

Taphonomic Biases on the Preservation of Within-Community Seed Size Distributions

Jason A. Cassara, GEOL 394H – 5/9/03
Advisors: Dr. Julio Friedmann and Dr. Hallie Sims

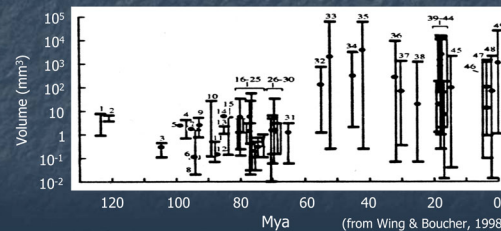
Abstract

Seed size distributions from the fossil record have been used by paleobotanists for paleoclimatological and paleoecological interpretation and reconstruction. However, the fidelity of the seed size distribution of a fossil assemblage to that of its source community had not been tested. Taphonomic filters such as transport, predation, biodegradation, abundance, and sampling issues may selectively preserve or destroy seeds on the basis of size, thus causing the seed size distribution of a fossil assemblage to differ from that of the living community represented by this assemblage. The study presented here is a live-dead study in which I have compared the seed size distributions of a potential fossil assemblage and the living plant community that it represents. The potential fossil (or "death") assemblage consists of 44 seed taxa/morphotypes extracted from sediment cores collected in a tidal estuary, and the life assemblage consists of 41 seed plant species currently living in the water and on the hillside adjacent to the location of the sediment cores.

The results of this study show no statistically significant difference between the seed size distributions of the life and death assemblages. Although similar tests remain to be conducted in different depositional settings, it appears that taphonomic filters affecting seed size distributions are not strong and that the use of seed size distributions from fossil assemblages in paleoecological and paleoclimatological interpretation and reconstruction is not without merit.

Background

Paleobotanists have used seed size distributions from fossil assemblages to interpret changes in ecosystem structure over geological time.



Problems

- Are seed size distributions from fossil assemblages accurate representations of the local flora that produced them?
- What are the taphonomic filters affecting seeds and seed size distributions in a fossil assemblage?

What is Taphonomy?

- Taphonomy is the Study of Burial and Fossilization
- One approach used by taphonomists is the live-dead study, in which a living assemblage is compared with its corresponding potential fossil assemblage

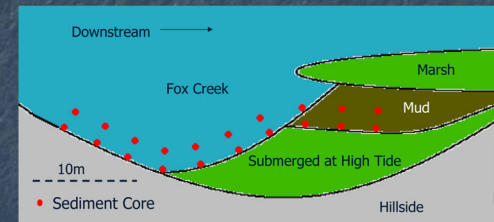
Potential Taphonomic Filters Affecting Seeds

- Seed Abundance
- Predation/Biodegradation
- Transport by Wind/Water
- Sampling Errors

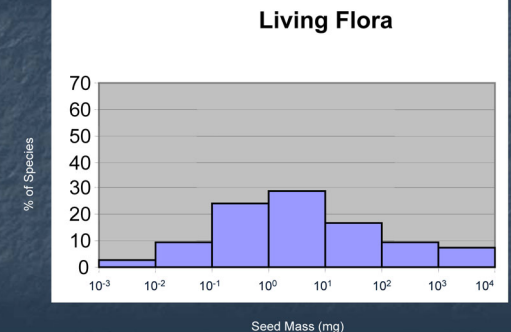
Approach

- Live-dead study conducted in a tidal estuary at Smithsonian Environmental Research Center (SERC), Edgewater, MD
- Death Assemblage
 - Seeds extracted from 20 sediment cores
- Life Assemblage
 - All seed plants on hillside adjacent to sediment cores
 - Subsets defined on basis of growth form of parent plant, location within study site and dispersal mode of seeds

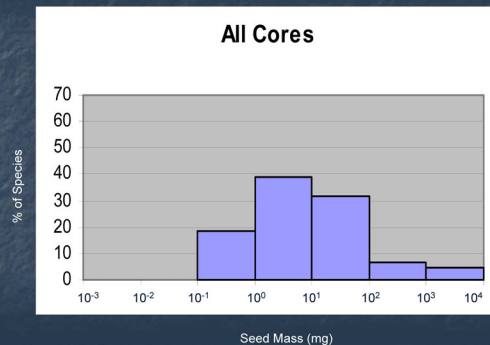
Sampling Regime



Seed Size Distributions



Seed Size Distributions



Results of Statistical Analyses

DISTRIBUTIONS COMPARED	TEST	# OF TIES	P-VALUE
Life assemblage, death assemblage (pooled data)	MWU	20	0.1259
Life assemblage, all 20 cores (A1-J1 and A2-J2)	KW	33	0.5728
All 20 cores (A1-J1 and A2-J2)	KW	31	0.9173
Transect 1 (A1-J1)	KW	25	0.7158
Transect 2 (A2-J2)	KW	25	0.8766
Western half (A1-E1 and A2-E2)	KW	21	0.8336
Eastern half (F1-J1 and F2-J2)	KW	24	0.9738
Pooled western half (A1-E1 and A2-E2), pooled eastern half (F1-J1 and F2-J2)	MWU	27	0.9129
Herbs/graminoids, shrubs/vines, trees	KW	0	< 0.0001
Hillside, Marginal/Overhanging, Aquatic	KW	19	0.0401
Biotic, Abiotic	MWU	0	< 0.0001
Death assemblage (pooled data), Hillside	MWU	18	0.7879
Death assemblage (pooled data), Marginal/Overhanging	MWU	11	0.3049
Death assemblage (pooled data), Aquatic	MWU	4	0.0004
Death assemblage (pooled data), herbs/graminoids	MWU	6	< 0.0001
Death assemblage (pooled data), shrubs/vines	MWU	3	0.0340
Death assemblage (pooled data), trees	MWU	10	0.0006
Death assemblage (pooled data), biotic	MWU	10	0.0197
Death assemblage (pooled data), abiotic	MWU	10	< 0.0001

MWU = Mann-Whitney U-test; KW = Kruskal-Wallis Test

Discussion of Results

- P-values < 0.05 show a significant difference between the distributions compared.
- P-values > 0.05 show no significant difference.
- There is no significant difference between the life and death assemblages (P = 0.1259)

Conclusions

- Seed size distributions from fossil assemblages in tidal estuarine deposits can be considered representative of the local floras that produced them.
- Interpretations based on such assemblages are not invalidated by this study.
- Future work needs to be performed in other depositional settings in order to verify the utility of fossil seed size distributions in general.