A Sampling of Paleozoic Sharks

David Lindberg

Shark Classification

- Sharks belong to the class Chondrichthyes (cartilaginous fishes)
- Along with their relatives, rays and skates, sharks belong to the subclass Elasmobranchii
- Another subclass, Holocephali. The only living order, Chimaeriformes, are informally referred to as “ghost sharks”.
- Still debate even at the subclass level.

Paleozoic Shark Preservation

- Because shark skeletons are made of cartilage, they are rarely preserved in fossils. Cartilage decays rapidly in oxygenated environments.
- Paleozoic sharks generally didn't replace teeth nearly as fast as modern sharks, so we don't find as many of their teeth
- Therefore, the very old shark fossil record is spotty, mainly denticles, teeth, and fin spines

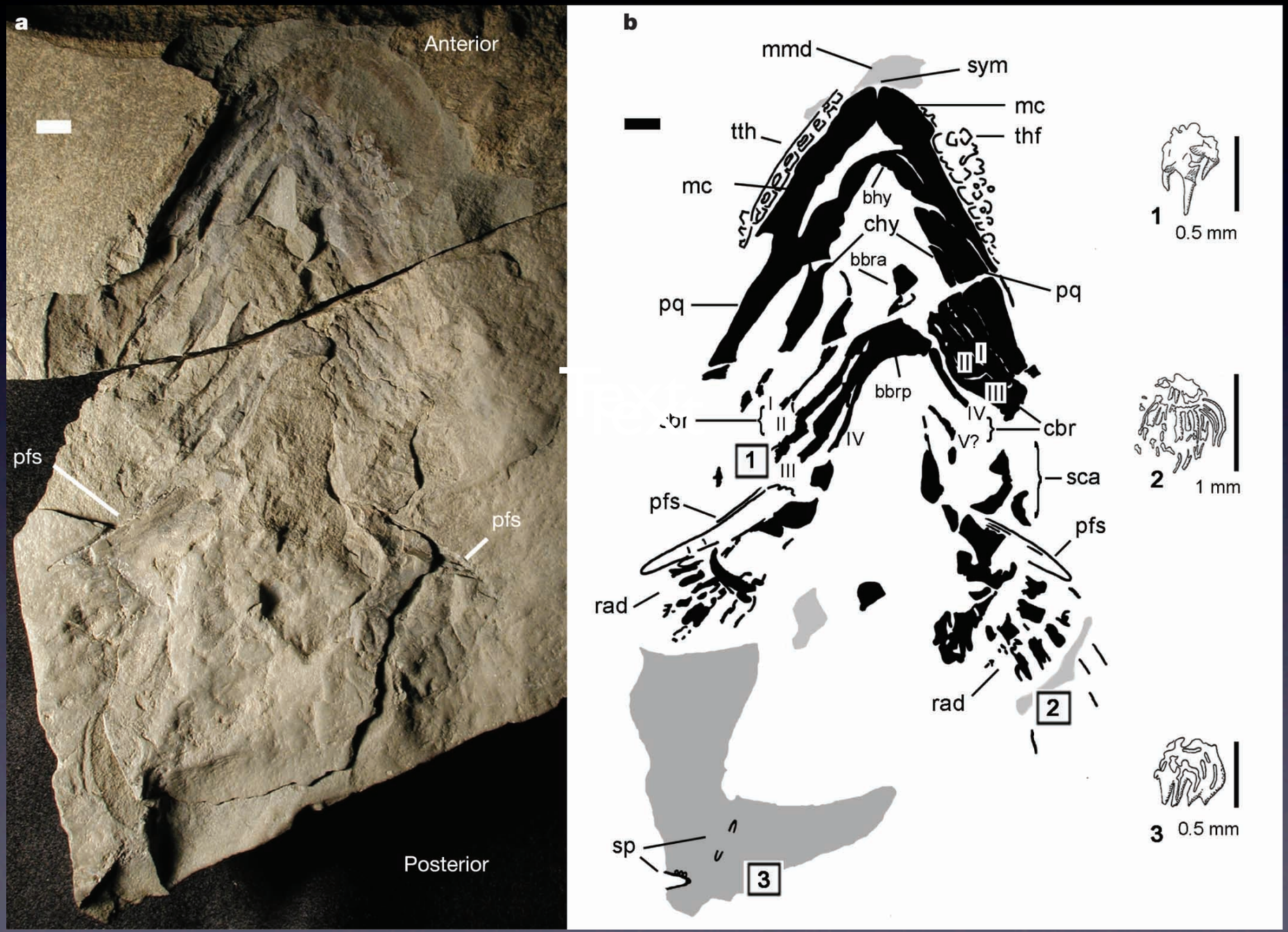
The Oldest Sharks

- The first shark-like fossils are denticles (minute teeth-like structures that cover much of the body) from the late Ordovician (about 455 mya).
- Denticles are thought to give rise to teeth in sharks.
- The first unambiguous shark teeth and shark body imprints are from the Devonian (about 409 mya).

One of the Oldest

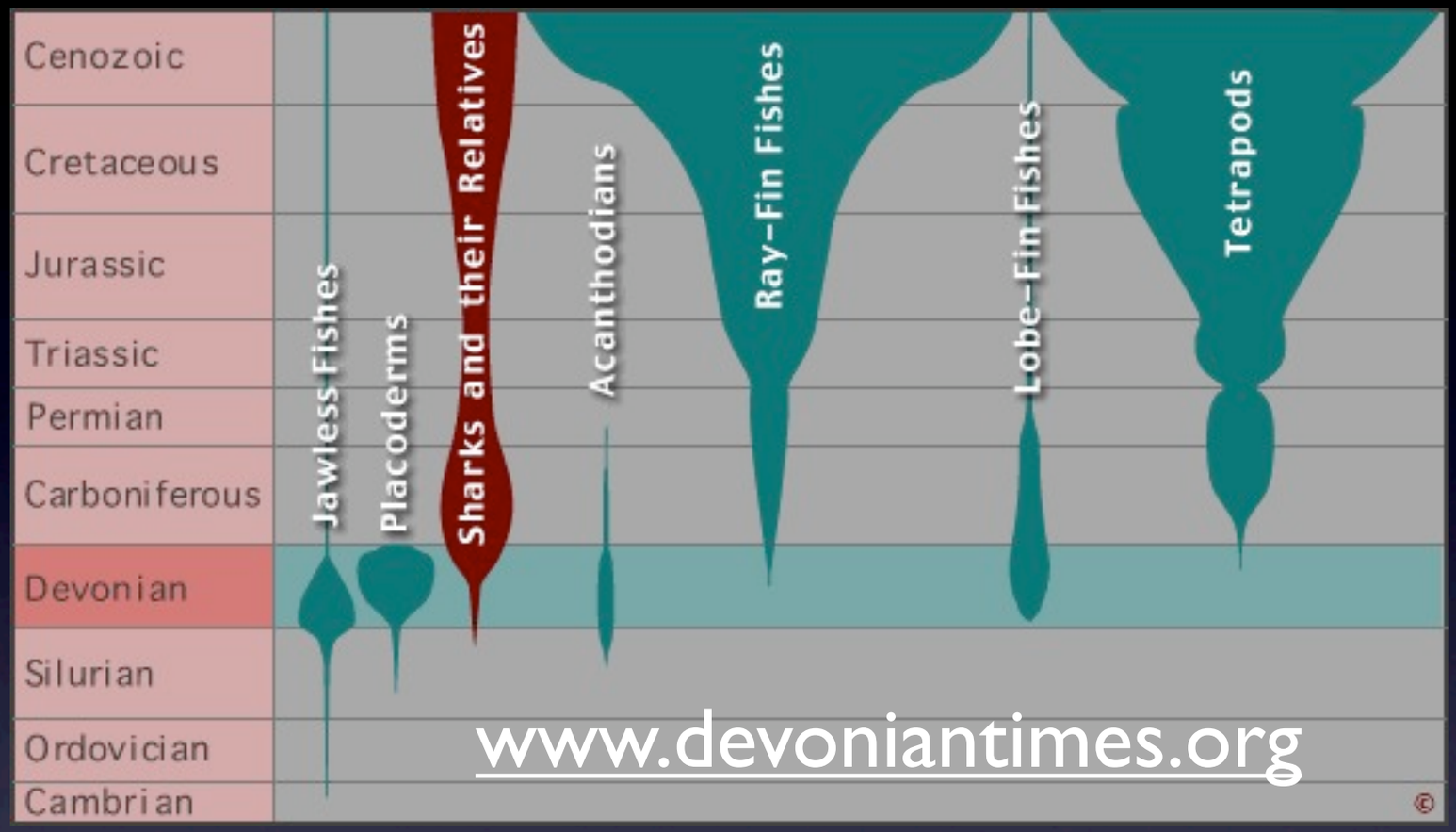
Shark like denticle from around
420 Million years ago

