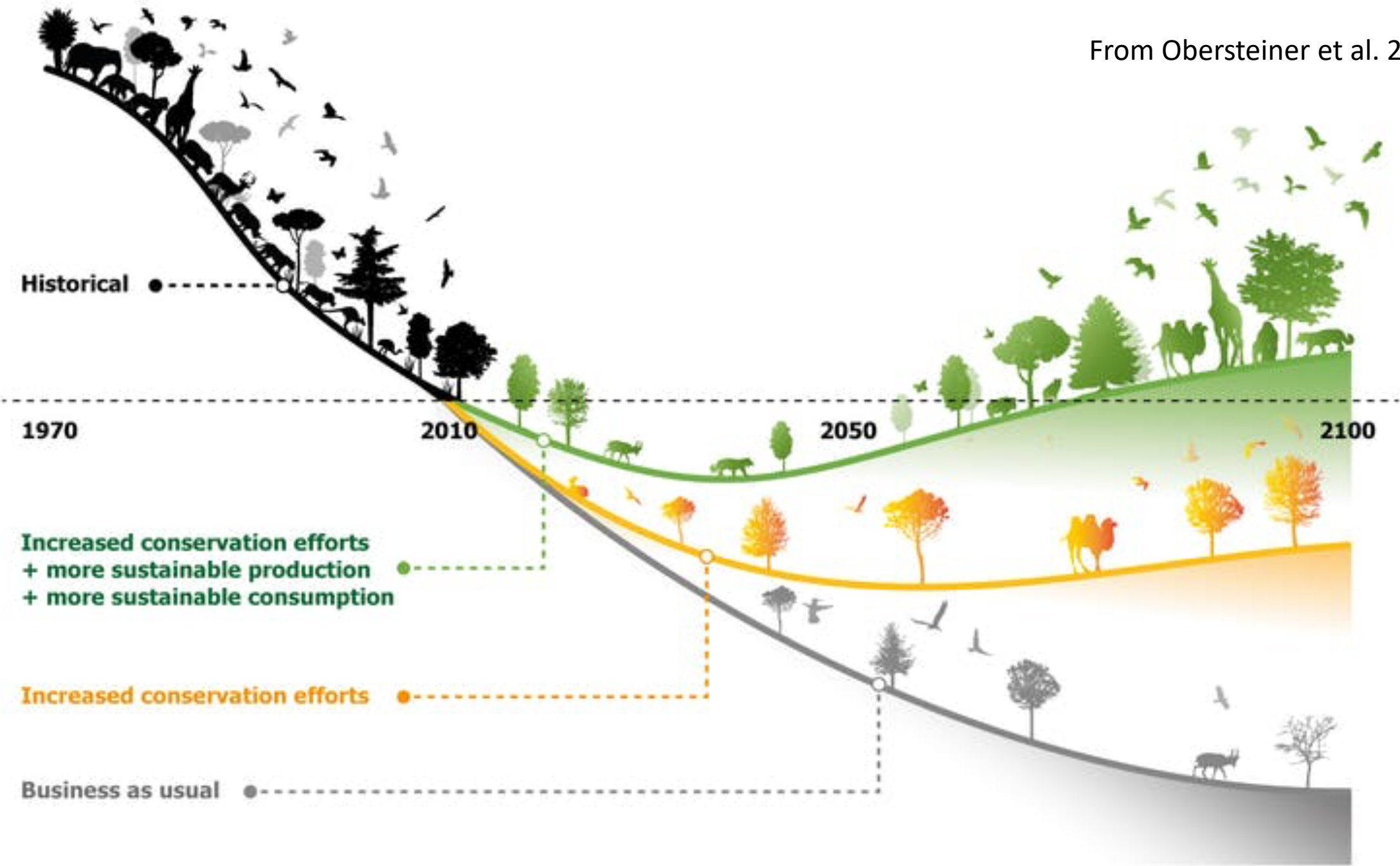


# Dead Shells Bring to Life Baselines for Conservation, Revealing Invisible Biodiversity Loss

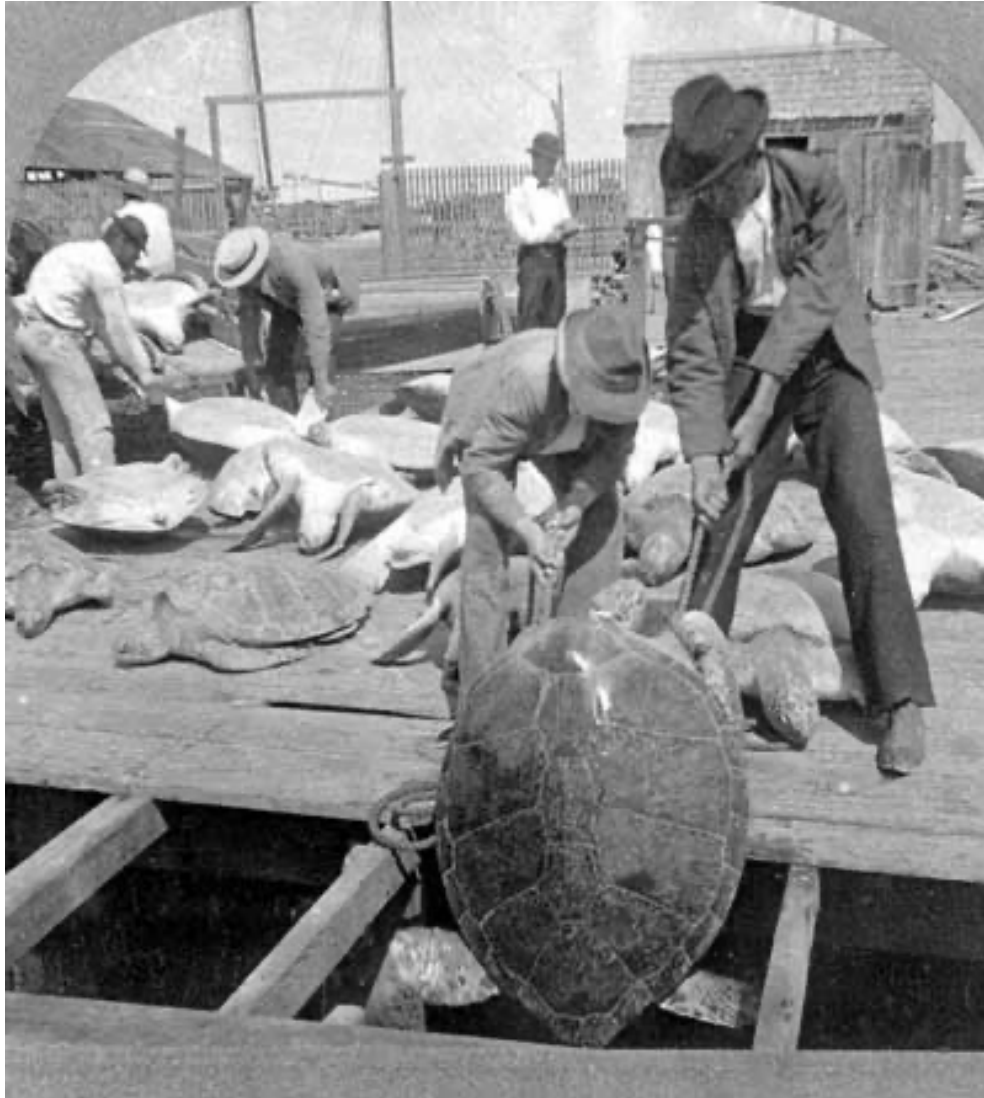
Andrew V. Michelson<sup>1</sup>, Julian J. Spergel<sup>2</sup>, Katalina C. Kimball-  
Linares<sup>3</sup>, Sarah Fitzpatrick<sup>4</sup>, Lisa Park Bousch<sup>5</sup>, and Jill S.  
Leonard-Pingel<sup>6</sup>

<sup>1</sup>SUNY Maritime, <sup>2</sup>Columbia University, <sup>3</sup>University of Chicago, <sup>4</sup>Duke University,  
<sup>5</sup>University of Connecticut <sup>6</sup>The Ohio State University Newark



This artwork illustrates the main findings of the article, but does not intend to accurately represent its results (<https://doi.org/10.1038/s41586-020-2705-y>)

