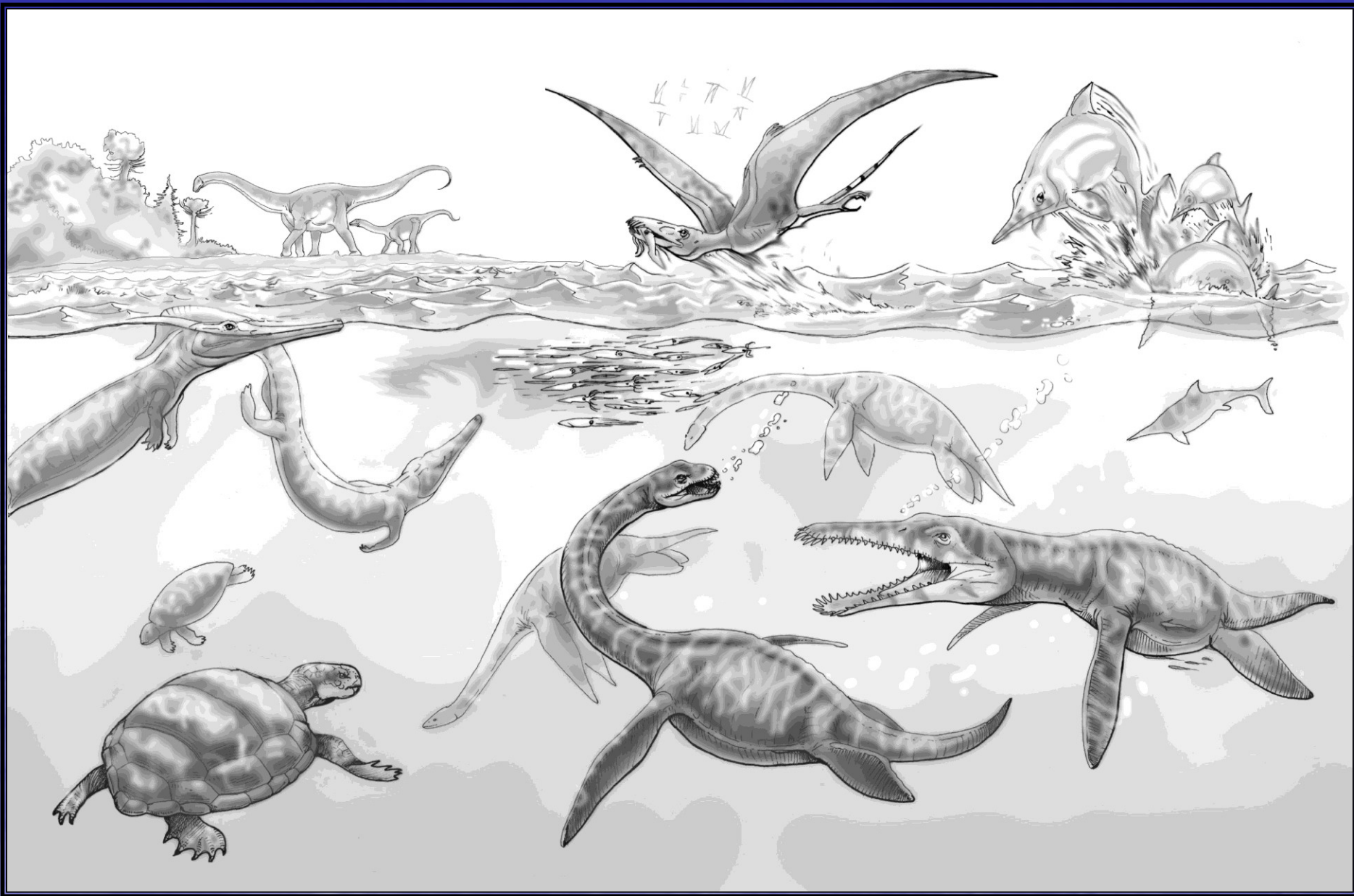


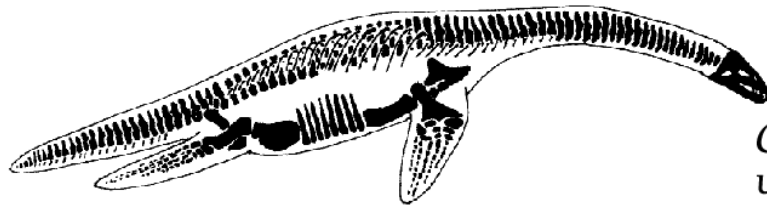
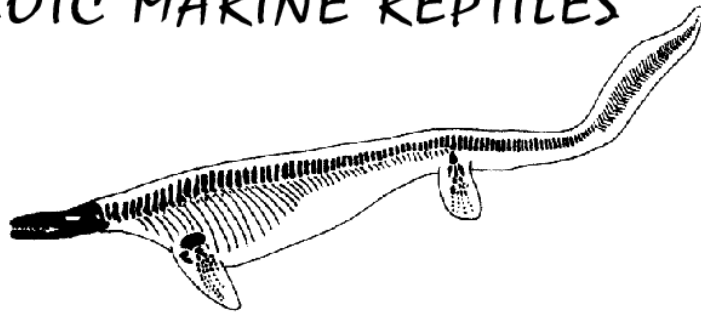
Now, on to
Mesozoic Marine Reptiles



NOT DINOSAURS!

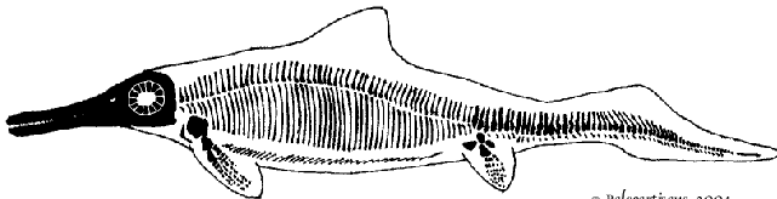
MESOZOIC MARINE REPTILES

Plotosaurus
Upper Cretaceous



Cryptocleidus
Upper Jurassic

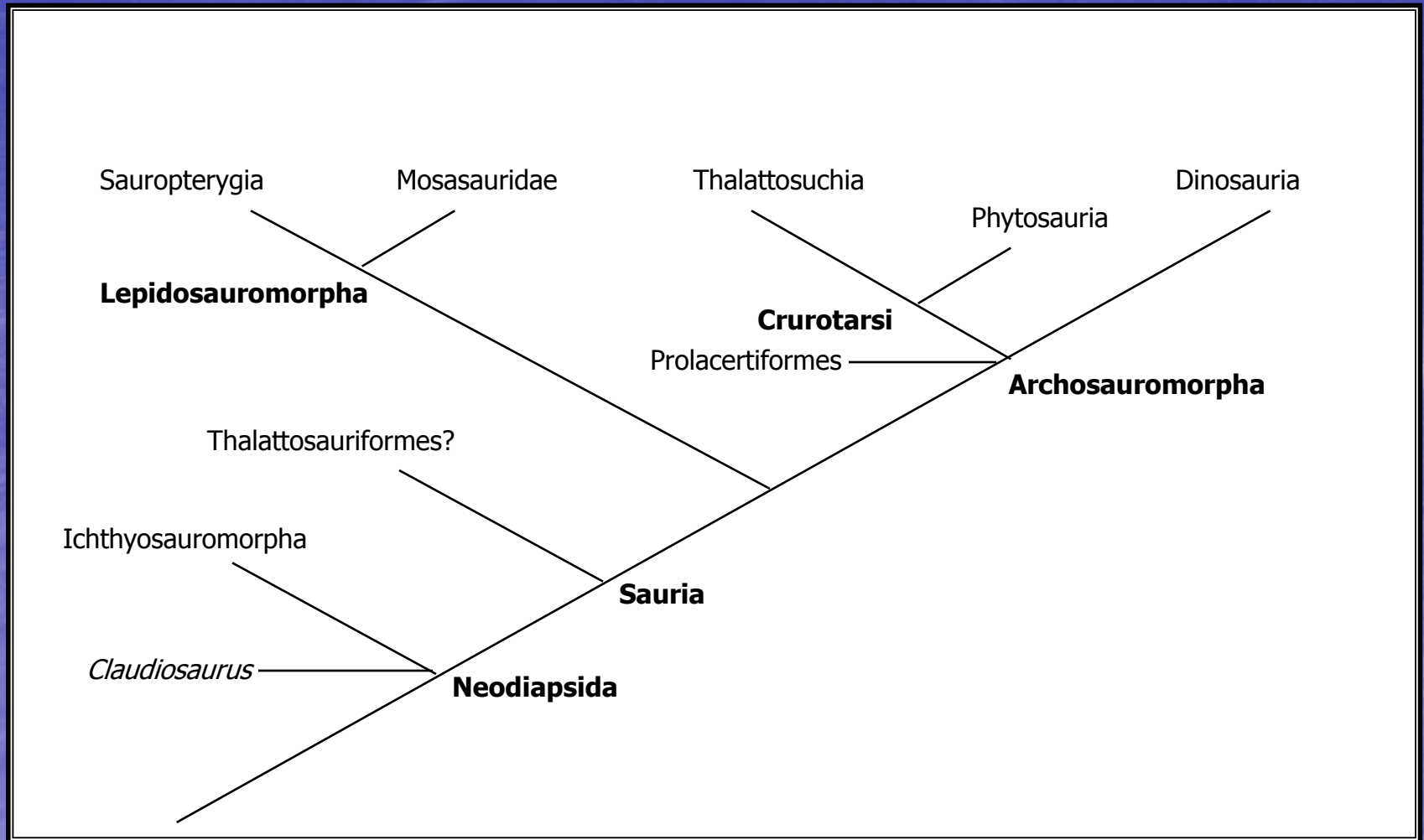
Mixosaurus
Middle Triassic



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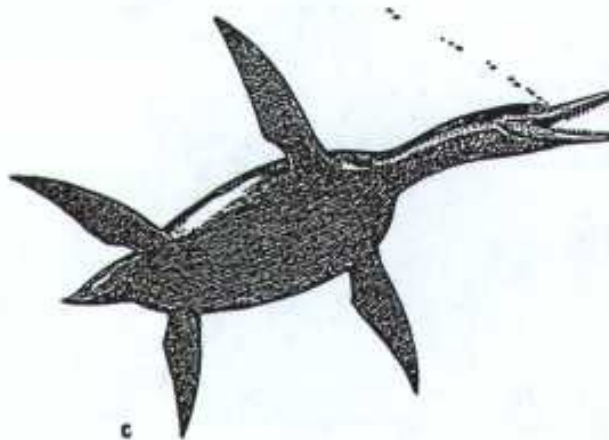
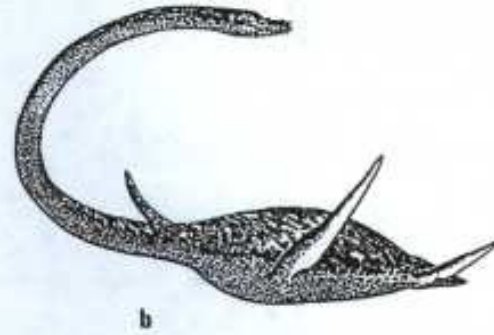
- They are reptiles, but some have adopted different skull fenestration
- “Euryapsid” and “Anapsid” conditions are likely modified Diapsids
- First reptiles returned to the sea in the Permian (*Mesosaurus*)

