

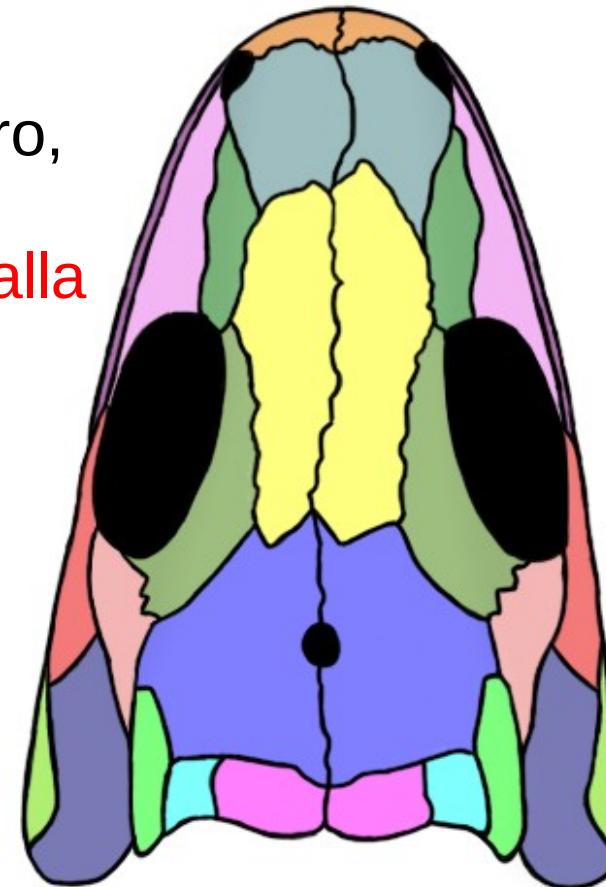
# Evoluzione dei muscoli mandibolari

**Grado evolutivo:** gruppo di specie che condividono determinati caratteri morfologici e fisiologici, senza necessariamente includere un antenato comune recente e tutti i suoi discendenti → **grado ≠ clade**

# Evoluzione dei muscoli mandibolari: grado amnioto primitivo

## Es. *Westlothiana*

- Dentizione *omodonte*: numerosi denti simili tra loro, dotati di un singolo rilievo (**cuspide**), idonei a catturare piccole prede, come gli insetti, ma **non alla masticazione**
- Finestra temporale assente



Premaxilla
Nasal
Maxilla
Lacrimal
Prefrontal
Frontal
Jugal
Postfrontal
Parietal
Postorbital
Squamosal
Supratemporal
Postparietal
Tabular
Quadratojugal

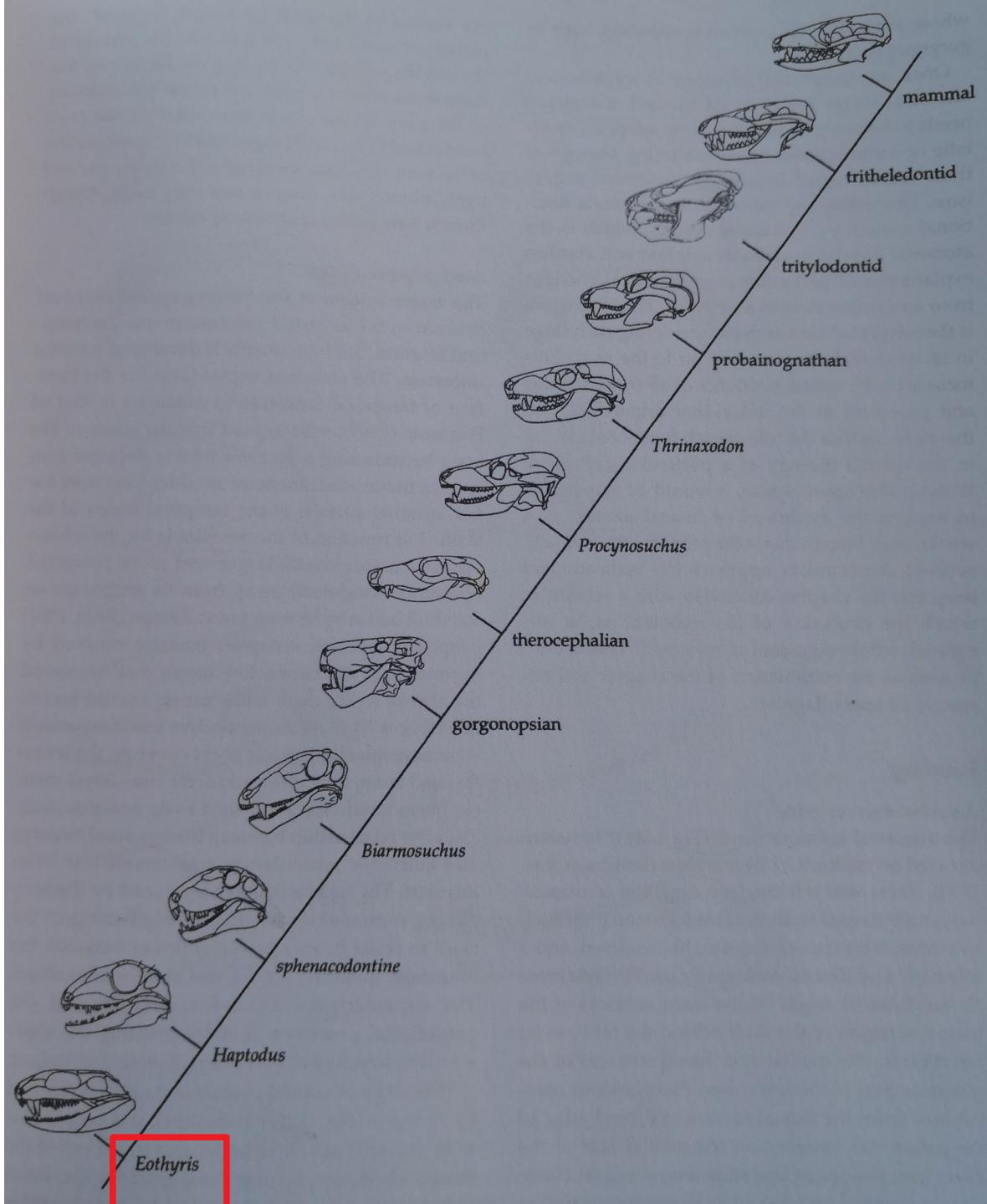
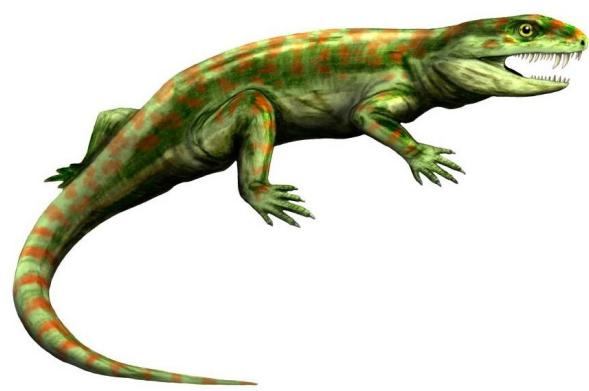


# Evoluzione dei muscoli mandibolari: **grado amnioto primitivo**

## Es. *Westlothiana*

- Un **m. mandibolare**, inserito sulla regione temporale del cranio dietro la cavità orbitale e sulle superfici laterale e mediale della mandibola
- **M. pterigoideo**, dalla parte posteriore del palato alla faccia mediale della mandibola (vedi più avanti)

# Il cladogramma dei Sinapsidi



# Classificazione dell'*Eothyris*

Domain: Eukaryota

Kingdom: Animalia

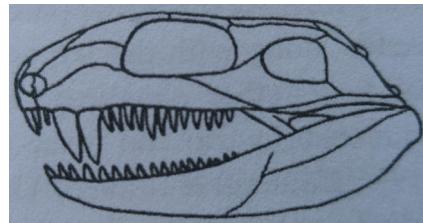
Phylum: Chordata

Clade: **Synapsida**

Clade: **Caseasauria**

Family: **Eothyrididae**

Genus: *Eothyris*



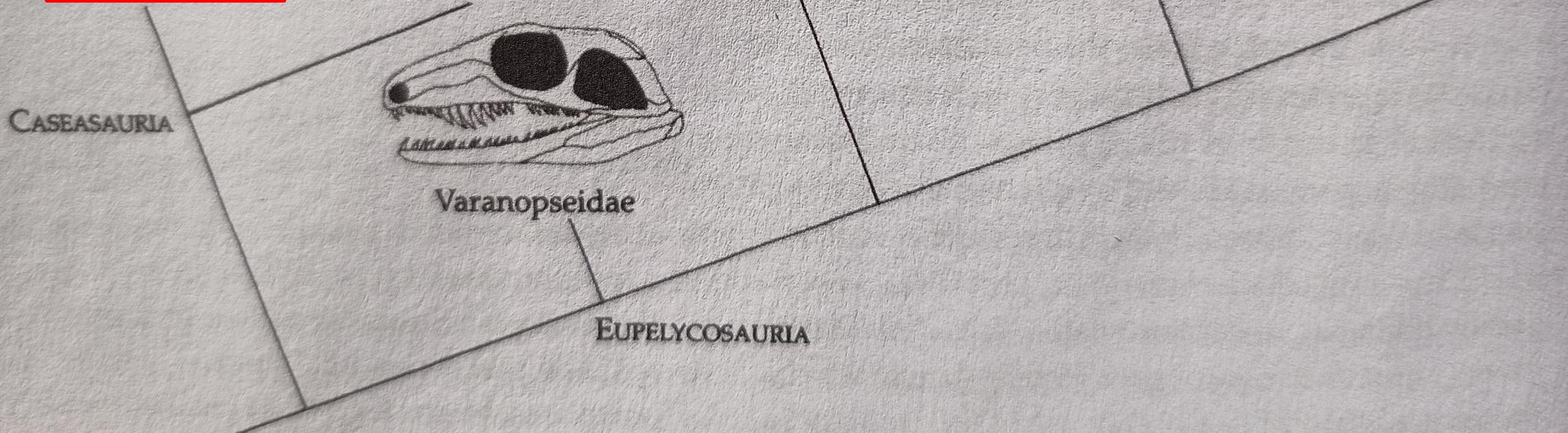
Eothyrididae

Caseidae

Ophiacodontidae

Edaphosauridae

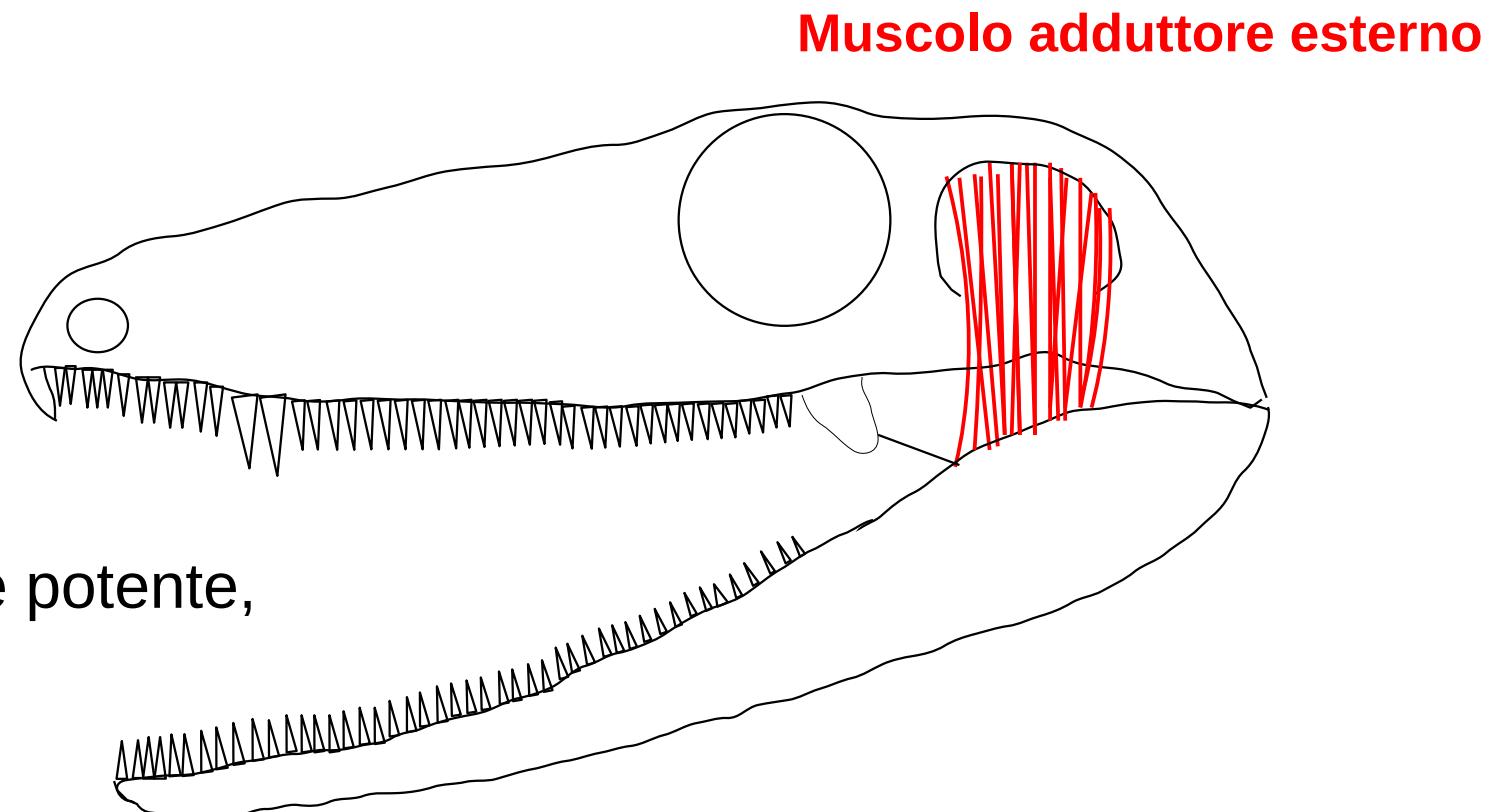
Sphenacodontidae



# Evoluzione dei muscoli mandibolari: **grado Pelicosauri**

Es. *Eothyris*

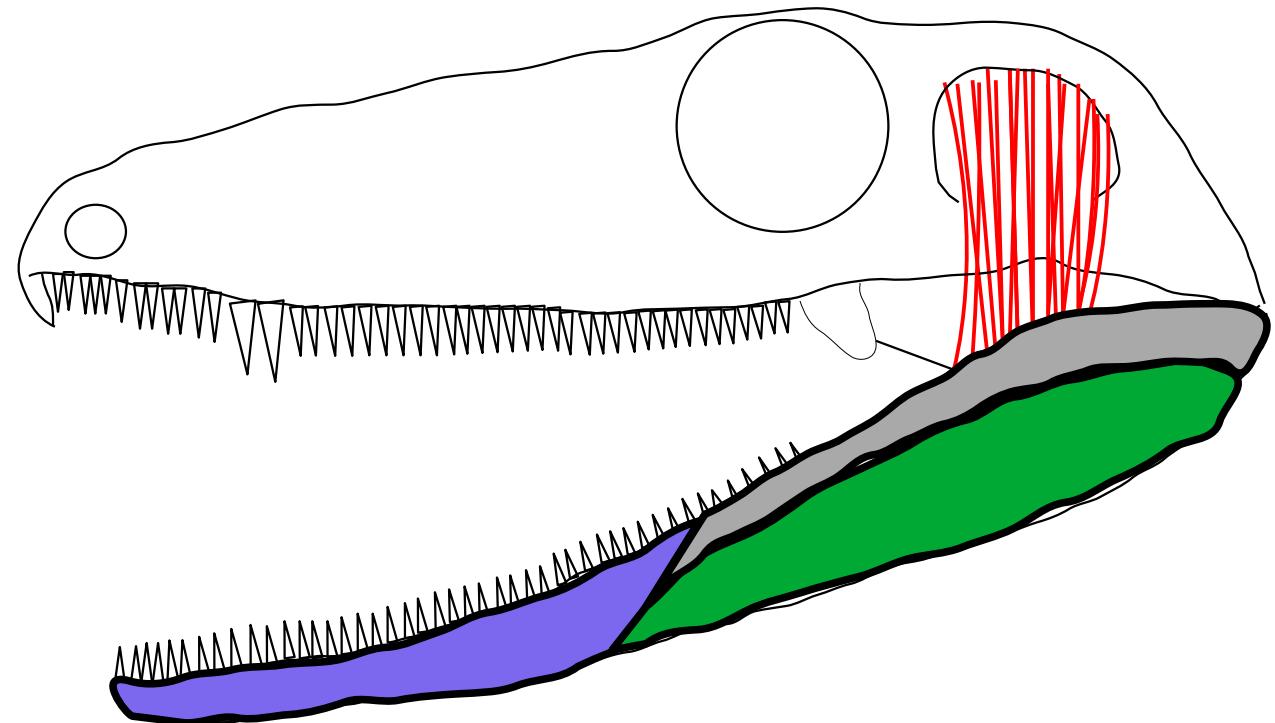
- **Finestra temporale**
- Il bordo della finestra temporale offre un attacco più forte al muscolo rispetto alla superficie, liscia, delle ossa del cranio
- Un **m. adduttore** più sviluppato e potente, chiude le mascelle sulla preda



