

Integration of Paleontology - Key to Building Impact*

Martin B. Farley¹

Search and Discovery Article #70087 (2010)

Posted November 22, 2010

*Adapted from oral presentation at AAPG Convention, New Orleans, Louisiana, April 11-14, 2010

¹University of North Carolina at Pembroke, Pembroke, NC (martin.farley@uncp.edu)

Abstract

Paleontology builds on a broad base of knowledge and technology developed in industry and academia. The field has challenges that must be addressed in integrating aspects of the discipline and marketing our technologies to the broader community to continue to be effective. Industry has contributed to utility by synthesizing data from multiple fossil groups, emphasizing geologic context, pioneering new approaches from sequence stratigraphy to well biosteering, and analyzing numerous sections in high sedimentation rate basins. Academia has emphasized biological effects on fossils in space and time, built integrative databases, provided high quality sections from land and Ocean Drilling Program, and pioneered stable isotope and multivariate analyses. Academic work has built on the sequence stratigraphic base of industry by modeling effects of sequence architecture on fossil occurrence and estimating statistical uncertainty for biostratigraphy. Environmental micropaleontology, such as the late Holocene of the Gulf of Mexico “dead zone,” brings tools developed for deeper time to bear on shallow time to the benefit of larger society.

Integration of all recoverable fossil groups with the larger context is the key to effective use of fossils. Industry has been better situated to integrate multiple groups, but data acquisition from consultants can allow fragmentation in industry to persist. Limits that must be addressed are narrow links between academia and industry, continued specialty and society fragmentation, such intense industry focus on today’s question that technology development is neglected, and the small faculty population at graduate universities to produce future micropaleontologists. From its outset in 1978, North American Micropaleontology Section (NAMS) has acted to bring the disparate parts of micropaleontology together. This includes sessions at AAPG and research conferences on geologic applications of microfossils. These have brought together specialists in multiple fossils, training in new tools like CHRONOS, and showcased the best integrated paleontologic-geologic case studies. We need to market paleontology more effectively to the larger

scientific communities. I advocate “infiltration” by presenting paleontology’s utility in the meetings of these other communities. NAMS can aid this effort by forging better links with other paleontological societies and continue to provide a link for micropaleontologic and industry/academic endeavors.

References

Armentrout, J.M., 1991, Paleontologic constraints on depositional modelling; examples of integration of biostratigraphy and seismic stratigraphy, Gulf of Mexico, *in* P. Weimer and M.H. Link, (eds.) Seismic facies and sedimentary processes of submarine fans and turbidite systems: Springer-Verlag, Berlin, p. 137-170.

Sen Gupta, B.K., R.E. Turner, and N.N. Rabalais, 1996, Seasonal oxygen depletion in continental-shelf waters of Louisiana: historical record of benthic foraminifers: *Geology*, v. 24, p. 227-230.

Holland, S.M., 1995, The Stratigraphic Distribution of Fossils: *Paleobiology*, v. 21/1, p. 92-109.

Neal, J.T. and R.E. Myers, 1995, Salt dissolution sinkhole at the Weeks Island, Louisiana, stratigraphic petroleum reserve storage site: *Proceedings Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst*, v. 5, p. 61-65.

Integration of Paleontology— Key to Building Impact

Martin B. Farley

Dept. of Geology & Geography

University of North Carolina

at Pembroke

Roadmap

- What is Integration?
- What academia and industry bring to the party
- Think outside the bottle
- Challenges of the next generation
- Infiltration

