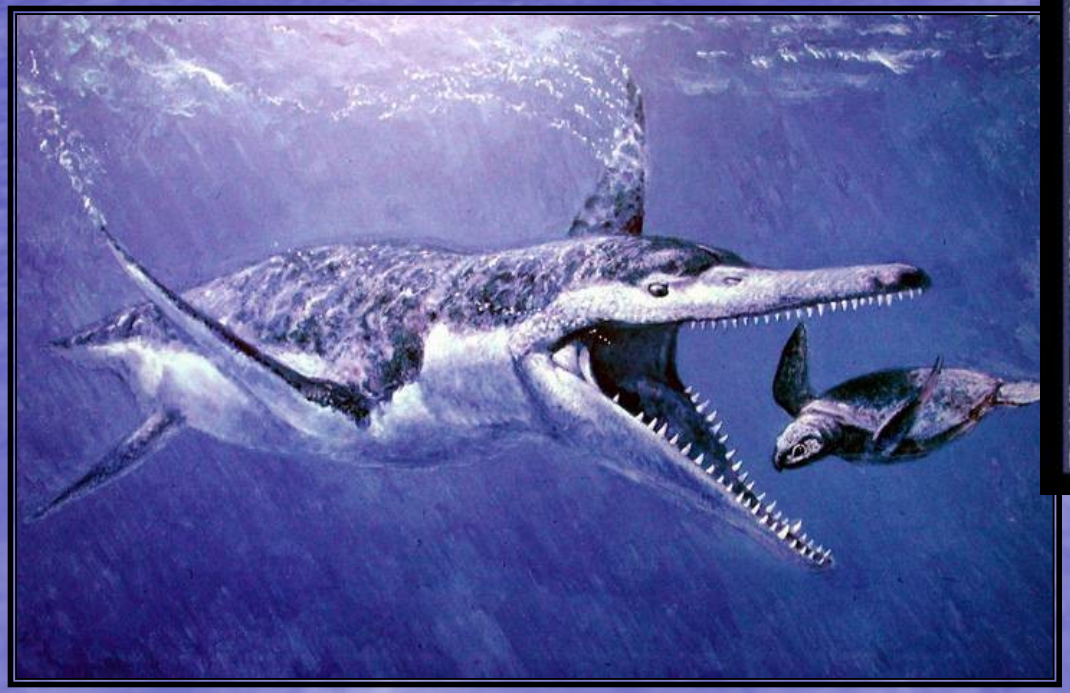
Pliosaurs and Mosasaurs

Continuing From Last Time…

- Pliosauridae: the big marine predators of the Jurassic

Pliosauridae

- Some of the largest marine predators of all time, these middle Jurassic sauropterygians include such giants as *Kronosaurus, Liopleurodon, Macroplata, Peloneustes, Pliosaurus,* and *Brachauchenius*

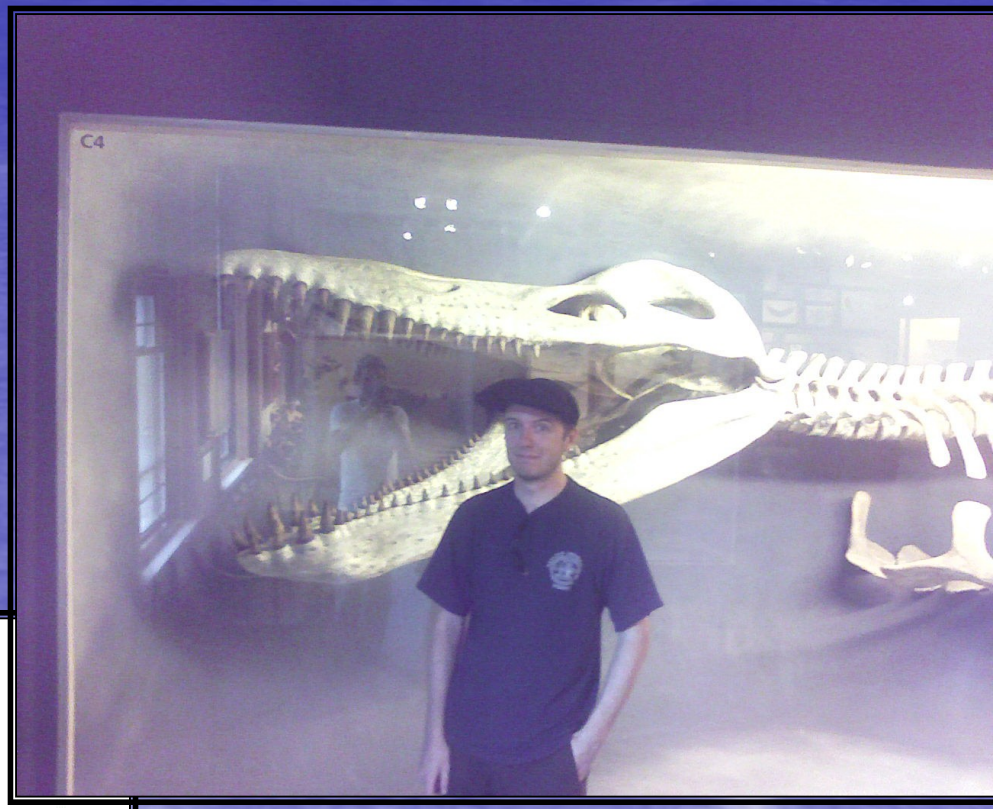


Pliosaur Mophology

- While the number of cervical vertebrae is less than in plesiosaurs, there is still variation: *Macroplata* (29) vs. *Kronosaurus* (13)

Pliosaur Morphology

- Larger pliosaurs adopted a more streamlined body shape, like modern whales, with a large skull and compact neck, and generally the hind limbs were larger than the front, while plesiosaurs had larger forelimbs

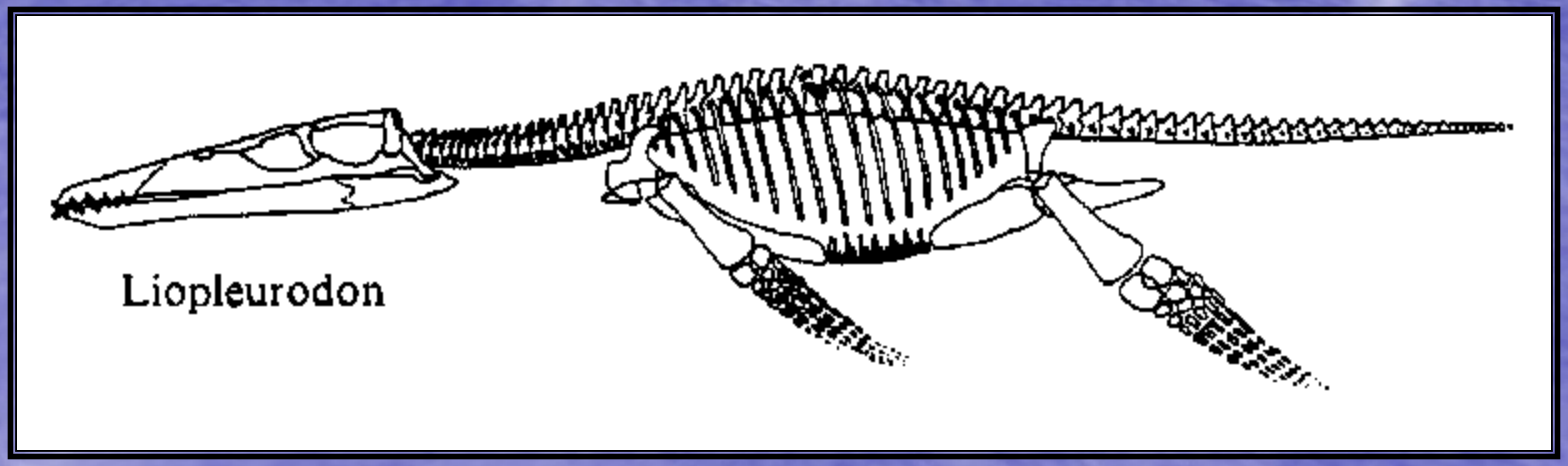


Pliosaur Morphology

- Powerful limb girdles and large (banana sized) conical teeth helped pliosaurs eat larger, quicker prey than the piscivorous plesiosaurs

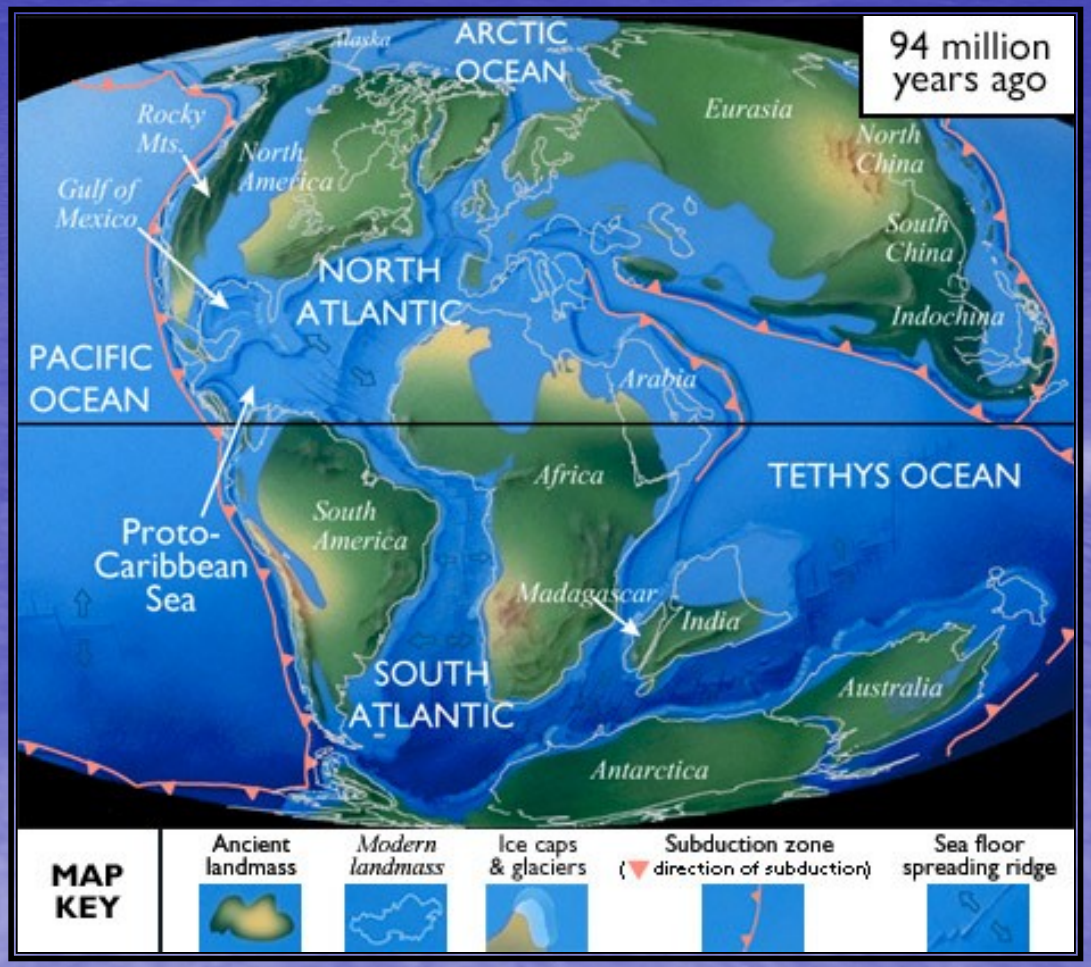
Liopleurodon

- NOT 25 m long in general (average of 40 feet), though perhaps certain individuals could reach that size, making *Liopleurodon ferox* the largest carnivore to ever live
- Recent skull studies indicate that *Liopleurodon* could sample water in stereo through nostrils, locating scents much as we locate sound