Oldest Preserved Shark



Miller RF, Cloutier R, Turner S. The oldest articulated chondrichthyan from the Early Devonian period. Nature. 2003;425:501–504

Shark Diversity

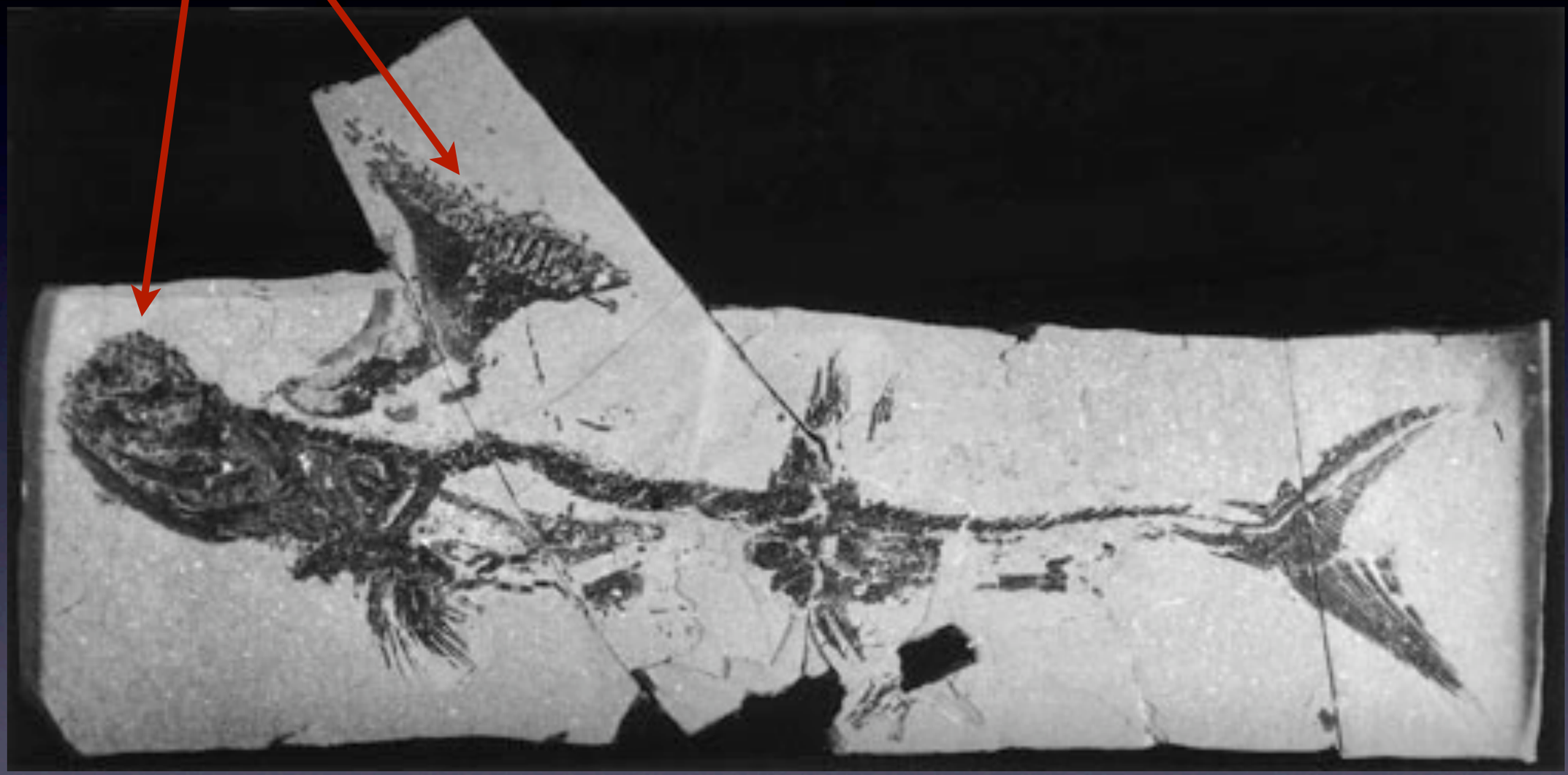


- Sharks experienced two time periods of wide diversity, during the Carboniferous and the Cenozoic
- The Carboniferous has been referred to as a "golden age of sharks", with lots of strange looking sharks

