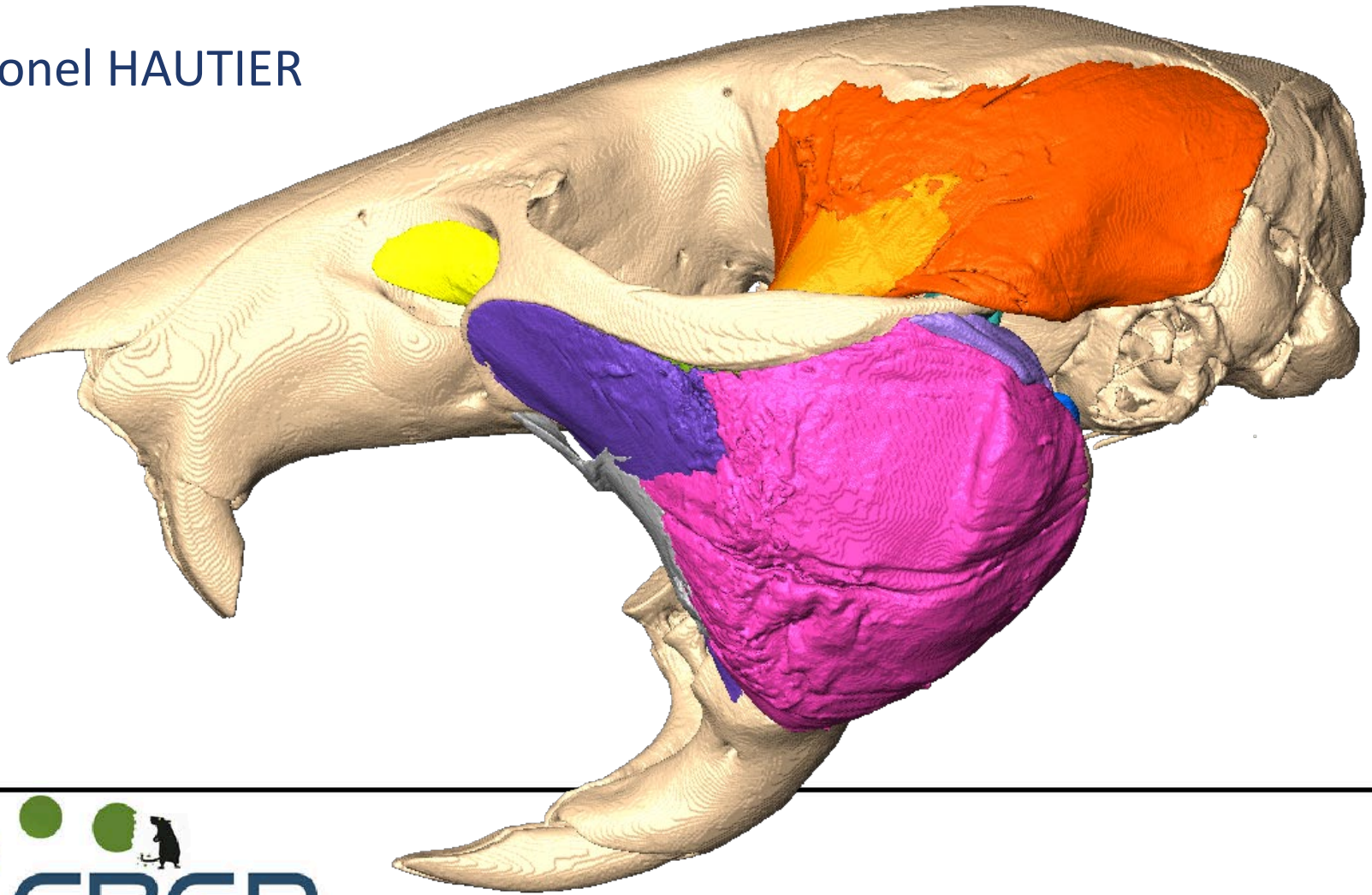


Evolution de l'appareil masticateur des rongeurs Nesomyidae

Lionel HAUTIER



Do you really know rodents?

Which one is a rodent?



Do you really know rodents?

Which one is a rodent?



Glis glis

The fat dormouse



Acrobates pygmaeus

A marsupial

Do you really know rodents?

Which one is a rodent?



Do you really know rodents?

Which one is a rodent?



Chrysochloris asiatica

An afrotherian



Spalax microphthalmus

Greater mole rat

Do you really know rodents?

Which one is a rodent?

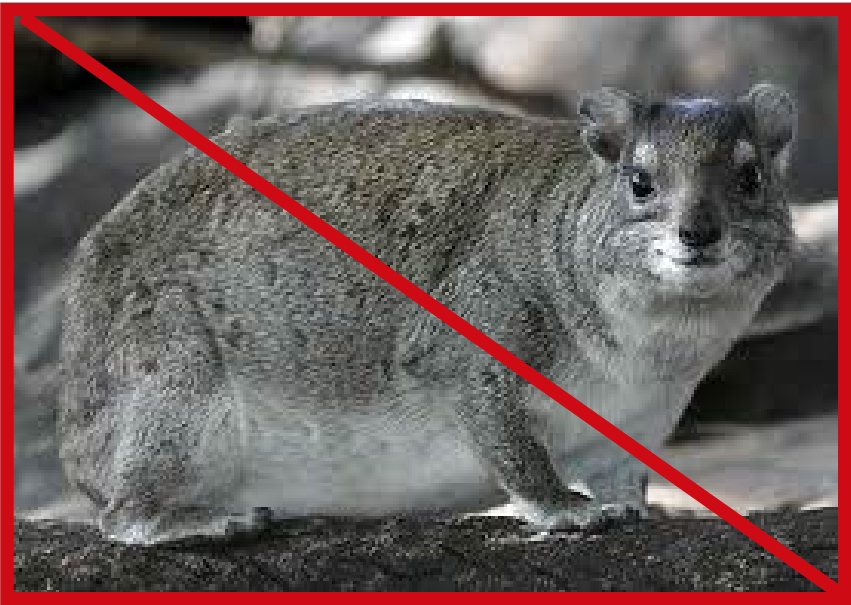


Do you really know rodents?

Which one is a rodent?



Kerodon rupestris
Guinea pig relative



Procavia capensis
An afrotherian



Do you really know your rodents?

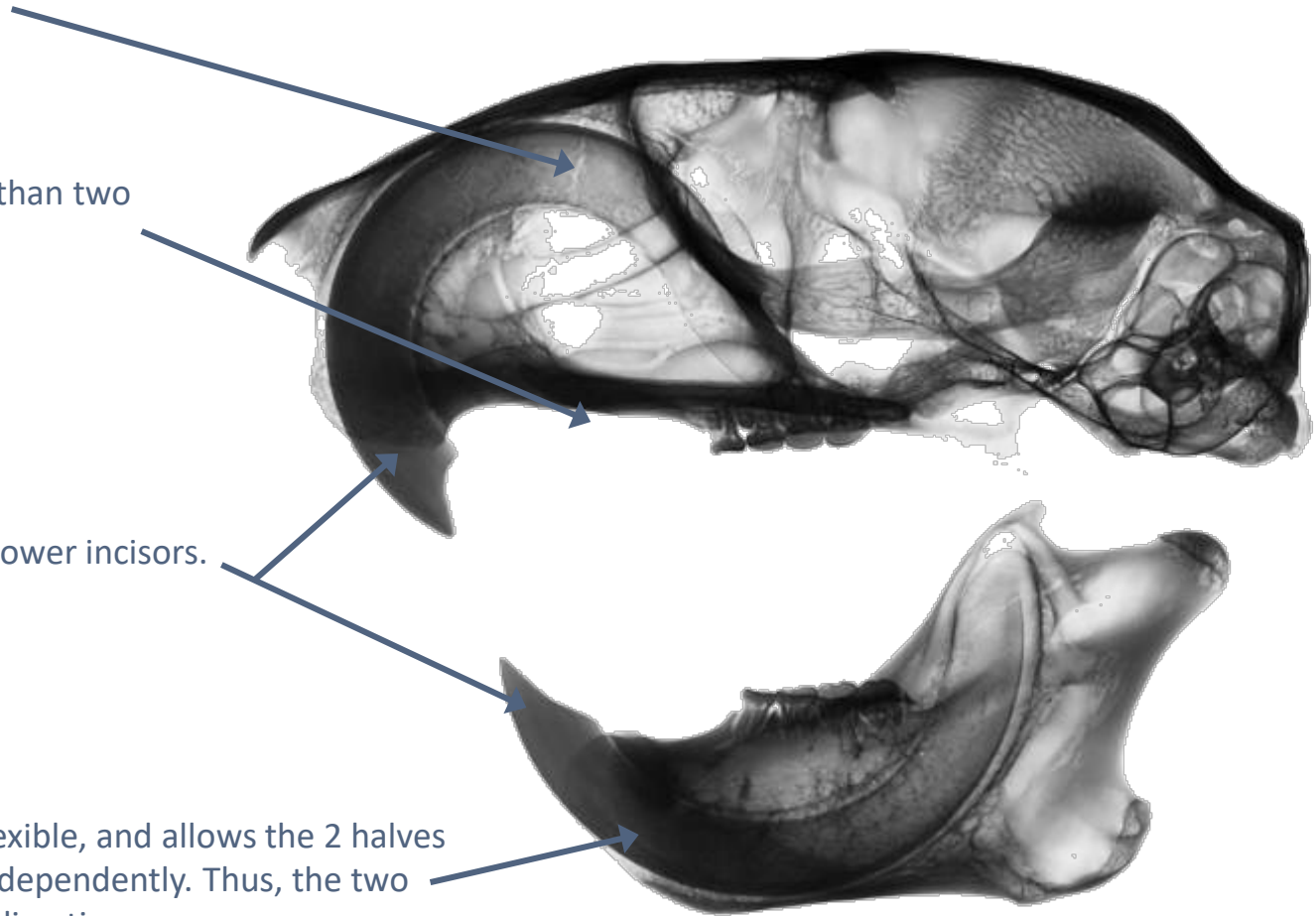
- **The diprotodonty**, teeth greatly reduced from the primitive eutherian number.

Incisors are open-rooted and ever-growing; anterior side is enamel and wears slower than posterior side (forms a chisel).

No canine and never more than two premolars: diastema.

Single pair of upper and lower incisors.

The mandibular symphysis is flexible, and allows the 2 halves of the dentary to move semi-independently. Thus, the two rami can be pulled in different directions.



The rodents

Rodentia (2600 species)

45% of placentals !



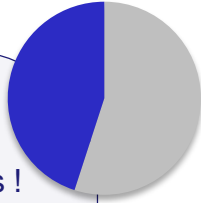
All rodents display a diprotodont skull!



Constrained phenotypic variation

=

A case study to study convergent evolution



The rodents

Rodentia (2600 species)

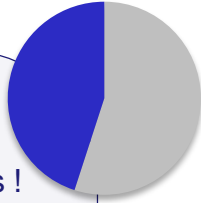


45% of placentals !

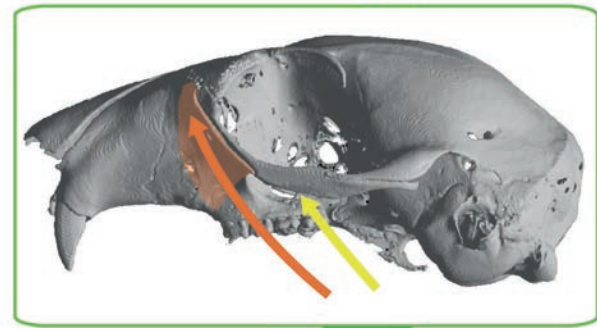
All rodents display a diprotodont skull!



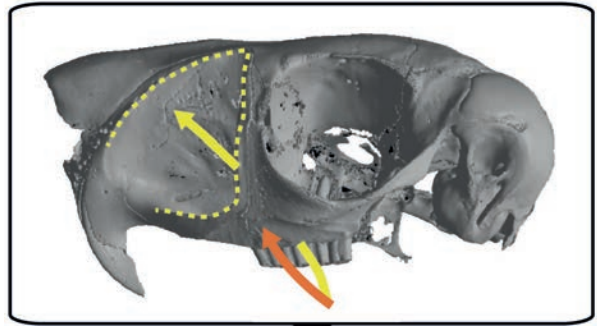
Constrained phenotypic variation
=
A case study to study convergent evolution



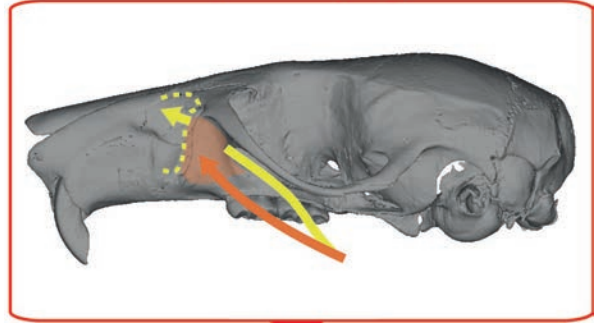
Sciuromorphy



Hystricomorphy



Myomorphy

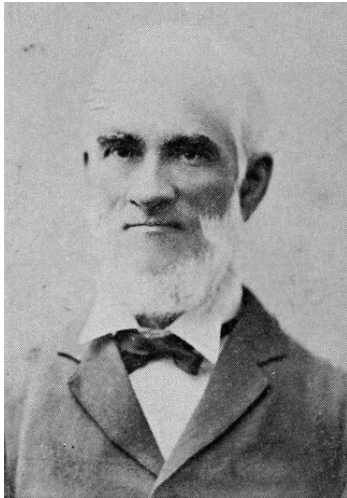
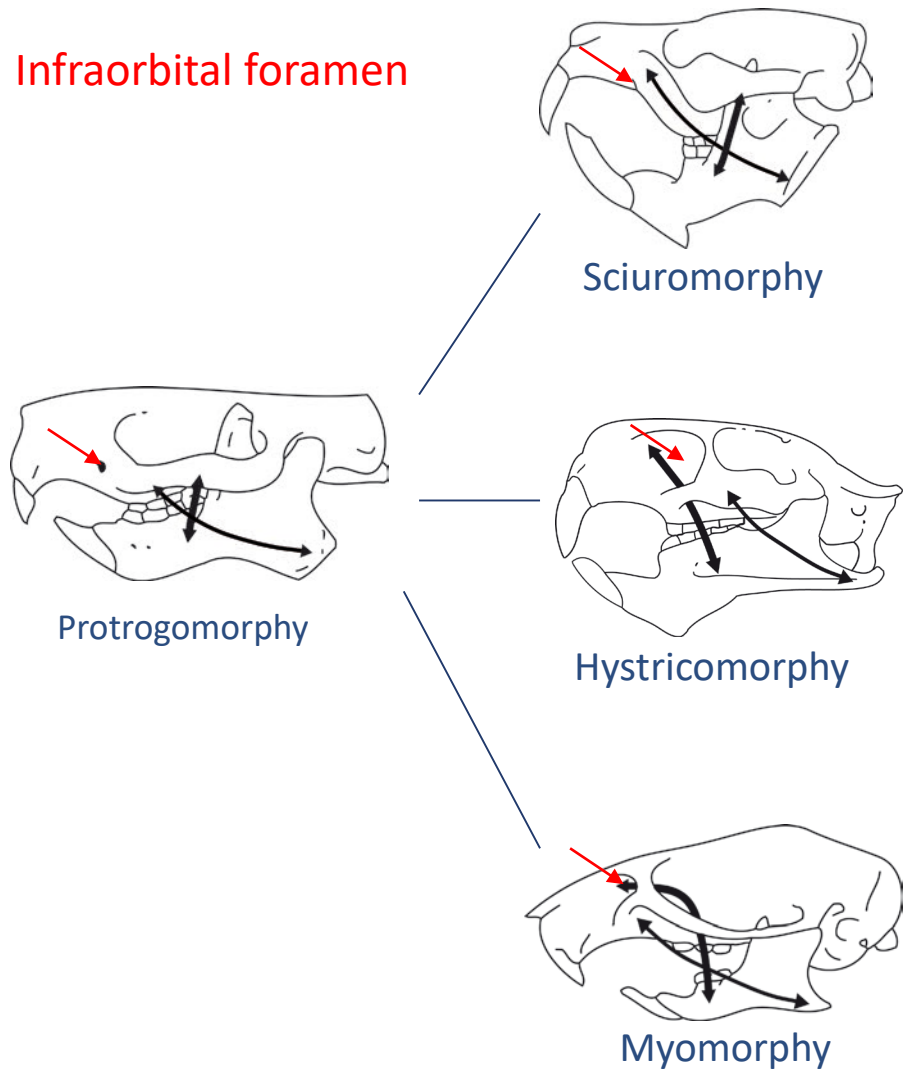


Morphotype = Suborder

About old classifications

4 skull morphotypes ↔ 4 suborders

Infraorbital foramen



G. R. Waterhouse (1810-1888)



J. F. von Brandt (1802-1879)

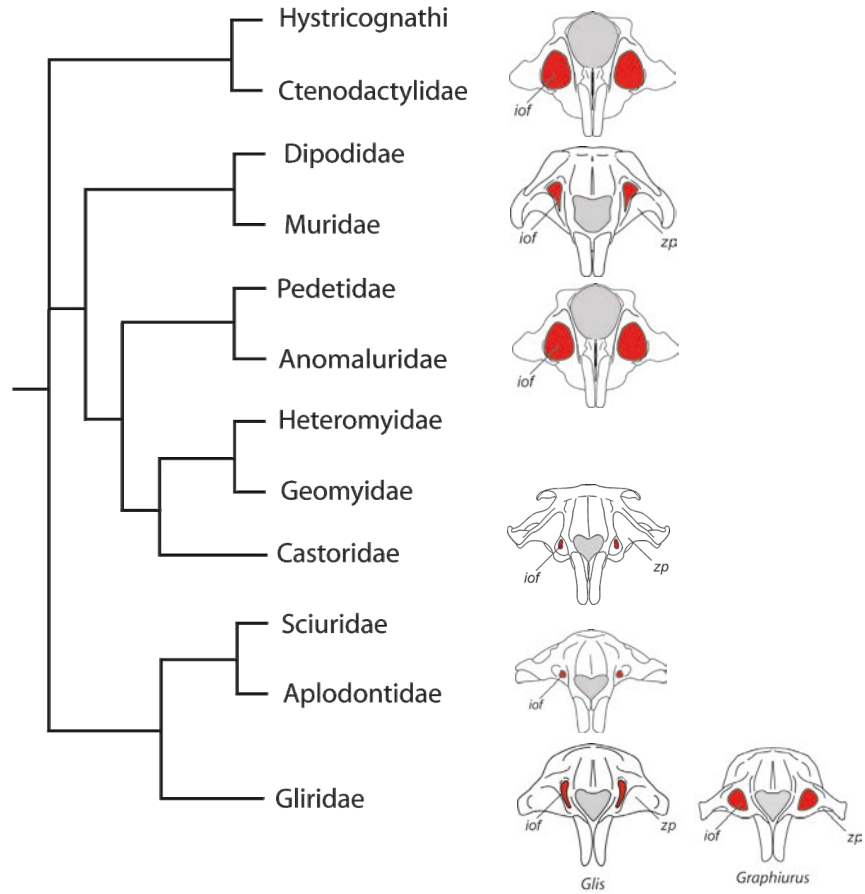
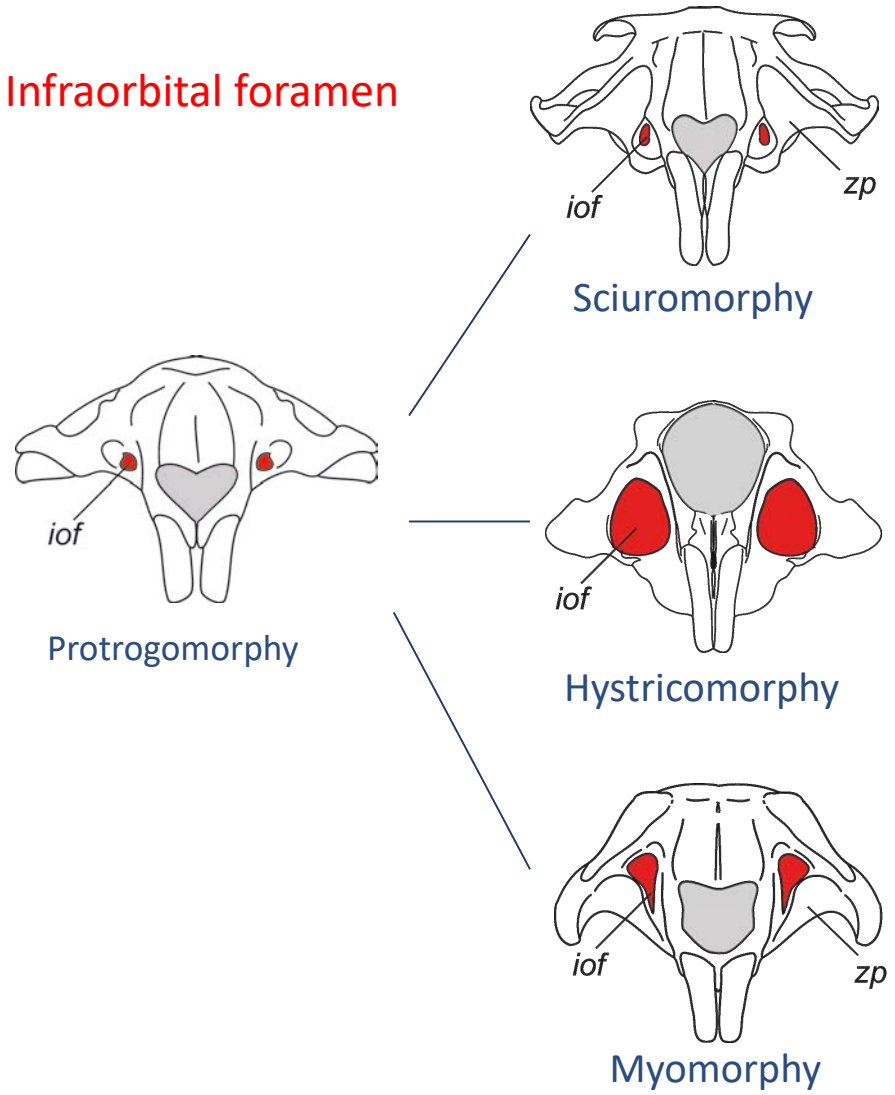


Albert Wood (1910-2002)

About old classifications

4 skull morphotypes ↔ 4 suborders

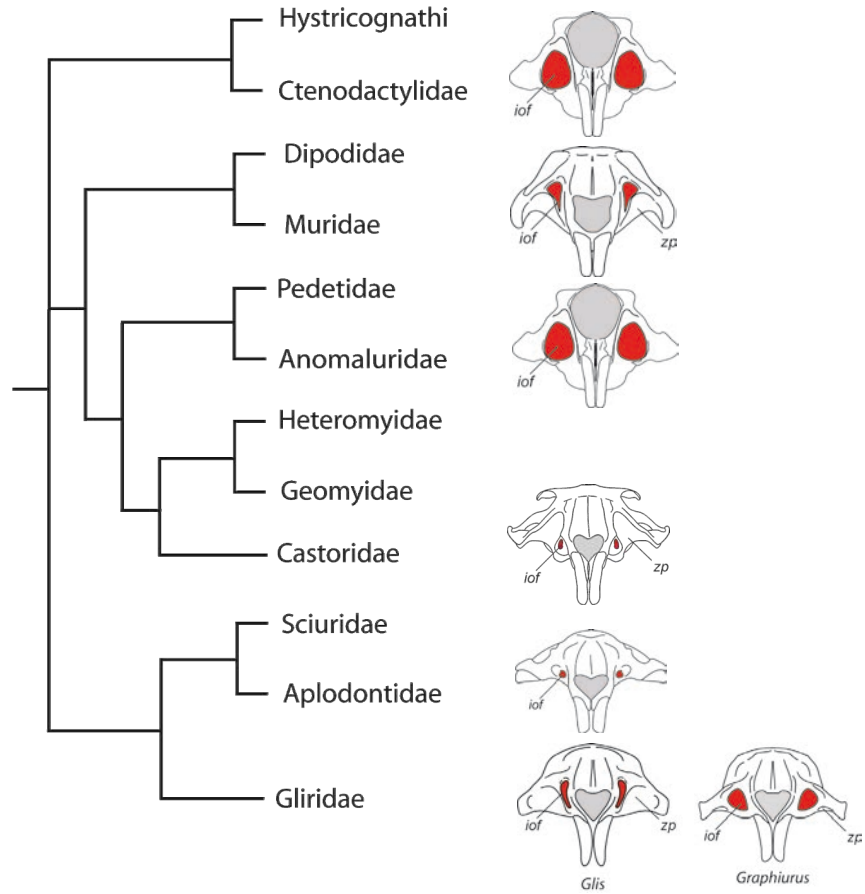
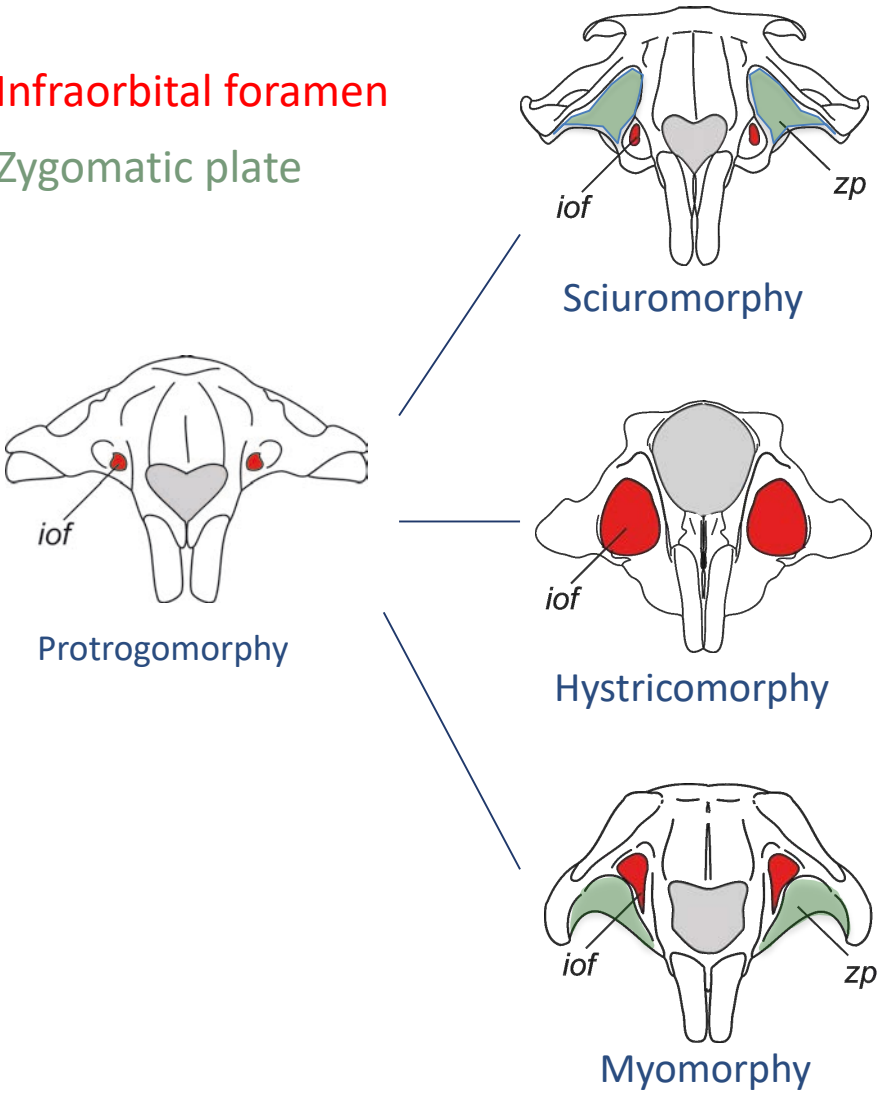
Infraorbital foramen