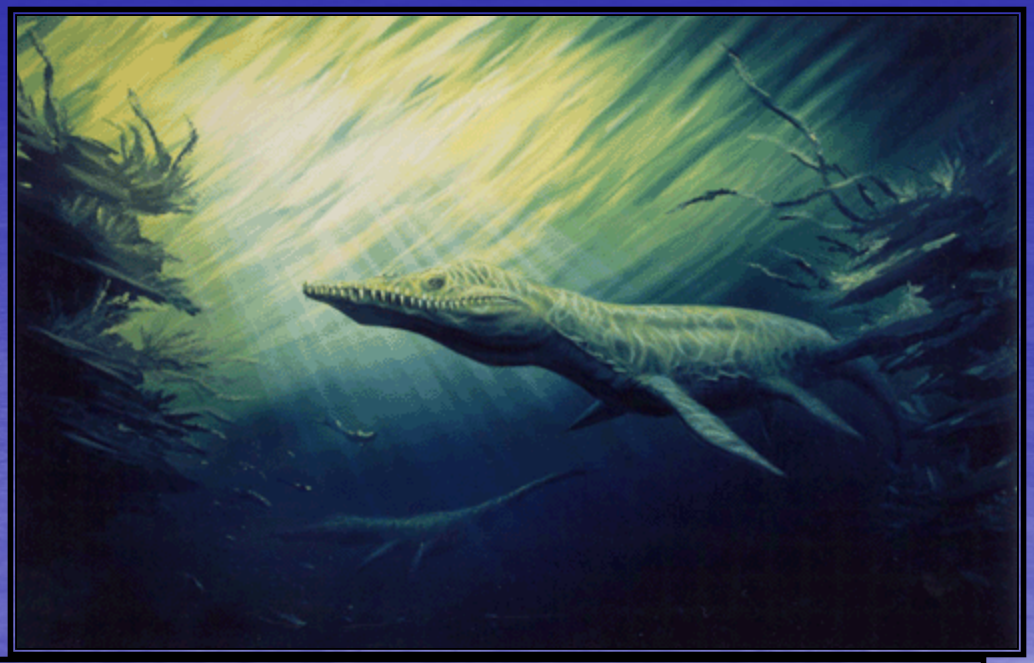
Cretaceous Seas

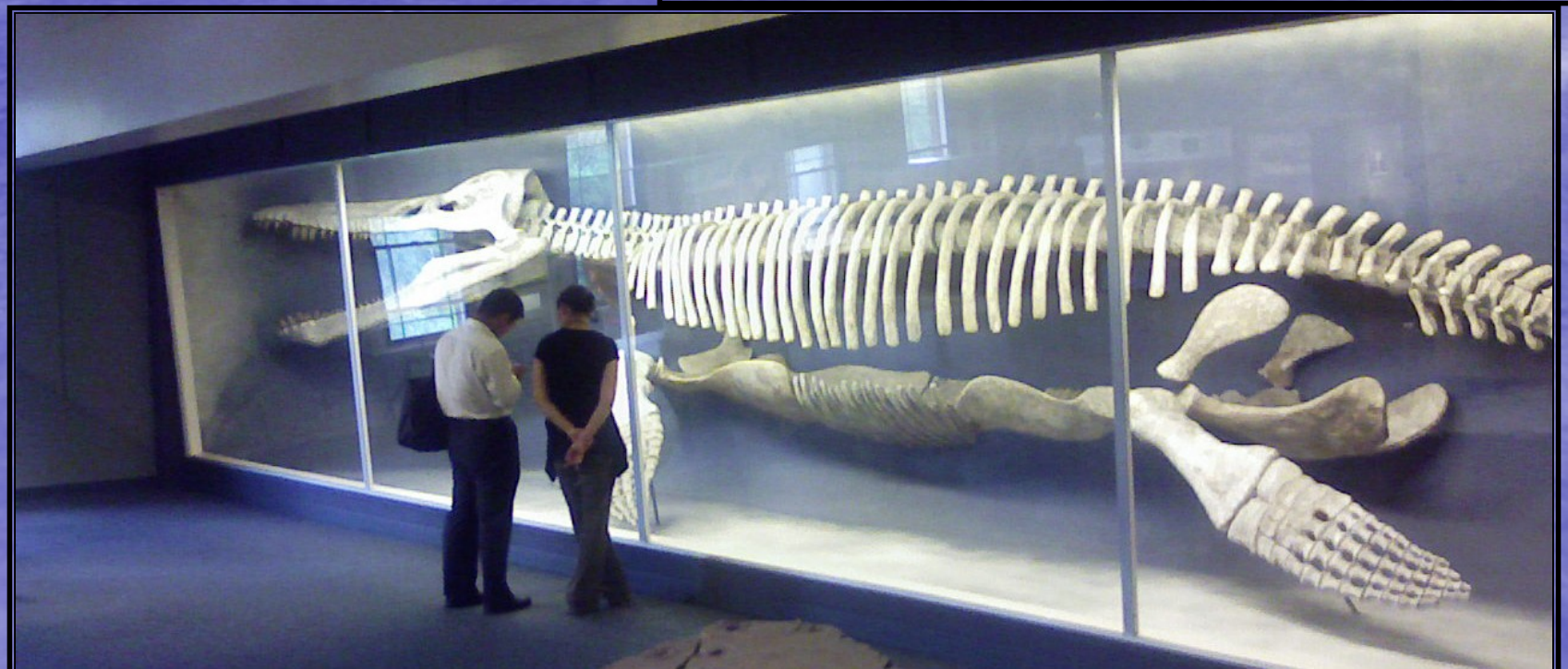
- Breakup of Gondwana causes large undersea mountain chains to form, raising sea levels everywhere
- Shallow seas encourage growth of corals, which increases calcium abundance and chalk formation
- Warm seas and a gentle thermal gradient yield a hospitable environment to rays, sharks, teleosts, and the first radiation of siliceous diatoms



Kronosaurus

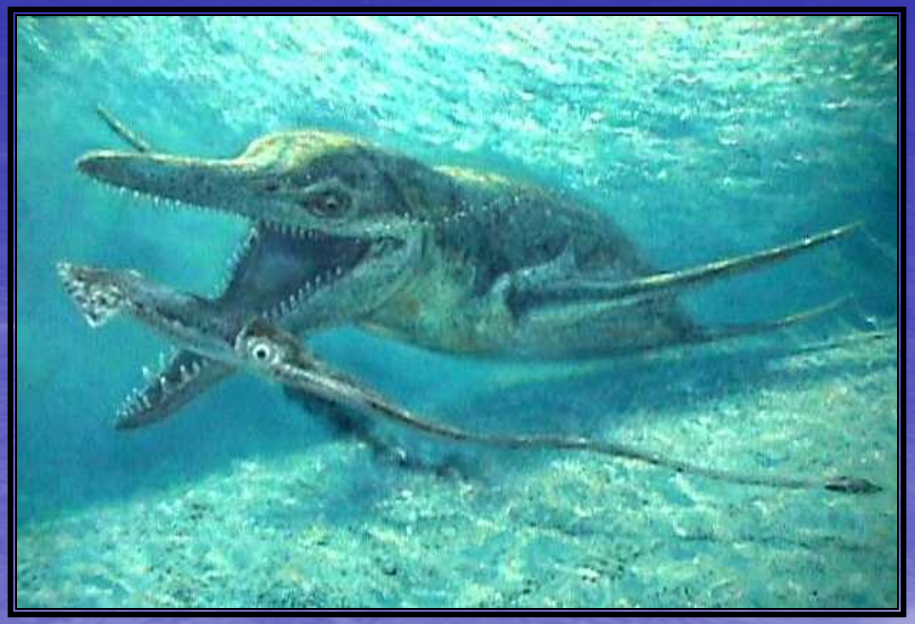
- Early Cretaceous Australian pliosaur that grew to 40 feet long

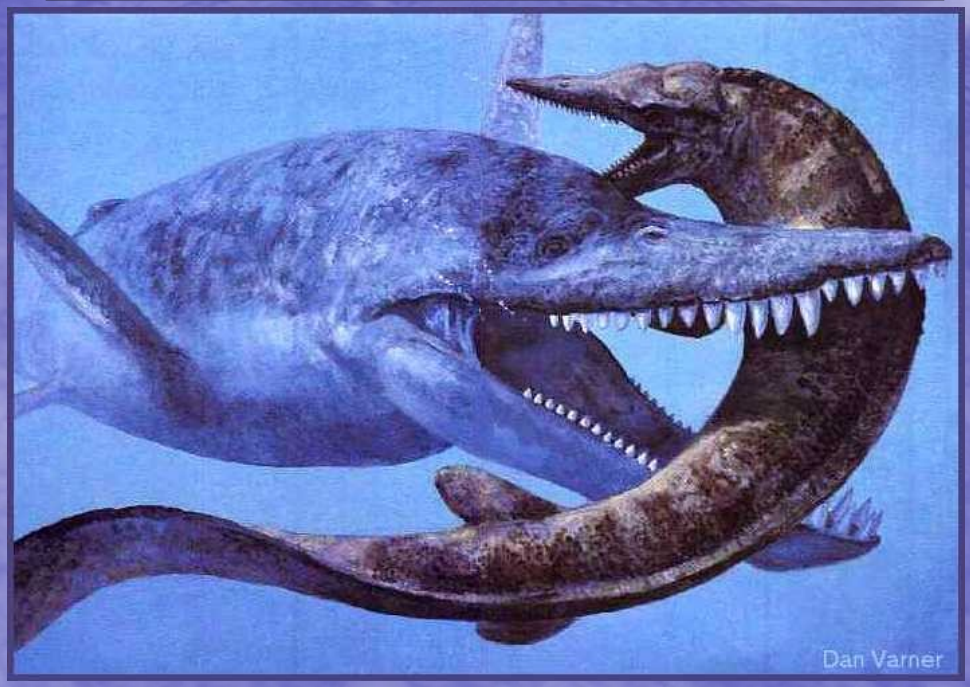




Brachauchenius

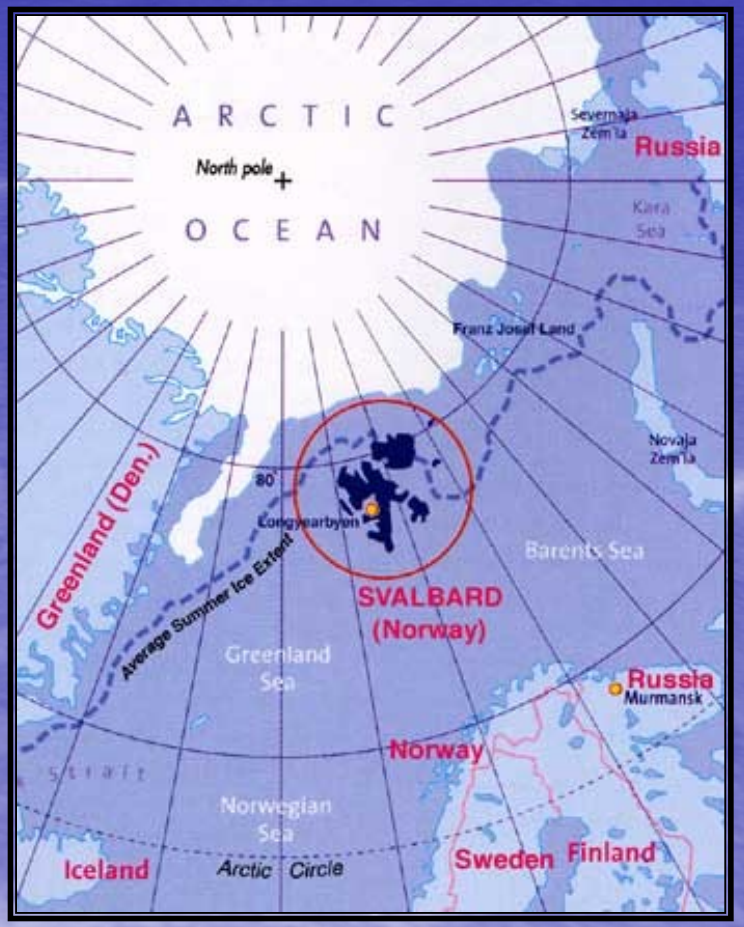
- A 40 foot long Late Cretaceous pliosaur of the Western Interior Sea in North America
- Last known North American pliosaur





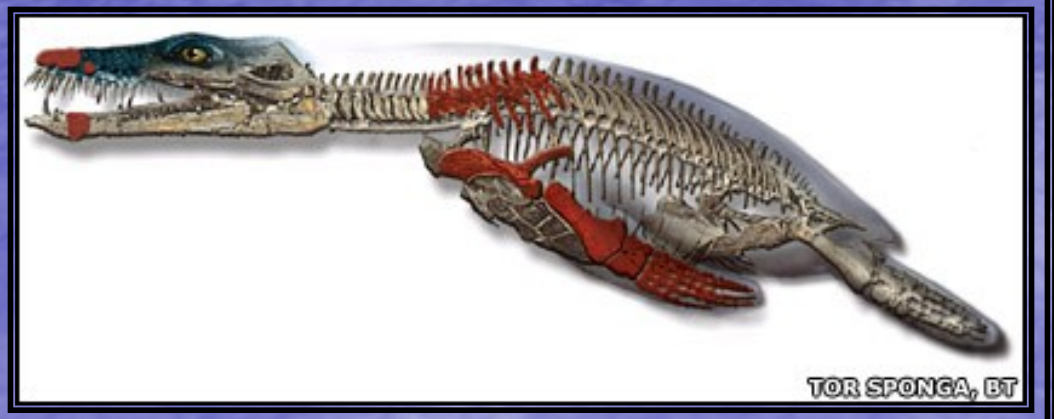
Case Study: The Svalbard Plesiosaurs

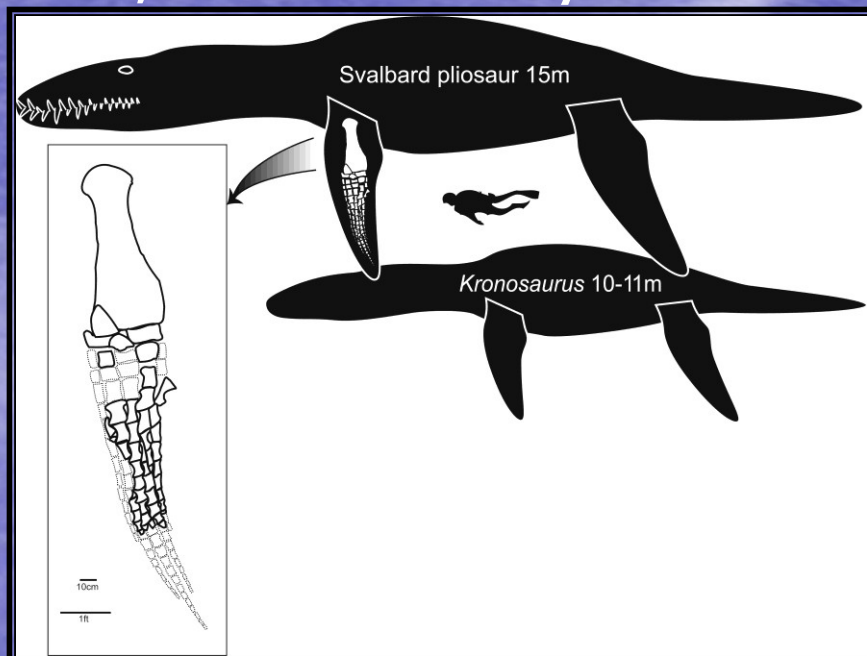
- 2006-ongoing: over 40 marine reptiles have been discovered on the island of Spitzbergen in Svalbard (island group north of Norway)
- 21 plesiosaurs, 6 ichthyosaurs, and two large pliosaurs identified, with fragments of many others



Case Study: The Svalbard Plesiosaurs

- The pliosaur (new unnamed species) is estimated to be nearly 50 feet long, 20% larger than the previous record holding *Kronosaurus* and *Liopleurodon*
- Estimates are made from portions of the skull, ribs, teeth, shoulder girdle, vertebrae, and a nearly complete forelimb

