

Multiple lines of evidence for nonlinear community responses to novel environmental gradients

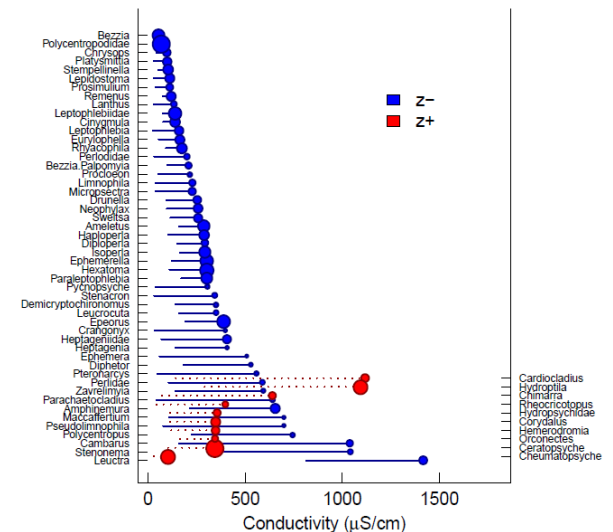
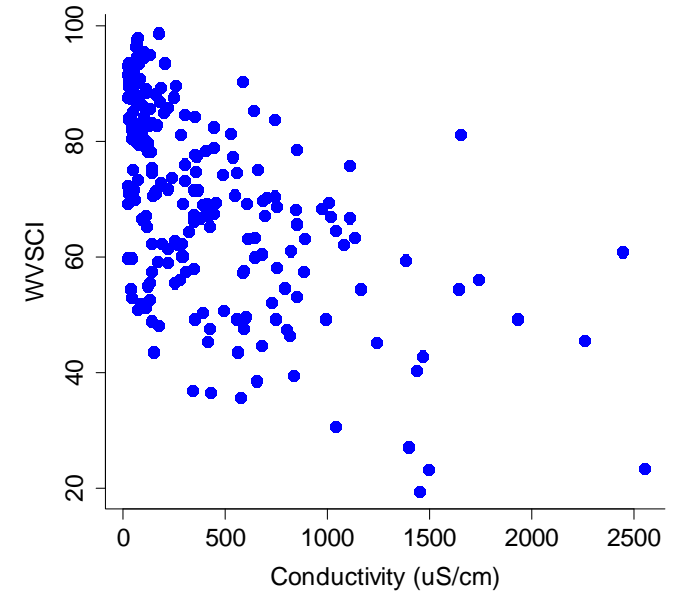
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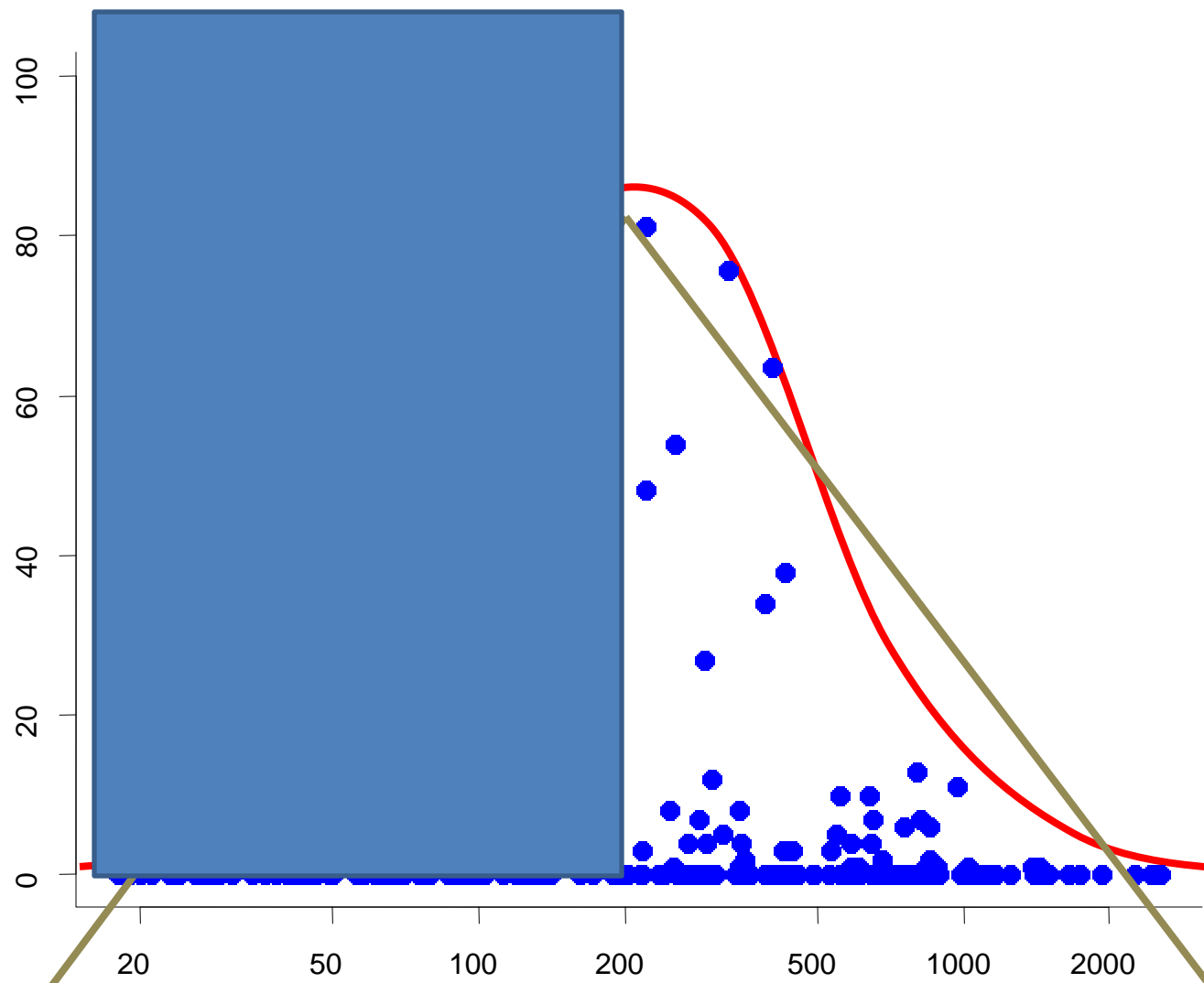
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- Threshold concept: contention, confusion (more than ever?)
- Aggregate metrics (IBI, EPT, etc)
 - Linear & wedge shaped responses
 - Can be insensitive to synchronous declines of taxa
- Cumulative response of individual taxa
 - Distinguish direction, magnitude, location
 - Can be difficult to model, esp. with faulty assumptions



Taxa abundance (no/unit area)

