Exploring adaptive capacity:

the story behind the buzzword

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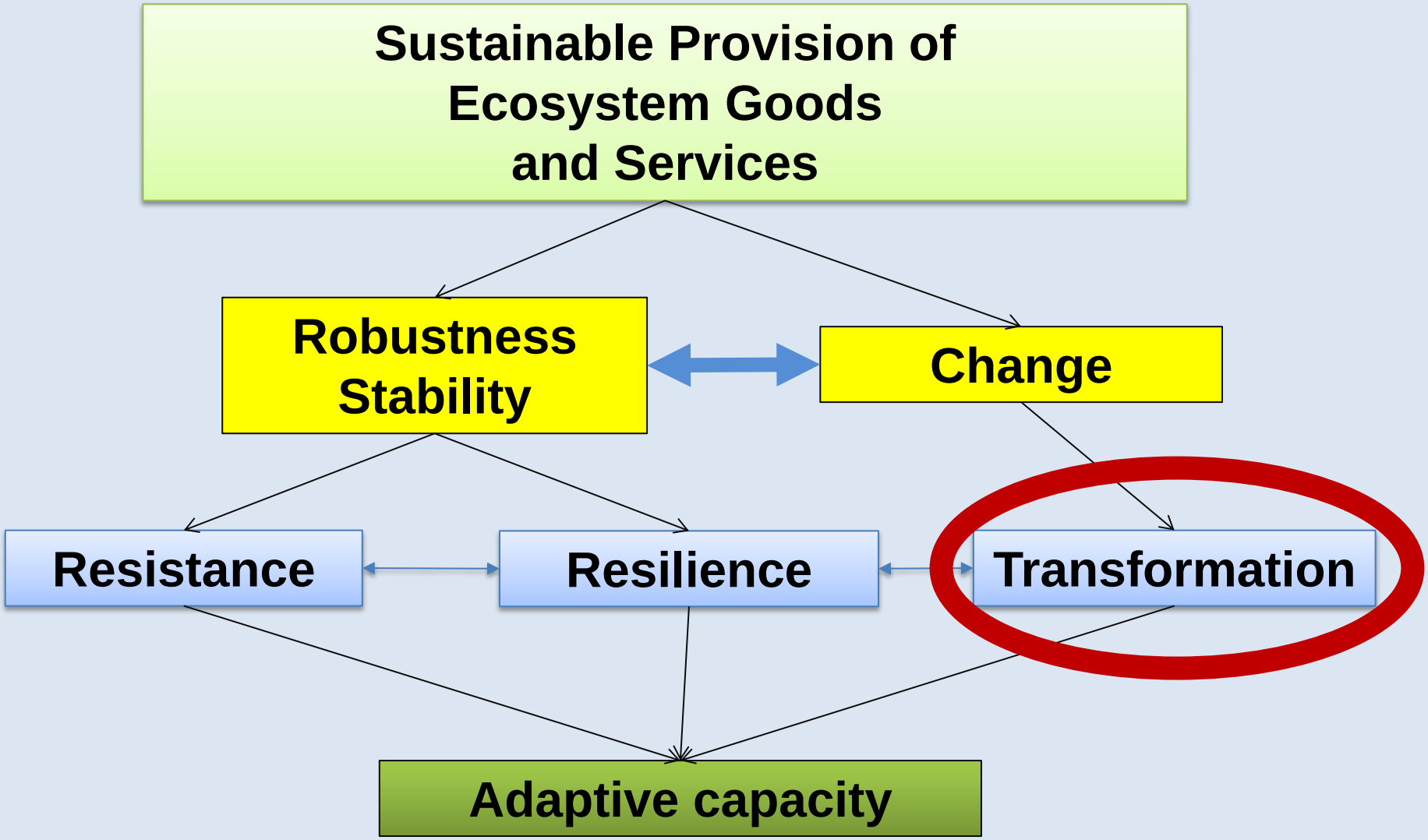
Edmund Hayes Professor in Silviculture Alternatives

and

Charles Bullard Fellow

with inspirations from students, colleagues, and cooperators

What is it really about ?



Background

Harvard Business Review

MANAGING UNCERTAINTY

Adaptability: The New Competitive Advantage

by Martin Reeves and Mike Deimler

FROM THE JULY–AUGUST 2011 ISSUE

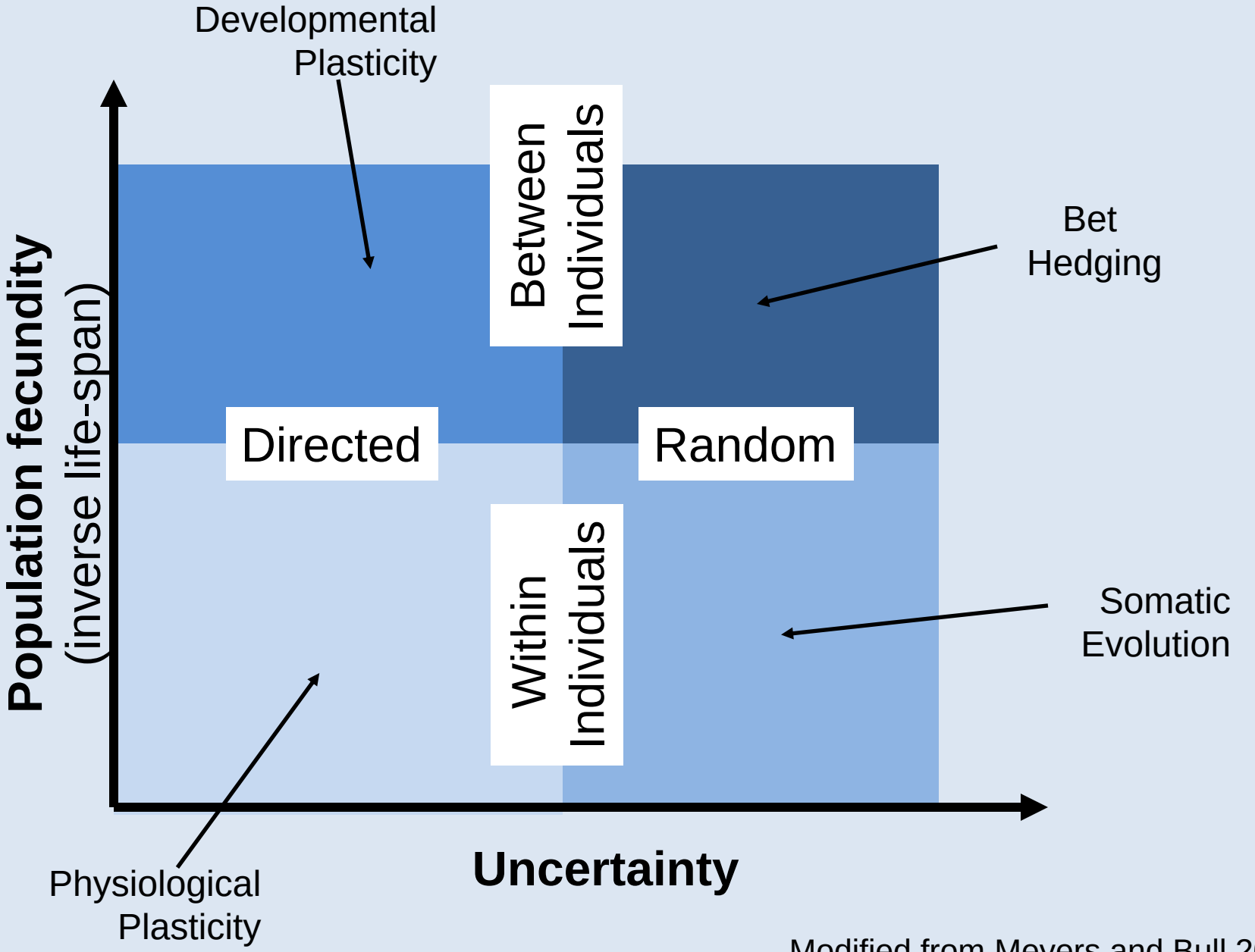
Background

Adaptation to current conditions ⟷ **Adaptability** to new conditions

Background

Adaptabilty$_{\text{enough}}$ = f (**uncertainty**)