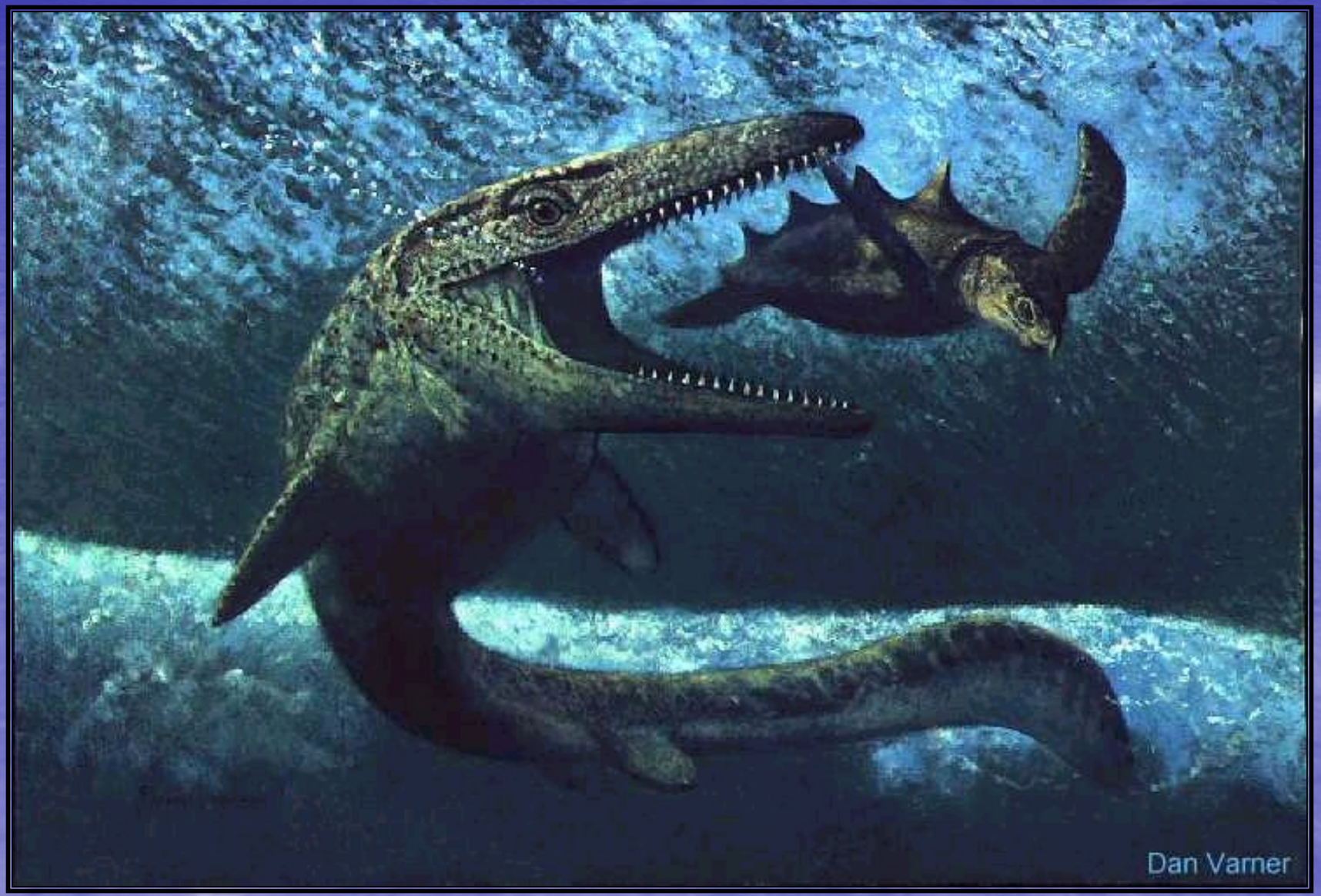




Case Study: The Svalbard Plesiosaurs

- Given what you know about the find, can you reconstruct a likely model for the late Jurassic ecology of Svalbard?

Mosasaurs



Mosasaur Morphology

- Mosasaur limbs were reduced, with flippers being formed by webbing between elongated digits

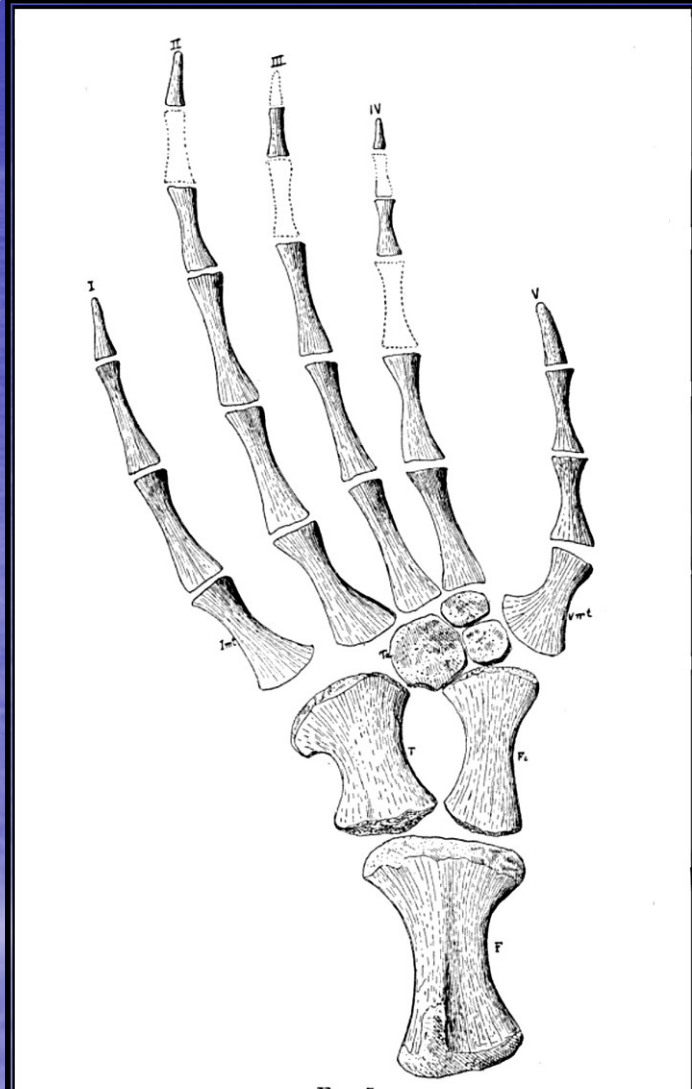


FIG. 5.

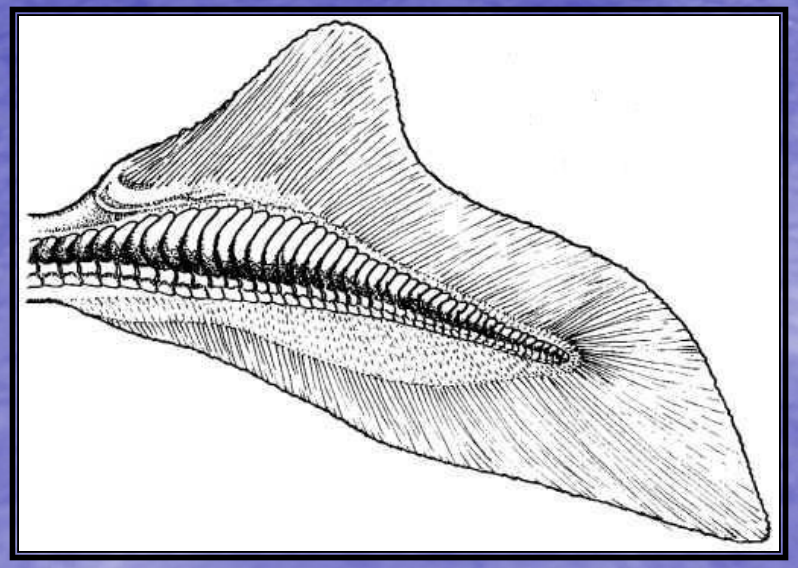
Hind paddle of *Platecarpus coryphæus*, in part after Marsh. *F*, femur; *T*, tibia; *Fi*, fibula; *Ta*, tarsals; *Imt–Vmt*, first-fifth metatarsals; *I–V*, first-fifth digits.

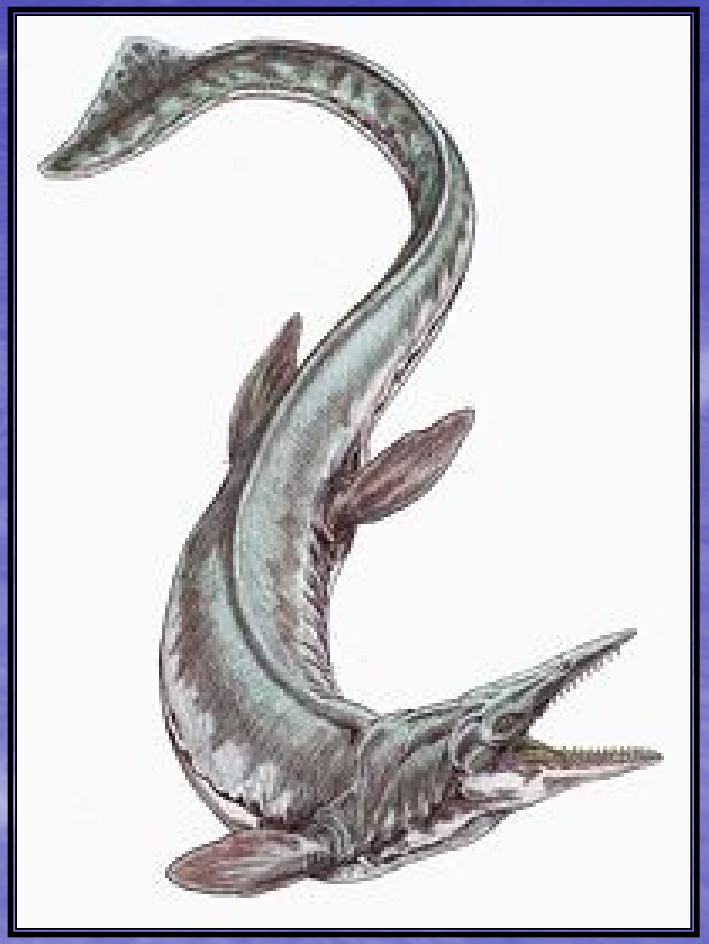
Mosasaur Morphology

- Long, broad, flat tails provided an anguilliform locomotion, which would help in a more ambush-oriented hunting style, much like their Varanid relatives

Mosasaur Morphology

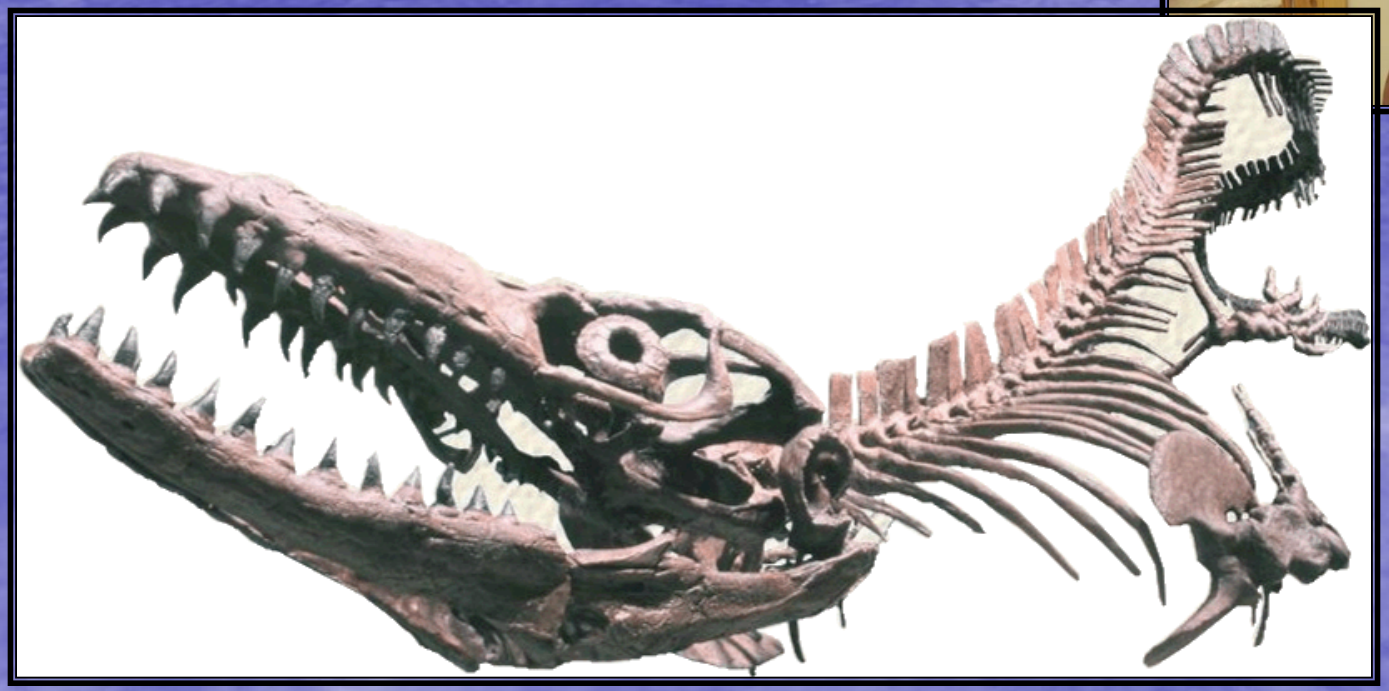
- Recent comparisons of mosasaur post-cranial anatomy to that of sharks by Dr. Johan Lindgren (recently of Berkeley) suggest that advanced mosasaurs possessed a true heterocercal caudal fin (not published yet)





