

Experimental Habitat Restorations as Tests of Climate Adaptation Strategies

Chris Nadeau, Northeastern University

Randall Hughes, Northeastern University

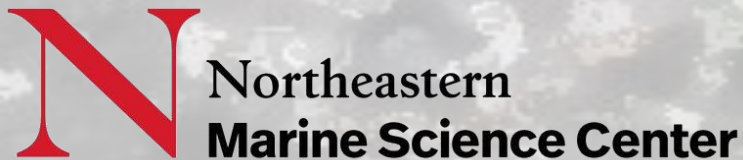
Abe-Miller Rushing, Acadia National Park

Nick Fisichelli, Schoodic Institute

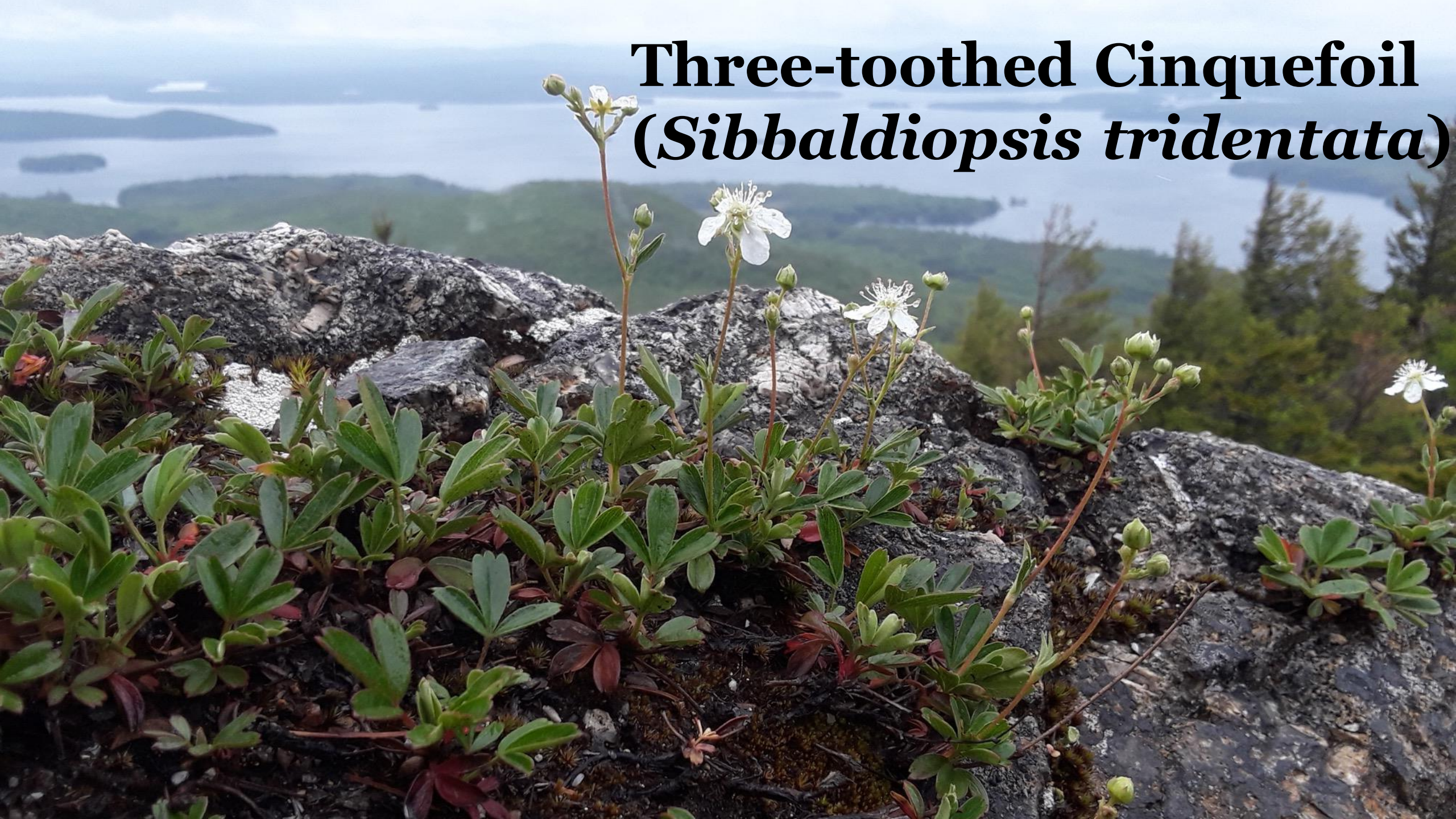
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Three-toothed Cinquefoil
(*Sibbaldiopsis tridentata*)



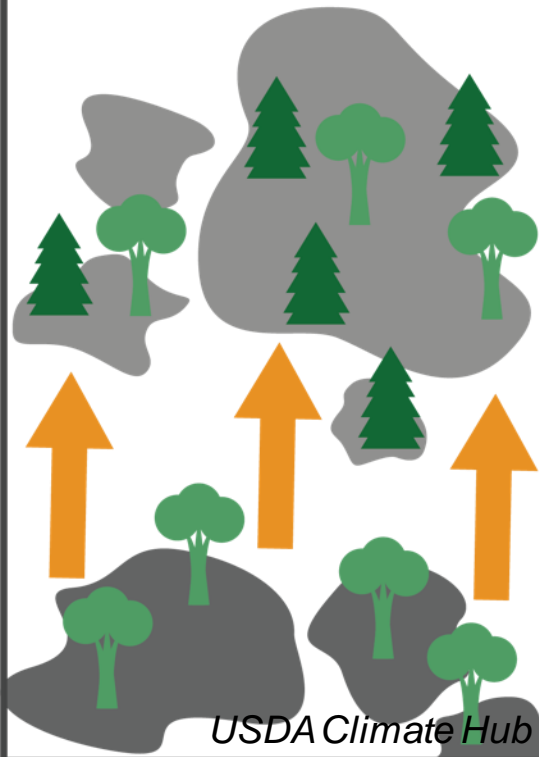
Three-toothed Cinquefoil
is highly sensitive to temperature increases.

98%

predicted habitat loss in Maine by 2100.

Dozens of Climate Change Adaptation Strategies Have Been Proposed

Assisted Migration



Protect Refugia



Reduce Non-climate Stressors



Increase Species Diversity



84%

**of proposed adaptation strategies
have NO empirical support**



Contents lists available at [ScienceDirect](#)

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon



Review

A good idea or just an idea: Which adaptation strategies for conservation are tested?