About old classifications

4 skull morphotypes ↔ 4 suborders

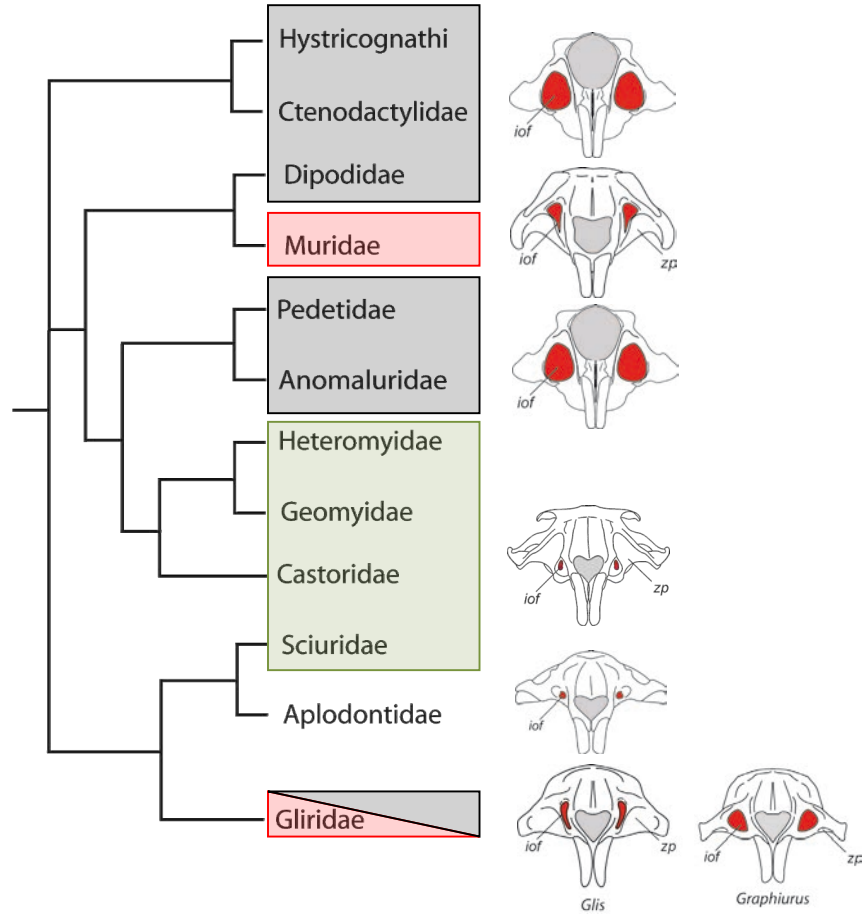
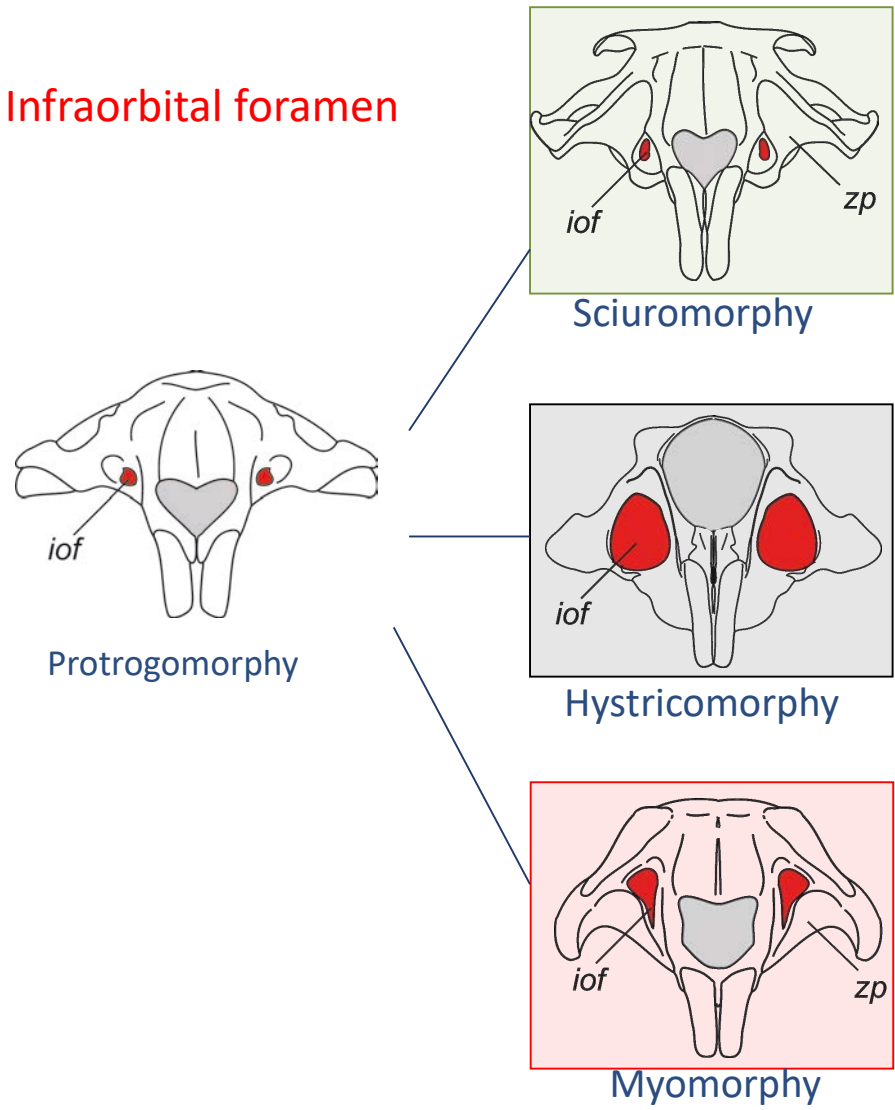
Infraorbital foramen
Zygomatic plate



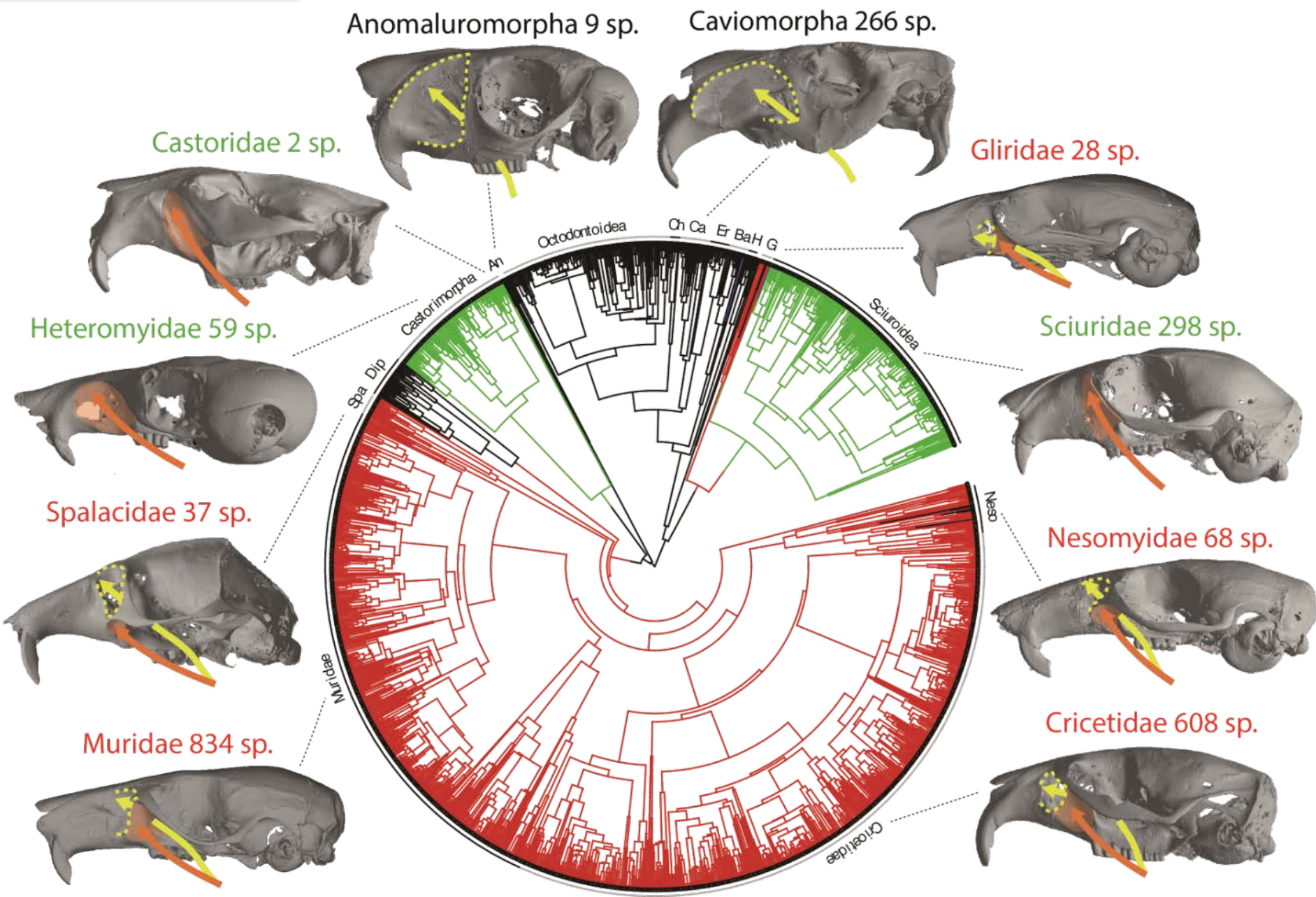
About old classifications

4 skull morphotypes ↔ 4 suborders

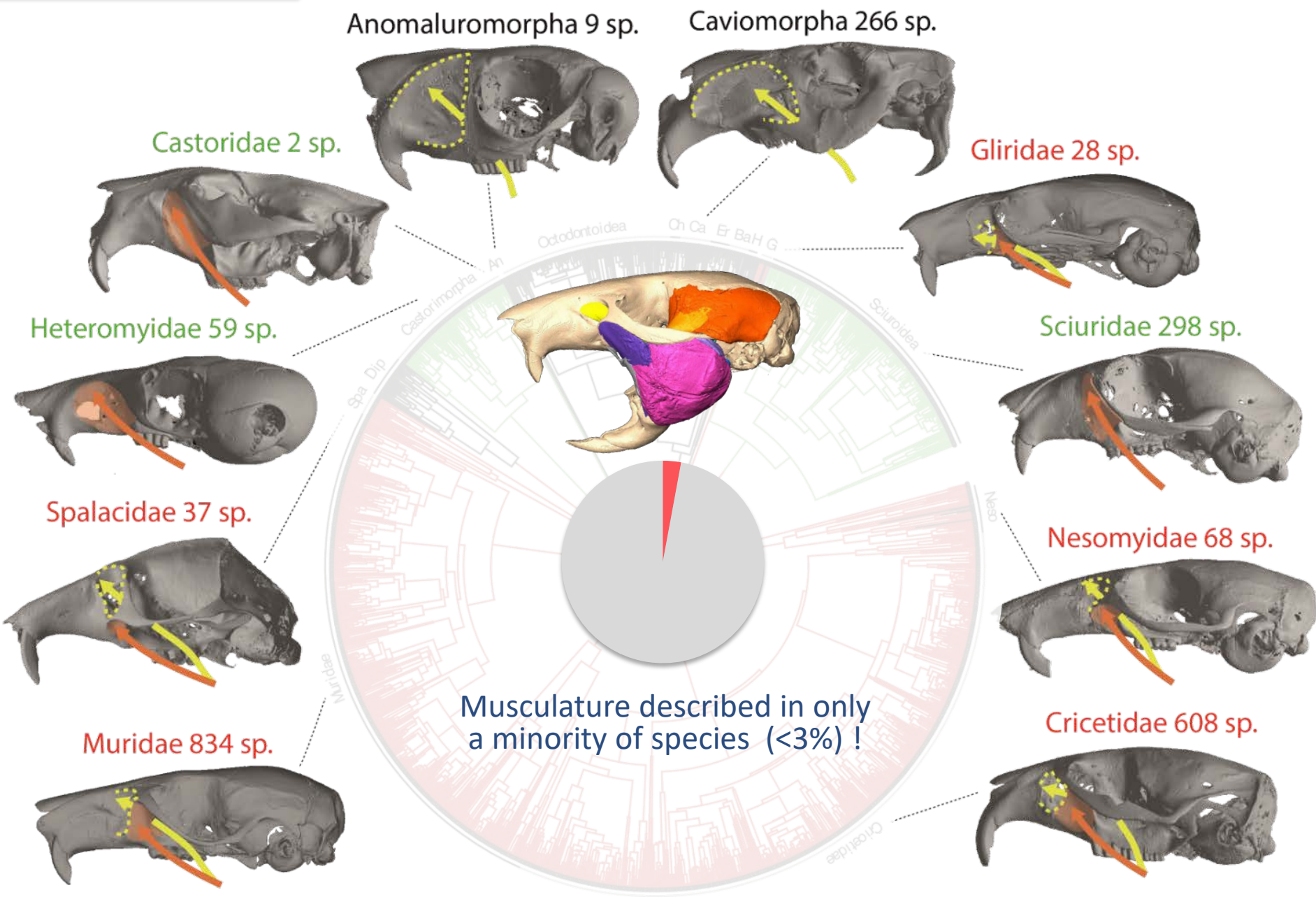
Infraorbital foramen



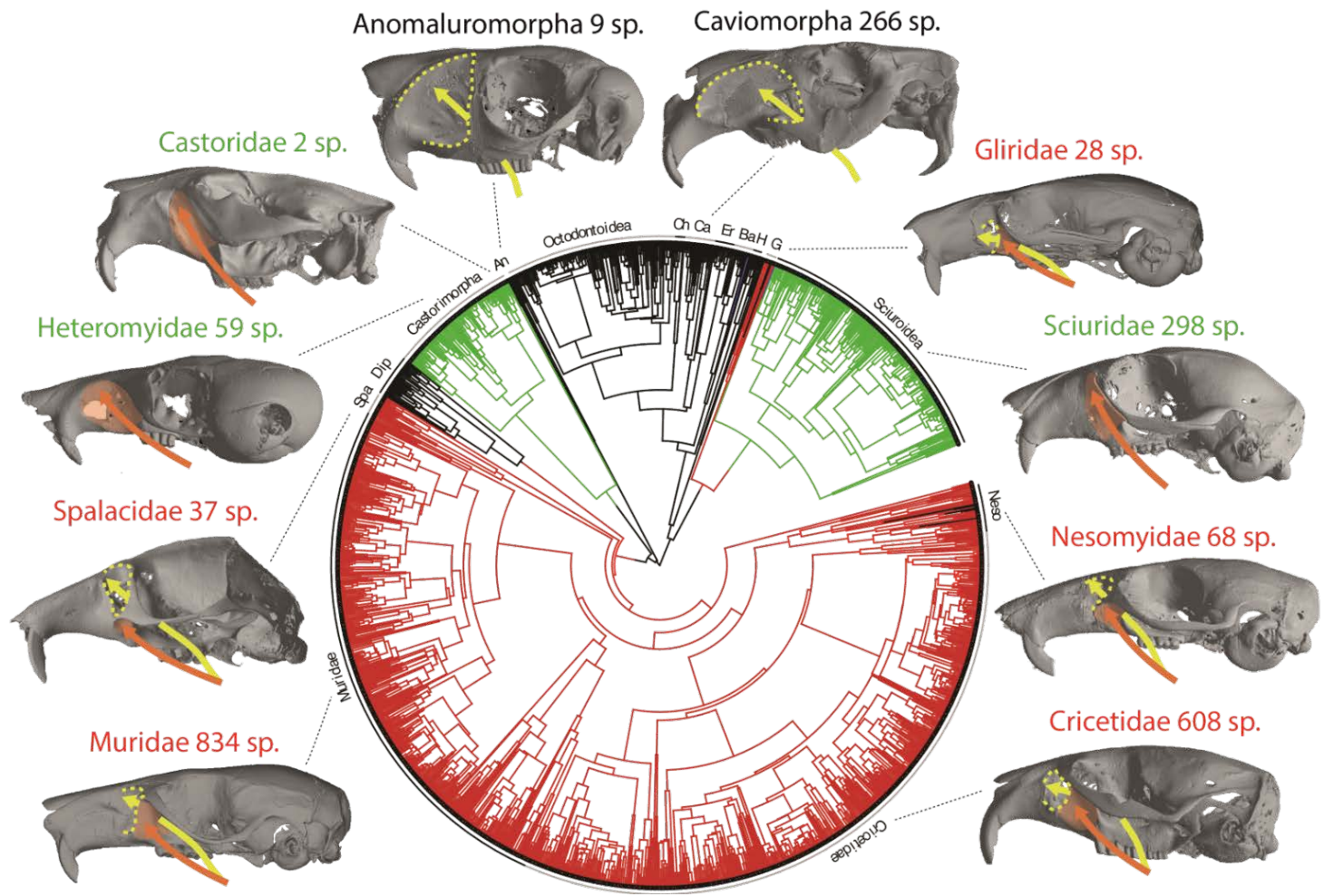
And new ones



And new ones



Where do we start?

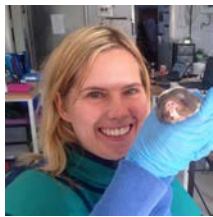


Where do we start?

Léa Da Cunha

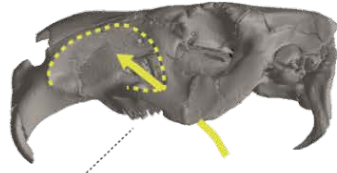
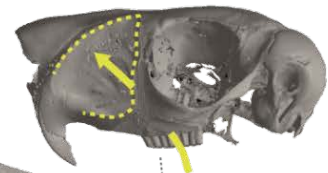


Andrea Kraus



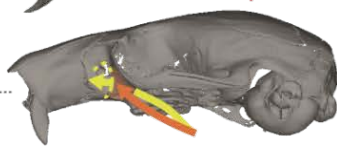
Anomaluromorpha 9 sp.

Caviomorpha 266 sp.



Castoridae 2 sp.

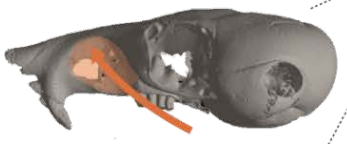
Gliridae 28 sp.



Marcos Alves

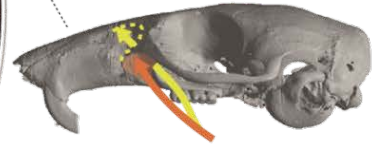
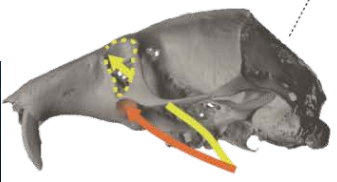
Heteromyidae 59 sp.

Sciuridae 298 sp.



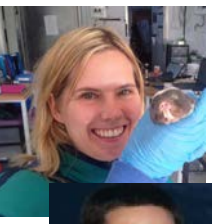
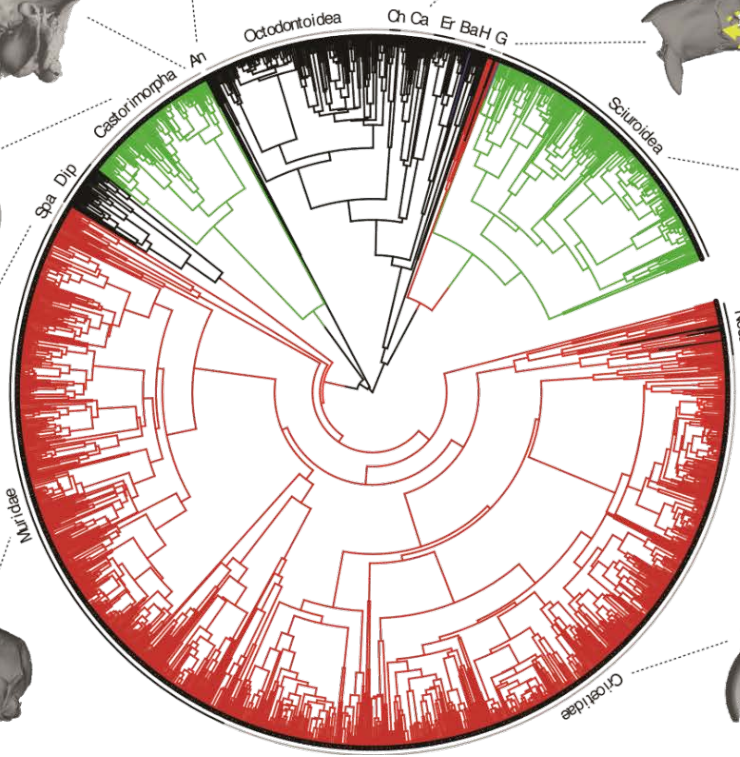
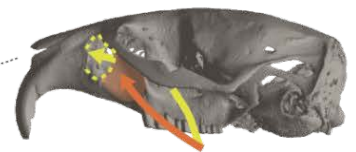
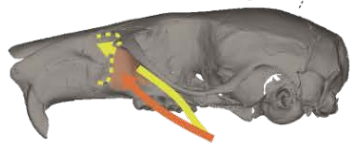
Spalacidae 37 sp.

Nesomyidae 68 sp.



Muridae 834 sp.

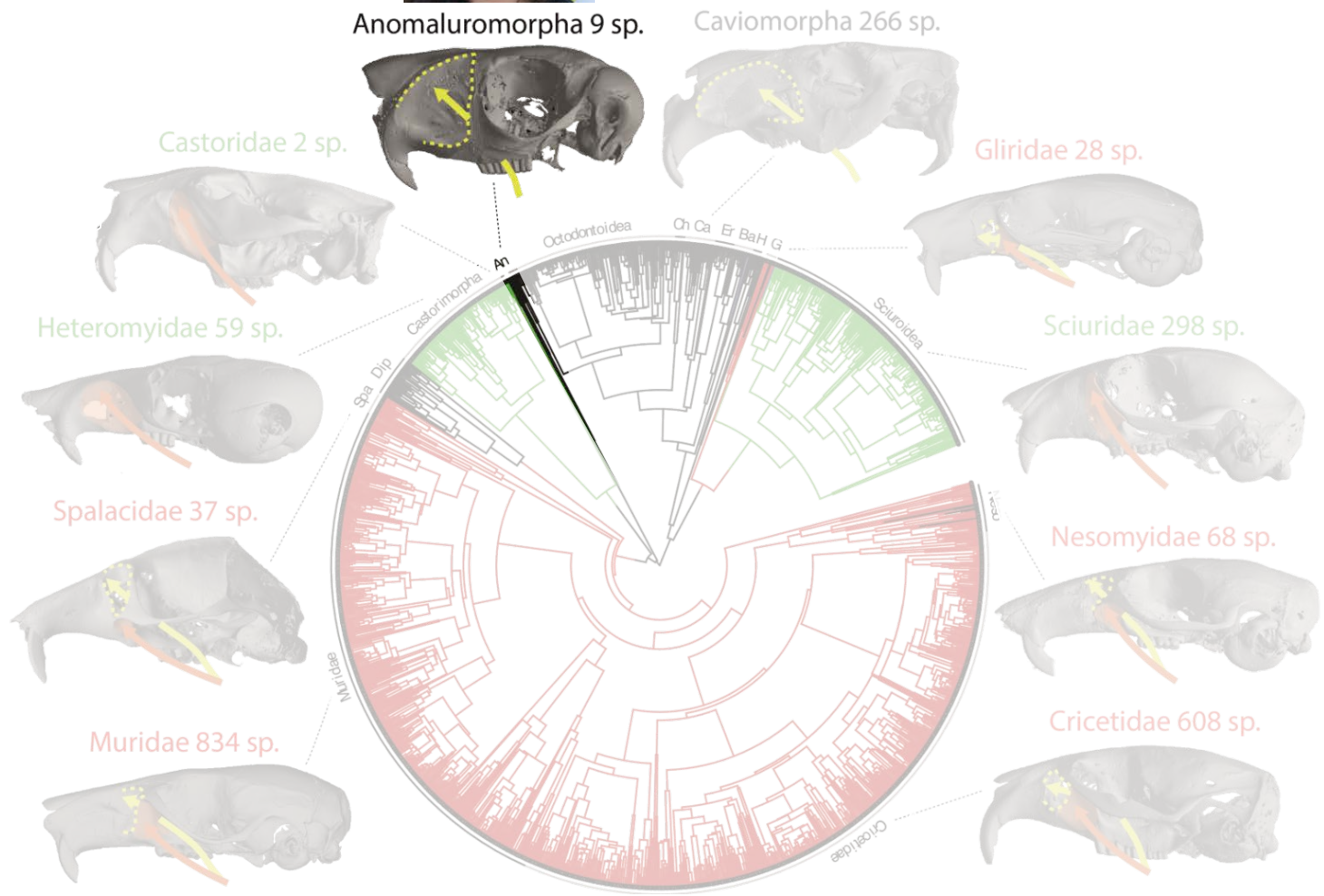
Cricetidae 608 sp.



