Paleoecological Perspective on Ecological Resilience: The Youngest Fossil Record as a Historical Archive of Ecosystems

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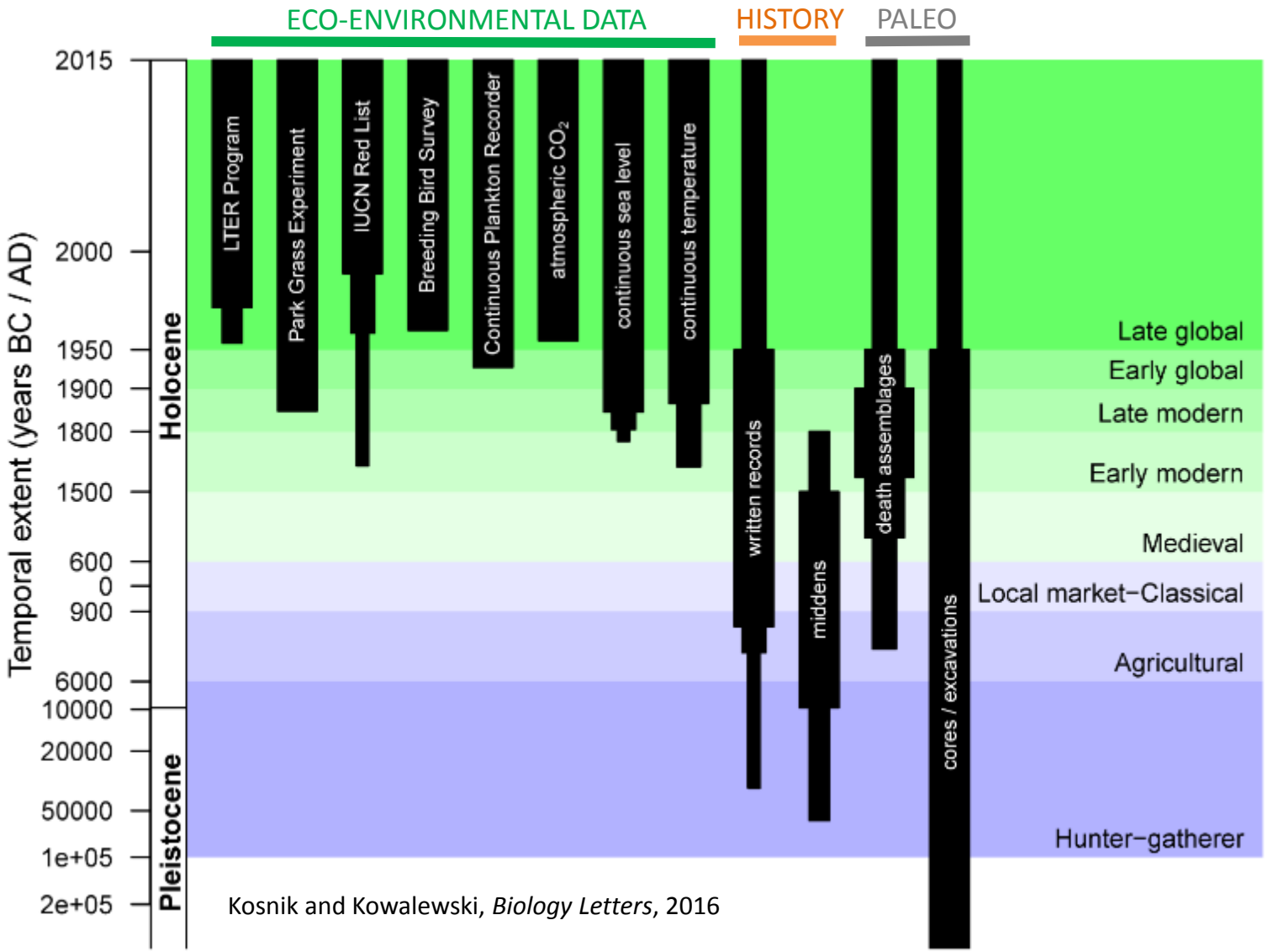


Kosnik and Kowalewski, *Biology Letters*, 2016

Question 1: Can we trust the fossil record as a proxy source of ecological data?

Literature on dead-live comparisons (mostly mollusks)

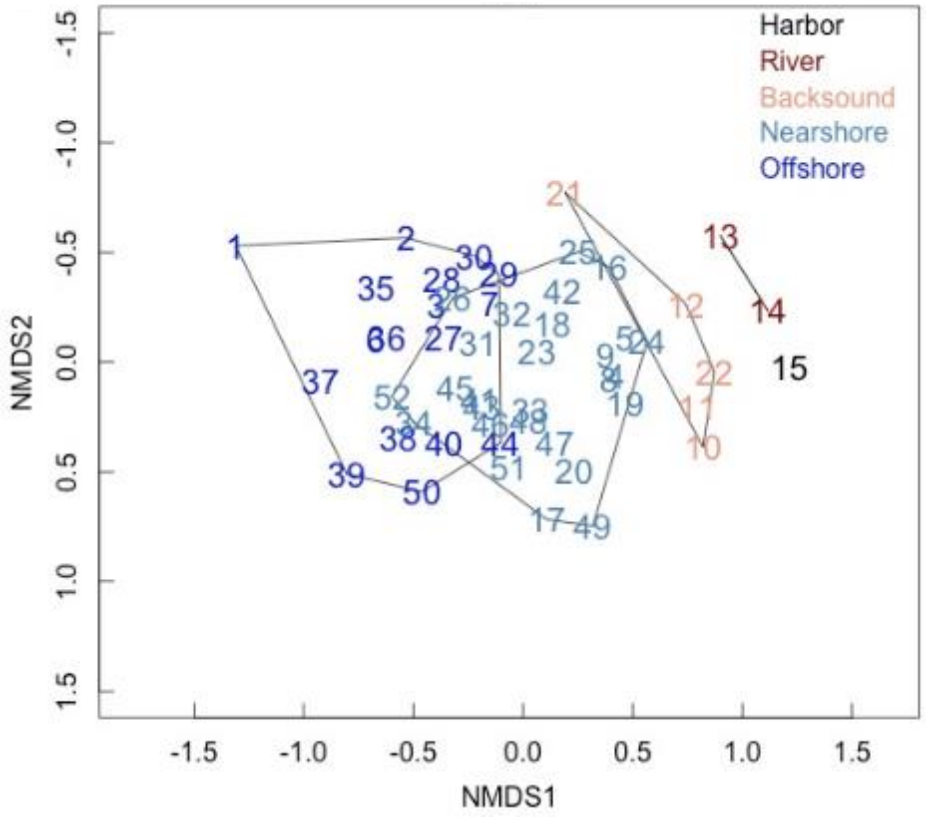
Numeric Proxies

Alpha diversity: Good (slightly elevated)
Evenness: Good (slightly elevated)
Beta diversity: Good (slightly depressed)

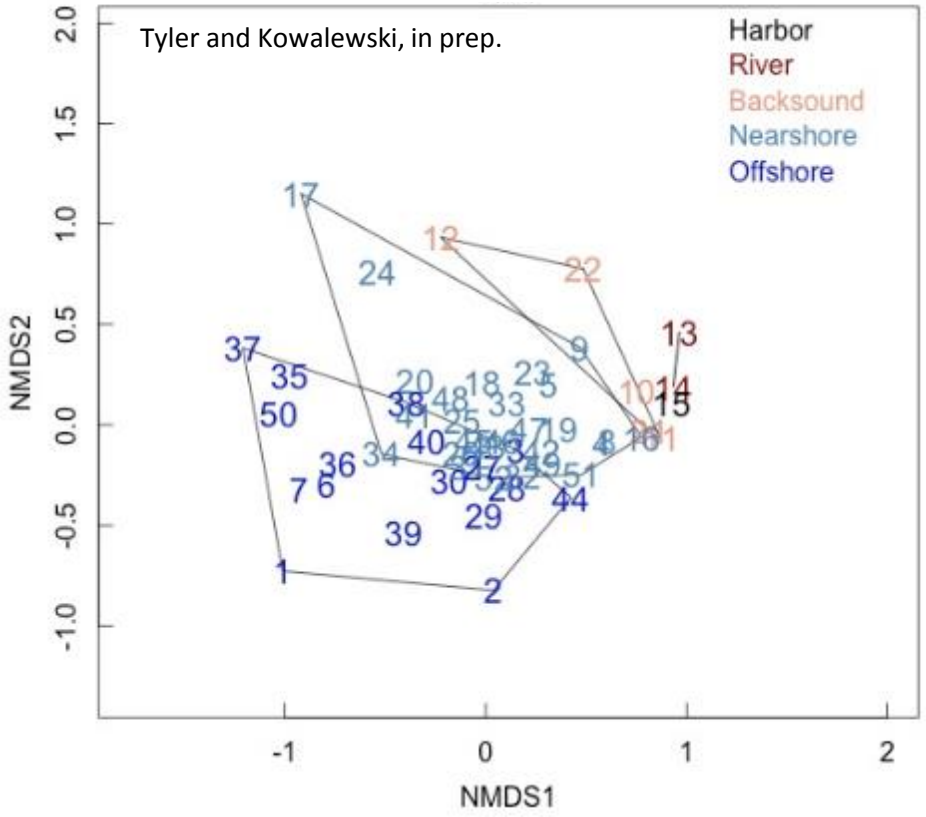
Relative Proxies

Species rank abundance: Good in 'pristine' habitats
Spatial variation across habitats: Good (limited data)
Community gradients: Good (limited data)

