The Cretaceous World - TCN

Bruce S. Lieberman

Biodiversity Institute and Department of Ecology & Evolutionary Biology, University of Kansas


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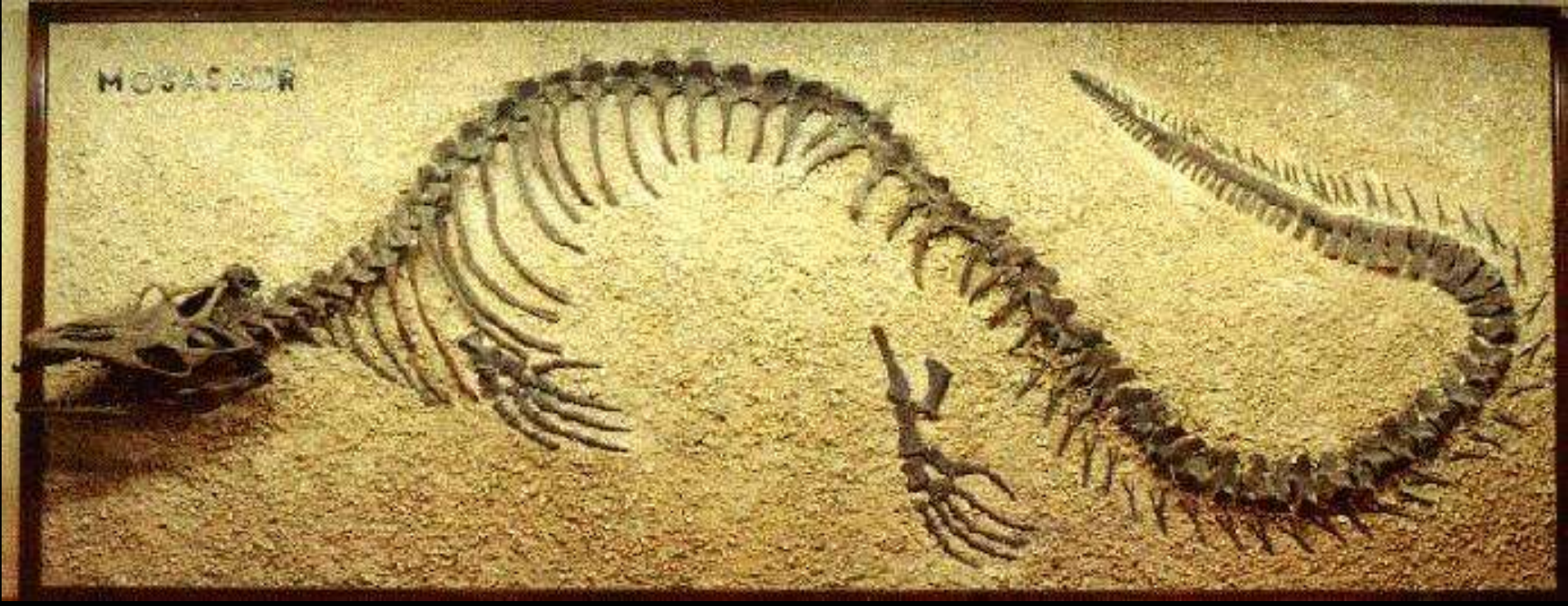
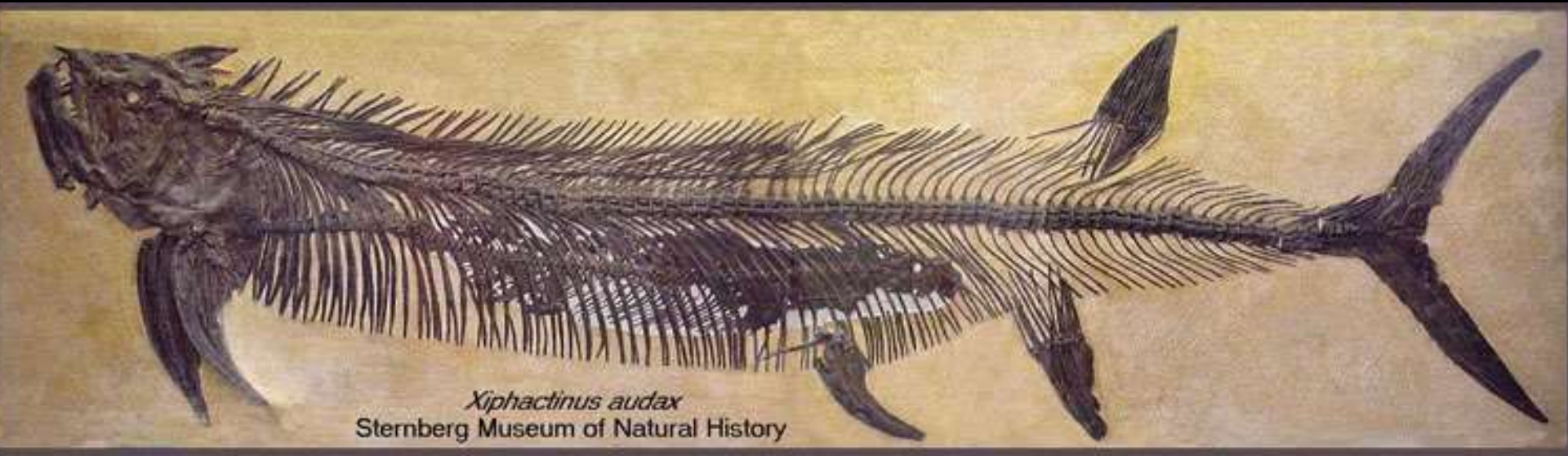
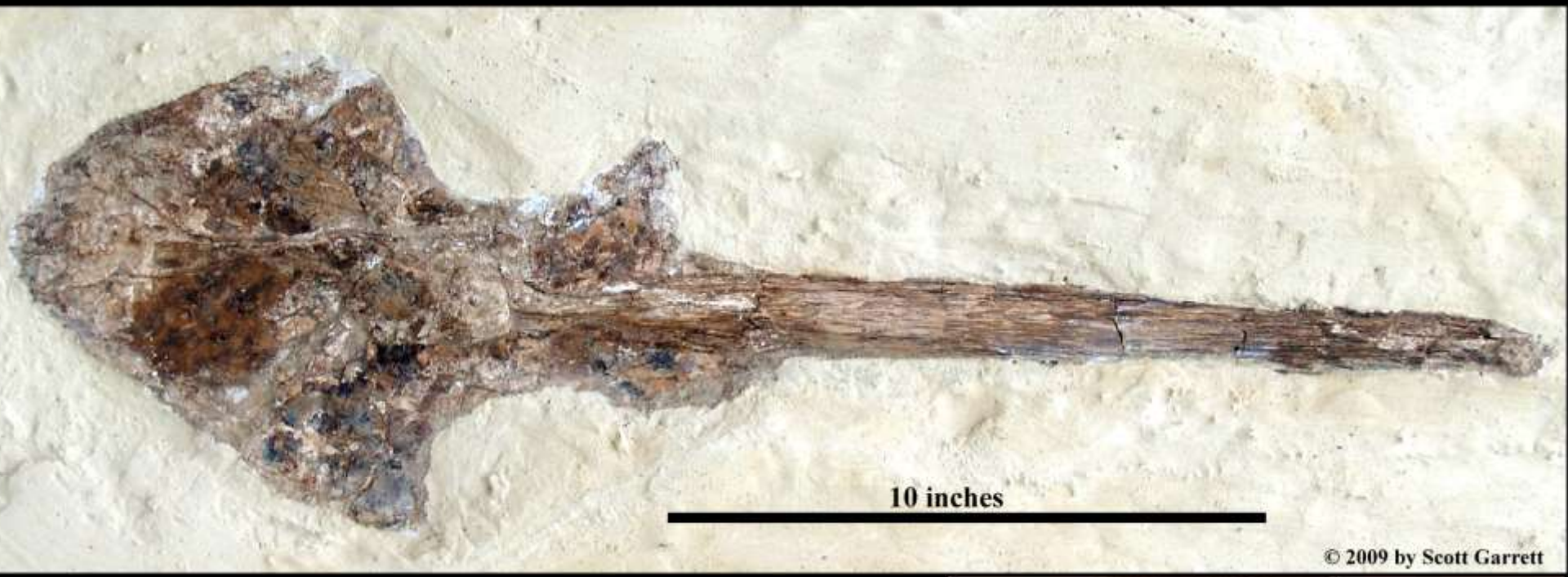
The Cretaceous World - TCN


