

Presentations

10-9-2015

**Snorkeling a 323myo Paleozoic Bay Community Structure and
Depositional Environment of the Bear Gulch Limestone of
Montana**

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Grogan, Eileen D. and Lund, Richard. "Snorkeling a 323myo Paleozoic Bay Community Structure and Depositional Environment of the Bear Gulch Limestone of Montana". 10-9-2015. VIMS 75th Anniversary Alumni Research Symposium.

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Snorkeling a 323myo Paleozoic Bay

Community Structure and Depositional Environment of the Bear Gulch
Limestone of Montana



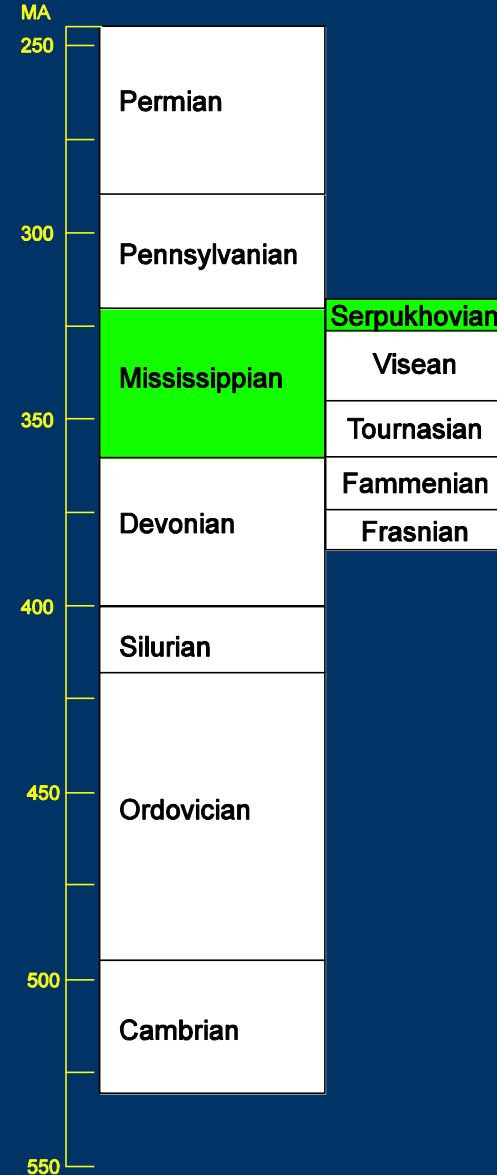
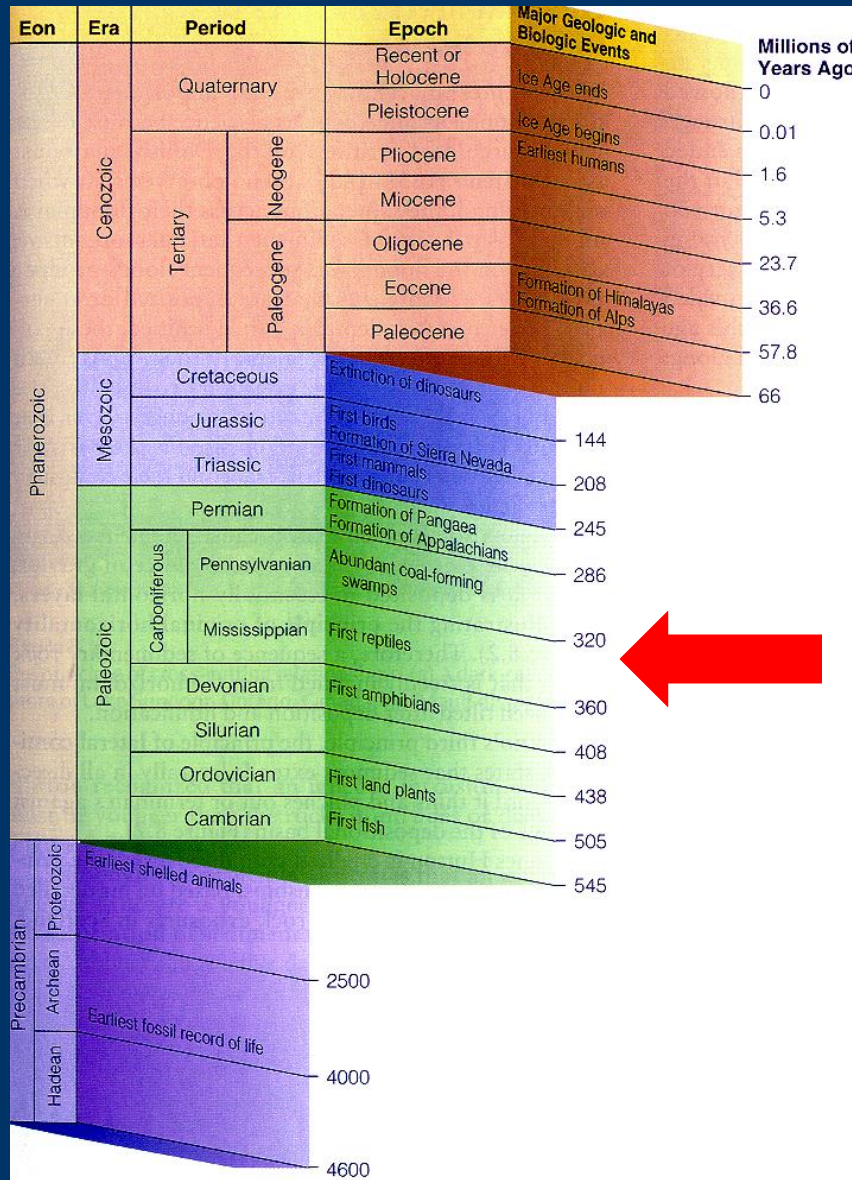
Eileen D. Grogan (Ph.D. '93) and Richard Lund
Saint Joseph's University & Carnegie Museum





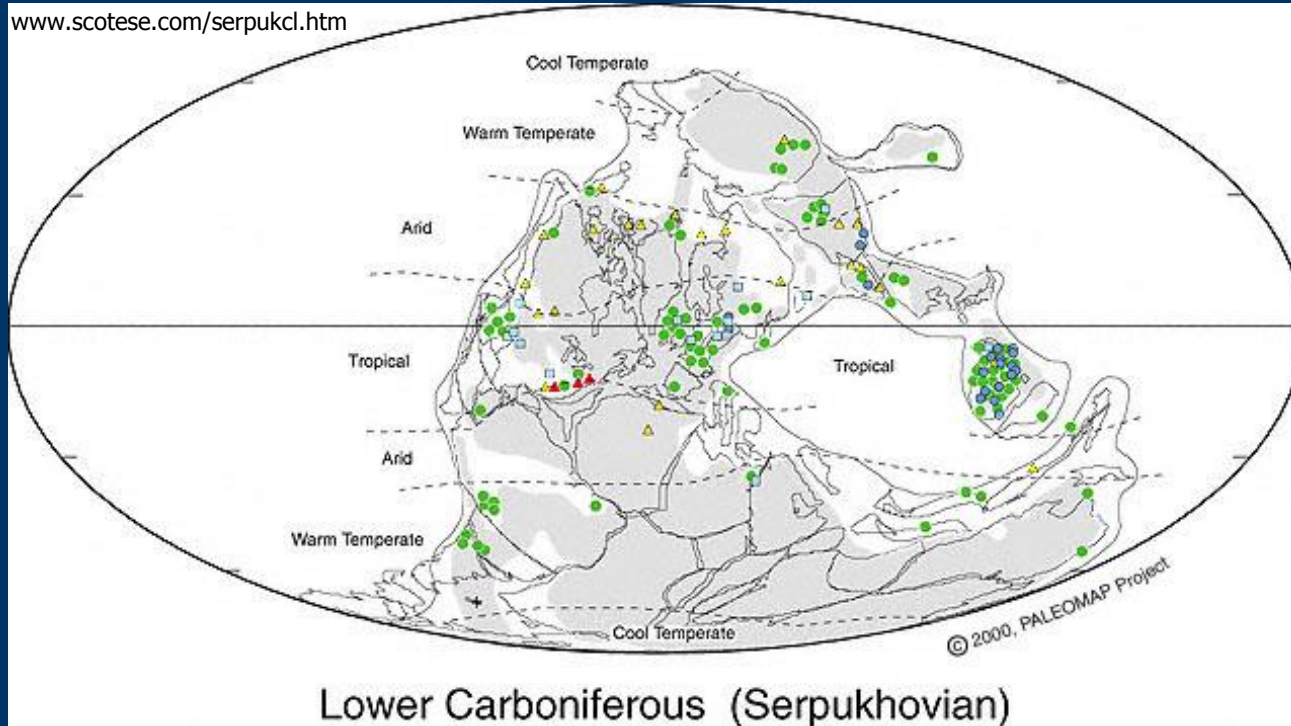
Where you see this logo in my presentation the work was impacted by my training and experience at VIMS

Bear Gulch Limestone of Montana: 323 MYO (Mississippian, Serpukhovian)