L.J. Hansen^{*}, K.N. Braddock, D.A. Rudnick

EcoAdapt, P.O. Box 11195, Bainbridge Island, WA 98110, USA



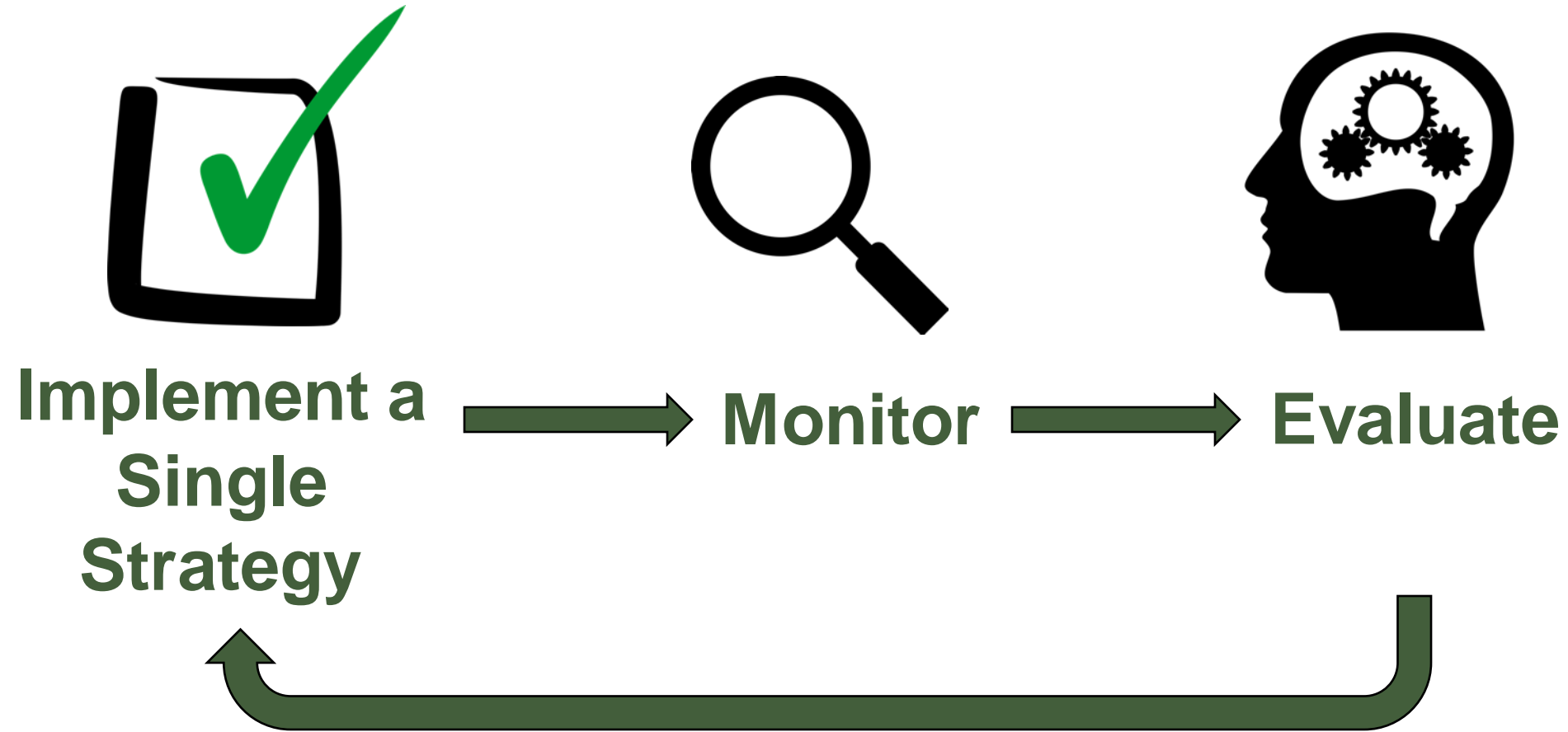
Take Home #1

we need more on-the-ground tests of
climate adaptation strategies

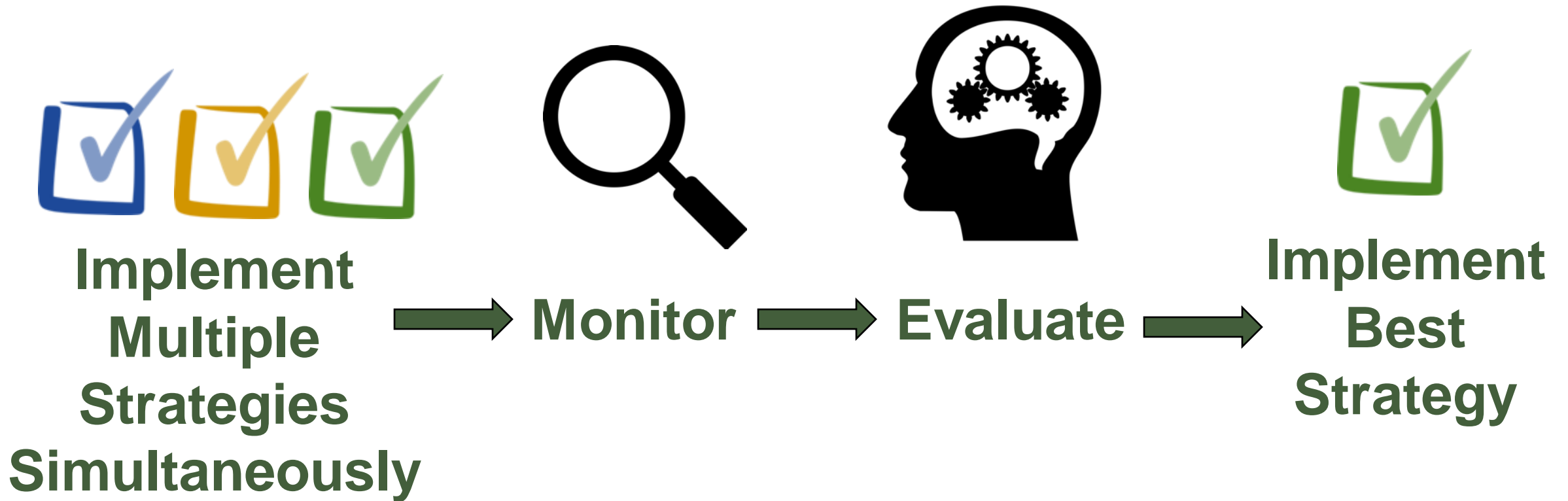
Learning-Doing Tradeoff is Limiting Action



A Common Form of Adaptive Management Is Too Slow



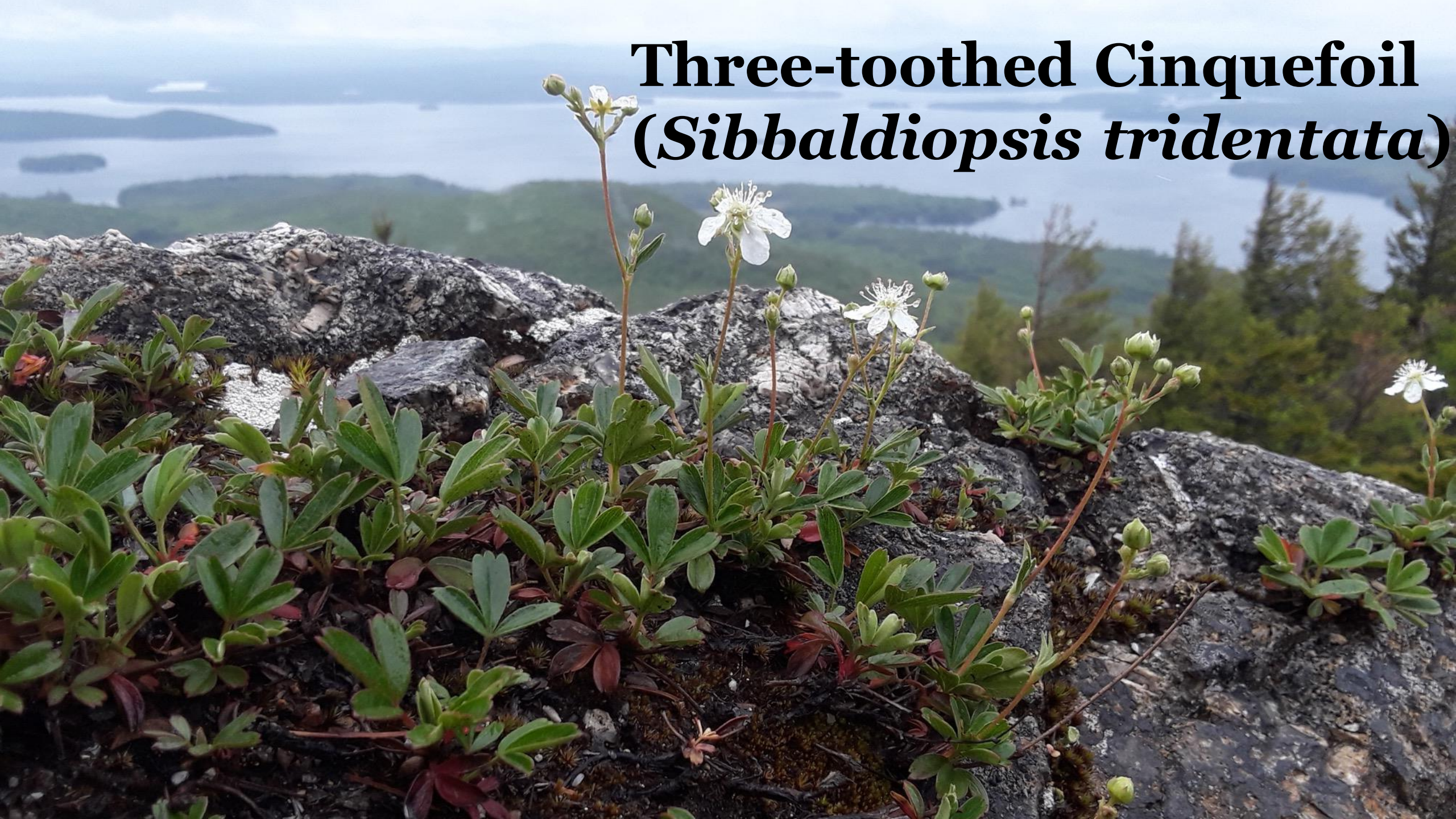
Experimental Adaptation as a New Way Forward