Pierre-Henri Fabre

Scaly-tailed flying squirrels and springhares

Léa Da Cunha



Scaly-tailed flying squirrels and springhares

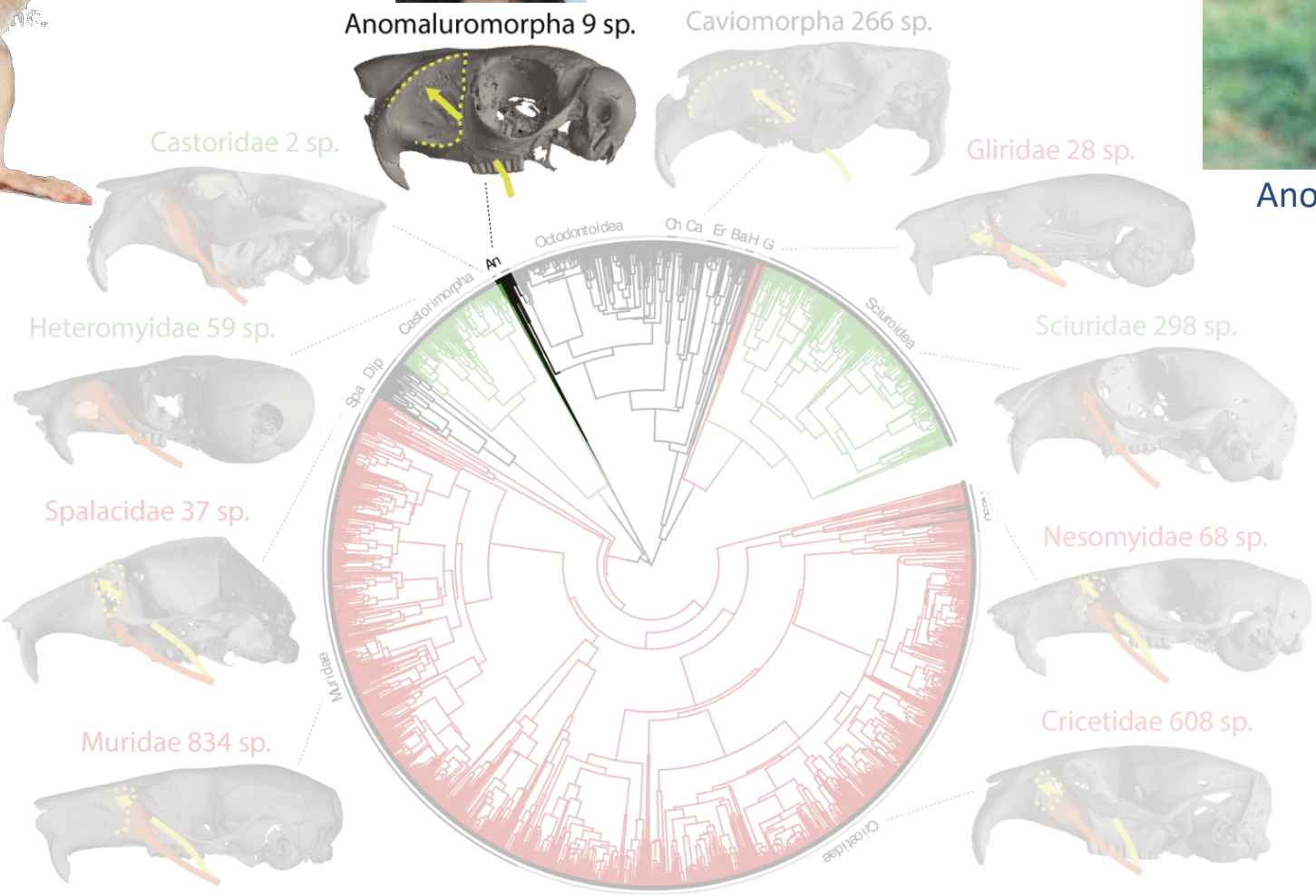
Léa Da Cunha



Pedetidae



Anomaluridae

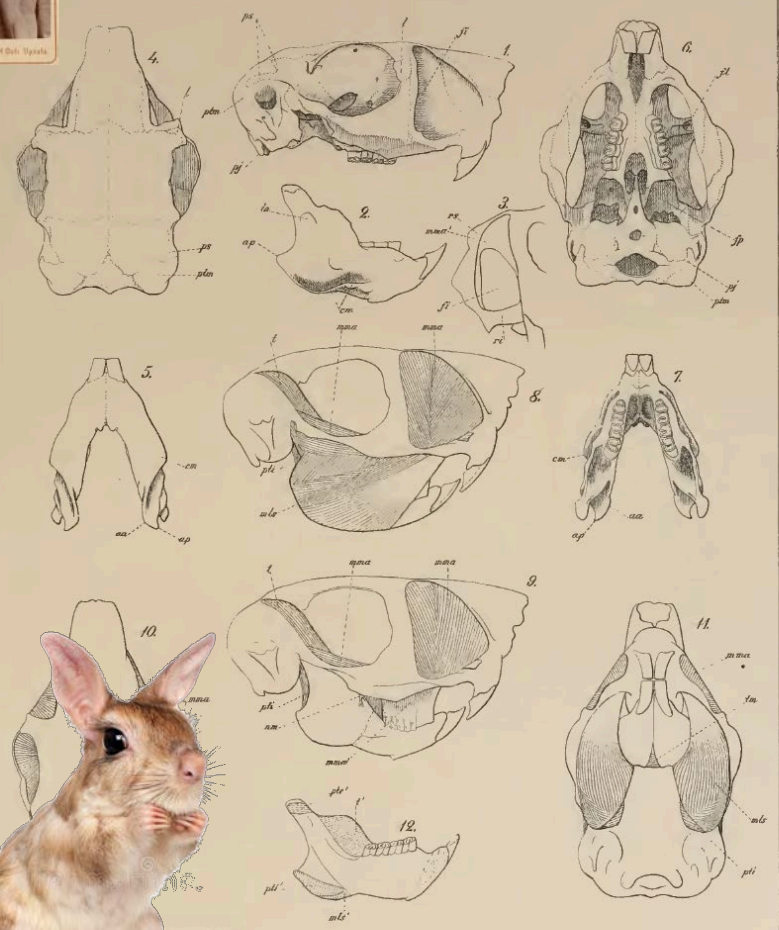


Scaly-tailed squirrels and springhares



T. Tullberg (1899)

Reg. Soc. Sc Ups. Ser. III. T. Tullberg, Najefhiere. Taf. X



Lith. L. Ljunggren Upsala.



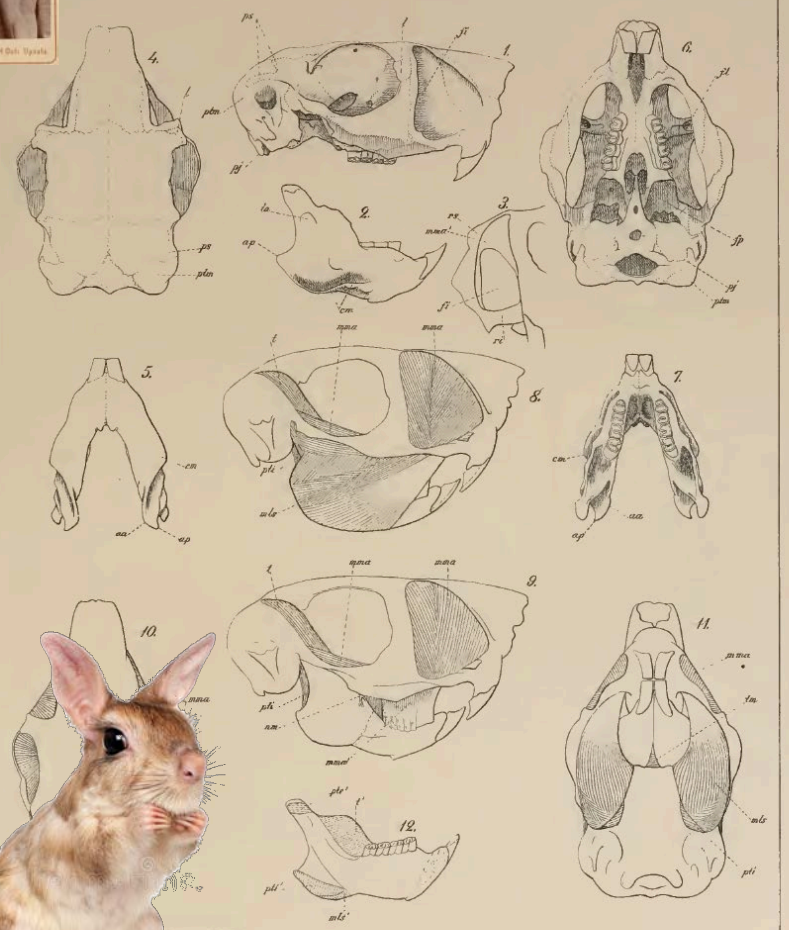
Pedetes

Scaly-tailed squirrels and springhares



T. Tullberg (1899)

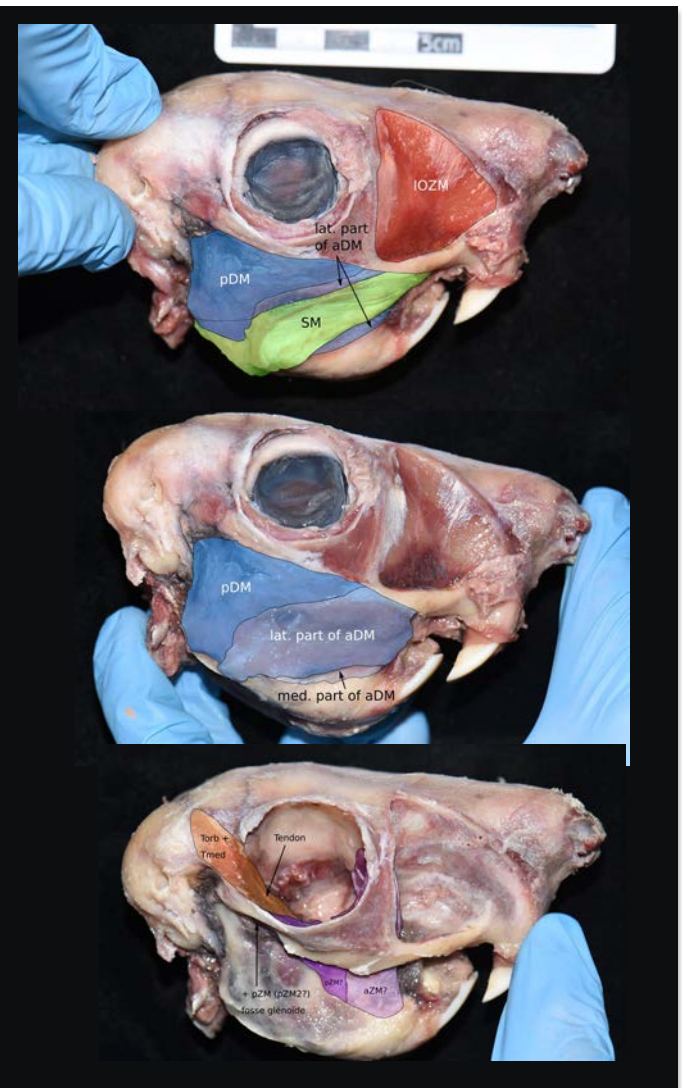
Reg. Soc. Sc Ups. Ser. III. T. Tullberg, Najefhiere. Taf. X



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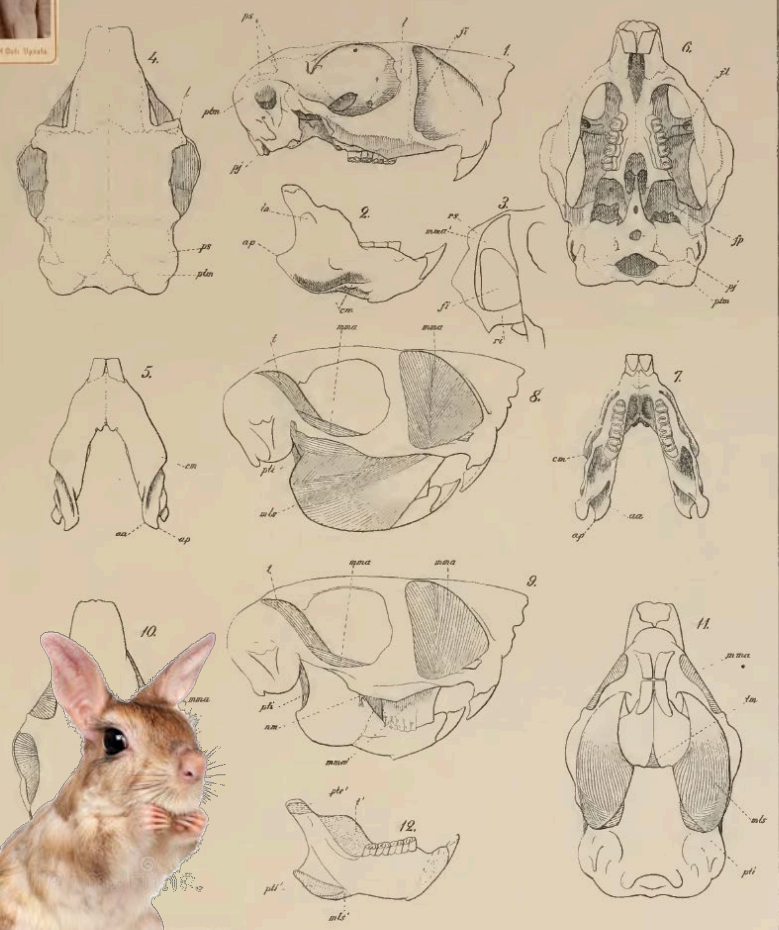
Pedetes





T. Tullberg (1899)

Reg. Soc. Sc Ups. Ser III. T. Tullberg, Najefhiere. Taf. X



Lith. L. Ljunggren Upsala.



Pedetes

The DiceCT revolution

Diffusible Iodine-based Contrast-Enhanced Computed Tomography. Specimens stained by immersion in a 10% solution of I₂KI



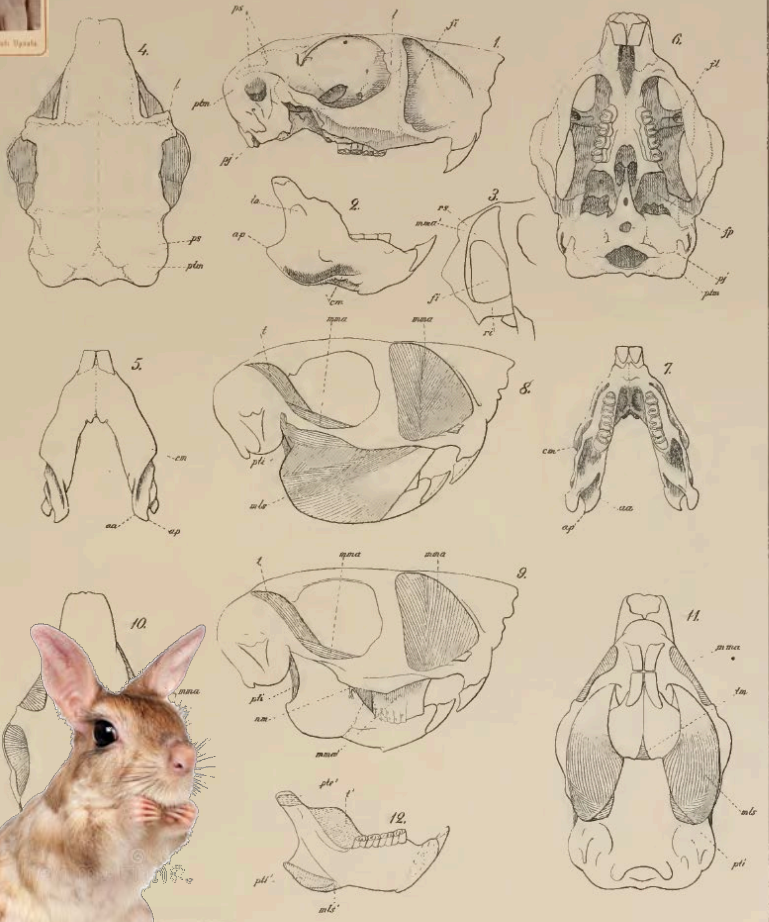
Scaly-tailed squirrels and springhares

Léa Da Cunha



T. Tullberg (1899)

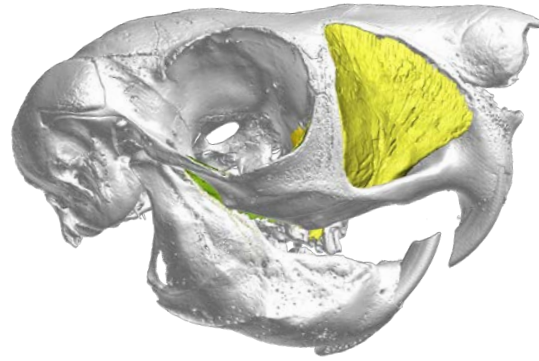
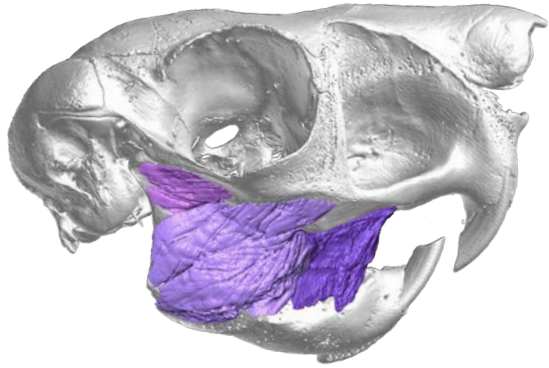
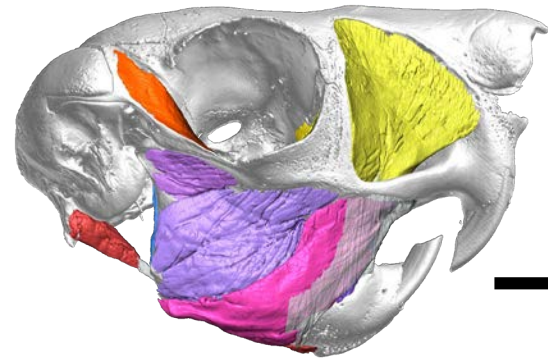
Reg. Soc. Sc Ups. Ser III. T. Tullberg, Najsthiere. Taf. X



Lith. L. Ljunggren Upsala.



Pedetes



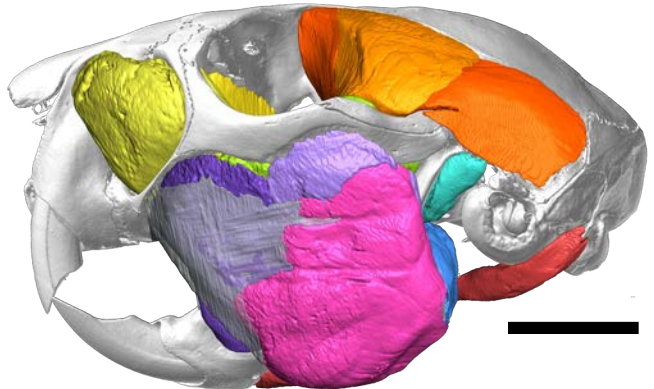
Scale bar : 1cm

Scaly-tailed squirrels and springhares

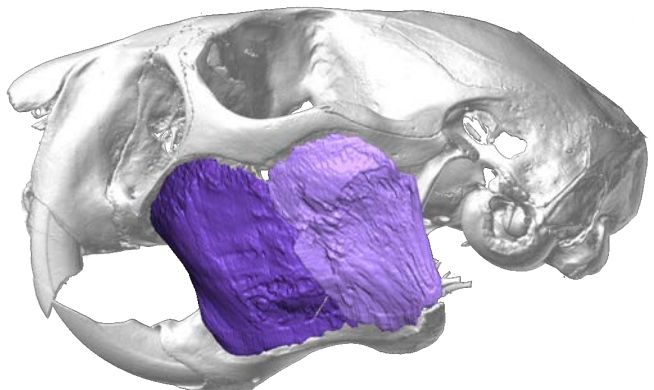
Léa Da Cunha



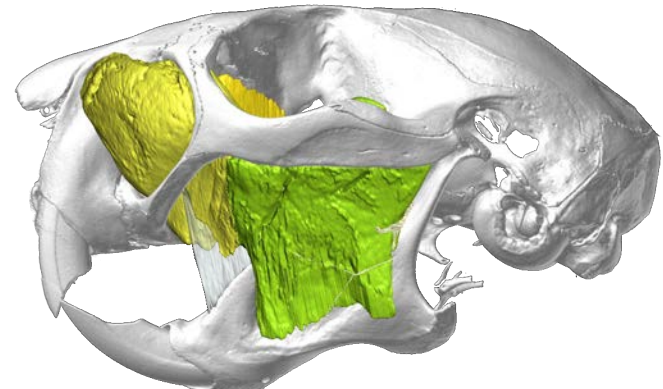
Zenkerella



Deep masseter layer



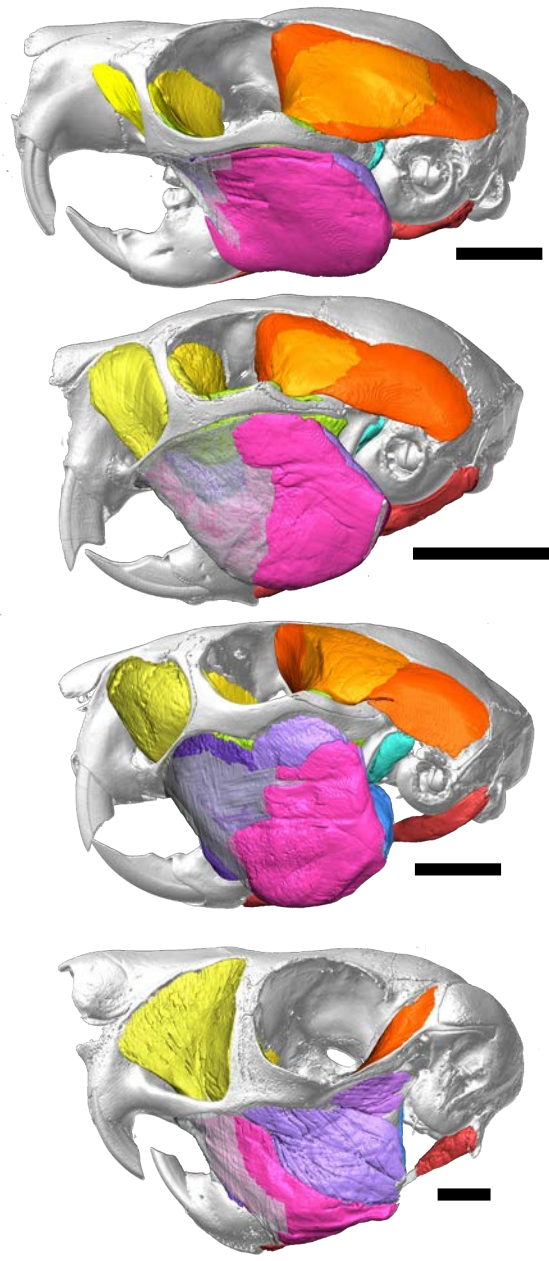
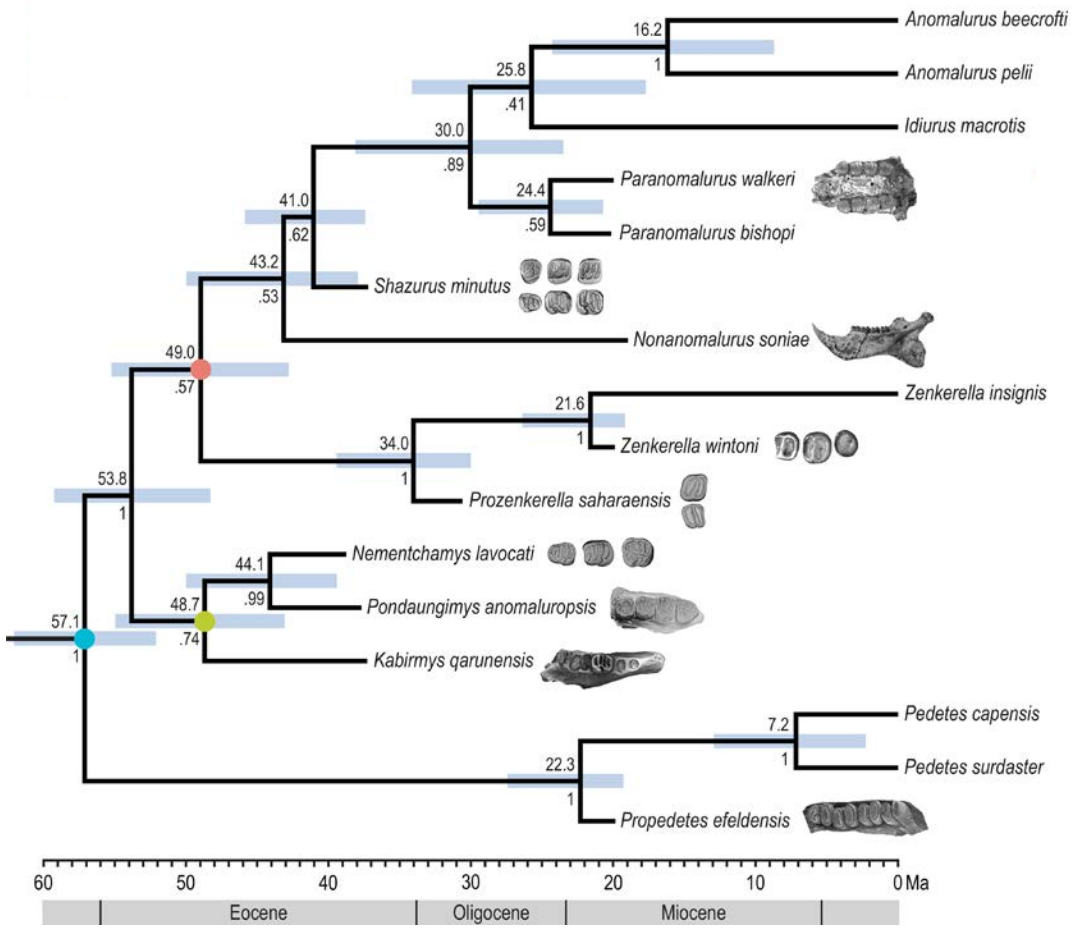
Zygomandibularis layer



