

Lecture 16: Cretaceous 2

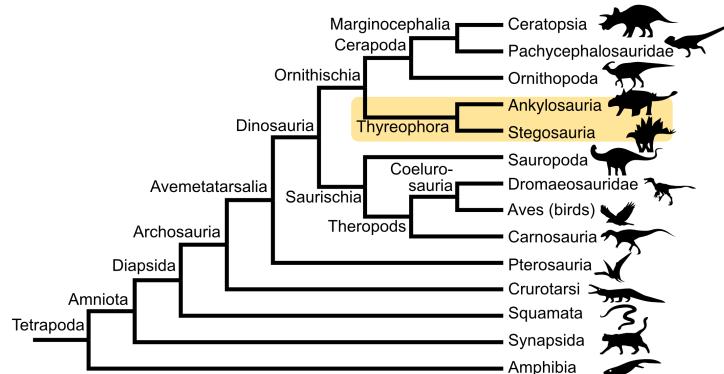


Chasmosaurus, Lambeosaurus, Styracosaurus, Euoplocephalus, Prosauropodus, and Panoplosaurus by J.T. Csotonyi (source)

Thyreophoran turnover

thyreophorans
(clade Thyreophora)
Greek: “thyreoph” = shield bearer

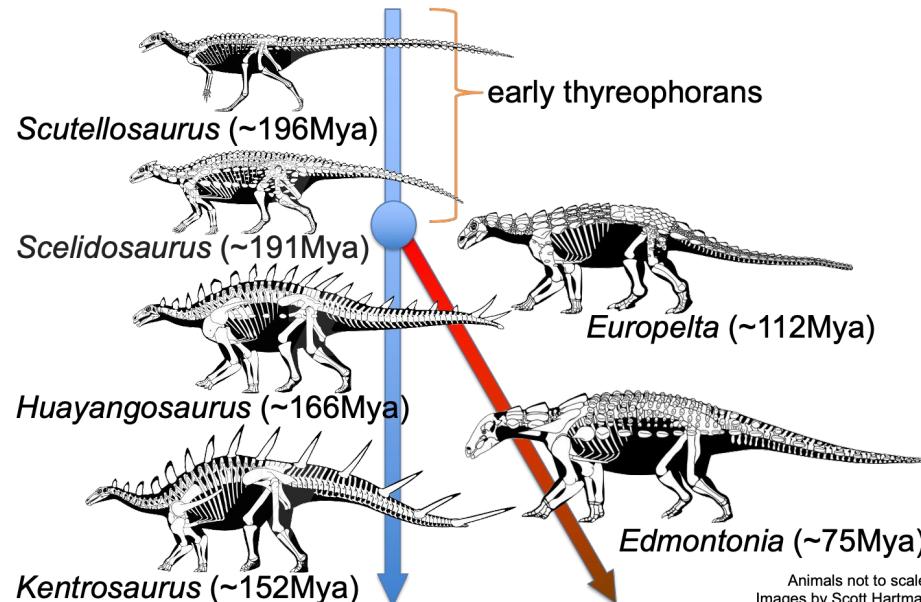
- Two major subclade:
Ankylosauria and **Stegosauria**



Thyreophoran turnover

Stegosauria

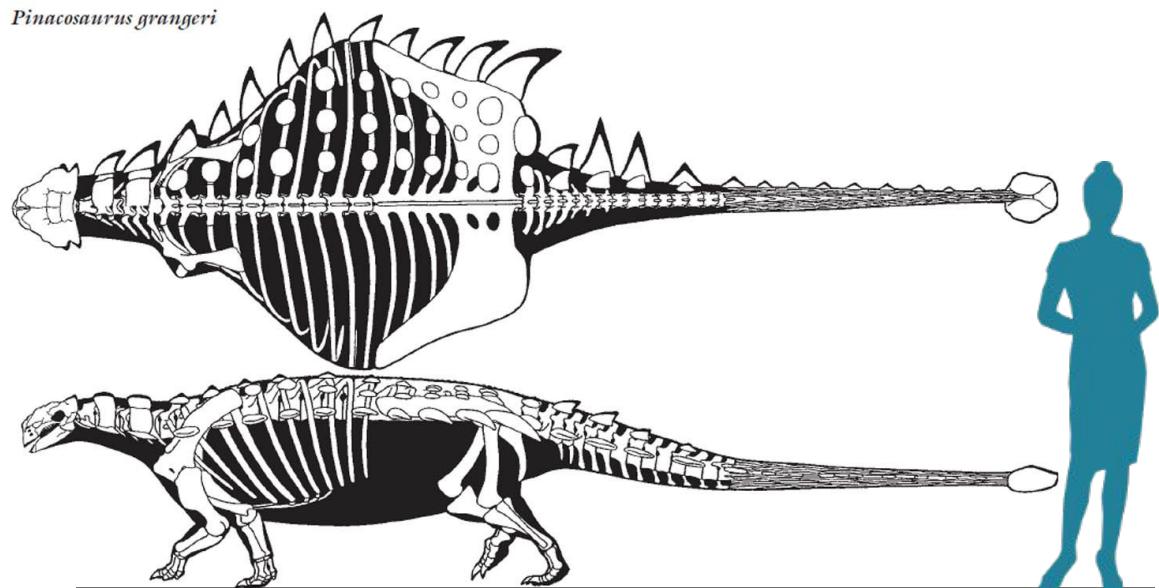
Thyreophorans with spikes and plates as armor



Ankylosauria

Thyreophorans with bony osteoderms (modified scutes)

Morphology of the Ankylosauria



Reconstructing *Tarchea*



Dinosaur evolution in Laurasia

- Several new groups of **ornithischian** dinosaurs evolve in Laurasia and become the dominant herbivores

