

ADAPTING TO NATURE IN THE NEW NORMAL IMPROVING NATURAL RESOURCE DECISION MAKING UNDER UNCERTAINTY

Evan H. Campbell Grant

US Geological Survey

Amphibian Research and Monitoring Initiative

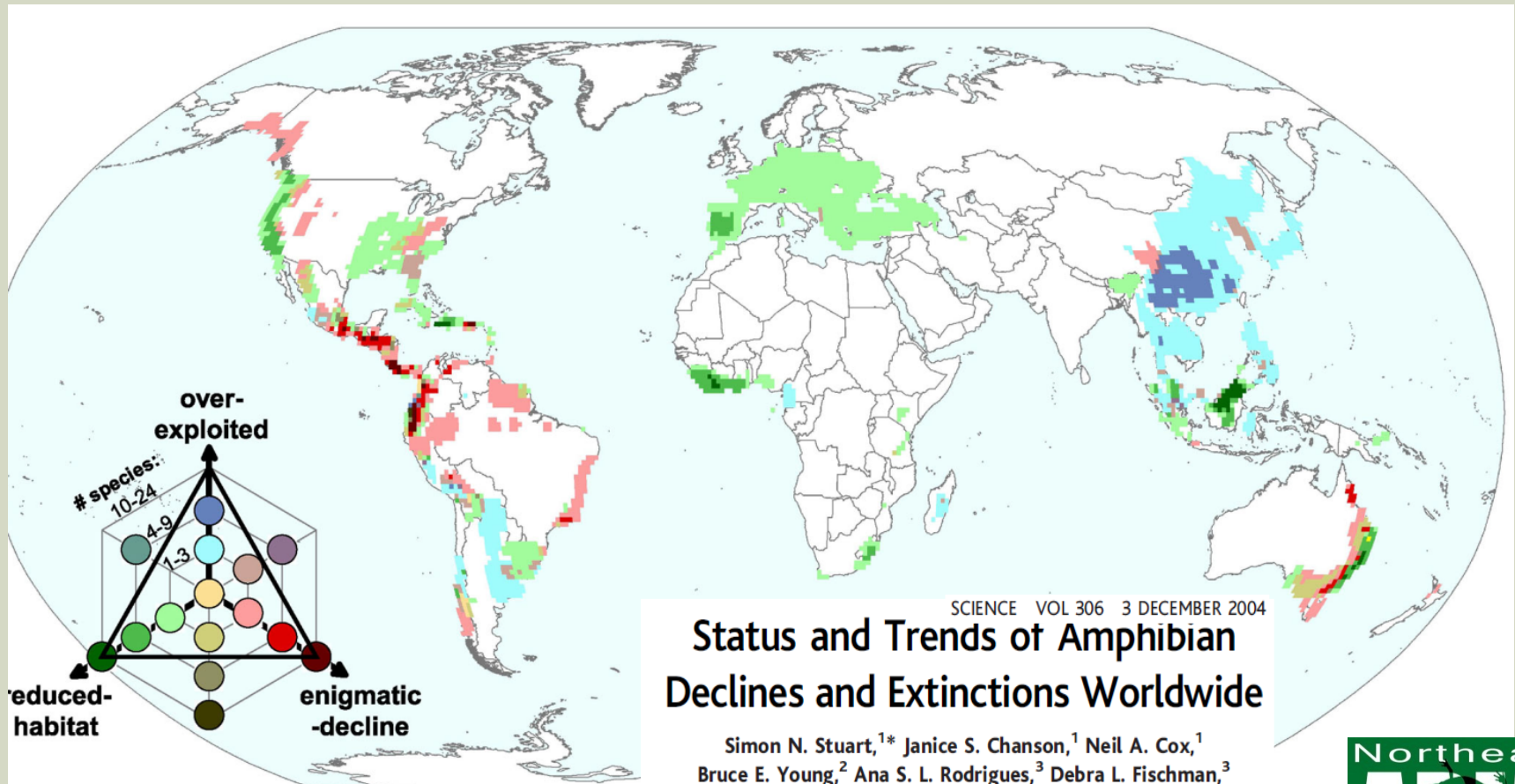
Patuxent Wildlife Research Center

SO Conte Anadromous Fish Research Laboratory

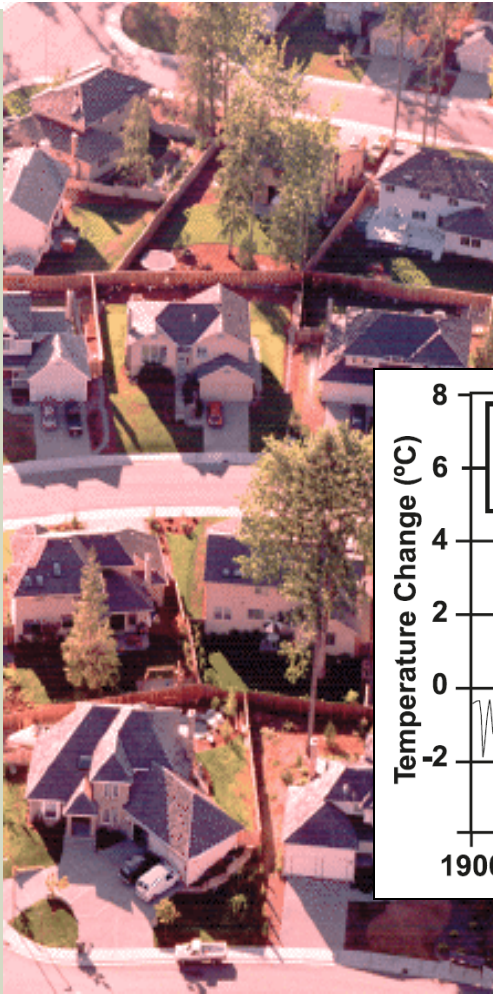
Turners Falls, MA



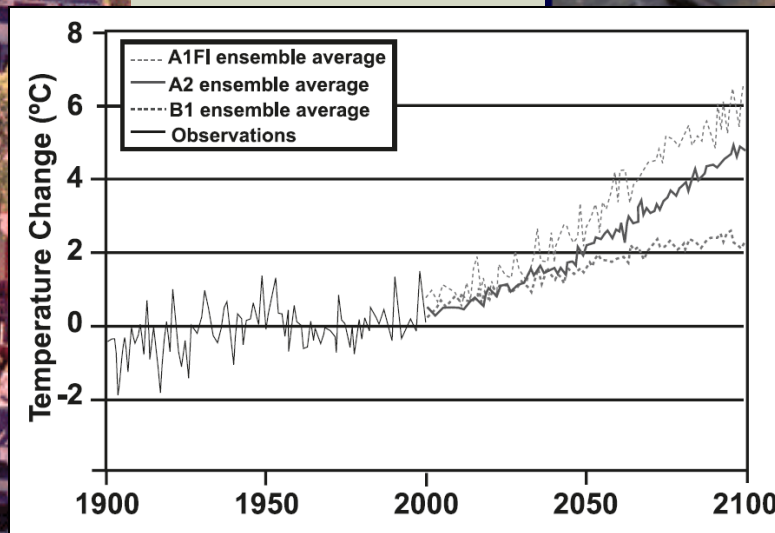
PROBLEM: AMPHIBIAN POPULATIONS ARE DECLINING WORLDWIDE