The Strange Ones

Stethacanthus

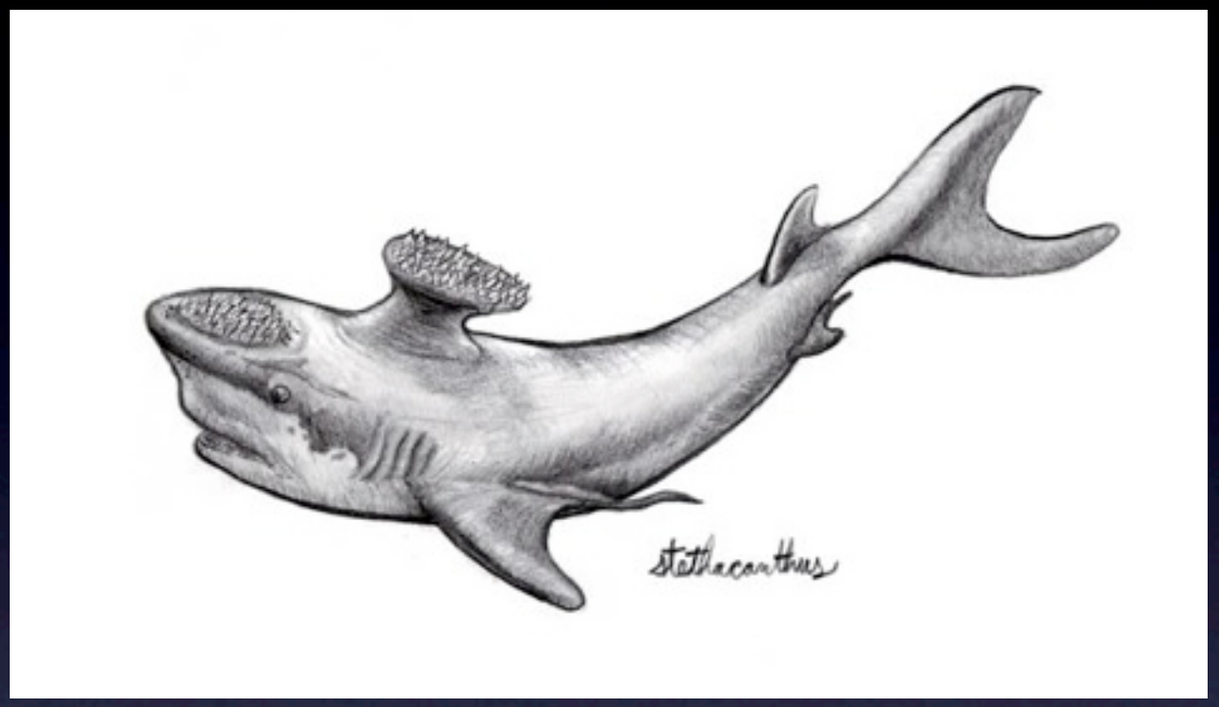
Dermal denticles

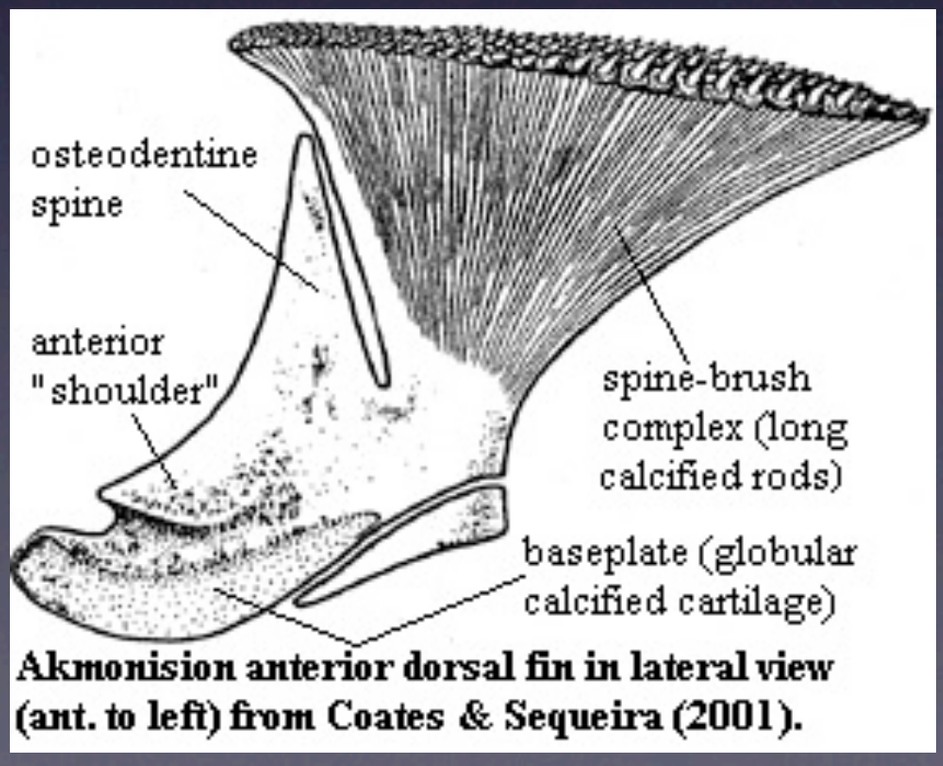


Benton, M.J. (2005) Vertebrate Palaeontology [3rd Edition]. Blackwell Publishing: Main, USA

Stethacanthus

Not sure why this shark had these "features"





Akmonision anterior dorsal fin in lateral view (ant. to left) from Coates & Sequeira (2001).

Symmorium

A contemporary of Stethacanthus, some believe Symmorium may be female Stethacanthus. No recognizable male Symmoriums have been found.

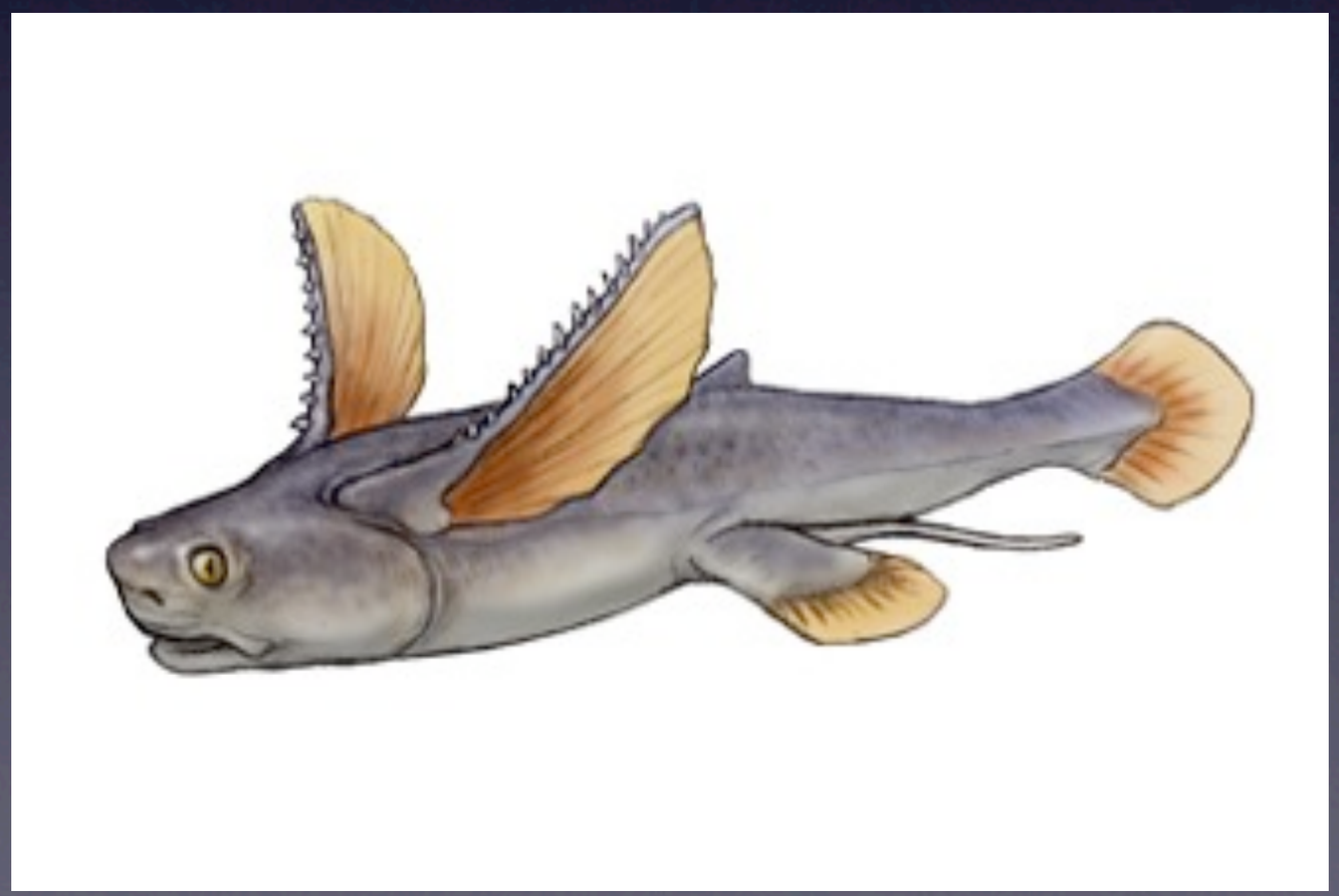
Falcultus and Damocles

The "Unicorn" shark

Falcultus and Damocles

Iniopteryx

- Iniopteryx has spines that resemble wings. Some speculate that Iniopteryx could "fly" similar to present day flying fish.
- Part of the Holocephali subclass