# Evoluzione dei muscoli mandibolari: grado Pelicosauri

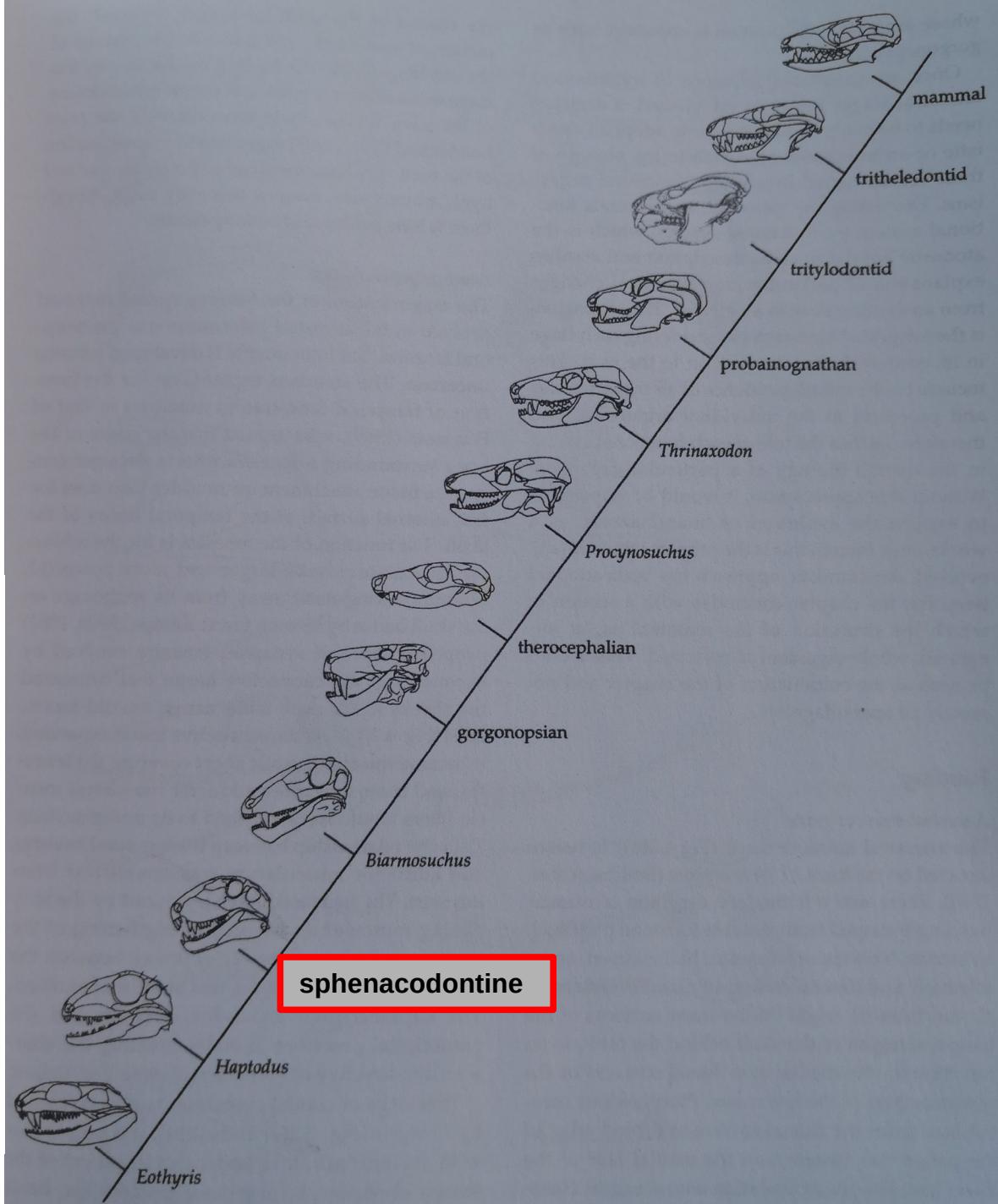
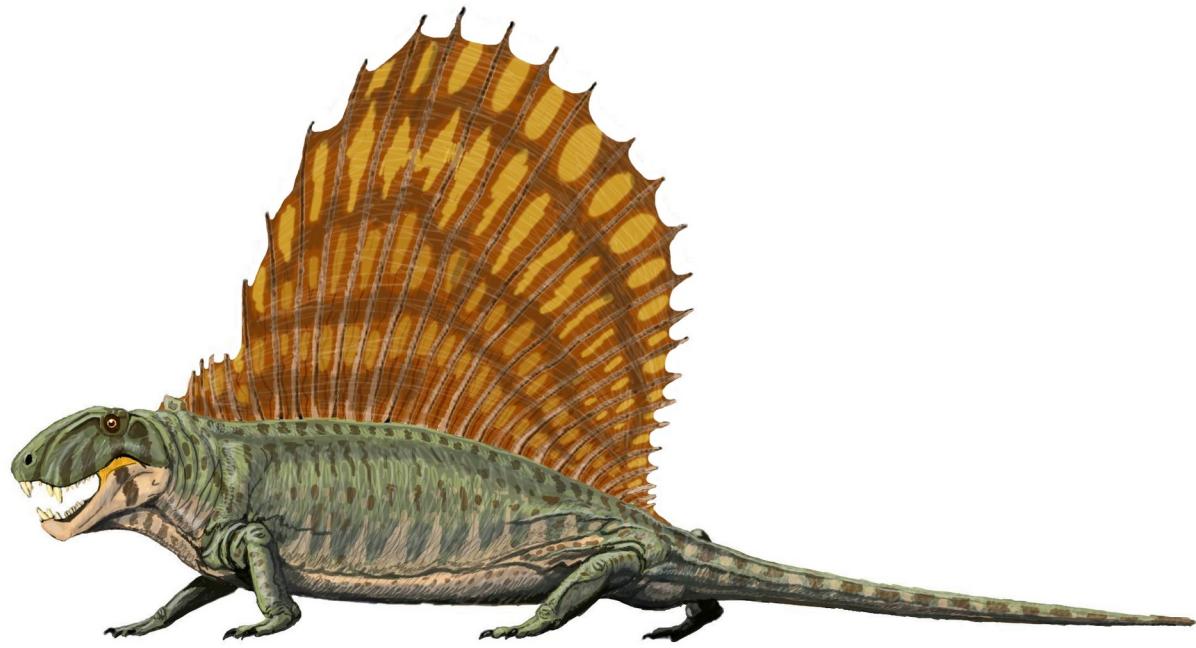
Es. *Eothyris*

Muscolo adduttore esterno

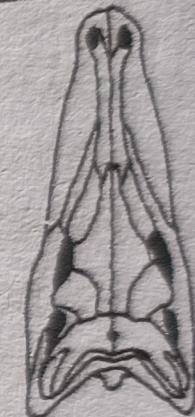
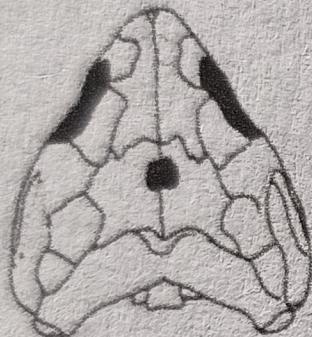
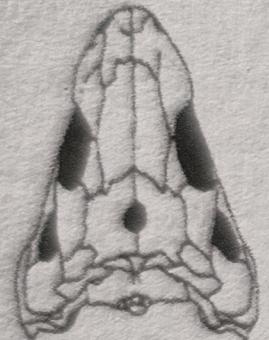
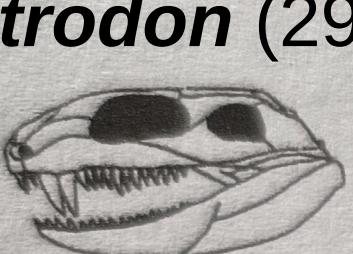


- [purple square] dentario
- [green square] angolare
- [grey square] surangolare

# Il cladogramma dei Sinapsidi



## II *Dimetrodon* (299÷273 Mya)



Eothyrididae

Caseidae

Ophiacodontidae

Edaphosauridae

Sphenacodontidae

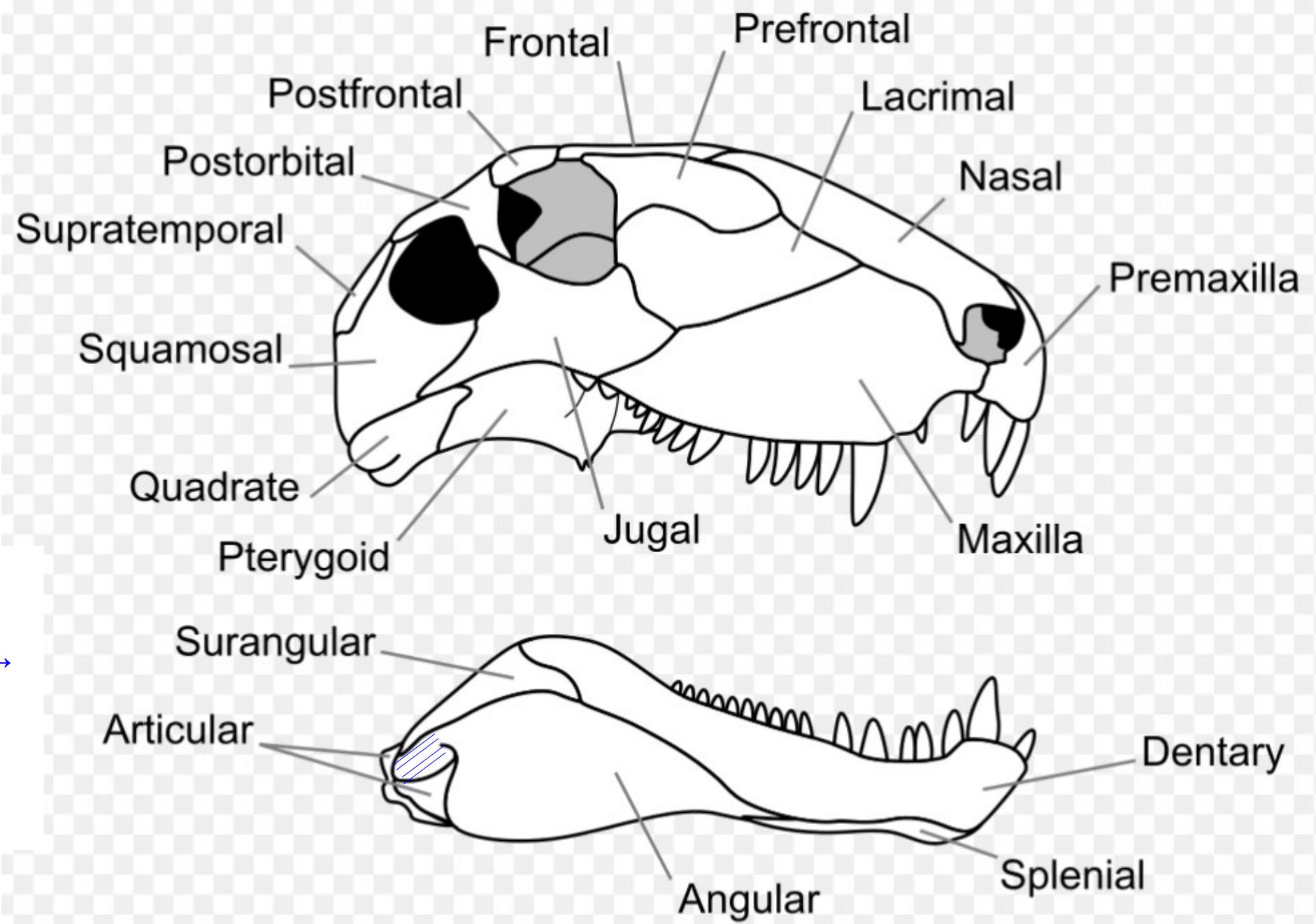
CASEASURIA



Varanopseidae

EUPELYCOSURIA

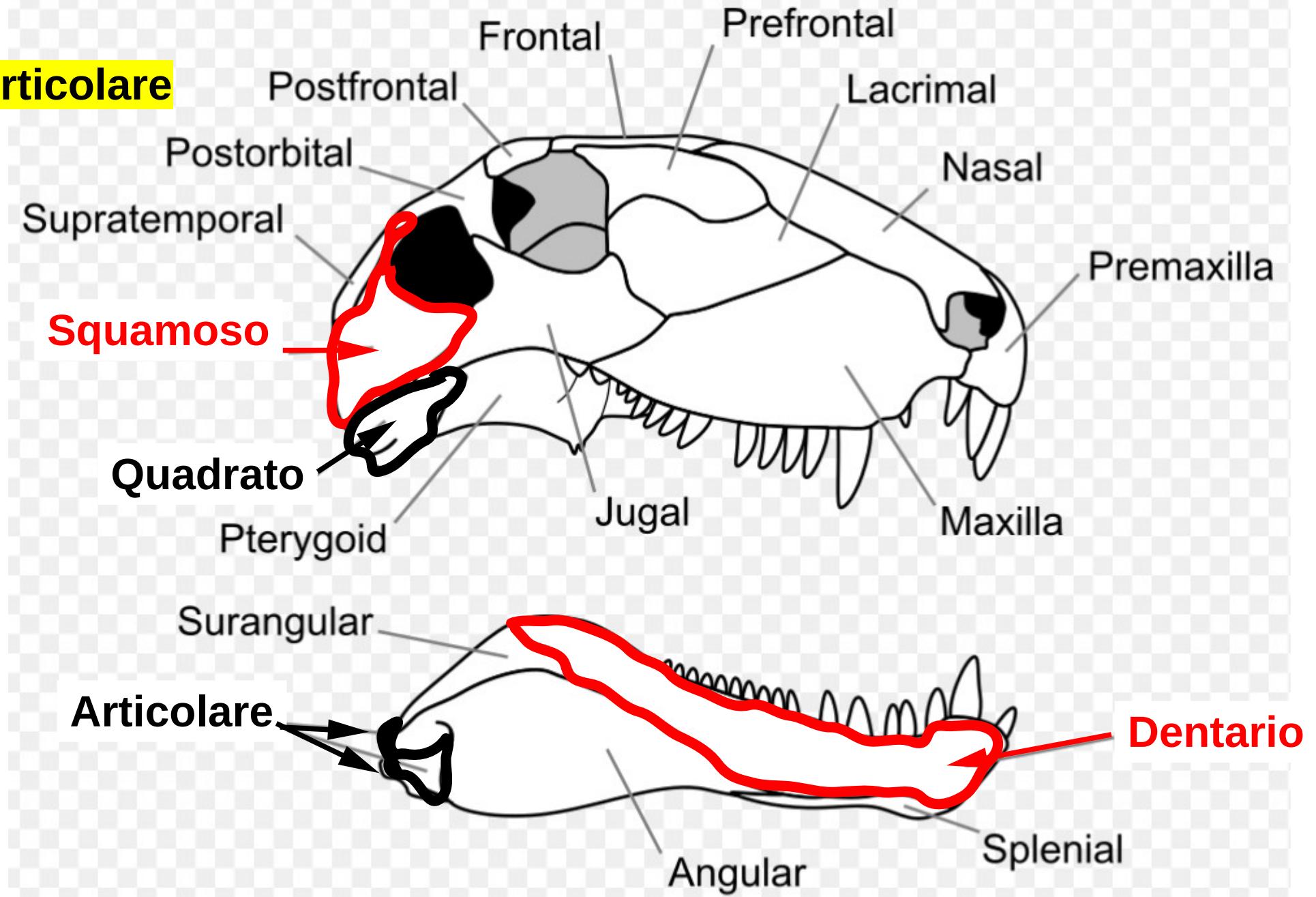
# Il Dimetrodon



Osso angolare della mandibola presenta una lamina ripiegata → sviluppo dell'orecchio medio nei sinapsidi successivi e nei mammiferi