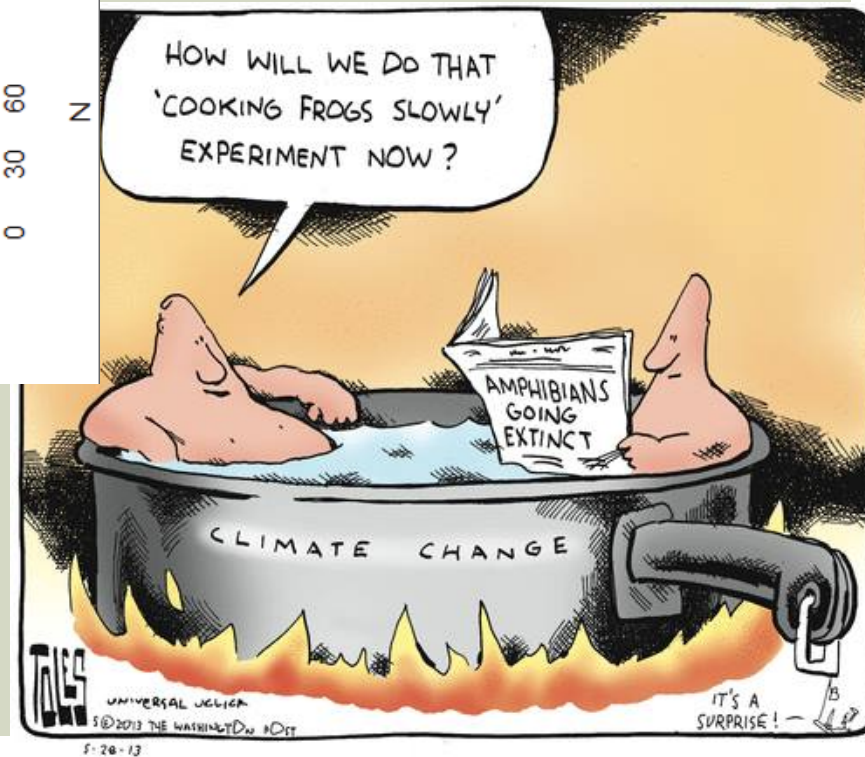
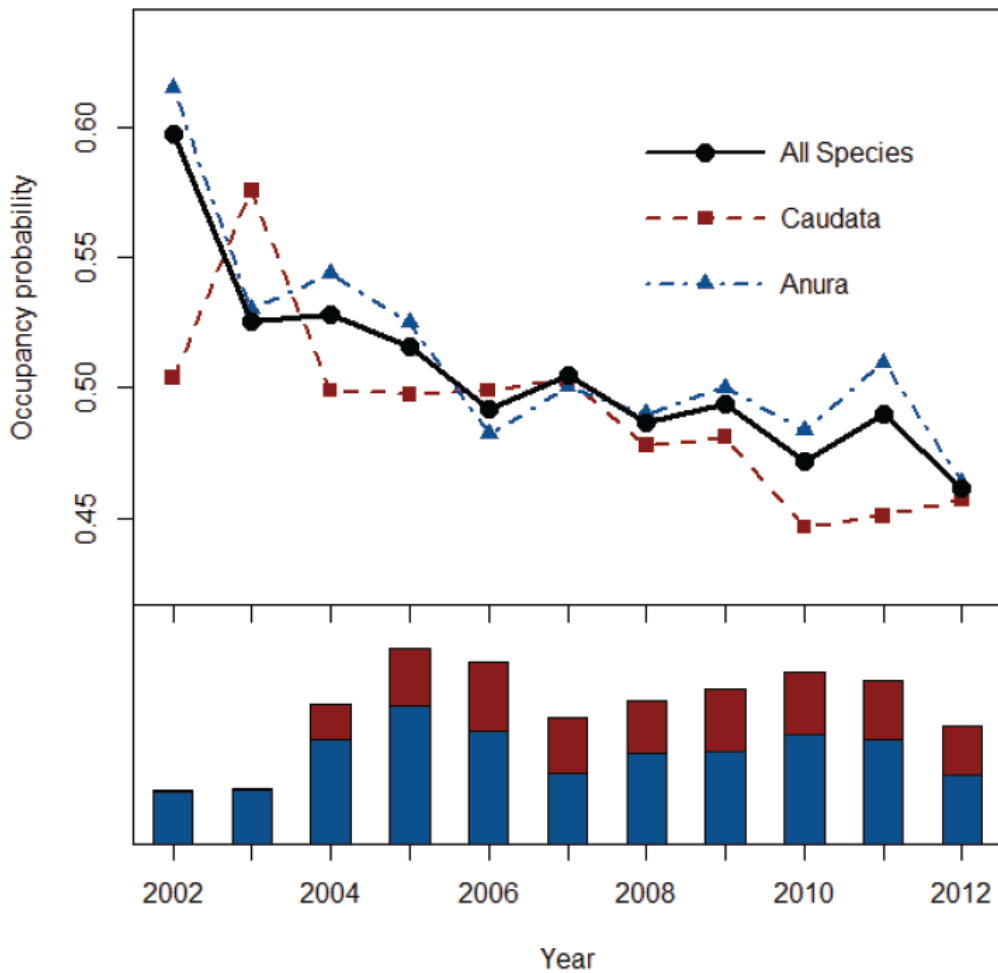
PROBLEMS ARE COMPLEX AND INTERACTING



Matt Gray, UT

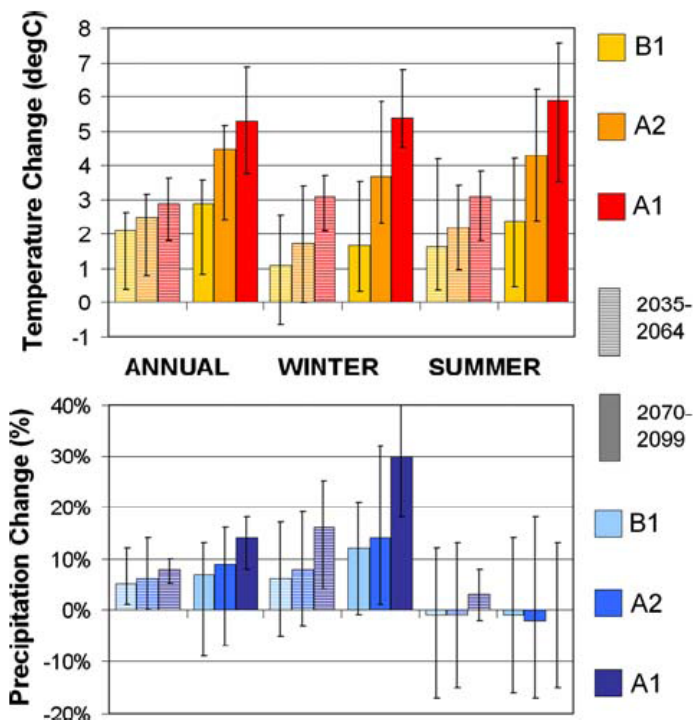






IN THE NORTHEAST...

K. Hayhoe et al.: Changes in climate and hydrological indicators



Clim Dyn (2007) 28:381–407

K. Hayhoe et al.: Changes in climate and hydrological indicators

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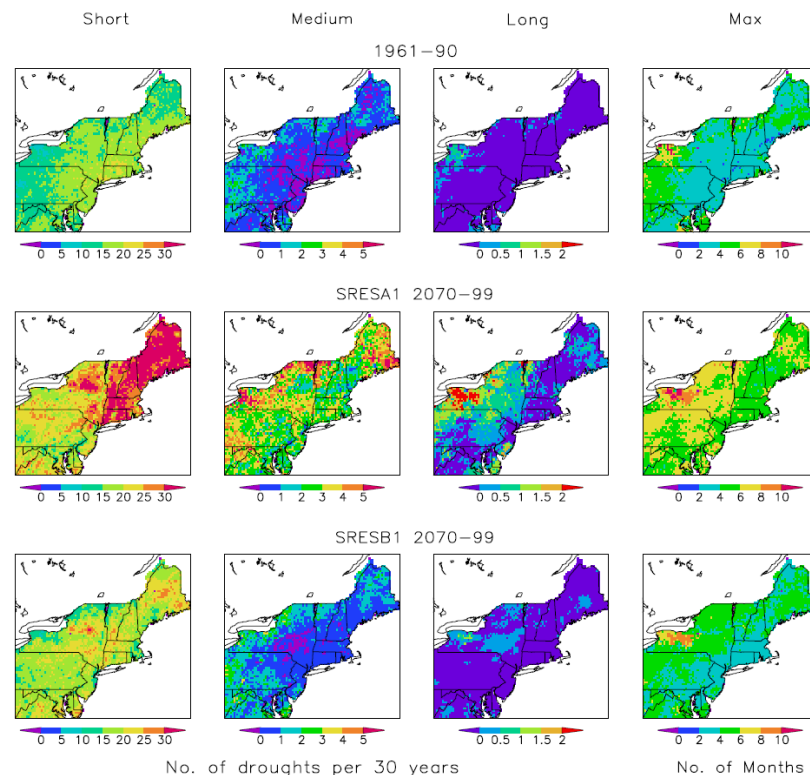


Fig. 6 Frequency of short (1–3 month), medium (3–6 months) and long-term (6 + months) droughts and the maximum drought duration (in months) for the historic (1961–1990) and future (2070–2099) periods. Droughts are defined as deficits of 10% or more in monthly soil moisture relative to the climatological

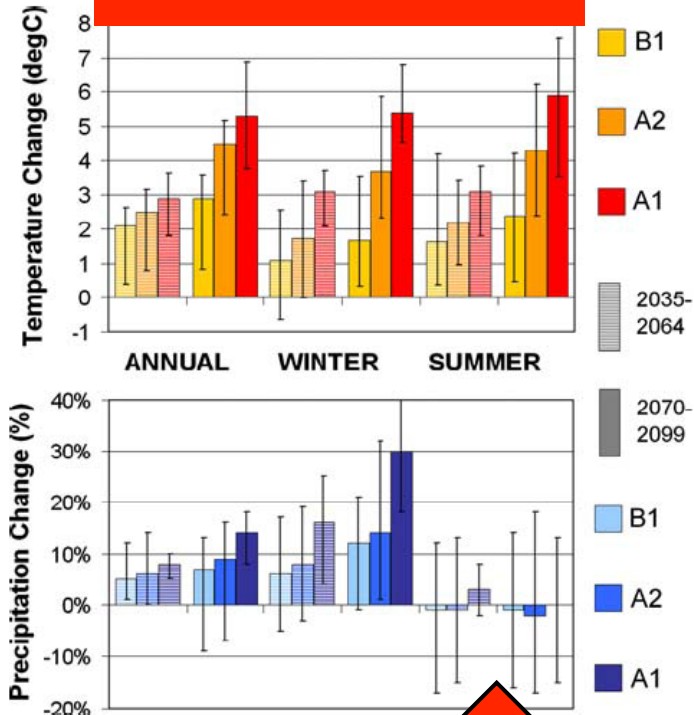
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IN THE NORTHEAST...

