

Is the Maned Rat *Lophiomyys imhausi* (Muridae, Lophiomyinae) converging toward a sea turtle jaw muscle morphology ?

Pierre-Henri Fabre, Adam Fergusson, Roberto Portela Miguez, Bernard Agwanda, Molly MacDonough, and Lionel Hautier



Fig. 1.

Huet Pinx.

Lophiomyys Imhausii, Alph. Milne-Edw.

G. Severeys, Chomolith, Brux.

Type d'une nouvelle famille de l'ordre des rongeurs

Alphonse Milne-Edwards (1867)



A specialized scent-releasing hair in the Crested rat *Lophiomy's imhausi*

D. MICHAEL STODDART. University of London King's College, Department of Zoology, Strand, London.



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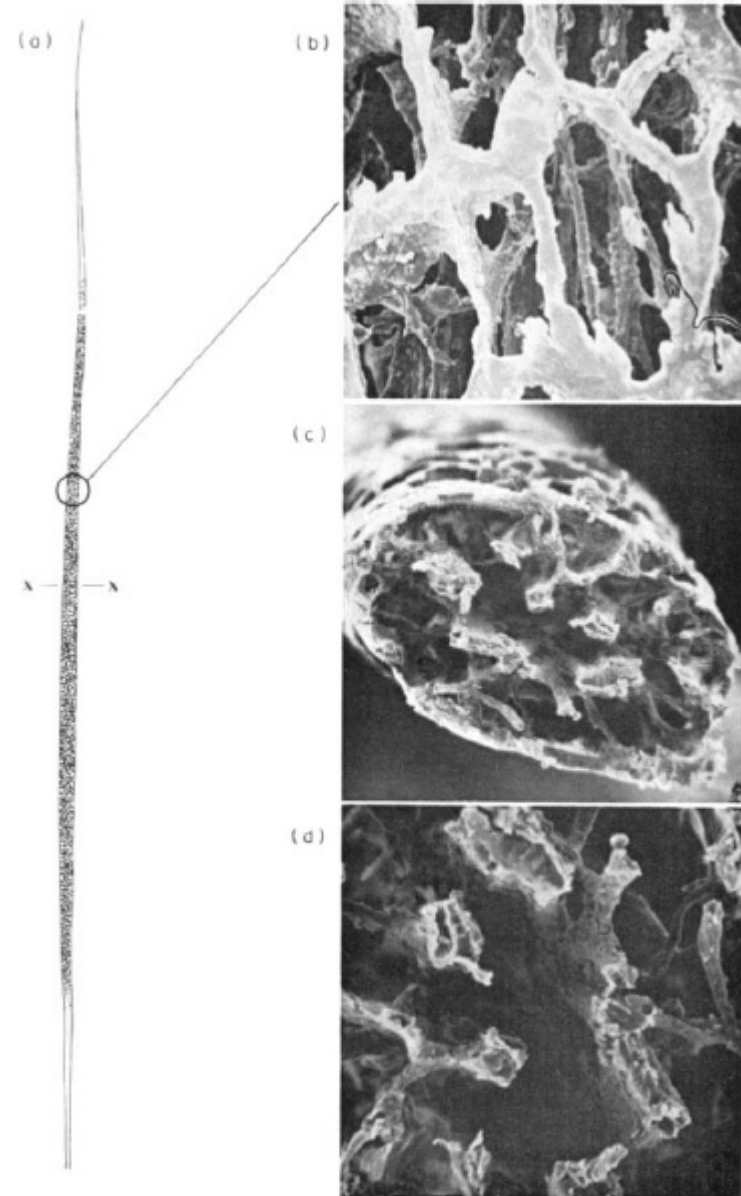


PLATE I. (a) Sketch of specialized scenting hair from the lateral gland of the crested rat *Lophiomy's imhausi* (Magnification, $\times 7.7$). (b) Scanning electron micrograph (SEM) of hair surface showing polygonal vacuities and labyrinthine medulla (Magnification $\times 425$). (c) SEM of surface of hair cut at point $\times-x$ (Magnification $\times 350$). (d) High power view of same to show complexity of medullary cavity (Magnification $\times 700$).

A specialized scent-releasing hair in the Crested rat *Lophiomy's imhausi*

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A poisonous surprise under the coat of the African crested rat

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Timothy O'Brien⁴, Christopher Holland¹, Thomas Gheysens¹,
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⁴Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, NY 10460, USA

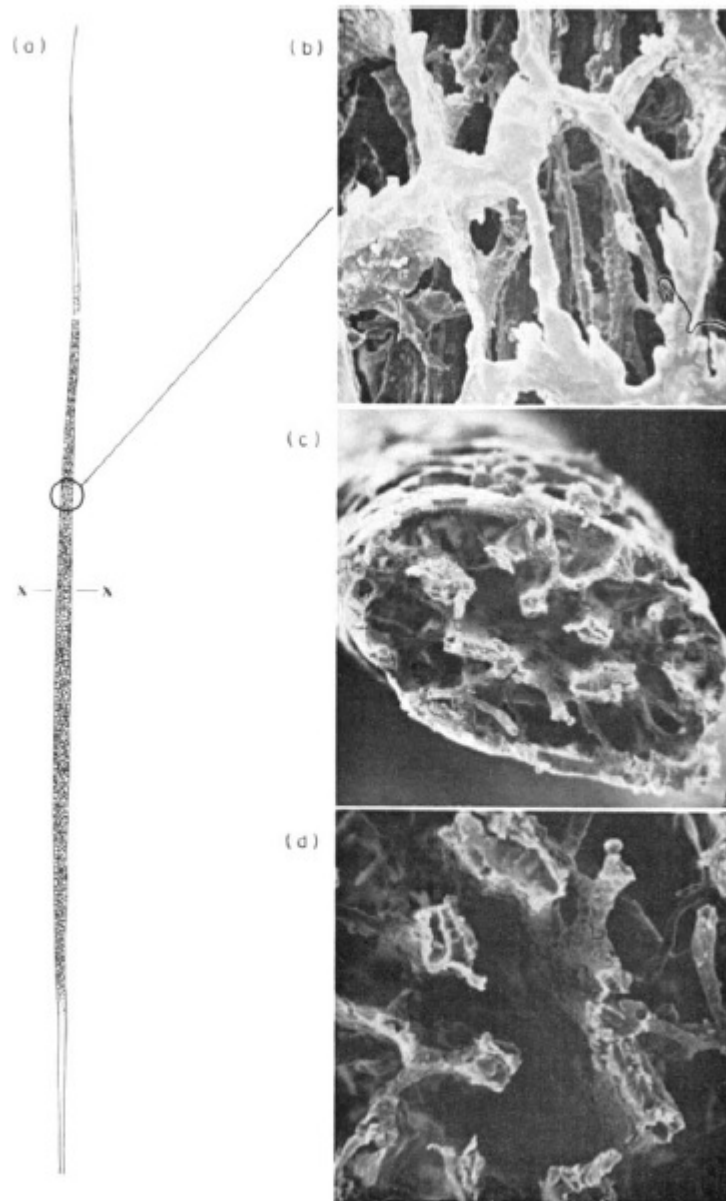


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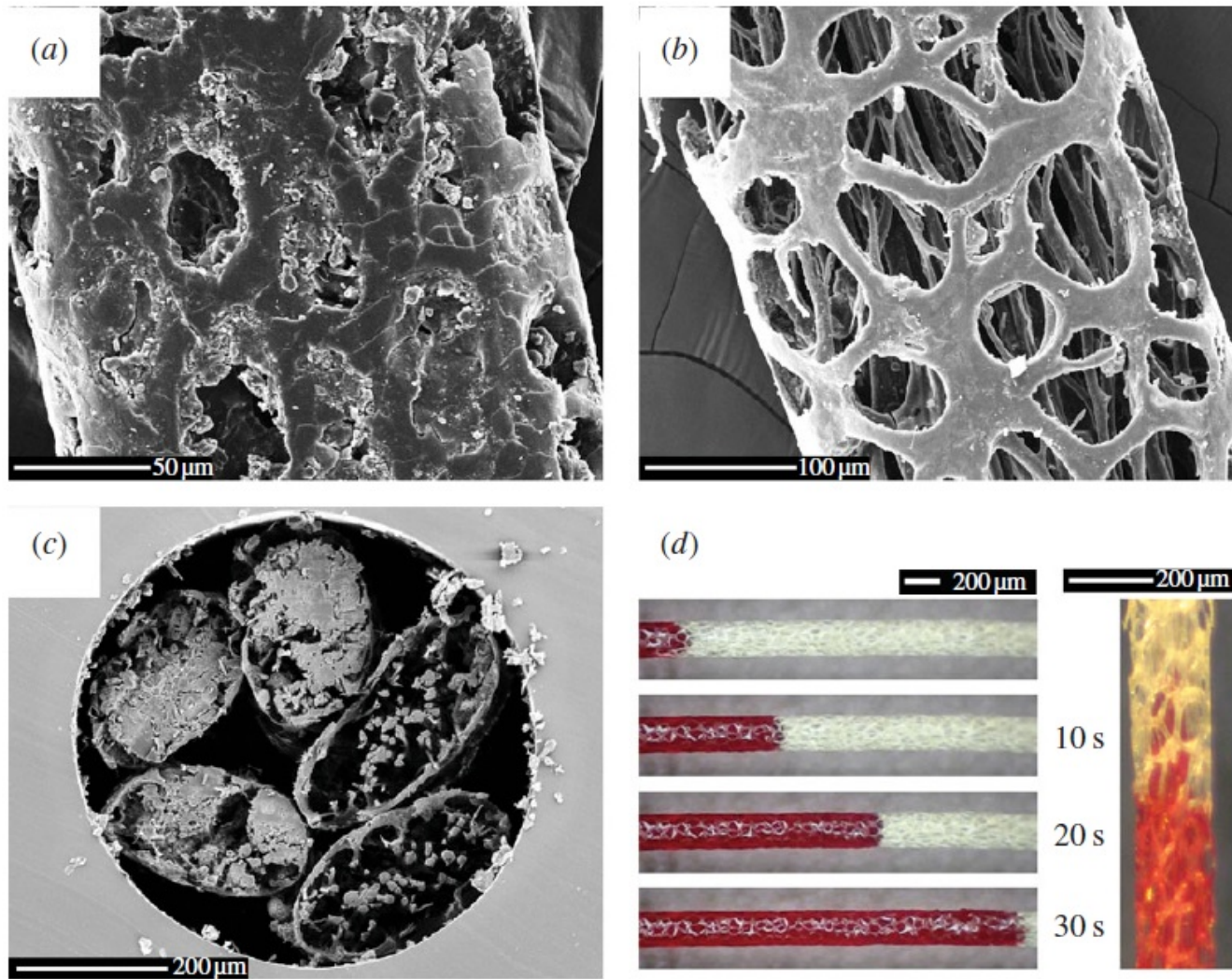


Figure 2. Microscopy images of the uniquely adapted poison-delivery hairs growing in a tract along the lateral lines of the African crested rat *Lophiomy's imhausi*. (a–c) Scanning electron microscopy images of the hair indicating (a) a section near the tip fully loaded with poison, (b) detail of the microfibrils running up the centre of a washed hair from a section near the root, and (c) cross-sections of five hairs to show internal microfibrils and how the saliva is stored. (d) Light microscopy of the ‘wicking’ effect using red ink over 30 s. See also the electronic supplementary material, video S1.



Apocynaceae:
Acokanthera schimperi (poison arrow tree)

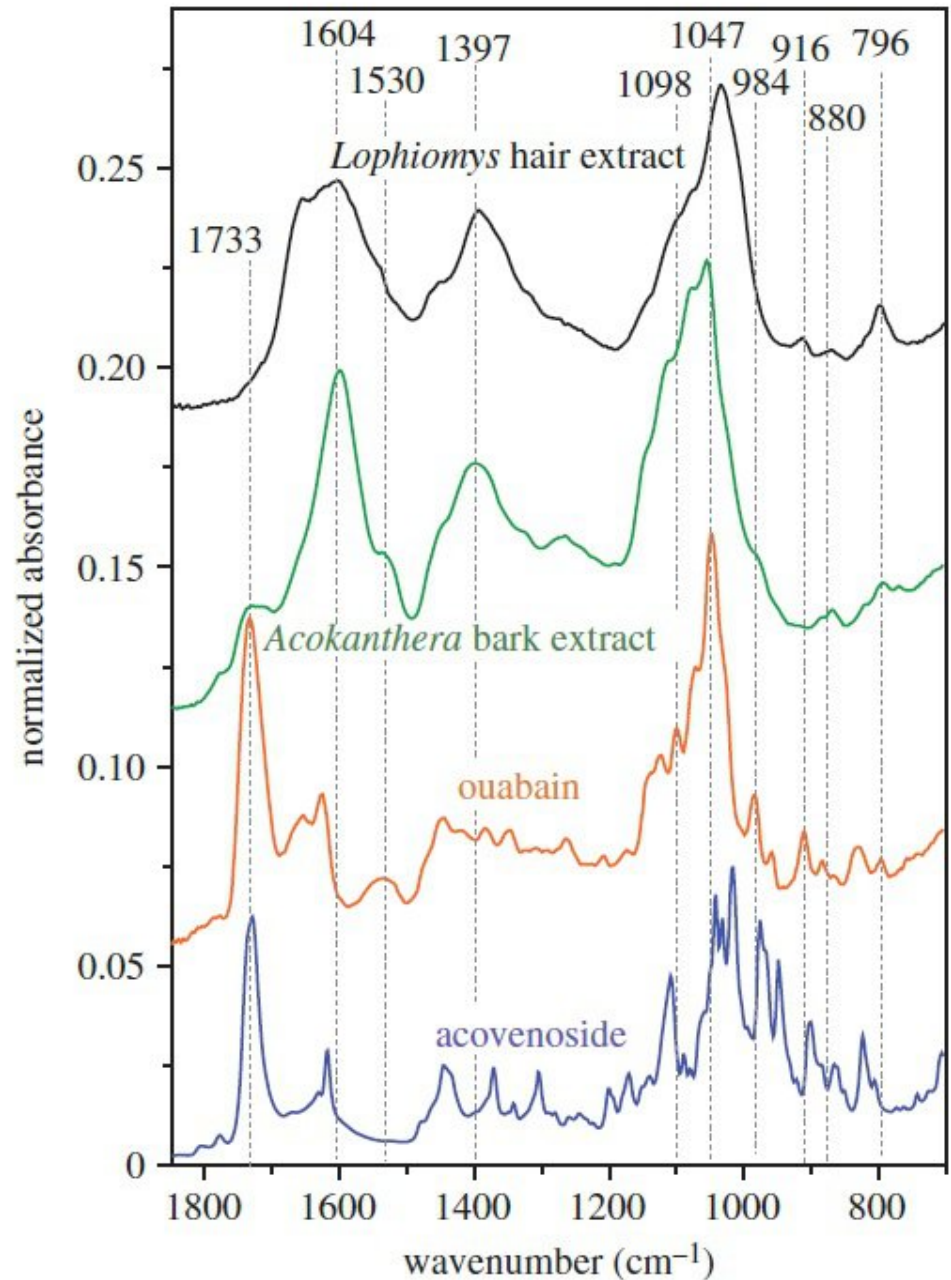


Figure 3. ATR FT-IR spectra of pure acovenoside, ouabain and extract from the *Acokanthera* bark and *Lophiomy's* hairs.

The secret social lives of African crested rats, *Lophiomys imhausi*

SARA B. WEINSTEIN,*^{1,2} KATRINA NYAWIRA MALANGA, BERNARD AGWANDA, JESÚS E. MALDONADO, AND M. DENISE DEARING

¹School of Biological Sciences, University of Utah, 257 South 1400 East, Salt Lake City, UT 84112, USA (SBW, MDD)

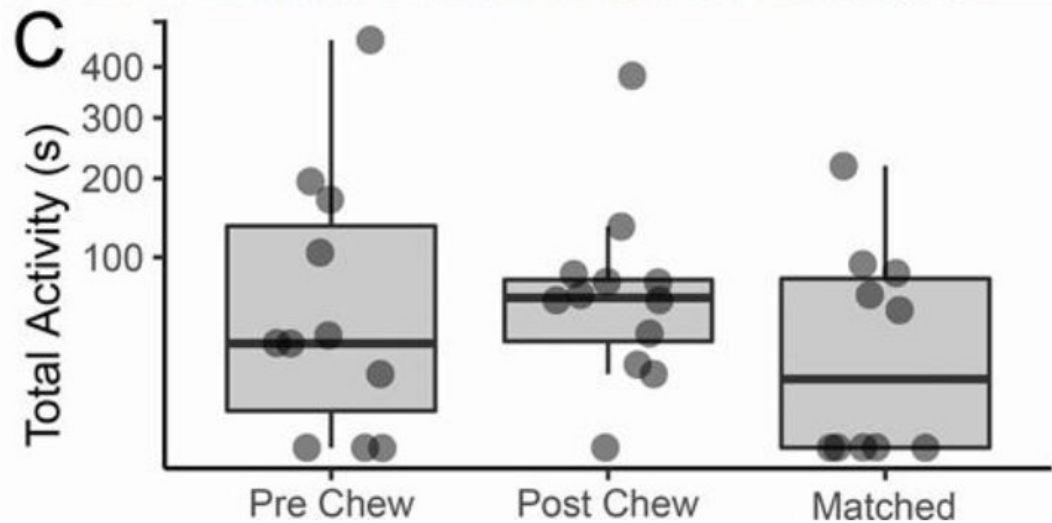
²Center for Conservation Genomics, Smithsonian Conservation Biology Institute, National Zoological Park, 3001 Connecticut Avenue NW, Washington, DC 20008, USA (SBW, JEM)

³Mpala Research Centre, Nanyuki 10400, Kenya (SBW, KNM)

⁴Department of Biological and Medical Sciences, Oxford Brookes University, Oxford OX3 0BP, United Kingdom (KNM)

⁵Mammalogy Section, National Museums Kenya, Nairobi 00100, Kenya (BA)

⁶Department of Biology and Department of Environmental Science and Policy, George Mason University, Fairfax, VA 22030, USA (JEM)



Lophiomys imhausi chewing *Acokanthera schimperi* (A) and anointing after chewing (B). Chewing on *A. schimperi* did not alter activity. There was no difference in activity rates measured before (“pre”) or after (“post”) chewing, or in a matched (“matched”) nonchewing time interval on another date (C).

See [Weinstein et al. \(2020\)](#) for videos of *L. imhausi* anointing.