How they are related:



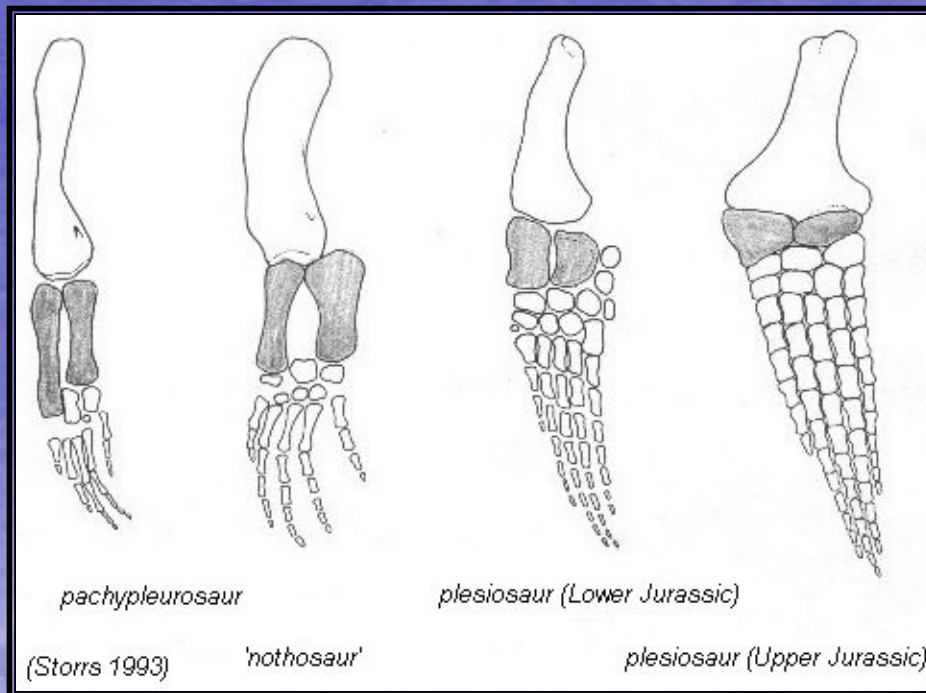
Morphology

- 4 basic body plans (Baupläne):
 - (a) Thunniform advanced ichthyosaur
 - (b) Long neck/small head plesiosaur (elasmosaur)
 - (c) Short neck/big head pliosaur
 - (d) Undulatory mosasaur (and basal ichthyosaur)
- + “functional group 3” after Robert L. Carroll (“swimming lizards”)



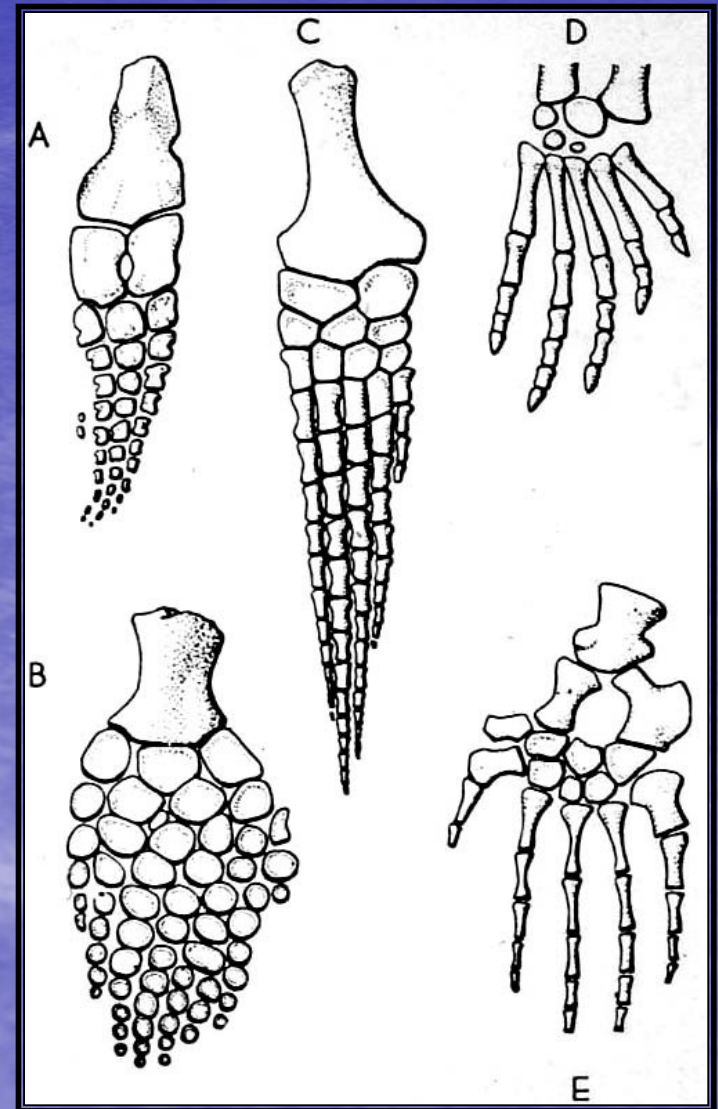
Morphological Trends

- Limbs become rigid, often with hyperphalangy (many phalanges)
- Polydactyly in ichthyosaurs



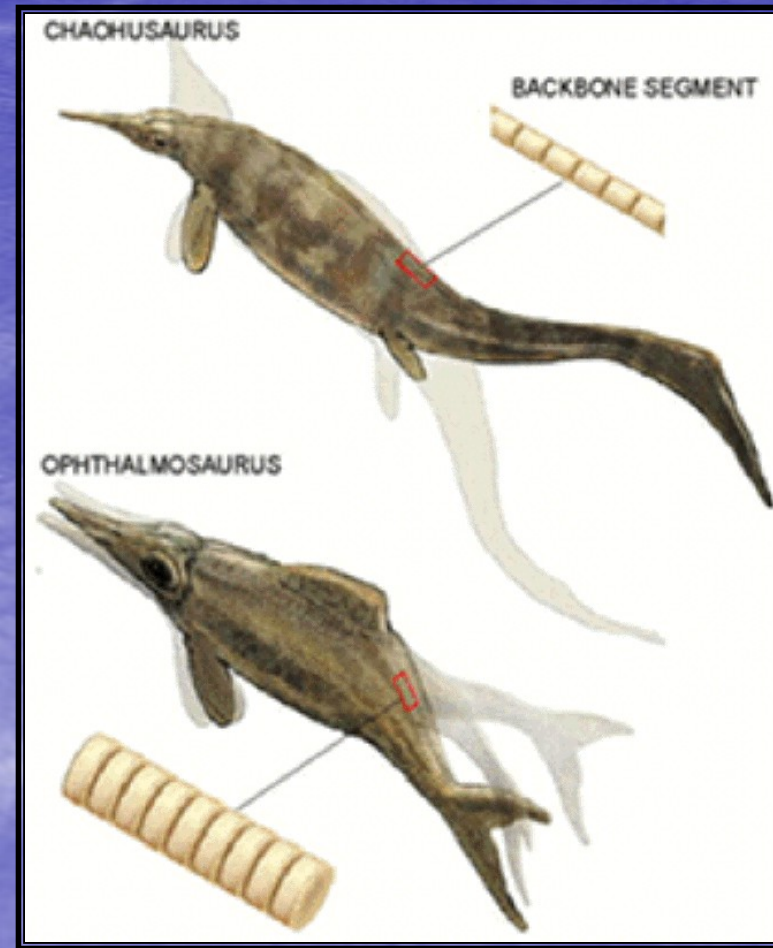
Morphological Trends

- (A) *Merriamia* (basal ichthyosaur) manus
- (B) *Opthalmosaurus* (Jurassic ichthyosaur) manus
- (C) *Elasmosaurus* (Cretaceous plesiosaur) manus
- (D) Nothosaur pes
- (E) Mosasaur pes