HOTTER

K. Hayhoe

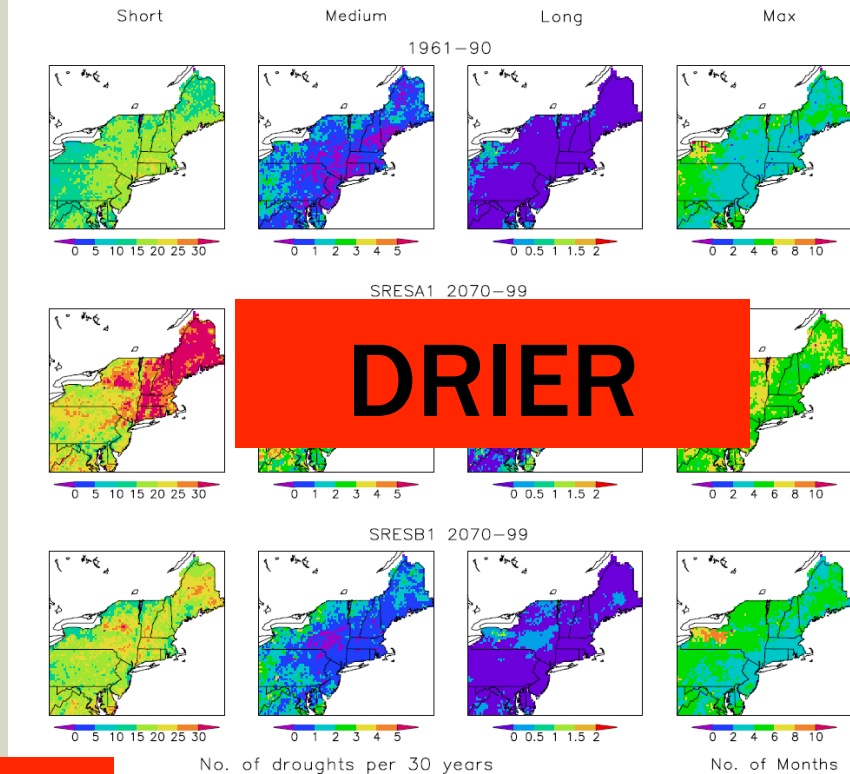
al indicators



UNPREDICTABLE

K. Hayhoe et al.: Changes in climate and hydrological indicators

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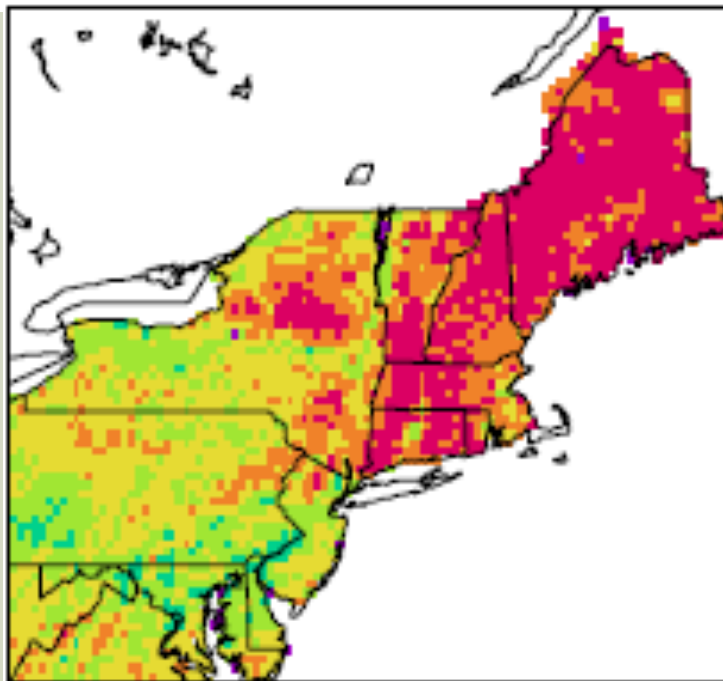


DRIER

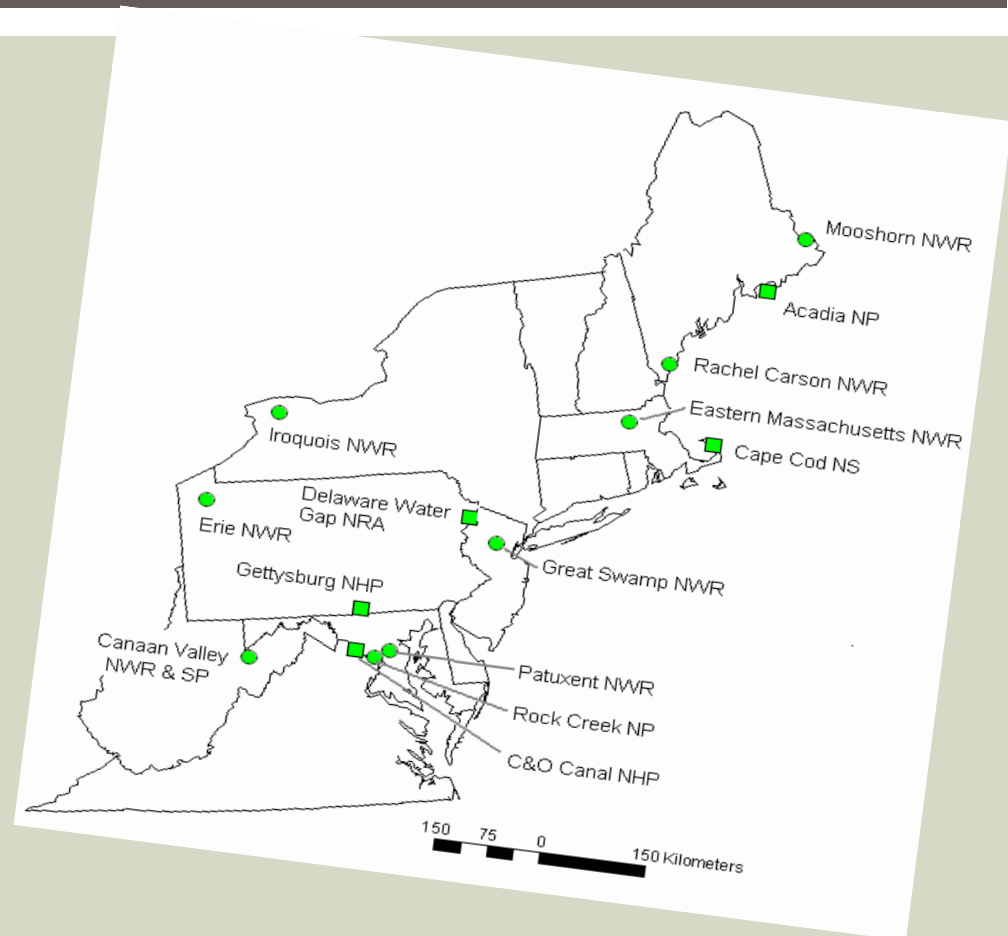
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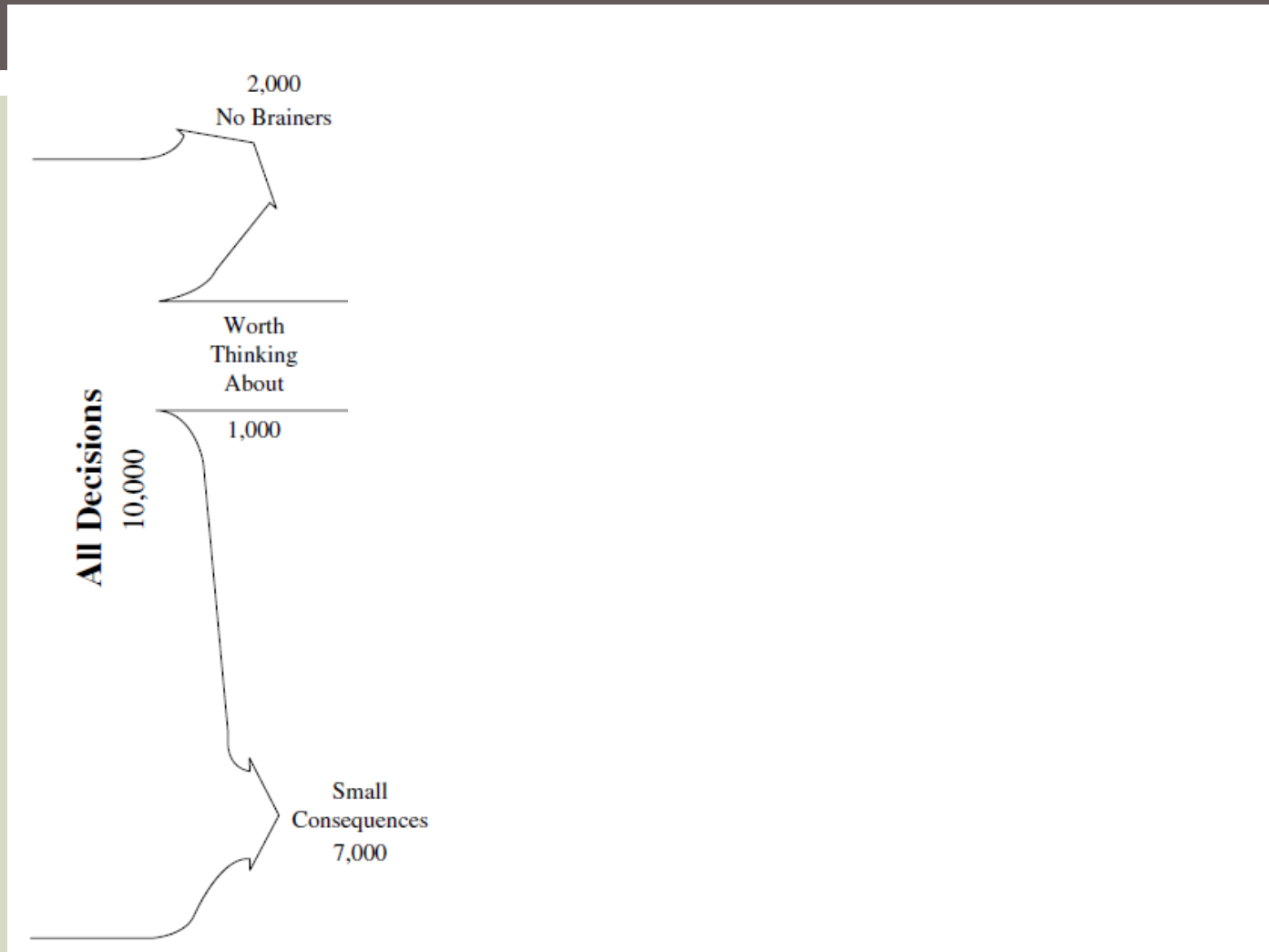
PROBLEM: HABITAT PROTECTION ALONE MIGHT NOT CUT IT



