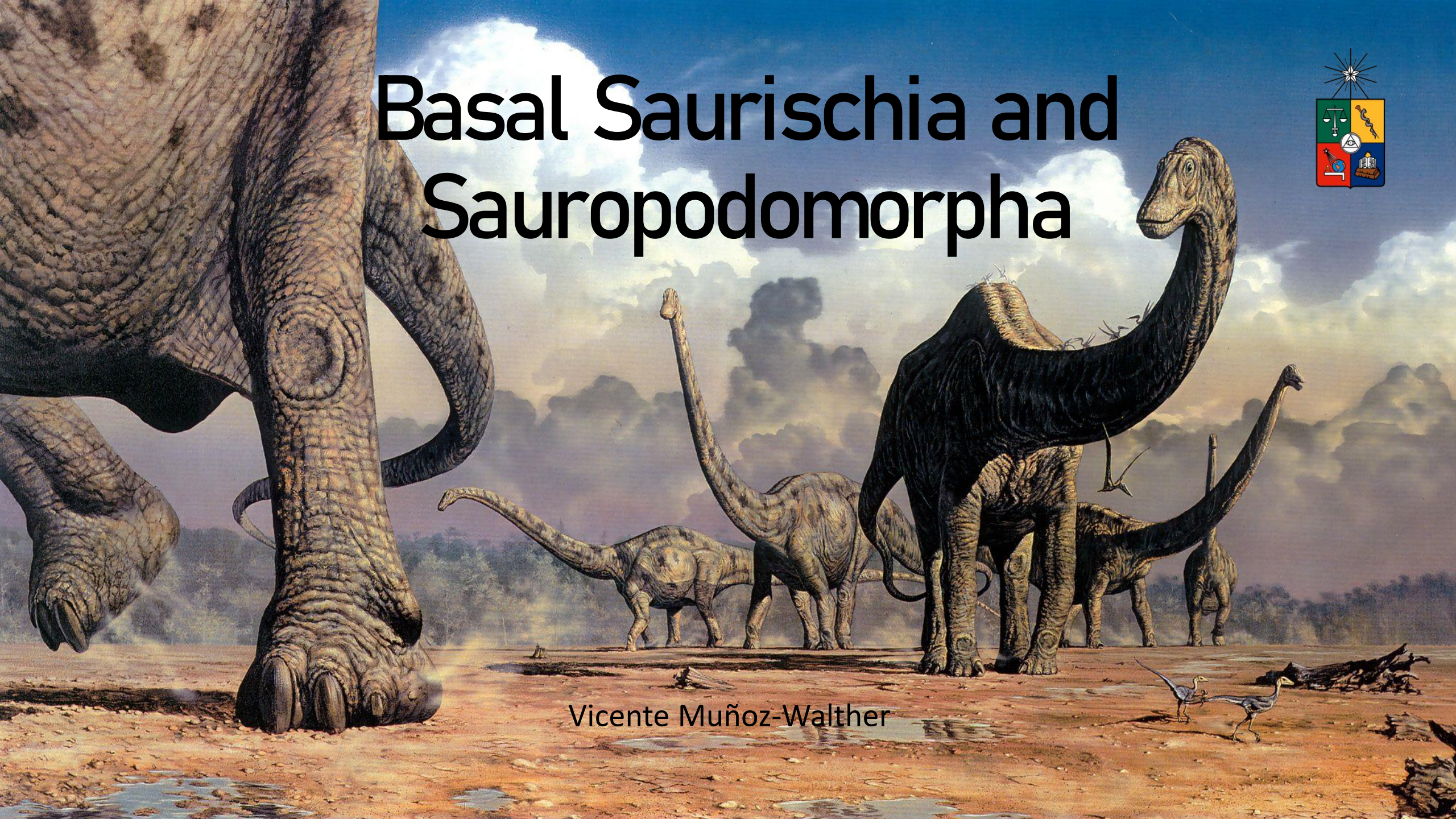
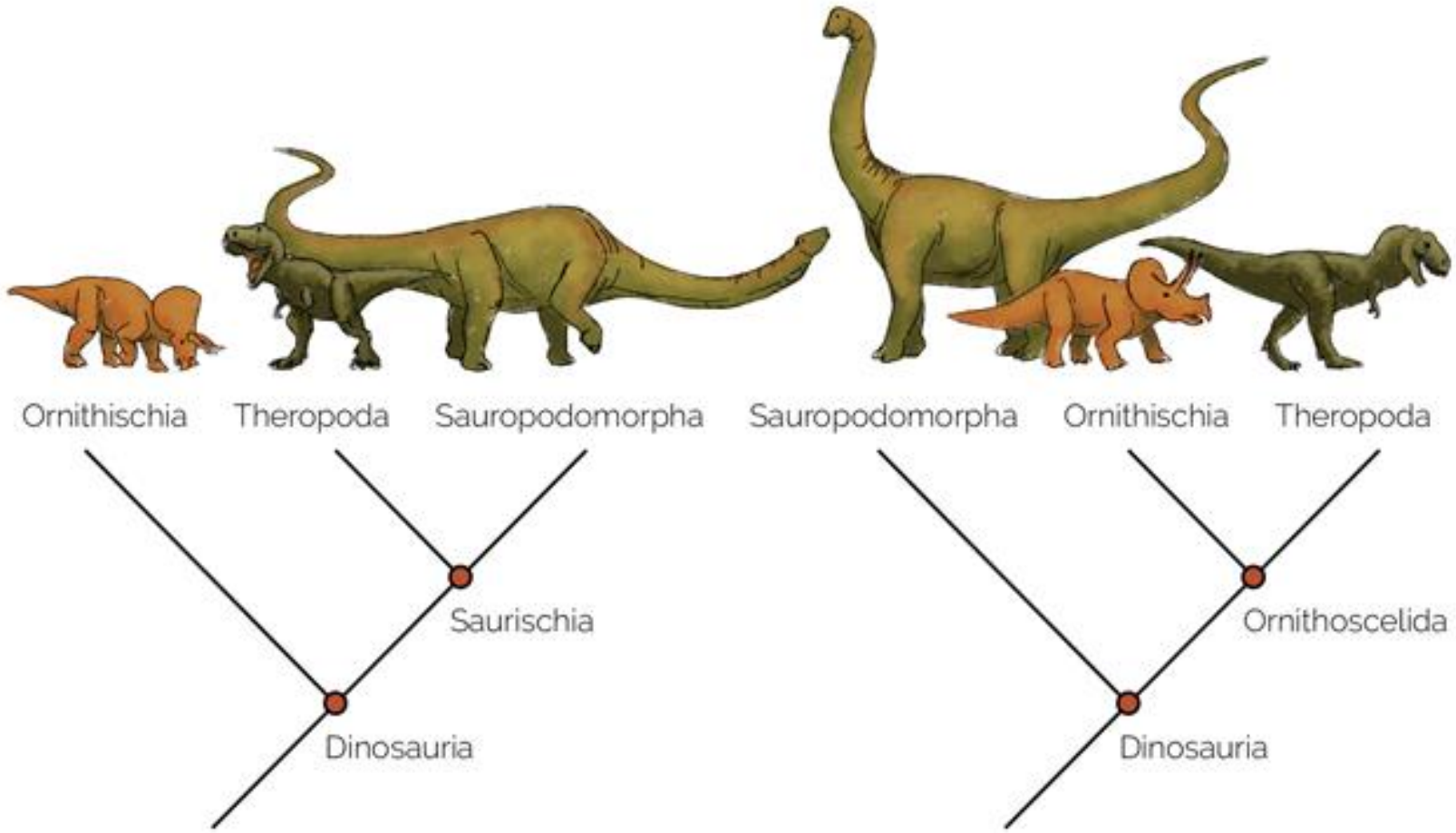
Basal Saurischia and Sauropodomorpha



Vicente Muñoz-Walther

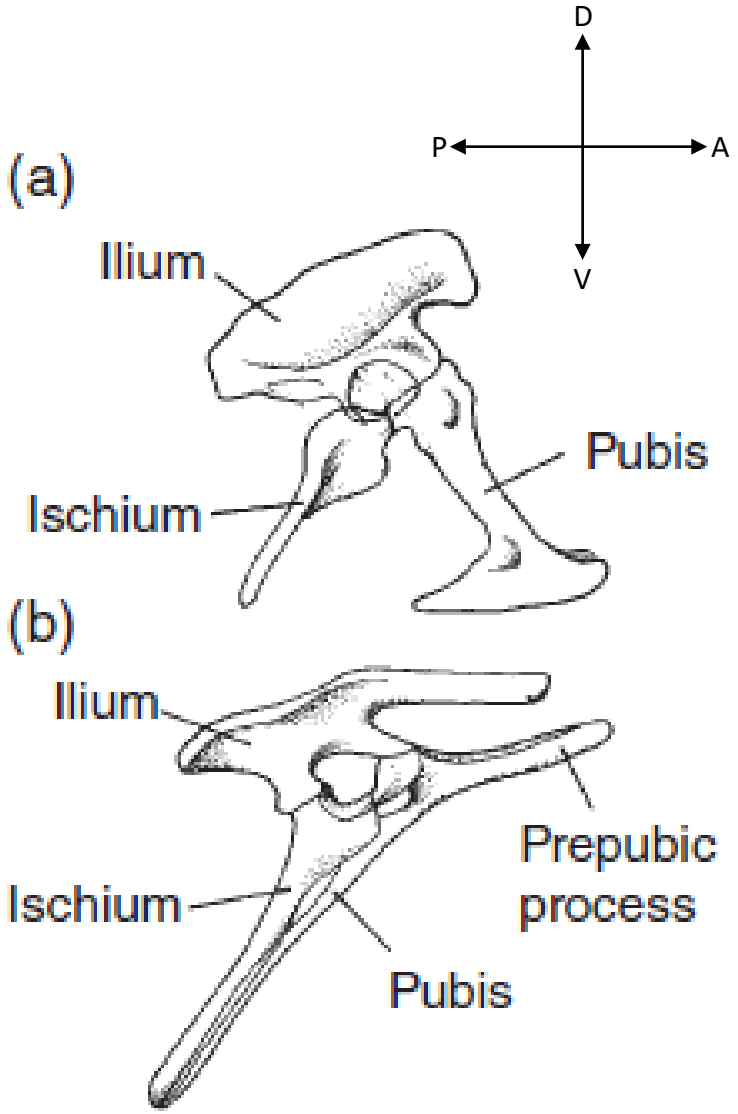
Saurischia and Ornithischia



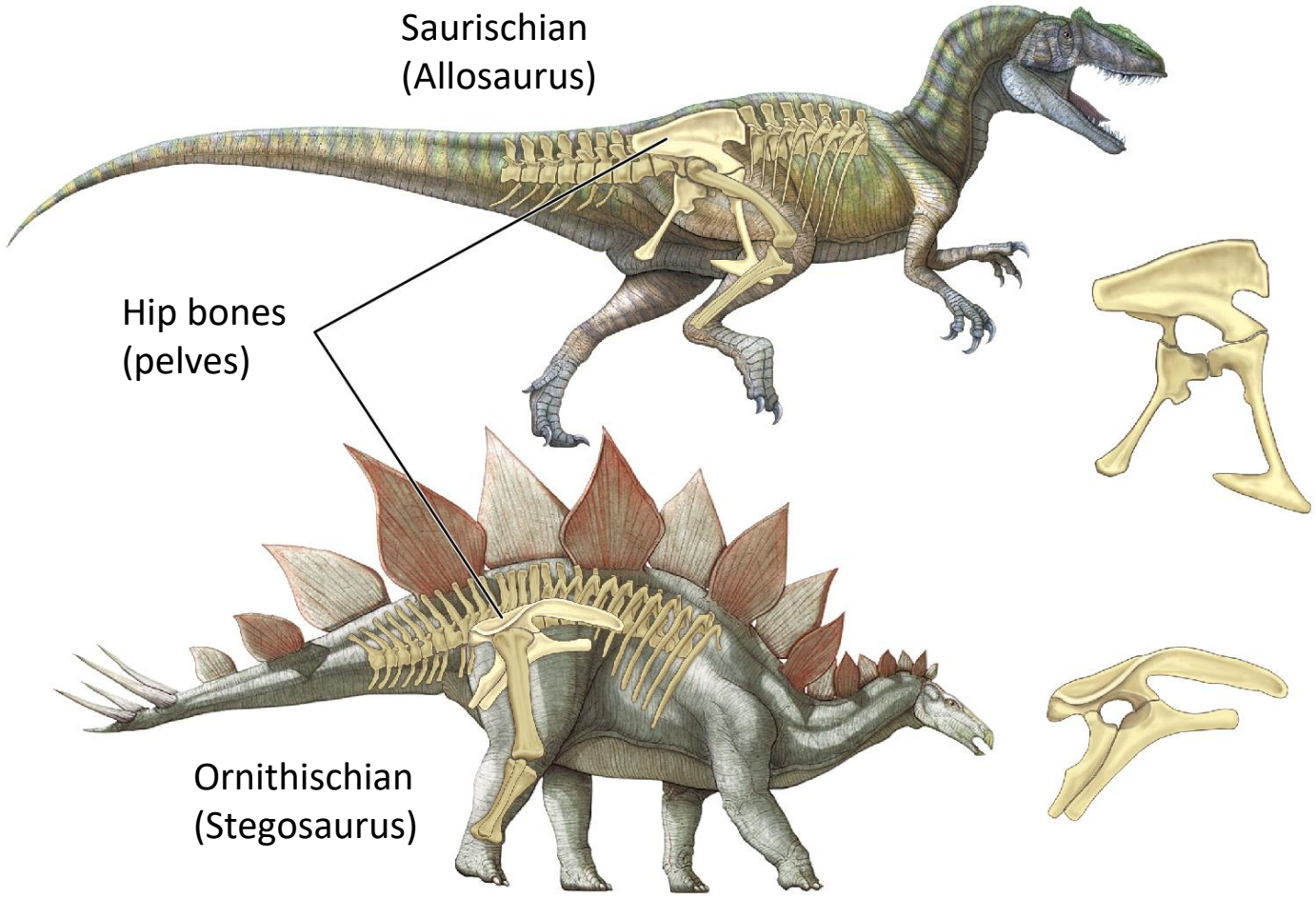
Saurischia + Ornithischia

Sauropodomorpha + Ornithoscelida

Saurischia and Ornithischia

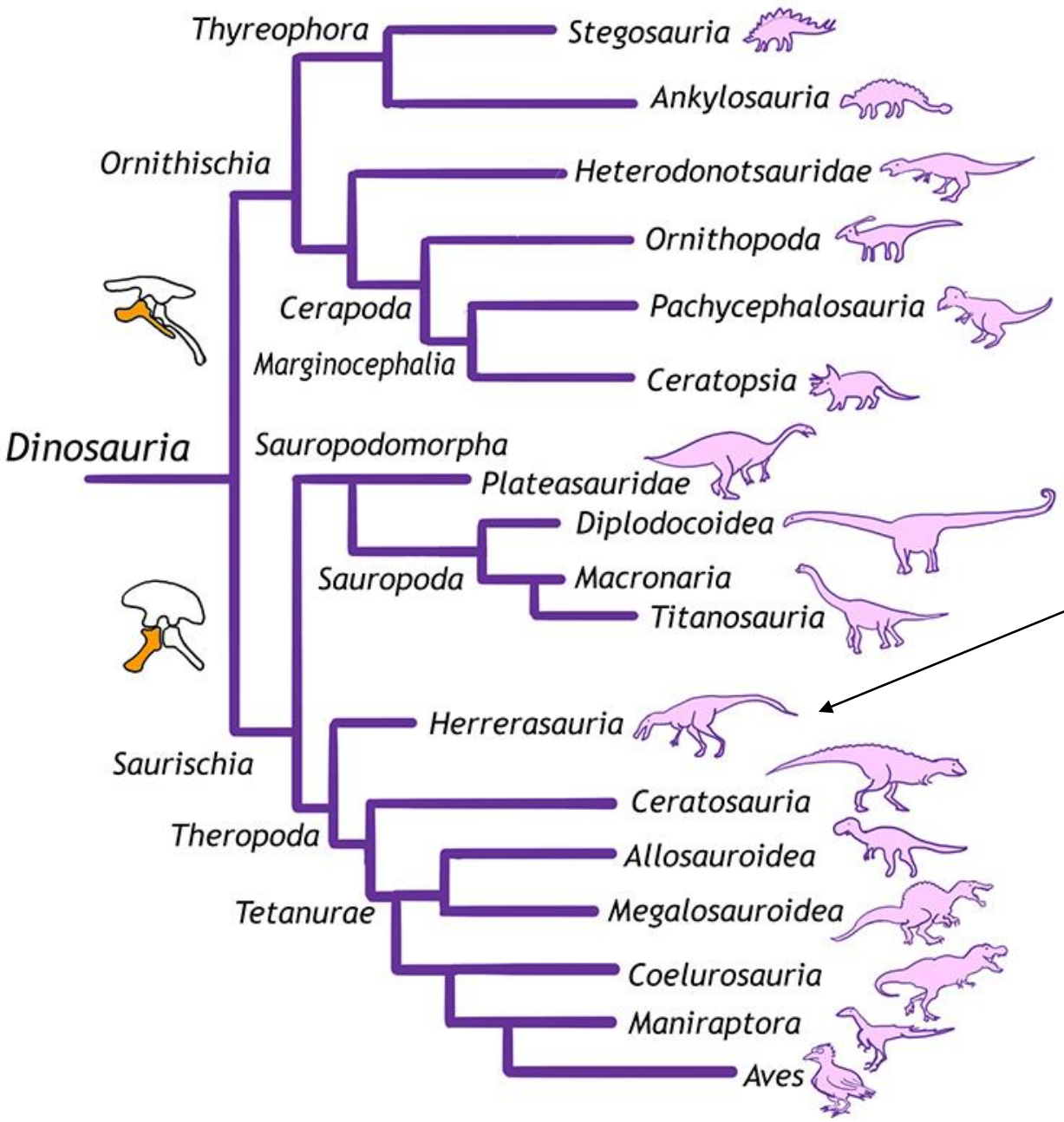


All taxa more closely related to birds than to *Triceratops*.



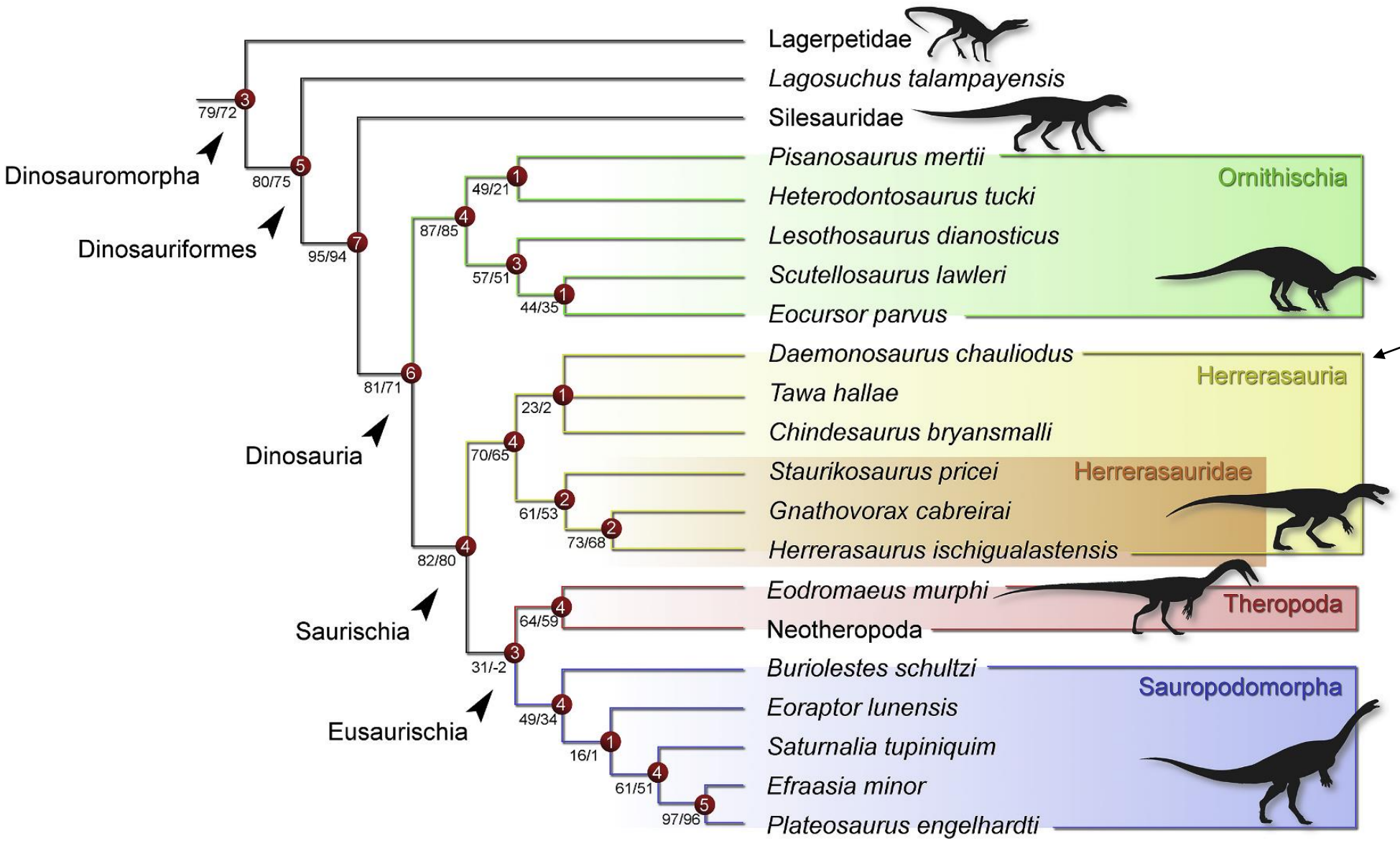
All taxa more closely related to *Triceratops* than to birds.

