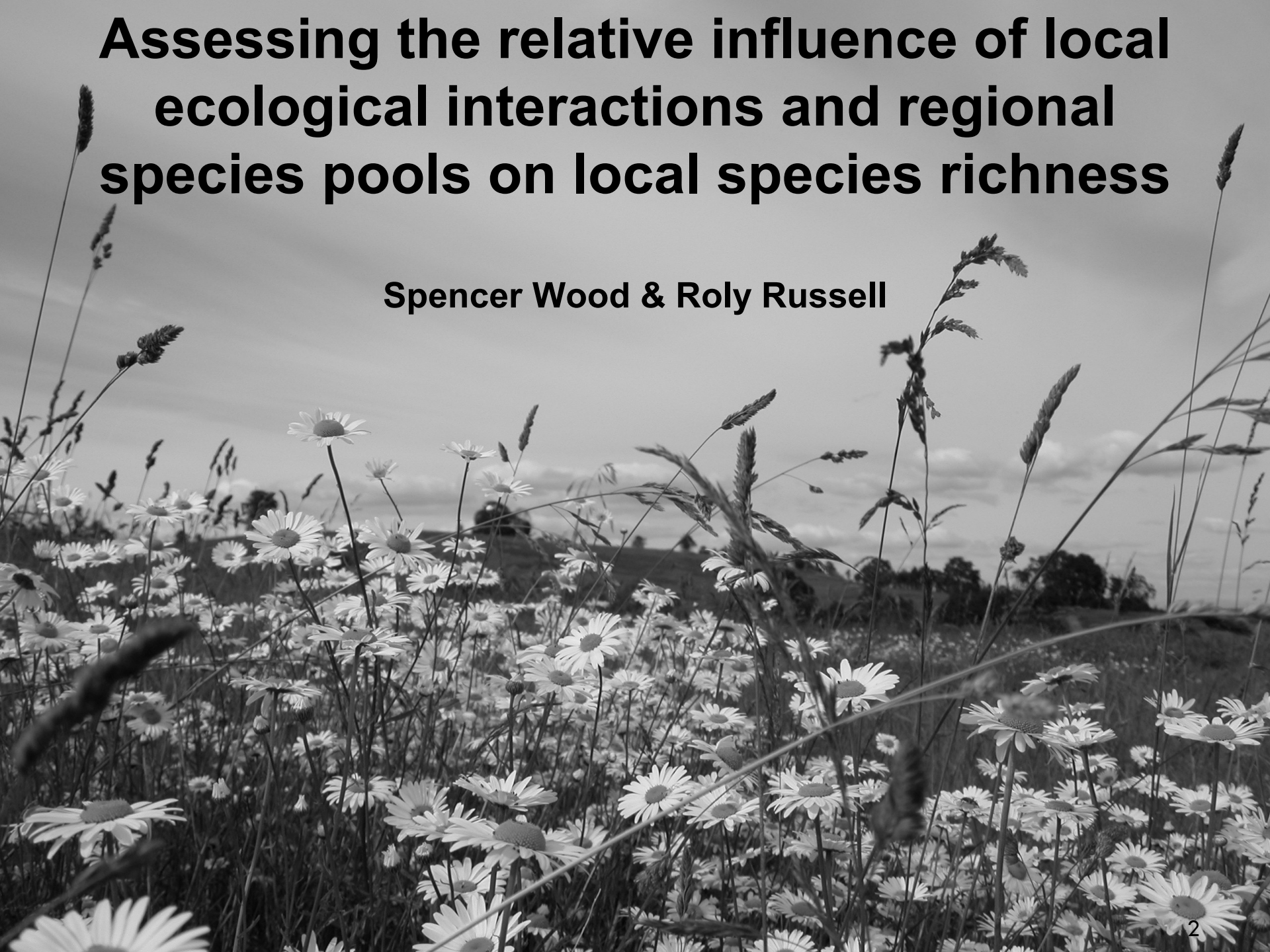
Assessing the relative influence of local ecological interactions and regional species pools on local species richness

Spencer Wood & Roly Russell



today's case study

Do local interactions impose a ceiling on local species richness, or do regional species pools determine local richness ?

what determines local community richness ?

- Local factors
  - biotic interactions
  - abiotic factors
- Regional factors
  - evolution history
  - abiotic factors
  - biogeography