Take Home #2

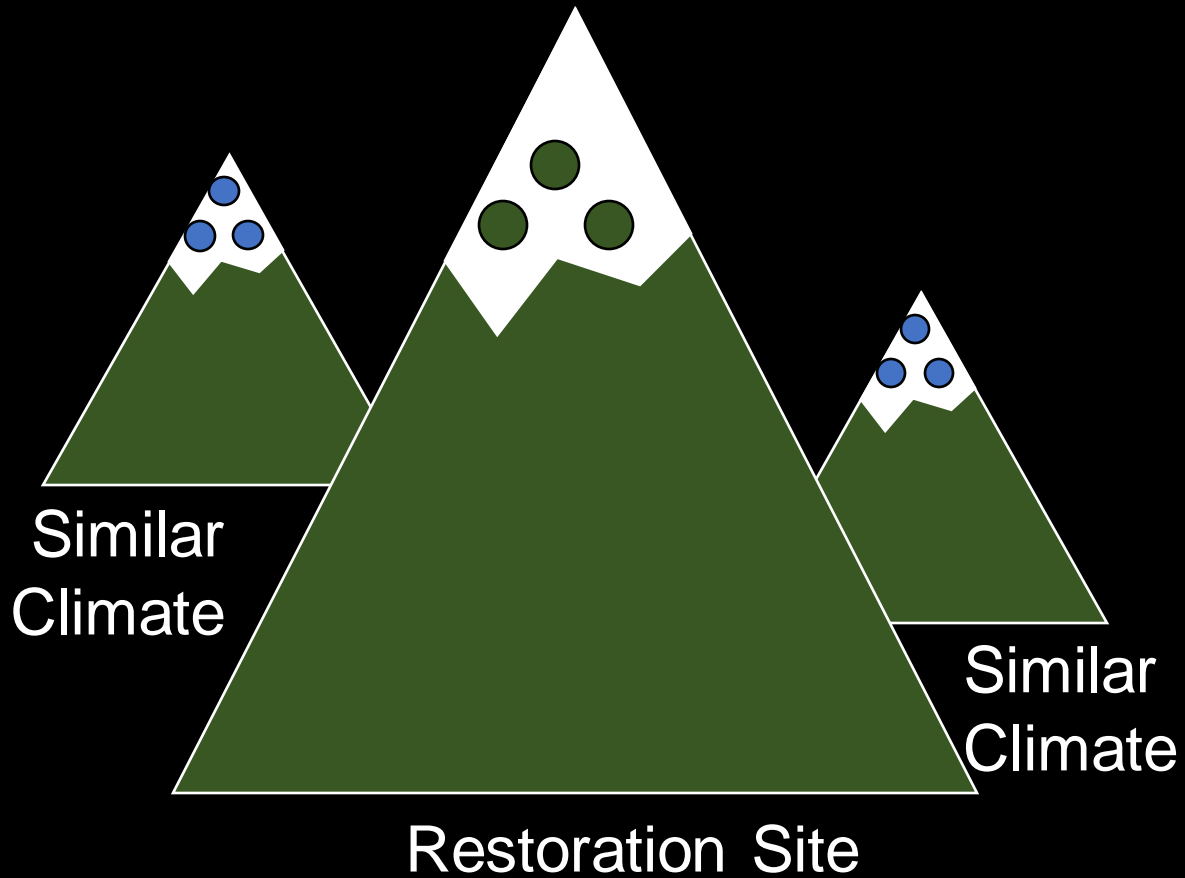
Implementing multiple adaptation strategies simultaneously increases the rate of learning

Three-toothed Cinquefoil
(*Sibbaldiopsis tridentata*)

