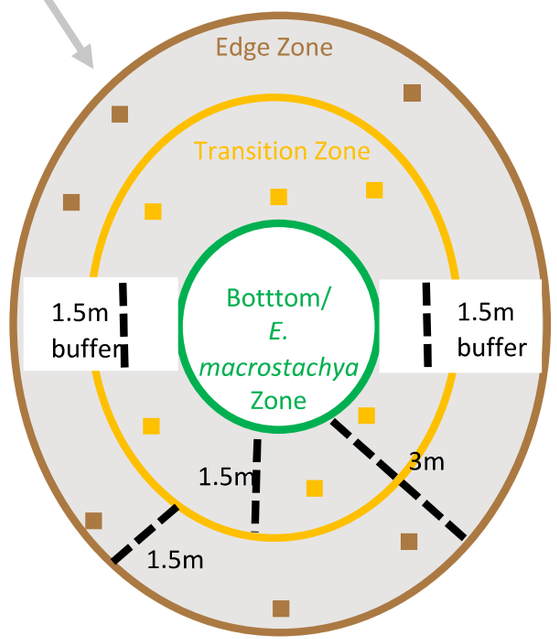
Treatment 1: thatch removal

Treatment 2: thatch disturbance

Treatment 3: no thatch manipulation (control)

Treatment 1 + native seed

Treatment 2 + native seed



Treatment 3 + native seed

Phalaris lemmonii

Hordeum brachyantherum