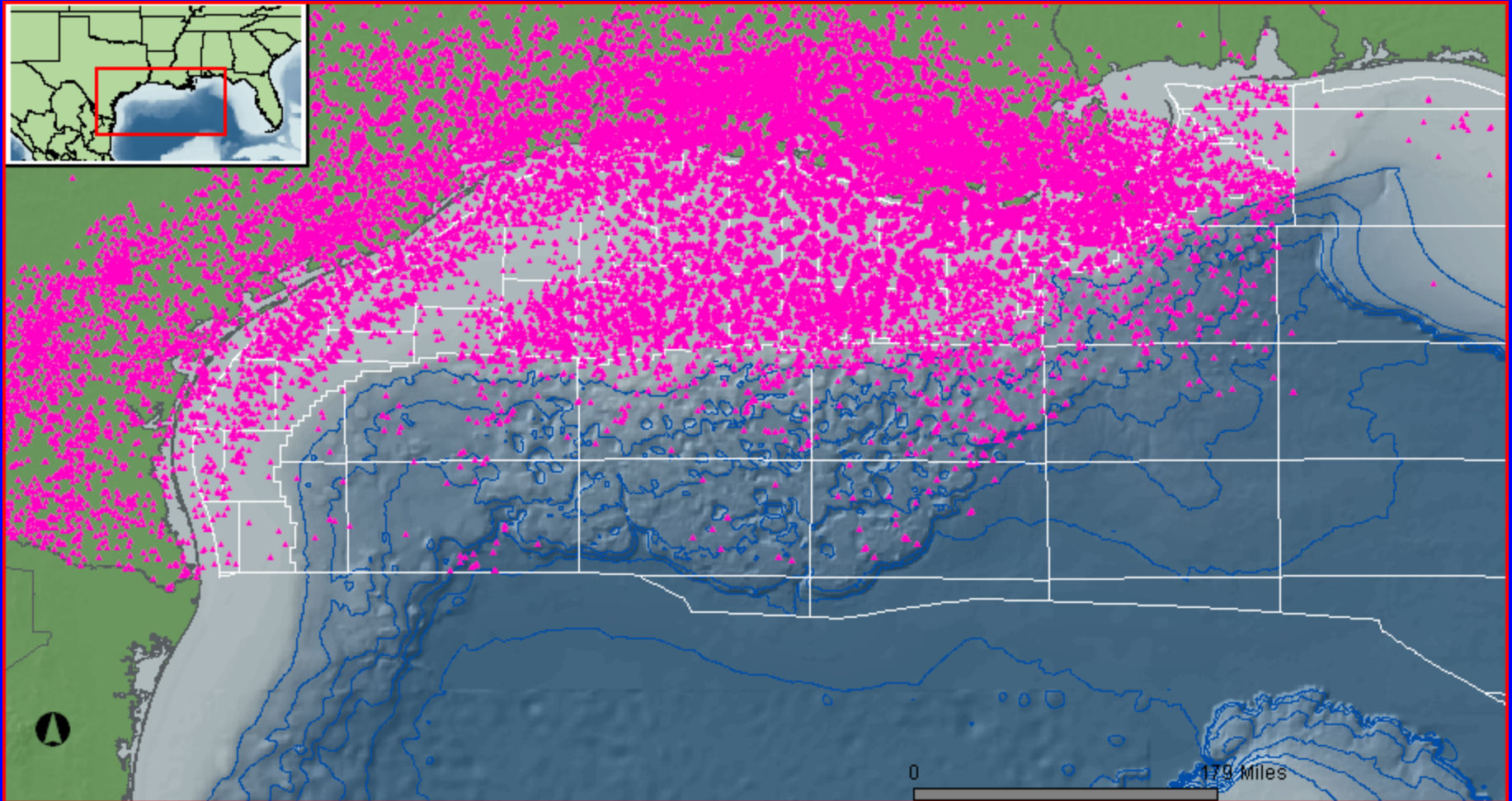
Integration Is

- Use of Multiple Fossil Groups
- Approaches Known Across all Paleontology
- Paleontology With Other Data (Geological or Biological)
- Societies, Meetings

Industry Contributions

- Well Density
- High Sedimentation Rates
- Fossil Group Integration
- Geologic Context

Gulf Basin Wells with Paleontology



Courtesy Roger Witmer and Tom Dignes, Chevron

High Potential Resolution

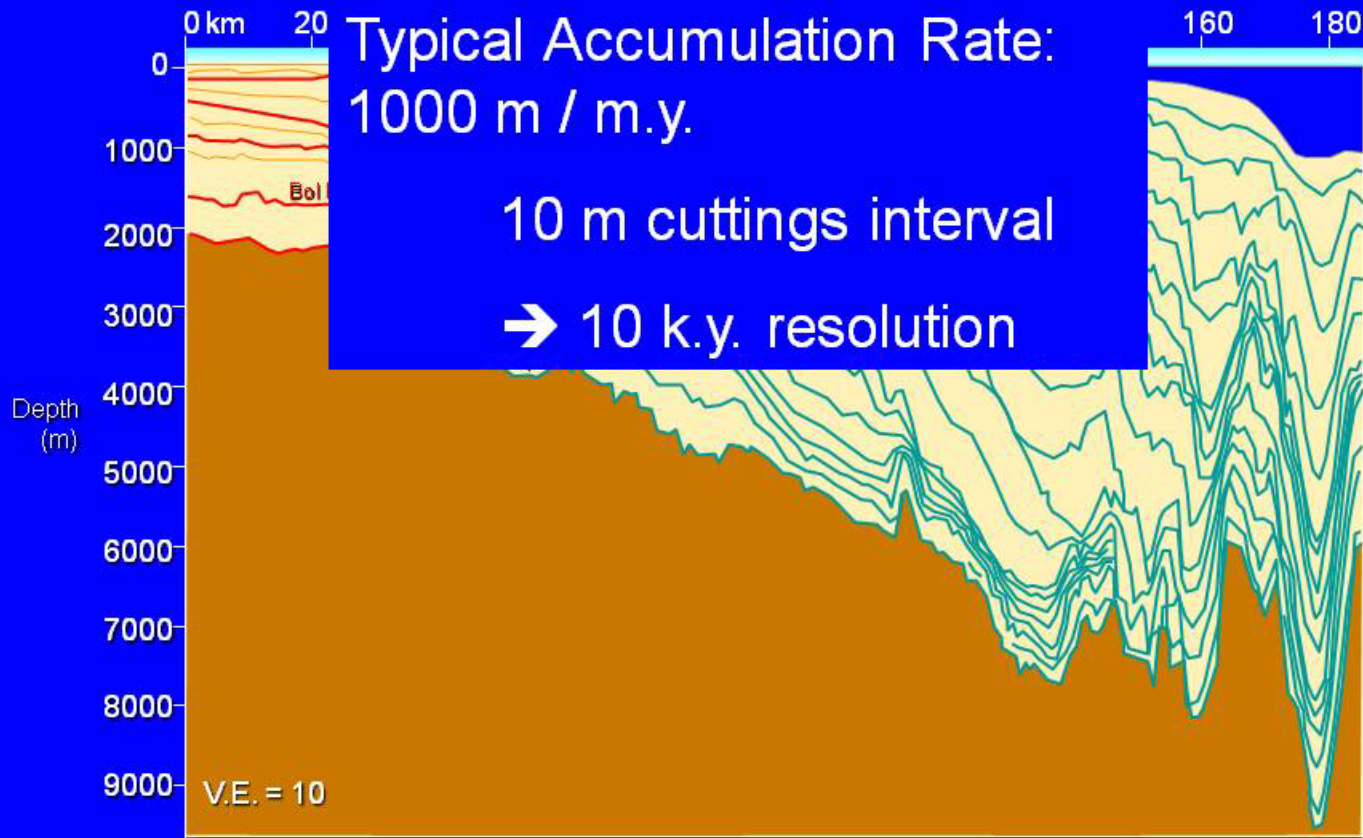
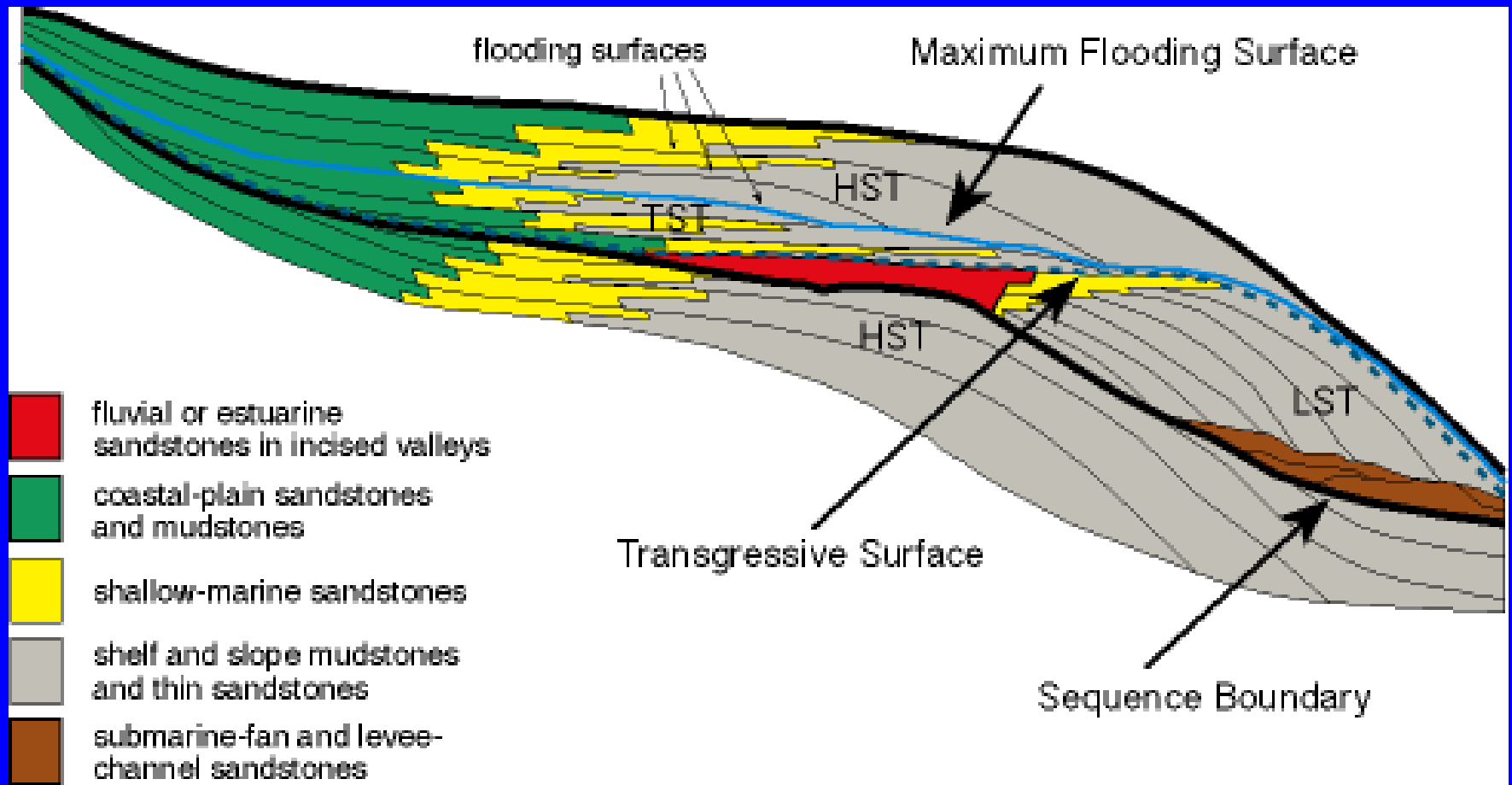