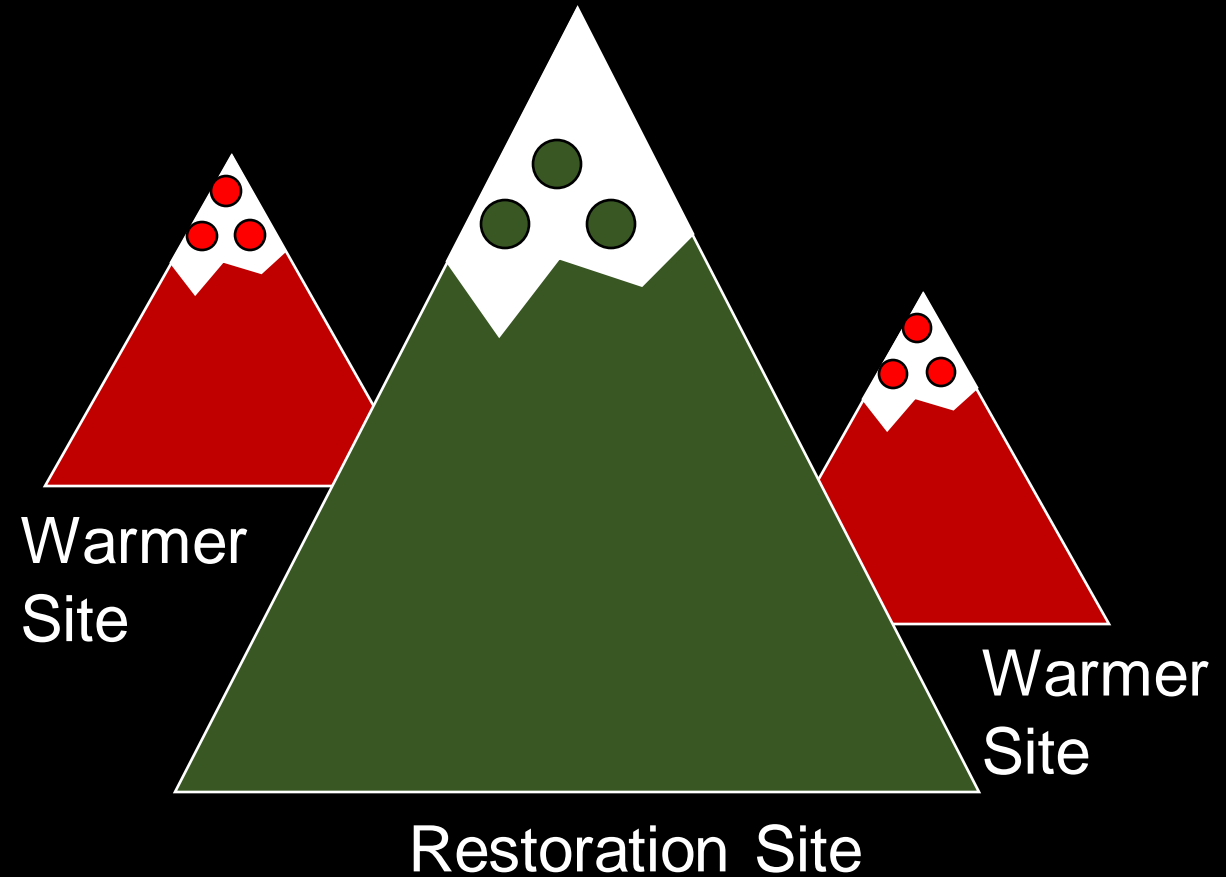


Potential Climate Change Adaptation Strategies

Increase Genetic Variation

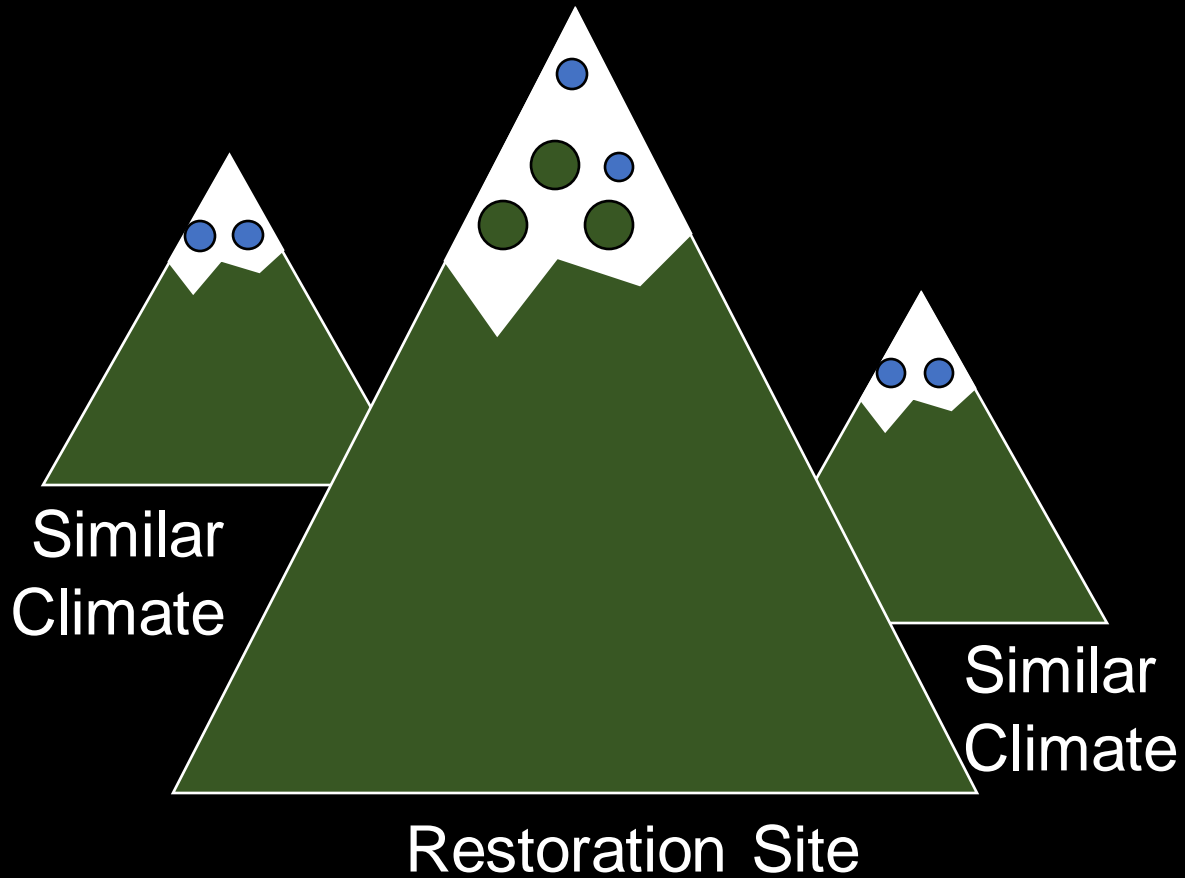


Add Pre-adapted Genotypes

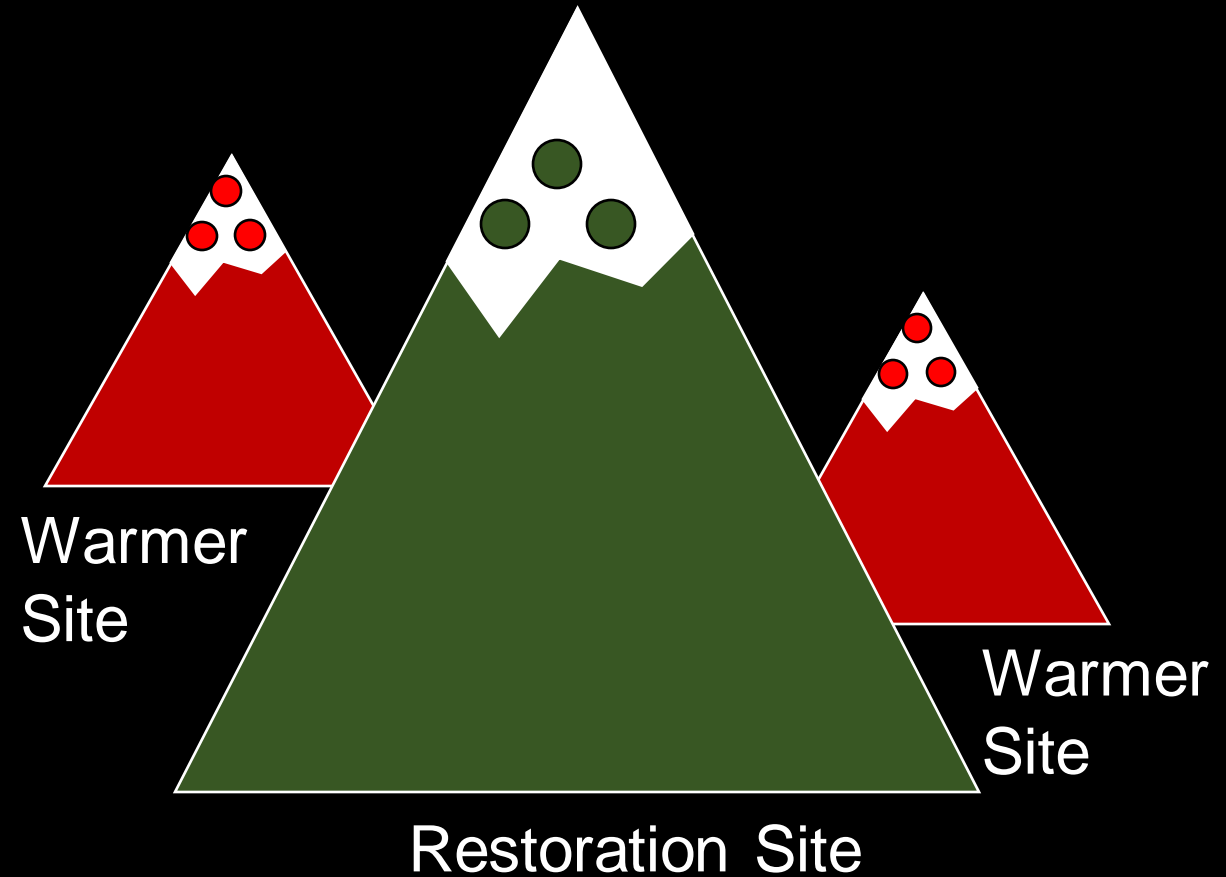


Potential Climate Change Adaptation Strategies

Increase Genetic Variation

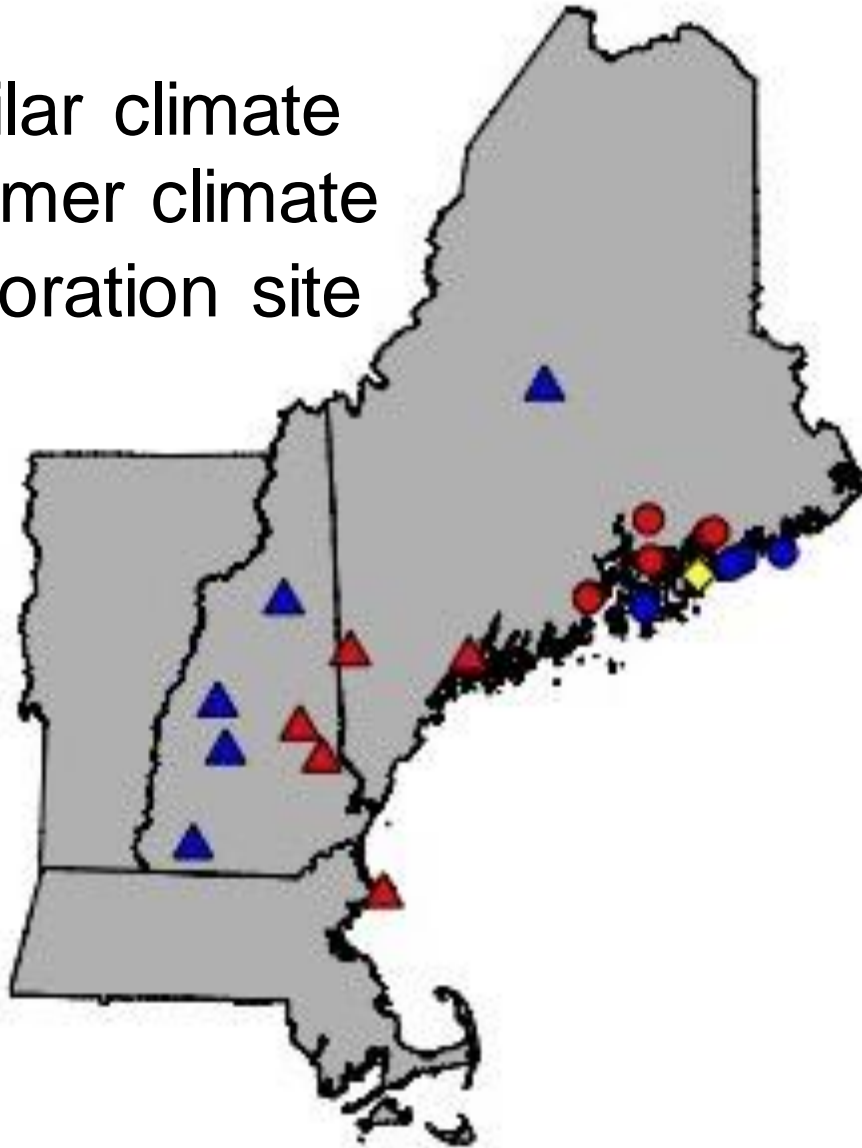


Add Pre-adapted Genotypes

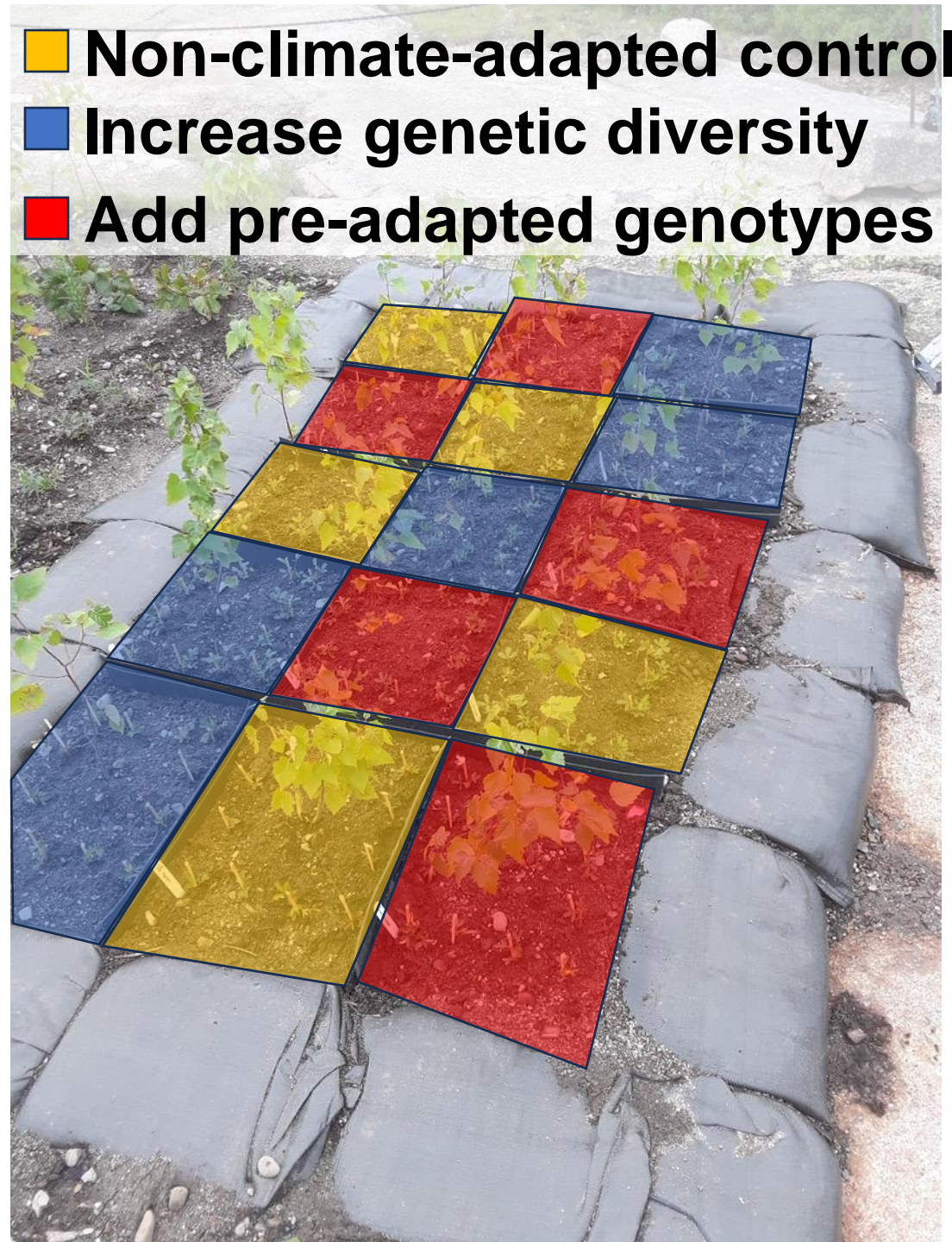


31 Collection Sites

- similar climate
- warmer climate
- ◆ restoration site



- Non-climate-adapted control
- Increase genetic diversity
- Add pre-adapted genotypes





Great Meadow *Friends of Acadia*



Friends of Acadia **Bass Harbor Marsh**

Glossy Buckthorn (*Frangula alnus*)



Nicole Kollars



National Park Service



Climate Change Could Exacerbate Invasive Species

Drying from Longer
Periods Between Rain
Events



Drying from
From Adaption to
Storms



Longer Growing
Season



Management Options

Removal Only
(current practice)