Scale bar : 1cm

Scaly-tailed squirrels and springhares

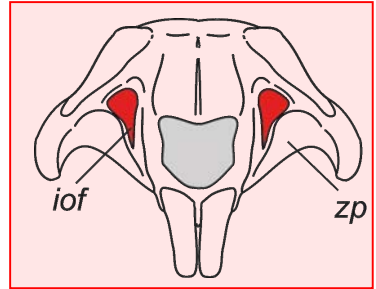
Léa Da Cunha



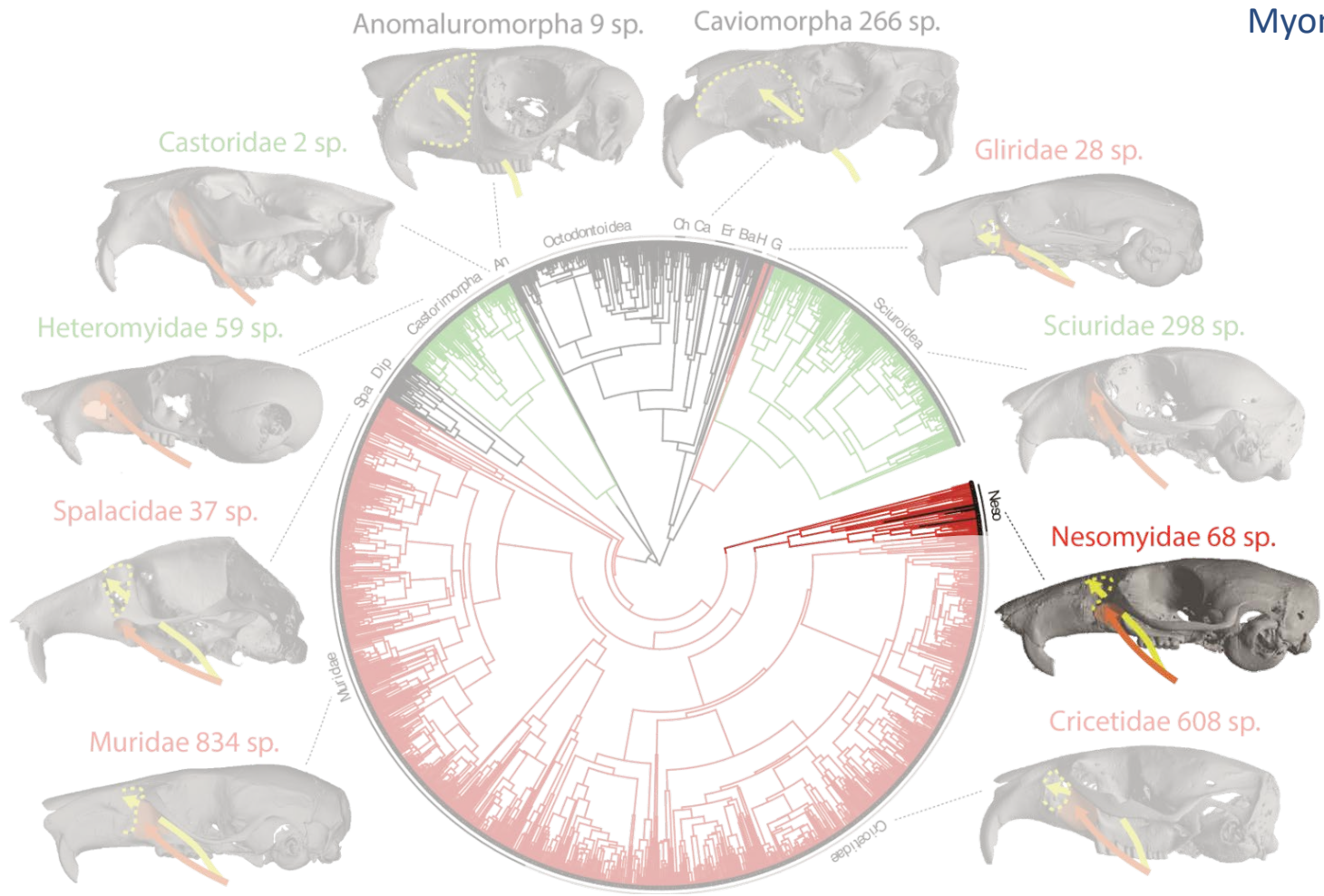
Heritage et al. (2016)

Scale bar : 1cm

Nesomyidae

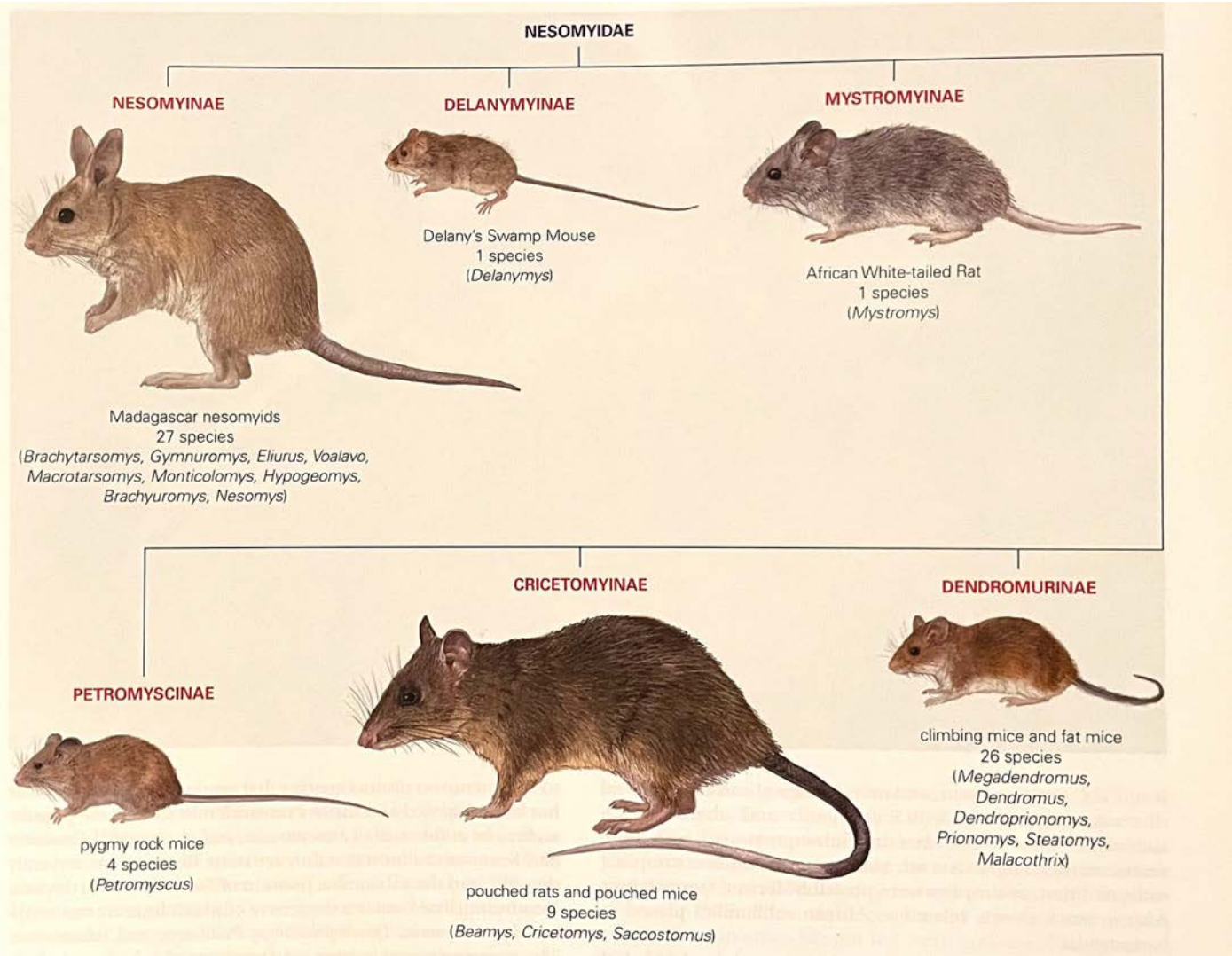


Myomorphy



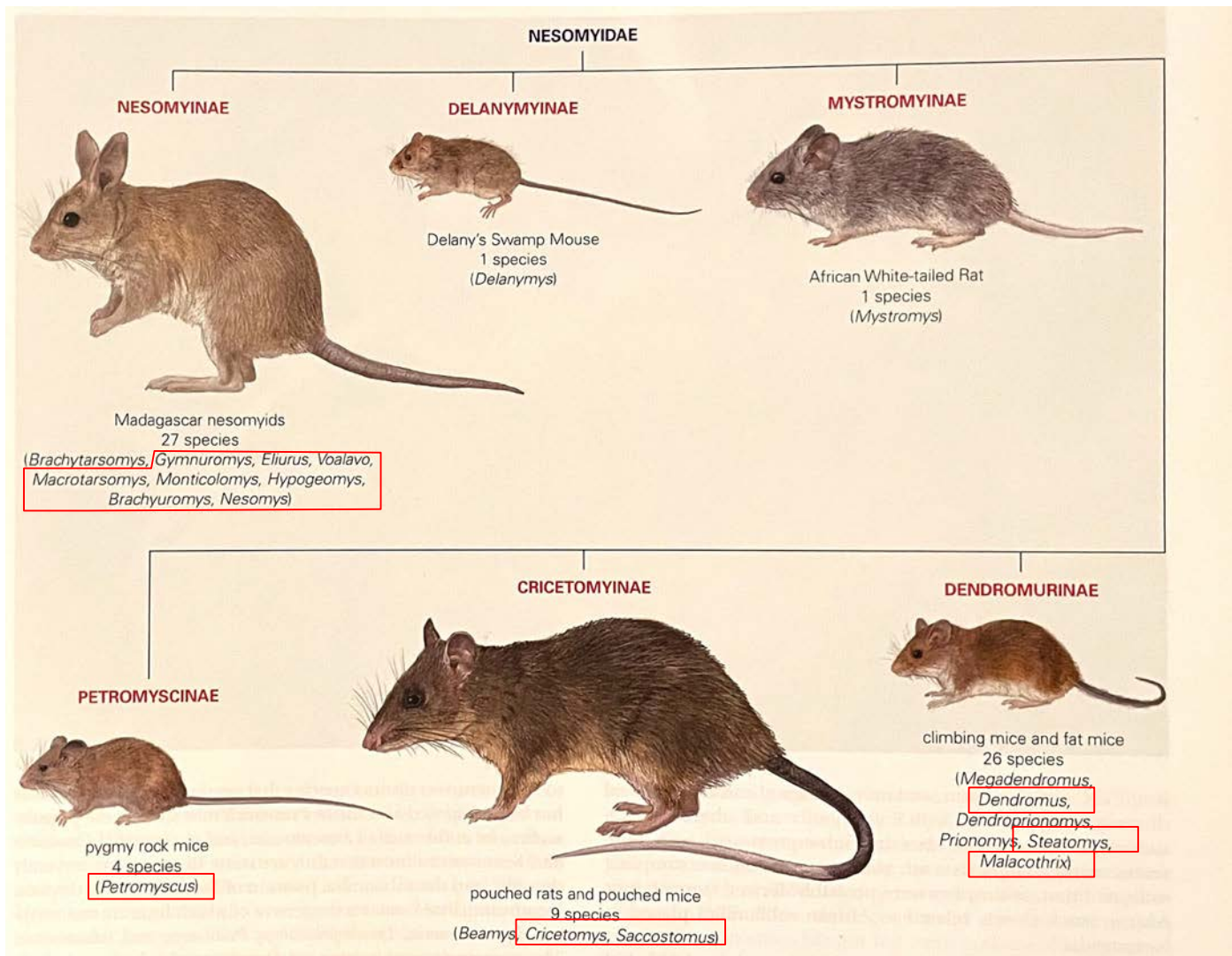
Nesomyidae

21 genera and 68 species



Nesomyidae

21 genera and 68 species

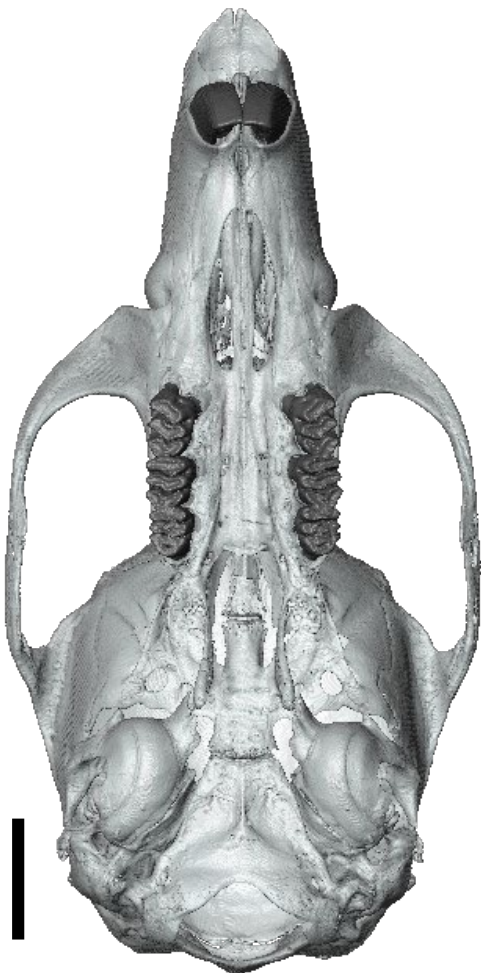


Nesomyidae

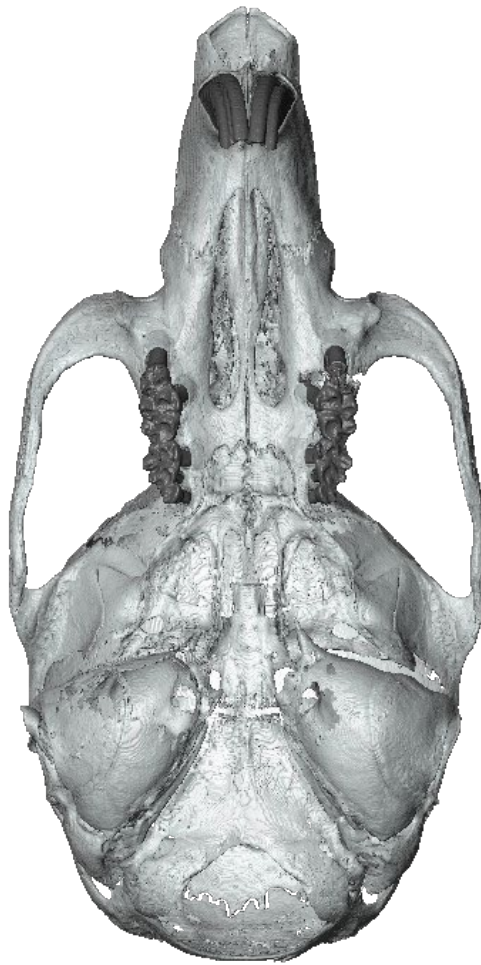
Three prominent classifications of nesomyine genera

Ellerman (1941)	Simpson (1945)	Lavocat (1978)
Family Muridae	Superfamily Muroidea	Superfamily Muroidea
Subfamily Murinae	Family Cricetidae	Family Cricetodontidae
<i>Eliurus</i>	Subfamily Cricetinae	Subfamily Afrocrinetodontinae
murines	Subfamily Nesomyinae	Family Nesomyidae
Subfamily Dendromyinae	Subfamily Lophiomyinae	Subfamily Nesomyinae
<i>Petromyscus</i>	Subfamily Microtinae	Subfamily Lophiomyinae
dendromurines	Subfamily Gerbillinae	Subfamily Mystromyinae
Subfamily Cricetinae	Family Spalacidae	Subfamily Tachyoryctinae
<i>Nesomys</i>	Family Rhizomyidae	Subfamily Gerbillinae
<i>Hypogeomys</i>	Family Muridae	Subfamily Otomyinae
<i>Calomyscus</i>	Subfamily Murinae	Family Muridae
<i>Mystromys</i>	Subfamily Dendromurinae	Subfamily Murinae
Old World cricetines	Subfamily Otomyinae	Subfamily Dendromurinae
New World cricetines	Subfamily Phloeomyinae	
Subfamily Gymnuromyinae	Subfamily Rhynchomyinae	
<i>Gymnuromys</i>	Subfamily Hydromyinae	
Subfamily Tachyoryctinae		
<i>Brachyuromys</i>		
<i>Tachyoryctes</i>		
Subfamily Microtinae		
<i>Brachytarsomys</i>		
arvicolines		

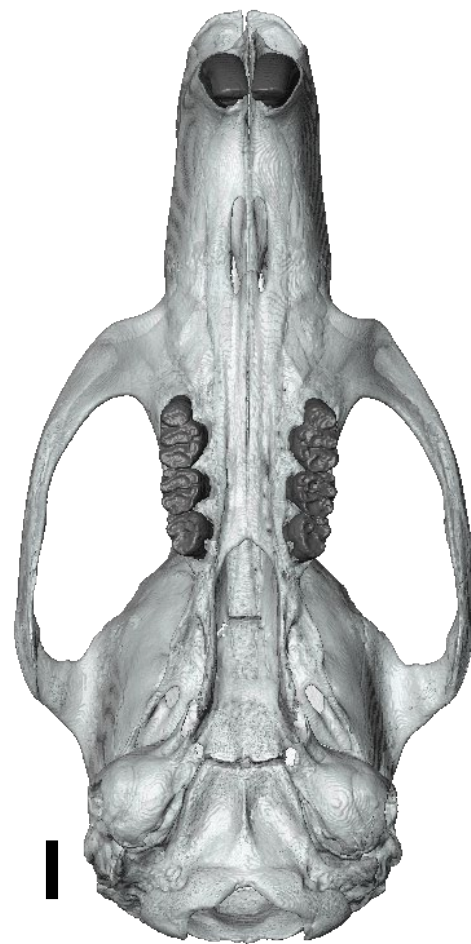
Nesomyidae



Eliurus



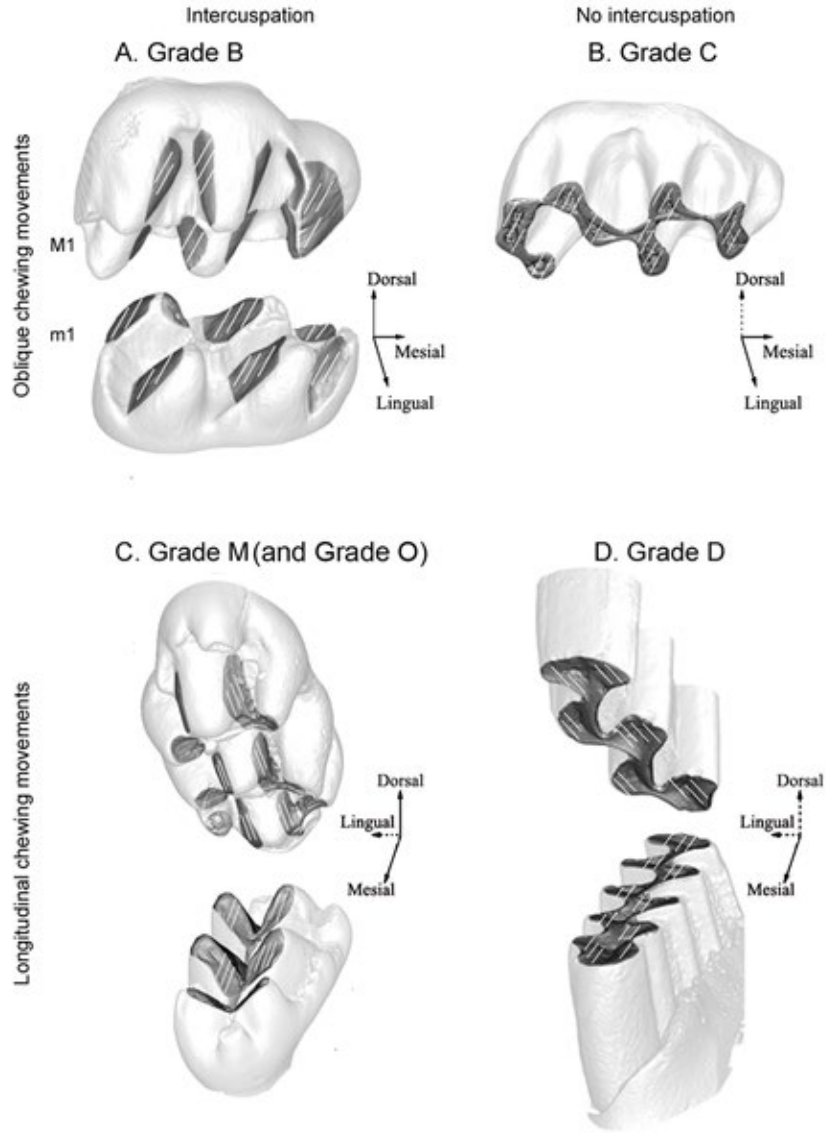
Dendromus



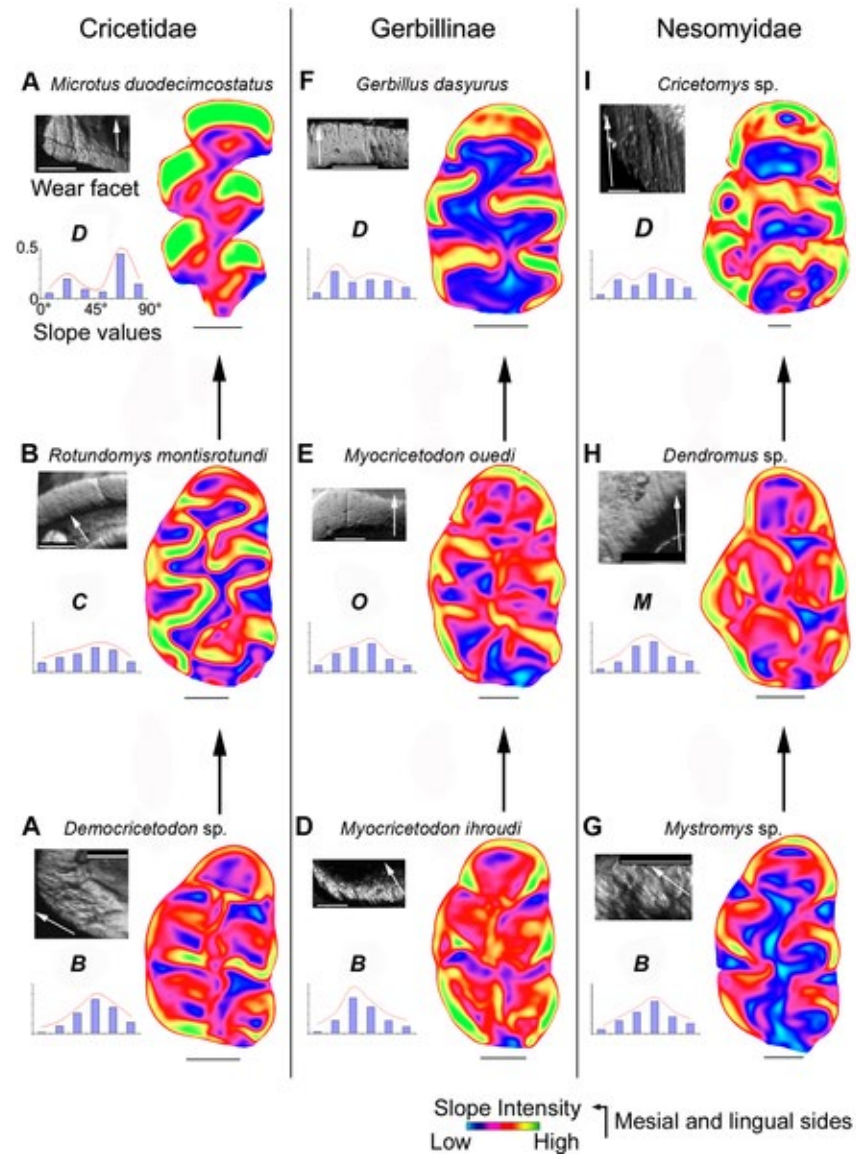
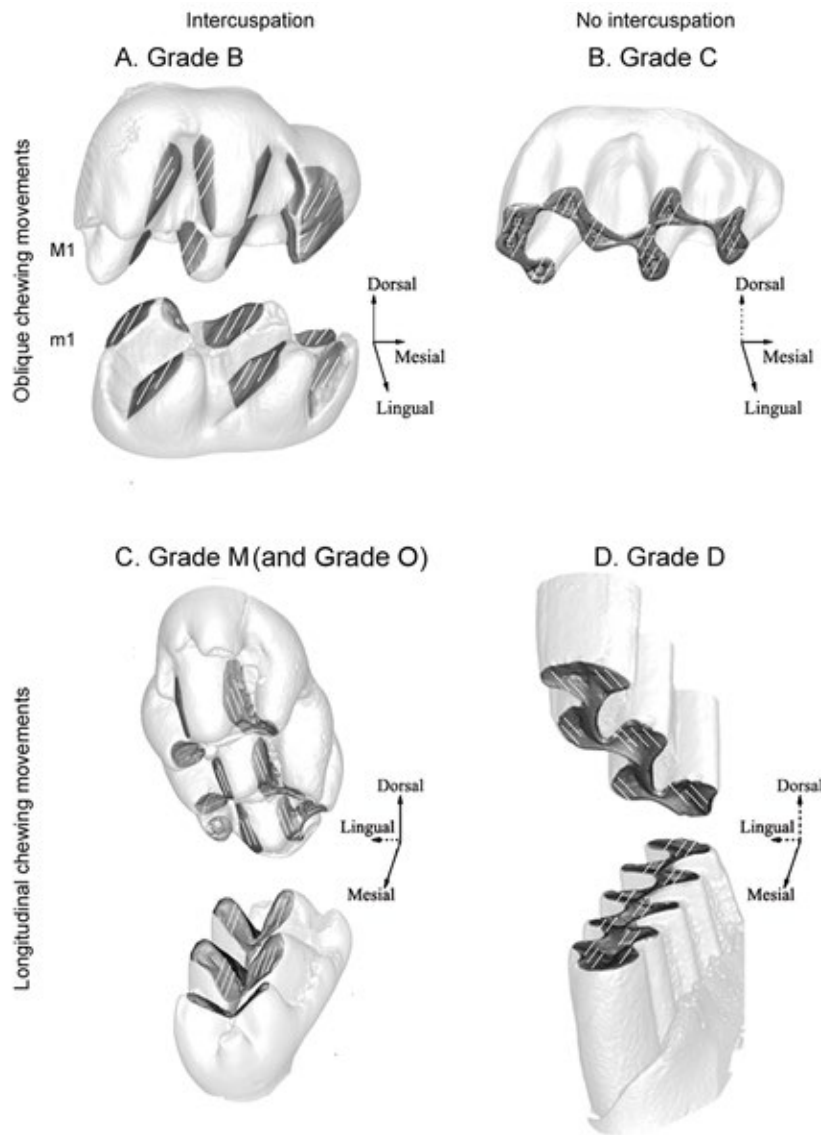
Cricetomys

