PISCO

OREGON STATE UNIVERSITY

The future of local-regional plots: rubbish or reconciliation?

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~ the ecological society of america ~
~ savannah, georgia ~ aug 2003 ~

the message box

problems

benefits

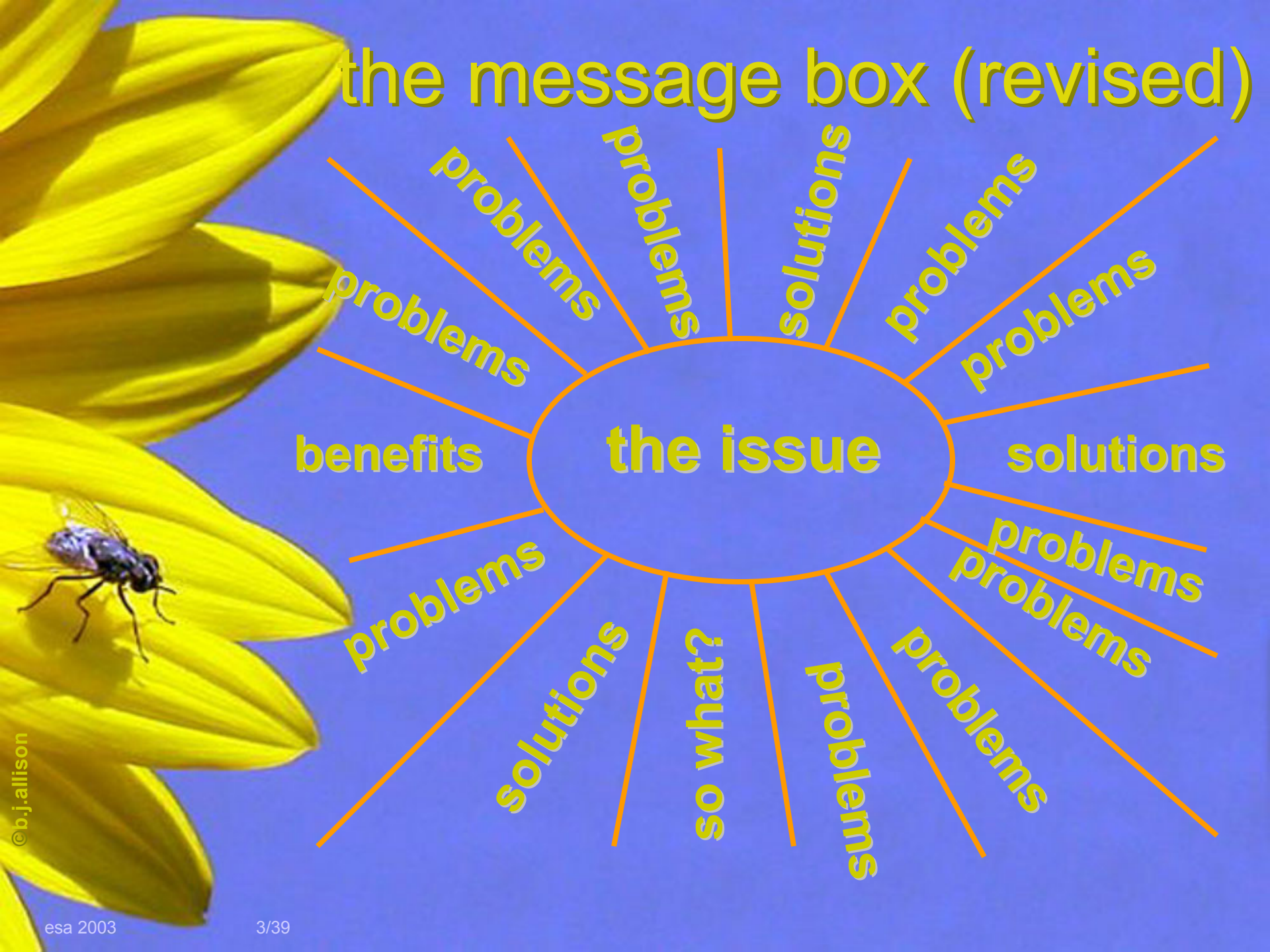
the issue

solutions

so what?

(from the aldo leopold leadership program)

the message box (revised)



the issue

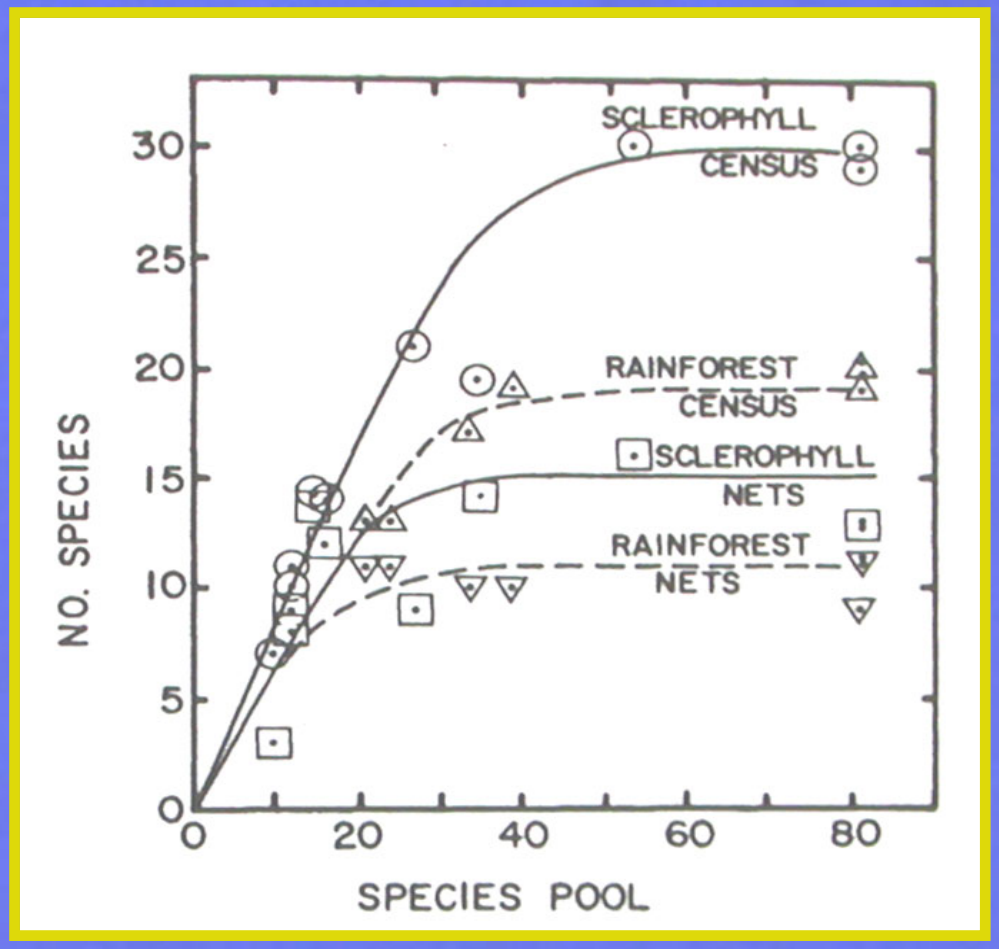
- what determines how many species exist in a place?
  - we know local factors are influential.
    - competition, predation, disturbance, abiotic stresses, et cetera.
  - we know regional factors are influential.
    - regional species pool, evolution & speciation, dispersal, biogeography

the problem

we need a tool to determine *relative* influence of regional versus local factors.