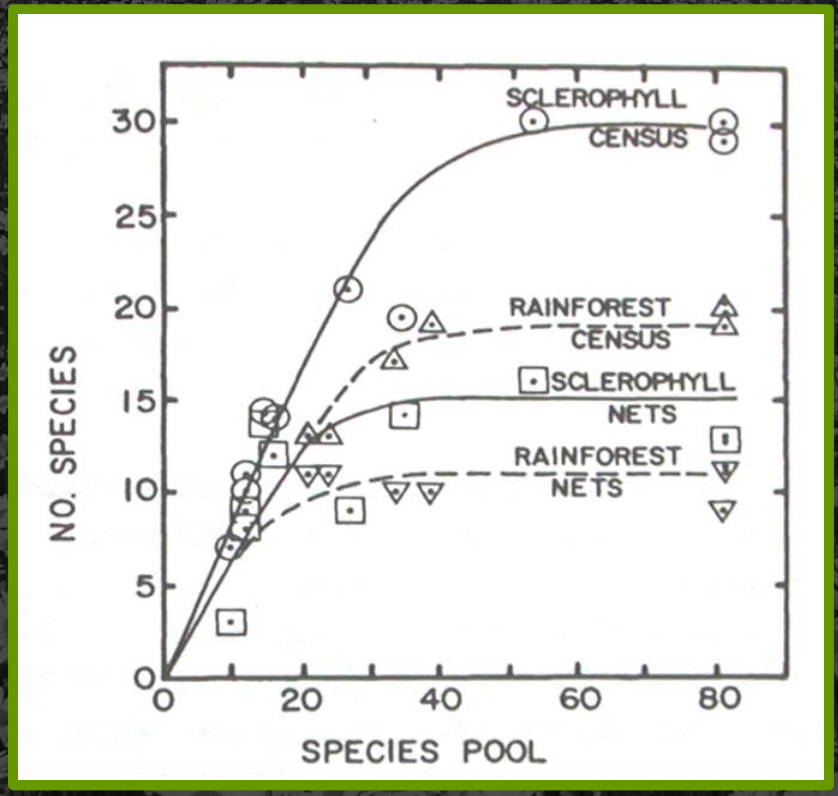
local limits of local richness

local interactions matter

e.g. herbivory, predation, & competition

birth of the tool

the local-regional plot
(mechanism = local ecological interactions)



Terborgh & Faaborg (1980)

outline

[Review]

Convince you that context is not properly appreciated in many studies.

[Analysis]

Convince you that this matters greatly for conclusions reached.

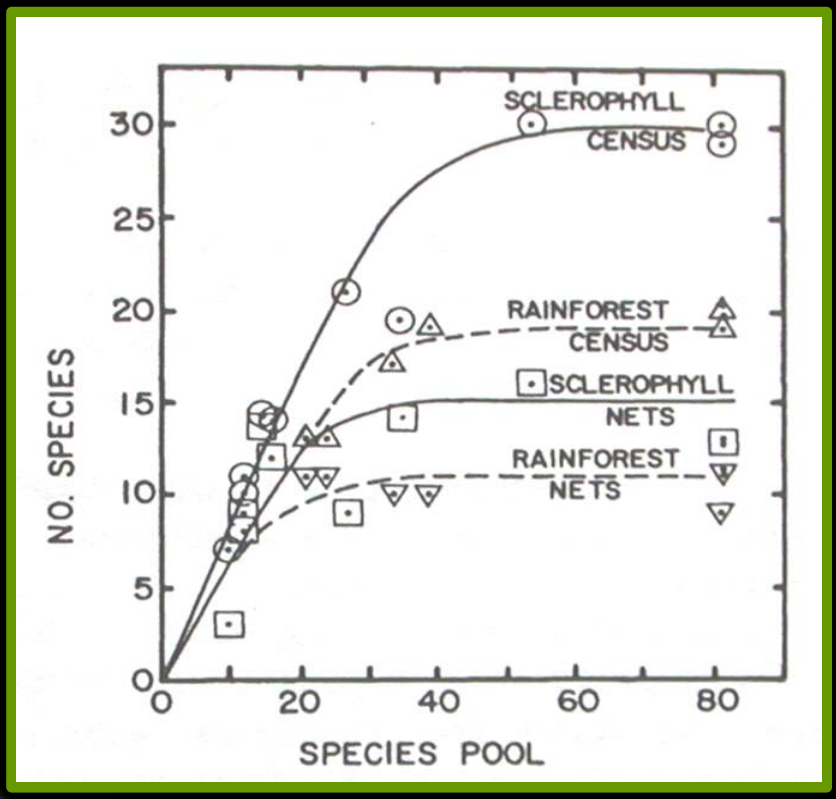
[Forecast]

Where to next ?

REVIEW

the last ¼ century has brought …

many studies looking at this pattern,
from where
Terborg & Faaborg
left off.



conclusions are varied.

Saturation does occur:

crustaceans (Abele ’84) fish (Westoby ’85) birds (Terborgh & Faaborg ’80) helminths (Kennedy & Grop ’94) leaf miners (Opler ’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)

why no general conclusion ?