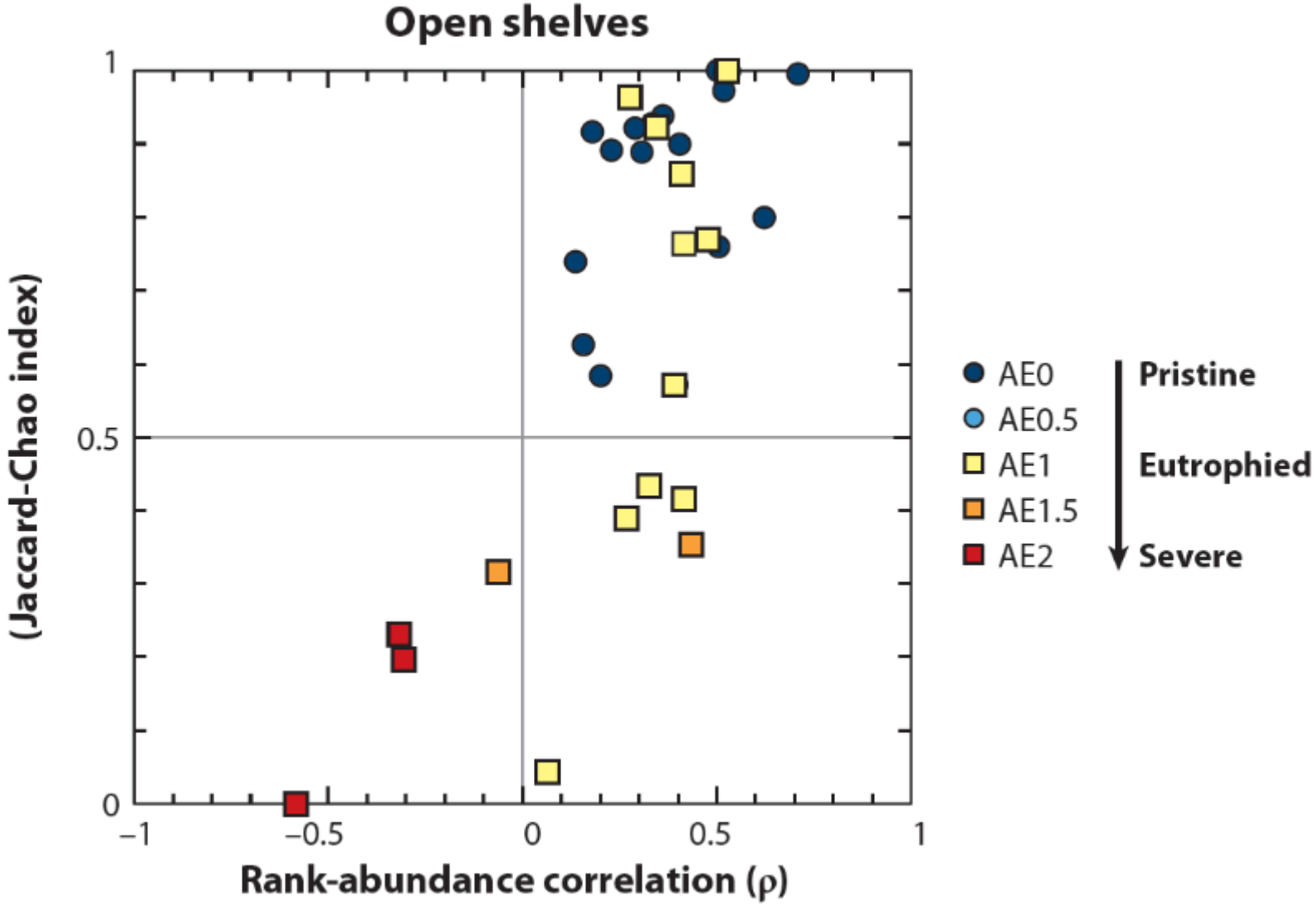
Live Benthos (7 Phyla)



Death Assemblage (7 phyla)

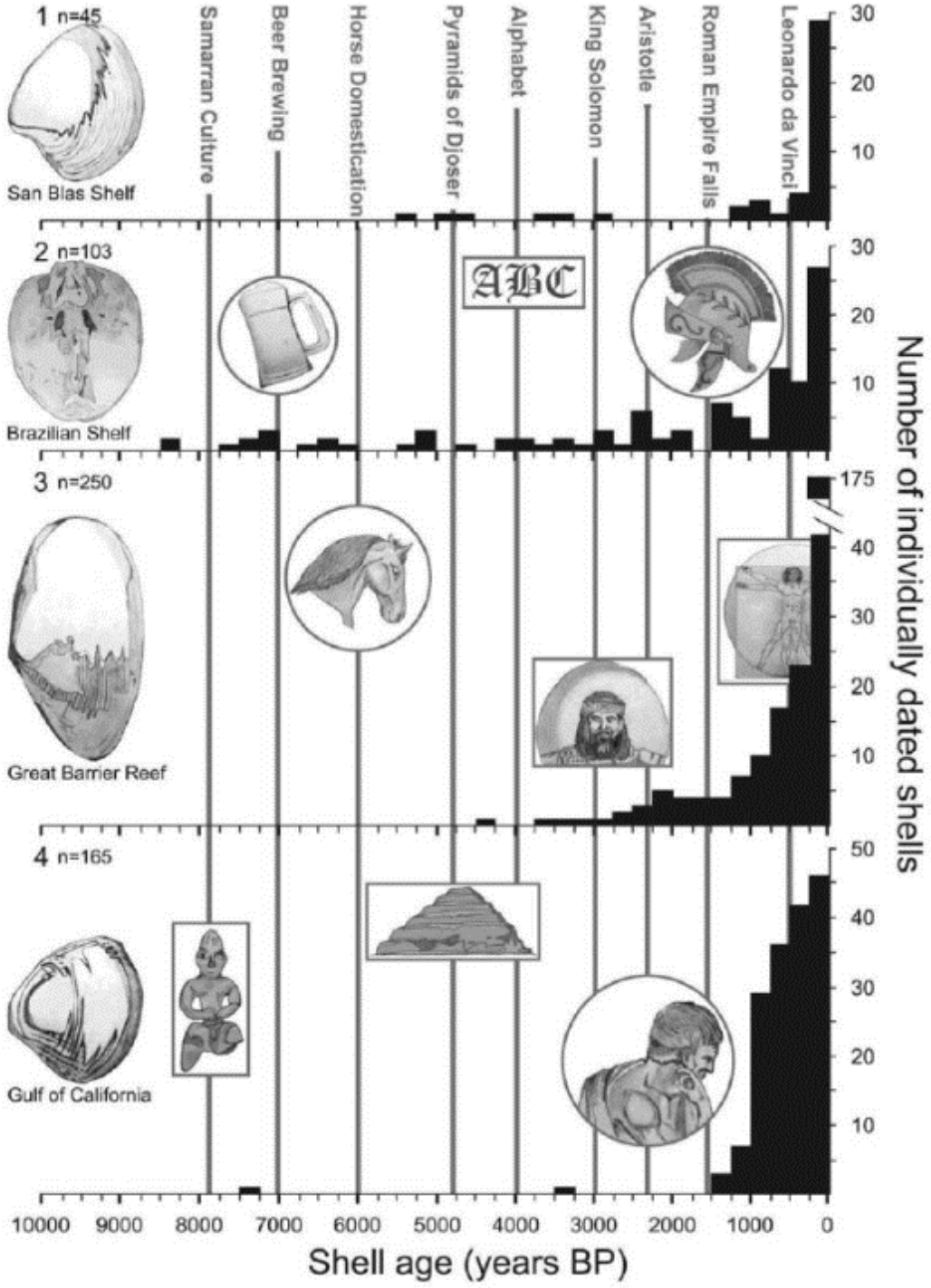


Corollary of Fidelity: Dead-Live Mismatches Measure Anthropogenic Changes



Kidwell & Tomasovych (2013) *Ann. Rev. Ecol. Evol. Sys.*

Time Resolution



Kowalewski 2009, Pal. Soc. Spec. Pap.

Age distributions of death assemblages

Span multiple millennia

Most specimens belong to youngest age classes
(>50% come from the last several centuries)

With sufficient number of dated specimens,
a continuous record can be provided for the last 1000 years in most settings

Dated skeletal remains can also provide chronologically controlled geochemical proxies (stable isotopes, trace elements, biomarkers)

Summary

Paleoecological Proxies

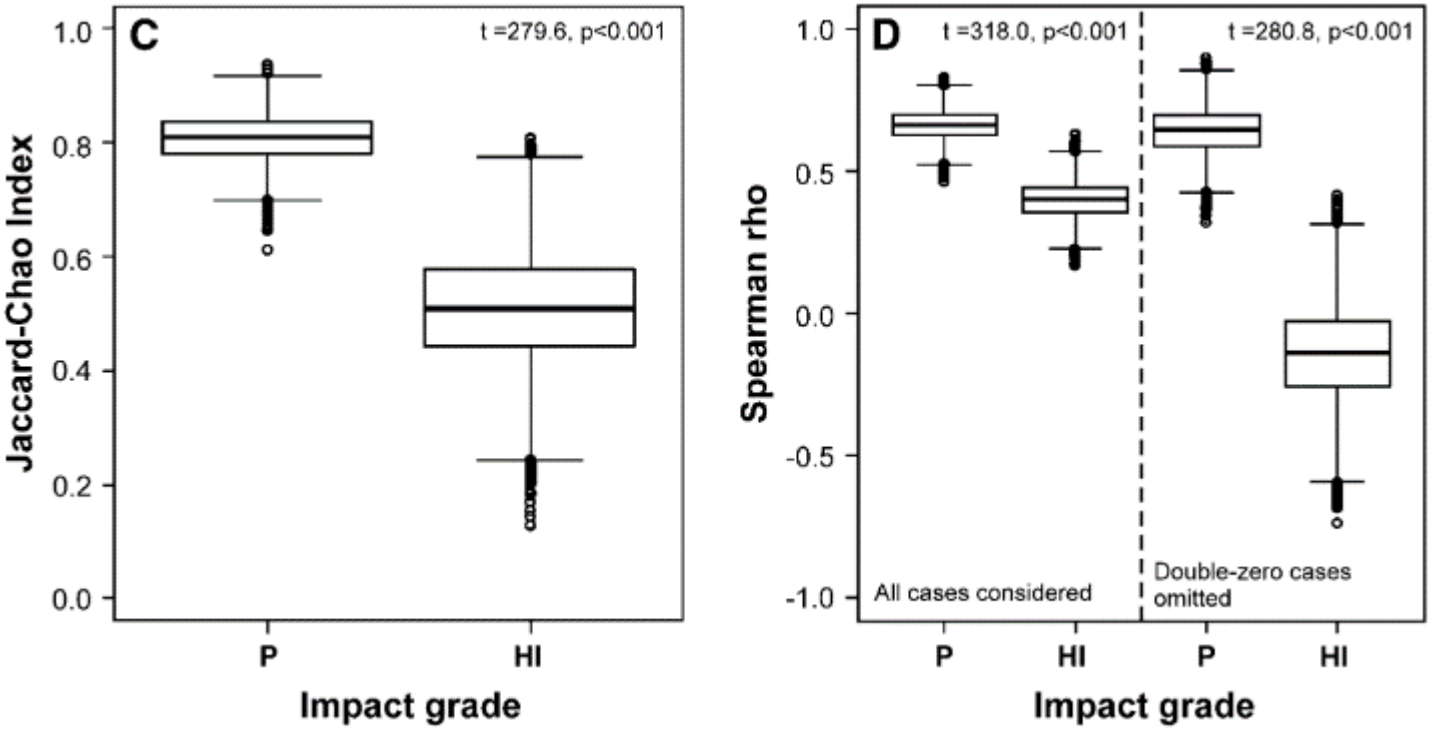
High fidelity proxy
Long-term historical perspective
Source of geochemical proxy data
Baseline for anthropogenic changes