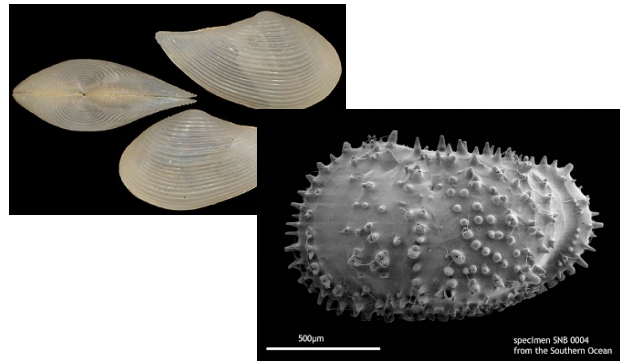
# Historical perspective is important for tracking biodiversity declines



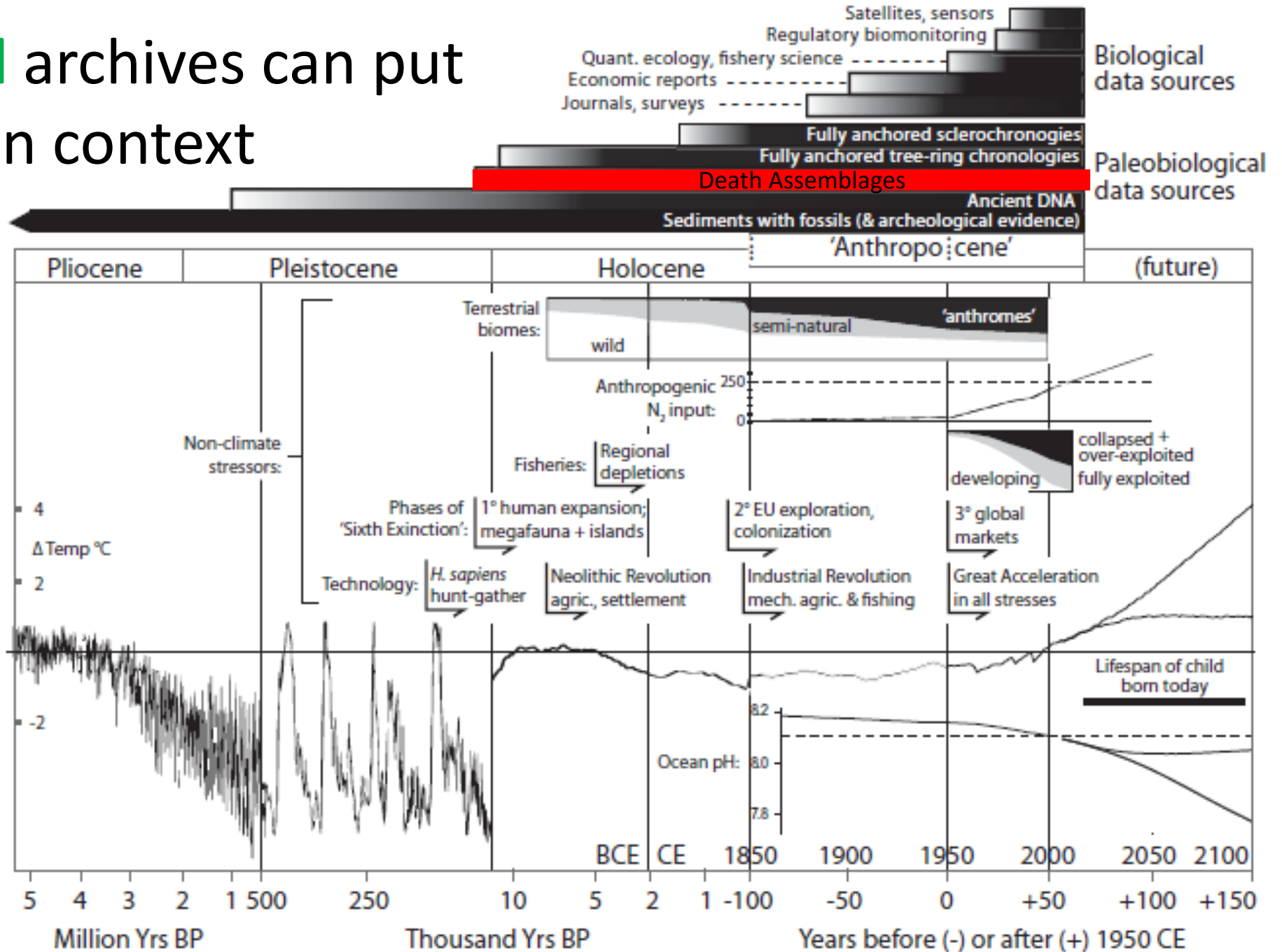
From McClenachan, 2009

# Paleobiological archives can put today's trends in context

Paleobiological archives contain **abundant records of invertebrate species**

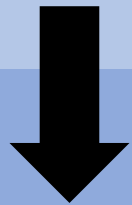


Kidwell, 2015



# What are Death Assemblages?

**Living Community  
(Snapshot)**



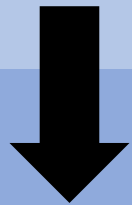
**Death Assemblage**

(Accumulation over Time)