Scale bar : 5 mm

Nesomyidae



Nesomyidae

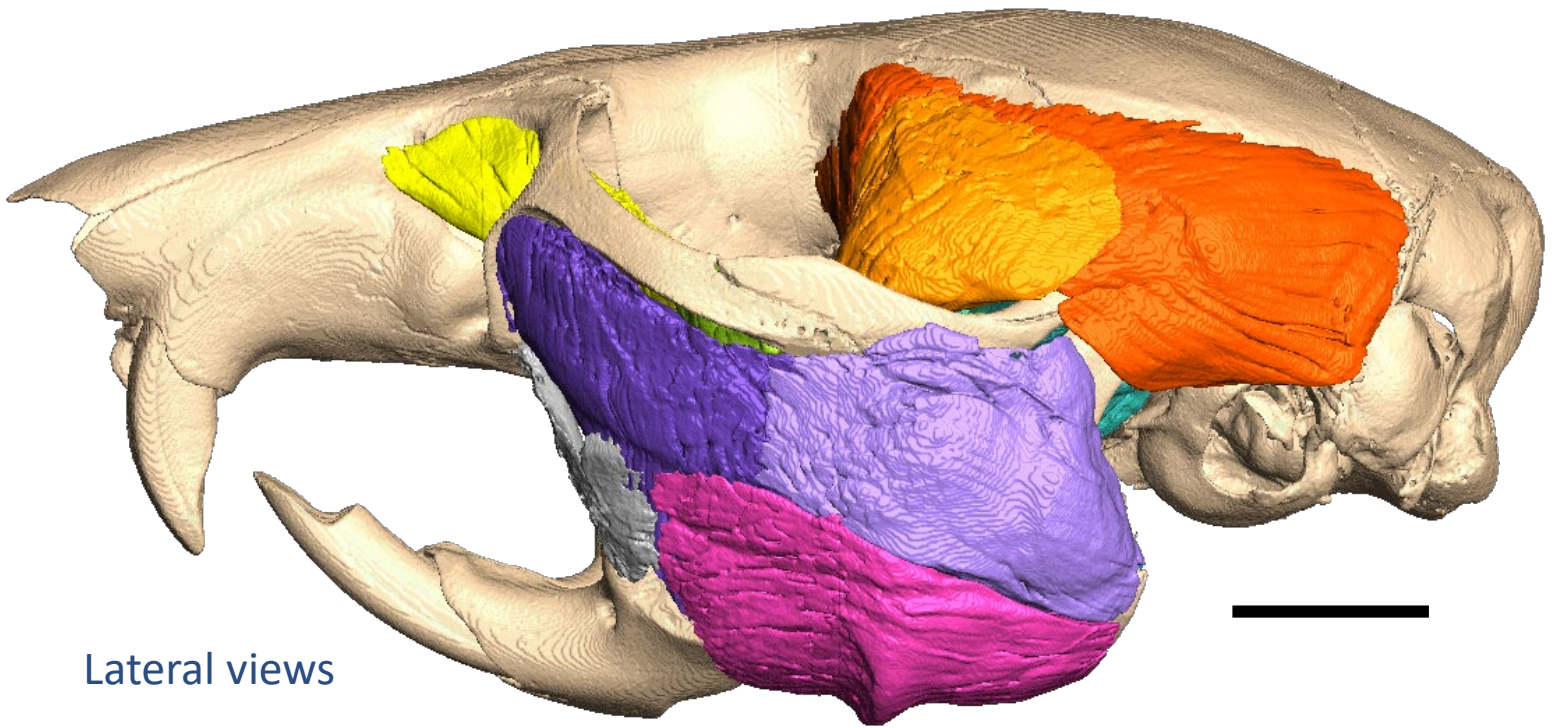
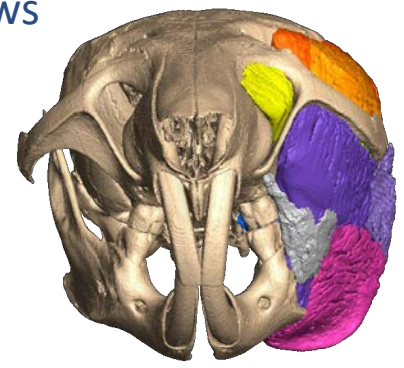


Nesomyidae



Eliurus

Frontal views



Lateral views

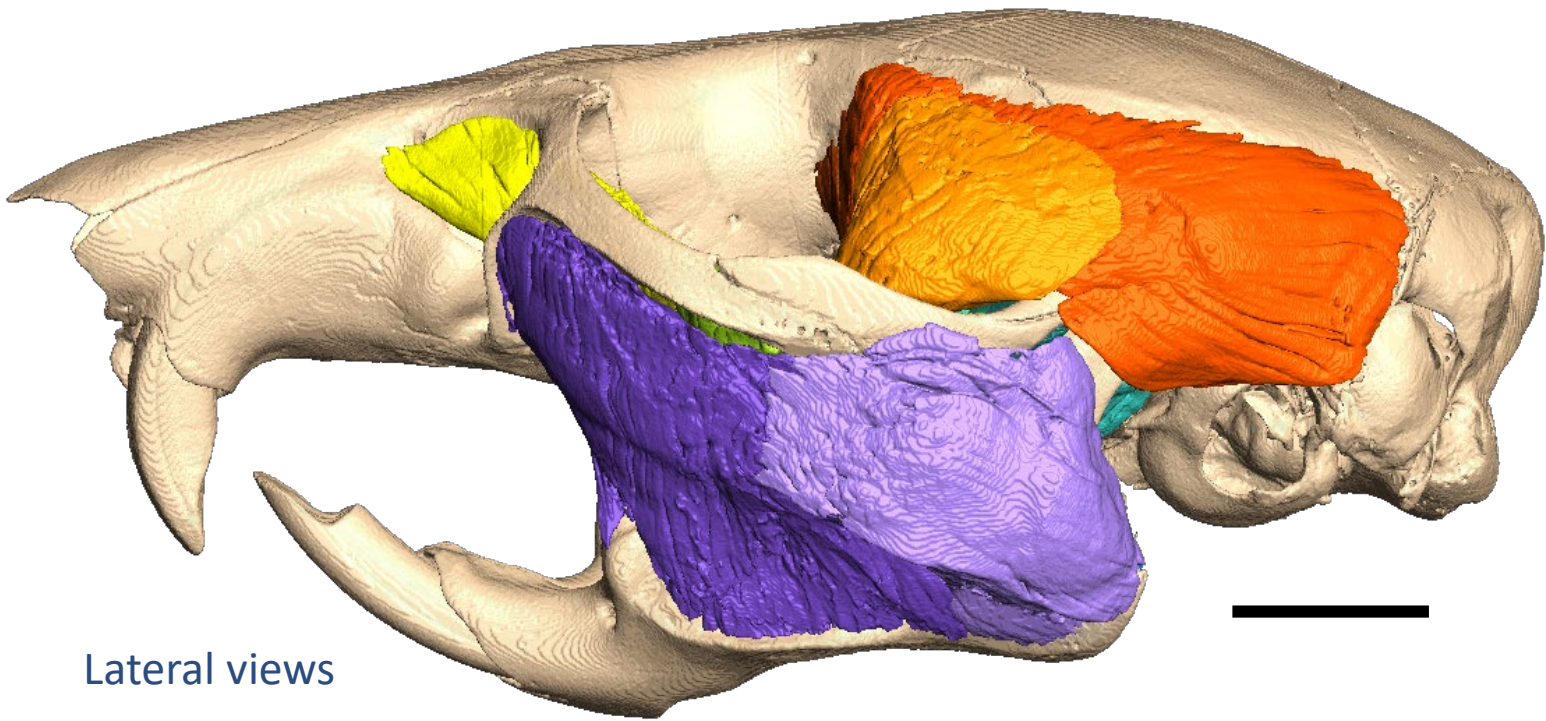
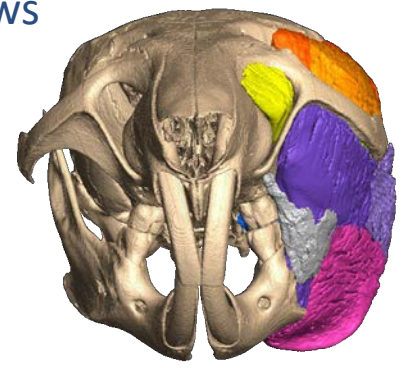


Nesomyidae



Eliurus

Frontal views



Lateral views

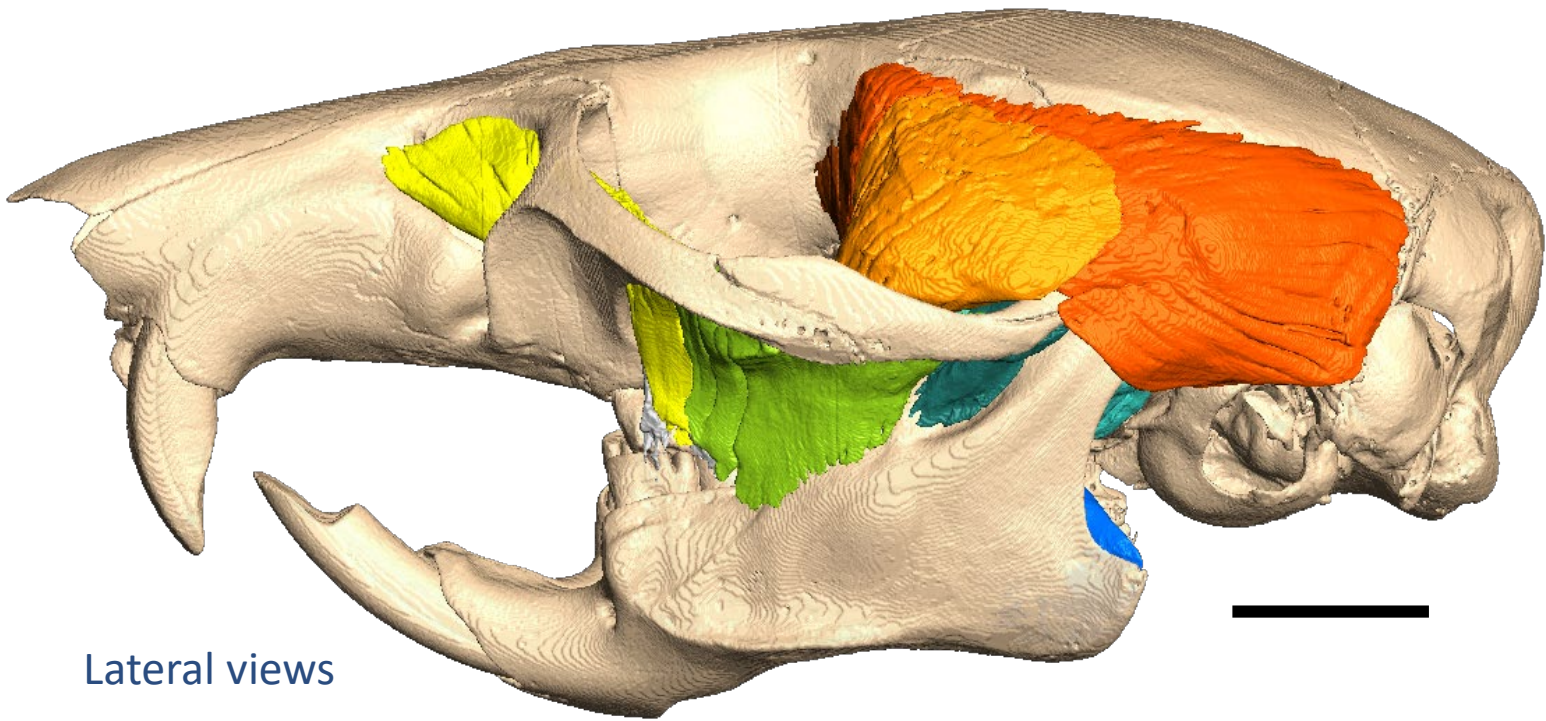
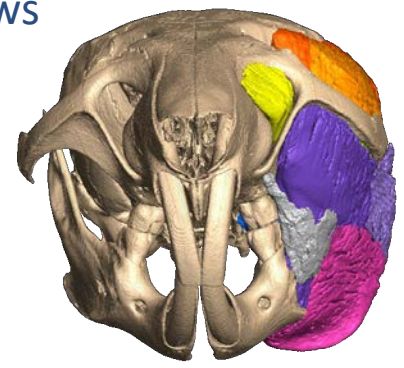


Nesomyidae



Eliurus

Frontal views

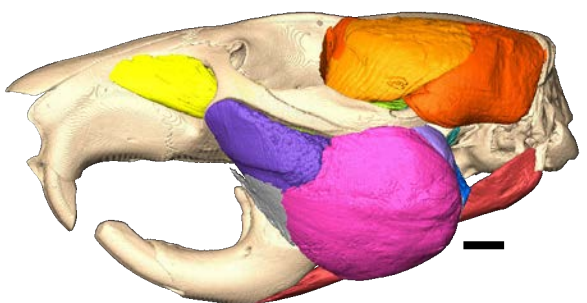


Lateral views

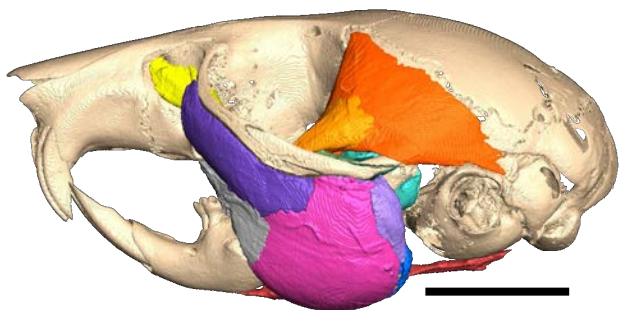


Nesomyidae

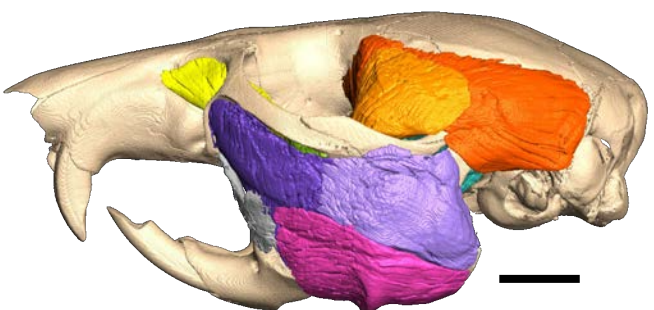
Lateral views



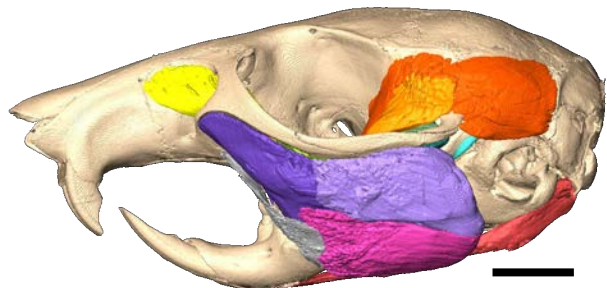
Cricetomys



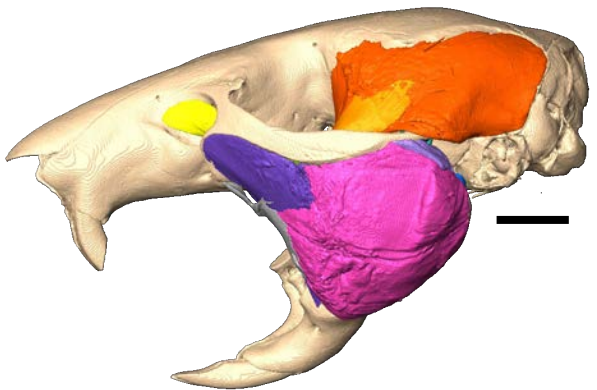
Dendromus



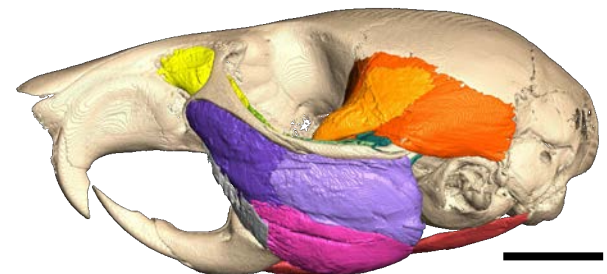
Eliurus



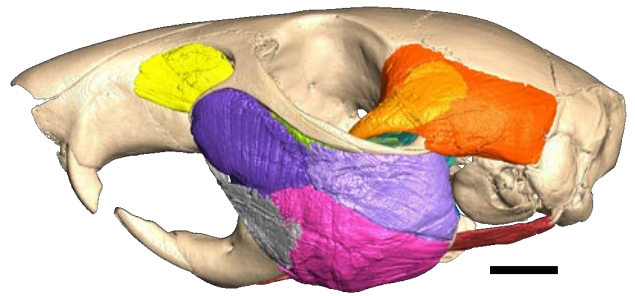
Macrotarsomys



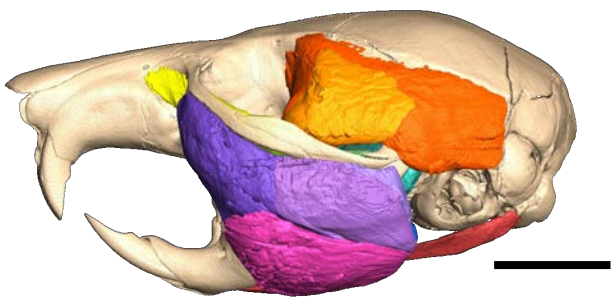
Gymnuromys



Monticolomys



Nesomys

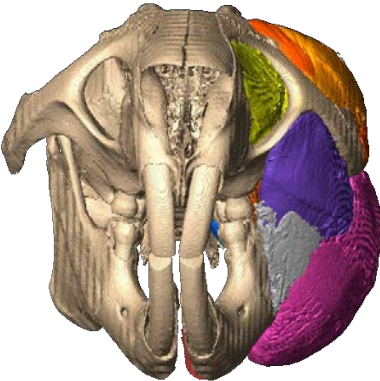


Voalavo

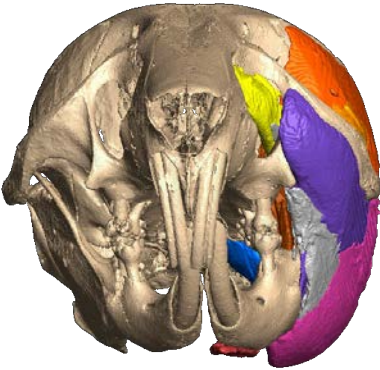
Scale bar : 5 mm

Nesomyidae

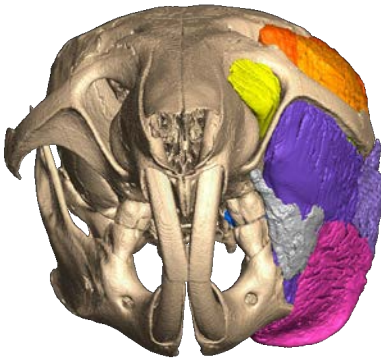
Frontal views



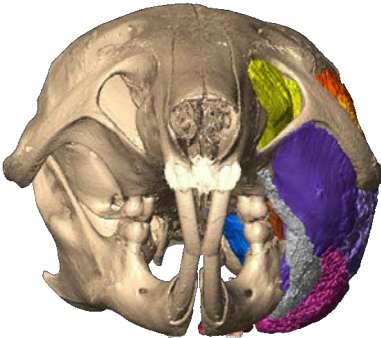
Cricetomys



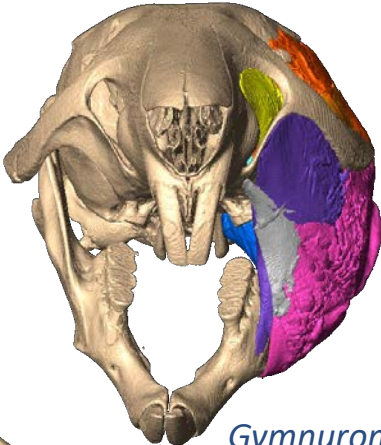
Dendromus



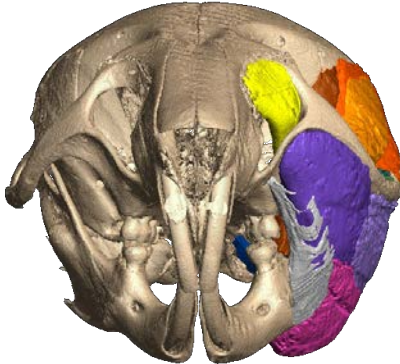
Eliurus



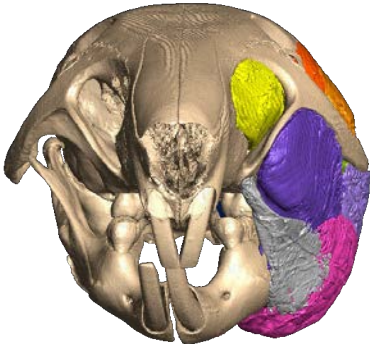
Macrotarsomys



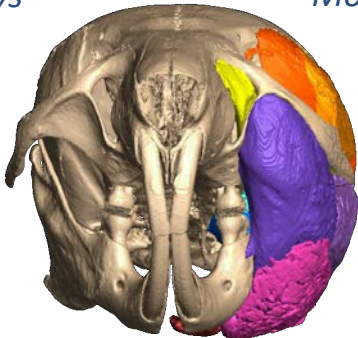
Gymnuromys



Monticolomys



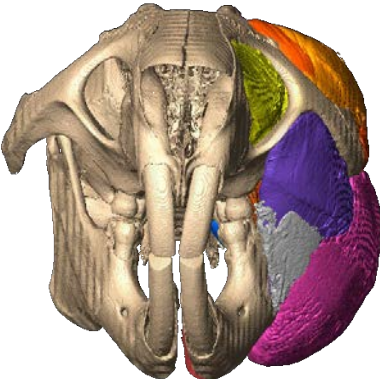
Nesomys



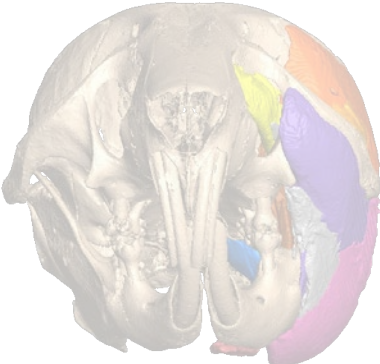
Voalavo

Nesomyidae

Frontal views



Cricetomys



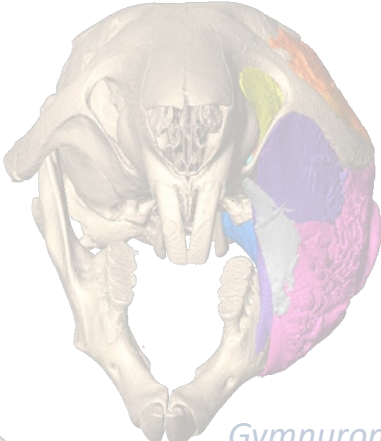
Dendromus



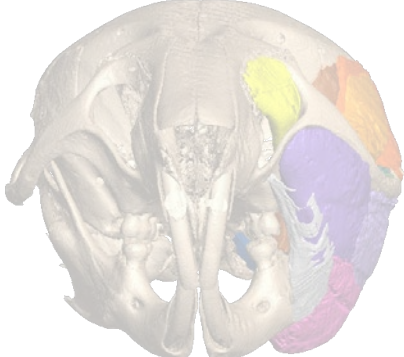
Eliurus



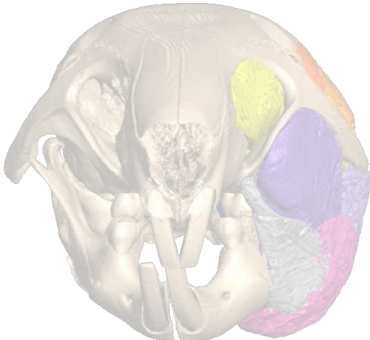
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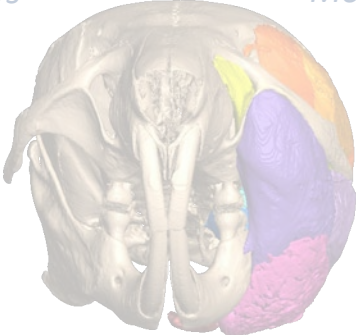
Gymnuromys