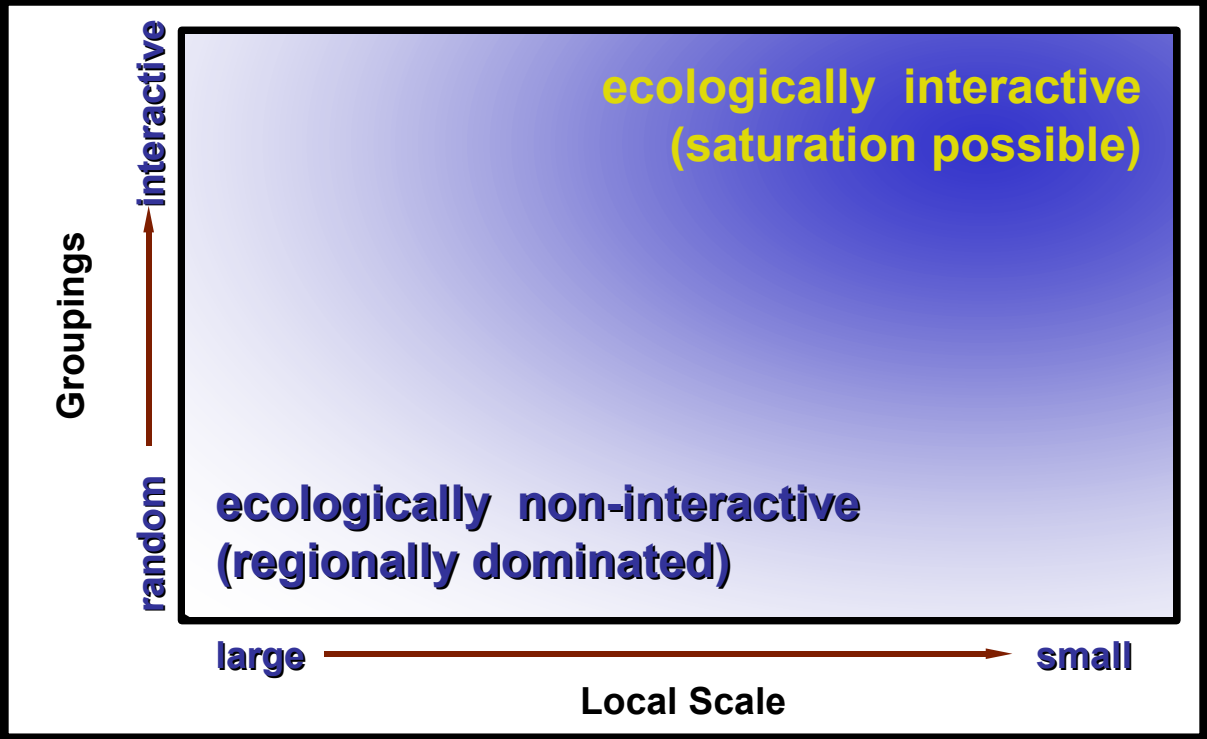
Potentially incongruous

- habitat, (little discussion)
- taxa, or (more discussion)
- scale. (most discussion)

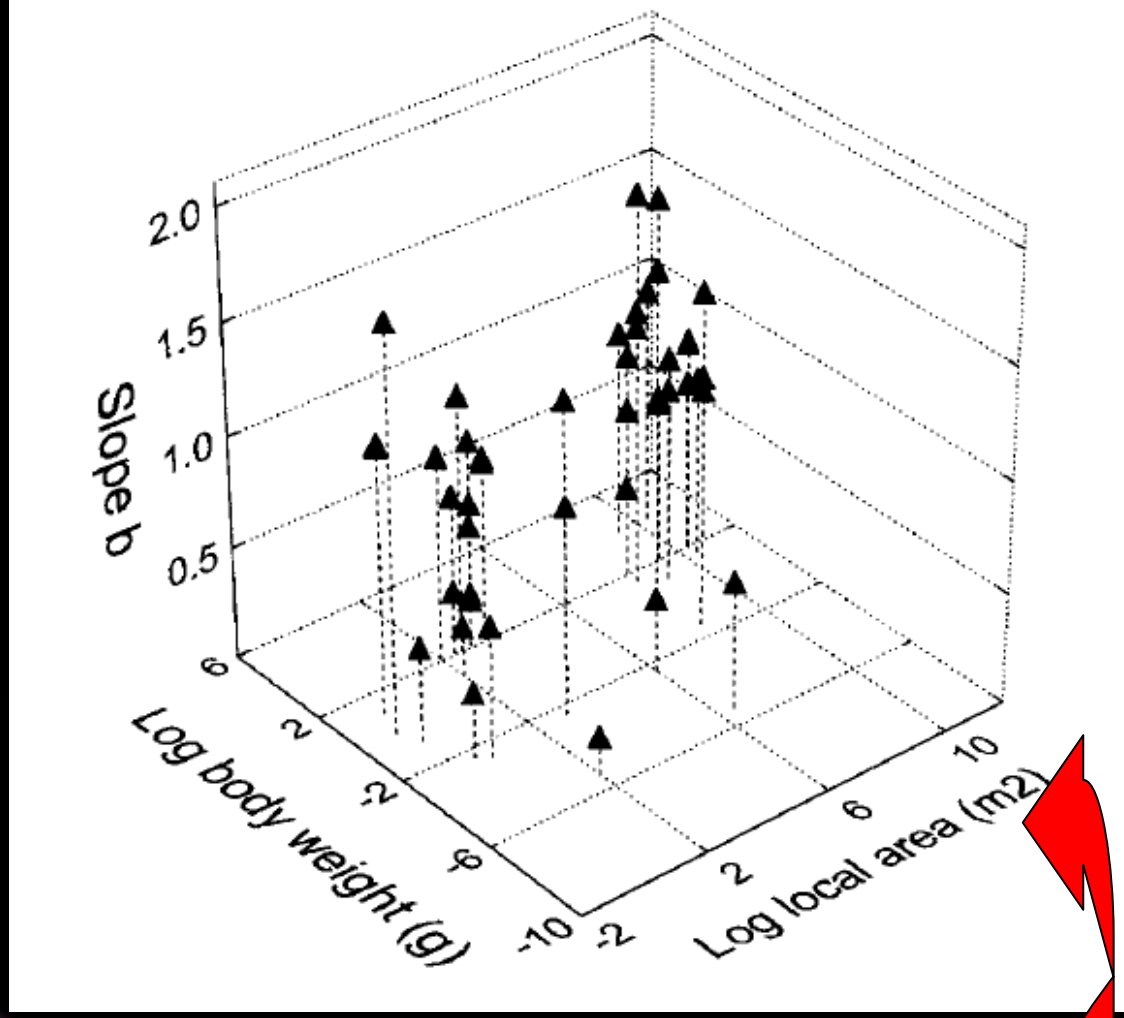
Some extreme examples:

Flora & fauna of a fish gut.
Plants in a ‘quadrat’.
All birds in an area ½ the size of Switzerland.

a theoretical model



Hillebrand & Blenckner 2002



1,000,000 m^2 !