СТРУКТУРА И ФУНКЦИИ ПИЩЕВАРИТЕЛЬНОГО ТРАКТА КОСМАТОГО ХОМЯКА, *LORHIOMYS IMHAUSI*

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Институт проблем экологии и эволюции РАН, Москва 119071

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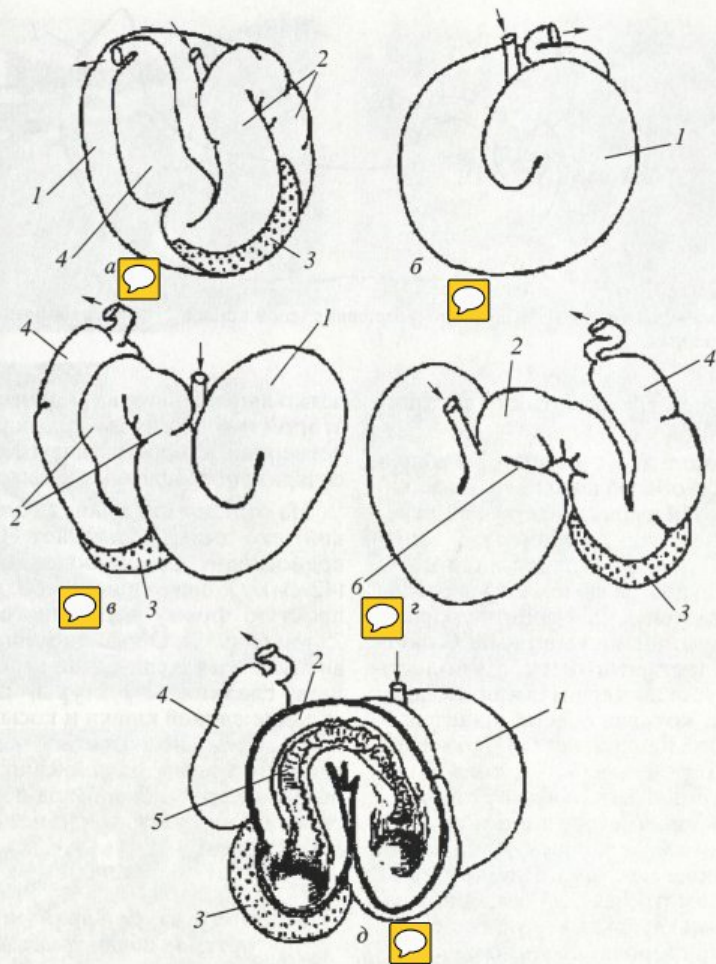
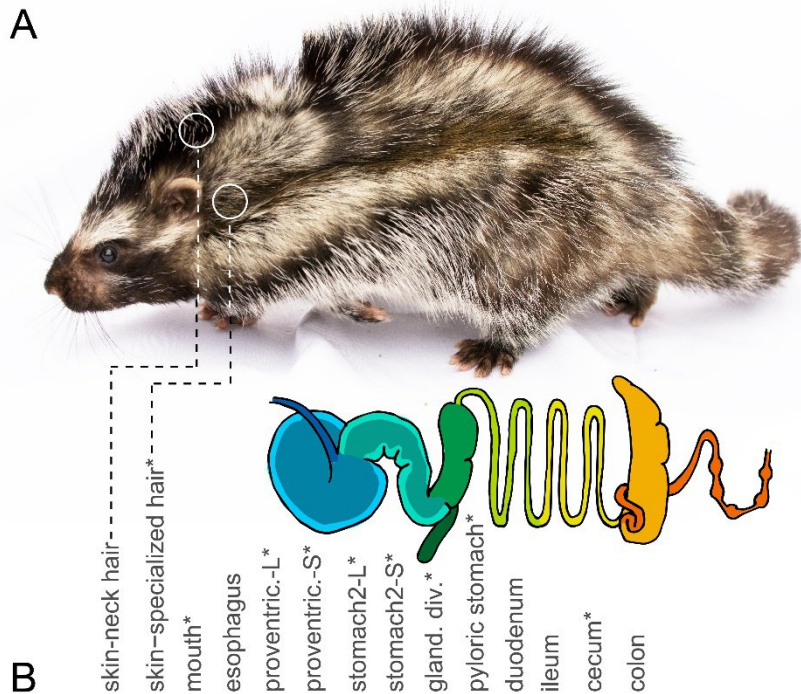


Рис. 1. Анатомическое строение желудка: *а* – вентральная сторона; *б* – дорсальная сторона; *в* – развернутый желудок, вид с антимезентериальной стороны; *г* – развернутый желудок, вид с мезентериальной стороны; *д* – внутренняя поверхность второй желудочной камеры; 1 – первая камера (преджелудок), 2 – вторая камера (с пищеводным желобом), 3 – железистый дивертикул (третья камера), 4 – пилорическая камера (четвертая), 5 – пищеводный желоб, 6 – серповидная изолирующая складка.

Naumova (2003)

1369



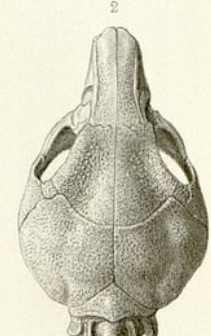
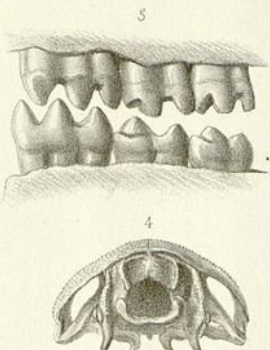
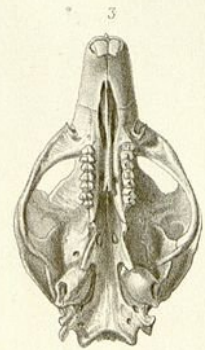
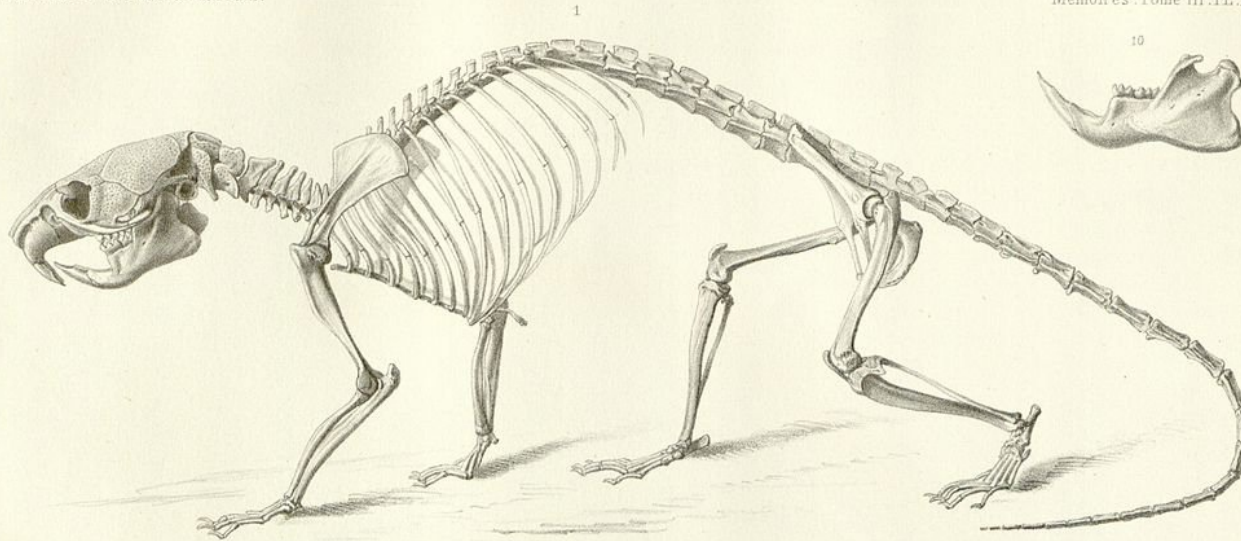
McDonough et al. (in prep)

Type d'une nouvelle famille de l'ordre des rongeurs

Alphonse Milne-Edwards (1867)

Nouvelles Archives du Muséum.

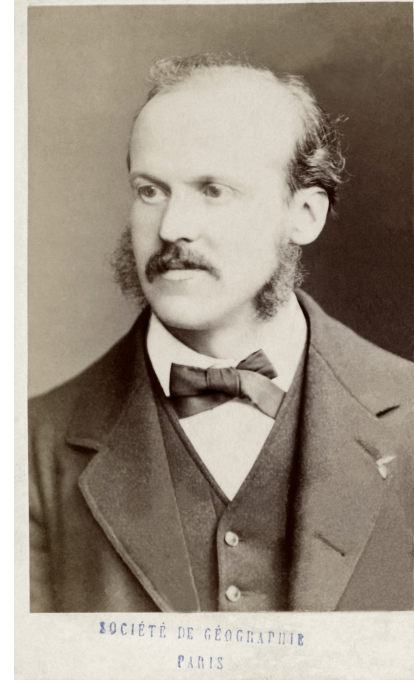
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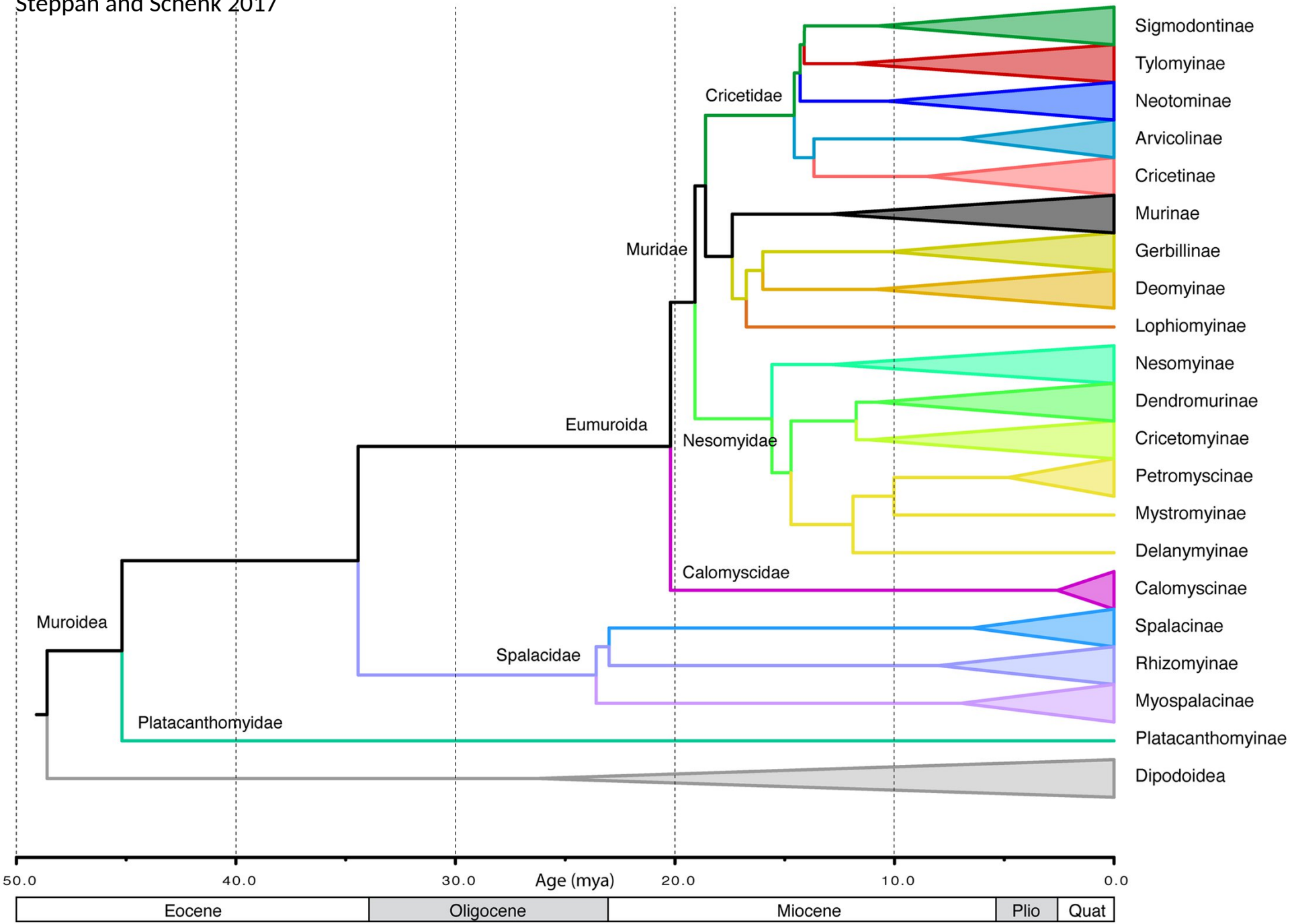


Louveau lith.

Imp. Bequet à Paris.

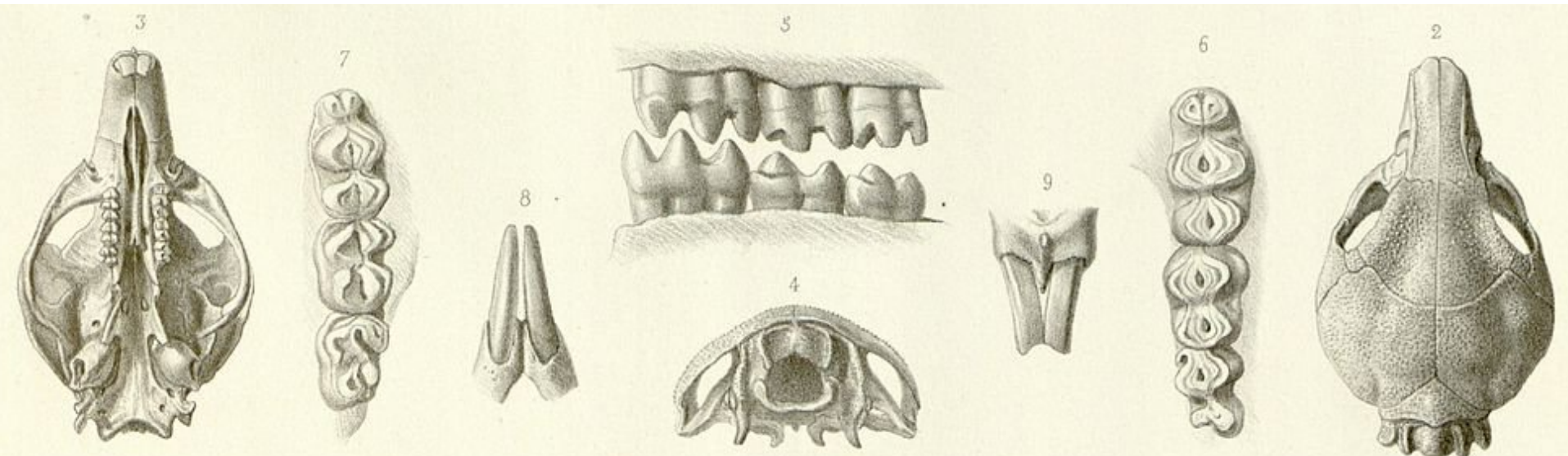
Ostéologie du *Lophiomys Imhausii*.





Type d'une nouvelle famille de l'ordre des rongeurs

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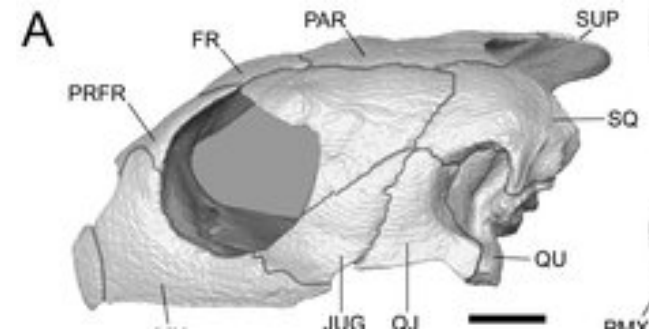
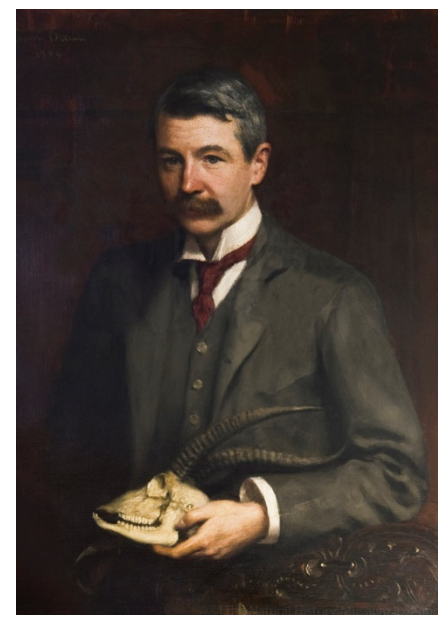


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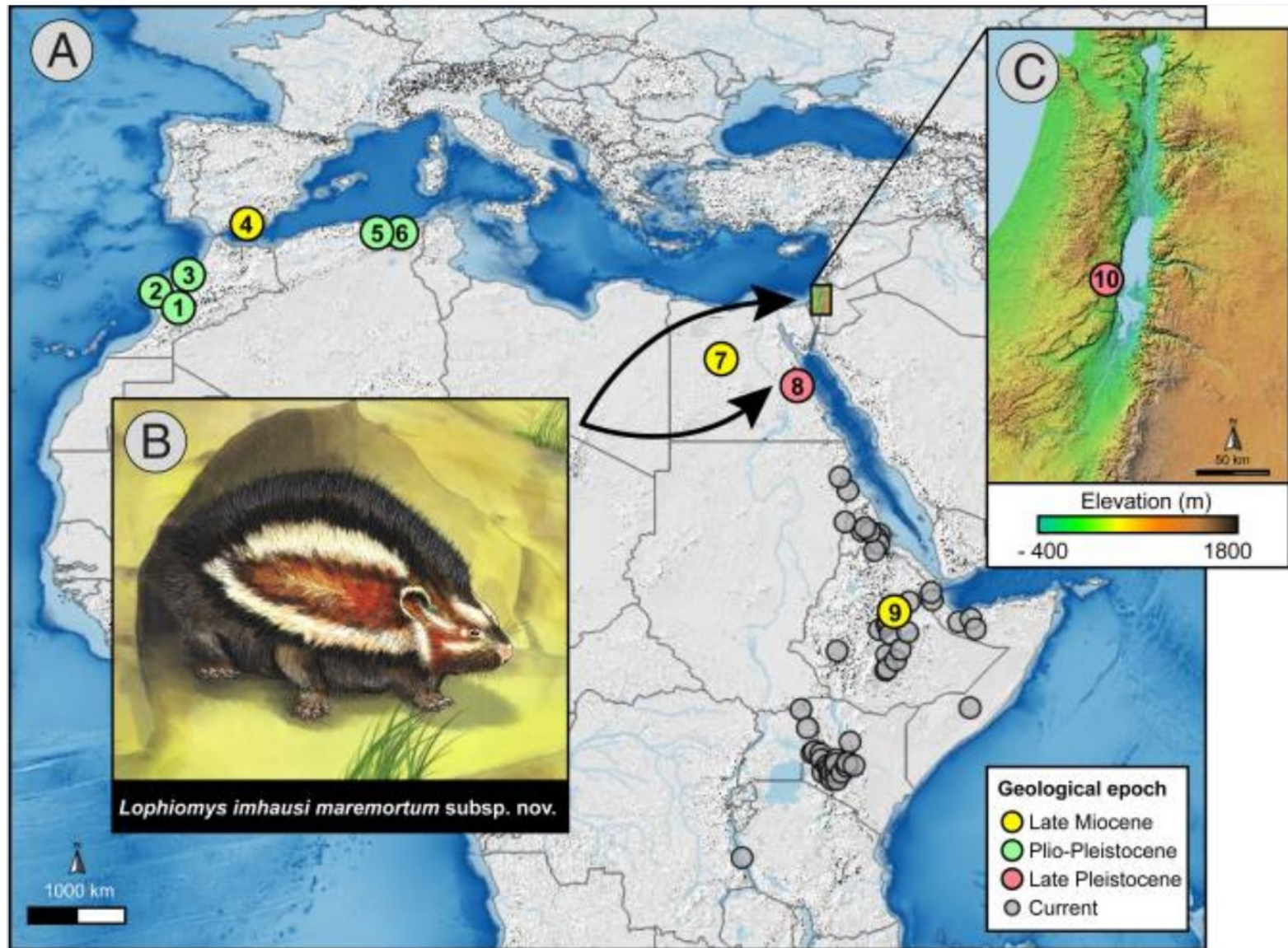
Imp. Becquet à Paris.

