

## SUPPLEMENTARY MATERIAL

### A micro-CT-based morphology of the palato-spheno-pterygoid complex of arvicoline rodents (Cricetidae) with special focus on Clethrionomyini palatine morphology

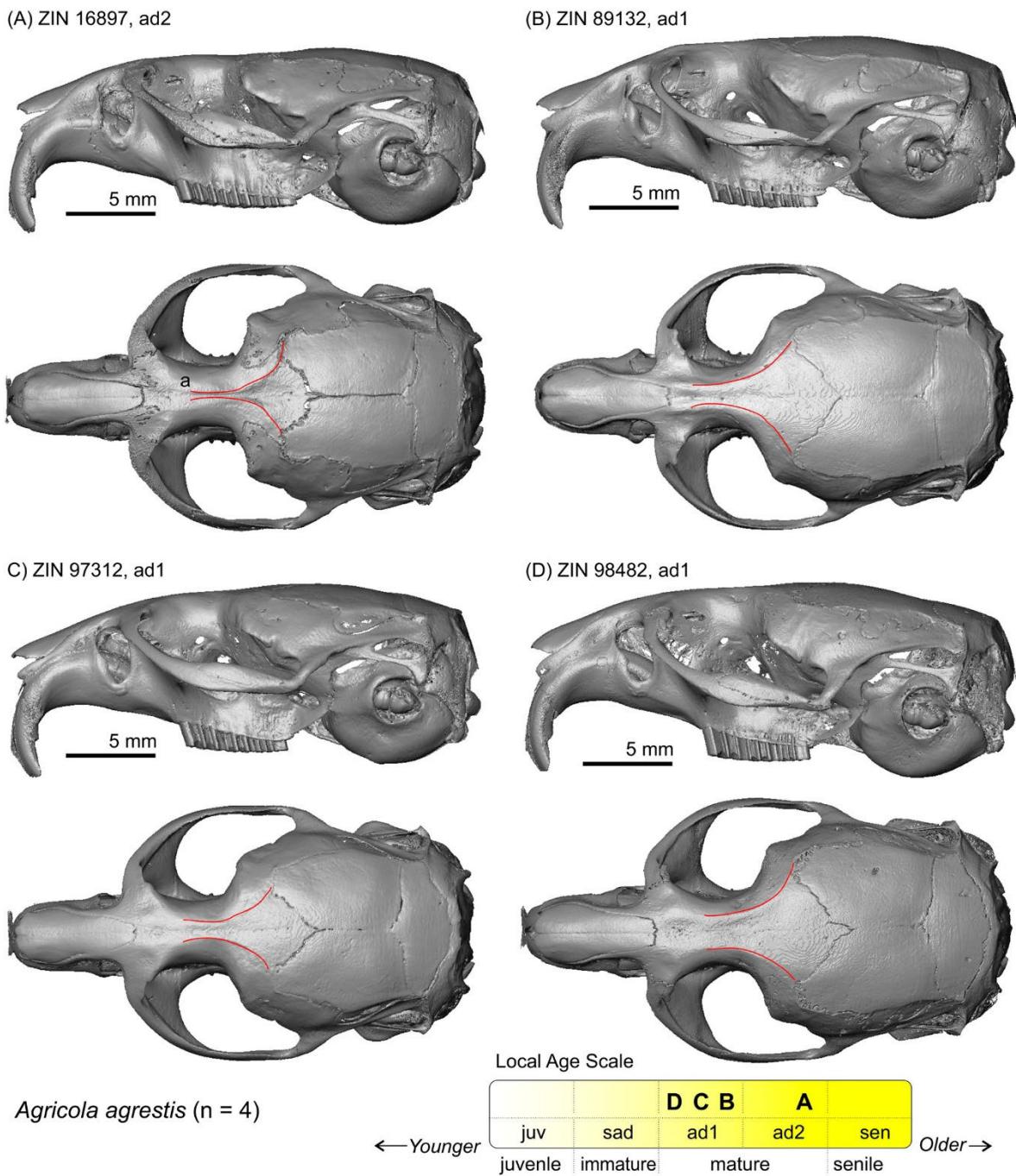
Authors: Leonid L. Voyta, Daniel A. Melnikov and Lyudmila Yu. Kryuchkova

#### Figures S01–S35

*Description of age groups for each species*

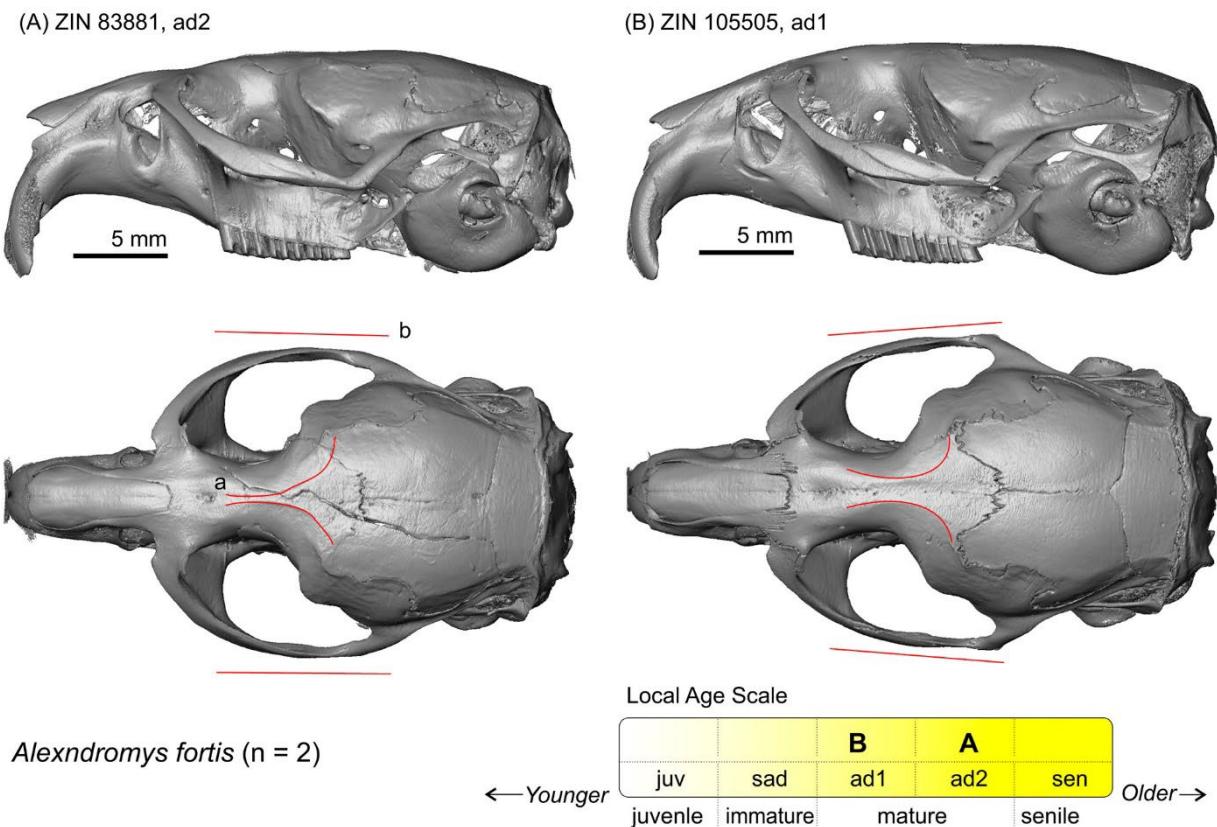
**Figure S1.** Relative age groups of the analysed specimens of *Agricola agrestis*: (A) ZIN 16897; (B) ZIN 89132; (C) ZIN 97312; (D) ZIN 98482.

Skulls are shown in lateral (top) and dorsal (bottom) view. Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, the temporal line in the adult specimen. 3D models available via link: [https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/agricola.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/agricola.html)



**Figure S2.** Relative age groups of the analysed specimens of *Alexandromys fortis*: (A) ZIN 83881; (B) ZIN 105505.

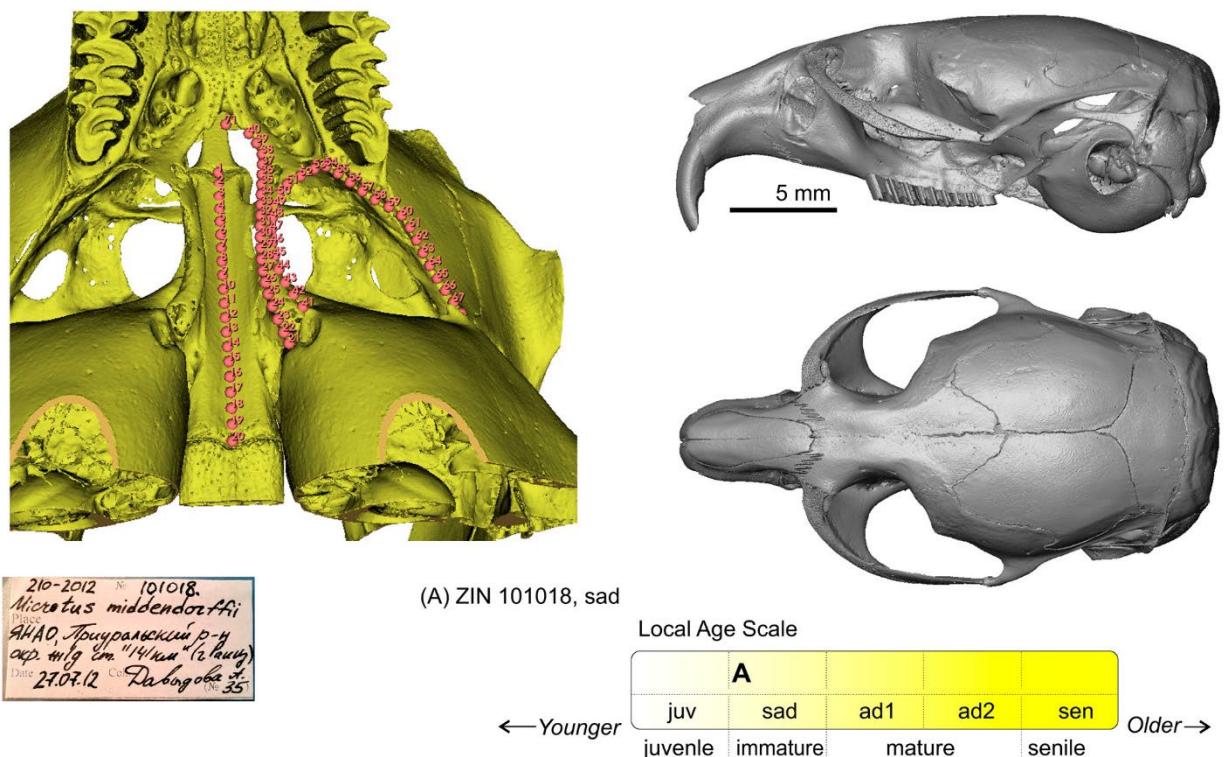
Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, the temporal line; **b**, line marks the profile of the zygomatic arch in a mature specimen compared to an immature specimen. 3D models available via link: [https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/alexandromys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/alexandromys.html)



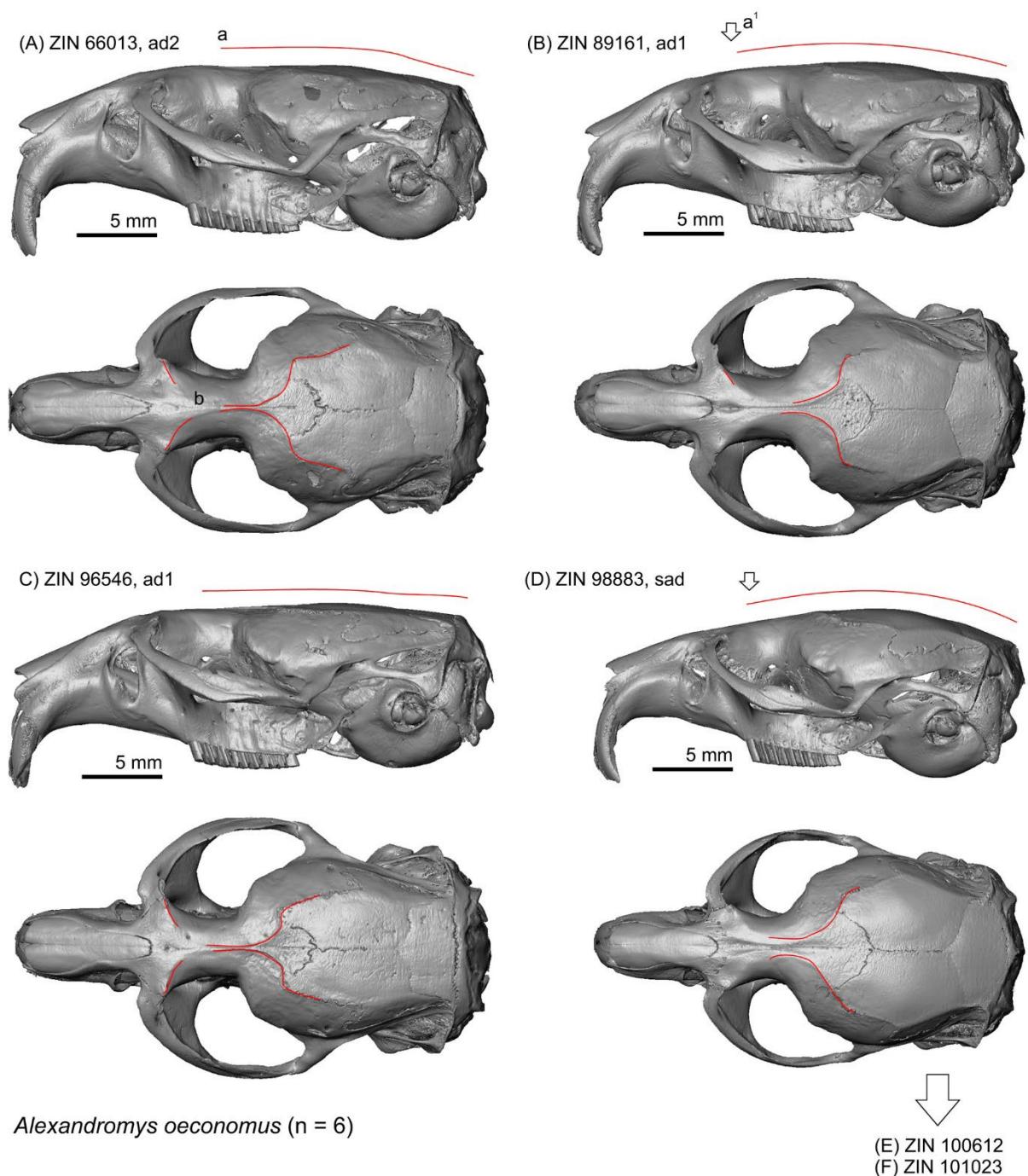
**Figure S3.** Screenshot of the PSP complex in subposterior view of specimen ZIN 101018 of *Alexandromys middendorffii* with landmark positions (left).