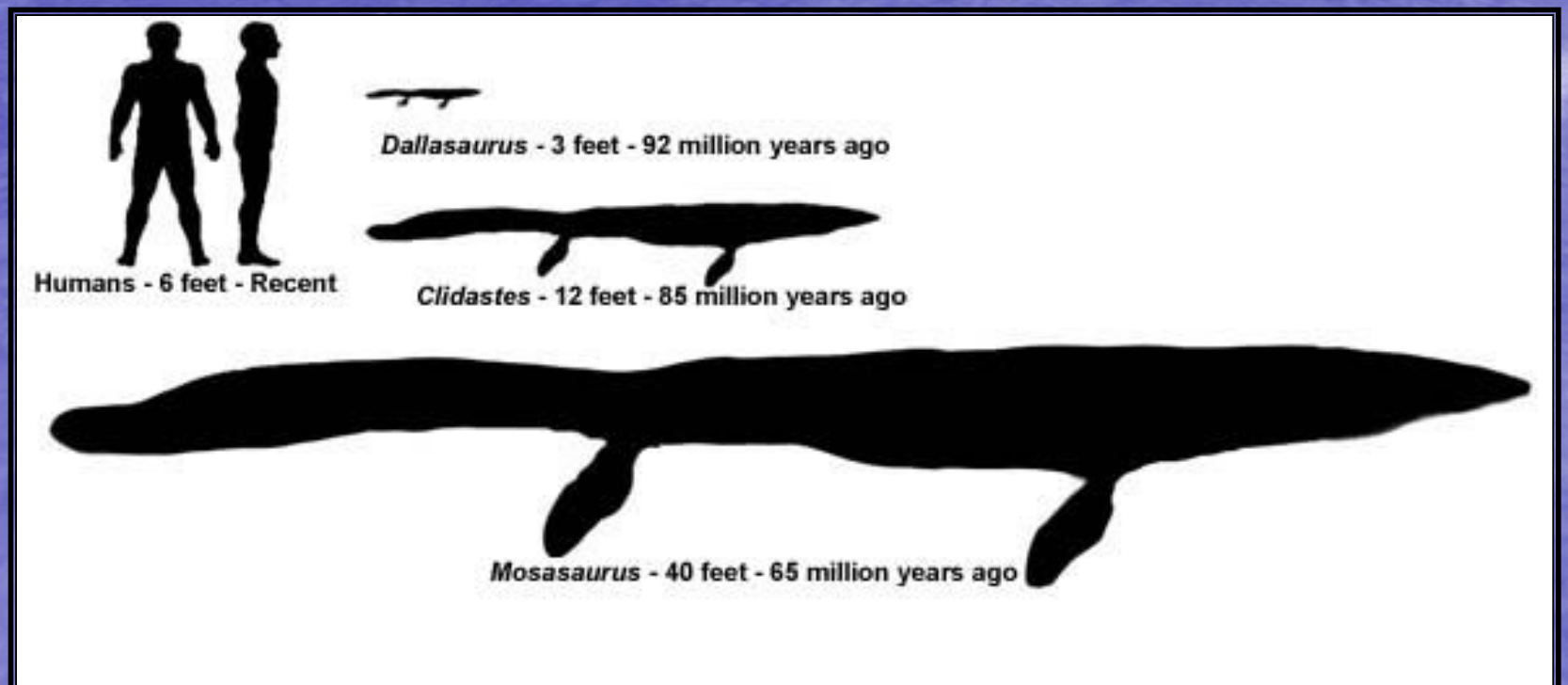
Mosasaur Morphology

- Mosasaurs had a double-hinged jaw with a double row of pterygoid (flanged) teeth on the palate, much like snakes



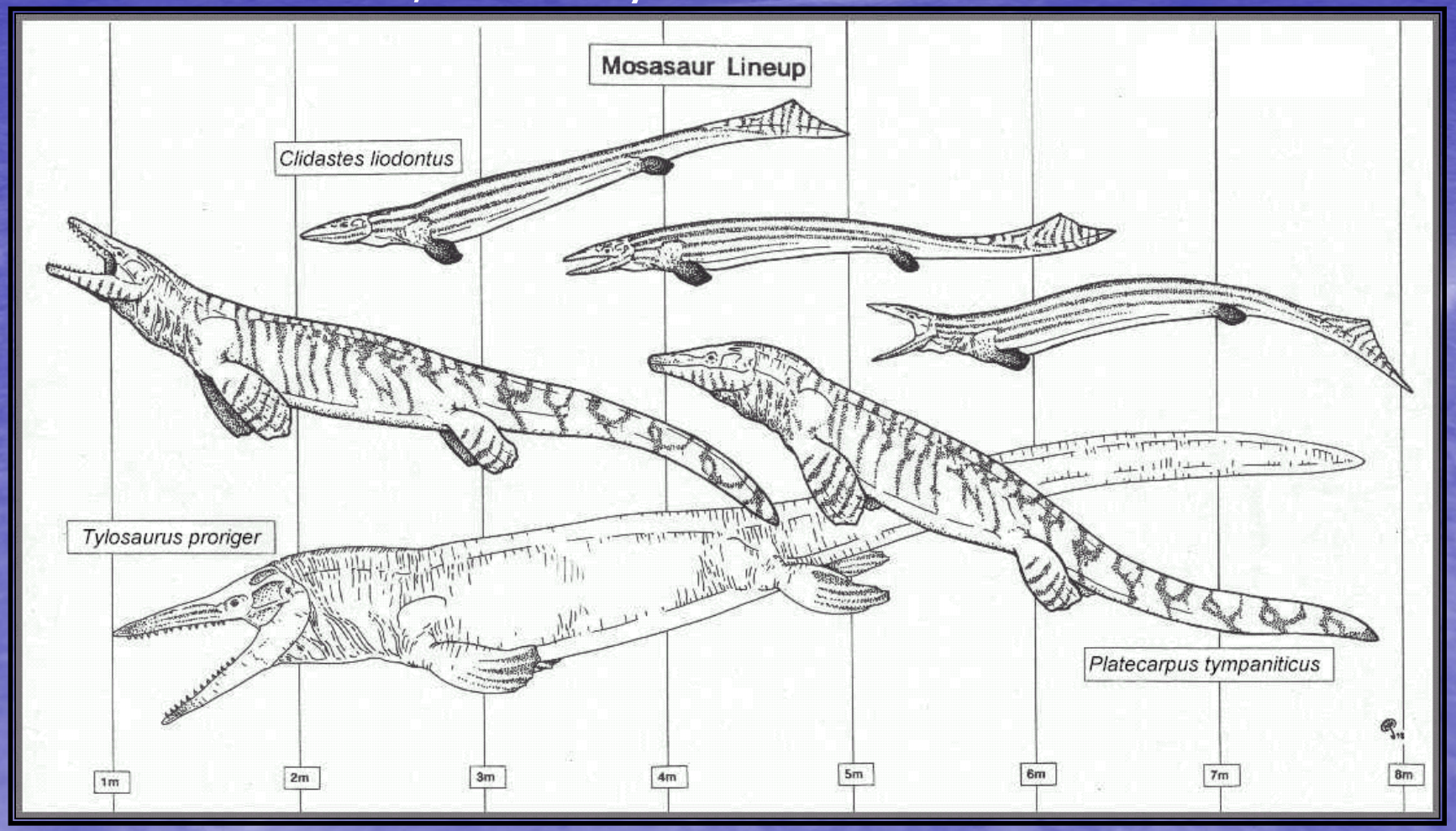
Mosasaur Phylogeny

- Mosasaurs evolved and radiated rather quickly, and became top marine predators in record time



Mosasaur Phylogeny

- Mosasaurs are lepidosaurs, closely related to snakes and Varanid lizards, and they come in several varieties

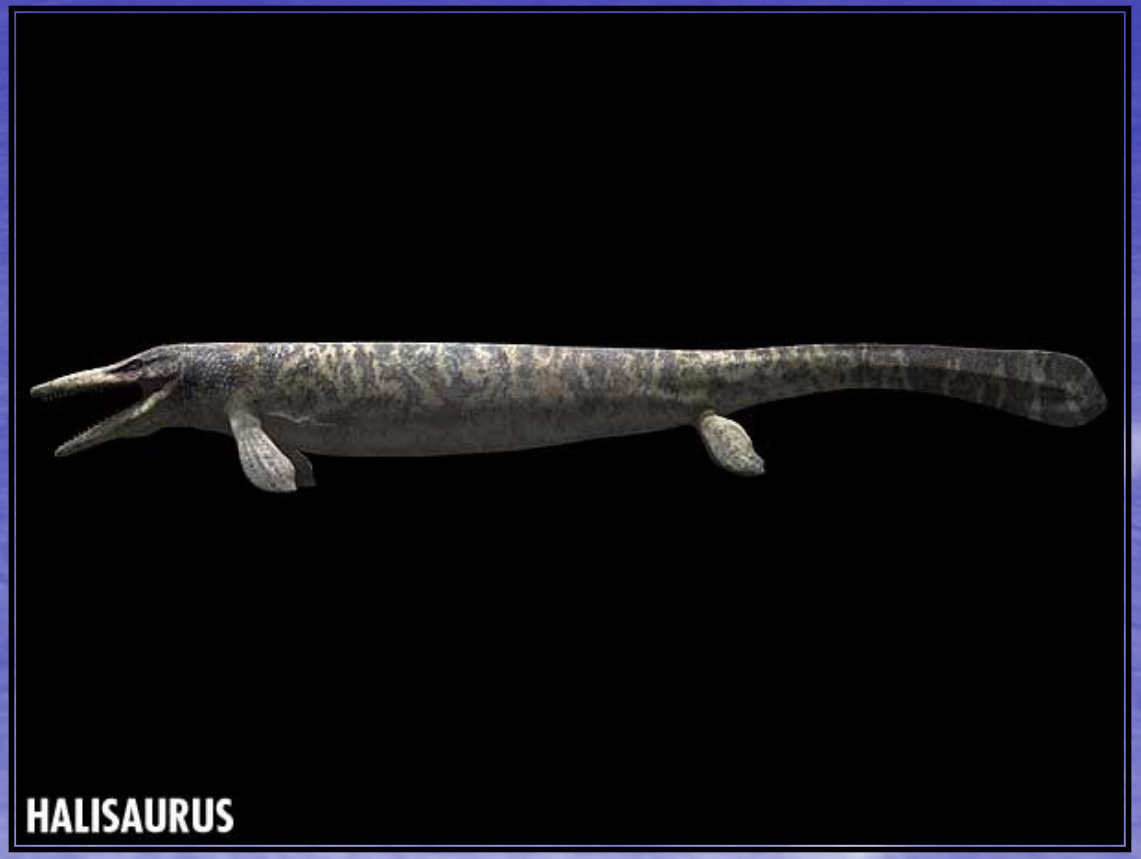


Aigialosaurs

- The most basal Mosasauroideans are the aigialosaurs: small aquatic squamates of the Late Cretaceous

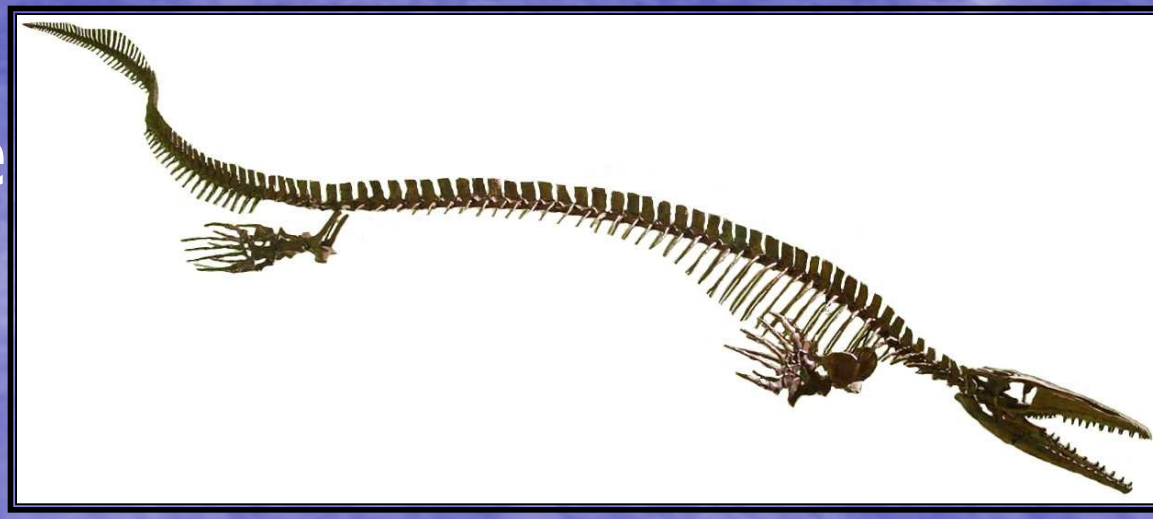
Halisaurinae

- A relatively basal and small offshoot of the mosasaurs, its 12 foot skeletons are often found near ancient shores, indicating that it might have lived as an ambush predator, like Moray eels