Ostéologie du *Lophiomys Imhausii*.

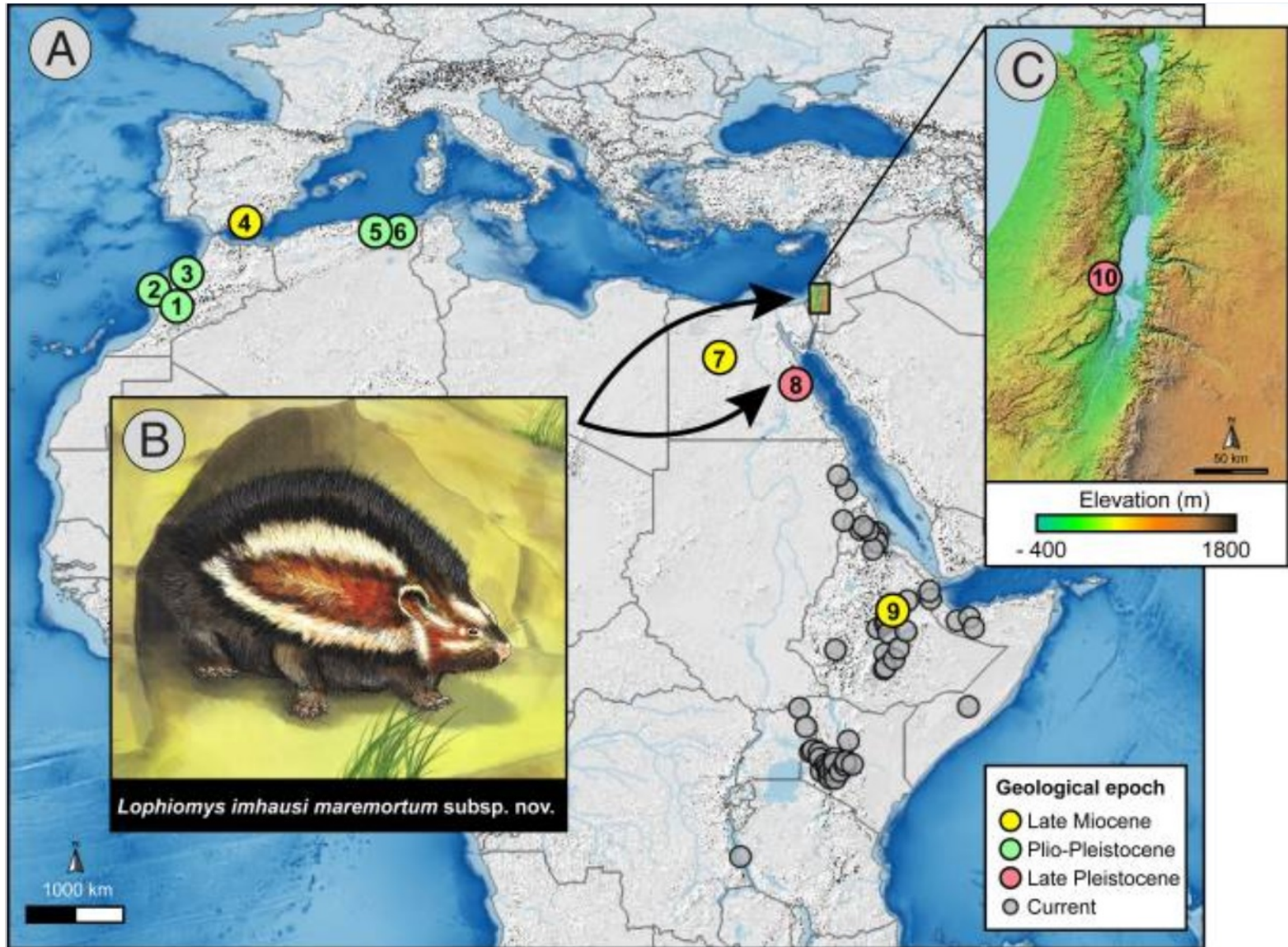
Lophiomyys imhausi testudo 99.8.4.97 Thomas

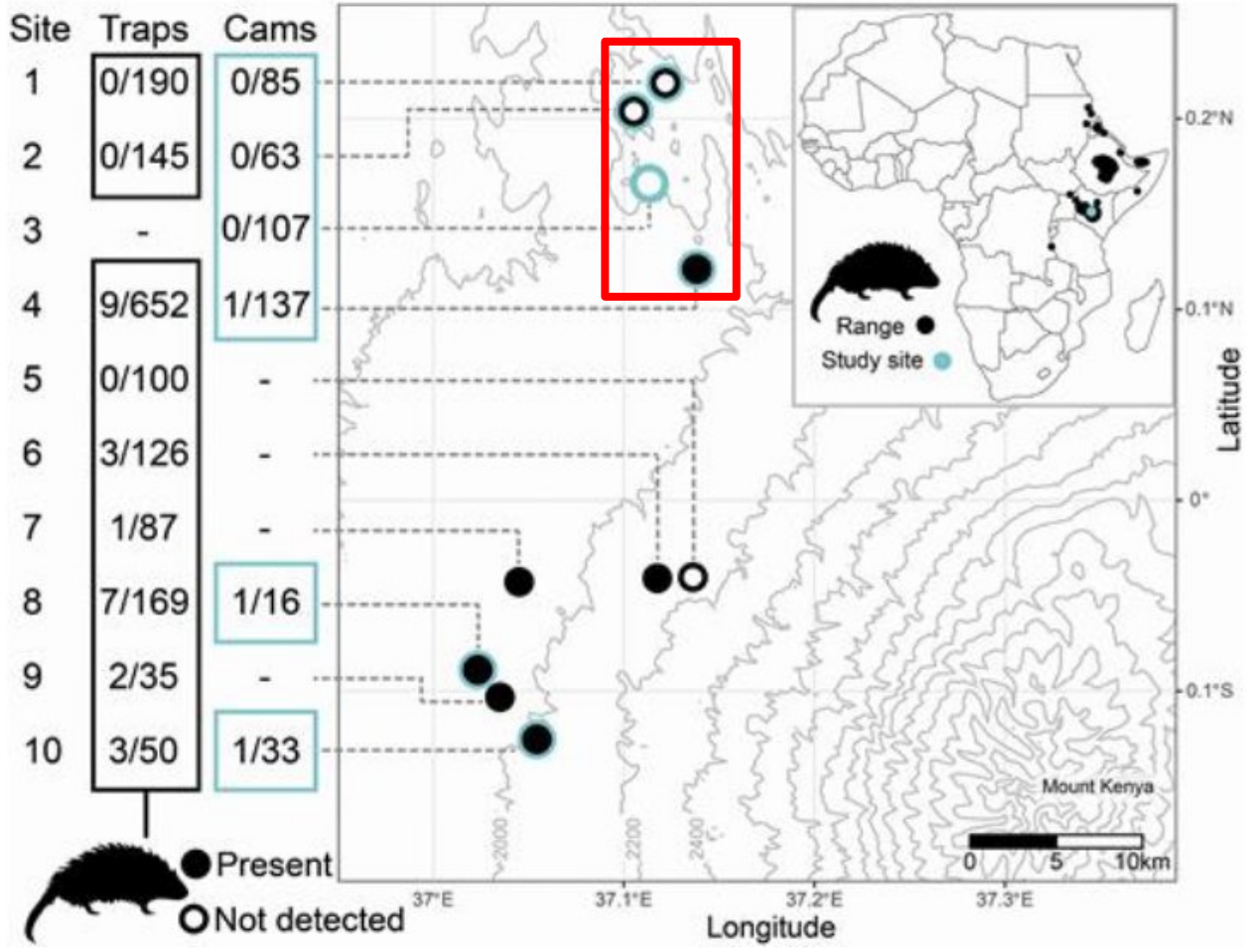


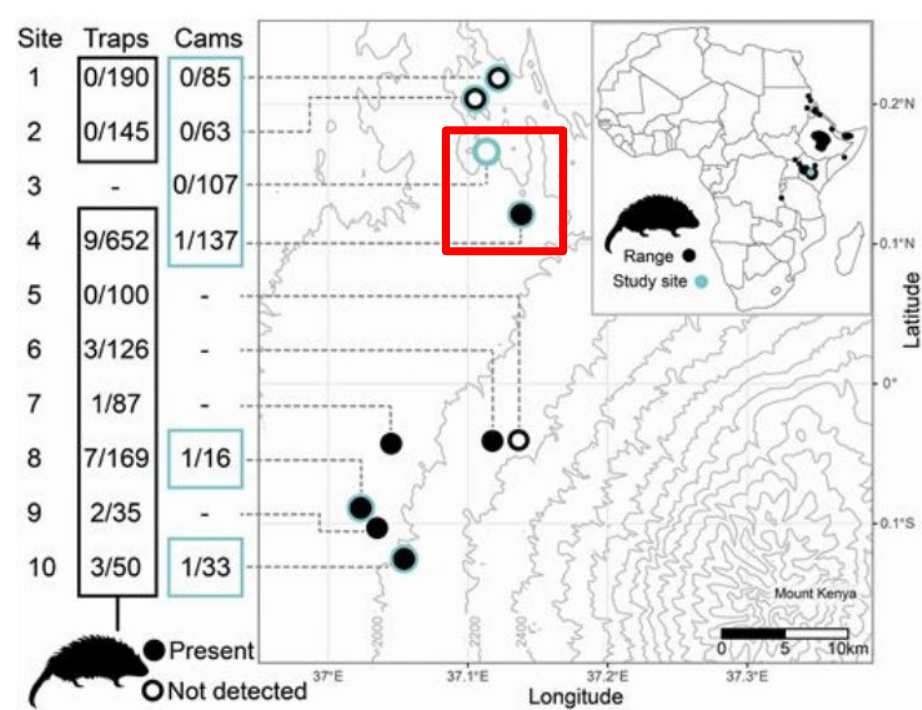
Distribution of extinct and extant *Lophiomys*

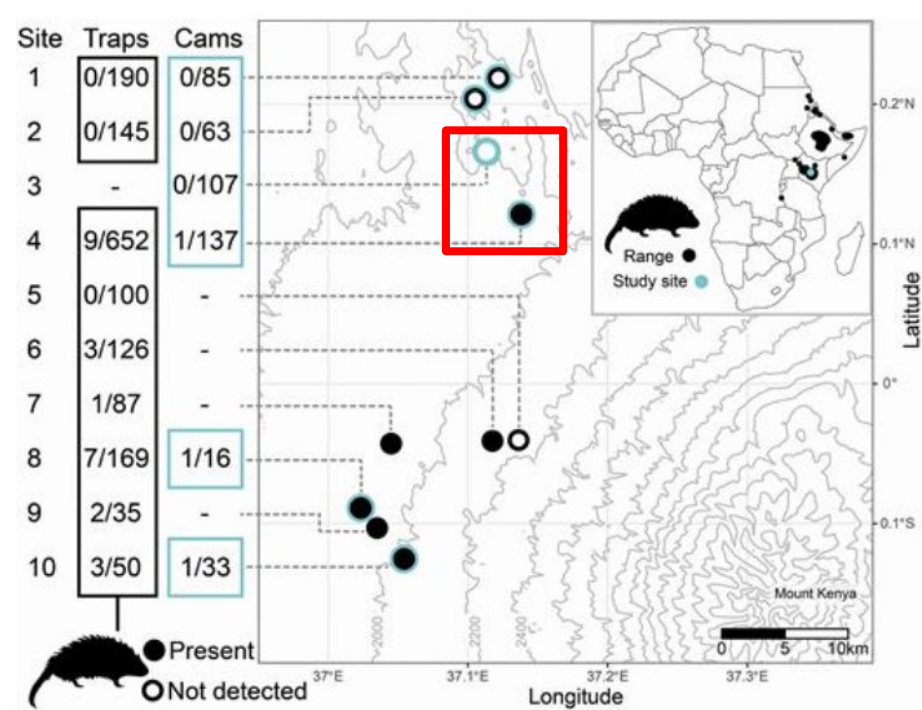


Material and methods







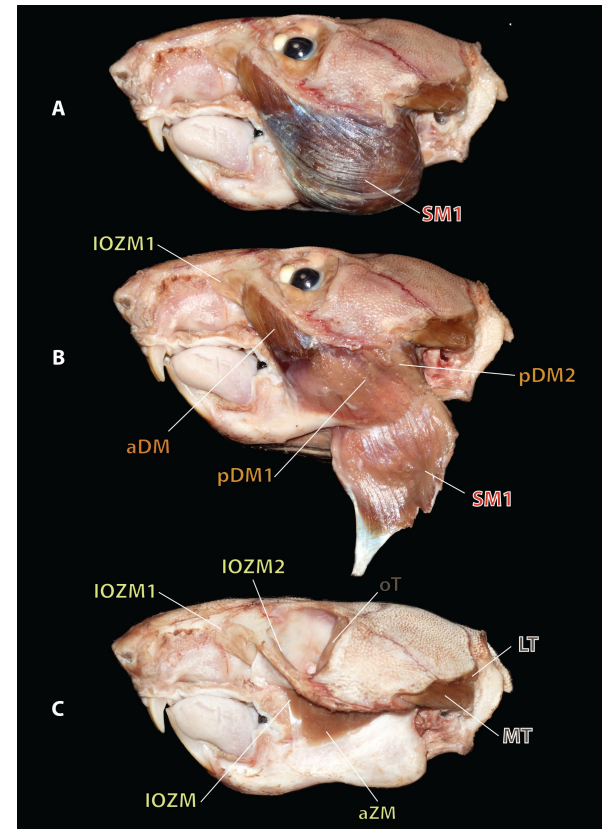
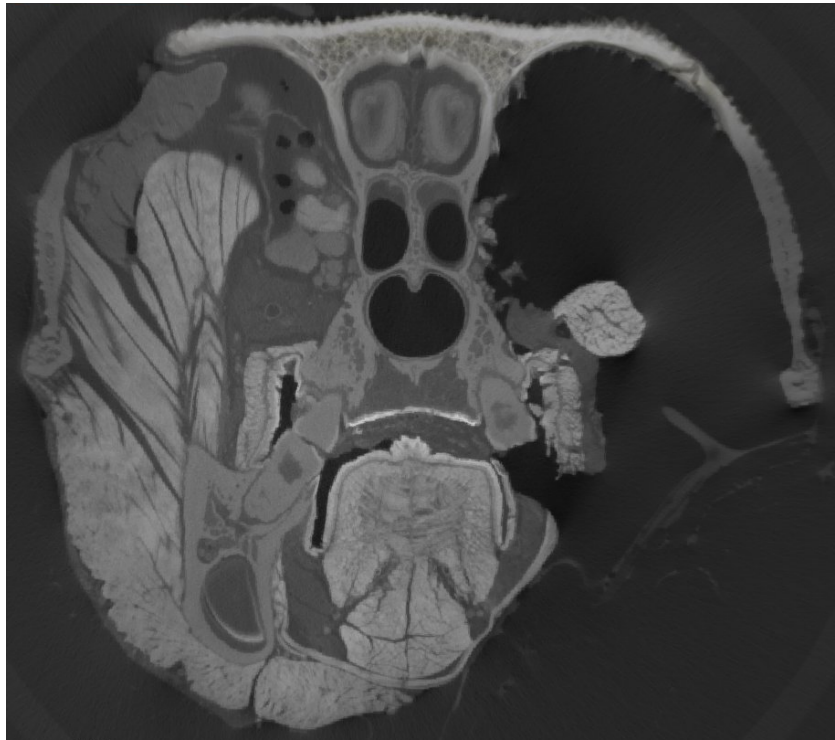


The families and genera of living rodents, volume 3

Ellerman (1849), a famous boat seller fascinated by rodents

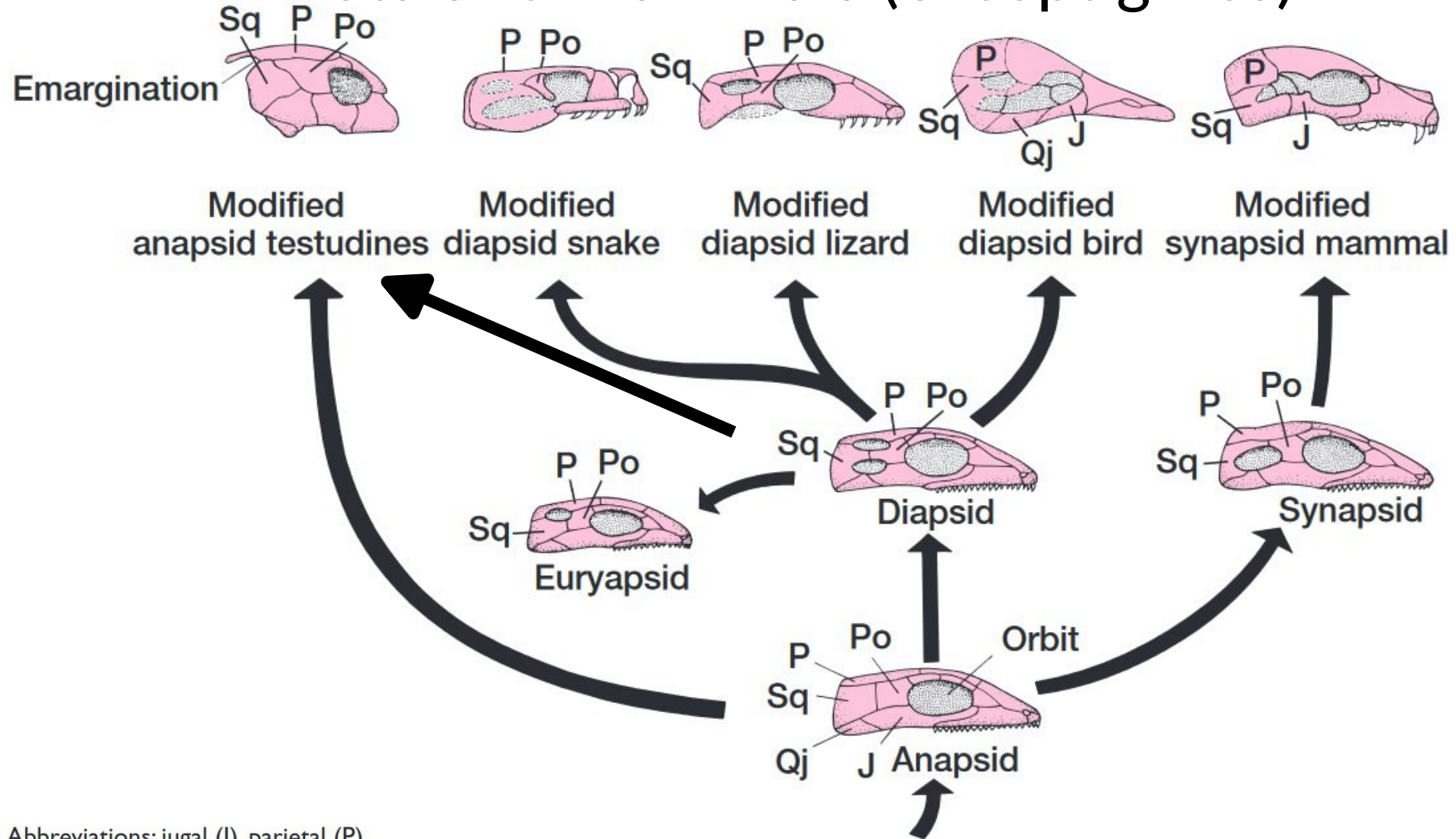


Is the Maned Rat *Lophiomys imhausi* (Muridae, Lophiomyinae) converging toward a sea turtle jaw muscle morphology ?