# II *Dimetrodon*

## Art. Quadrato - Articolare



# Evoluzione dei muscoli mandibolari: **grado Sfenacodontidi**

## Es. *Dimetrodon*

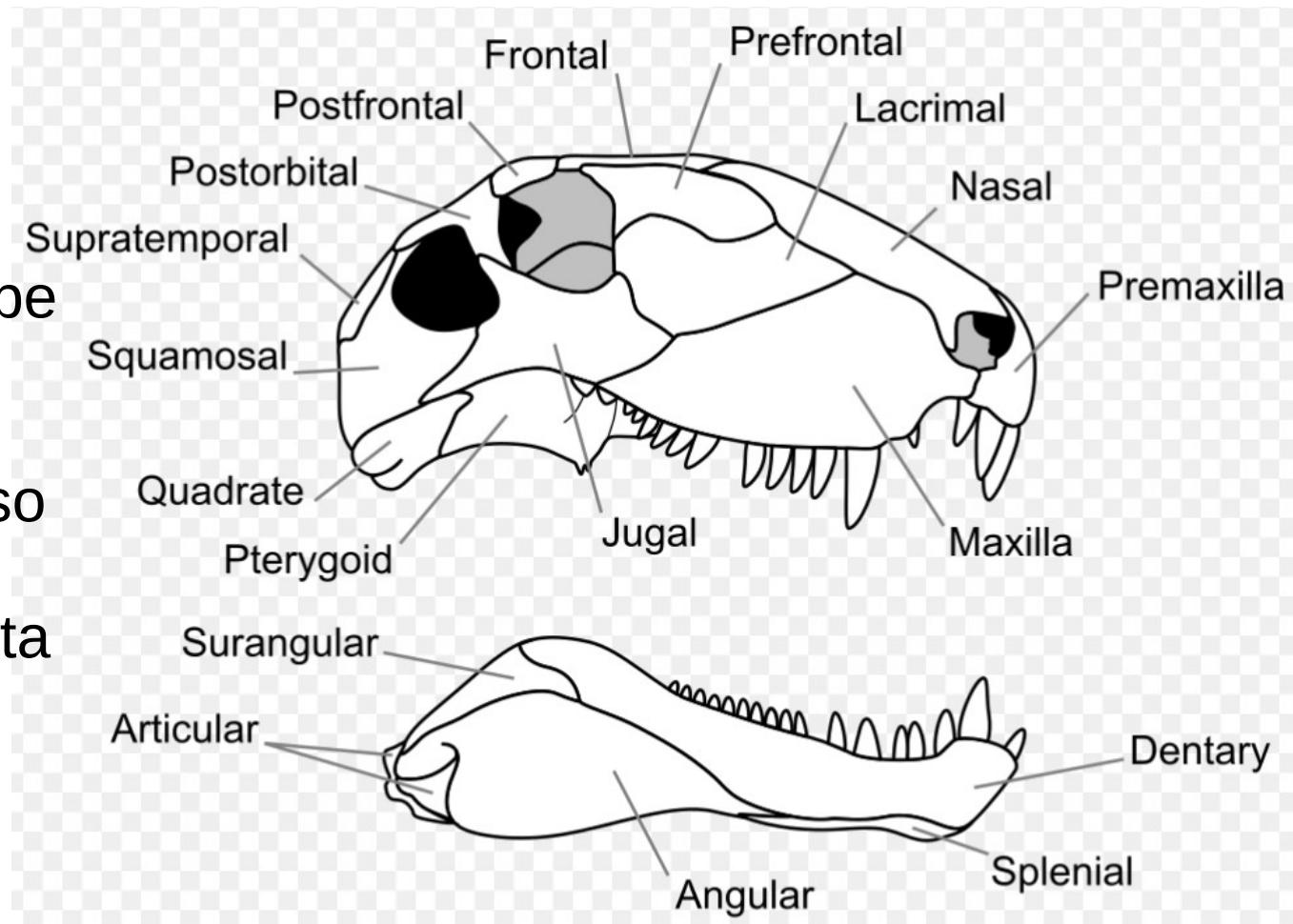
Gli antenati dei Mammiferi avevano mandibole complicate, suddivise in diverse ossa: oltre al **dentario**, sul quale si trovavano i denti, e all'**articolare**, il perno che giuntandosi con l'osso quadrato del cranio permetteva di serrare le mascelle, c'erano l'angolare, il surangolare, lo spleniale.

# Evoluzione dei muscoli mandibolari: grado Sfenacodontidi

## Es. *Dimetrodon*

### Dentizione differenziata (eterodonte):

- incisivi grandi ed arrotondati in sezione trasversale, atti a ghermire la preda, seguiti da un **grosso canino** su entrambe le arcate
- Postcanini più piccoli, schiacciati in senso medio-laterale, affilati e leggermente ricurvi, utili a trattenere la preda che si sta ancora dibattendo

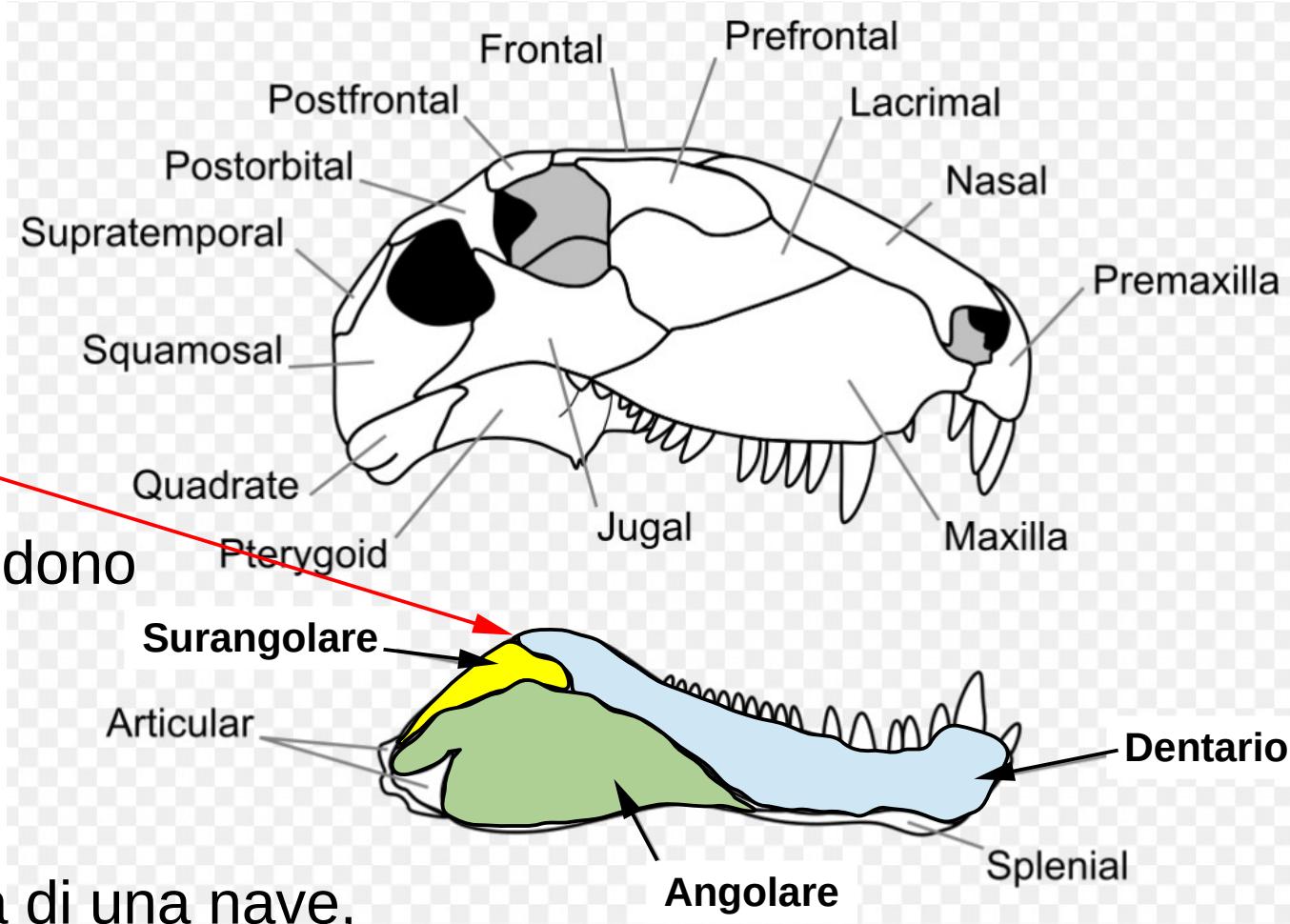


# Evoluzione dei muscoli mandibolari: **grado Sfenacodontidi**

Es. *Dimetrodon*

**processo coronoideo**

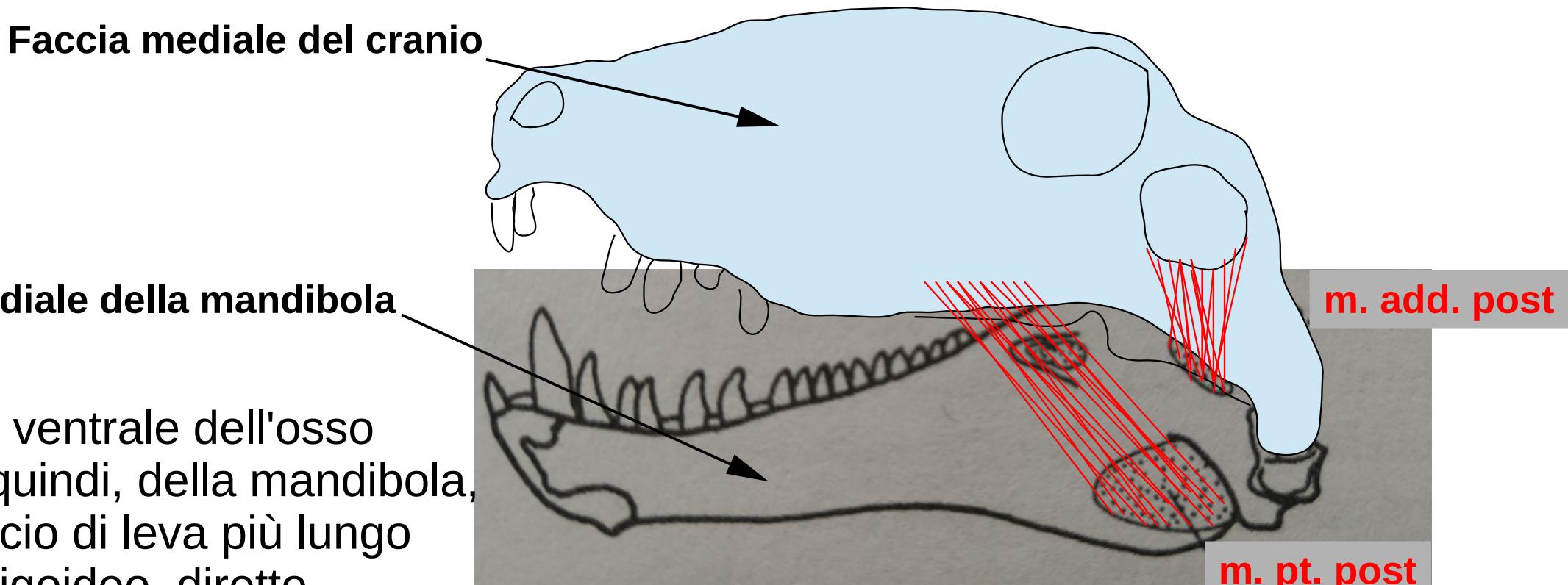
- Le ossa dentario e surangolare si espandono dorsalmente, formando il precursore del **processo coronoideo** dei mammiferi
- L'angolare si espande ventralmente, formando una struttura simile alla chiglia di una nave, molto al di sotto dell'articolazione mandibolare



# Evoluzione dei muscoli mandibolari: **grado Sfenacodontidi**

Es. *Dimetrodon*

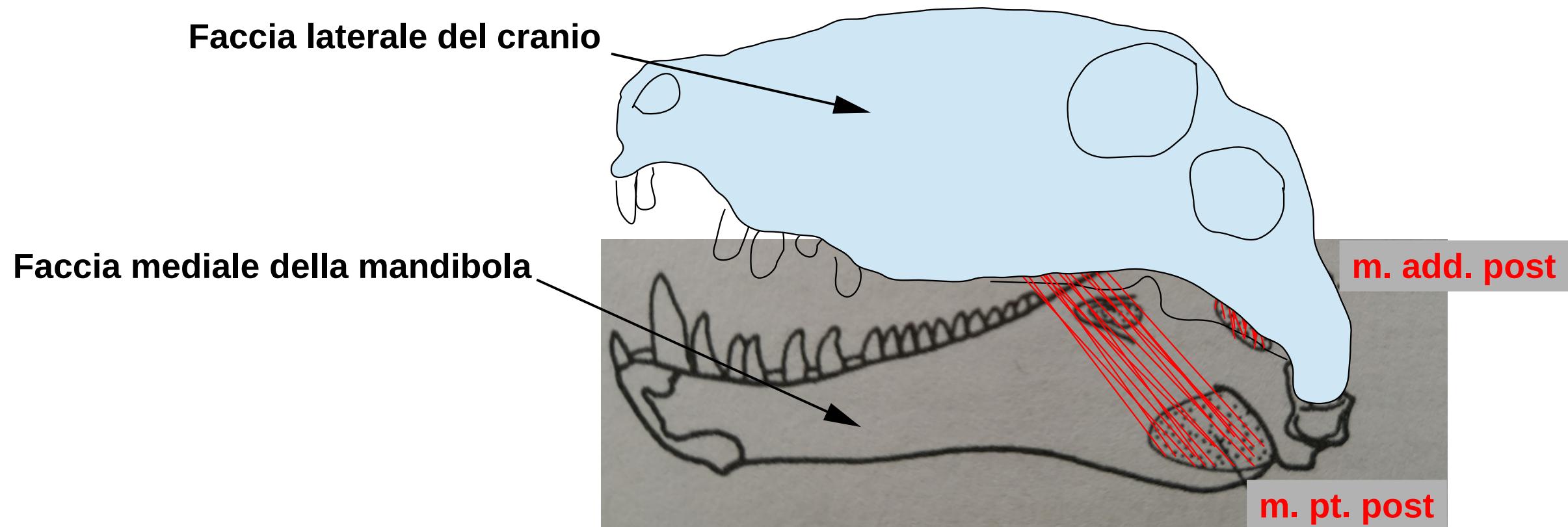
## Muscoli pterigoideo posteriore e adduttore posteriore