Implications

Improved understanding of long-term ecosystem dynamics
Historical perspective on ecosystem resilience (natural vs. anthropogenic)
Estimates of magnitude of anthropogenic changes
Assessment of efficacy of restoration efforts

Anthropogenic Impacts: Non-Marine Example

Land Snails of Bahamas

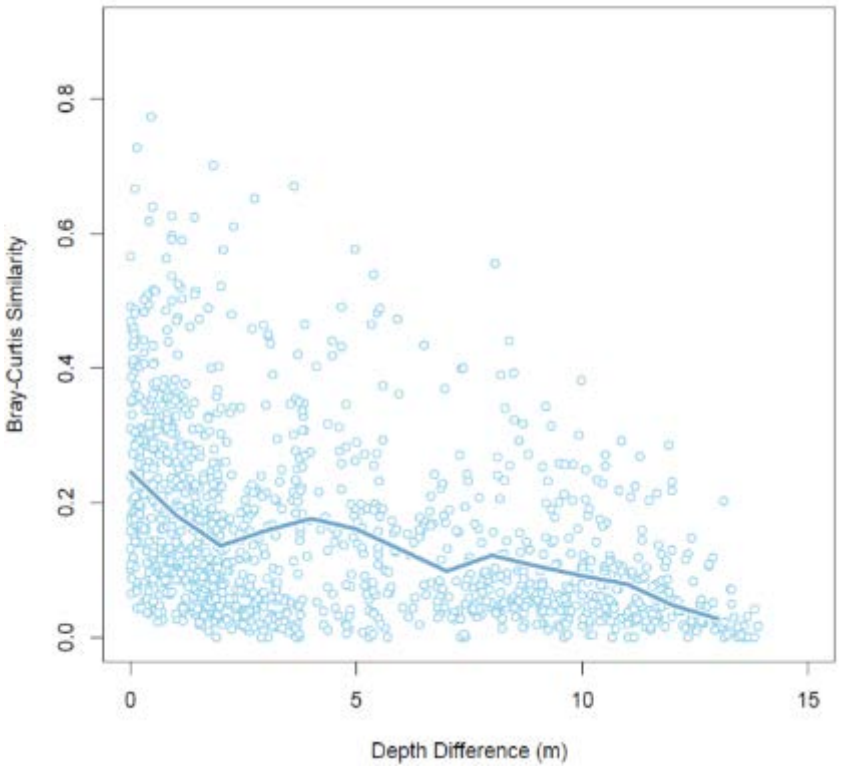


Yanes (2012) *Biodivers. Conserv.*

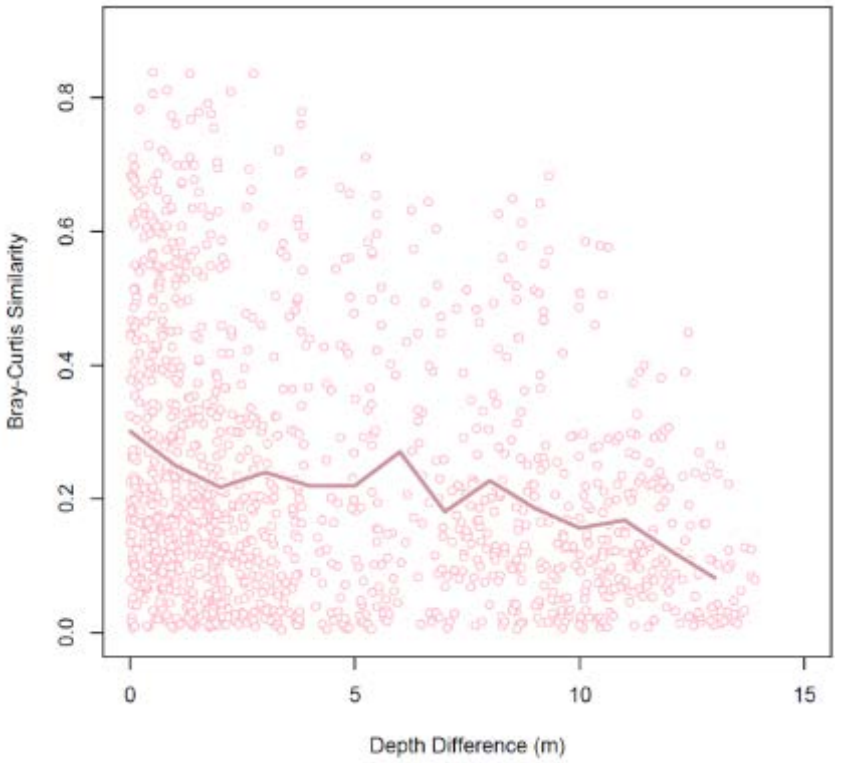
Discussion Slides # 1

Stability of Environmental Gradients

Live Benthos (all groups)



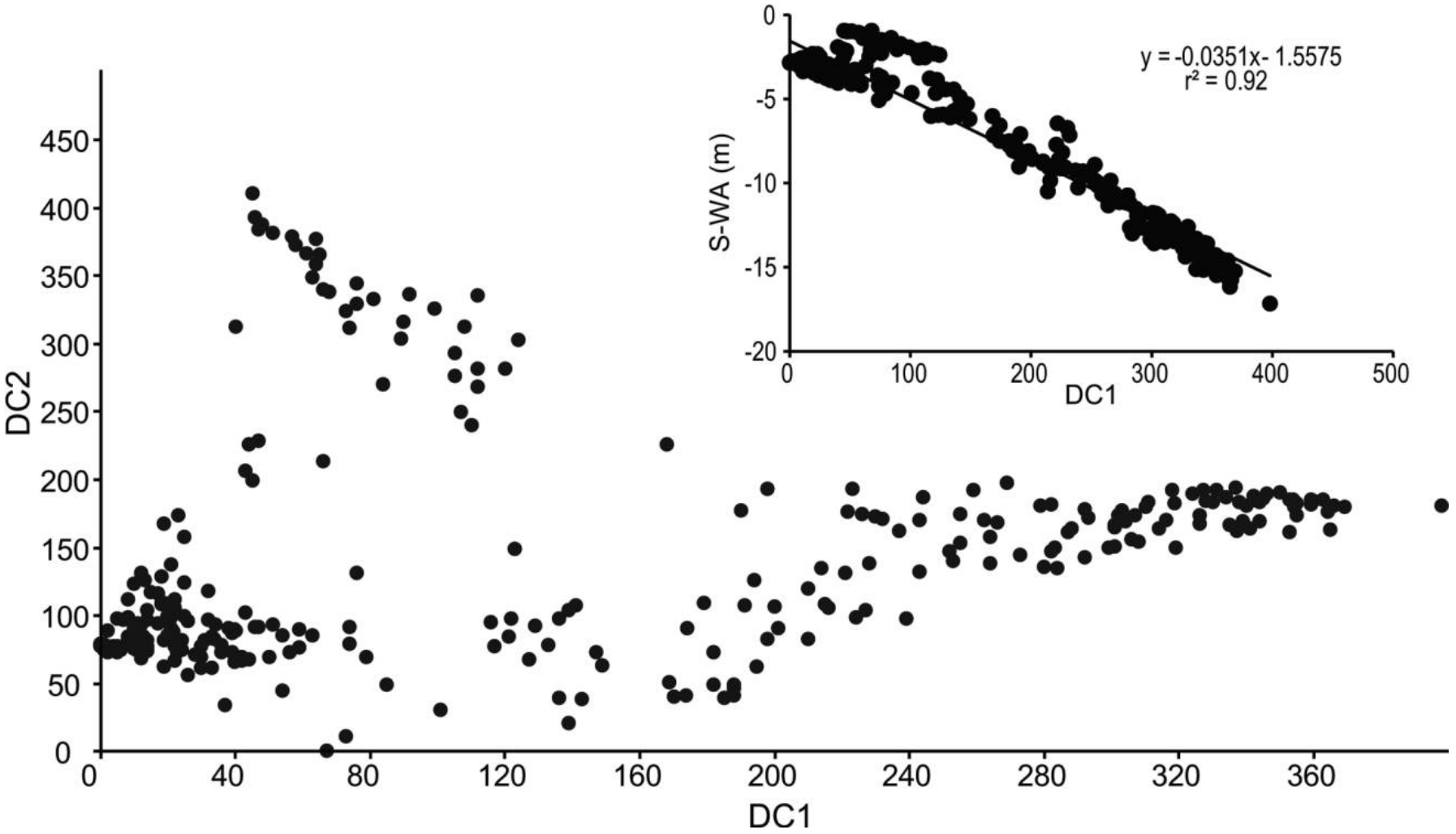
Death Assemblage (mollusks)



Tyler and Kowalewski, in prep.