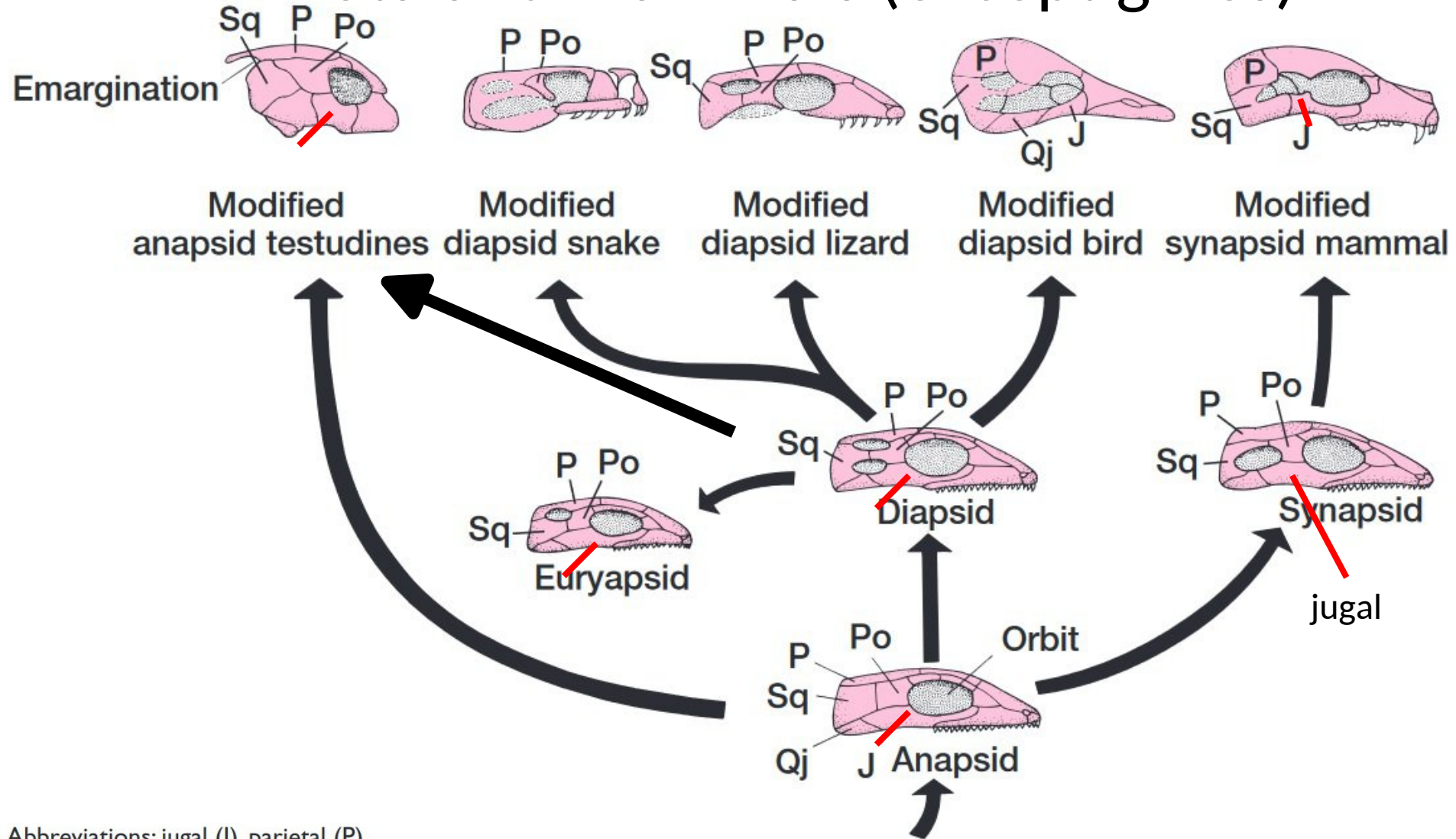
Fabre P-H

The temporal fossa and jugal evolution in Amniota and mammals (except glires)



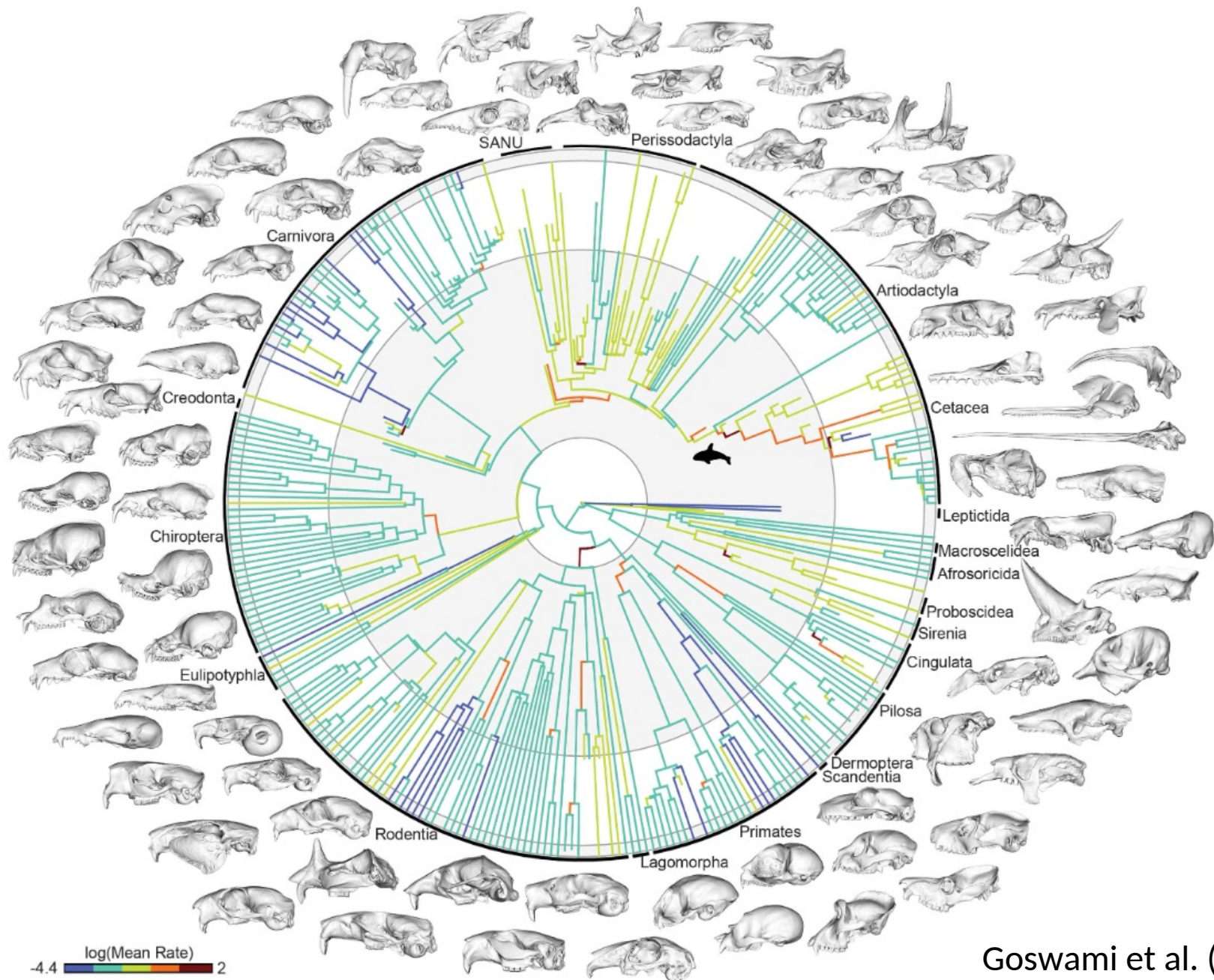
Abbreviations: jugal (J), parietal (P), postorbital (Po), quadratojugal (Qj), squamosal (Sq).

The temporal fossa and jugal evolution in Amniota and mammals (except glires)



Abbreviations: jugal (J), parietal (P), postorbital (Po), quadratojugal (Qj), squamosal (Sq).

Le jugal chez les mammifères non glires



The jugal in non-glires mammals

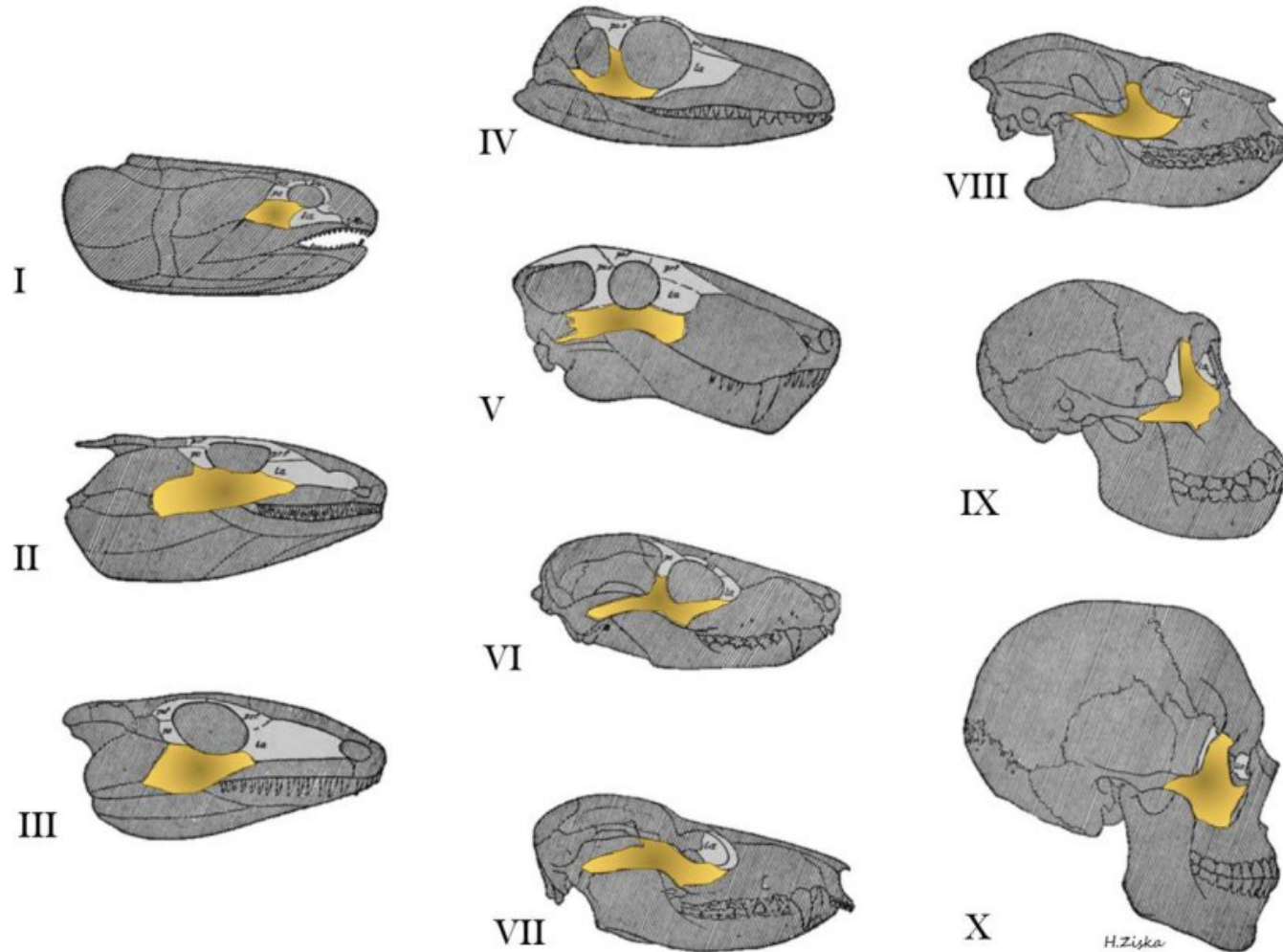
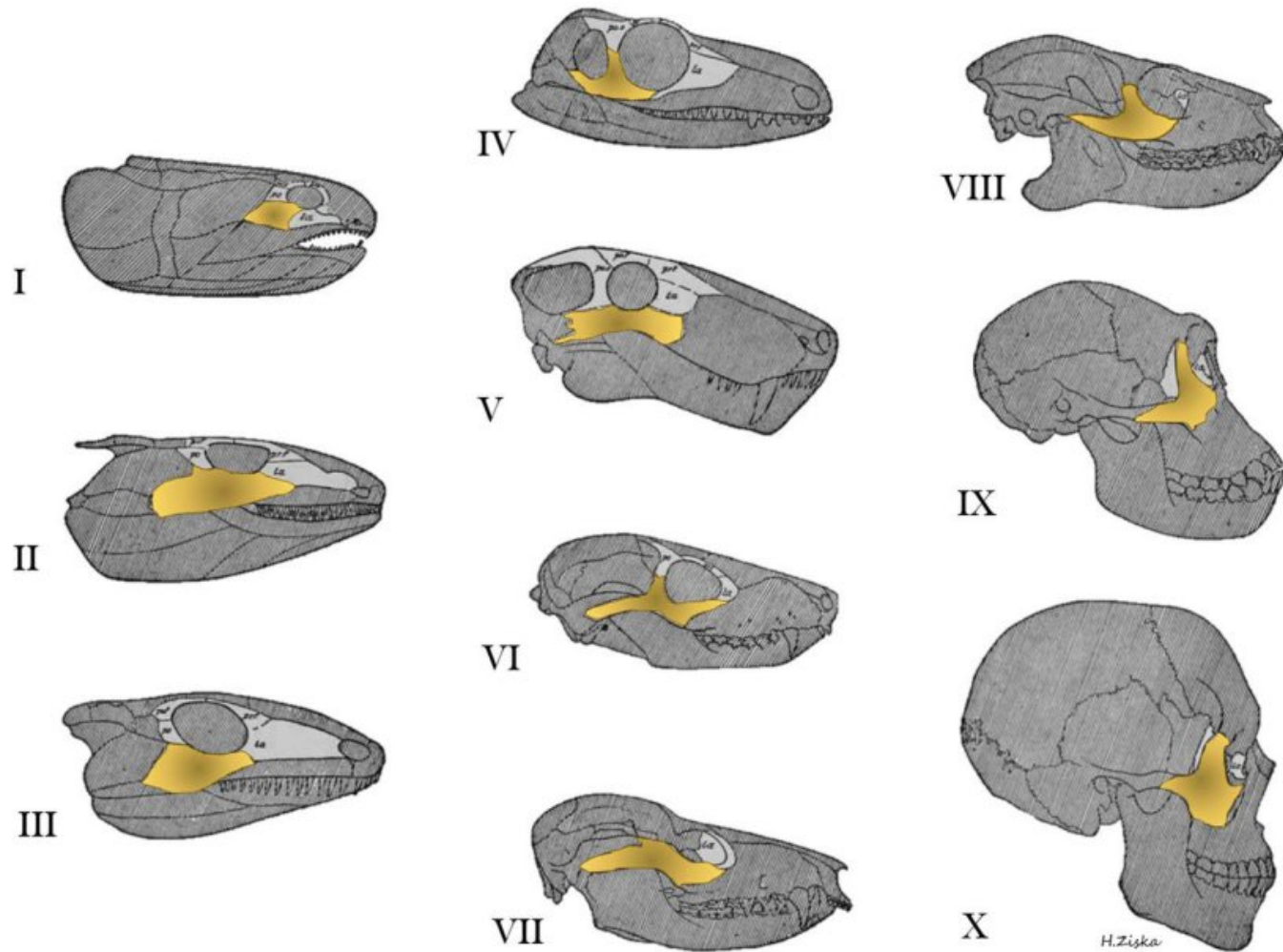


Fig. 1. Evolution of circumorbital bones of the dermatocranium from William King Gregory's, "Our face from fish to man" (1929) showing the change in zygomatic morphology over evolutionary time. The orbital series is figured in light gray while the zygoma or jugal is highlighted in yellow. I, Lobe-finned fish, Devonian age; II, Primitive amphibian, Lower Carboniferous; III, Primitive cotylosaurian reptile, Permian-Carboniferous; IV, Primitive theromorph reptile, Permian-Carboniferous; V, Gorgonopsian reptile, Permian; VI, Primitive cynodont reptile,

Triassic; VII, Primitive marsupial, Upper Cretaceous; VIII, Primitive primate, Eocene; IX, Anthropoid (female chimpanzee), Recent; Man, Recent. Gregory was an expert primatologist, paleontologist, and functional and comparative morphologist and a leading contributor to several theories of evolution including the "Palimpsest theory" (Gregory, 1947) and "Williston's Law" (Gregory, 1935). Adapted from Gregory's (1929) Figure 51, p.81.



Result 1: The jugal (or zygomatic) bone is quite unusual in mammals by its anterior position. It usually contact the squamosal (posteriorly), the maxillary (anteriorly), and sometime the frontal.