Ceratopsia:
horned dinosaurs



Diabloceratops by Andrey Atuchin ([source](#))

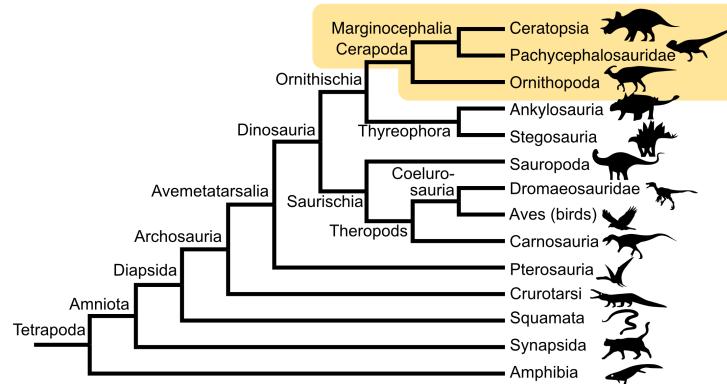
Hadrosaurs:
duck billed
dinosaurs

Pachycephalosauria:
bone-headed
dinosaurs



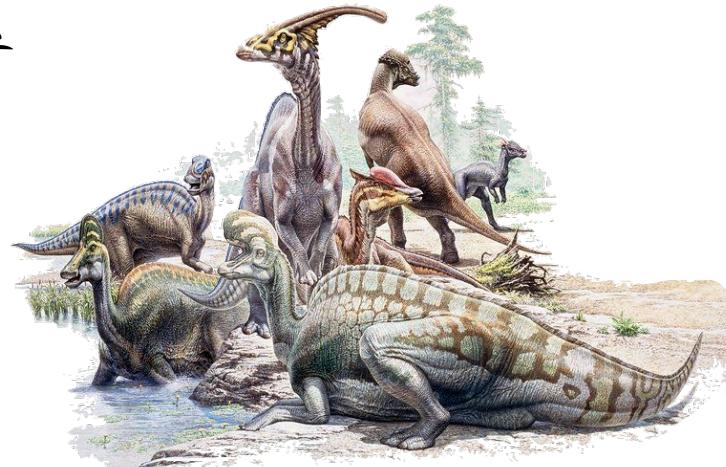
Hadrosaurs and pachycephalosaurs by John Sibbick ([source](#))

Cerapods



Cerapoda

The clade encompassing the last common ancestor of Ceratopsia and Ornithopoda



Jurassic ornithopods



Lesothosaurus by Gabrielle Uguero ([source](#))



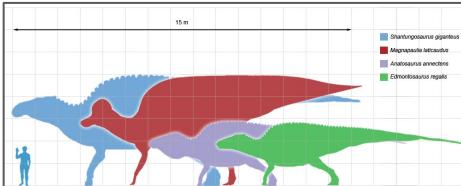
Dryosaurus by Raul Ramos ([source](#))



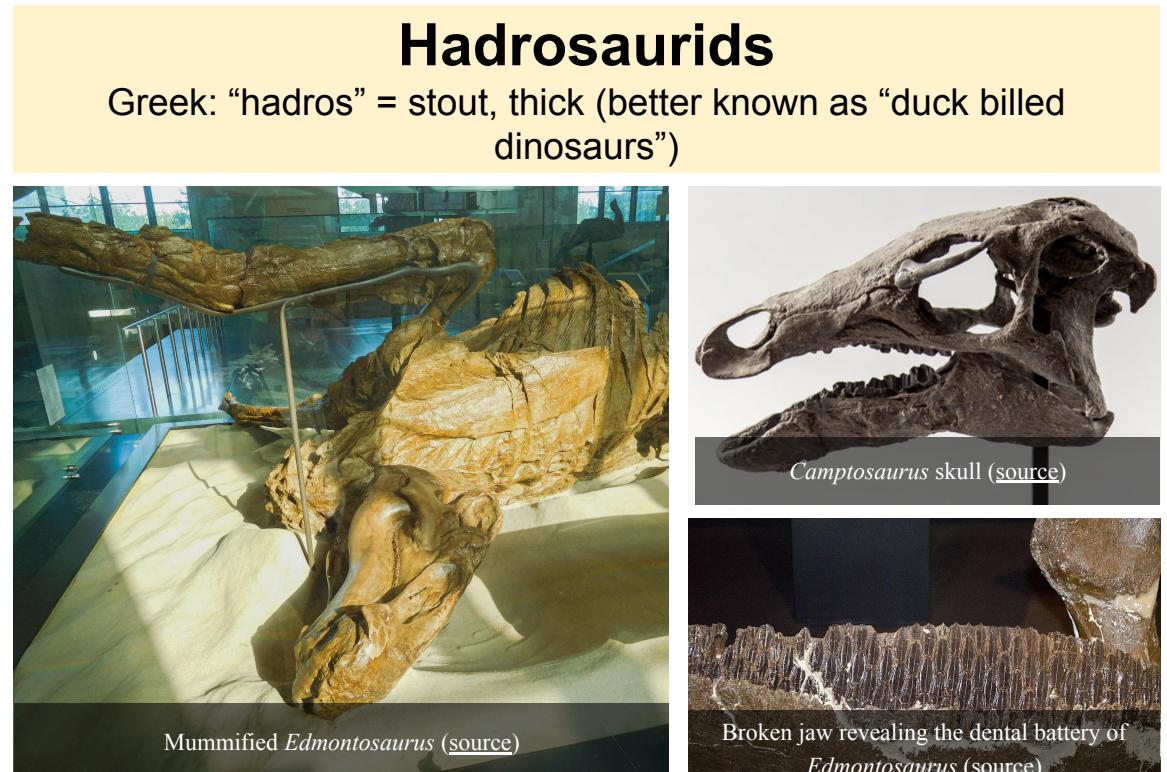
Camptosaurus by NPS/Bob Walters, Tess Kissinger ([source](#))