Conclusion:

Huge range in defined 'local' scales and species groups.
(Wide range of contexts in general)

Implication:

Could be responsible for the unsatisfying range of observed conclusions.

ANALYSIS

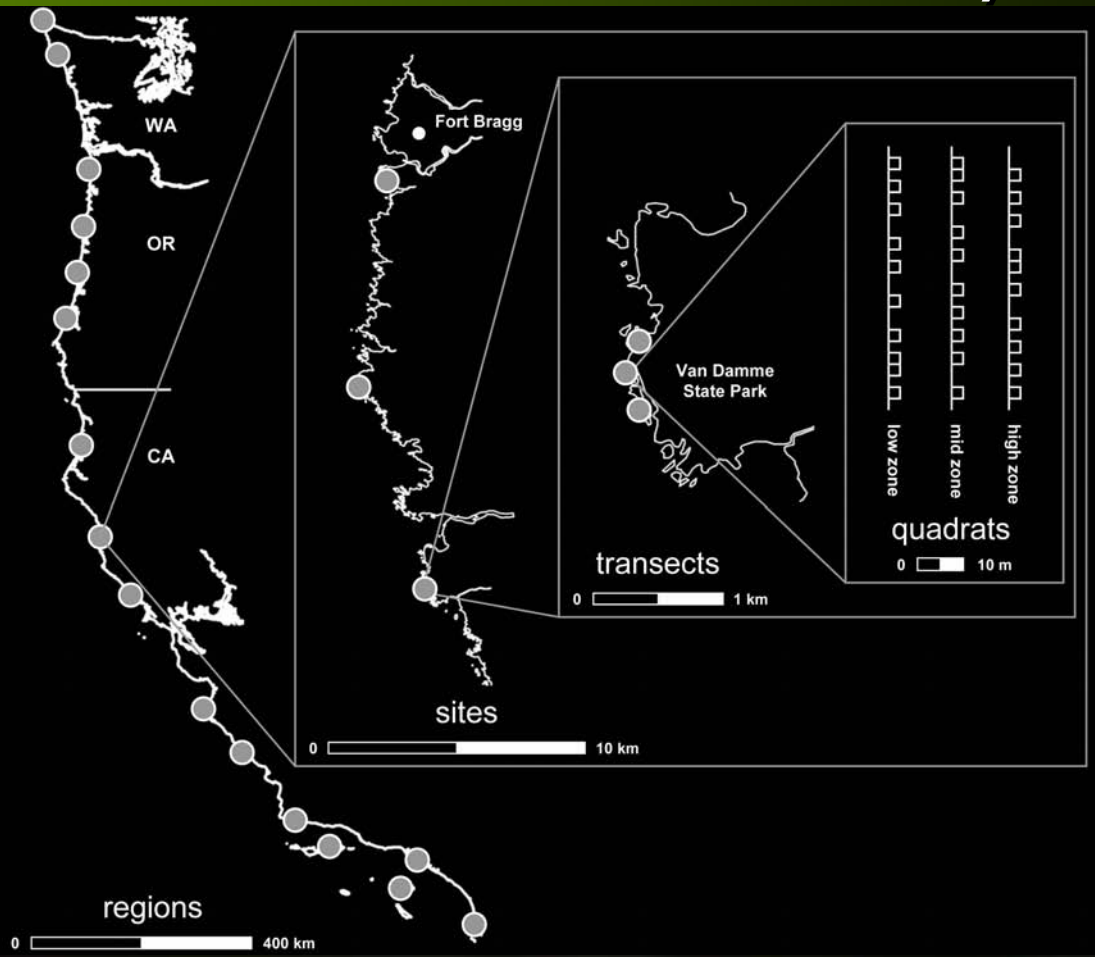
understanding the local context

Test for a ceiling in local species richness, irrespective of the regional species pool.

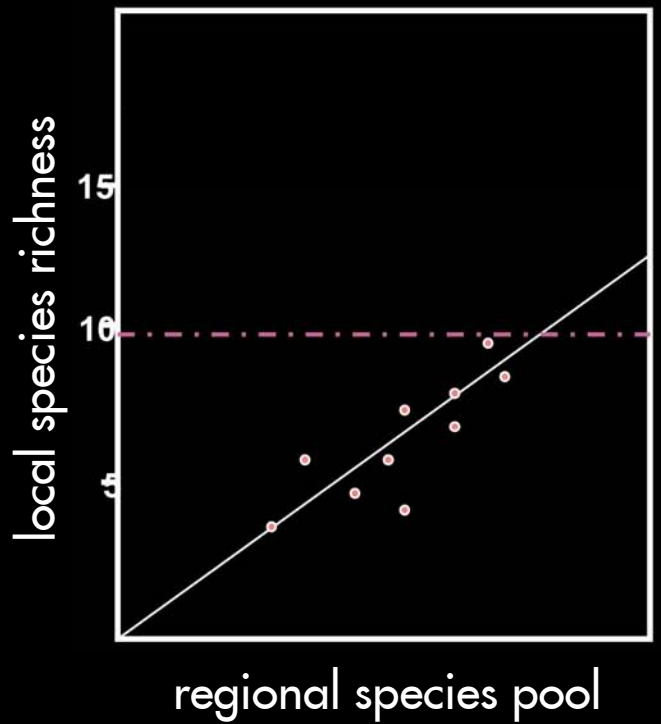
Observe the dependence of conclusions to changes in local contexts