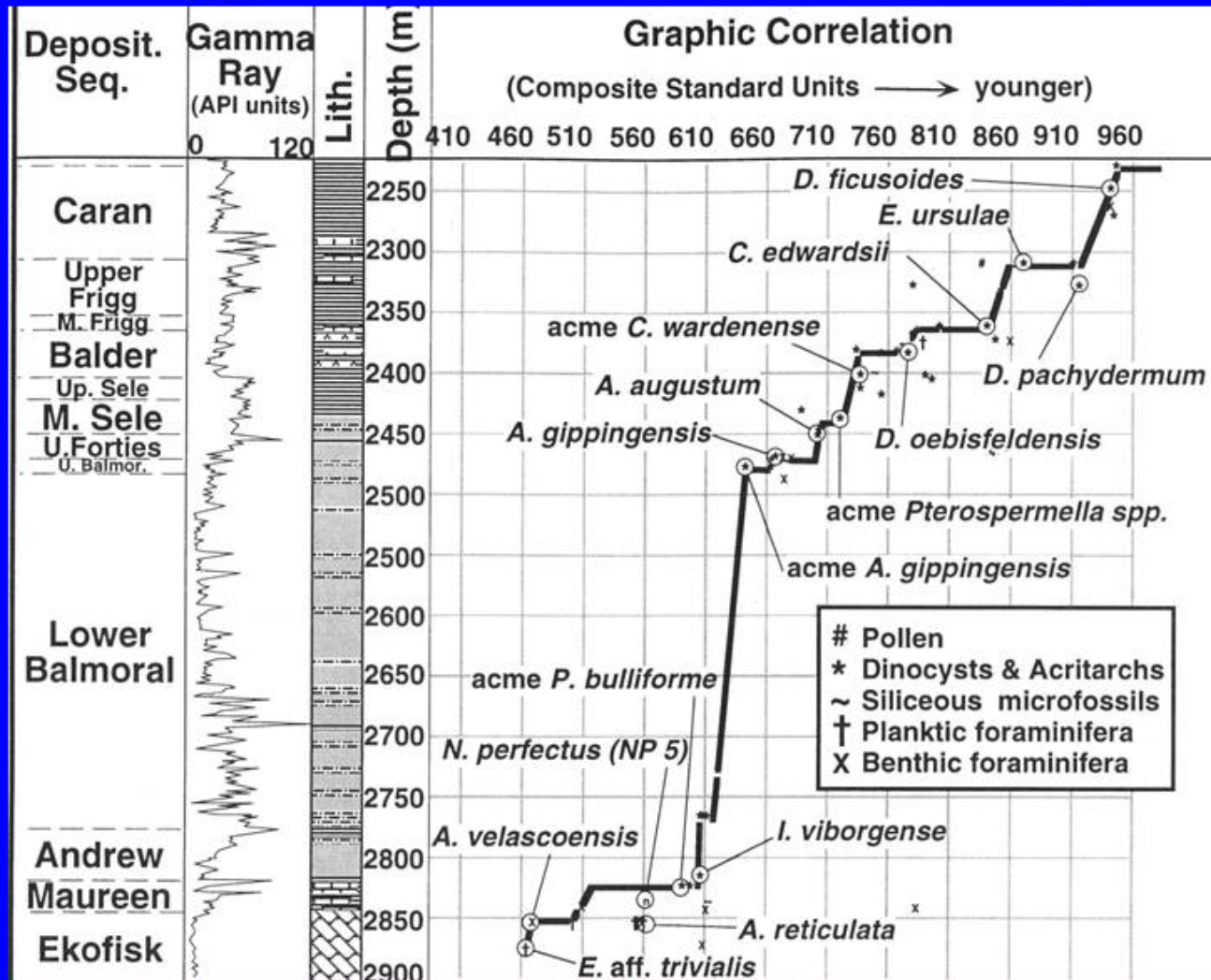
Figure from John M.
Armentrout, 1998

Notes by Presenter: This increased biostratigraphic resolution is illustrated on this schematic of a Gulf of Mexico offshore Texas seismic profile using Mobil's bioevent framework. The five updip benthic correlation horizons have been supplemented with the addition of basinward planktonic events, providing a three-fold increase in regional biostratigraphic resolution. Locally, additional events facilitate in-field correlation between the 22 illustrated bioevents.

