

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 S36–S63

Landmark wireframe images and specimen tags

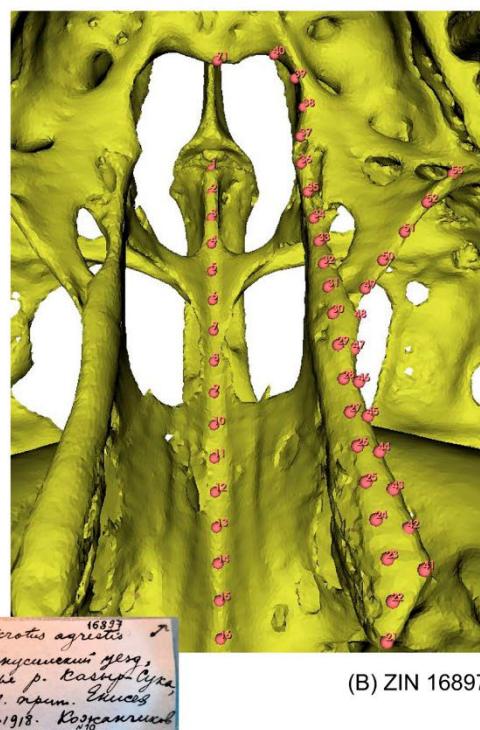
Figure S36. Screenshots of the palato-spheno-pterygoid complex (PSP complex) in posterior view of four specimens of *Agricola agrestis* with landmark positions: (A) ZIN 89132; (B) ZIN 16897; (C) ZIN 97312; (D) ZIN 98482.

Each screenshot is accompanied by a label image. Screenshots taken from 3D Slicer space to show variation in the posterior palatal margin and adjacent structures. Not scaled.

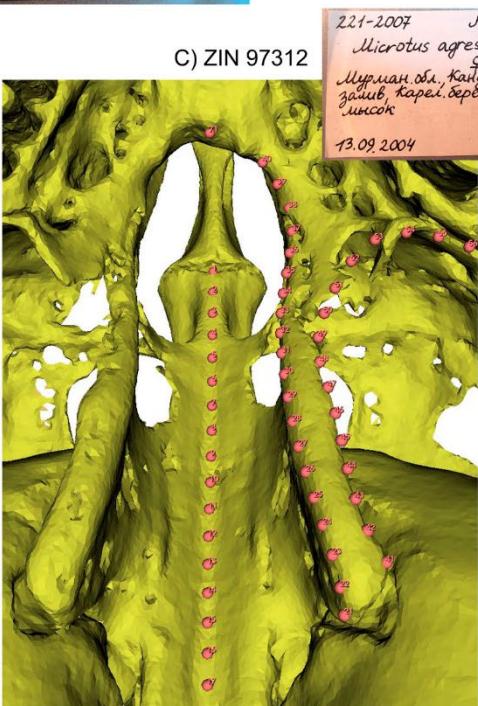
Agricola agrestis (n = 4)