Skull in lateral (top, right) and dorsal (bottom, right) view. Scale bar is 5 mm. 3D model available via link: [https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/alexandromys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/alexandromys.html)

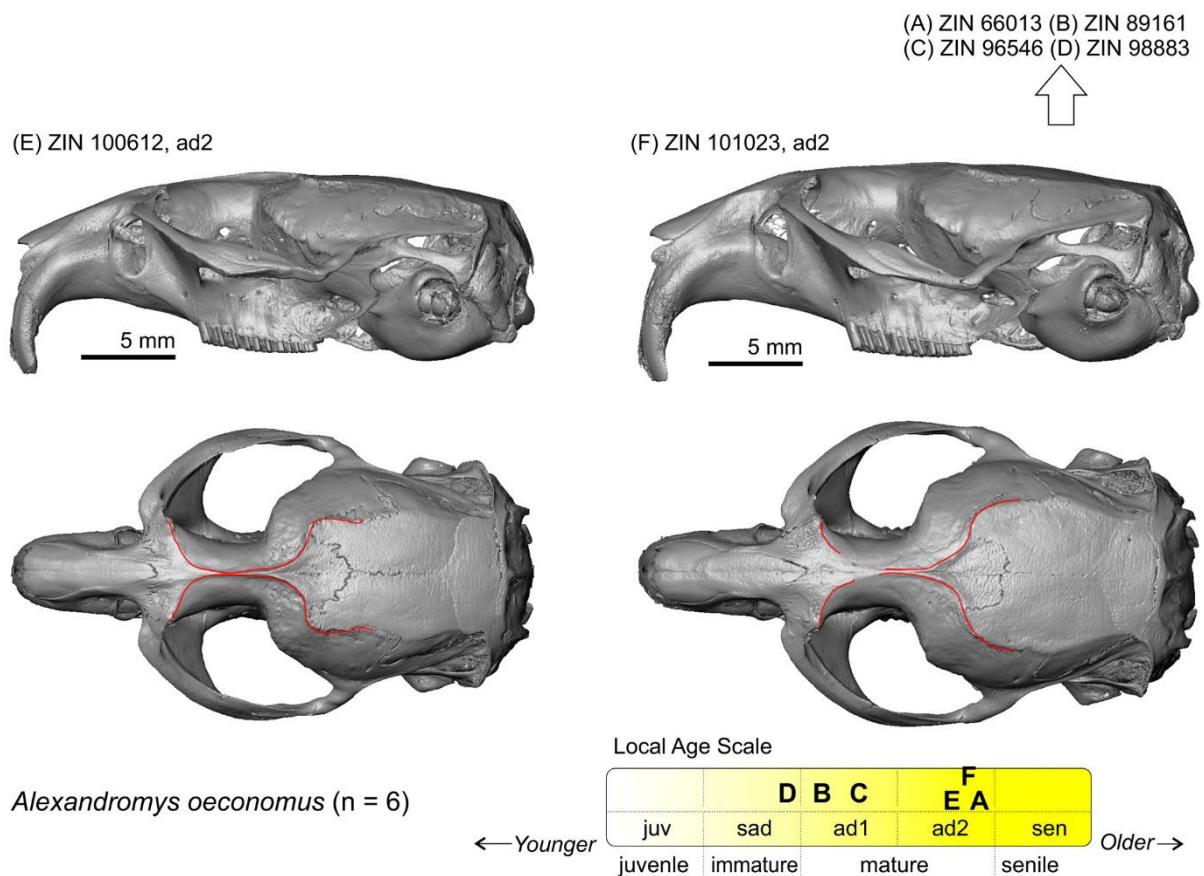
*Alexandromys middendorffii* (n = 1)



**Figure S4.** Relative age groups of the analysed specimens of *Alexandromys oeconomus*: (A) ZIN 66013; (B) ZIN 89161; (C) ZIN 96546; (D) ZIN 98883; (E) ZIN 100612; (F) ZIN 101023. Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, line with arrow 'a1' marks differences between mature and immature specimens; **b**, temporal line. 3D models available via link: [https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/alexandromys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/alexandromys.html)



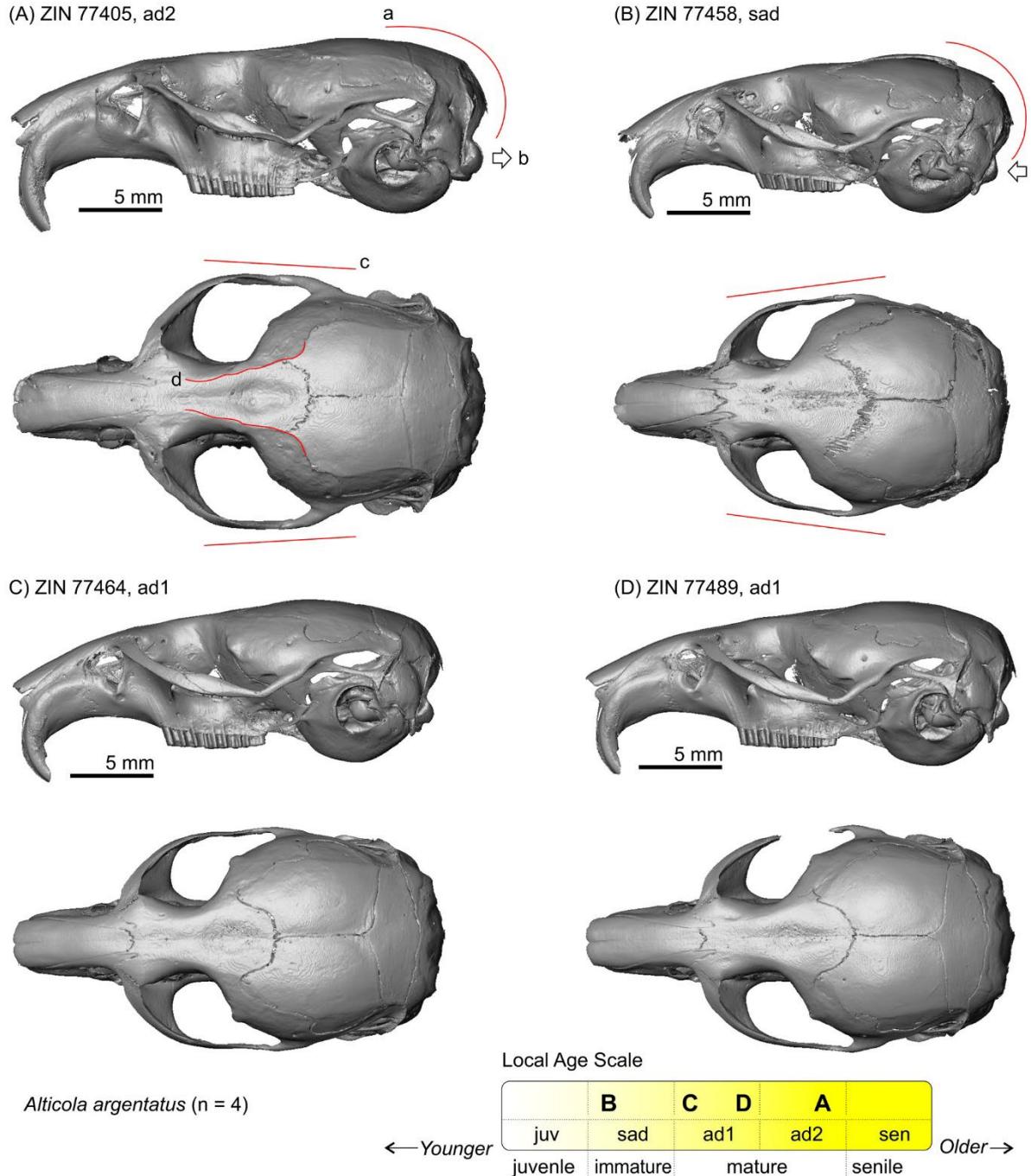
**Figure S4.** Continue.



**Figure S5.** Relative age groups of the analysed specimens of *Alticola argentatus*: (A) ZIN 77405; (B) ZIN 77458; (C) ZIN 77464; (D) 77489.

Skulls are shown in lateral (top) and dorsal (bottom) view. Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, line together with arrow 'b' marks differences between mature and immature specimens; **b**, arrow marks condylar position in mature vs immature specimen; **c**, line marks the profile of the zygomatic arch in a mature specimen compared to an immature specimen; **d**, temporal line in mature specimen. 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/alticola.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/alticola.html)

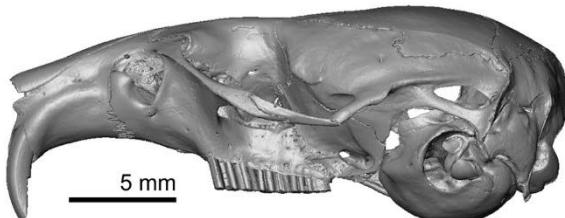


**Figure S6.** Relative age groups of the analysed specimens of *Alticola lemminus*: (A) ZIN 101796; (B) ZIN 101797.

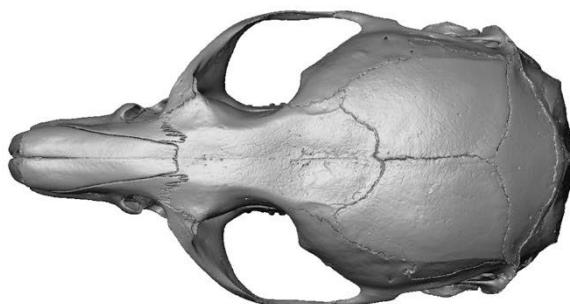
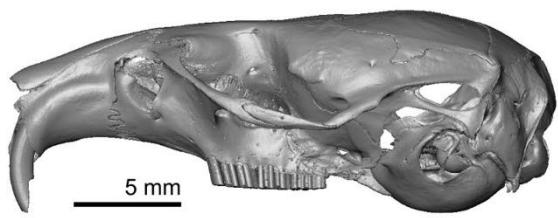
Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. The age group was determined with the aid of *A. argentatus* age attribution (see Fig. S5). 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/alticola.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/alticola.html)

(A) ZIN 101796, ad1



(B) ZIN 101797, ad1



*Alticola lemminius* ( $n = 2$ )

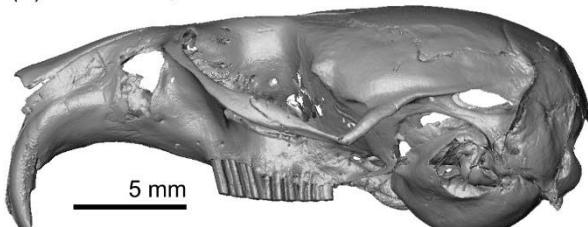
## Local Age Scale

**Figure S7.** Relative age groups of the analysed specimens of *Alticola macrotis*: (A) ZIN 102289; (B) ZIN 102307; (C) ZIN 99351.

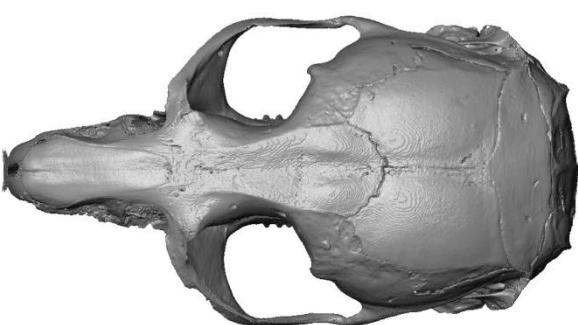
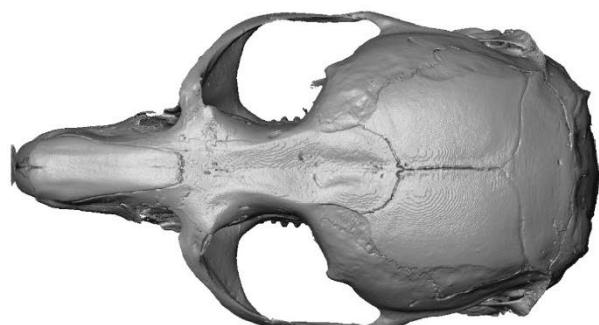
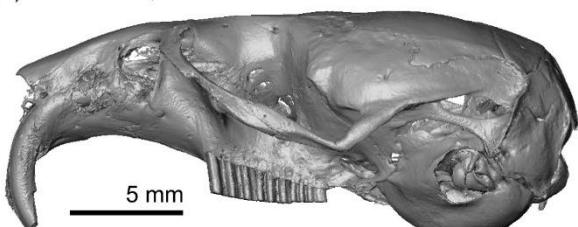
Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. The age group was determined with the aid of *A. argentatus* age attribution (see Fig. S5). 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/alticola.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/alticola.html)

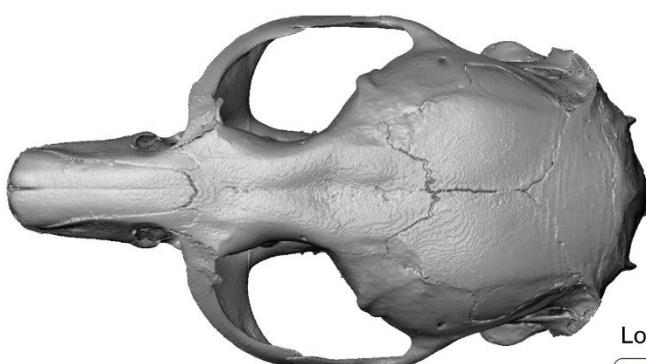
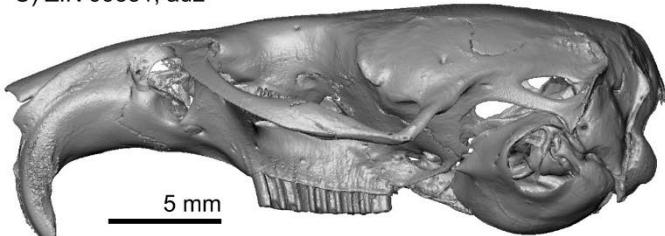
(A) ZIN 102289, ad1



(B) ZIN 102307, ad1



C) ZIN 99351, ad2



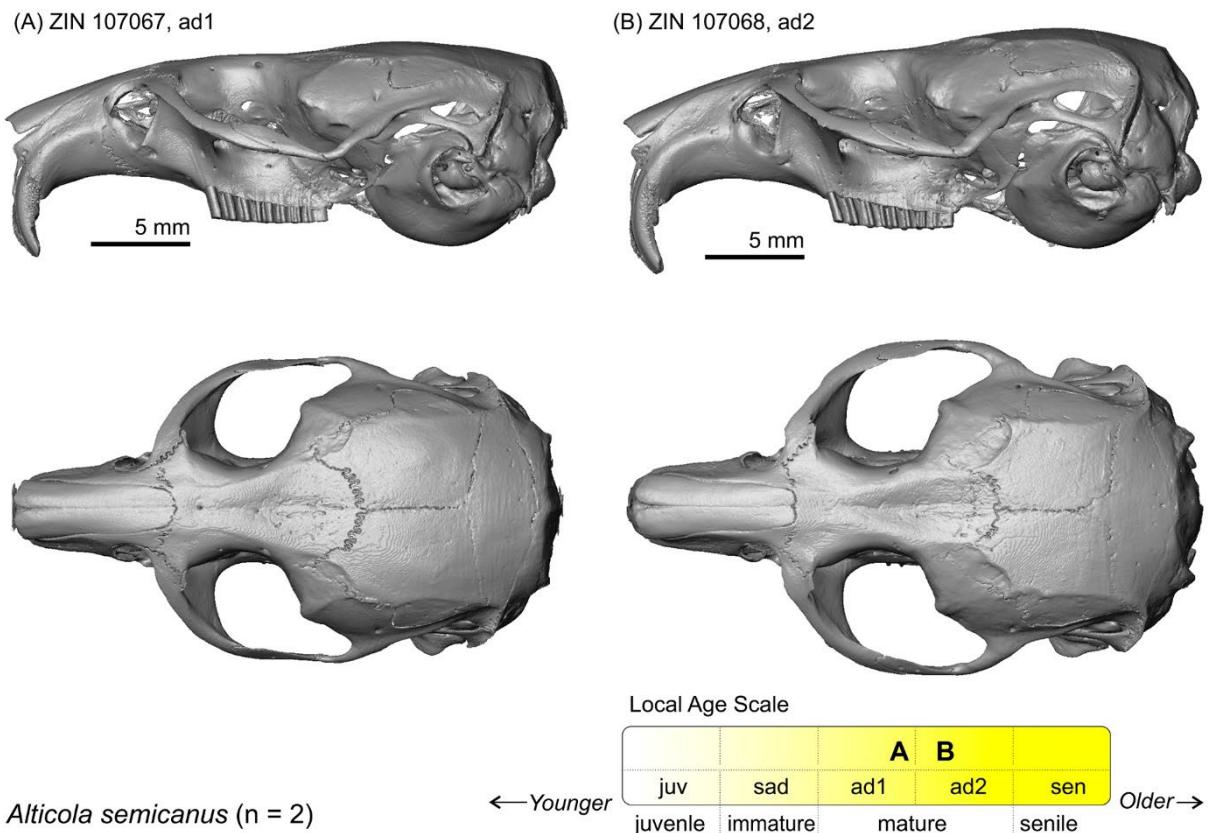
*Alticola macrotis* (n = 3)

Local Age Scale				
		B A	C	
← Younger	juv	sad	ad1	Older →
	juvenile	immature	mature	senile

**Figure S8.** Relative age groups of the analysed specimens of *Alticola semicanus*: (A) ZIN 107067; (B) ZIN 107068.

Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. The age group was determined with the aid of *A. argentatus* age attribution (see Fig. S5). 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/alticola.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/alticola.html)

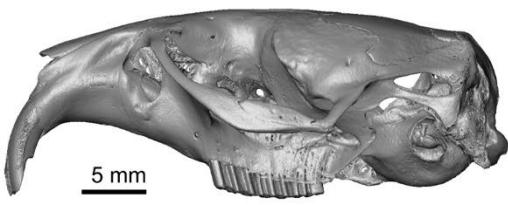


**Figure S9.** Relative age groups of the analysed specimens of *Arvicola amphibius*: (A) ZIN 10034; (B) ZIN 16365; (C) ZIN 45399.