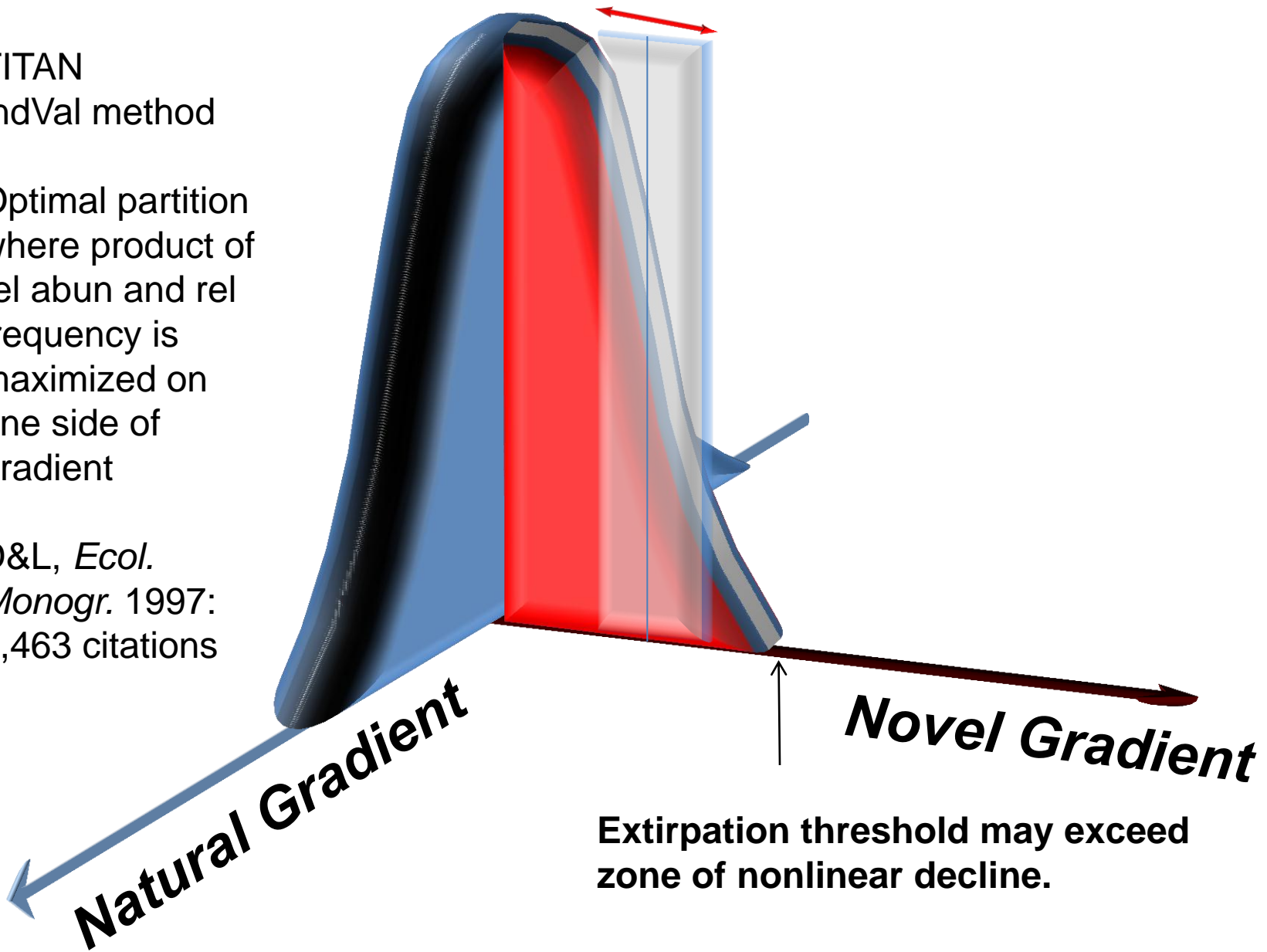


Environmental Gradient

TITAN
IndVal method

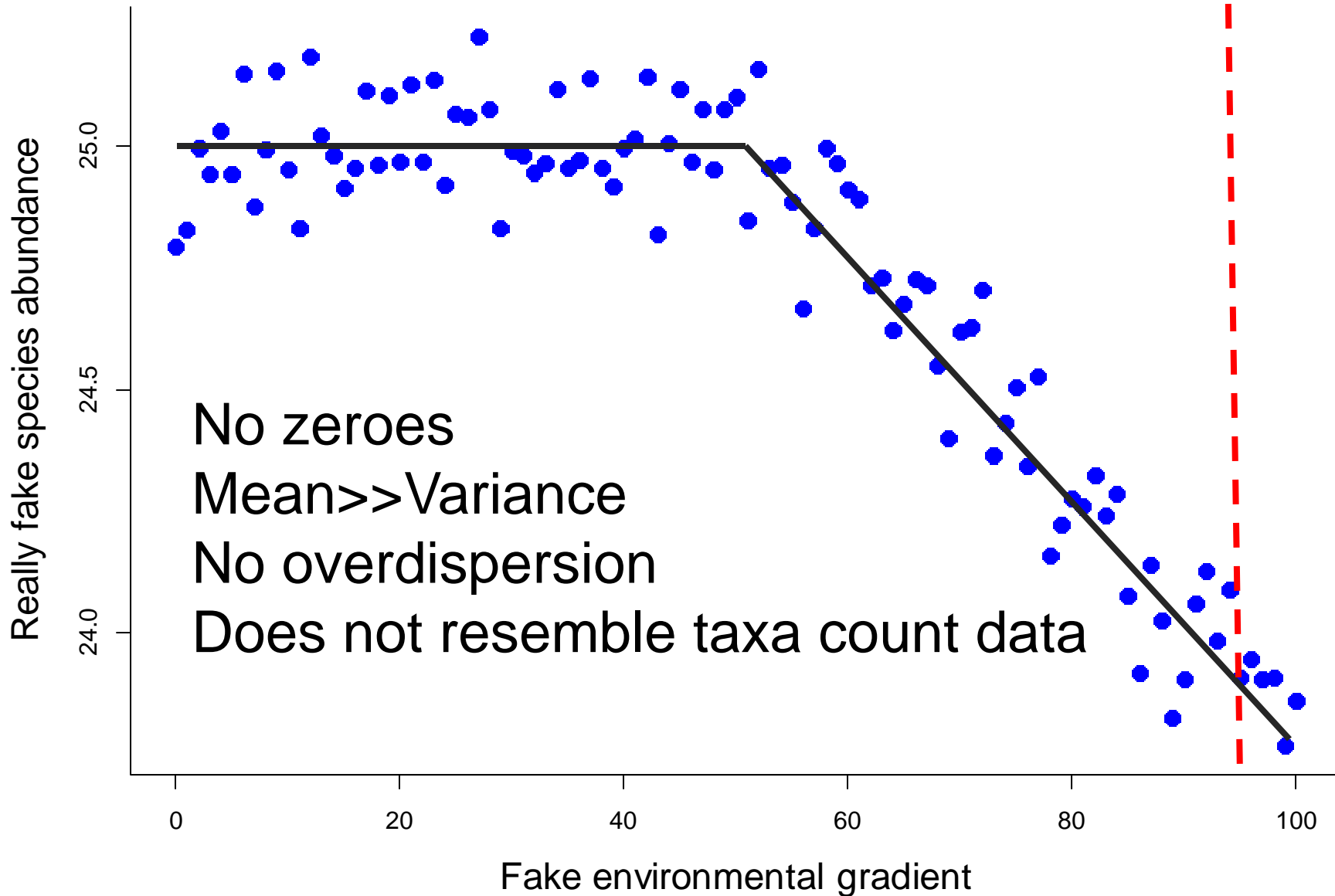
Optimal partition
where product of
rel abun and rel
frequency is
maximized on
one side of
gradient