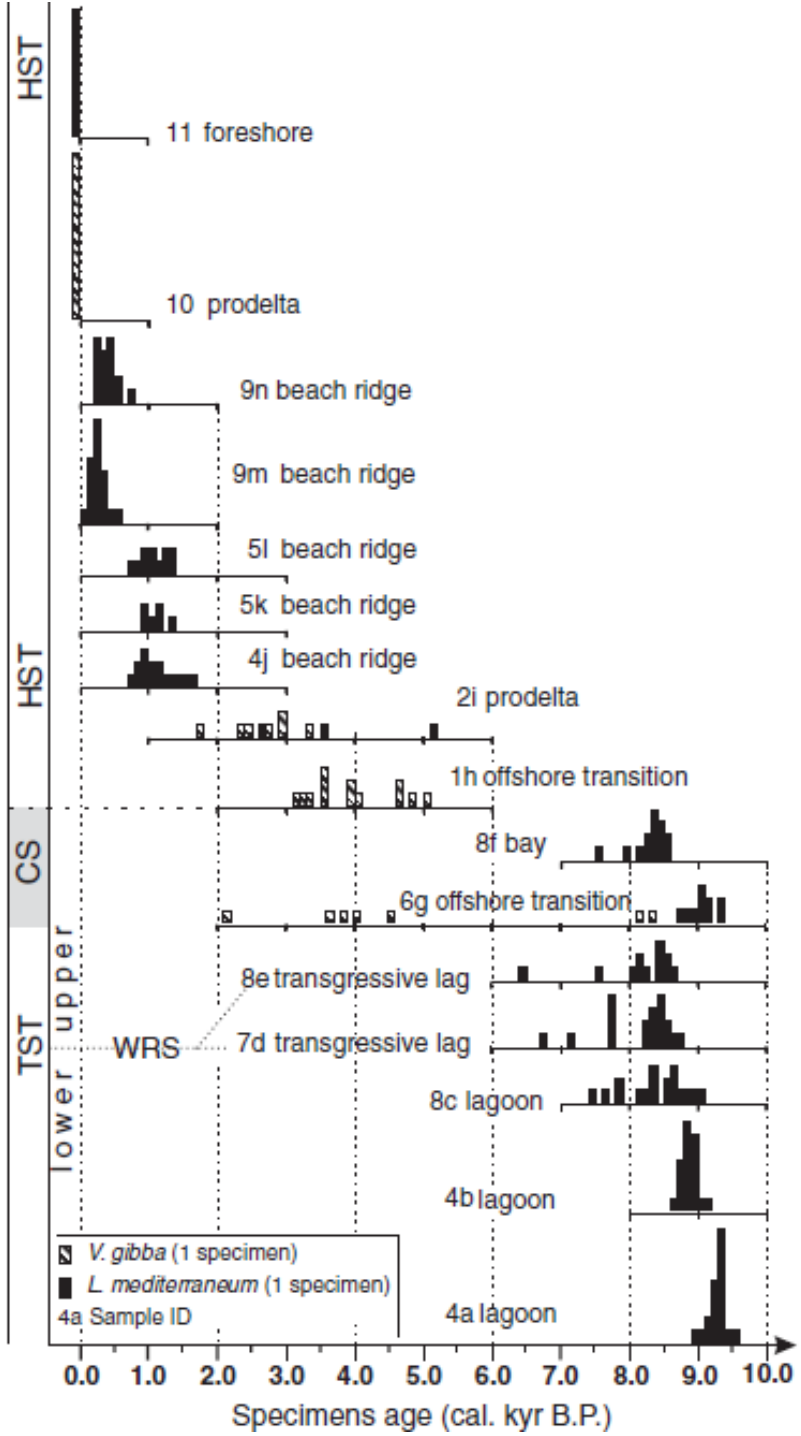
Discussion Slides # 2.1

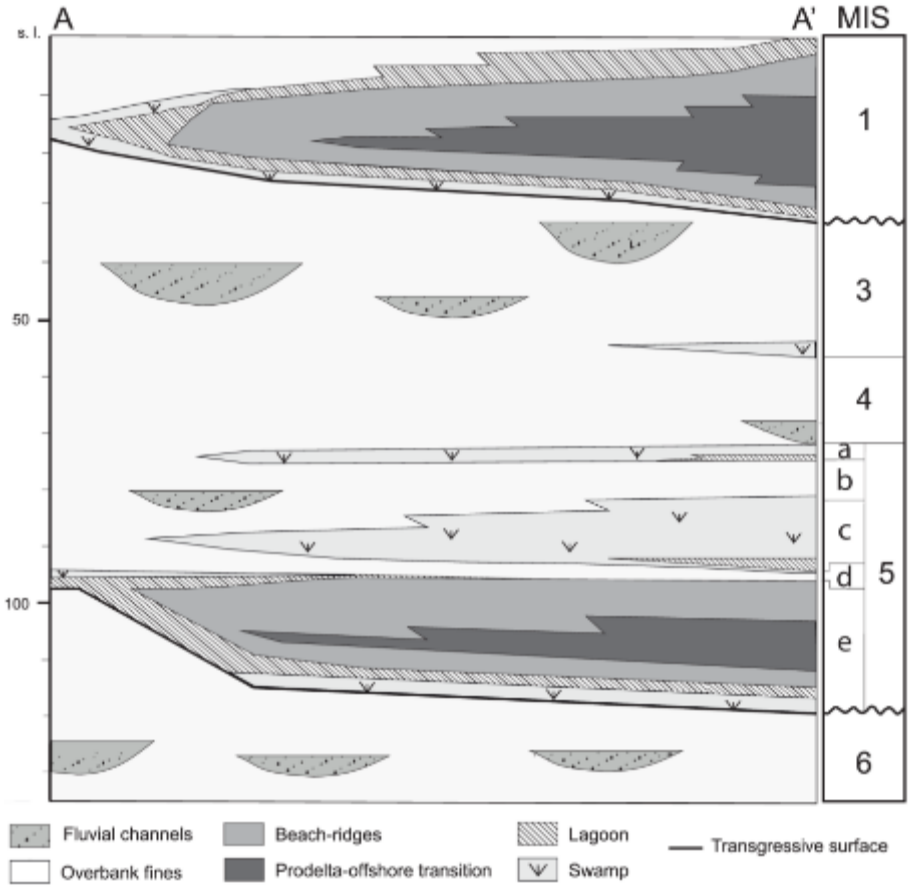
Core Samples as a Proxy of Environmental Gradients



Wittmer, Dexter, Amorosi, Scaropni, Kowalewski, 2014, *Journal of Geology*

Time Averaging in Cores

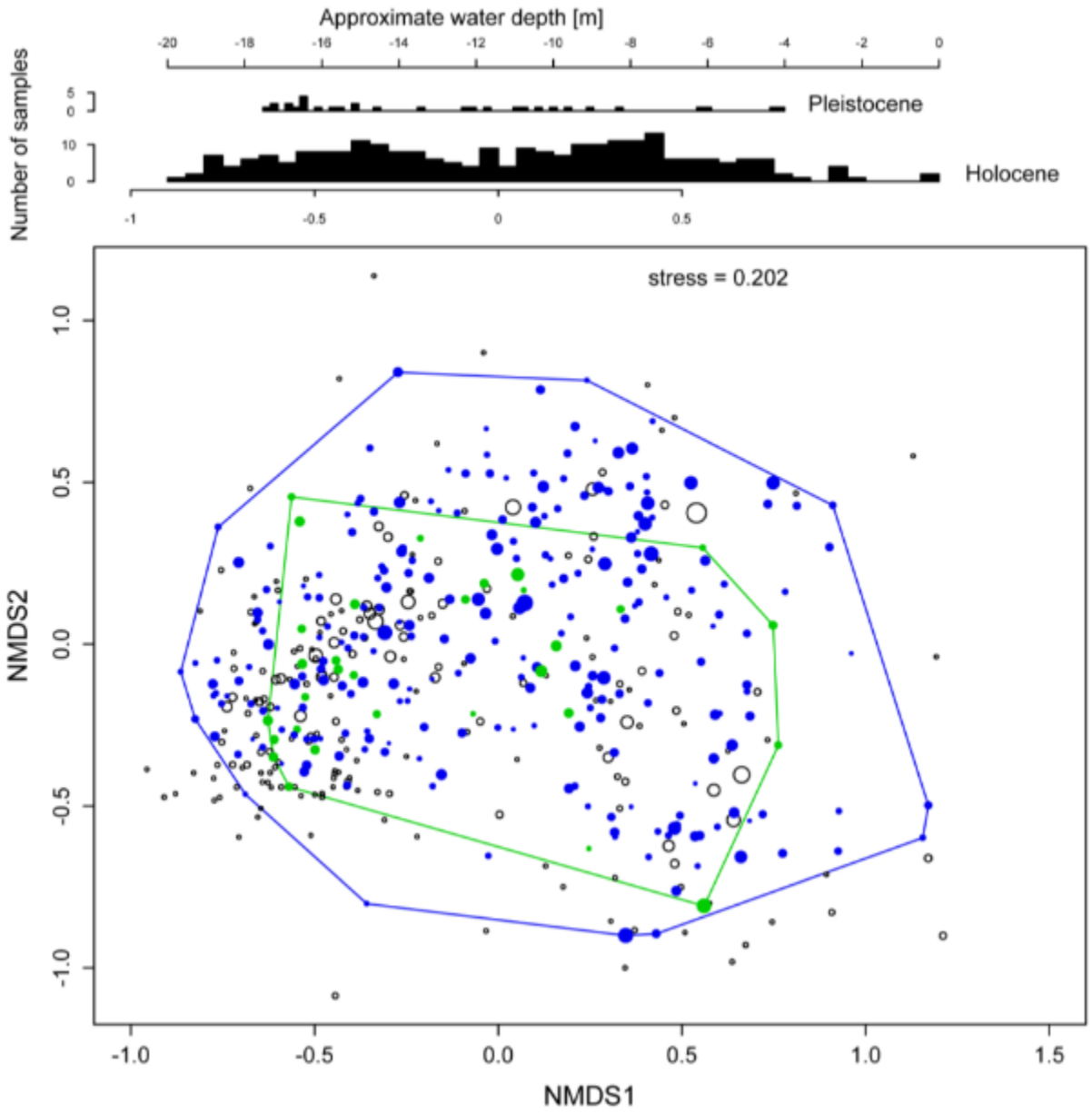




Scarponi, Kaufman, Amorosi, and Kowalewski, 2013, *Geology*

Discussion Slides # 3

Long-term Ecosystem Changes (Cores)