Number of droughts

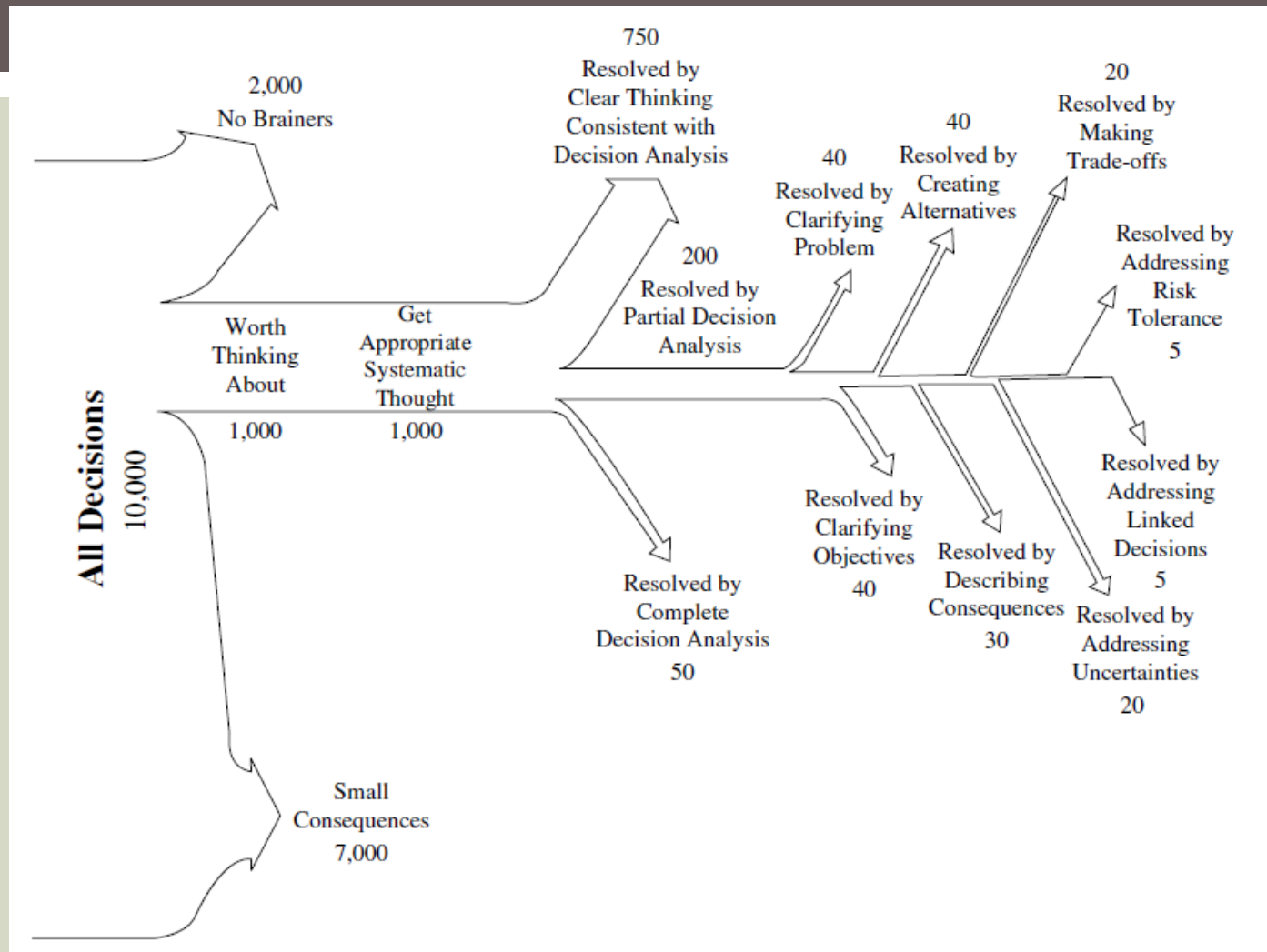


PRESCRIPTION FOR RESOLVING 10,000 DECISIONS



Keeney 2004. Making better decision makers. Decision Analysis 1:193-204.

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WHAT IS DECISION ANALYSIS?

- The structuring of a decision problem
 - in terms of *choices*, *outcomes*, and *values*
 - to identify the choice that is most likely to achieve the values of the decision maker.
- Decisions involve
 - valuing the outcomes
 - predicting outcomes from alternative choices
- The first part is the (subjective) role of society; the second part is the (objective) role of science

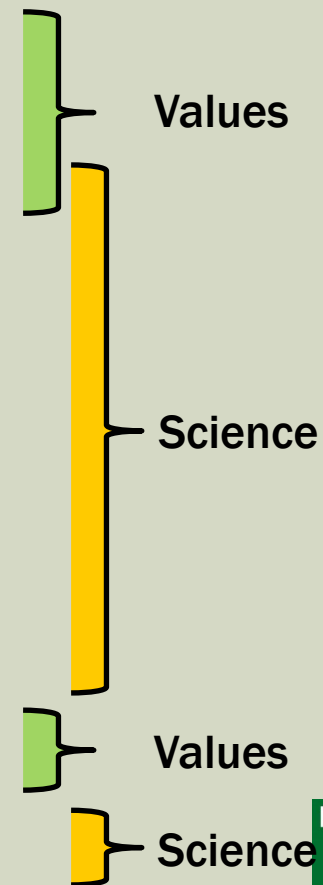
STRUCTURED DECISION MAKING

Elements:

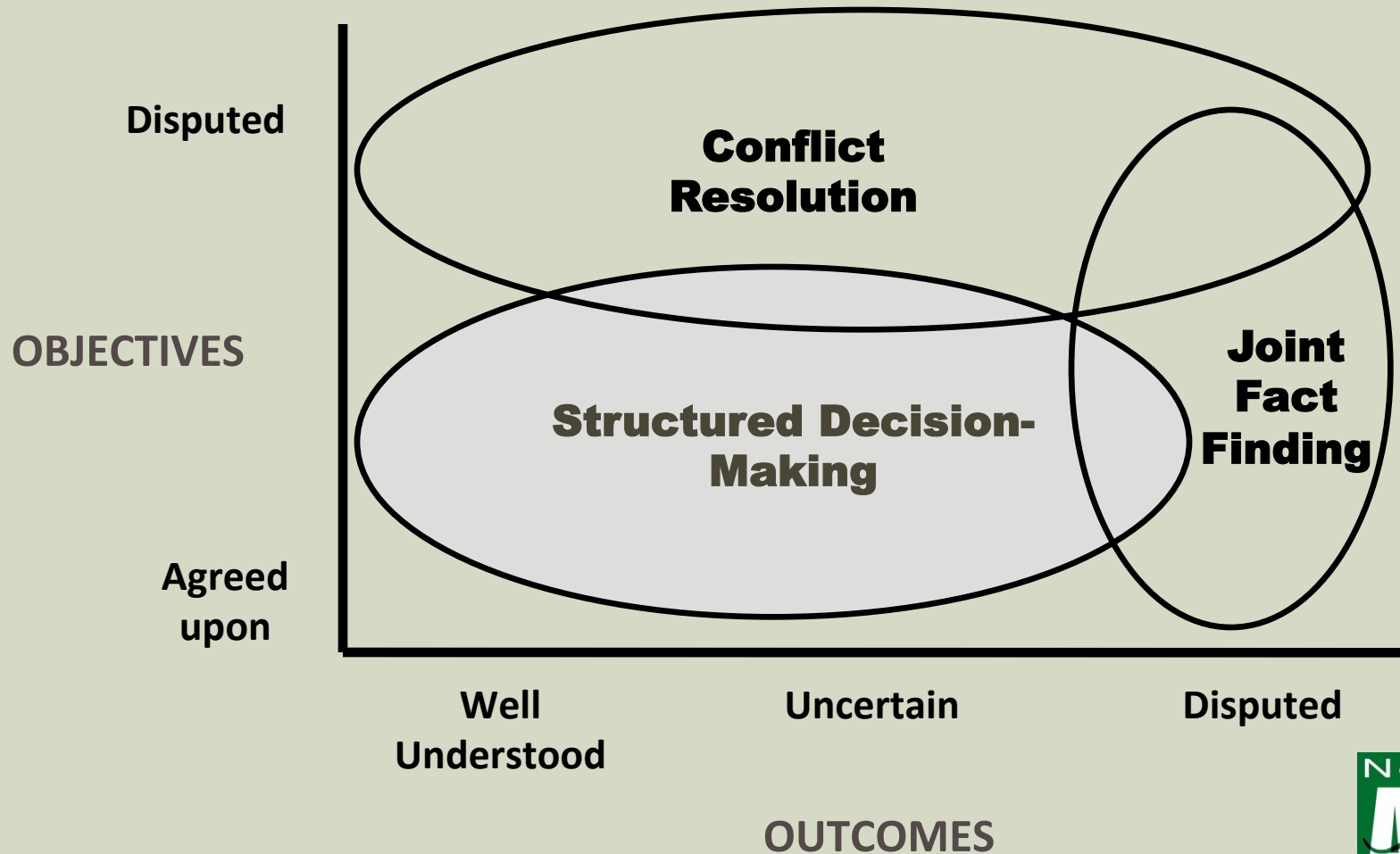
- Clear Objectives
- Creative management Alternatives
- Models linking actions to objectives, generate predictions
- Optimization to determine best approach, given observations and objectives
- Implement a decision
- Monitor system state changes