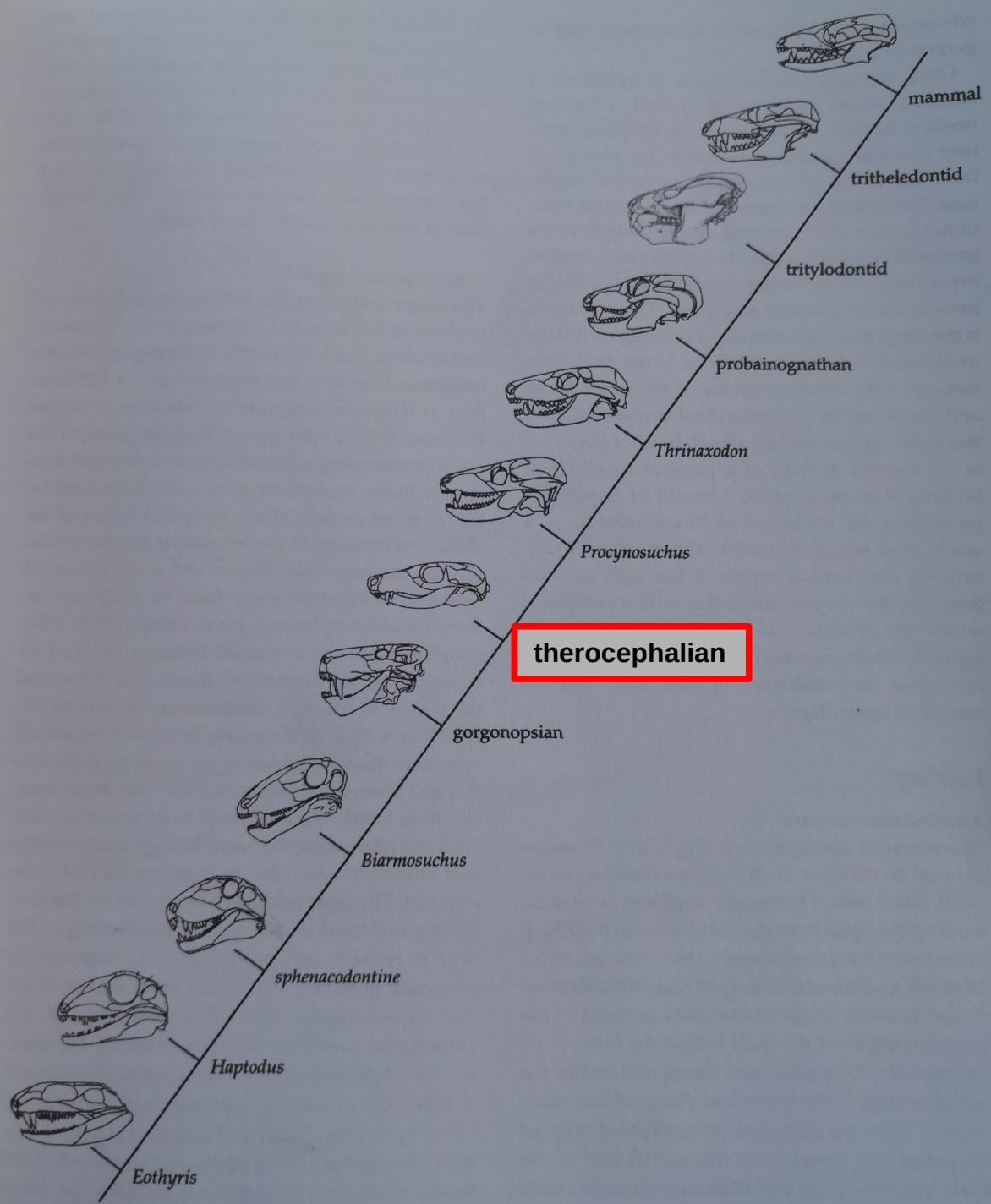
# Evoluzione dei muscoli mandibolari: **grado Sfenacodontidi**

Es. *Dimetrodon*

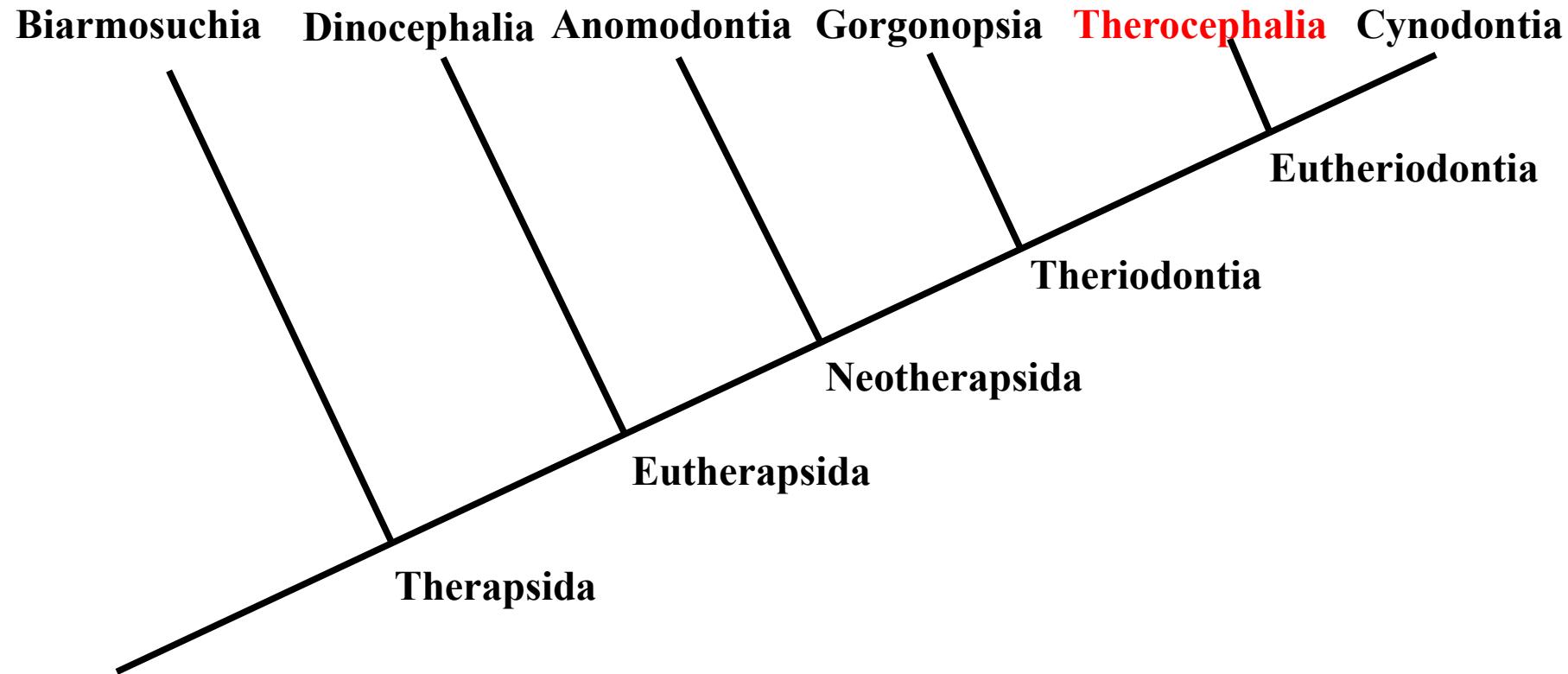
## Muscoli pterigoideo posteriore e adduttore posteriore



# Il cladogramma dei Sinapsidi



# Il cladogramma dei Terapsidi



< PALEONTOLOGY AND EVOLUTIONARY SCIENCE

# A new therocephalian (*Gorynychus masyutinae* gen. et sp. nov.) from the Permian Kotelnich locality, Kirov Region, Russia

Christian F. Kammerer<sup>✉</sup><sup>1</sup>, Vladimir Masyutin<sup>2</sup>

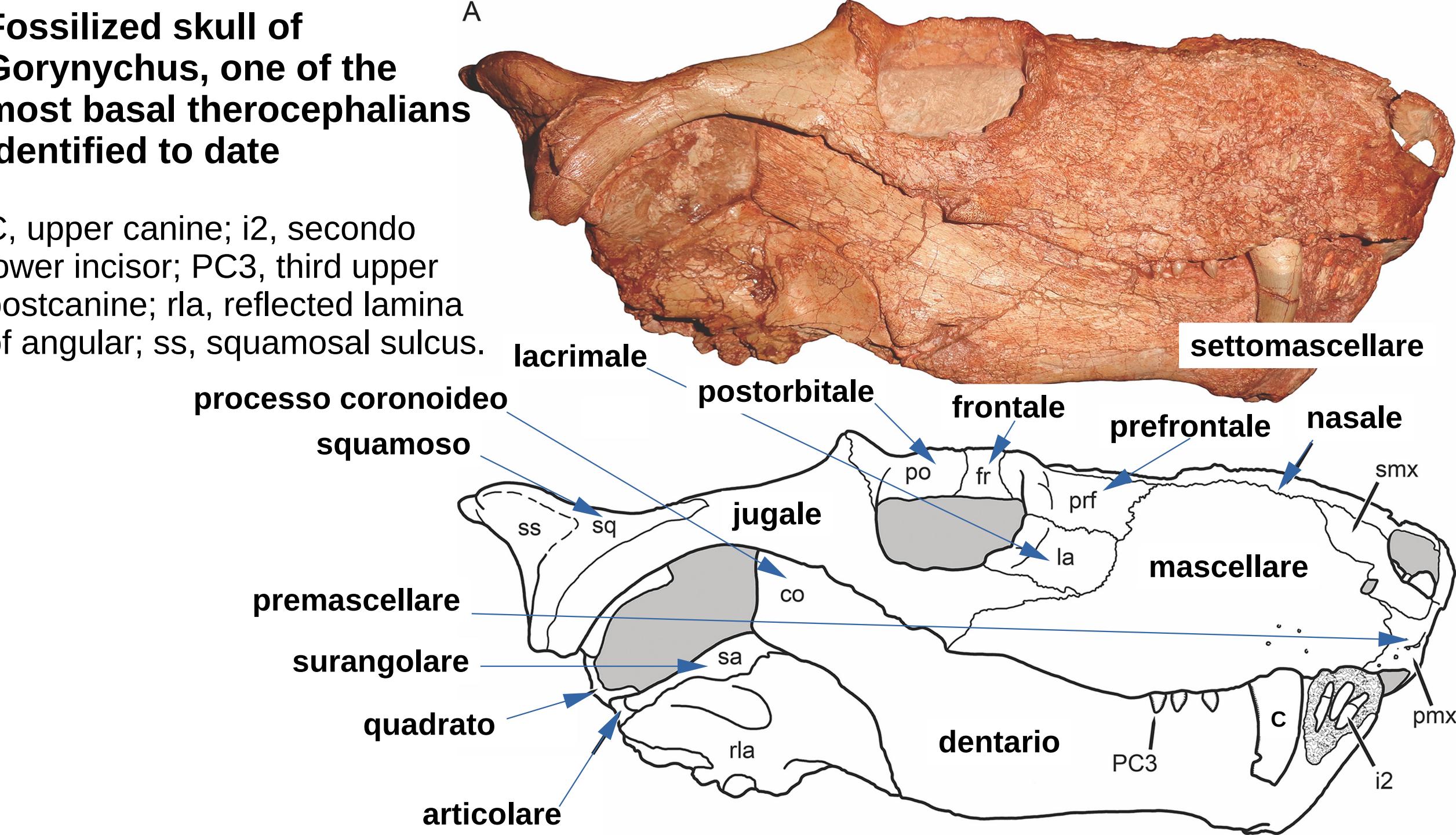
Published June 8, 2018



Read the peer review reports

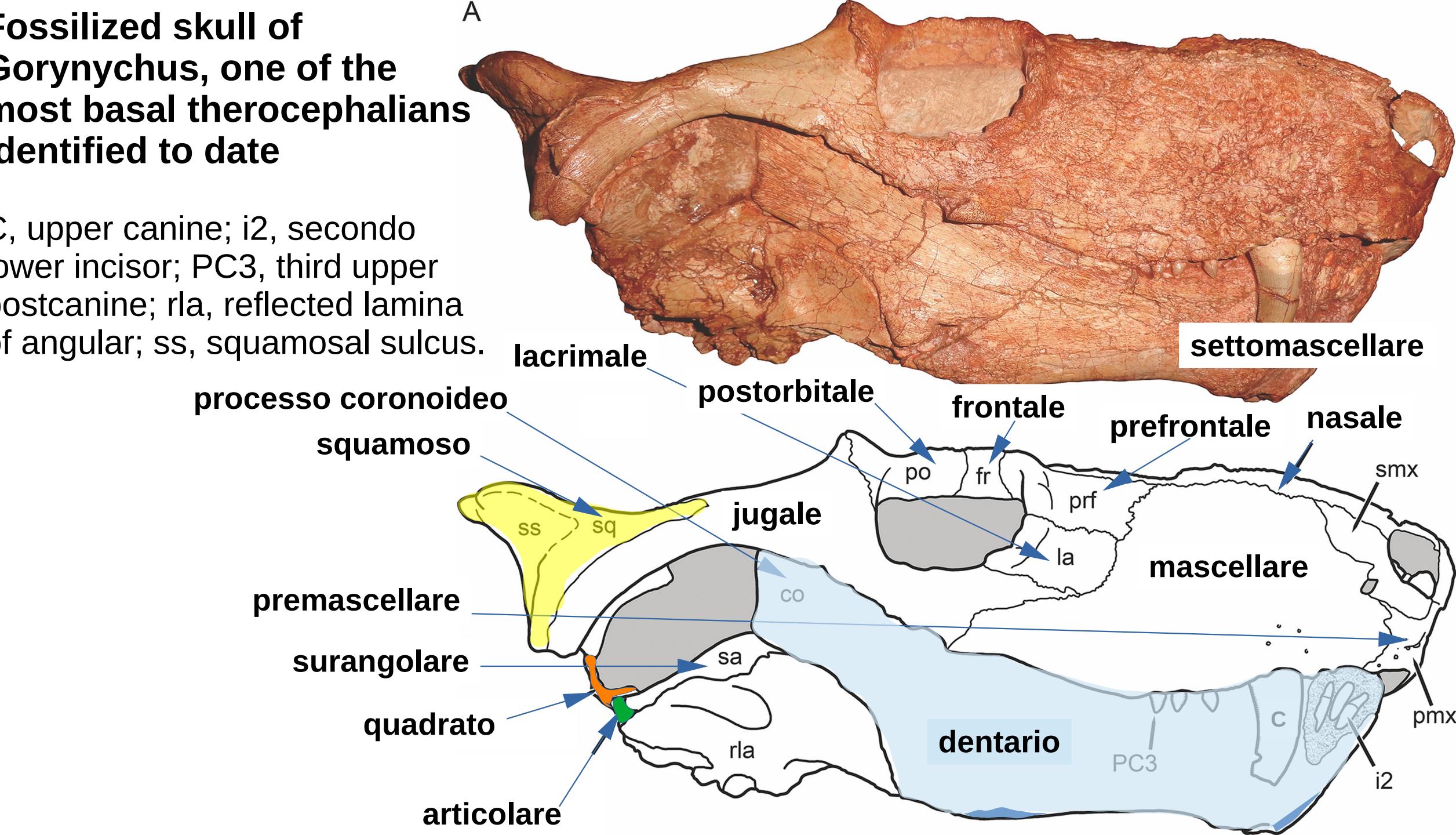
# Fossilized skull of *Gorynychus*, one of the most basal therocephalians identified to date

C, upper canine; i2, secondo lower incisor; PC3, third upper postcanine; rla, reflected lamina of angular; ss, squamosal sulcus.



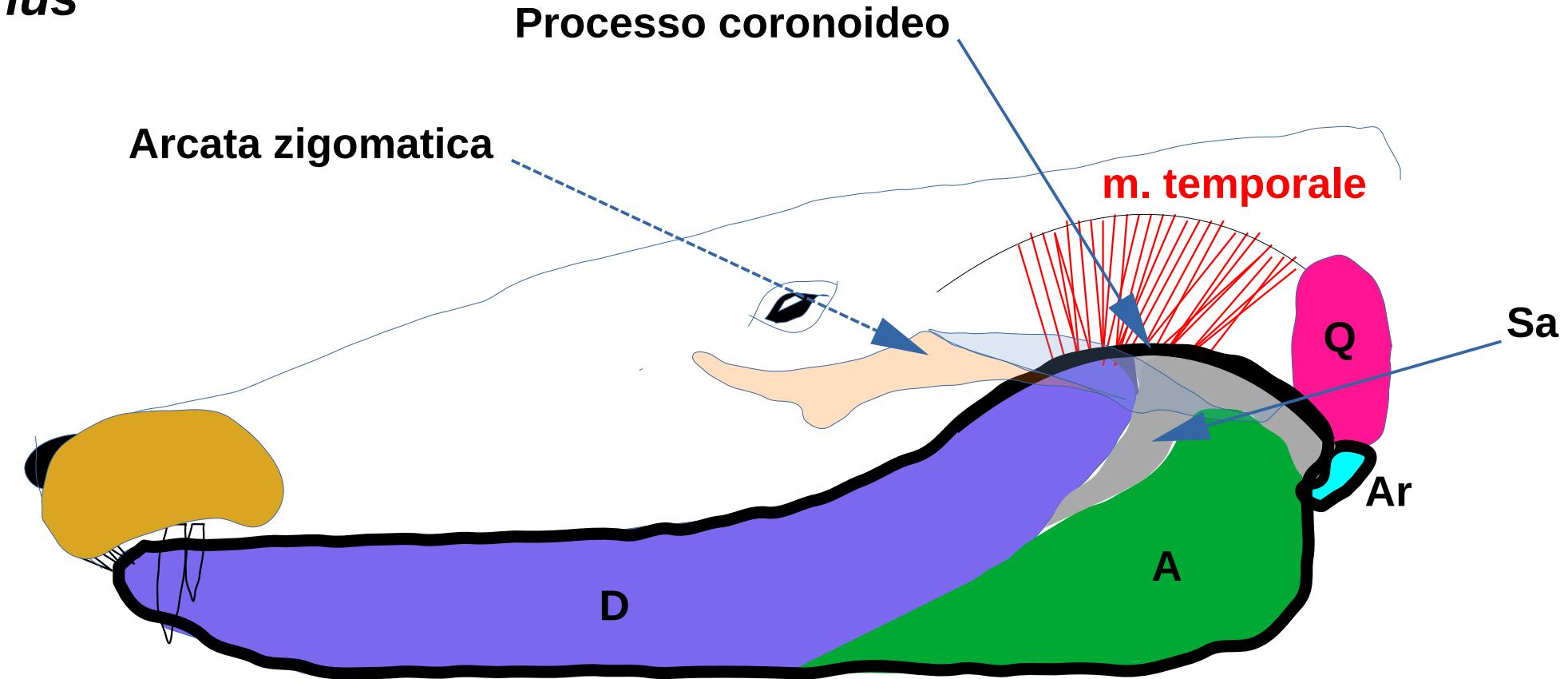
# Fossilized skull of *Gorynychus*, one of the most basal therocephalians identified to date

C, upper canine; i2, secondo lower incisor; PC3, third upper postcanine; rla, reflected lamina of angular; ss, squamosal sulcus.