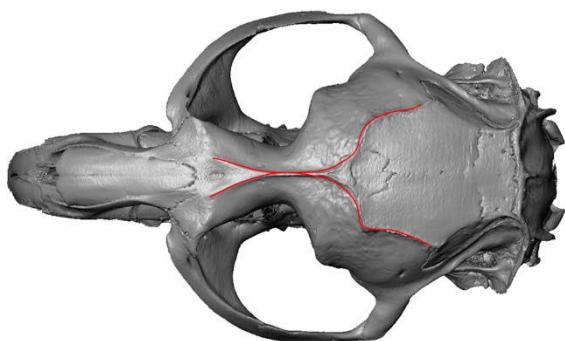
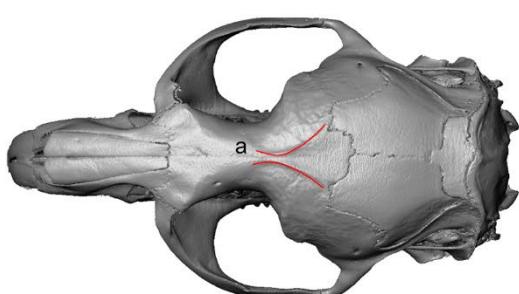
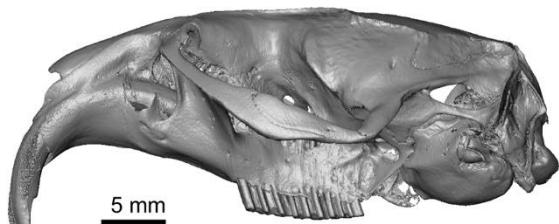
Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. Key: a, temporal line. 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/arvicola.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/arvicola.html)

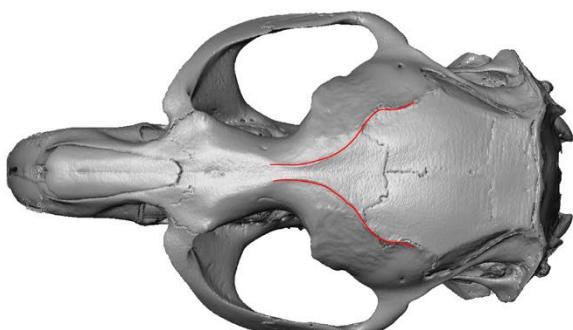
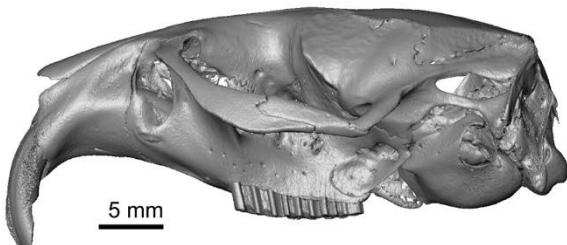
(A) ZIN 10034, sad



(B) ZIN 16365, ad2



C) ZIN 45399, ad1



*Arvicola amphibius* (n = 3)

← Younger

Local Age Scale

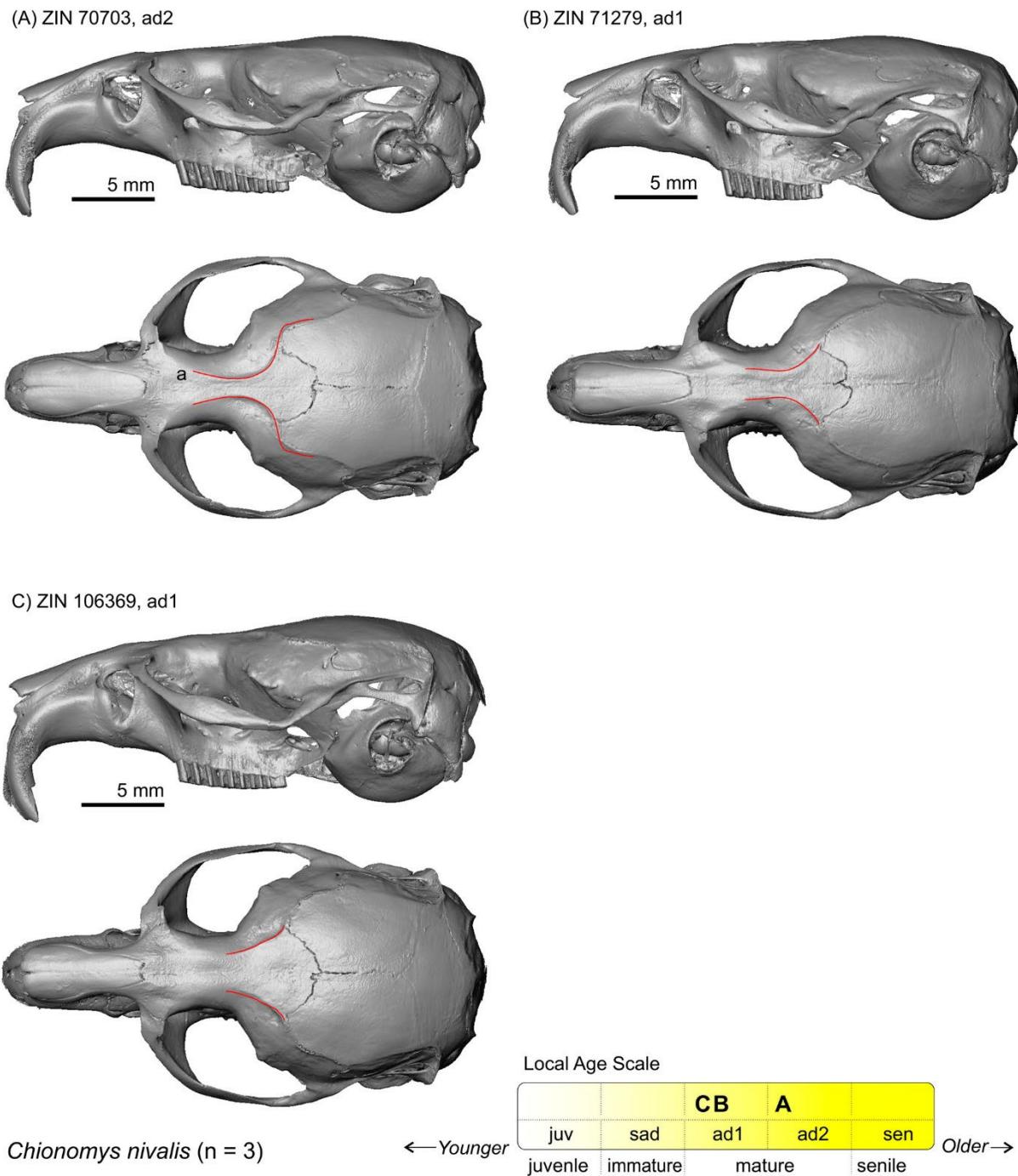
	A	C	B	
juv	sad	ad1	ad2	sen
juvenile	immature	mature		senile

Older →

**Figure S10.** Relative age groups of the analysed specimens of *Chionomys nivalis*: (A) ZIN 70703; (B) ZIN 71279; (C) ZIN 106369.

Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. Key: a, temporal line. 3D models available via link:

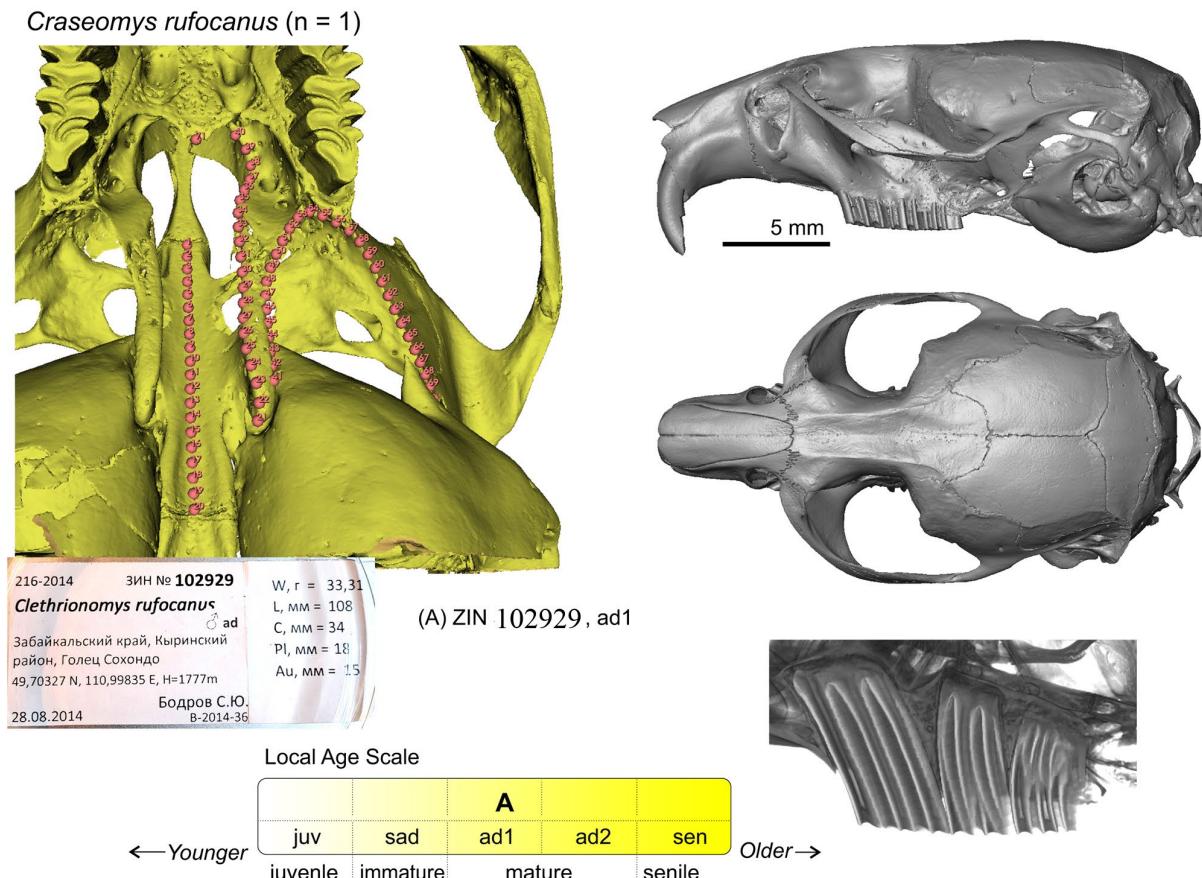
[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/chionomys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/chionomys.html)



**Figure S11.** Screenshot of the PSP complex in subposterior view of specimen ZIN 102929 of *Craseomys rufocanus* with landmark positions (left). Skull in lateral (top, right) and dorsal (bottom, right) view.

The lower image shows lateral radiograph of molar roots (root-bearing species only). Scale bar is 5 mm. 3D model available via link:

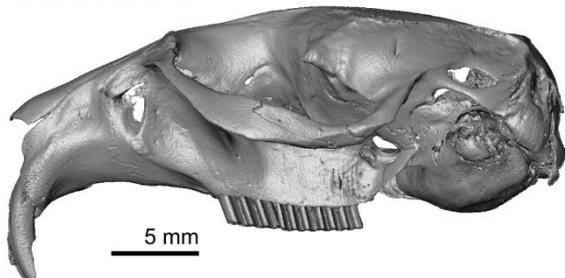
[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/craseomys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/craseomys.html)



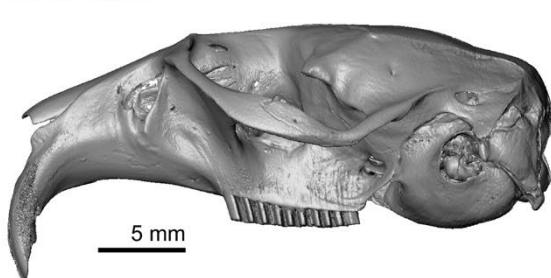
**Figure S12.** Relative age groups of the analysed specimens of *Dicrostonyx torquatus*: (A) ZIN 81169; (B) ZIN 81254; (C) ZIN 81552.

Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. The age group was determined with the aid of *L. sibiricus* age attribution (see Fig. S21 below). Key: **a**, temporal line; **b**, nuchal crest. 3D models available via link: [https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/dicrostonyx.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/dicrostonyx.html)

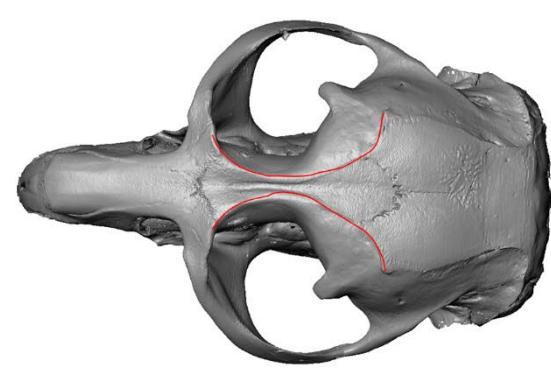
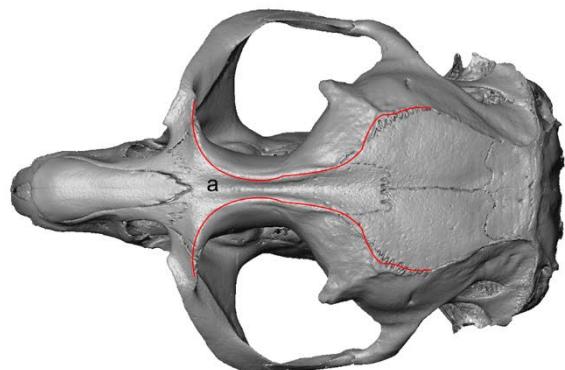
(A) ZIN 81169, ad2