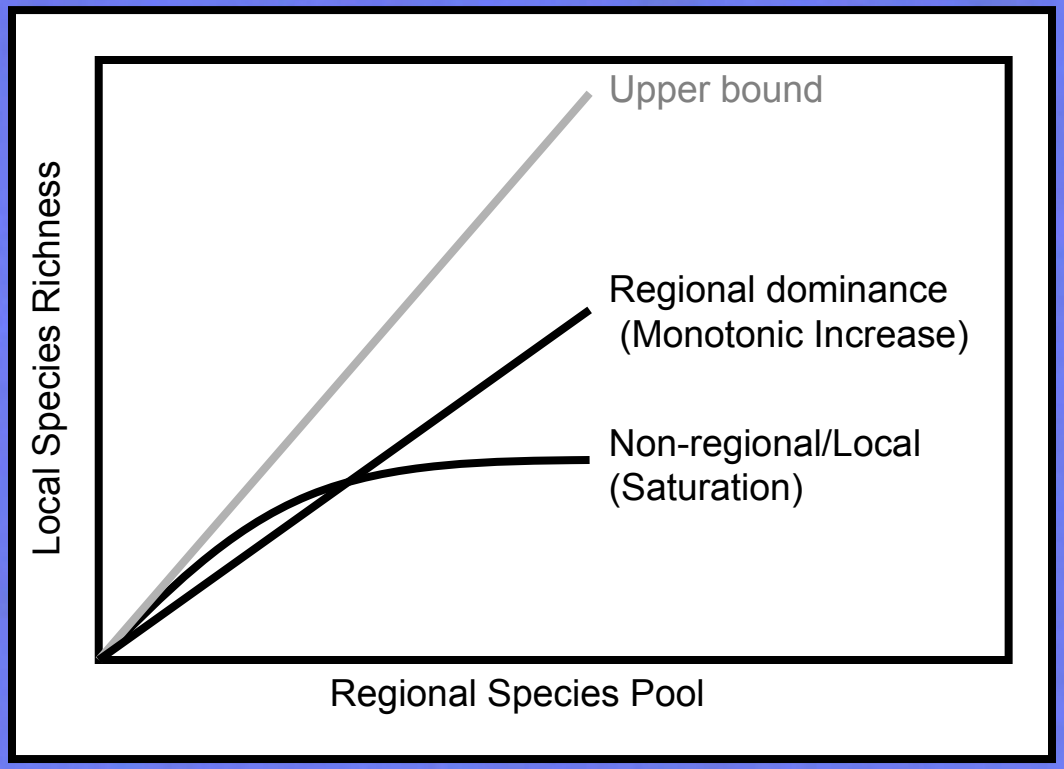
solution:

a tool for simultaneously investigating regional & local factors.



Terborg & Faaborg 1980

two potential outcomes.



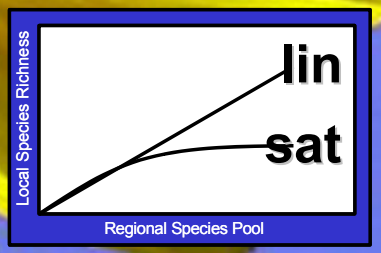
the data show …

- **Saturation does occur:**
  crustaceans (Abele ’84) fish (Westoby ’85) birds (Terborgh & Faaborg ’80) helminths (Kennedy & Guegan ‘94) leaf miners (Gal[illegible] ’74) birds (Lawes, Eeley & Piper ’00)

- **Saturation does *not* occur:**
  fig wasp parasitoids (Hawkins & Compton ’92) birds (Ricklefs ’87; Weins ’89) oak gall wasps (Cornell) corals (Cornell & Karlson ’96) bracken herbivores (Lawton et al. ’93) fish (Hugeny & Paugy ’95; Oberdorff et al. ’98)

PROBLEM!

… that both patterns exist.



solution

- **Option A …**
  trash the tool.
- **Option B** … build a predictive framework.

theory predicts that…

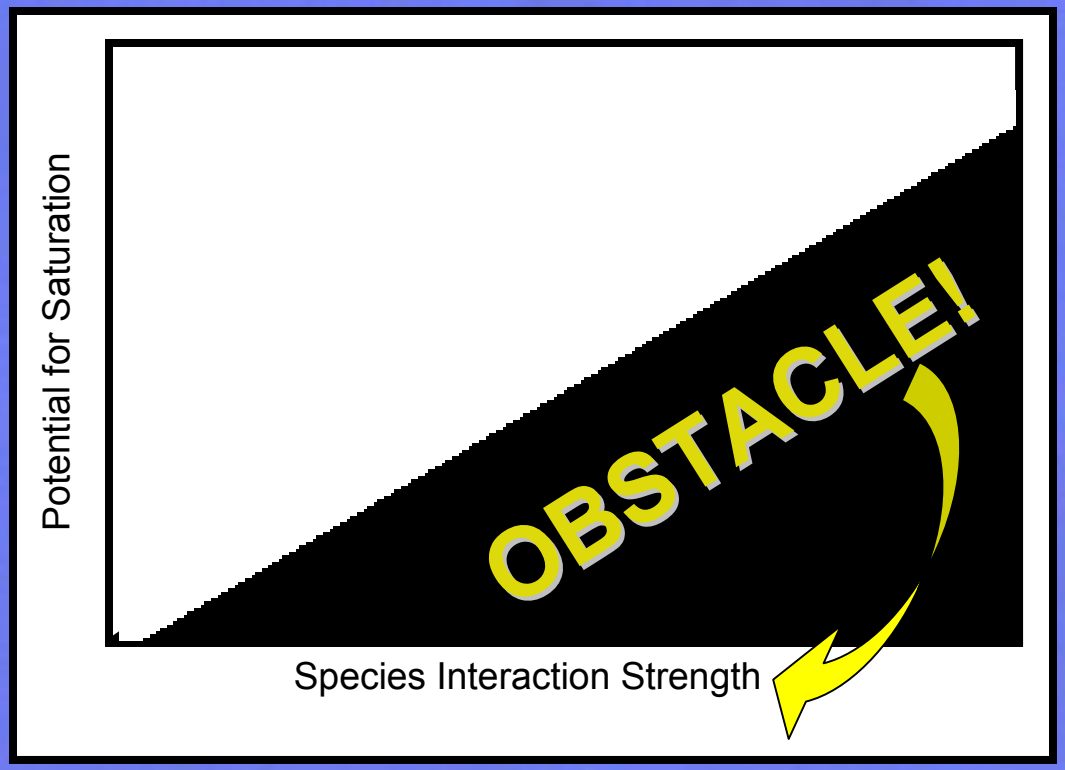
(c.f. Cornell 1993)

- **Saturation should occur:**
  MacArthur 1972 (niche) Tilman 1985 (resources) Huston 1979 (disturbance)
  (Hutchinson/Gause)

- **Saturation should *not* occur:**
  Hubbell 2001 (neutral) Hubbell & Foster 1986 (random) Sale 1977 (lottery) Janzen 1970 (specialist predators) Caswell 1976 (non-interactive)