The traditional saurischian phylogeny



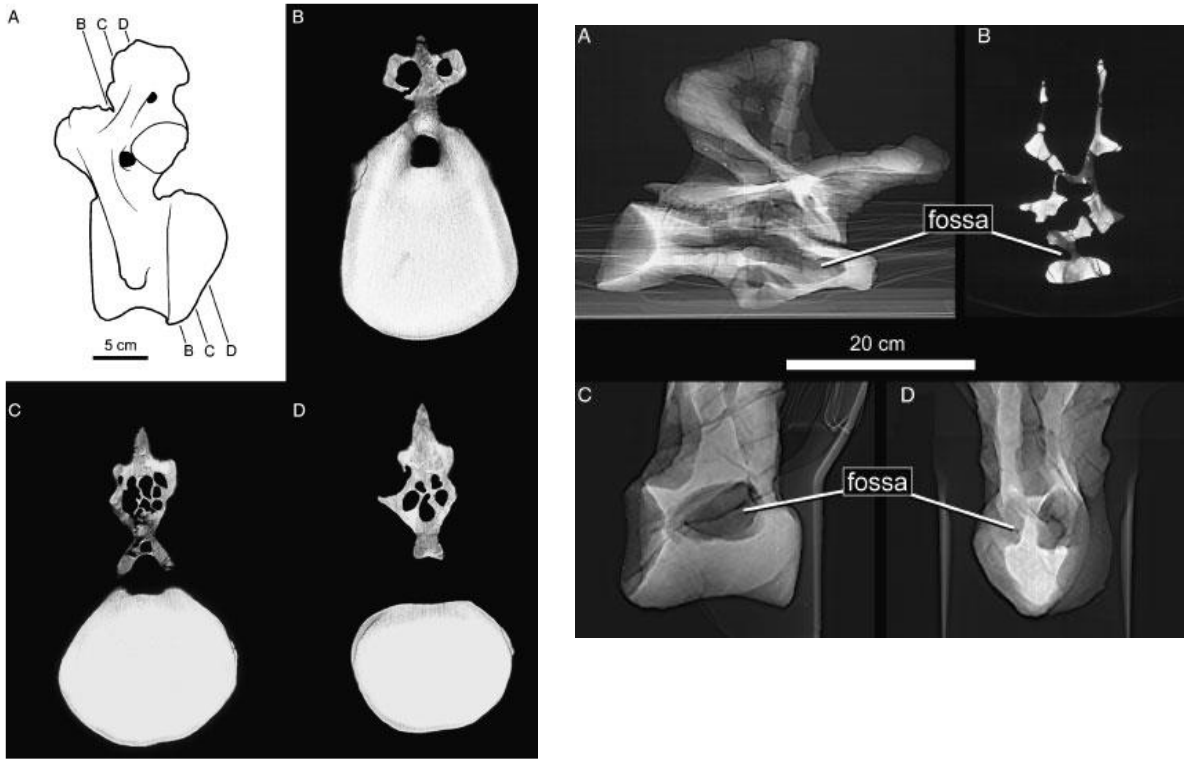
Herrerasauria as basal theropods

Modern saurischian phylogenies

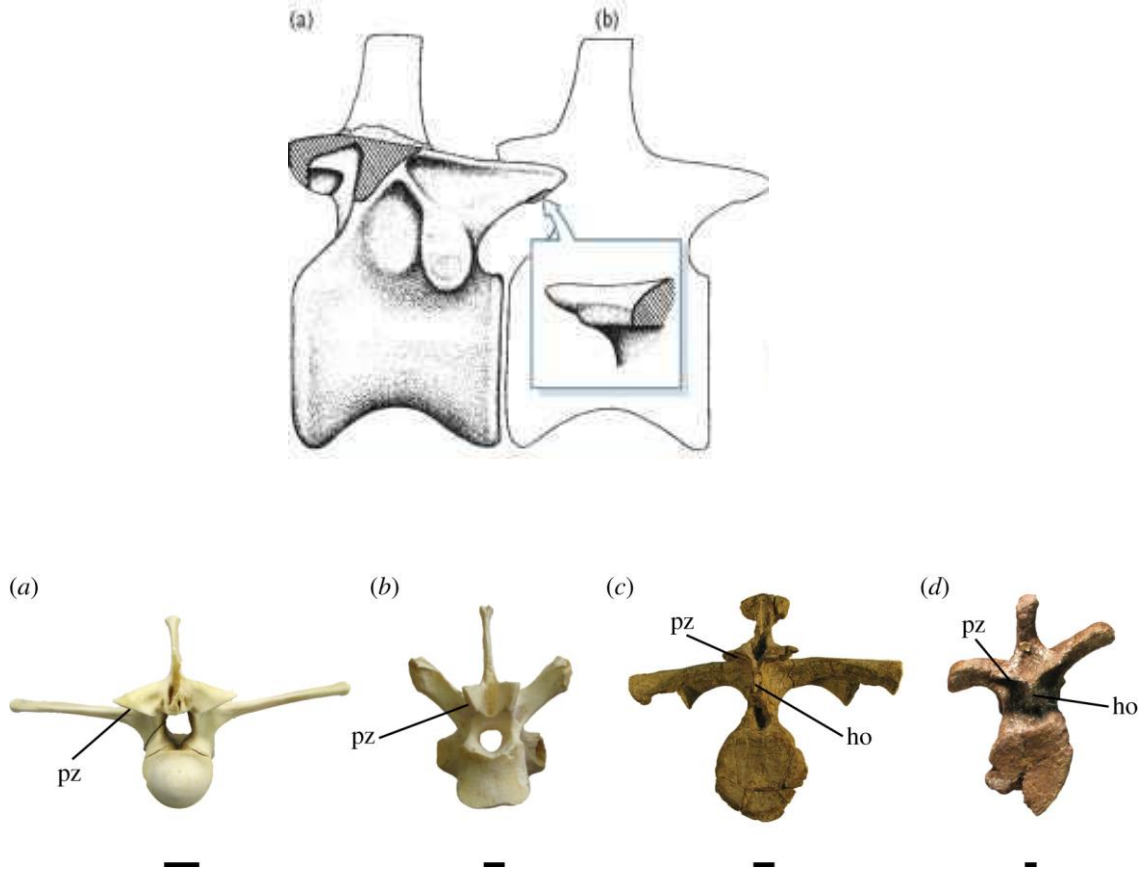


Herrerasauria as basal saurischians

Saurischian synapomorphies

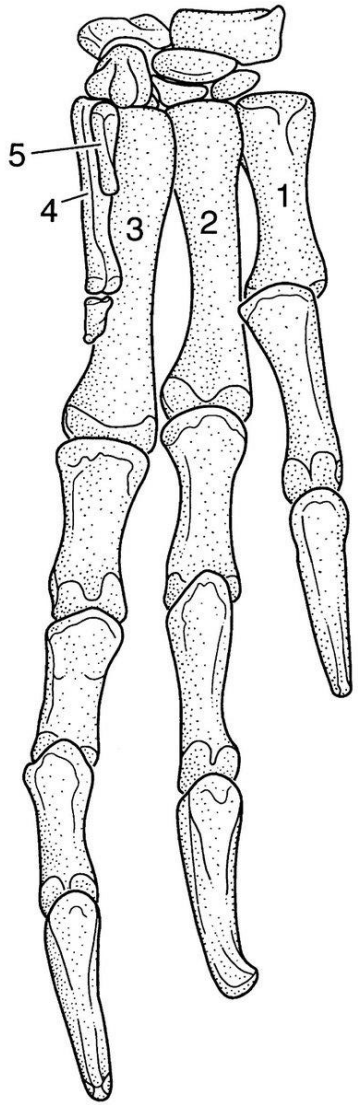


Air sacs in saurischian vertebrae



Hyposphene-hypantrum articulation

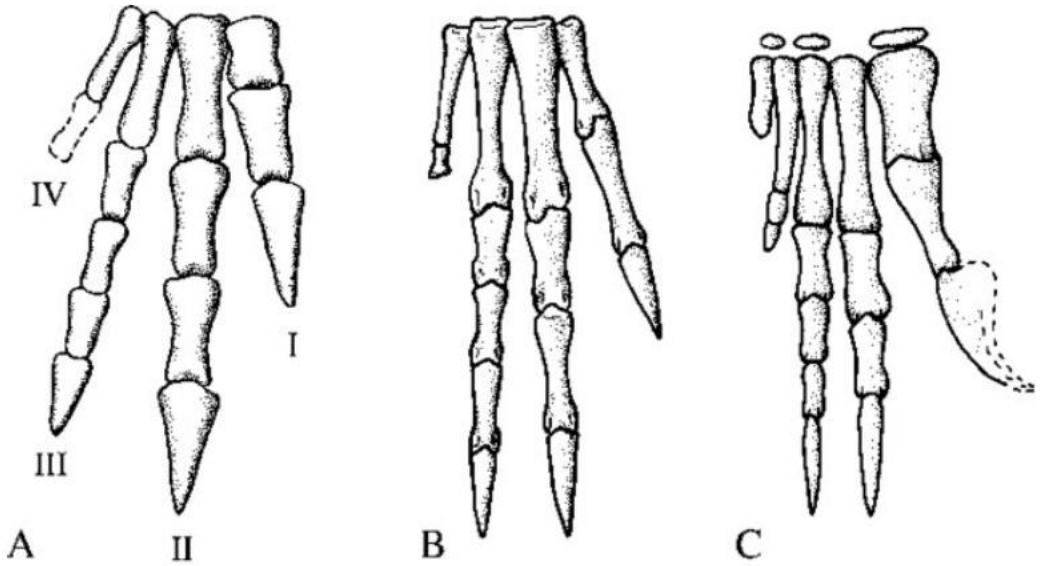
Saurischian synapomorphies



Herrerasaurus

Plateosaurus

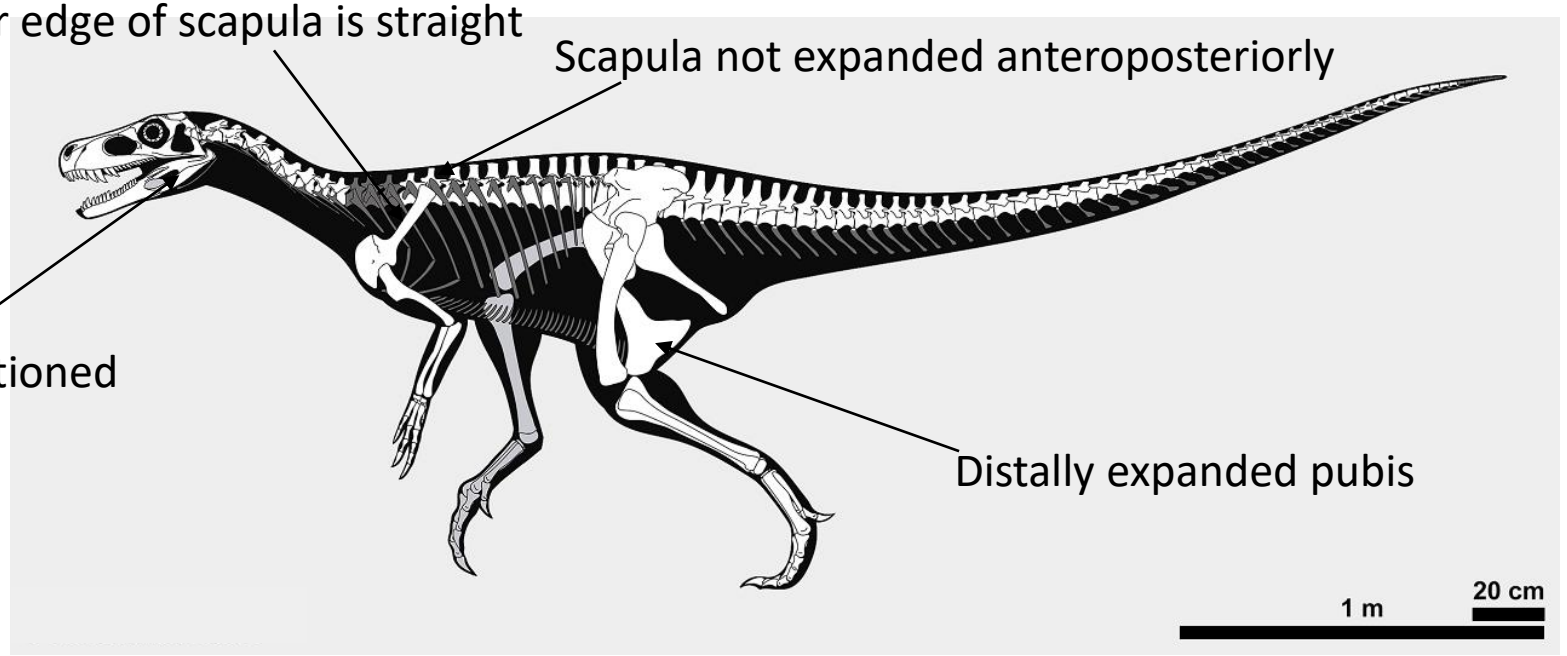
Guaibasaurus *Coelophysis* *Thecodontosaurus*



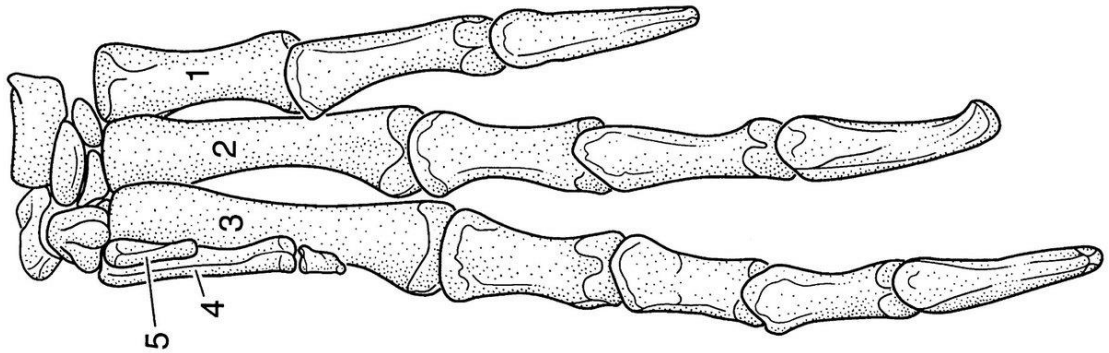
Anchisaurus

Riojasaurus

Herrerasaurids

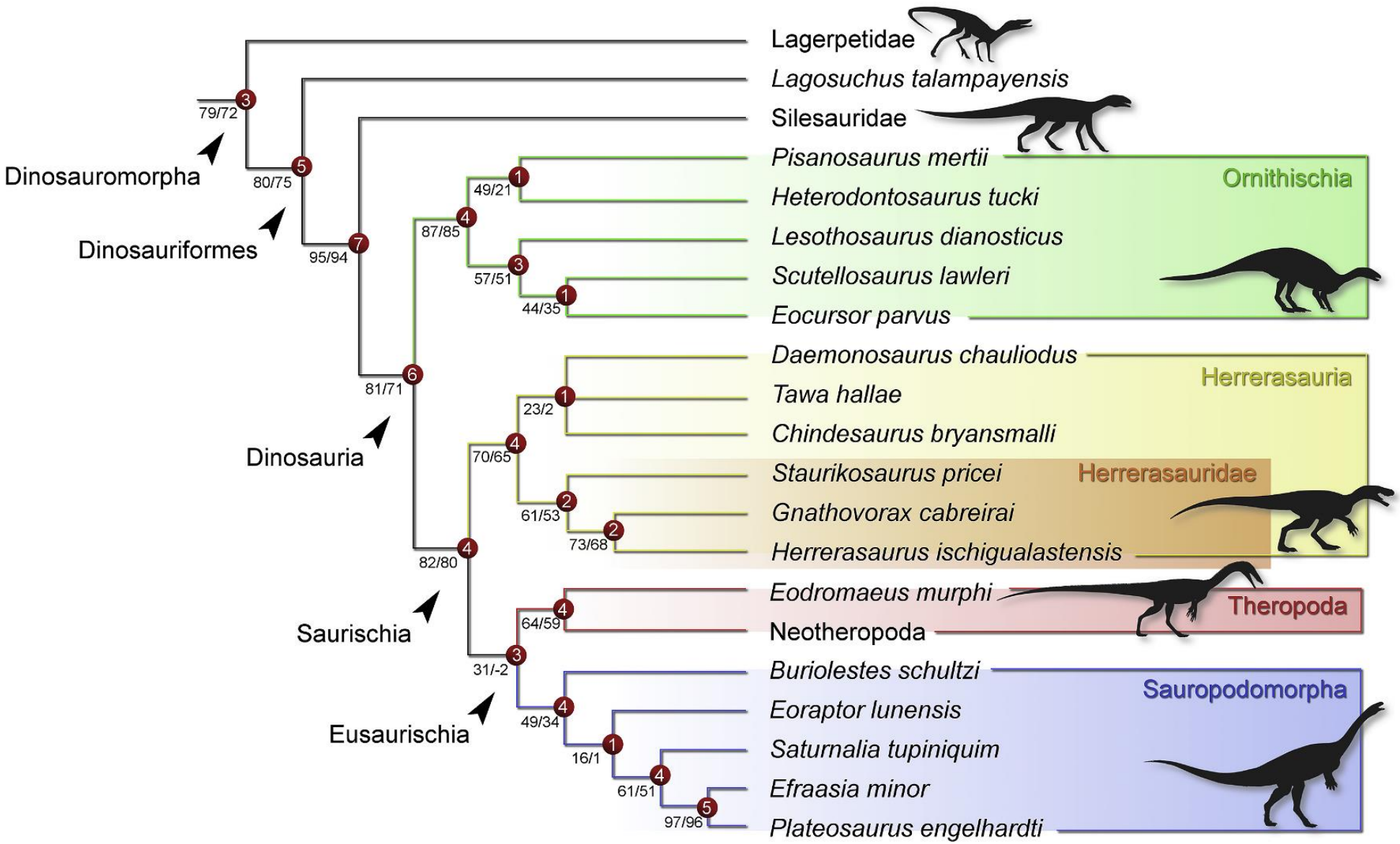


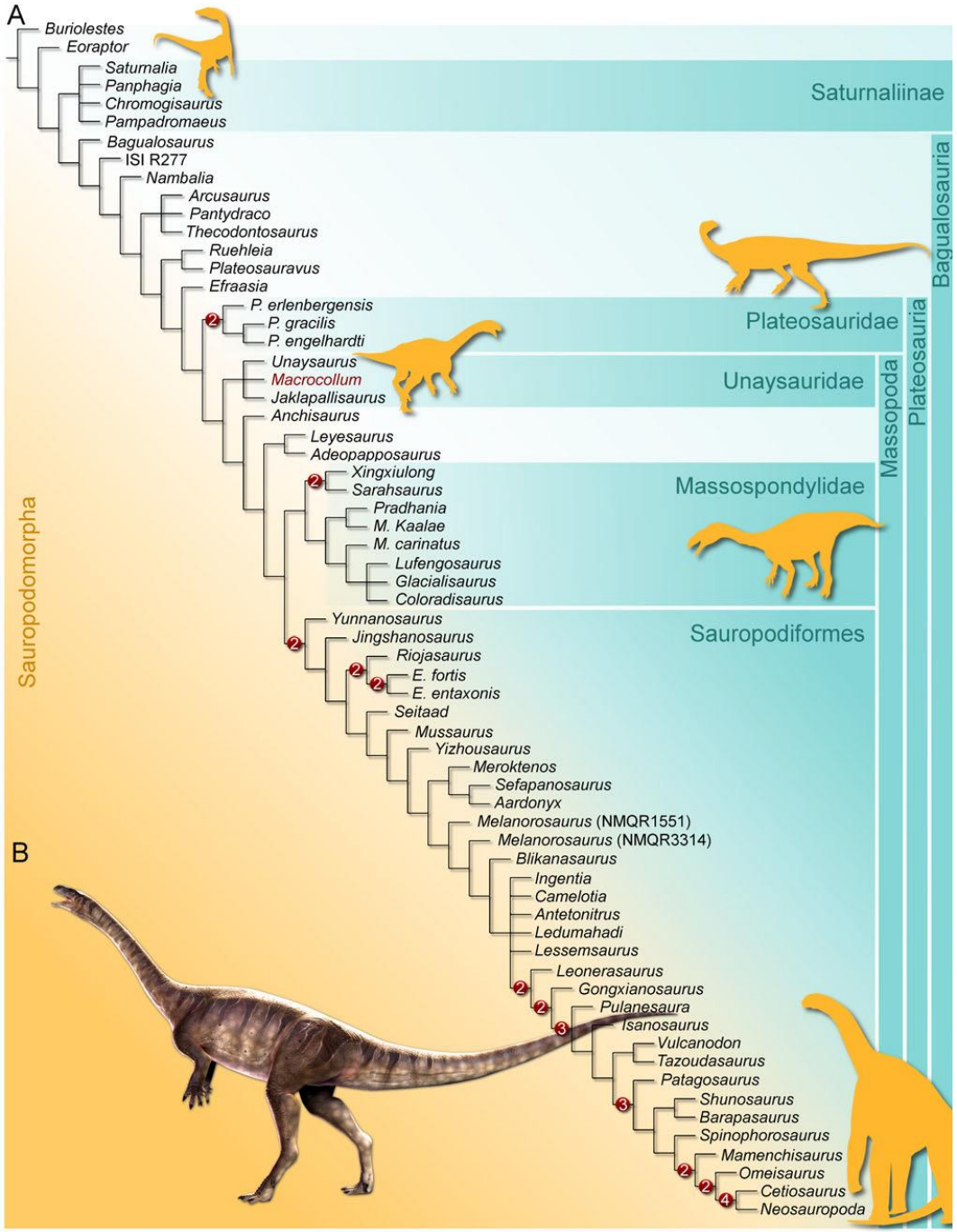
Herrerasaurus, Late Triassic of South America