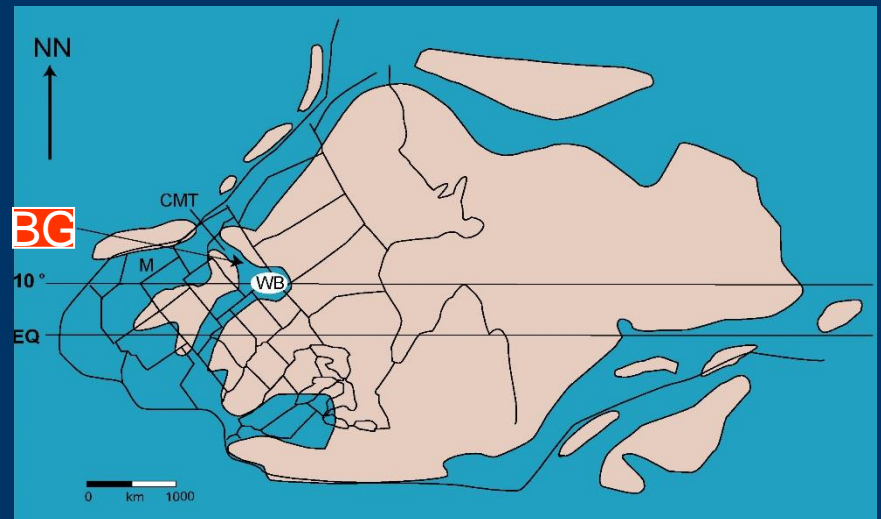


In Historical Context

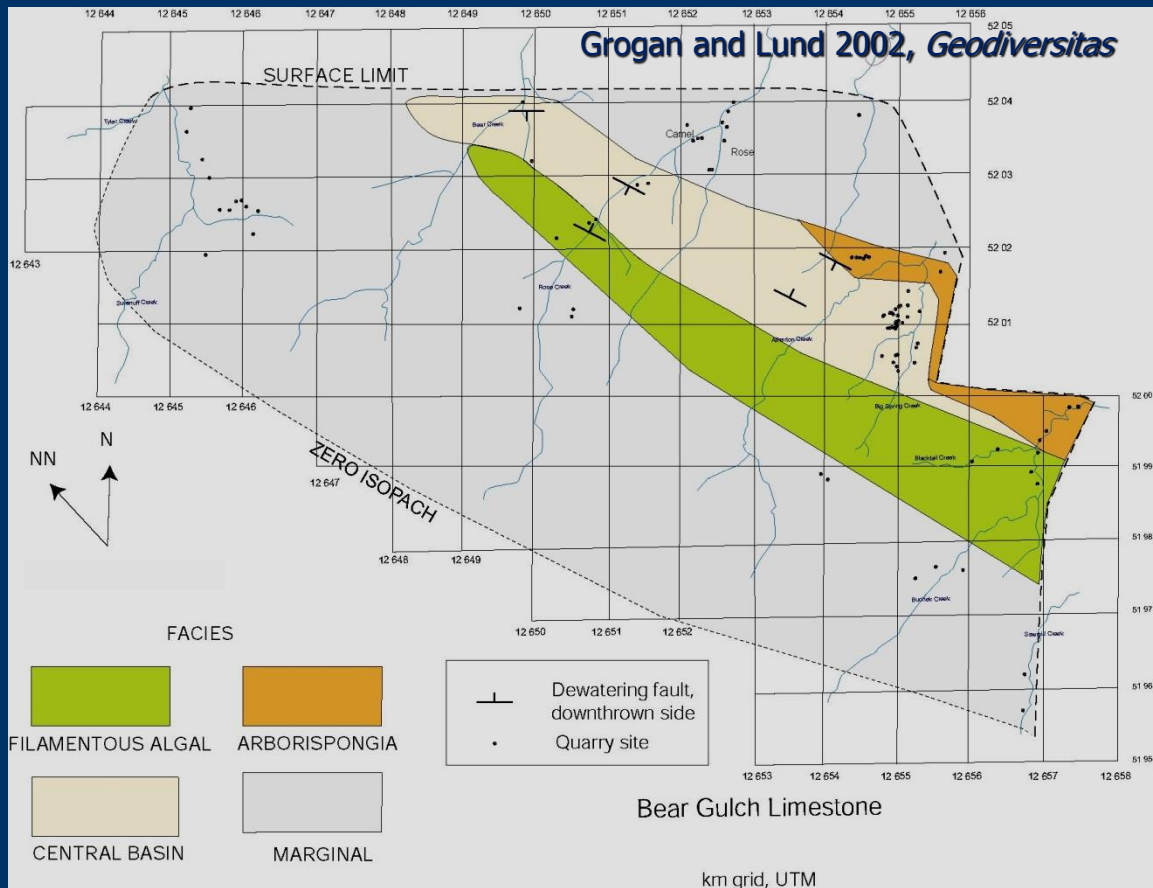
www.scotese.com/serpukcl.htm



shallow tropical marine bay
tropical to arid



Reconstruction of Paleozoic Bay



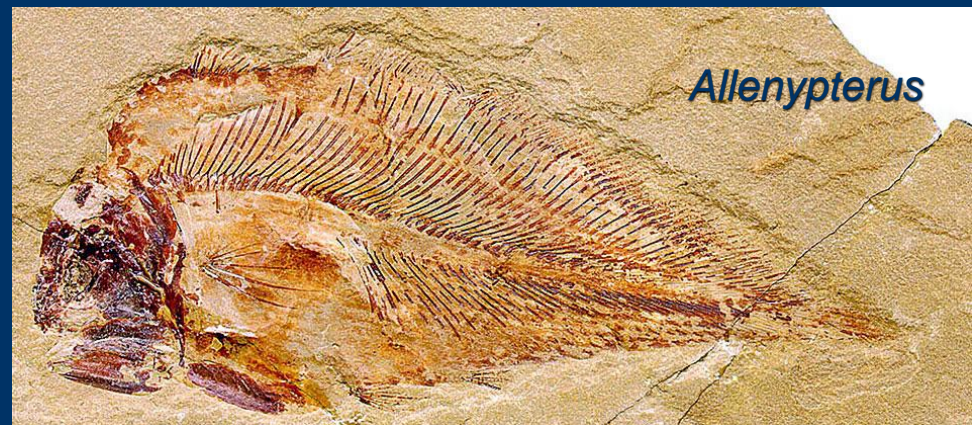
Entire bay 12 km x 19 km by 30 m deep
 variation in regional environments
 community structure
Lagerstätte

Quality of Fossil Preservation

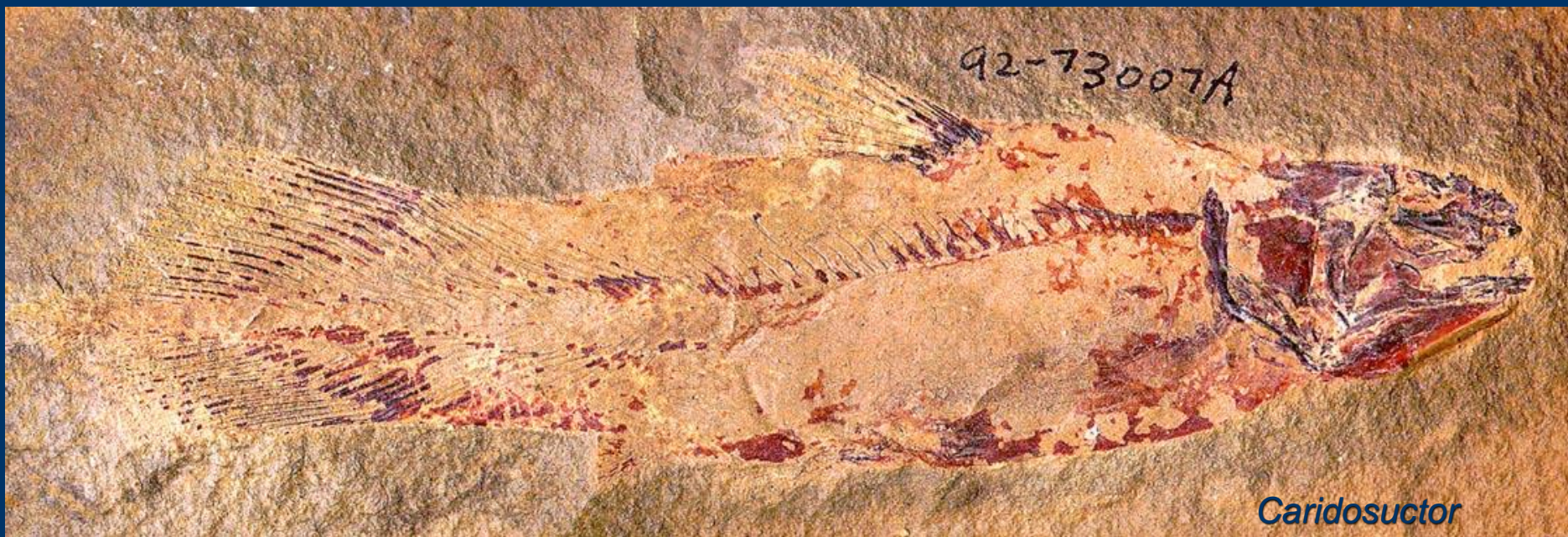
Diversity of Life vertebrate & invertebrate