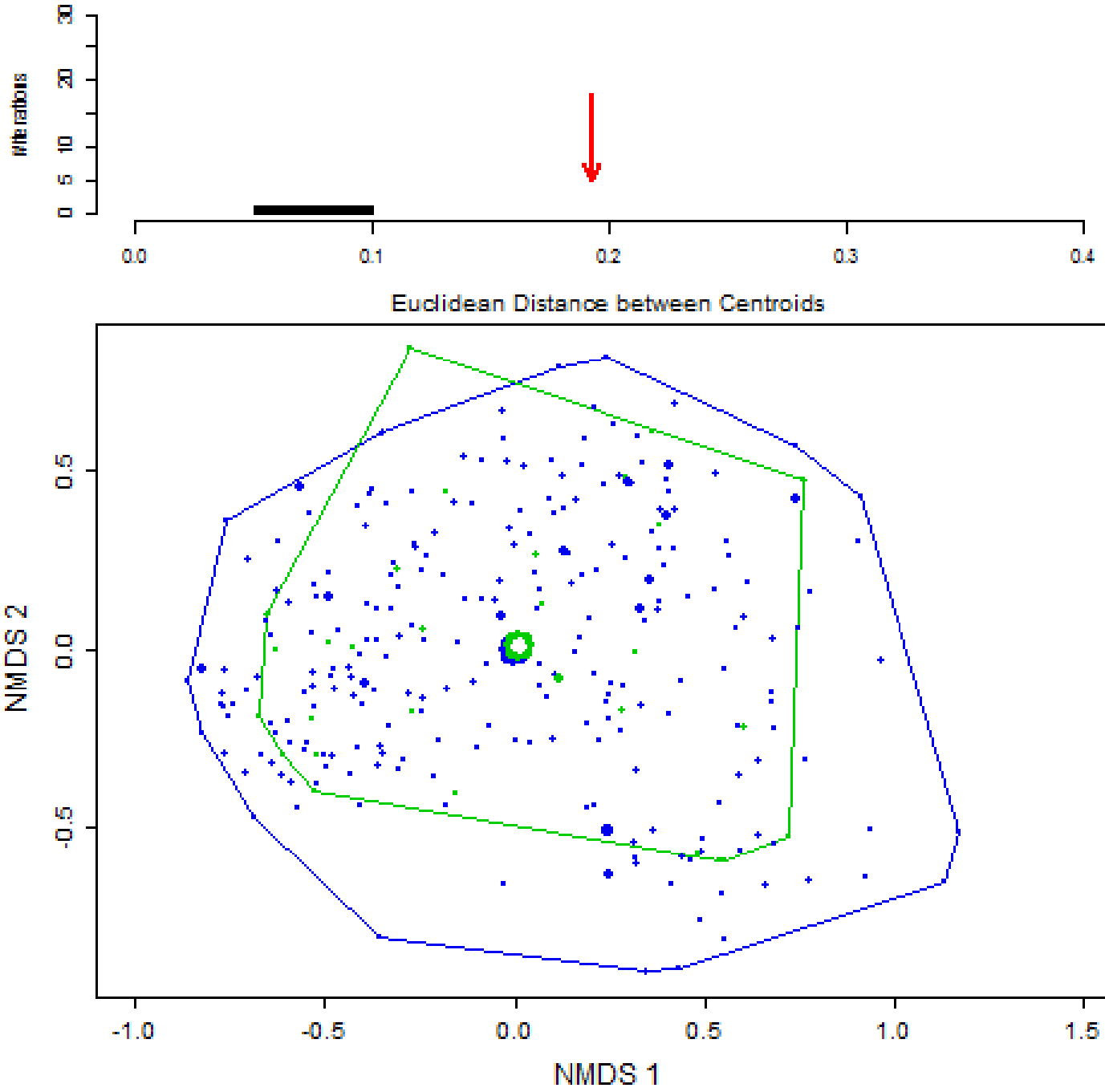
- **Holocene samples**
- **Pleistocene samples**
- Mollusk genera