Monticolomys



Nesomys



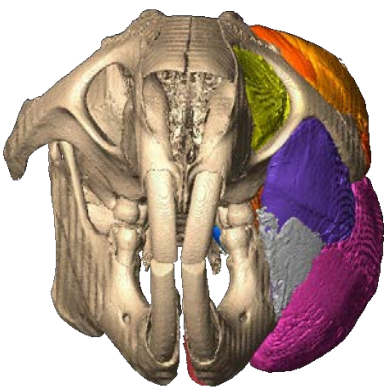
Voalavo

Nesomyidae

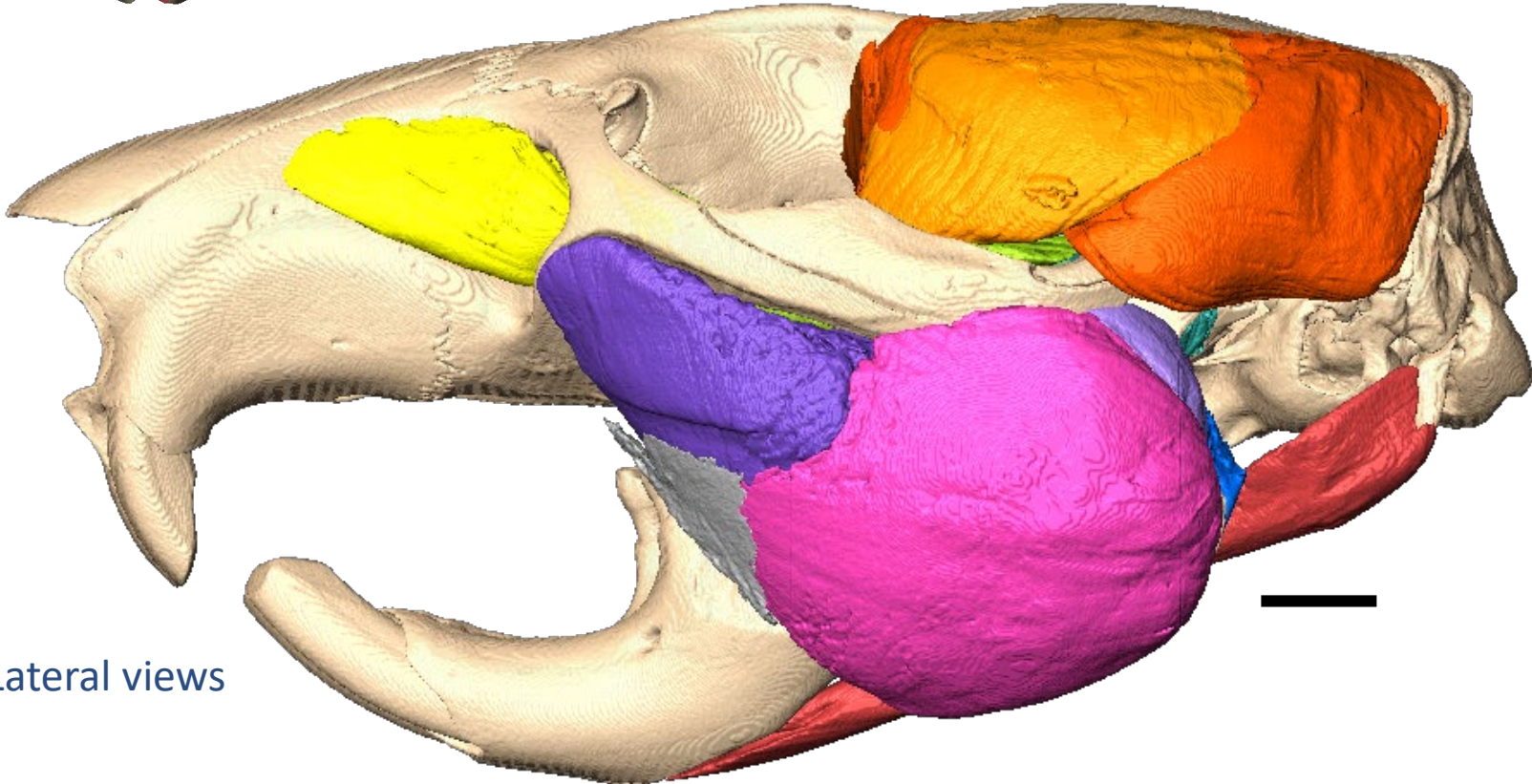
Cricetomys gambianus



Frontal views



Lateral views



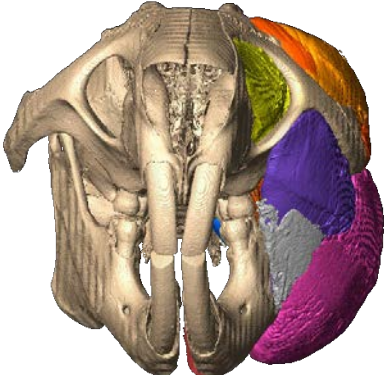
Scale bar : 5 mm

Nesomyidae

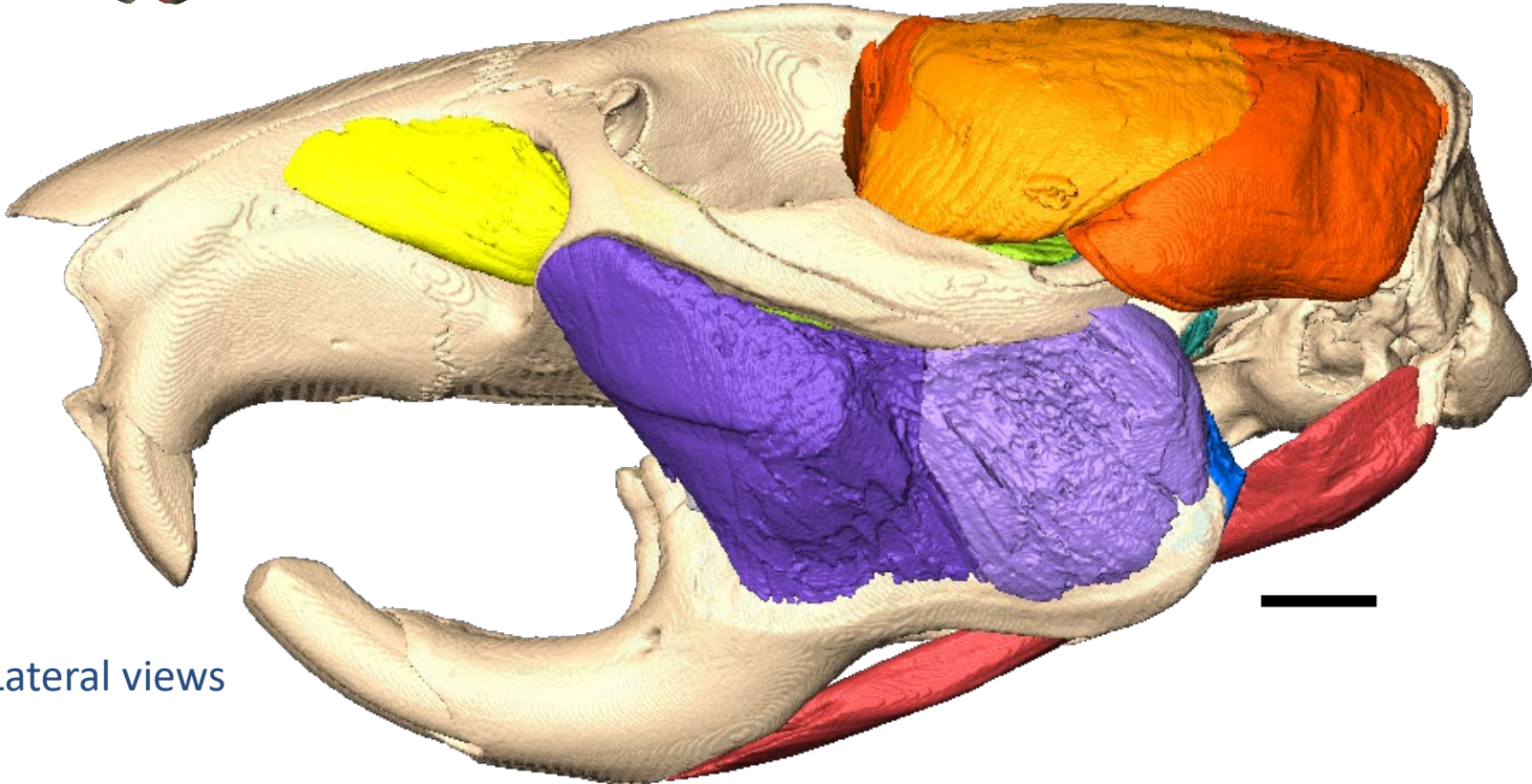
Cricetomys gambianus



Frontal views



Lateral views



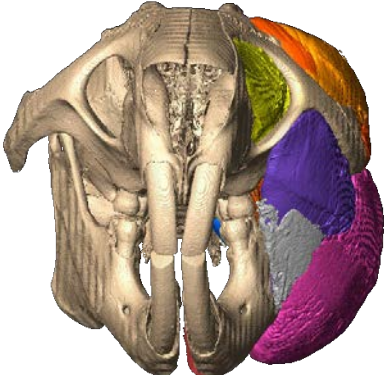
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Nesomyidae

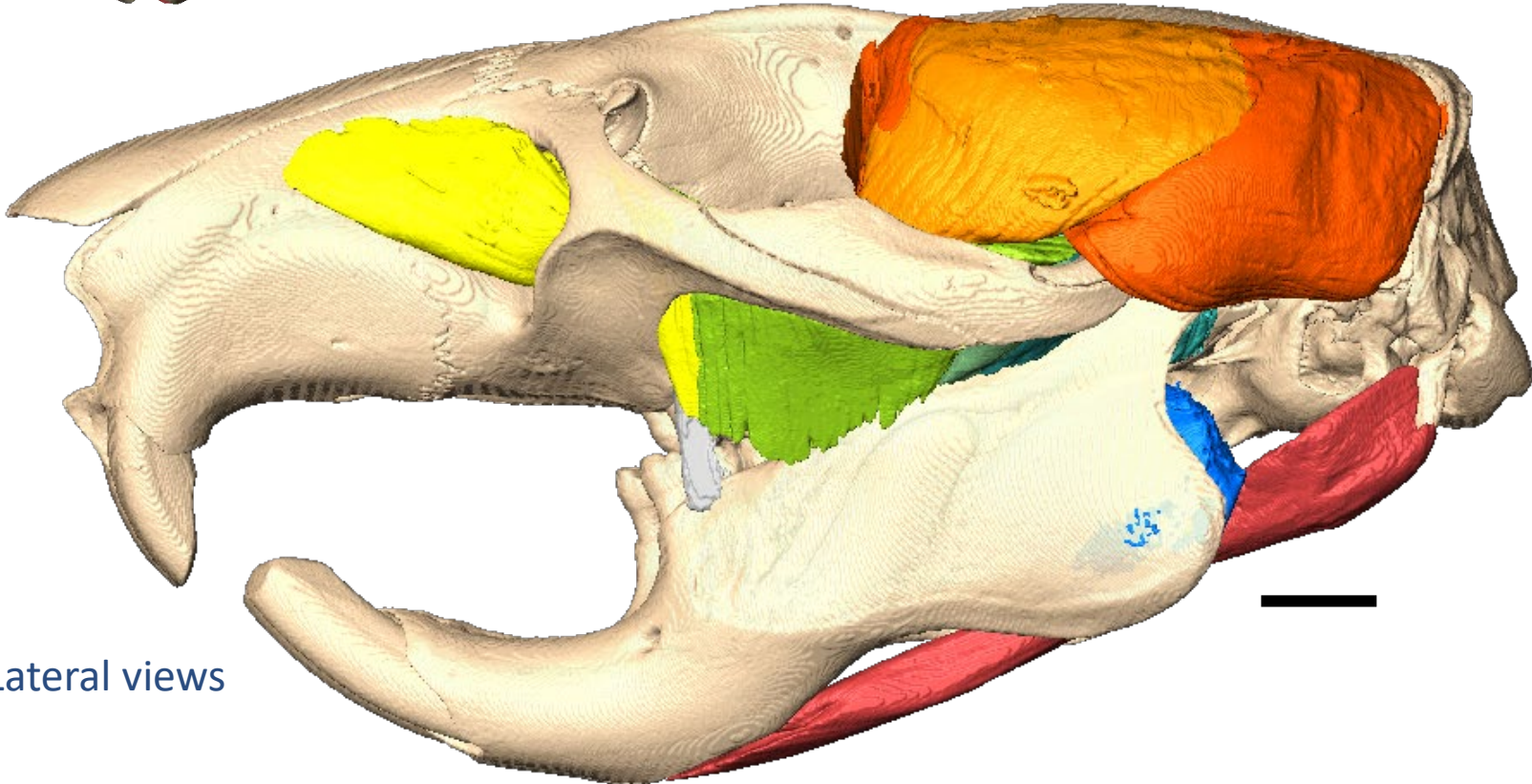
Cricetomys gambianus



Frontal views



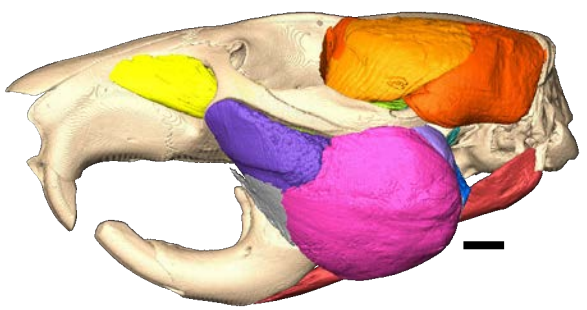
Lateral views



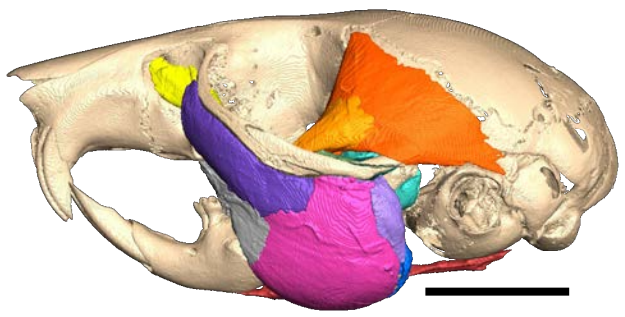
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Nesomyidae

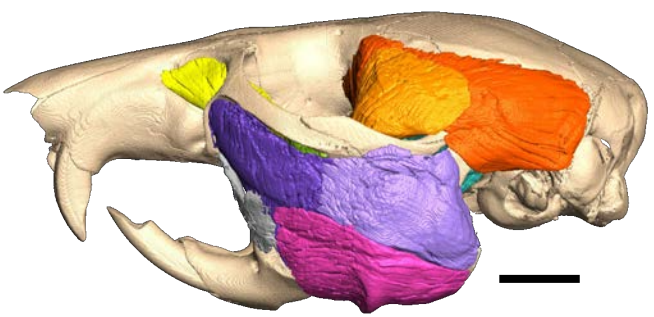
Lateral views



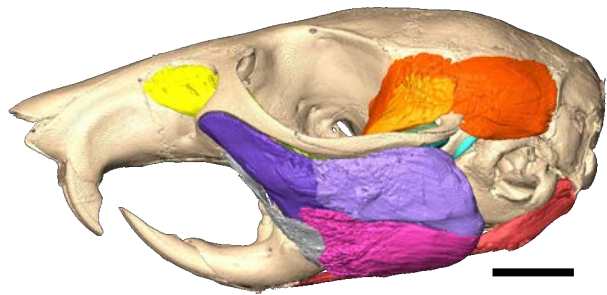
Cricetomys



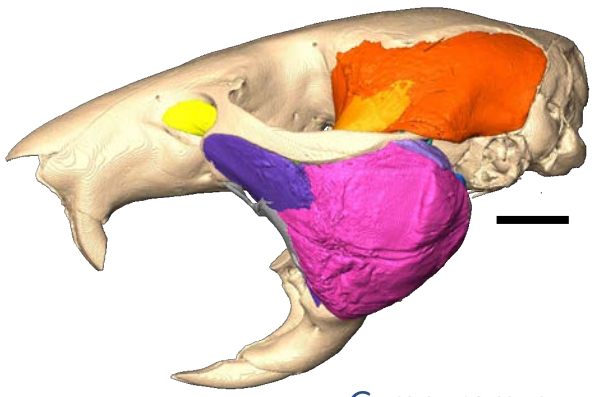
Dendromus



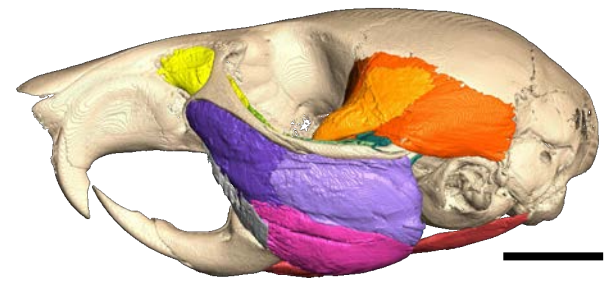
Eliurus



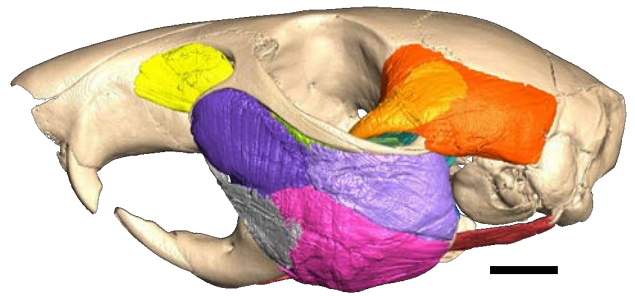
Macrotarsomys



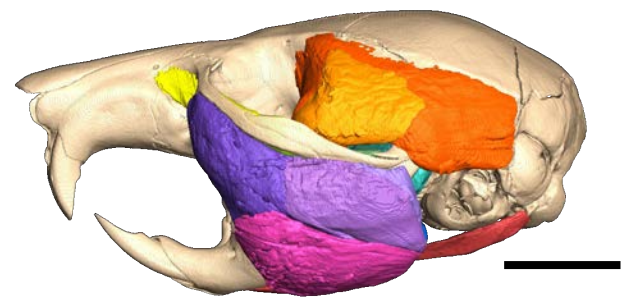
Gymnuromys



Monticolomys



Nesomys



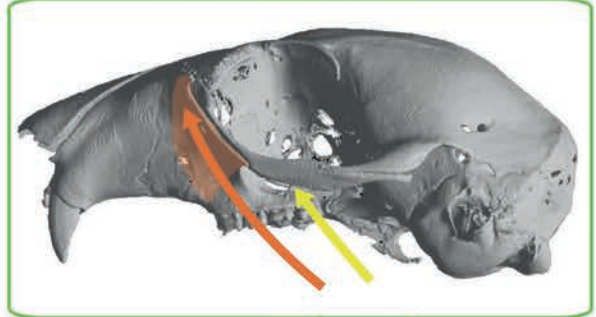
Voalavo

Scale bar : 5 mm

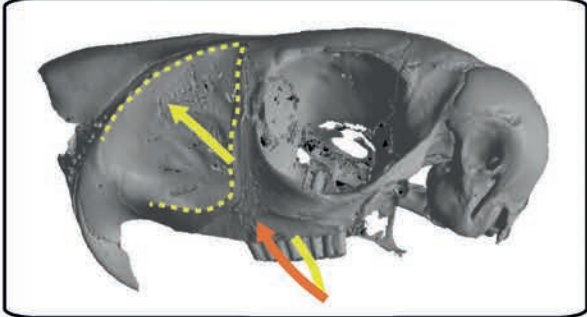
The DispaRat project

SKULL

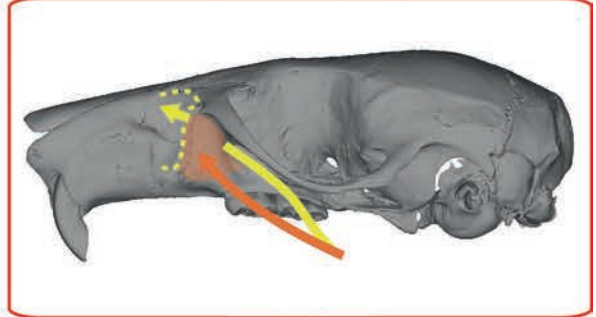
Sciuromorphy



Hystricomorphy



Myomorphy

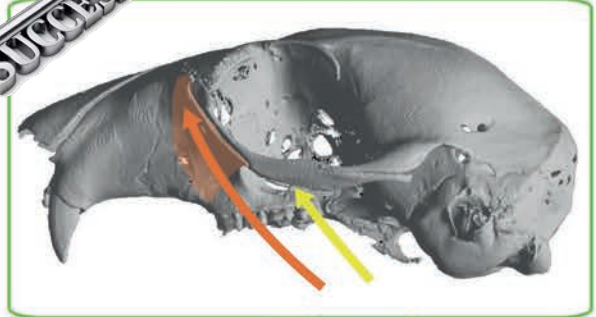


Key innovations?

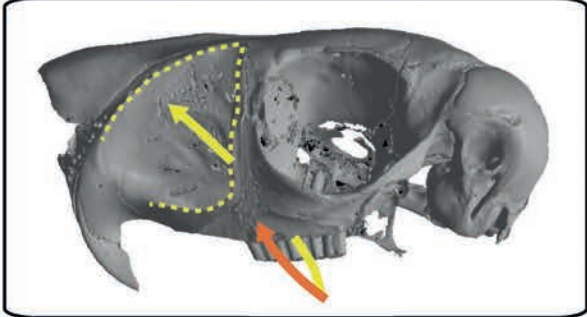
The DispaRat project



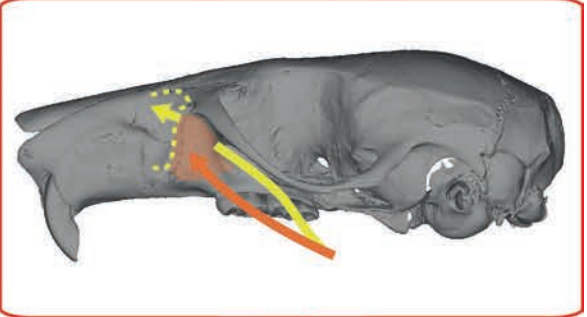
Sciuromorphy



Hystricomorphy



Myomorphy

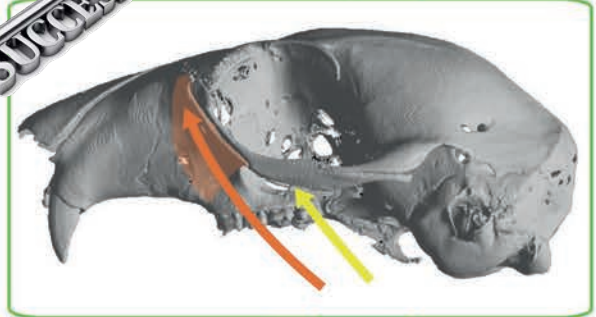


Key innovations?