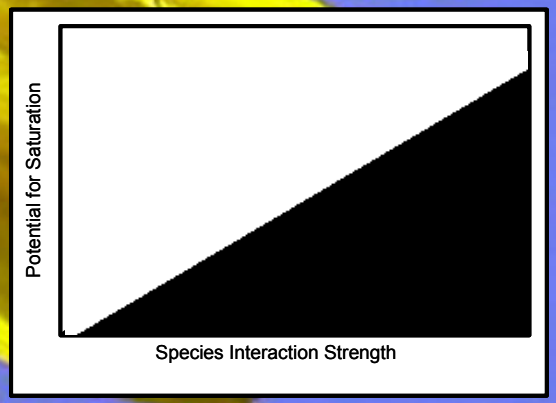
theory predicts both patterns.

simply, theory predicts that…



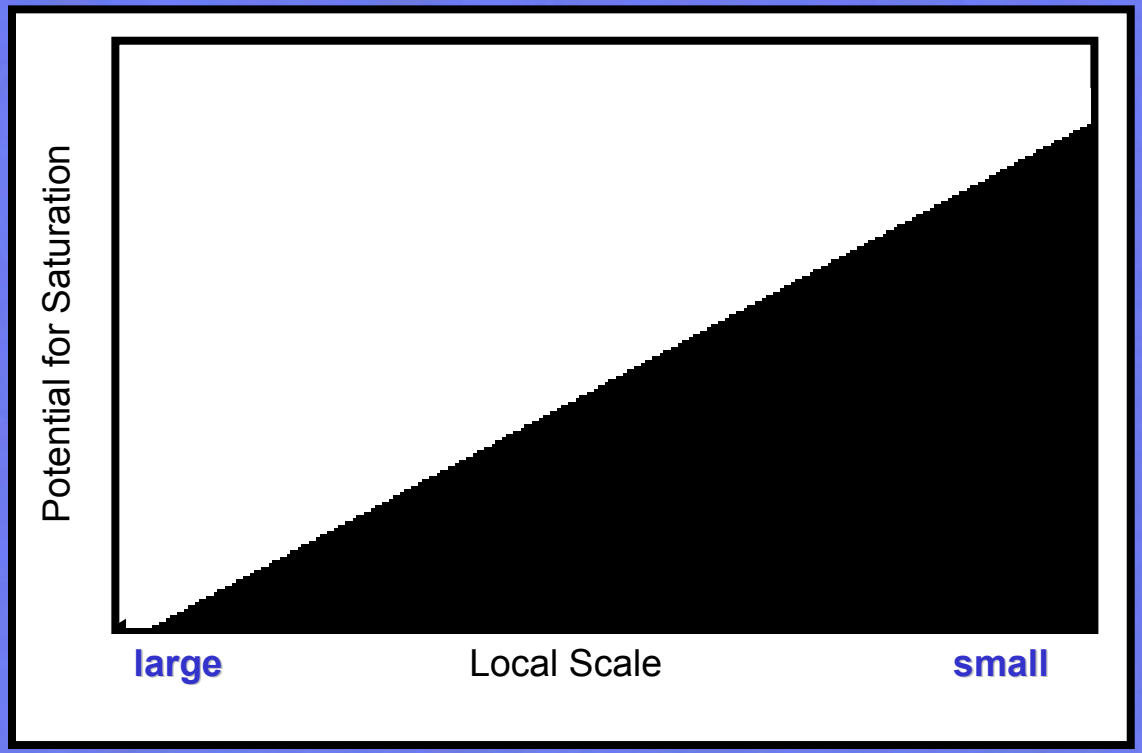
proposed solution:
deconstruct 'interaction strength' into multidimensional space.

- Theory only predicts saturation where species are interactive, so…
  - Scale
    - dispersal; home ranges; body size. Often local scales encompass multiple 'locales'.
  - Categorization of species
    - Some groupings of species are ecologically irrelevant, other include strong interactions.
  - Habitat history (evolutionary time)
    - Certain communities have evolved in more abiotically variable (stressful?) places.



local scale

- Perhaps these discrepancies can—in part—be accounted for by viewing empirical evidence in an appropriate theoretical framework.



species groupings

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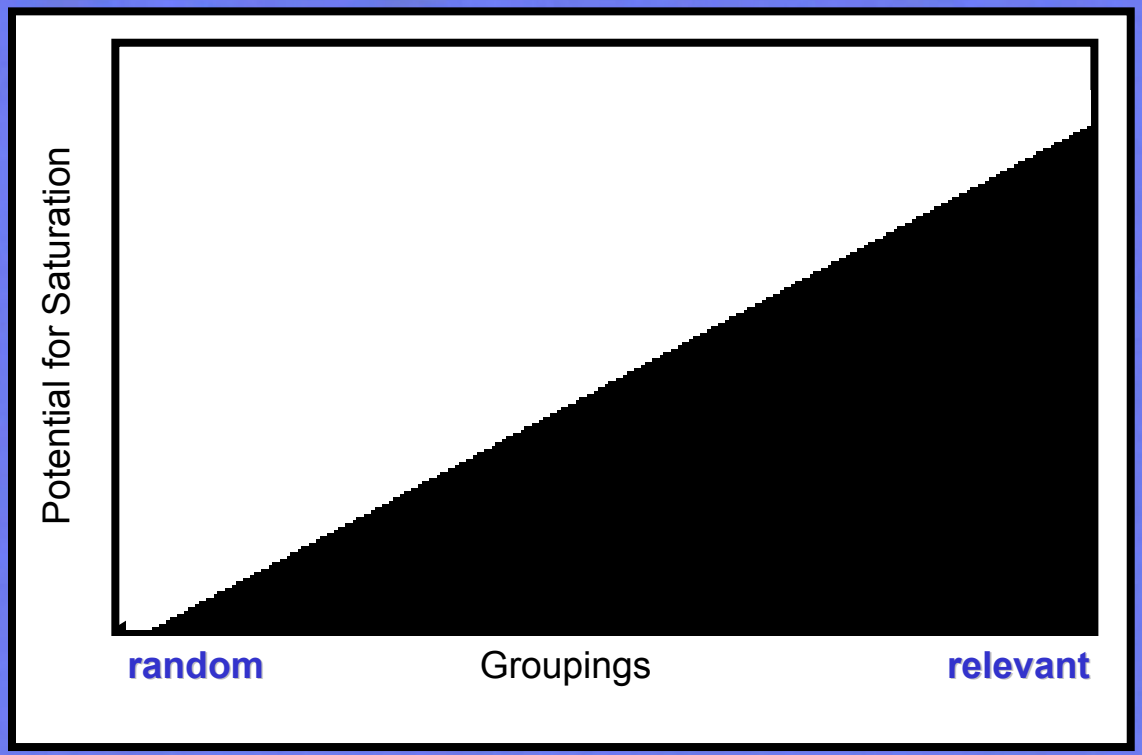