# Evoluzione dei muscoli mandibolari: **grado Terocefali**

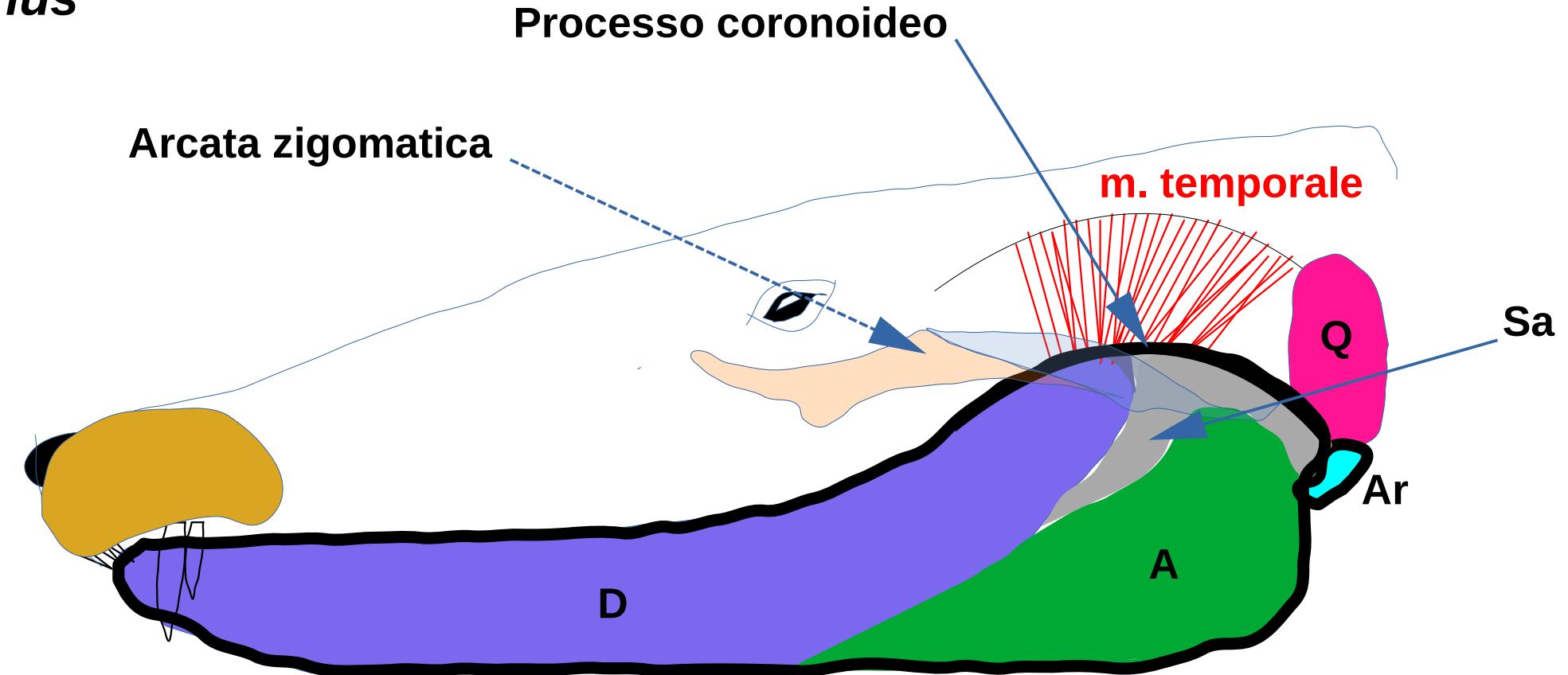
Es. *Theriognathus*



- Finestra temporale più ampia
- il m. adduttore diventa il m. temporale, caratterizzato da una forte componente mediale
- il processo coronoideo offre una più estesa area di inserzione al m. temporale

# Evoluzione dei muscoli mandibolari: **grado Terocefali**

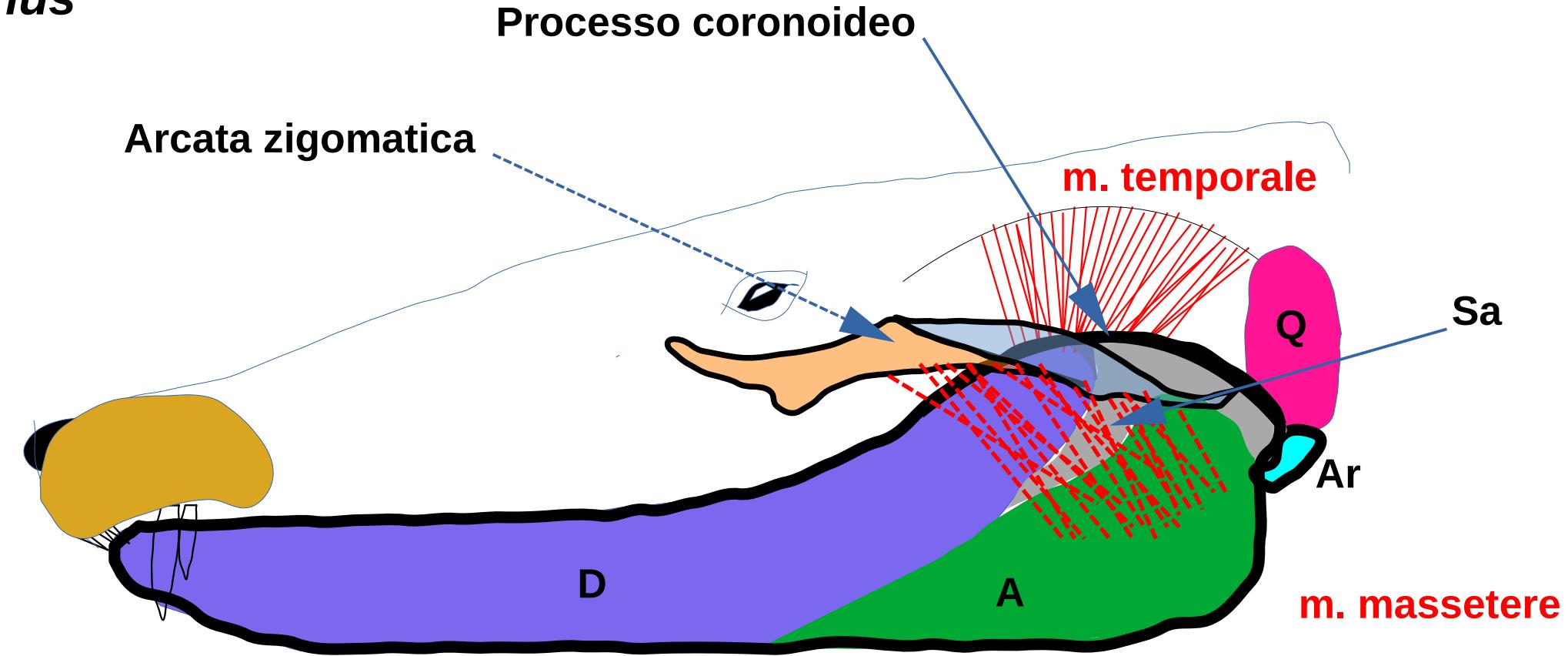
Es. *Theriognathus*



- A coronoid process of the dentary had evolved, as a postero-dorsal extension of the dentary bone above the level of the rest of the jaw, and this increases the attachment area of the newly enlarged temporalis muscle

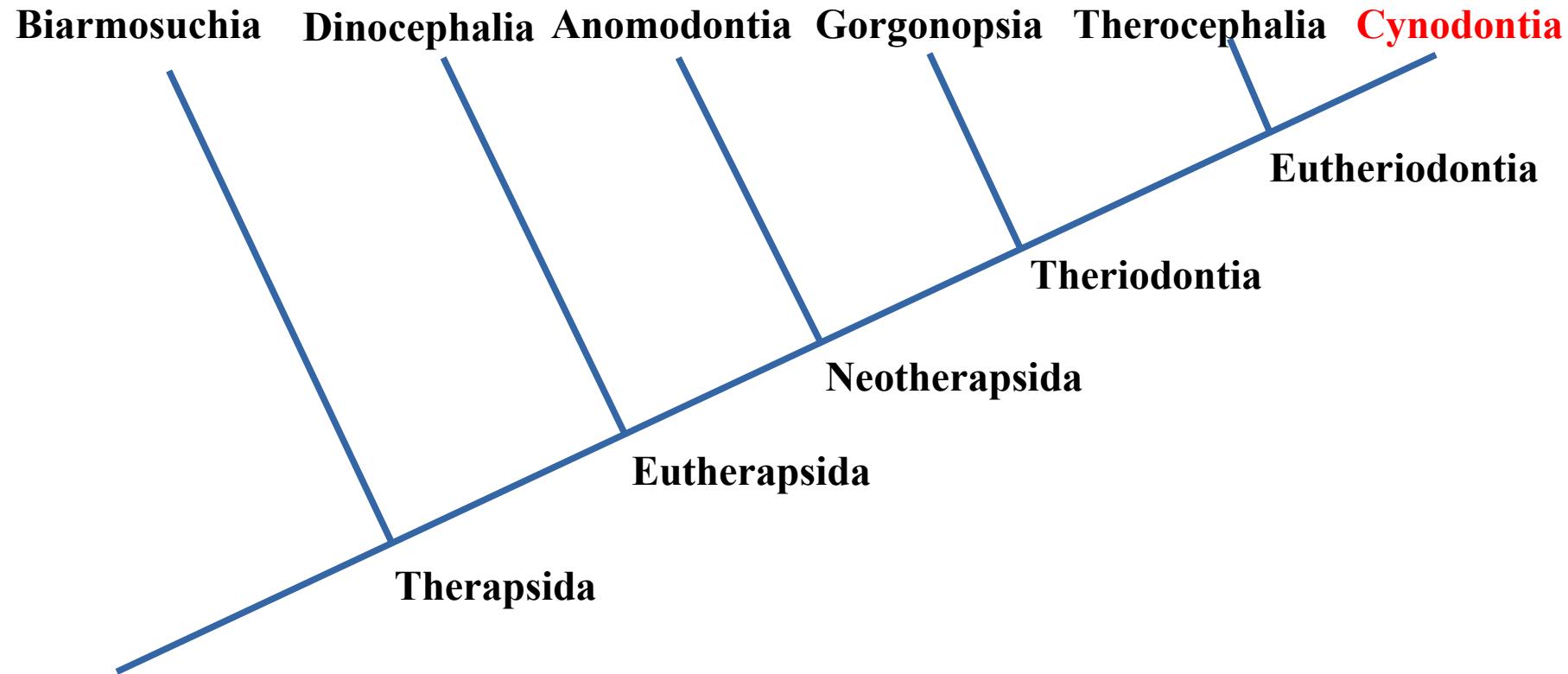
# Evoluzione dei muscoli mandibolari: **grado Terocefali**

Es. *Theriognathus*

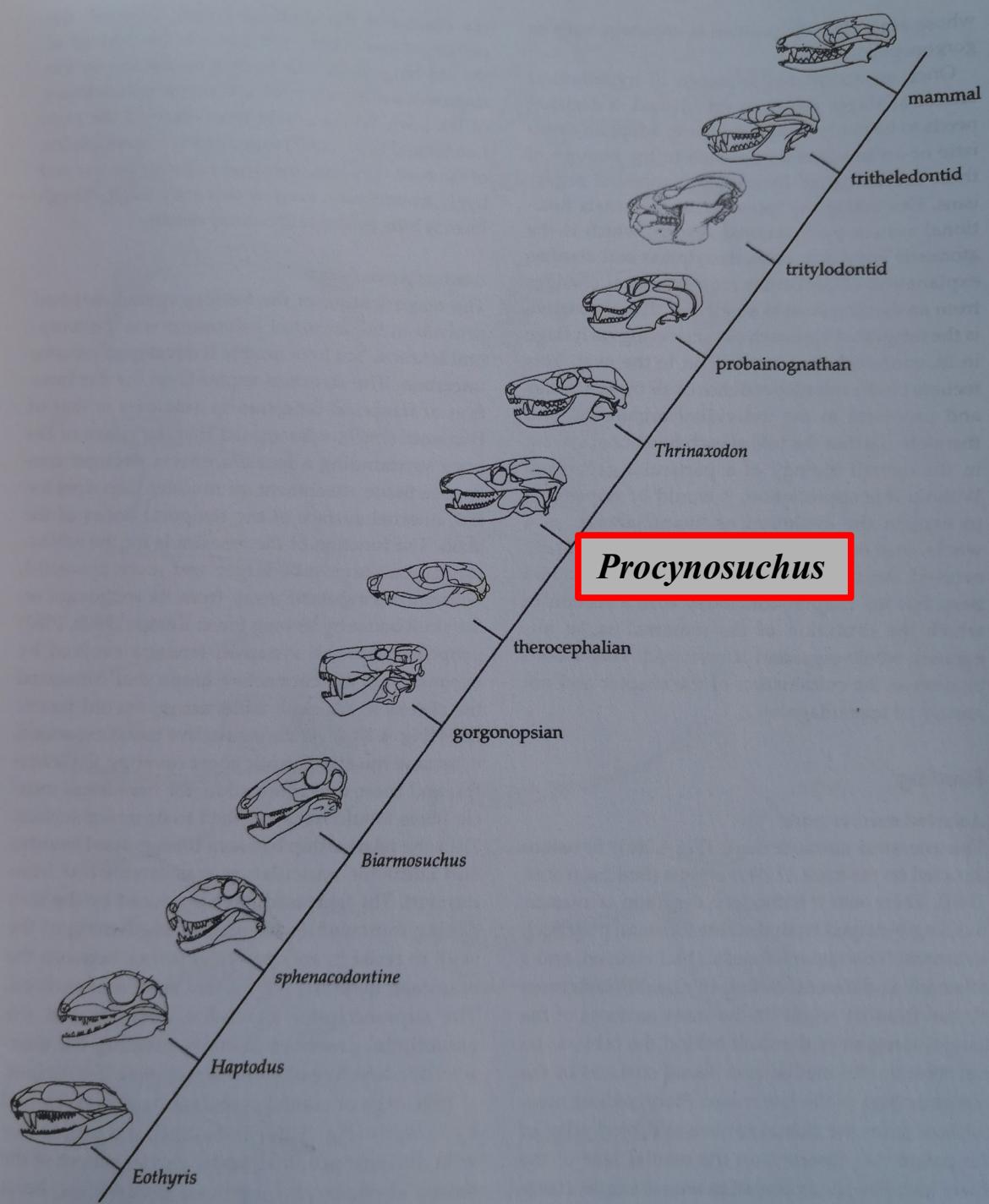


- The masseter muscle is the lateral component of the adductor mandibuli found in later evolutionary stages, where it takes its origin from an expanded zygomatic arch bounding the temporal fenestra laterally
- Its fibers began to invade a **small area of the lateral face of the jaw**