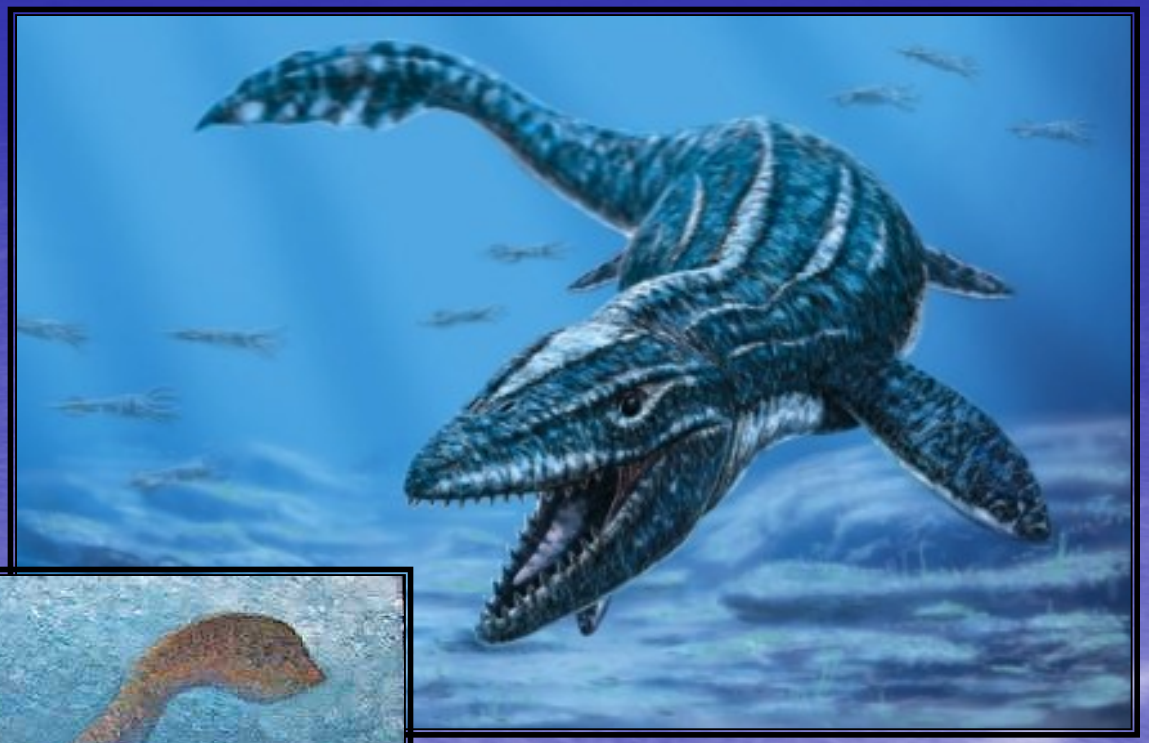


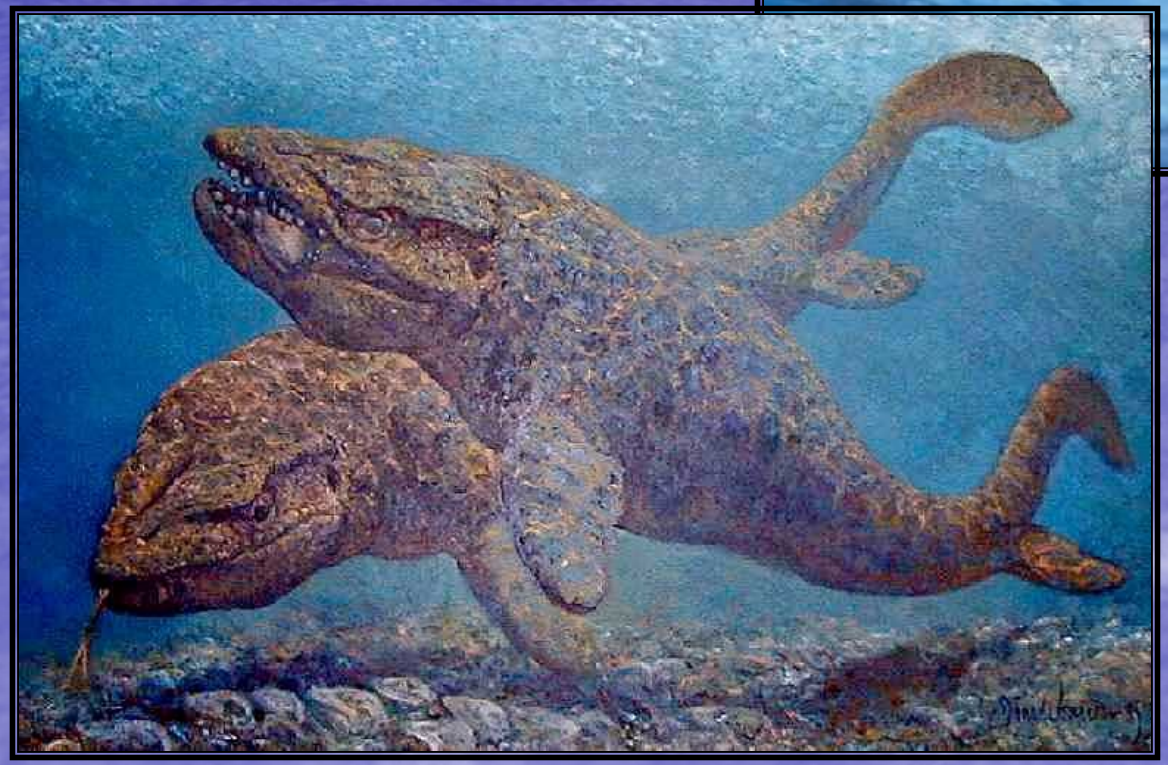
Mosasaurinae

- *Clidastes, Mosasaurus,* and *Plotosaurus* were members of this diverse clade, found on nearly every continent and including the smallest and largest mosasaurs



Globidensini

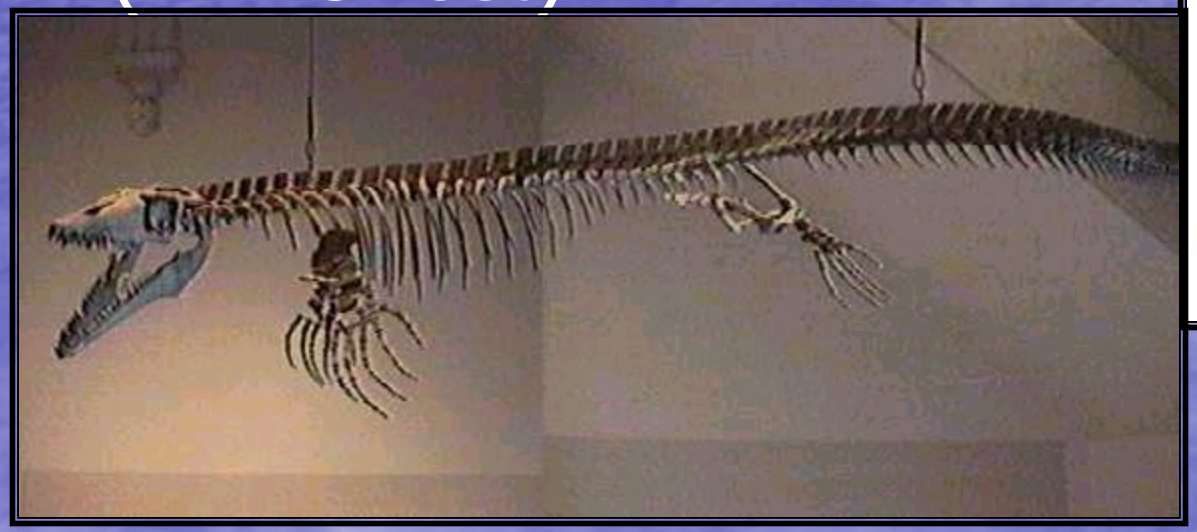


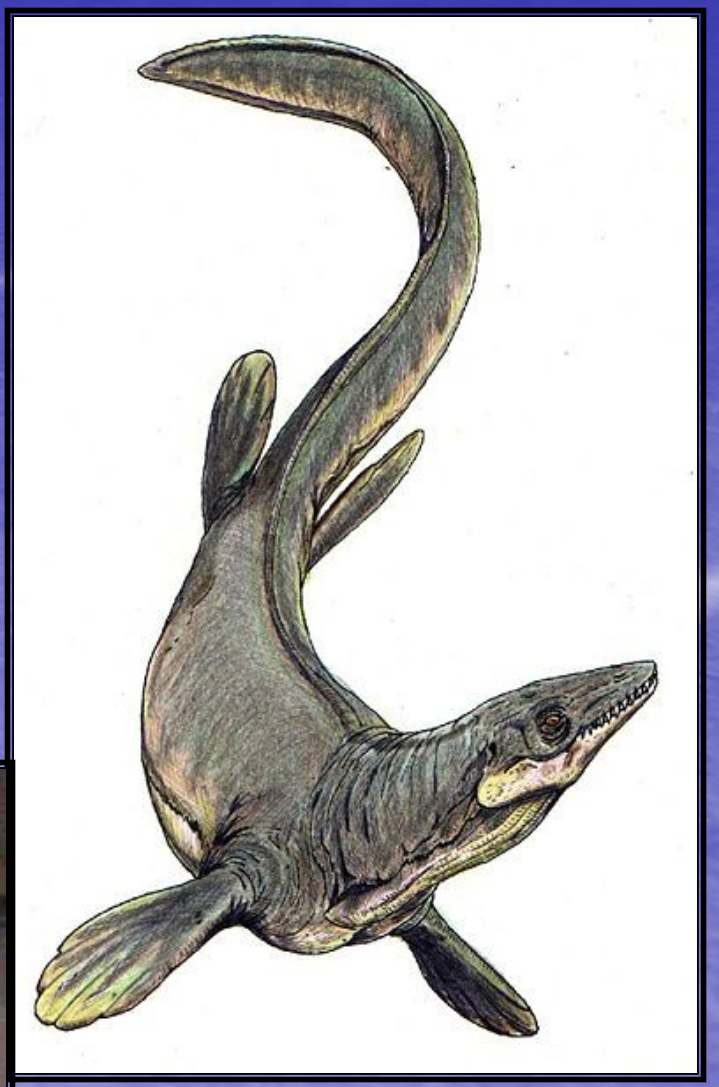


- Some mosasaurs, like *Globidens* and *Prognathodon* possessed round, peg-like teeth used for crushing mollusks and bivalves

Plioplatecarpini

- *Platecarpus* and *Plioplatecarpus* date from the beginning of the Late Cretaceous to the end, and were medium sized (12-25 feet)





The Western Interior Seaway

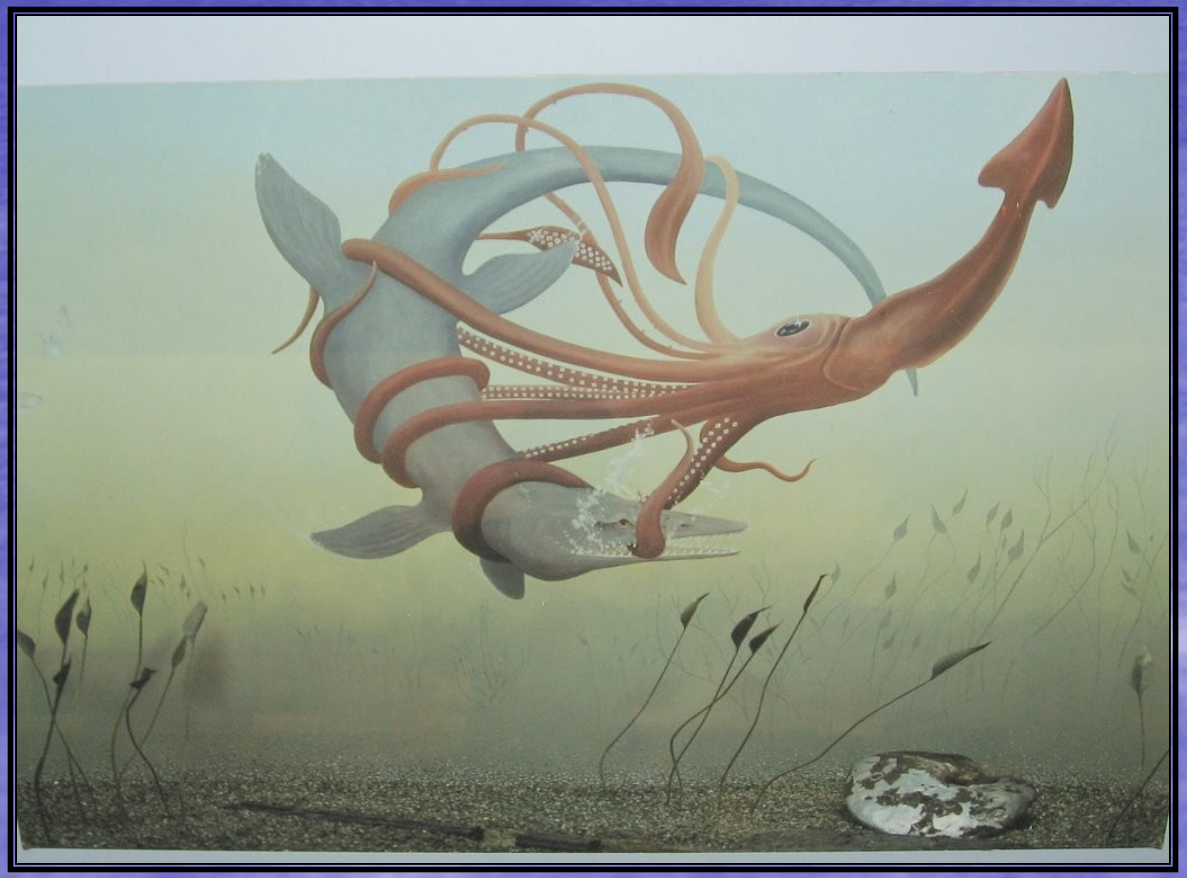
- The middle of North America, from the Arctic Ocean to the Atlantic, was filled with a shallow (200 feet) sea (foreland basin) that promoted varied ecosystems in the late Cretaceous, and laid down the Kansas chalk formation

Mosasaur Ecology

- Mosasaurs were almost certainly viviparous, due to their highly modified aquatic morphology