a predictive framework

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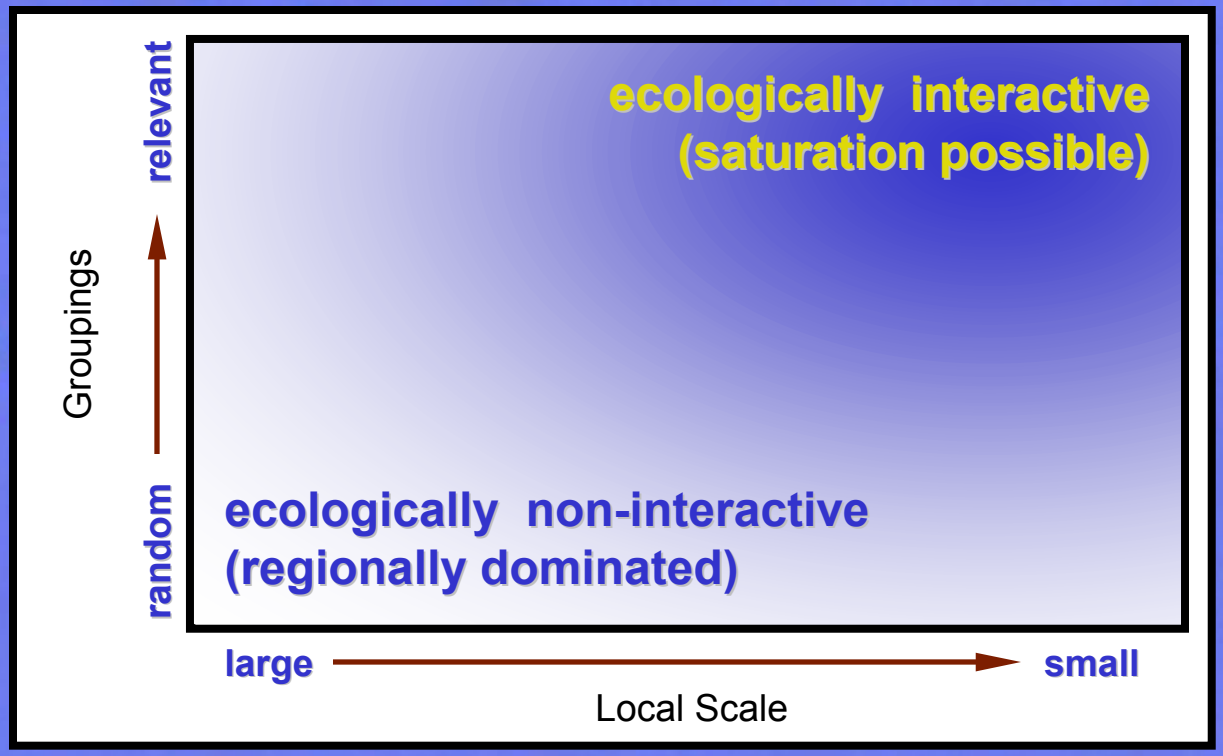
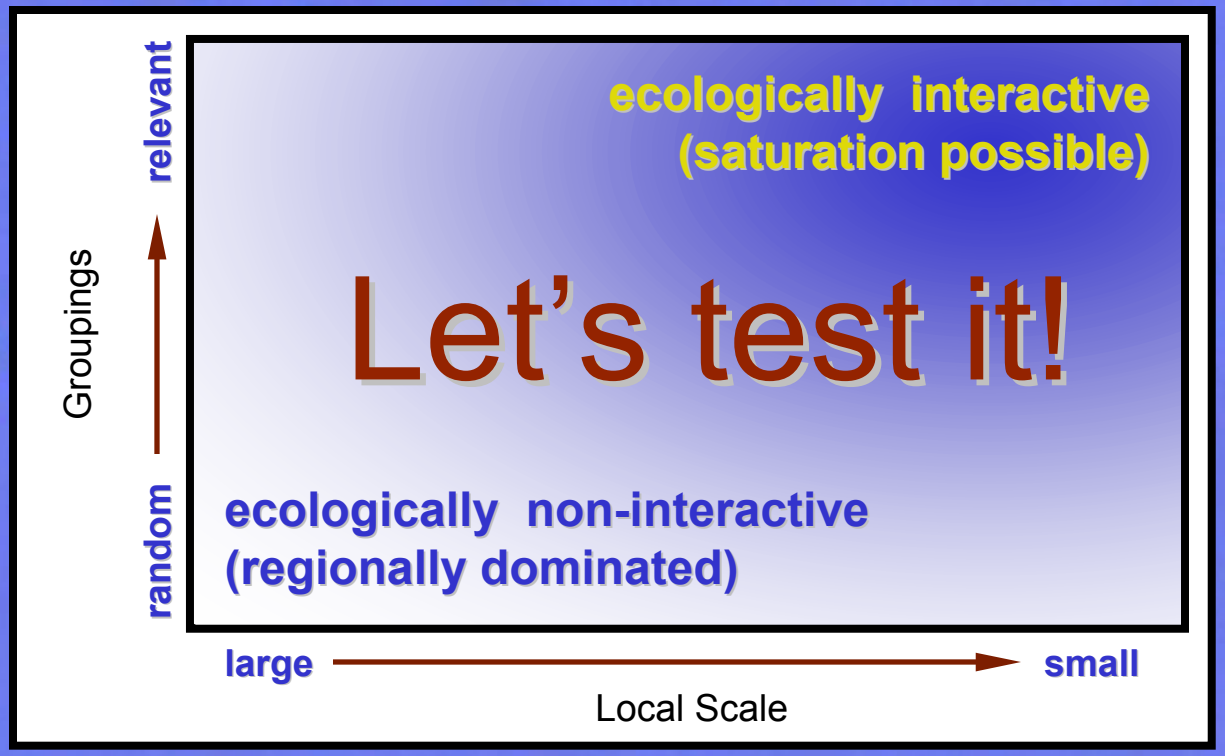