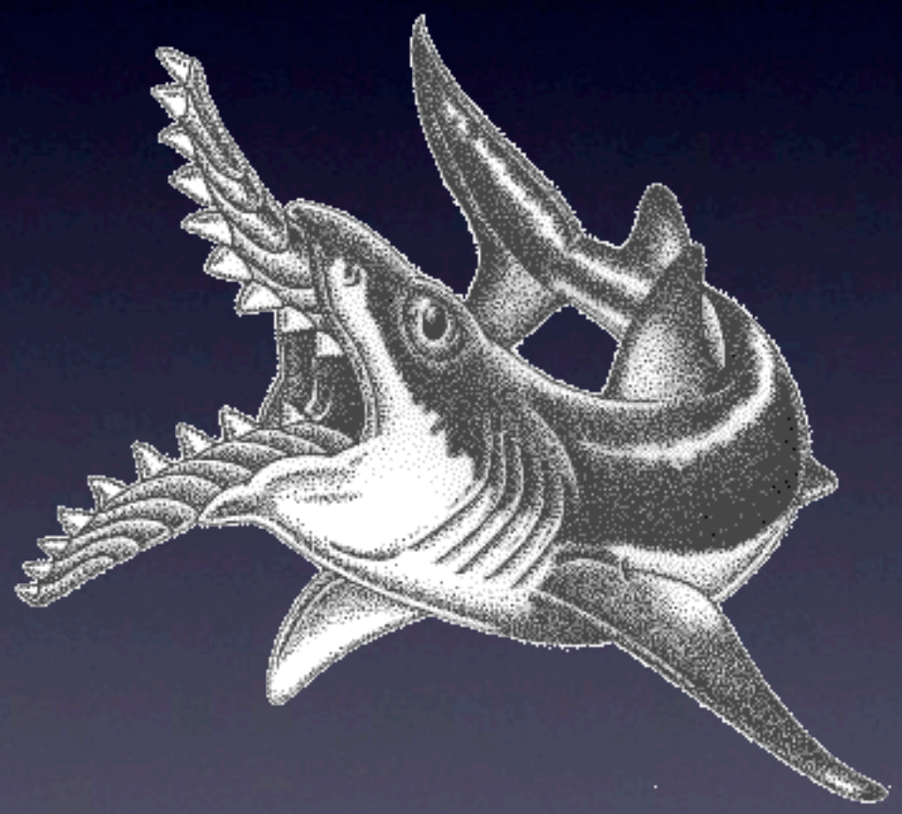


Edestus, the "scissor-tooth" shark

Edestus newtoni

Edestus

Edestus teeth probably grew new teeth and gum at the back of its mouth, pushing the older teeth forward out of its mouth



Edestus giganteus, known from a single set of teeth, may have grown to the size of a modern white shark

One specimen found at Lake Jacksboro

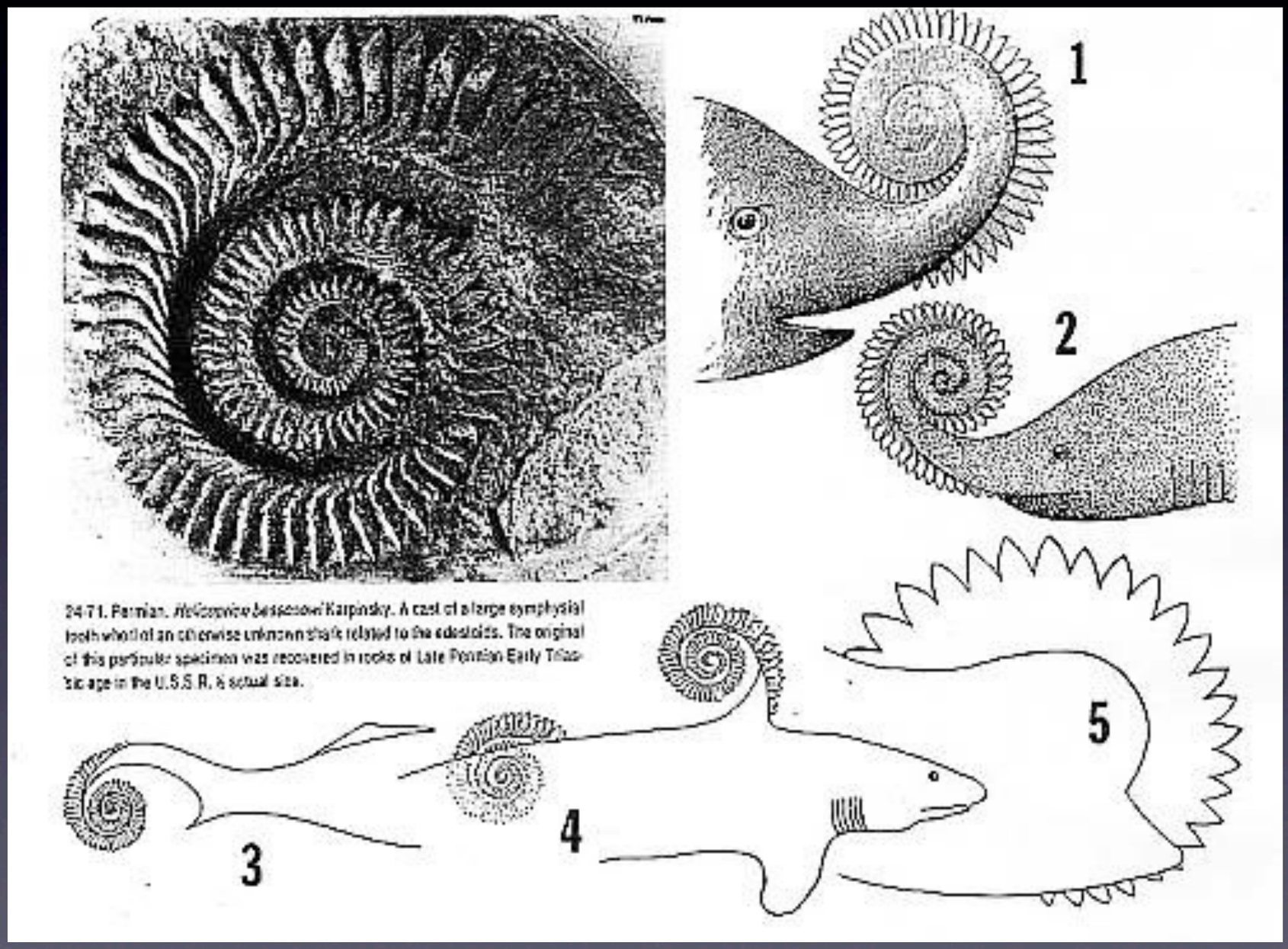
Helicoprion

No, this is not an ammonite!

Helicoprion

- The spiral arrangement of teeth, called a symphysial whorl, has puzzled Paleontologist for years
- Since we only have sets of teeth, there have been some very imaginative conjectures as to what Helicoprion looked like