Stipa pulchra

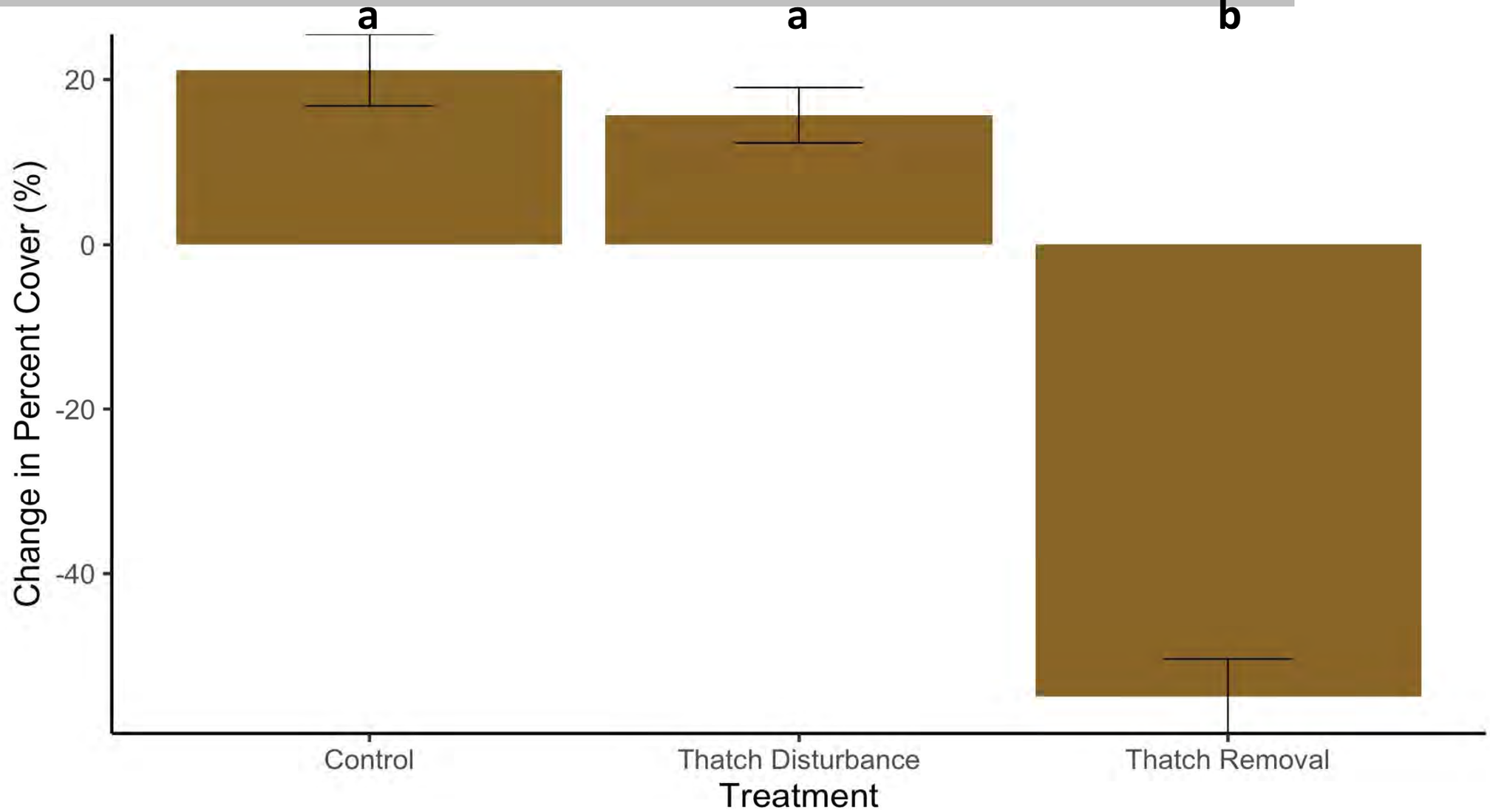
Juncus bufonius

Juncus occidentalis

Grindelia camporum

Eryngium vaseyi

Thatch removal decreased thatch cover



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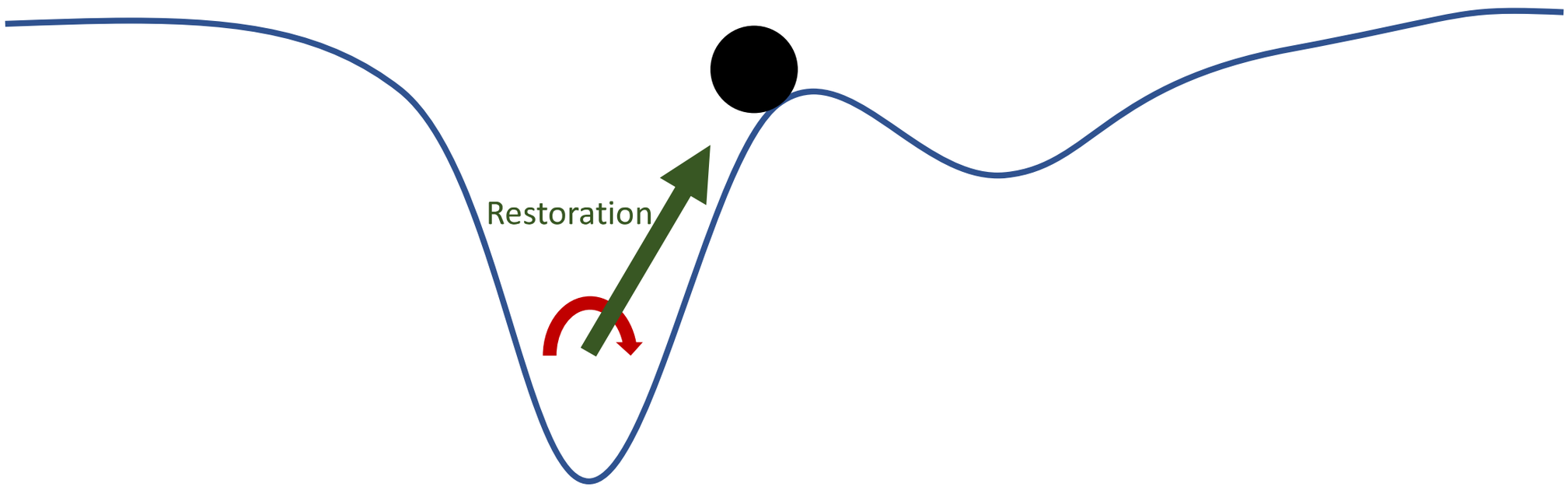