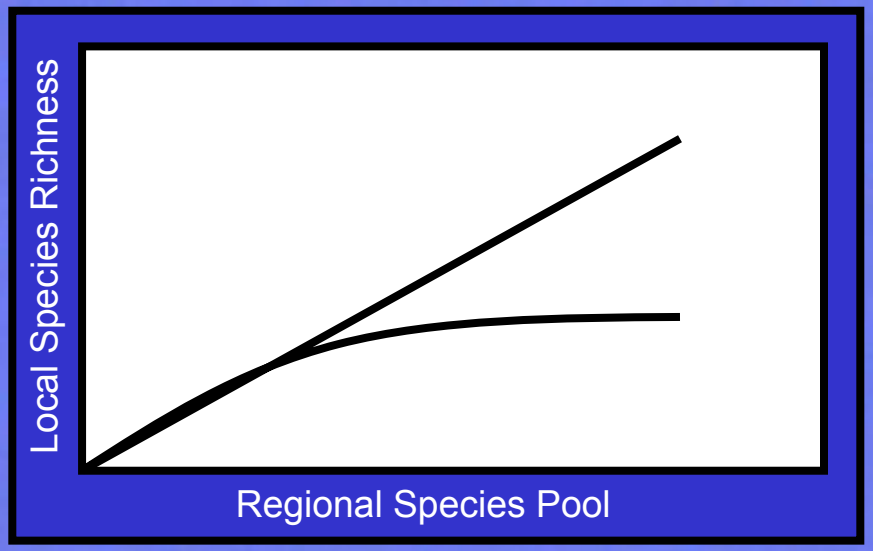
a predictive framework



statistical approach

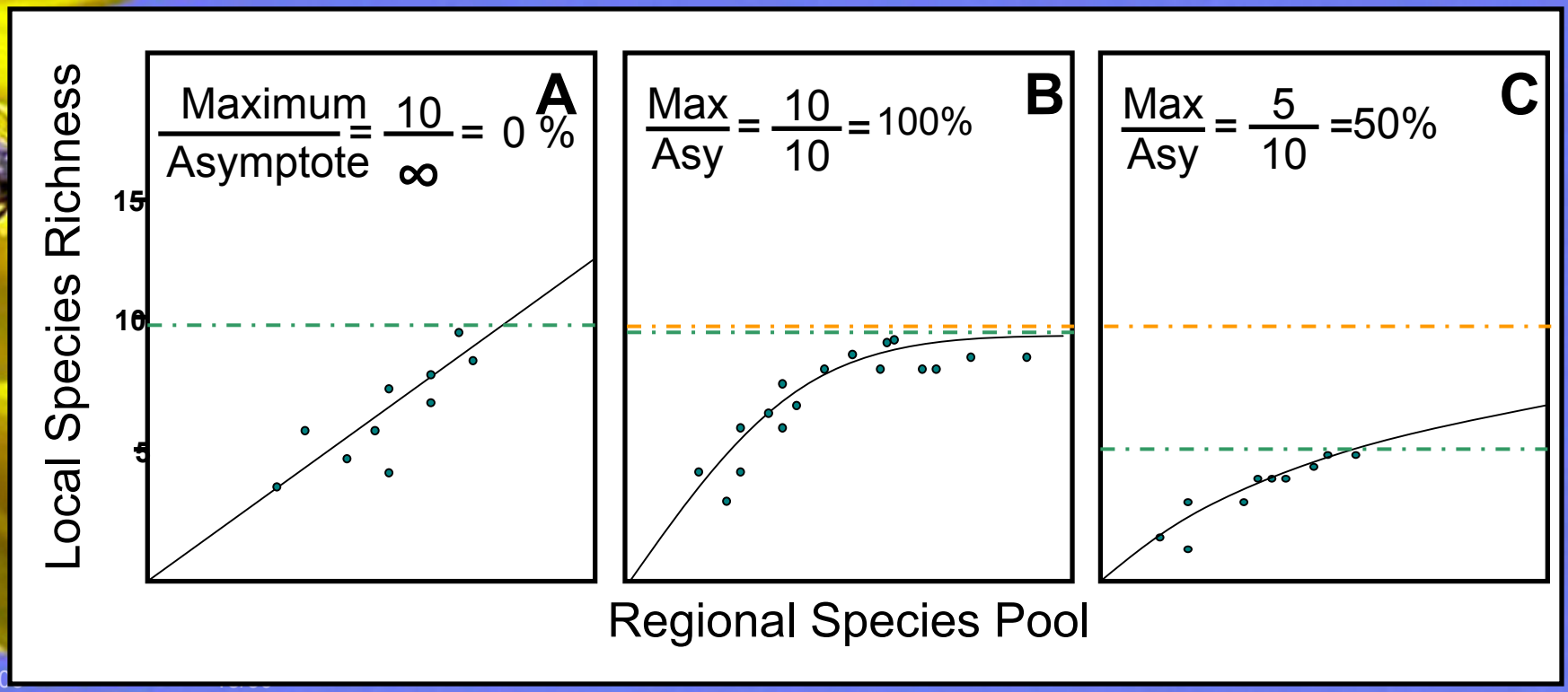
- Non-linear modified Michaelis-Menton Model:

(Local Richness) = Intercept + (Vmax*Regional Richness) / (Km + Regional Richness)



our metric of saturation

$$\frac{\text{maximum local richness}}{\text{estimated asymptote}}$$



need some data
(methods—nested surveys)

data
(methods—nested surveys)

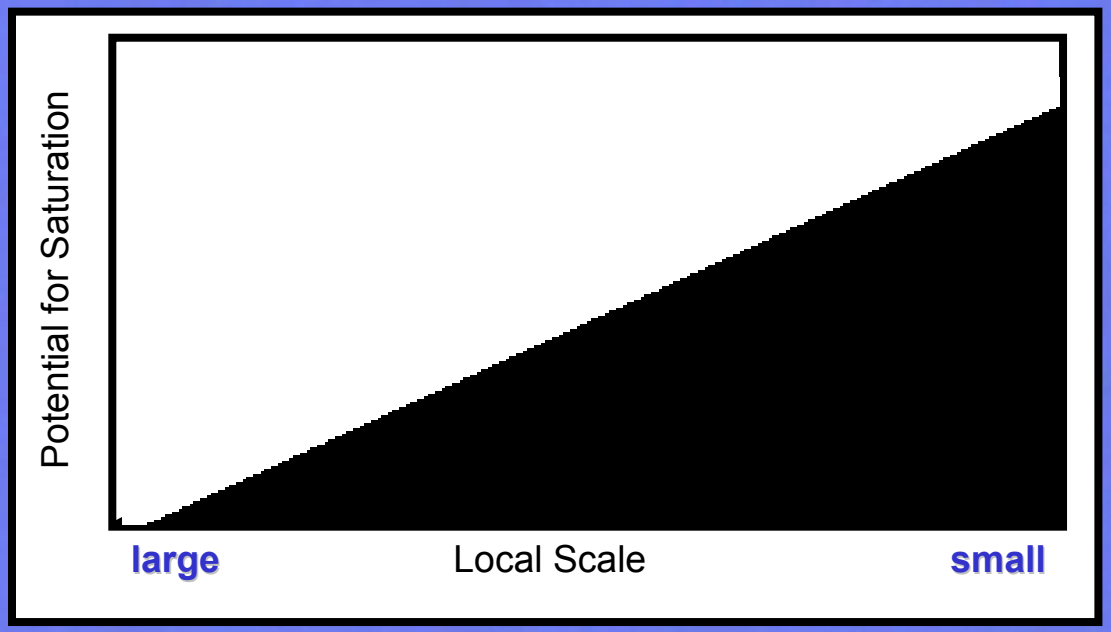
- Resolution
  - species or OTUs

testing the framework

- Scale
  - dispersal; home ranges; body size. Often local scales encompass multiple ‘locales’.
- Categorization of species
  - Some groupings of species are ecologically irrelevant, other include strong interactions.
- Habitat history (evolutionary time)
  - Certain communities have evolved in more abiotically variable places.

tests of the context (testing scale)