Longer digit 3, plesiomorphic state missing in eusaurischians

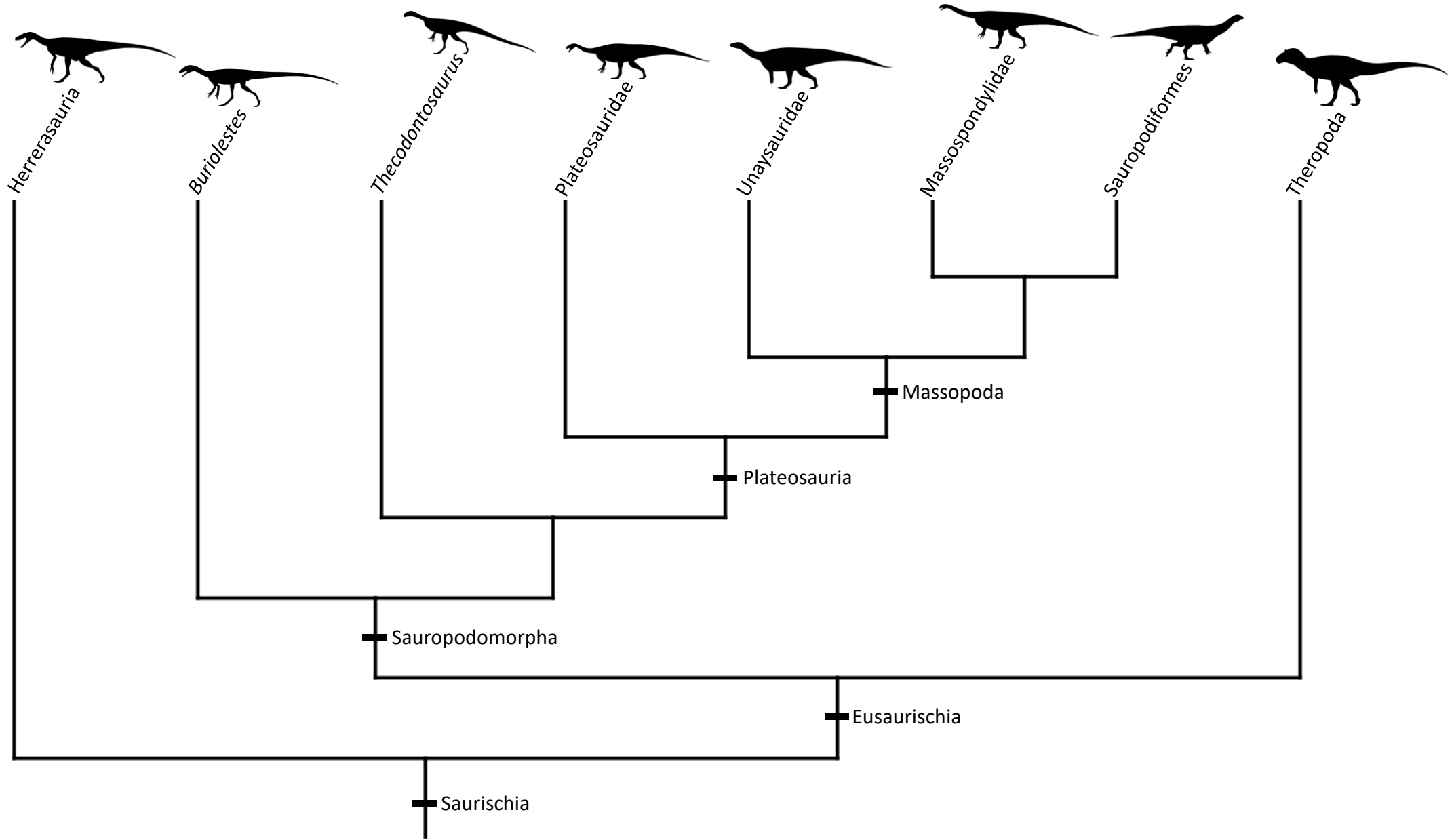
Modern saurischian phylogenies





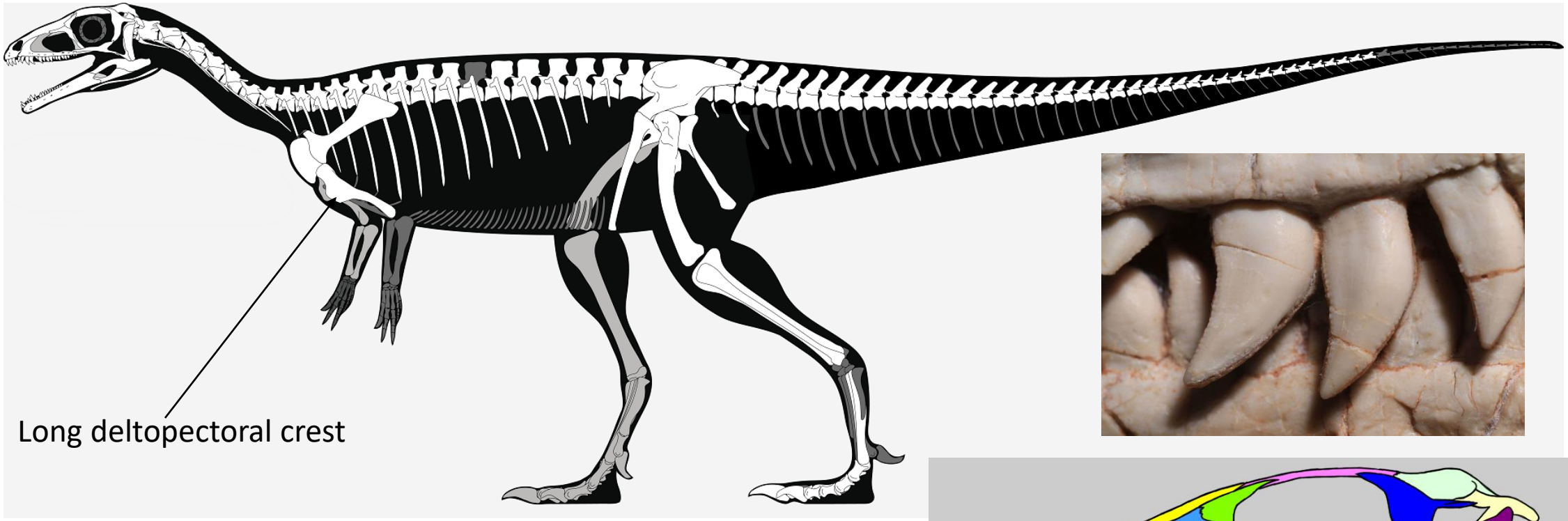
Müller et al., 2019

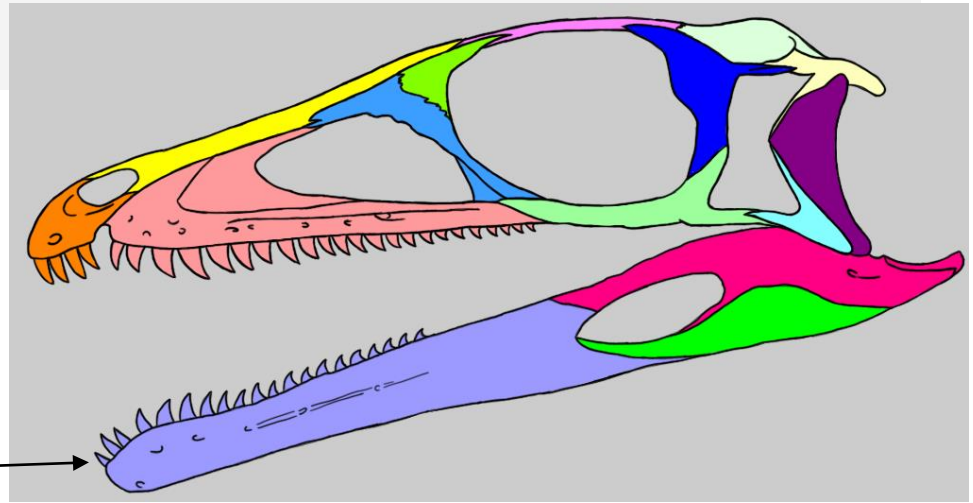
Basal Sauropodormorph phylogeny



Basal Sauropodomorpha

Buriolestes, the basalmost sauropodomorph, from the Late Triassic (Carnian) of South America

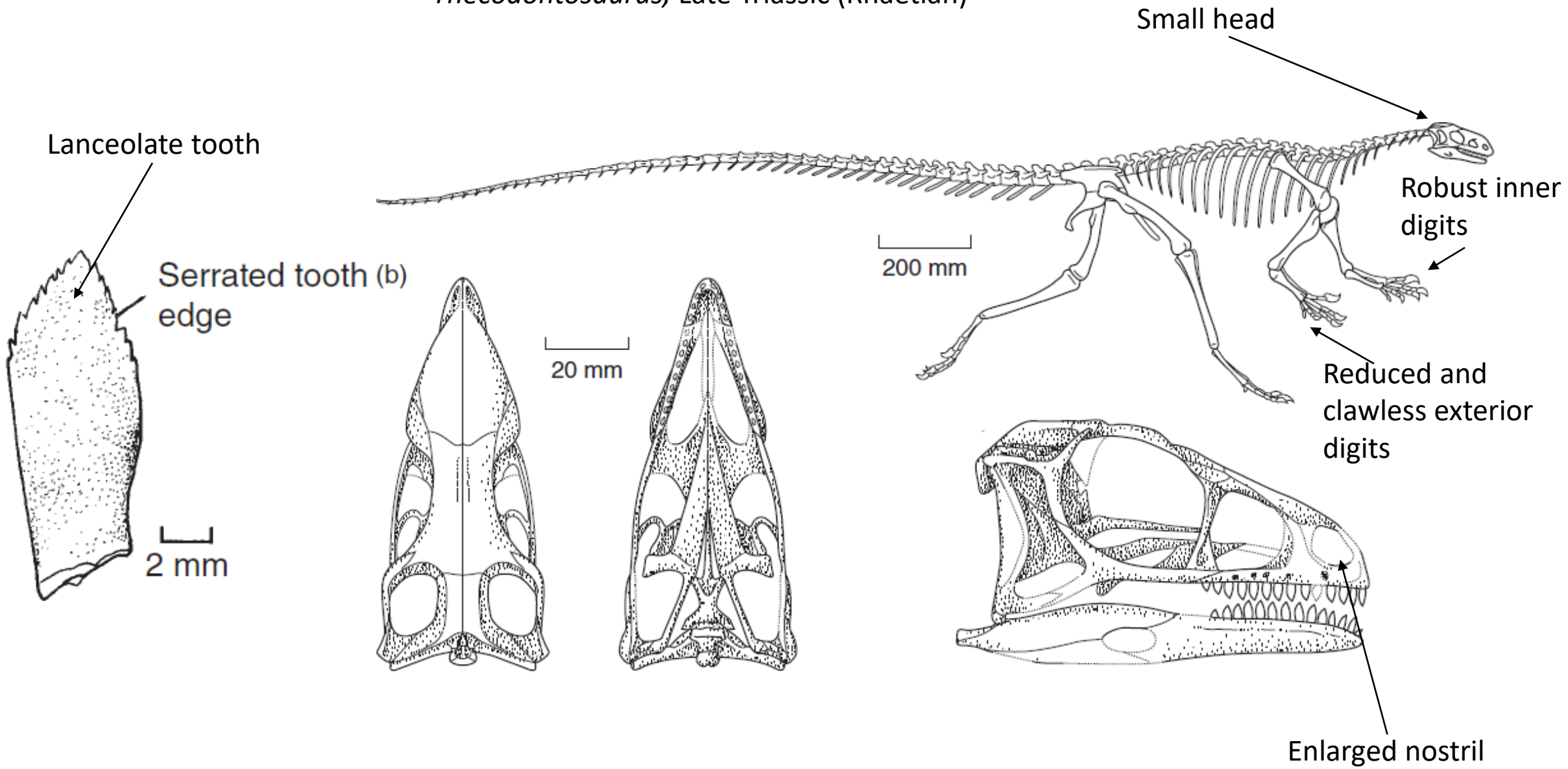




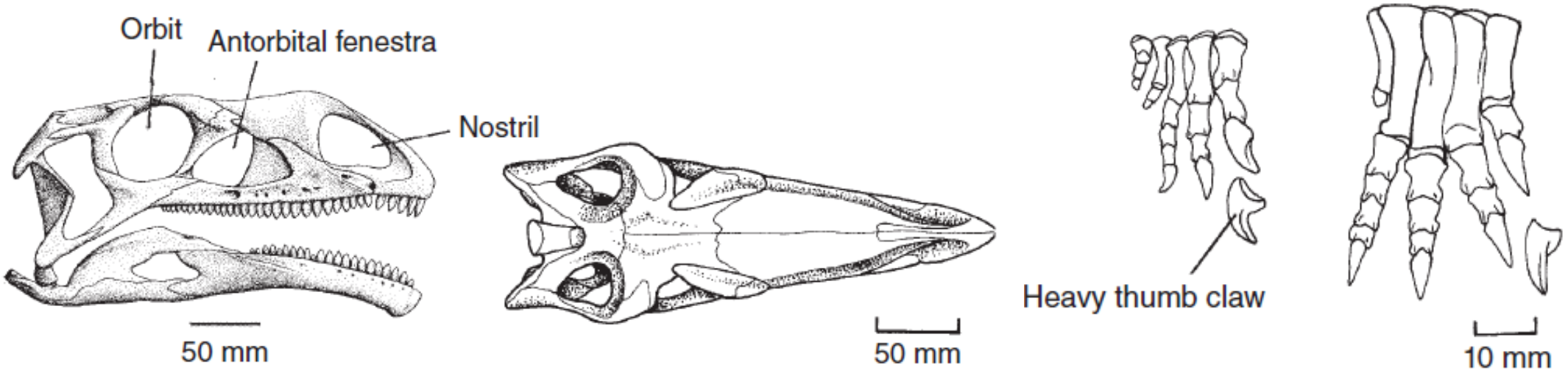
- It lacks a small head and enlarged nostrils, which are typical among more derived sauropodomorphs.
- Like *Eoraptor*, it was probably carnivorous.

Basal Sauropodomorpha

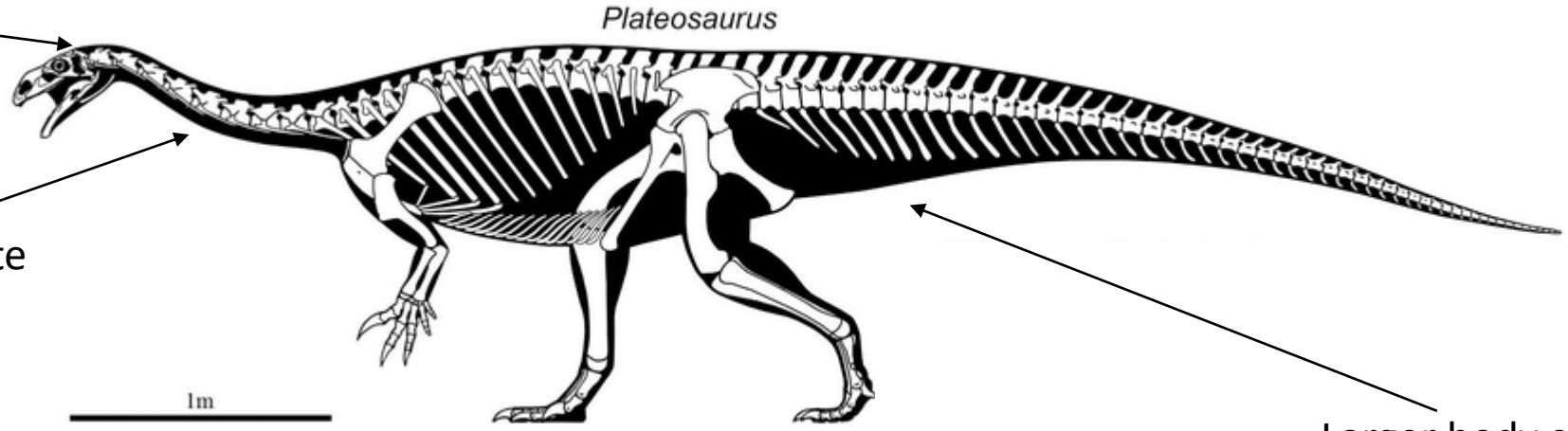
Thecodontosaurus, Late Triassic (Rhaetian)



“Prosauropoda”



Longer neck and cervical vertebrae

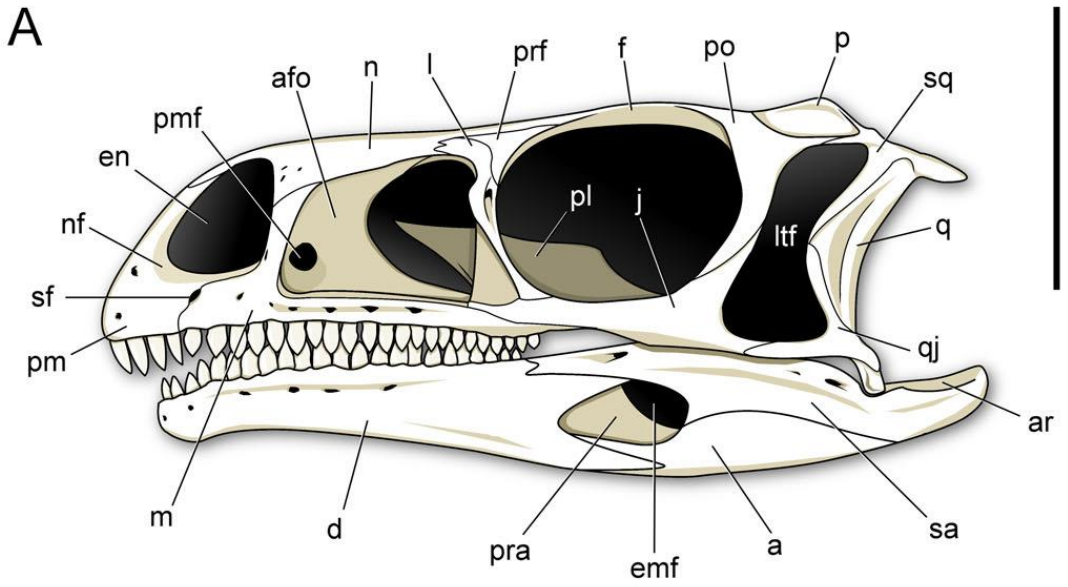


Could not pronate hands (obligate bipedalism)

Larger body size

Plateosaurus, Late Triassic

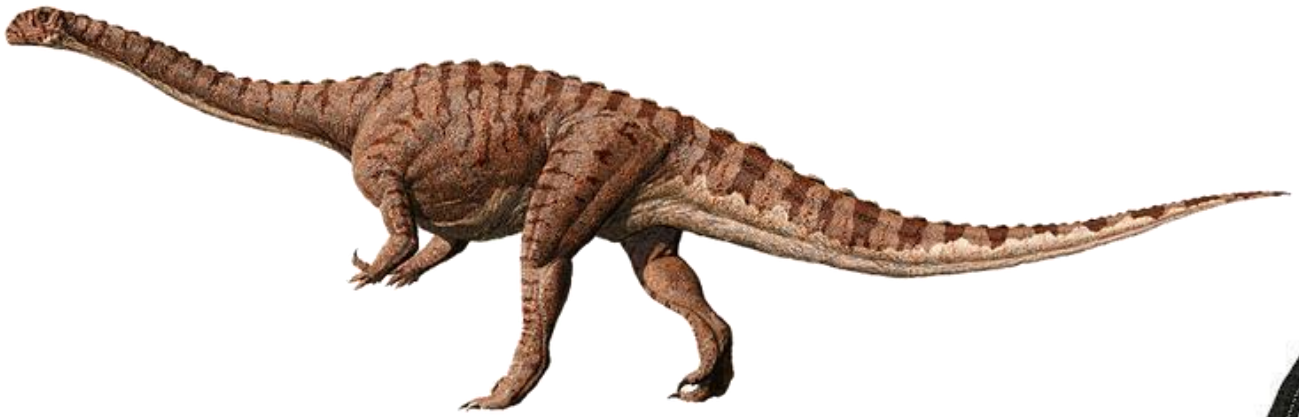
Unaysauridae and Plateosauridae, two groups of prosauropods



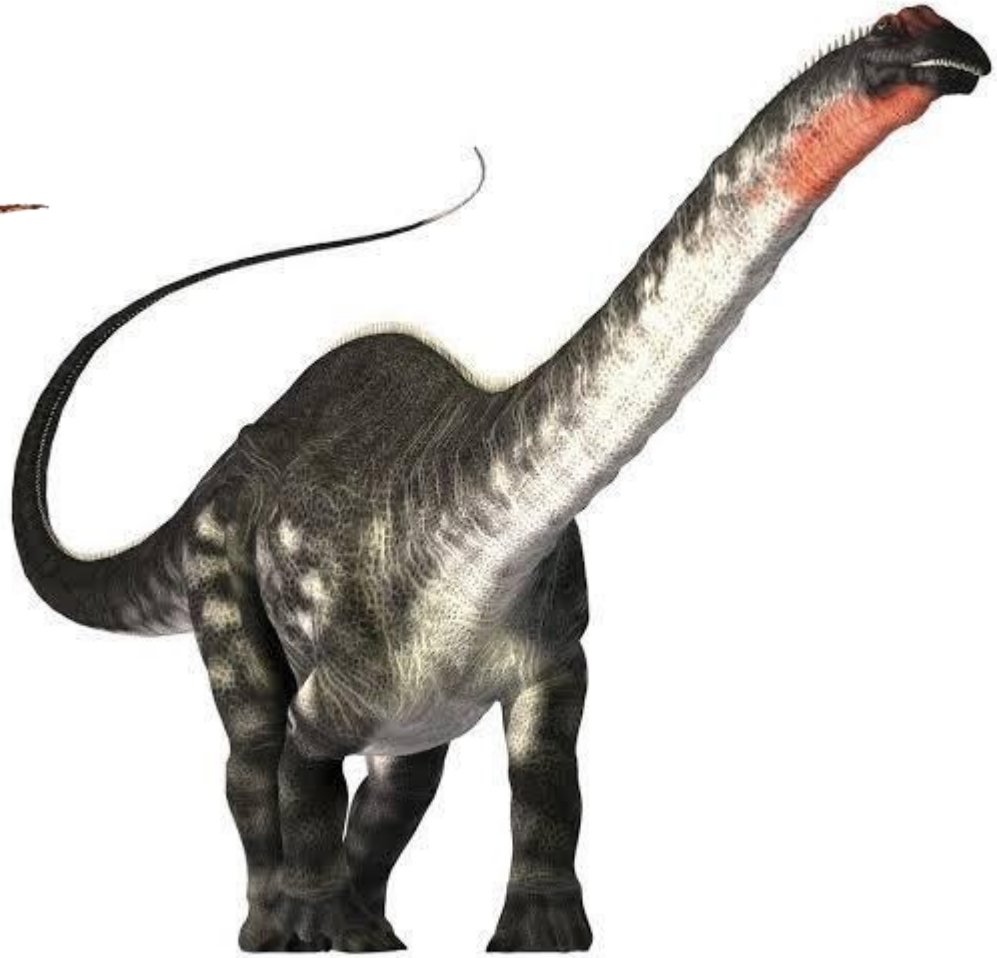
Macrocollum, Unaysauridae
presence of promaxillary fenestra

Plateosaurus, Plateosauridae

Massopoda Every taxa closer to *Apatosaurus* than to *Plateosaurus.* Etymology = Massospondylidae + Sauropoda