Hadronector



Alleenypterus

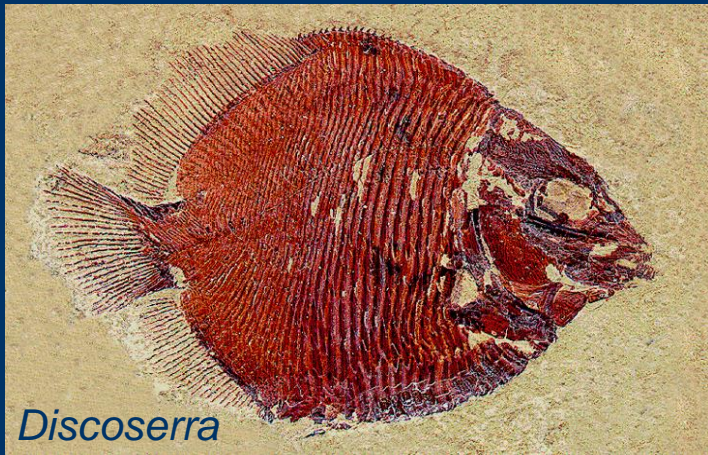


Caridosuctor

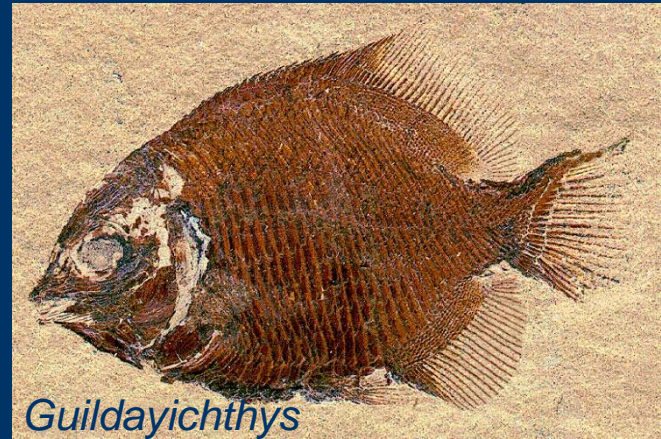
Vertebrates: Actinopterygians



Paratarrasius



Discoserra



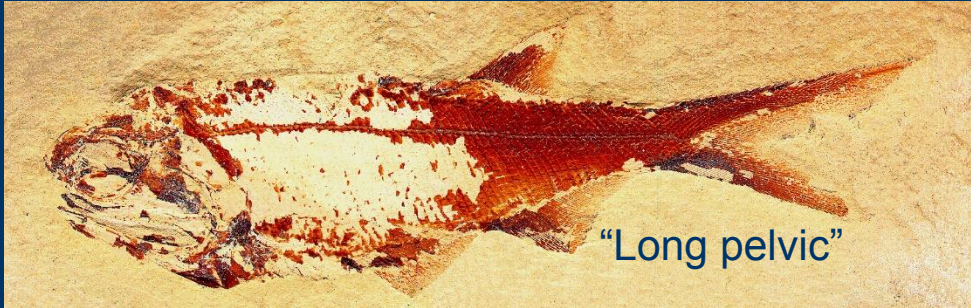
Guildayichthys



Paphosiscus

Vertebrates:

Actinopterygians (bony, ray-finned fishes)



"Long pelvic"