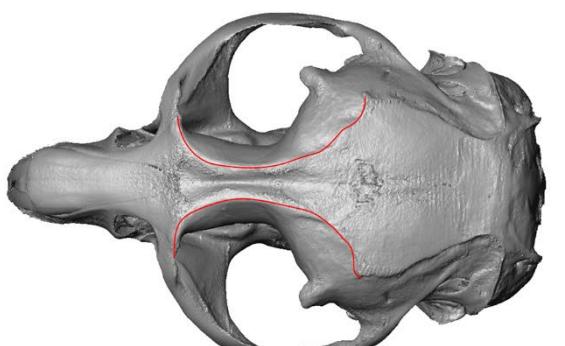
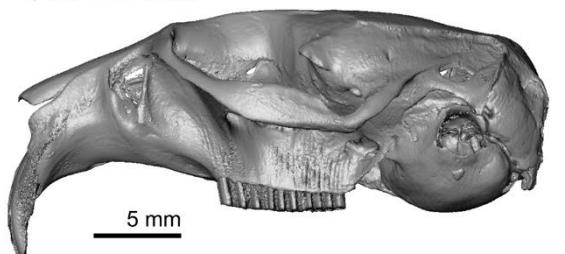
(B) ZIN 81254, ad1



a



C) ZIN 81552, ad1



Local Age Scale

		C	B	A	
juv	sad	ad1	ad2	sen	
juvenile	immature	mature		senile	Older→

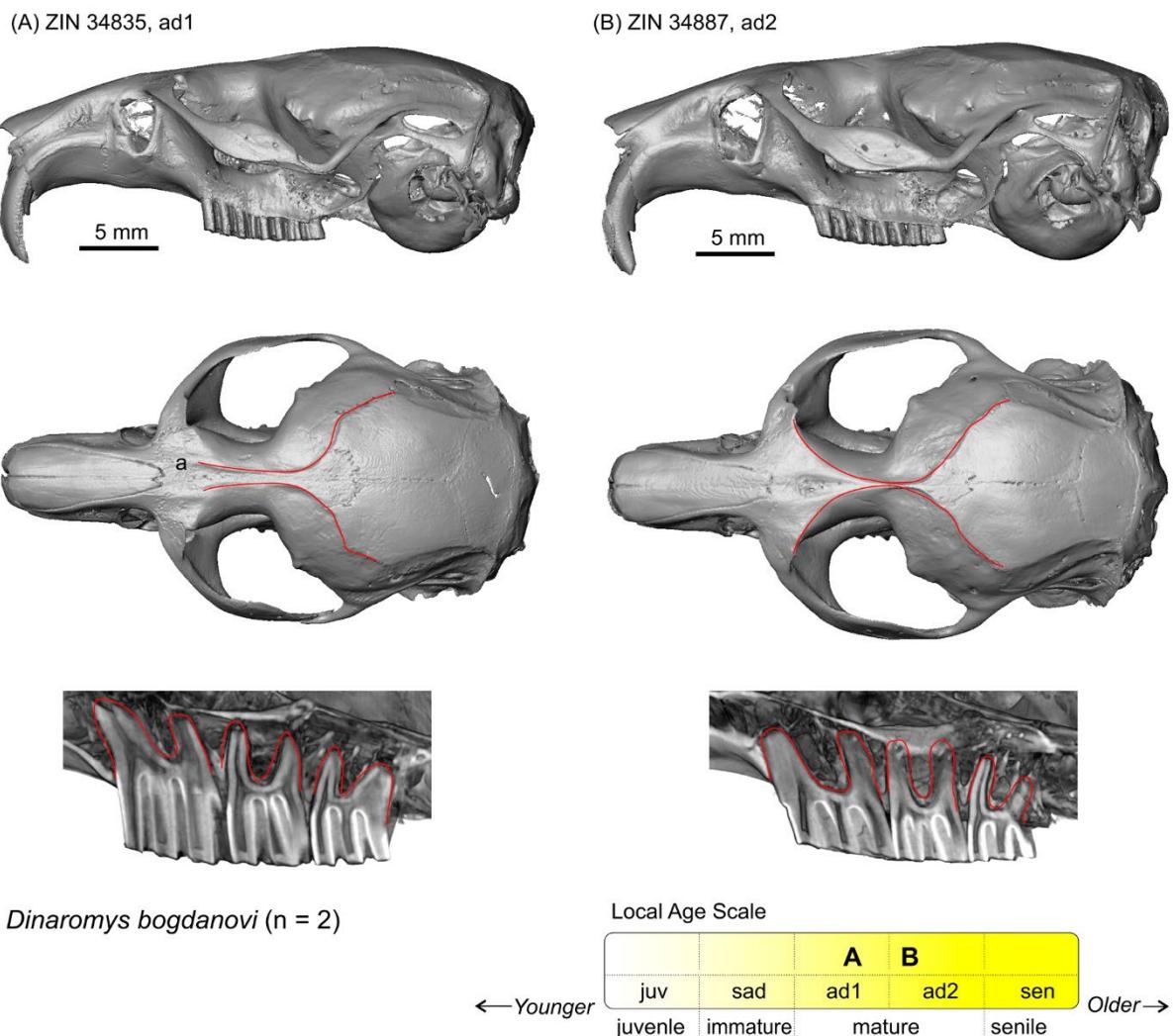
← Younger

*Dicrostonyx torquatus* (n = 3)

**Figure S13.** Relative age groups of the analysed specimens of *Dinaromys bogdanovi*: (A) ZIN 34835; (B) ZIN 34887.

Skulls are shown in lateral (top) and dorsal (middle) views. The lower images show lateral radiographs of molar roots (root-bearing species only). Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, the temporal line. 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/dinaromys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/dinaromys.html)

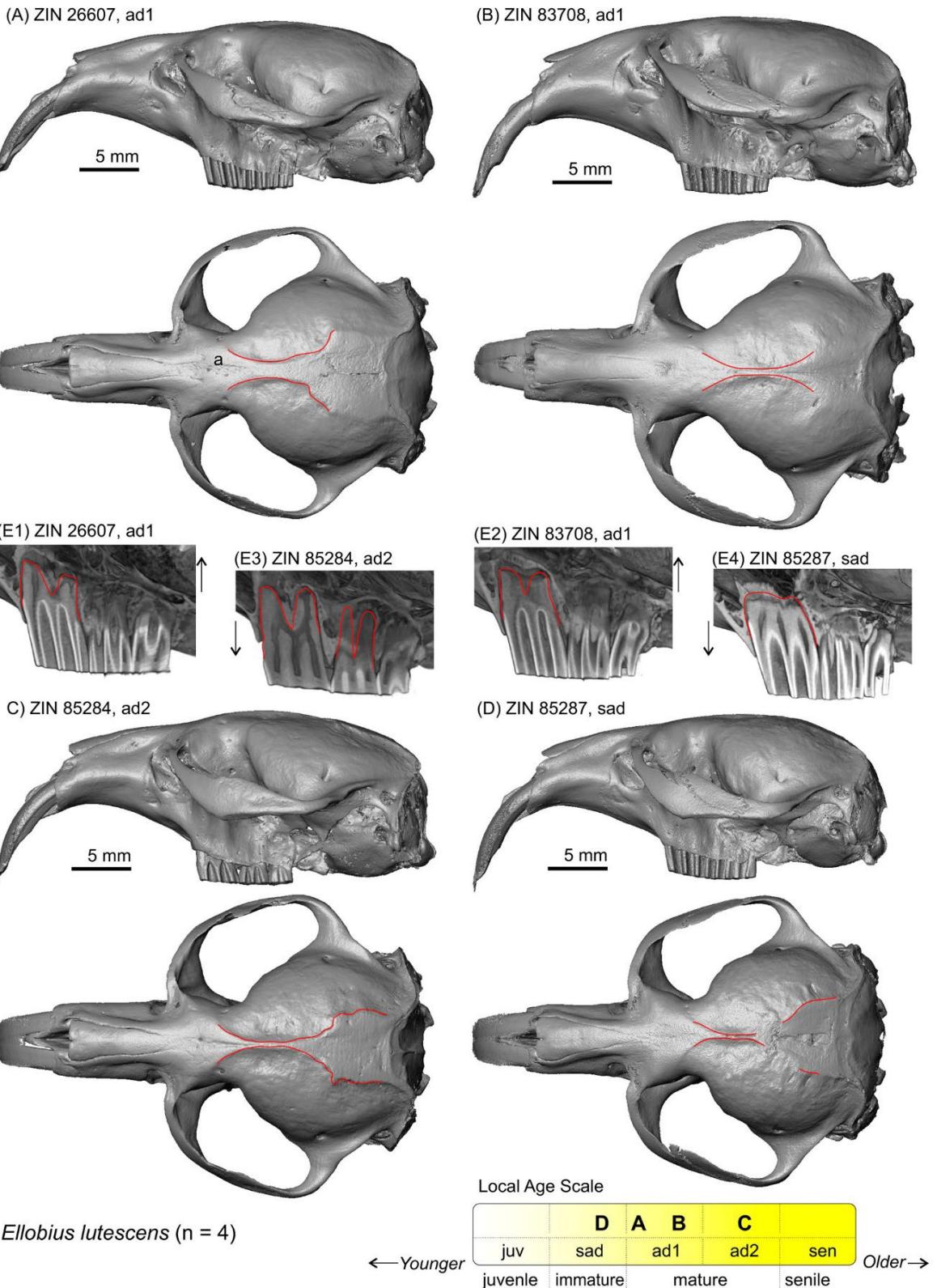


**Figure S14.** Relative age groups of the analysed specimens of *Ellobius lutescens*: (A) ZIN 26607; (B) ZIN 83708; (C) ZIN 85284; (D) ZIN 85287.

Skulls are shown in lateral (top) and dorsal (bottom) views. (E1–E4) Lateral radiographs of molar roots (root-bearing species only). Scale bars are 5 mm; skulls are shown at the same scale.

Key: **a**, temporal line. 3D models available via link:

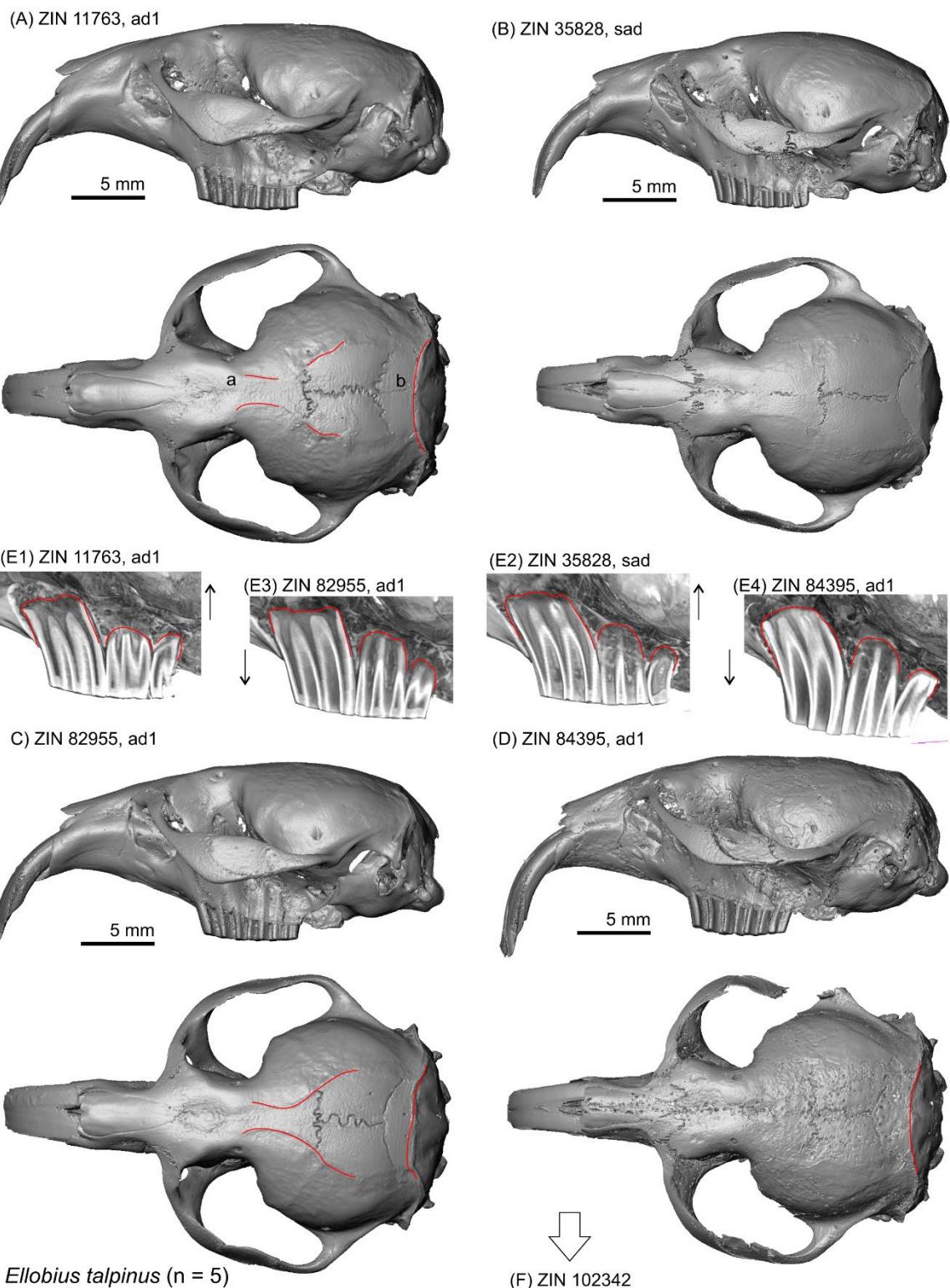
[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/ellobius.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/ellobius.html)



**Figure S15.** Relative age groups of the analysed specimens of *Ellobius talpinus*: (A) ZIN 11763; (B) ZIN 35828; (C) ZIN 82955; (D) ZIN 84395; (F) ZIN 102342.

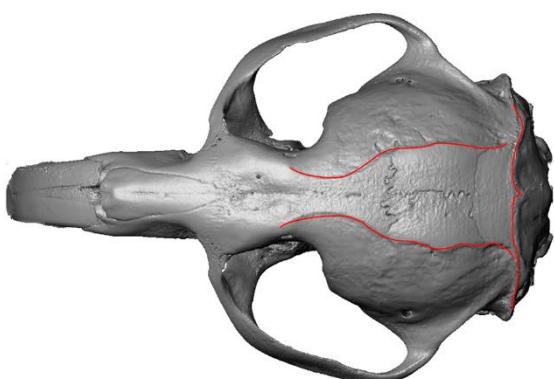
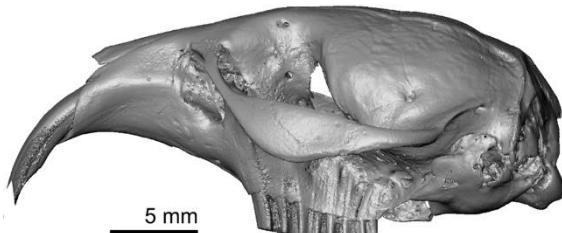
(E1–E5) Lateral radiographs of molar roots (root-bearing species only). Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. The age group was determined with the aid of *E. lutescens* age attribution (see Fig. S14). Key: **a**, temporal line; **b**, nuchal crest. 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/ellobius.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/ellobius.html)



**Figure S15.** Continue.

(F) ZIN 102342, ad1

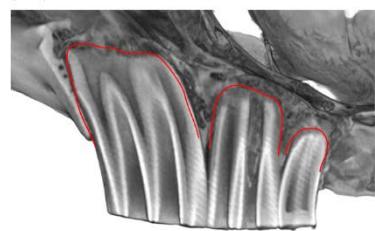


*Ellobius talpinus* (n = 5)

← Younger

(A) ZIN 11763 (B) ZIN 35828  
(C) ZIN 82955 (D) ZIN 84395

(E5) ZIN 102342, ad1



Local Age Scale

	B	C	D	F <sup>(E5)</sup>	
juv	sad	ad1	ad2	sen	
juvenile	immature	mature		senile	

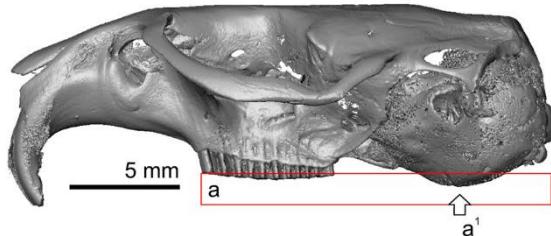
Older →

**Figure S16.** Relative age groups of the analysed specimens of *Lagurus lagurus*: (A) ZIN 29170; (B) ZIN 57188.

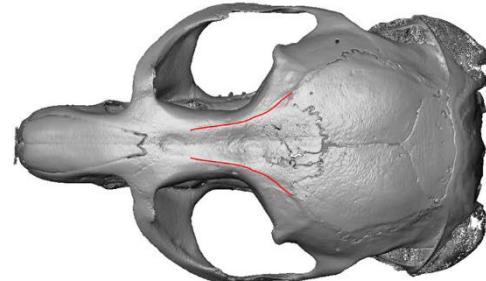
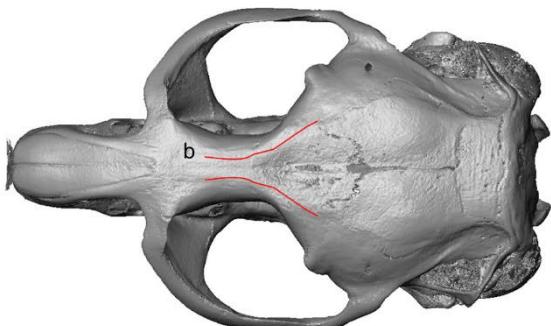
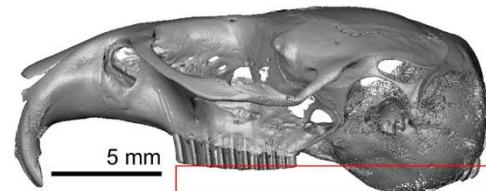
Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. *Key:* **a**, frame with arrow 'a1' marks differences in relative position of teeth and tympanic bulla levels between mature and immature specimens; **b**, temporal line. 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/lagurus.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/lagurus.html)