Geologic Context



Integration of Fossil Groups



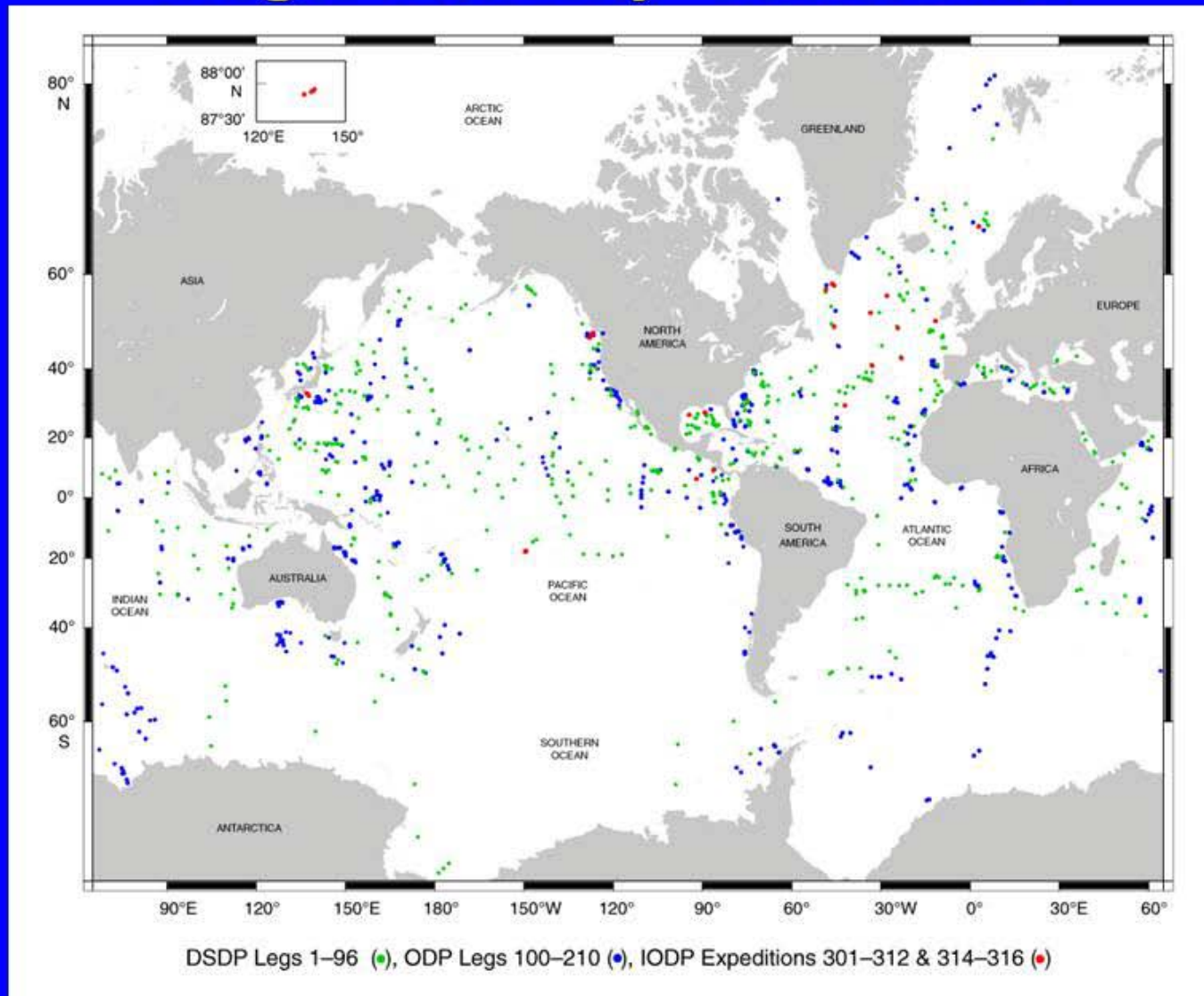
From Neal, et al. (1995)

Notes by Presenter: Jack Neal, et al graphic correlation with multiple fossil groups

Academic Contributions

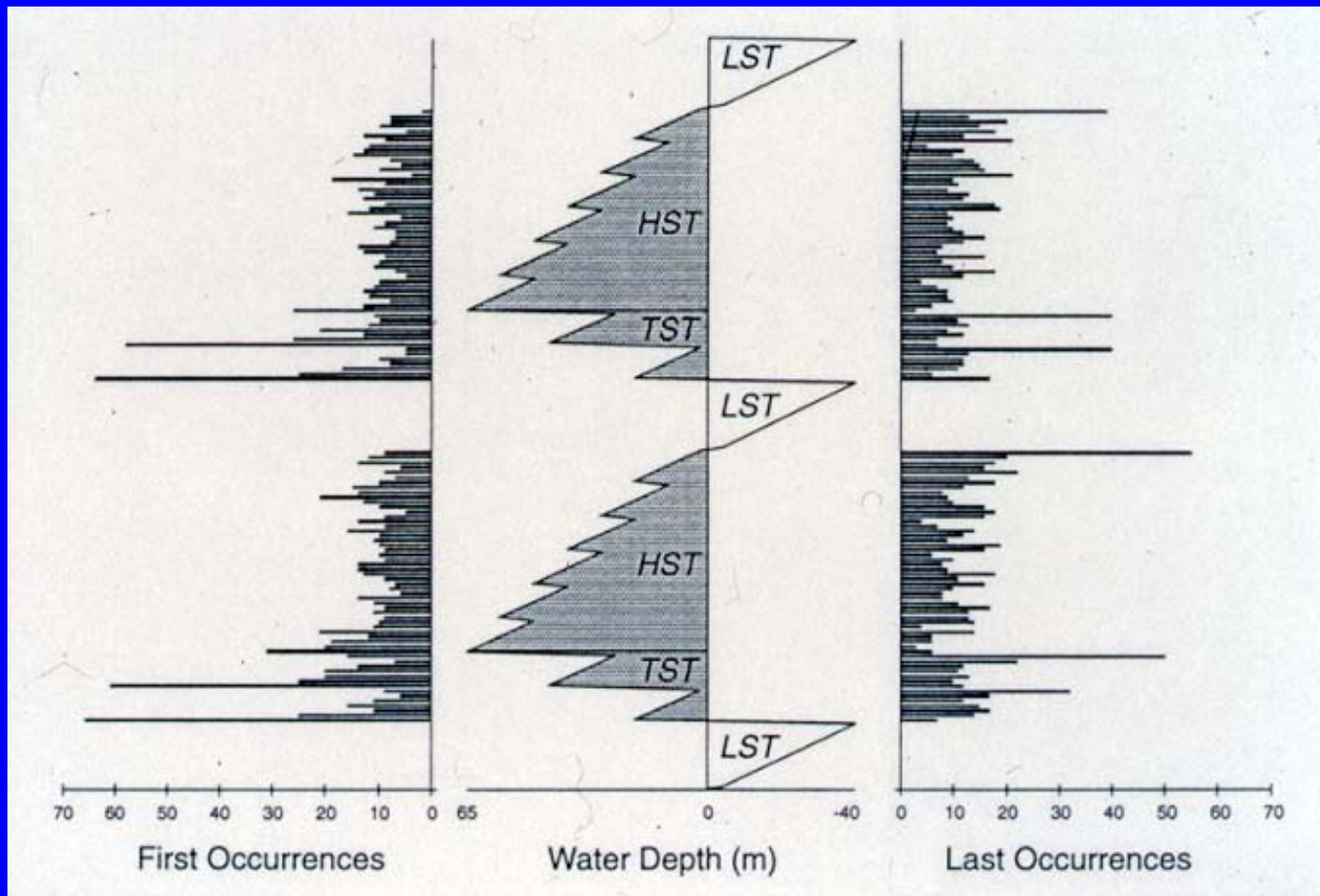
- High Quality Section (Outcrop/IODP)
- Models and Statistics
- Links to Biology
- CHRONOS and Data Interpretation