Aesopichthys



Kalops monophrys

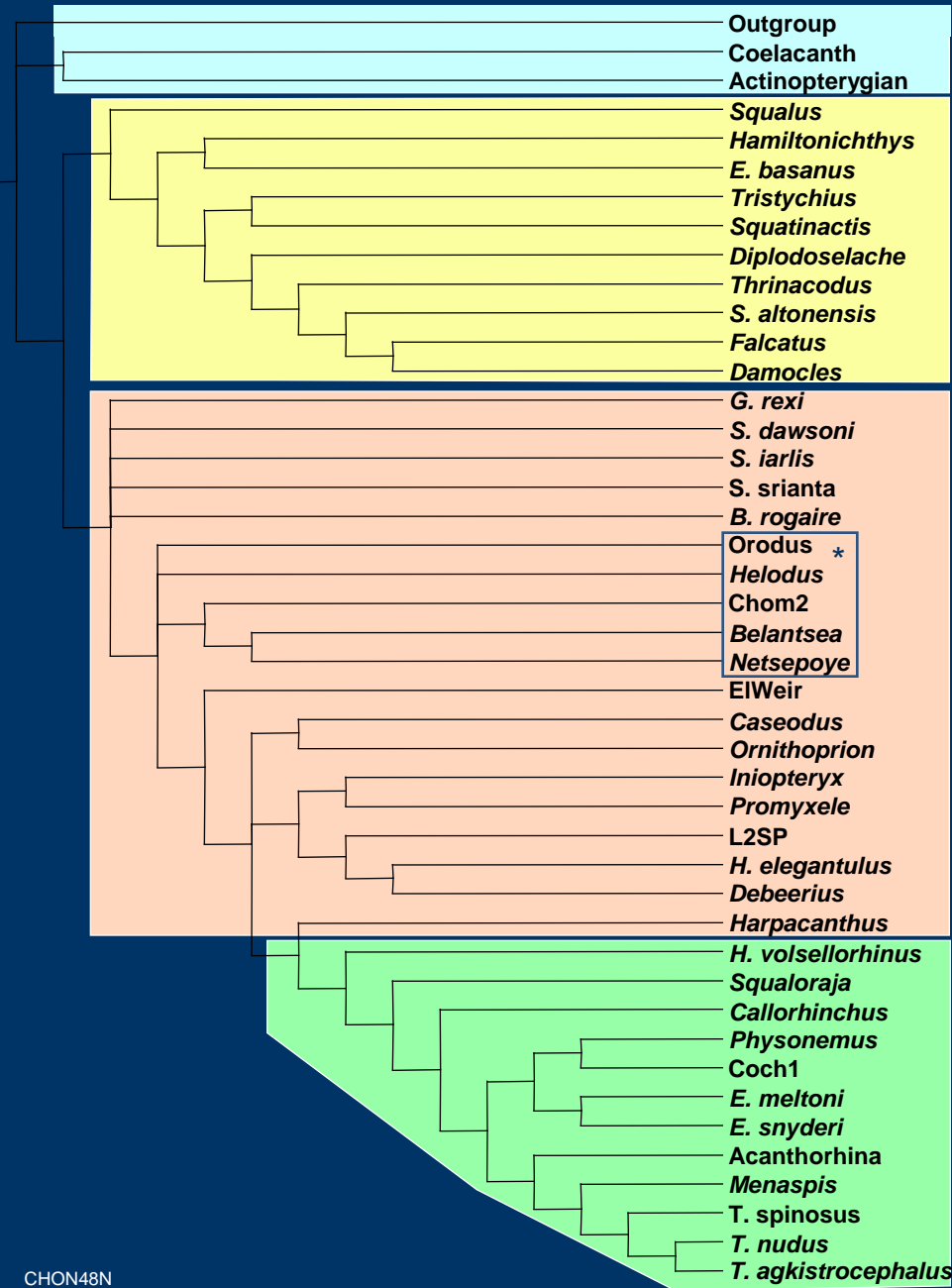


Paleoniscoid Fishes

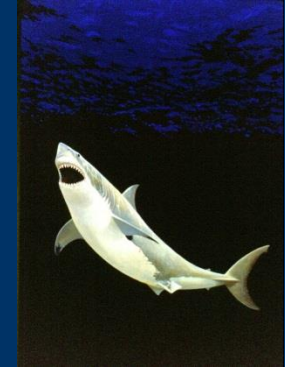


Lunch? Dinner? A very small fish

the most startling
and revolutionary



Elasmobranchii



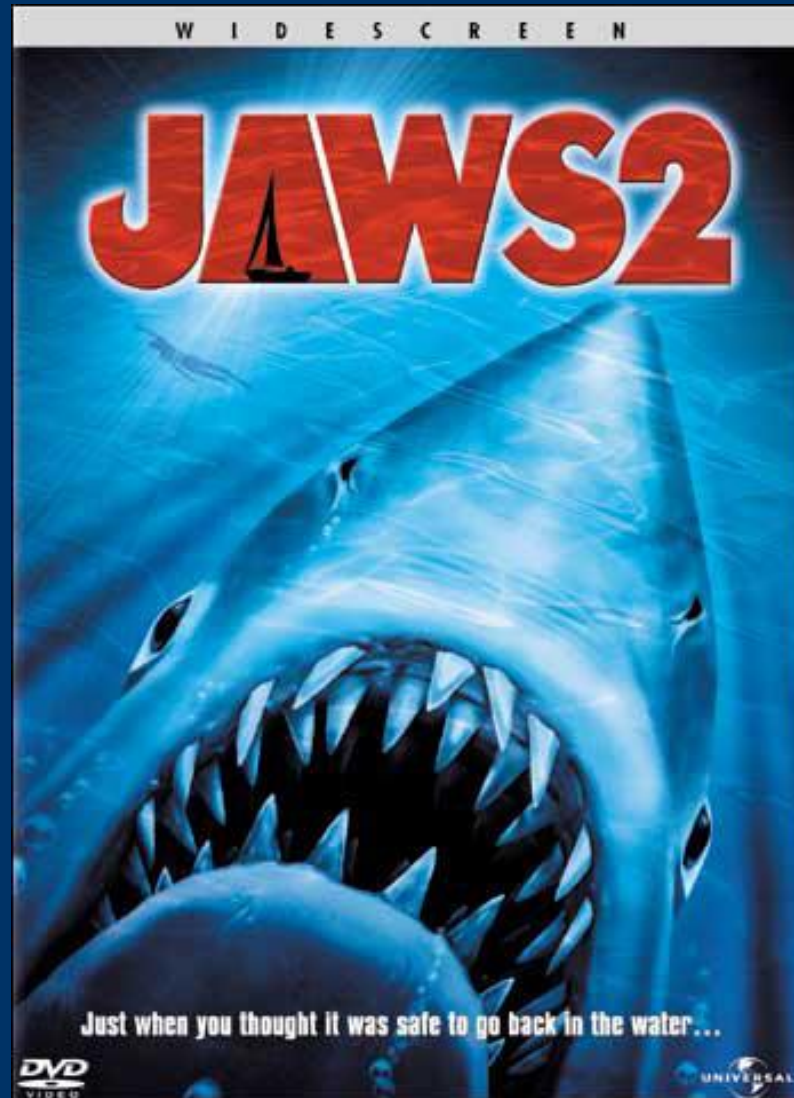
Paraselachians
Non-holostylic

Euchondrocephali



Holocephali

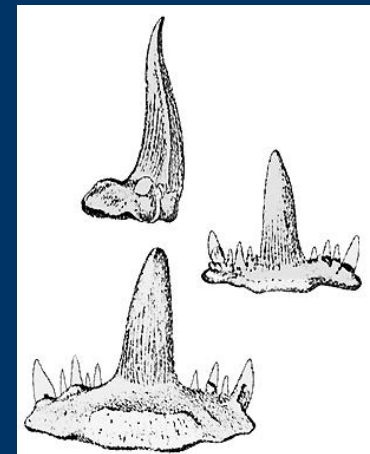
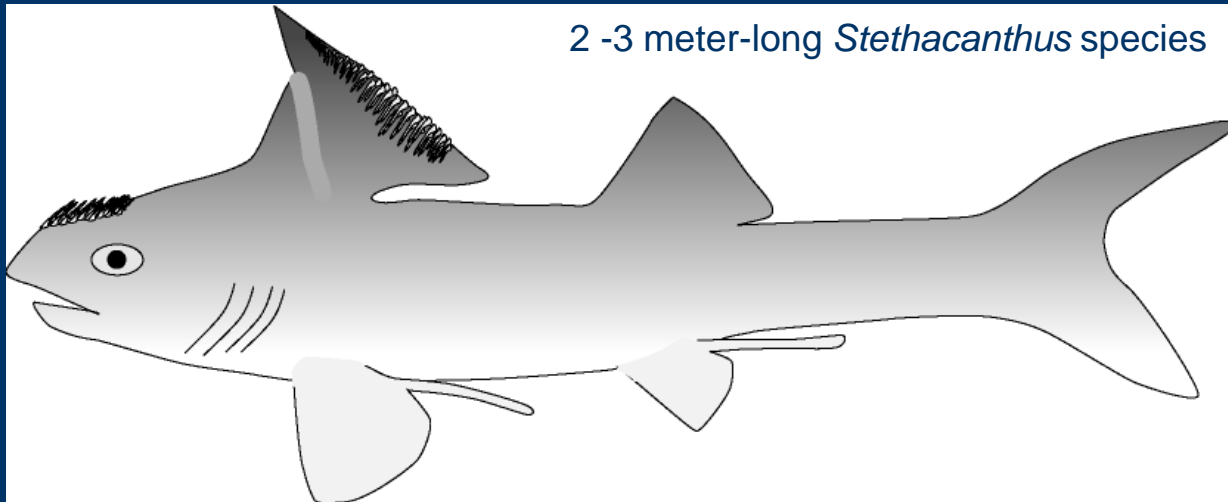
When YOU think of sharks, do you think of



Bear Gulch sharks are only vaguely reminiscent of today's forms *e.g. Stethacanthids (8 species)*



2-3 meter-long *Stethacanthus* species



Cladodus-like teeth

Lagerstätte

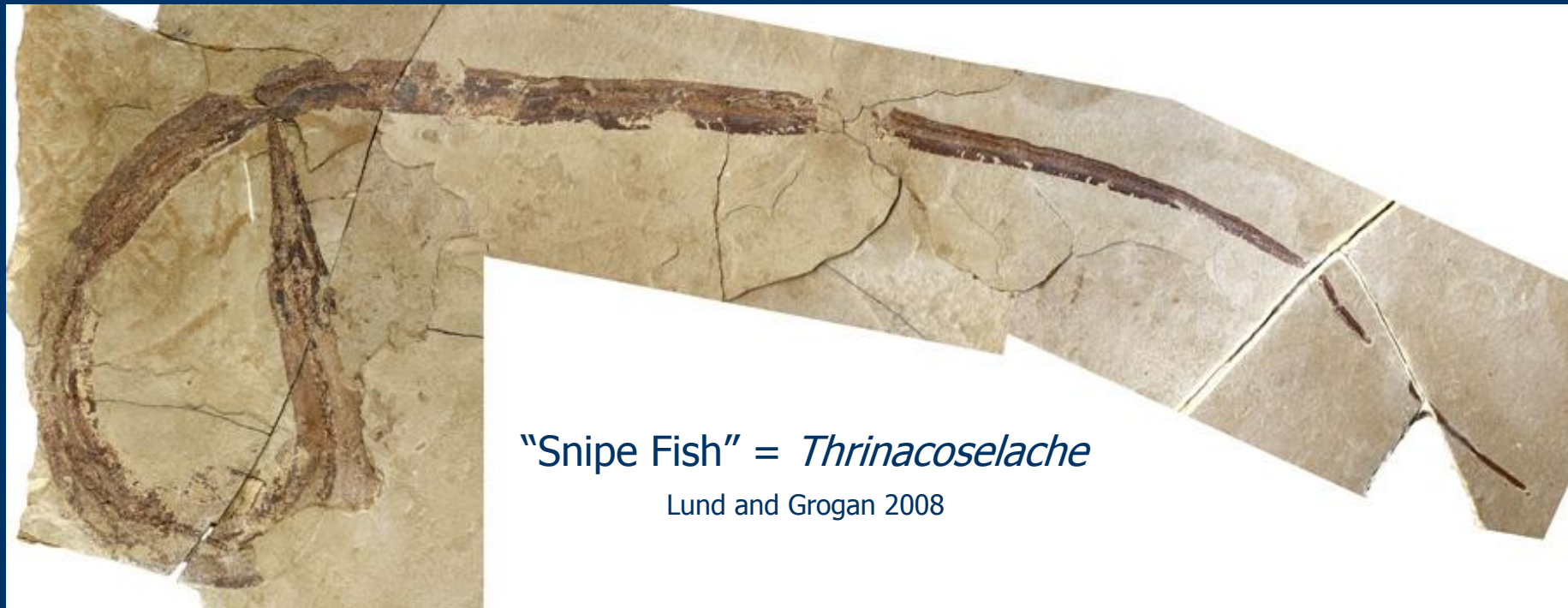
female



male

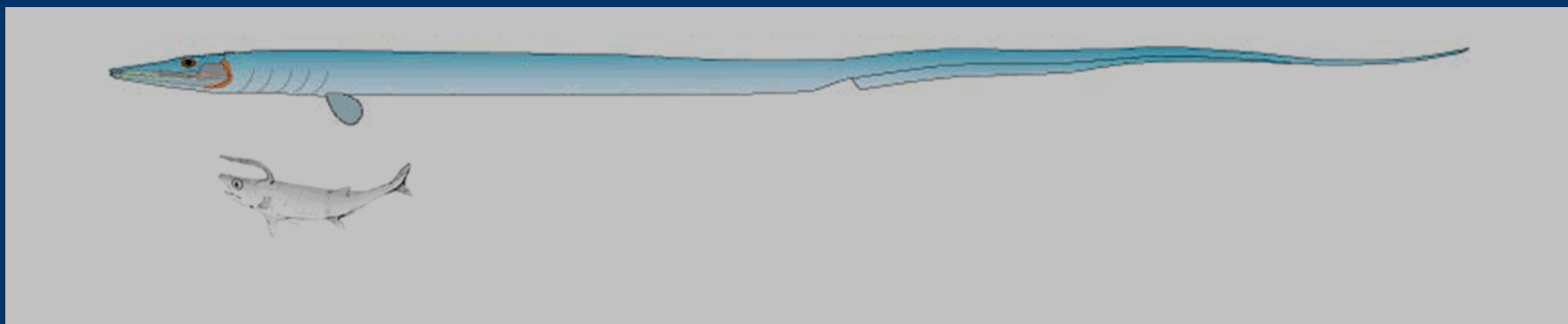
Shrimp dinner

Other sharks are radically different: For example, an eel-like shark?

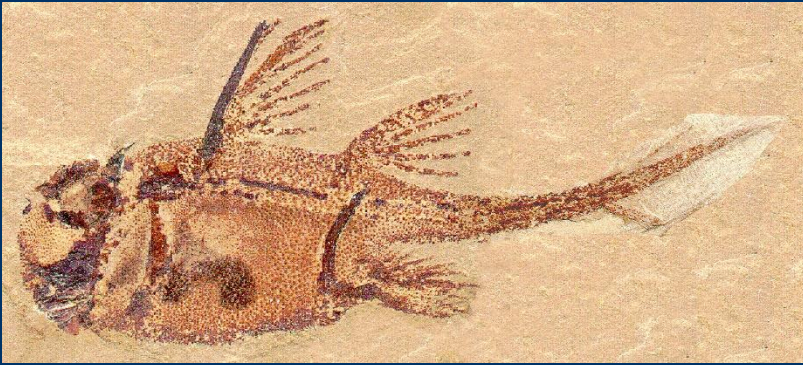


"Snipe Fish" = *Thrinacoselache*

Lund and Grogan 2008



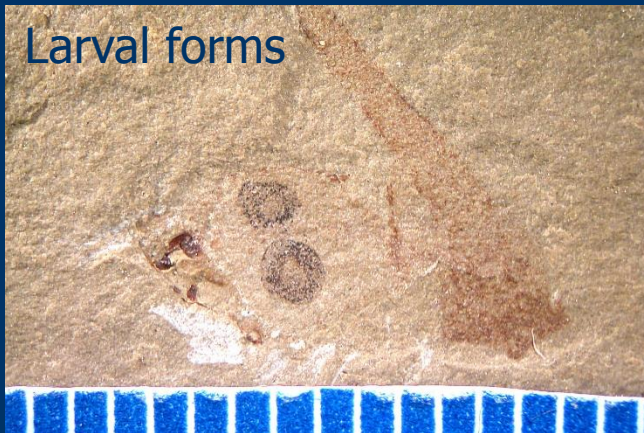
Holocephalans: a variety, all ages, and sexually dimorphic



Echinochimaera



Larval forms



mm scale!