Background



Modified from Meyers and Bull 2002

Maintining healthy communities

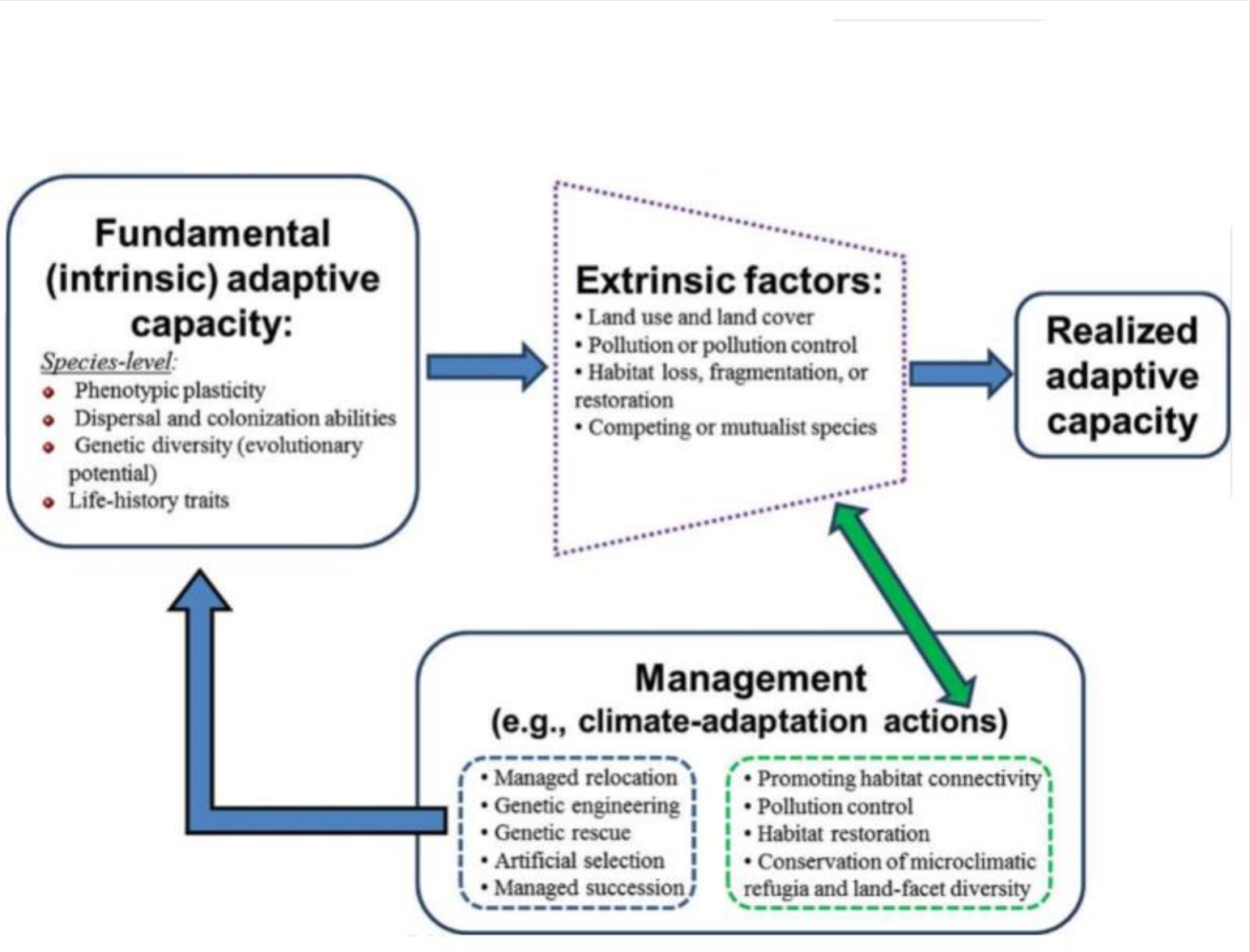
Capital asset	Example activities
Financial	Service and commodity outlets expand in the local and district centers.
Physical	Housing physical status is maintained and improved.
Human	Greater array of value-added products are produced locally.
Social	Economic and other shocks are buffered by systems of social reciprocity.
Natural	Processes that maintain biodiversity are conserved. Ecosystem function is maintained
	Modified from Campbell et al. 2001

Background

Adaptation provided by:

Society **Ecosystem**

Background



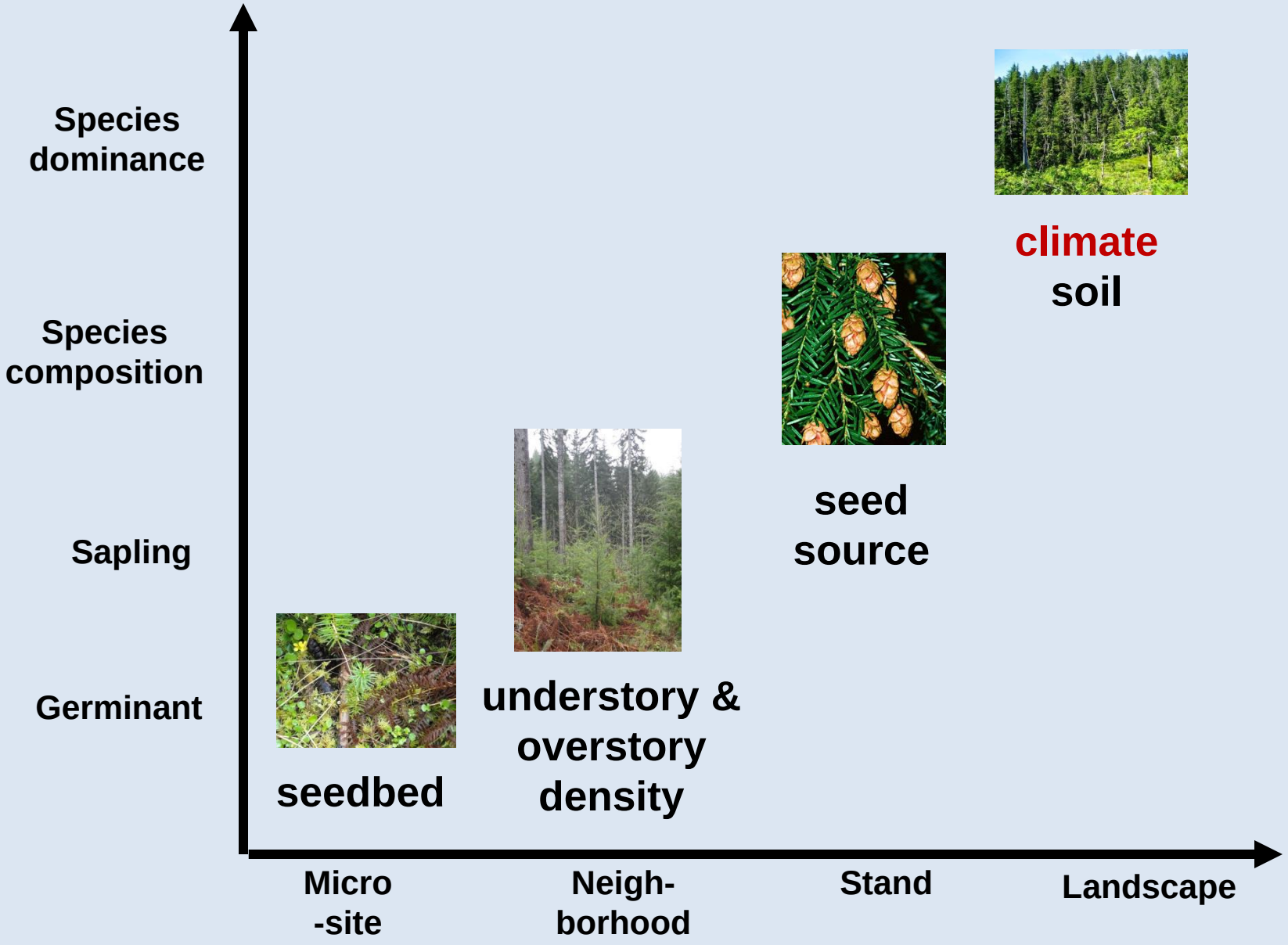
From Beever et al. 2016 Conservation Letters