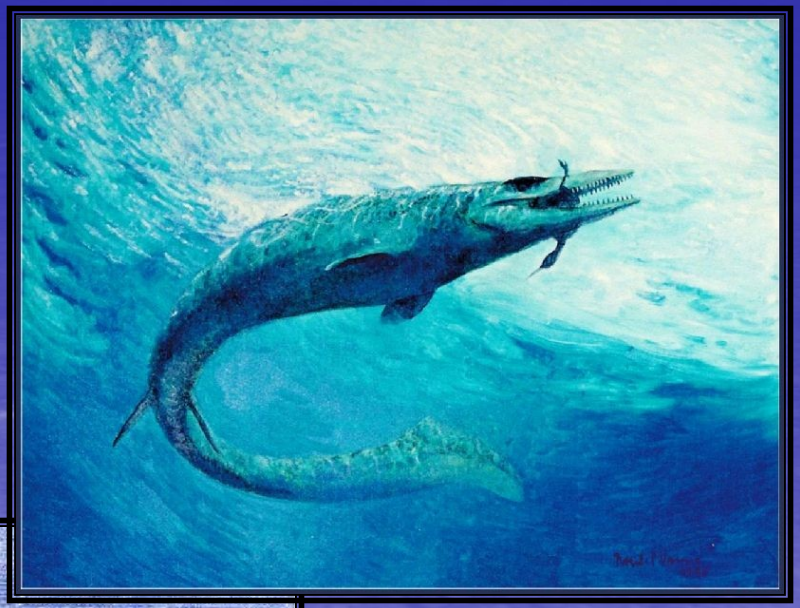
Mosasaur Ecology

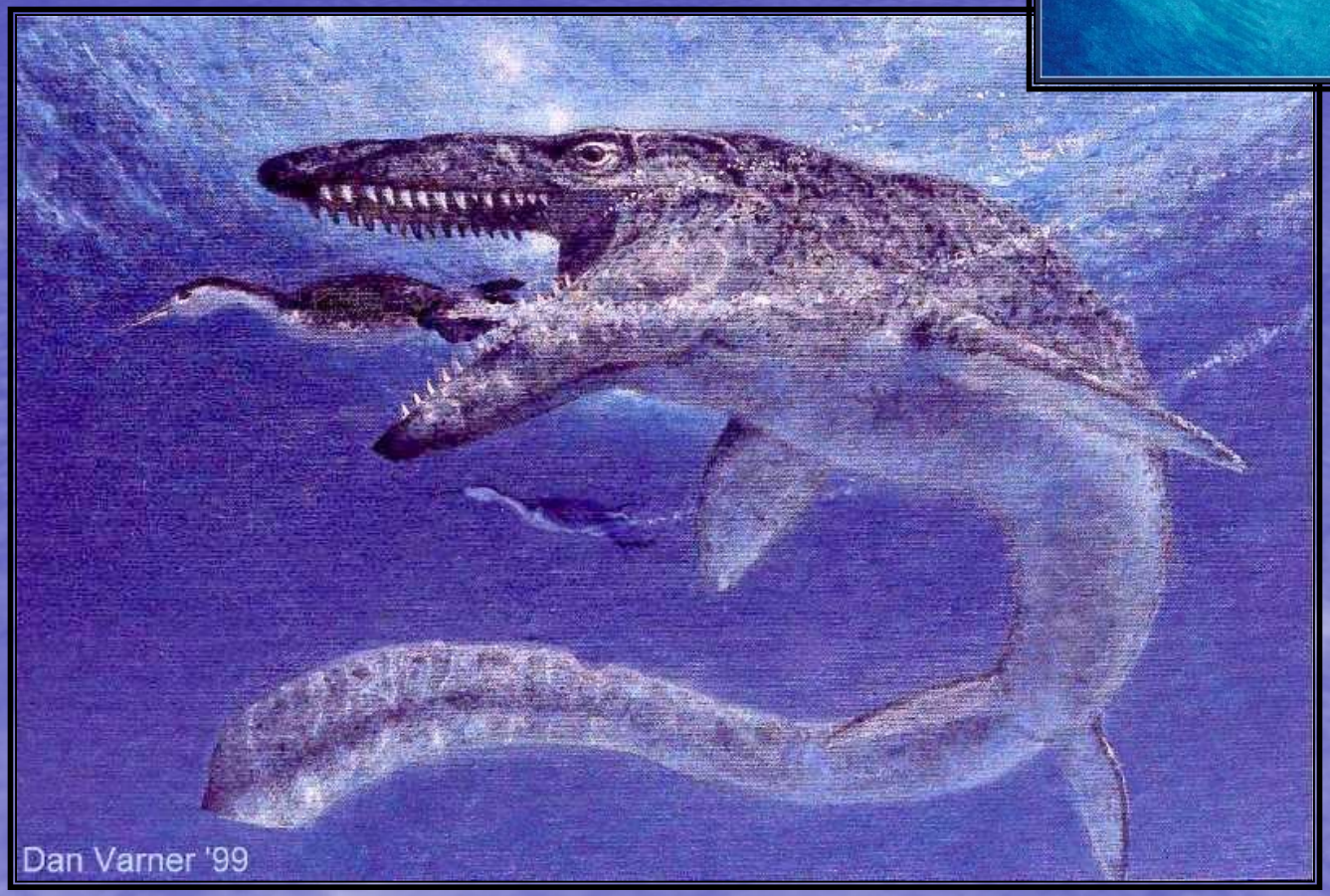
- The double-hinged jaw and kinetic skull of mosasaurs enabled them to gulp down prey nearly whole, and so it is easy to identify stomach contents, like squid (hooks/beaks),