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SDM IS NOT A PANACEA



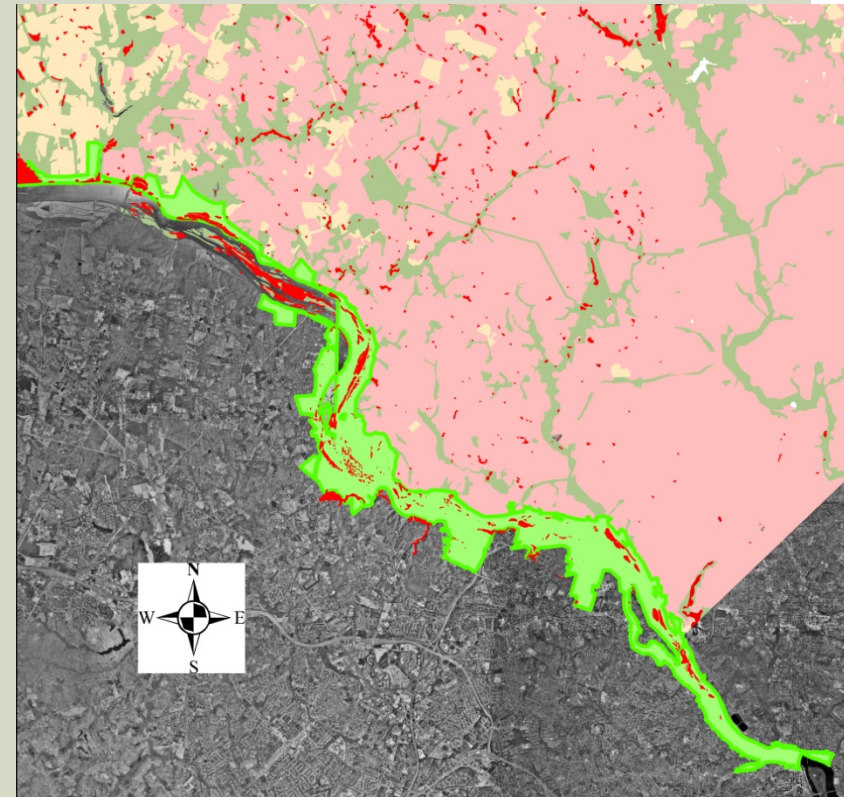
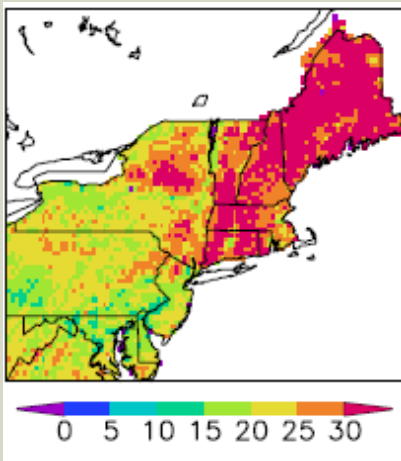
EXAMPLE FROM C&O CANAL NHP

■ 'Potomac Gorge' area of C&O

■ Threats (Allen and Flack 2001)

- Urbanization
- Invasive/alien species
- Isolation

■ Climate change (and variability)

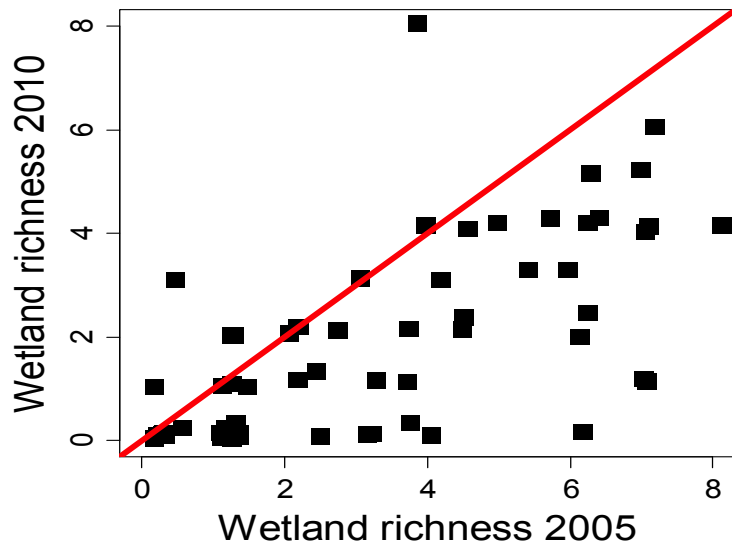


WHAT IS VALUED BY RESOURCE MANAGEMENT: OBJECTIVES

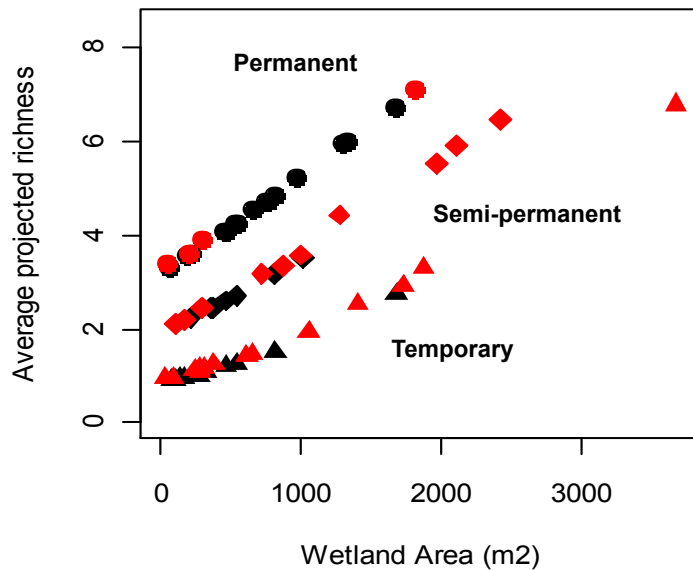
- Maintain average amphibian species richness at C&O Canal NHP wetlands.
- Minimize cost of doing management.
- * Can include other competing objectives (e.g., visitor use and enjoyment, access to recreation, other species-specific goals)



**Monitoring data:
Since 2005**



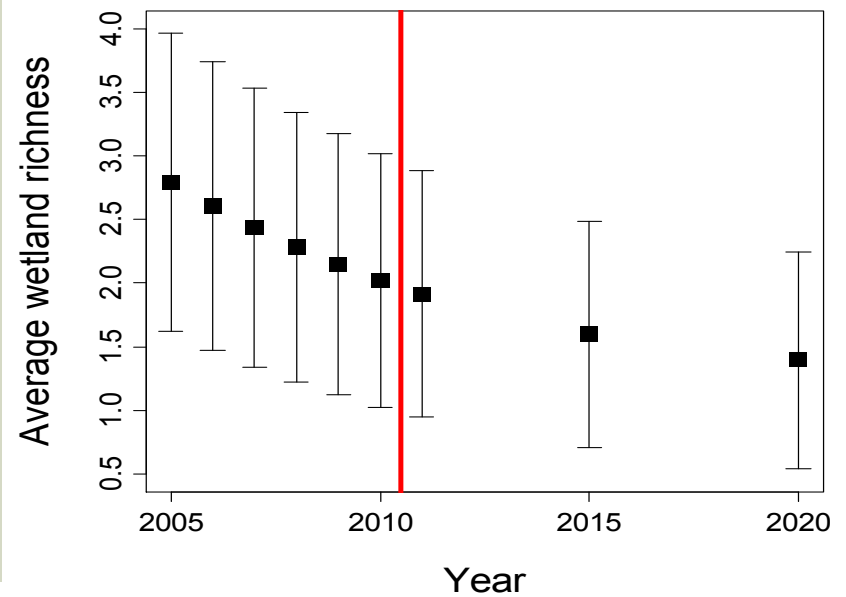
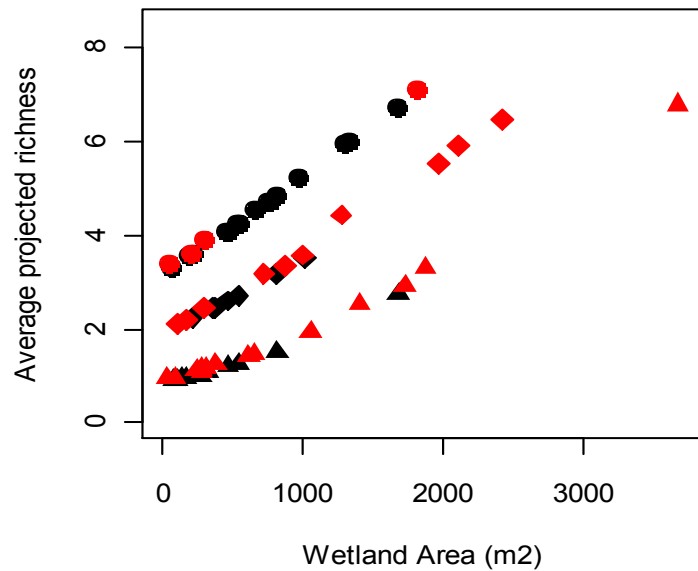
**Observe a decline in
occupancy for all species**