High Quality Sections



Notes by Presenter: Large number of cored holes with magnetostrat. Largely in low sedi rate settings.

Models and Statistics



From
Holland (1995)

Simulation of Sequence Effects on ranges
Confidence Limits

Notes by Presenter (for Previous slide):

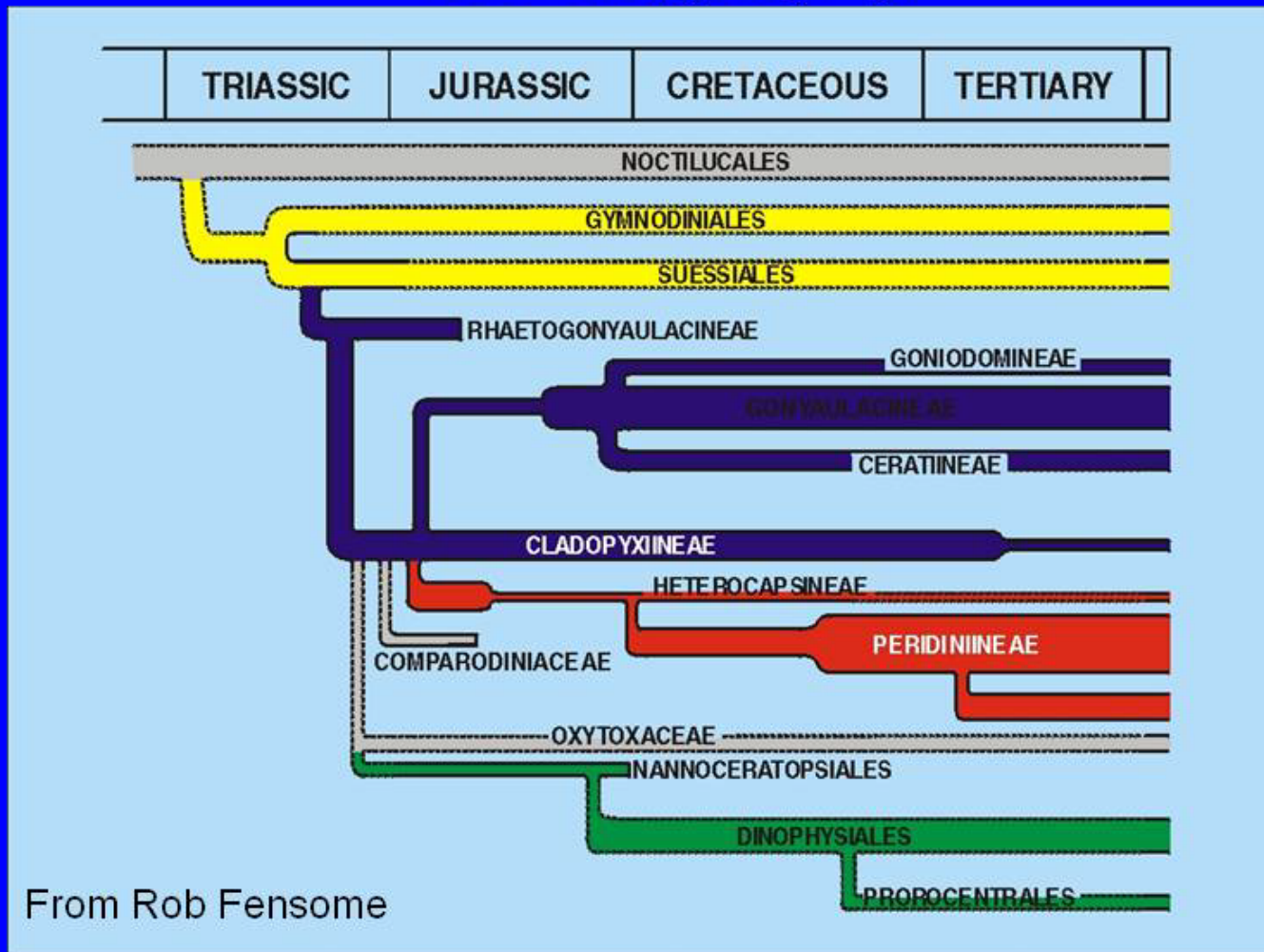
This simple model shows ranges concentrated in the “condensed section,” but since it is purely in the time domain, isn’t affected by the geology of the condensed section. This is important for advancing understanding of all the controls on ranges.

Other academic work on confidence limits on ranges, although using statistical models that may not apply to many real world settings, are addressing uncertainty in interpretation which is important.

Holland’s model is purely in the time domain and assumes no lateral transport, so many features of the condensed section don’t apply: abundant microfossil abundance created by sedimentation starvation, transport of pelagic ocean fossils into continental margins.