D&L, *Ecol.*
Monogr. 1997:
2,463 citations



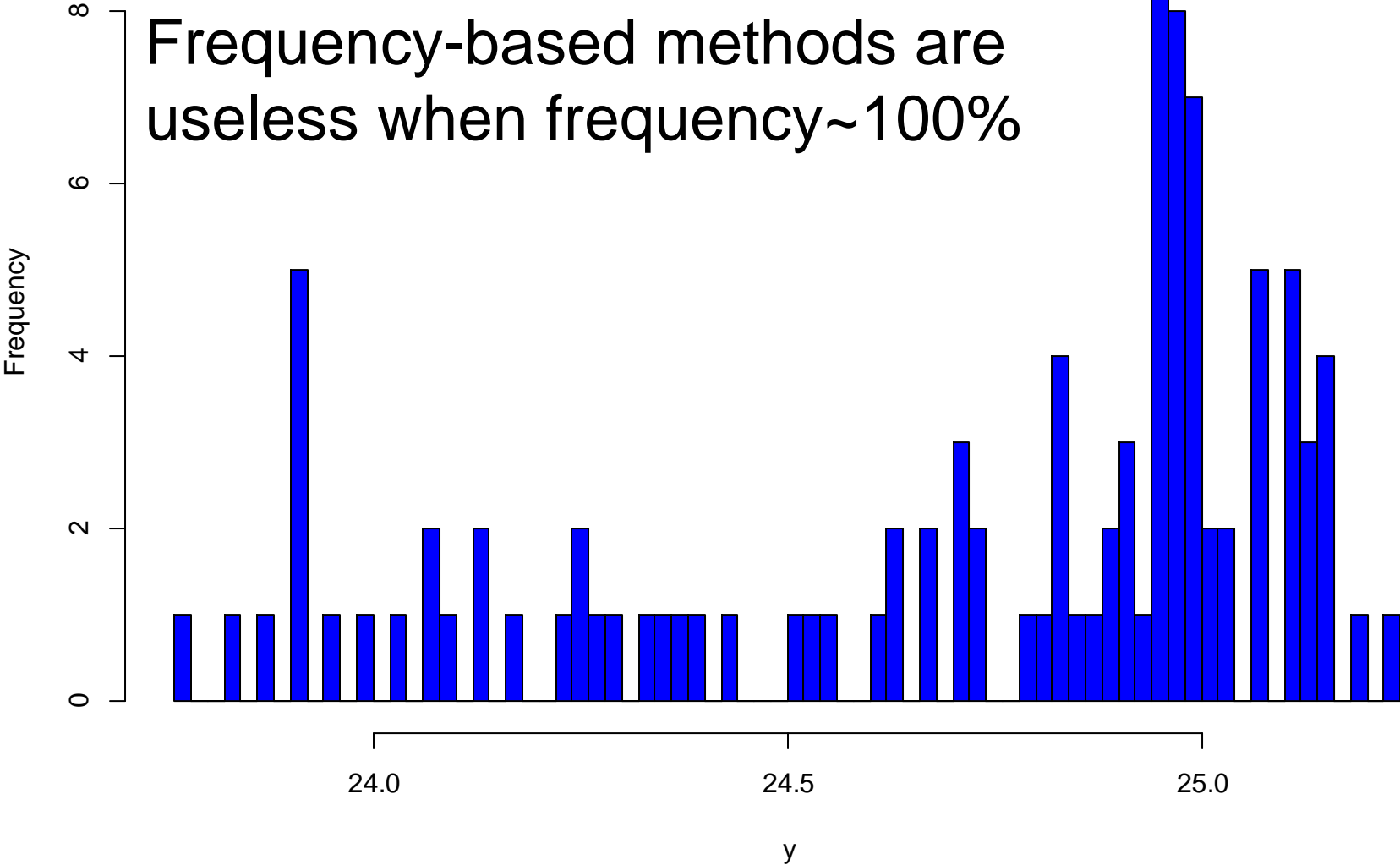
Simulated data

IndVal max here

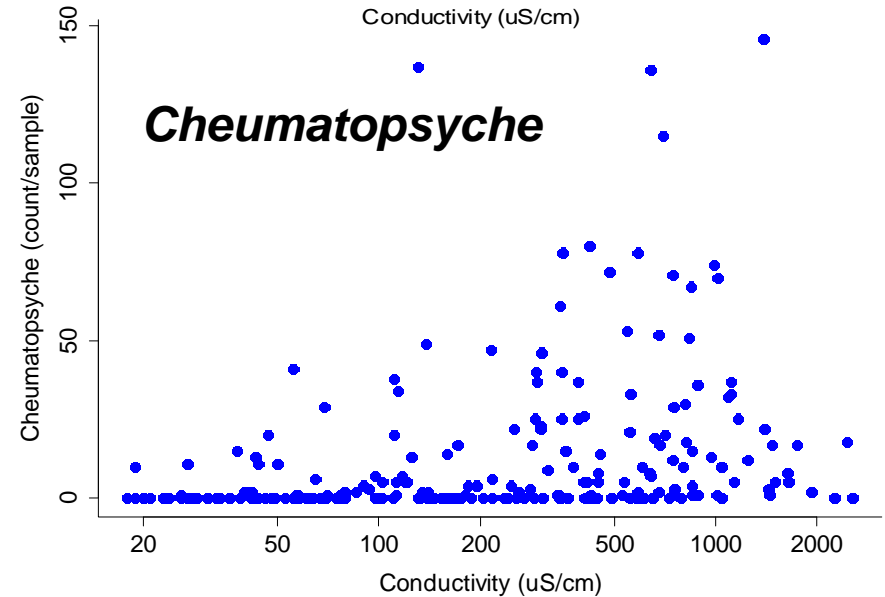
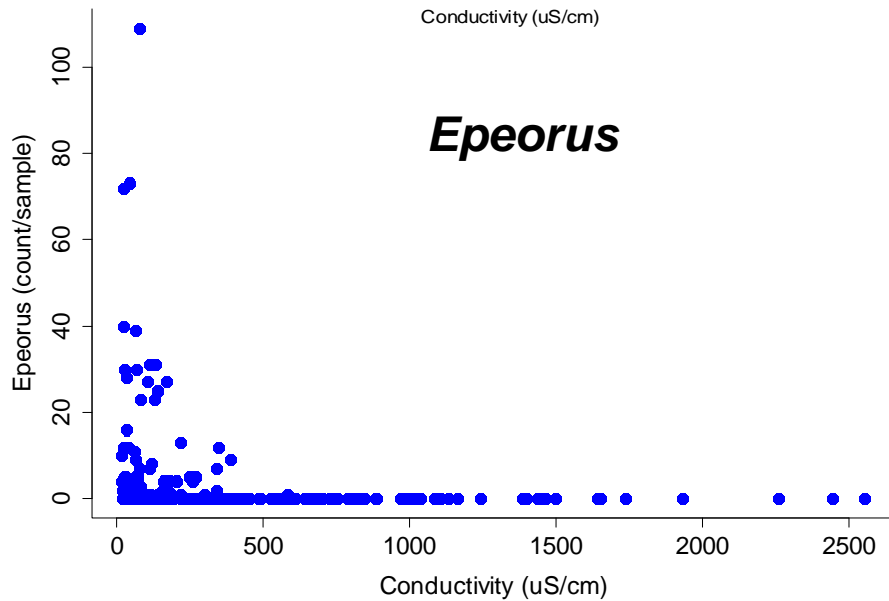
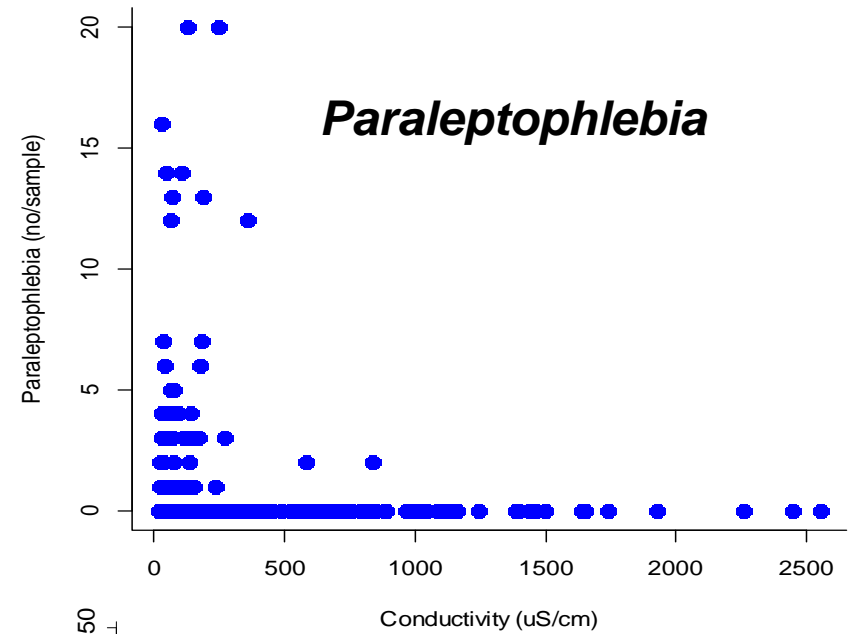
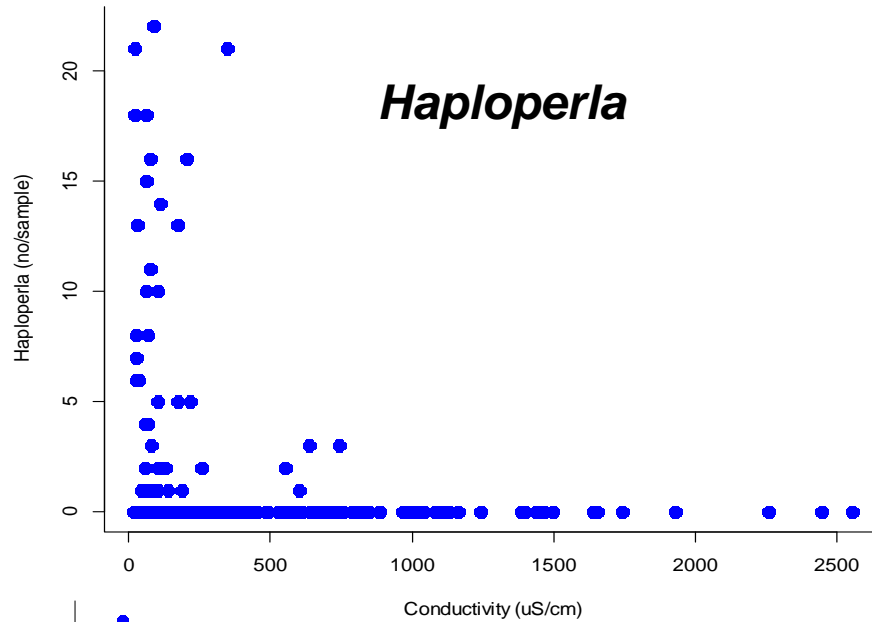


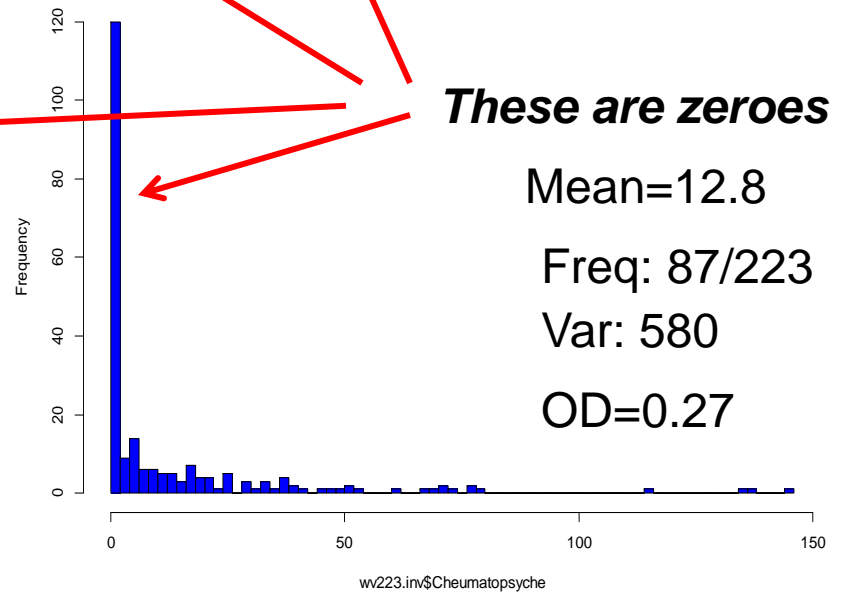
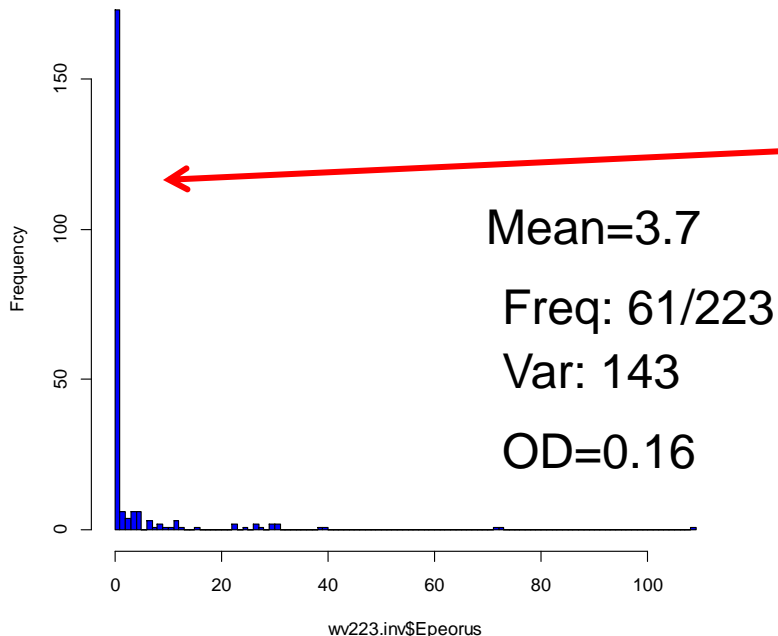
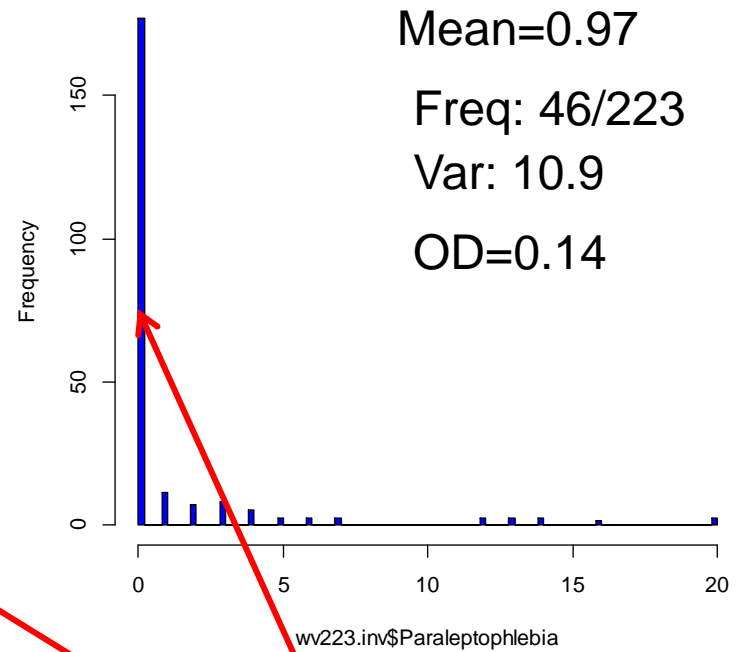
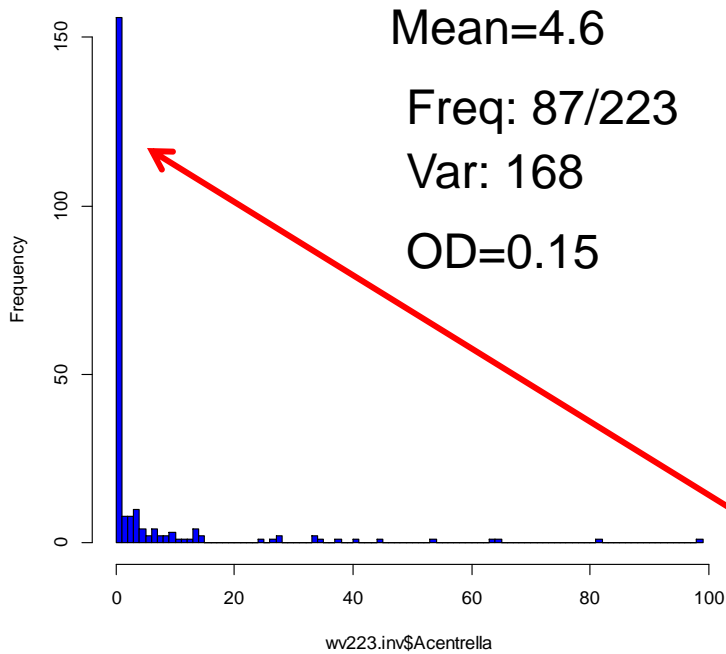
Data of these type are unequivocally inappropriate for TITAN