(A) ZIN 29170, ad2



(B) ZIN 57188, sad



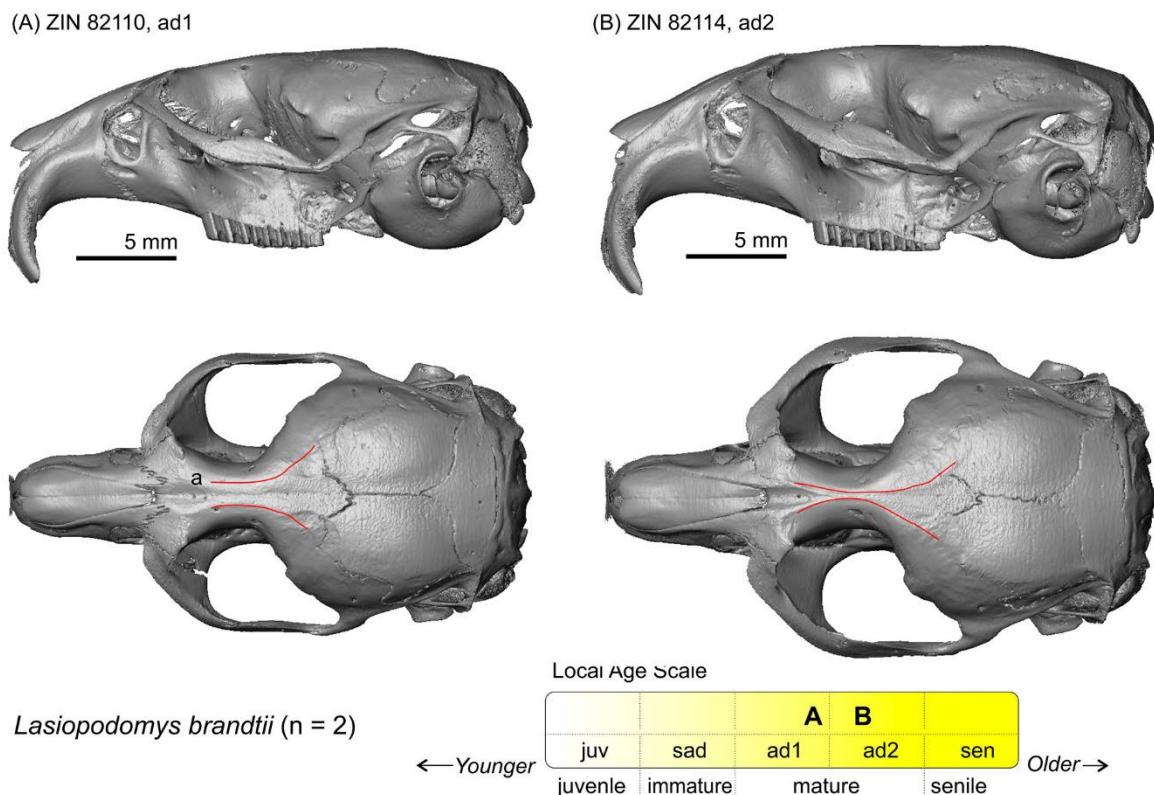
*Lagurus lagurus* ( $n = 2$ )

## Local Age Scale

	B	A		
← Younger	juv juvenile	sad immature	ad1 ad2 mature	sen senile
Older →				

**Figure S17.** Relative age groups of the analysed specimens of *Lasiopodomys brandtii*: (A) ZIN 82110; (B) ZIN 82114.

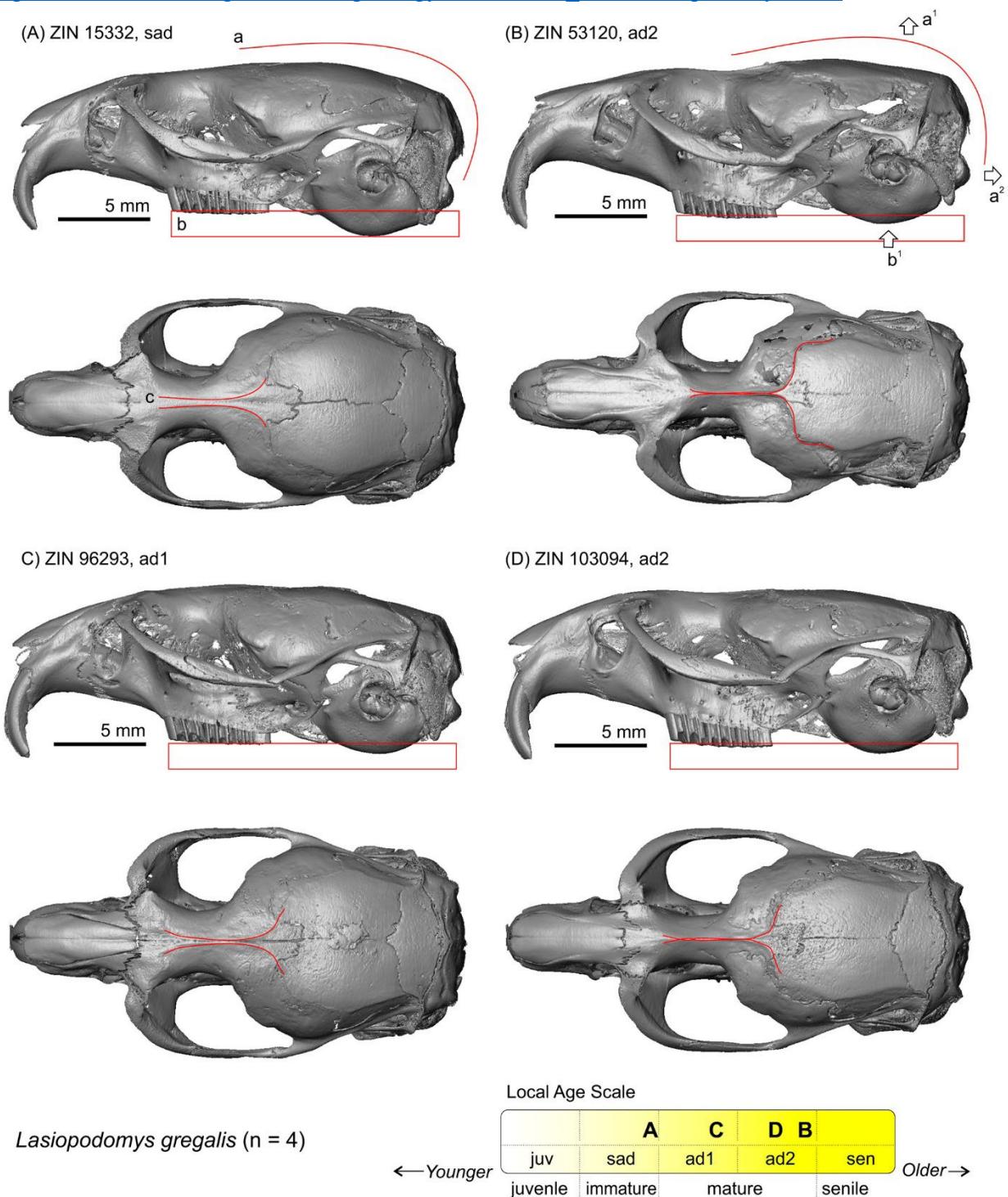
Skulls are shown in lateral (top) and dorsal (bottom) view. Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, the temporal line in the mature specimen. 3D models available via link: [https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/lasiopodomys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/lasiopodomys.html)



**Figure S18.** Relative age groups of the analysed specimens of *Lasiopodomys gregalis*: (A) ZIN 15332; (B) ZIN 53120; (C) ZIN 96293; (D) ZIN 103094.

Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, line with arrows 'a1–a2' marks differences between mature and immature specimens; **b**, frame with arrow 'b1' marks differences in relative position of teeth and tympanic bulla levels between mature and immature specimens; **c**, temporal line. 3D models available via link:

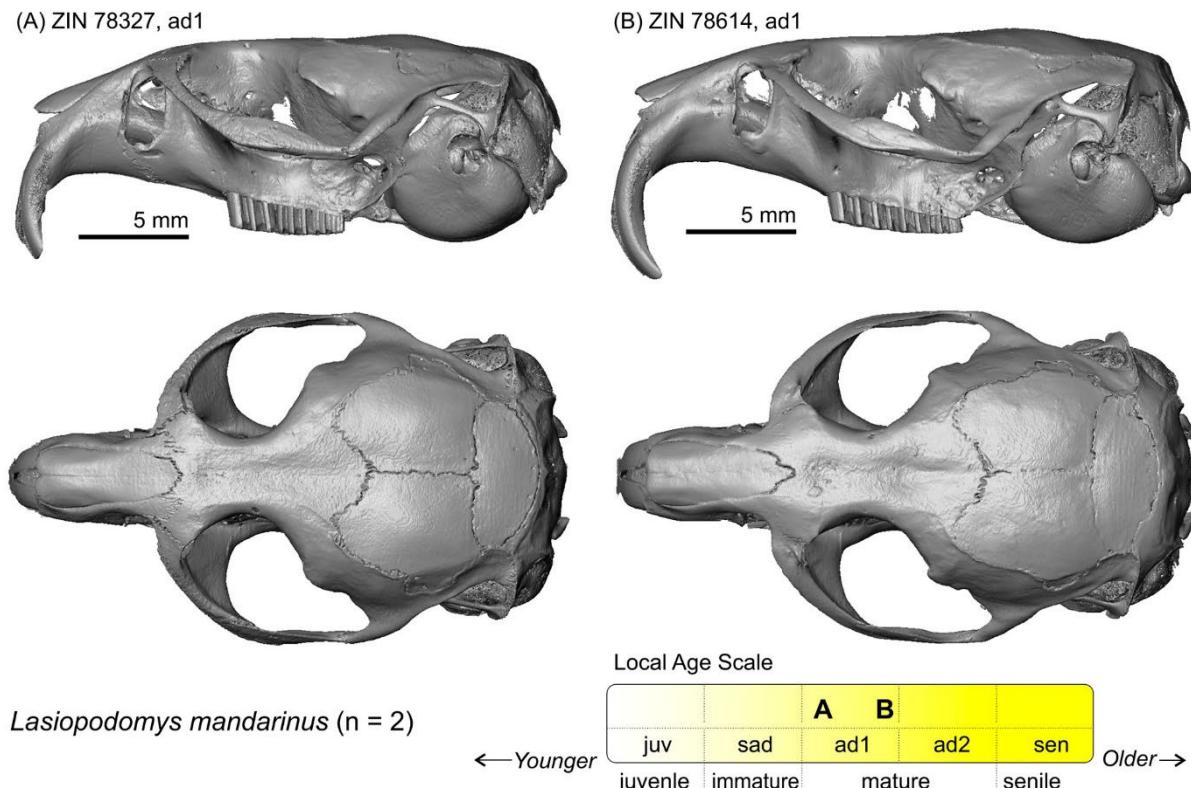
[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/lasiopodomys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/lasiopodomys.html)



**Figure S19.** Relative age groups of the analysed specimens of *Lasiopodomys mandarinus*: (A) ZIN 78327; (B) ZIN 78614.

Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. The age group was determined with the aid of *L. brandtii* age attribution (see Fig. S17). 3D models available via link:

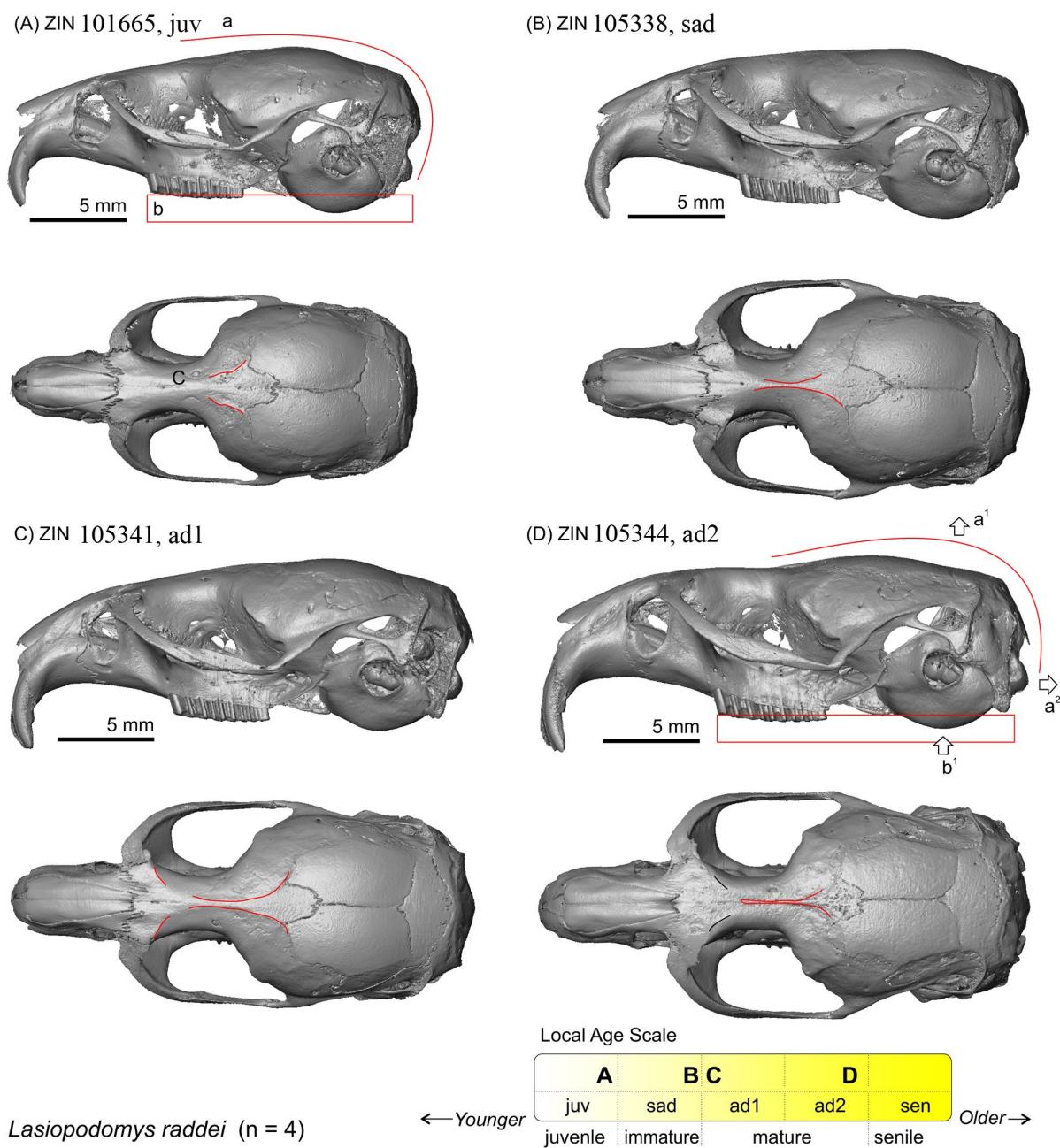
[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/lasiopodomys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/lasiopodomys.html)



**Figure S20.** Relative age groups of the analysed specimens of *Lasiopodomys raddei*: (A) ZIN 101665 (B) ZIN 105338; (C) ZIN 105341; (D) ZIN 105344.

Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. The age group was determined with the aid of *L. gregalis* age attribution (see Fig. S18). Key: **a**, line with arrows 'a1–a2' marks differences between mature and immature specimens; **b**, frame with arrow 'b1' marks differences in relative position of teeth and tympanic bulla levels between mature and immature specimens; **c**, temporal line. 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/lasiopodomys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/lasiopodomys.html)

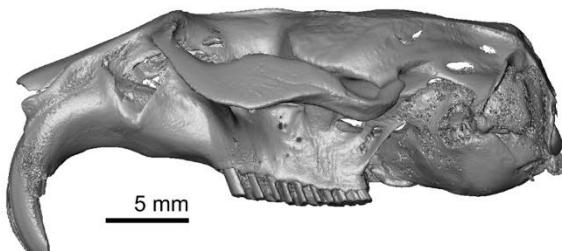


**Figure S21.** Relative age groups of the analysed specimens of *Lemmus sibiricus*: (A) ZIN 64159; (B) ZIN 81239; (C) ZIN 81241.