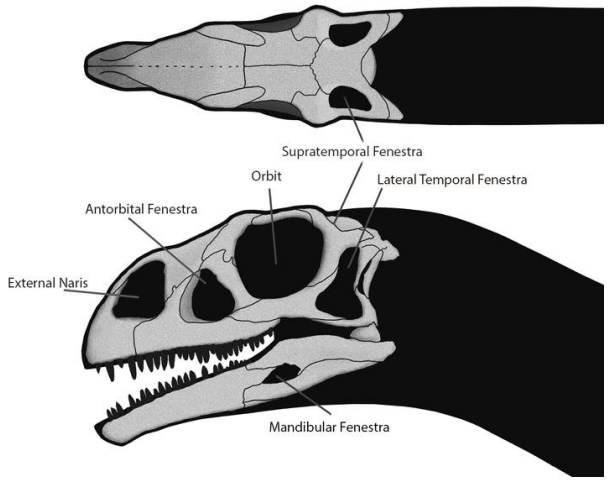
Massospondylus



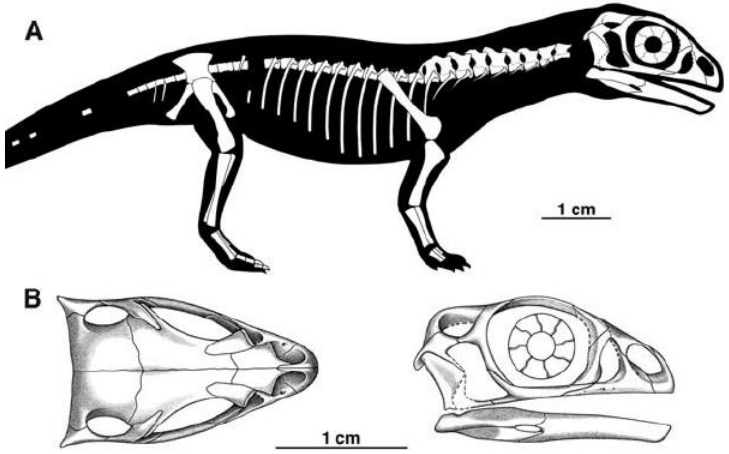
Apatosaurus

Juvenile *Mussaurus*

Massospondylidae

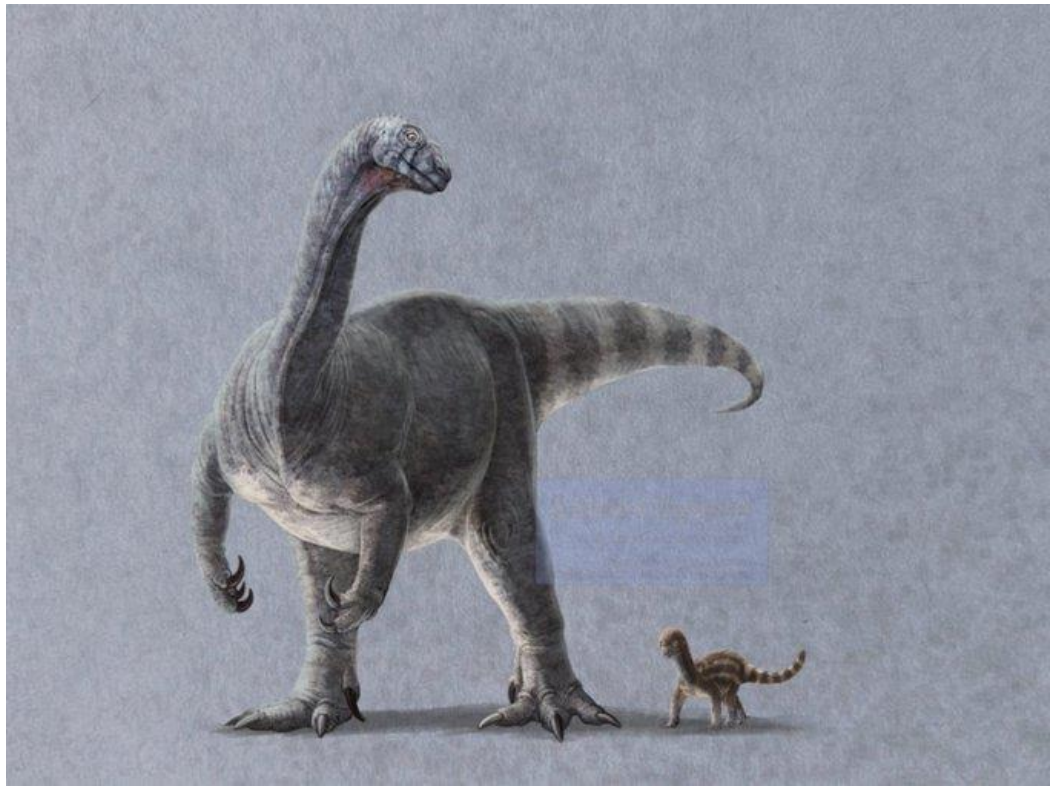


Massospondylus, Early Jurassic

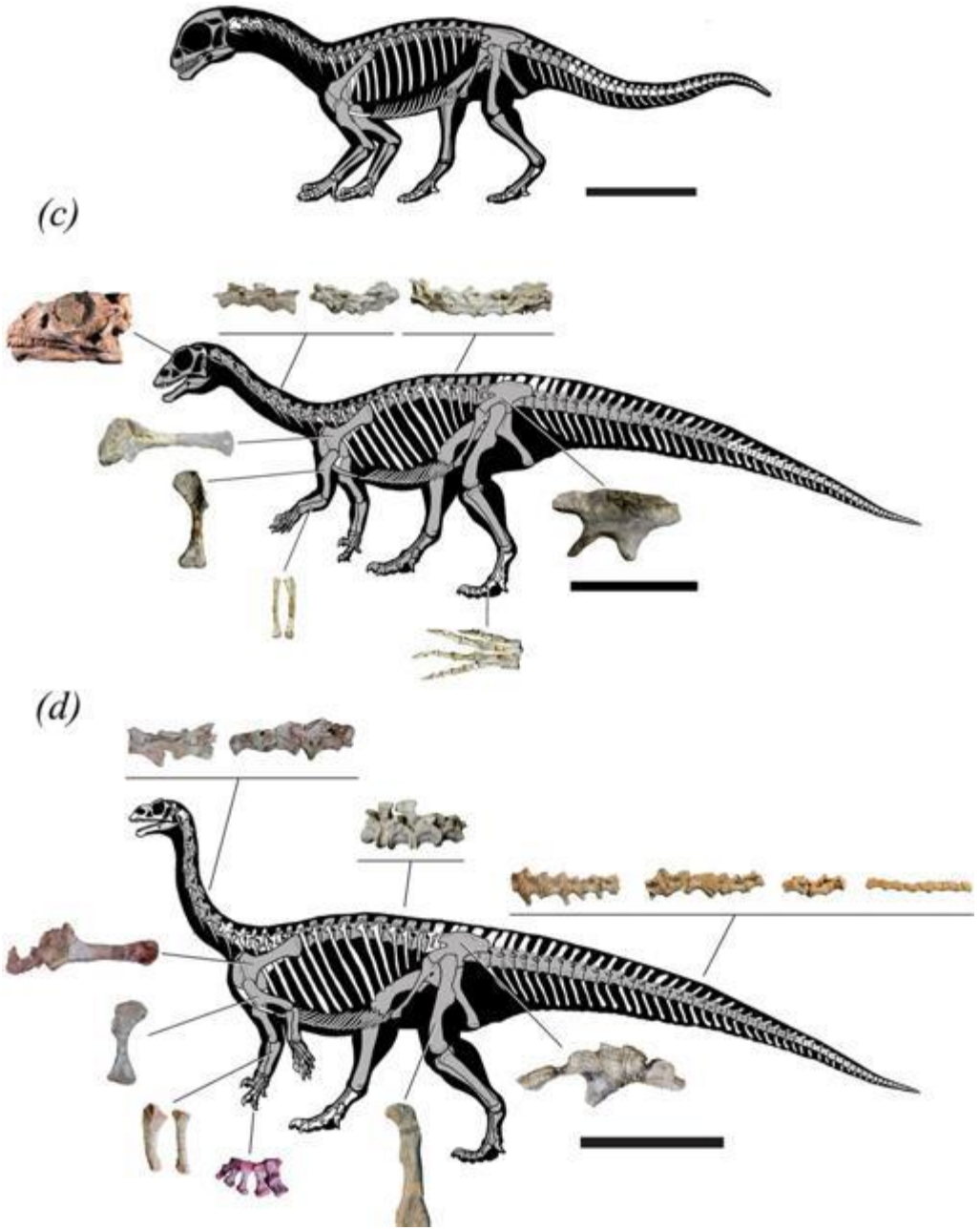


- Smaller and with a slighter build than plateosaurids.
- Longer necks, with foremost cervicals four times longer than wider.
- Juvenile proportions and tracks in nesting sites indicate a quadrupedal gait, but adults retain ancestral bipedalism.

Juvenile quadrupedalism

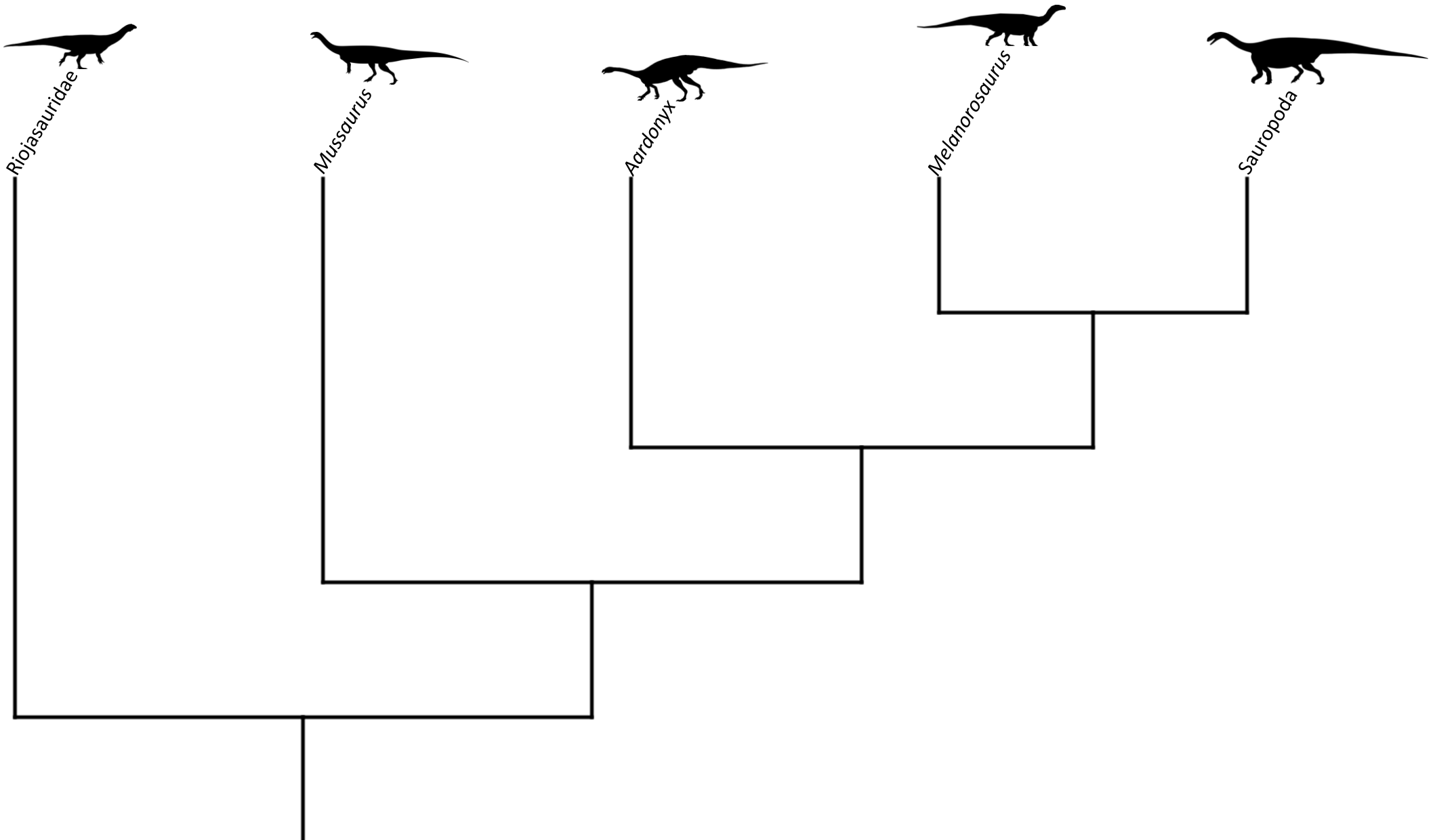


Massospondylidae and some basal Sauropodiformes (such as *Mussaurus*) appear to transition to a bipedal gait as adults.



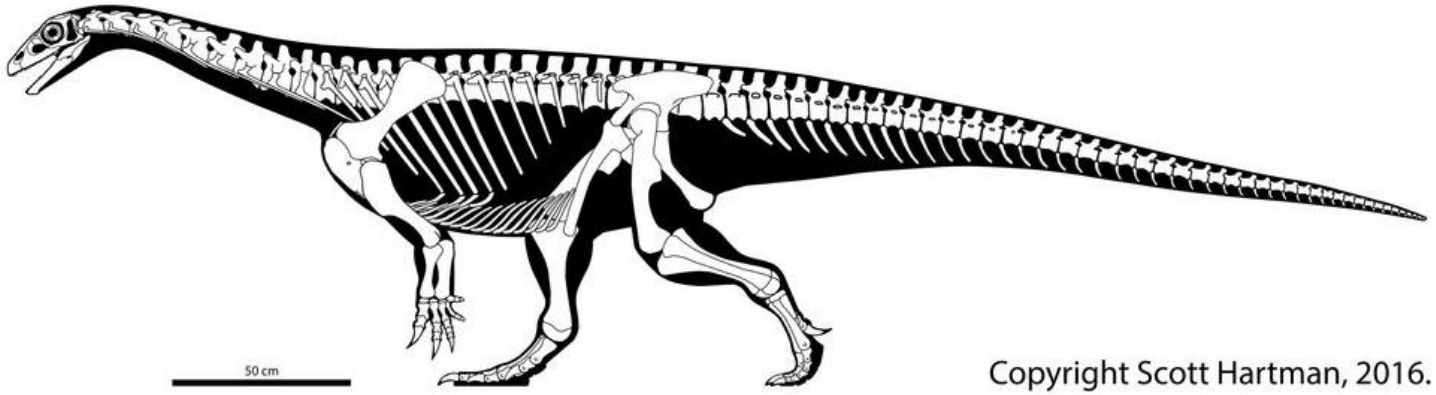
Mussaurus, early Jurassic

Sauropodiformes All taxa closer to *Saltasaurs* than to *Massospondylus*



Riojasauridae

- Heavier body and bulkier legs than most earlier sauropodomorphs.
- Although usually described as obligate quadrupeds, a 2016 study concluded that it was a biped.
- Four sacral vertebrae instead of three.

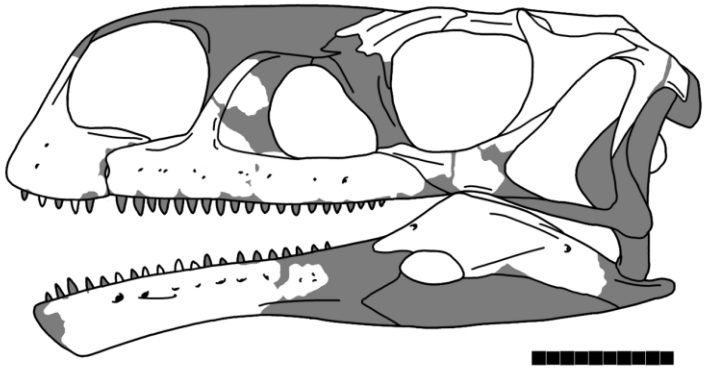


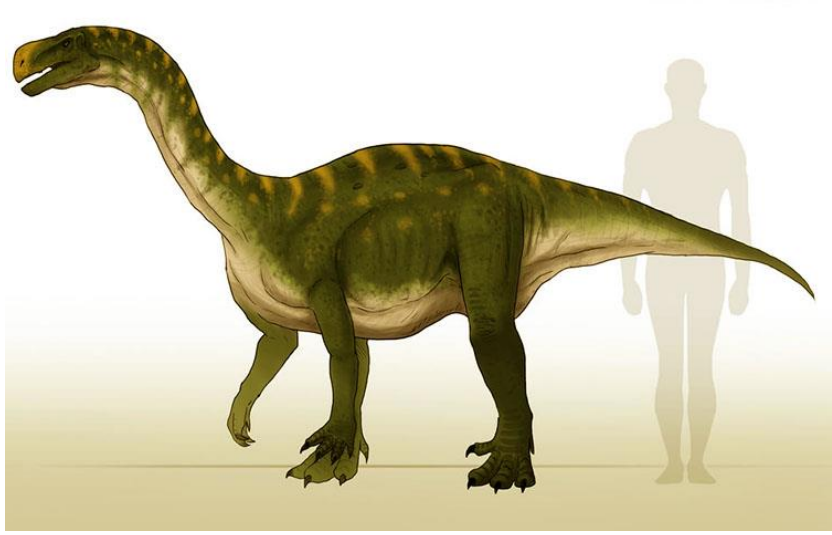
Riojasaurus, Late Triassic

Outdated quadrupedal depiction of *Riojasaurus*

Aardonyx

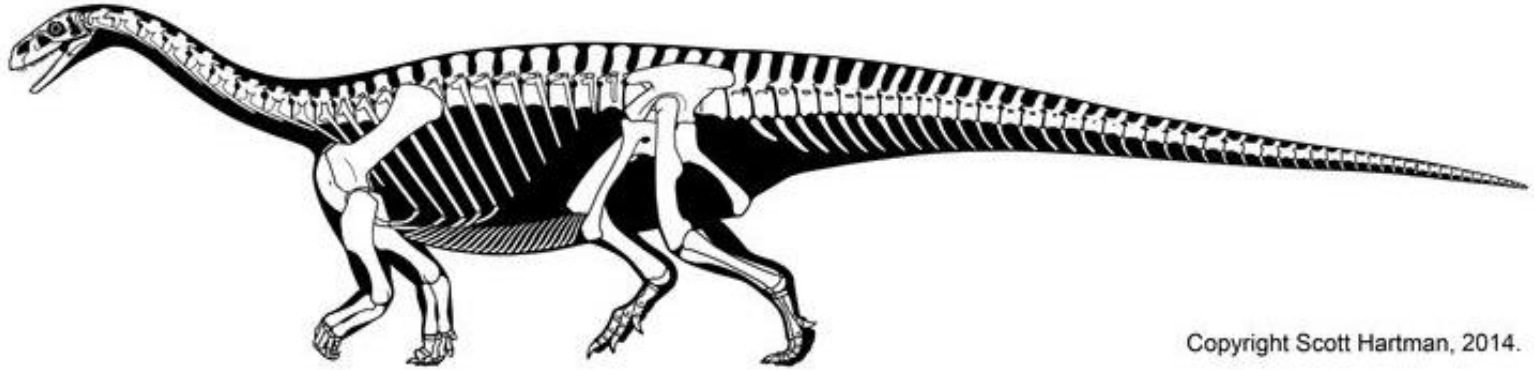
- Although a biped, features of the hand and ulna suggest it could walk quadrupedally as an adult.
- Fourth trochanter of the femur is more distally positioned. Typical characteristic of large sauropods.

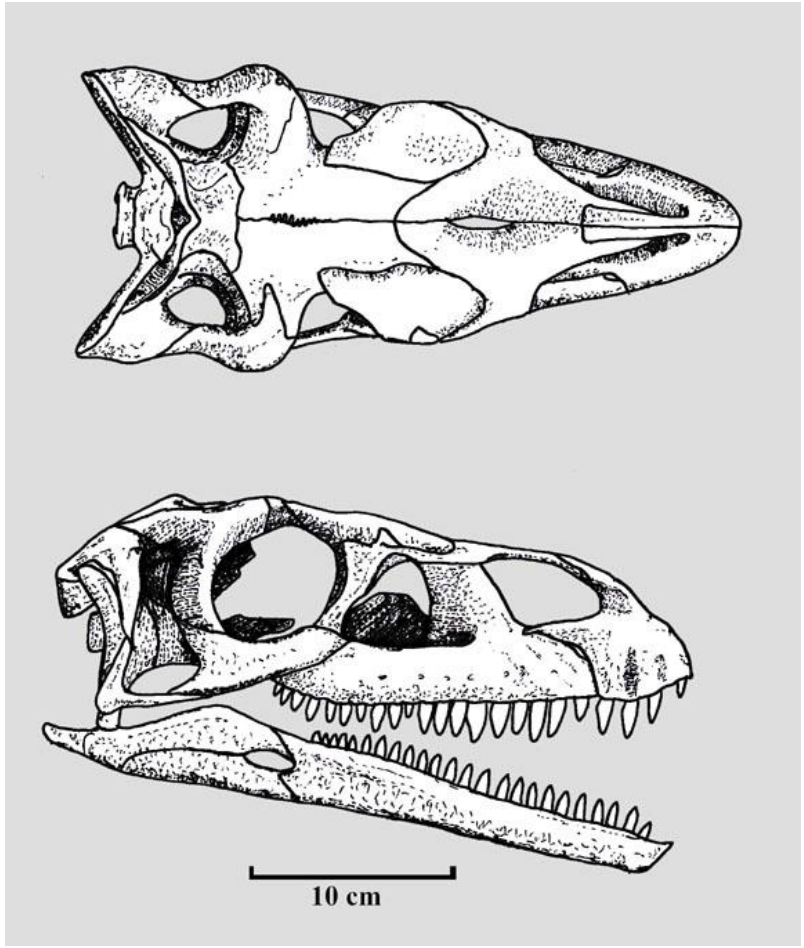




Melanorosaurus

- Earliest truly quadrupedal sauropodomorphs.
- Retained some primitive sauropodomorph characteristics, such as a premaxilla with four teeth on each side.
- Four sacral vertebrae.
- The genus is probably paraphyletic.