MOSASAUR


Xiphactinus audax
Sternberg Museum of Natural History


Pteranodon



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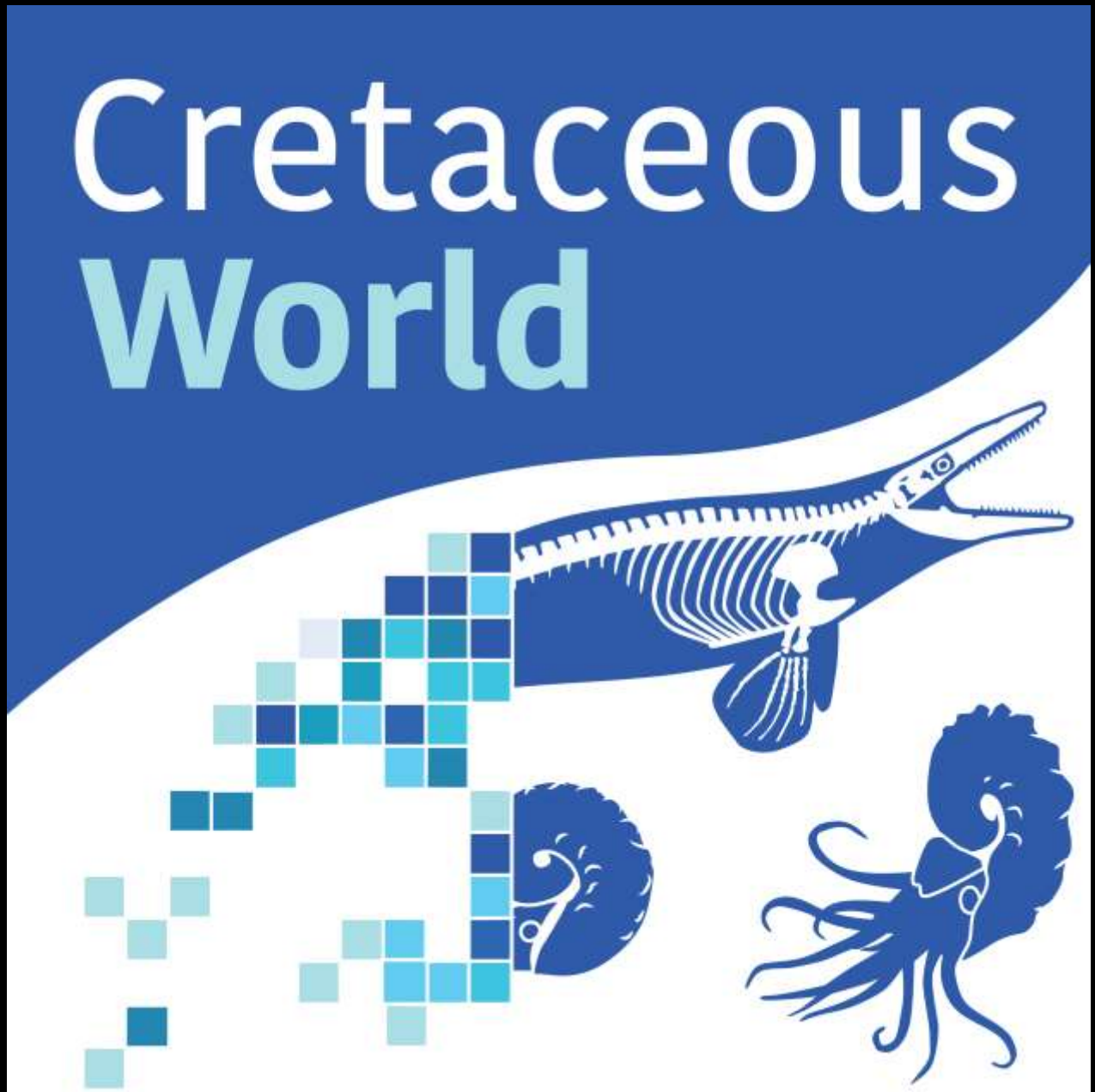
The Cretaceous World - TCN