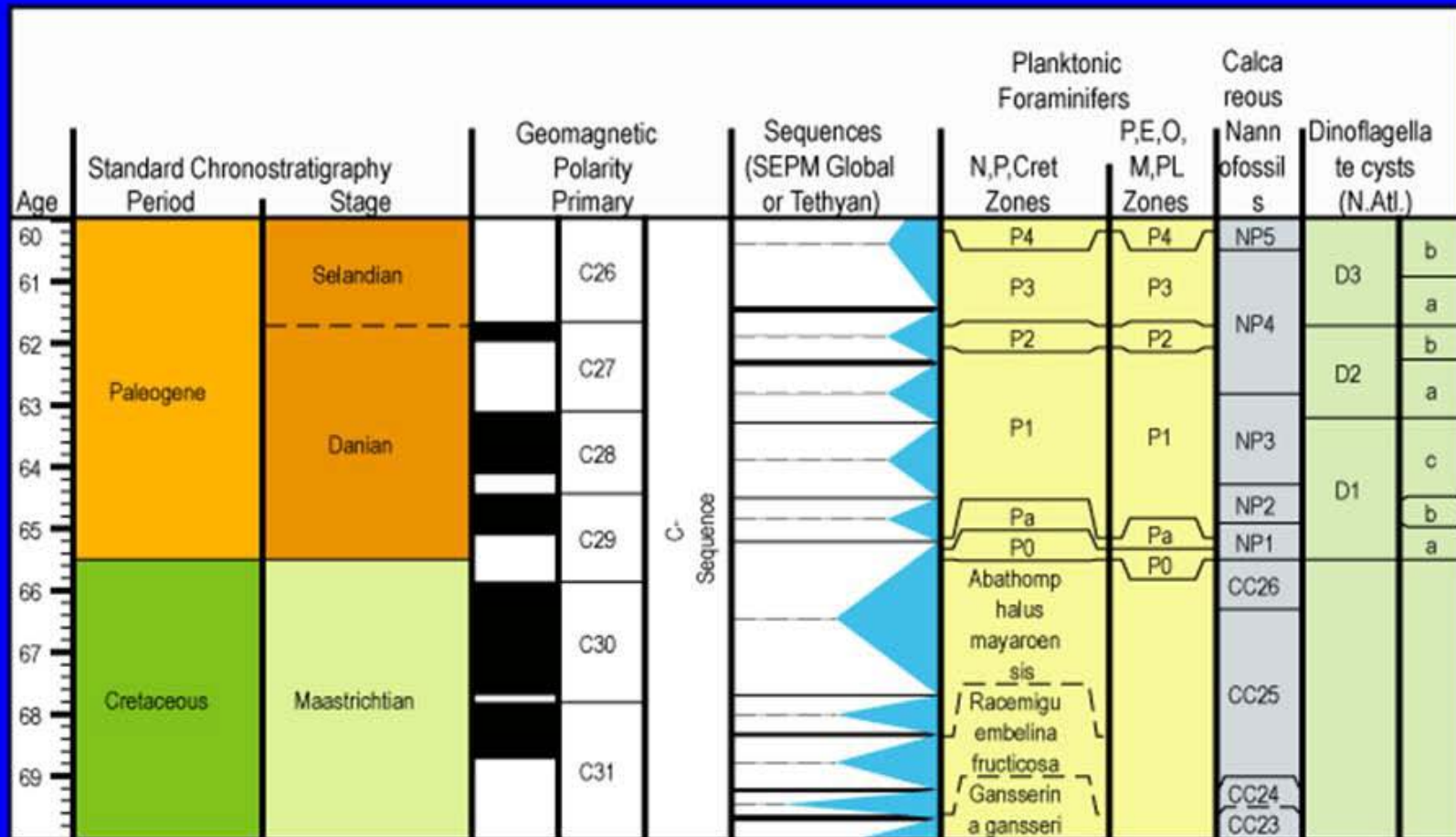
Also mention confidence limits on strat ranges.

Molecular Phylogeny meets Biostratigraphy



Notes by Presenter: Linking data from molecular systematics to age through paleontology. Testing the molecular clock (no one point extrapolations).