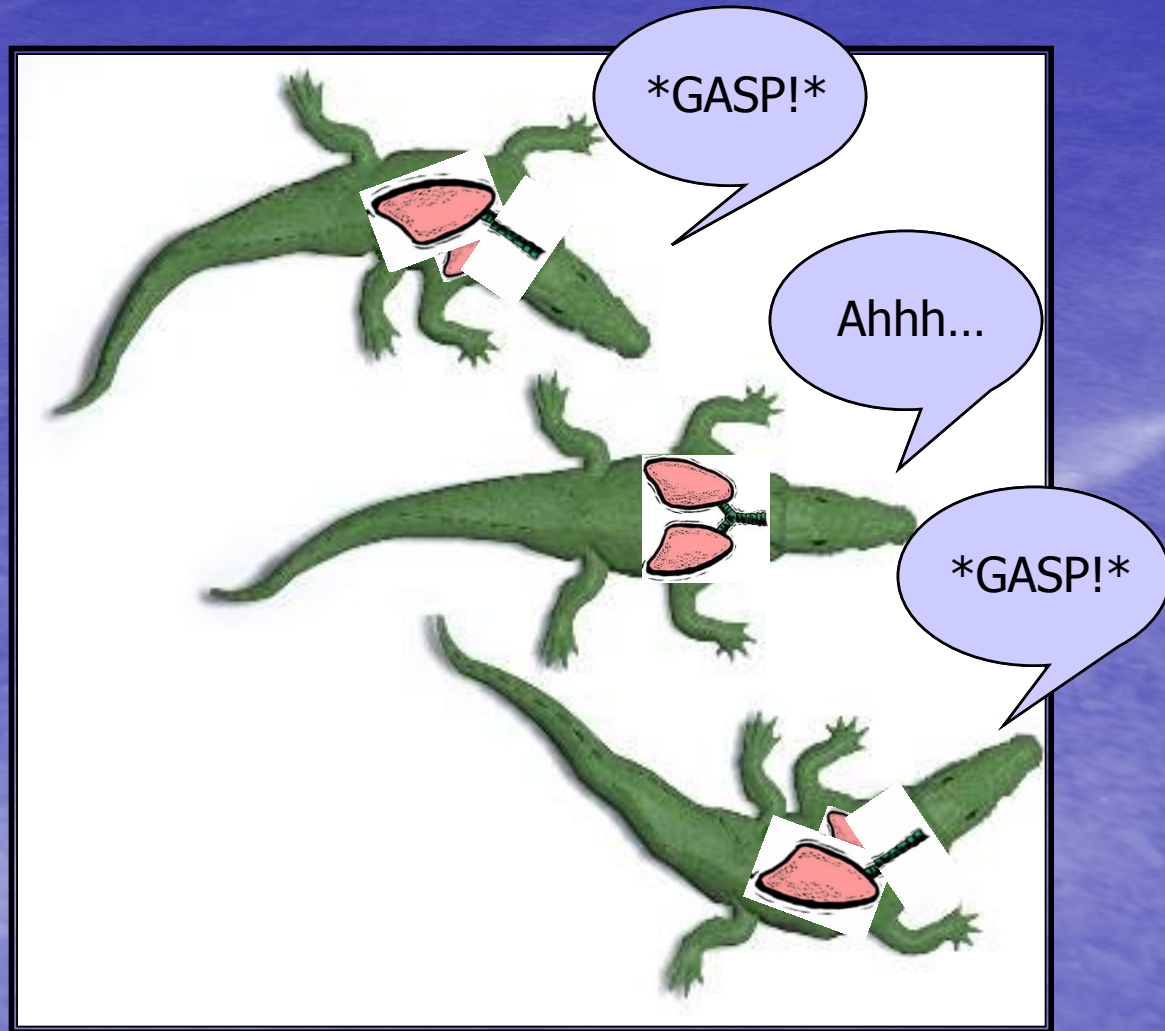
Morphological Trends

- Thoracic stiffening a usual trend
- Lateral flexion directed posteriorly, or propulsion moved paraxially



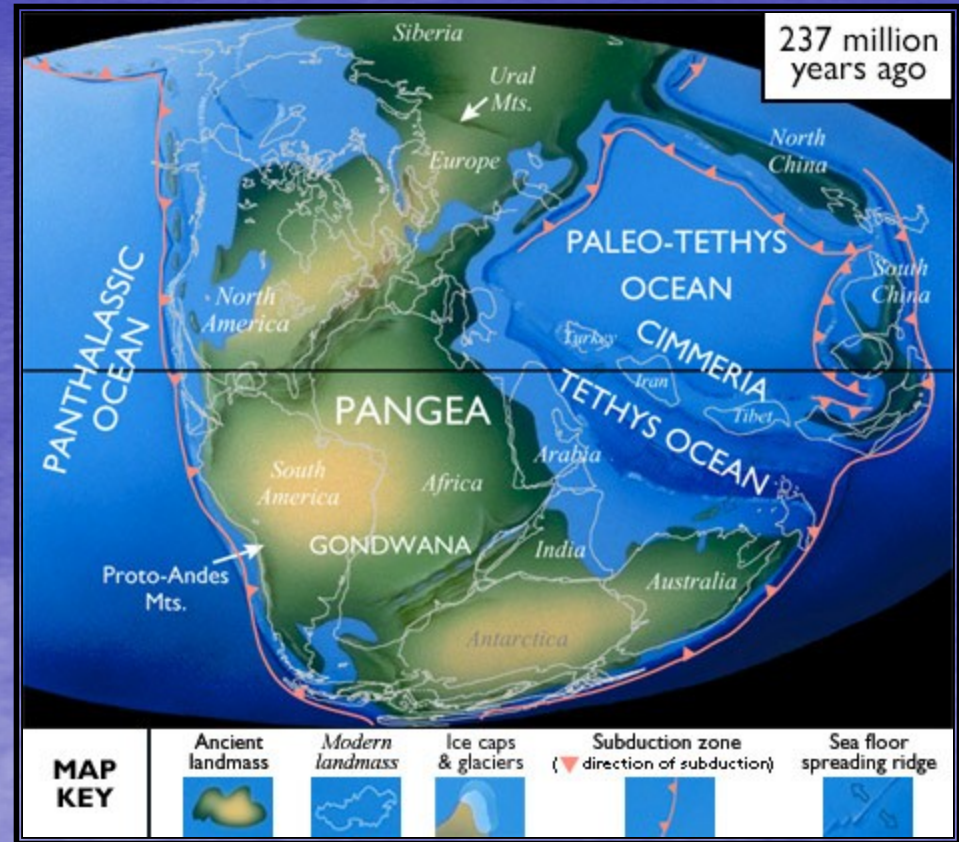
Carrier's Constraint

- Because of their sprawling gait, reptiles cannot breathe and run at the same time
- Same applies to marine reptiles with lateral flexion (they breathe air!)
- Solved by moving propulsion posteriorly, stiffening thorax, or moving limbs independently of spine



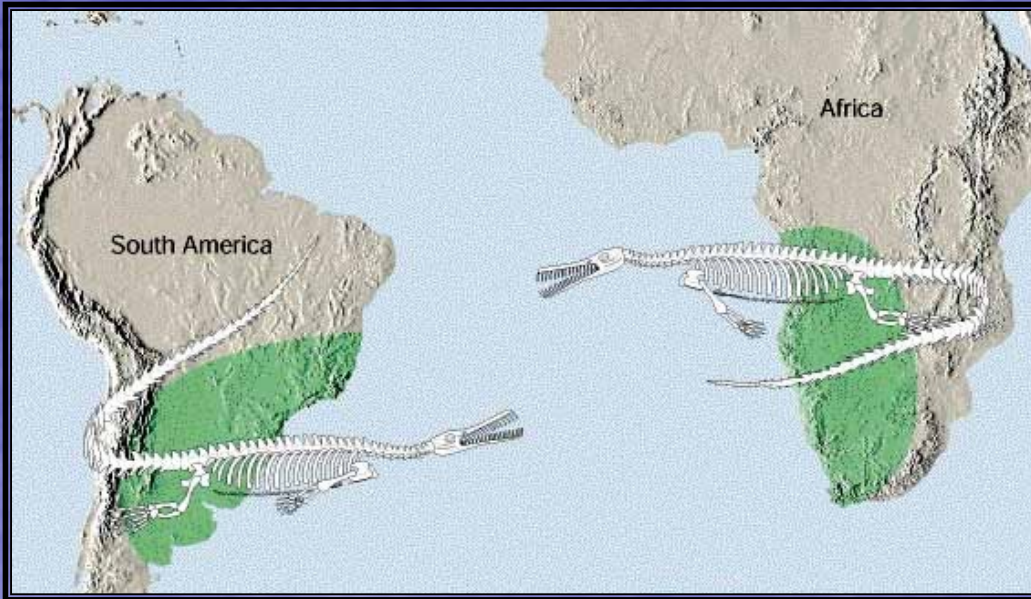
Triassic Seas

- Pangea beginning to break up
- Marine ecosystems recovering from Permian extinction (95% extinction)
- Evolution of new coccolithophorids, dinoflagellates, algae/coral symbionts, and planktonic foraminifera allowed carbonate sedimentation of deeper waters



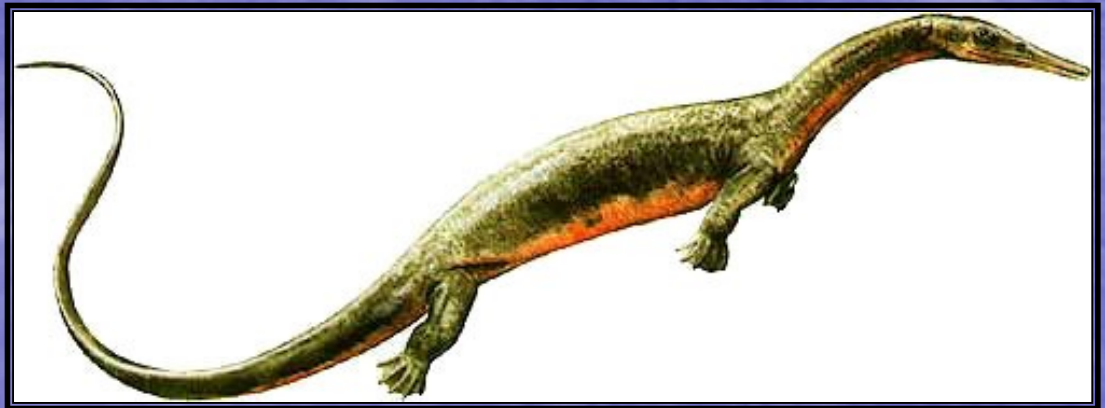
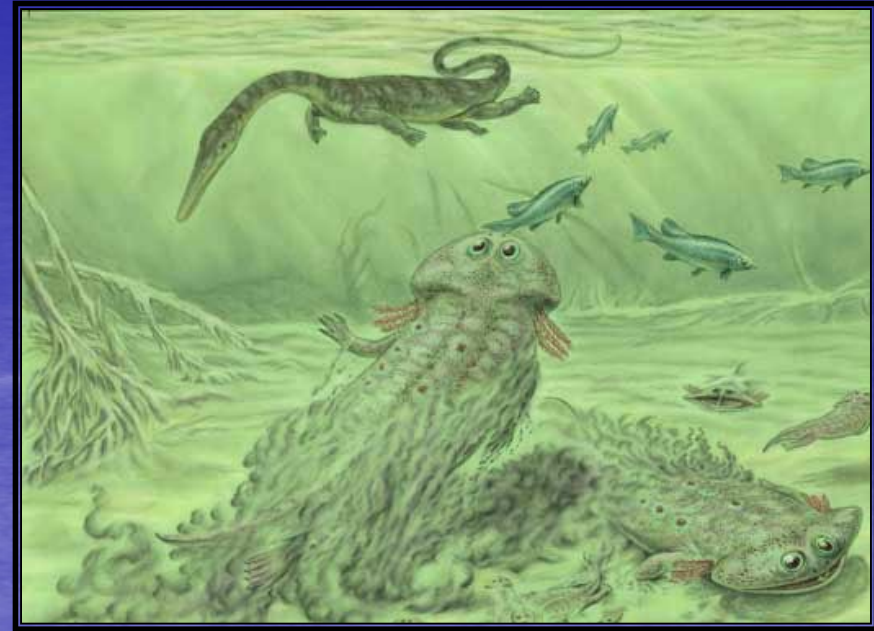
Mesosaurs