Cretaceous ornithopods

- Mummified skin shows scales
- No defensive weapons, but many attained large sizes



- Notable for having dental batteries

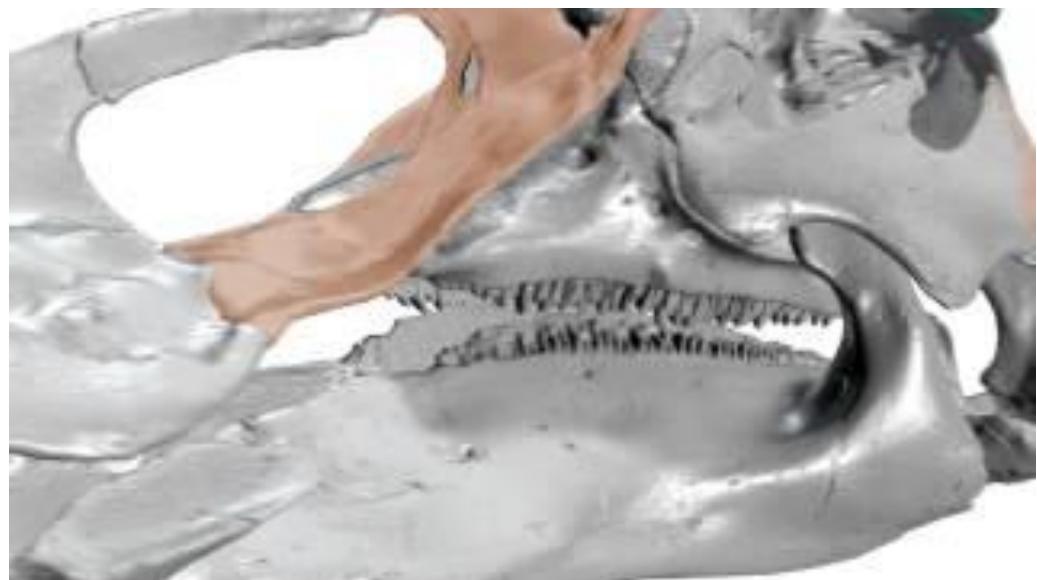


Hadrosaurid dental battery

- Kinetic skull allows for complex chewing motion
- Their success may be connected to rise of **angiosperms** in the Cretaceous

Hadrosaurids

Greek: “hadros” = stout, thick (better known as “duck billed dinosaurs”)

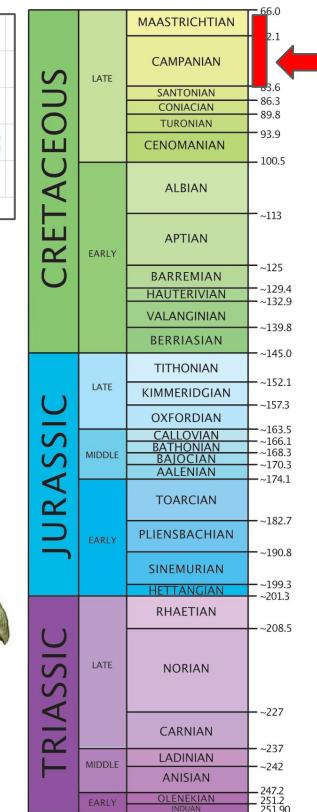
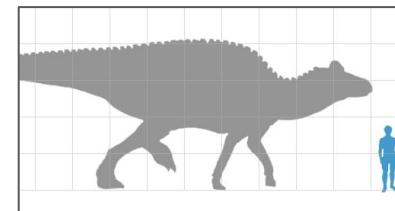
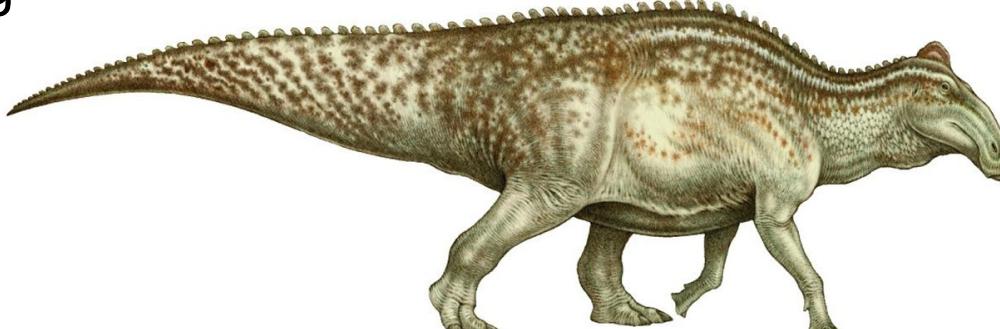


Key Taxon: *Edmontosaurus*

Edmontosaurus

Edmonton, Canada + Greek: “saurus” = lizard

- Common across N. America
- ~30-40 feet long



Camptosaurus versus *Edmontosaurus*



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Camptosaurus versus *Edmontosaurus*

Morphology terms:

Anterior (head) /
posterior (tail)

Dorsal ↑ \ Ventral ↓

Humerus : tibia ratio

Pelvis: pubis / ischium

Neural spines

Ossified tendons



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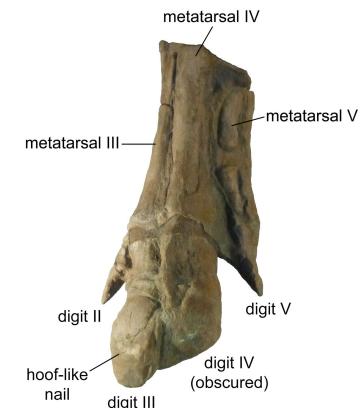
Ossified tendons