Melanorosaurus, Late Triassic

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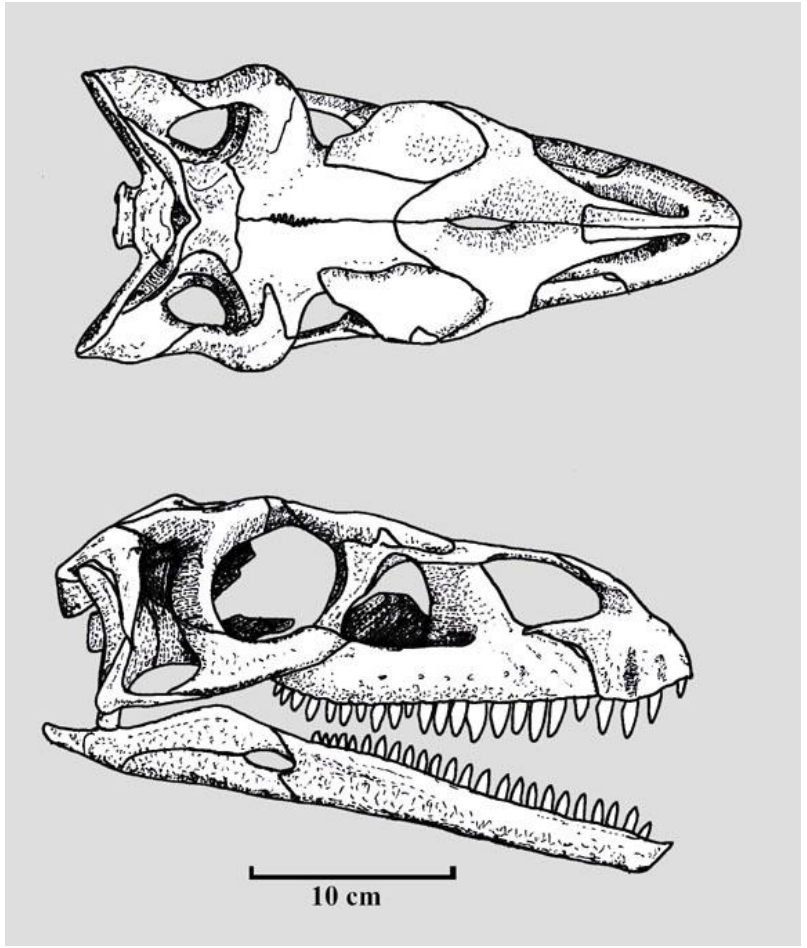
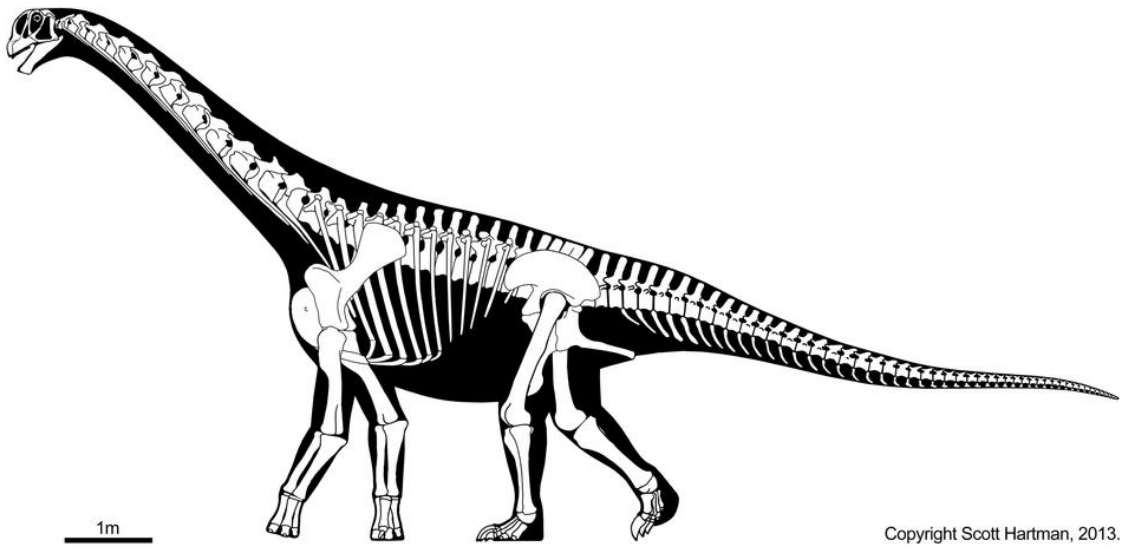
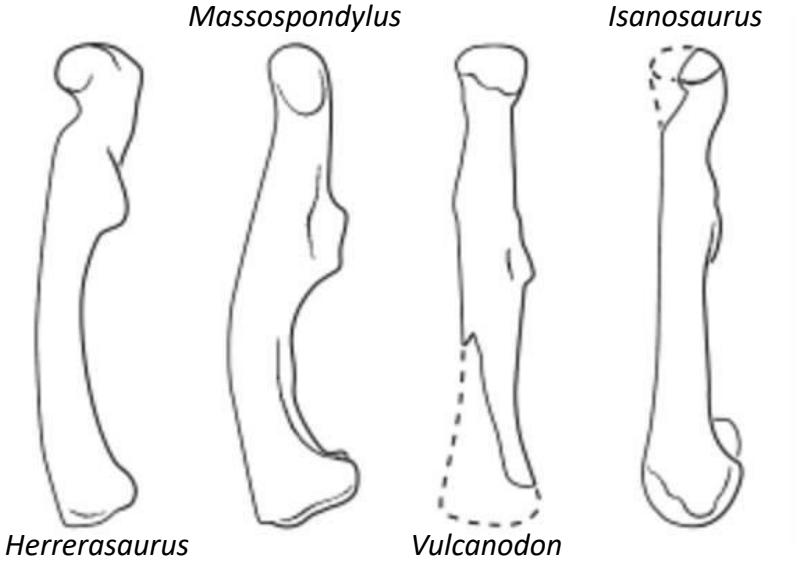


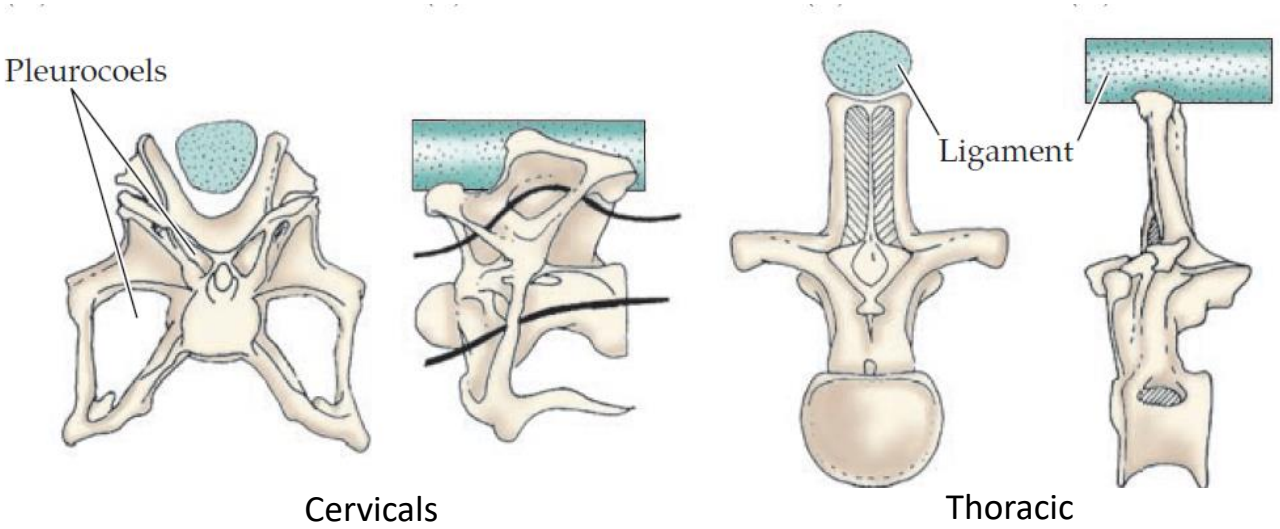
Melanorosaurus, Late Triassic

Sauropoda Sometimes defined as all taxa more closely related to *Saltasaurus* than to *Melanorosaurus*

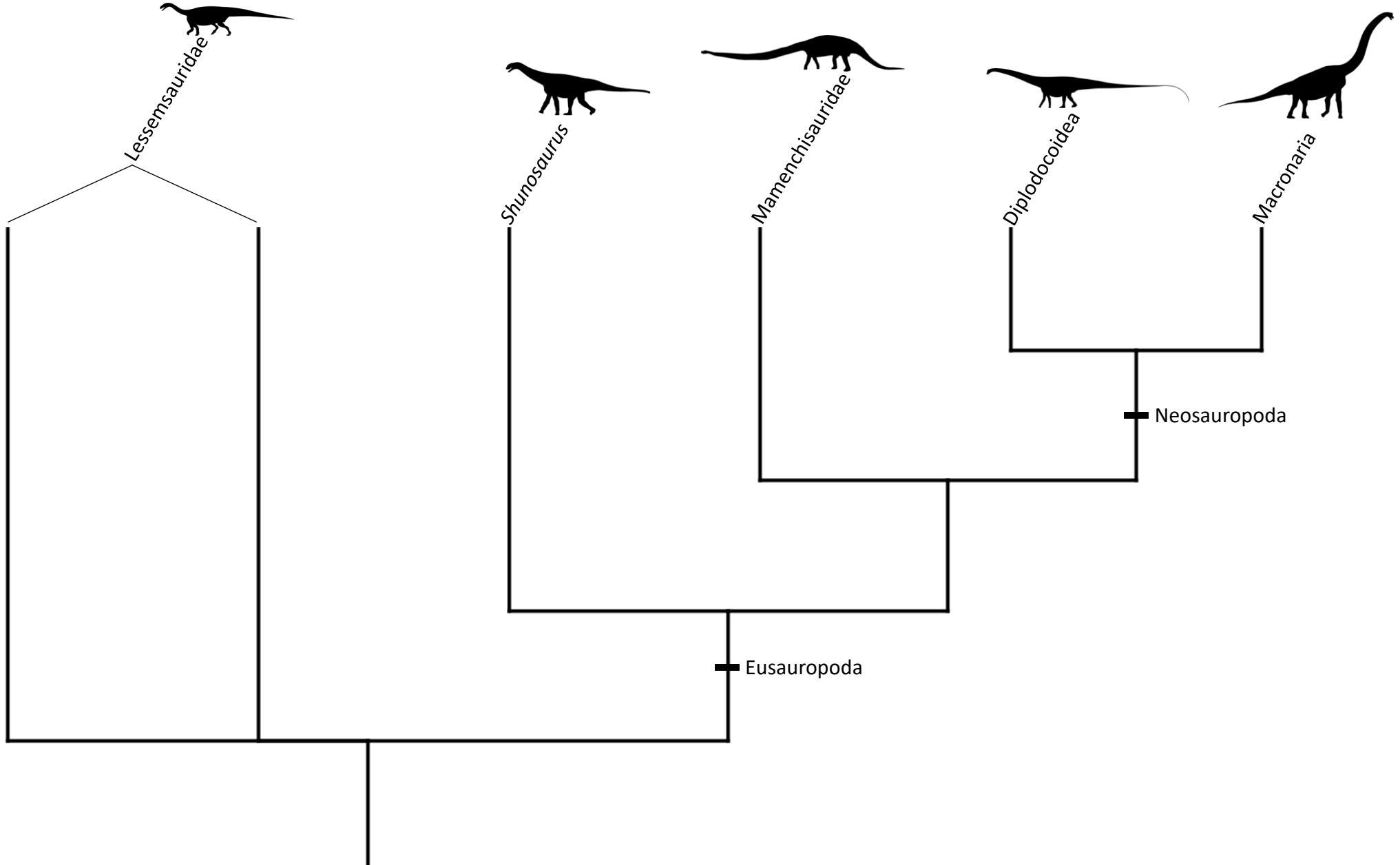
- Massive graviportal, obligate quadrupeds.
- Straight limb bones, forming “columnar legs”.
- Articular surfaces of bones not ossified, forming thick cartilaginous caps.
- Distal carpals and some distal tarsals not ossified.
- Tendency to increase the number of sacral vertebrae (from 3-4, to 6 in derived sauropods)
- Evidence for a thick supraspinous ligament that supports neck and tail.



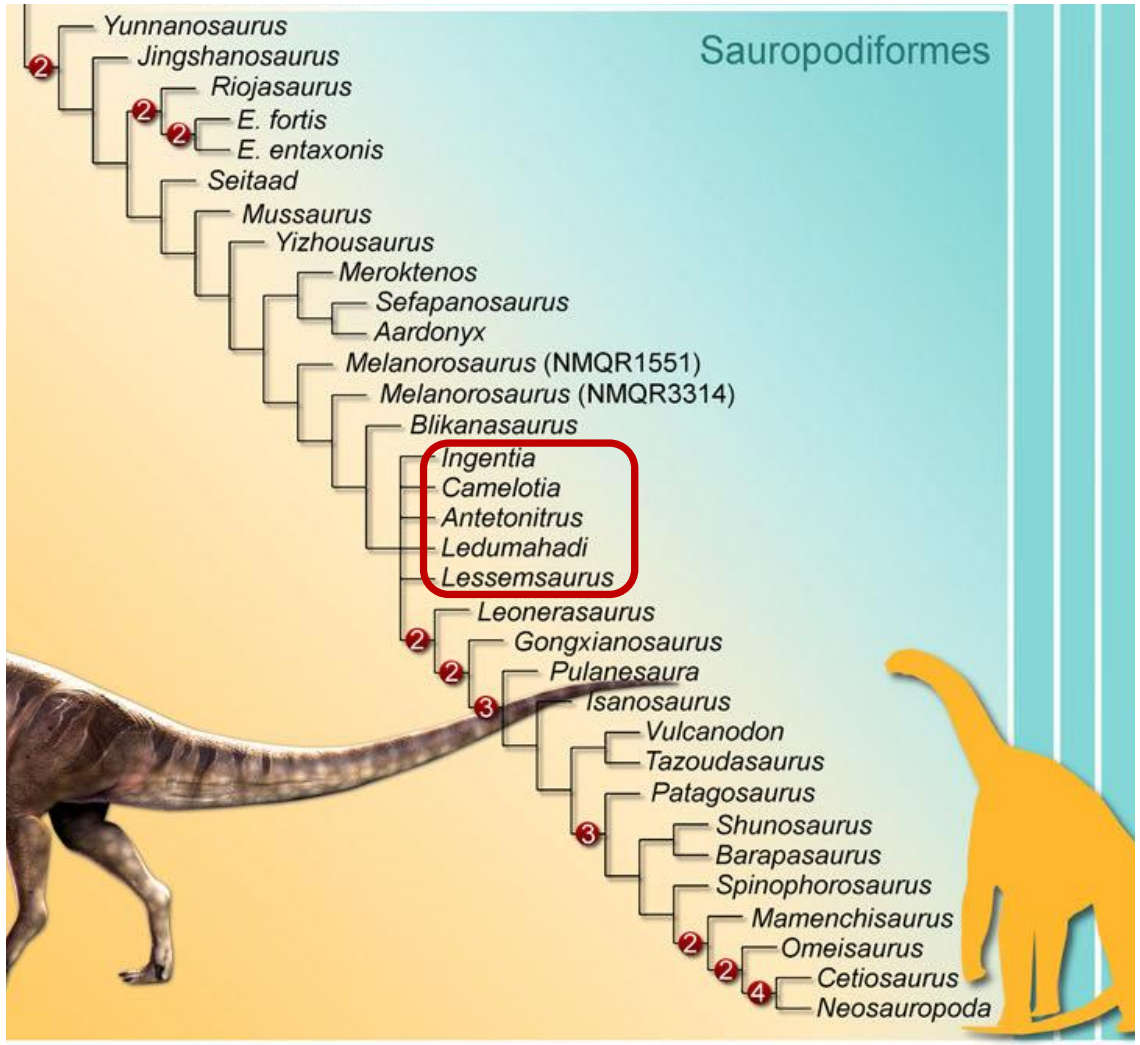




Sauropoda All taxa more closely related to *Saltasaurus* than to *Melanorosaurus*

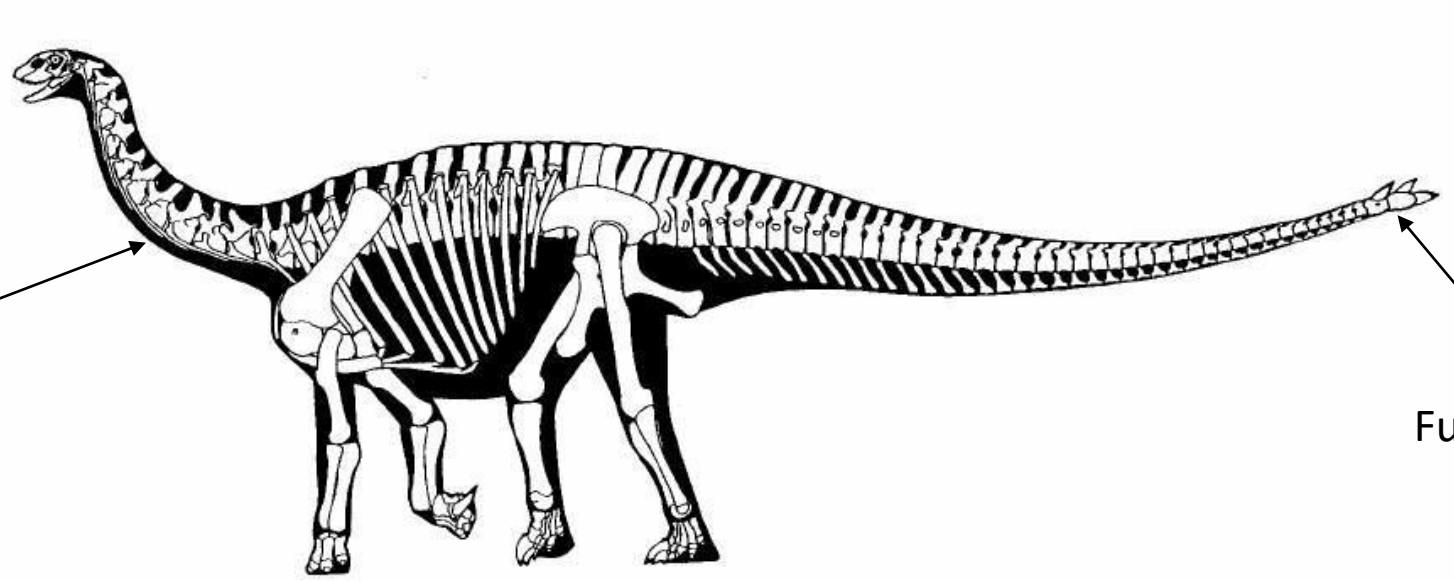


“Lessemsauridae”



First giant sauropodomorphs, some reaching masses of up to 12 metric tonnes. Depending on the phylogeny and the definition of Sauropoda, they can either be basal sauropods, the sister group to Sauropoda, or form a polytomy at the base of Sauropoda.

Eusauropoda All taxa more closely related to *Shunosaurus* than to *Vulcanodon*



Relatively short neck

Fused caudal vertebrae forming a tail club

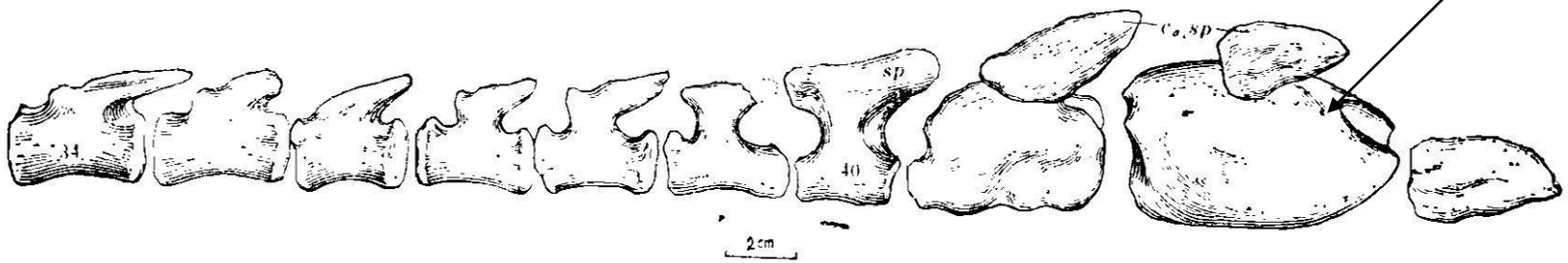
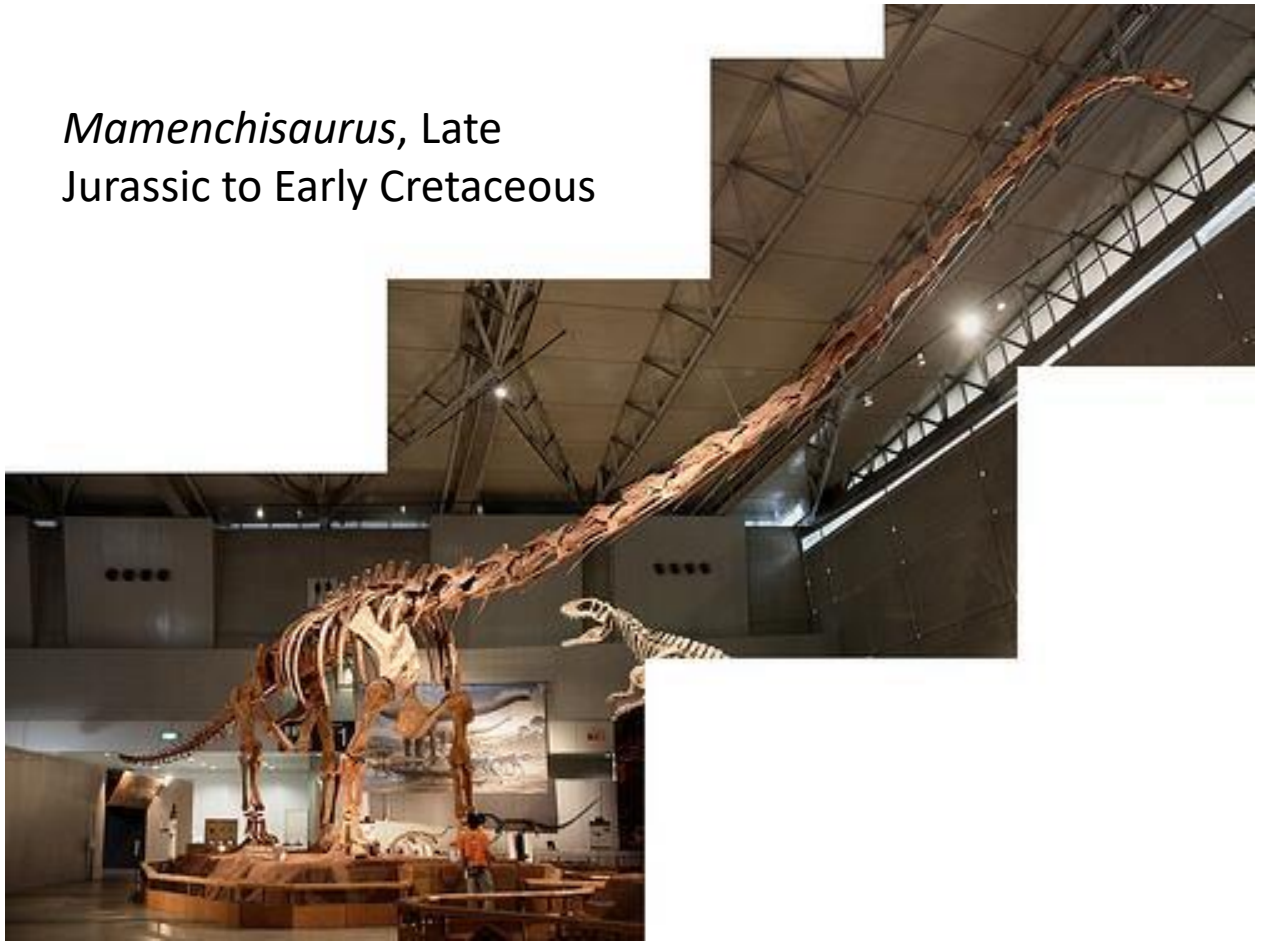