# Il cladogramma dei Terapsidi



# Il cladogramma dei Sinapsidi

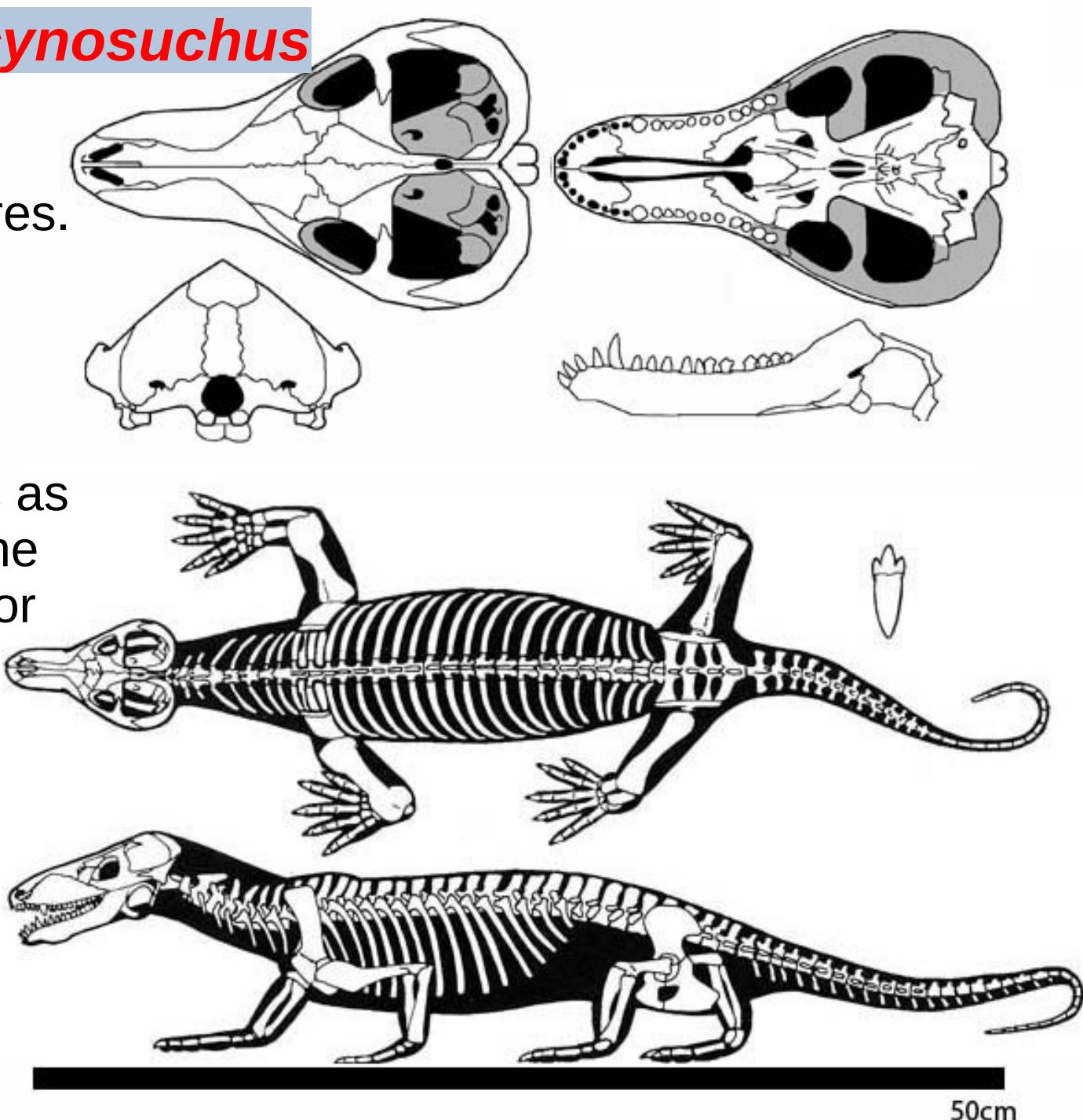


# Evoluzione dei denti: grado *Procynosuchus*

The procynosuchian grade was a significant advance in a number of features.

The dentition achieved the mammalian pattern of **heterodonty**:

- Simple incisors are followed by canines as in earlier stages; however the postcanine dentition has become the main region for food manipulation, with around a dozen teeth, divided into a series of simpler premolariform teeth with little more than a swelling around the base of the main cusp, and a series of more complex molariform teeth behind.



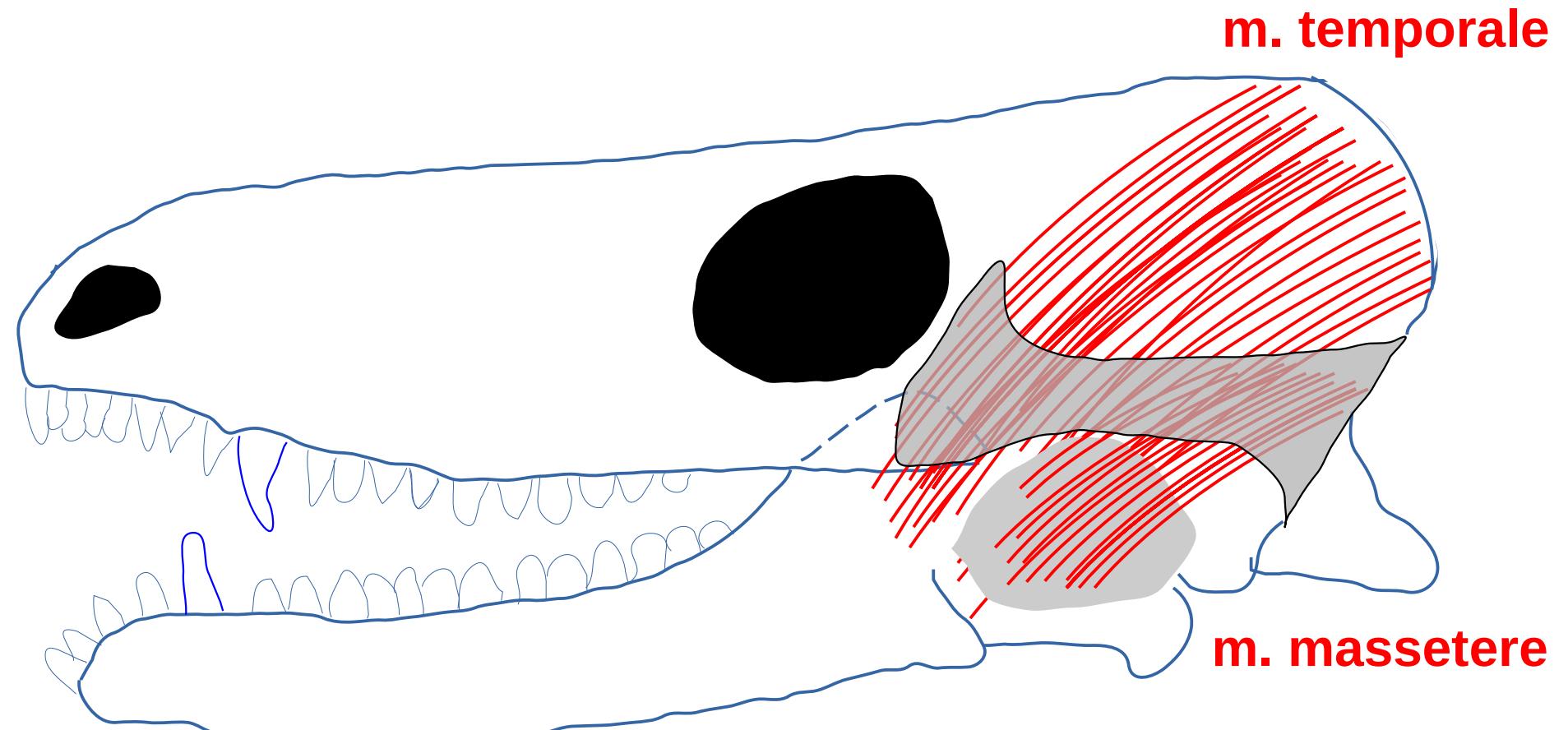
## Evoluzione dei denti: **grado *Procynosuchus***

- In the latter there is a **large main cusp** and a lingual cingulum (serie) of small but distinct **accessory cusps** around the base; for the first time, incipiently multicusped teeth had evolved, teeth that ultimately were to evolve into the array of highly elaborate, precisely occluding teeth that characterise the mammalian radiation
- At this stage, there was no direct, precise occlusion between upper and lower postcanines, although the nature of the wear facets indicates that there was general, abrading contact
- The function of the incisors and canines was to seize and ingest insects and other small prey
- The postcanines, particularly the molariforms, masticated the food prior to swallowing
- The effect of the accessory cuspules of the molariform teeth would have been particularly important when dealing with tough insect cuticle

## Evoluzione dei denti: **grado *Procynosuchus***

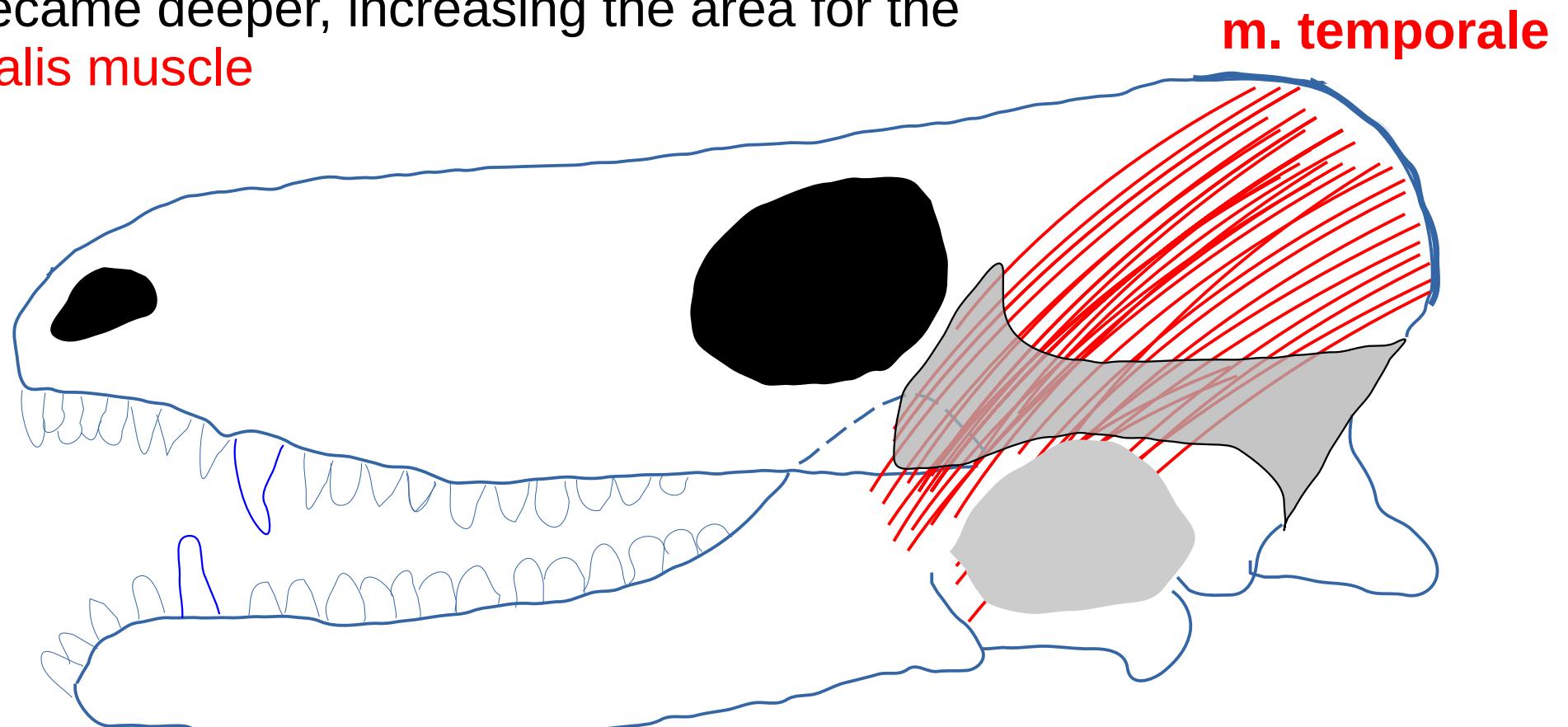
- As opposing teeth entered the prey, the relative movement between opposing teeth would cause tearing of the stiff cuticle
- Use of dentition in this way requires a larger bite force than does crude disablement with the anterior teeth, and it was provided by further increase in the size and effectiveness of the adductor musculature

# Evoluzione dei denti: grado *Procynosuchus*



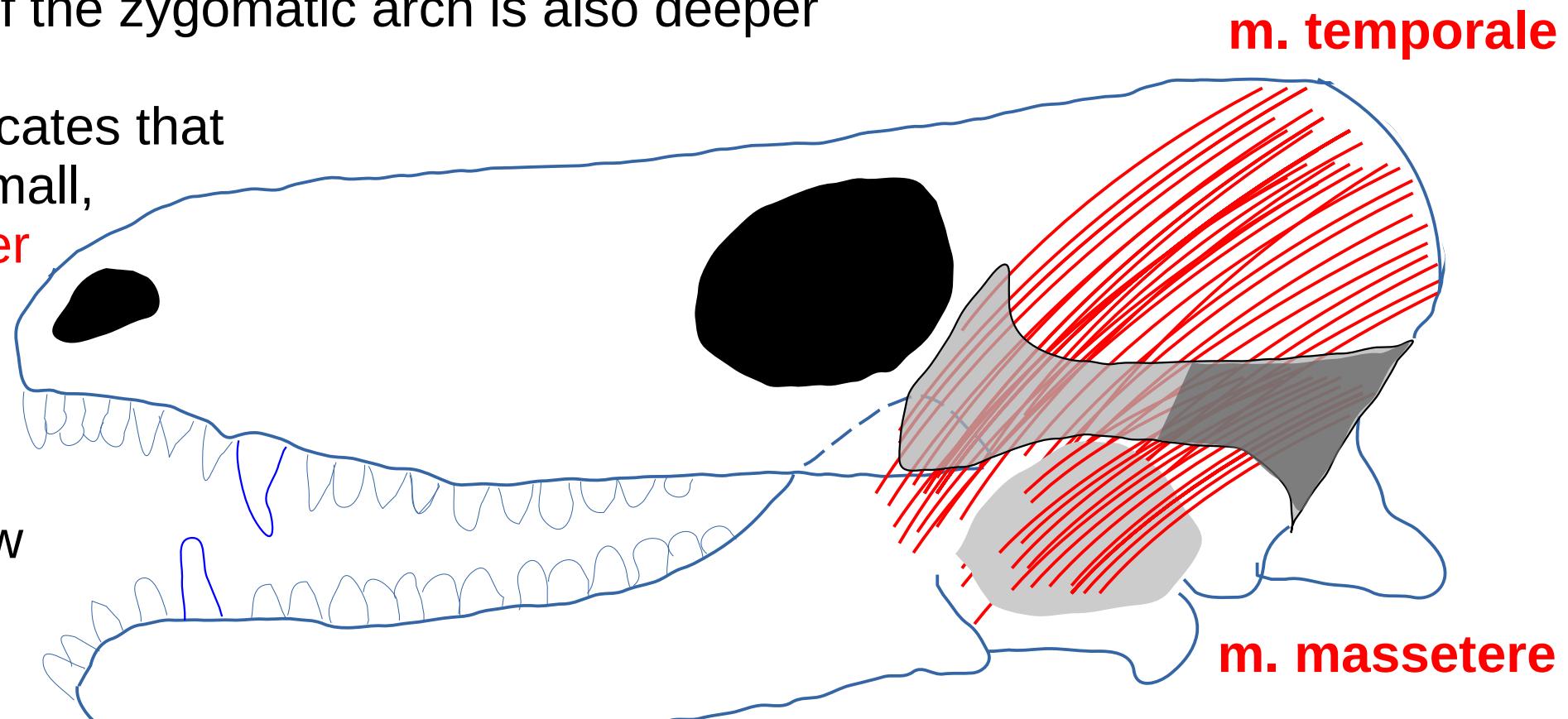
# Evoluzione dei denti: *grado Procynosuchus*

- The sagittal crest became deeper, increasing the area for the origin of the **temporalis** muscle