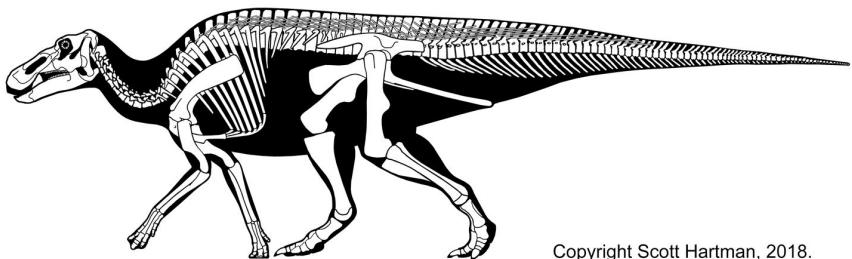
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Edmontosaurus vs *Parasaurolophus* vs *Lambeosaurus*



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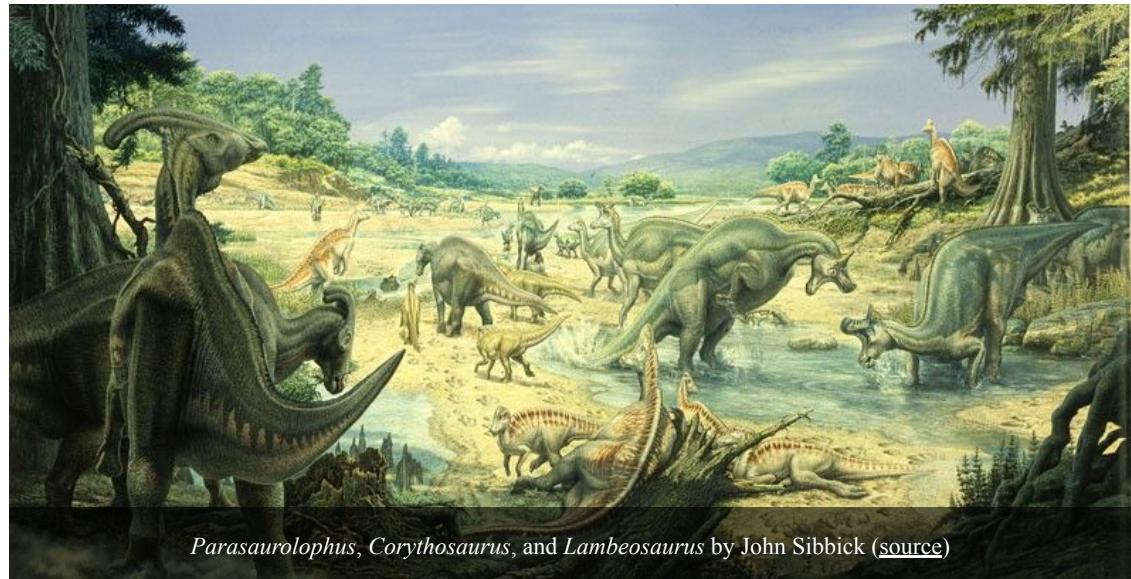


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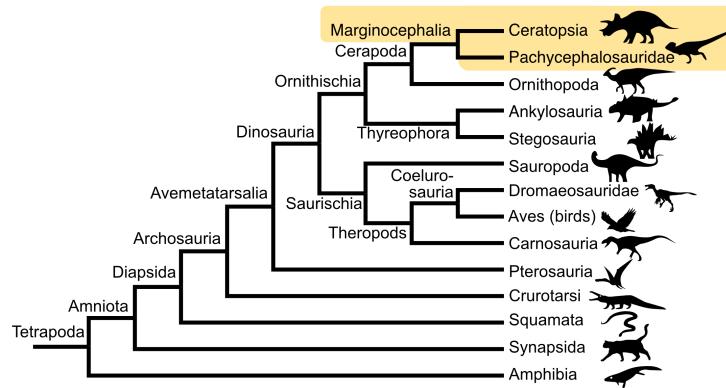


Edmontosaurus vs *Parasaurolophus* vs *Lambeosaurus*

- Multiple hadrosaur genera are found in Dinosaur Park Formation (Alberta, Canada)
- How did so many similar species coexist?