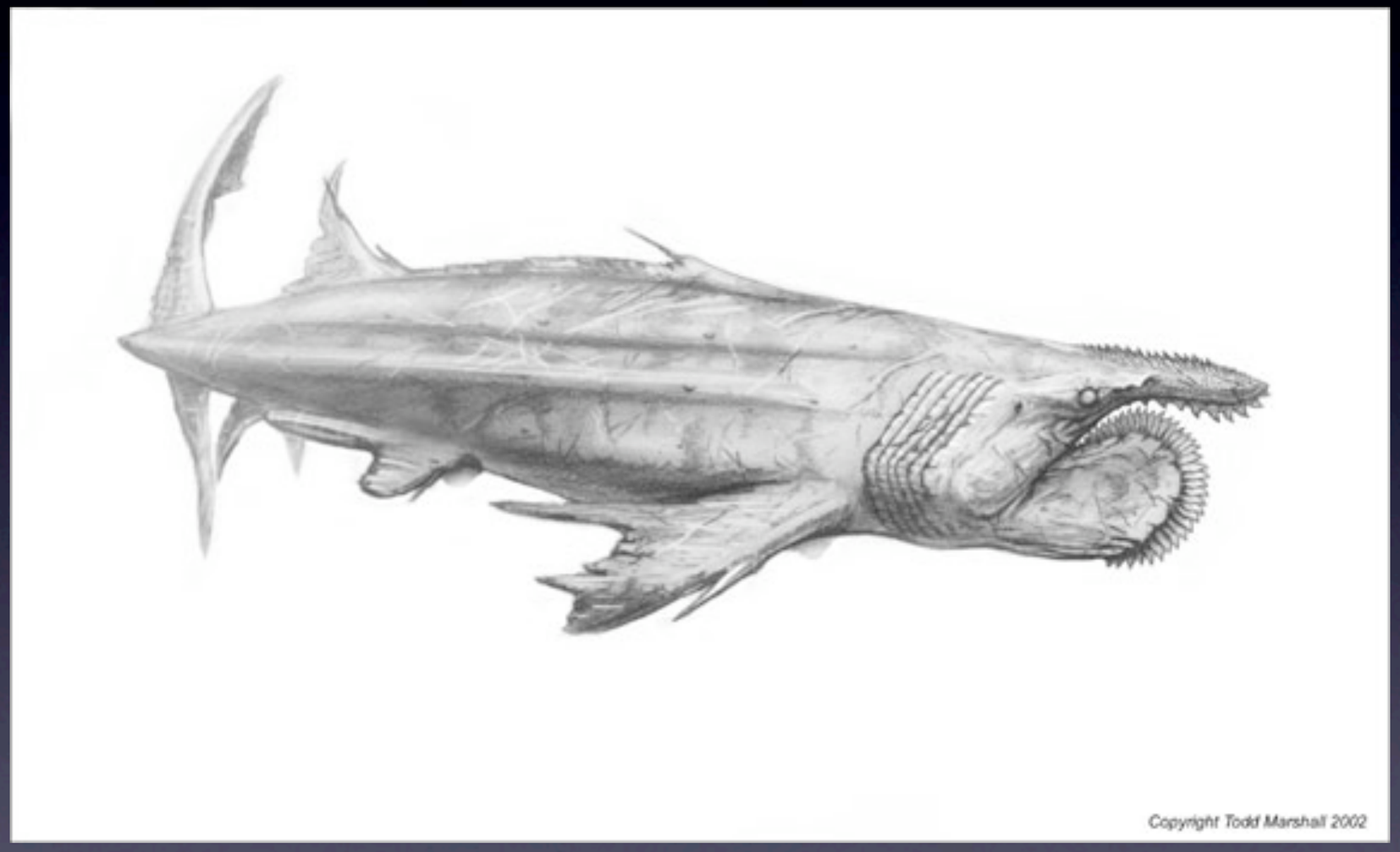
Helicoprion



24-71. Permian. *Helicoprion bessonowi* Karpinsky. A cast of a large symphysial tooth whorl of an otherwise unknown shark related to the edestoids. The original of this particular specimen was recovered in rocks of Late Permian-Early Triassic age in the U.S.S.R. ¼ actual size.

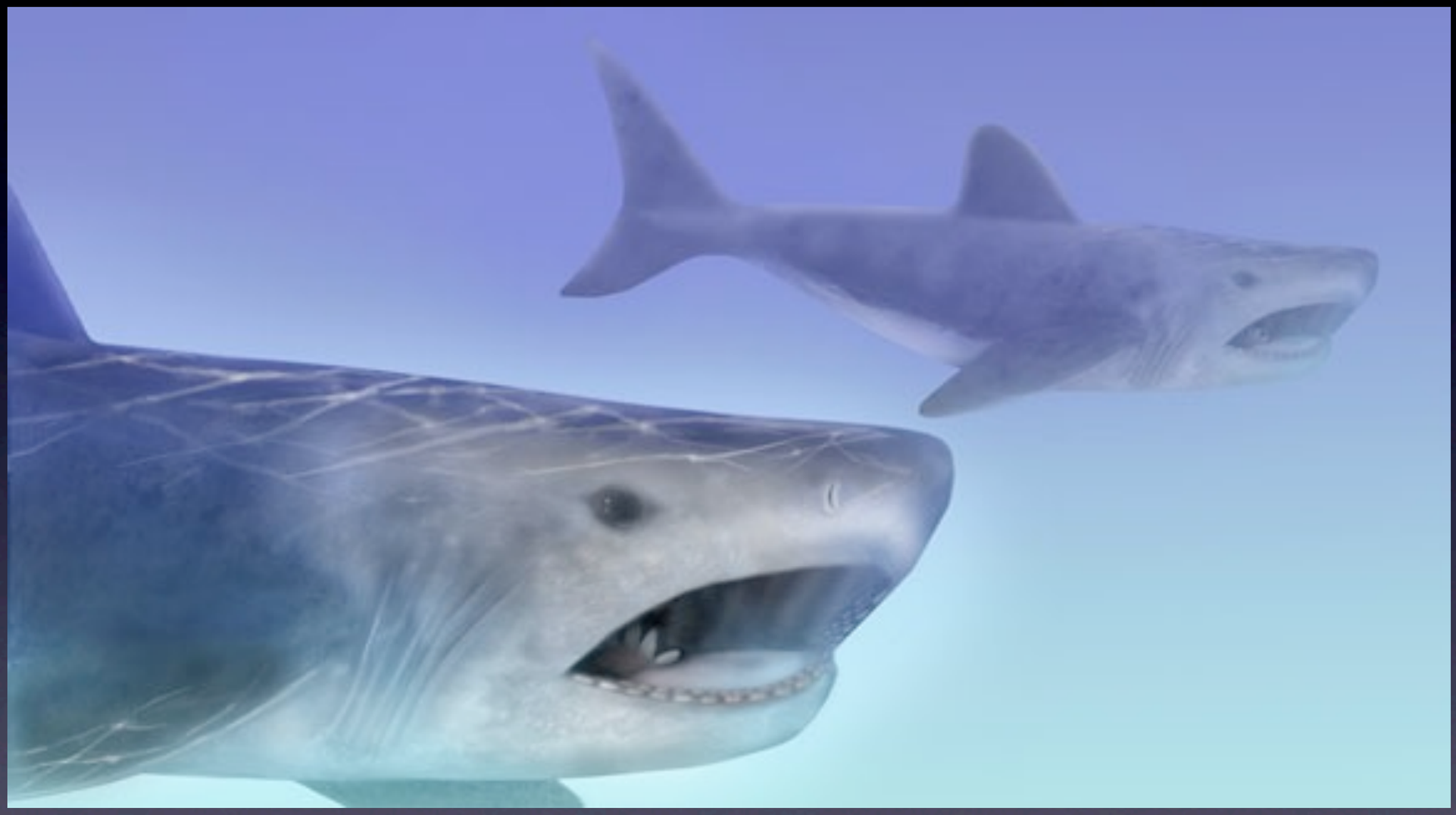
Early speculation

Helicoprion



A more modern guess

Helicoprion



The latest - the spiral teeth are in the throat!