Frequency-based methods are useless when frequency ~100%

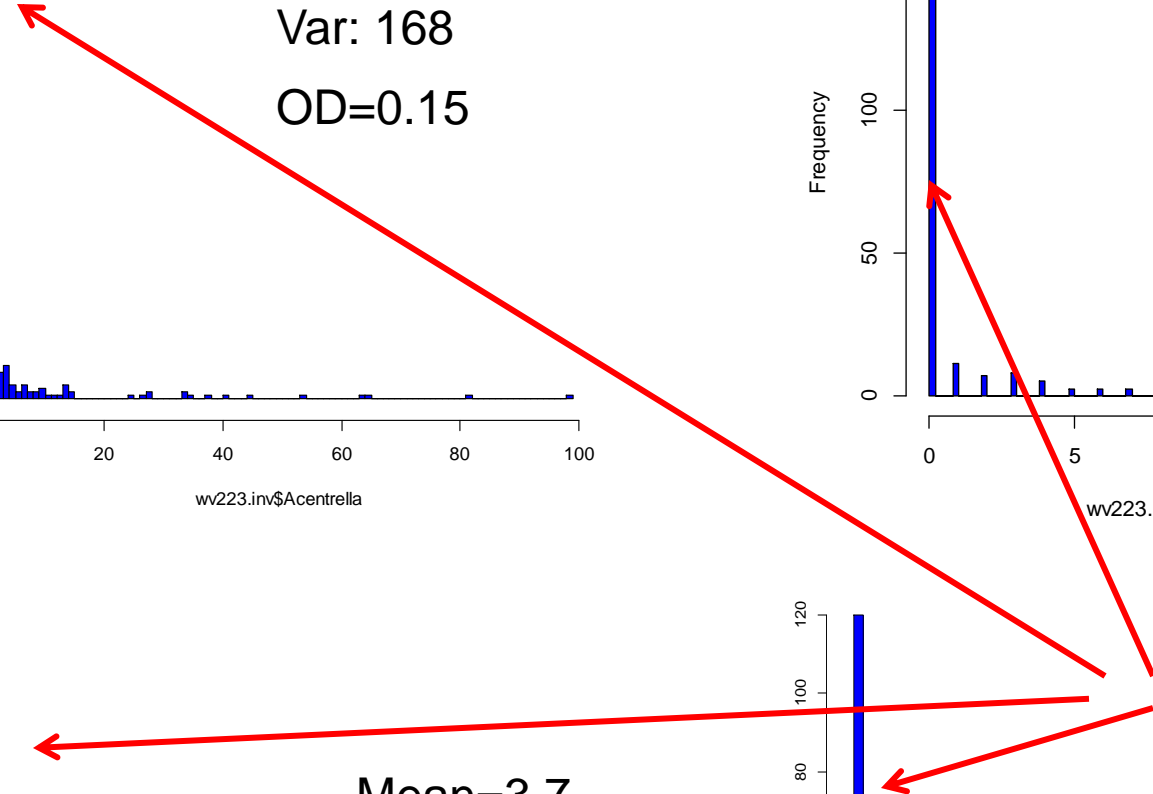


Real data

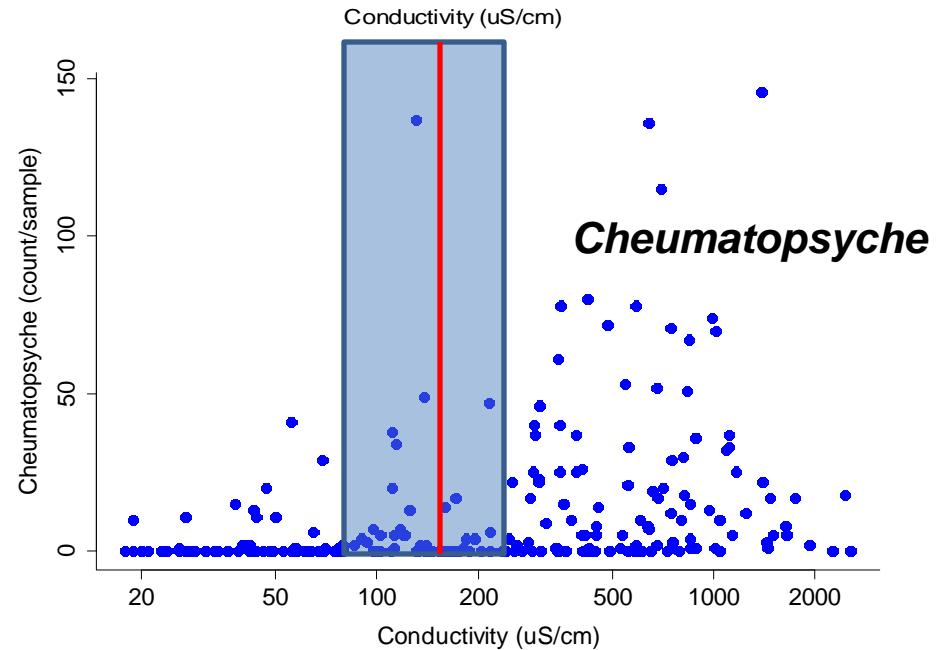
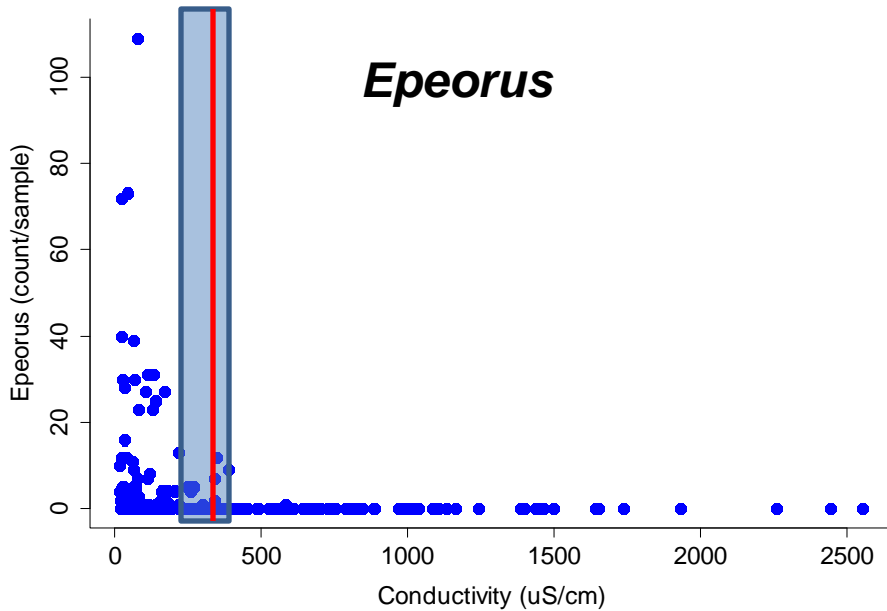
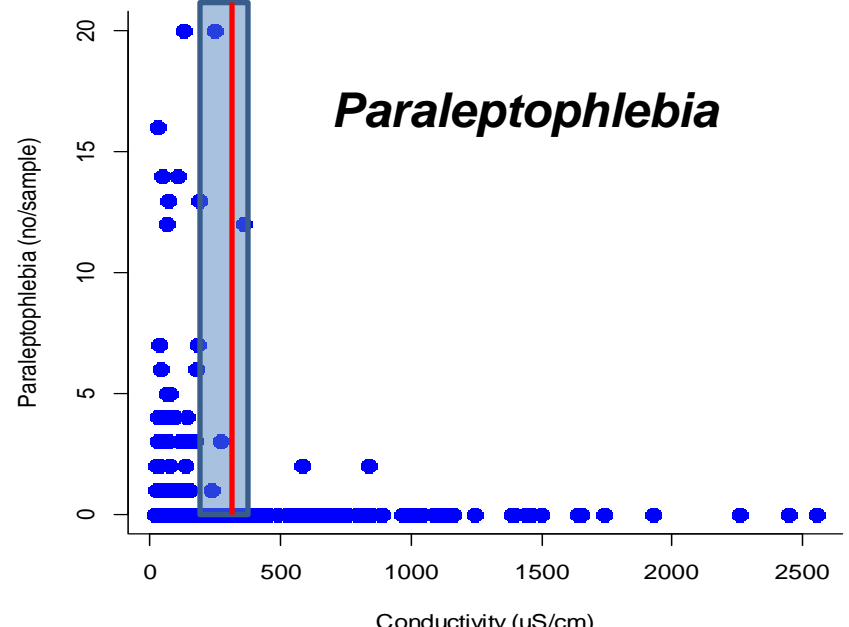
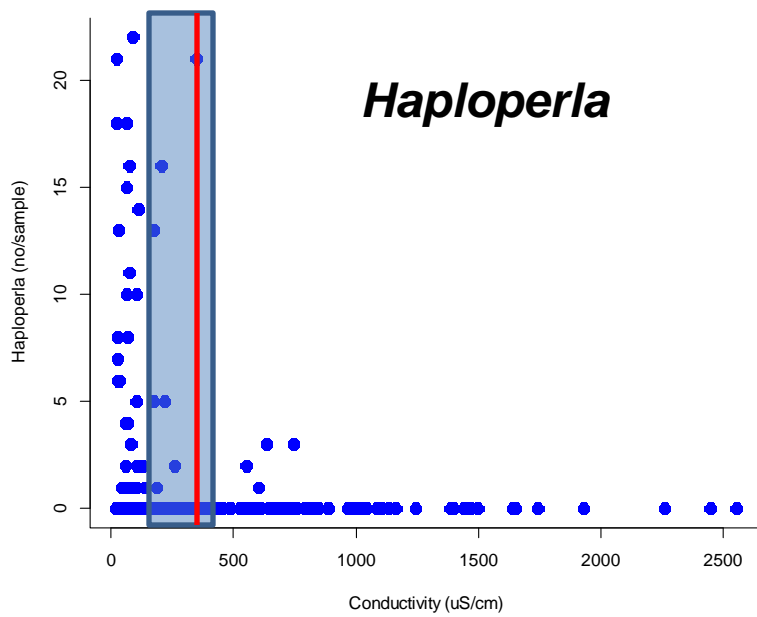