# What are Death Assemblages?

**Living Community**  
(Snapshot)



**Death Assemblage**  
(Accumulation over time)



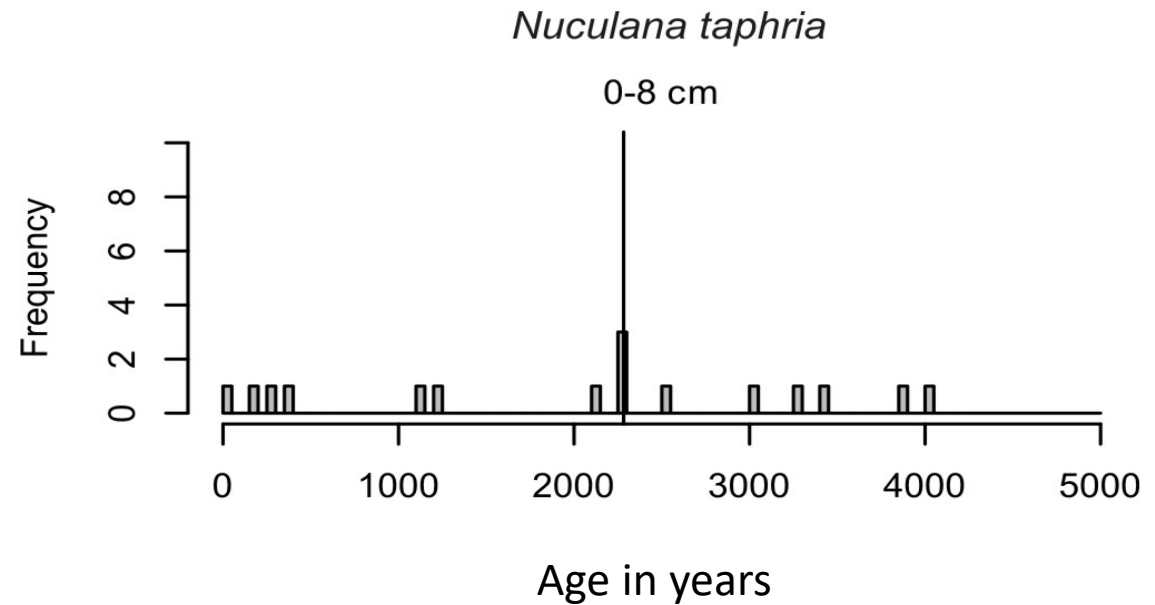


## Summary of Case Study Data

Geographic Location	Taxonomic Group	Environment	n, point-scale	n, habitat-scale	Current Condition	Total Shells	Species Richness
Southern California	Bivalves	Continental shelf	1	1	Remediated	228	31
Bahamas	Ostracods	Marginal marine, lacustrine	80	10	Impacted	15,001	23
Bahamas	Ostracods	Marginal marine, lacustrine	88	11	“Pristine”	35,508	16
Wisconsin, USA	Ostracods	Freshwater, lacustrine	15	3	Impacted	311	4
Wisconsin, USA	Ostracods	Freshwater, lacustrine	18	2	Remediated	1028	5



Dating of individual *Nuculana taphria* shows that many individuals are centuries to millennia old.



From Tomasovych et al, 2019

Because shells show so much time-averaging, the death assemblages can tell us what the community was like before human impact.