scale : taxa : habitat

rocky intertidal data



metric of saturation



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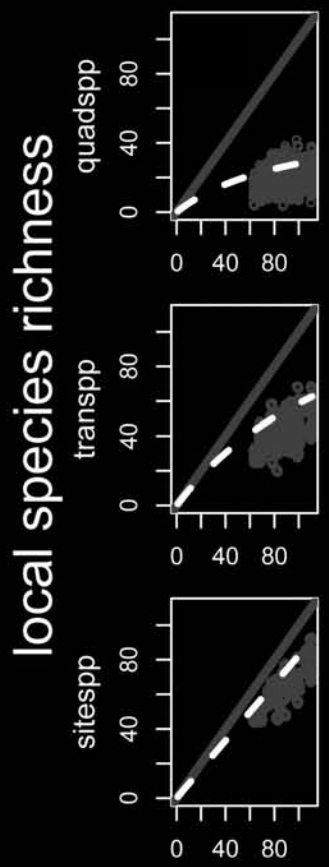
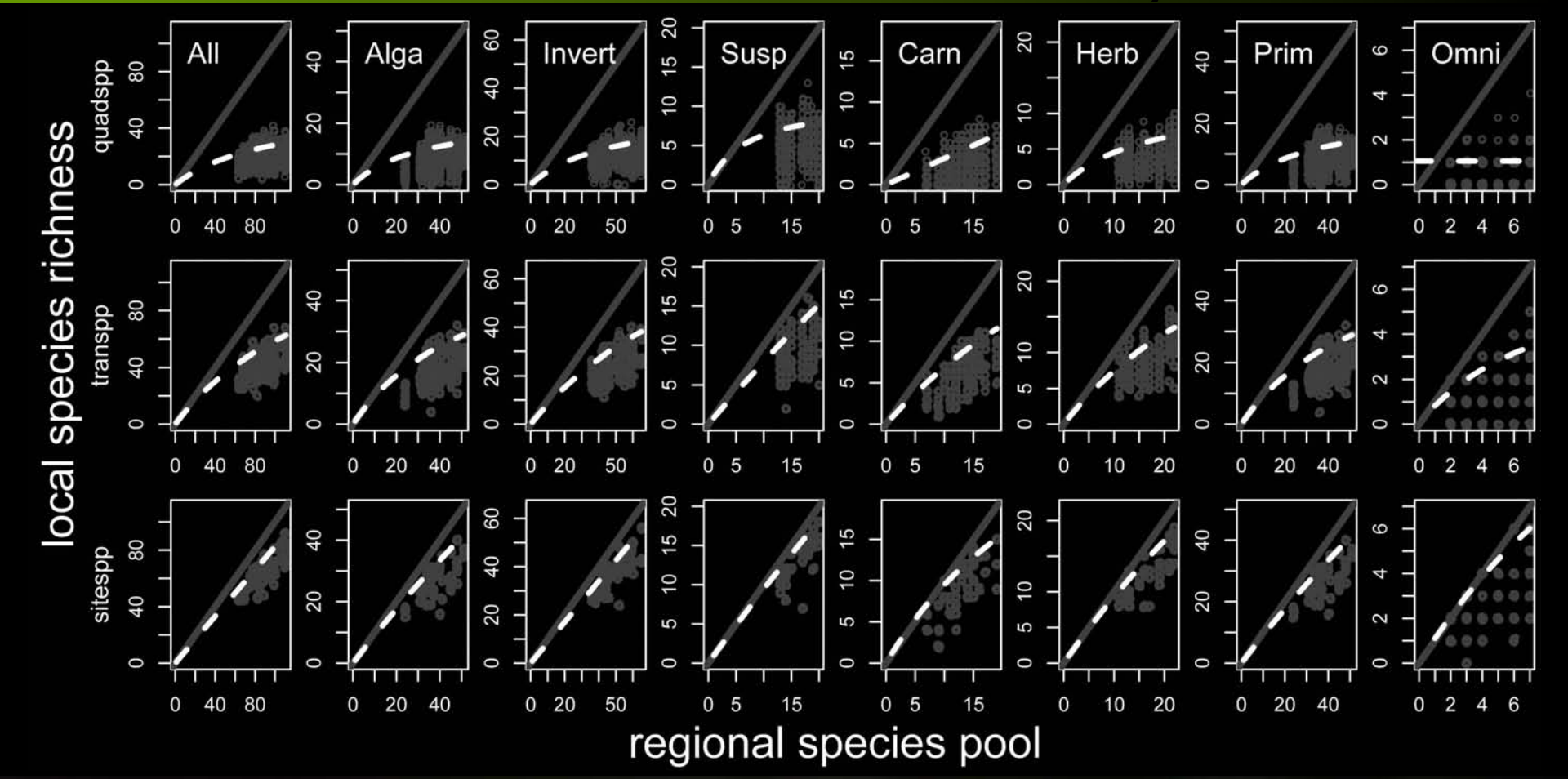