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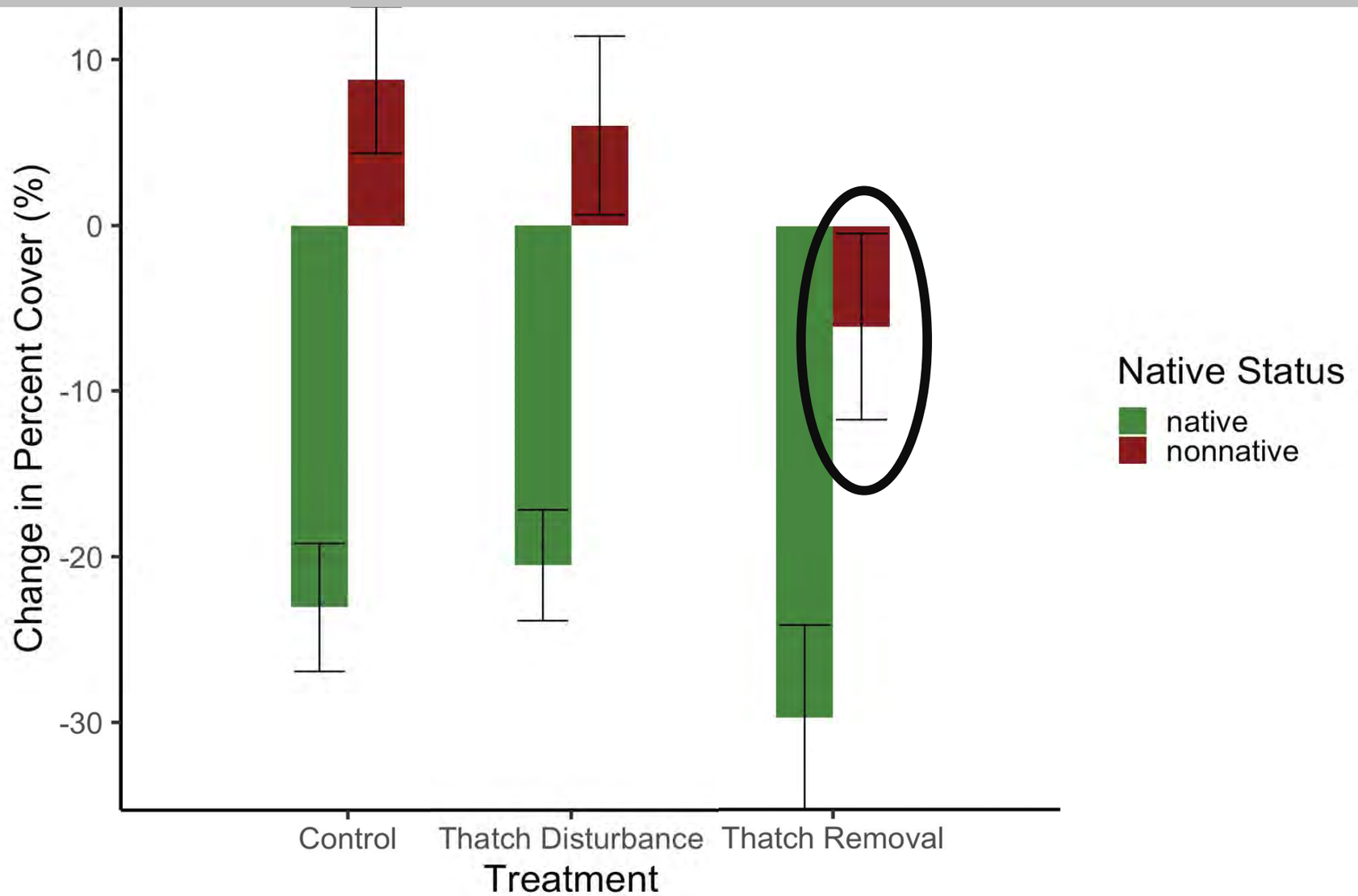
Thatch removal decreased nonnative cover



How can invasive feedbacks be overcome to sustain a stable restored ecosystem?