Background: Cross-scale interactions

Organizational level	Measurable property	Adaptation potential
Biota	Species composition	Migration, extinction, speciation
	Food web structure	Different routes and rates of energy movement (matter?)
Population	Number of organisms	Culturability, e.g., flexibility in reproduction rates, social structures and relationships
	Spatial location of organisms	Social plasticity, movement
Organism	Number of organs, relative position of organisms	Developmental plasticity (e.g., muscle, leaf area, size)
		Physiological and behavioral plasticity
Genome	DNA sequence	Gene pool diversity

Modified from Conrad 1983

Adaptation: Climate change



Based on Dodson et al. 2014

Merci d'avoir écouté

Adaptive capacity as an organizing theme

= everybody plays

Adaptive capacity of complex adaptive systems

= multiple scales and cross-scale hierarchy

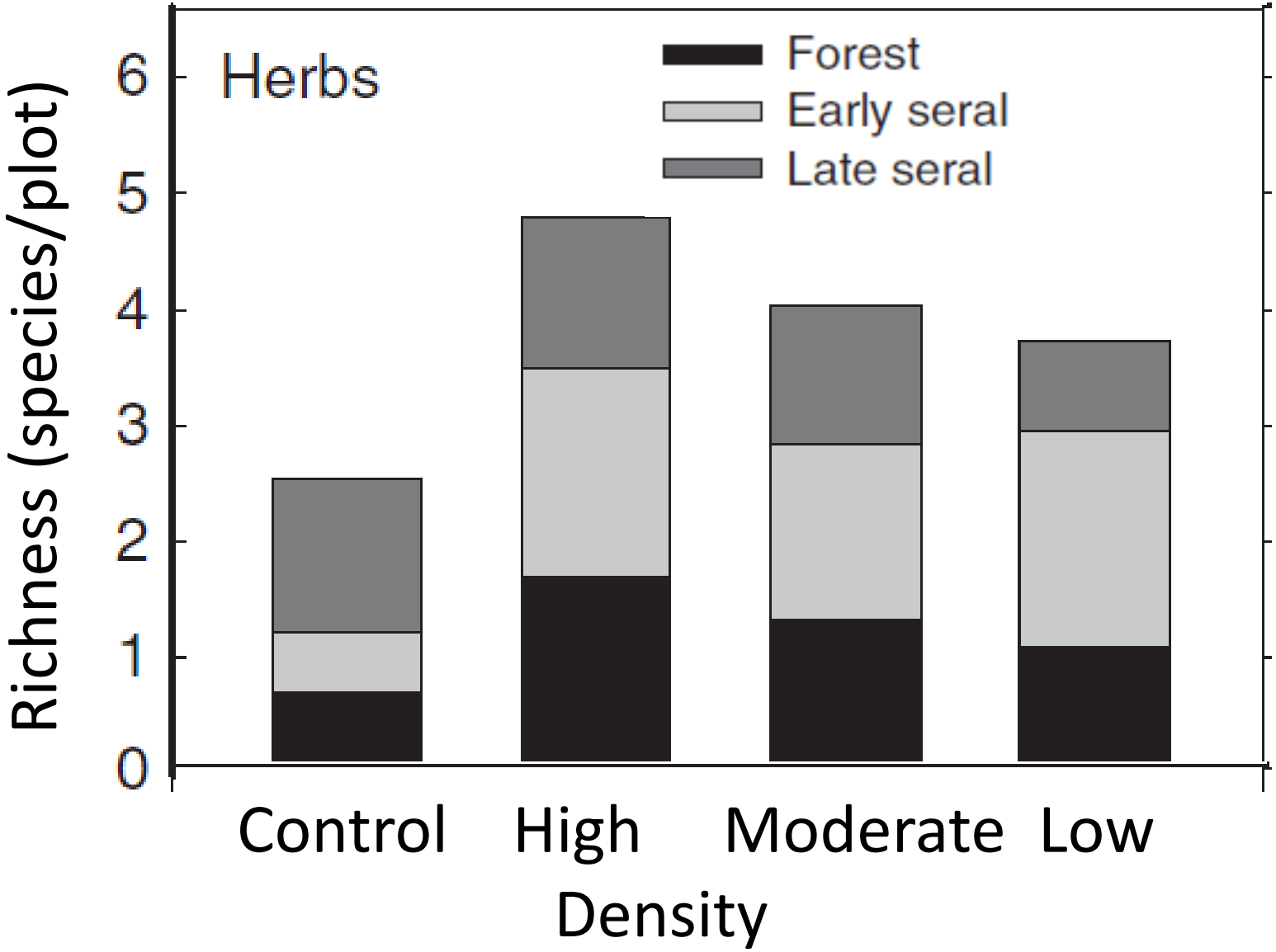
Background

Example

Density Management Study: Evaluating treatments designed to accelerate development towards late-successional conditions