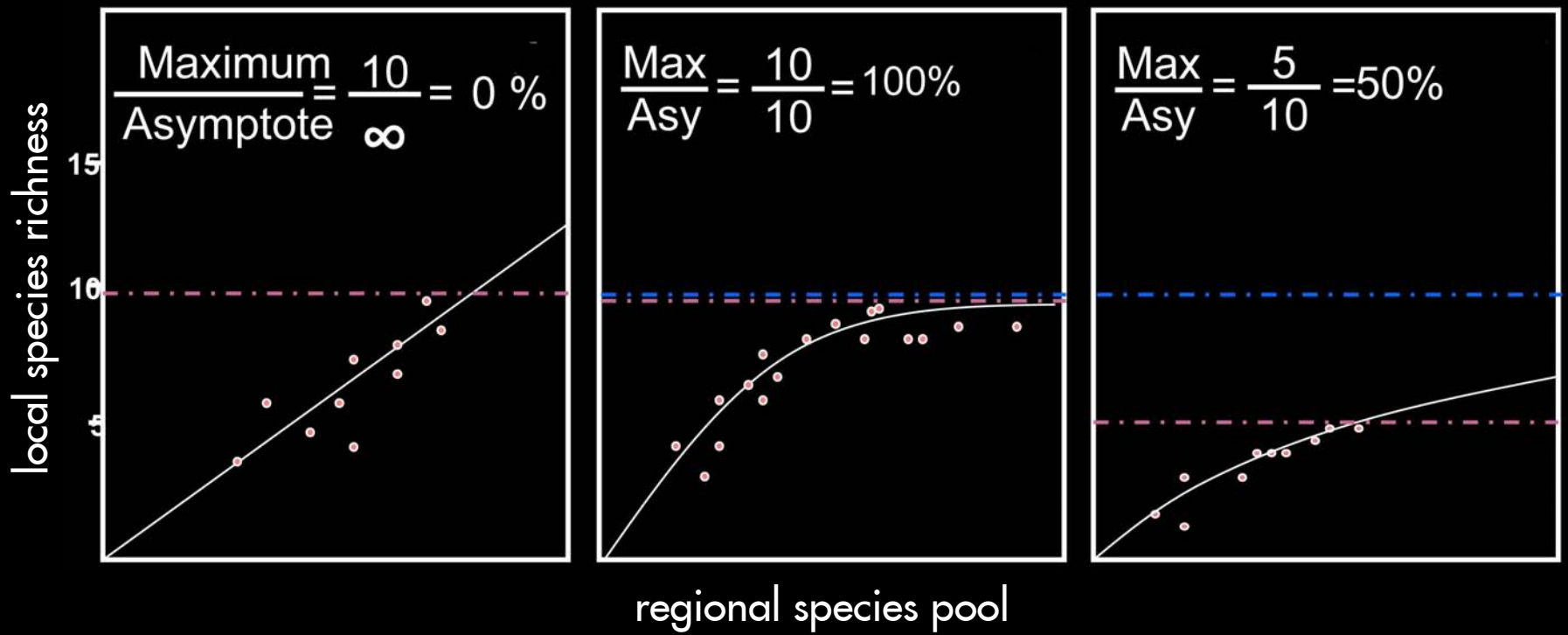
small local scale

large local scale

rocky intertidal data



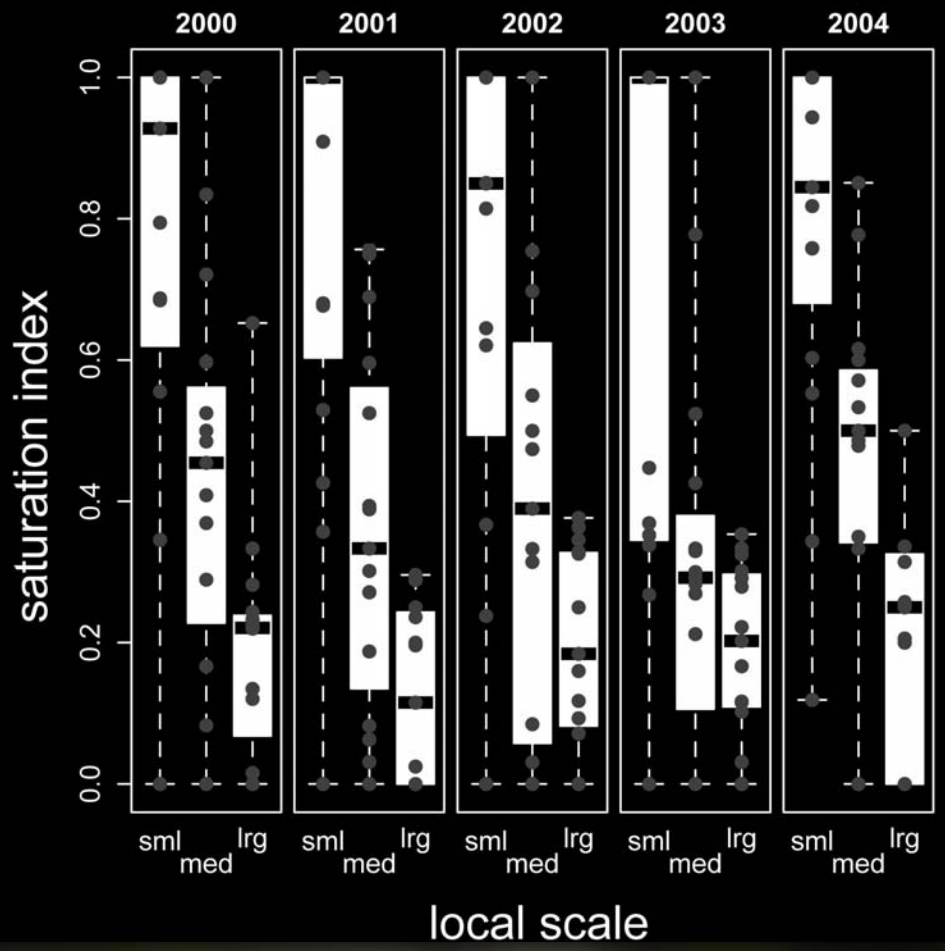
metric of saturation



larger scales ~ regional influence

local interactions

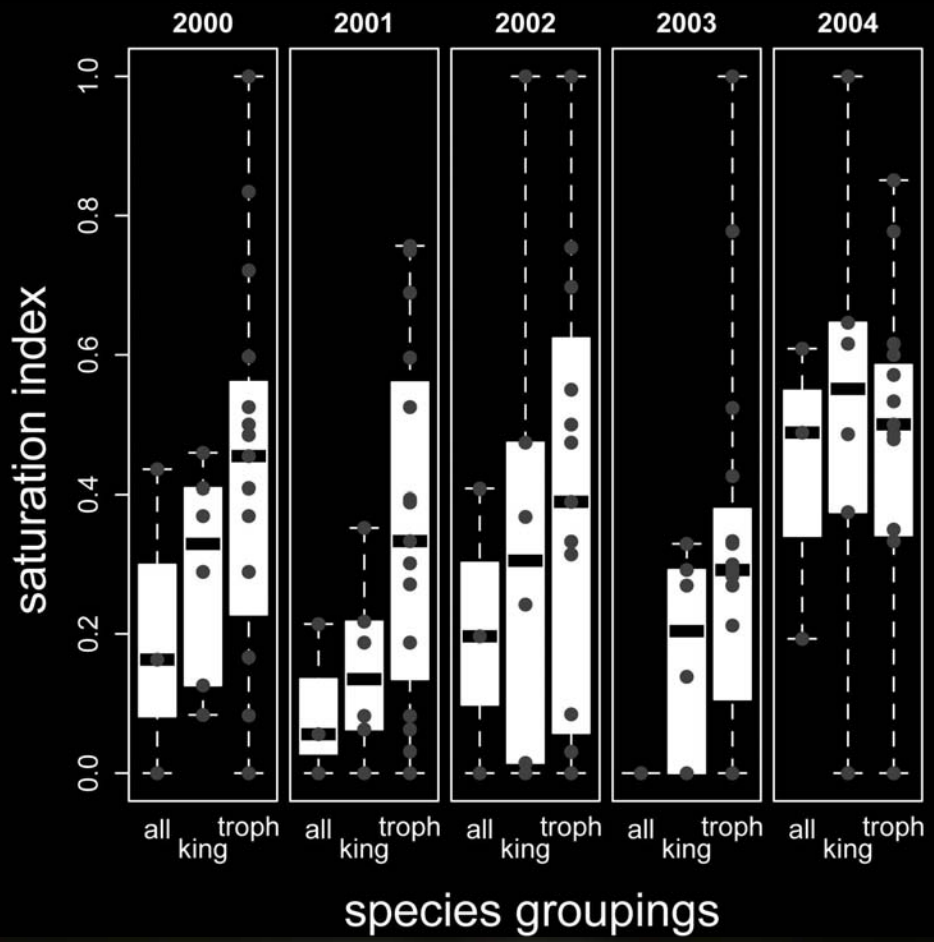
regional pools



random species ~ less interaction

local interactions

regional pools



analysis conclusion : scale