Kowalewski, Wittmer, Dexter, Amorosi, and Scarponi, 2015, *Proc. Royal Soc. B*

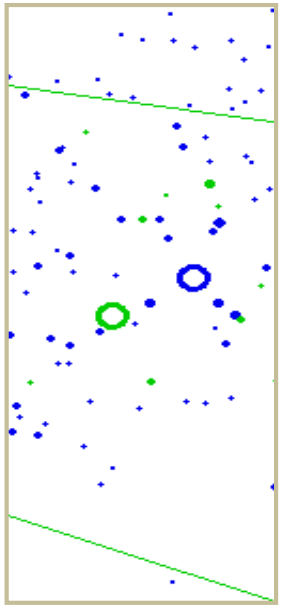
Discussion Slides # 4.1

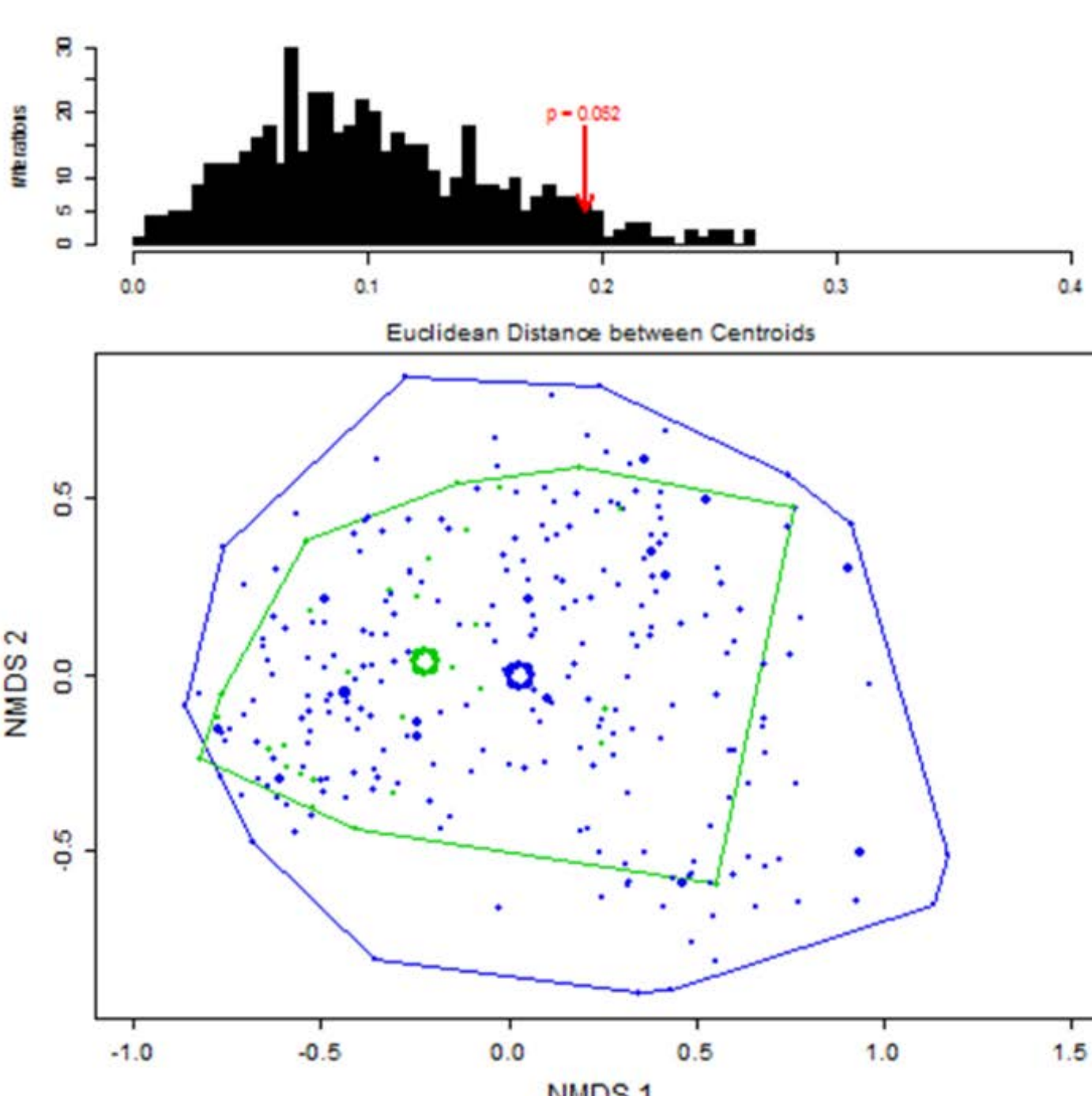
Holocene

Pleistocene

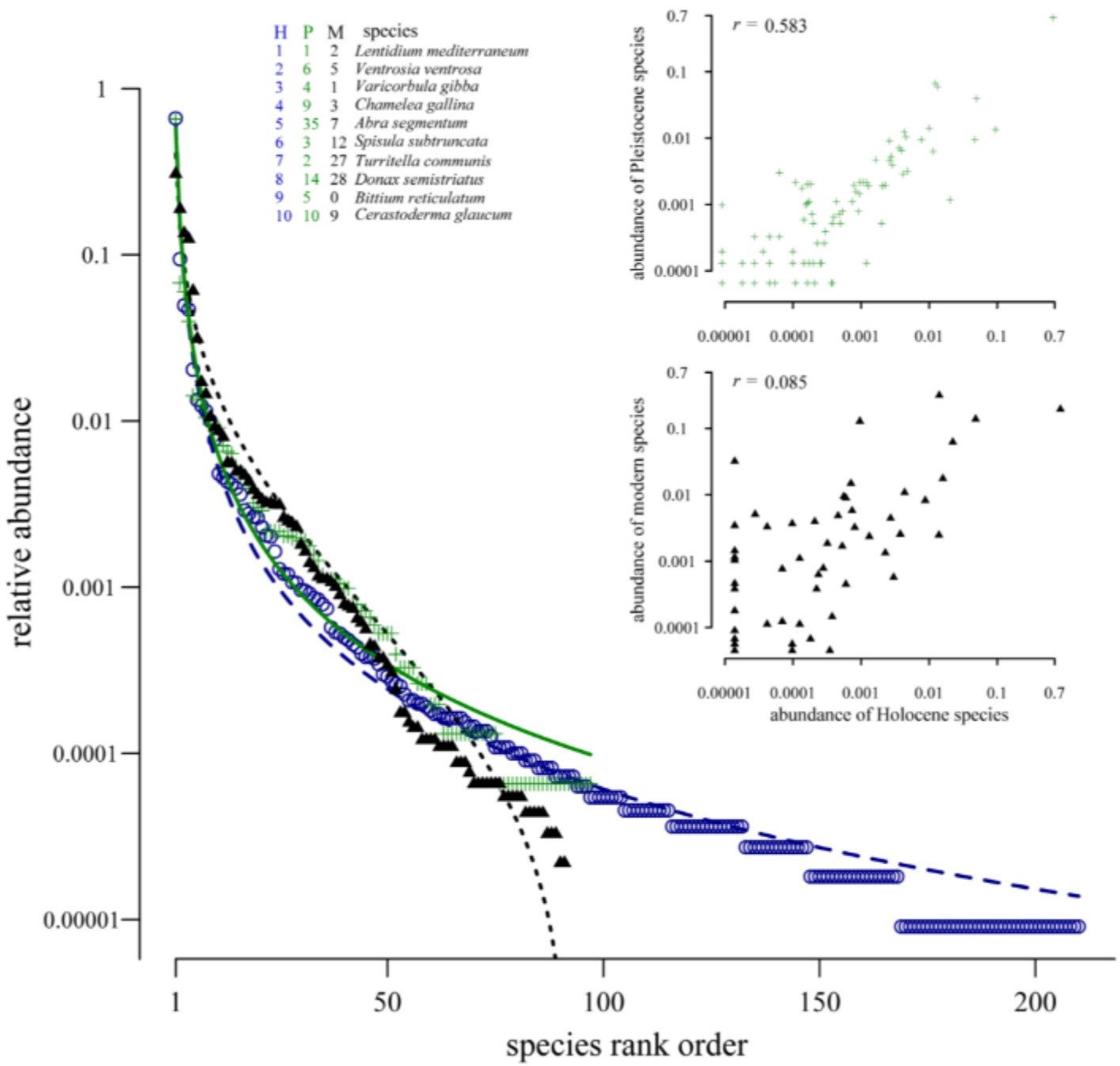


Actual data



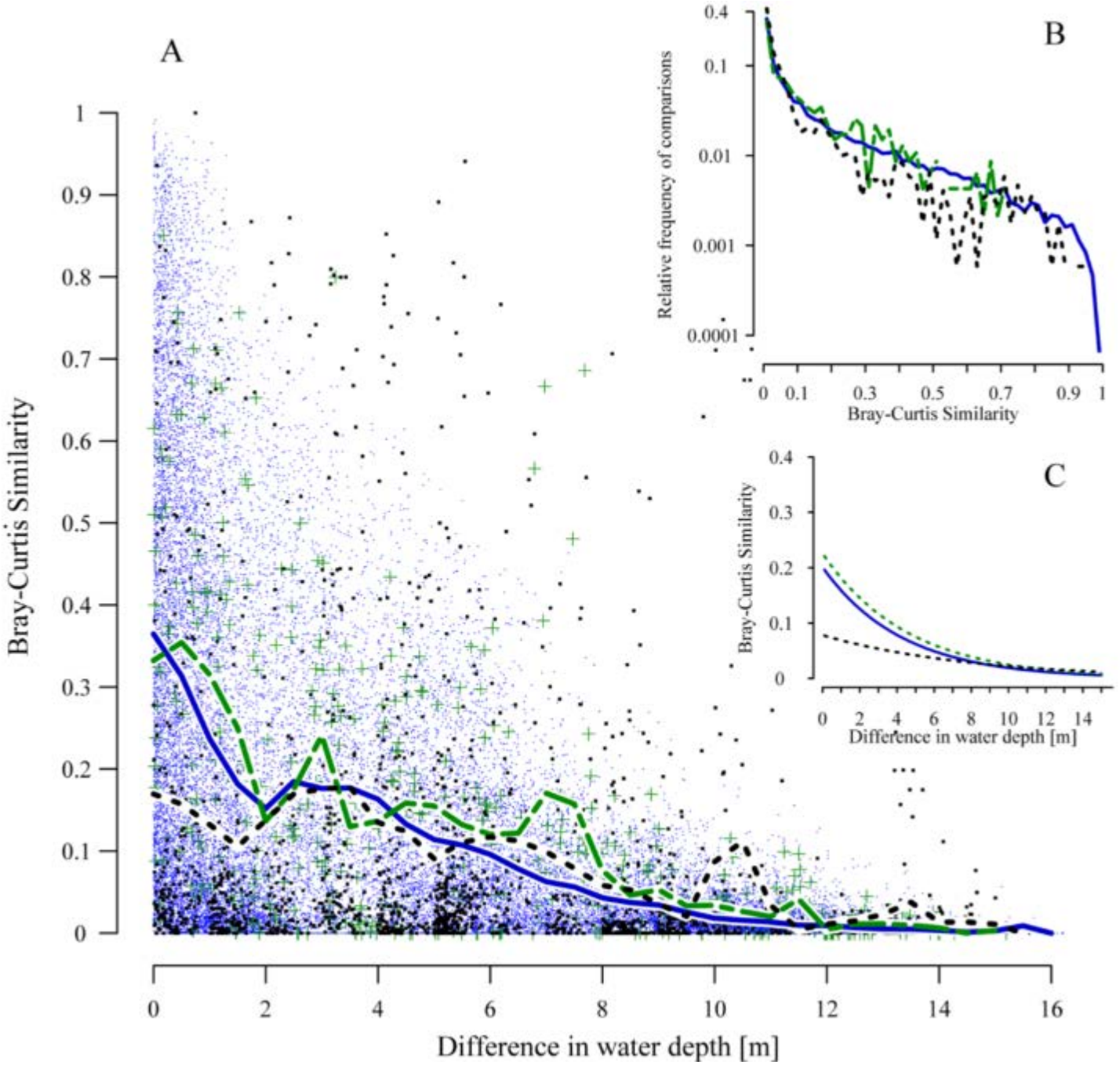


Discussion Slides # 4.3



Kowalewski, Wittmer, Dexter, Amorosi, and Scarponi, 2015, *Proc. Royal Soc. B*

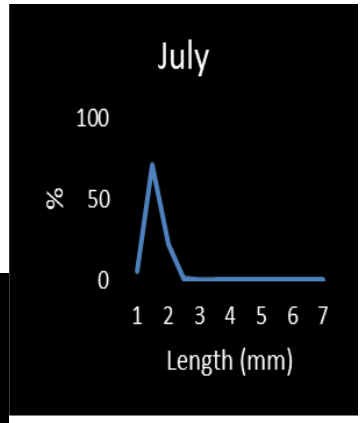
Discussion Slides # 5

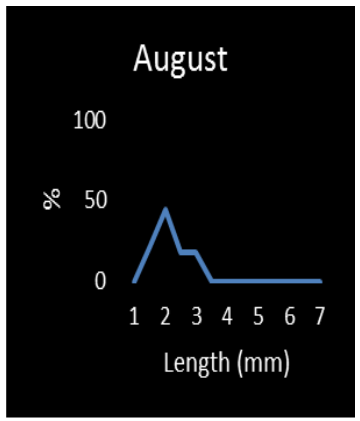


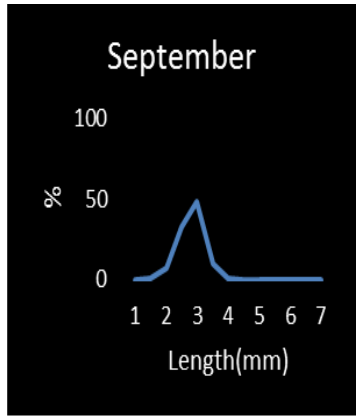
Kowalewski, Wittmer, Dexter, Amorosi, and Scarponi, 2015, *Proc. Royal Soc. B*