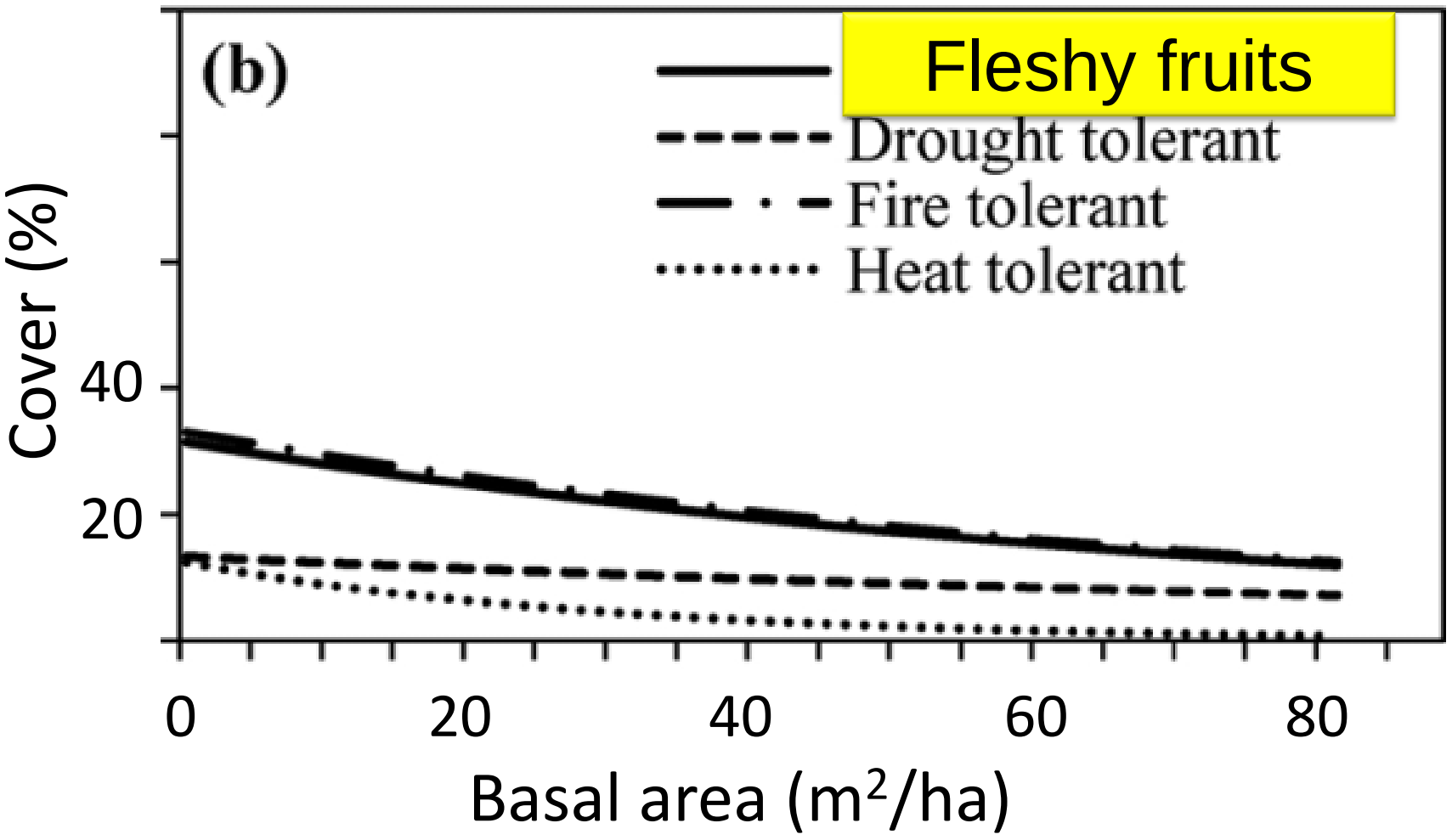
BLM

Example: Ecology study



From Ares et al. 2009

Example: Adaptive capacity



Example

Applied Vegetation Science 12: 472–487, 2009

Understory vegetation response to thinning disturbance of varying complexity in coniferous stands

Ares, Adrian*[1]; Berryman, Shanti D.[1,2] & Puettmann, Klaus J.[1,3,]

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NRC Research Press

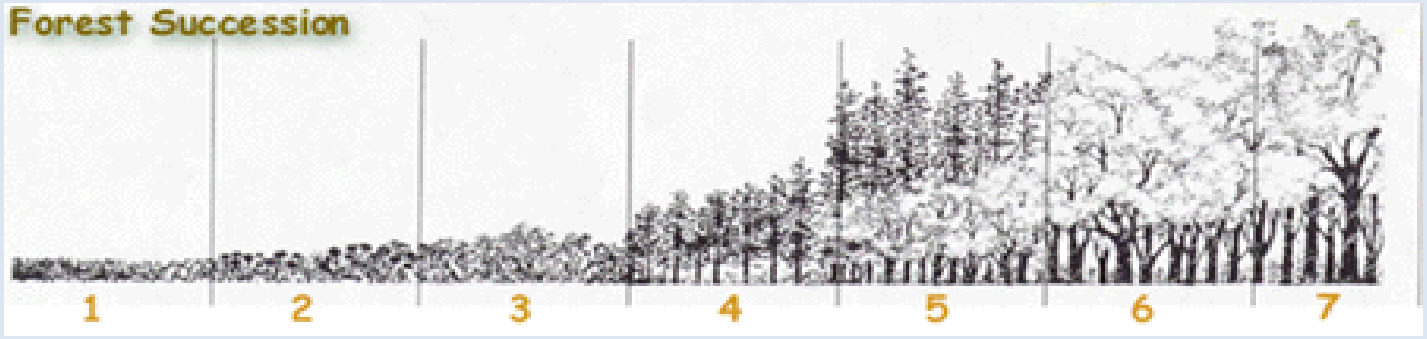
ARTICLE

Managing for adaptive capacity: thinning improves food availability for wildlife and insect pollinators under climate change conditions

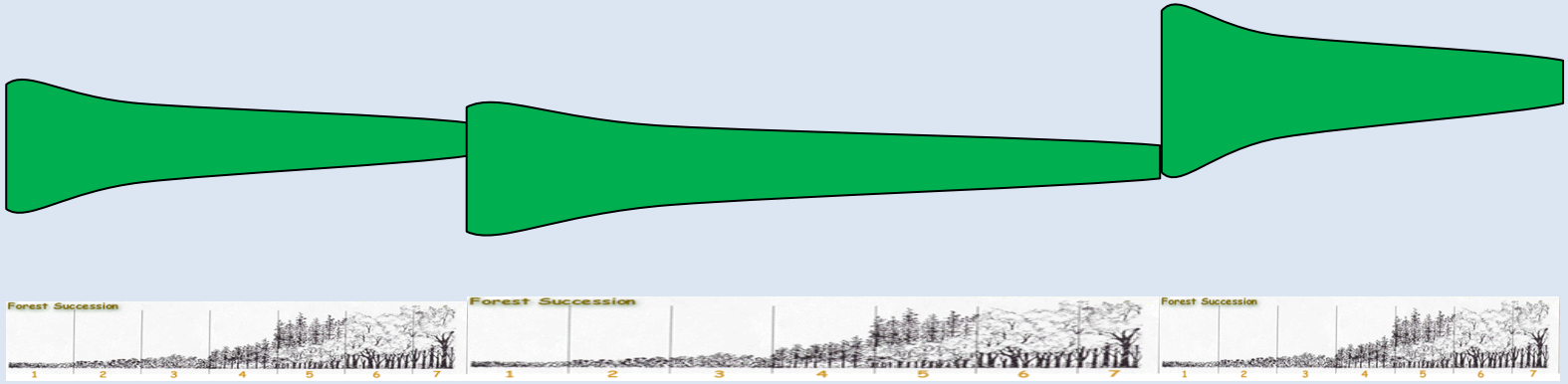
Andrew R. Neill and Klaus J. Puettmann

Disturbance and succession

Possible pathways
Adaptive capacity



Disturbance and succession



Disturbances (increasing creativity)
+ Succession (focusing resources)