CHRONOS



Notes by Presenter: Database and Display: Standard Stratigraphic Framework

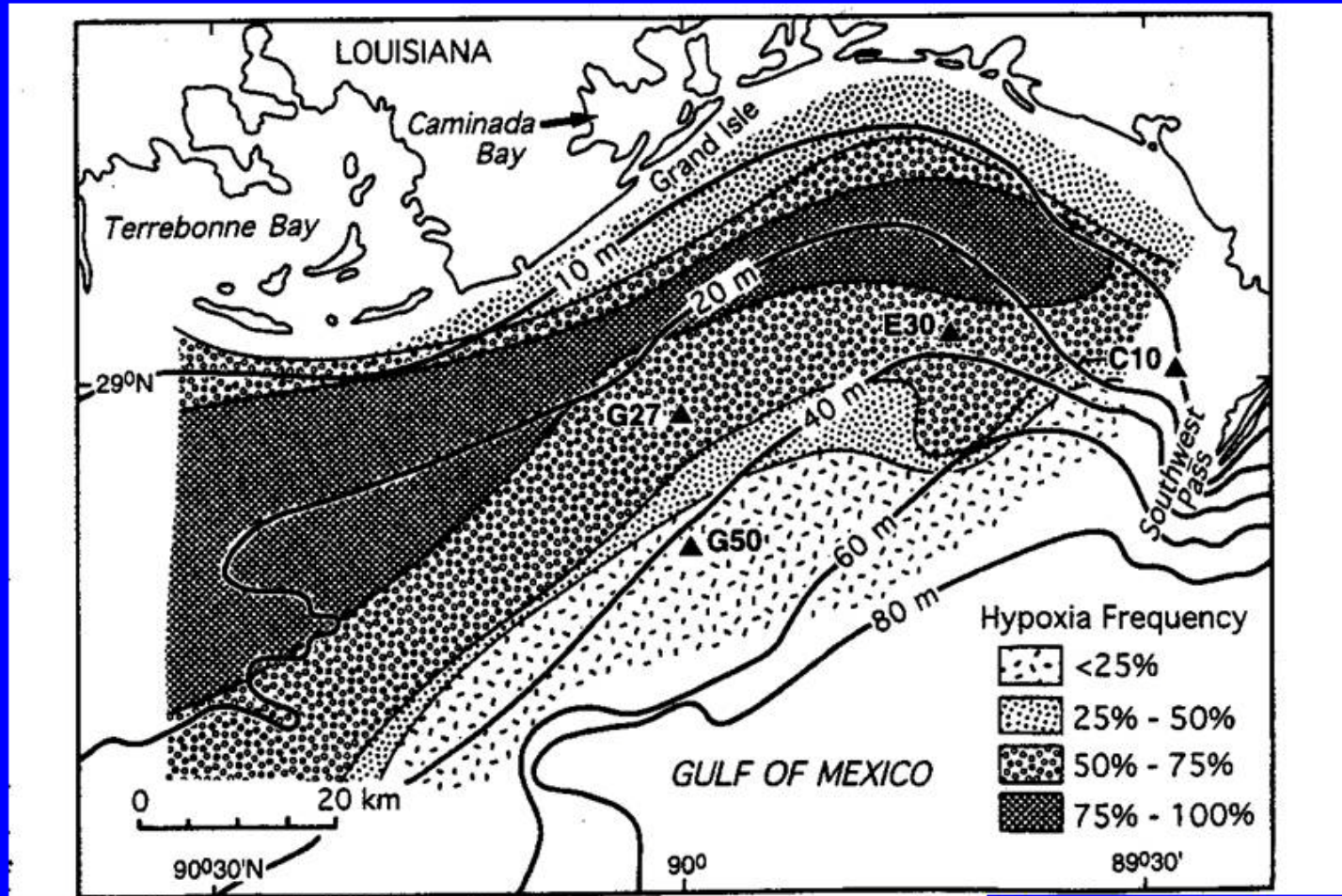


Thinking Outside The Bottle

- Environmental Micropaleontology
- USDA gets a life

Environmental Micropaleontology

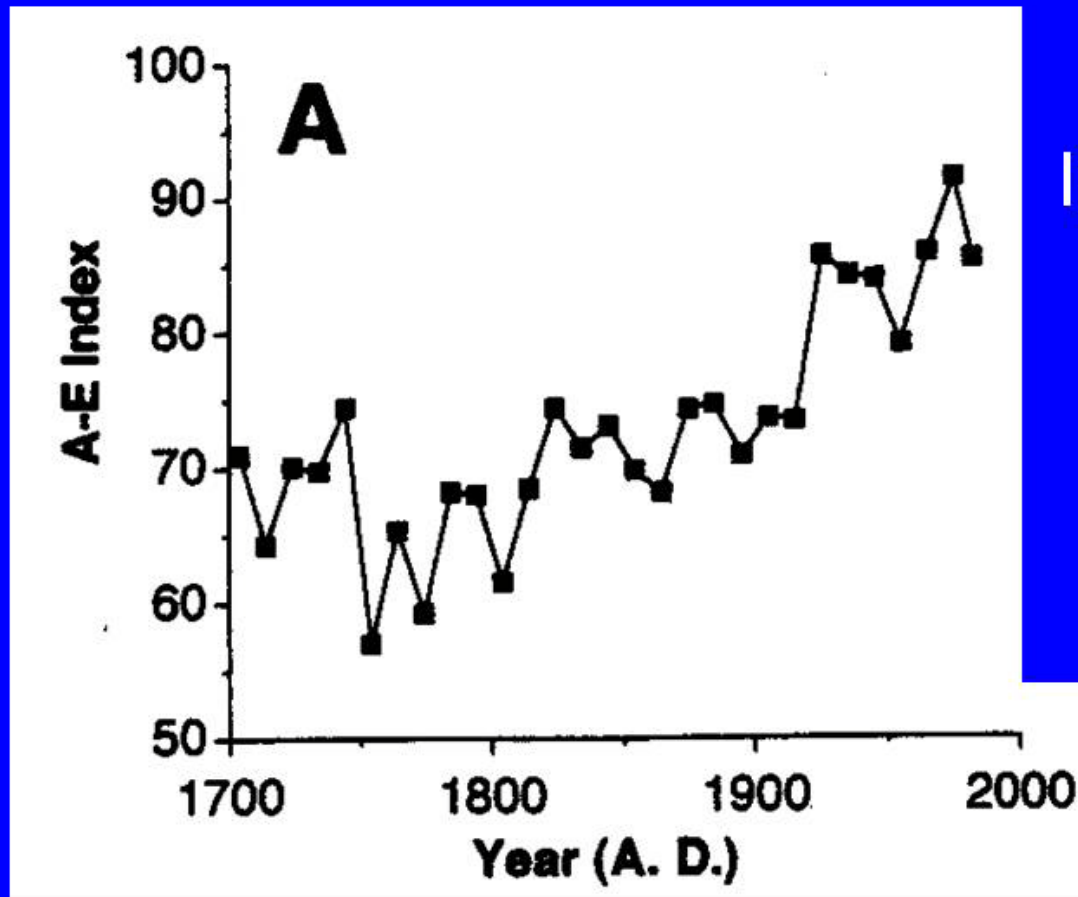
Gulf of Mexico "Dead Zone"



From Sen Gupta, et al. (1996)

Notes by Presenter: How long has anything you see today existed? Current low-oxygen bottom. Note Core G27 in center.

Ammonia-Elphidium, Core G27



Increasing Index

=>

Increasing
Hypoxia

From Sen Gupta, et al. (1996)