Gregory (1929), Heuzé et al. (2016)

The frontal apophysis in non glire mammals

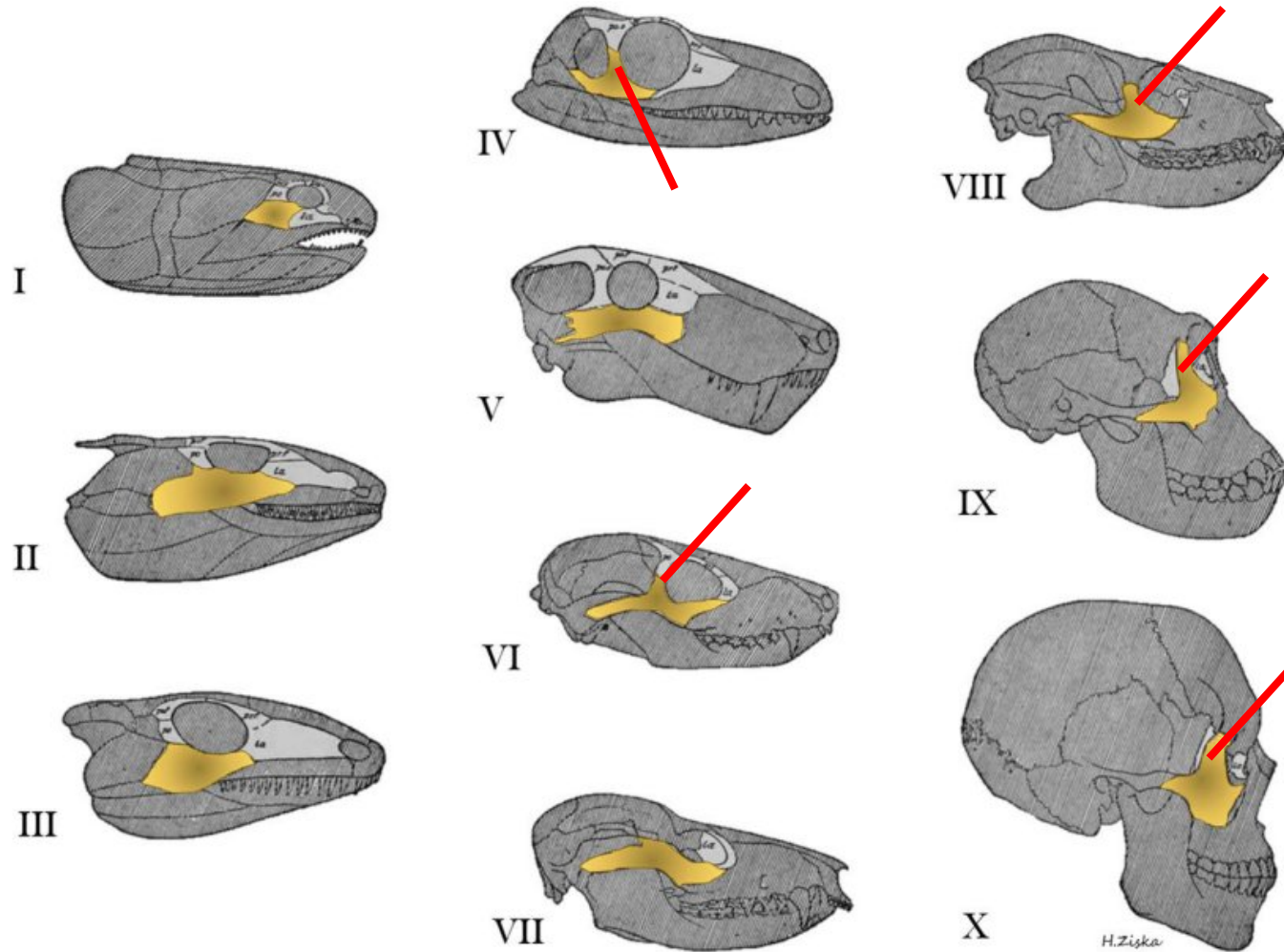
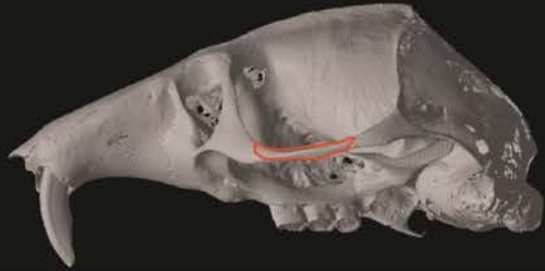


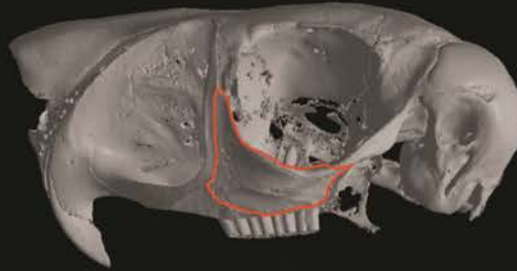
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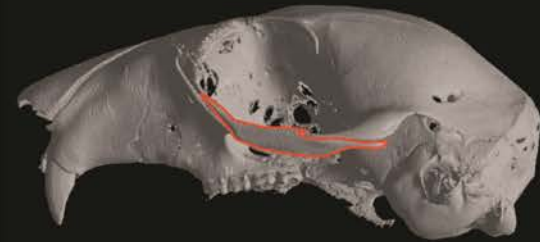
The in between position of the jugal in glires (a special case in mammals)



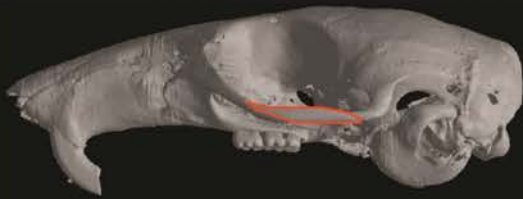
Spalacidae



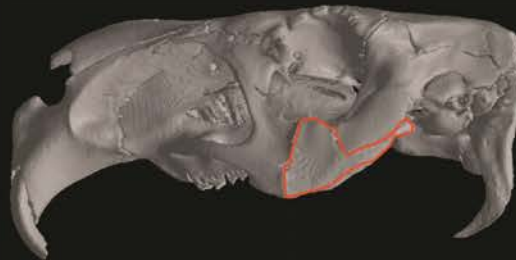
Pedetidae



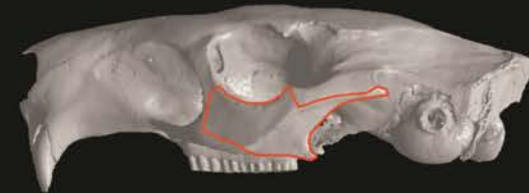
Sciuridae



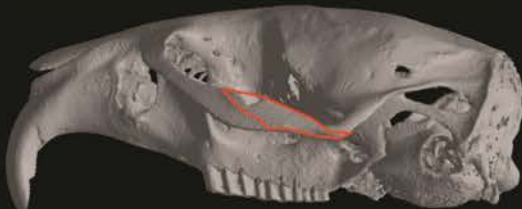
Nesomyidae



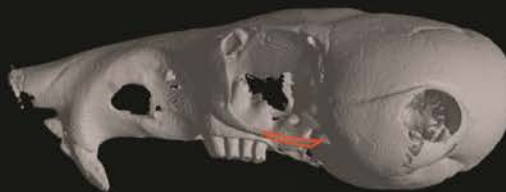
Castoridae



Capromyidae



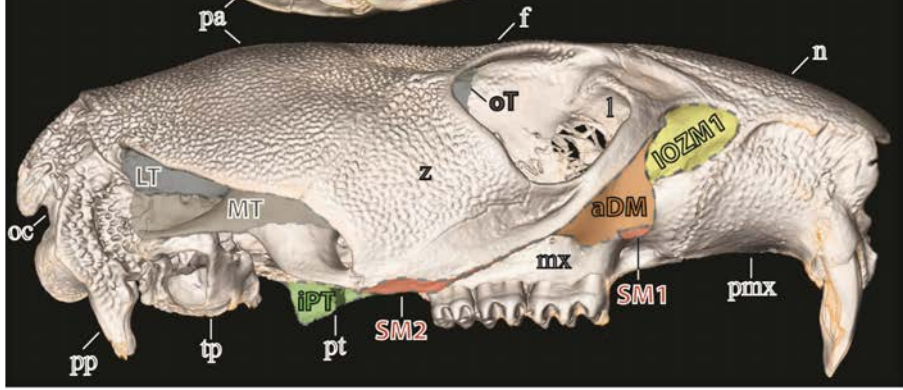
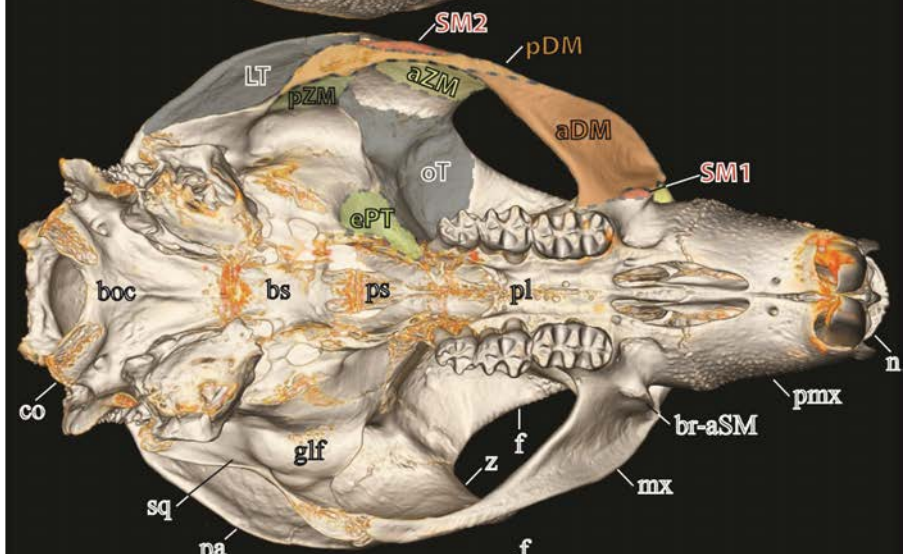
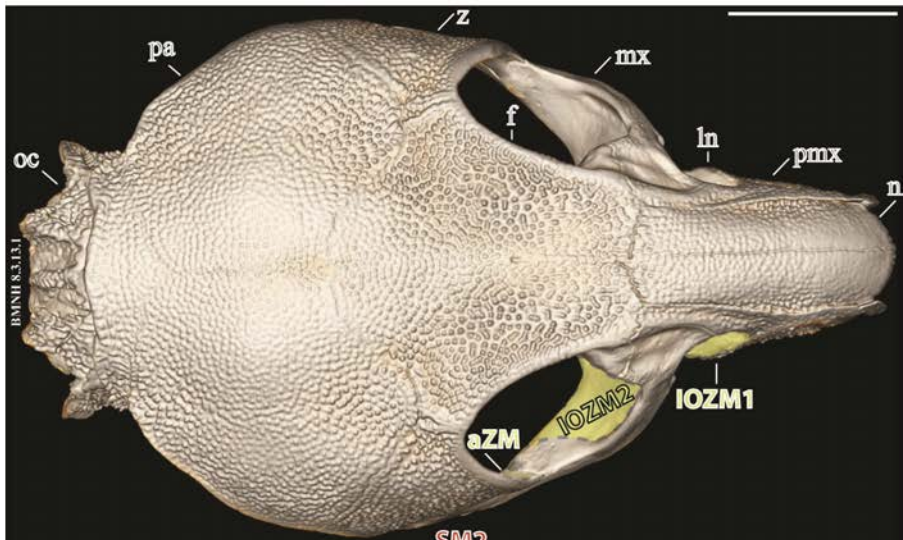
Arvicolinae



Heteromyidae



Ctenodactylidae

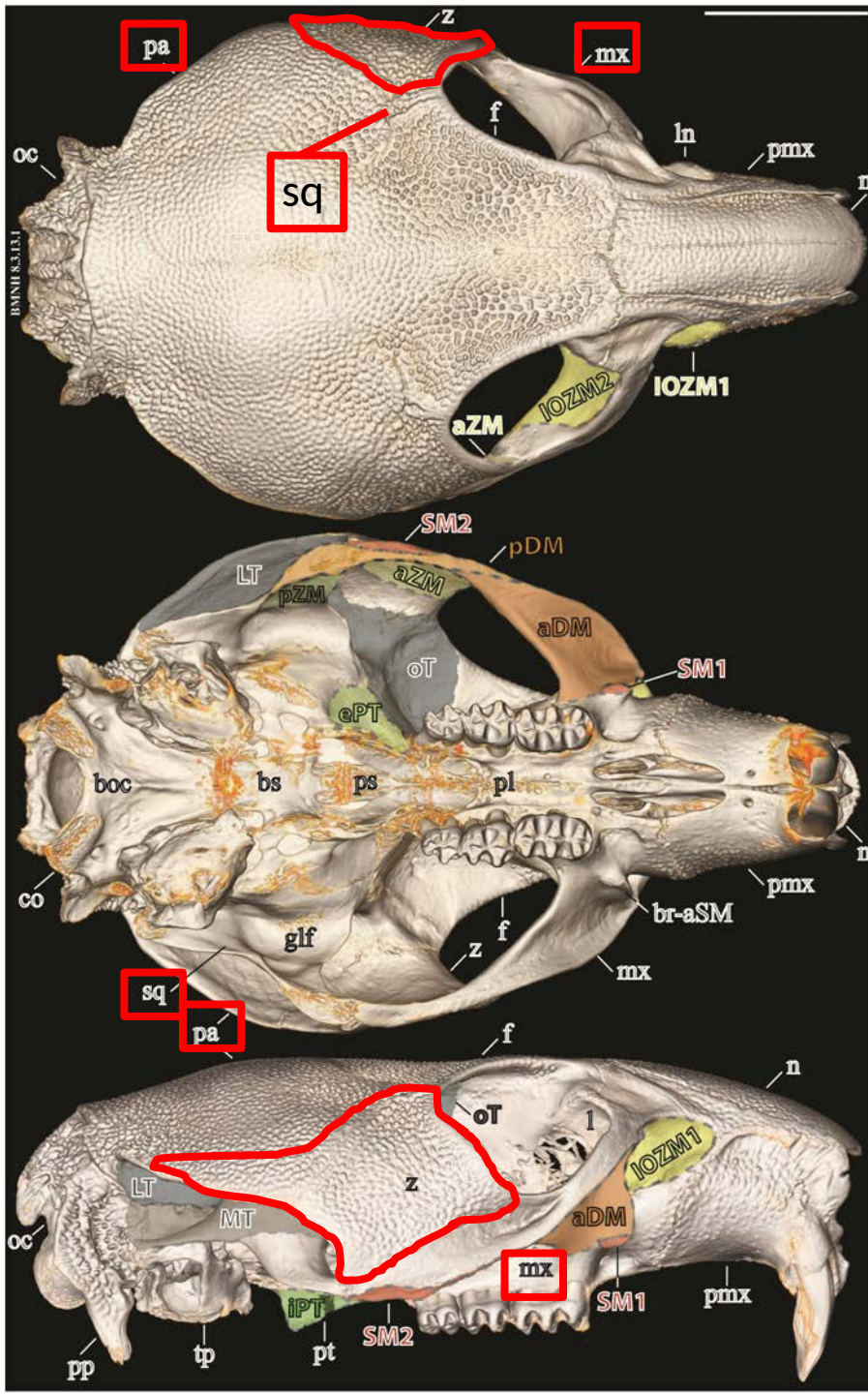


Results 2:

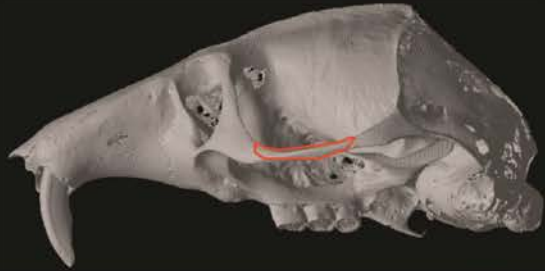
The jugal (or zygomatic) bone is quite unusual in *Lophiomys* by its more posterior position as compared to other mammals.

It contact the squamosal (posteriorly), the maxillary (anteriorly), and the frontal as observed in several in mammals)

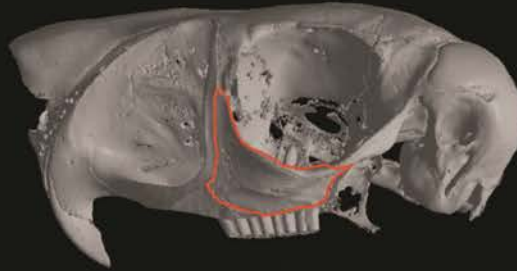
and it is contact with the parietal bones and a dorsal projection of the squamosal forming a lateral wall such analog to the one found in sea turtles or anapsida



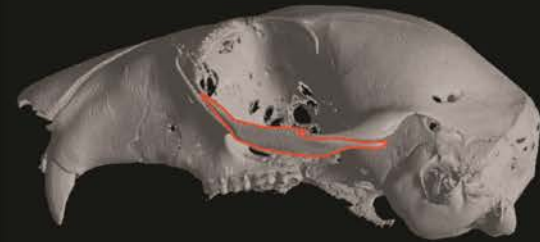
The in between position of the jugal in glires (a special case in mammals)