The Competition

Placoderms
Armored Fish

- Placoderms (meaning plate skin) were armored by their extensive dermal skeleton
- Placoderms lived during the Silurian and Devonian, going extinct at the Devonian
- They may have gone extinct because of competition with bony fish and early sharks (plus the end Devonian extinction event)

Dunkleosteus

Order

Petalodontiformes

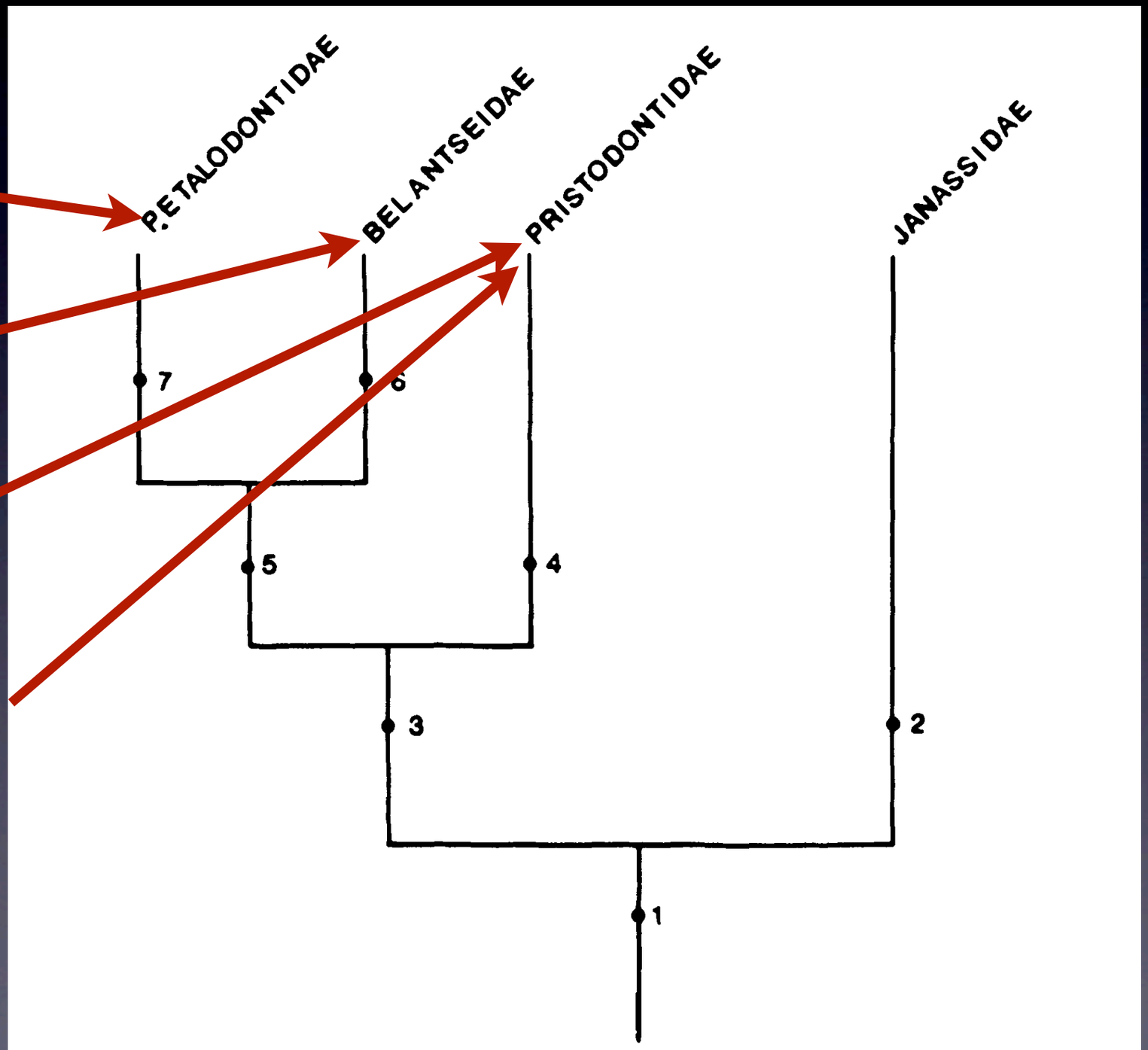
Petalodontiform Cladogram

Petalodus

Belantsea

Peripristus

Megactenopetalus

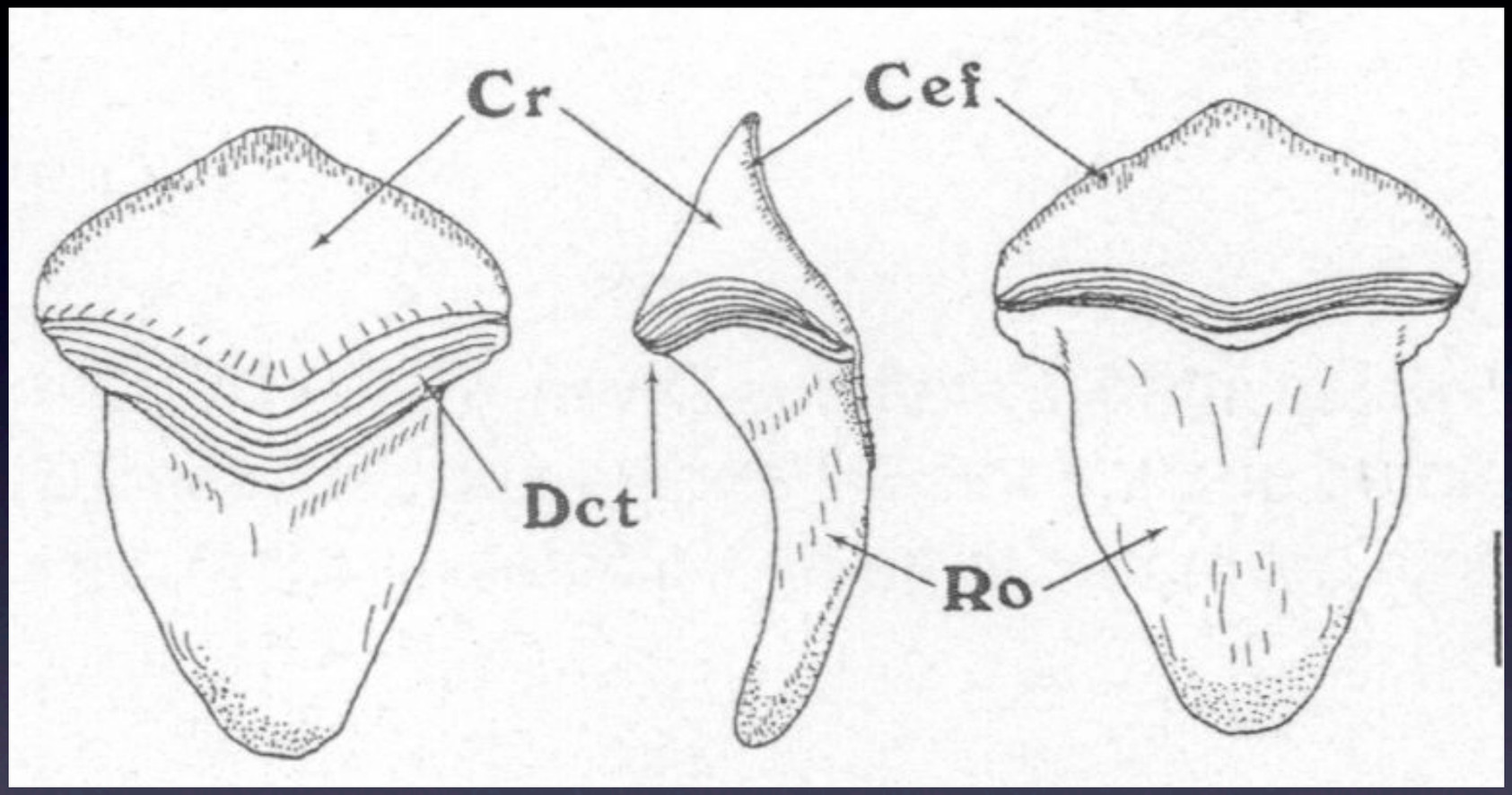


Lund, Journal of Vertebrate Paleontology, Vol. 9, No. 3 (Sep. 28, 1989), pp. 350-368