**Relate occupancy to
measured variables
(*hydroperiod)**



Make predictions

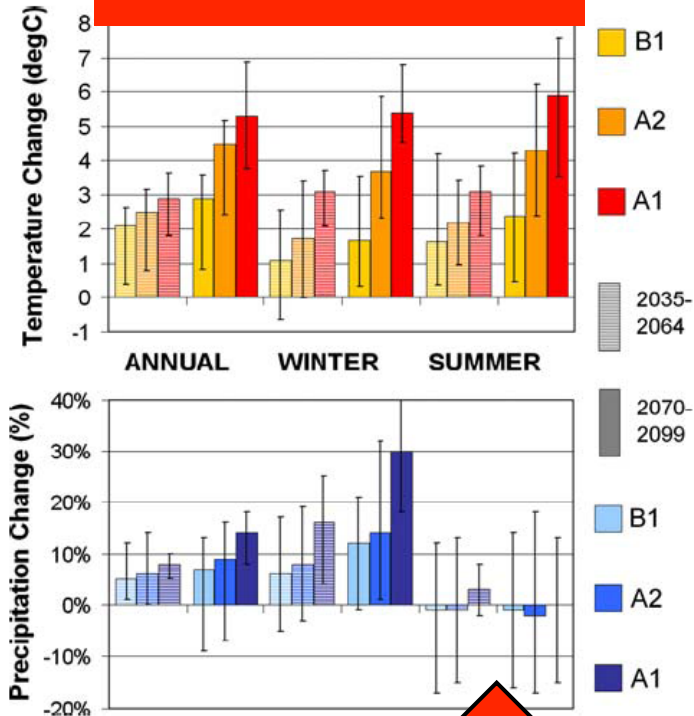


THINKING BACK TO OUR FORECASTS

HOTTER

K. Hayhoe

Climate indicators

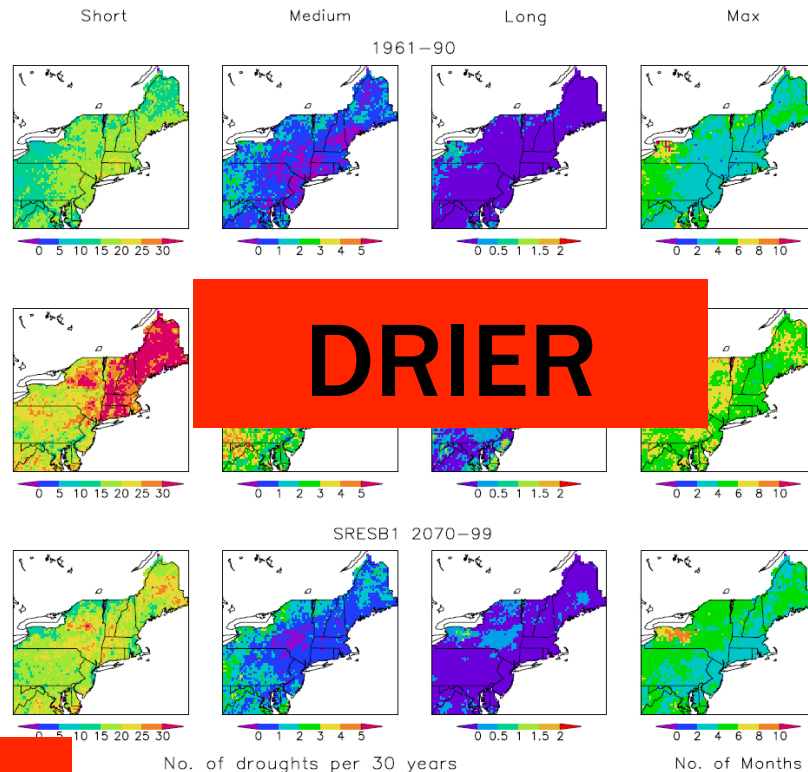


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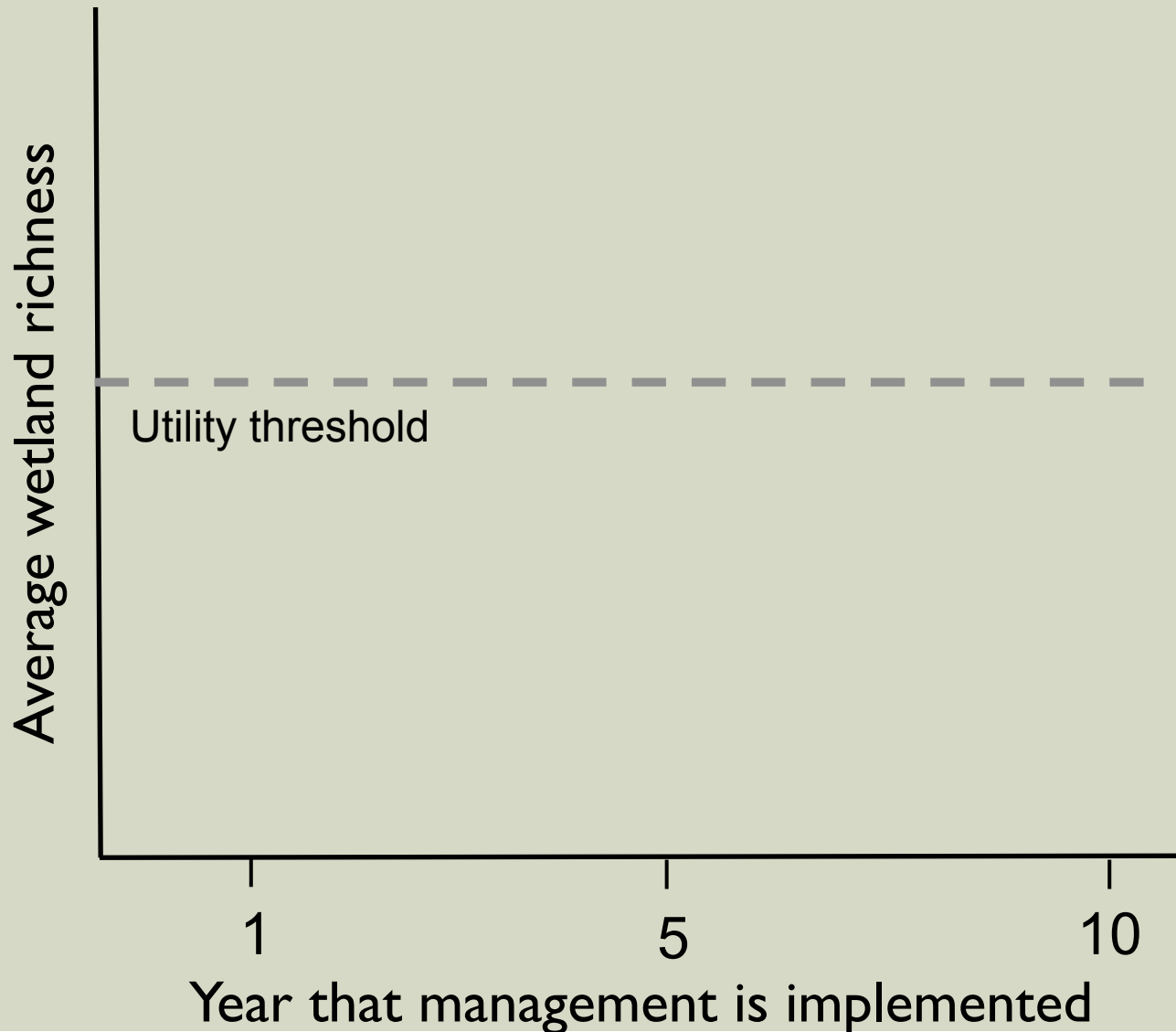
USING THE MODEL TO GUIDE MANAGEMENT: OPTIMIZATION