Cretaceous World – TCN: Participants and Institutions

University of Kansas – Bruce S. Lieberman, Julien Kimmig, Chris Beard & Jim Beach

Paleontological Research Institution – Jonathan Hendricks

American Museum of Natural History – Neil Landman & Ruth O'Leary

University of Texas– Ann Molineux, Rowan Martindale, Lisa Boucher & Matt Brown

Cretaceous World – TCN: Participants and Institutions, cont.

Yale University Peabody Museum of Natural History – Susan Butts & Chris Norris

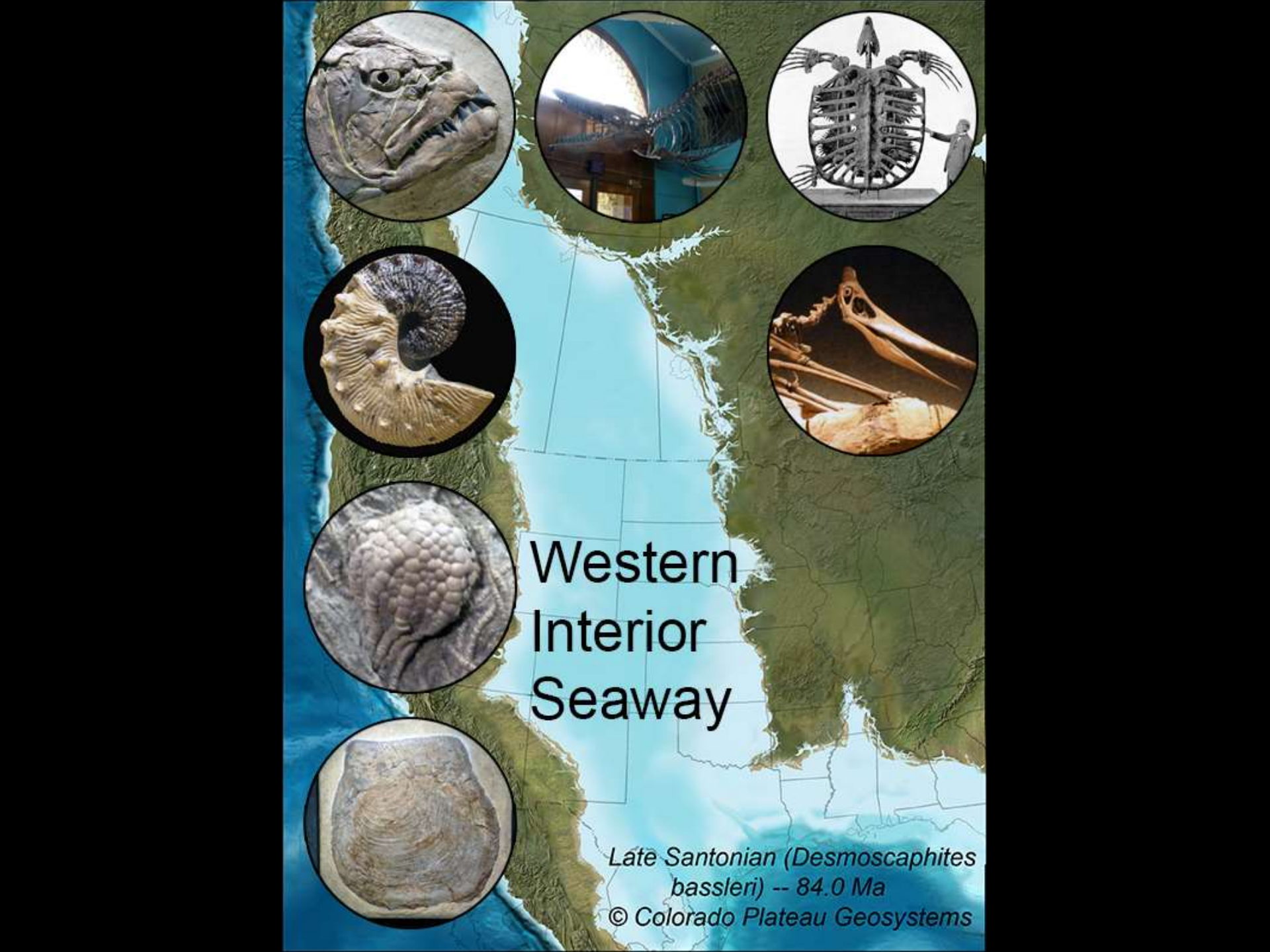
University of Colorado – Talia Karim

South Dakota School of Mines & Technology – Laurie Anderson & Maribeth Price

University of New Mexico – Corinne Myers

Sternberg Musem / Fort Hays State University – Laura Wilson

And PEN at *University of Oklahoma* – Steve Westrop & Roger Burkhalter


Western
Interior
Seaway
Late Santonian (Desmoscaphites bassleri) -- 84.0 Ma
© Colorado Plateau Geosystems