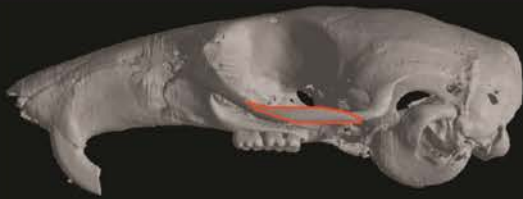
Spalacidae



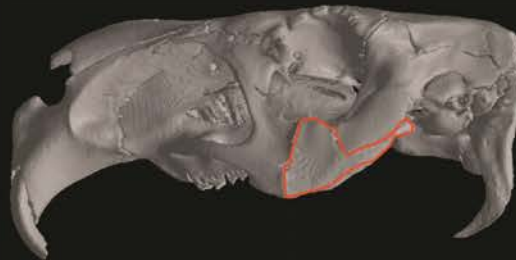
Pedetidae



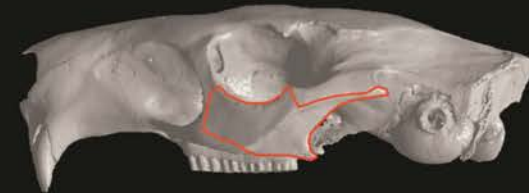
Sciuridae



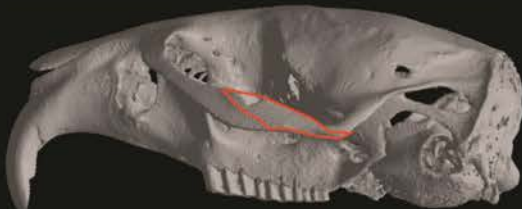
Nesomyidae



Castoridae



Capromyidae



Arvicolinae



Heteromyidae



Ctenodactylidae

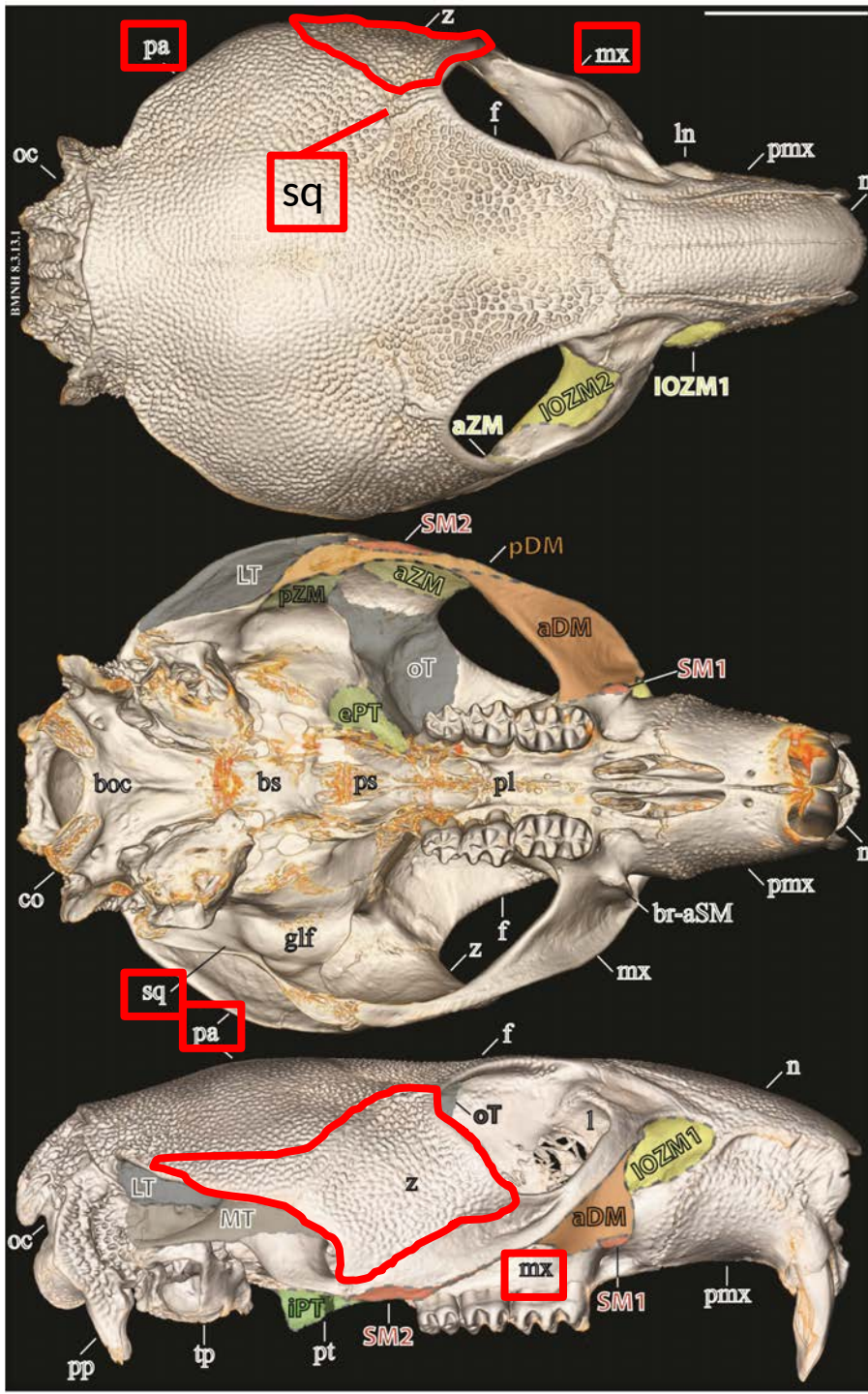
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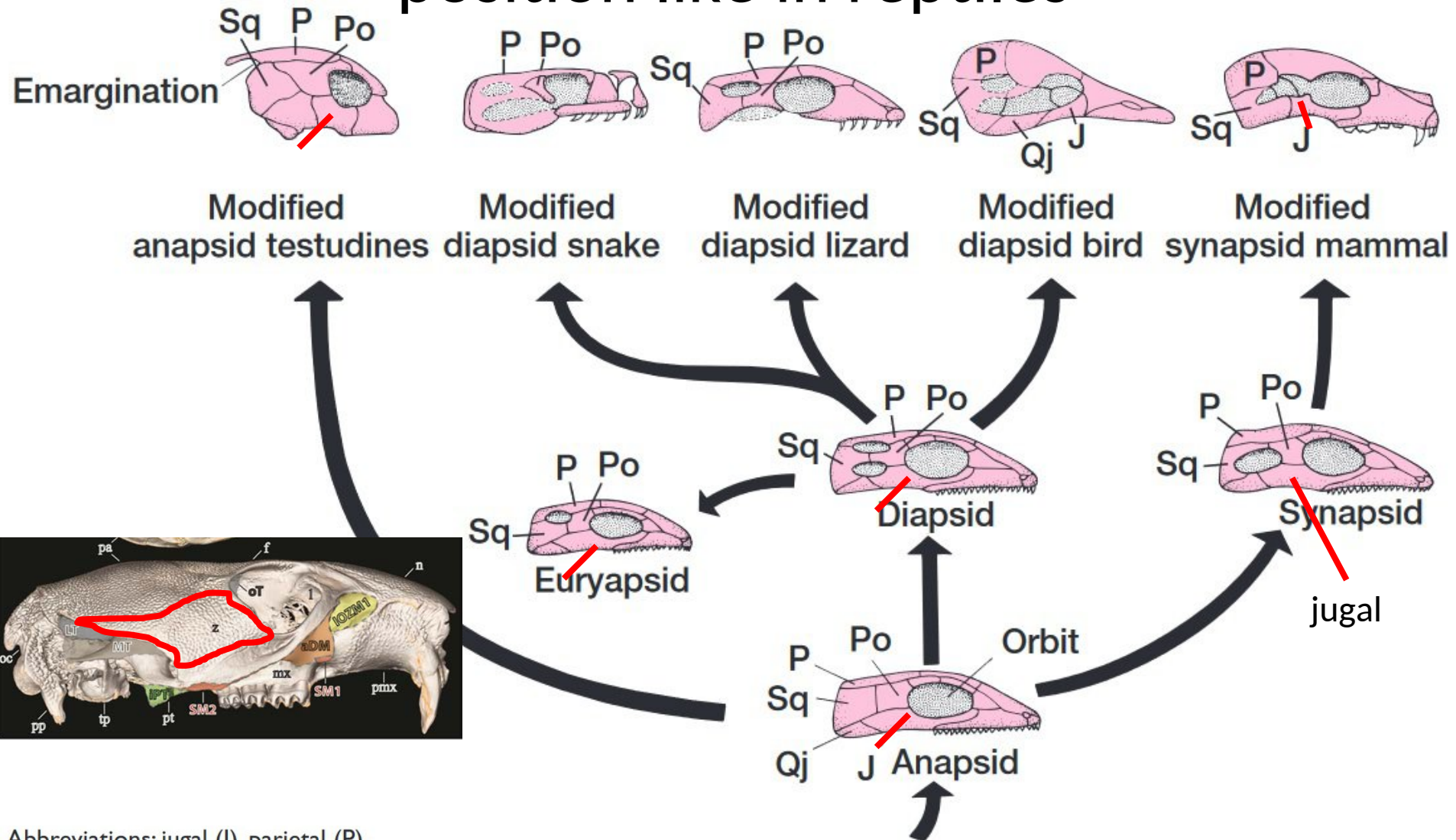
It contact the squamosal (posteriorly), the maxillary (anteriorly), and the frontal as observed in several in mammals)

and it is contact with the parietal bones and a dorsal projection of the squamosal forming a lateral wall such analog to the one found in sea turtles or anapsida

And it is dorsal to maxillary and squamosal bones !

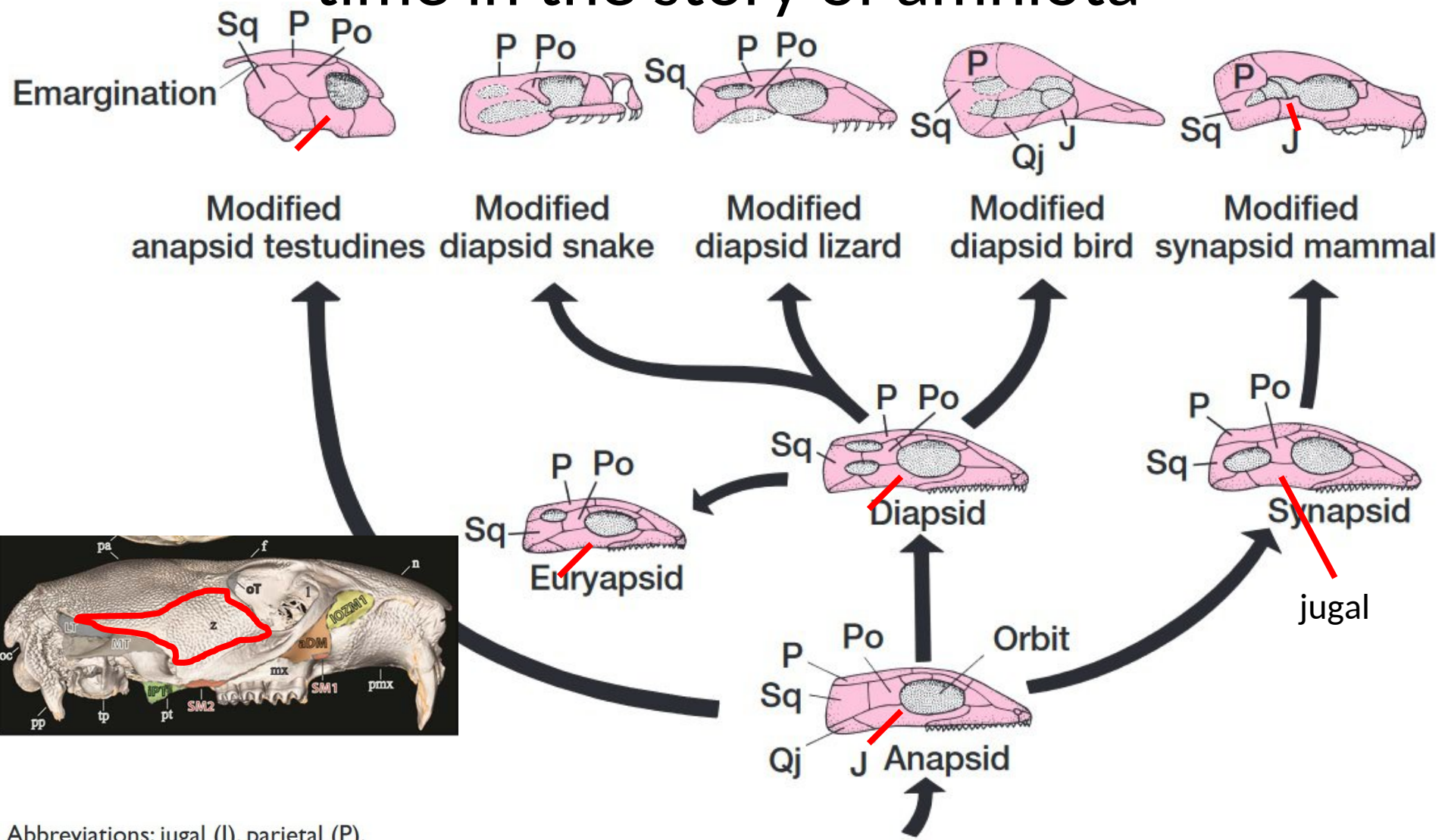


Part 1: A come back to a more posterior position like in reptiles



Abbreviations: jugal (J), parietal (P), postorbital (Po), quadratojugal (Qj), squamosal (Sq).

Part 1: ...but a dorsal positioning for the first time in the story of amniota



Abbreviations: jugal (J), parietal (P), postorbital (Po), quadratojugal (Qj), squamosal (Sq).

Part 2: Which muscles are involved into the temporal and jugal regions ?

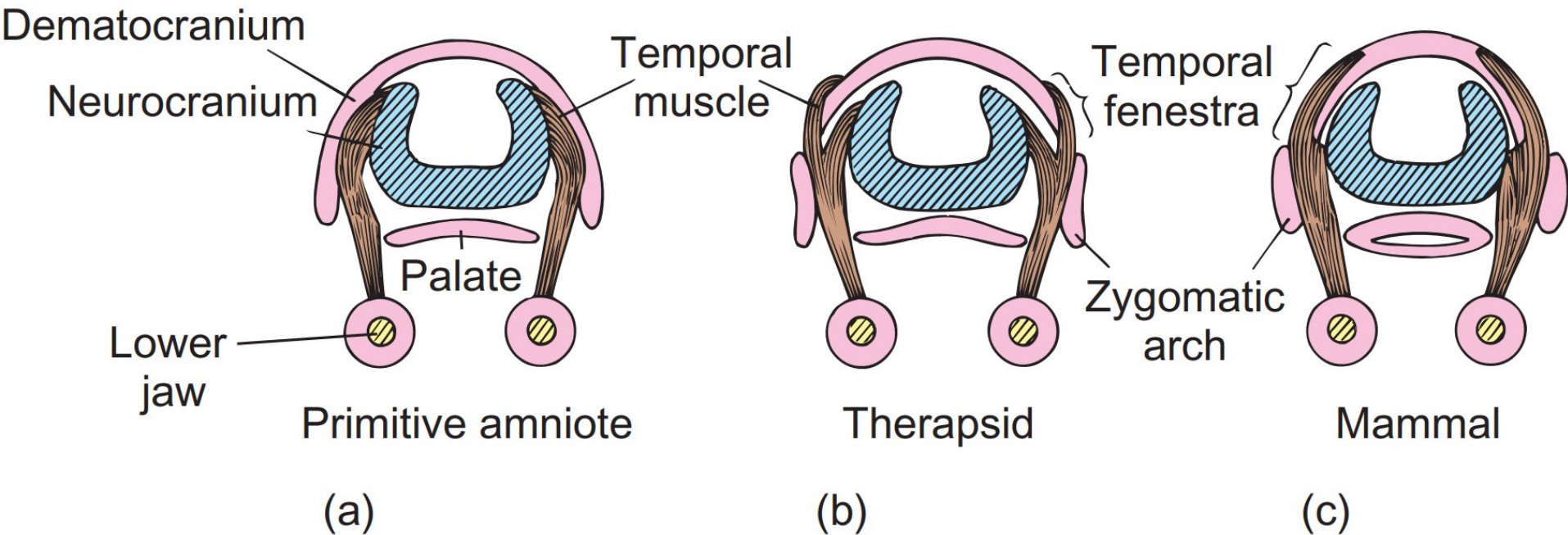
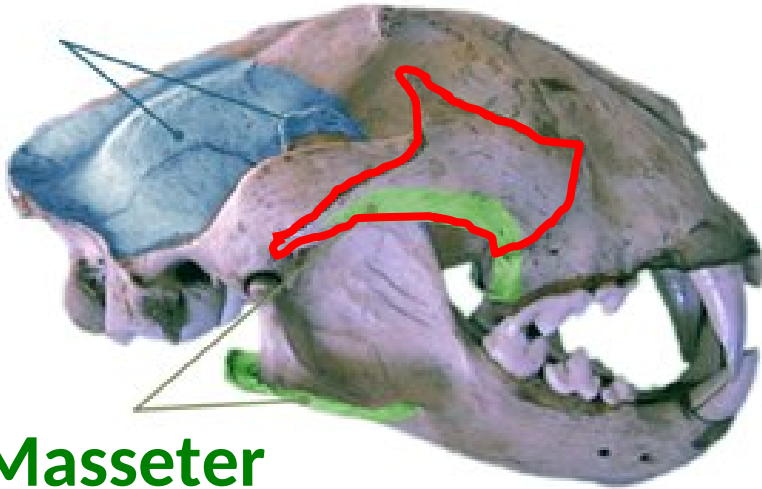


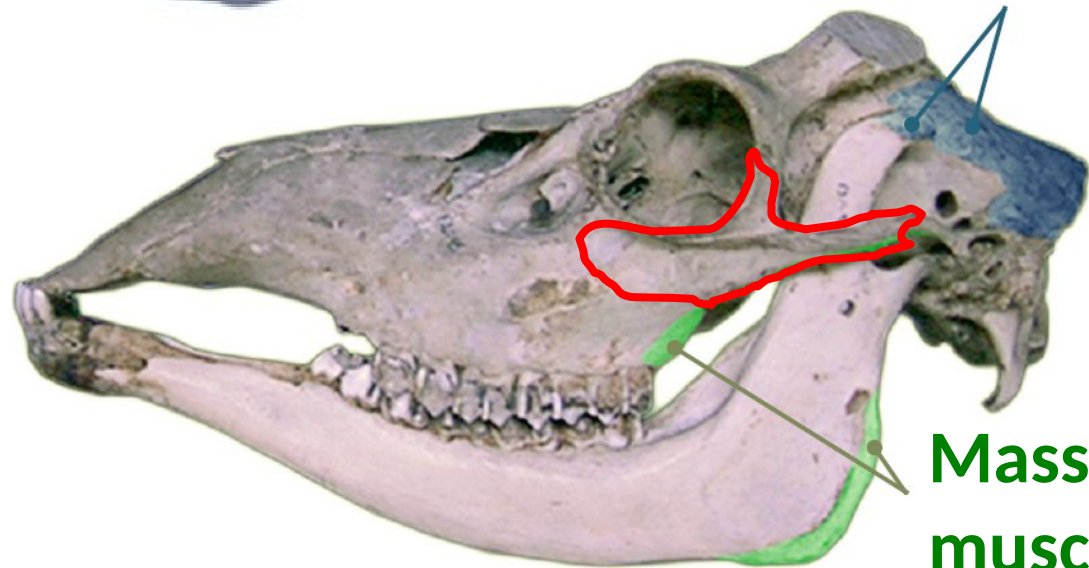
FIGURE 7.35 Temporal fenestrae. The shift in jaw muscle attachment to the skull is shown. (a) Anapsid skull. In early amniotes, temporal muscles run from the neurocranium to the lower jaw. Such a skull is retained in modern turtles. (b) Perforation in the dermatocranium opens fenestrae, and attachment of jaw muscles expands to the edges of these openings. (c) Extensive attachment of jaw muscles to the surface of the dermatocranium. Such development of fenestrae characterizes the diapsid and synapsid radiations.

After Smith.