Marginocephalia



- Noted for a “margin” of bone in the **posterior** portion of the skull

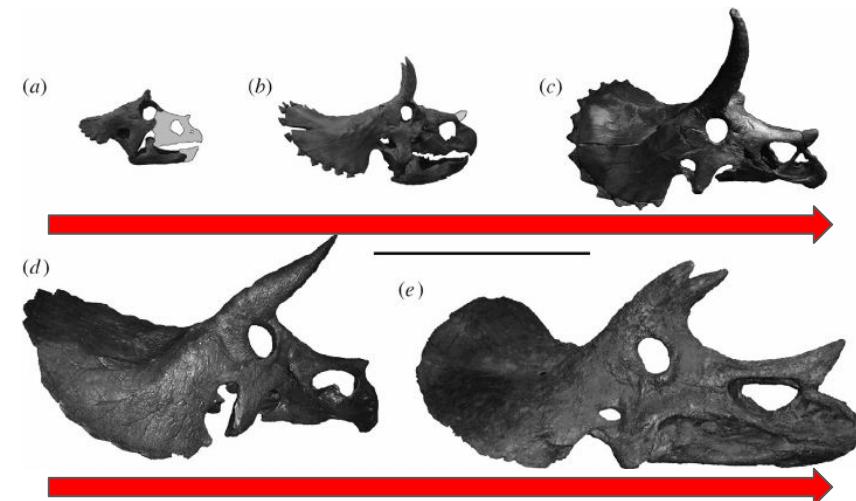
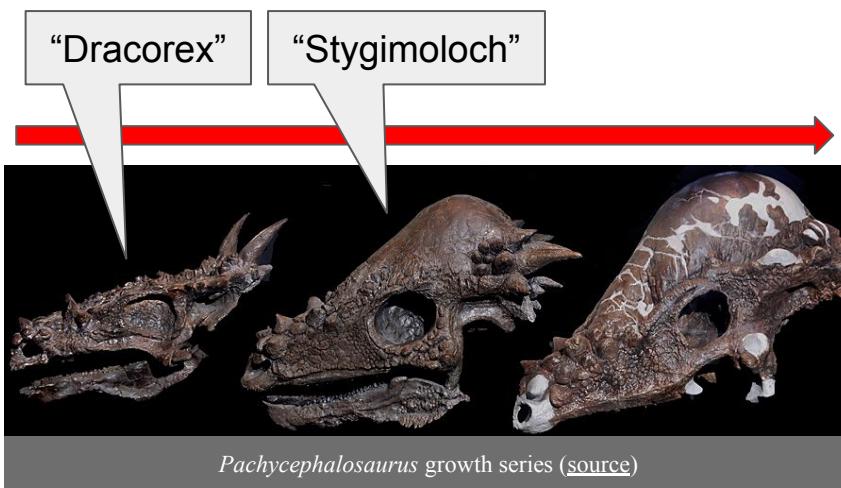
Marginocephalia
Latin: “margino” = margin; “cephalia” = head

The clade encompassing the last common ancestor of Ceratopsia and Pachycephalosauria



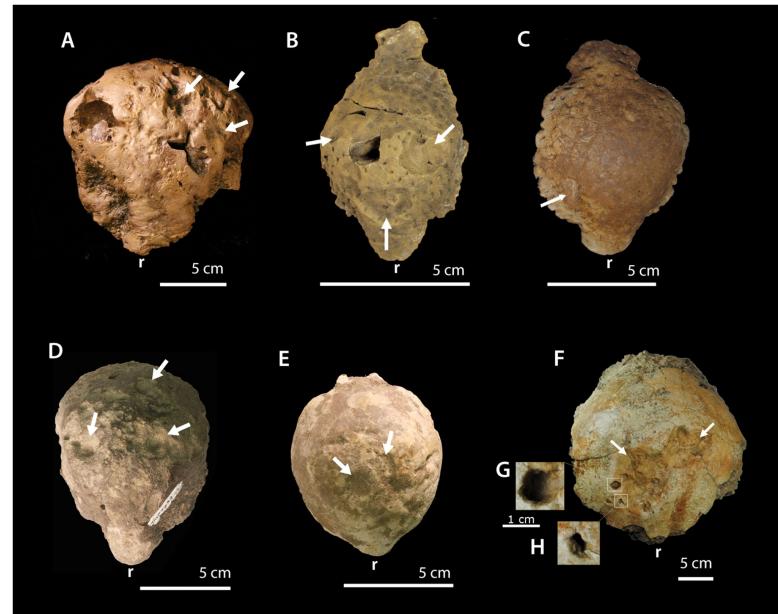
Growth in marginocephalians

- Remarkable plasticity in bony margin allows for major changes in skull shape through life



Cranial injury in Pachycephalosauria

- “remarkably high” rate, where 22% of specimens have lesions on the dome
- although lesions are distributed across the dome, they cluster near the apex



Peterson, J. E., Dischler, C., & Longrich, N. R. (2013). Distributions of cranial pathologies provide evidence for head-butting in dome-headed dinosaurs (Pachycephalosauridae). *PLoS one*, 8(7), e68620.

Reconstructing *Pachycephalosaurus*



Ceratopsia

Ceratopsia

Greek: “cerato” = horned; “psia” = face

- Horned dinosaurs (though early members lack horns)
- Skin impressions show earlier, smaller species had a mixture of scales and quills (feathers?); larger species only found with scales so far



Psitacosaurus fossil and reconstruction ([source](#))

Ceratopsia

- Later species develop large, heavy skulls
- Develop dental batteries like hadrosaurs
(convergent evolution)



Eoraptor skull ([source](#))



Triceratops prorsus



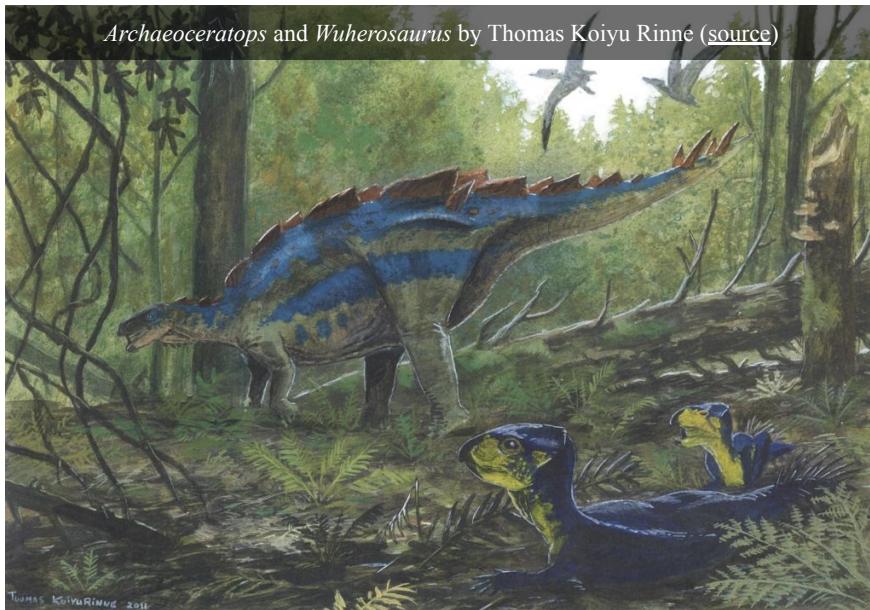
Triceratops skull ([source](#))