Cochliodonts: *the missing link to explain the origin of the chimaeroids?*



Cochliodont



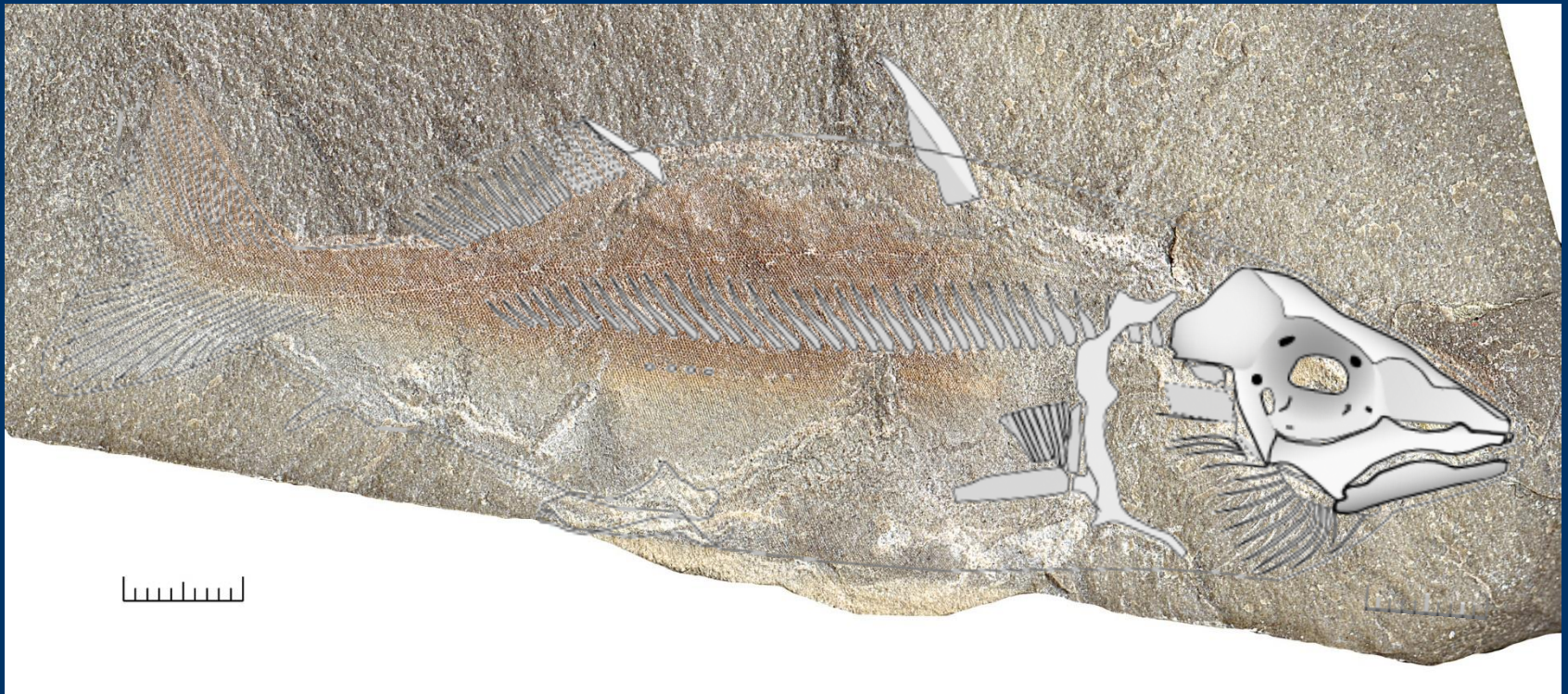
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Callorhinchus capensis



DWD106 1990

Many Bear Gulch chondrichthyans are
neither elasmobranch nor holocephalan.



Gregorius, one of five species in a family, that ranged
in size from 6 inches to 3 feet

And *Debeerius ellefseni*

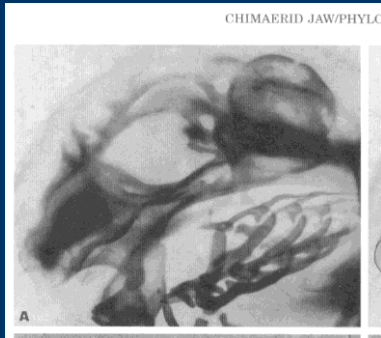
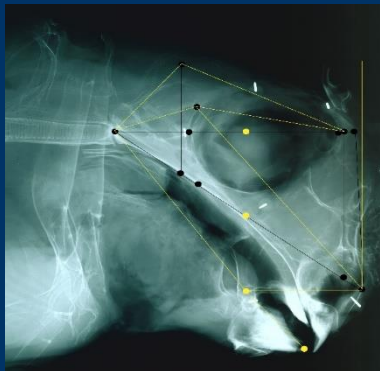
With color pattern

gut contents

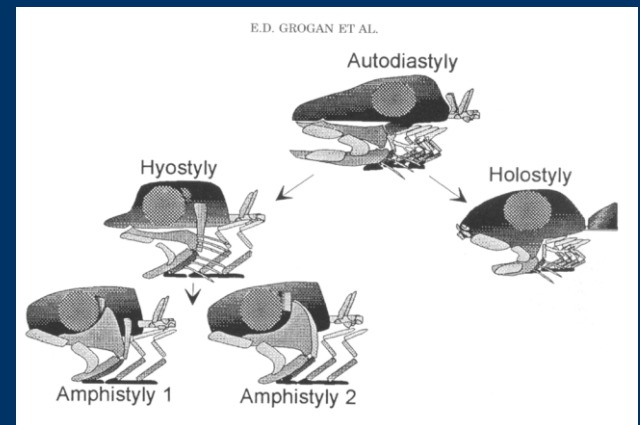
blood vessels



The skeleton

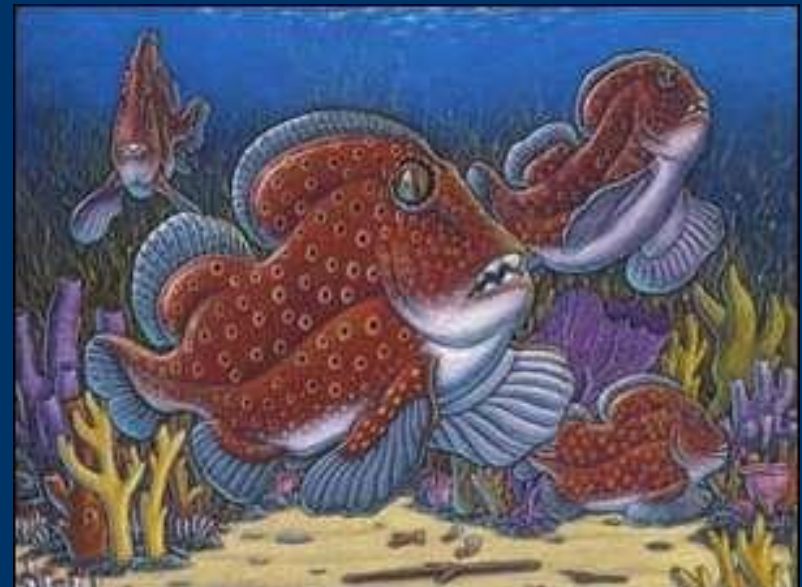
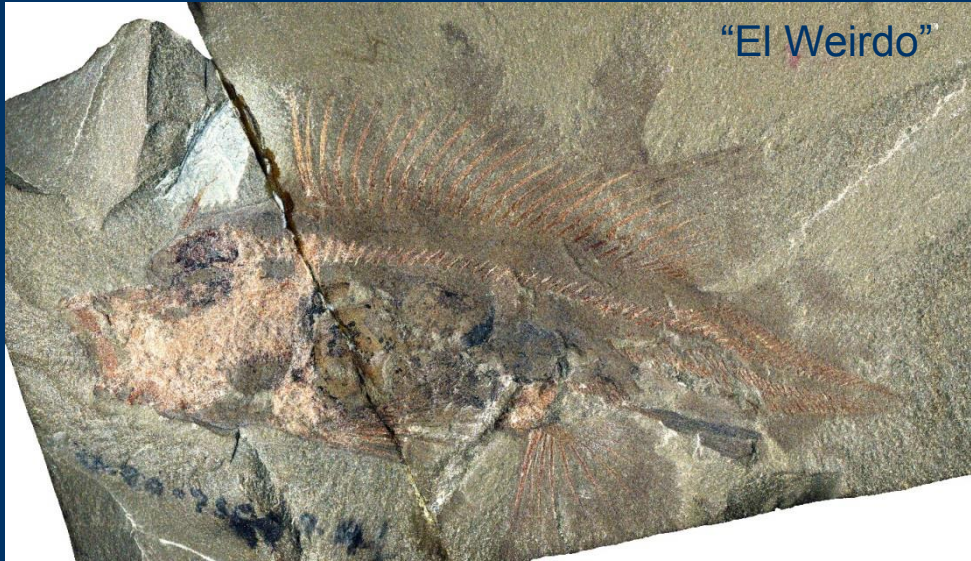