Removal +
Plant Graminoids



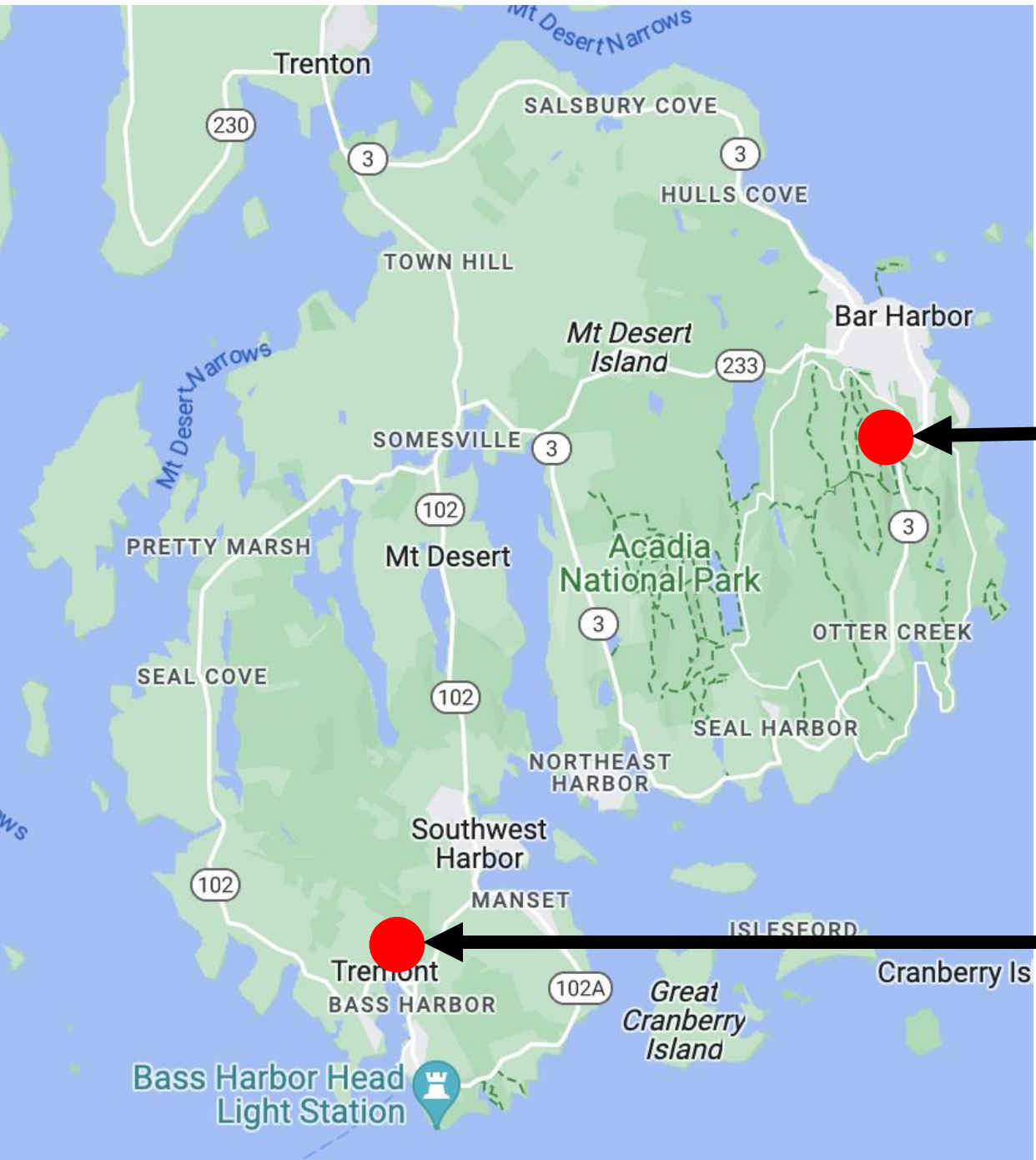
Removal +
Plant Shrubs



15 Plots in Different Environmental Conditions

Great Meadow
8 plots

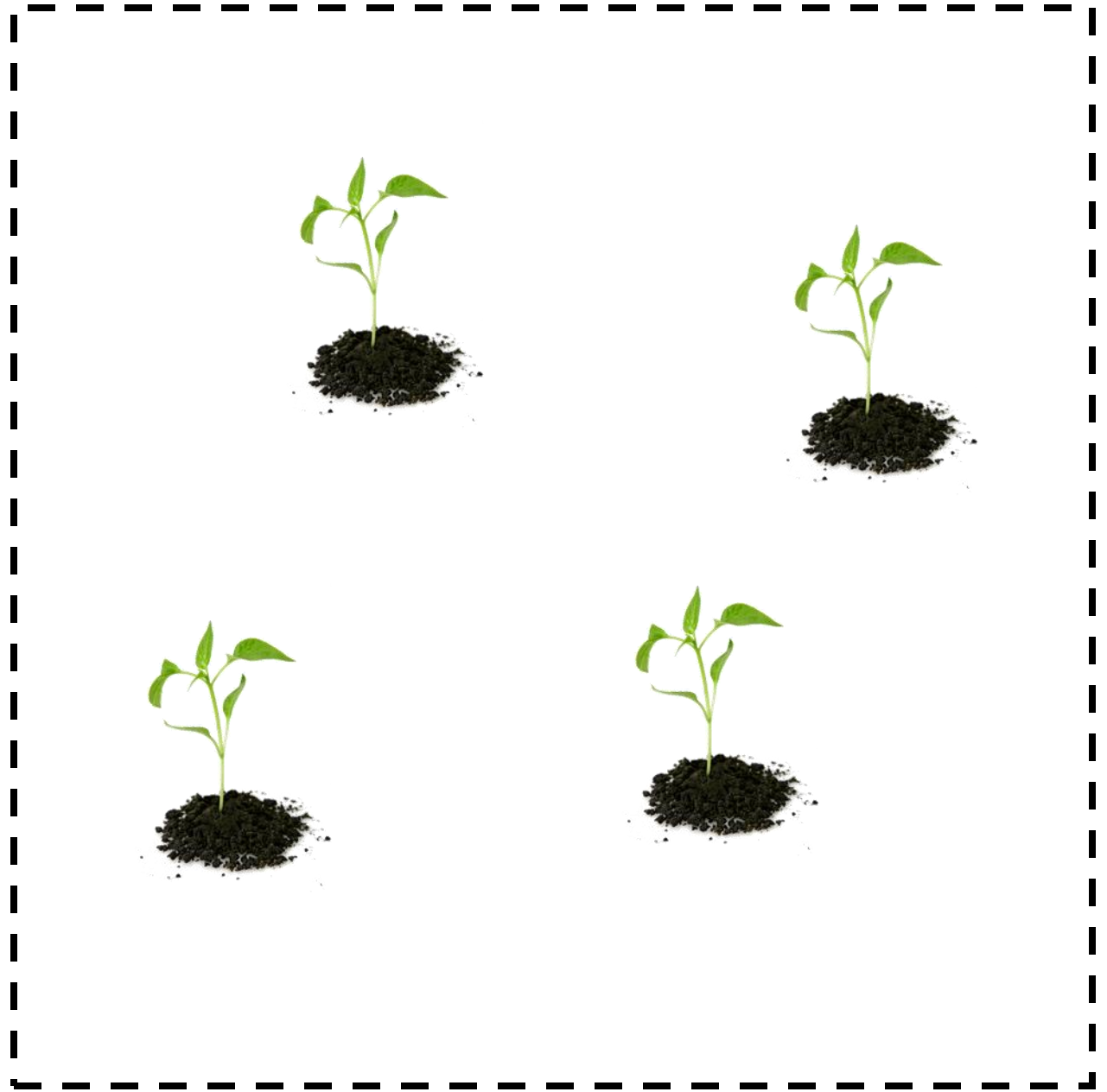
Bass Harbor Marsh
7 plots



Example Plot



deer fence



10 m

10 m

Example Plot



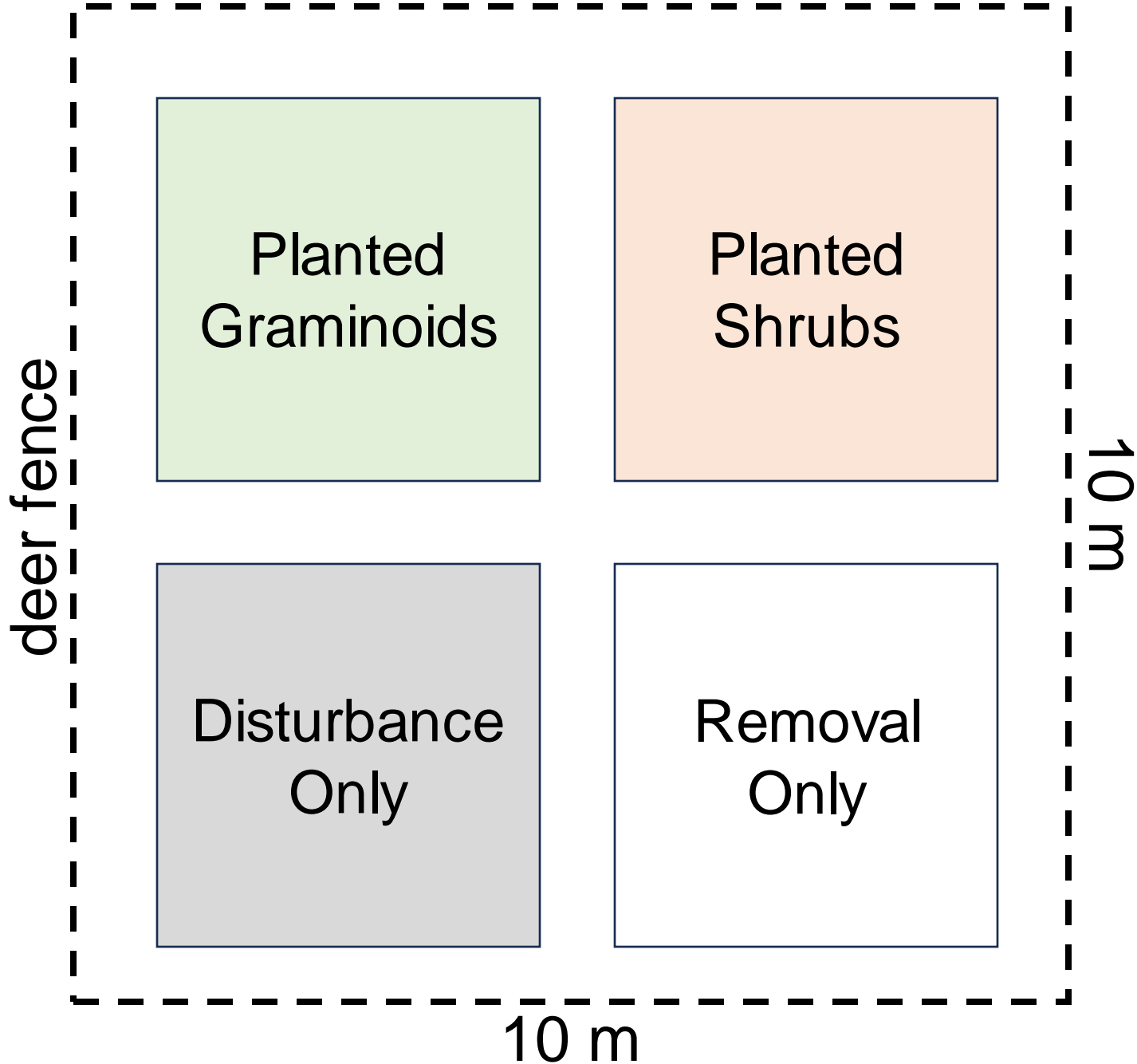
10 m

10 m

Removed
Glossy Buckthorn

deer fence

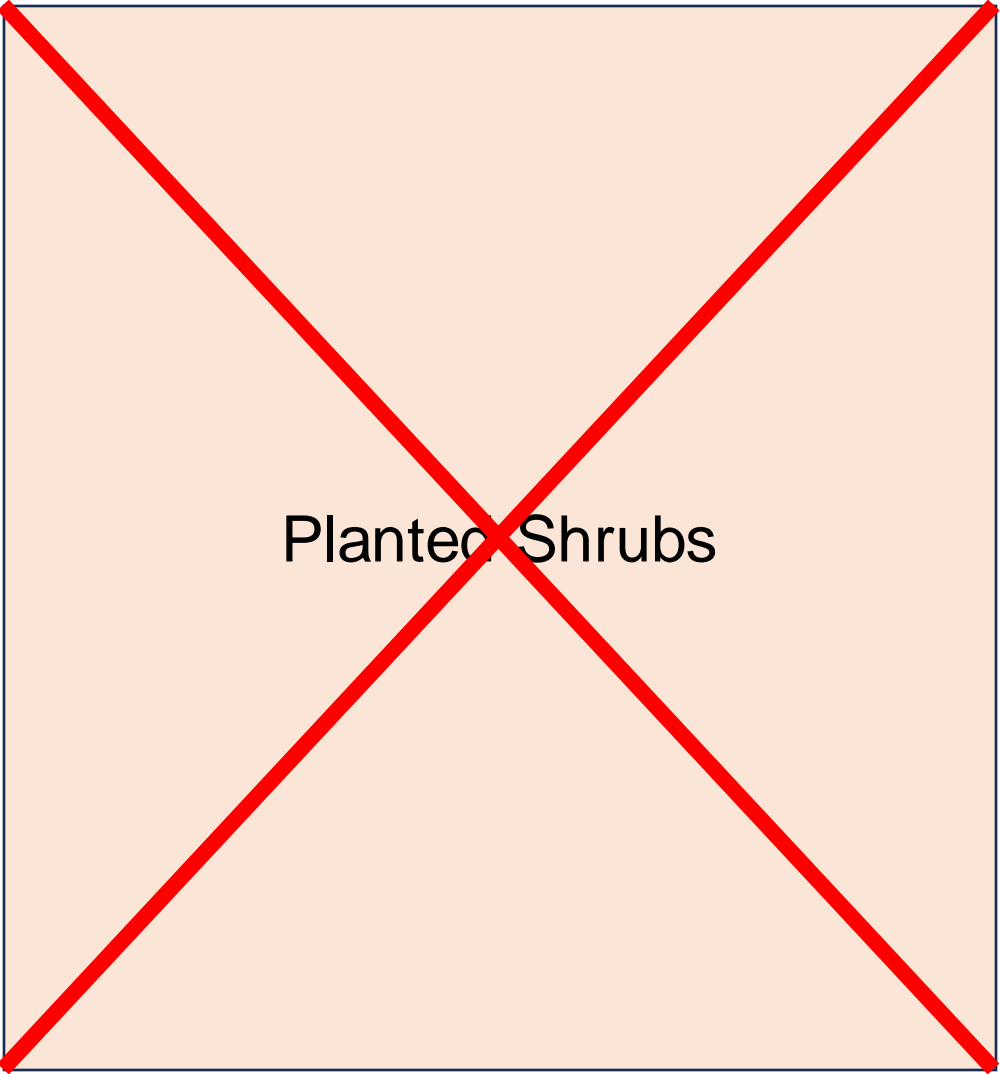
Example Plot



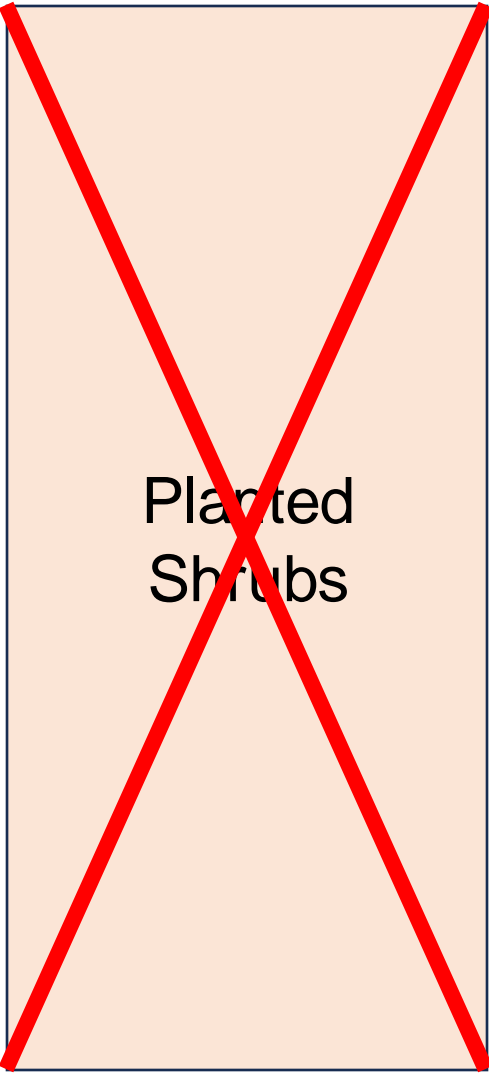
Take Home #3

Experimental adaptation has many
secondary benefits

Resilience Through the Portfolio Effect



Single Strategy Approach



Multiple Strategy Approach



Management and Science Communication