Key Taxon: *Archaeoceratops*

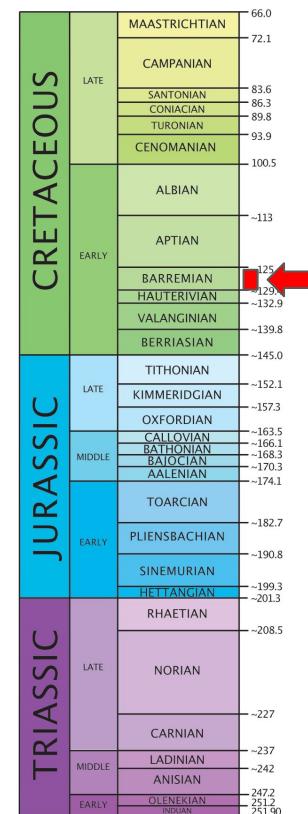
Archaeoceratops

Edmonton, Canada + Greek: “saurus” = lizard

Archaeoceratops and *Wuherosaurus* by Thomas Koyu Rinne ([source](#))



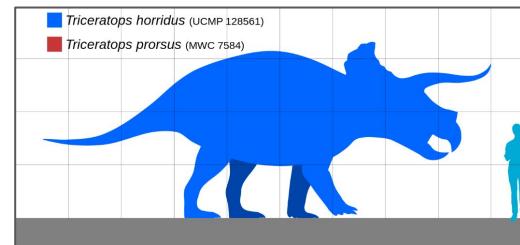
- ~3 feet long, 22 pounds
- One of the earliest ceratopsians
- Many ancestral traits (bipedal; five fingered hands)



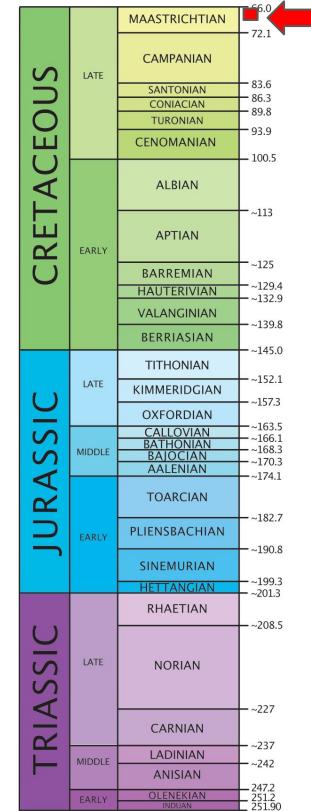
Key Taxon: *Triceratops*

Triceratops

Greek: “tri” = three; “cerato” = horned; “tops” = face



- One of the last ceratopsians
- ~30 feet long, ~6 tons



Archaeoceratops versus *Triceratops*

Morphology terms:

Anterior (head) /
posterior (tail)

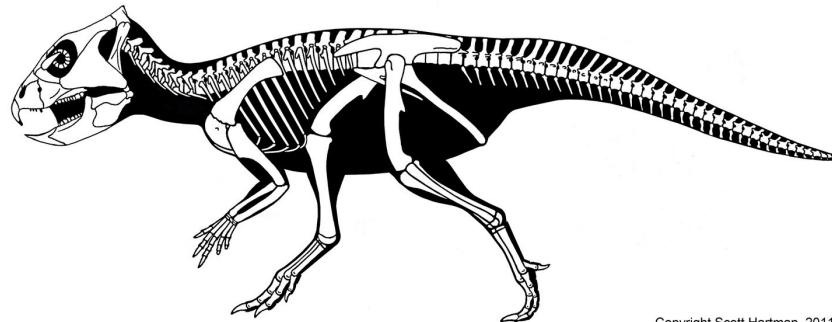
Dorsal ↑ \ Ventral ↓

Humerus : tibia ratio

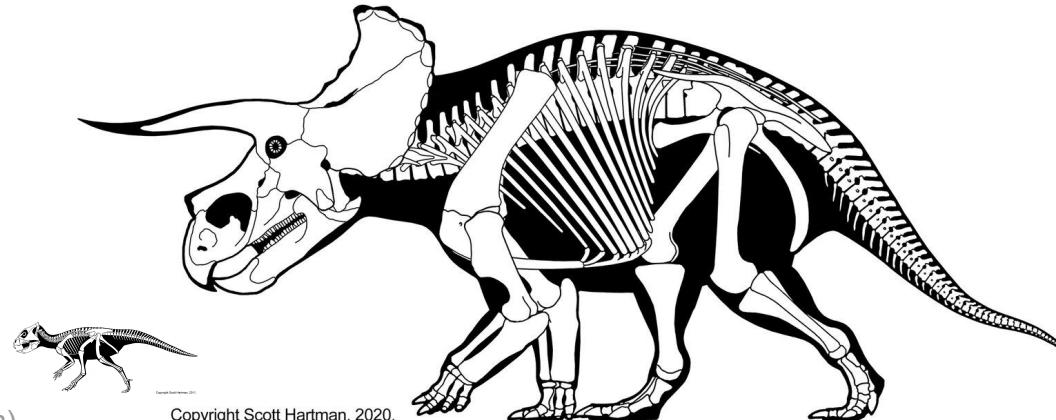
Pelvis: pubis / ischium

Neural spines

Ossified tendons



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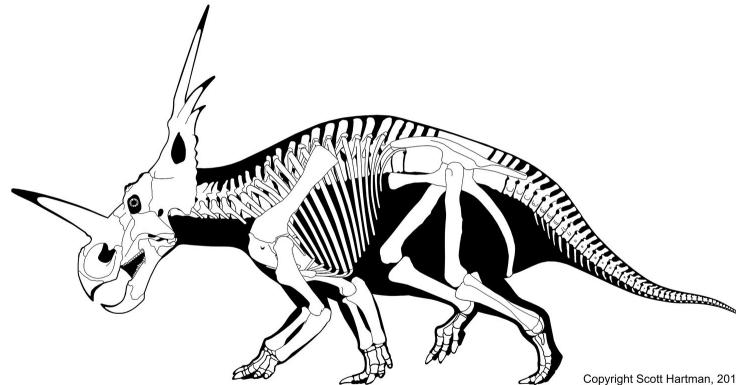