Petalodontiforms

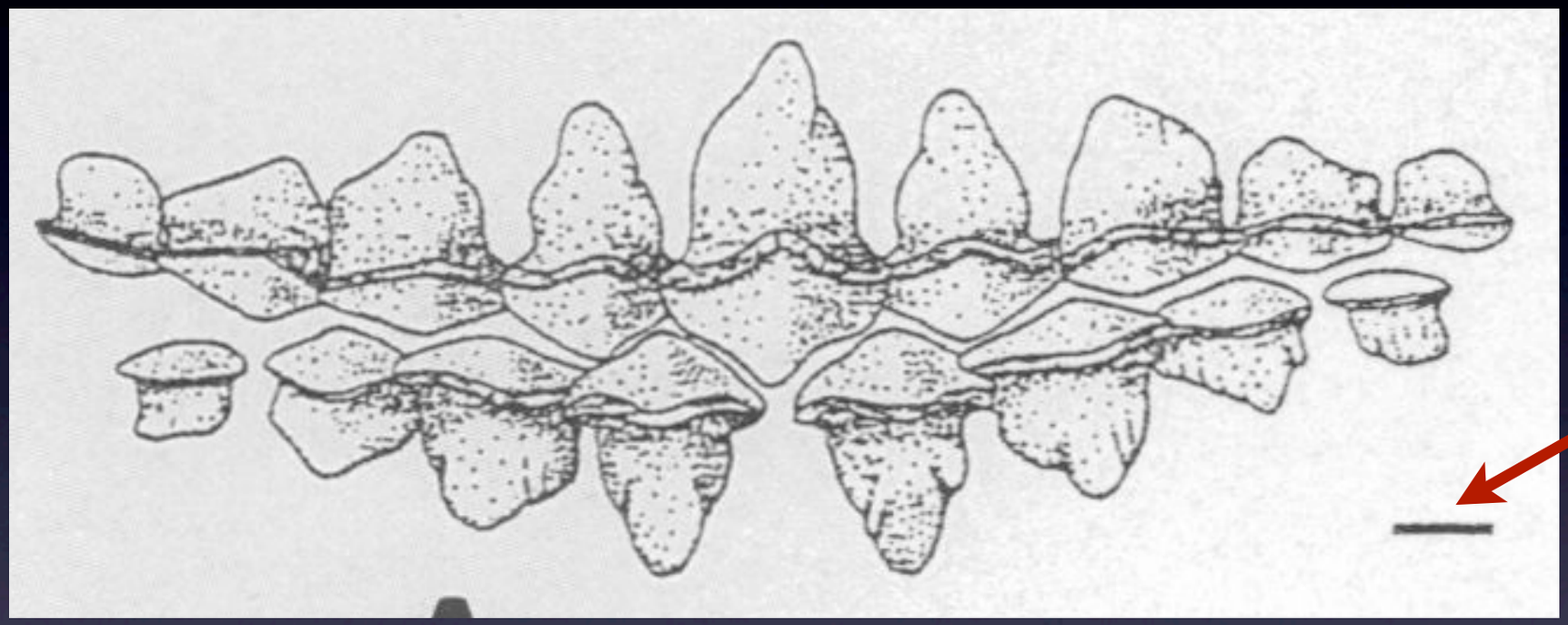
- Petalodontiforms are know almost exclusively from their teeth
- What they look like is speculation
- Their teeth typically have a sigmodial shape (elongated ‘S’) with an elongated root
- They existed from the Mississippian to the Permian
- Debate on which subclass they belong to

Petalodus Teeth



Ro - Root
Dct - Distal crown tongue
Cr - Crown
Cef - Cutting edge furrows

Petalodus Teeth Placement



It's uncertain whether some of the teeth are on the upper or lower jaw

Hansen, M. C. 1996. Phylum Chordata-Vertebrate Fossils; pp. 288–369 in R. M. Feldmann and M. Hackathorn (eds.), Fossils of Ohio. Ohio Division of Geological Survey Bulletin 70, Columbus, Ohio.

Petalodus

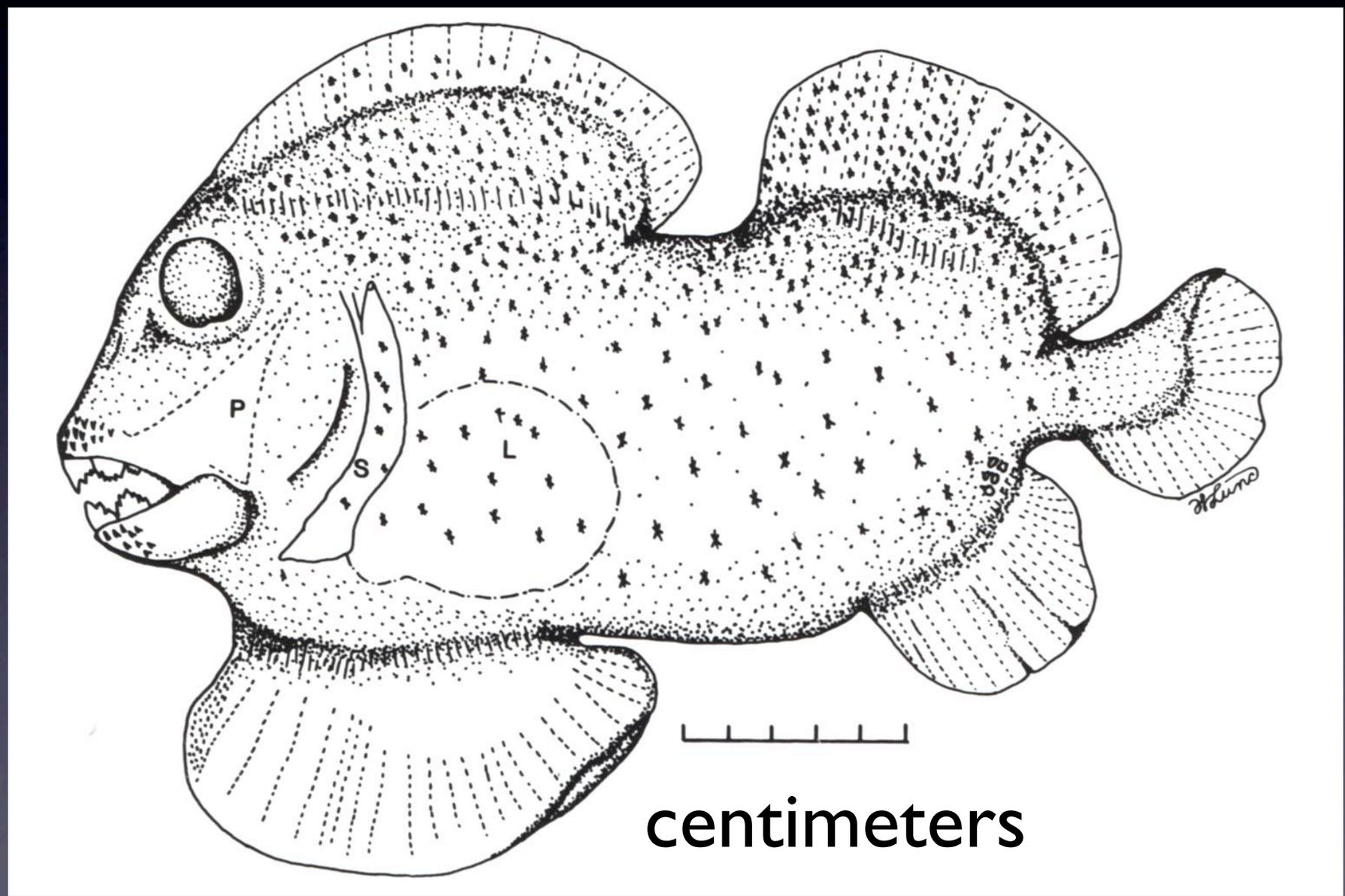
- Distribution of Petalodus is wide spread, from New Mexico to Ohio, several places in Europe, and Asia.
- The teeth suggest the Petalodus diet consisted of soft tissue prey, possibly cephalopods
- May have been up to 2 m long
- Most numerous of Carboniferous “shark” teeth found