 **Mike Quigley**  @RepMikeQuigley · Sep 9, 2021

Replying to @RepMikeQuigley

Hello 🙌 from Cadillac Mountain in @AcadiaNPS! Behind me are some plants brought in from other states that are part of an experiment to see how they fare on this rocky peak because we can no longer focus on restoration- the mission is now adaptation and resilience.
#SEECinAcadia



**U.S. Representative
Mike Quigley**

“the mission now is
adaptation and resilience”

Take Home #4

Implementing experimental adaptation
widely will require systemic change

More Models of Effective Coproduction



Novel Funding Strategies



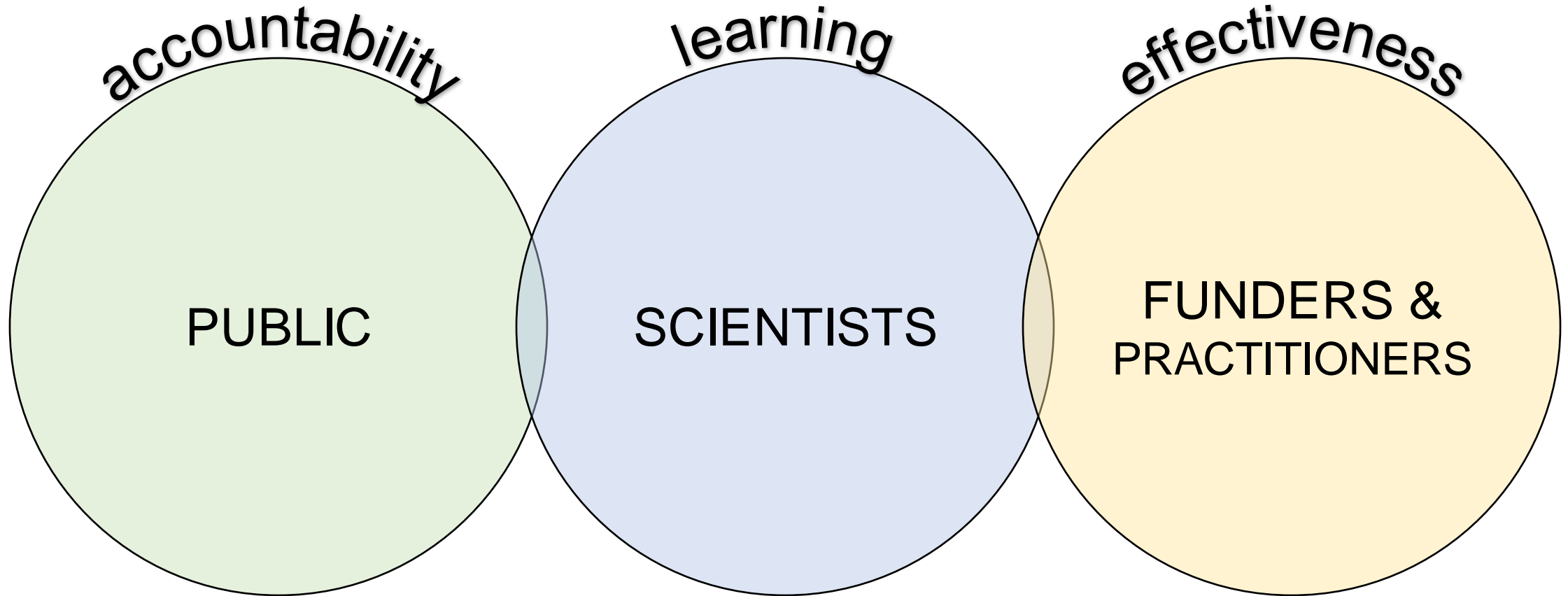
Partnership to Advance
Conservation Science
and Practice