- The first aquatic “reptiles” (early Permian)
- Anapsids-not “true” reptiles (Eureptilia~Diapsida)
- Provided evidence for continental drift theory
- Small, needle-like teeth for small fish or straining for invertebrates
- Thickened ribs (pachyostosis)

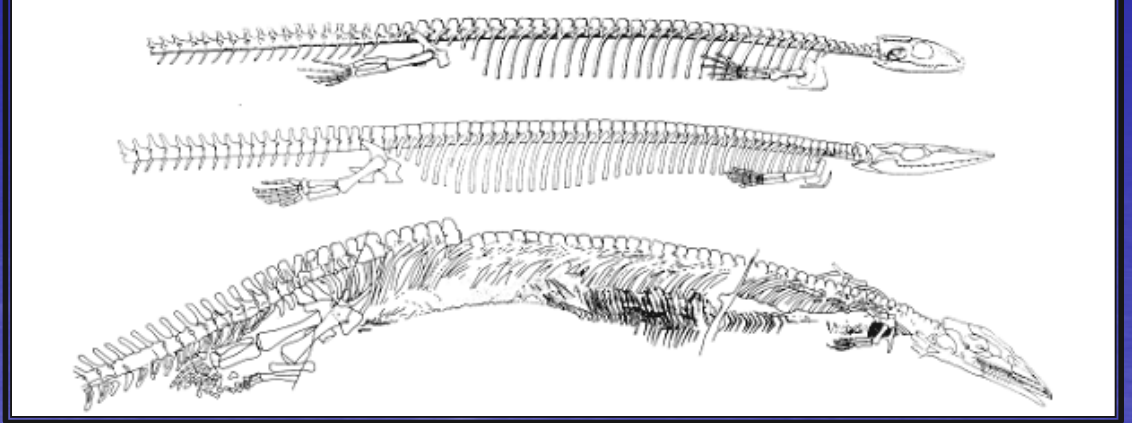


Thalattosauria

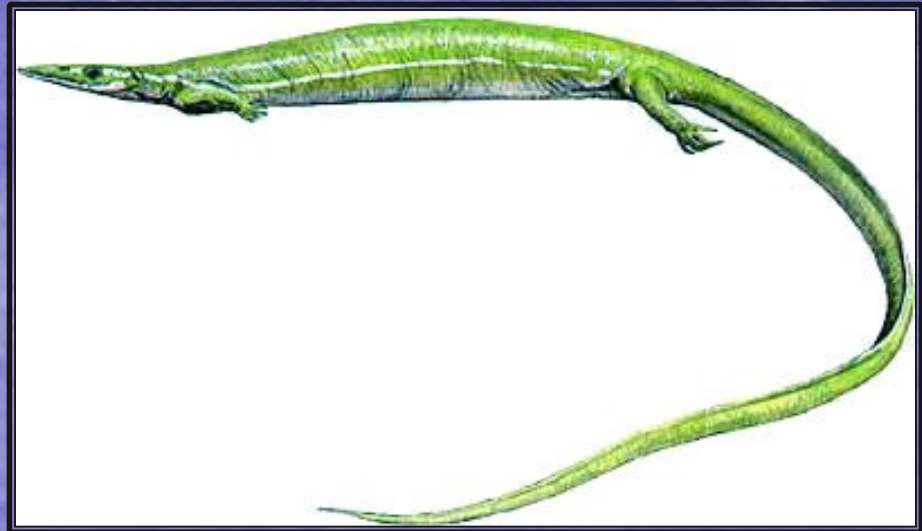
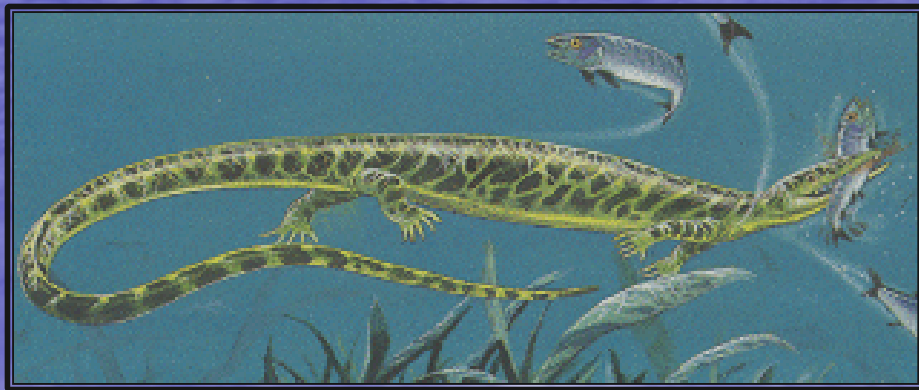
- Thalattosaurs are basal Saurians (just outside lepidosaurs and archosaurs), or basal Sauropterygians that were mostly aquatic (shallow marine) and ate fish/shellfish
- Askeptosaurs (sister taxon) are thought to have hunted deeper, as they have larger eyes/sclerotic rings
- Both groups have webbed feet, not paddles, and are found in the Middle to Late Triassic



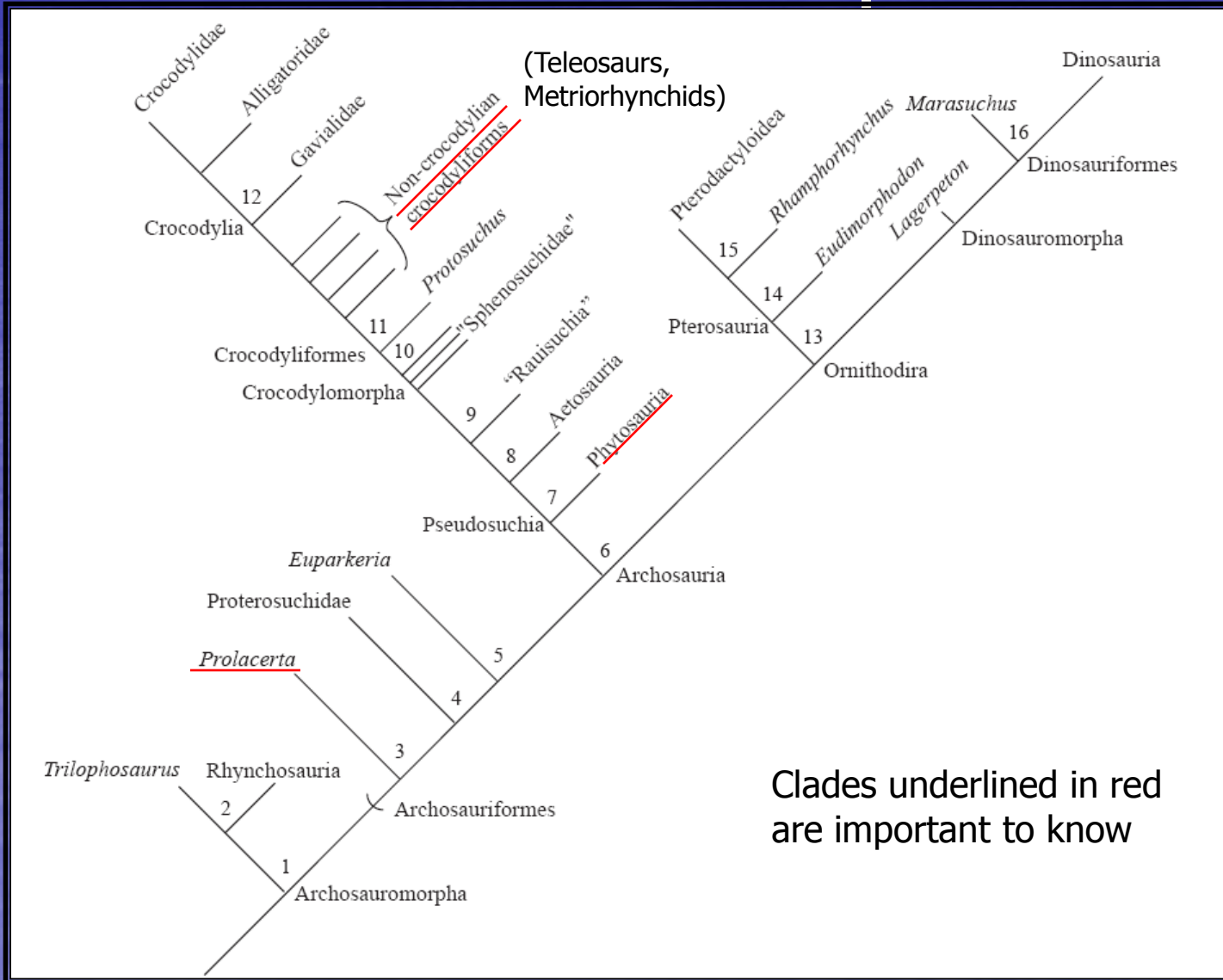
Pleurosaurs



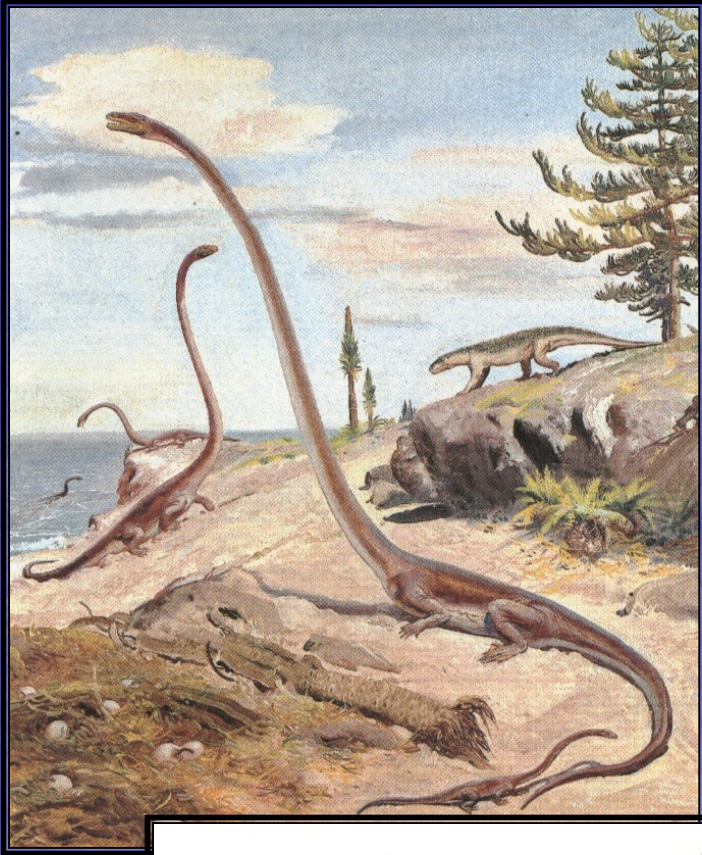
- Aquatic sphenodonts (lepidosaurs) that lived in the Late Jurassic to Early Cretaceous
- Elongate, streamlined body only adaptation to marine life