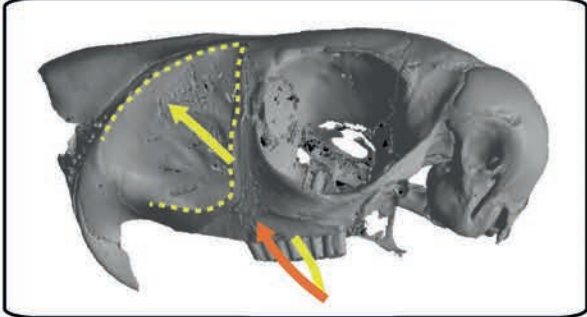
The DispaRat project



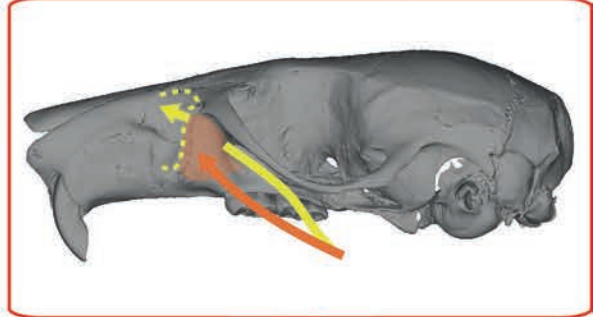
Sciuromorphy



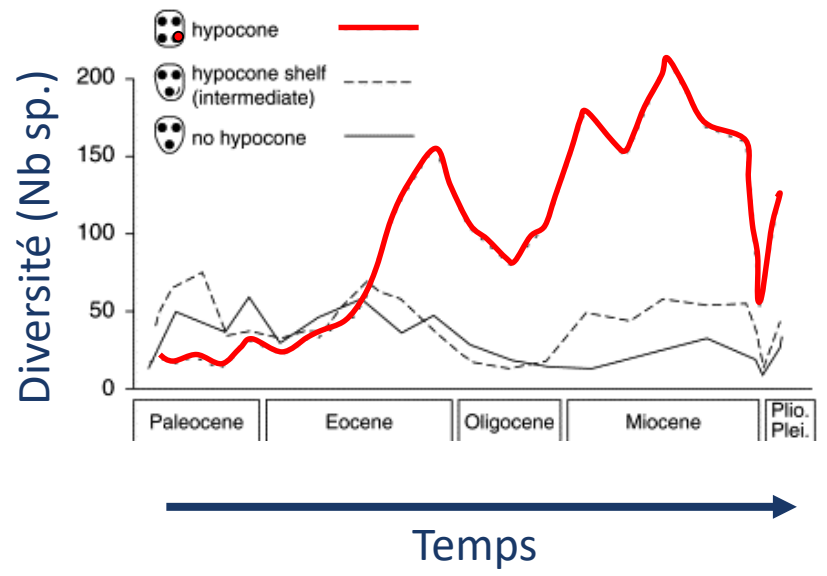
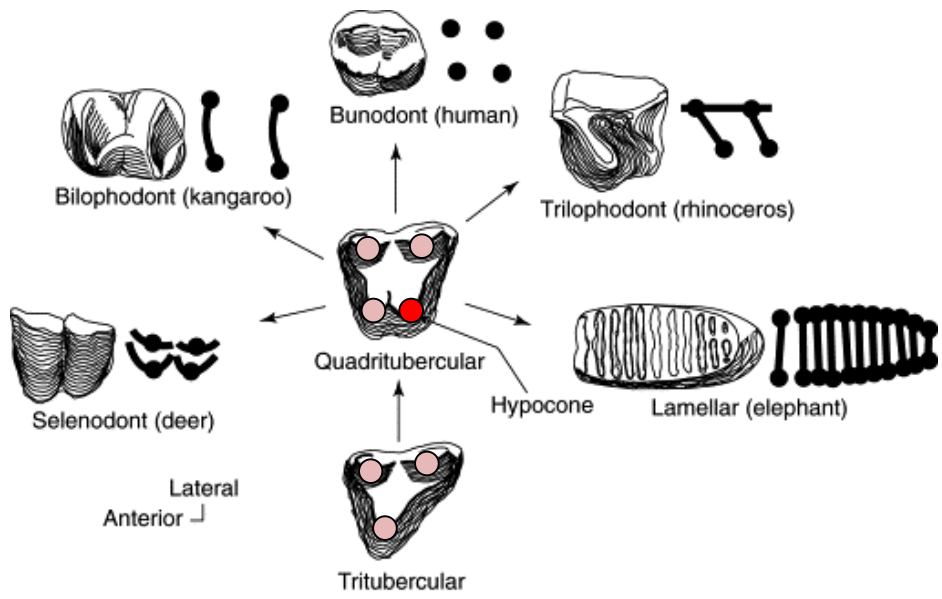
Hystricomorphy



Myomorphy



Key innovations?

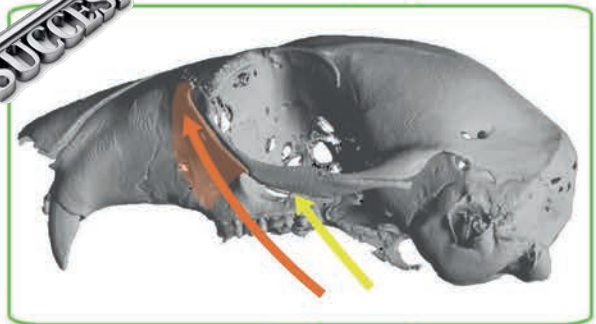


The DispaRat project

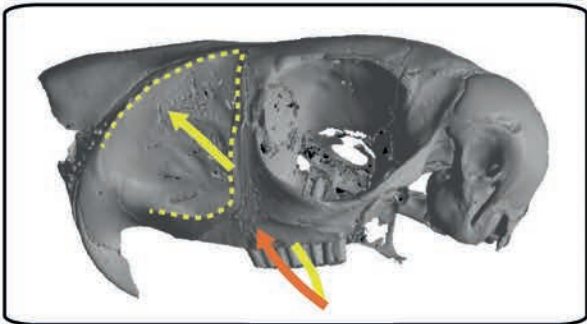


SKULL

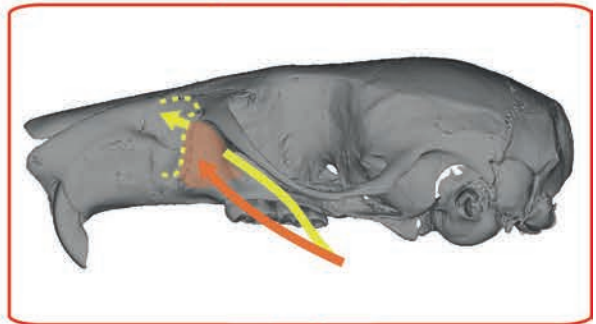
Sciuromorphy



Hystricomorphy

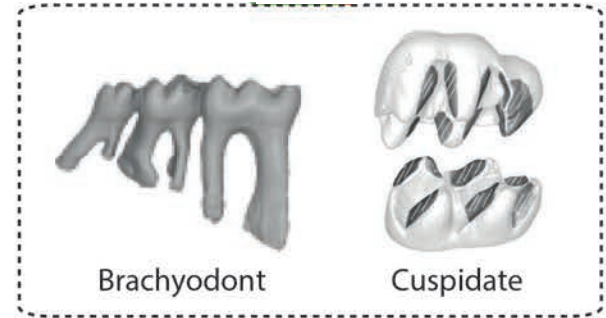
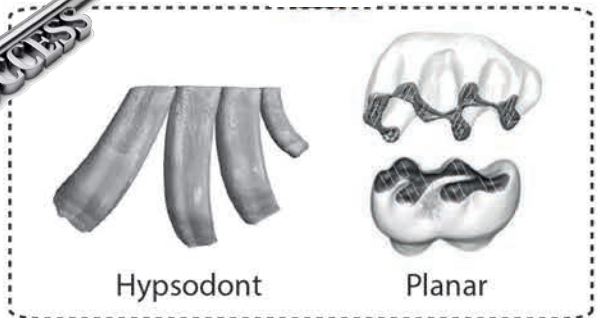


Myomorphy

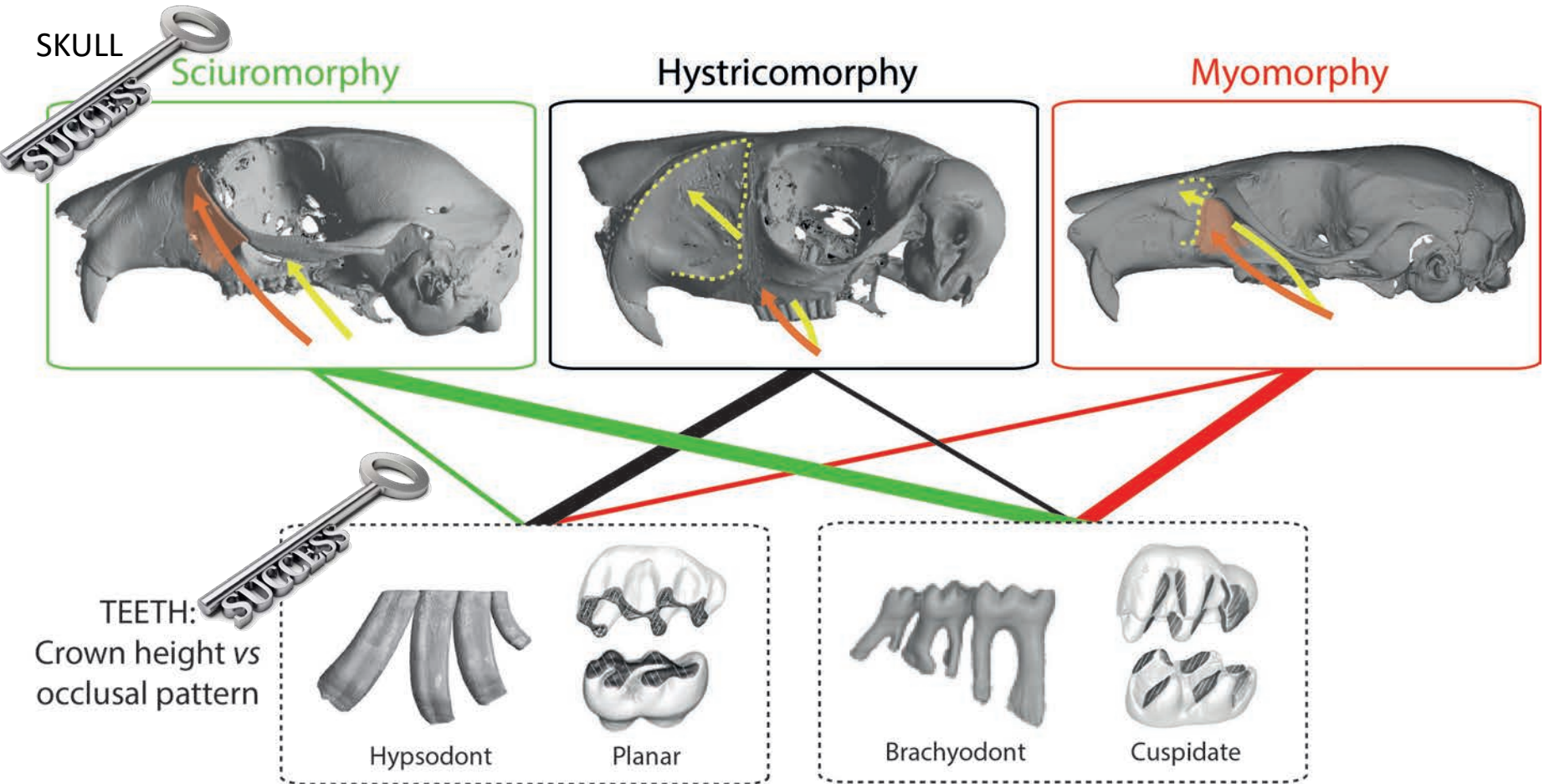


TEETH:

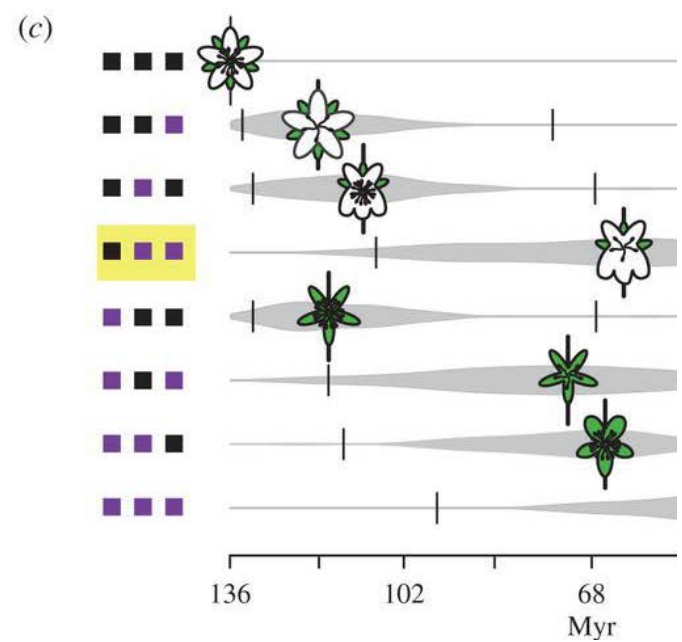
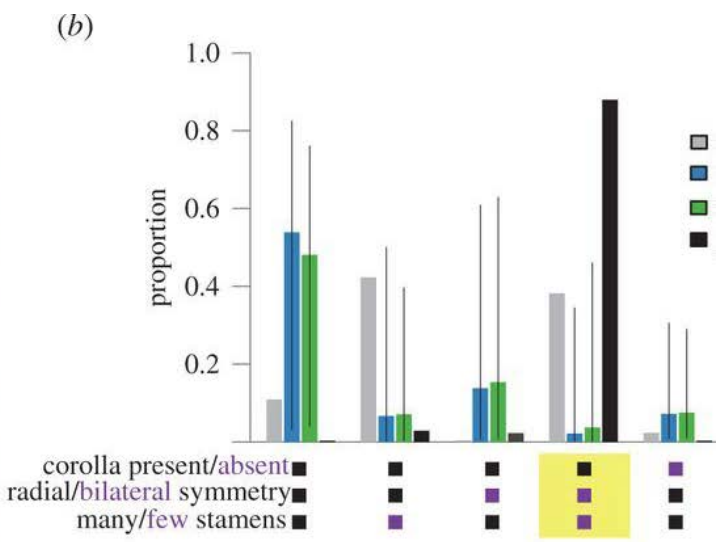
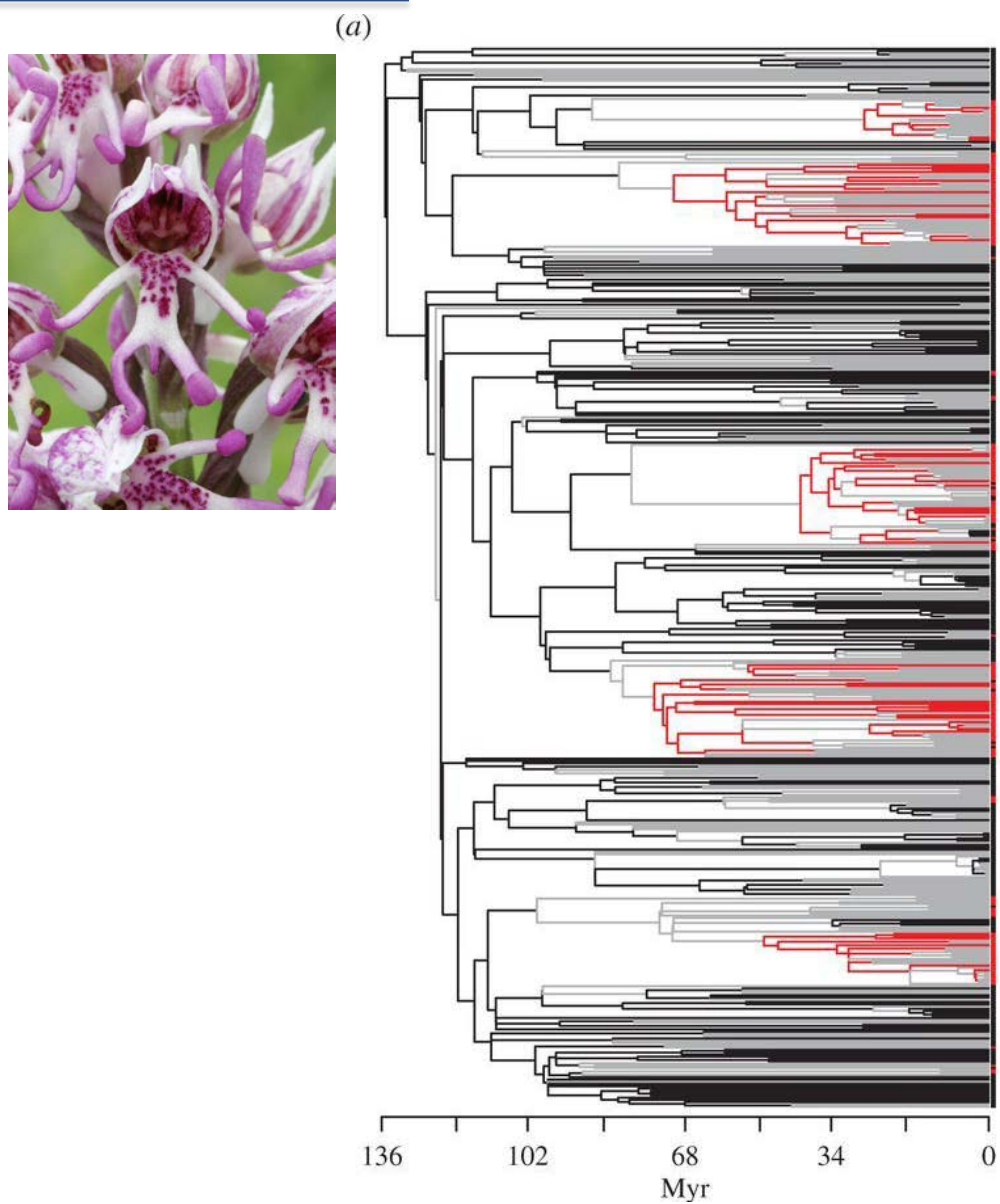
Crown height vs occlusal pattern



The DispaRat project

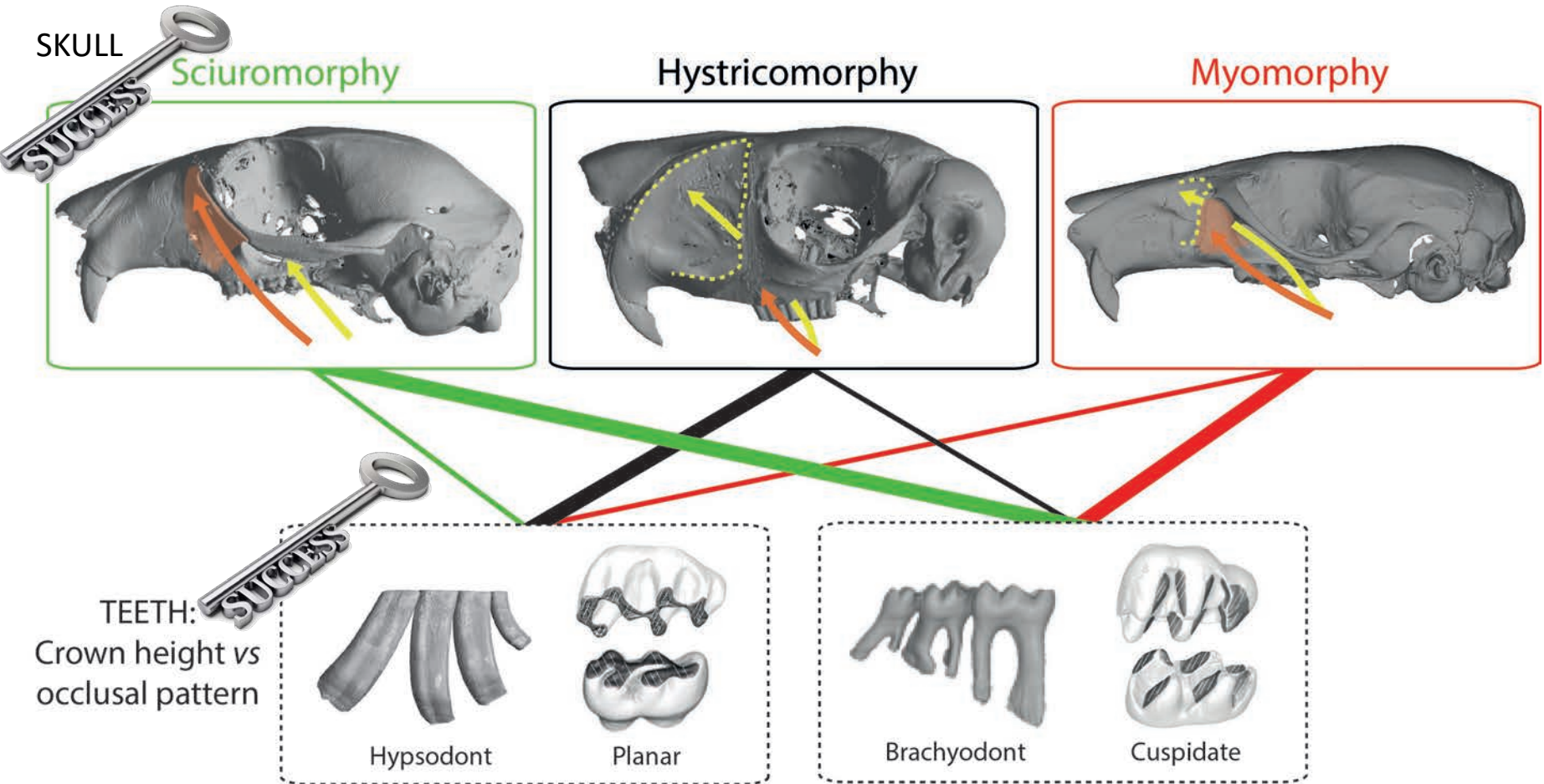


The DispaRat project



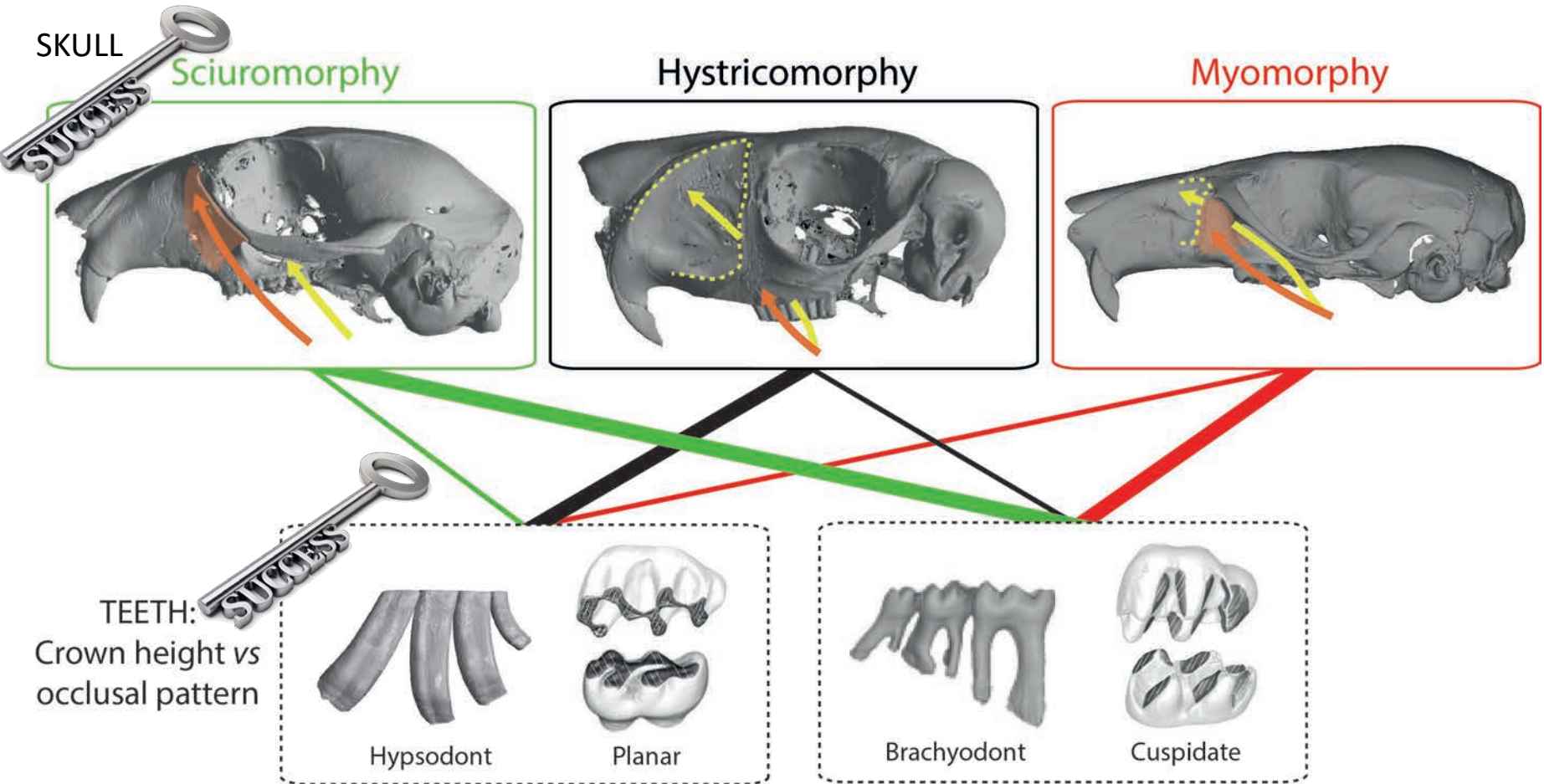
State-dependent speciation and extinction (SSE) methods to estimate transition rates among character states, character combinations, and diversification rates within those combinations.

The DispaRat project



Hypothesis 1 – Osteological, dental, and muscular traits are highly interdependent functionally and can characterize dietary habits and lifestyle.

The DispaRat project



Hypothesis 1 – Osteological, dental, and muscular traits are highly interdependent functionally and can characterize dietary habits and lifestyle.

Hypothesis 2 - Specific associations of cranial features act synergistically as a key innovation to promote diversification of rodents.