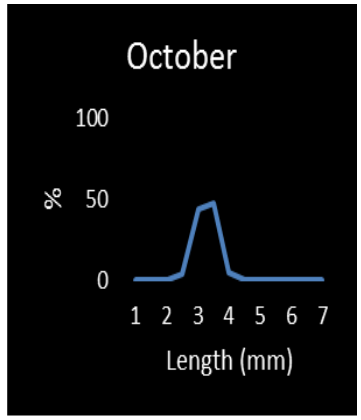
Discussion Slides # 6

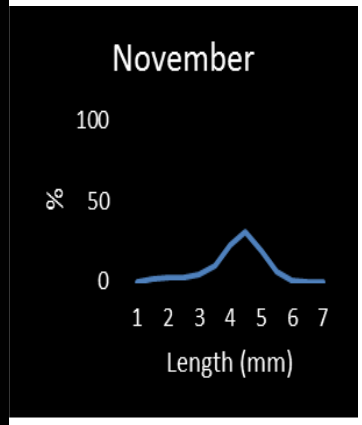
Paleoecological Proxies in Archeology

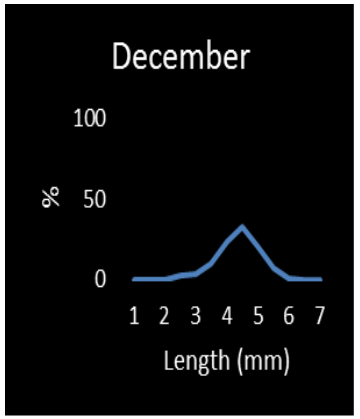


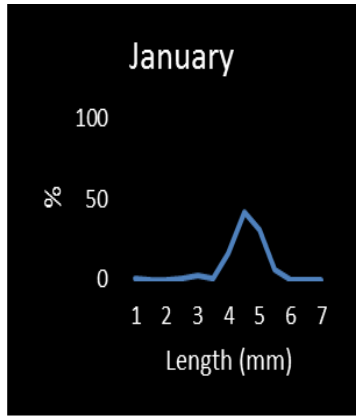


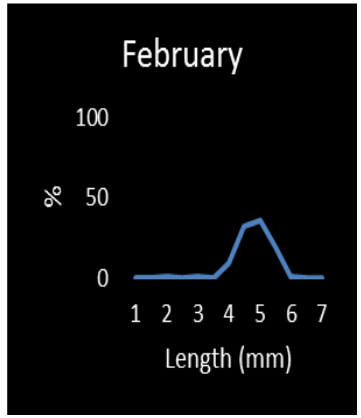


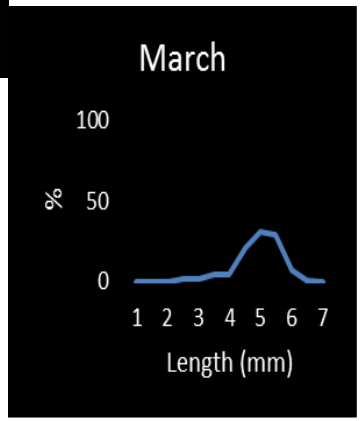


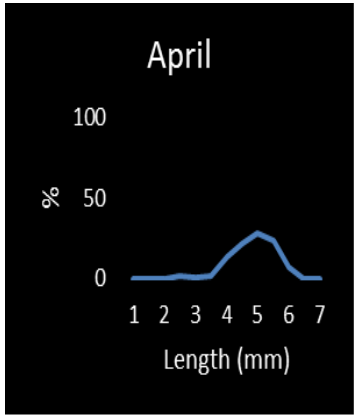


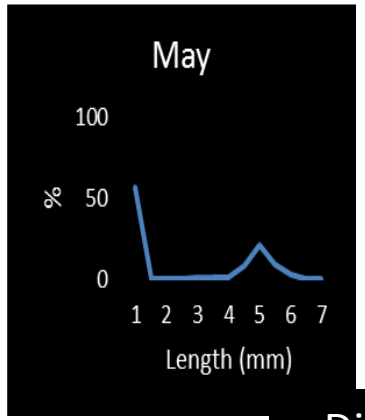


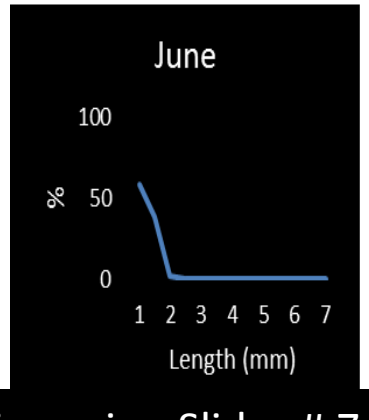






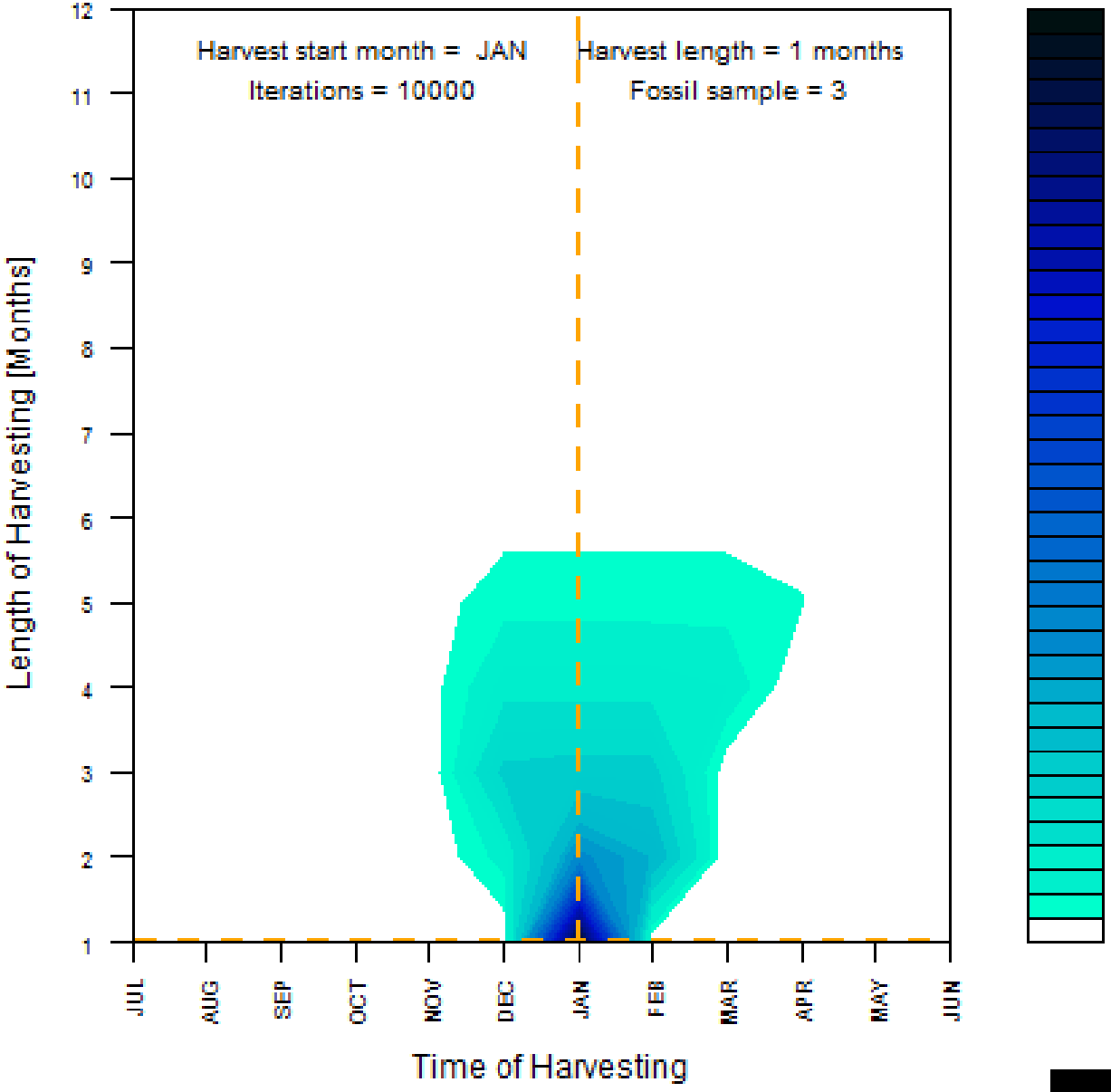






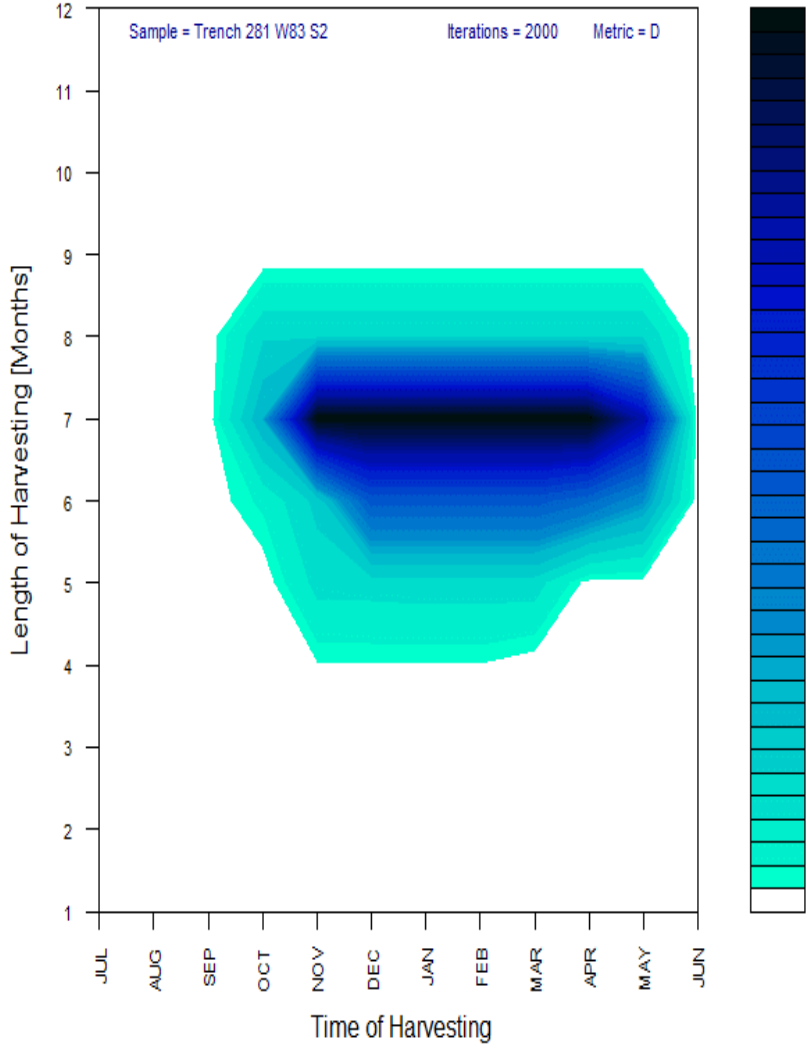
Discussion Slides # 7

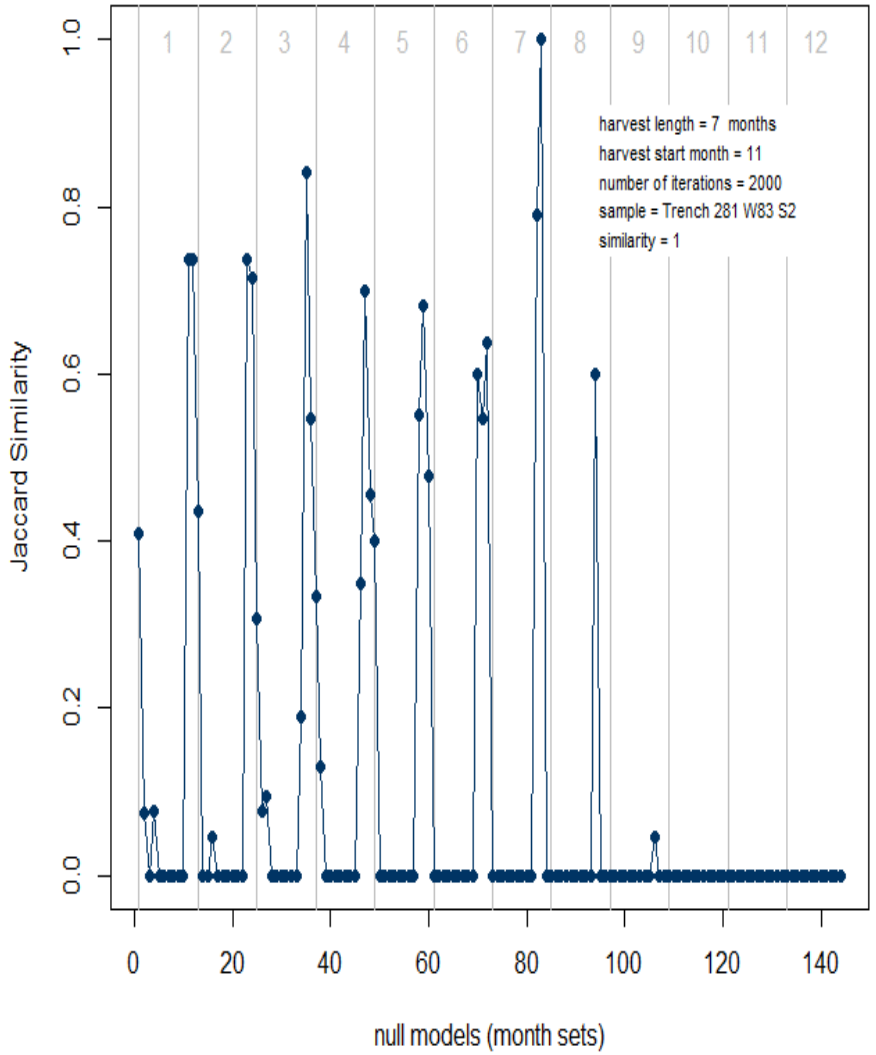