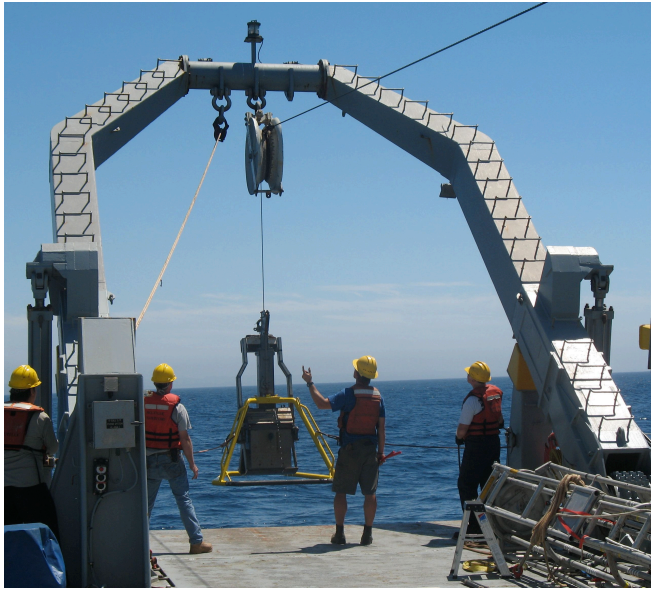
# Sampling Plan, Ostracodes

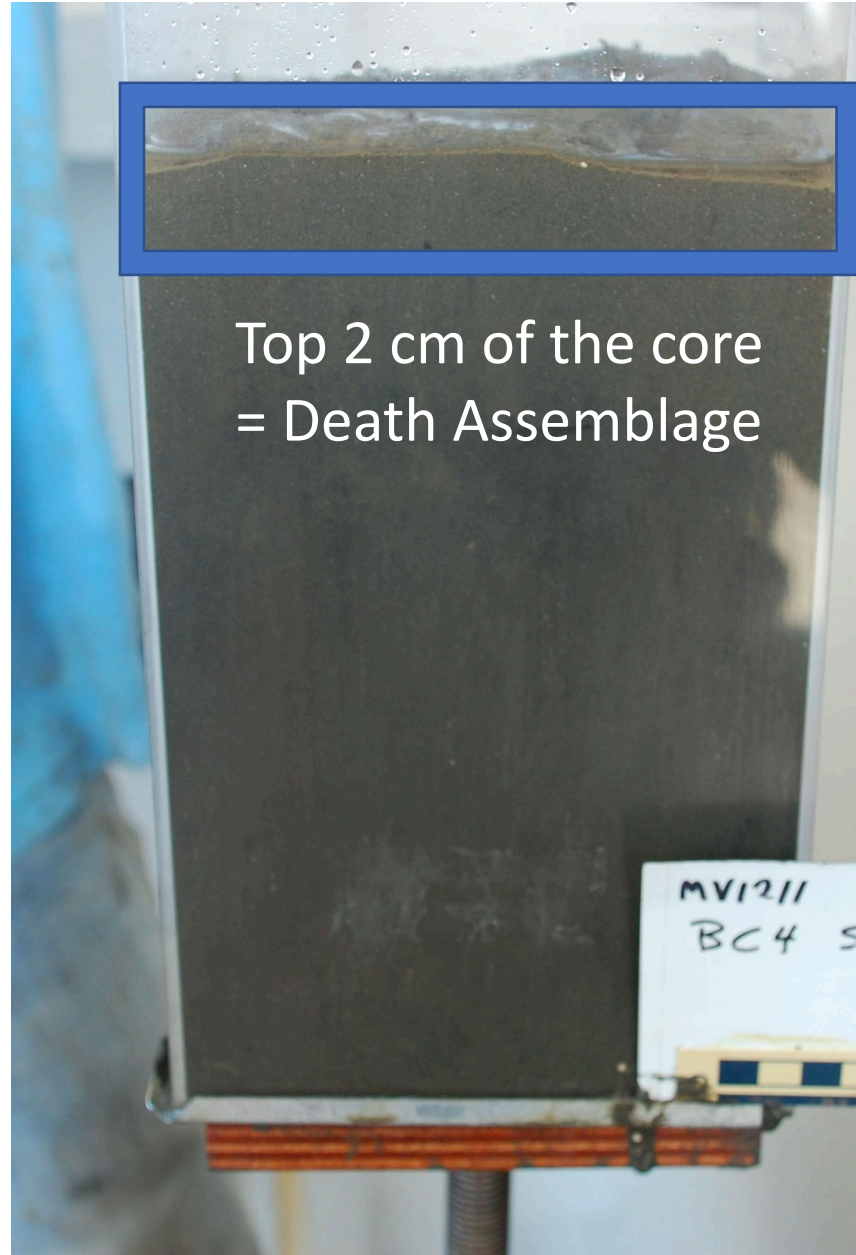
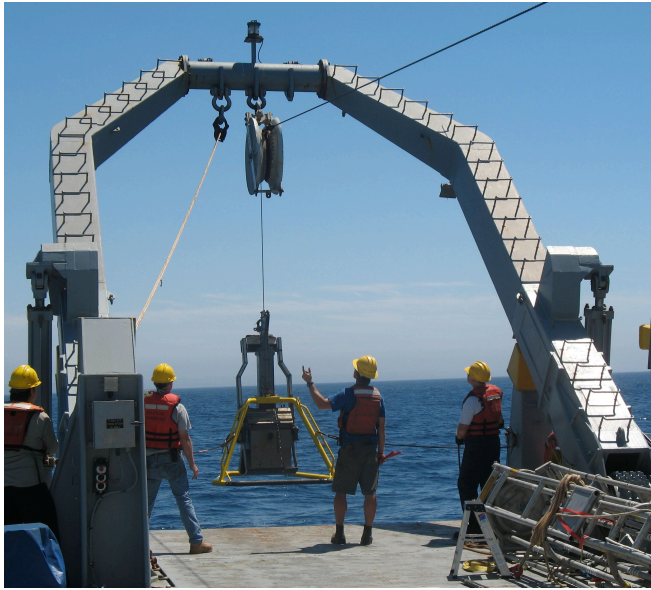