Spatial scale of "local" will influence
expected—and observed—results

[reminder: spatial scale of proposed mechanism must match observations]

A richness ceiling, if evident, will only be apparent at
"small" local scales

(relative to most previous studies)

analysis conclusion : taxa

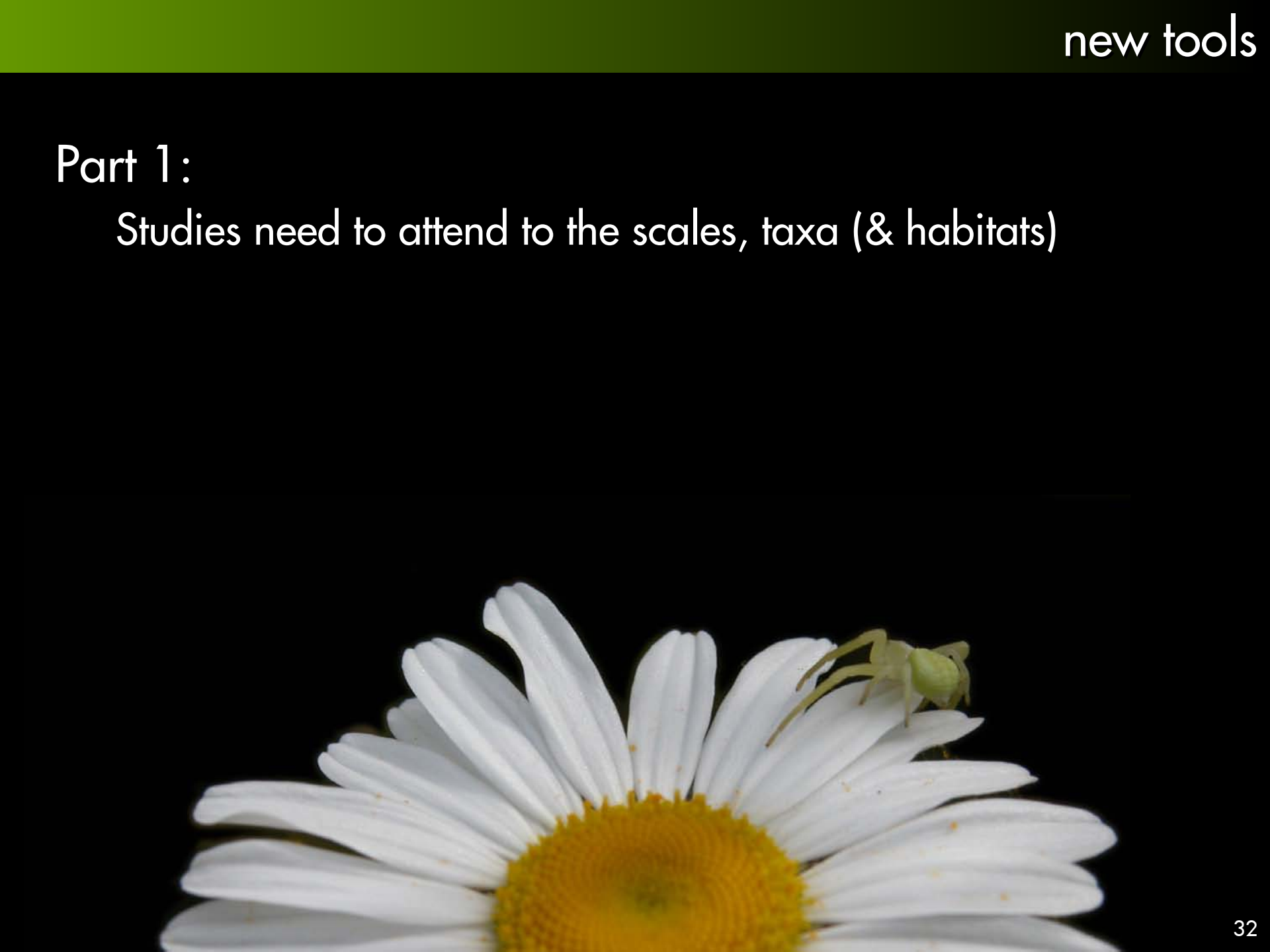
How species are grouped will change perception of influence of regional species pool