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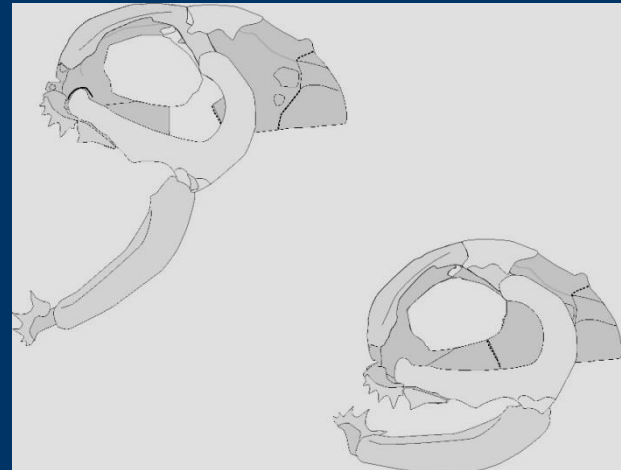
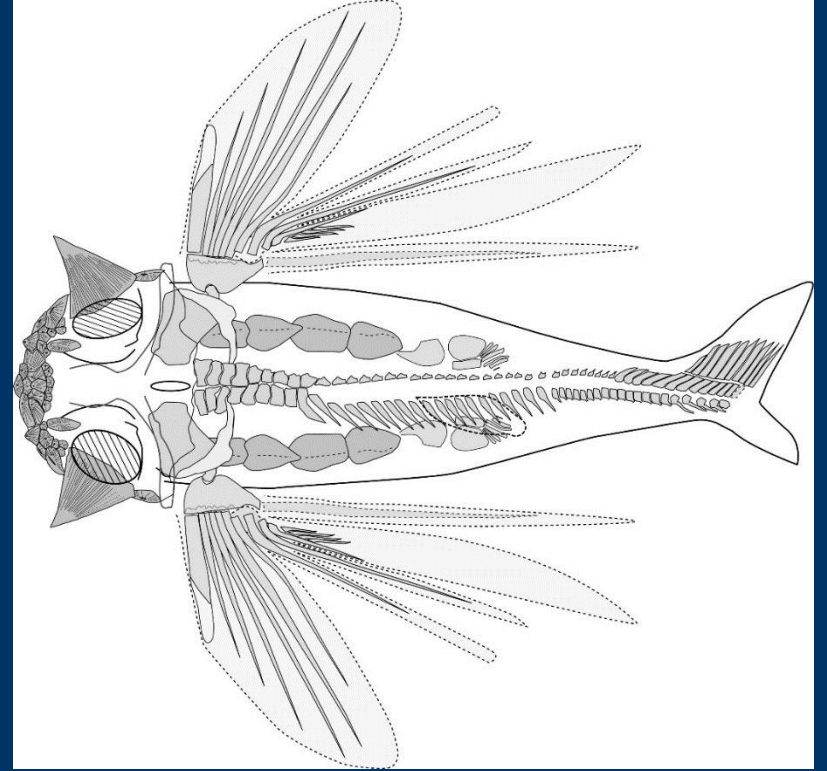
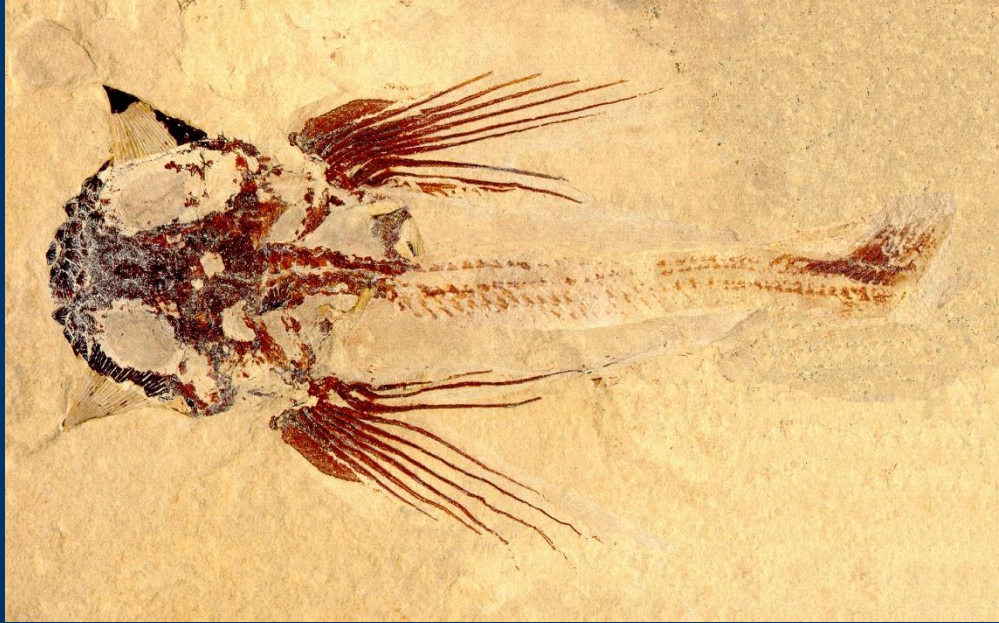


New Proposal for Jaw Evolution

Then there are the “others”



Iniopterygians



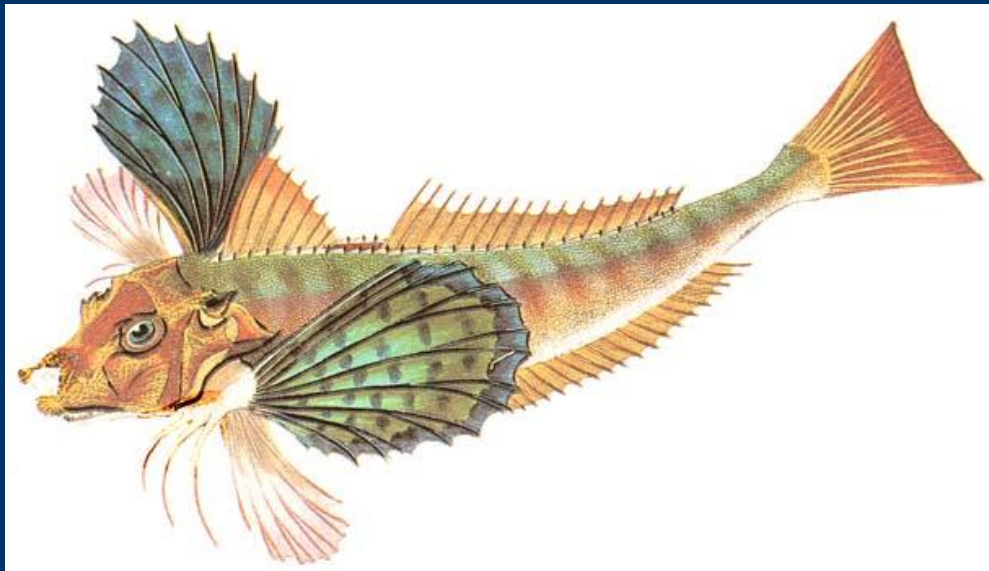
Is this what the Iniopts did?



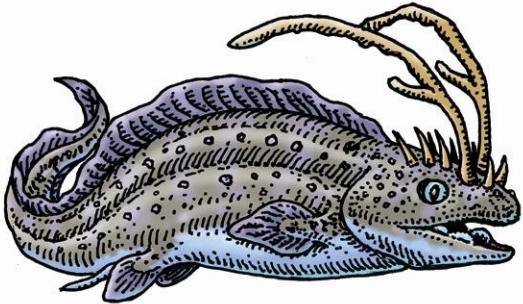
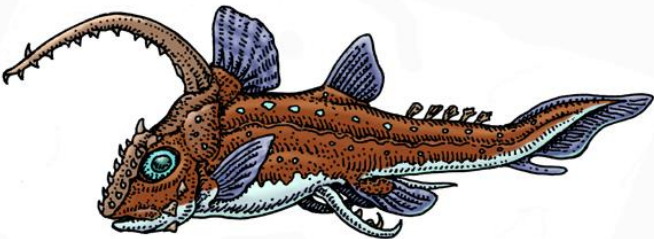
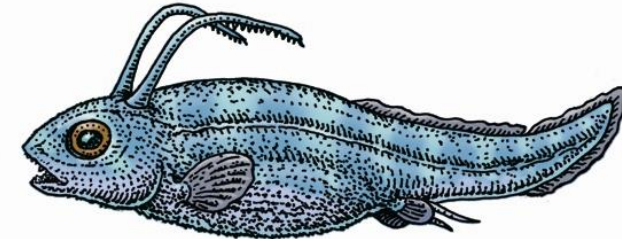
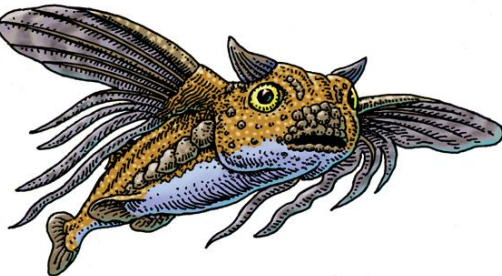
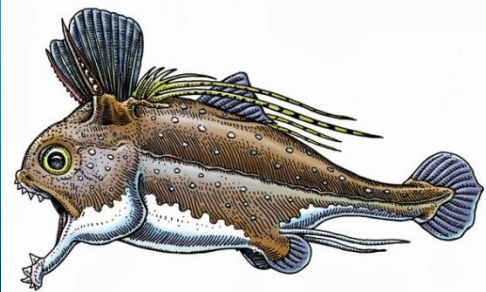
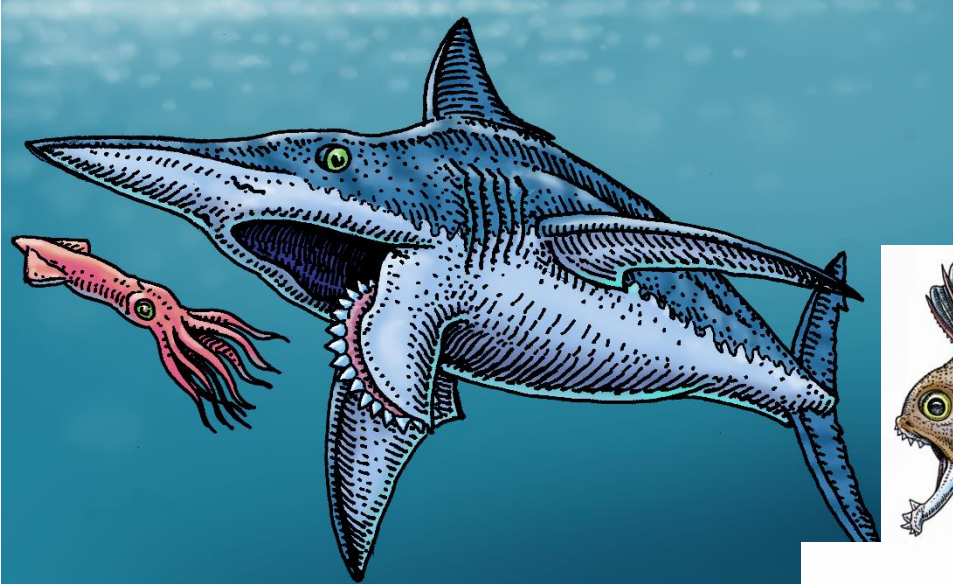
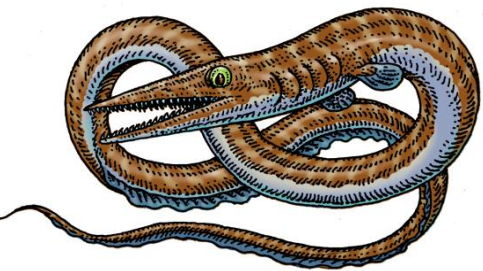
A modern analog?
Trigla (Sea Robin)



Courtesy of Ray Troll, trollart.com



Chondrichthyans have changed greatly over their evolutionary history!!