Blue Hole 5,  
San Salvador,  
Bahamas

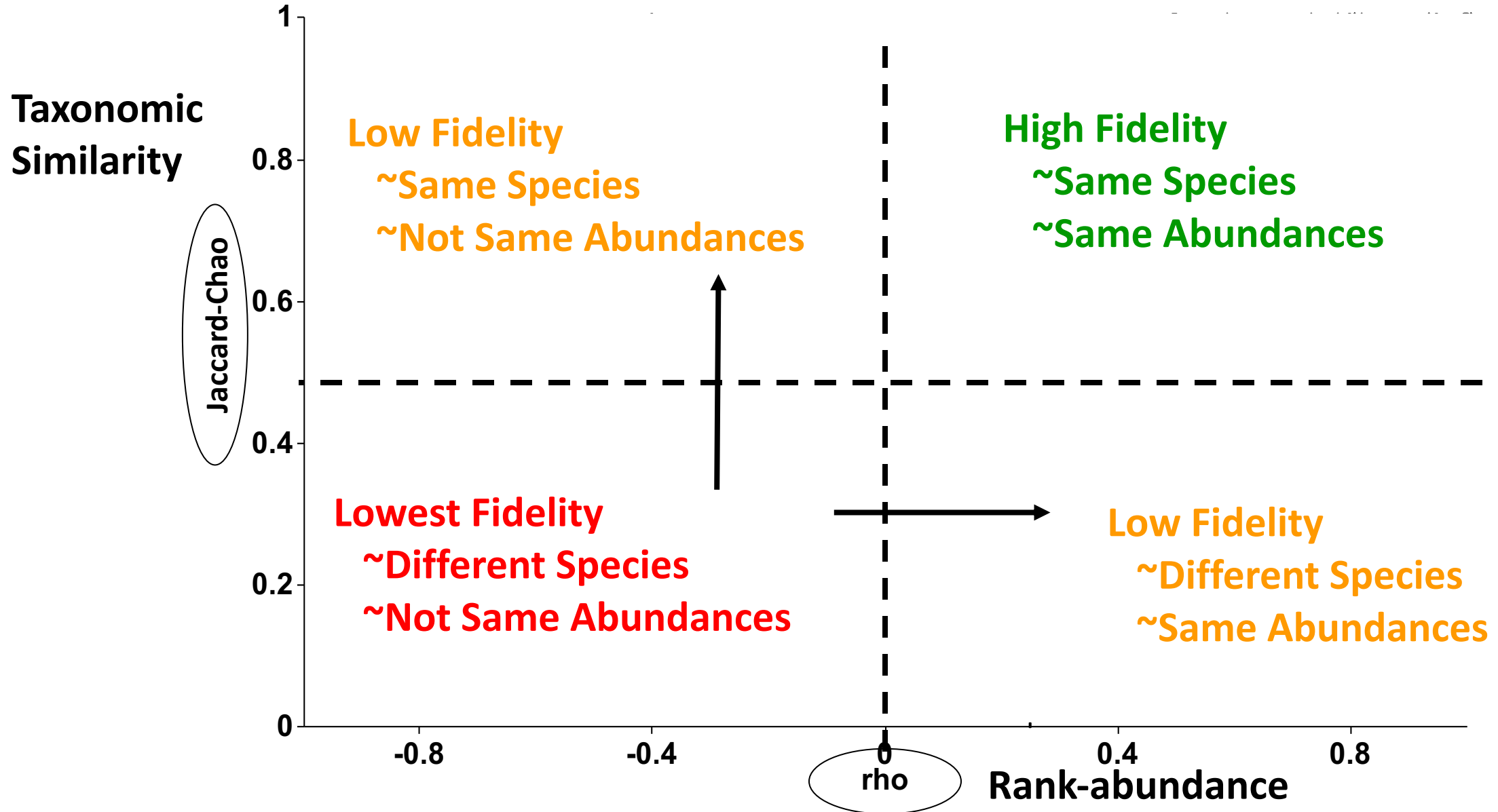


Allequash Lake,  
Vilas Co., WI,



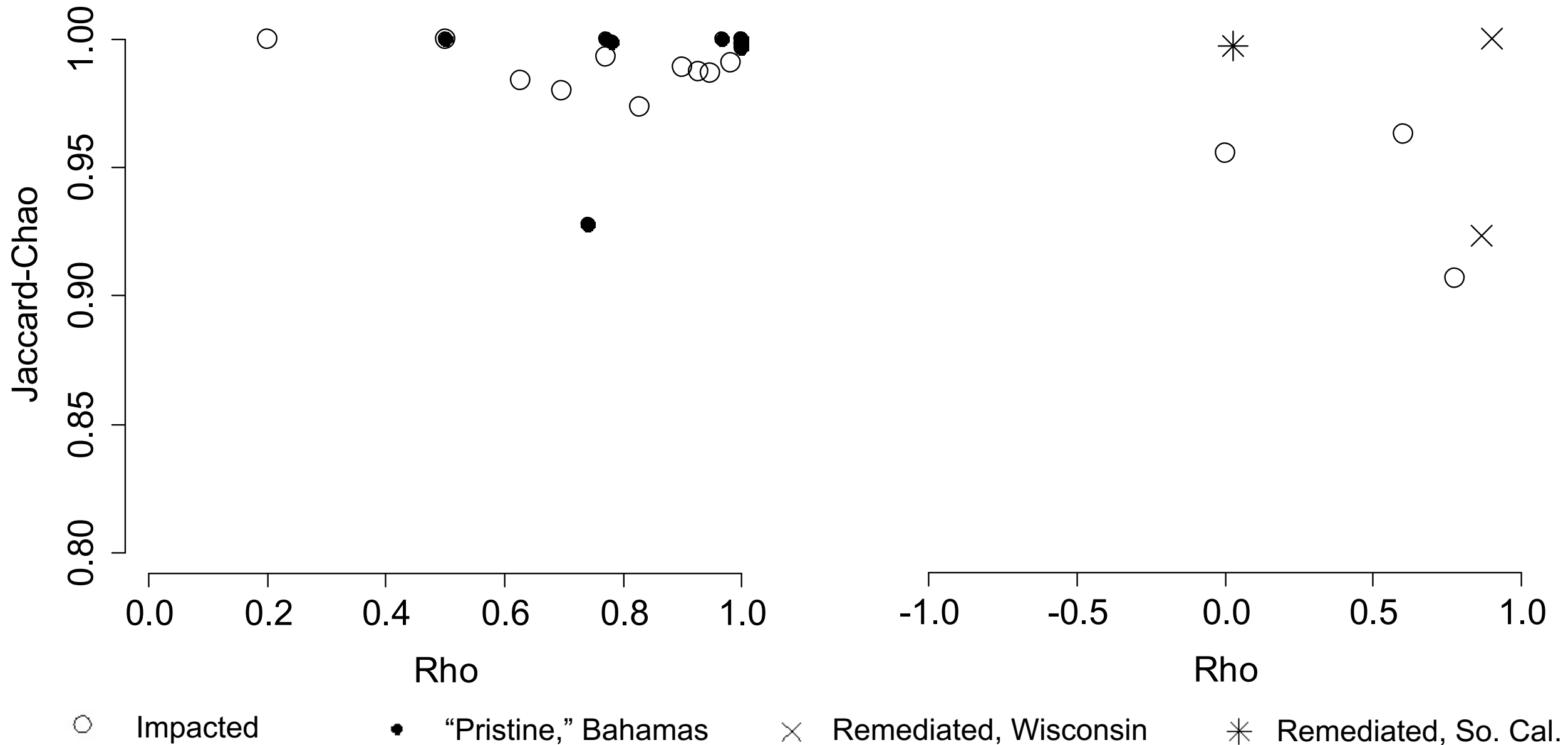


# Live/Dead comparison tracks changes in species composition and abundance



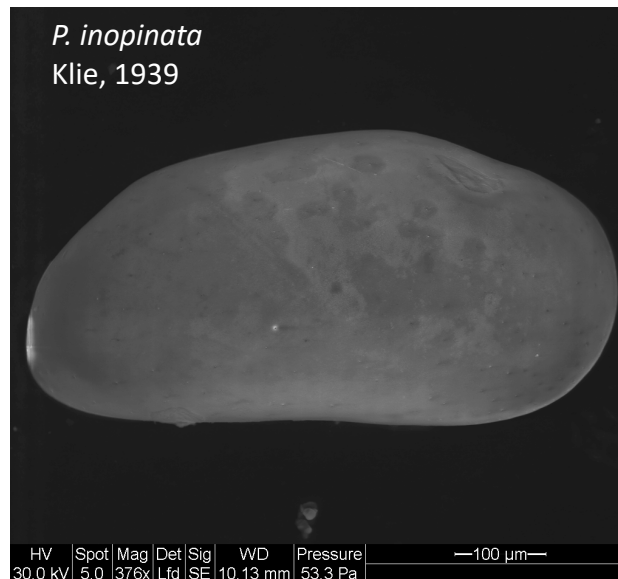
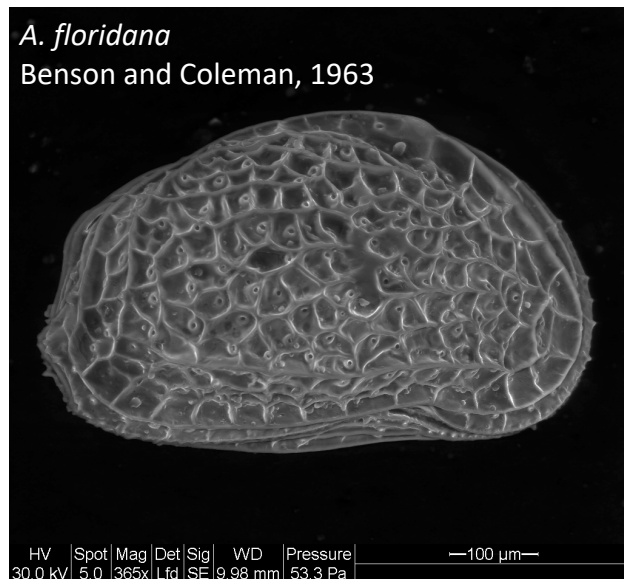


# Habitat Scale



# Death assemblages track biodiversity change

- Mismatch in live/death comparisons can ***flag areas in need of management***
- Death assemblages can help us ***identify local extirpations***
- Death assemblages can help us ***identify changes in population structures***



Michelson et al., 2018



# Death assemblages in conservation

Death assemblages can be used to supplement already existing live surveys

Collection of death assemblages is low-tech and low-cost in lacustrine environments

Requires time and taxonomic knowledge (skilled labor)

Can identify bioindicator species

Sparkling Lake,  
Vilas Co., WI




Airport Blue  
Hole, Rum Cay,  
Bahamas

Please feel free to contact us with questions, or to talk about how you can use death assemblages in your research on biodiversity conservation.

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 andy\_michelson



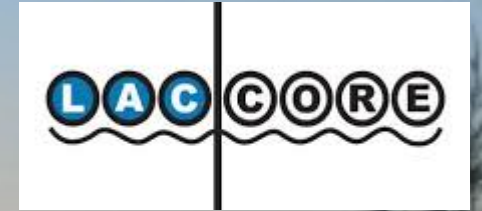
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# Thank you!



The College of The Bahamas  
**Gerace Research Centre**  
San Salvador, Bahamas

## Funding:

NSF EAR postdoc 1249831  
NSF REU 0851847  
KECK Geology Consortium  
NSF EAR-1124189