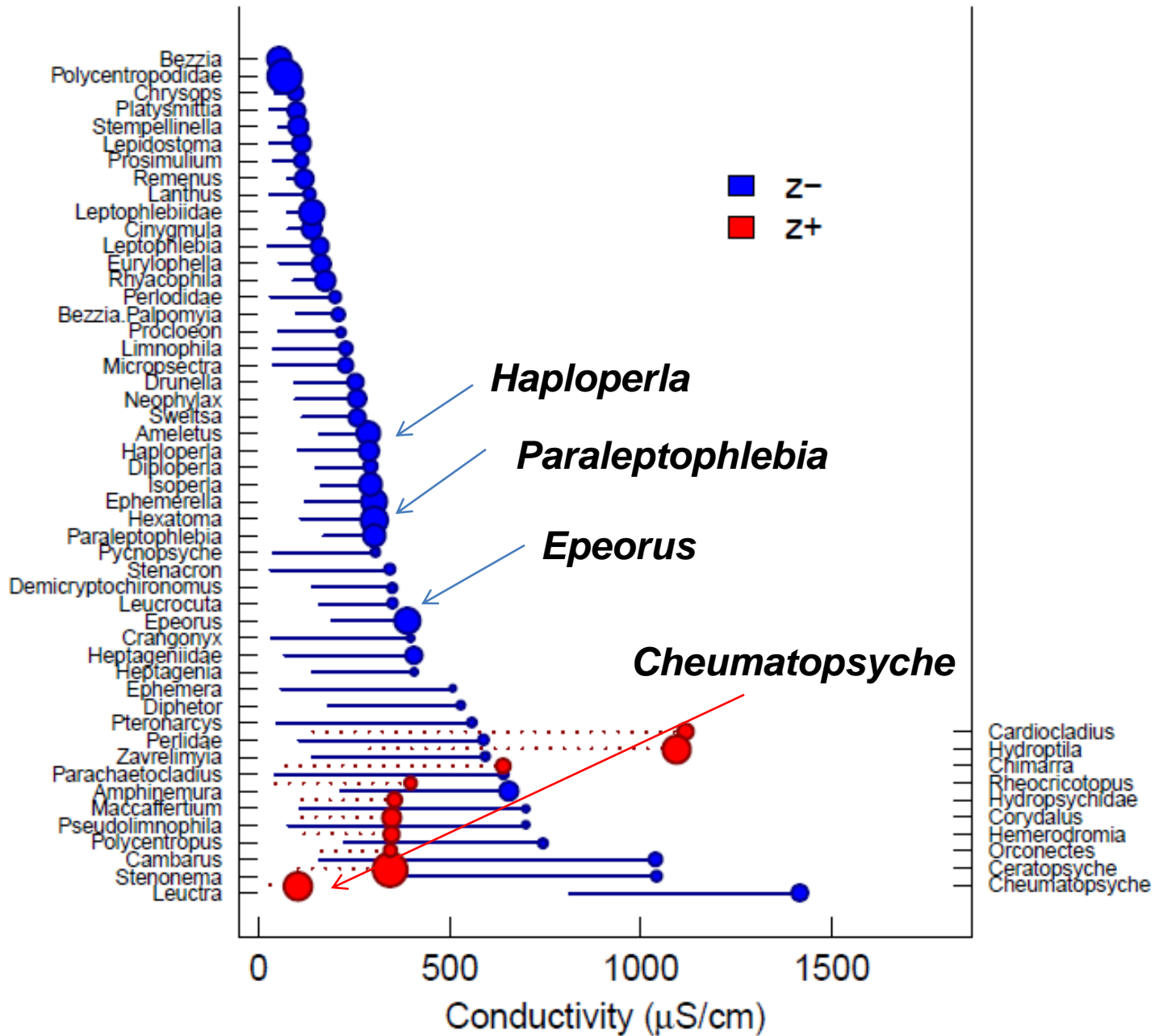


These are zeroes



Real data: IndVal max, CIs





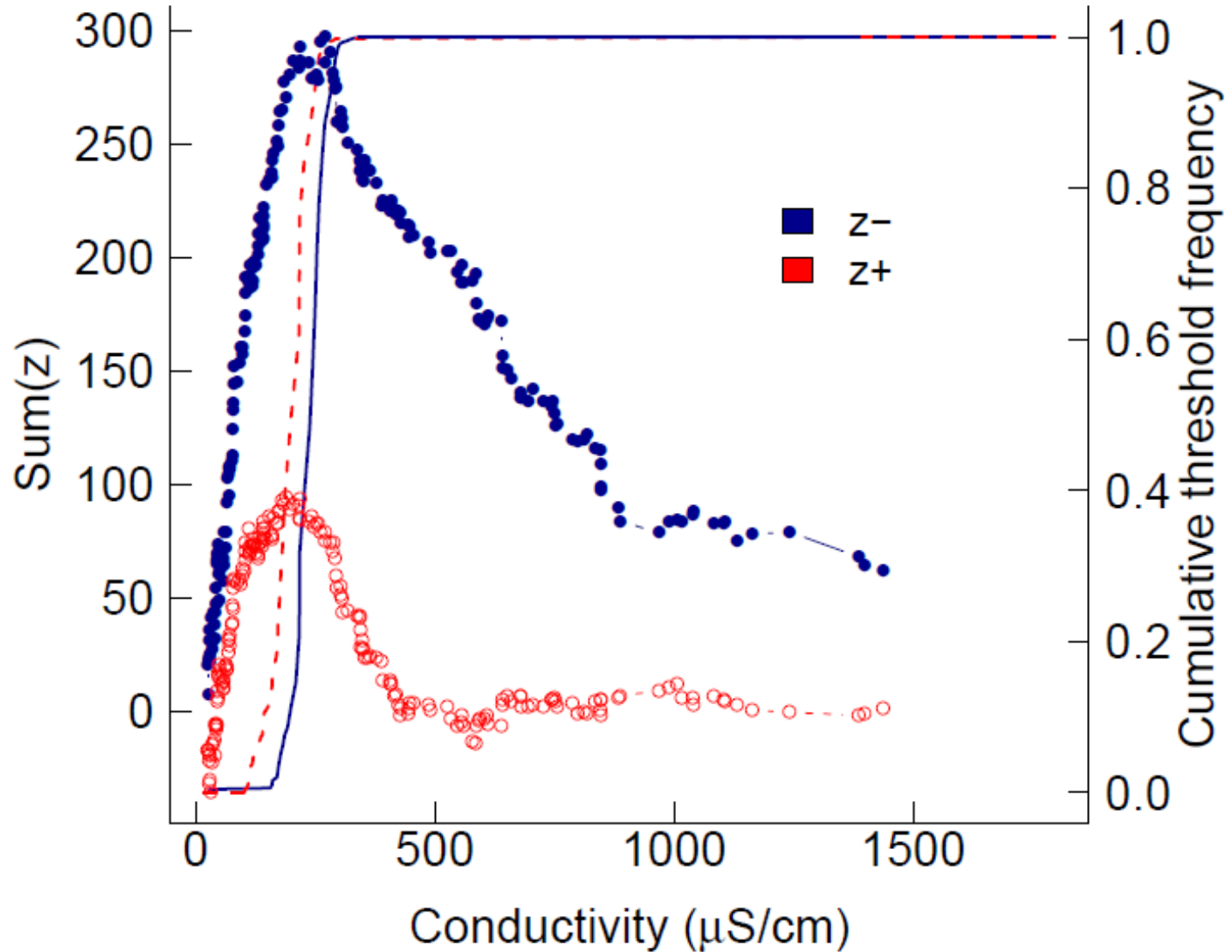
How do results compare to other studies?