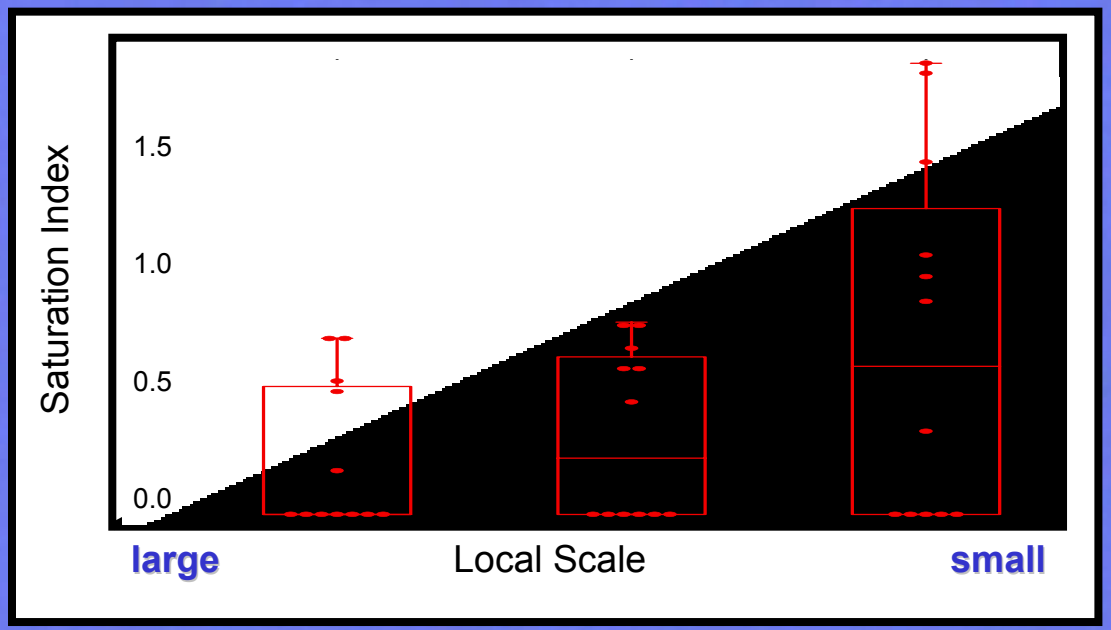
- large local scale *should* = low saturation potential

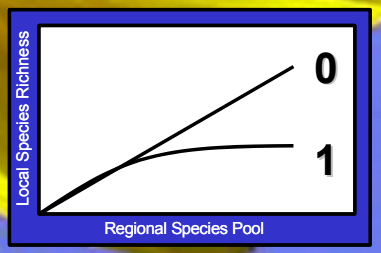


tests of the context (testing scale)

- large local scale *does* =

  low saturation potential





testing the framework

- Scale
  - Smaller local scales are more saturated
- Categorization of species
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testing the framework

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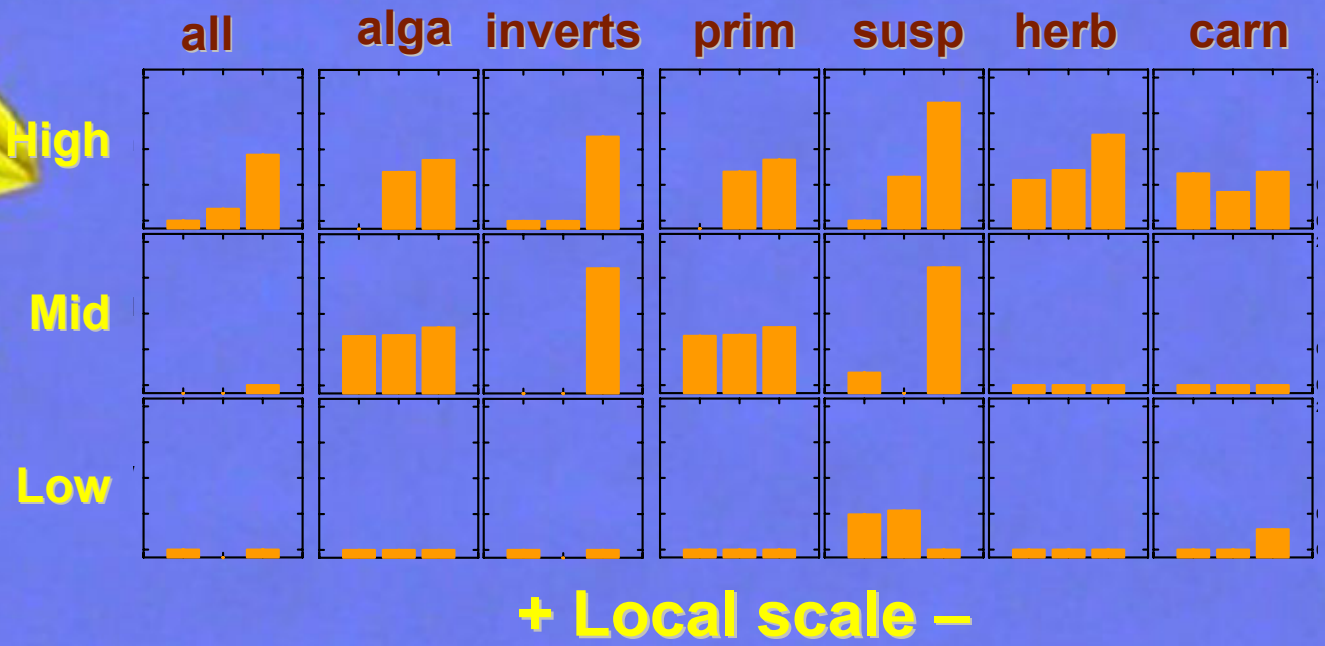
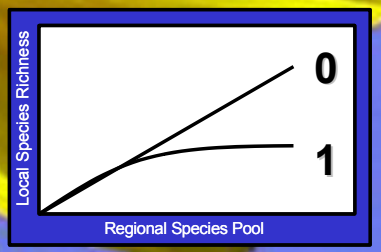
tests of the context (testing groupings)

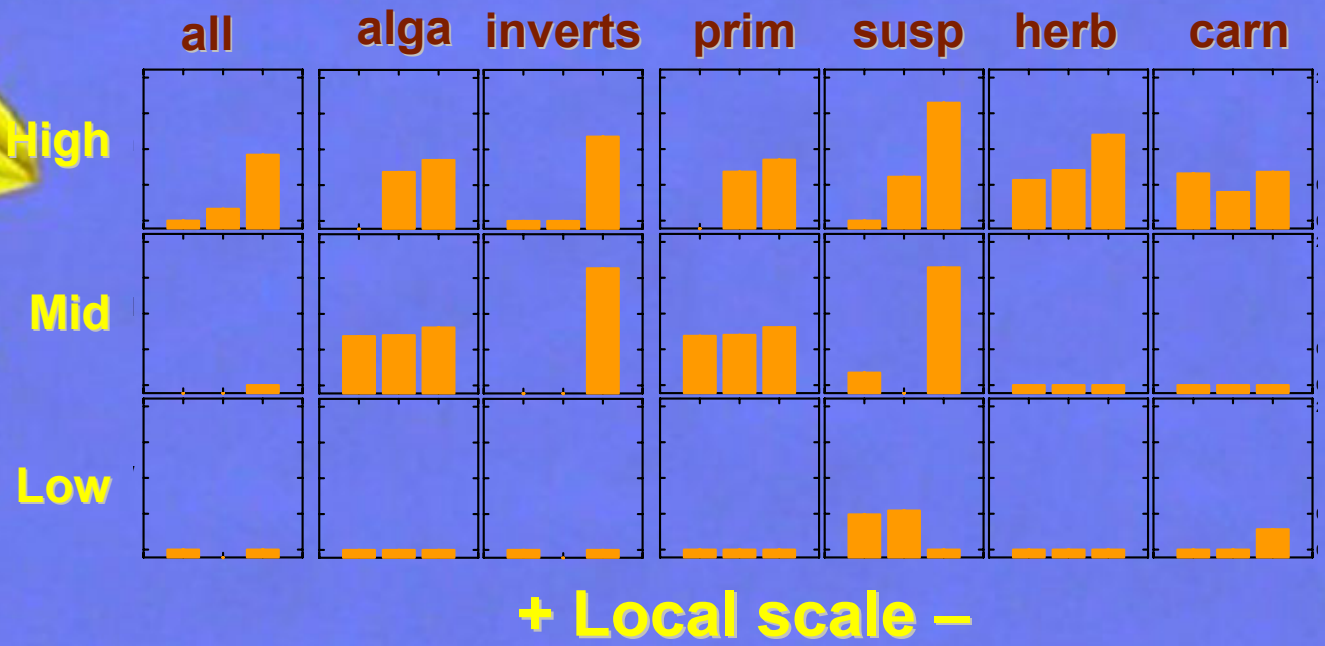
- As groupings become more relevant to ecological interacting groups, saturation potential *should* increase.