DWD 106



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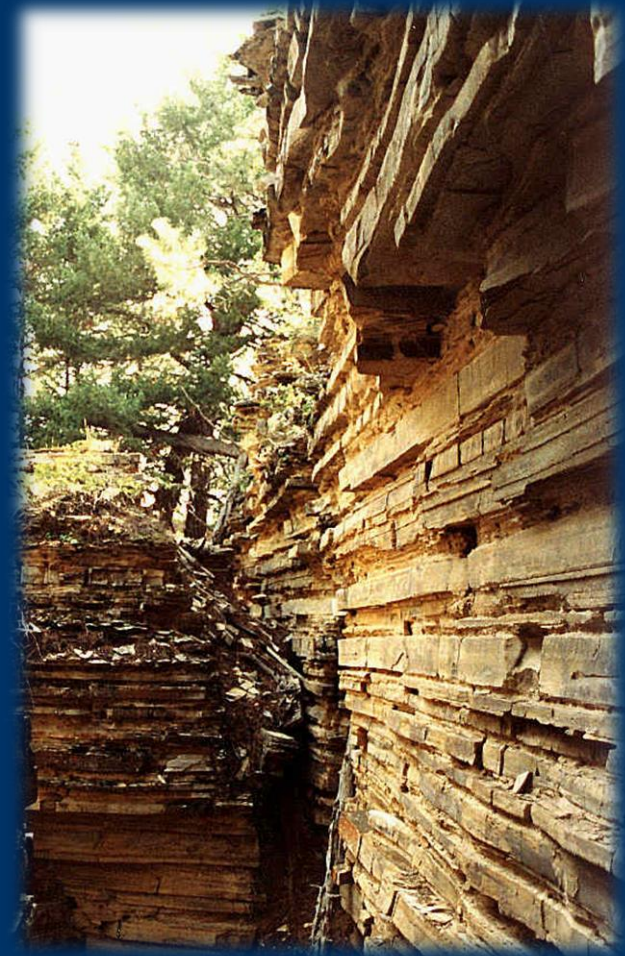
Nunnally Collection



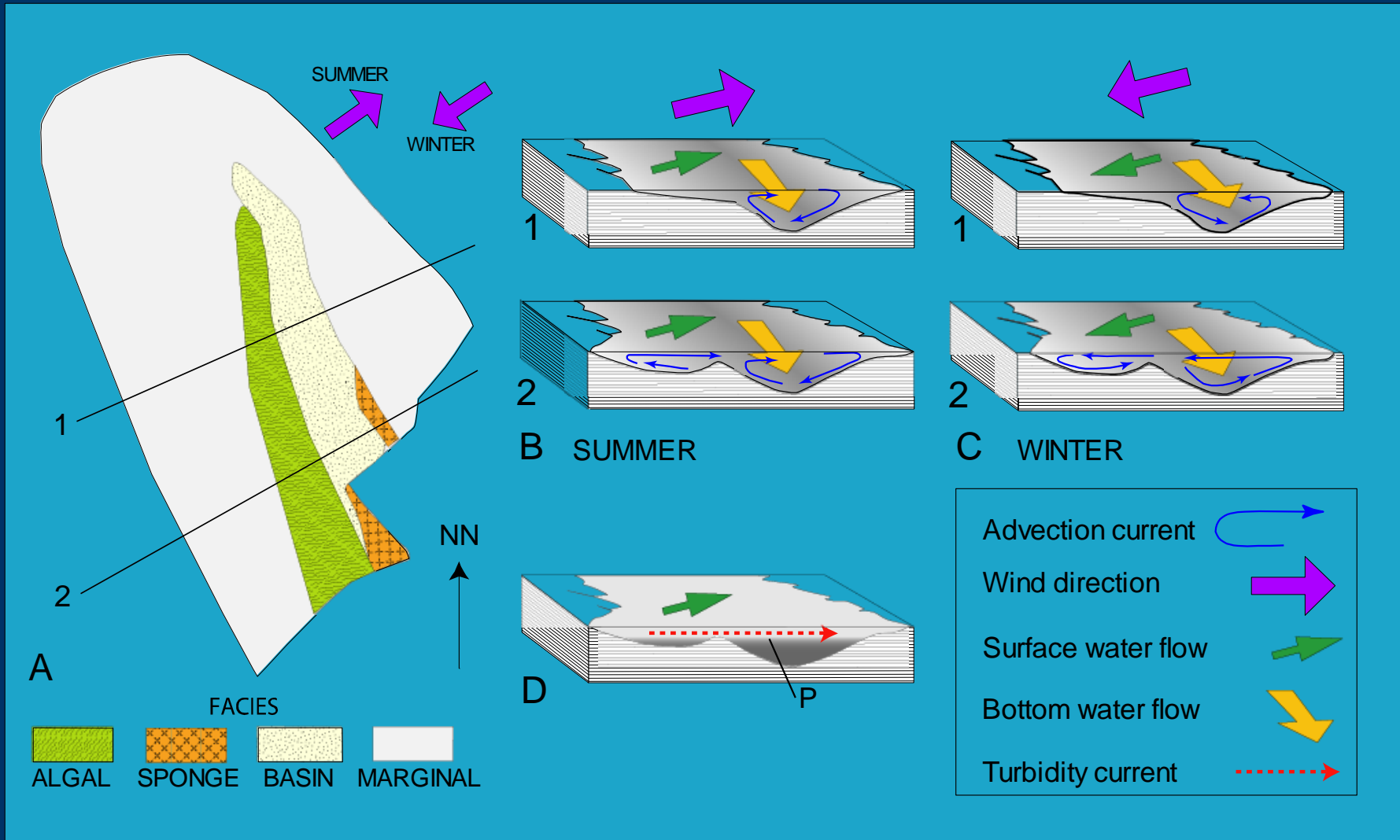
Lagerstätte

Quality of Fossil Preservation

- soft-bodied organisms
- soft tissues, pigment patterns in fishes



Climate & Deposition Model (Grogan & Lund 2001)



A rare opportunity for paleo-ecological study.

Bulk sampling across multiple habitat zones.