Cretaceous World – TCN: Data

> 175,000 specimens databased

> 12,250 fossil localities georeferenced

> 8,250 images of fossil specimens

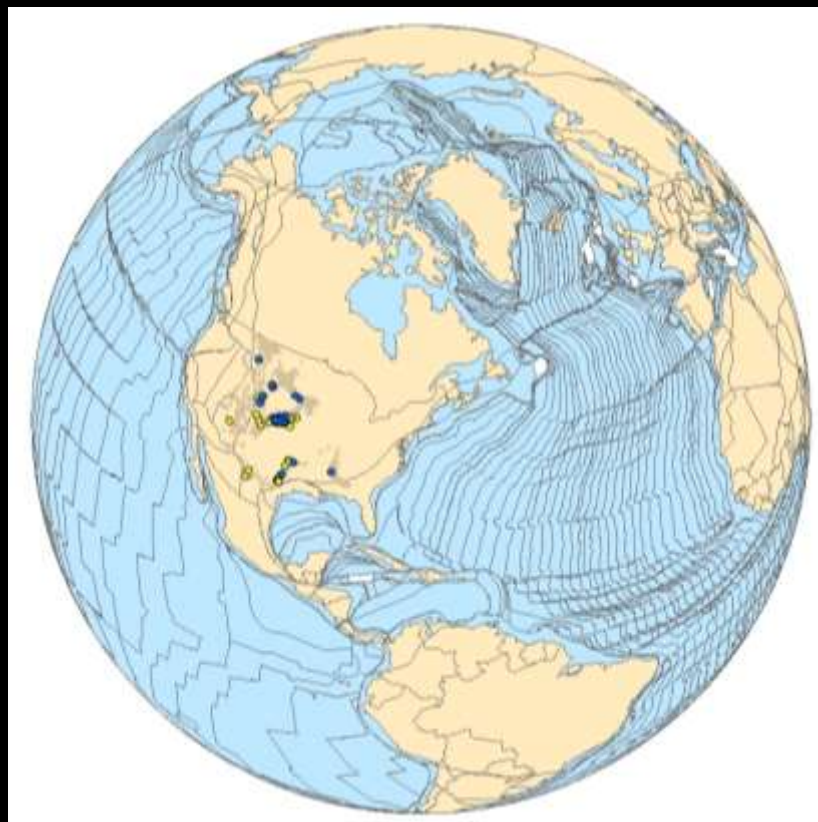
Data shared/published via iDigBio and institutional websites