- **H1:** Layer of built-up thatch promotes nonnative germination but suppresses native germination

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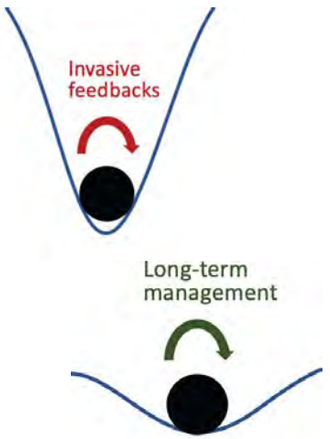
- **H2:** Build-up of thatch prevents native seed rain from contributing to the seed bank

  → Annual addition of native seed will further increase native diversity



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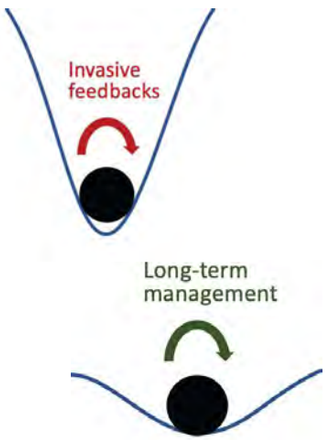

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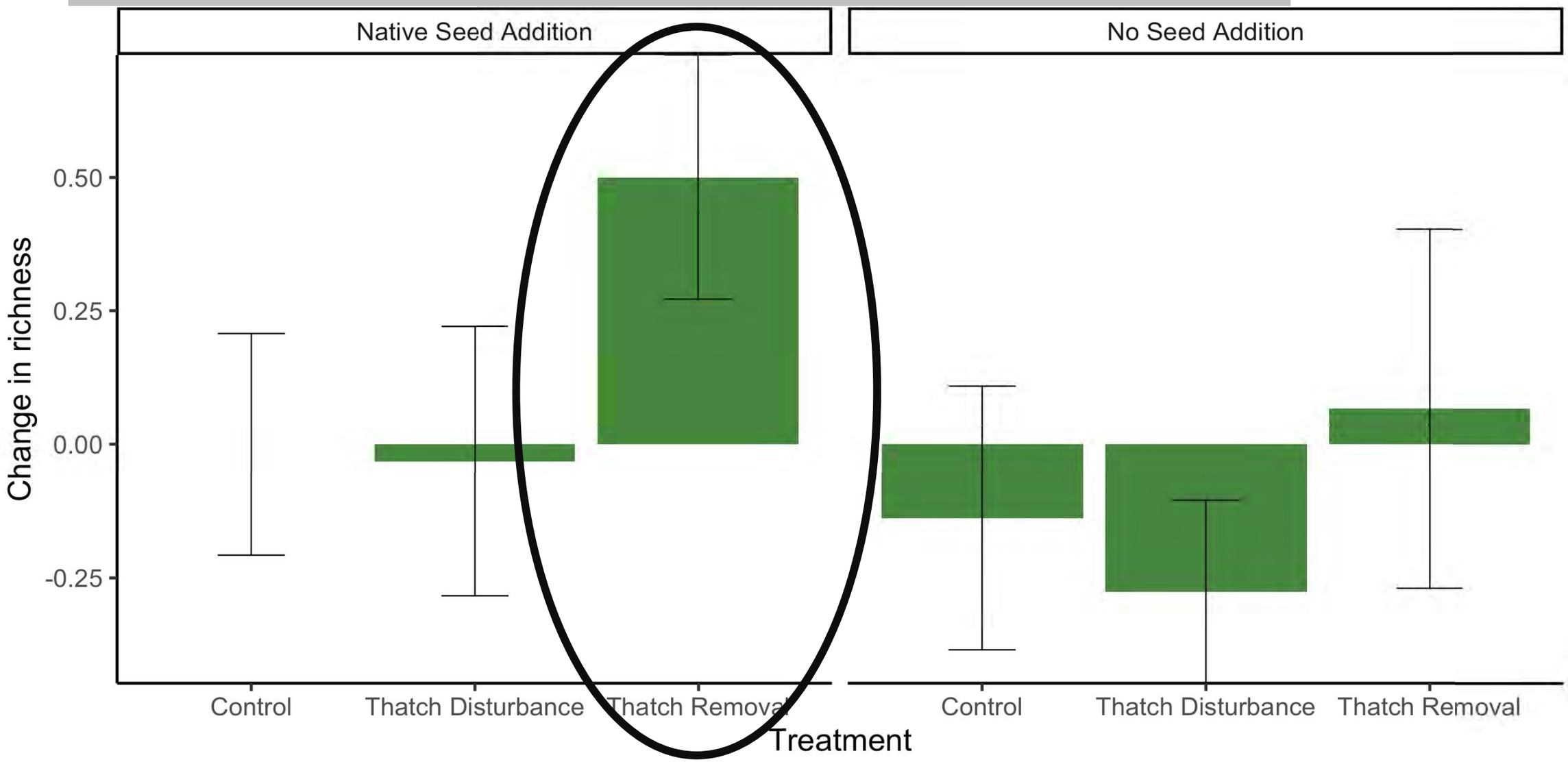
Seed addition increased native richness