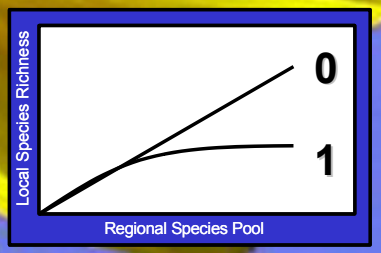




tests of the context (testing groupings)

- These data indicate a slight trend toward greater saturation in finer groupings.





creating the null hypothesis

H_a:

these groups are more or less saturated than we would expect with random assemblages.

H_o:

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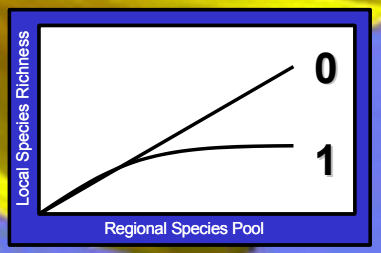
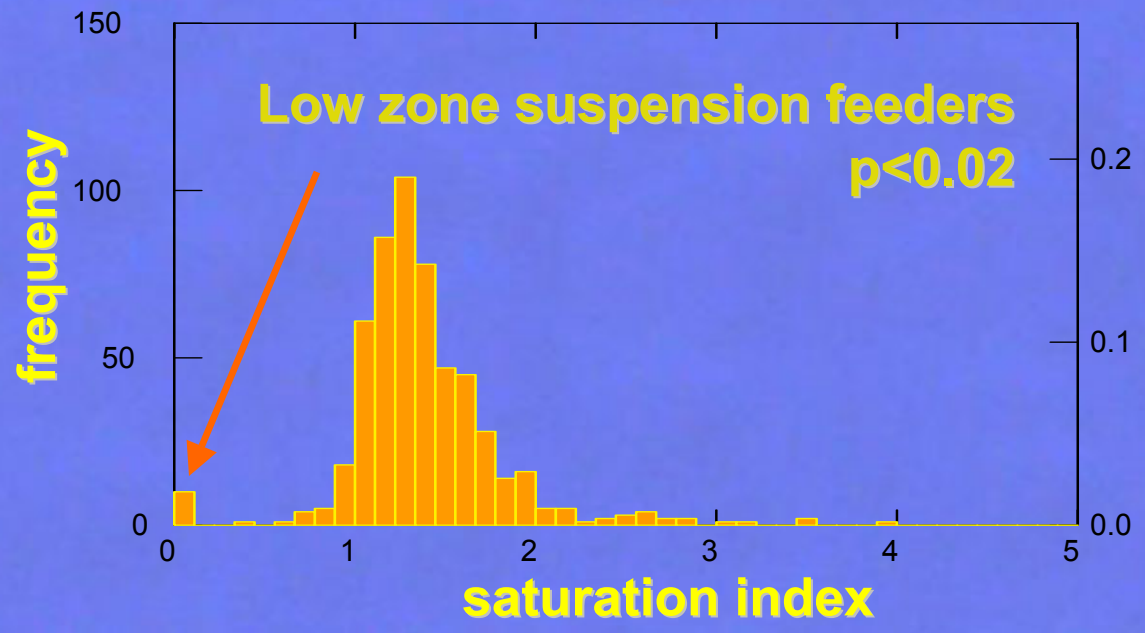
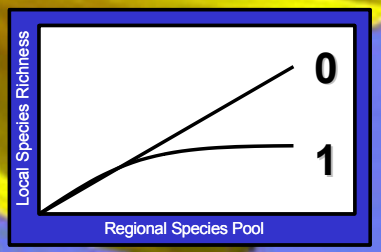


creating the null model

- select random species groups
- determine regional pools
- run non-linear regression
- record saturation index estimates
- repeat lots of times
- compare empirical data to random sets

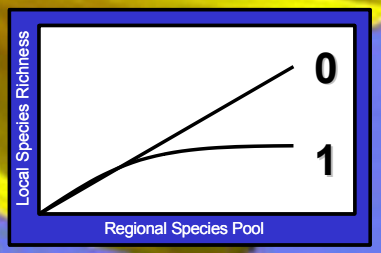




tests of the context (testing groupings)

		High	Mid	Low
	All	.	.	.
KINGDOMS				
	Alga	0.24	0.55	0.00
	Invert	0.86	1.00	0.03
TROPHIC LEVELS				
	Prim	0.24	0.55	0.03
	Susp	0.61	0.72	0.02
	Herb	0.30	0.00	0.01
	Carn	0.03	0.00	0.02
FUNCTIONAL GROUPS				
	Thin_branc	0.54	0.61	0.03
	Crust	0.31	0.08	0.19
	Sheet	0.62	0.03	0.02
	Leather	0.13	0.01	0.03
	Coarse_bra	0.05	0.03	0.02

(close to 0 = regional influence
close to 1 = saturation
***relative* to random species sets)**



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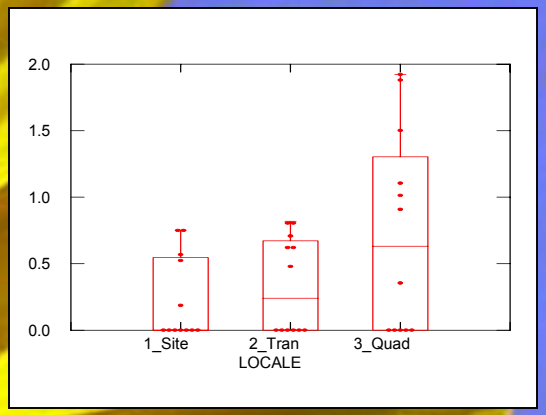
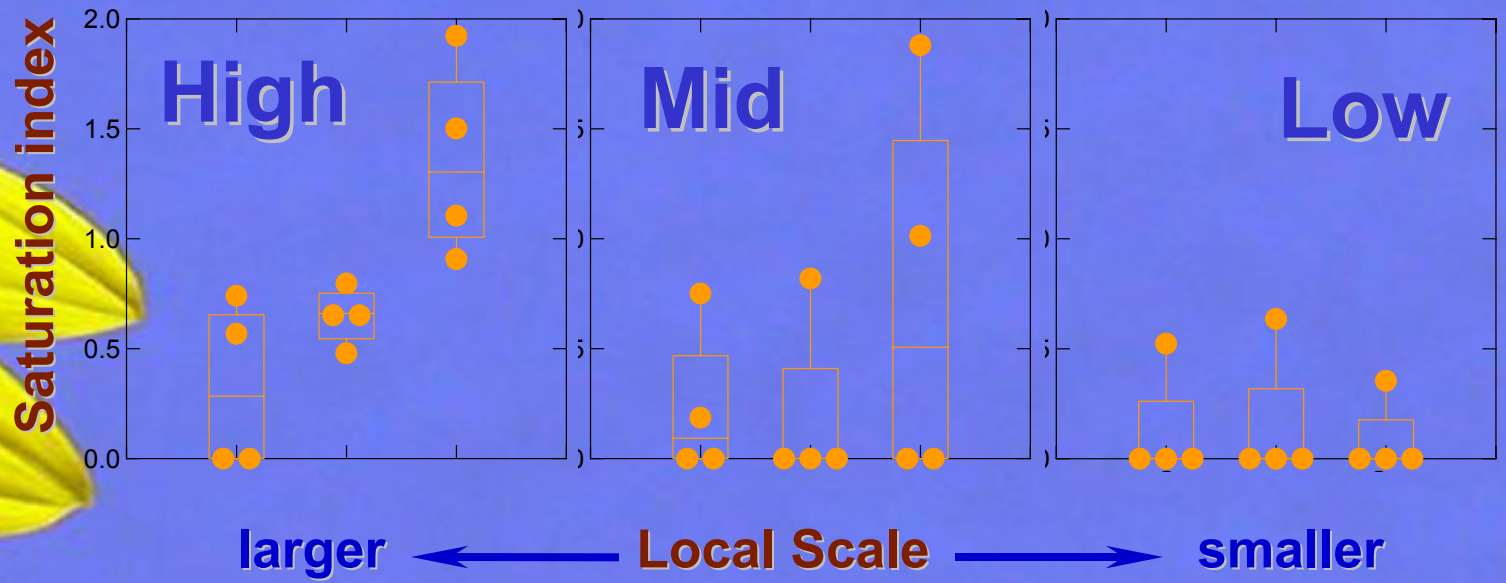