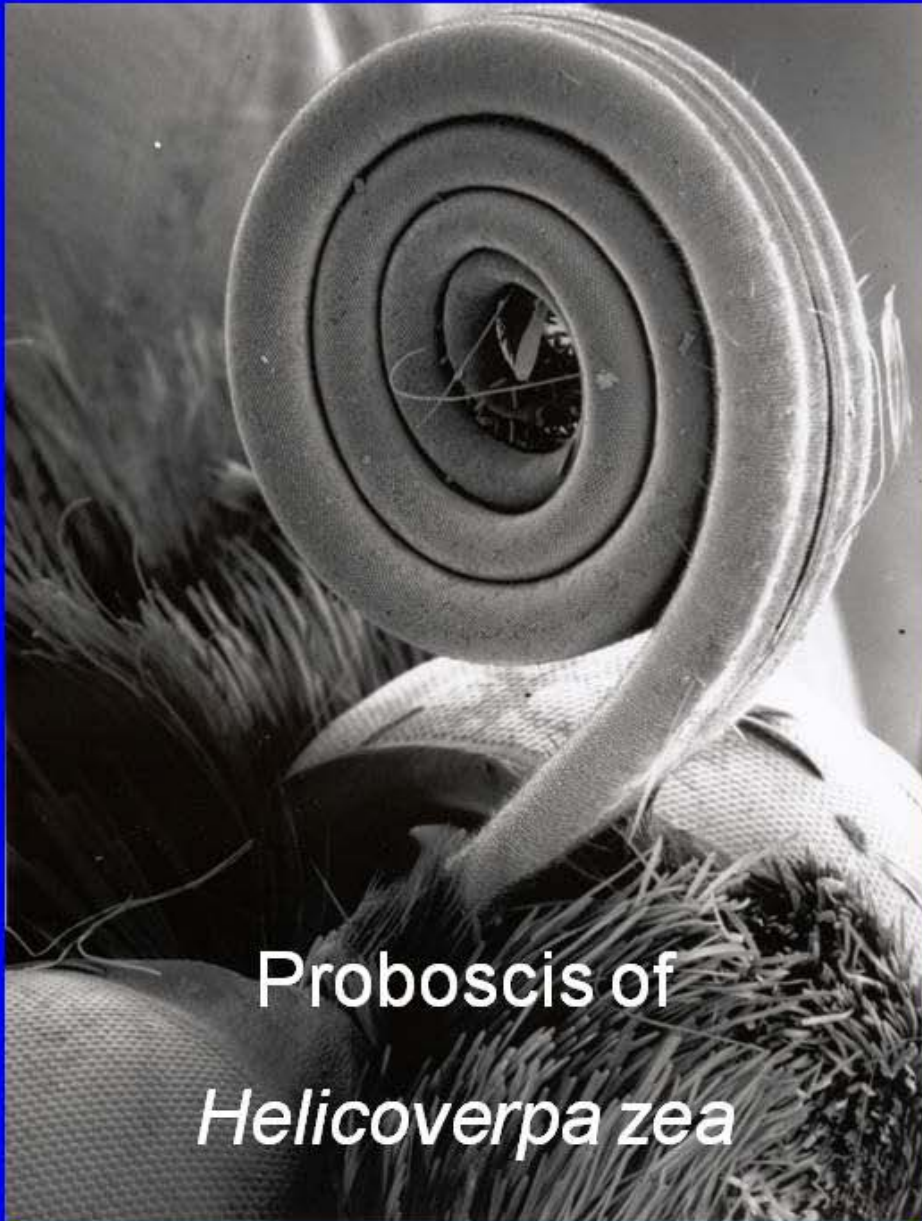
Notes by Presenter: So, the historical record shows the “dead zone” has existed for some time and is apparently getting more anoxic. Applying techniques of deep time to very shallow time

USDA Gets a Life (stage)

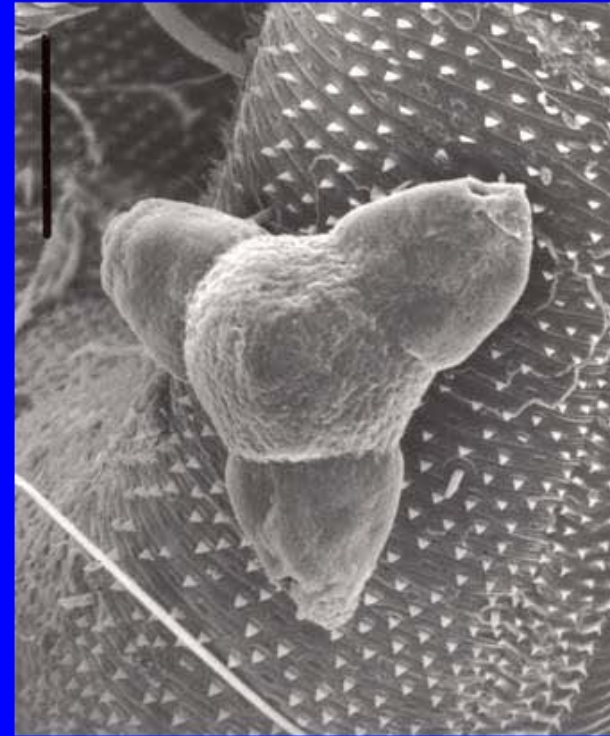
Palynology in
Integrated Pest Management

Corn Earworm (*Helicoverpa zea*)—
agricultural pest

What does it do when it grows up?



Proboscis of
Helicoverpa zea

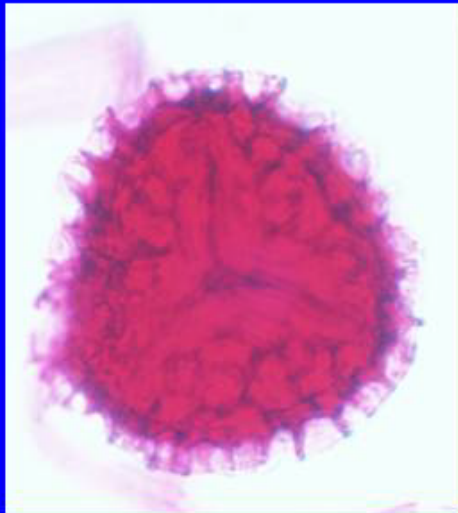


Gaura sp.
pollen

Images from Gretchen Jones



Track the Moth



	Moths	% with <i>Lycopodium</i>
Work Field	143	20
Hargill	148	22
Pheromone trap	92	11
La Gloria	62	2
Moore AFB	104	1
Uvalde	74	1

The Next Generation

“Without biostratigraphers, the effective application of biostratigraphy is not possible”

Recruitment and training of new micropaleontologists

Heightened extinction risk of small populations

Without users who understand
paleontologic data,
biostratigraphy won't work either

Will geology students learn more than
invertebrate paleo?

Gap: Teaching activities on “industry-
style” problems

Building the Case for our Value

What are our benefits

Promoting those benefits

Presentations and Publications

All can play a role

Present Ideas to Others in their arena

Notes by Presenter: Society meaning other paleontologists, industry, broader society, government. People won't pay attention to us just because they ought to. To be blunt, beat the others over the head with what you can do. All MUST play a role. Publications are only permanent record; industry can't leave this entirely up to academia

Infiltration

Unfamiliar Sessions, Familiar Meetings

Unfamiliar Meetings

Opportunities may come to you

Get Ideas from Others

The Challenges

Integrating multiple groups within a project

Communicating What We Can Do

Across the Whole Field

Beyond Paleontology

Integration

- Address Problems with Multiple Fossil Groups
- Unite Paleontology
- Paleontology With Geology or Biology
- Promote our value through infiltration, regular meetings, and publication