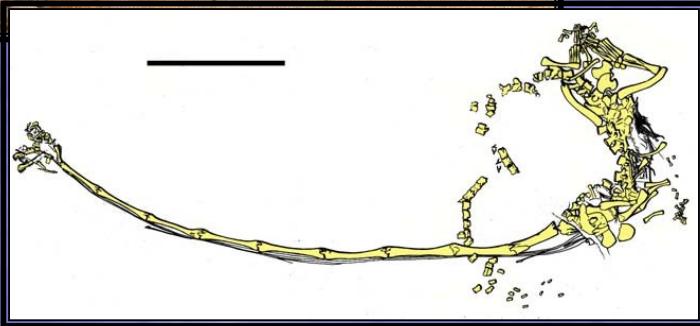
Archosaur Marine Reptiles



Tanystropheus



- 20 foot mid-Triassic archosaur (prolacertiform)
- Only had 10 neck vertebrae, despite 10 foot neck
- Most likely a piscivorous “reverse amphibian” snatching fish from shore



Crocodylomorphs

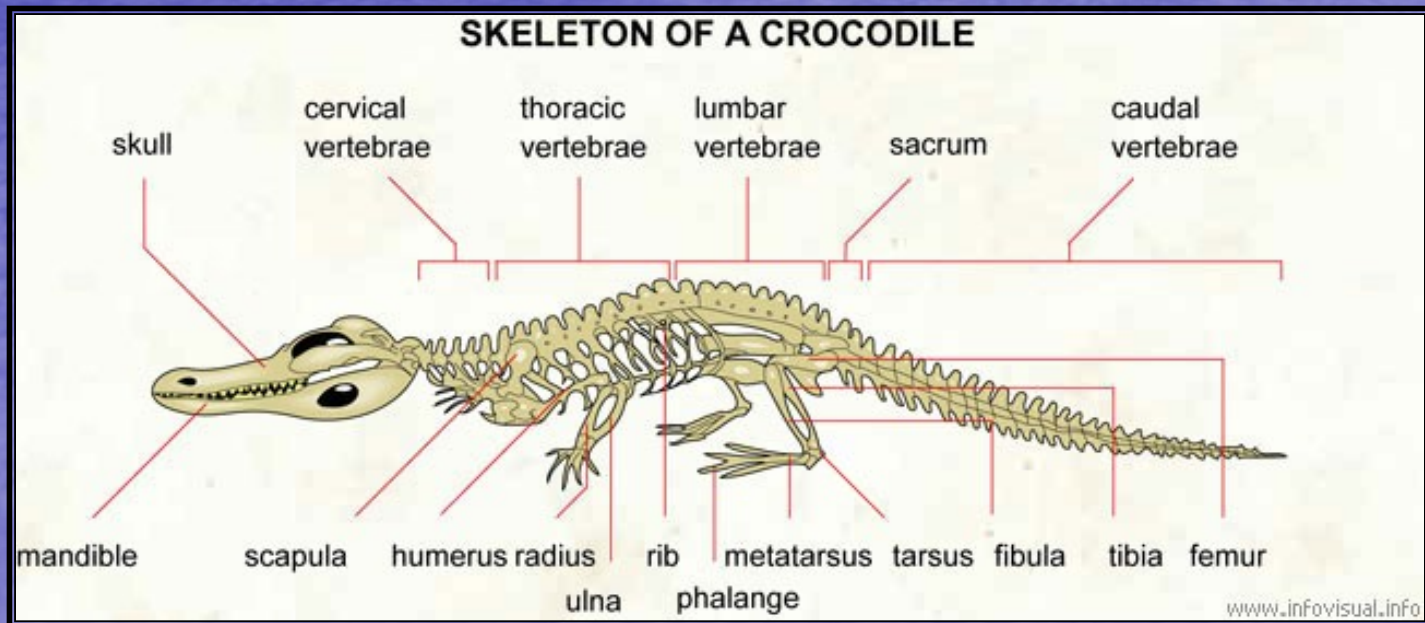
Crocodylomorphs

- “Crocodile-shaped” aquatic reptiles have existed since the late Triassic
- Generally inhabit shallow swampy areas, though some have taken to open ocean



Crocodylomorph Ecology

- All extant (and probably extinct) crocodylomorphs are ambush predators, and several morphological characteristics suggest this (can you guess some?)

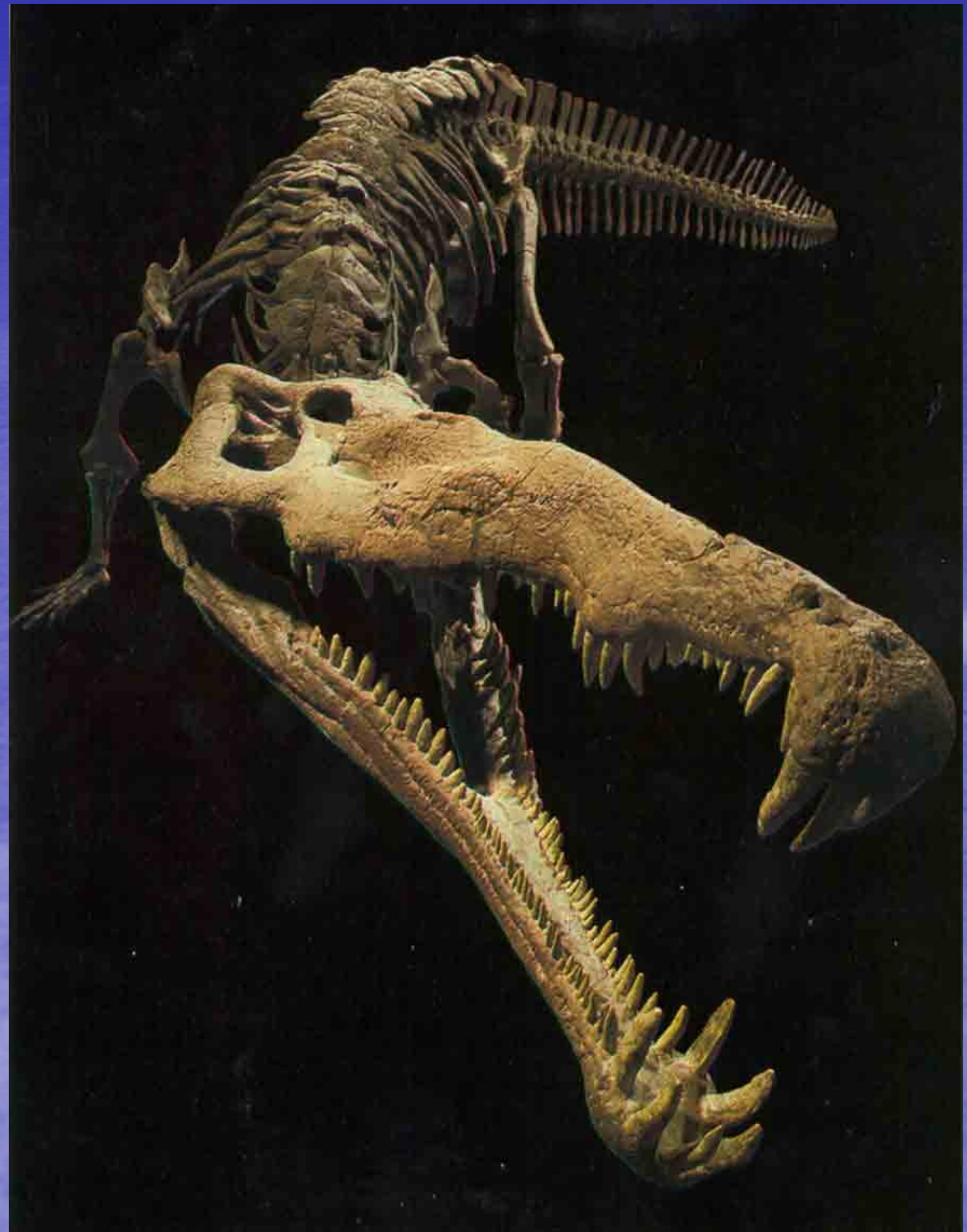


Crocodylomorph Anatomy

- Very powerful jaw adductor muscles (so much muscle mass that almost none is given to abduction)
- Bite force is more than 5,000 pounds per square inch (human = 150 psi, Rottweiler = 335 psi, great white shark = 690 psi, hyena = 800 psi)
- T. Rex, however, had a bite force of 40,000 psi, and Dunkleosteus had 80,000!

Phytosaurs

- Late Triassic crocodylomorphs-not crocodiles (cousins, though, through the crurotarsal pod articulation)



Champsosaurs

- Semi-aquatic crocodylomorphs that lived from the Jurassic to Oligocene
- Hunted small fish and invertebrates in rivers, swamps, and estuaries



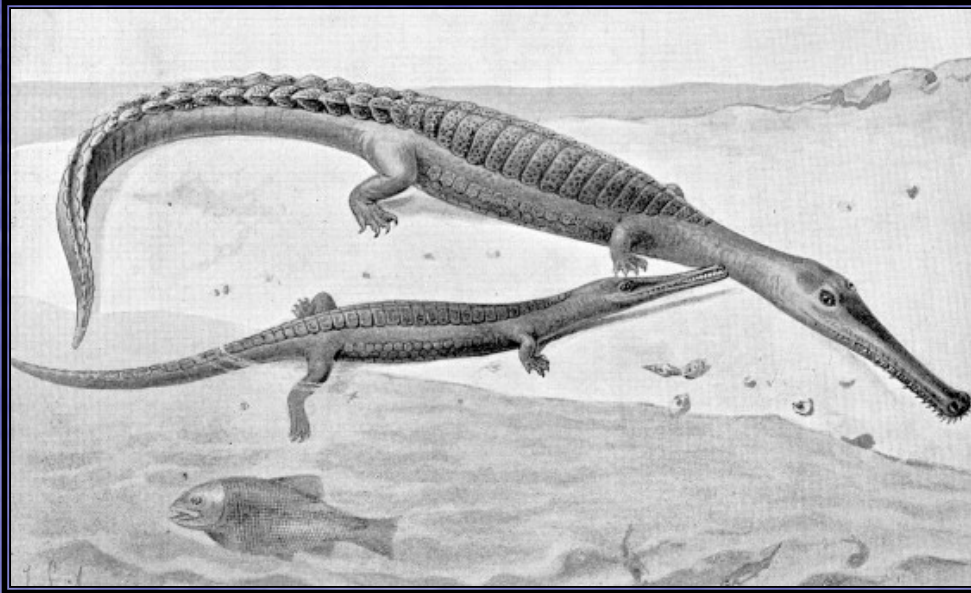
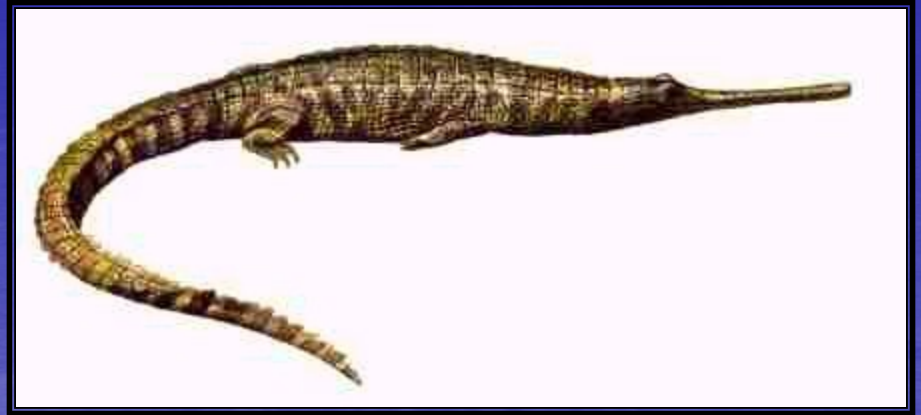
Pholidosaurids and Dyrosaurids