O'Halleran Congressional Bill

H.R. 5145

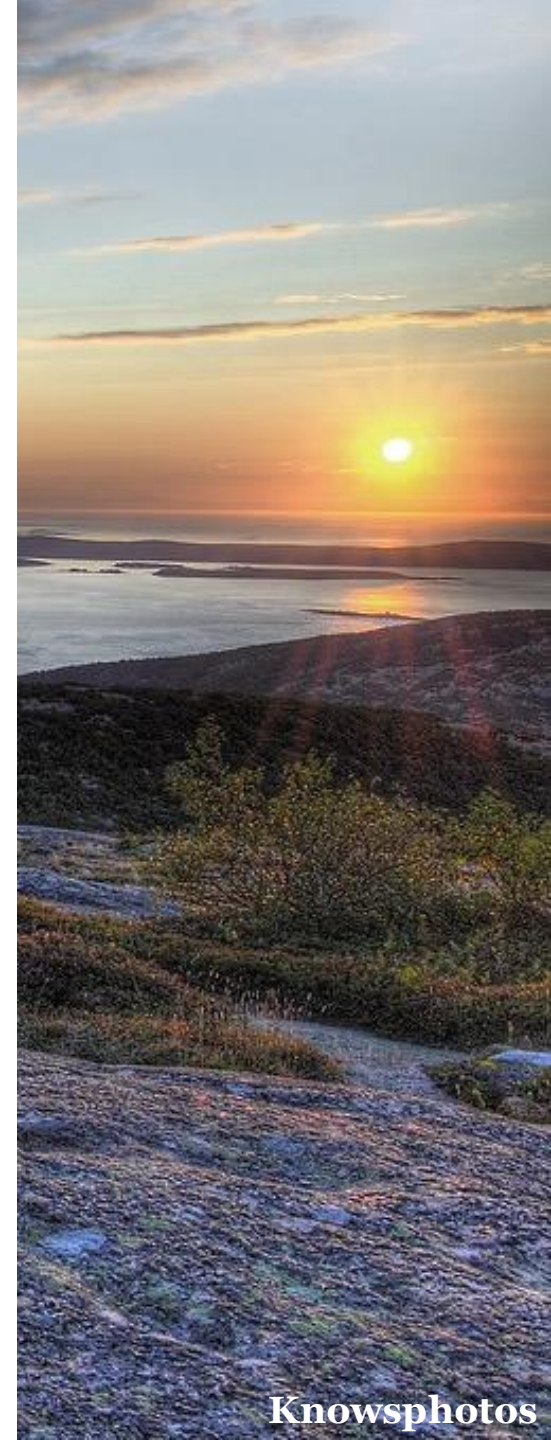
New Grants for Research into
Riparian Forest Genetics and
Climate Adaptation.

Change Values



Take-Home Messages

1. We need more tests of adaptation strategies
2. Implementing multiples strategies speeds learning
3. Experimental adaptation has many benefits
4. Wide application requires systemic change





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Incorporating experiments into management to facilitate rapid learning about climate change adaptation

Christopher P. Nadeau^{a,*}, A. Randall Hughes^b, Eric G. Schneider^c, Phil Colarusso^d,
Nicholas A. Fisichelli^a, Abraham J. Miller-Rushing^e