= Ecosystem Adaptation

Thresholds and traps

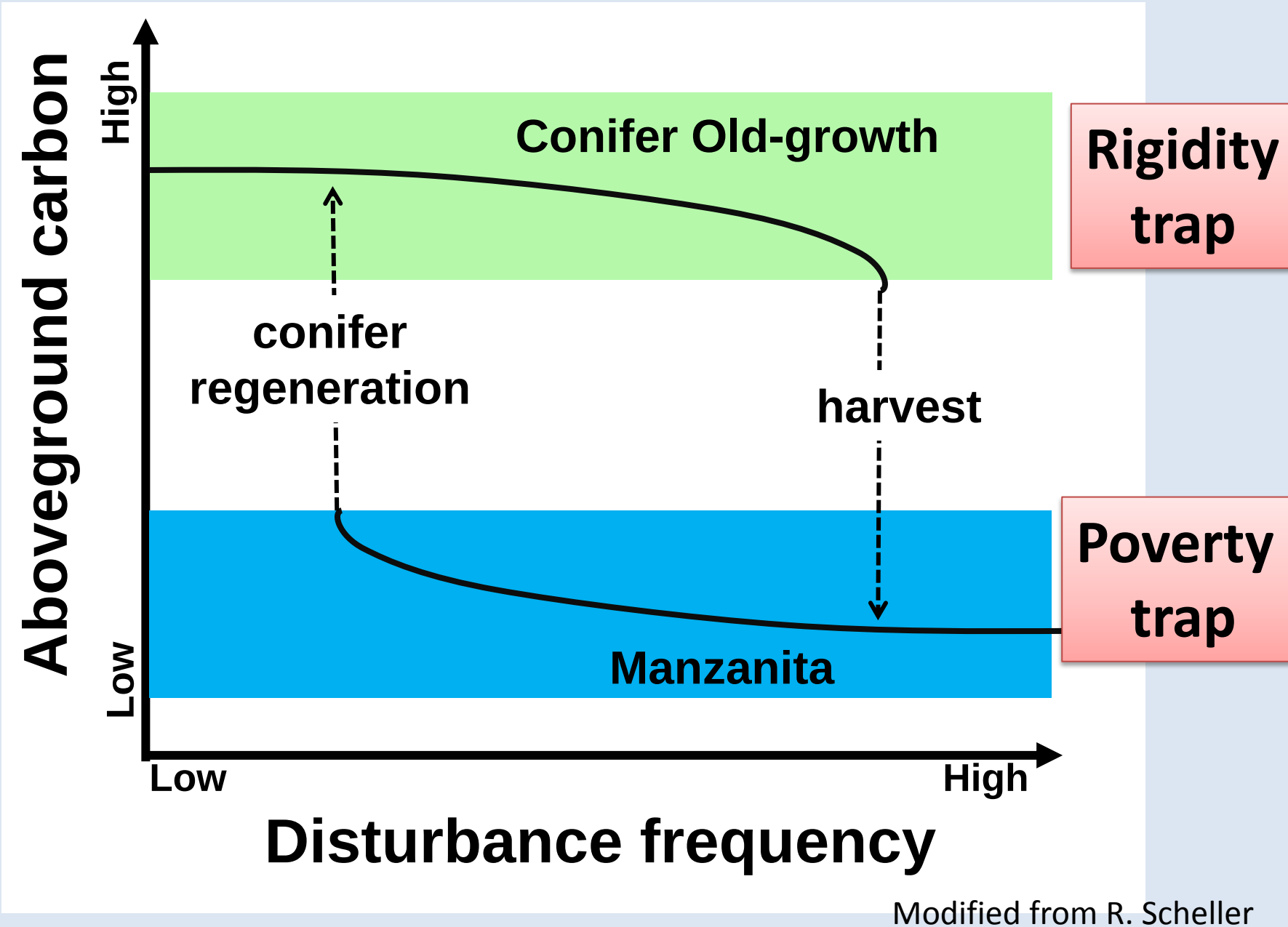
Robustness

Stability

Adaptability Trap

$$\text{Transformation} = \frac{1}{\text{Stability}}$$

Thresholds and traps



Modified from R. Scheller

Thresholds and traps

Rigidity trap

- Highly connected, self-reinforcing inflexible
- Nutrients locked up few shade-tolerant species
- Little opportunity to change from endogenous process
- Susceptible to external disturbances

Poverty trap

- Connectedness is low
- Heterogeneity is high
- Potential for change is high, but not realized
- Areas where frequent disturbances don't allow succession to occur
- Little opportunity to change from endogenous processes

Modified from Carpenter and Brock 2008

Thresholds and traps

Rigidity trap

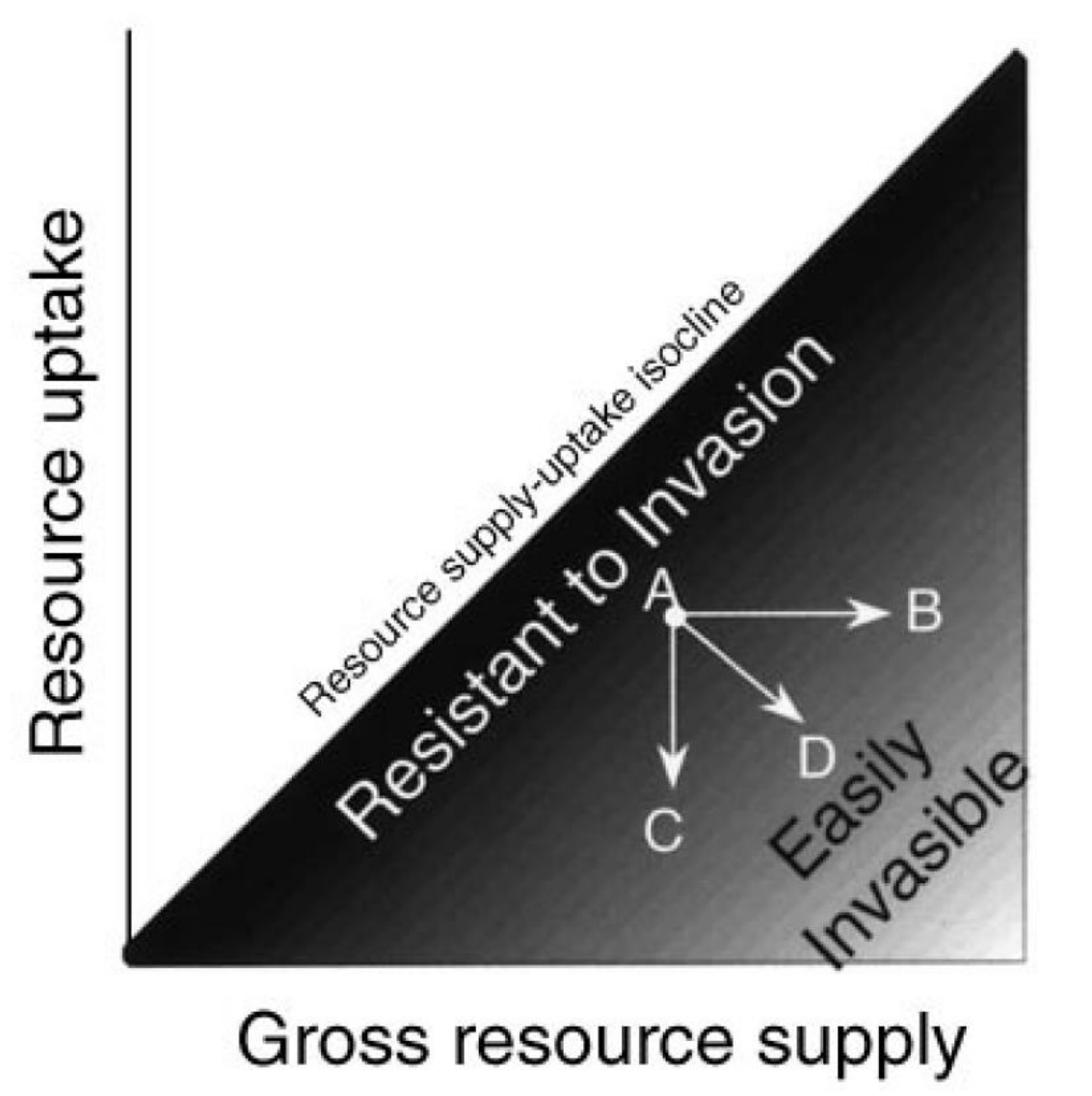
- Gaps to initiate regeneration
- Establish early seral vegetation
- Introduce new species
- Others ??