Largest aggregate change in both increasing and decreasing taxa at **~300 $\mu\text{S}/\text{cm}$**

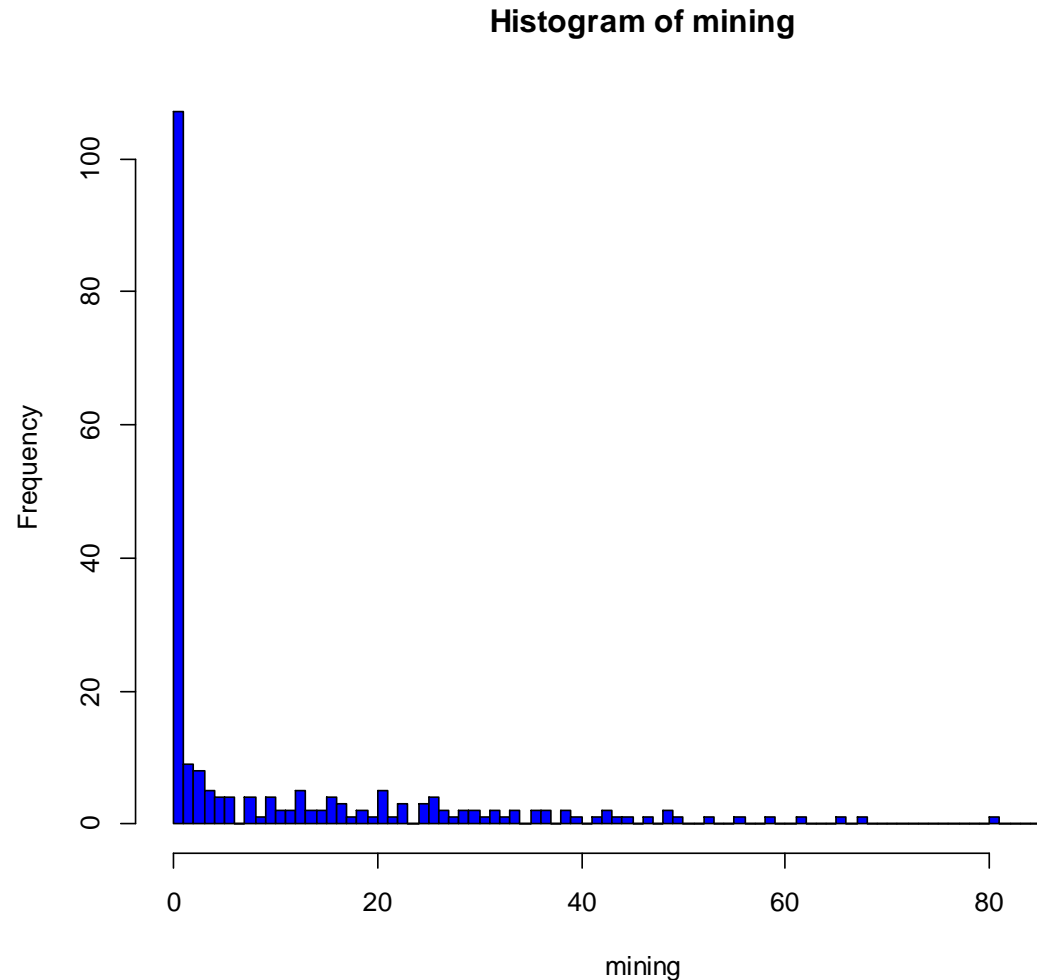
Happens to correspond to EPA Conductivity Benchmark (2011)

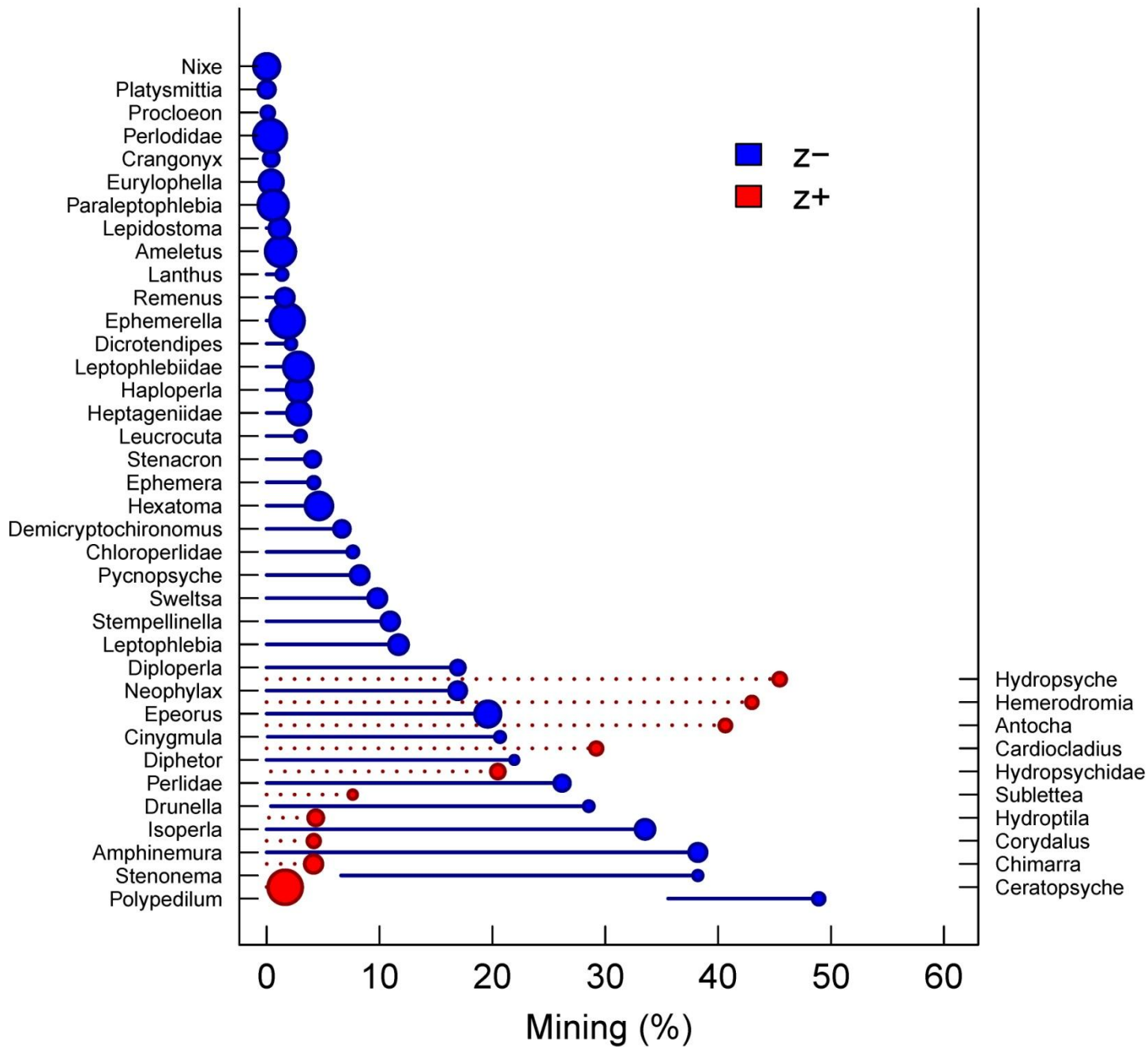
&

Where WVSCI and GLIMPSS (MMIs) scores are classified as impaired (Bernhardt et al. 2012)



- Skewed sample distribution
- *Any* method can be biased by skewed predictor values
- Suggestion: sensitivity analyses