46 years of quarrying

> 5700 fish specimens

> 149 fish species

pre-teleostan marine fish assemblage

Bear Gulch

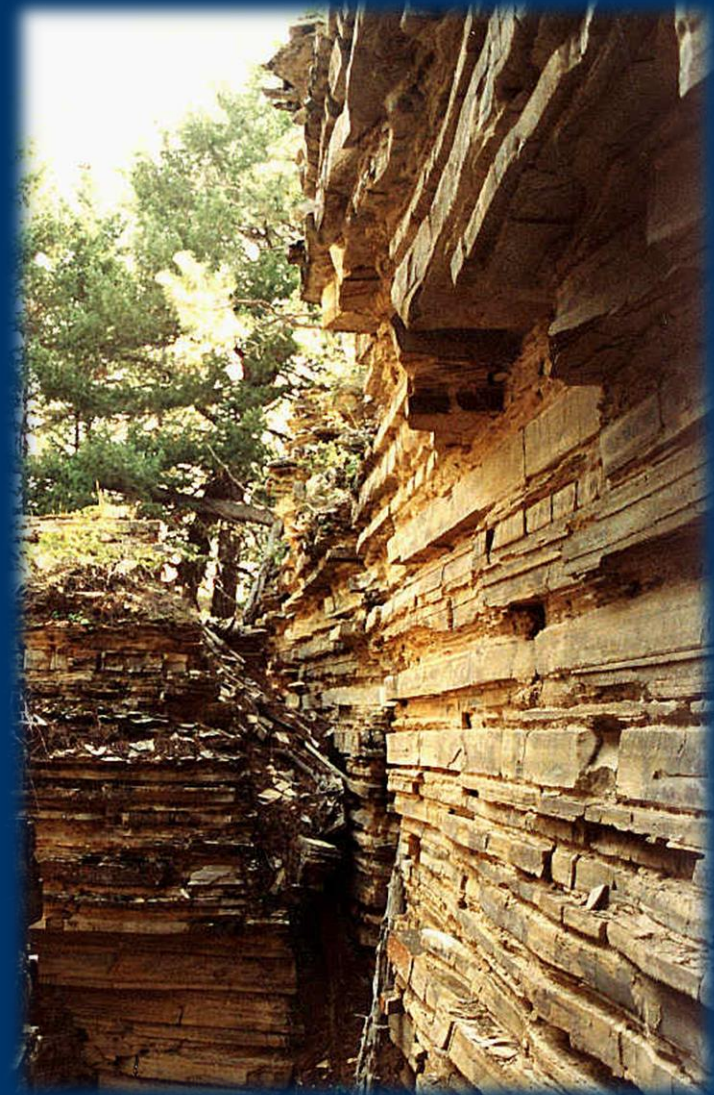
Today's Oceans

60.0%	Chondrichthyan	3.4%
32.8%	Actinopterygian	96.0%
4.8%	Coelacanth	0.004%

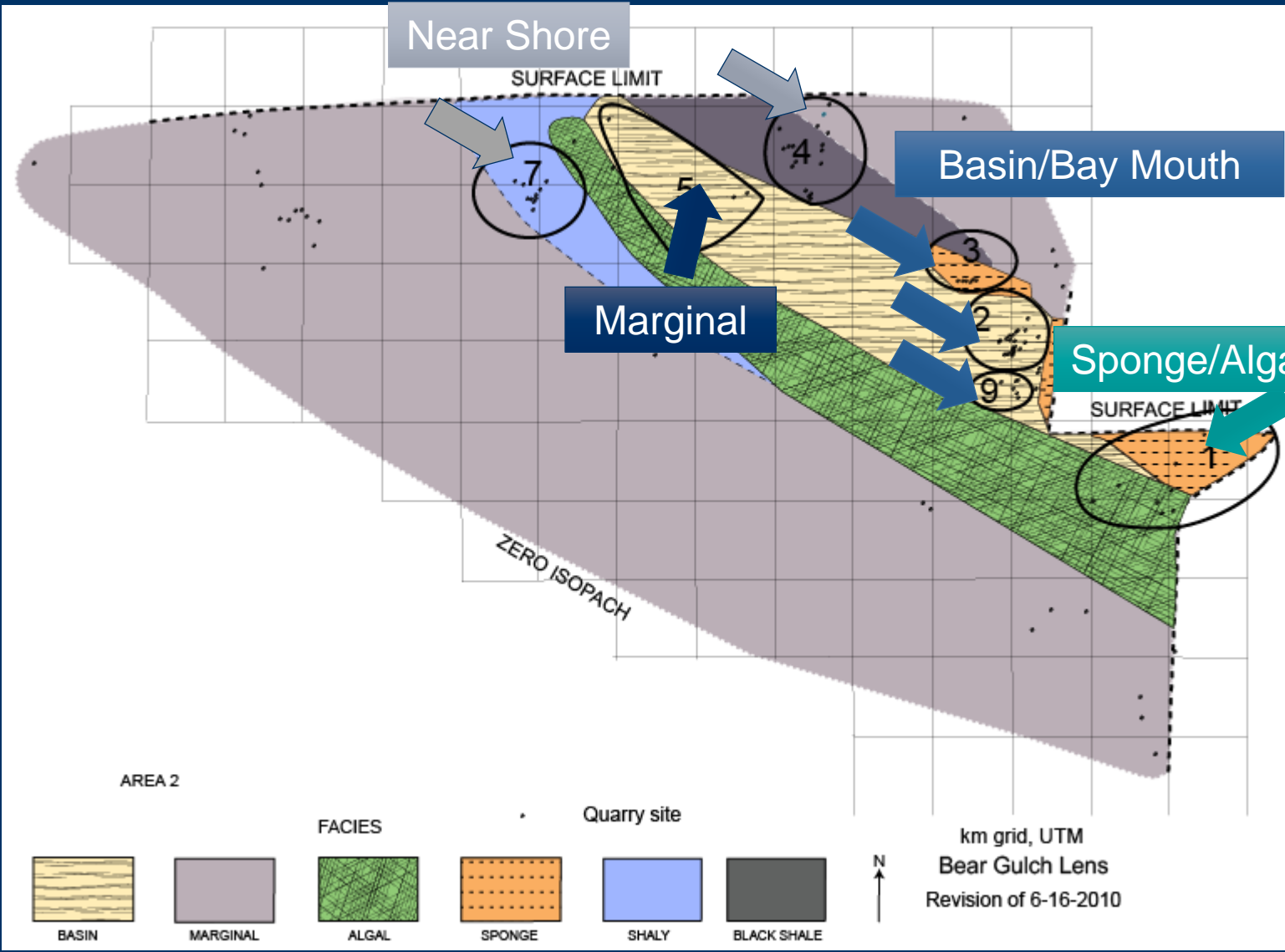
How is that diversity partitioned across the bay?

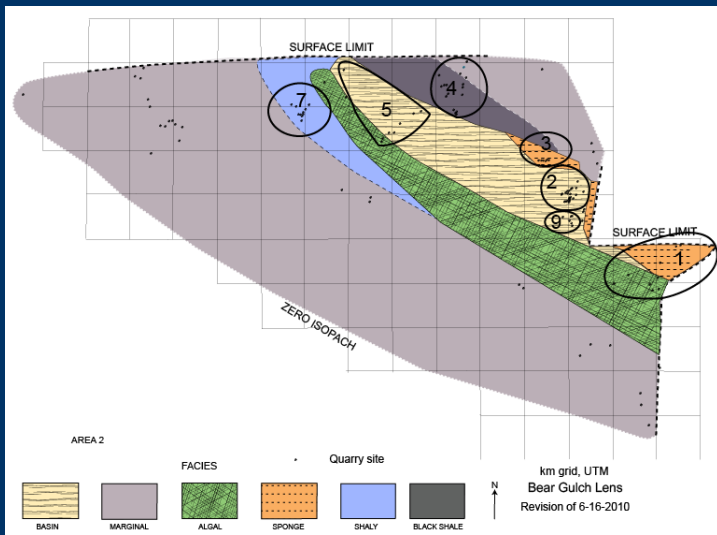
- within an individual habitat (α)
- changes in diversity across habitats (β)
- within a region (γ)

What ecological and evolutionary process drive the assembly or generation of that diversity?



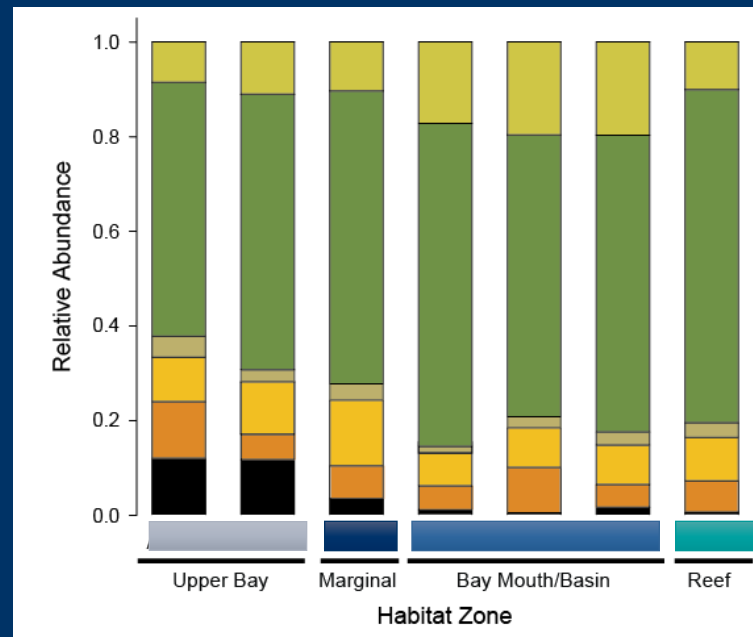
44 quarry sites
 7 habitat zones corresponding to 4 marine environments.





Assemblage different from modern.

- ✓ Bony fish dominate.
- ✓ Sharks most speciose.



Osteichthyes
37% species

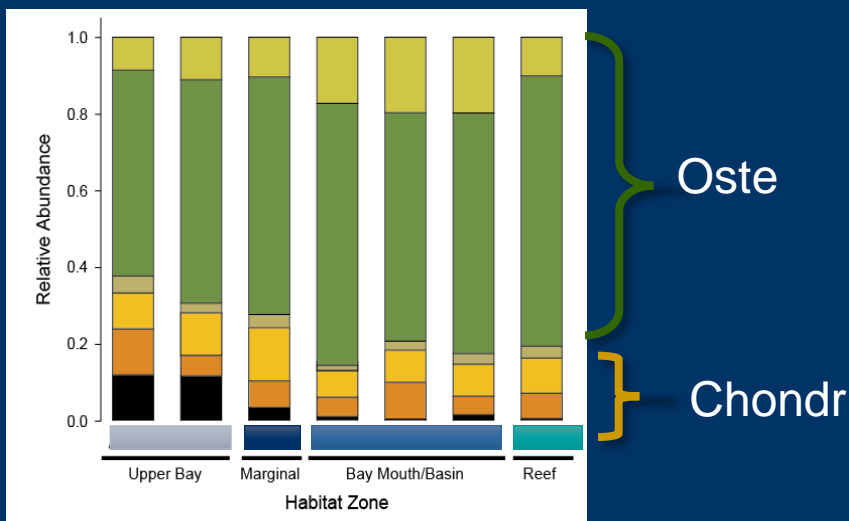
Chondrichthyes
62% species

A rare opportunity for paleo-ecological study.

How is that diversity partitioned across the bay?

- within an individual habitat (α)
- changes in diversity across habitats (β)
- within a region (γ)

What ecological and evolutionary process drive the assembly or generation of that diversity?



- within individual habitat (α)
- changes in diversity across habitats (β)
- within a region (γ)

α -diversity varies across the bay

γ -diversity varies across the bay.

- Genus richness significantly varies across broad environmental zones (Near Shore, Basin, Reef)
- For both sharks and bony fish, rare taxa are distributed randomly across the bay
 - High β -diversity
 - Community assembly driven by: exploitation of specialty resources, broad geographic ranges, ecological role (apex predator)
- For both sharks and bony fish common taxa show characteristic distribution patterns
 - Low β -diversity within broad environmental zones
 - High β -diversity between broad environmental zones
 - Community assembly driven by environment and ecosystem

The Scientific Value of the Bear Gulch Deposit

Unique window into the marine life during the Upper Carboniferous

Diversification and Interrelationships of Fishes

- * early bony fishes
- * coelacanth diversity
- * sharks and their relatives



Sharks

Sexual Dimorphism, Reproductive Behavior
Data Impacts Classical Theories on the

- evolution of jaws
- evolution of modes of reproduction
- stem chondrichthyan condition



Ecological analyses, Community structure, Niche Partitioning



Thank you, VIMS Community!!



Thank you, Jack!!!