Poverty trap

- Understory vegetation
- Advanced regeneration
- Landscape connectivity
- Reduce disturbances
- Others ??

Modified from Carpenter and Brock 2008

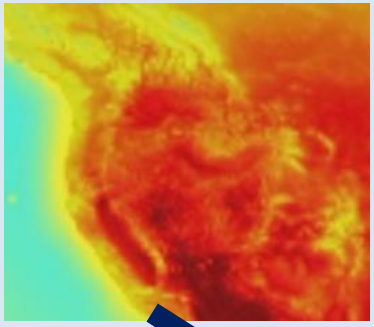
Plant invasion ~ Transformation



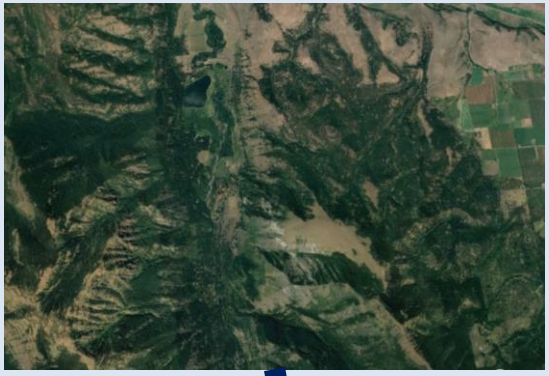
From Davis et al. 2000

Plant invasion

Climate



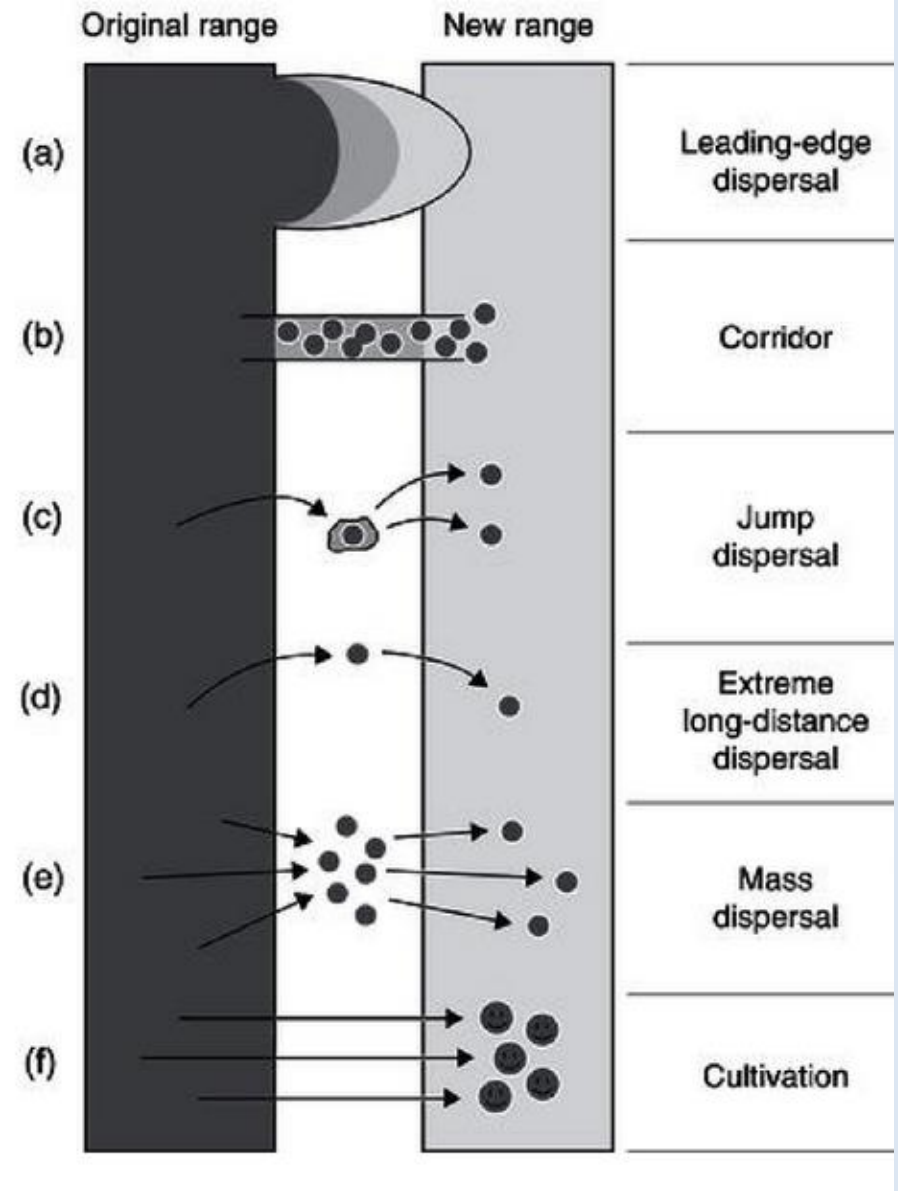
Land use