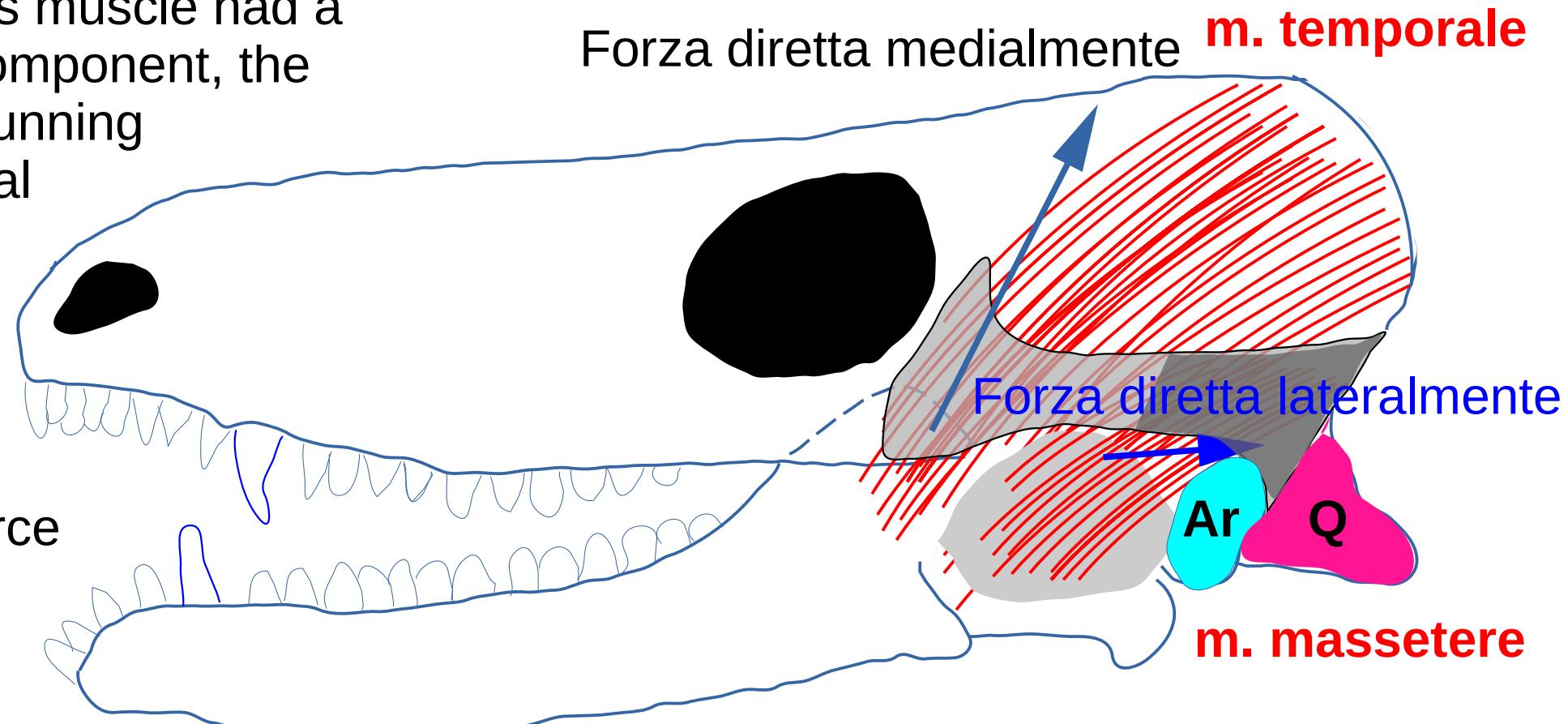
# Evoluzione dei denti: grado *Procynosuchus*

- The posterior part of the zygomatic arch is also deeper
- Its internal face indicates that it gave origin to a small, but definite **masseter muscle**, that invaded a wider area of the lateral surface of the lower jaw, where a shallow concavity is to be found (light grey)



# Evoluzione dei denti: grado *Procynosuchus*

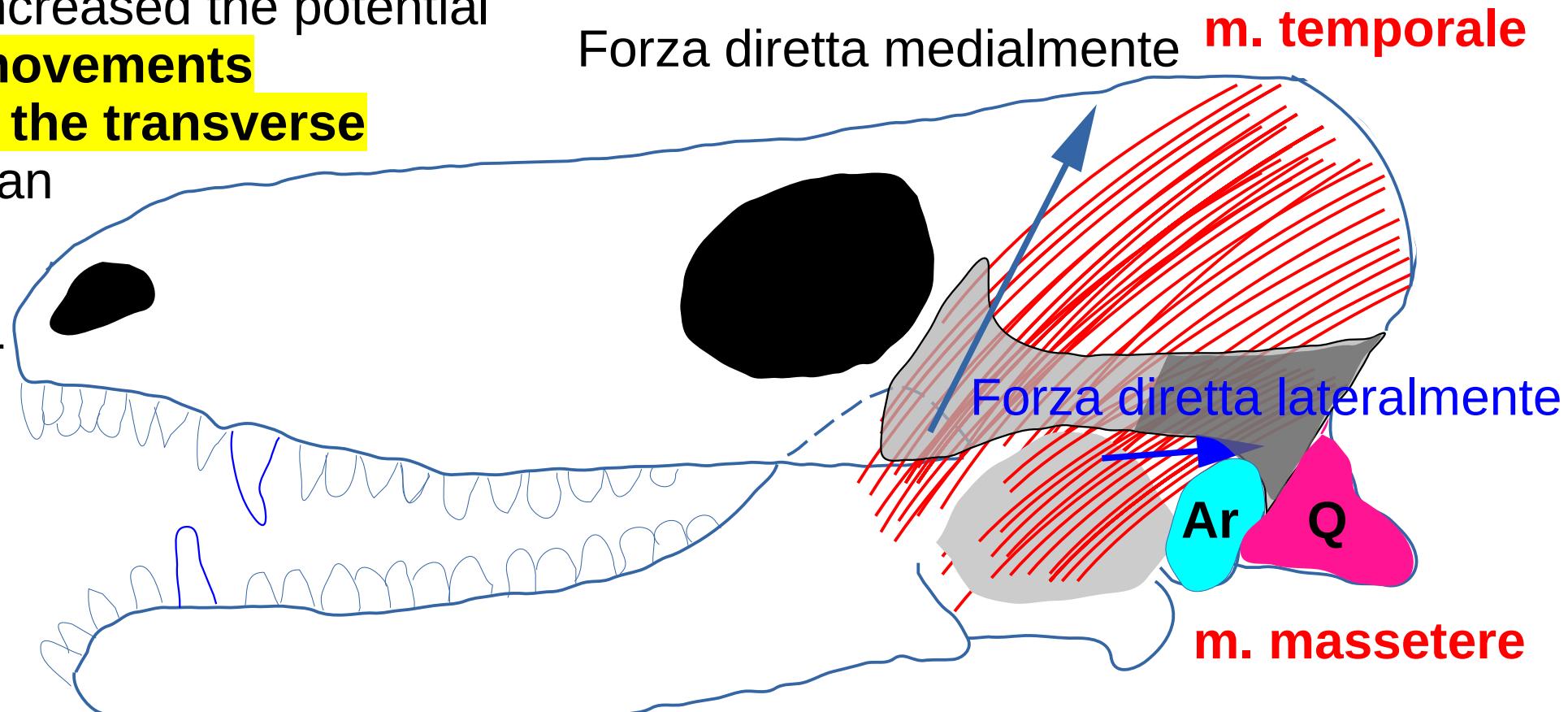
- While the temporalis muscle had a medially directed component, the masseter muscle, running between the external face of the jaw and the more laterally placed zygomatic arch, had a laterally directed component of its force



- To some degree at least, these medial and lateral components acting on the jaw would have cancelled each other out, reducing the stress between the articular and quadrate bones of the jaw hinge

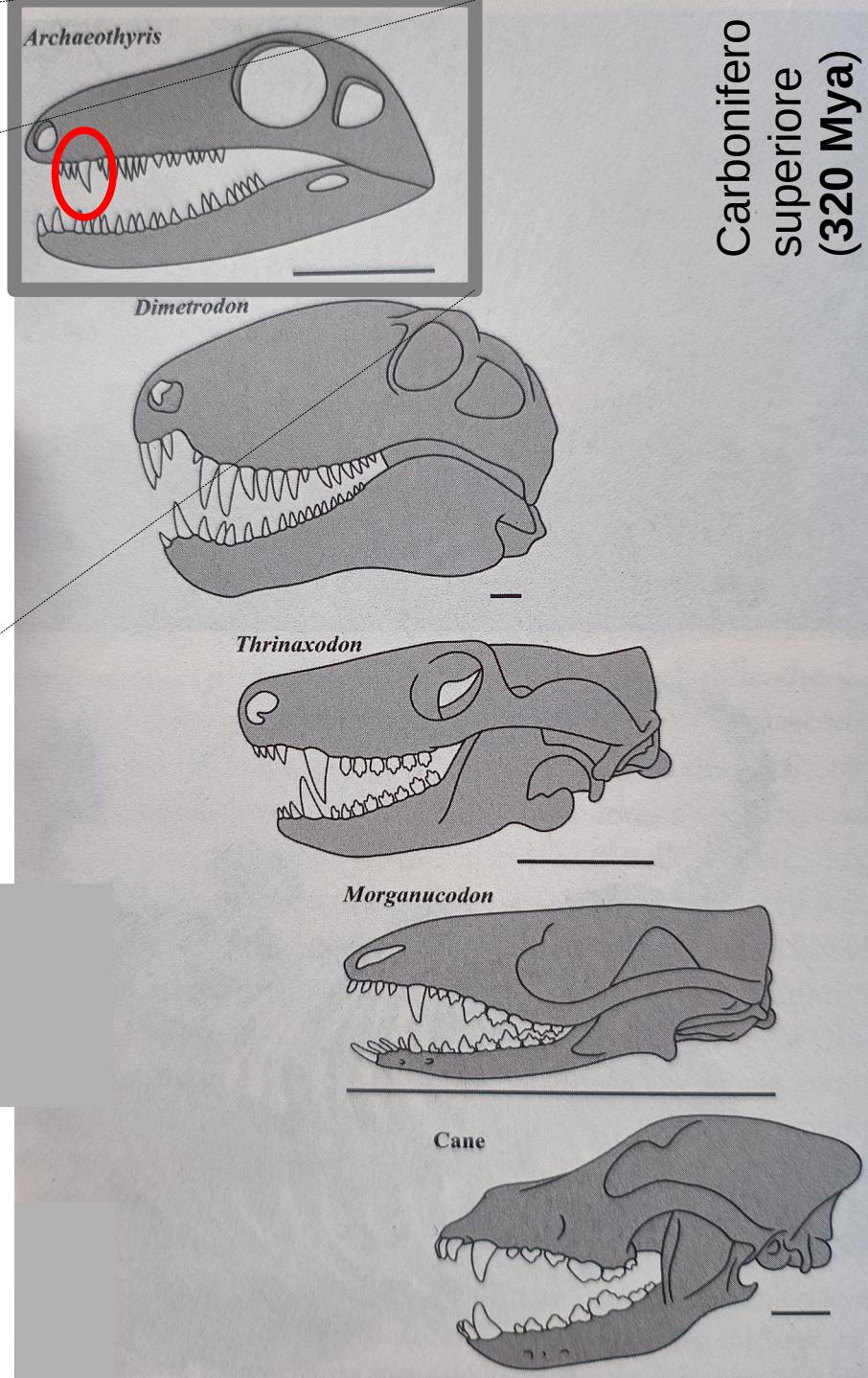
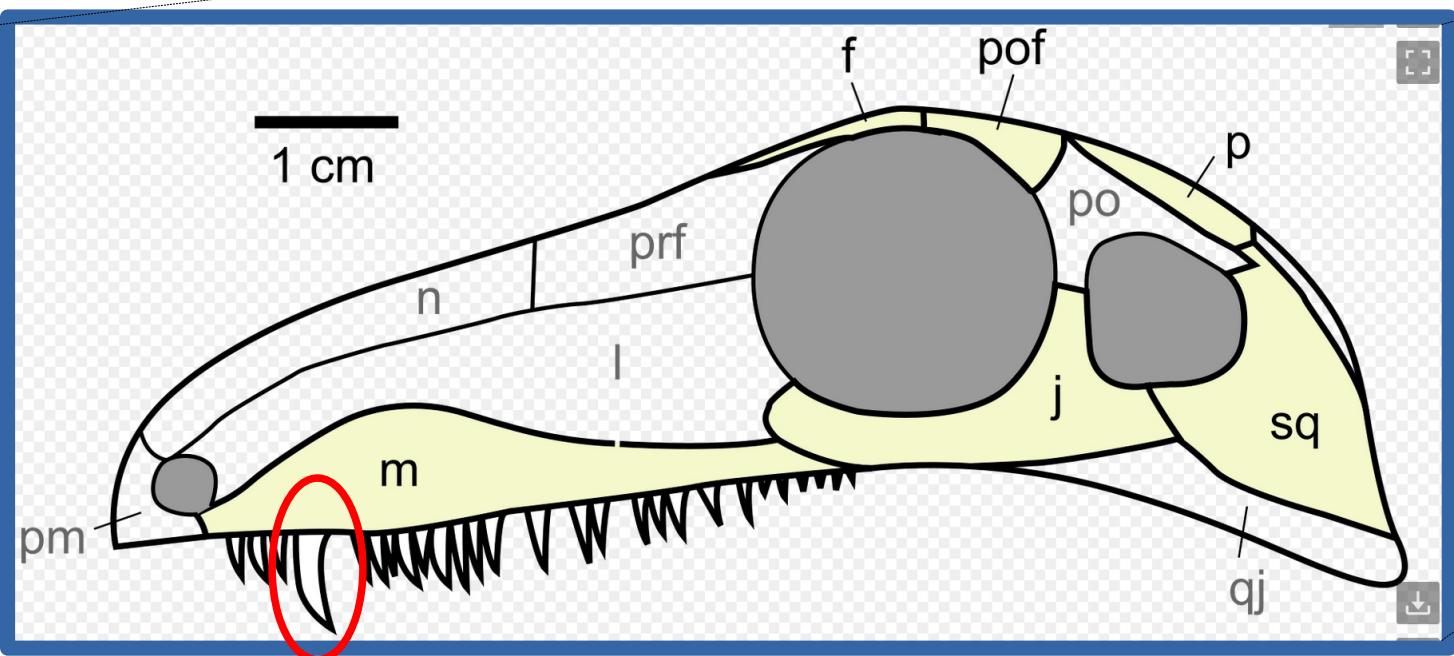
# Evoluzione dei denti: grado *Procynosuchus*

- This arrangement increased the potential ability to control movements of the lower jaw in the transverse direction, allowing an accurate placing of the lower teeth relative to the upper ones during mastication



- This is an essential requirement of musculature for operating large, complex, occluding teeth: a combination of a large bite force with fine precision of movement of the lower jaw in the horizontal plane