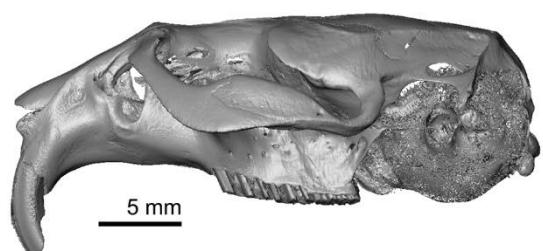
Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. The age group was determined with the aid of *M. schisticolor* age attribution (see Fig. S30 below). 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/lemmus.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/lemmus.html)

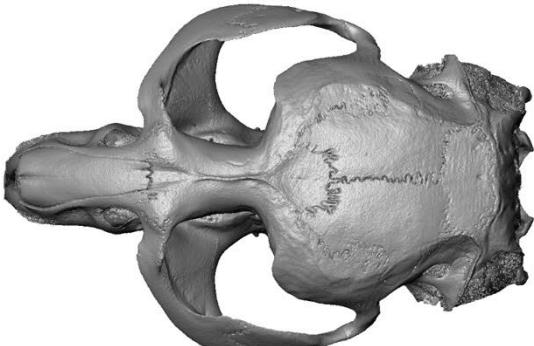
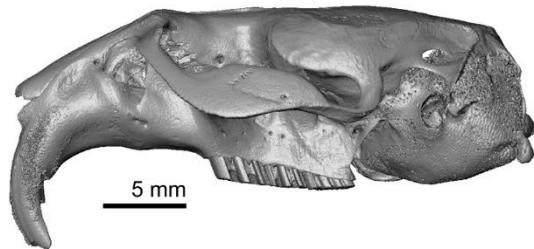
(A) ZIN 64159, ad2



(B) ZIN 81239, ad2



C) ZIN 81241, ad2



*Lemmus sibiricus* (n = 3)

Local Age Scale

C B A				
juv	sad	ad1	ad2	sen
juvenile	immature	mature		senile

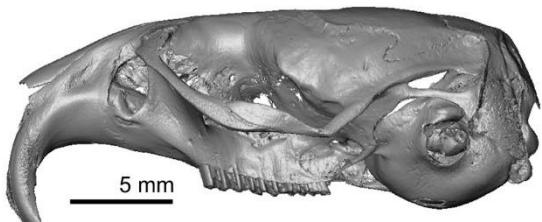
← Younger

Older →

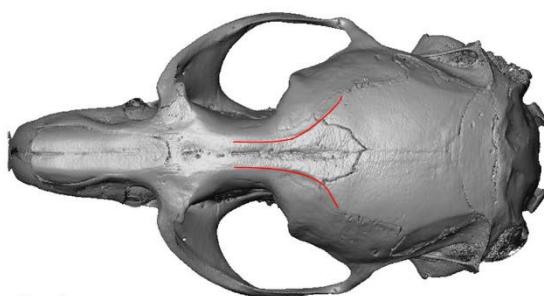
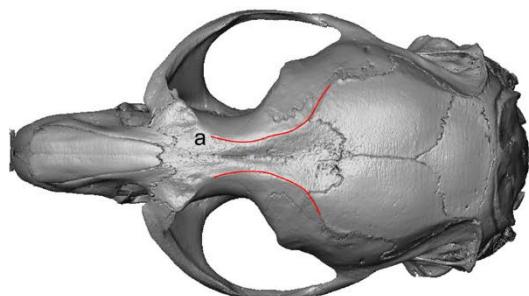
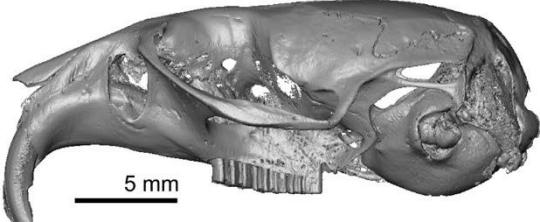
**Figure S22.** Relative age groups of the analysed specimens of *Microtus arvalis*: (A) ZIN 19431; (B) ZIN 56750 (neotype).

Skulls are shown in lateral (top) and dorsal (bottom) view. Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, the temporal line in the mature specimen. 3D models available via link: [https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/microtus.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/microtus.html)

(A) ZIN 19431, ad2



(B) ZIN 56750, ad2



Local Age Scale

*Microtus arvalis* (n = 2)

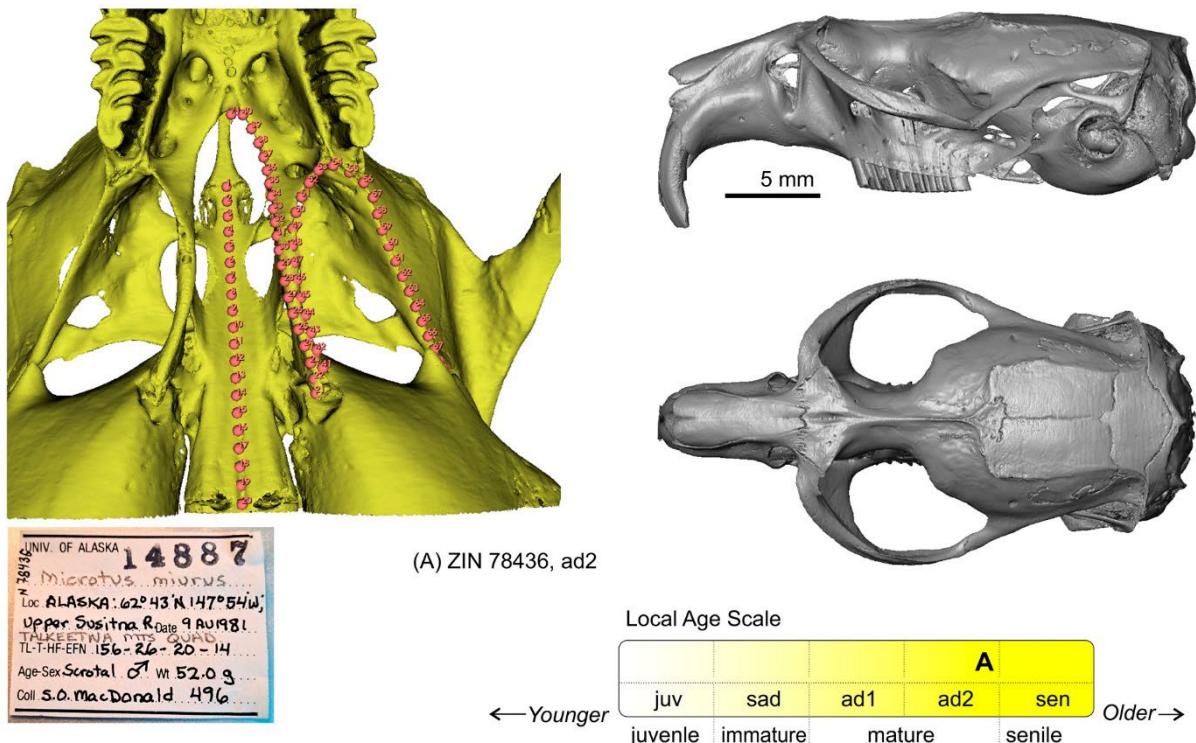
			B	A	
← Younger	juv	sad	ad1	ad2	Older →
	juvenile	immature	mature	senile	

**Figure S23.** Screenshot of the PSP complex in subposterior view of specimen ZIN 78436 of *Mynomes miurus* with landmark positions (left). Skull in lateral (top, right) and dorsal (bottom, right) view.

Scale bar is 5 mm. The age group was determined with the aid of *L. gregalis* age attribution (see Fig. S18). 3D model available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/mynomes.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/mynomes.html)

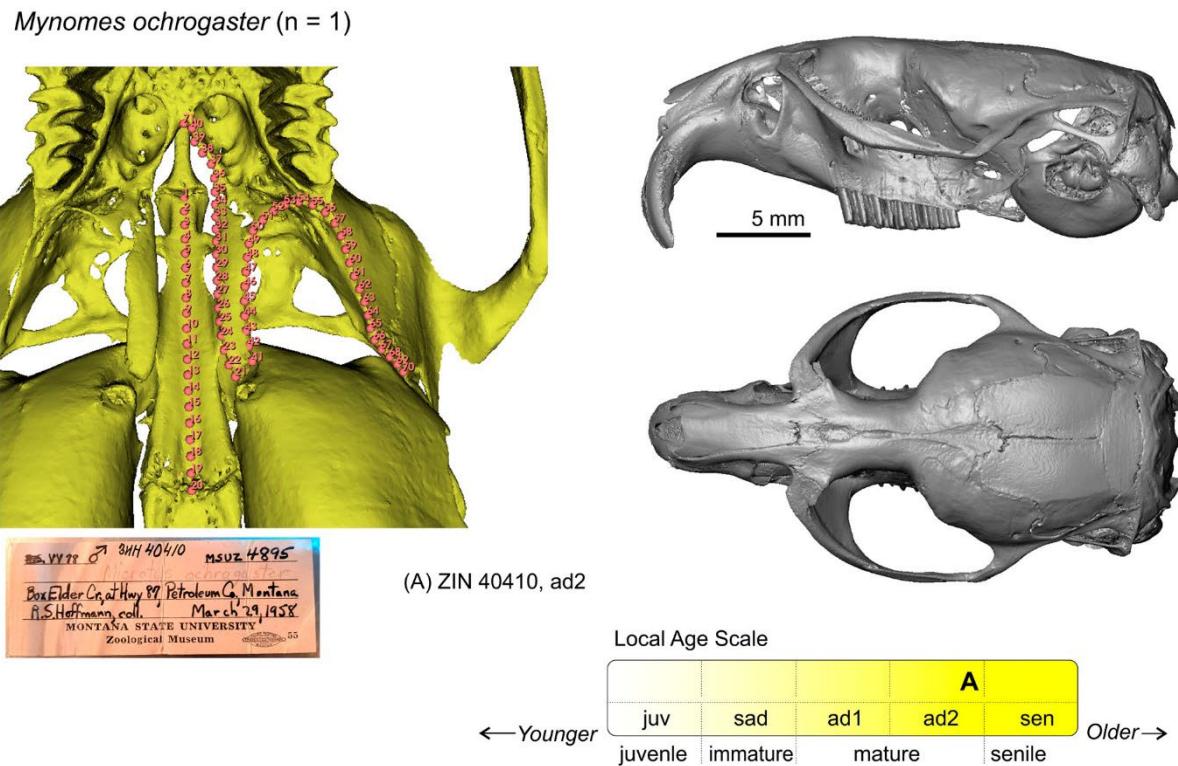
*Microtus miurus* (n = 1)



**Figure S24.** Screenshot of the PSP complex in subposterior view of specimen ZIN 40410 of *Mynomes ochrogaster* with landmark positions (left). Skull in lateral (top, right) and dorsal (bottom, right) view.

Scale bar is 5 mm. The age group was determined with the aid of *A. fortis* age attribution (see Fig. S2). 3D model available via link:

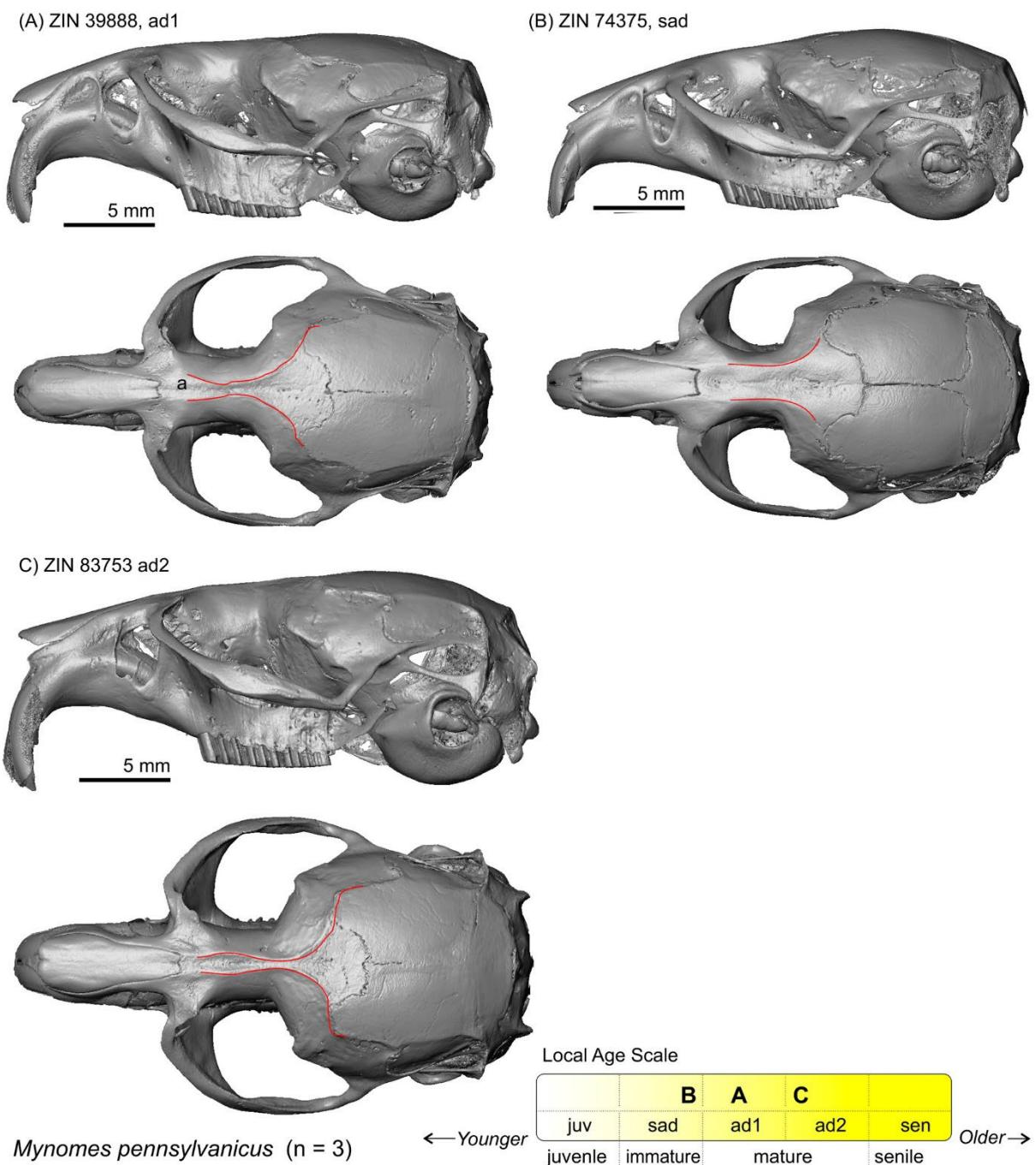
[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/mynomes.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/mynomes.html)



**Figure S25.** Relative age groups of the analysed specimens of *Mynomes pennsylvanicus*: (A) ZIN 39888 (B) ZIN 74375; (C) ZIN 83753(6951).

Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. Key: a, temporal line. 3D models available via link:

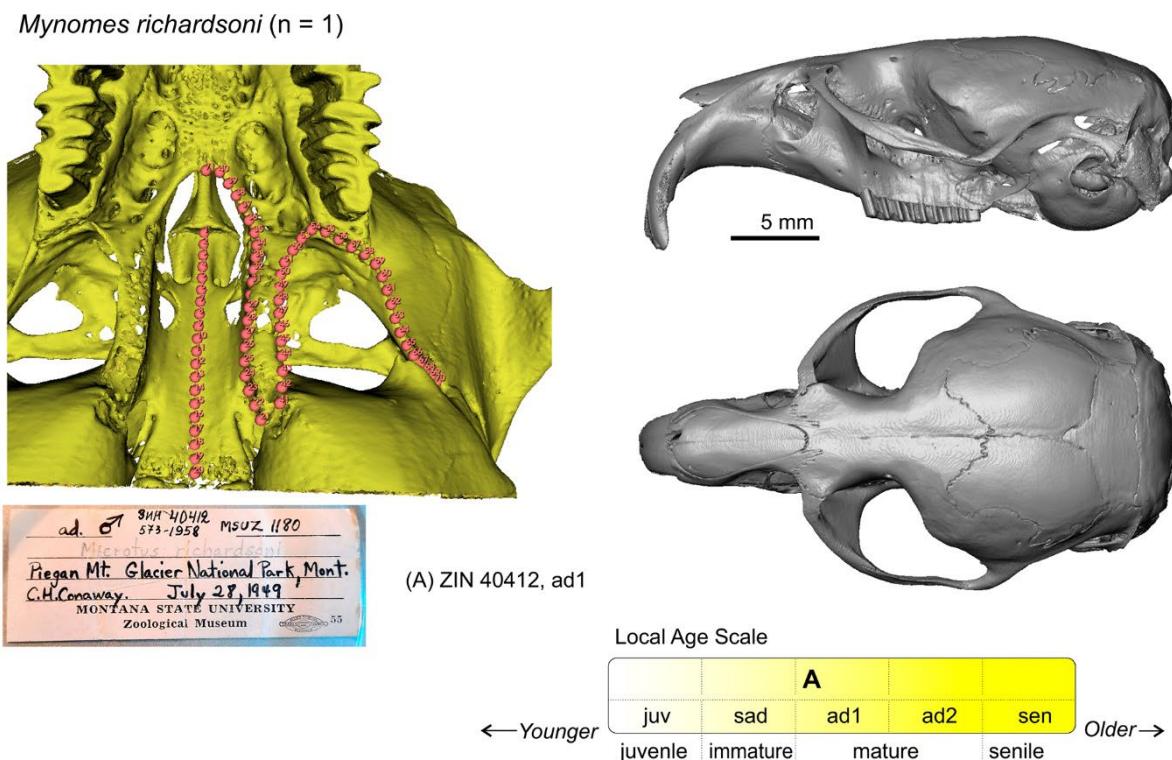
[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/mynomes.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/mynomes.html)



**Figure S26.** Screenshot of the PSP complex in subposterior view of specimen ZIN 40412 of *Mynomes richardsoni* with landmark positions (left). Skull in lateral (top, right) and dorsal (bottom, right) view.