- Early Cretaceous crocodylomorphs that could reach enormous size
- *Sarcosuchus* could be as long as a city bus, weigh up to 9 tons, and is known to have eaten dinosaurs



Teleosaurs

- Early Jurassic – Early Cretaceous
- Marine crocodylomorphs similar to metriorhynchids
- Archosaurs (Thalattosuchia)



Metriorhynchidae

- Aquatic crocodyliforms from Middle Jurassic to Cretaceous
- Lost osteoderms (armor scutes) and had small caudal fin
- Only archosaurs completely adapted to marine



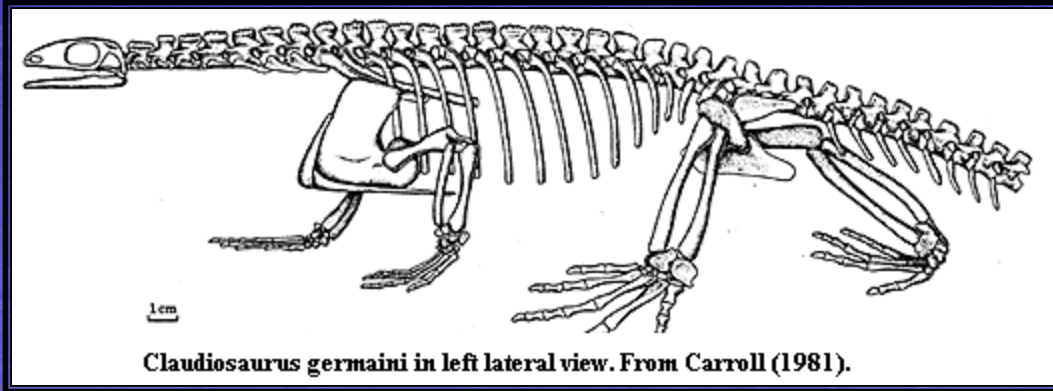
Modern Crocs

- Modern crocodylomorphs are found in 3 families of 23 species
- Alligators, crocodiles, caimans, gharials
- Some may grow to nearly 30 feet long, exemplifying the slow, continual growth rate of primitive reptiles



Ichthyosaurs

Claudiosaurus



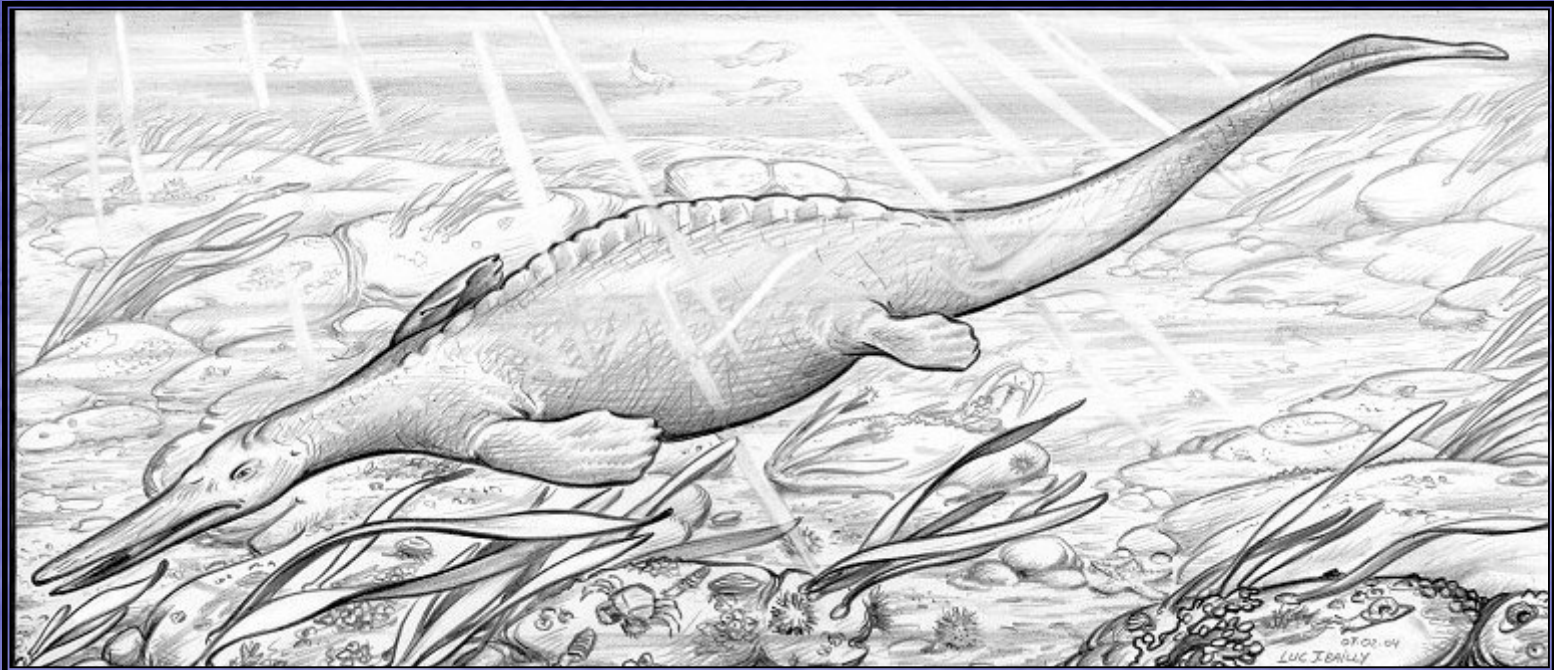
- Lived much as marine iguanas do today

- A partially marine diapsid of the Late Permian, possibly an early relative of ichthyosaurs and Saurians



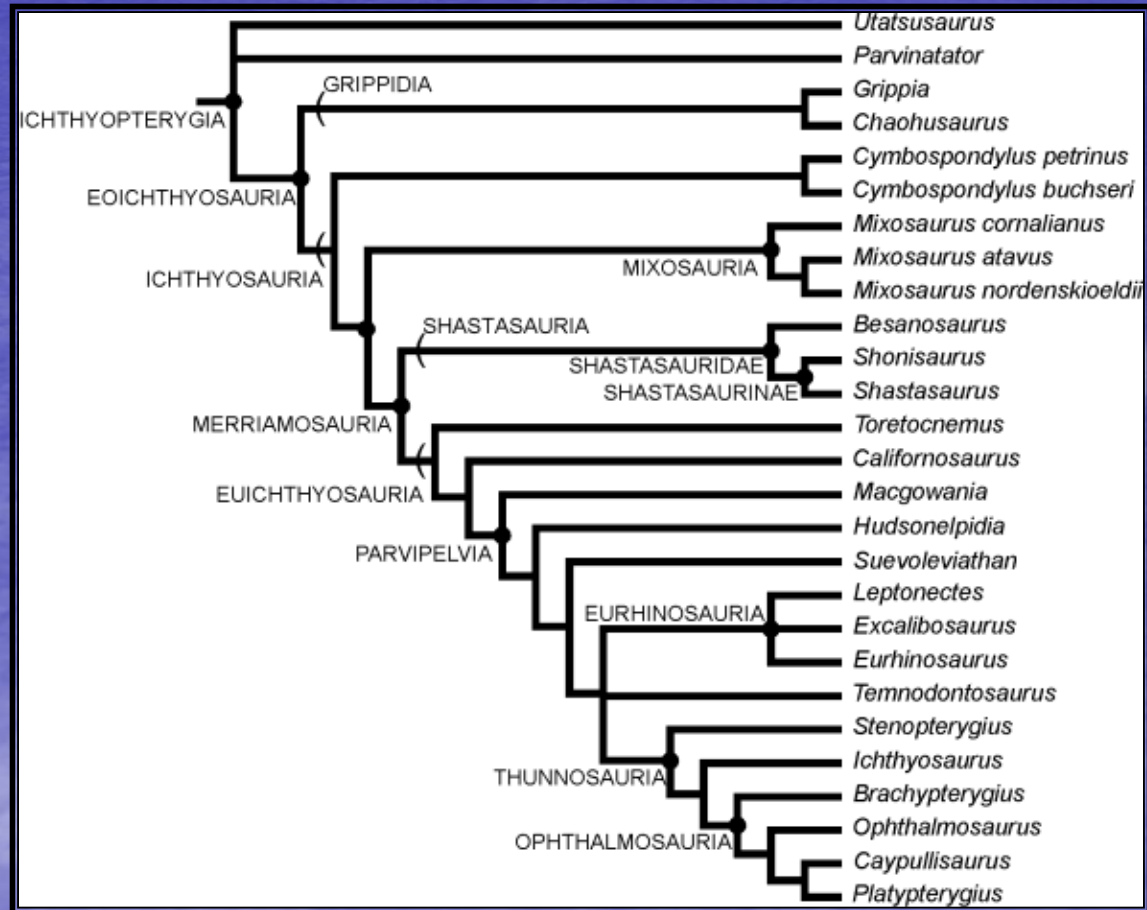
Where Do Ichthyosaurs Come From?