# L'evoluzione dei denti: l'*Archaeothyris*

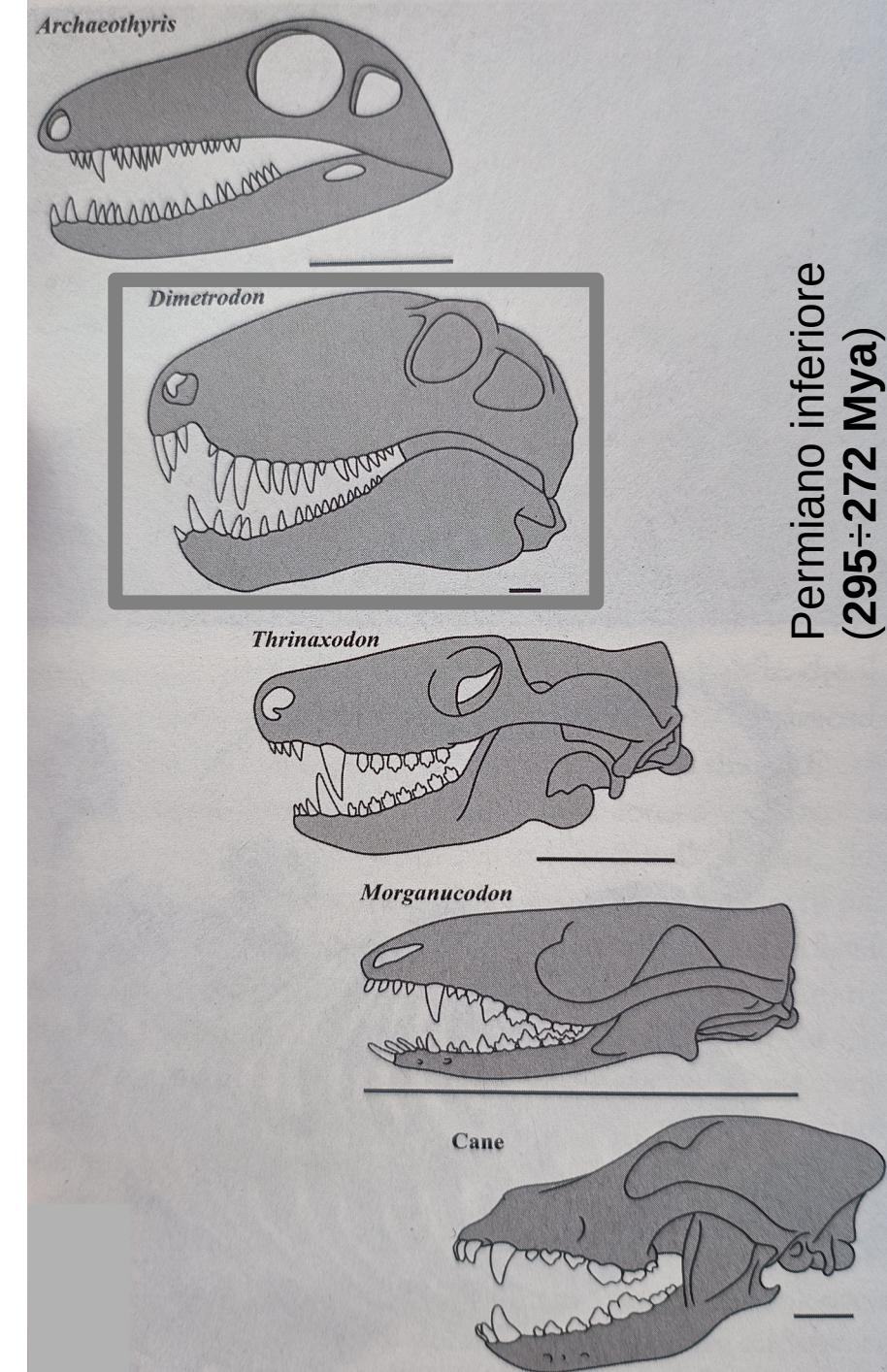


A differenza dei Rettili, la cui dentatura è uniforme sull'intera arcata, l'*Archaeothyris* aveva un canino superiore molto sviluppato

Carbonifero  
Superiore  
(320 Mya)

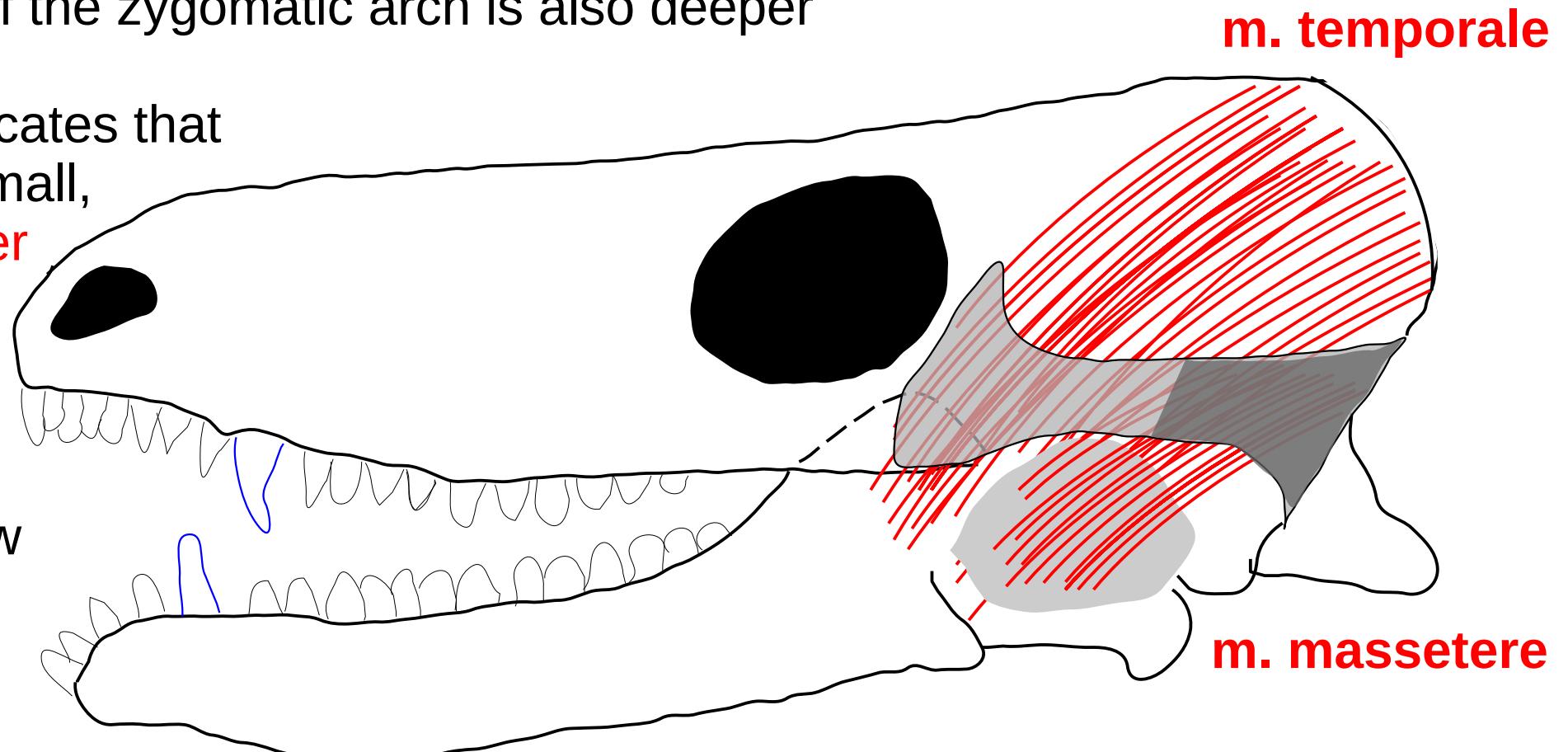
# L'evoluzione dei denti: il *Dimetrodon*

- Il *Dimetrodon* aveva incisivi grandi e arrotondati, seguiti da un grosso canino e da una serie di post-canini laterali più piccoli, curvi e affilati
- Era il superpredatore in un ecosistema di foreste planiziali punteggiate di stagni e attraversate da fiumi



# Evoluzione dei denti: grado *Procynosuchus*

- The posterior part of the zygomatic arch is also deeper



- Its internal face indicates that it gave origin to a small, but definite **masseter muscle**, that invaded a wider area of the lateral surface of the lower jaw, where a shallow concavity is to be found (light grey)

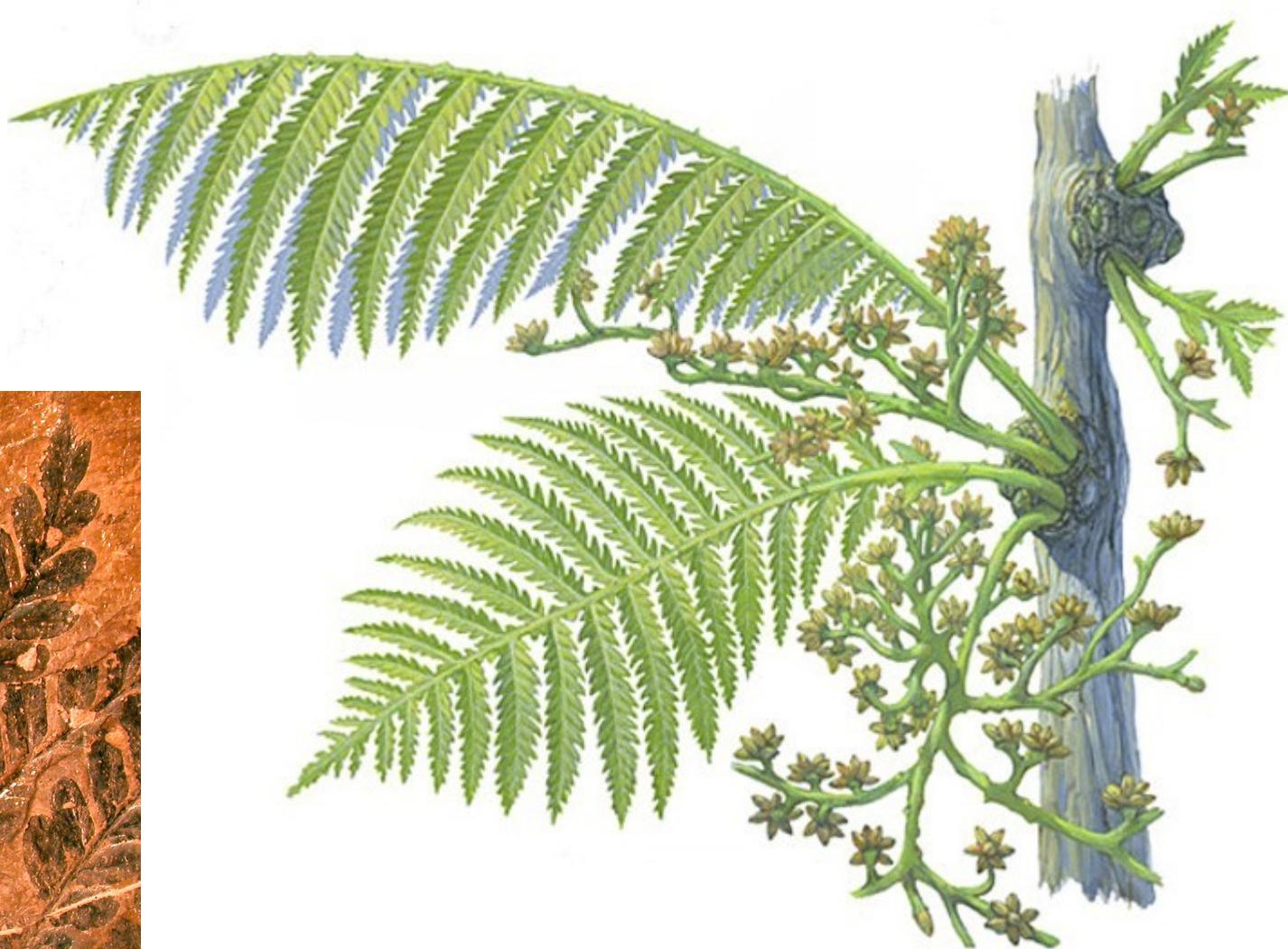
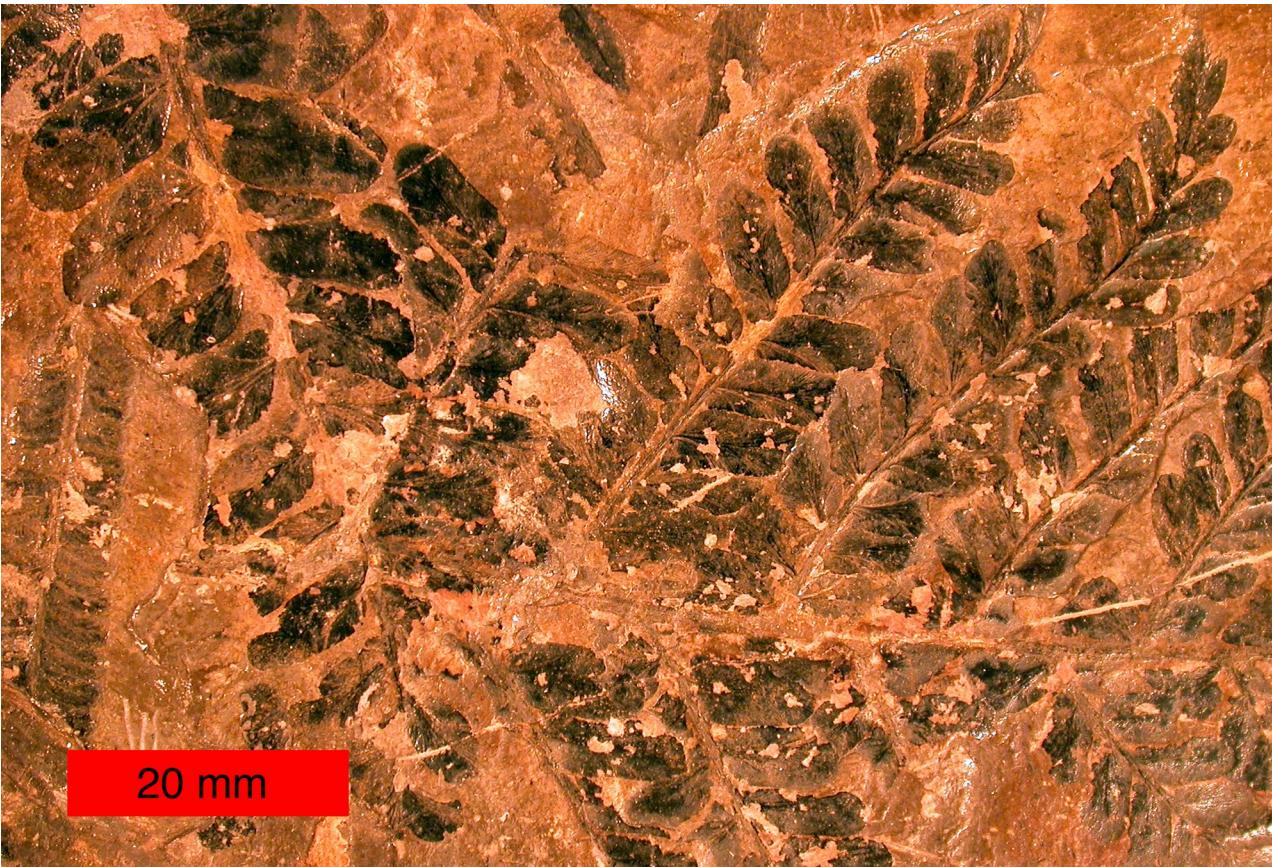
- Permiano superiore (250 Mya)

# Evoluzione dei denti: grado *Procynosuchus*



# Flora e fauna del Permiano superiore (prima della catastrofe)

- Foreste di pteridospermatofite



# Flora e fauna del Permiano superiore (prima della catastrofe)

- Gorgonopsi



# Flora e fauna del Permiano superiore (prima della catastrofe)

- Gorgonopsi

*Sauroctonus parringtoni*



# Flora e fauna del Permiano superiore (prima della catastrofe)

- Gorgonopsi



# Flora e fauna del Permiano superiore (prima della catastrofe)

- **Gorgonopsi**

Gorgonopsia is an extinct clade of sabre-toothed therapsids from the Middle to the Upper Permian, roughly between 270 and 252 million years ago. They are characterised by a **long and narrow skull**, as well as **elongated upper and sometimes lower canine teeth and incisors** which were likely used as slashing (taglienti) and stabbing (che agiscono come pugnali) weapons. Postcanine teeth are generally reduced or absent. For hunting large prey, they possibly used a bite-and-retreat tactic, ambushing and taking a debilitating bite out of the target, and following it at a safe distance before its injuries exhausted it, whereupon the gorgonopsian would grapple the animal and deliver a killing bite. They would have had an exorbitant gape (bocca aperta), possibly in excess of 90°, without having to unhinge the jaw.



# Flora e fauna del Permiano

## superiore

### • Gorgonopsi

holotype of *Viatkogorgon ivakhnenkoi*, in right lateral view with (B) interpretive drawing.

Abbreviations: an, angular; **ar**, articular; C, upper canine; c, lower canine; **d**, dentary; fr, frontal; I, upper incisor; i, lower postcanine; j, jugal; la, lacrimal; mf, maxillary flange; mx, maxilla; na, nasal; pa, parietal; PC, upper postcanine; pc, lower postcanine; pf, pineal foramen; pmx, premaxilla; po, postorbital; pof, postfrontal; pp, prefrontal; prf, prefrontal; q, quadrate; rla, reflected lamina of angular; sa, surangular; sc, sclerotic ring; sf, squamosal flange; smx, septomaxilla; **sq**, squamosal; ss, squamosal sulcus. Gray indicates matrix, hatching indicates plaster.

Scale bars equal 1 cm.