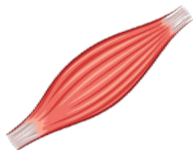
Methods



Skull



Teeth

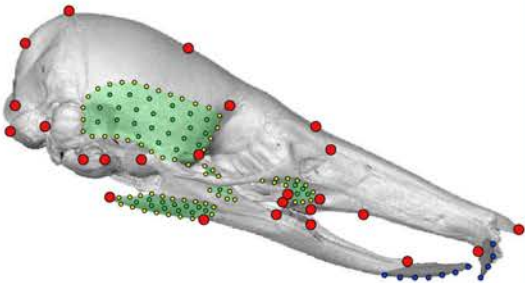


Muscles

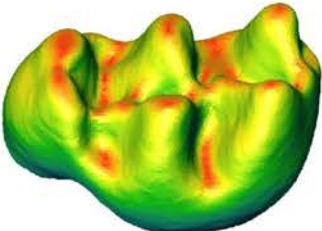
Microtomography



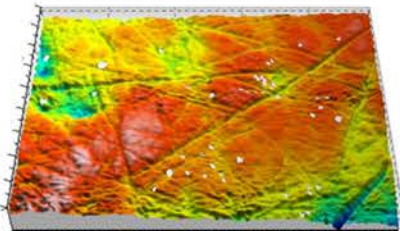
Geometric morphometrics



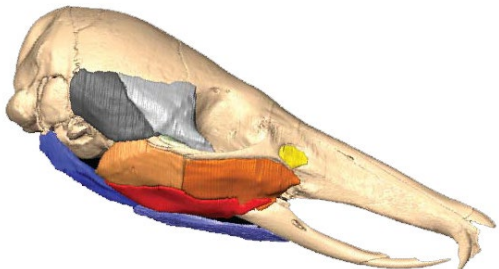
Dental topography



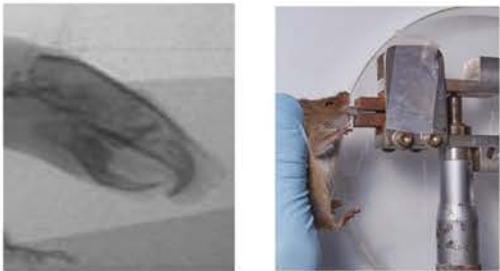
Microwear



Dissections



Cineradiography & bite force



2/3 of the rodent generic diversity, i.e. 250 genera

Expected results

Hypothesis 1



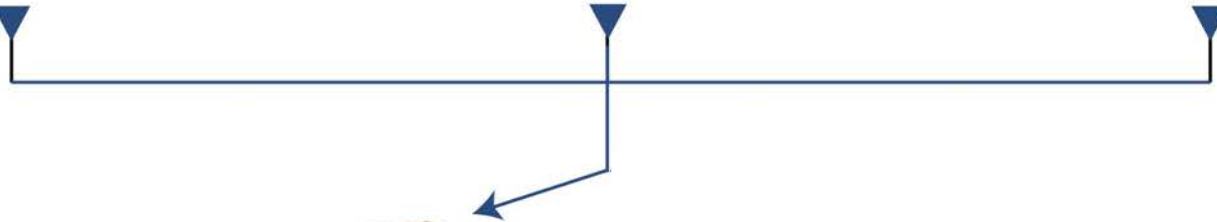
Skull



Teeth

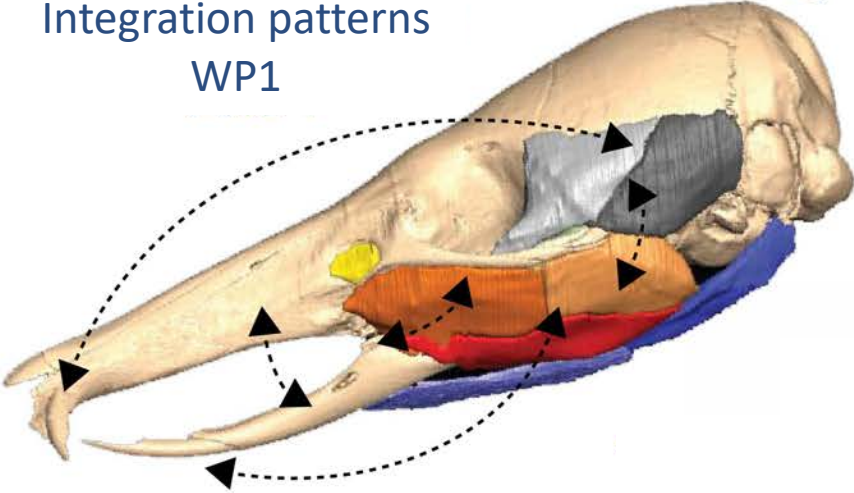


Muscles



Integration patterns

WP1



Expected results

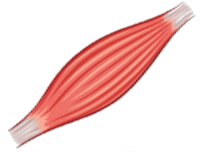
Hypothesis 1



Skull



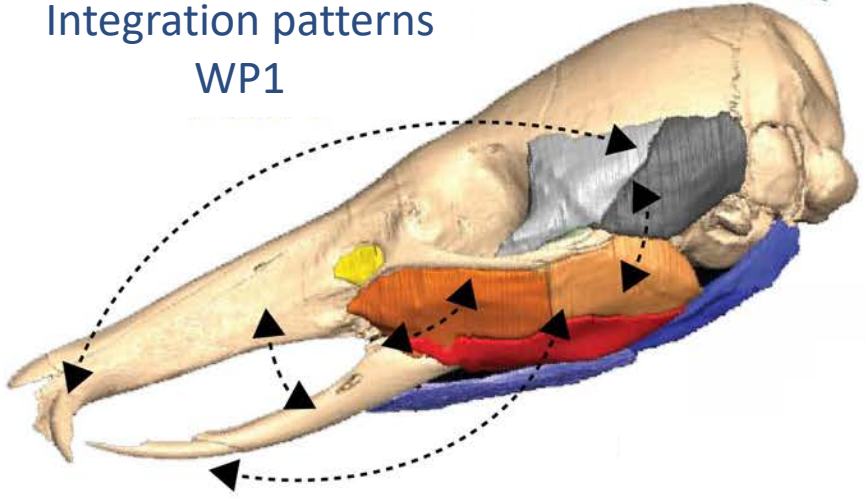
Teeth



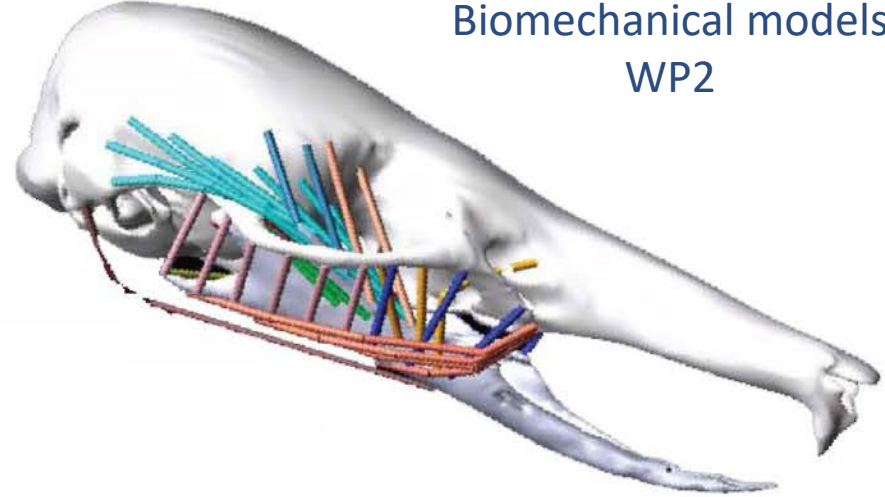
Muscles



Integration patterns
WP1



Biomechanical models
WP2



Expected results

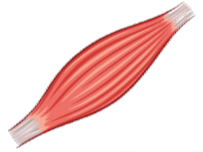
Hypothesis 1



Skull



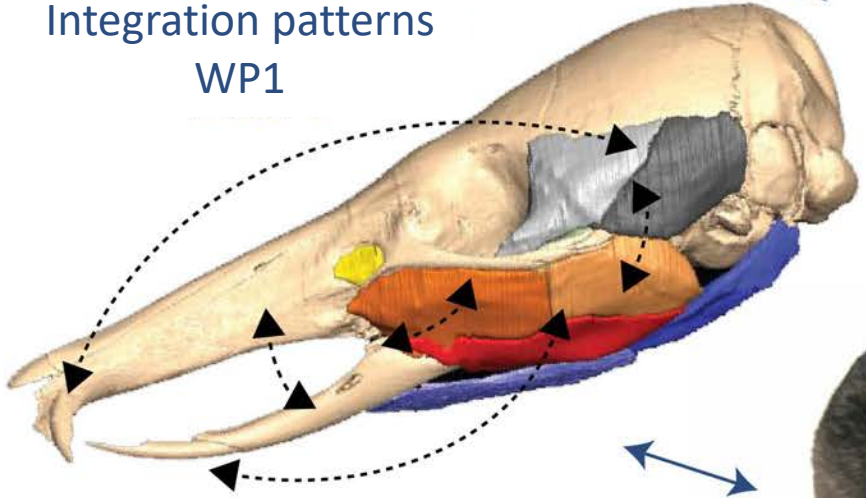
Teeth



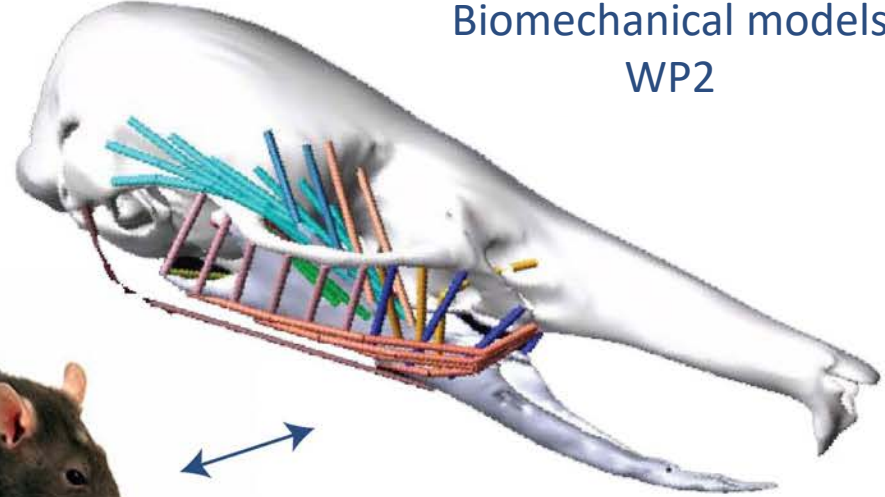
Muscles



Integration patterns
WP1



Biomechanical models
WP2

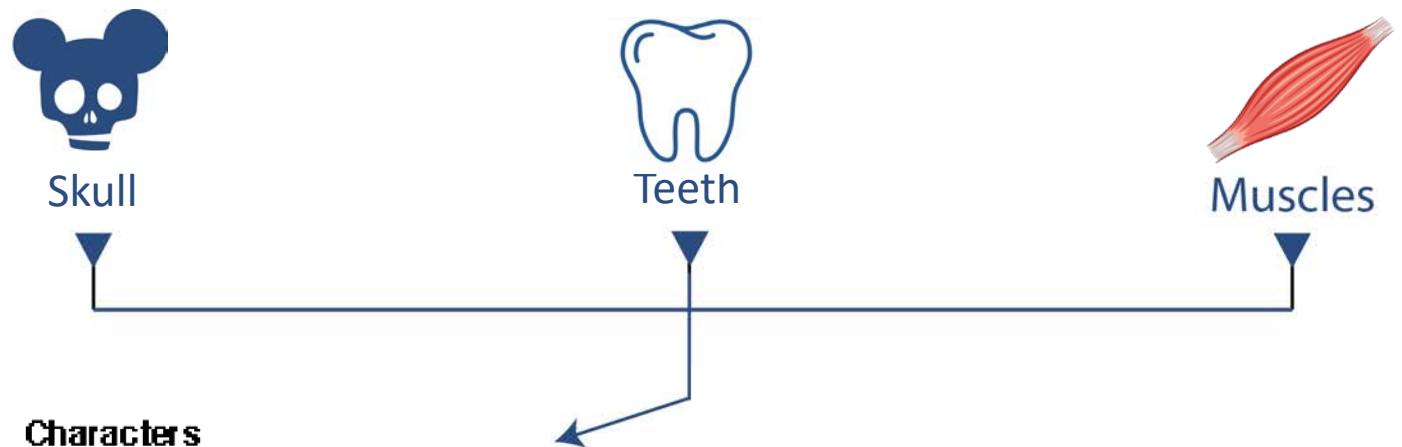


Ecology



Expected results

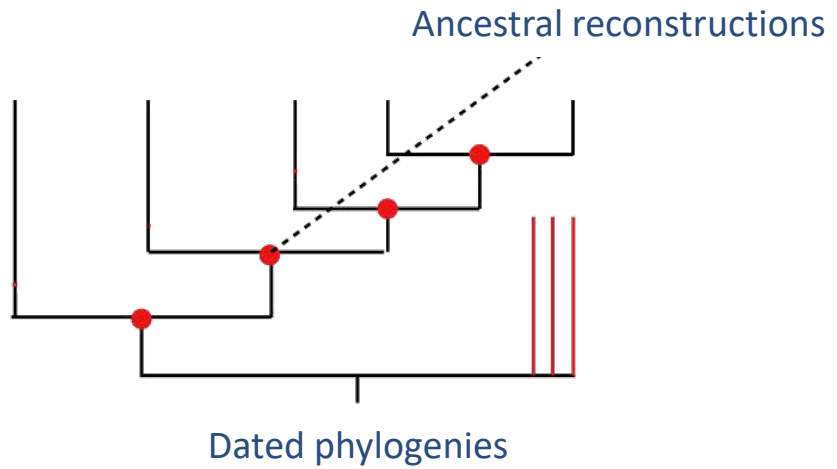
Hypothesis 2



	Characters									
Taxa	1	2	3	4	5	6	7	8	9	10
A	1	1	1	1	1	1	1	1	1	0
B	1	1	1	0	0	1	1	1	0	0
C	1	1	1	1	0	1	1	1	0	1
D	1	1	0	0	0	1	0	0	0	0
E	1	1	0	0	0	0	1	0	0	0

Total-evidence matrix

Phylogenetic analyses
WP3



Dated phylogenies

Expected results

Hypothesis 2



	Characters									
Taxa	1	2	3	4	5	6	7	8	9	10
A	1	1	1	1	1	1	1	1	1	0
B	1	1	1	0	0	1	1	1	0	0
C	1	1	1	1	0	1	1	1	0	1
D	1	1	0	0	0	1	0	0	0	0
E	1	1	0	0	0	0	1	0	0	0

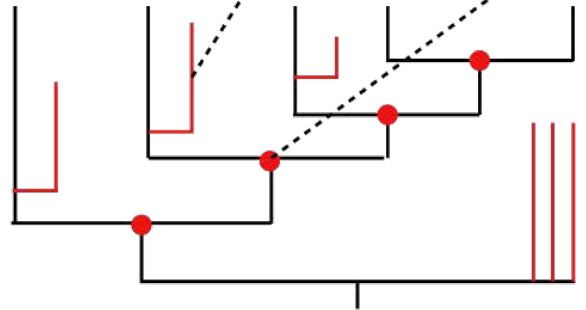
Total-evidence matrix



Fossils

+ Ancestral reconstructions

Phylogenetic analyses
WP3



Dated phylogenies

Expected results

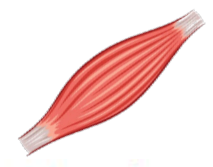
Hypothesis 2



Skull



Teeth



Muscles

Characters

Taxa	1	2	3	4	5	6	7	8	9	10
A	1	1	1	1	1	1	1	1	1	0
B	1	1	1	0	0	1	1	1	0	0
C	1	1	1	1	0	1	1	1	0	1
D	1	1	0	0	0	1	0	0	0	0
E	1	1	0	0	0	0	1	0	0	0

Total-evidence matrix

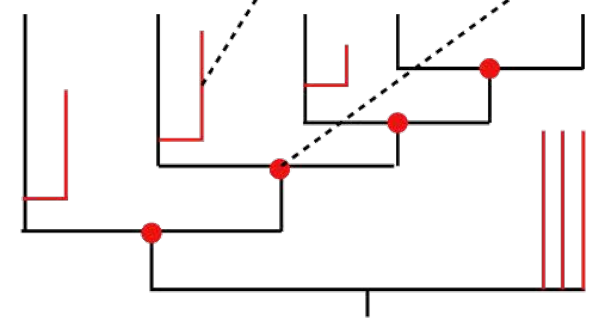


Fossils

+ Ancestral reconstructions

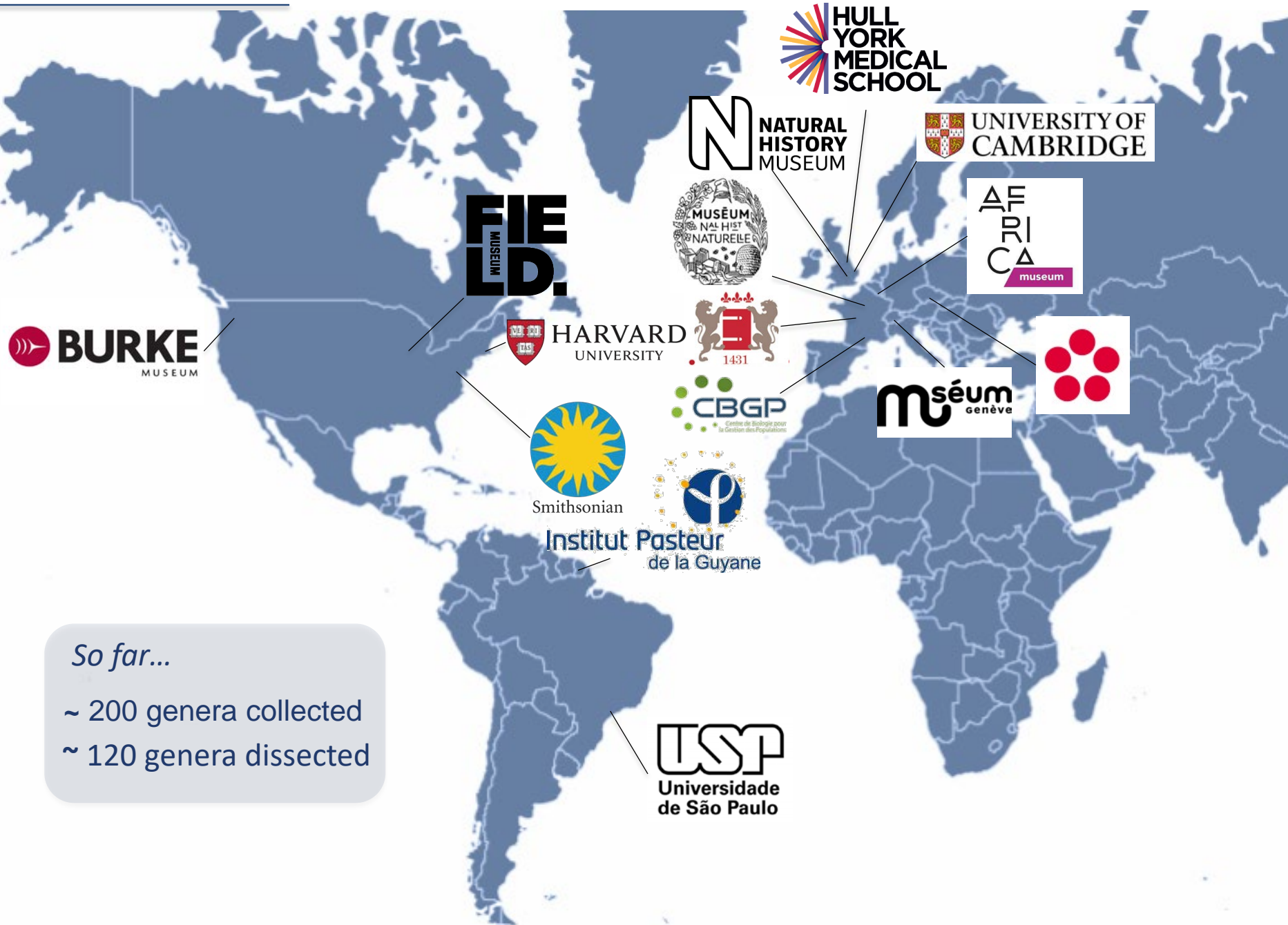
Phylogenetic analyses
WP3

Comparative analyses
WP4



Dated phylogenies

Collaborative network



So far...
~ 200 genera collected
~ 120 genera dissected

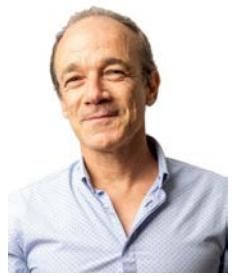
Merci !



Roberto Portela Miguez



Benoit de Thoisy



Violaine Nicolas



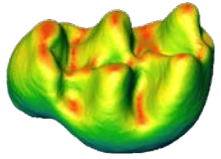
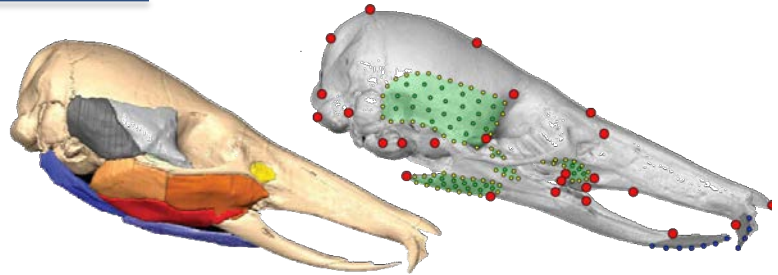
Smithsonian



Jihočeská univerzita v Českých Budějovicích University of South Bohemia in České Budějovice



The DispaRat consortium



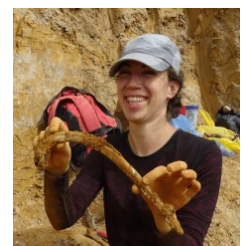
Vincent Lazzari



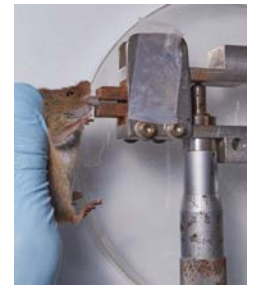
Helder Gomes Rodrigues



Franck Guy



Anthony Herrel

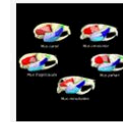
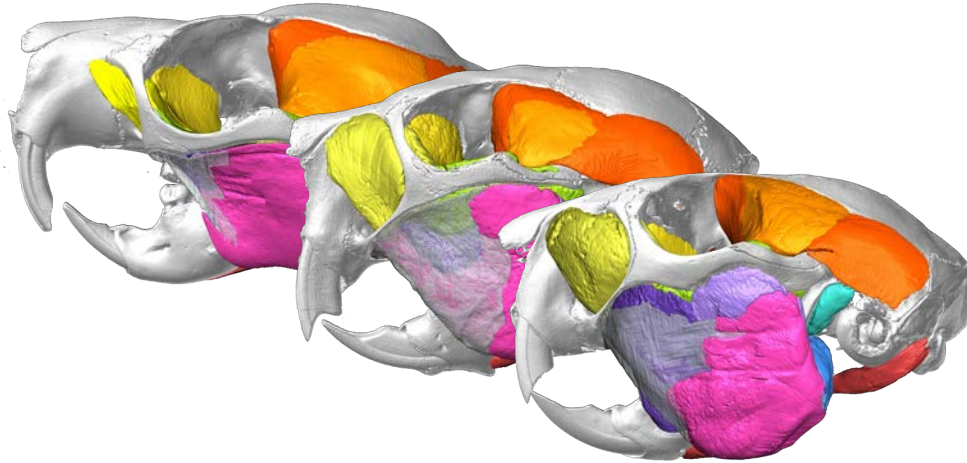


Phil Cox



Sharing is caring...

The 3D reconstructions produced during this project will be used to create the first freely available 3D interactive atlas of the rodent masticatory apparatus, which we also envision to publish in a book format.



3D models related to the publication: One skull to rule them all? Descriptive and comparative anatomy of the masticatory apparatus in five mice species based on traditional and digital dissections.

Samuel Ginot, Julien Claude and Lionel Hautier

Keywords: *Dissection*; *iodine-enhanced CT-scan*; *Masticatory musculature*; *Murinae*; *skull myology*

doi: [10.18563/journal.m3.65](https://doi.org/10.18563/journal.m3.65)

[Abstract](#)

Specimens and 3D Data

Mus cervicolor R7314 [View specimen](#)



M3#343_R7314

.ply surfaces of the skull and masticatory muscles of *Mus cervicolor*. Created with MorphoDig, .pos and .ntw files also included. Scans were obtained thanks to the Institut des Sciences de l'Evolution de Montpellier MRI platform.

[Download 3D data](#)

Type: "3D_surfaces"

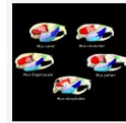
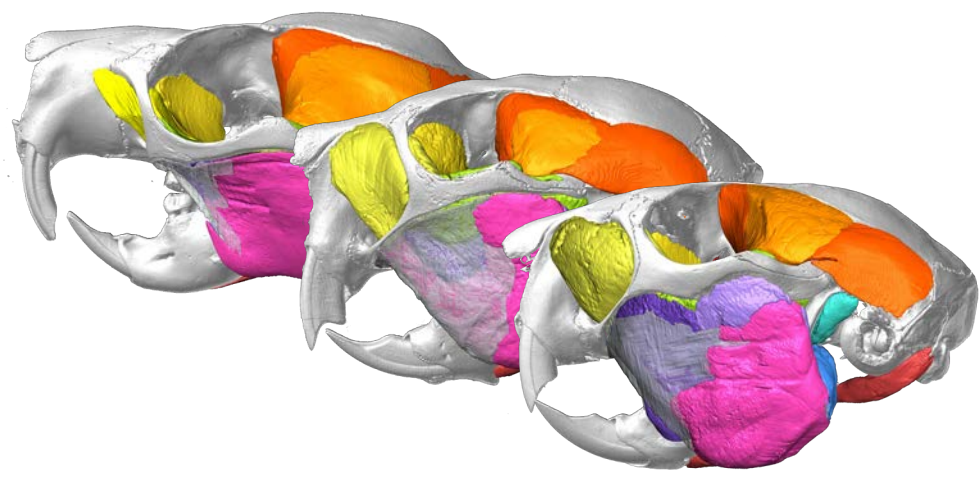
3D view: doi: [10.18563/m3.sf.343](https://doi.org/10.18563/m3.sf.343)

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Sharing is caring...

The 3D reconstructions produced during this project will be used to create the first freely available 3D interactive atlas of the rodent masticatory apparatus, which we also envision to publish in a book format.



3D models related to the publication: One skull to rule them all? Descriptive and comparative anatomy of the masticatory apparatus in five mice species based on traditional and digital dissections.

Samuel Ginot, Julien Claude and Lionel Hautier

Keywords: Dissection; iodine-enhanced CT-scan; Masticatory musculature; Murinae; skull myology

doi: 10.18563/journal.m3.65

Abstract

Specimens and 3D Data

Mus cervicolor R7314 [View specimen](#)



M3#343_R7314

.ply surfaces of the skull and masticatory muscles of *Mus cervicolor*. Created with MorphoDig, .pos and .ntw files also included. Scans were obtained thanks to the Institut des Sciences de l'Evolution de Montpellier MRI platform.

[Download 3D data](#)

Type: "3D_surfaces"

3D view: doi: 10.18563/m3.sf.343

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