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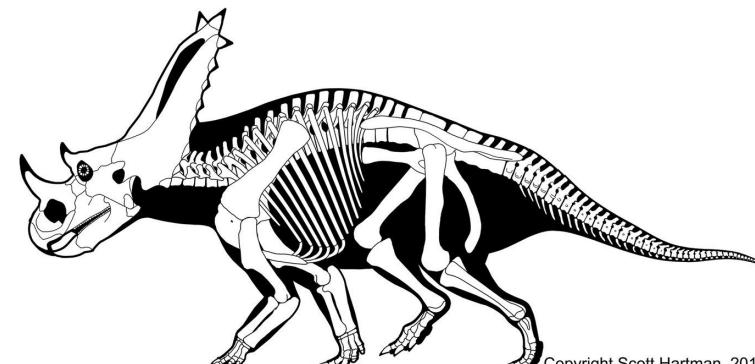
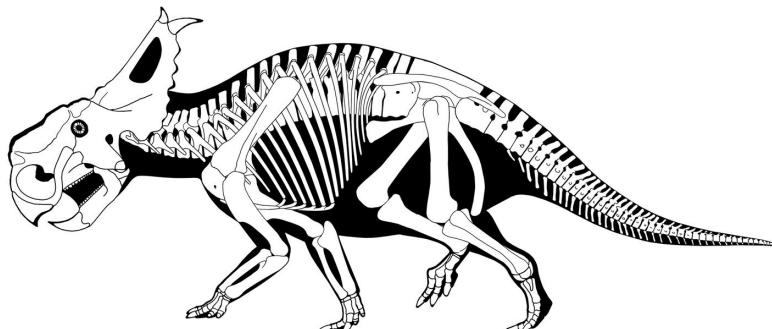
Triceratops vs *Styracosaurus* vs *Pachyrhinosaurus* vs *Chasmosaurus*



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Triceratops vs *Styracosaurus* vs *Pachyrhinosaurus* vs *Chasmosaurus*

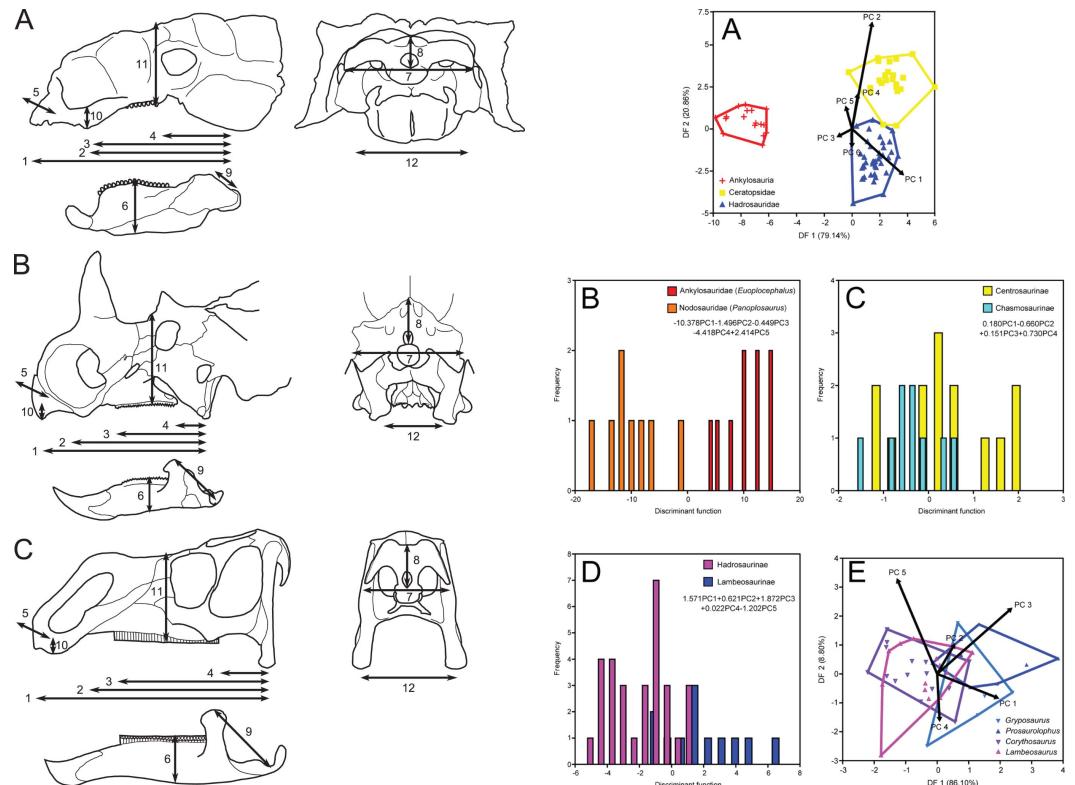
- Like hadrosaurs, many ceratopsian genera are found in Dinosaur Park Formation (Alberta, Canada)
- How did so many similar species coexist?