Cretaceous World – TCN: Research

Focus on GIS and ecological niche modeling

Present Day

~87Ma



◆ ***Cretoxyrhina mantelli***

◆ ***Tylosaurus s***

Myers & Lieberman. 2011. Proceedings of the Royal Society

Cretaceous World – TCN: Outreach

igital Atlas of Ancient Life

Guide to Ordovician, Pennsylvanian, and Neogene fossils

www.digitalatlasofancientlife.org

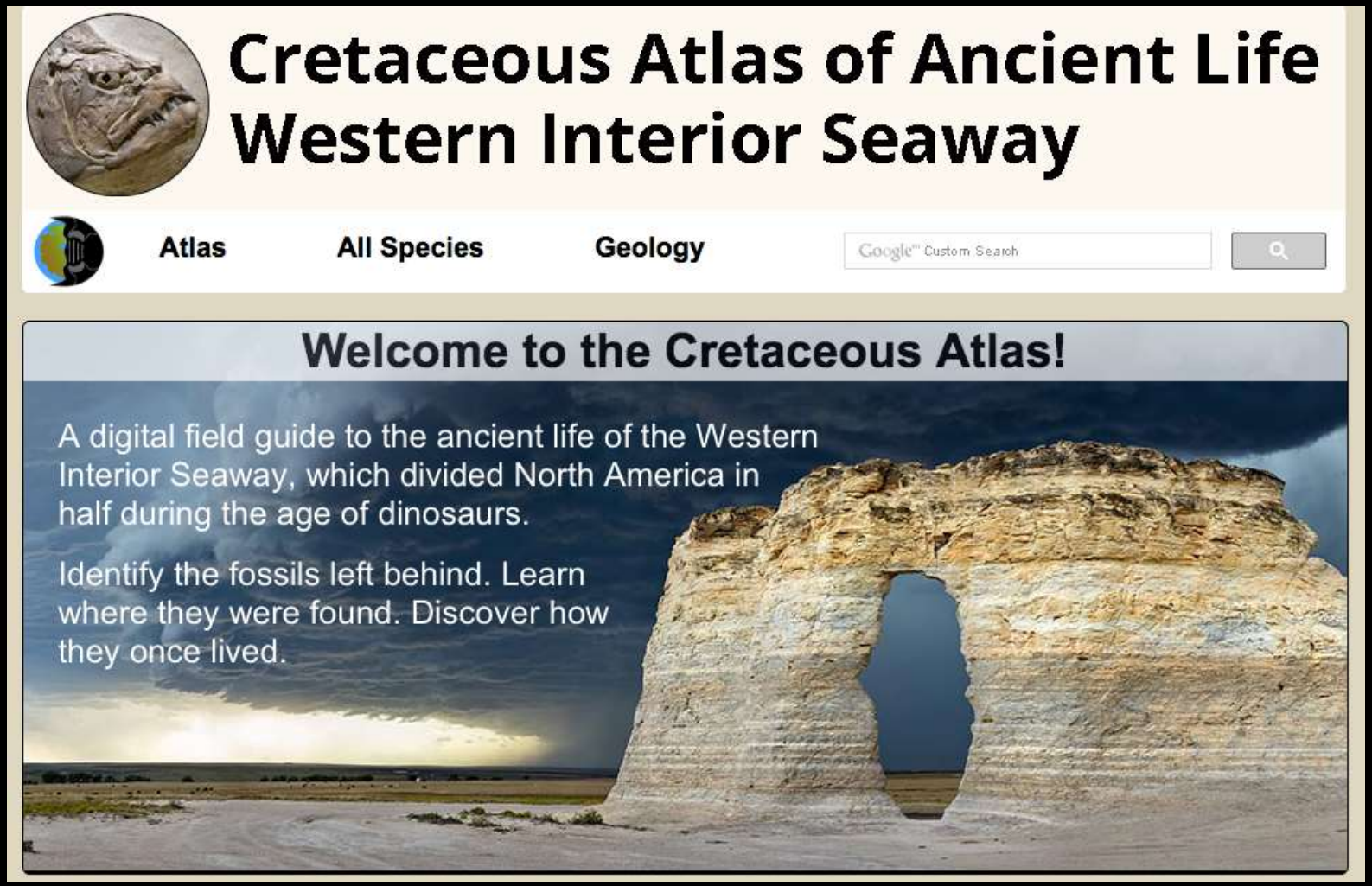
@PaleoDigAtlas

Digital Atlas App

Free for iPhone/iPad

Hendricks, Stigall, and Lieberman. 2015. *Palaeontologia Electronica*

Cretaceous World – TCN: Outreach, cont.



Cretaceous World – TCN: Outreach, cont.

Cretaceous Atlas of Ancient Life Website: www.cretaceousatlas.org

More than 225 species represented with information and images, maps to come soon

Cretaceous World – TCN: Outreach, cont.

Digital Encyclopedia of Ancient Life: www.digitalatlasofancientlife.org/learn

Open Access textbook on History of Life

Chapters on “Geological Time”; “Evolution”; “Systematics”; and more

Cretaceous World – TCN: Outreach, cont.

- Contributions to museum exhibits
- Creating collections for K-12 classrooms
- Outreach to K-12 students
- Undergraduate and graduate student training

Digital Atlas of Ancient Life
Electronic Field Guide

Explore taxonomic information, images and maps for three Paleontological time periods.

START

BROWSE

TIME PERIOD

Digital Atlas of Ancient Life App

- Derived from *Digital Atlas of Ancient Life* website
- Works on *iPad* and *iPhone*
- Available for free at *Apple App Store*
- Programmers Rod and Zach Spears
- > 7,900 downloads and > 4,300 active users

The Paleoniches - TCN

Ordovician
Cincinnati Region

Pennsylvanian
Midcontinent U.S.

Neogene
Southeastern U.S.

B.S. Lieberman, J.R. Hendricks, A.L. Stigall, U. C. Farrell, S. Butts, A. Molineux, J.H. Beach, R. Portell, J. Kimmig, B. Hunda, K. Hauer

U. of Kansas, Paleontological Research Institution, Ohio U., Yale U., U. of Texas, U. of Florida, Cincinnati Museum, Miami University

Paleoniches – TCN: Data

> 1,000,000 specimens databased

> 14,000 fossil localities georeferenced

> 1,250 fossil species imaged

Data shared/published via iDigBio and institutional websites

Paleoniches – TCN: Research

Scientific publications in various journals including:

Global Ecology and Biogeography, *Proceedings of the Royal Society Series B,* *Journal of Biogeography*, and *Paleobiology*

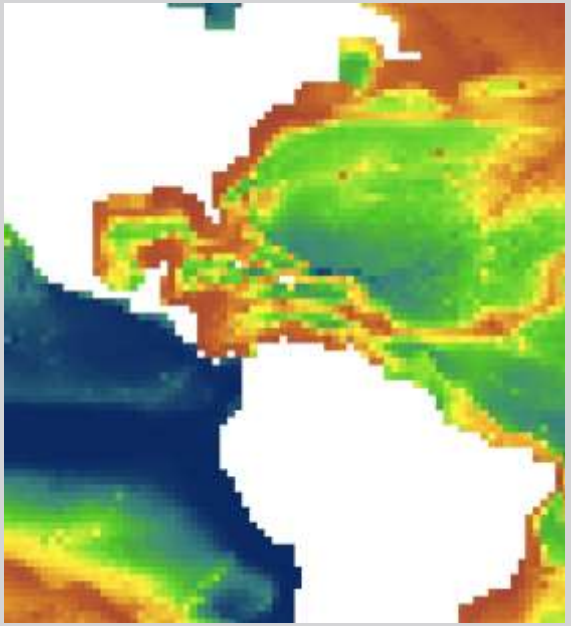
Used GIS, Ecological Niche Modeling and analysis of physiology to study macroevolutionary effects of climate change

SSS

Nitrogen

Diatom Phytoplankton

$$p(x) = e^{(\lambda_1 x_1 + \ldots + \lambda_n x_n)}$$



Paleoniches – TCN: Research

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Research

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Subject Category:
Palaeobiology

Subject Areas:
palaeontology, physiology, evolution

Keywords:
extinction, body size, temperature, bivalve, gastropod, hierarchy

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THE ROYAL SOCIETY PUBLISHING