tests of the context (testing habitat history)

- Unique habitats may manifest different patterns of saturation potential.



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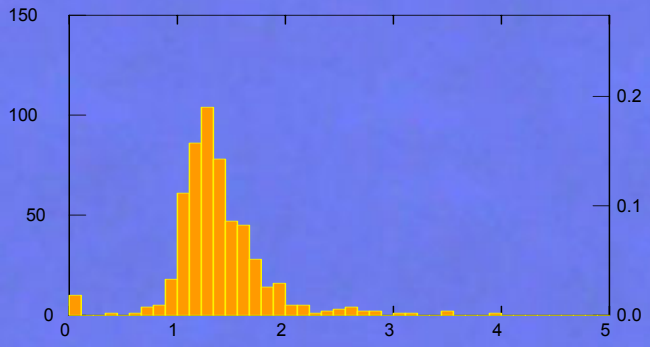
conclusions

- Scale matters
  - Small local scales = more saturated.
- Groupings matter
  - Weak evidence for finer trophic groups being more saturated.
- Habitat matters
  - Lower intertidal = more regionally driven.

insights

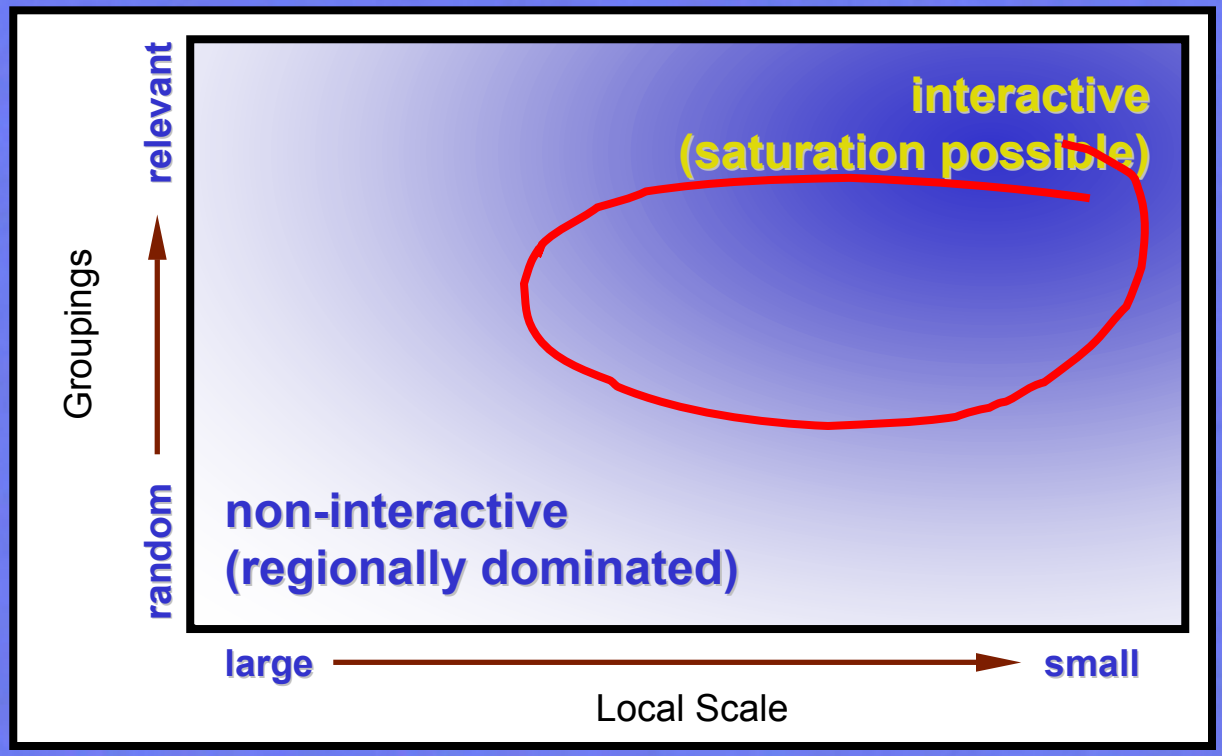
- Estimating appropriate scales & groupings is going to be tough!

- Random permutations are *extremely* useful to test these patterns.



insights

- Context matters!!
  - We need to do a better job of matching the context of our experiments with the predictions of theory.



… and finally…

'we are like dwarfs on the shoulders of giants so that we can see more than they, and things at a greater distance not by virtue of any sharpness of sight on our part, or any physical distinction but because we are carried high and raised up by their size'

– Bernard of Chartres

to our giants…

INTELLECTUALLY: For the novel perspectives and ingenious ideas; Christine Carlson, Anne Guerry, Josh Lawler, Francis Chan, Sara Ann Thompson, Sheri Etchemendy, Melissa Foley, April Hayward, Maria Kavanaugh, Chris Krenz, Heather Leslie, Karen Overholtzer, the **NUT** group, and all the other individuals involved.

LOGISTICALLY: For an admirable job of collecting data, thanks go to Alison Kendall, Annie DiSorbo, Annie Wilson, Carl Schoch, CC, Dylan Digby, Erin Maloney, GA, Julian Uselman, Kathy Ann Miller, Kristen Kusic, Luke Keeton, MK , Megan Williams, Melissa Foley, Molly Dutton, Morgan Packard, Rachael Pecore, ST, SE, SW, Stuart Clausen, & Wayne Wood.

FINANCIALLY: This research was funded by the Dave & Lucile Packard Foundation (PISCO – the partnership for interdisciplinary studies of coastal oceans), NSERC (Canada), the Fulbright Foundation, and the Andrew W. Mellon Foundation.