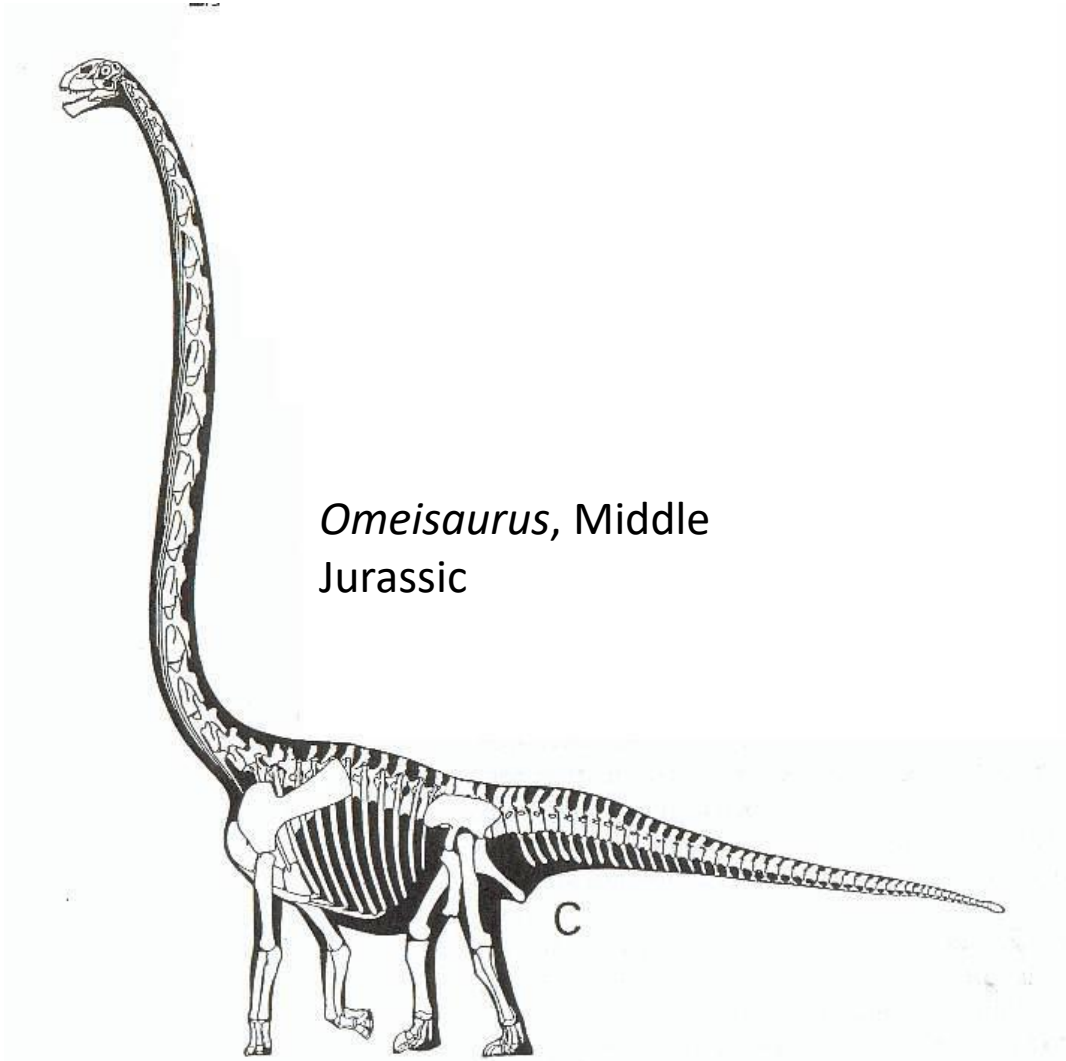
图39 李氏蜀龙的后部尾椎与“尾刺”左视. NO.T5401. 原大×1/4

Shunosaurus, Late Jurassic.

Eusauropoda All taxa more closely related to *Shunosaurus* than to *Vulcanodon*

Mamenchisaurus, Late Jurassic to Early Cretaceous



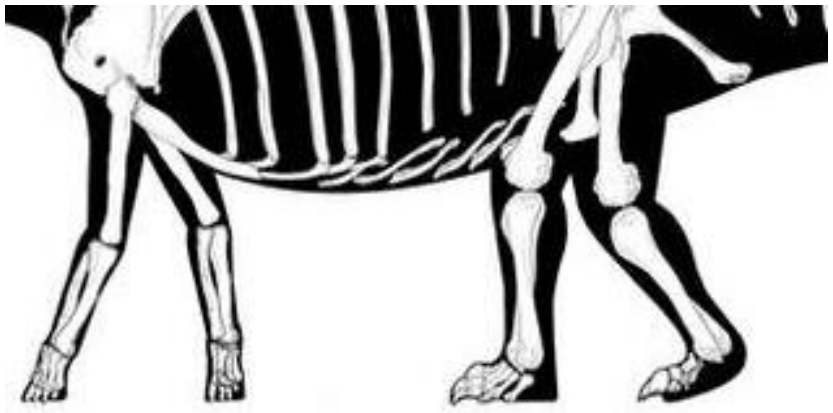


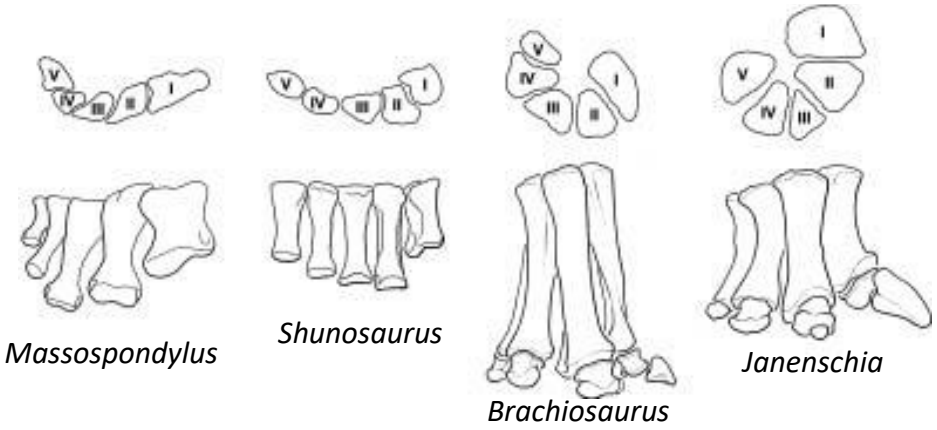
Omeisaurus, Middle Jurassic

Mamenchisauridae, possibly paraphyletic group of extremely long-necked sauropods, some with tail clubs.

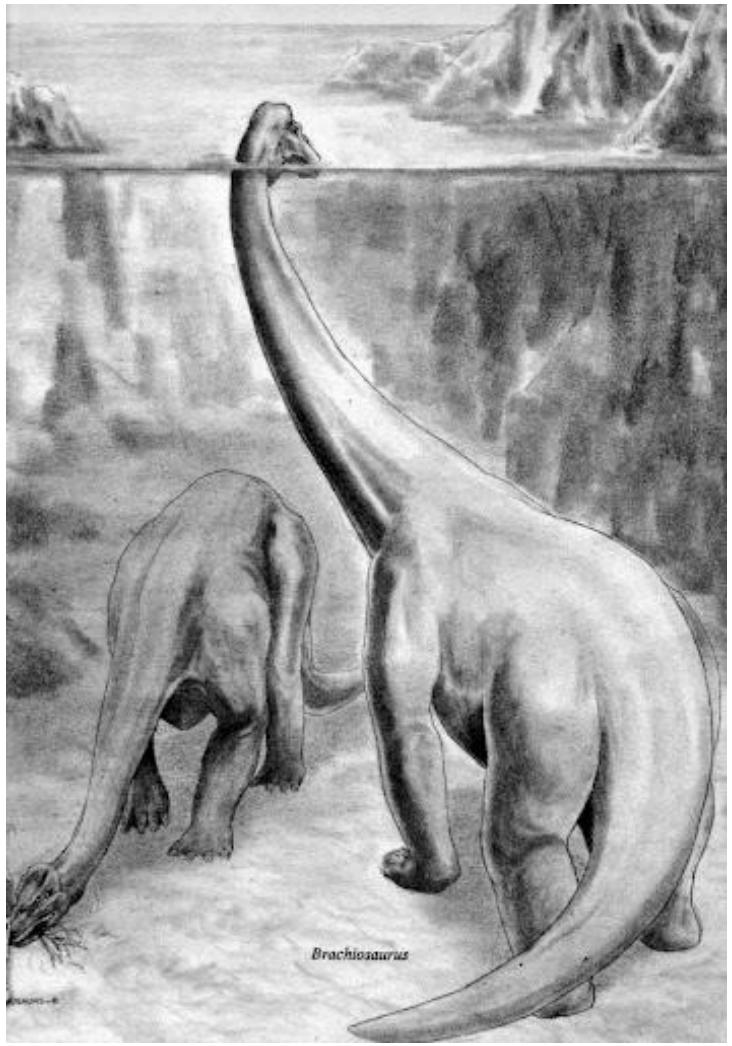
Neosauropoda Most recent common ancestor of *Saltasaurus* and *Diplodocus*, and oll of its descendants.

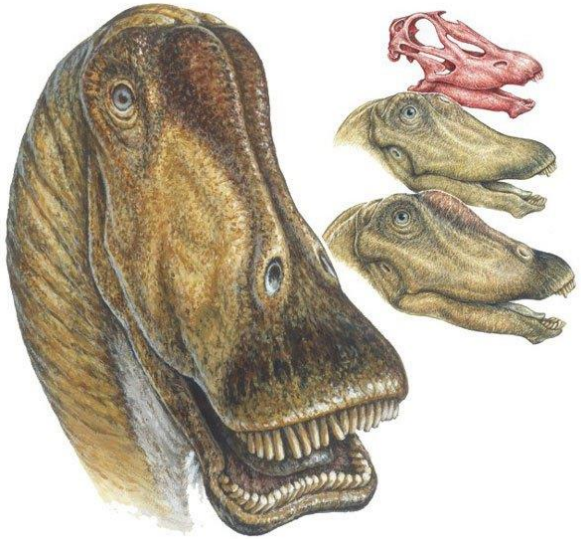
- Dorsally located nasal openings.
- Vertical metacarpals, in a semilunate configurations.
- Forelimb phalanges reduced.
- Wrist carpal bones reduced.
- Astragalus reduced.

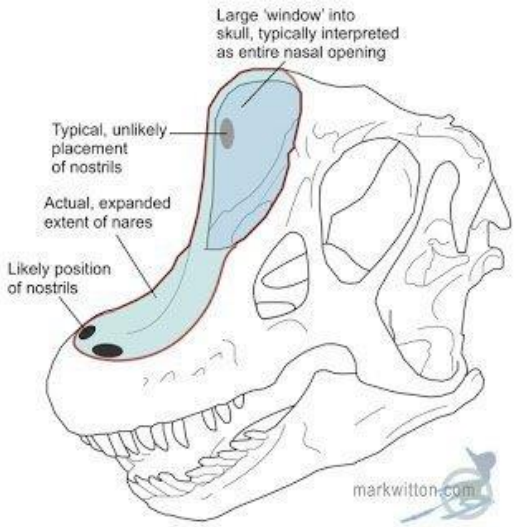




Neosauropoda Most recent common ancestor of *Saltasaurus* and *Diplodocus*, and oll of its descendants.







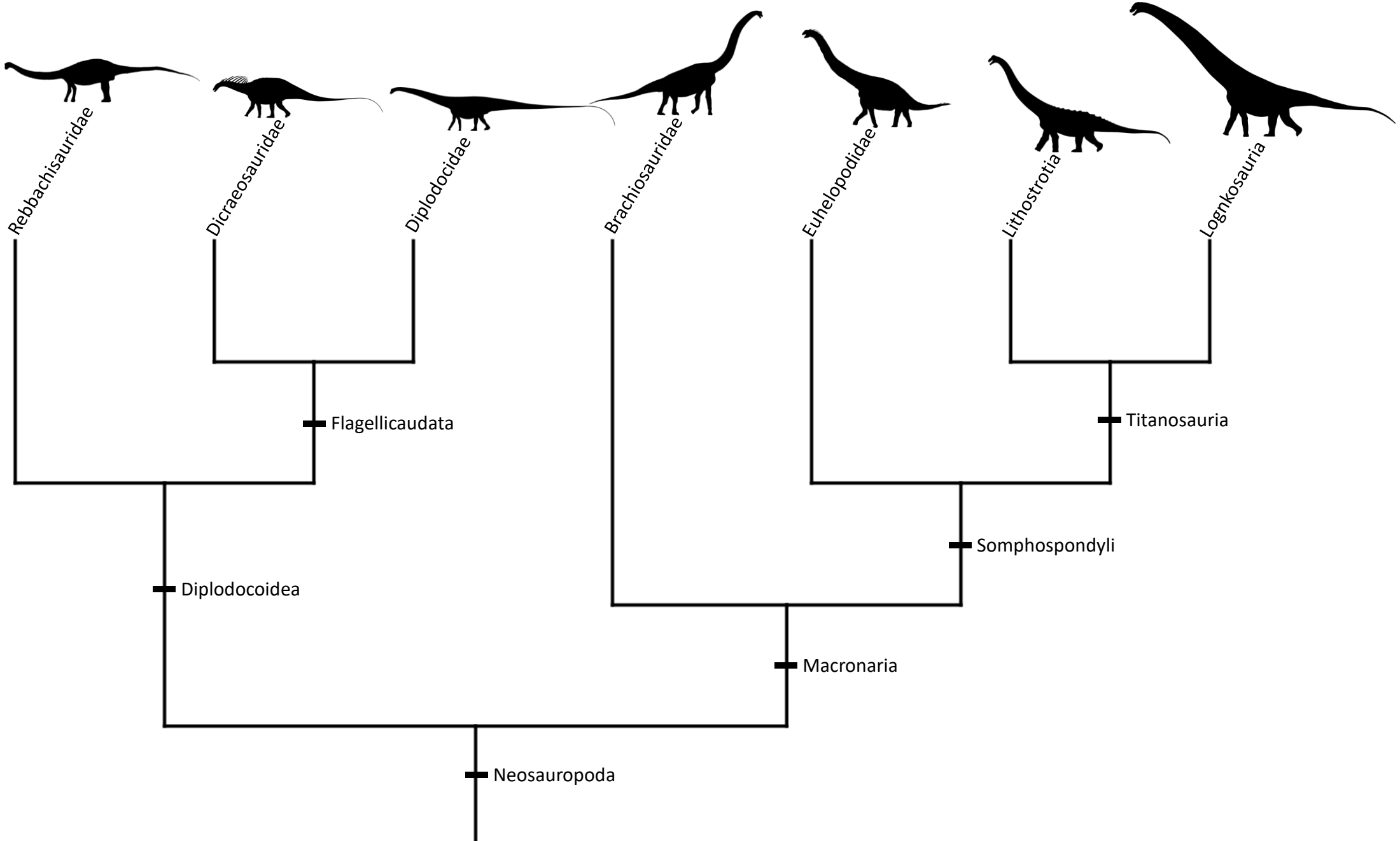
Neosauropod misinterpreted “snorkel”

Neosauropoda Most recent common ancestor of *Saltasaurus* and *Diplodocus*, and oll of its descendants.

Diplodocoidea

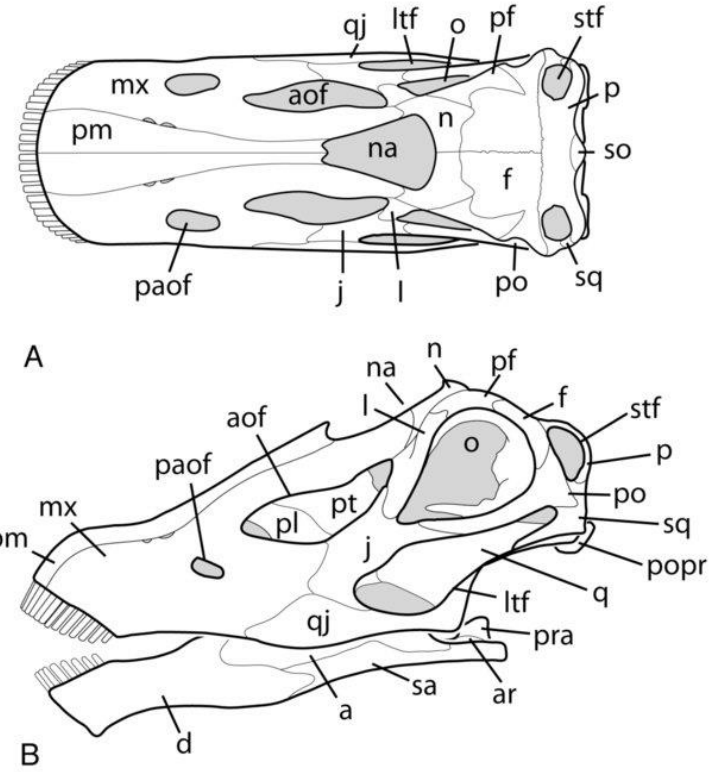
Macronaria

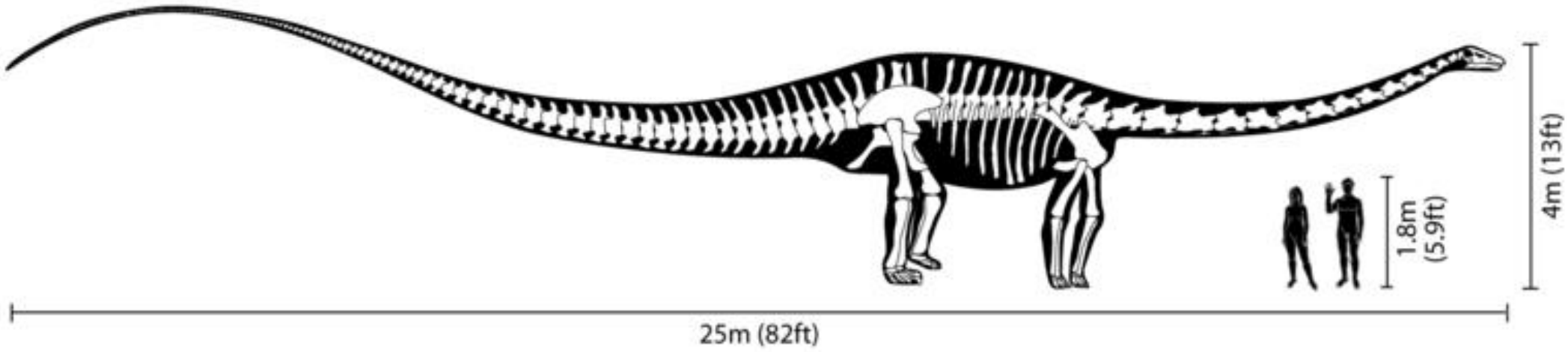
Neosauropoda Most recent common ancestor of *Saltasaurus* and *Diplodocus*, and oll of its descendants.



Diplodocoidea

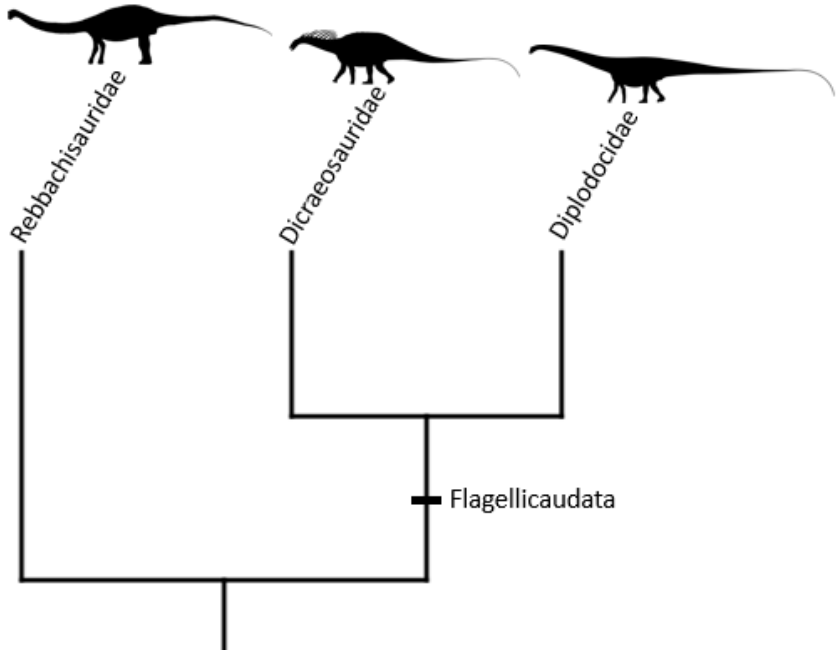
- Teeth restricted to anterior portion of mouth.
- Jaw articulation displaced anteriorly.
- Relatively square jaw and rostrum.
- Cylindrically shaped teeth.
- More than 30 distal caudal vertebrae without arches.



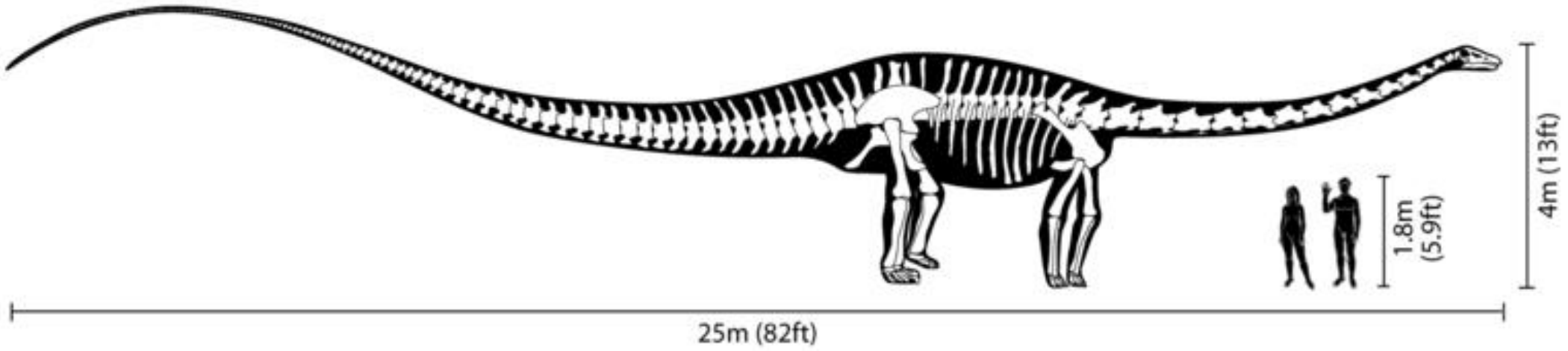


Diplodocoidea

- Teeth restricted to anterior portion of mouth.
- Jaw articulation displaced anteriorly.
- Relatively square jaw and rostrum.
- Cylindrically shaped teeth.
- More than 30 distal caudal vertebrae without arches.