Which muscles are associated to the jugal bone in mammals



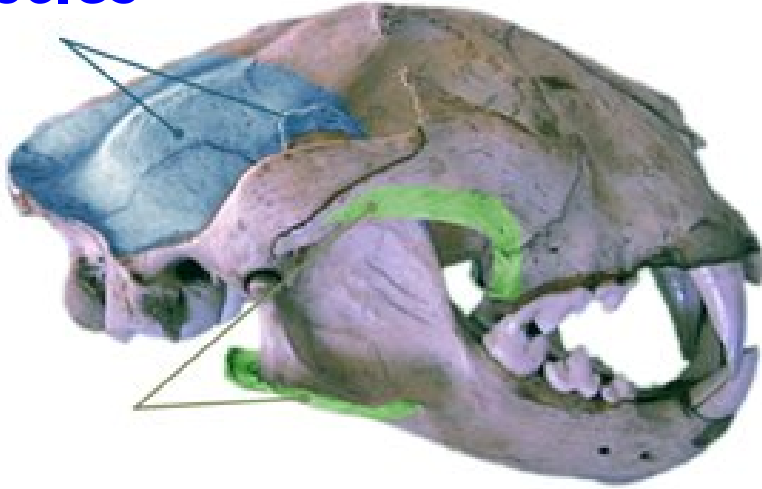
**Masseter
muscles**



**Masseter
muscles**

Which muscles are associated to the temporal fossa in mammals

**Temporalis
Muscles**



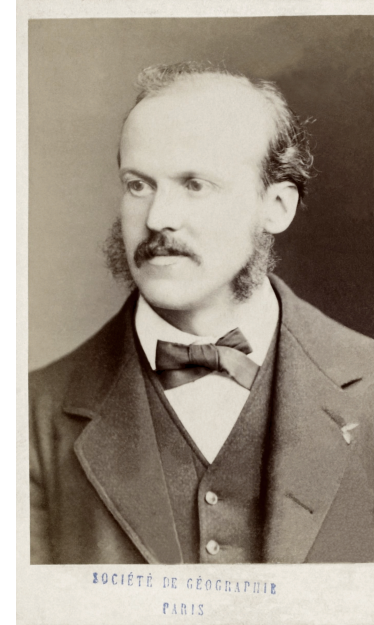
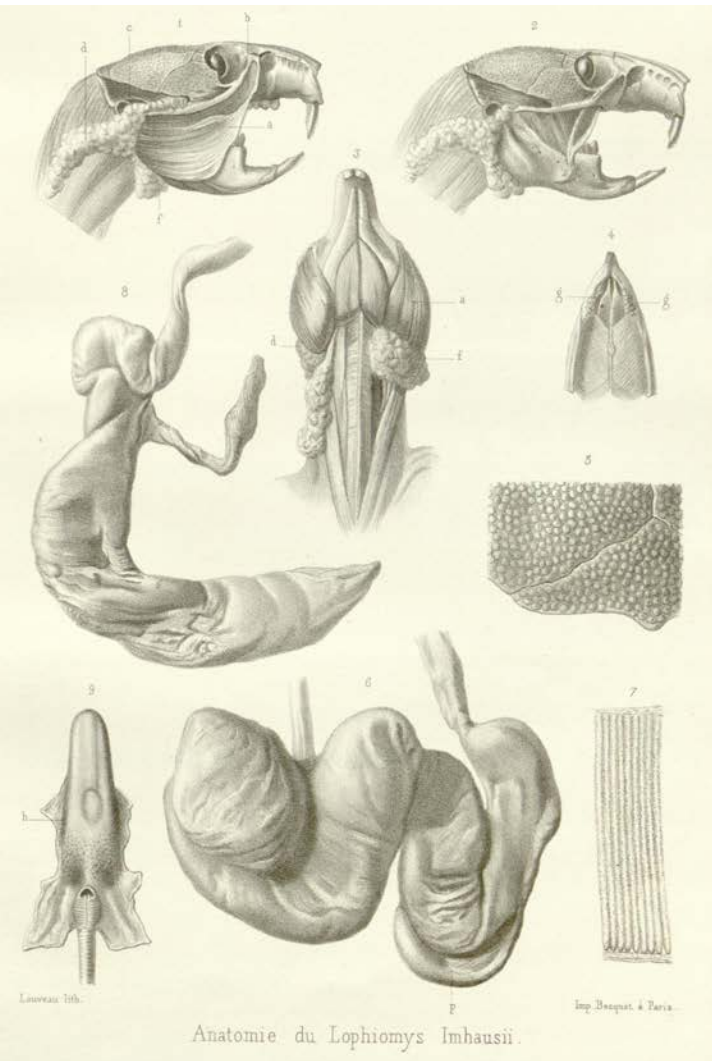
**Temporalis
Muscles**



Part 2: Which muscles are involved into the temporal and jugal regions of *Lophiomys*?

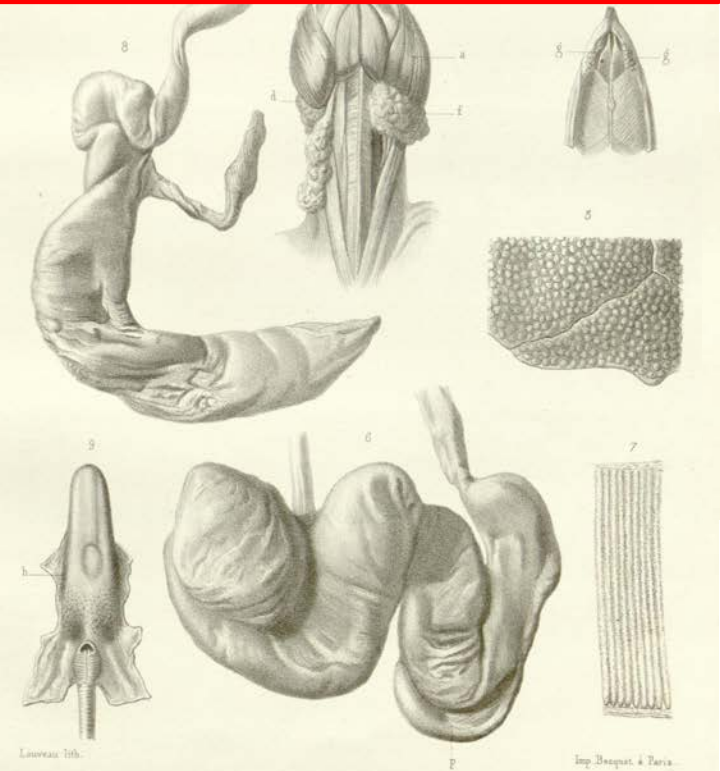
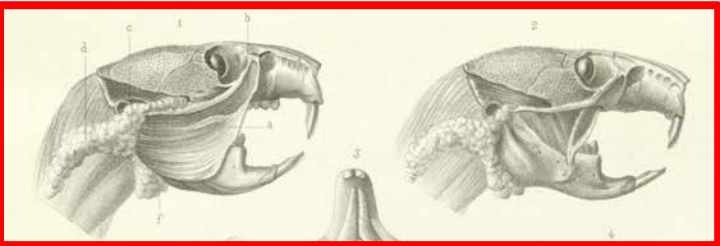
Type d'une nouvelle famille de l'ordre des rongeurs

Alphonse Milne-Edwards (1867)

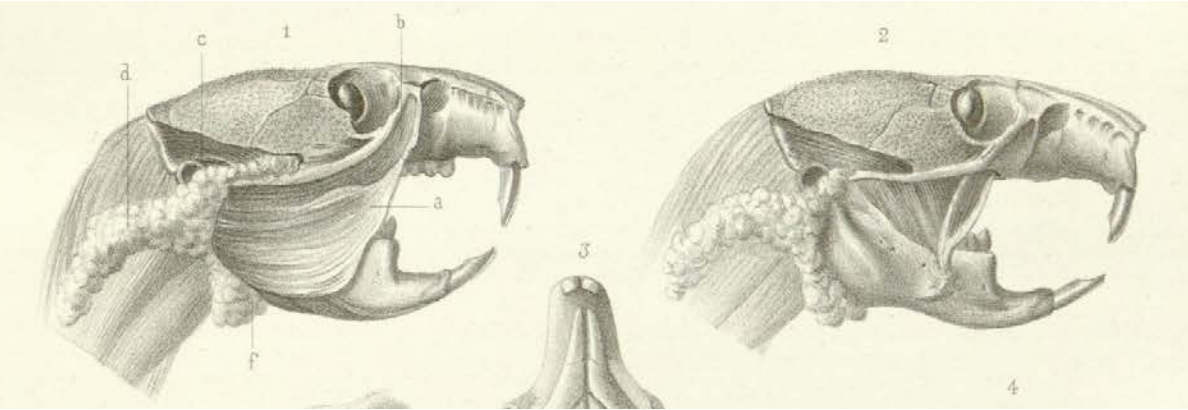


Type d'une nouvelle famille de l'ordre des rongeurs

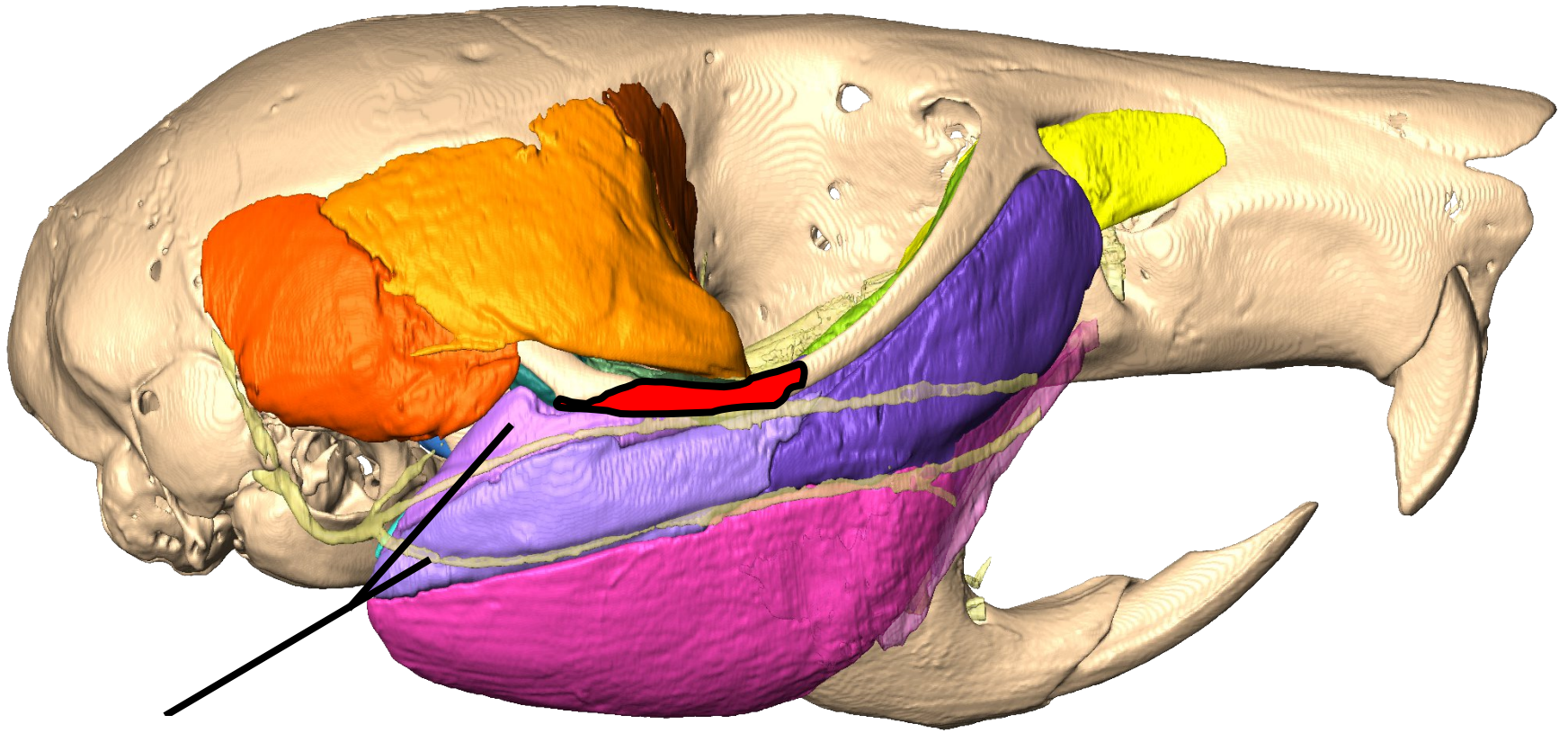
Alphonse Milne-Edwards (1867)



Anatomie du *Lophiomys Imhausii*.



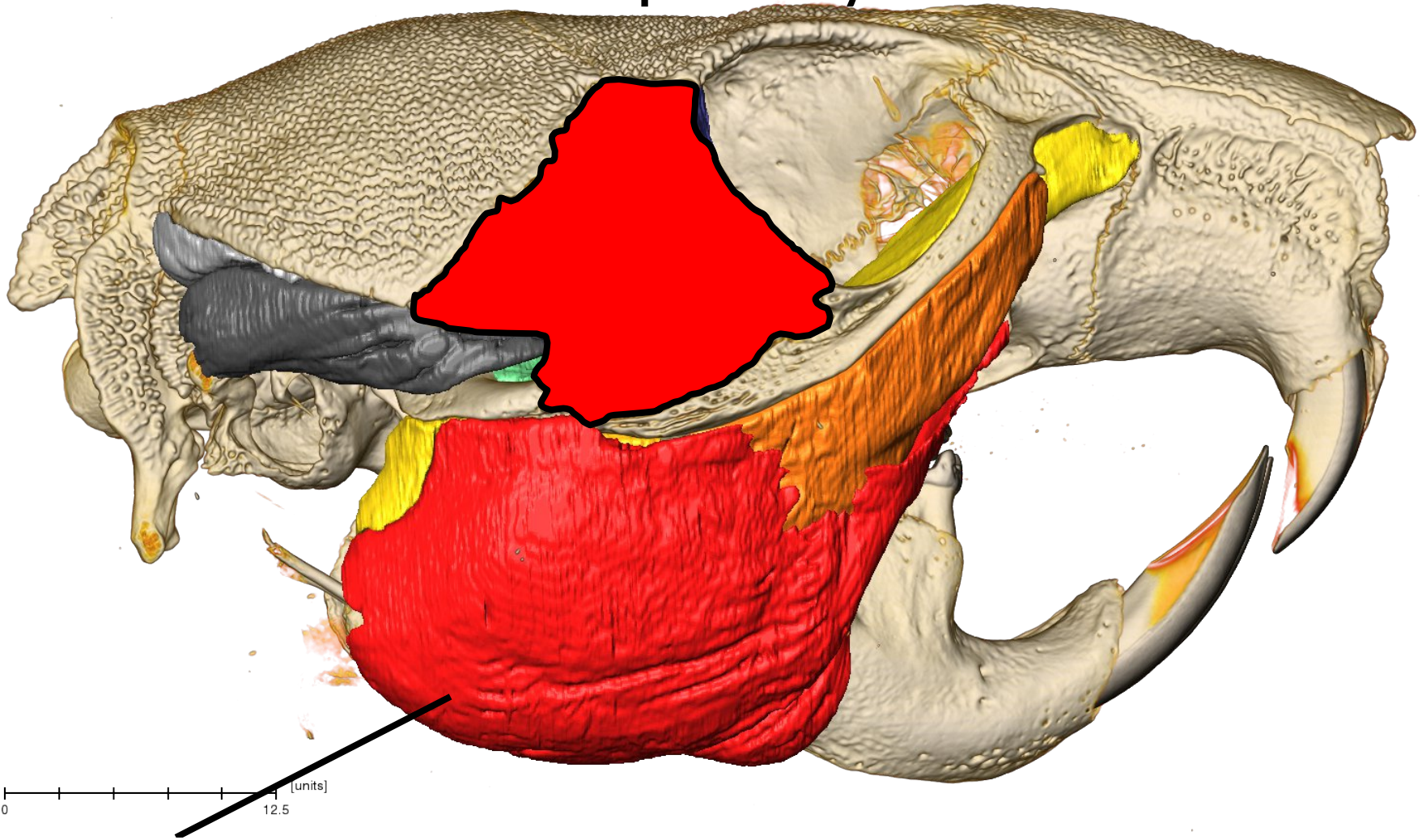
Which muscles are associated to the jugal bone in rodents



Posterior Deep Masseter

Lateral masseter muscles

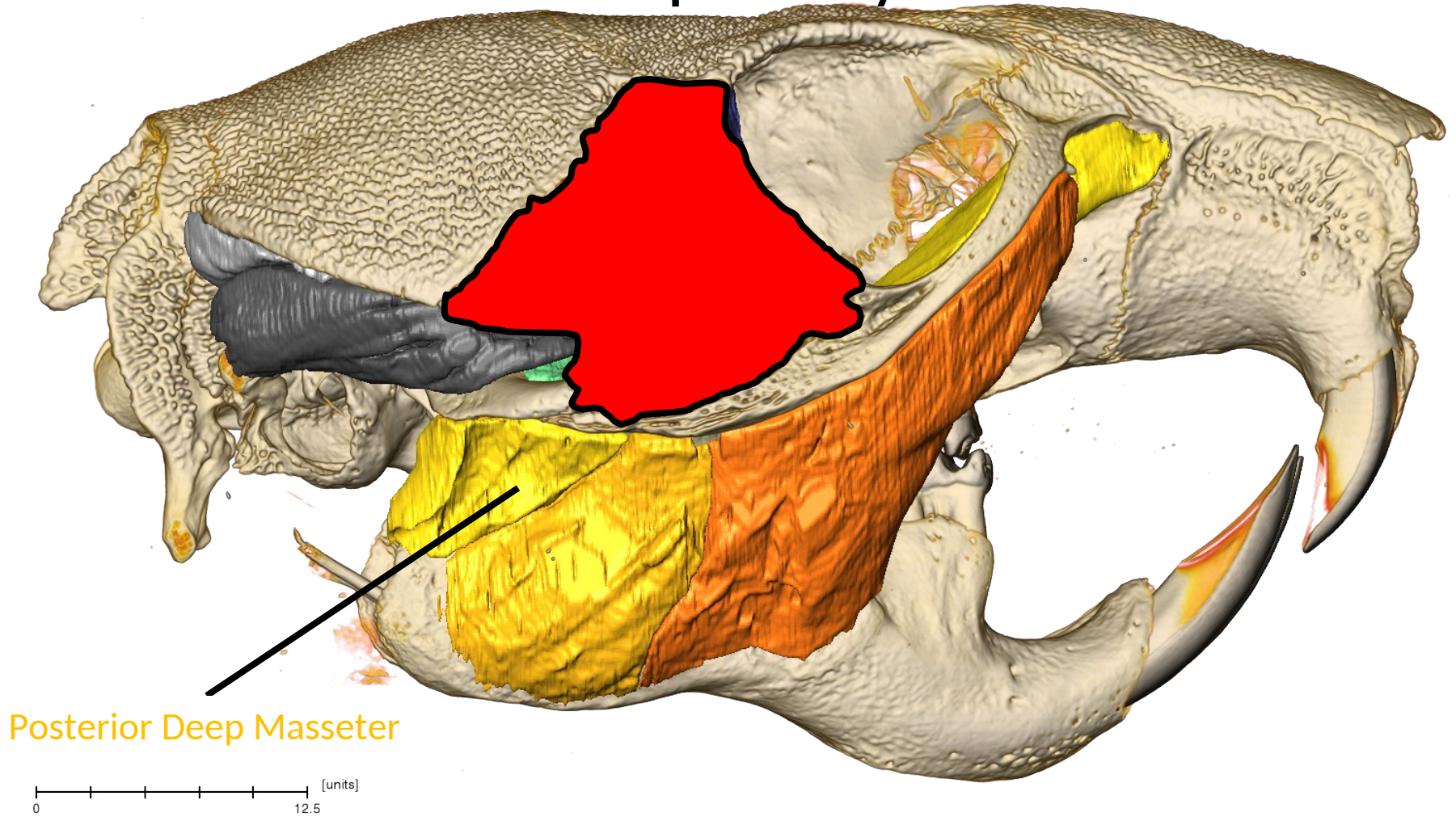
Which muscles are associated to the jugal bone in *Lophiomys*