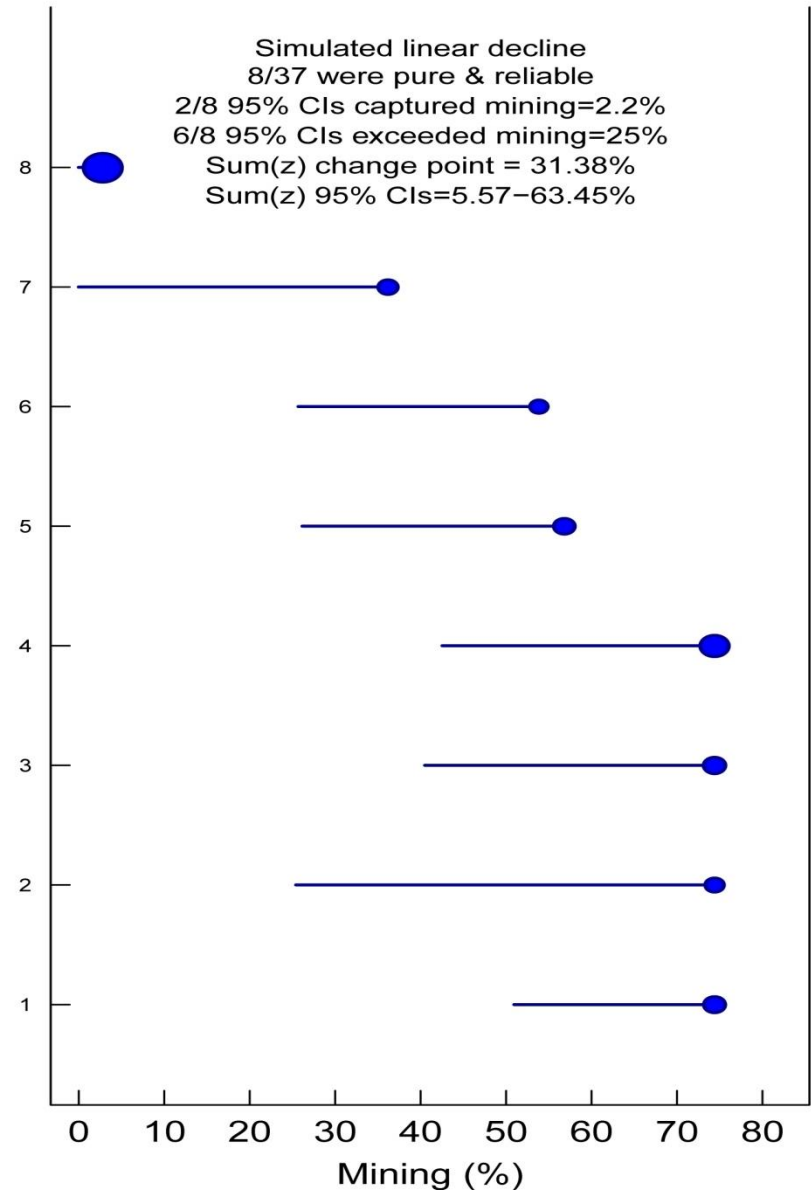




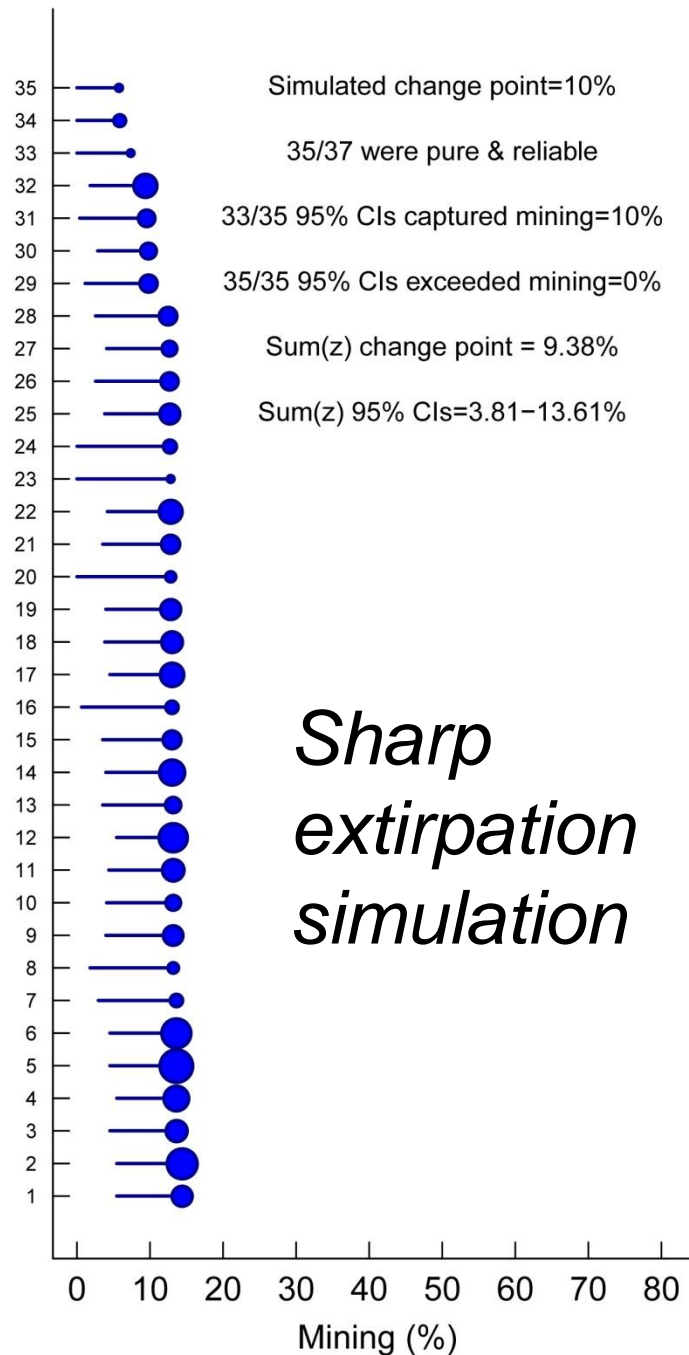
- Simulations:
 - Linear (mean=0 at max mining)
 - No response (random)
 - Extirpation at 10%
- 37 titan taxa
- Negative binomial
- Real taxa means & overdispersion

Linear: 4-8 taxa/sim
 Only 1 taxon CIs overlapped
 real data
 Community cp=31-63% mining

Linear simulation



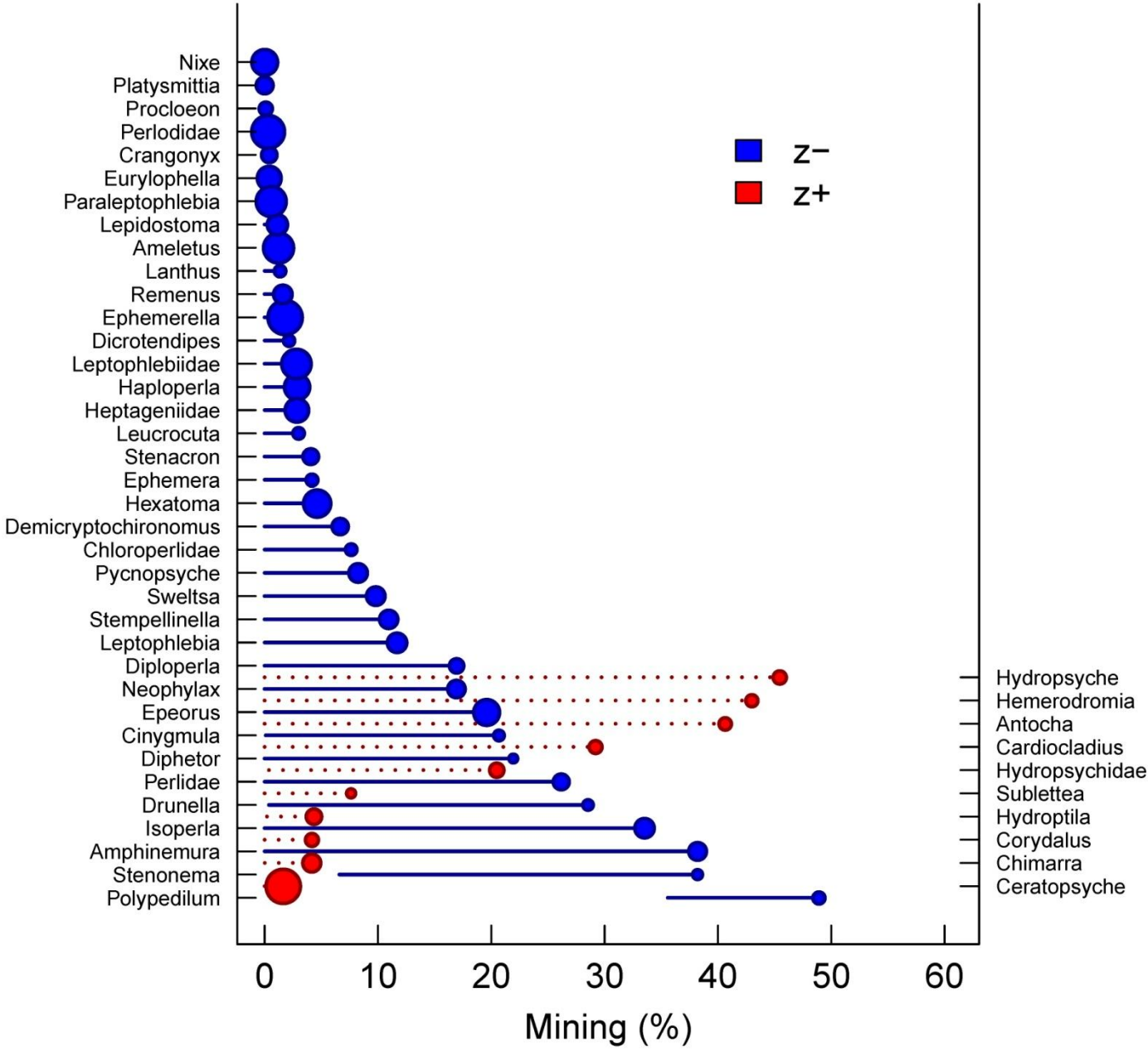
- Random:
 - No taxa pure/reliable
- Extirpation=10%
 - Average: 35 of 37 taxa
 - 33/35 CIs = 10%



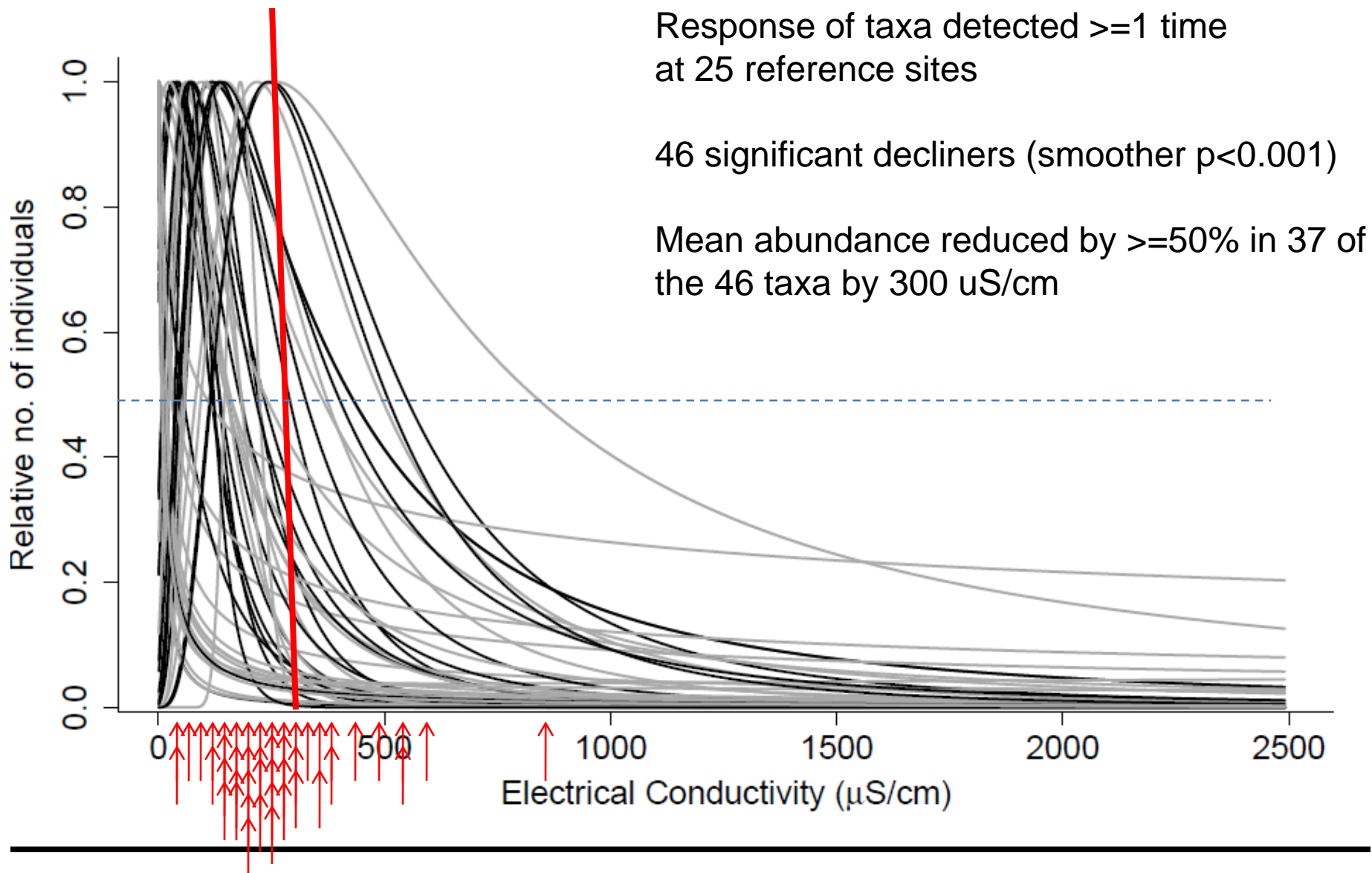
Mining vs conductivity indicator taxa?