Mosasaur Ecology

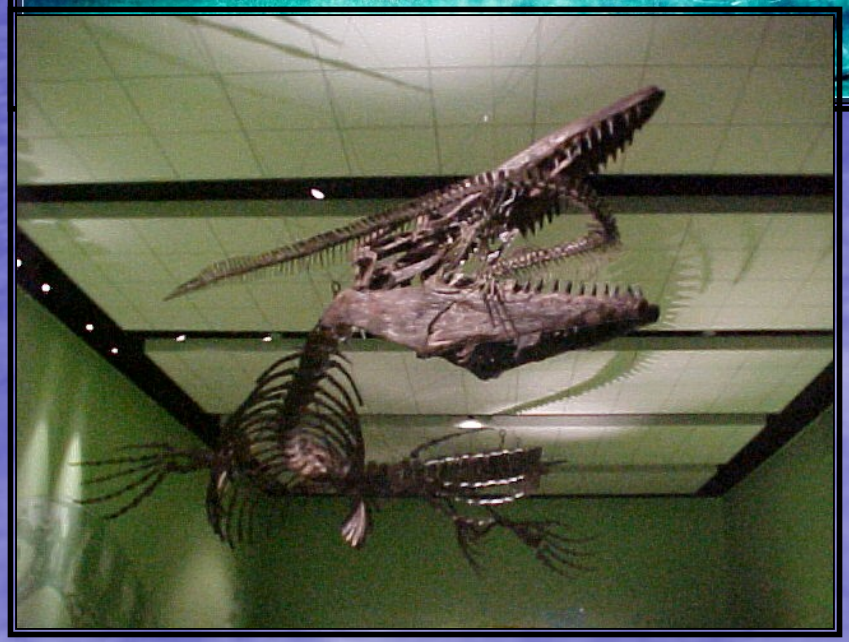
the diving bird *Herperornis,*





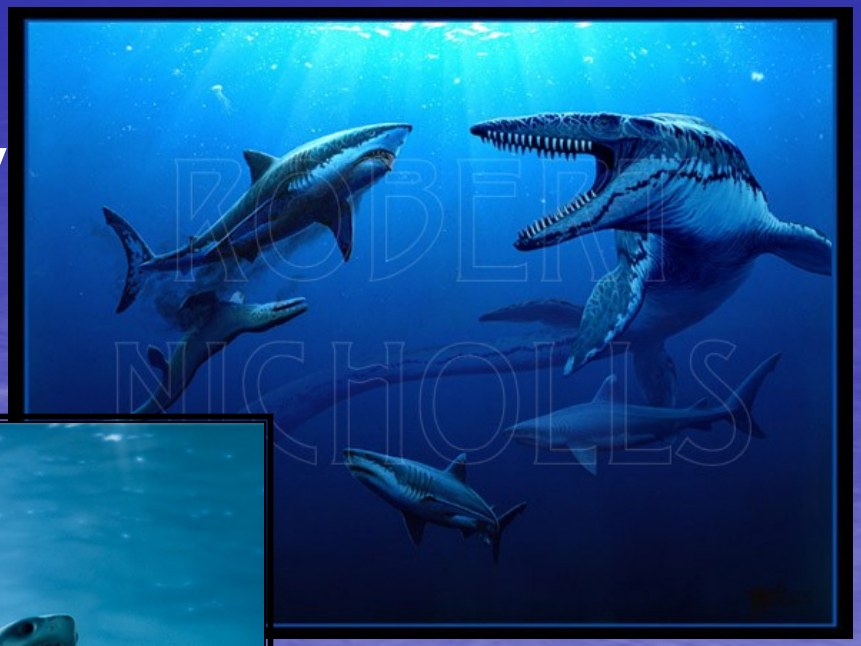
Mosasaur Ecology

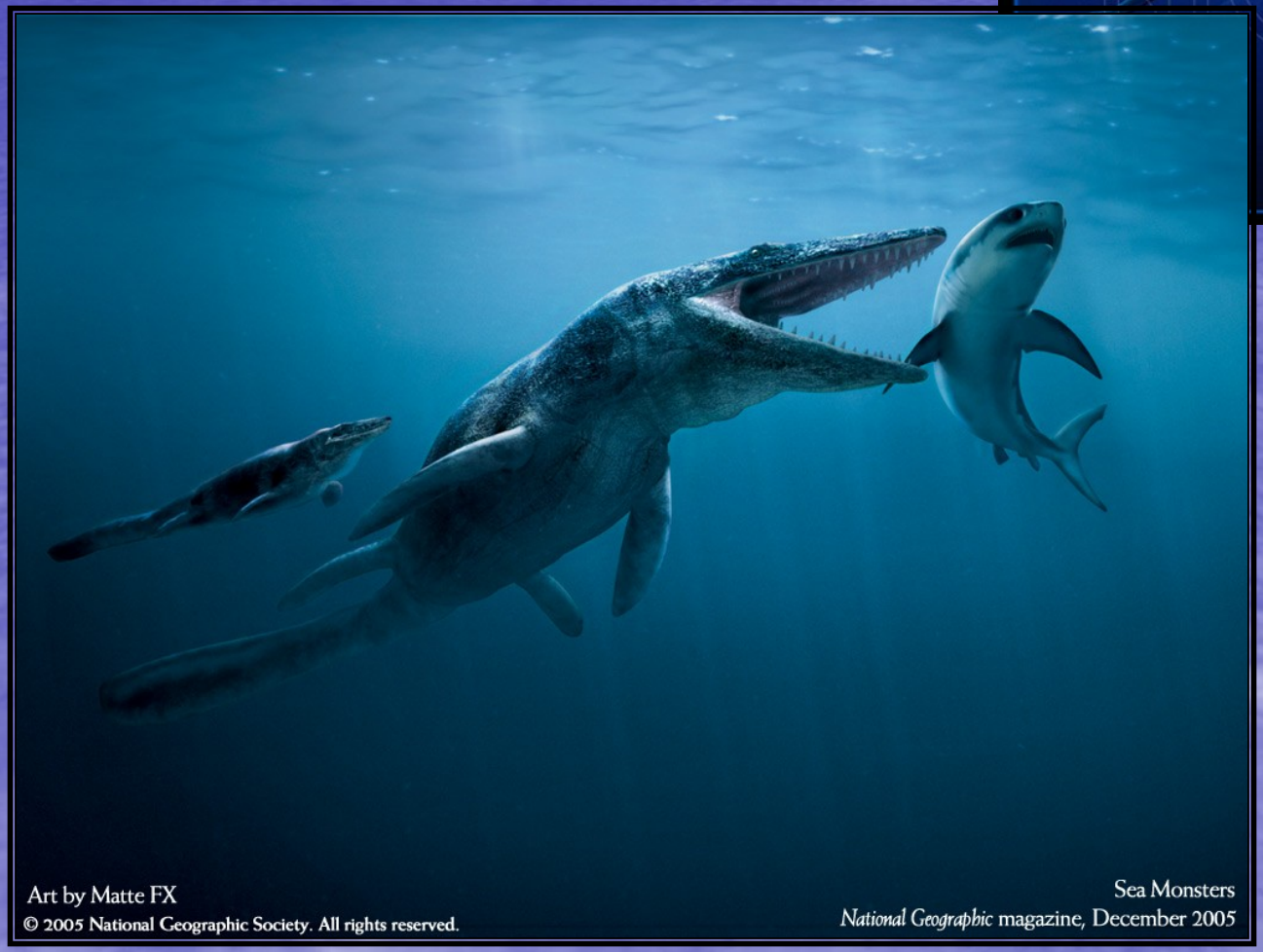
other mosasaurs,



Mosasaur Ecology

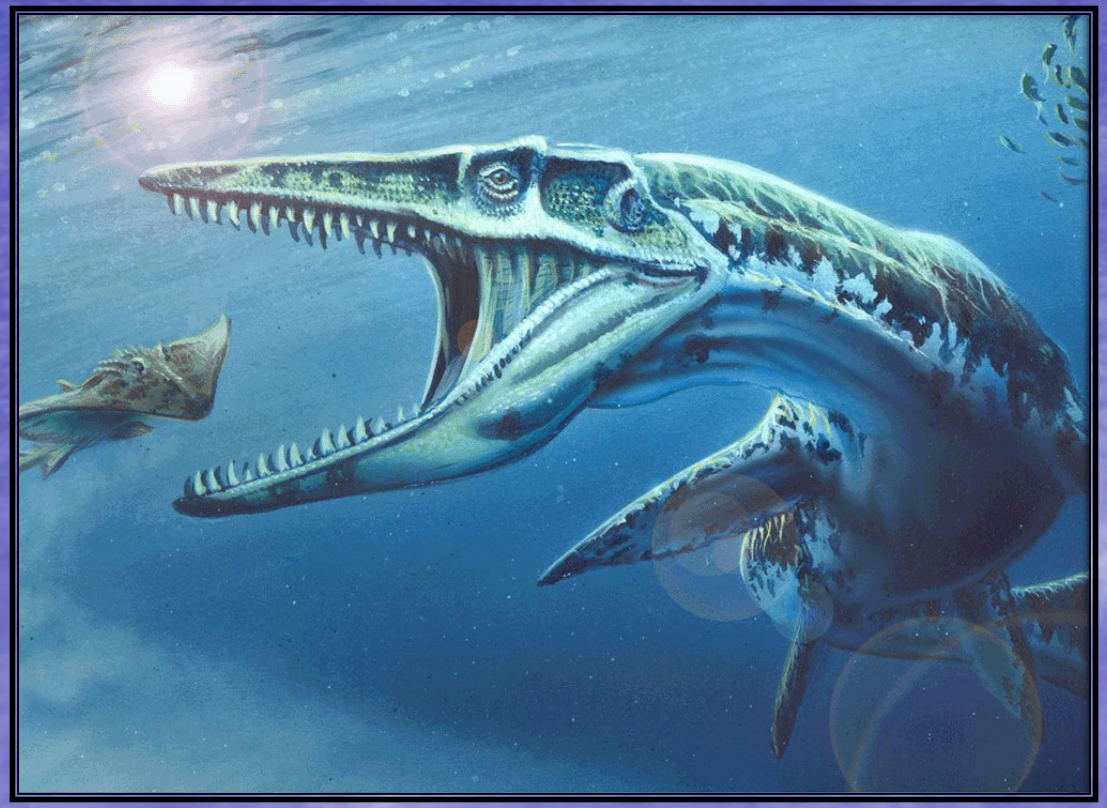
sharks,





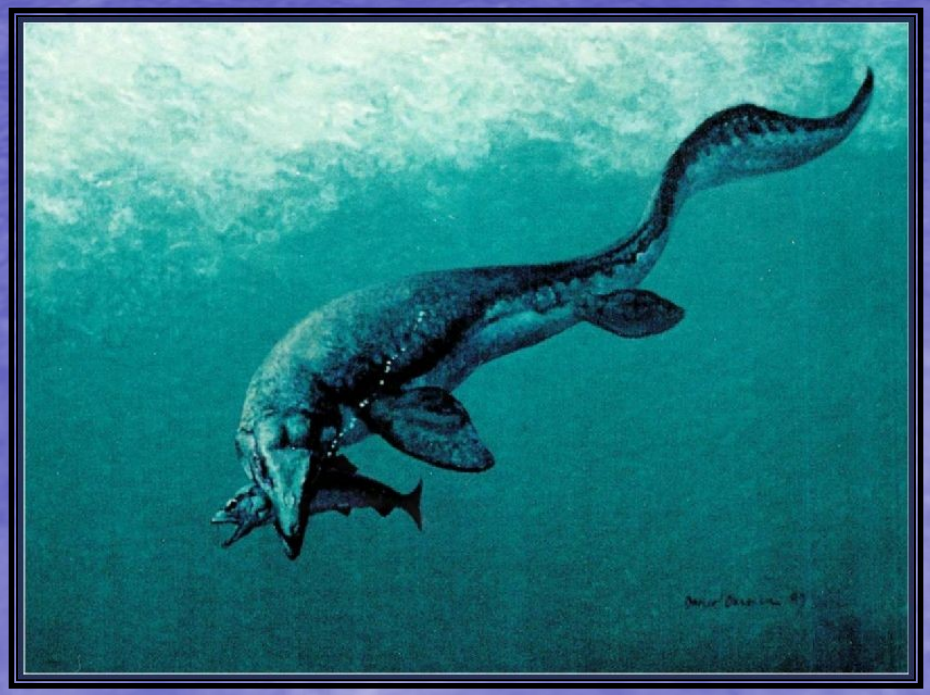
Mosasaur Ecology

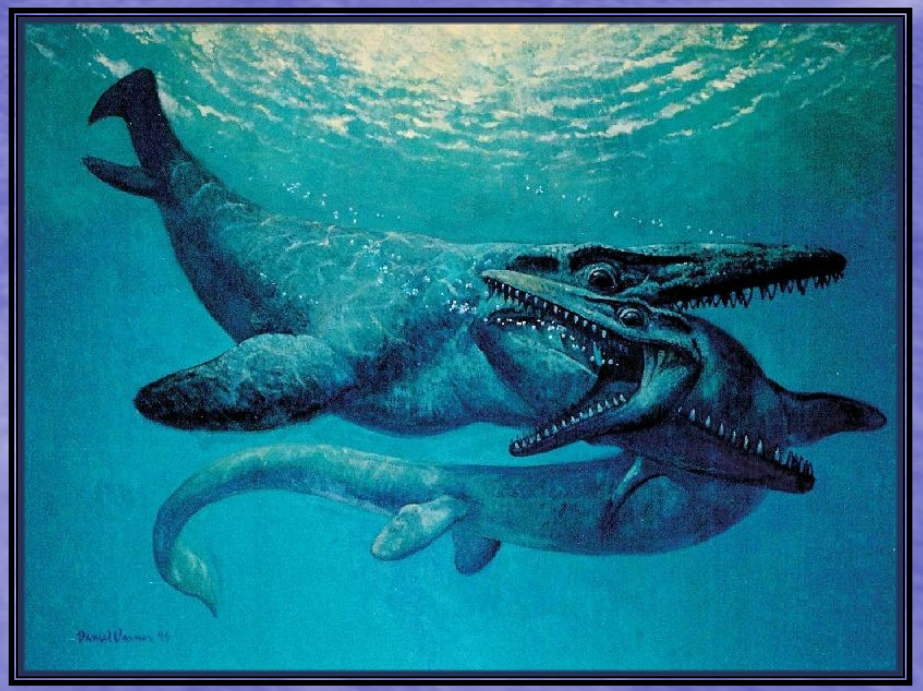
fish, rays, turtles, and even pterosaurs



Mosasaur Ecology

- We have to remember, though, that while mosasaurs were the dominant marine predators of the Late Cretaceous…





Mosasaur Ecology

shark tooth marks indicate that they lived in a food *web*, not a food *chain*

Mosasaur Ecology

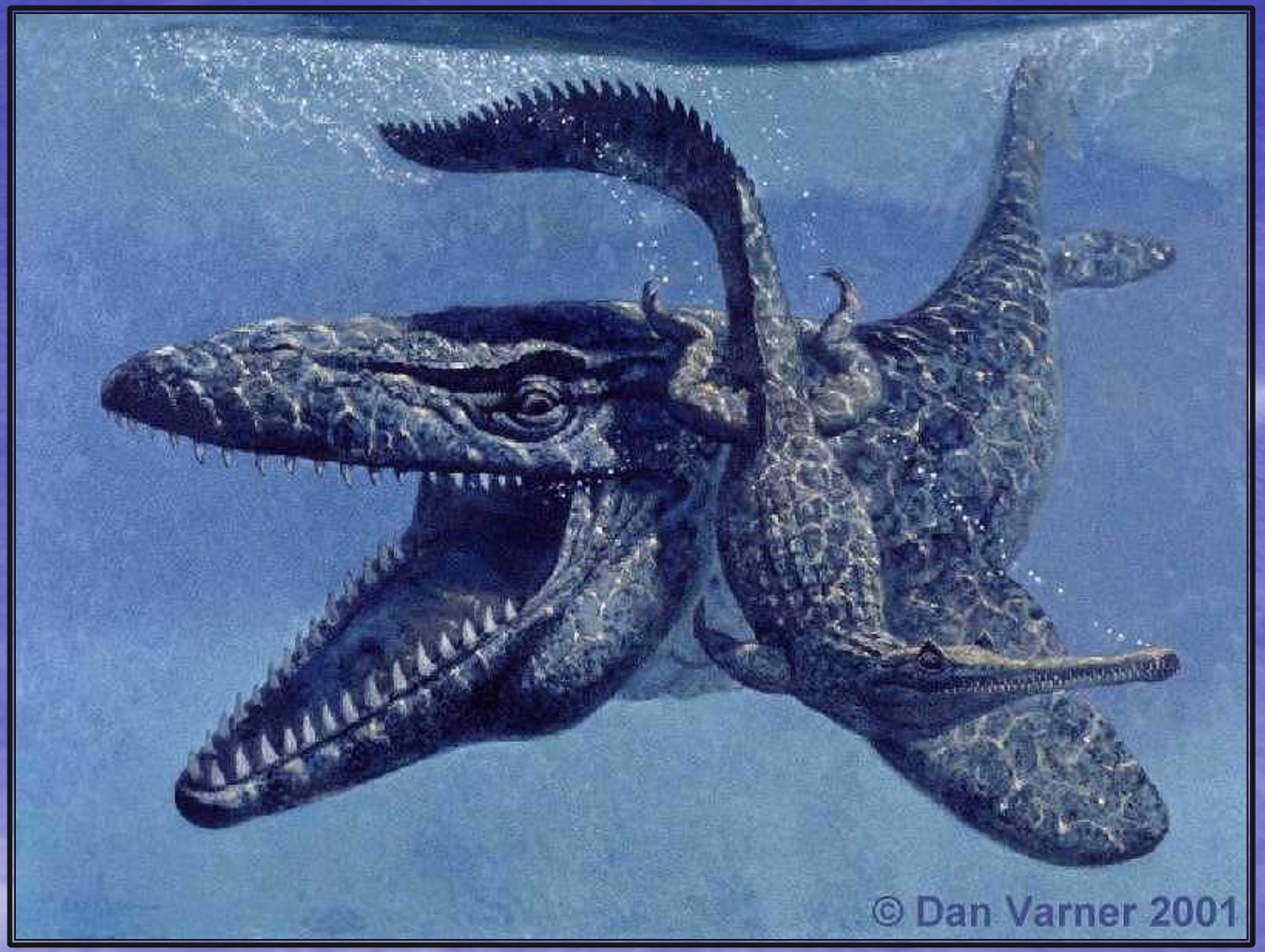
- *Squalicorax* and *Cretoxyrhina* made regular meals of smaller mosasaurs

Mosasaur Ecology

- Some mosasaur skeletons have damage diagnostic of avascular necrosis, commonly known as "the bends" from diving too deep

Mosasaur Ecology

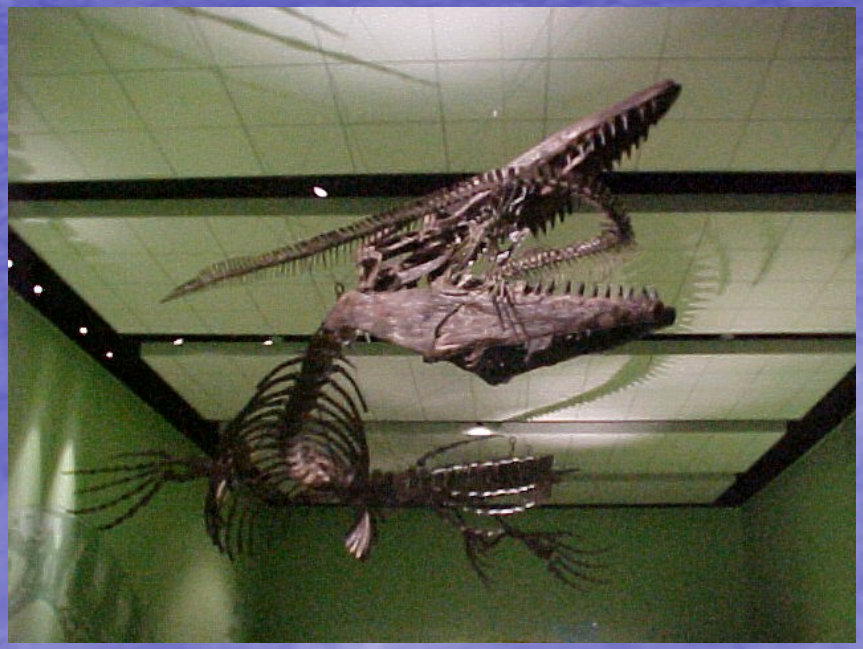
- Mosasaurs were the premier sea predators at the end of the Cretaceous



Mosasaurus with *Thoracosaurus*, a teleosaur

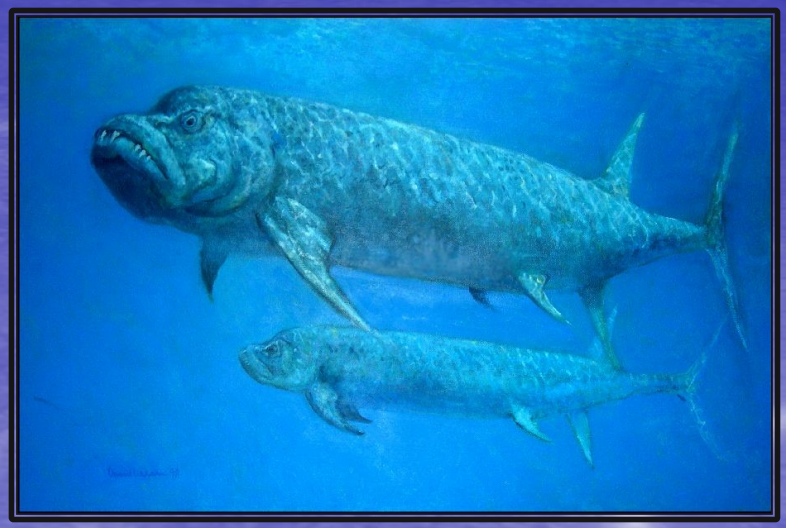
Tylosaurus

- Large (50+ feet) mosasaur of the Western Interior Seaway that lived on a varied diet and in varied marine environments