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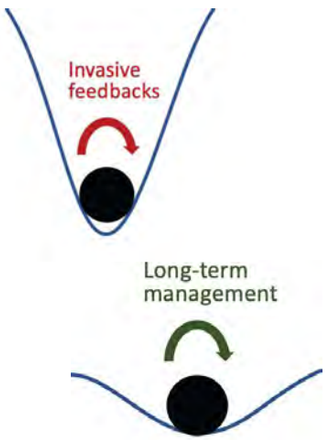

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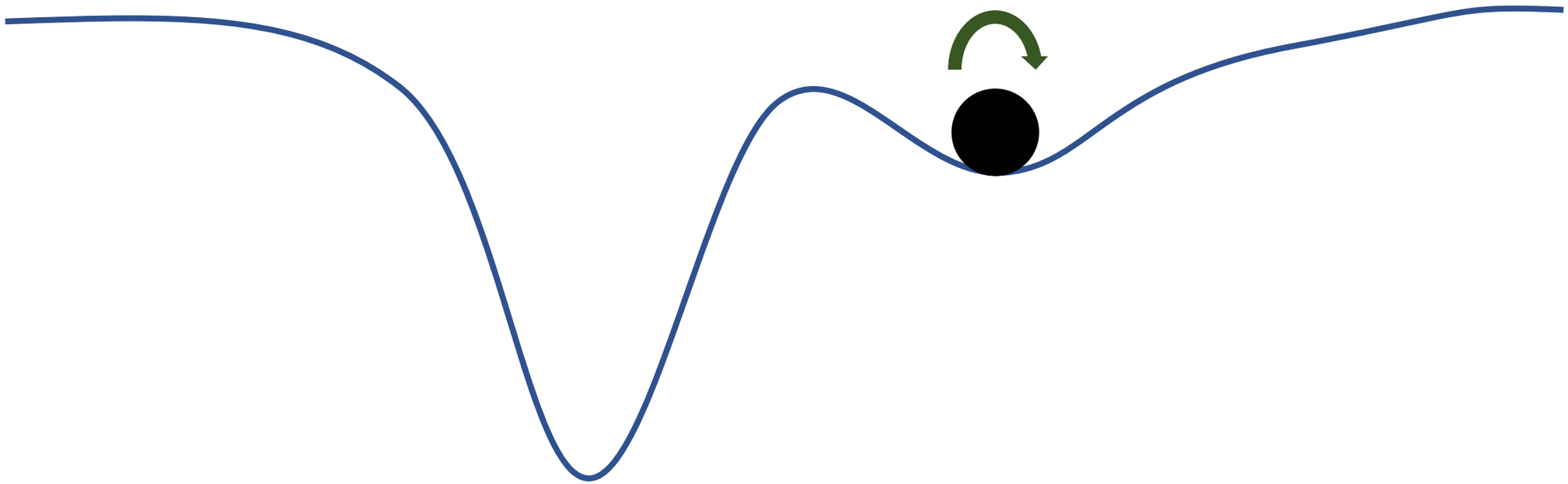

Invaded ecosystem

Conclusions & Implications for Management

- Restoration projects must include long-term management plans
  - ✓ to ensure site stability
  - ✓ that target invasive feedbacks
  - ✓ that are feasible (cost-effective & time-efficient)

Summer	Fall	Winter	Spring
Thatch removal	*Native seed addition*	*Hydrology monitoring*	*Vegetation monitoring*