Ceratopsian diversity; with *Styracosaurus*, *Centrosaurus*, *Vagaceratops*, and *Chamsosaurus* highlighted. Image by Julius Csotonyi ([source](#))

Explanations for diversity in herbivores

- Cryptic niche partitioning



Mallon, Jordan C., and Jason S. Anderson. "Skull ecomorphology of megaherbivorous dinosaurs from the Dinosaur Park Formation (upper Campanian) of Alberta, Canada." *PLoS One* 8.7 (2013): e67182.

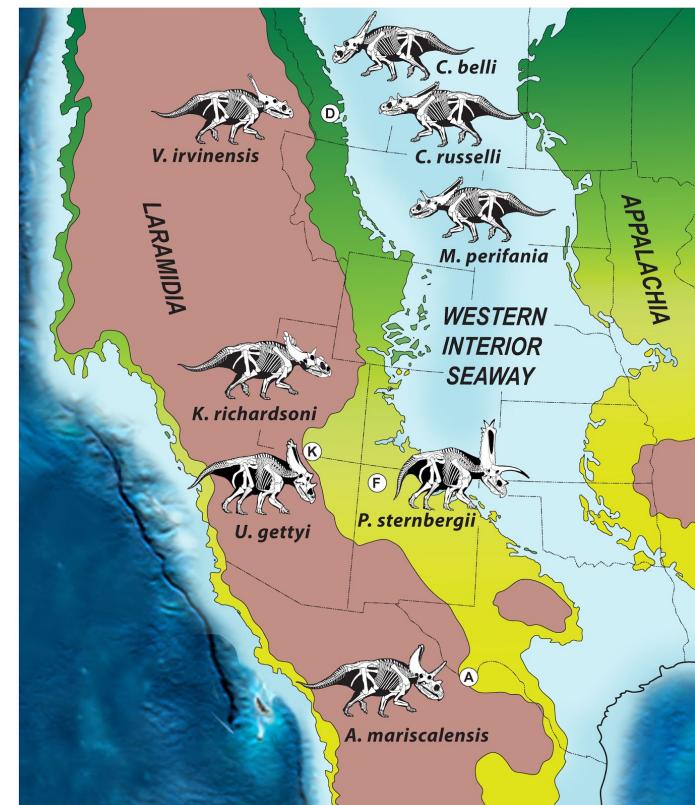
Explanations for diversity in herbivores

- Sexual selection
- Display potential for crests in hadrosaurs and ceratopsians
- Damage in ceratopsians



Explanations for diversity in herbivores

- Geographic isolation

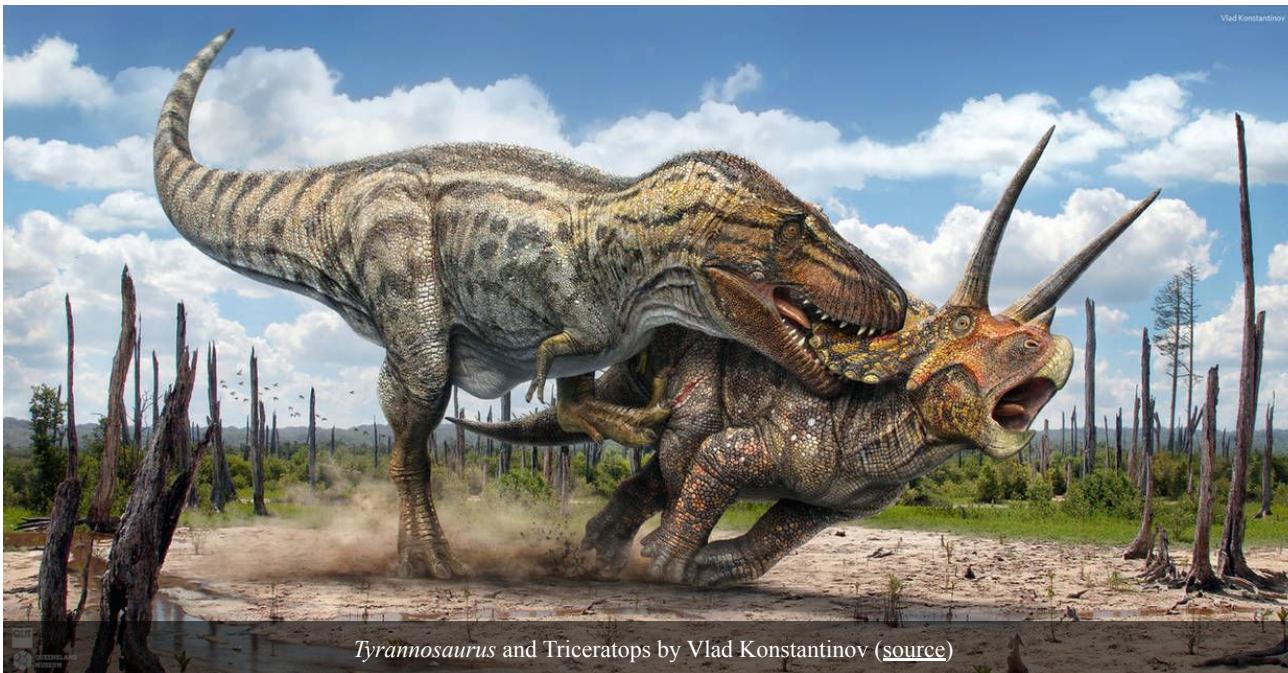


Conclusions

- New herbivore groups dominate the Cretaceous
- Hadrosaurs and ceratopsians are particularly diverse and share similar teeth structures
- Diversity likely driven by a number of factors beyond niche partitioning



Next class



Tyrannosaurus and Triceratops by Vlad Konstantinov ([source](#))