Habitat

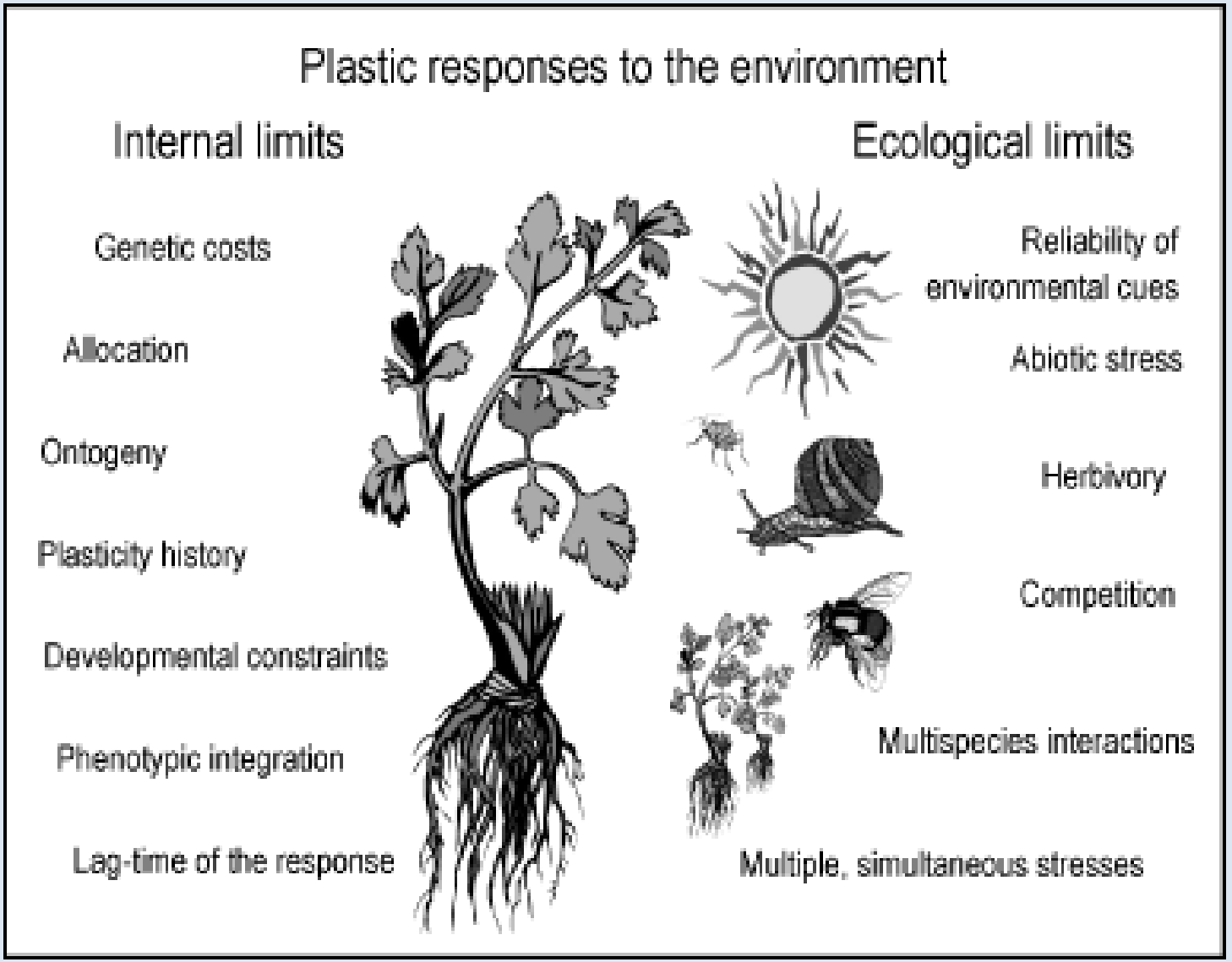
Plant invasion

Plant invasion



Wilson et al. 2009

Mechanisms



New Phytologist
Volume 176, Issue 4, pages 749-763, 8 NOV 2007 DOI: 10.1111/j.1469-8137.2007.02275.x
http://onlinelibrary.wiley.com/doi/10.1111/j.1469-8137.2007.02275.x/full#f1

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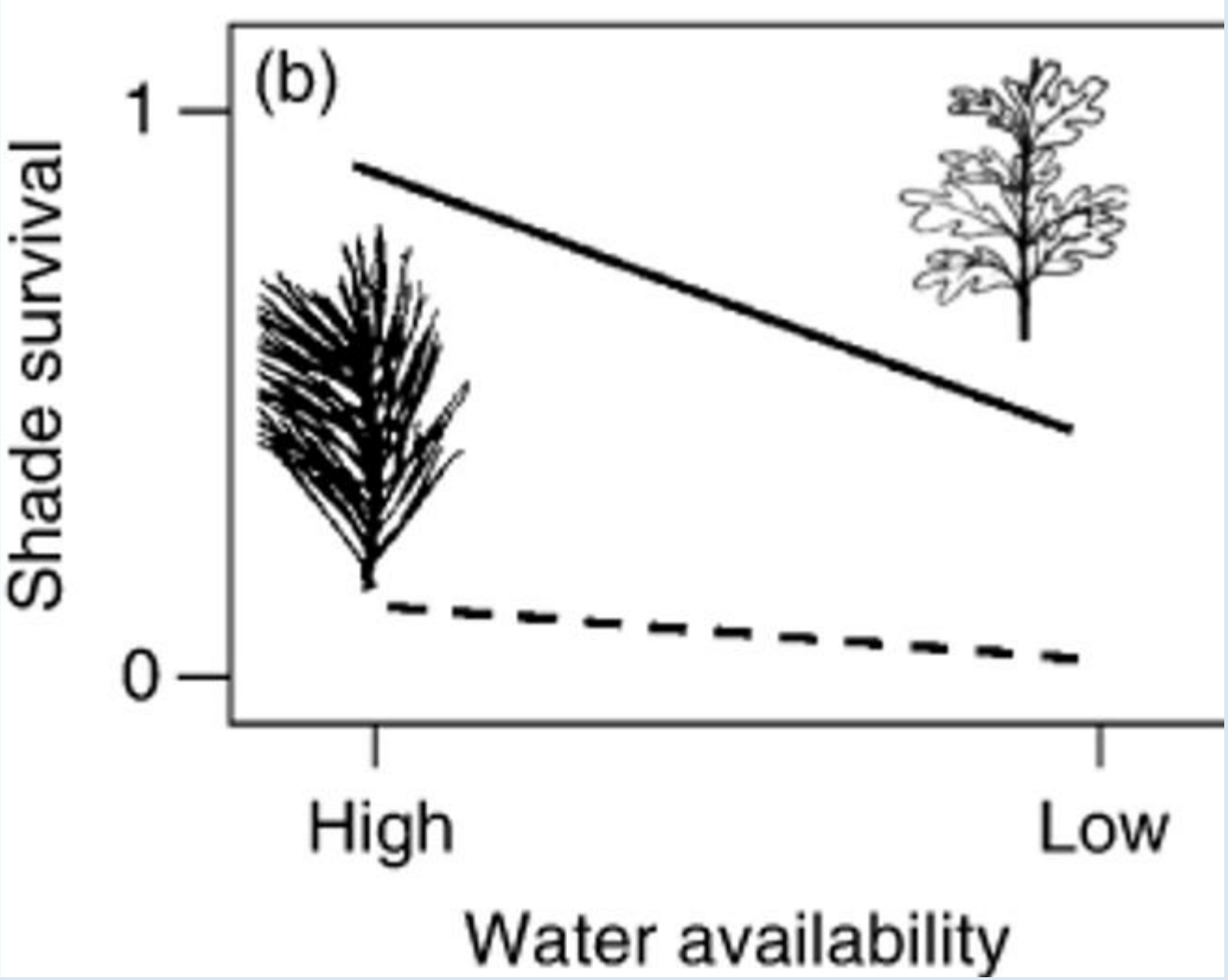