Metabolic rates, climate and macroevolution: a case study using Neogene molluscs

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Basal metabolic rate (BMR) is posited to be a fundamental control on the structure and dynamics of ecological networks, influencing organism resource use and rates of senescence. Differences in the maintenance energy requirements of individual species therefore potentially predict extinction likelihood. If validated, this would comprise an important link between organismic ecology and macroevolutionary dynamics. To test this hypothesis, the BMRs of organisms within fossil species were determined using body size and temperature data, and considered in the light of species' survival and extinction through time. Our analysis focused on the high-resolution record of Phanerozoic to recent molluscs (bivalves and gastropods) from the Western Atlantic. Species-specific BMRs were calculated by measuring the size range of specimens from museum collections, determining ocean temperature using the HadCM3 global climate model, and deriving values based on relevant equations. Intriguingly, a statistically significant difference in metabolic rate exists between those bivalve and gastropod taxa that went extinct and those that survived throughout the course of the Neogene. This indicates that there is a scaling up from organismic properties to species survival for these communities. Metabolic rate could therefore represent an important metric for predicting future extinction patterns, with changes in global climate potentially affecting the lifespan of individuals, ultimately leading to the extinction of the species they are contained within. We also find that, at the assemblage level, there are no significant differences in metabolic rates for different time intervals throughout the entire study period. This may suggest that Neogene mollusc communities have remained energetically stable, despite many extinctions.

1. Introduction

Metabolic rate is defined as the rate of energy uptake, transformation and allocation for an individual organism [1], and plays a fundamental role in resource use and rates of senescence [1–3]. Notably, population dynamics [4], geographical patterns in species richness [5] and community dynamics [6] are all related to body size and temperature, the primary determinants of metabolic rate for poikilotherms. There is also an association between metabolic rate and latitudinal diversity gradients, and perhaps between metabolism and rates of speciation [1,7,9]. These examples provide a clear connection as to how ecological processes operating at the organismic level scale up to higher level patterns, a hypothesis previously investigated in a variety of modern [1,7,10,11] and fossil ecosystems [12–14].

Here, we explore the relationship between metabolic rate and extinction to try to further consider the connection between organismic ecology and macroevolutionary dynamics [15–18]. As metabolic rate is a primary control for traits important for identifying extinction likelihood [19] and with maximum lifespan shown to scale with body size and temperature [4,20,21], we propose metabolic

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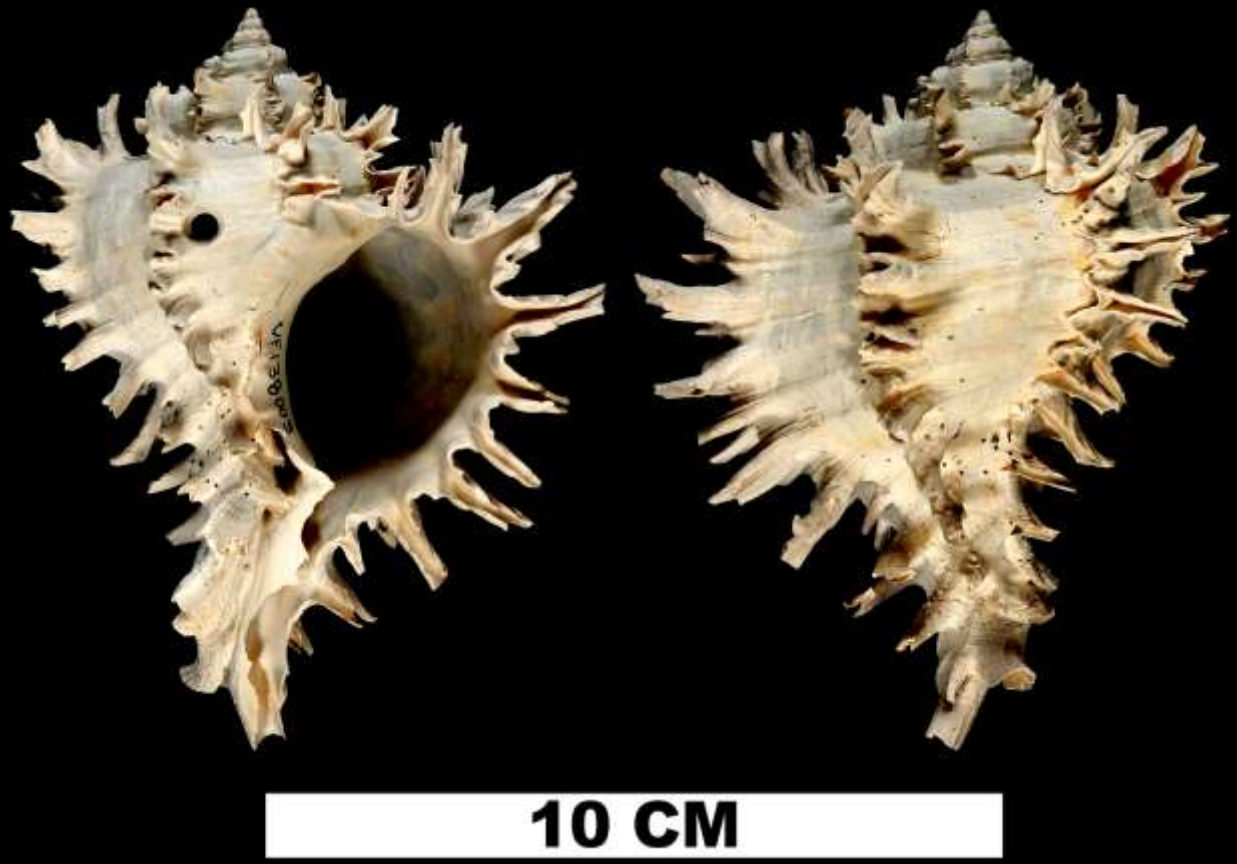
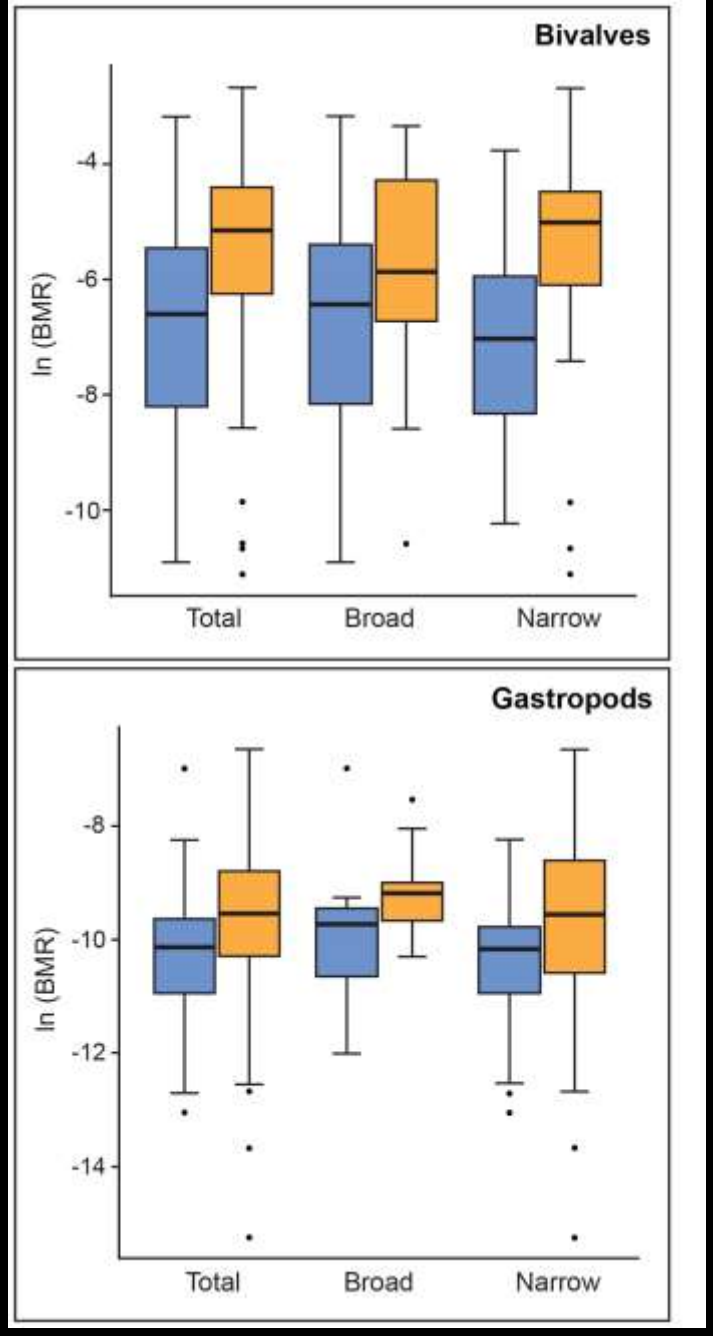
Hendricks, Stigall, and Lieberman. 2015. *Palaeontologia Electronica*