Superficial Masseter

Lateral masseter muscles

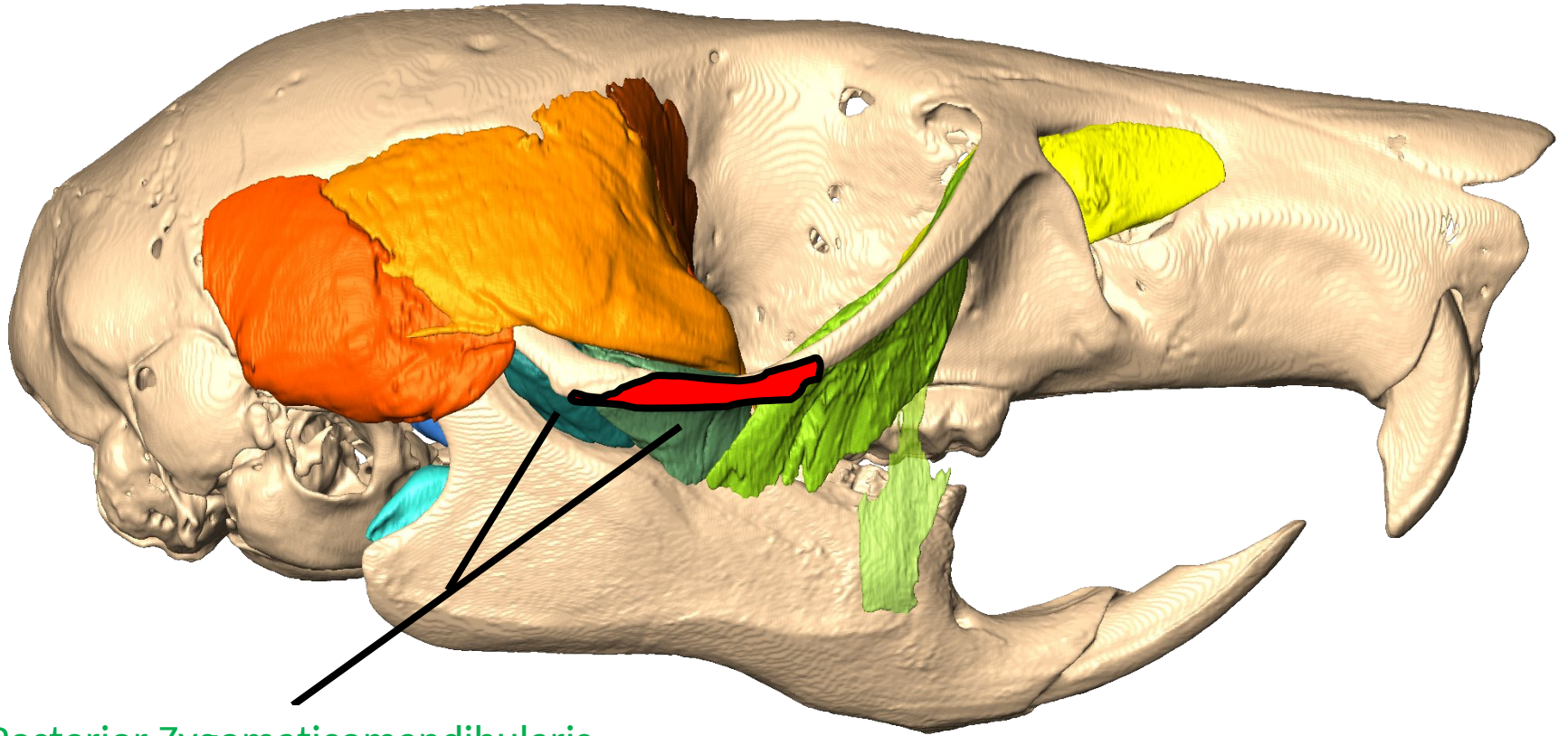
Which muscles are associated to the jugal bone in Lophiomys



Posterior Deep Masseter

Lateral masseter muscles

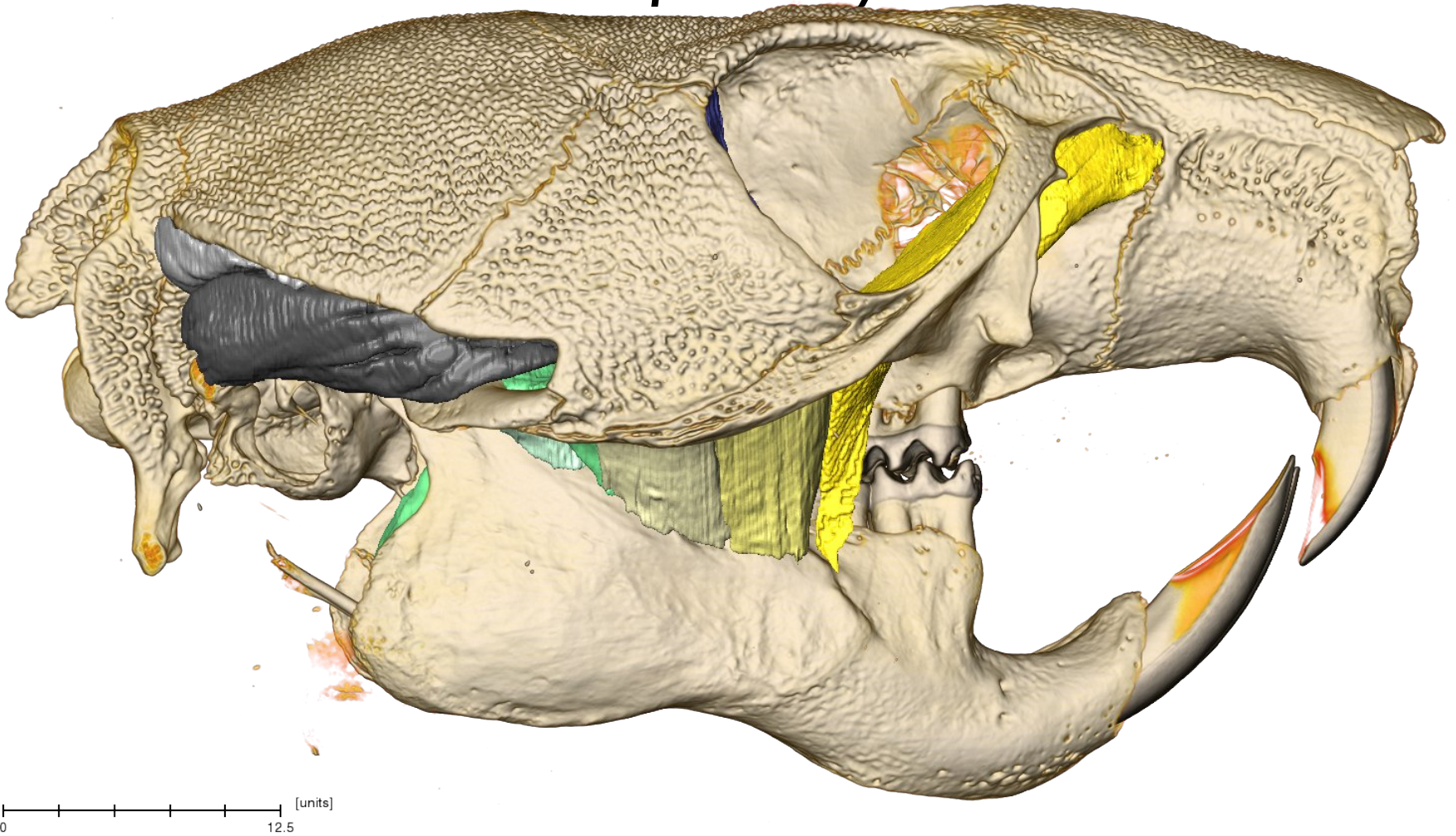
Which muscles are associated to the jugal bone in rodents



Posterior Zygomaticomandibularis

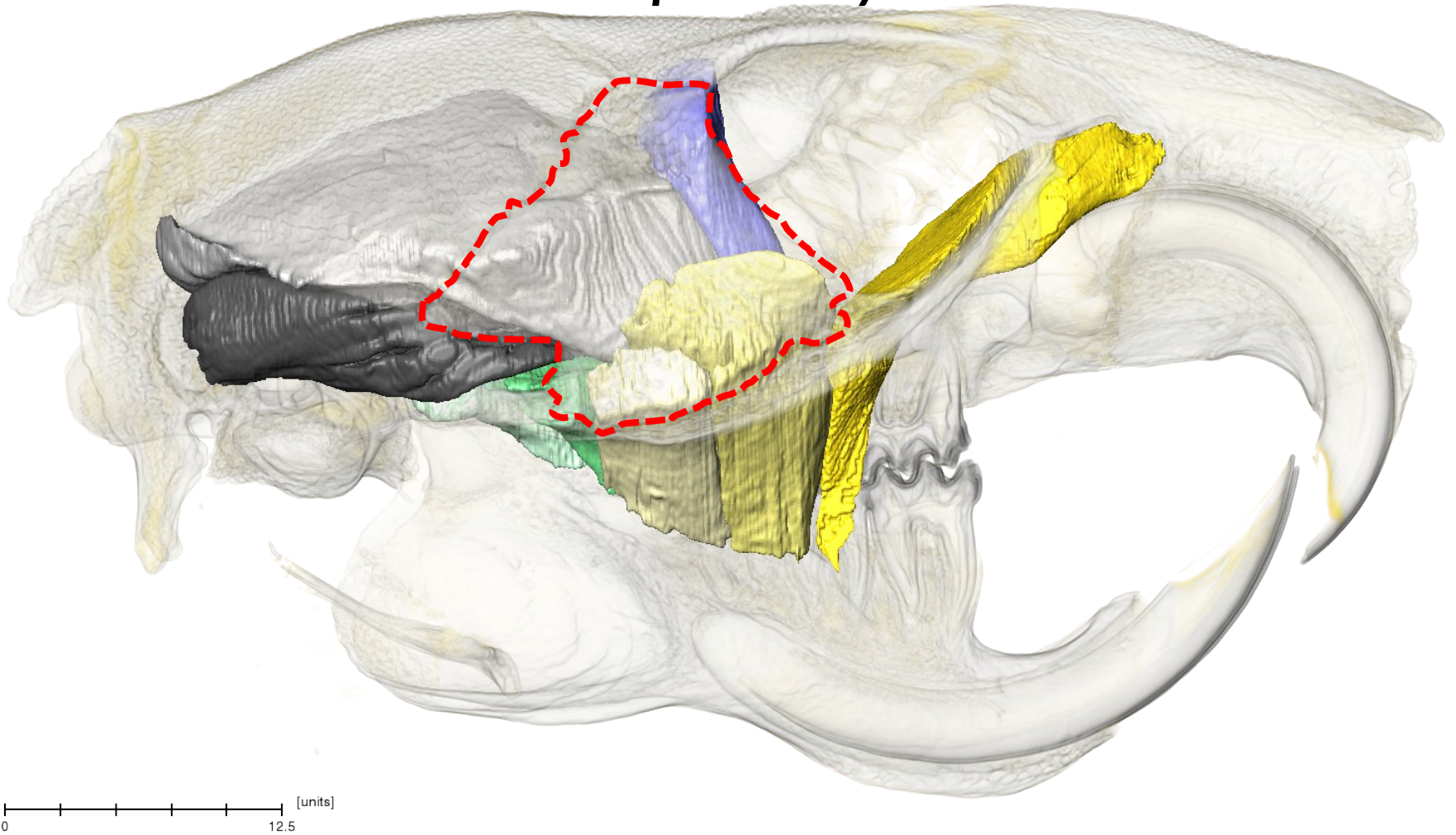
Medial masseter muscles

Which muscles are associated to the jugal bone in *Lophiomys*



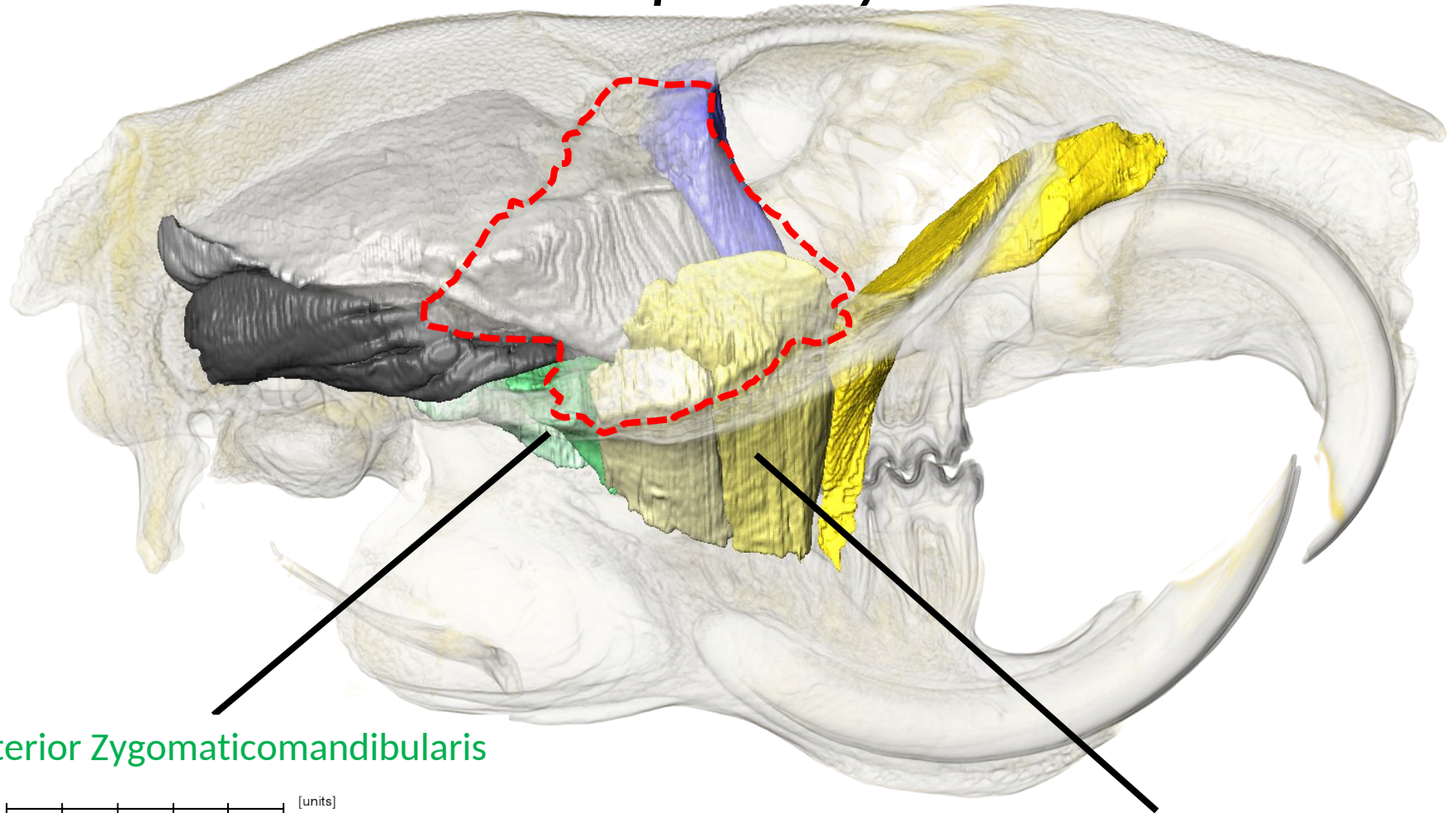
Medial masseter muscles

Which muscles are associated to the jugal bone in *Lophiomys*

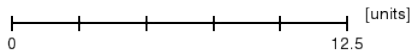


Medial masseter muscles

Which muscles are associated to the jugal bone in *Lophiomys*



Posterior Zygomaticomandibularis

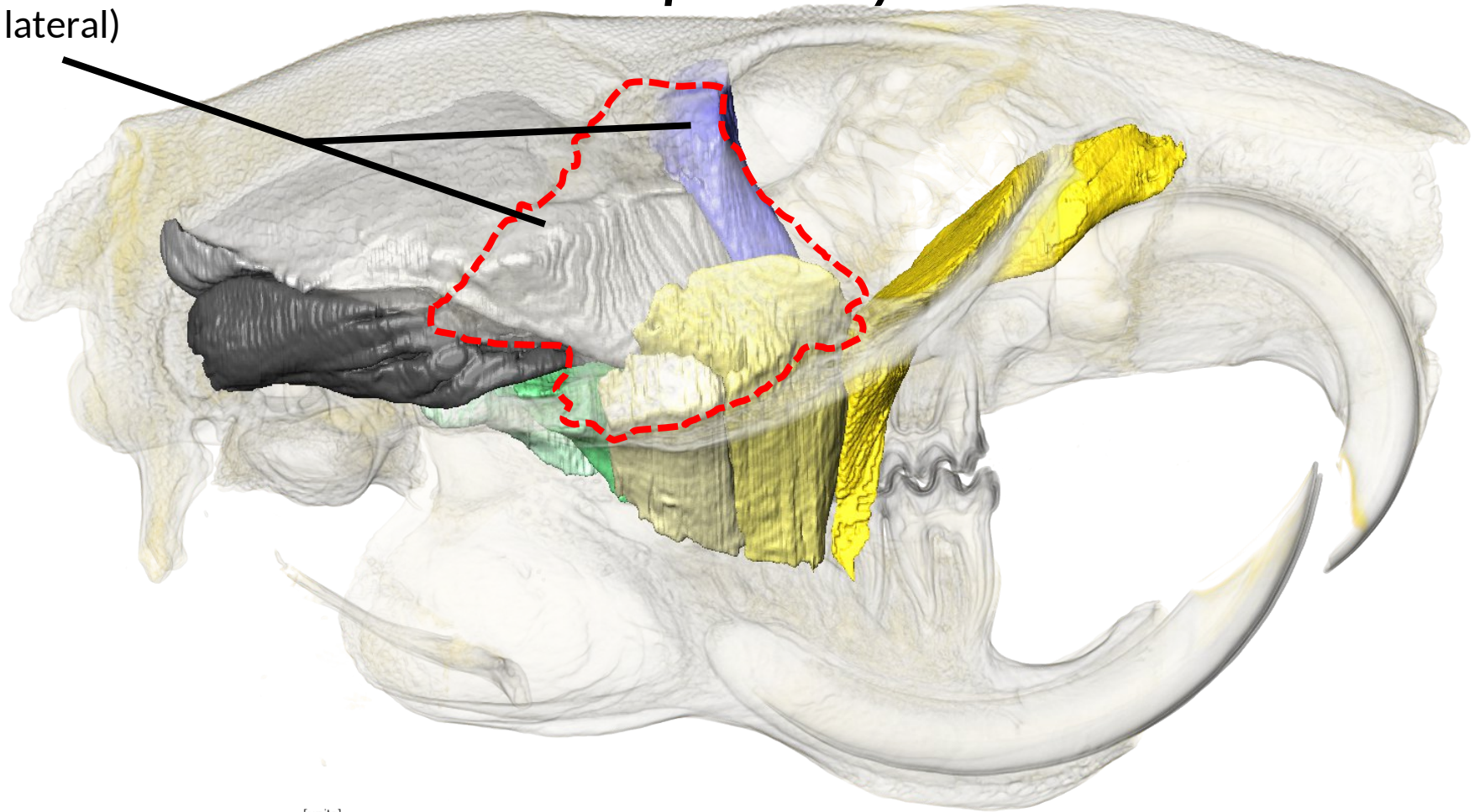


Anterior Zygomaticomandibularis

Medial masseter muscles

Which muscles are associated to the jugal bone in *Lophiomys*

Temporalis (pars orbital and lateral)



0 12.5 [units]

Temporalis muscles (the sea turtle muscle)

Is the Maned Rat *Lophiomys imhausi*
(Muridae, Lophiomyinae) converging toward
a sea turtle jaw muscle morphology ?

Conclusions:

Yes, in some ways as he developed a bony shelf from the jugal, squamosal, and parietal bones on which attached the temporalis muscles

However, it retains several mammalian and rodents characters along with a set of unique ones

It represent a second case of convergence toward a derivate anapsidy in vertebrates

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with one lost documented fossil intermediary