- *Hupehsuchus* may be a basal ichthyosaur from mid-Triassic China



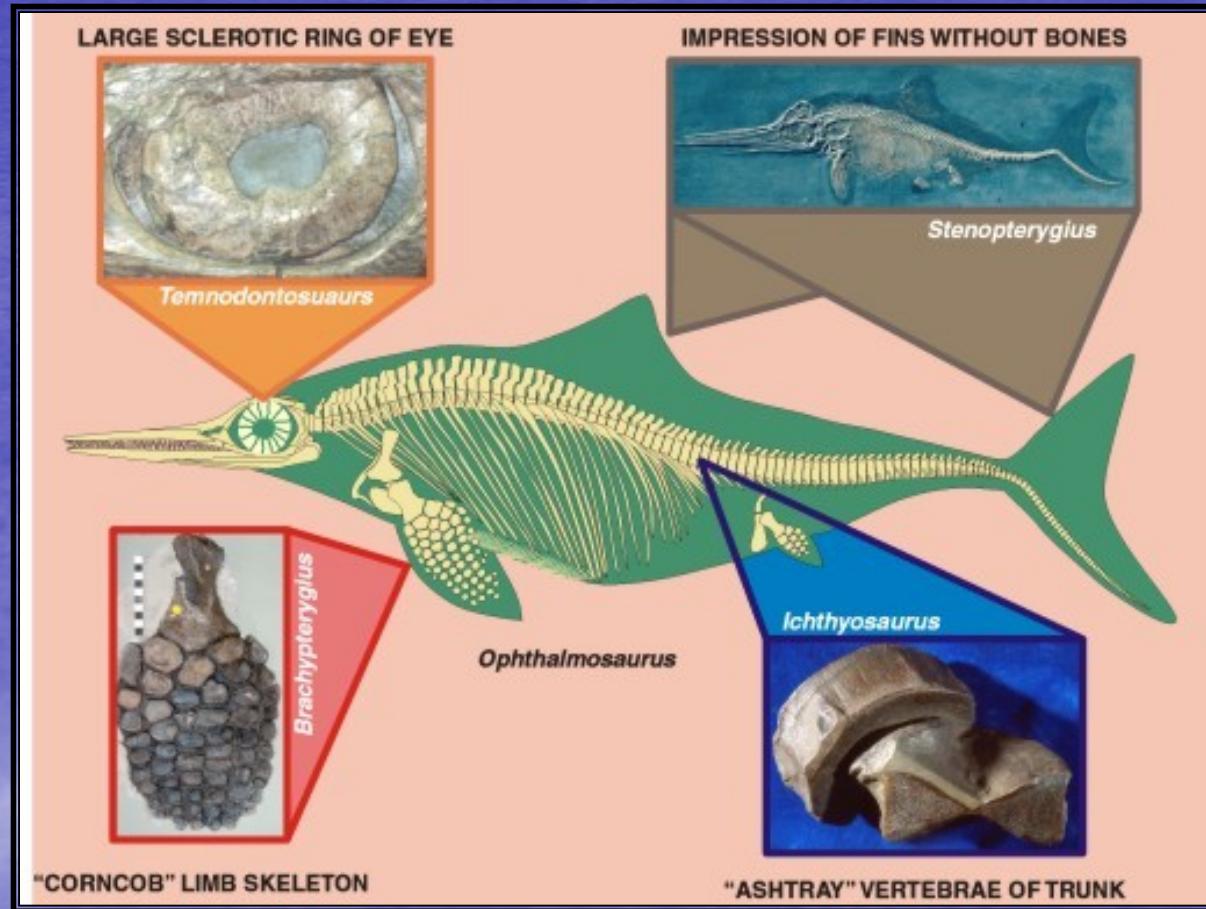
Ichthyosauromorpha

- Ichthyosaurs were marine reptiles with a fish or dolphin-like morphology (basal forms different) that lived from the Early Triassic to the mid Cretaceous



Ichthyosaur Morphology

- Typical ichthyosaur morphology (not basal)



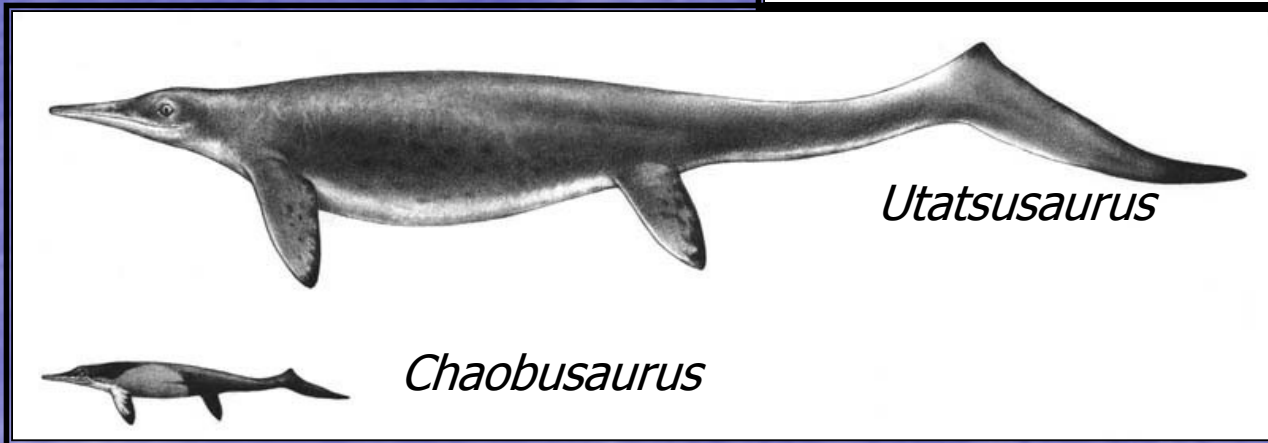
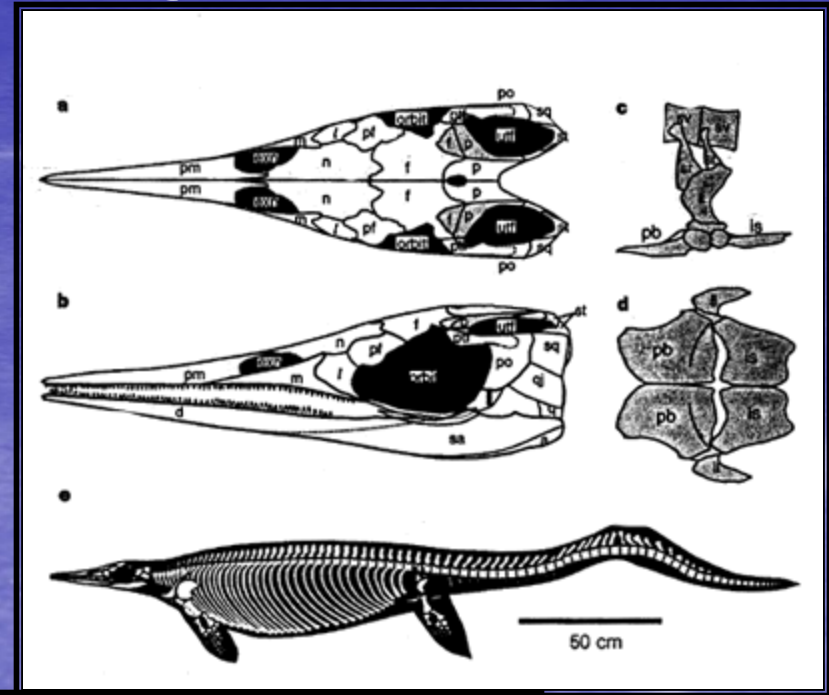
Triassic Ichthyopterygians

- First fossil forms already entirely aquatic
- Difficult to determine phylogenetic relationships
- Early forms small, anguilliform, shallow marine hunters
- Died out in Middle Triassic to be replaced by true ichthyosaurs
- Ex: *Cymbospondylus*, *Utatsusaurus*



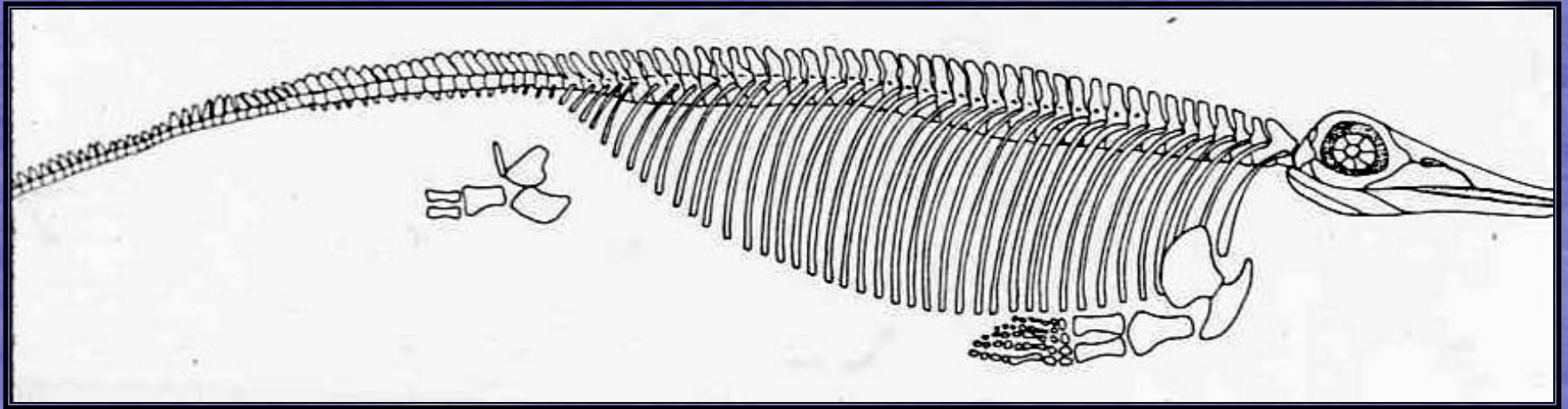
Triassic Ichthyopterygians

- *Utatsusaurus* is the earliest known Ichthyopterygian from the middle Triassic
- Ryosuke Motani (from Cal!) determined that ichthyosaurs are close cousins to primitive diapsids from this fossil