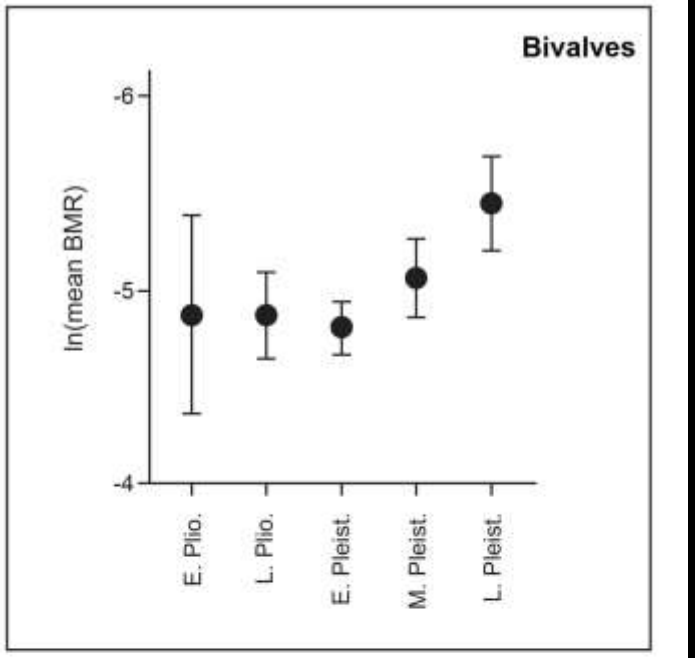
Hendricks, Stigall, and Lieberman. 2015. *Palaeontologia Electronica*