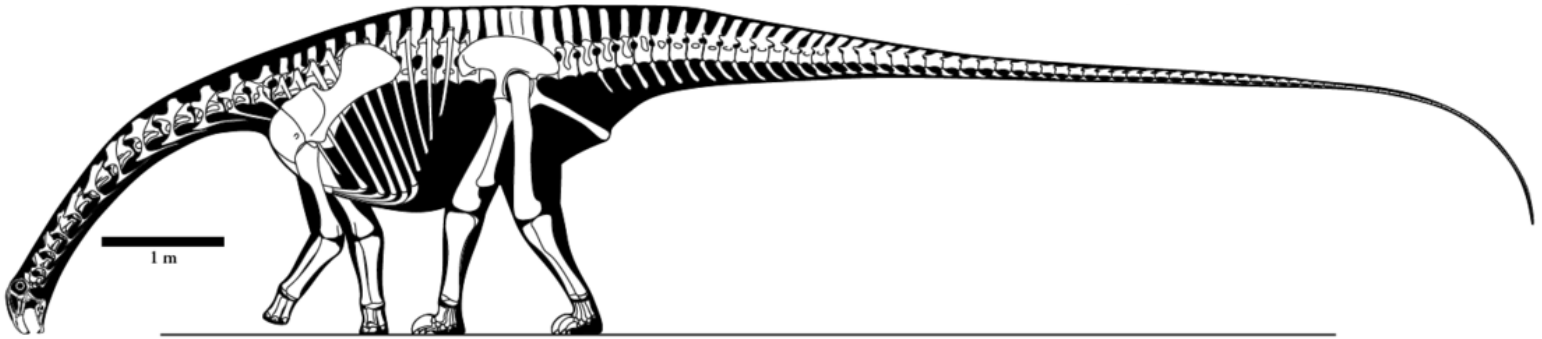


Based in Tschopp et al., 2015



Rebbachisauridae

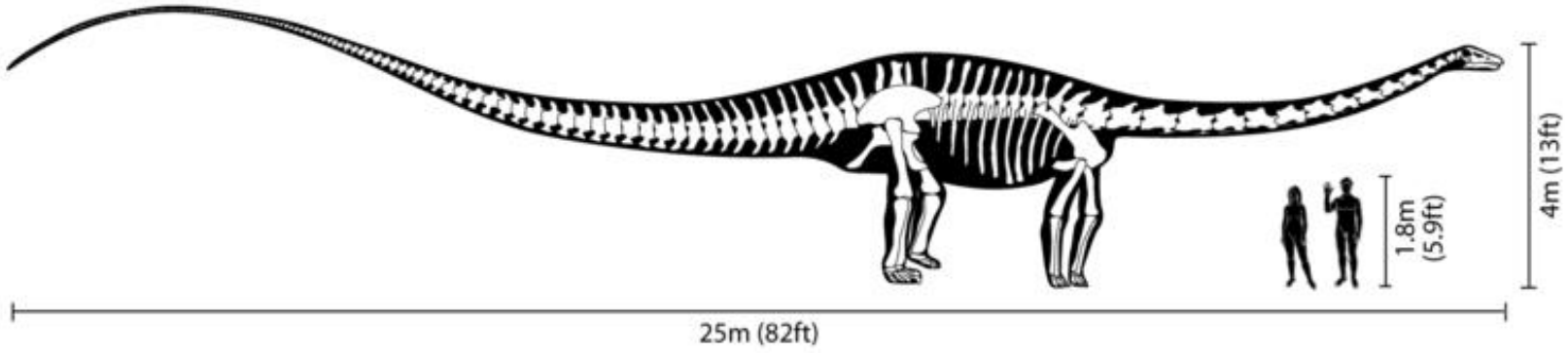
- Last diplodocoids to disappear (Late Cretaceous).
- Maxillary and dentary tooth rows rotated 90°, to form a straight front tooth row.
- It is unknown if whip tails characteristic of more derived diplodocoids were present in this group.

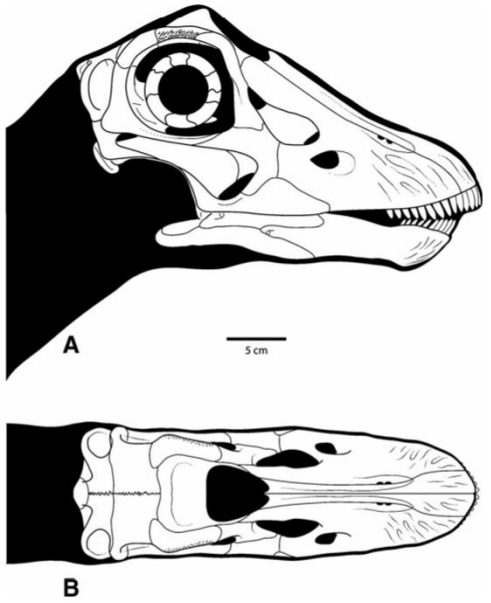


Nigersaurus, Middle Cretaceous

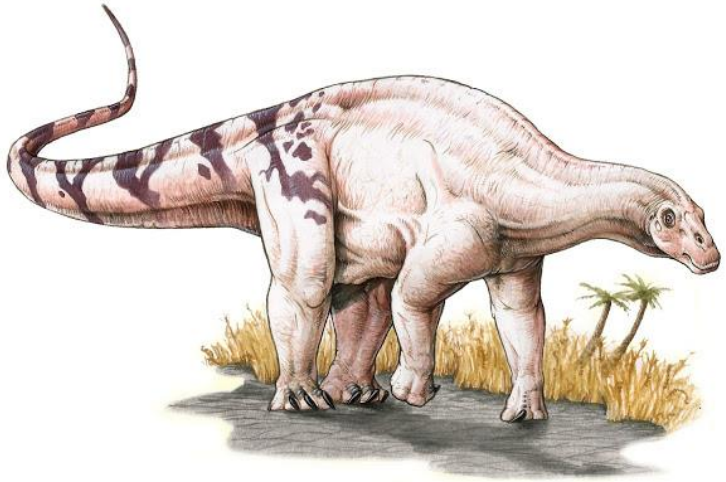
Flagelicaudata

- Nares fused into one opening.
- Long skulls.
- Short limbs.
- Long whip-like tails, with more tan 80 caudal vertebrae in some cases.
- Bifurcated neural spines.





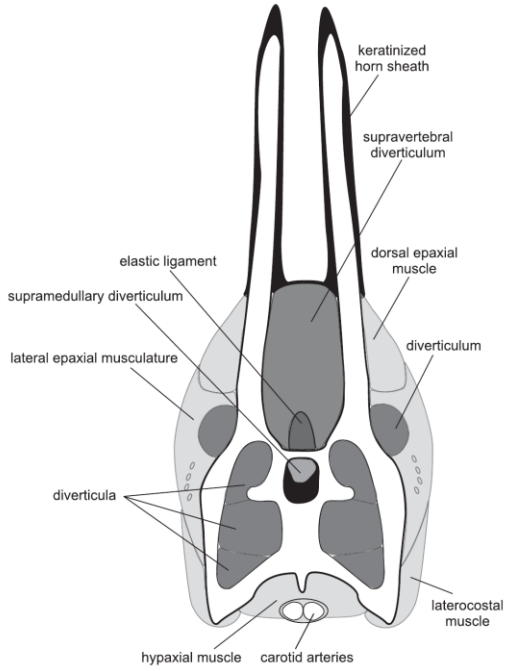
Dicraeosauridae



Brachytrachelopan,
Late Jurassic

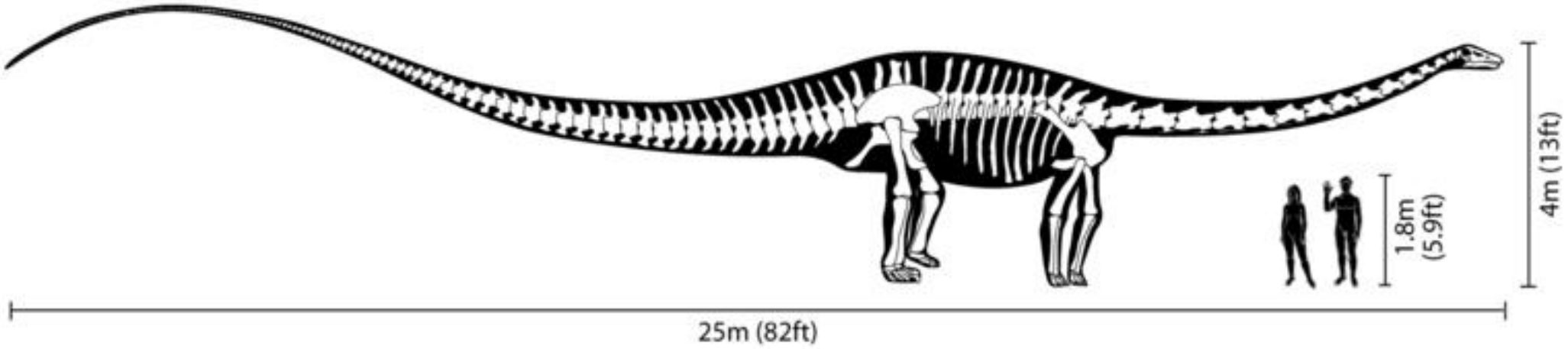
- Relatively small body size.
- Long neural spines.
- Short necks.

Amargasaurus, Early Cretaceous



Diplodocidae

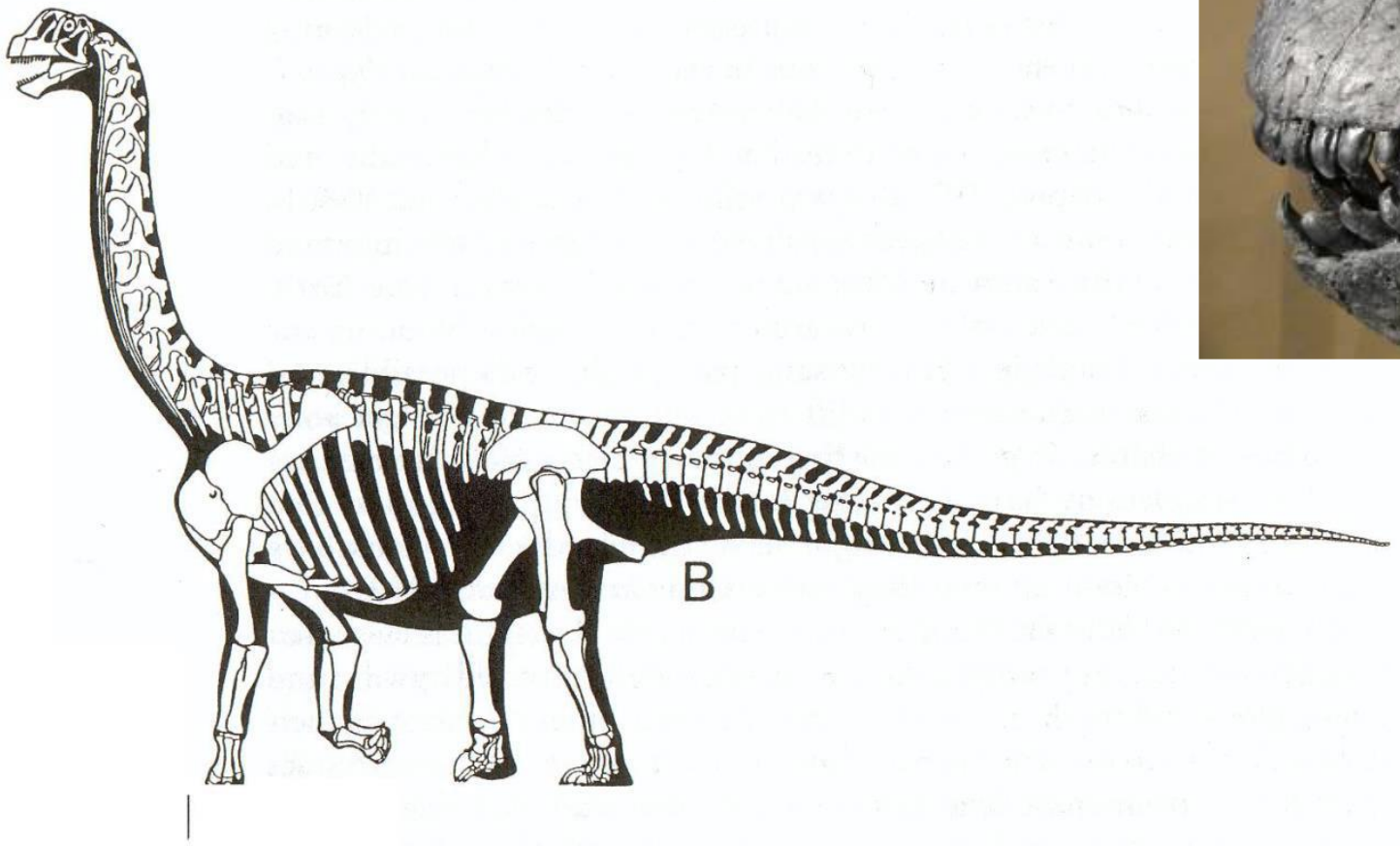
- Extremely long bodies. some, like Supersaurus, could reach lengths of up to 34m.
- Longest tails of any sauropod.



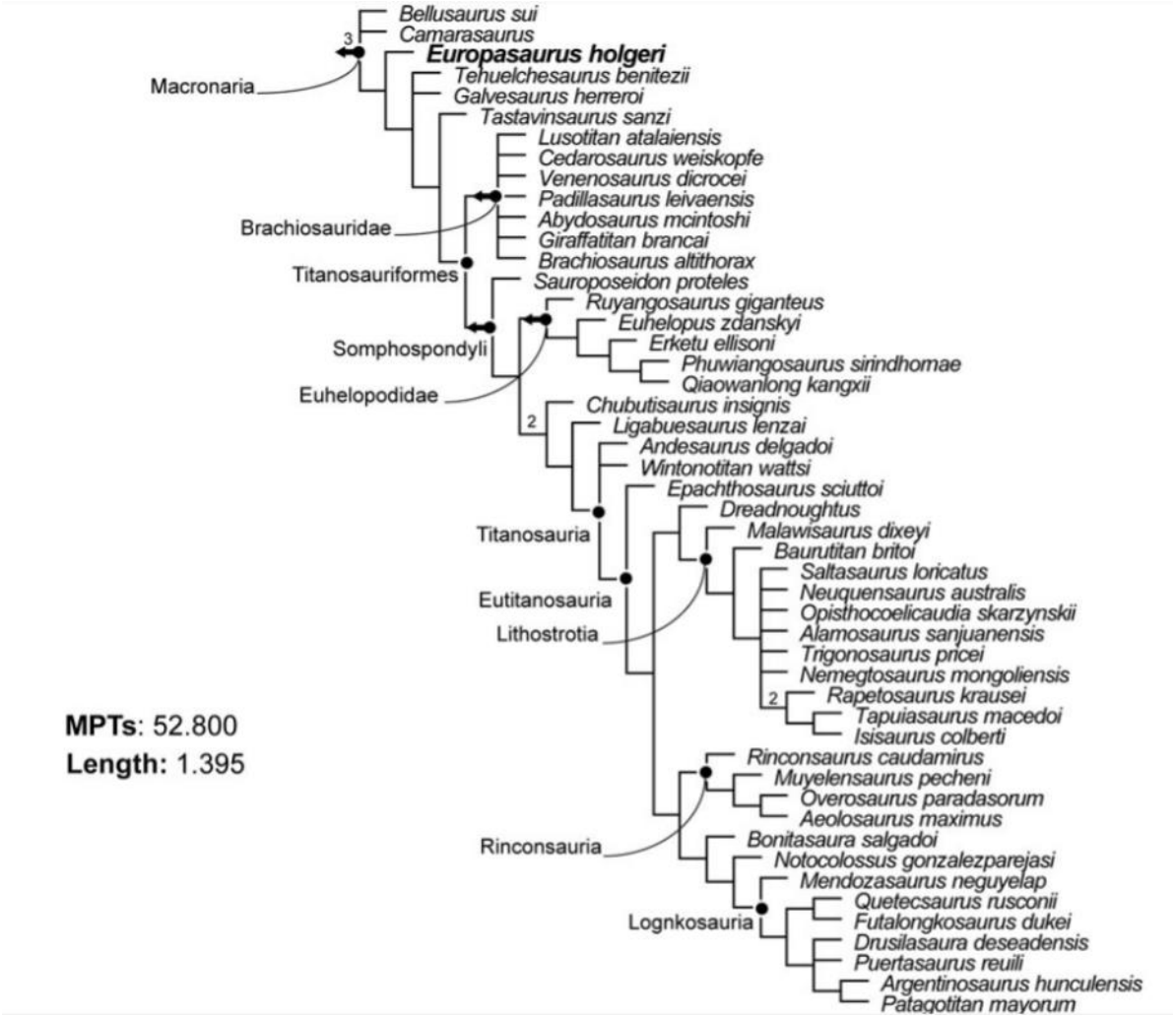
Diplodocus, Late Jurassic

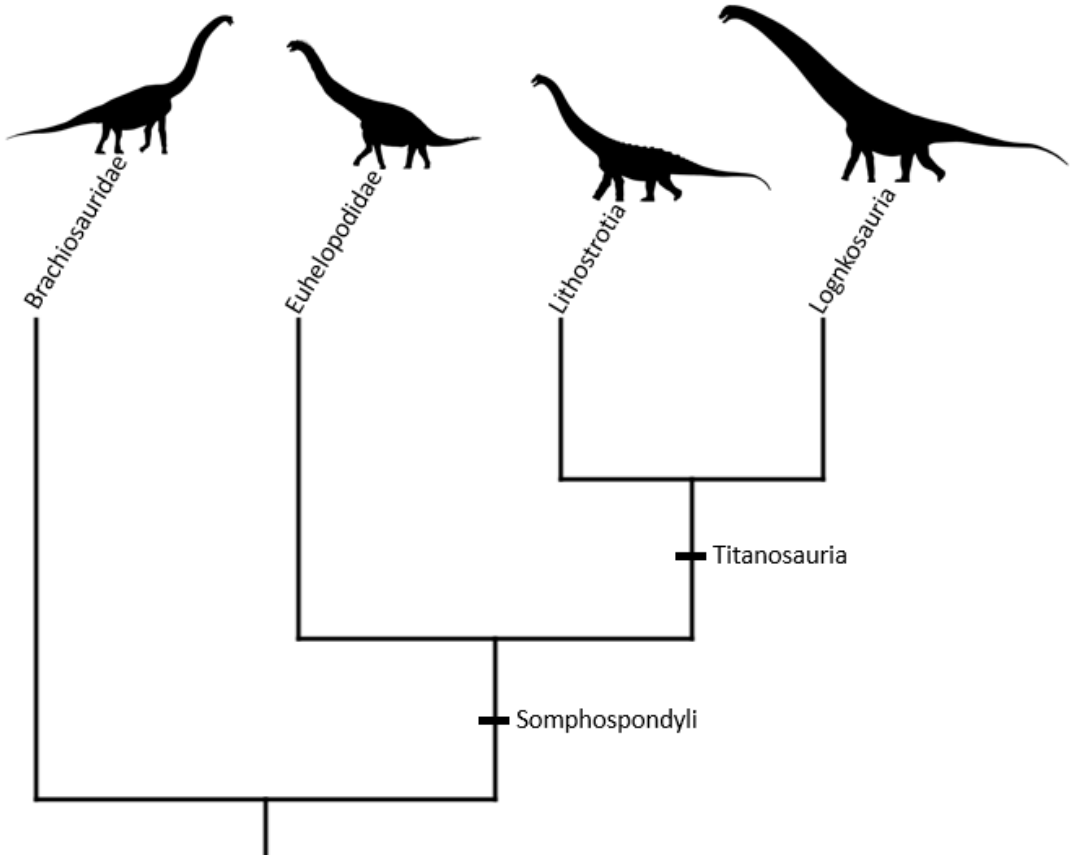
Macronaria

- Huge nares, equaling or exceeding size of orbit.
- Elongated metacarpals.
- Crests formed by protruding nasals.
- Forelimbs usually longer tan hindlimbs.