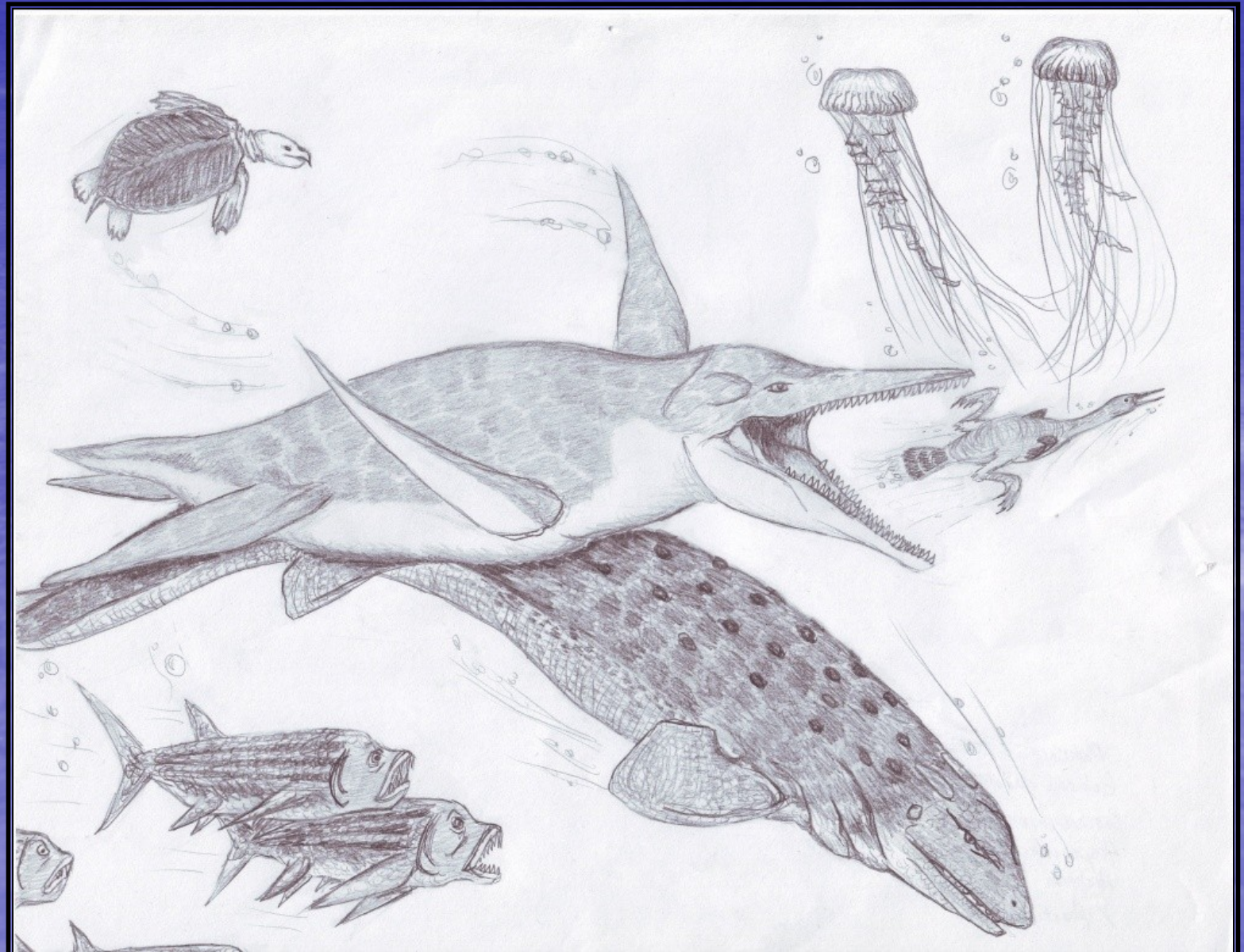


Other Cretaceous Marine Life

- The Upper Cretaceous also saw the evolution of highly derived predatory teleost fishes, some reaching 20 feet long (*Xiphactinus*)
- The comparitively recent advent of birds (and their marine subgroup) also filled the seas with fish eaters like *Hesperornis* and *Ichthyornis,* who were in turn eaten by the marine predators



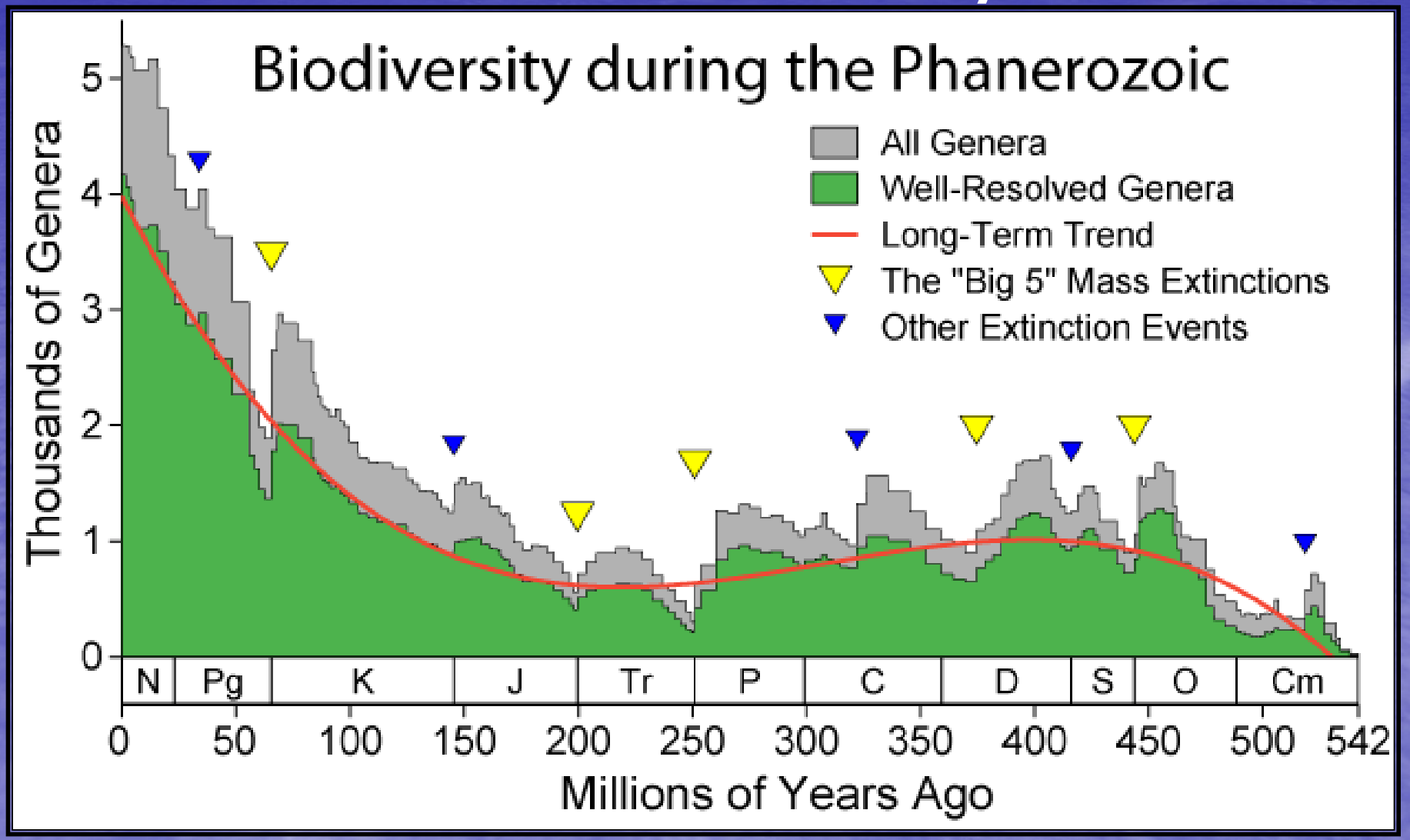
Life in the Western Interior Sea



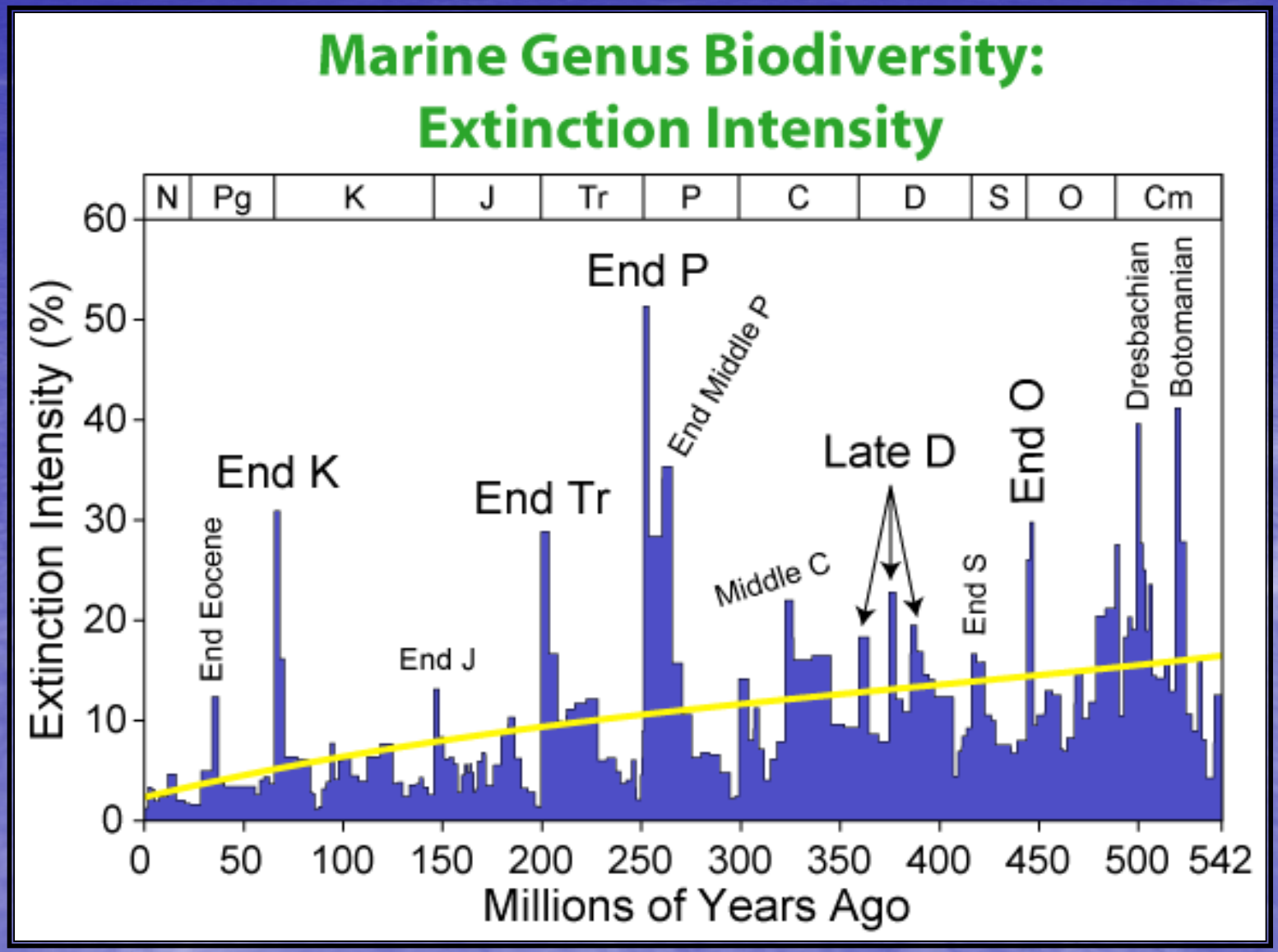
The K-T Boundary

- The end of the Cretaceous marked a mass extinction due to a number of factors:
- Asteroid impact
- Deccan traps formation (Indian volcanoes)
- Receding sea levels

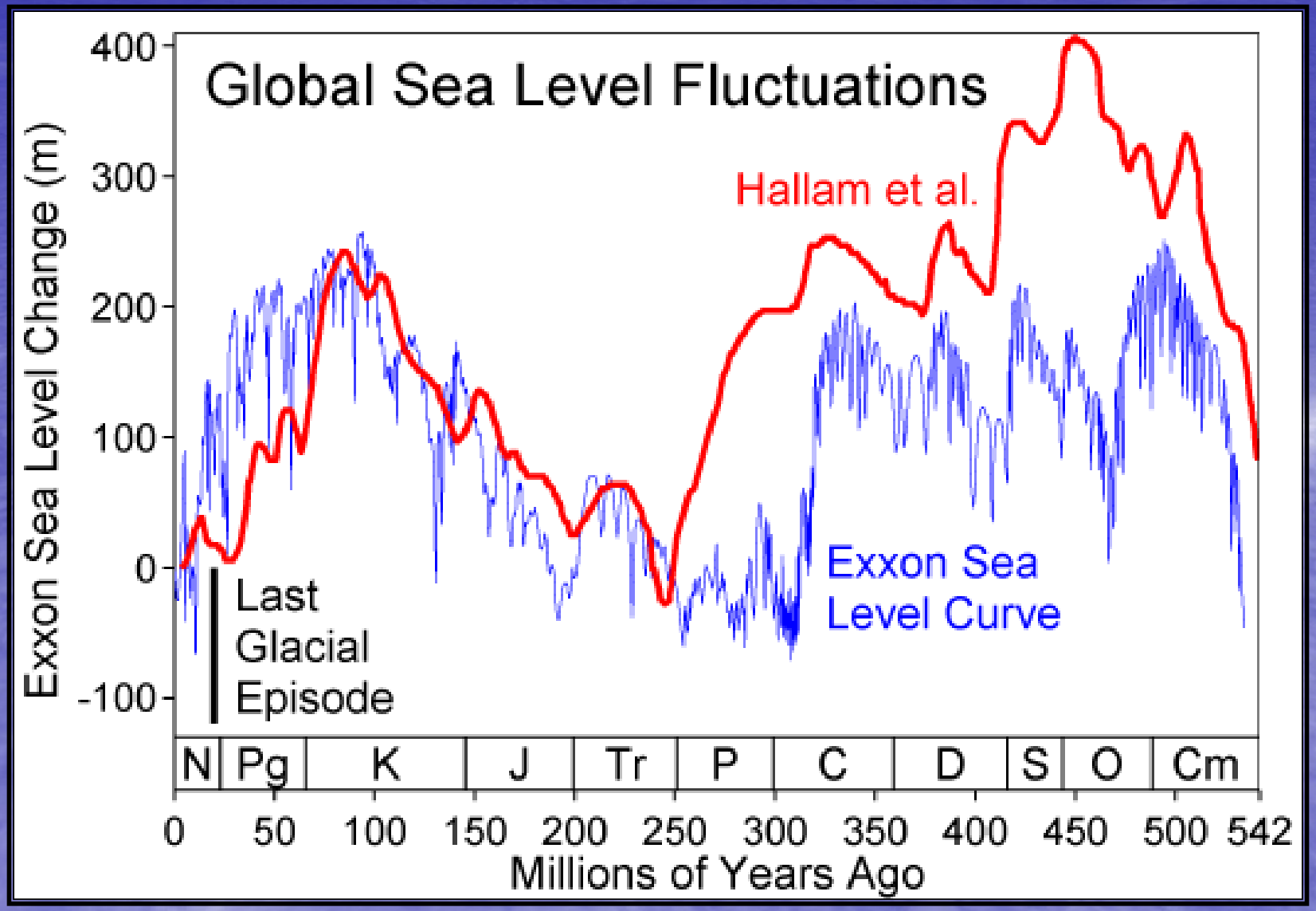
Phanerozoic Biodiversity



Marine Extinctions



Phanerozoic Sea Levels



Next Week…

- Ancient Whales
- Modern Marine Reptiles
- Other Sea Predators
- Don’t forget to print out the test and bring it in next week!