34 of 37 mining decliners also declined with conductivity

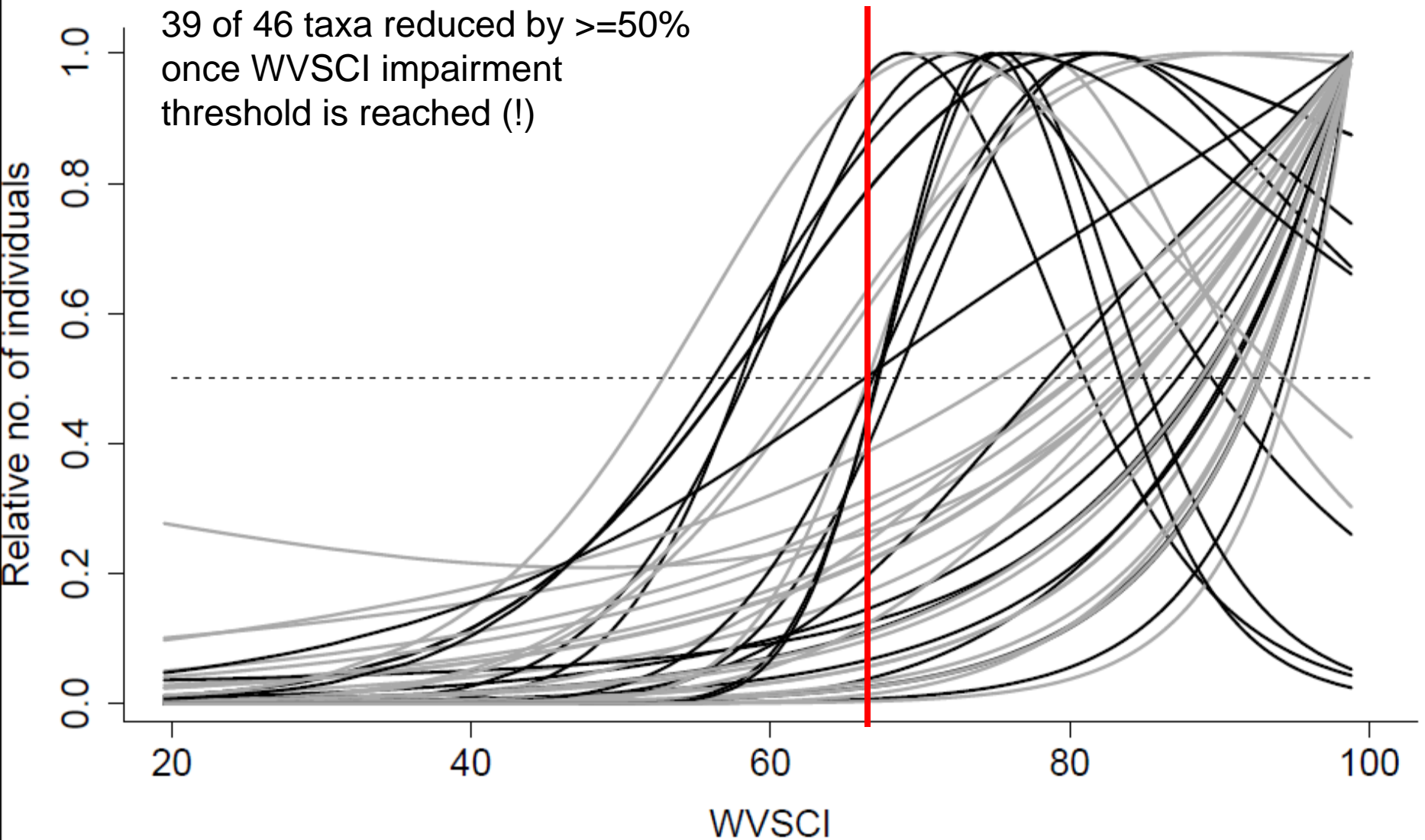
8 of 10 mining increasers also increased with conductivity



Further validation: compare to other models



Taxa response vs. MMI (WVSCI)

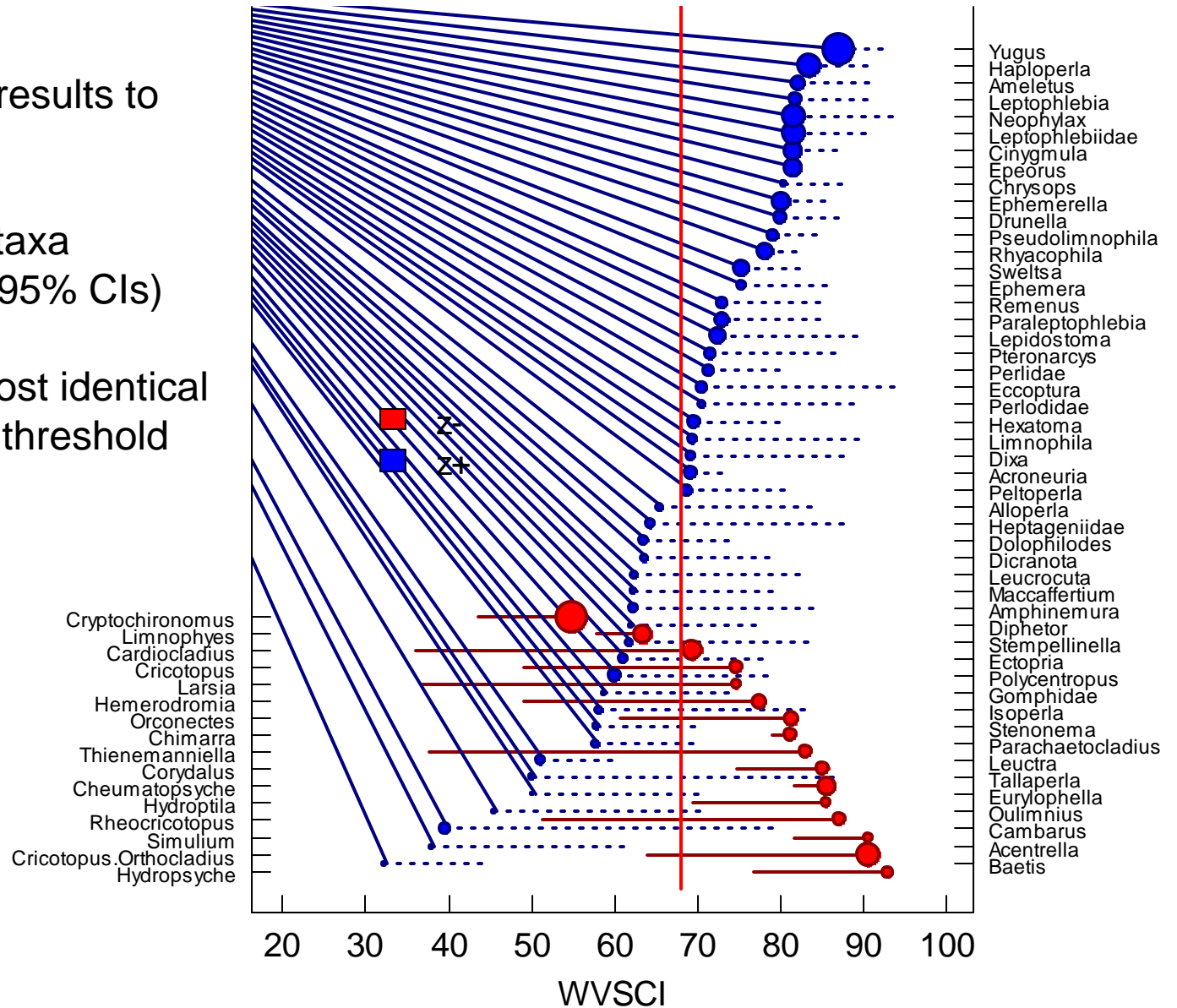


Taxa response vs. MMI (WVSCI)

TITAN yields similar results to negbin models.

Location of greatest taxa decline=69.9 (68-73 95% CIs)

TITAN threshold almost identical to numerical WVSCI threshold used by WV DEP



- TITAN / IndVal NOT APPROPRIATE for aggregate metric data or ANY type of data with near 100% nonzero values
- Multiple lines of evidence approach leads to stronger inference. Should *include* MMIs/metrics.
- Distinguishing which taxa respond and in which direction and at what level of env enhances understanding of community response to novel gradients. That is our goal, anyway.

- Baylor, UMBC departmental support
- Emily Bernhardt, Brian Lutz, John Fay (Duke U.)
- WV DEP