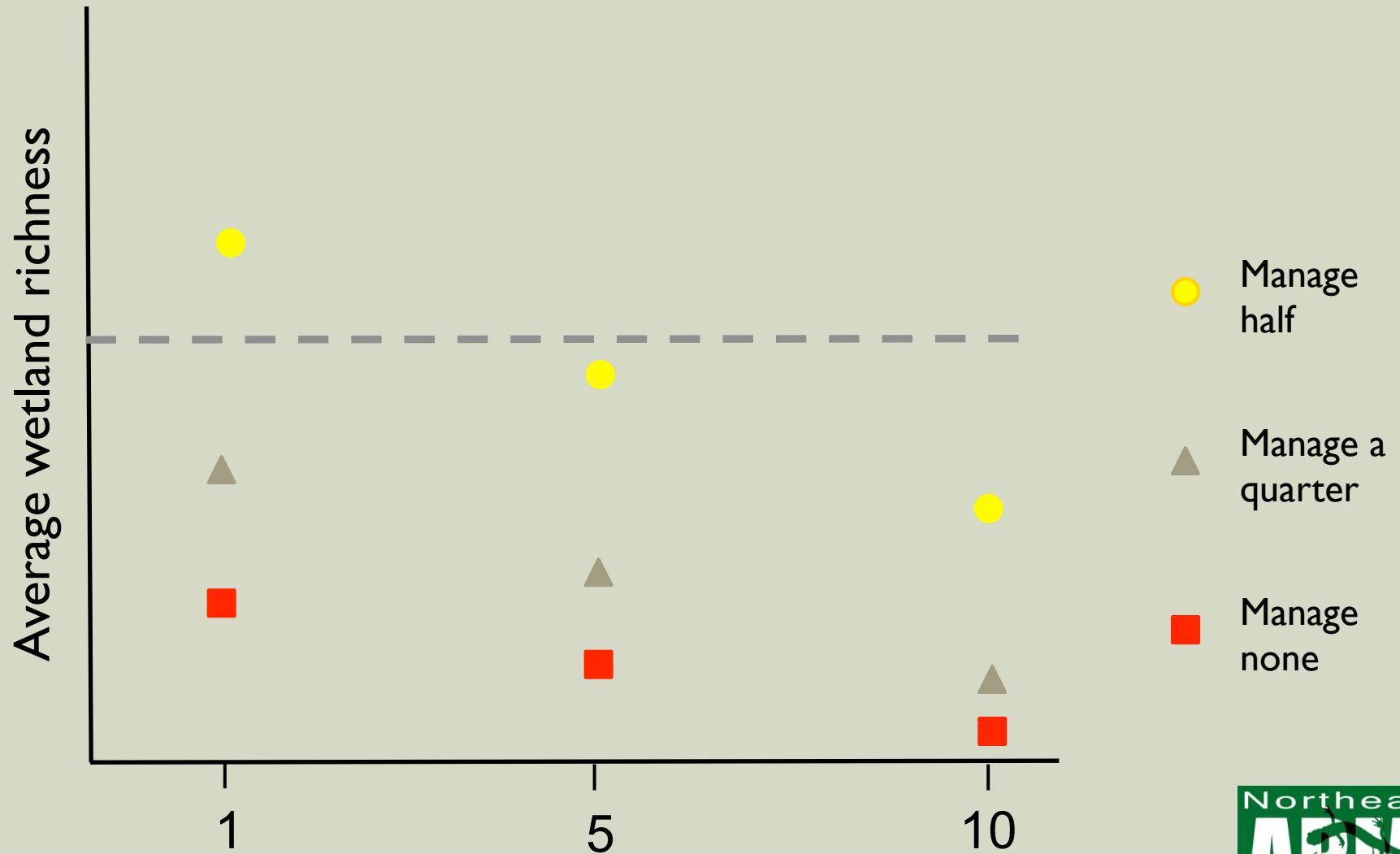
- **Best Alternative:** increase hydroperiod of temporary wetlands
- **Optimization:** Rank wetlands by the expected increase in richness, to choose most suitable sites for management each year

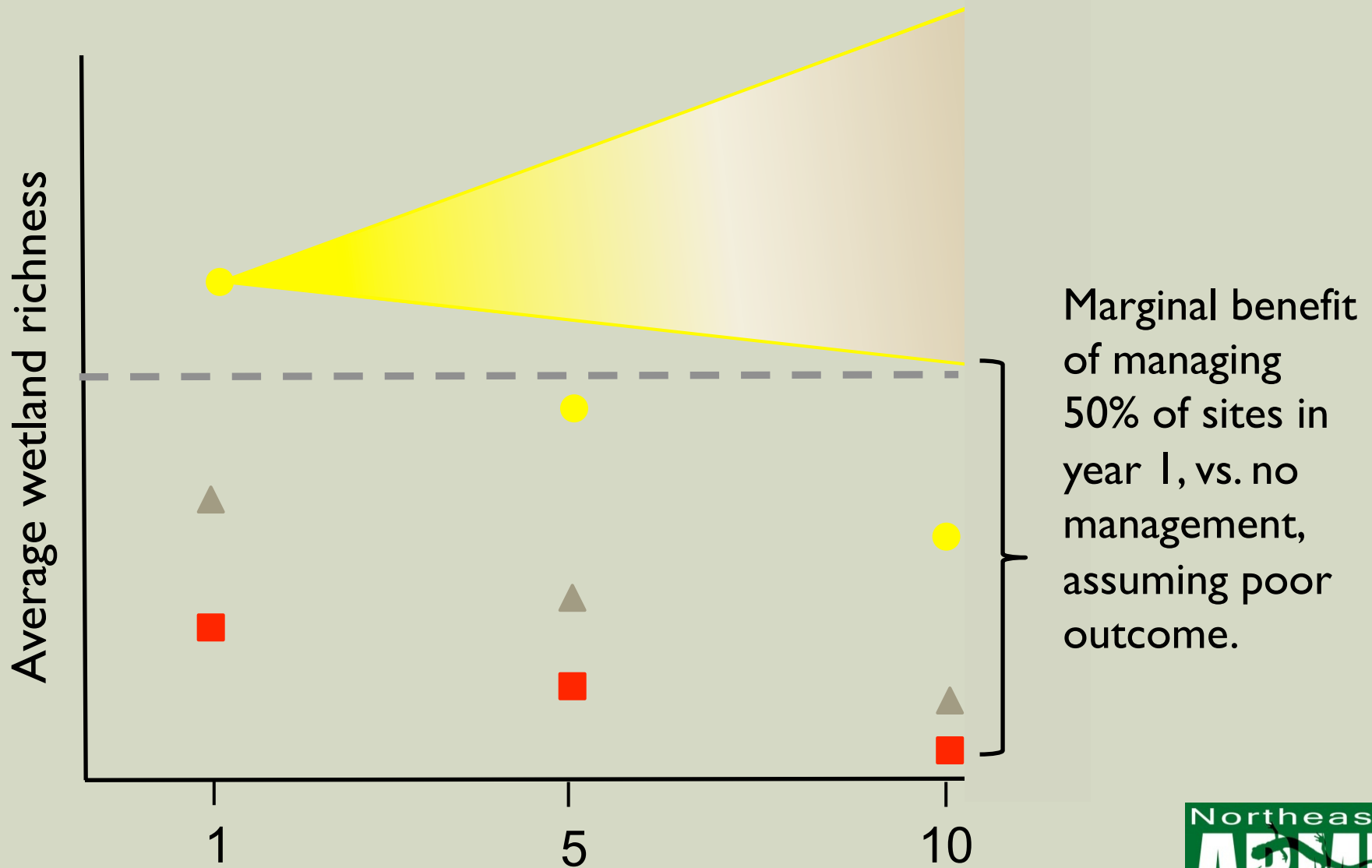
NOW WHAT?

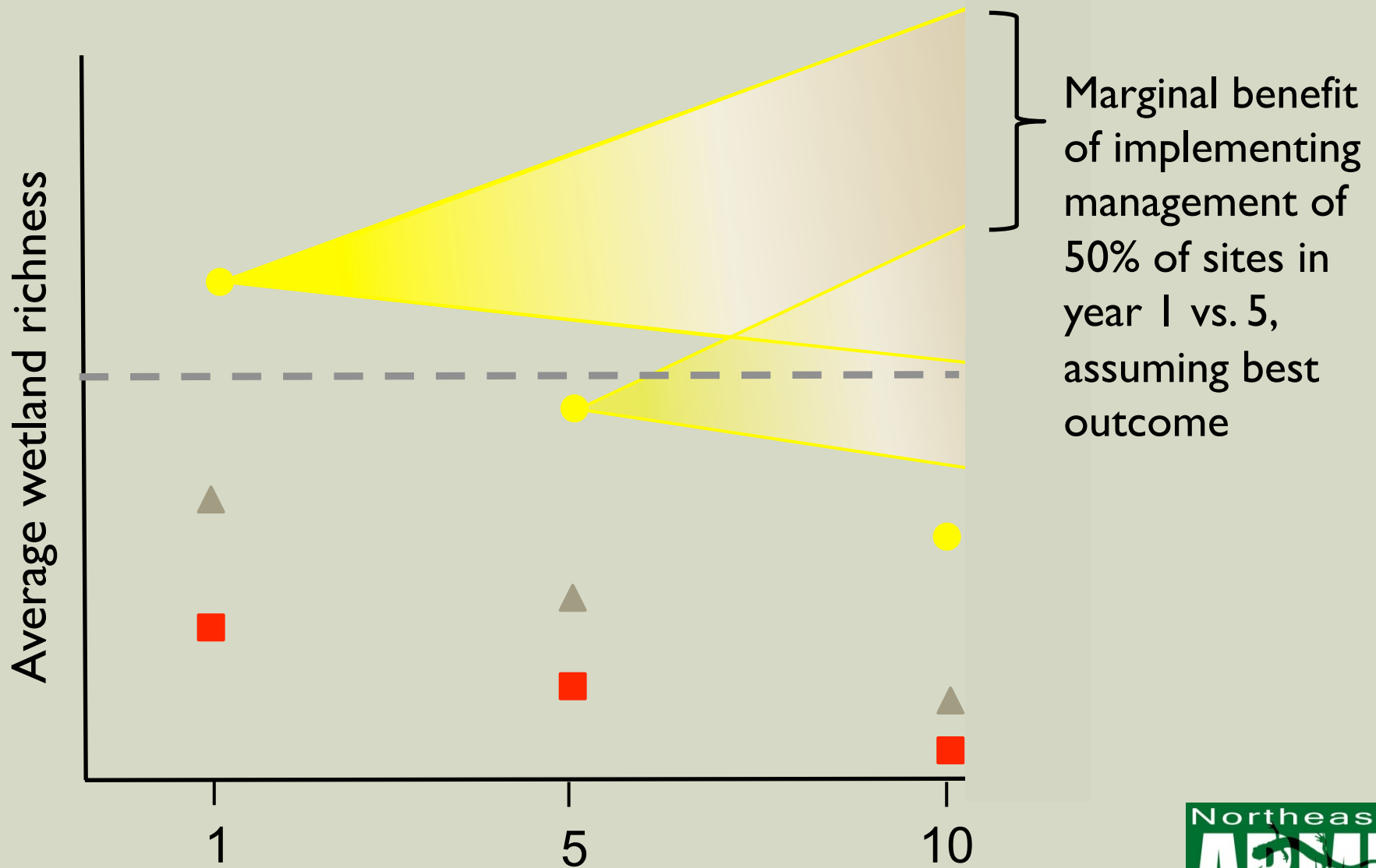
- Typical response is to want to understand what's causing declines,
- But there is a tradeoff in *waiting* for more information (which may be imperfect) and a need for *action*
- Both have components of uncertainty.