Demographic Modeling



Discussion Slides # 8

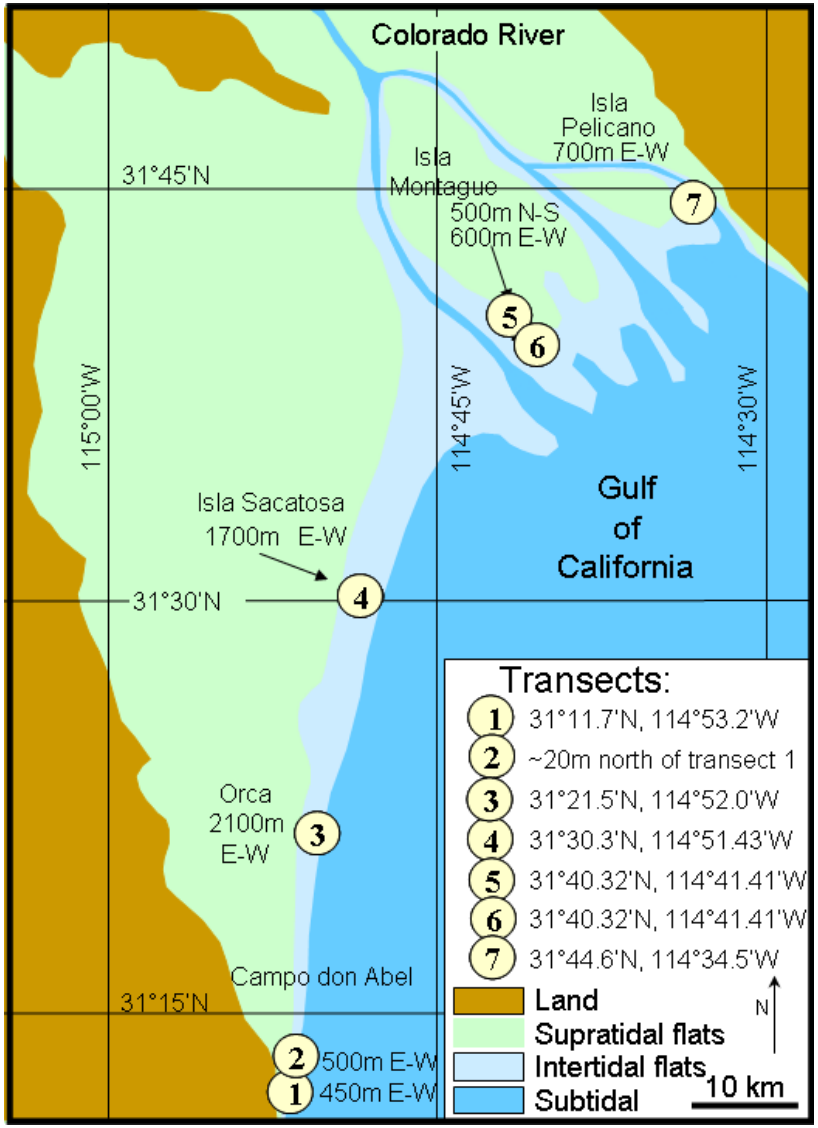
Archeological sample matches live samples pooled for November - May



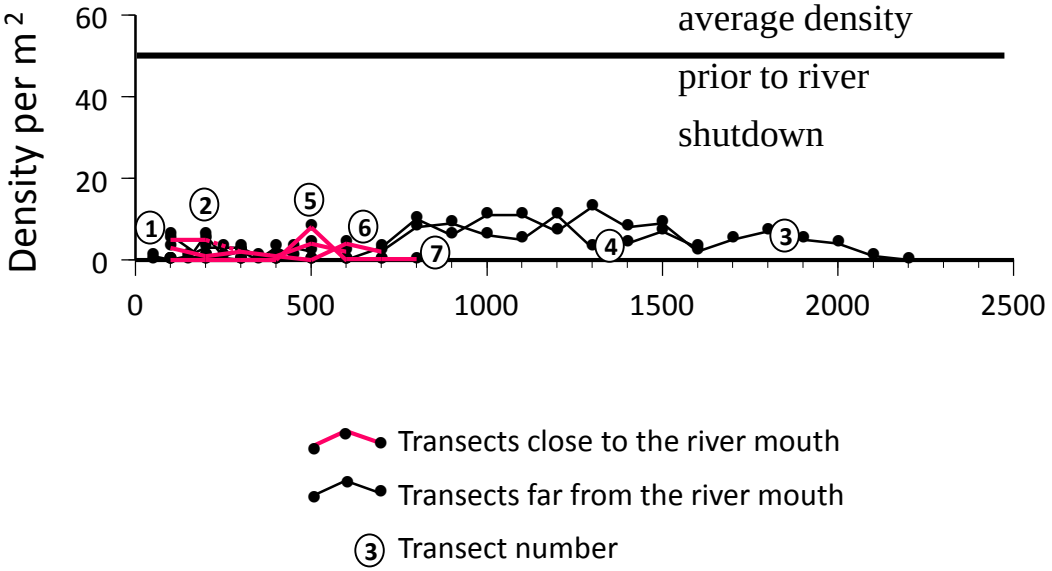


Sample	Harvest length	Season	n
W83S2	November-May	winter/spring	218
789N801E	December-May	winter/spring	132
784N811E	January-May	winter/spring	228

Assessing Restoration Efforts



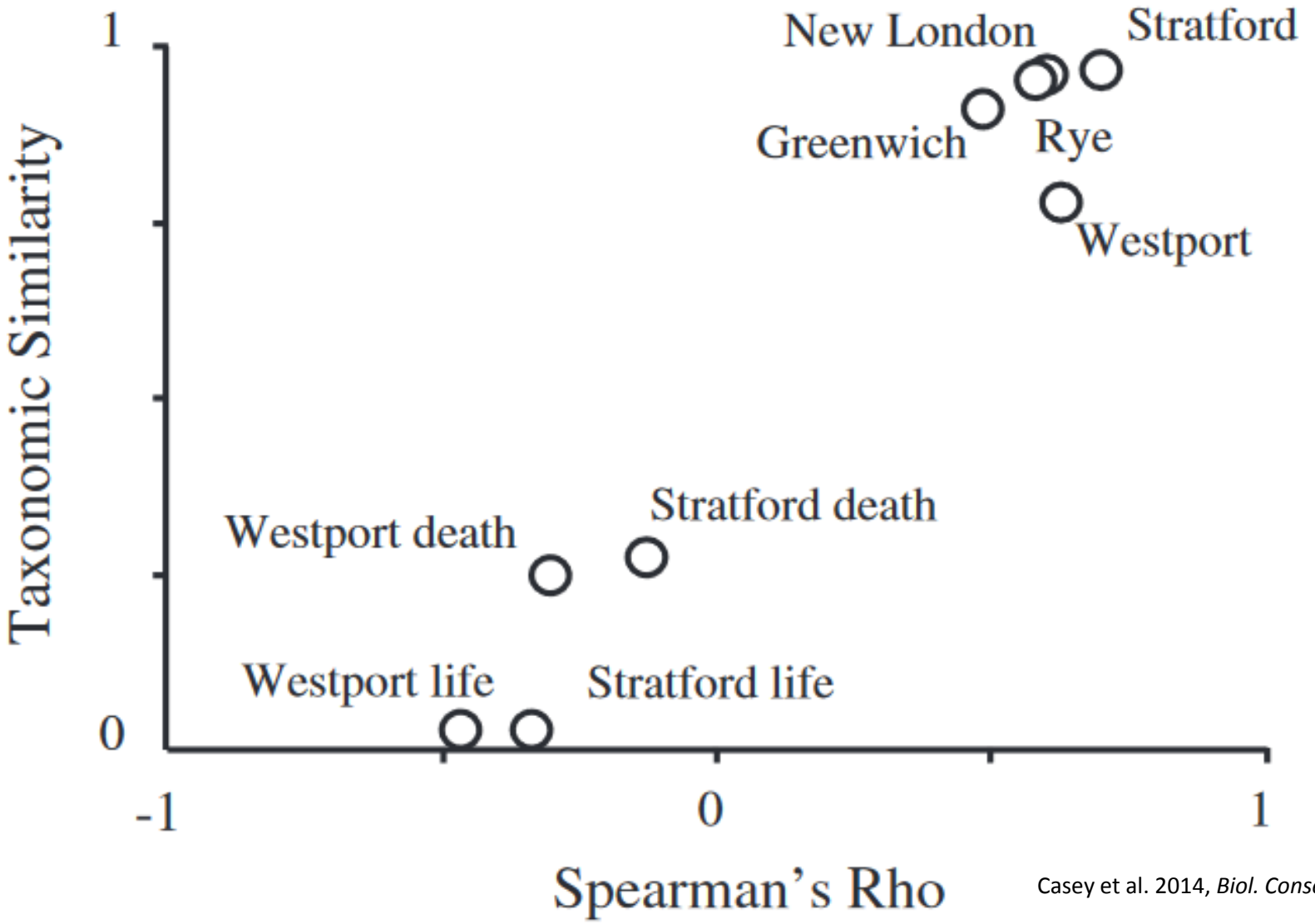
shelly macrofauna (> 12.5 mm)



Kowalewski et al. 2000, *Geology*, **28**: 1059-1062.

Discussion Slides # 10

The Problem of Taphonomic Inertia



Casey et al. 2014, *Biol. Conserv.*