Scale bar is 5 mm. The age group was determined with the aid of *A. fortis* age attribution (see Fig. S2). 3D model available via link:

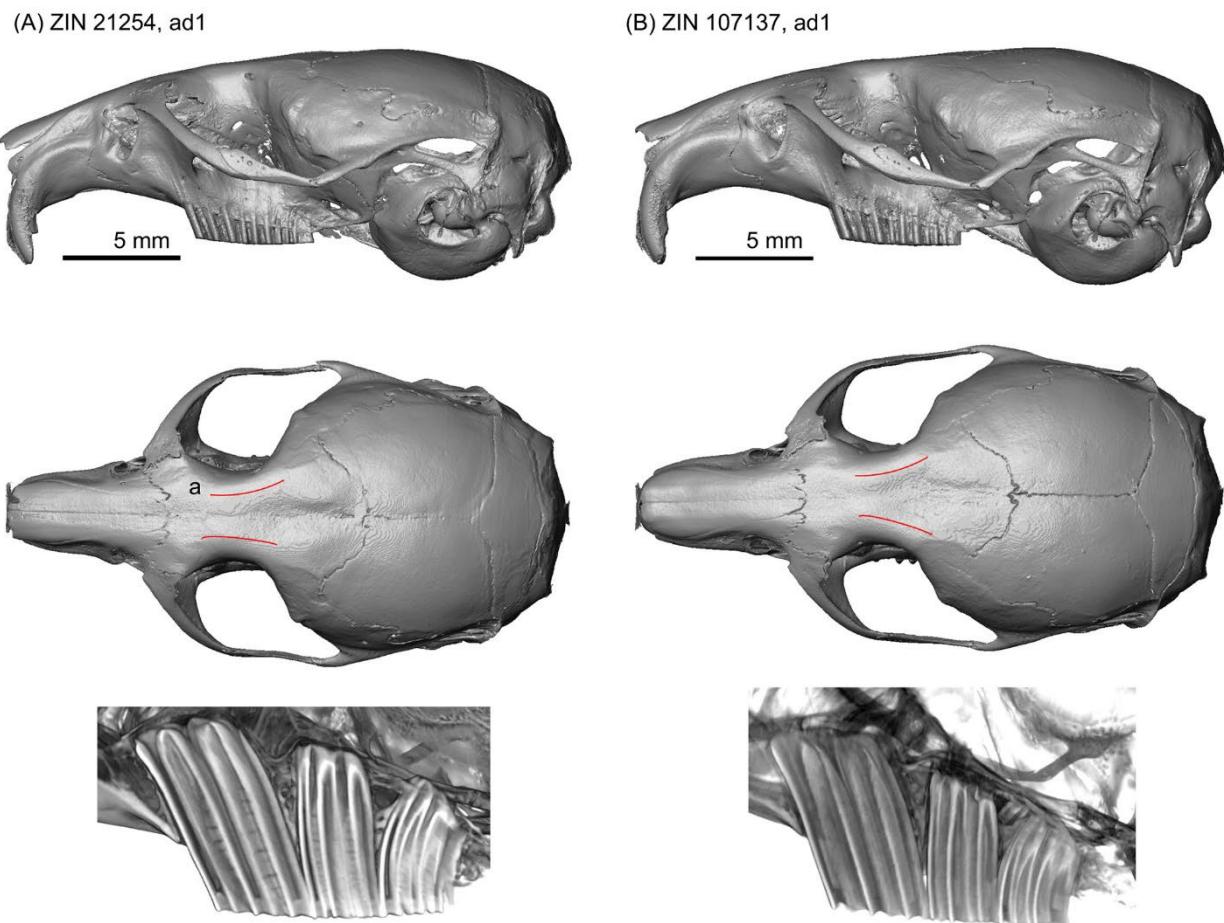
[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/mynomes.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/mynomes.html)



**Figure S27.** Relative age groups of the analysed specimens of *Clethrionomys centralis*: (A) ZIN 21254; (B) ZIN 107137.

Skulls are shown in lateral (top) and dorsal (middle) views. The lower images show lateral radiographs of molar roots (root-bearing species only). Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, the temporal line. 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/clethrionomys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/clethrionomys.html)



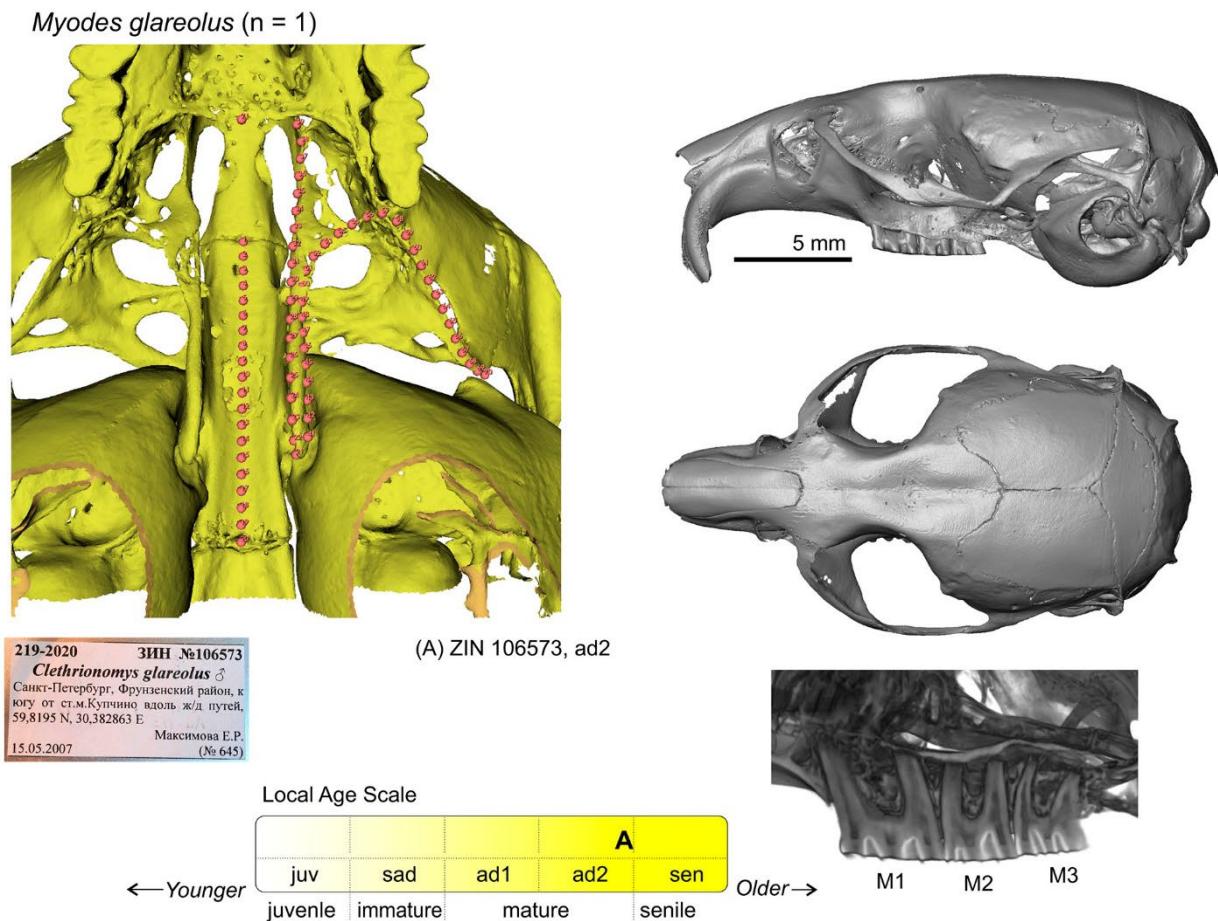
*Myodes centralis* (n = 2)

Local Age Scale				
		A	B	
← Younger		juv	sad	ad1
		juvenile	immature	mature
				ad2
				senile
				Older→

**Figure S28.** Screenshot of the PSP complex in subposterior view of specimen ZIN 106573 of *Clethrionomys glareolus* with landmark positions (left). Skull in lateral (top, right) and dorsal (middle, right) view.

The lower image shows lateral radiograph of molar roots (root-bearing species only). Scale bar is 5 mm. 3D models available via link:

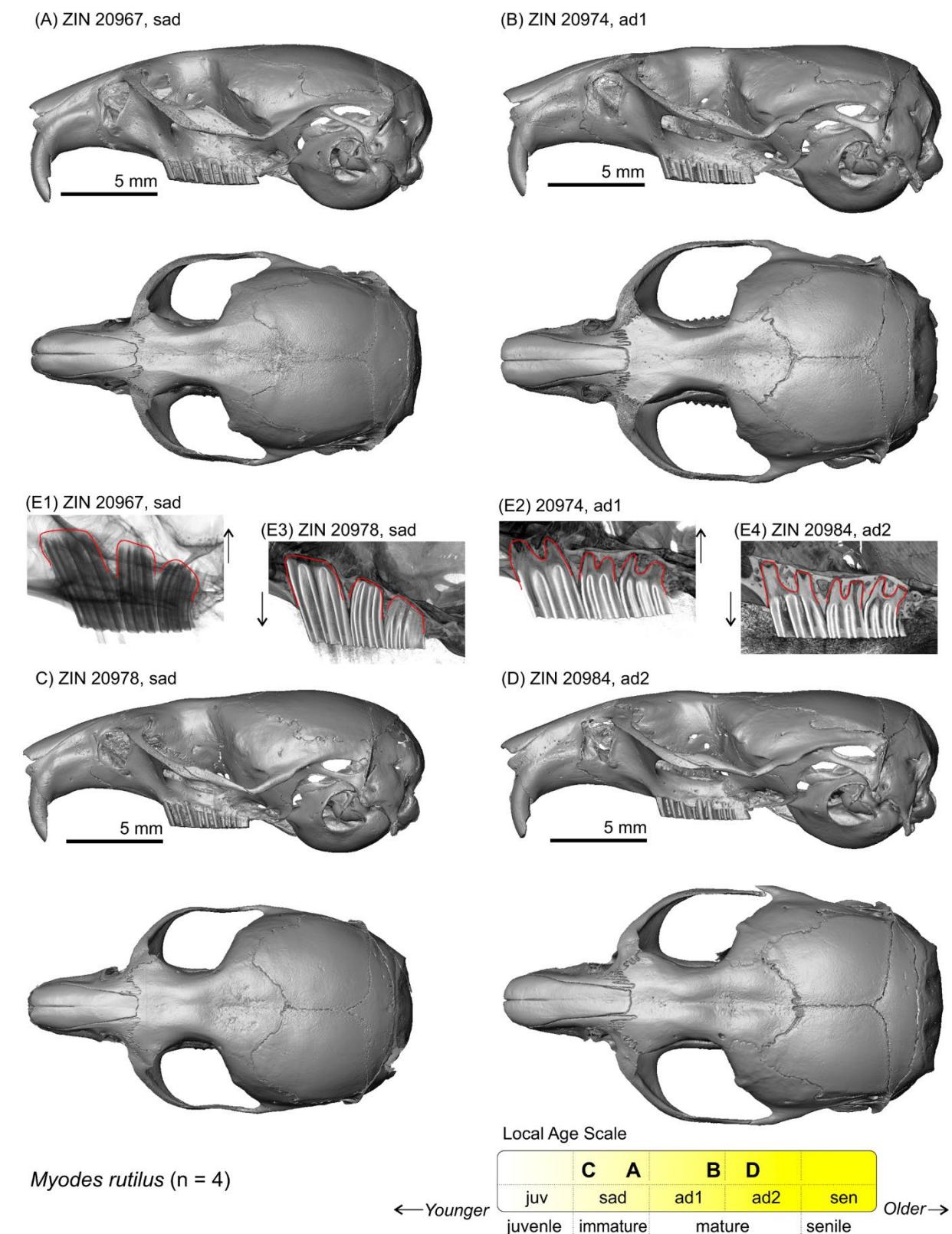
[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/clethrionomys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/clethrionomys.html)



**Figure S29.** Relative age groups of the analysed specimens of *Clethrionomys rutilus*: (A) ZIN 20967; (B) ZIN 20974; (C) ZIN 20978; (D) ZIN 20984.

Skulls are shown in lateral (top) and dorsal (bottom) views. (E1–E4) Lateral radiographs of molar roots (root-bearing species only). Scale bars are 5 mm; skulls are shown at the same scale. 3D models available via link:

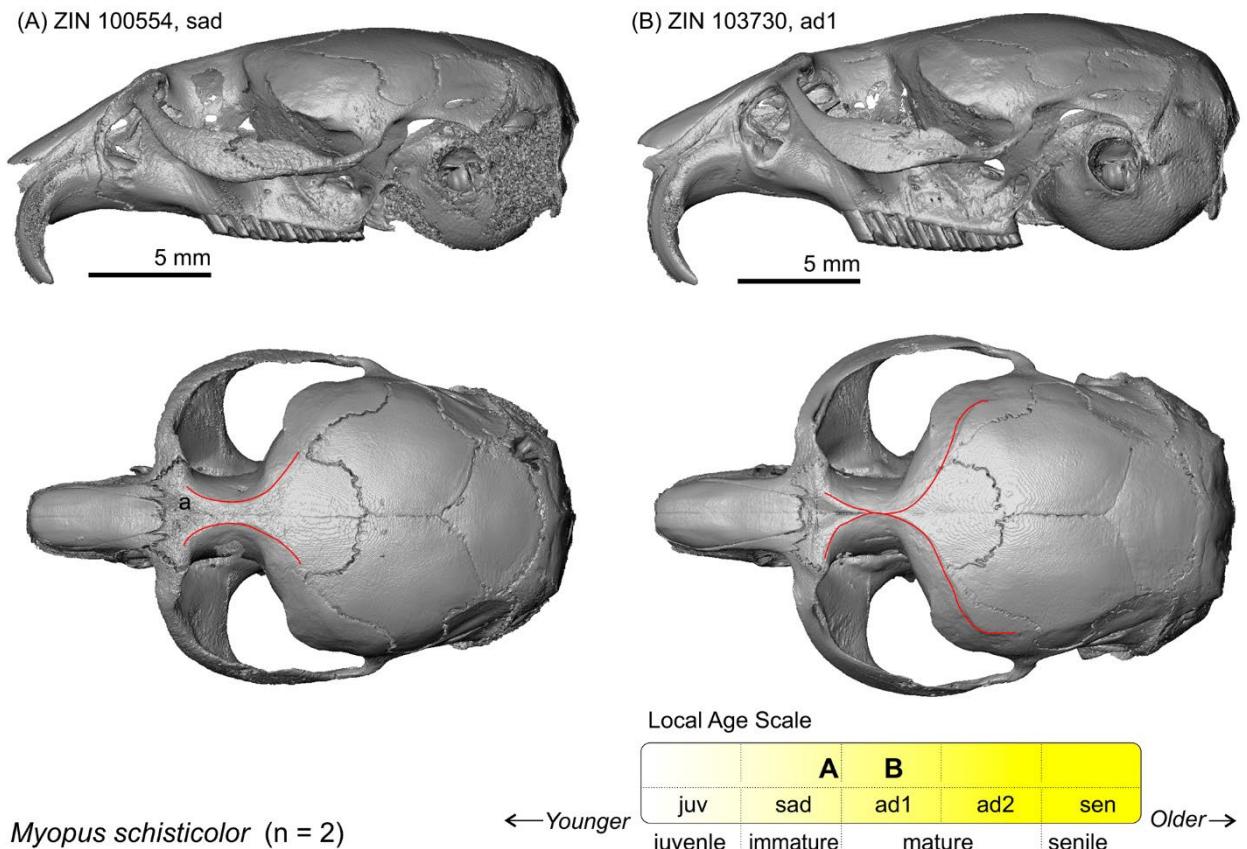
[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/clethrionomys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/clethrionomys.html)