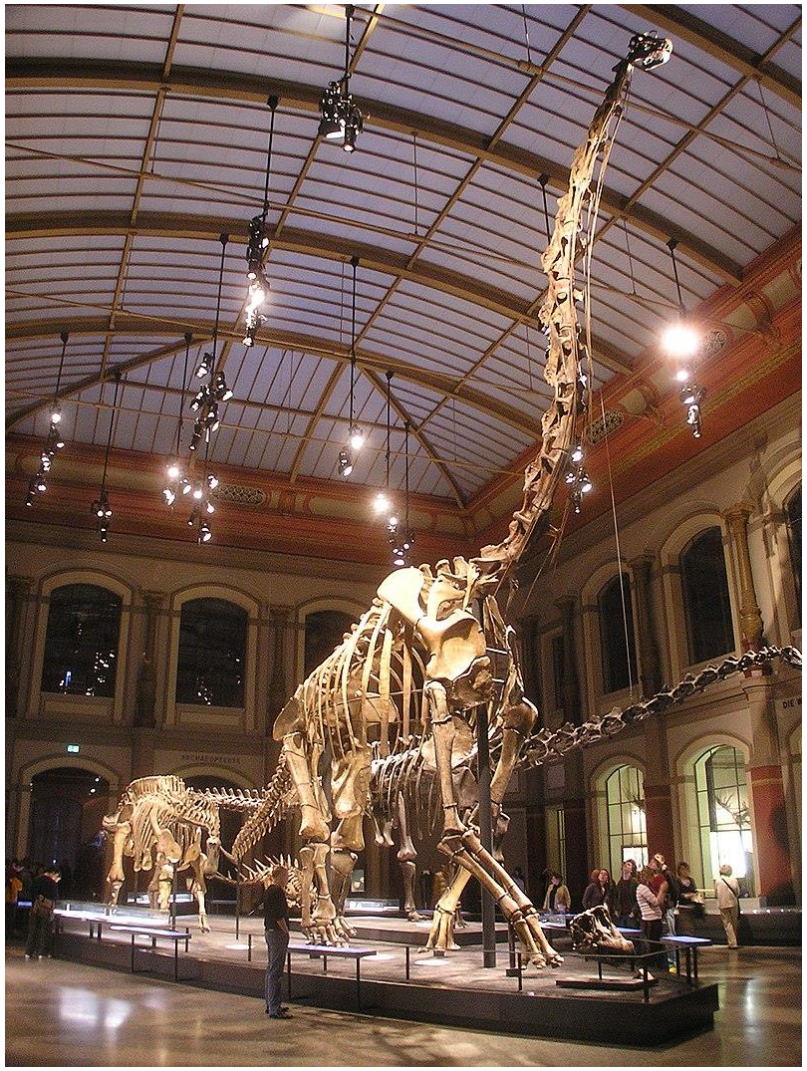
Macronaria



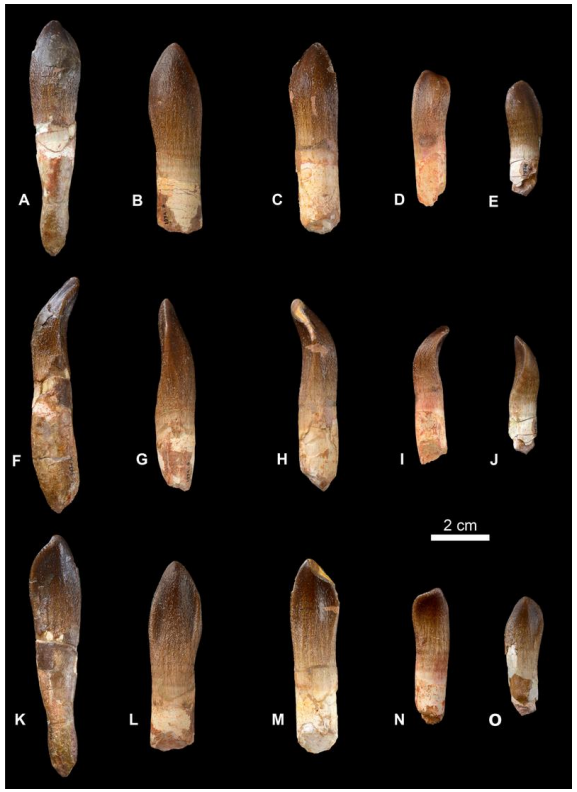


Carballido et al., 2020

Brachiosauridae

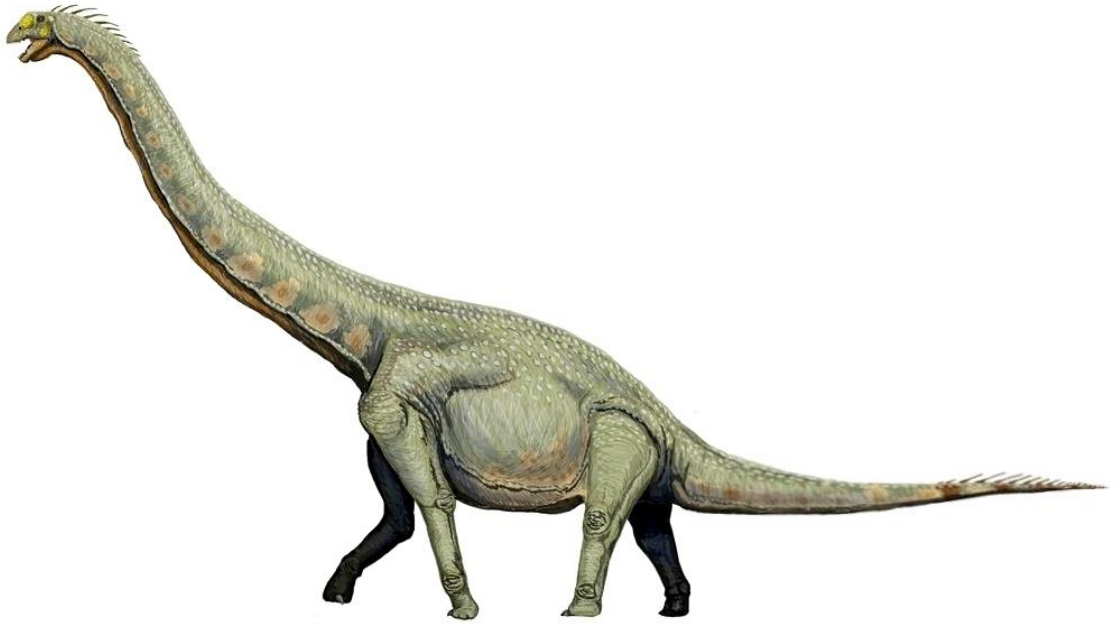


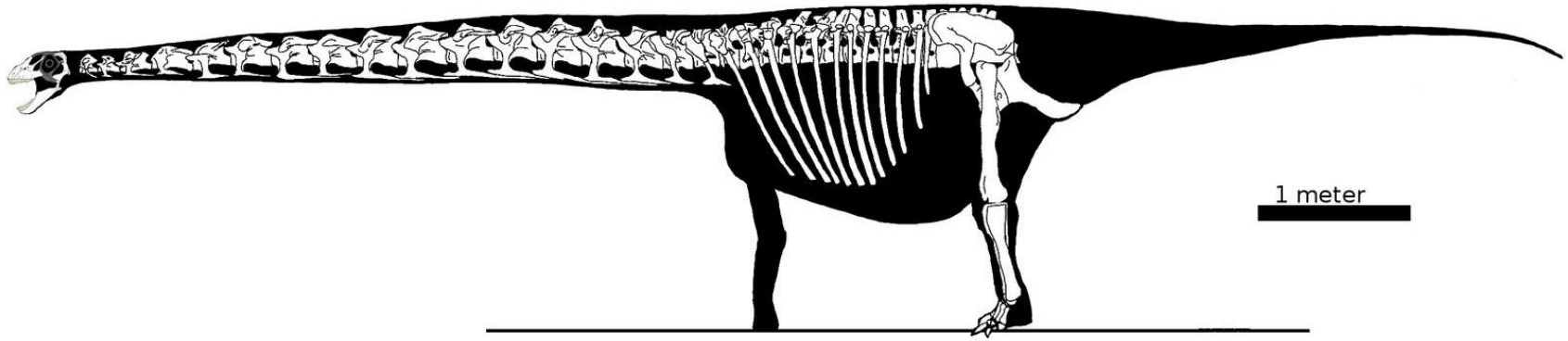
- Nares higher in the head.
- Forelimb and hindlimb size different more pronounced.
- Broad, spoon-shaped teeth, that allowed precise shearing of vegetation.
- Brachiosaurs were some of the taller sauropods.



Euhelopodidae

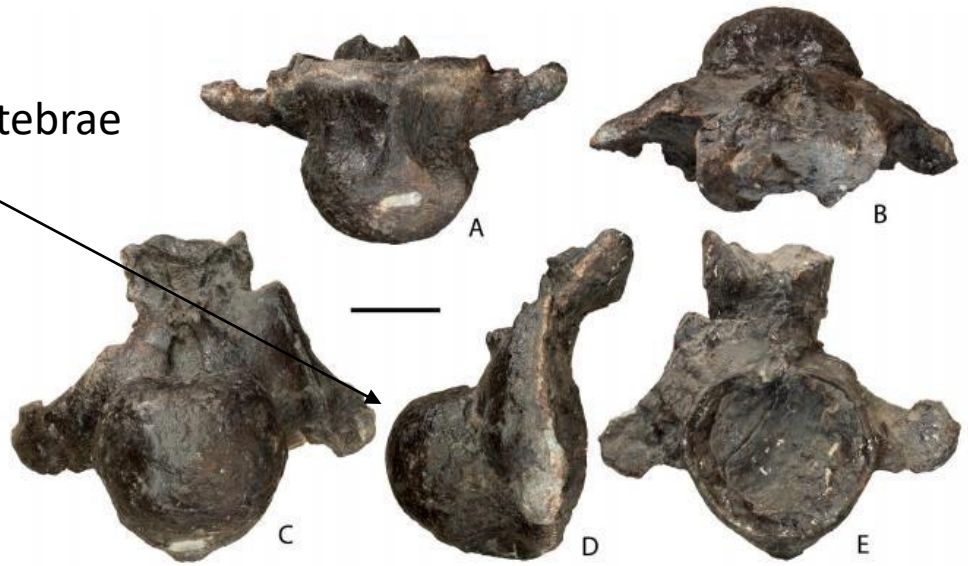
- Relatively slender limbs.
- Cervical neural spines reduced in height and length.
- Cervical pleurocoels reduced to foramina.
- Cervical rib shafts strongly positioned below the vertebral body.
- Presacral pneumaticity extends into the ilium, thus having pneumatic hips.

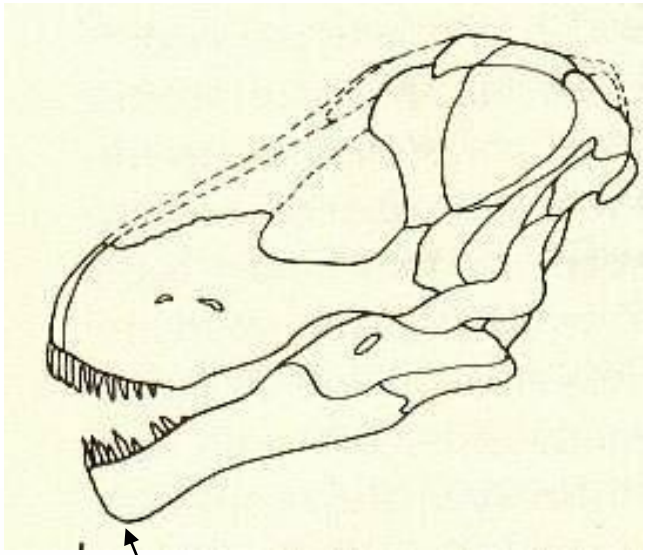




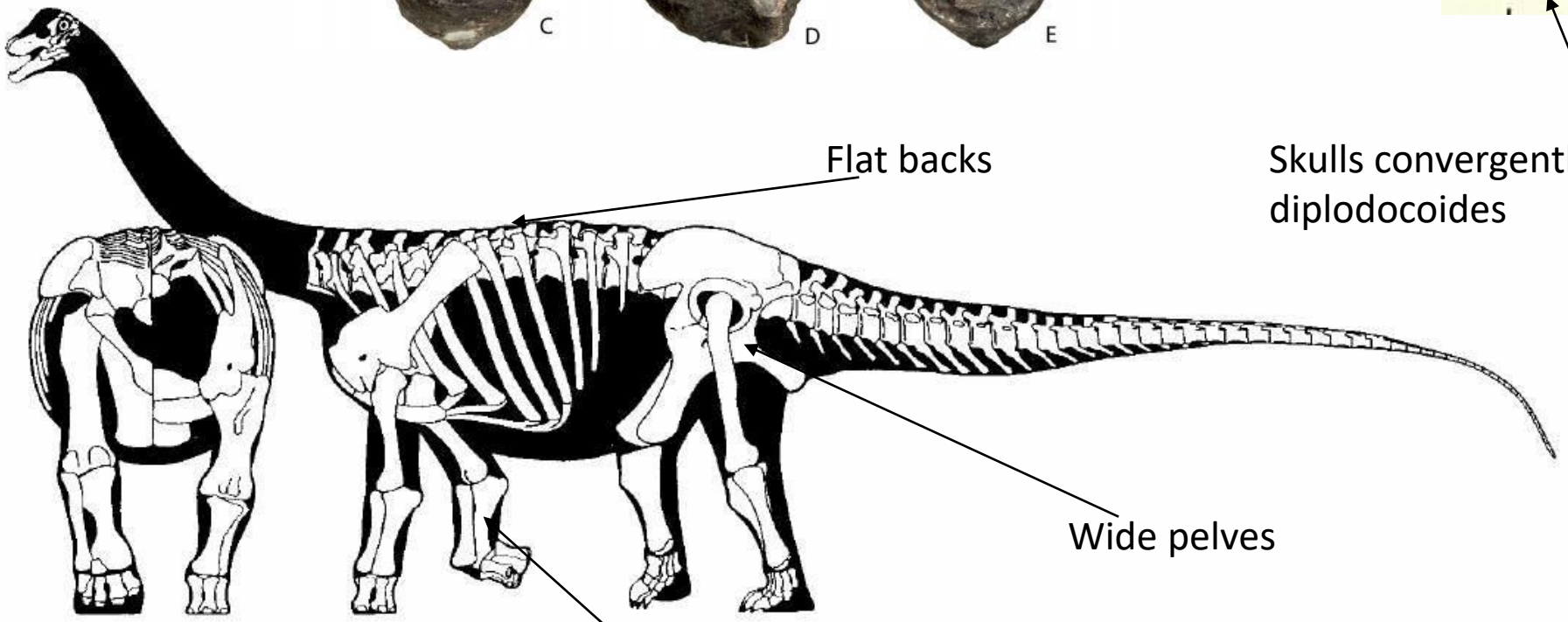
Titanosauria

Procoelic caudal vertebrae





Skulls convergently similar to the skulls of diplodocoides



Flat backs

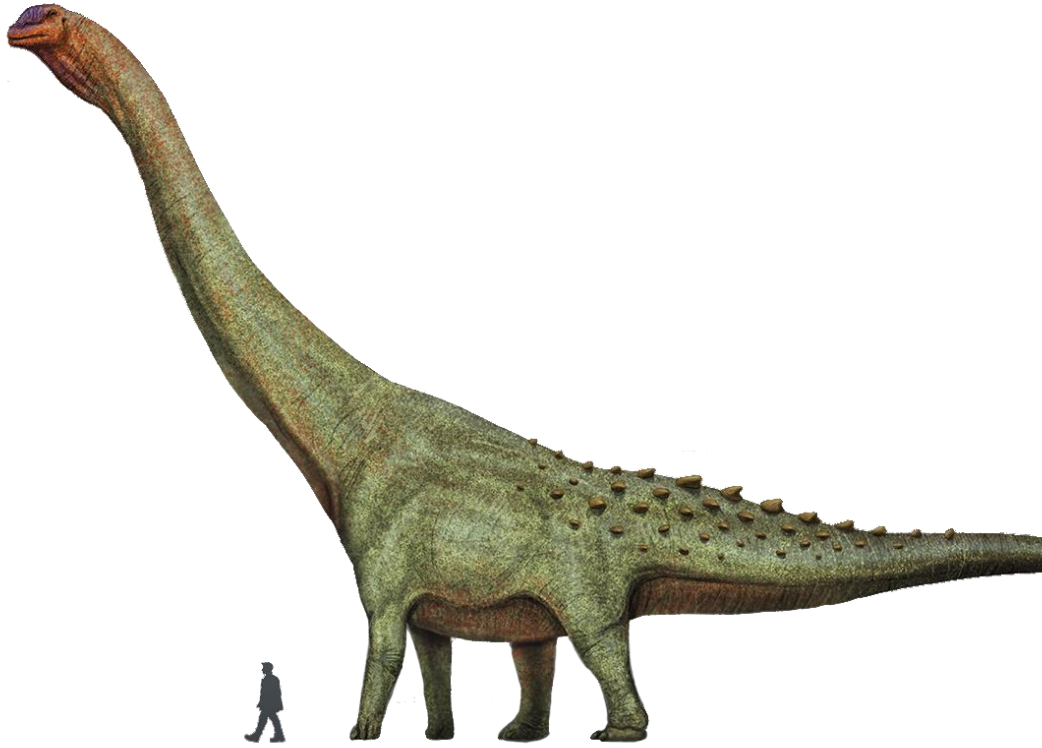
Wide pelves

Robust radius and ulna

Lognkosauria

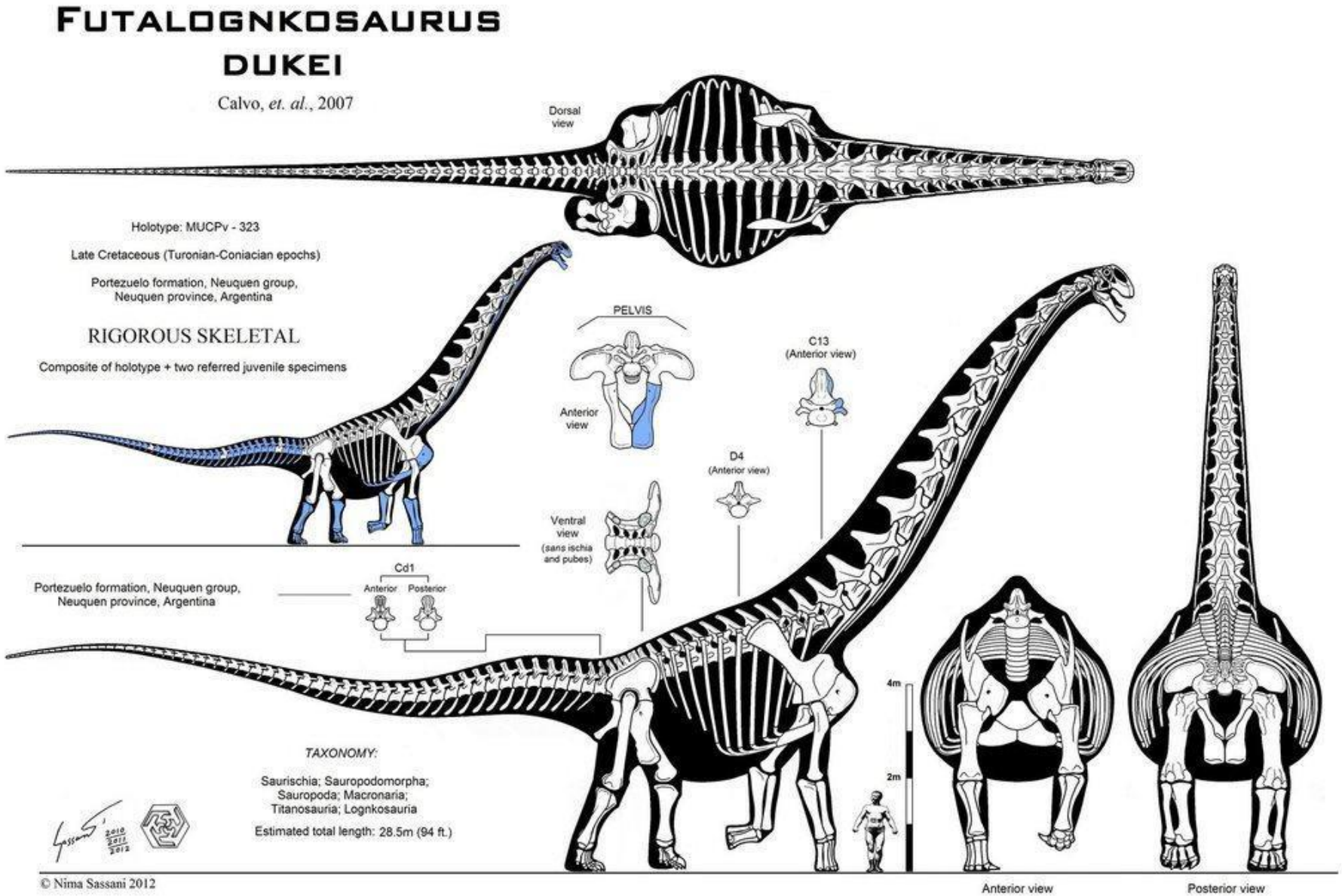
- Wide and robust cervical ribs.
- Extremely robust neural arches and massive neural spines.
- Wide rib cages.

Argentinosaurus, Late Cretaceous.



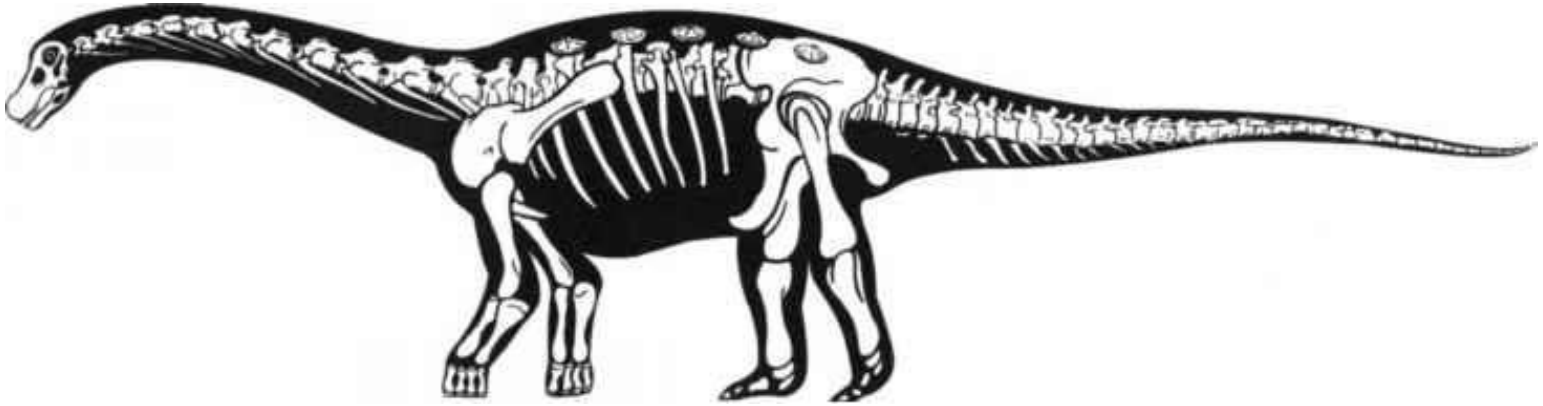
Patagotitan, Late Cretaceous.

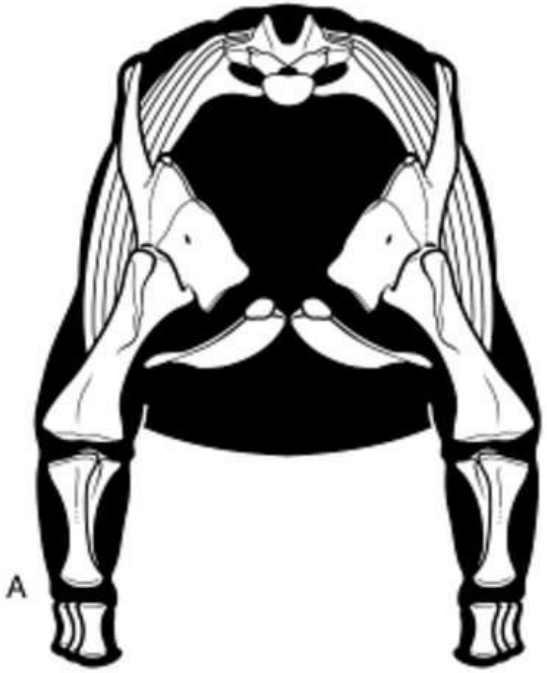
Lognkosauria



Lithostrotia

- Osteoderms typical in this group.
- Derived taxa, such as saltasaurids, lose all phalanges in the manus.
- Quadrangular coracoids.





Forelimbs

Hindlimbs

Saltasaurus, Late Cretaceous.