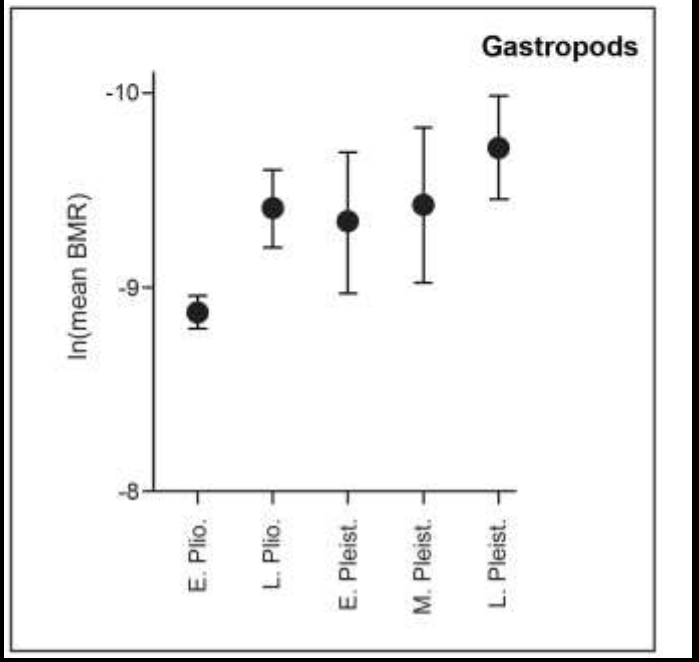


Strotz et al. 2018. *Proceedings of the Royal Society, Series B*

Survival of the Sluggish

Strotz et al. 2018. *Proceedings of the Royal Society, Series B*





Strotz et al. 2018. *Proceedings of the Royal Society, Series B*

Paleoniches – TCN: Research

Species containing organisms with higher physiologies more likely to go extinct

Total energy used by mollusk assemblages constant

Paleoniches – TCN: Outreach

Digital Atlas of Ancient Life Website: www.digitalatlasofancientlife.org

More than 1,000 species represented with information, images, and maps

> 1,700,000 hits

Digital Atlas of Ancient Life
Electronic Field Guide

Explore taxonomic information, images and maps for three Paleontological time periods.

START

BROWSE

TIME PERIOD

Class
Gastropoda

Order
Heterobranchia

Family
Architectonicidae

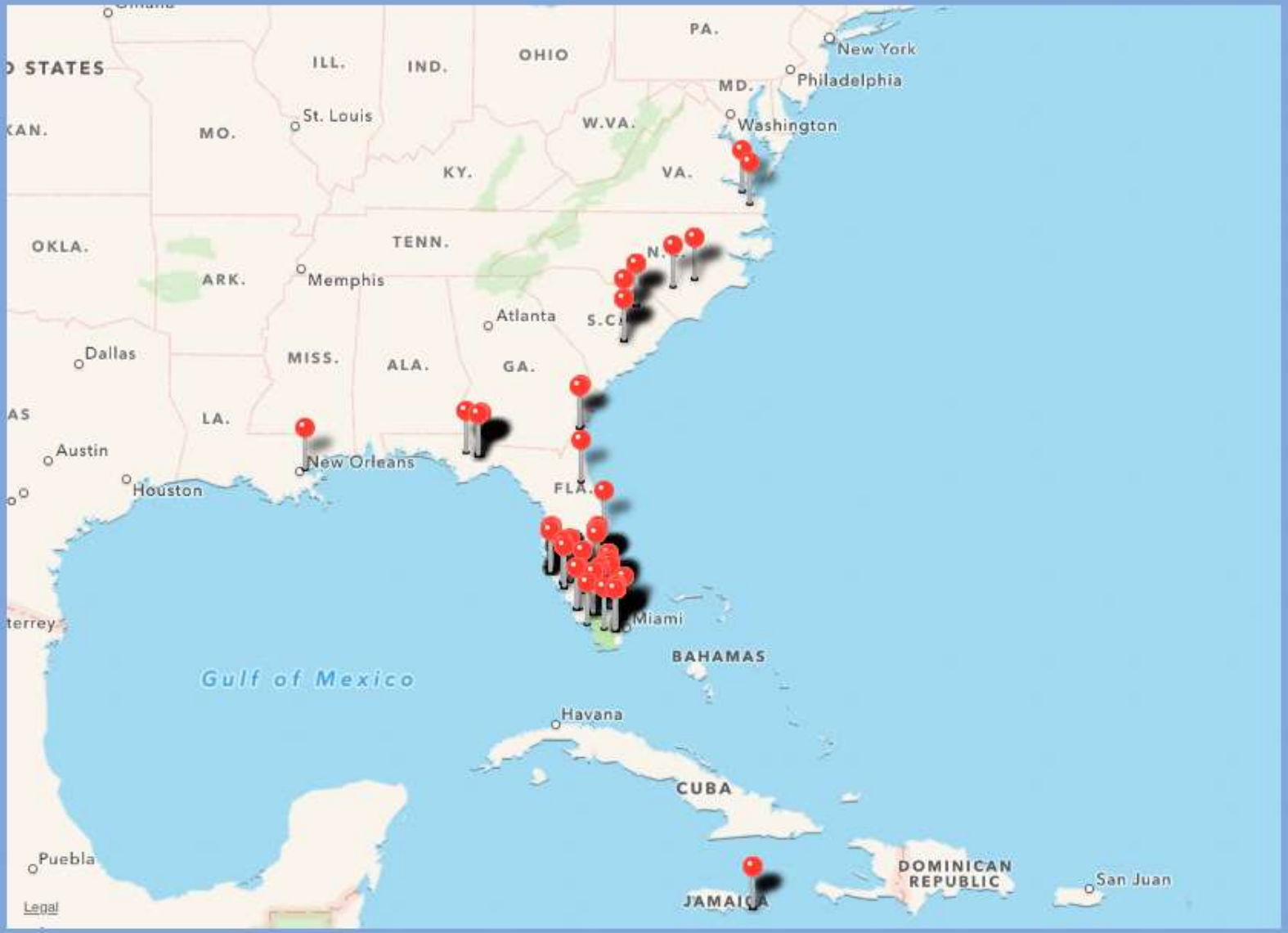
Genus
Architectonica

Species
Architectonica no...

Back

Architectonica nobilis

Roding, 1798



Conclusions

Digitizing museum collections provides insights into macroevolution and biogeography

Conclusions, cont.

Approach digitization of fossils same way as digitization of extant taxa

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