**Figure S30.** Relative age groups of the analysed specimens of *Myopus schisticolor*: (A) ZIN 100554; (B) ZIN 103730.

Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. Key: a, the temporal line. 3D models available via link:

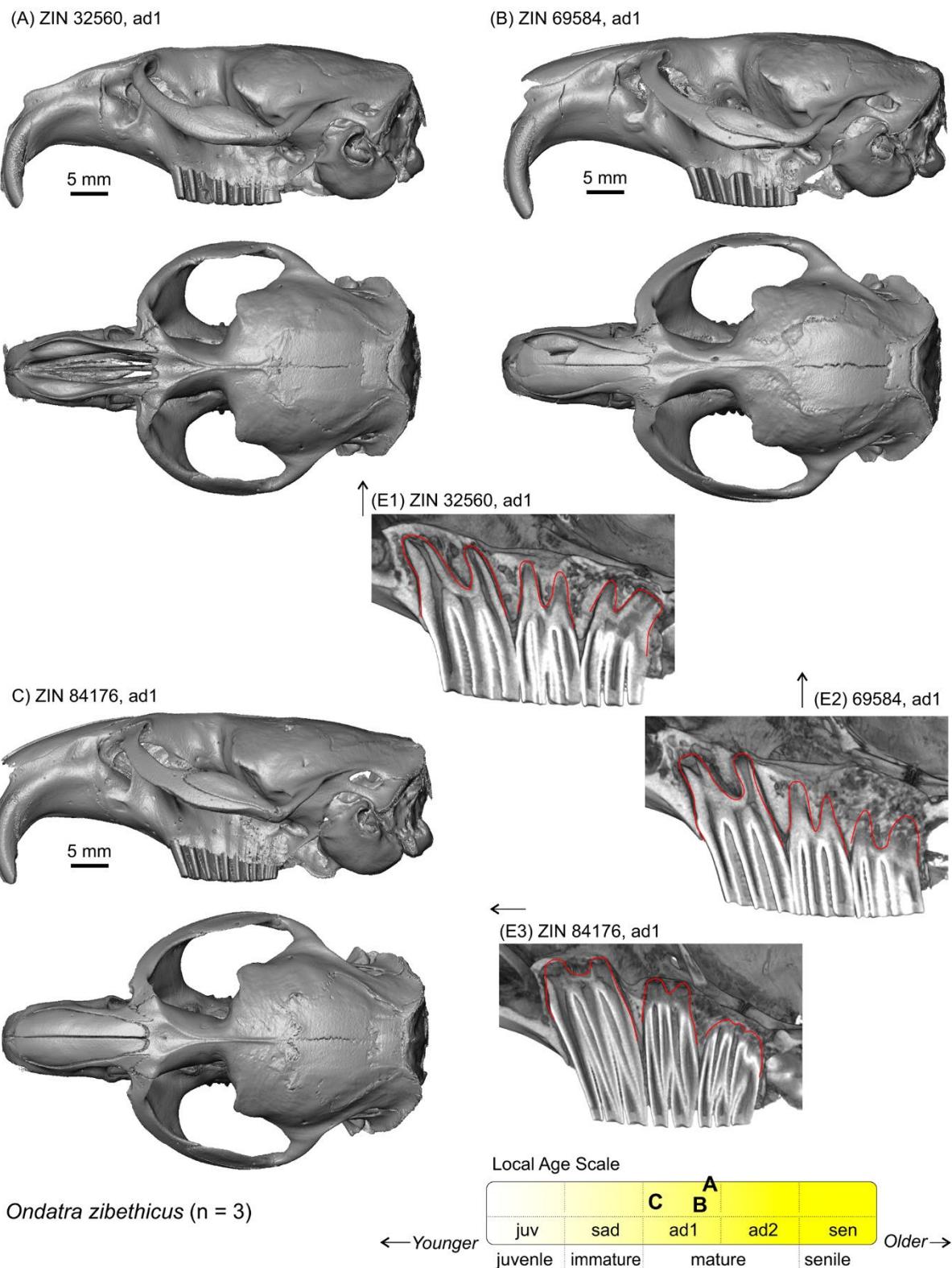
[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/myopus.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/myopus.html)



**Figure S31.** Relative age groups of the analysed specimens of *Ondatra zibethicus*: (A) ZIN 32560; (B) ZIN 69584; (C) ZIN 84176.

Skulls are shown in lateral (top) and dorsal (bottom) views. (E1–E3) Lateral radiographs of molar roots (root-bearing species only). Scale bars are 5 mm; skulls are shown at the same scale. 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/ondatra.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/ondatra.html)



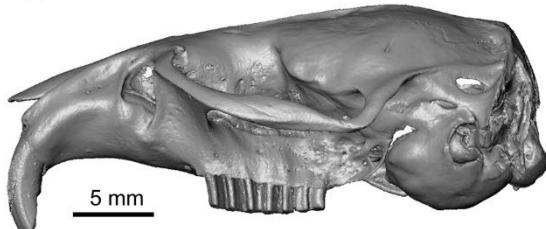
**Figure S32.** Relative age groups of the analysed specimens of *Prometheomys schaposchnikowi*:

(A) ZIN 31495; (B) ZIN 74487.

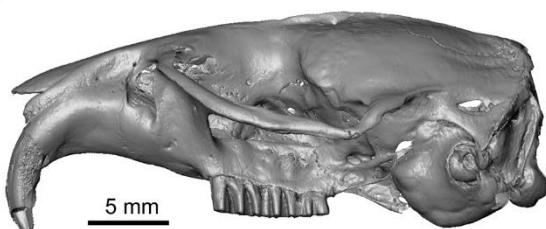
Skulls are shown in lateral (top) and dorsal (middle) views. Bottom images show lateral radiographs of molar roots (root-bearing species only). Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, the temporal line. 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/prometheomys.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/prometheomys.html)

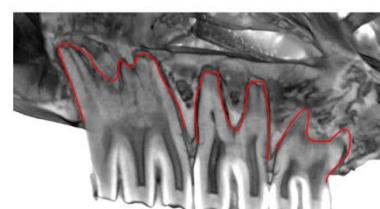
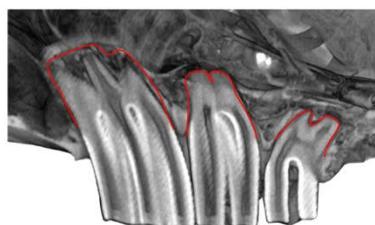
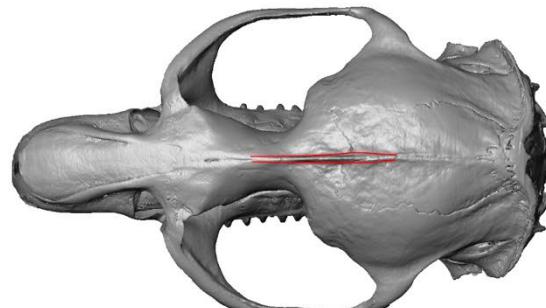
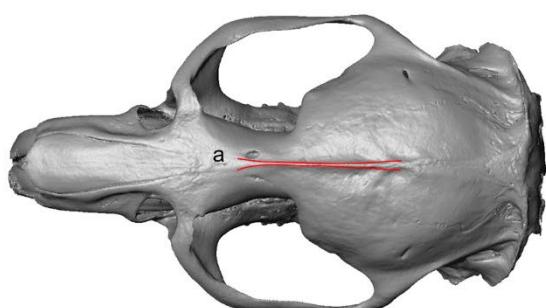
(A) ZIN 31495, ad1



(B) ZIN 74487, ad2



**a**



*Prometheomys schaposchnikowi* (n = 2)

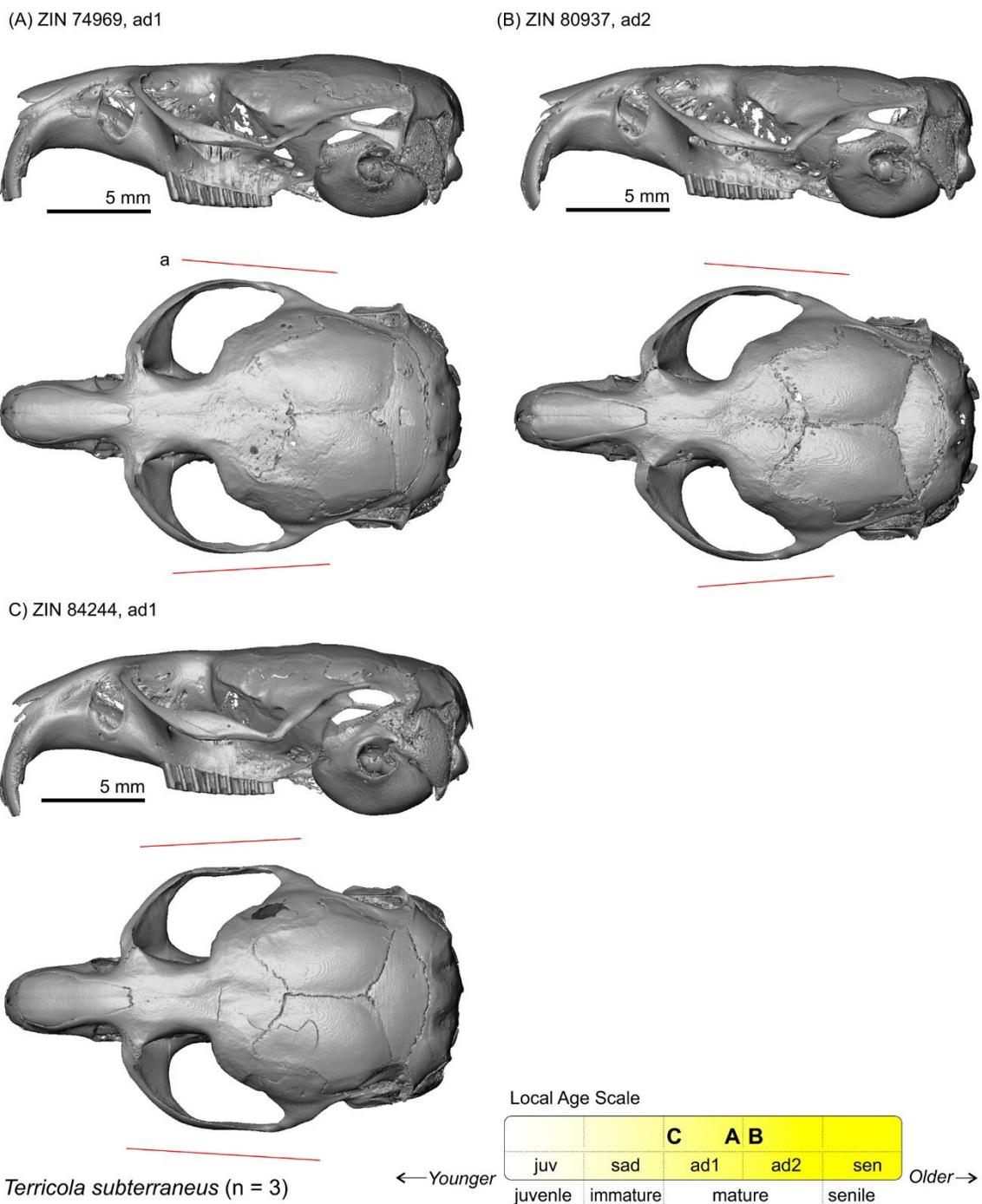
Local Age Scale

		<b>A    B</b>				
		juv	sad	ad1	ad2	sen
← Younger		juvenile	immature	mature	senile	Older →

**Figure S33.** Relative age groups of the analysed specimens of *Terricola subterraneus*: (A) ZIN 74969; (B) ZIN 80937; (C) ZIN 84244.

Skulls are shown in lateral (top) and dorsal (bottom) views. Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, line marks the profile of the zygomatic arch in a mature specimen compared to an immature specimen. 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/terricola.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/terricola.html)

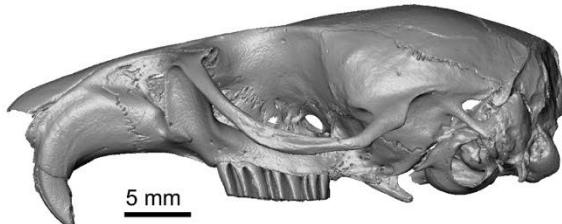


**Figure S34.** Relative age groups of the analysed specimens of *Neotoma mexicana*: (A) ZIN 39375; (B) ZIN 39376.

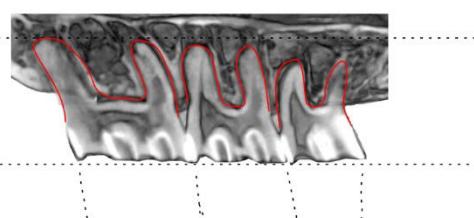
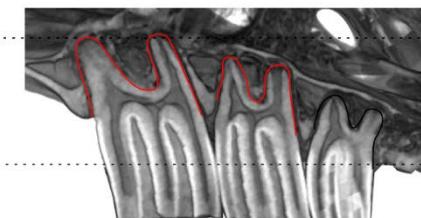
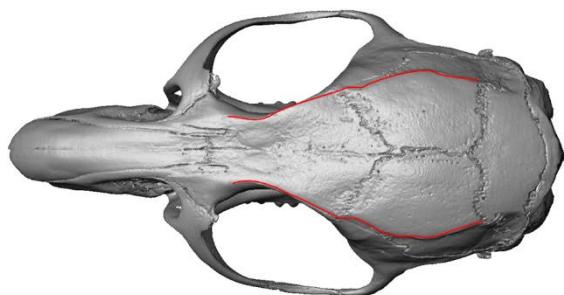
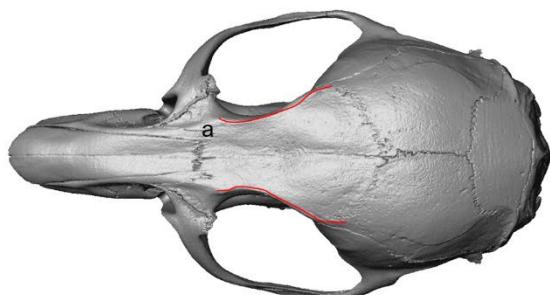
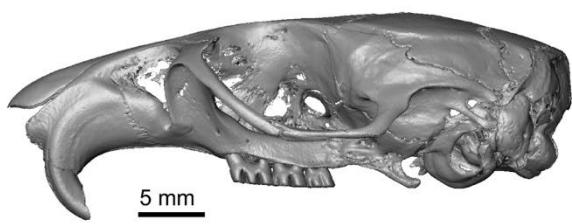
Skulls are shown in lateral (top) and dorsal (middle) views. Bottom images show lateral radiographs of molar roots (root-bearing species only). Scale bars are 5 mm; skulls are shown at the same scale. Key: **a**, the temporal line. 3D models available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/neotoma.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/neotoma.html)

(A) ZIN 39375, ad1



(B) ZIN 39376, ad2



worn part of crown

*Neotoma mexicana* (n = 2)

Local Age Scale

		A	B		
← Younger	juv	sad	ad1	ad2	Older →
	juvenile	immature	mature	senile	

**Figure S35.** Screenshot of the PSP complex in subposterior view of specimen ZIN 101697 of *Cricetulus barabensis* with landmark positions (left).

Skull in lateral (top, right) and dorsal (middle, right) view. The lower images show lateral radiographs of molar roots (root-bearing species only) and the upper row of teeth in occlusal view. Scale bar is 5 mm. 3D model available via link:

[https://zin.ru/labs/evolgenome/morphology/multimedia\\_Part1/cricetus.html](https://zin.ru/labs/evolgenome/morphology/multimedia_Part1/cricetus.html)

*Cricetulus barabensis* (n = 1)