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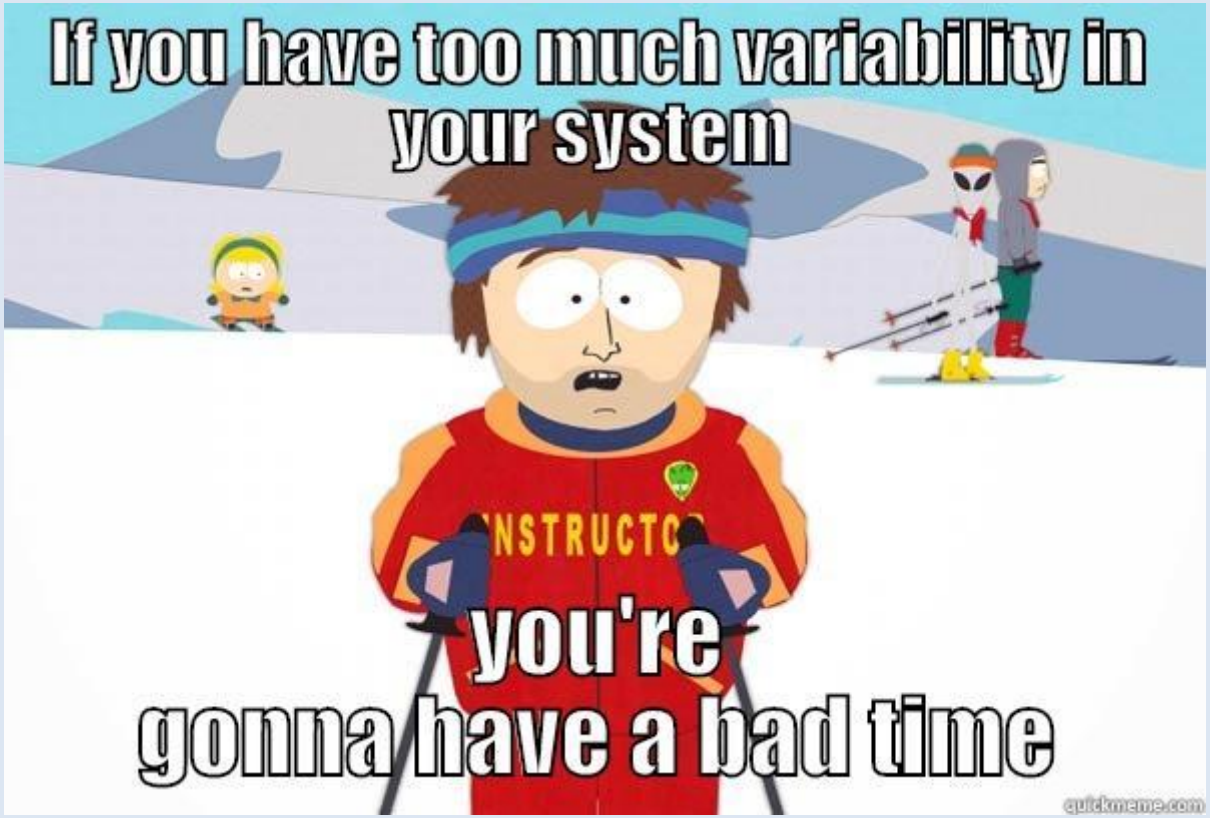
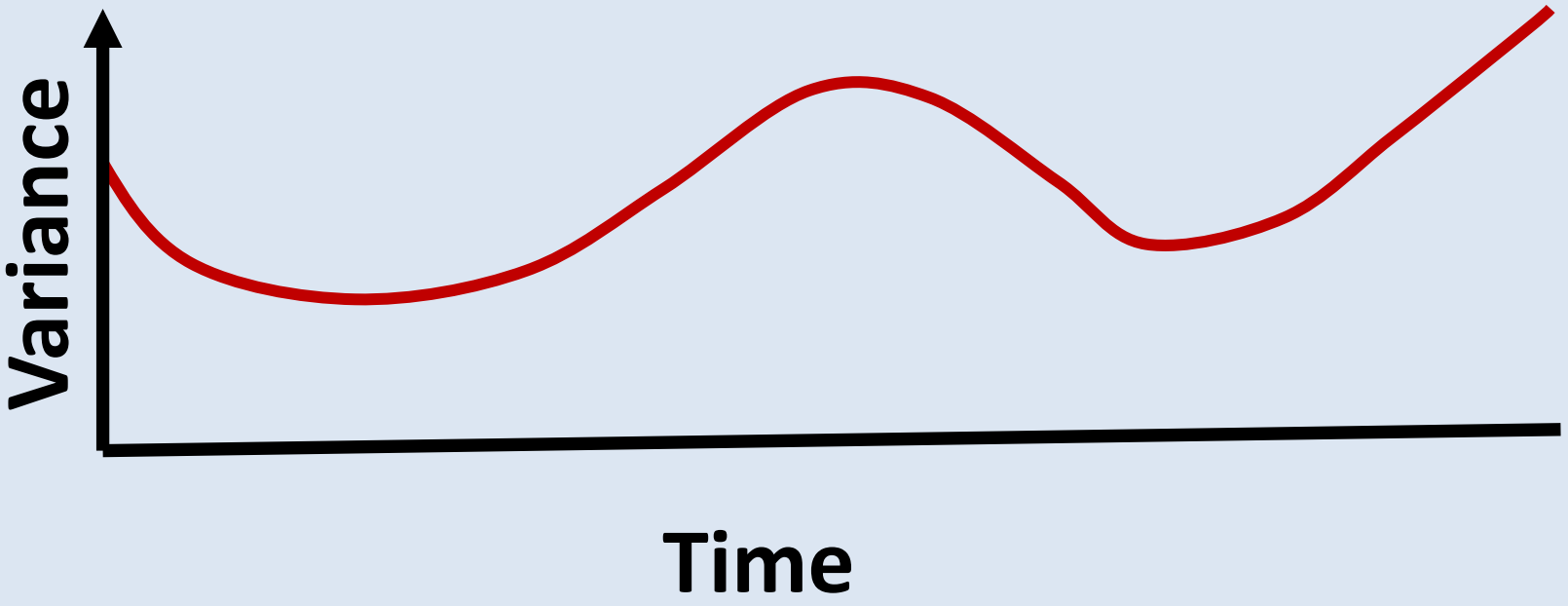
Variability



$$\text{Transformation} = \sum_{scale=1}^{n} \text{Variability}$$

Variability



Conclusion

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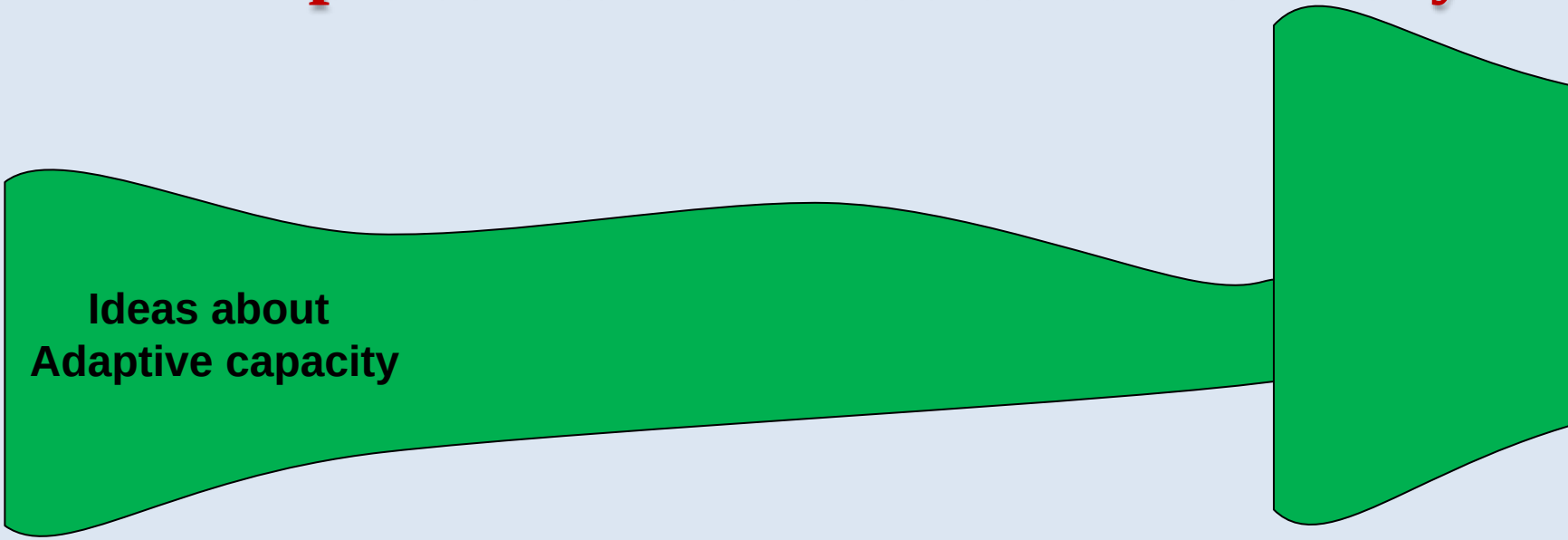

Merci d'avoir écouté

Questions et commentaires:

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