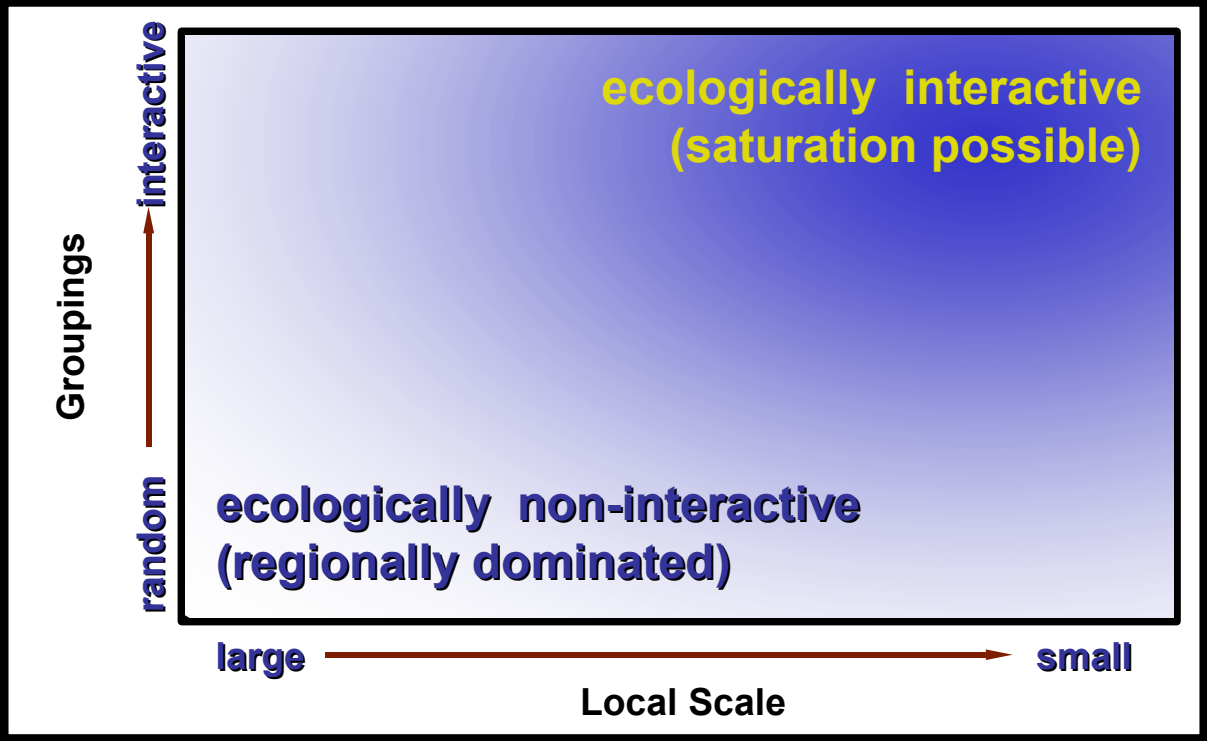
A richness ceiling, if evident, will be more apparent with potentially interacting species

FORECAST

Part 1:

Studies need to attend to the scales, taxa (& habitats)




Groupings
interactive
random
ecologically interactive
(saturation possible)
ecologically non-interactive
(regionally dominated)
large
small
Local Scale

Part 2:

Tool cannot distinguish local limitations of species richness versus regional species pool limitation—only tests whether regional species pools drive local richness.

Part 3:

Truly multi-factor analyses are needed,
but extremely difficult data to collect.

Need simultaneous assessment of:

a) interaction strength,

b) abiotic factors, and

c) regional species pools.

conclusions

Ecological context has overwhelming influence on predicted patterns—particularly definition of local spatial scales. We don't pay enough attention to this.

gratitude to …

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