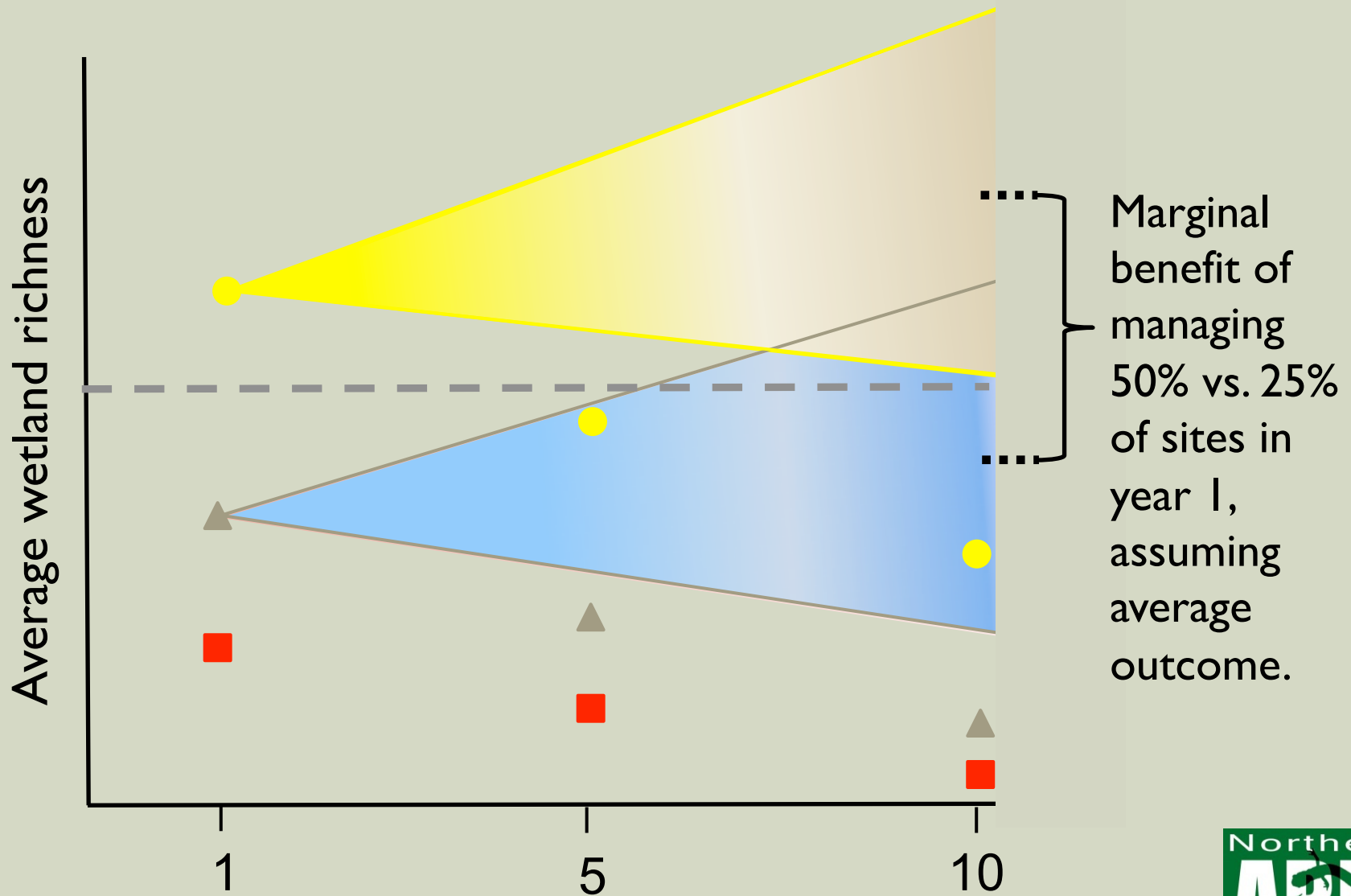
When to initiate a decision?

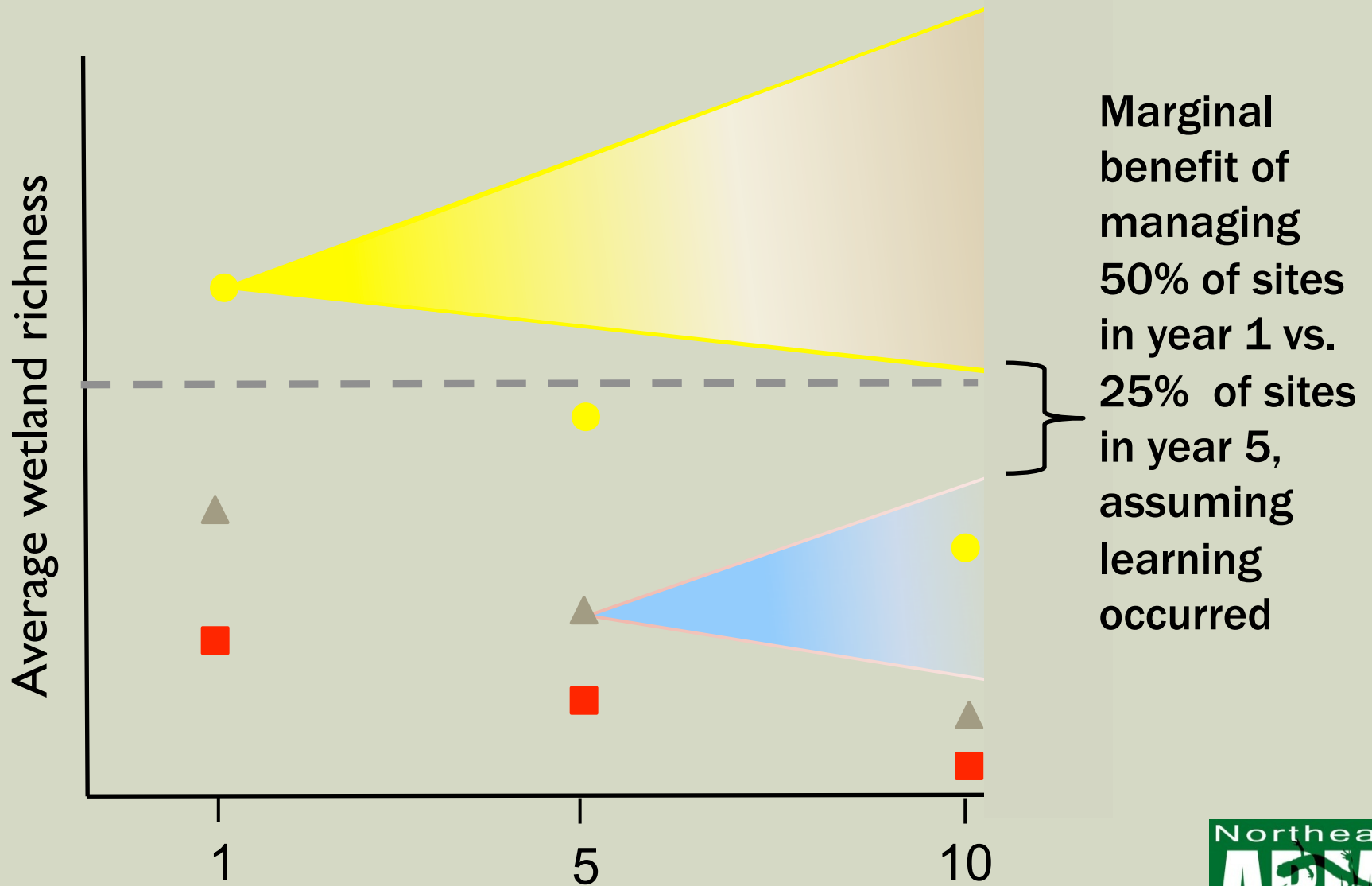












IN SUMMARY

- Amphibians are in trouble (or may be...)
- Even amphibians in protected areas are at risk under climate change

Are we in the midst of the sixth mass extinction? A view from the world of amphibians

David B. Wake^{*†} and Vance T. Vredenburg^{*‡}

^{*}Museum of Vertebrate Zoology and Department of Integrative Biology, University of California, Berkeley, CA 94720-3160; and [†]Department of Biology, San Francisco State University, San Francisco, CA 94132-1722

Many scientists argue that we are either entering or in the midst of the sixth great mass extinction. Intense human pressure, both direct and indirect, is having profound effects on natural environments. The amphibians—frogs, salamanders, and caecilians—may

families and nearly 60% of the genera of marine organisms lost (1, 2). Contributing factors were great fluctuations in sea level, which resulted from extensive glaciations, followed by a period of great global warming. Terrestrial vertebrates

UNCERTAINTY IS SCARY, BUT -

- *IF* we value amphibians, where they are, we need to make hard decisions about active management



A proactive approach to conservation

- Designed to preempt (or respond to) climate change effects – short term focus
- Maintain community and *prevent* LOCAL extinctions
- A structured approach to decision making



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