Belantsea Montana

From the Bear Gulch Limestone (Mississippian)

TeLund, Richard, and Grogan, E.D., 2005, Bear Gulch web site, www.sju.edu/research/bear_gulch, date accessed 08/01/10, date updated 2/1/2006

Drawing of Belantsea Type Specimen



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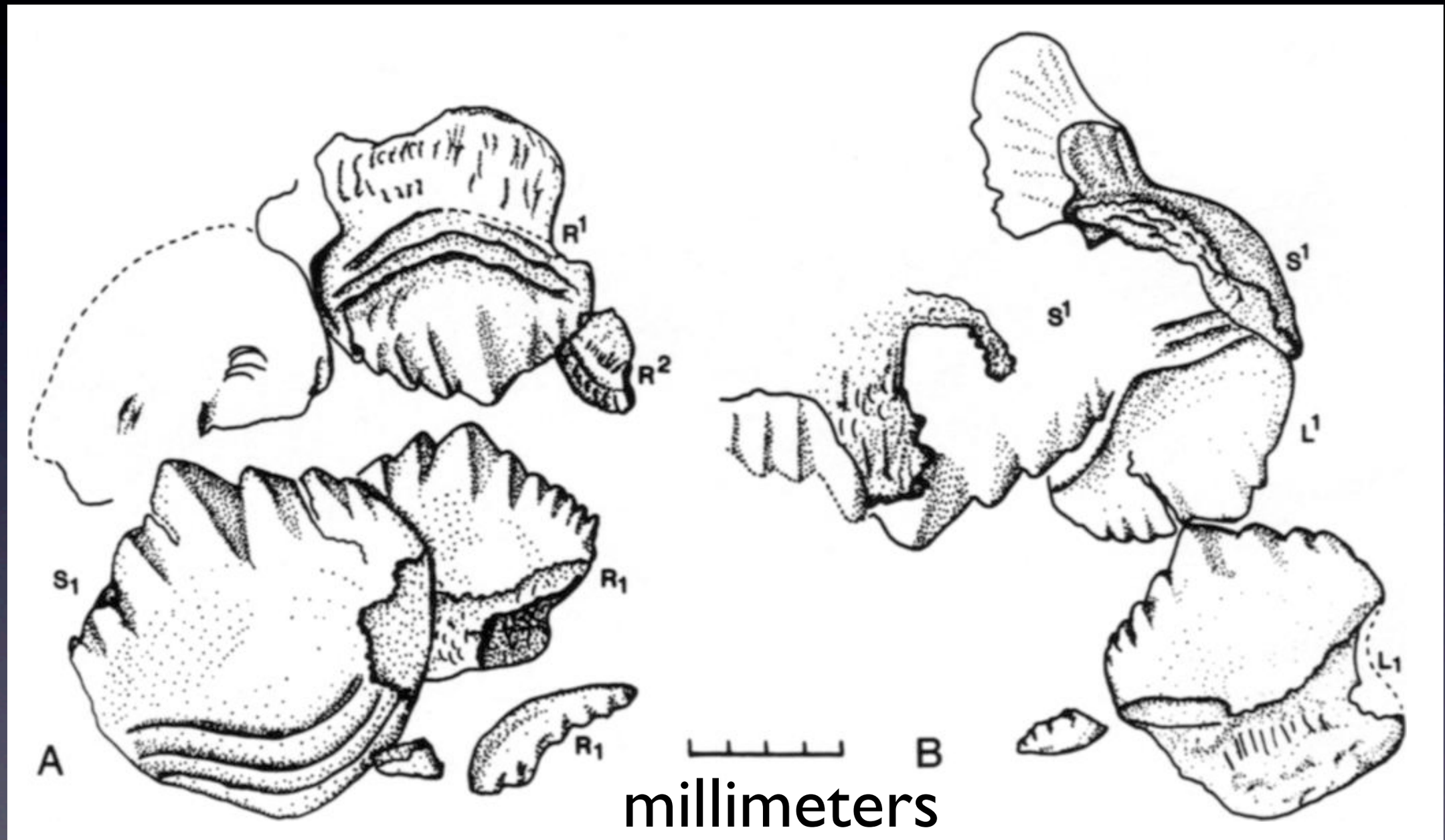
Belantsea Teeth



Belantsea

- Belantsea is the closest relative to Petalodus where we have a good idea of what it looks like.
- Fossil evidence suggests several immature replacement teeth existed behind each of the front teeth.
- Belantsea teeth are rare.

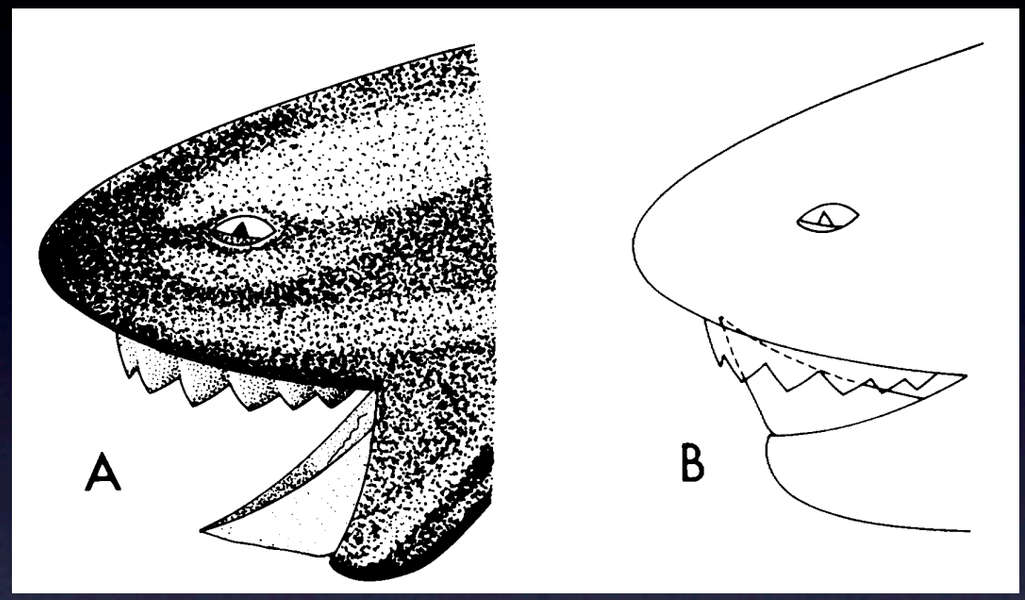
Peripristis

- Have been found in Texas, New Mexico, Ohio, Colorado, and Illinois, but not outside of North America
- Not much is known about Peripristis. Only isolated teeth have been found.
- May have fed on corals and/or conularids, like modern parrot fish.
- Originally name Ctenoptychius (ten-op-tik'i-us).

Peripristis Teeth

http://snr.unl.edu/data/geologysoils/fossils/fossilfish.asp

Megactenopetalus



- Dentation includes a single lower tooth
- Found in North America, Iran, and China
- Teeth have been found in the Glass Mountains of Texas

Conclusion

- During the Carboniferous, sharks enjoyed a golden age
- Many different body types and teeth arrangements were experimented with
- A lot of sharks are only know from their teeth
- Still a lot to learn about Paleozoic sharks