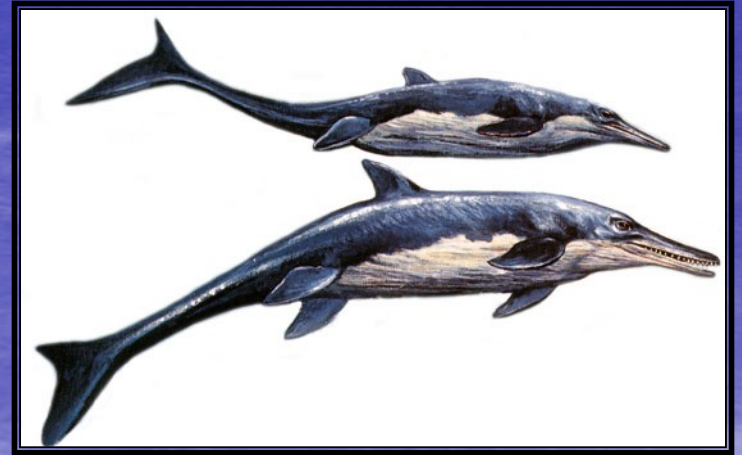
Triassic Ichthyopterygians

- *Chaohusaurus*, from the Early Triassic of China
- neural spines of tail not strongly differentiated
- relatively unmodified forefin



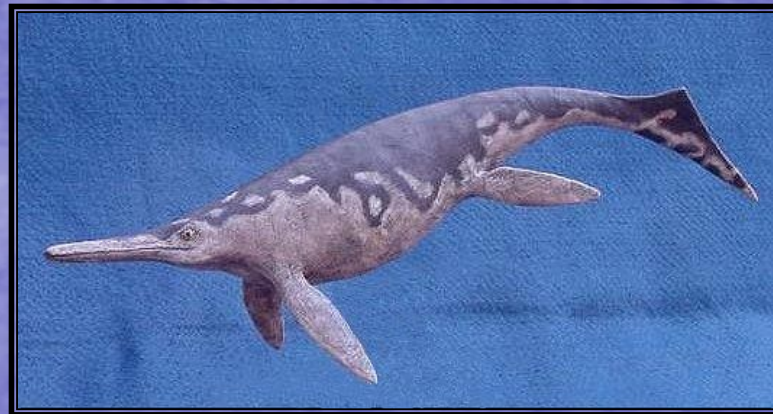
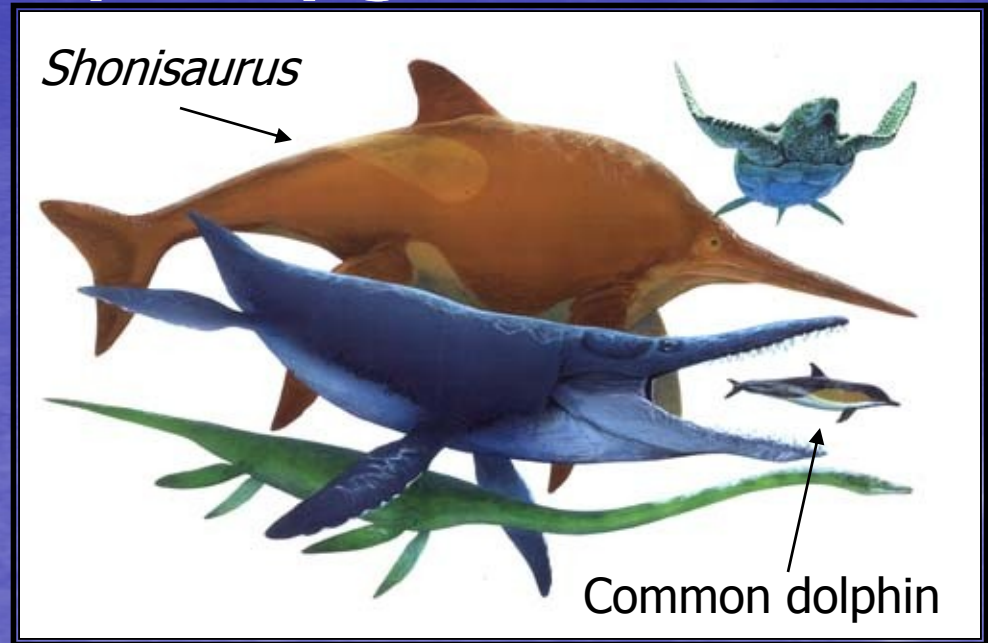
Triassic Ichthyopterygians

- *Cymbospondylus* lacked a dorsal fin and lunate caudal fin
- Though primitive, it was one of the larger ichthyopterygians (18-30 feet)

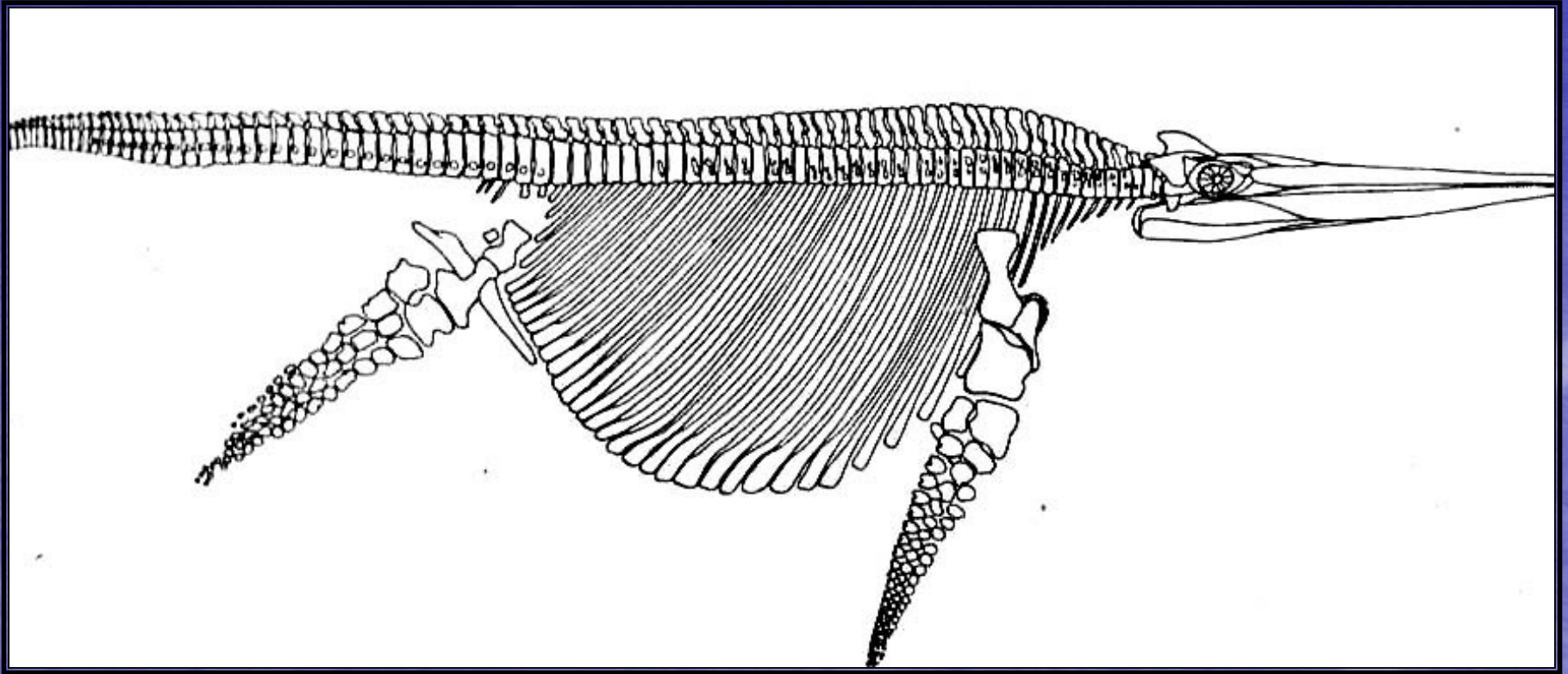


Triassic Ichthyopterygians

- *Shonisaurus*, another Shastasaur, grew to over 50 feet in length



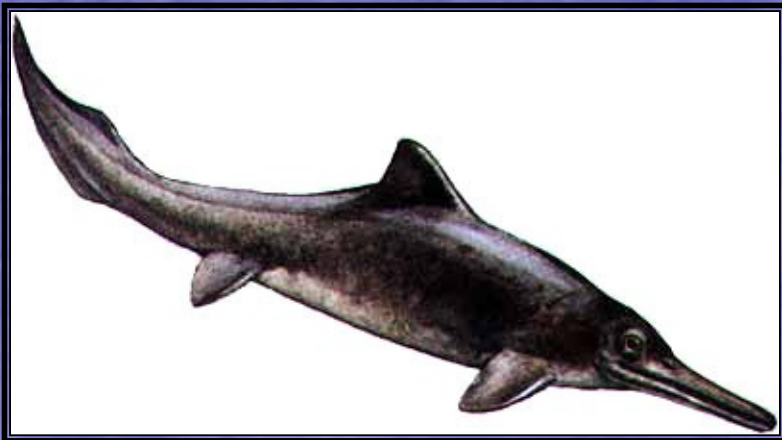
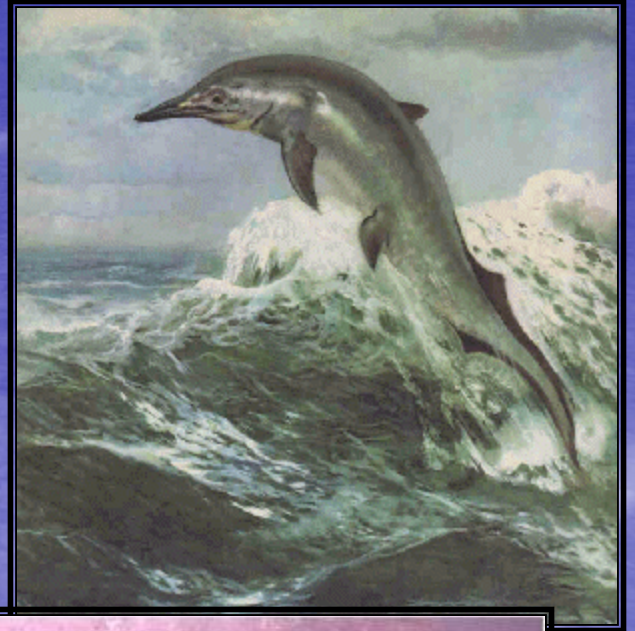
Triassic Ichthyopterygians



- Note no tail bend; very long skull; long thin fins; long ribs, expanded distally; also enlarged pelvis and hindlimb; vertebral spines uniform after pectoral “hump”

Triassic Ichthyopterygians

- *Mixosaurus* is thought to be a transistional form bewteen Triassic ichthyopterygians and true ichthyosaurs (they possess a dorsal fin, but no lunate caudal fin)



Next Week:

- Advanced ichthyosaurs (Jurassic-Cretaceous)
- Ichthyosaur extinction