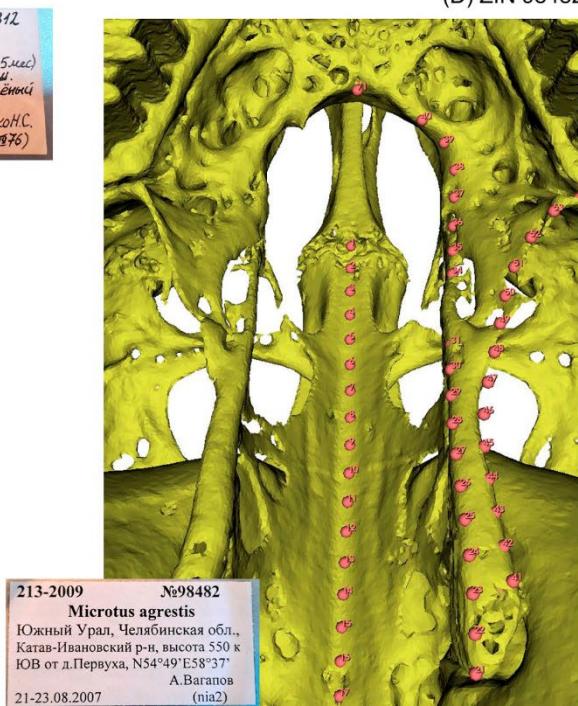
(A) ZIN 89132



(B) ZIN 16897



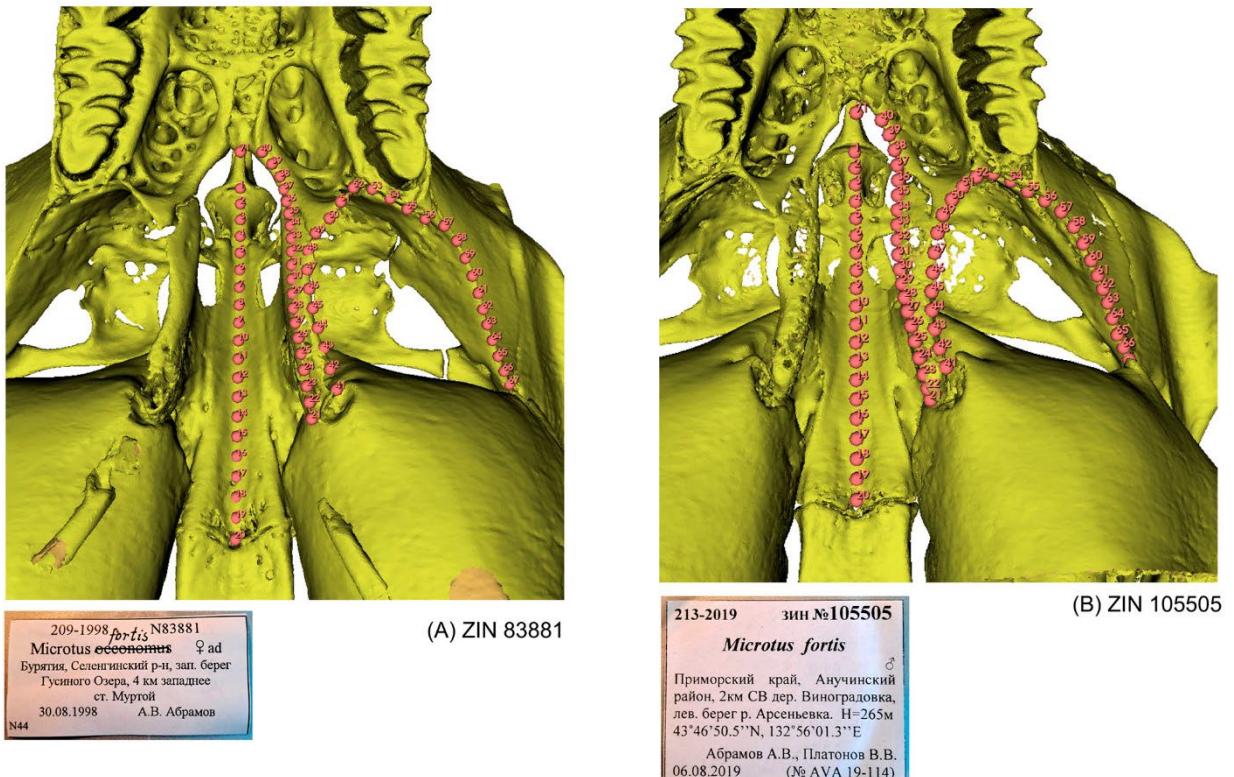
C) ZIN 97312



(D) ZIN 98482

Figure S37. Screenshots of the PSP complex in subposterior view of two specimens of *Alexandromys fortis* with landmark positions: (A) ZIN 83881; (B) ZIN 105505. See figure S36 for details. Not scaled.

Alexandromys fortis ($n = 2$)



Note: See the Supplementary Material (Figure S3: 4) for information on *Alexandromys middendorffii*: <https://github.com/desmanazin-svg/The-cranial-morphology-of-the-arvicoline-voles/blob/main/JCZ-D-25-00219 AGE FIGURES-S01-S35.pdf>

Figure S38. Screenshots of the PSP complex in subposterior view of six specimens of *Alexandromys oeconomus* with landmark positions: (A) ZIN 66013; (B) ZIN 89161; (C) ZIN 96546; (D) ZIN 98883; (E) ZIN 100612; (F) ZIN 101023.

See figure S36 for details. Not scaled.

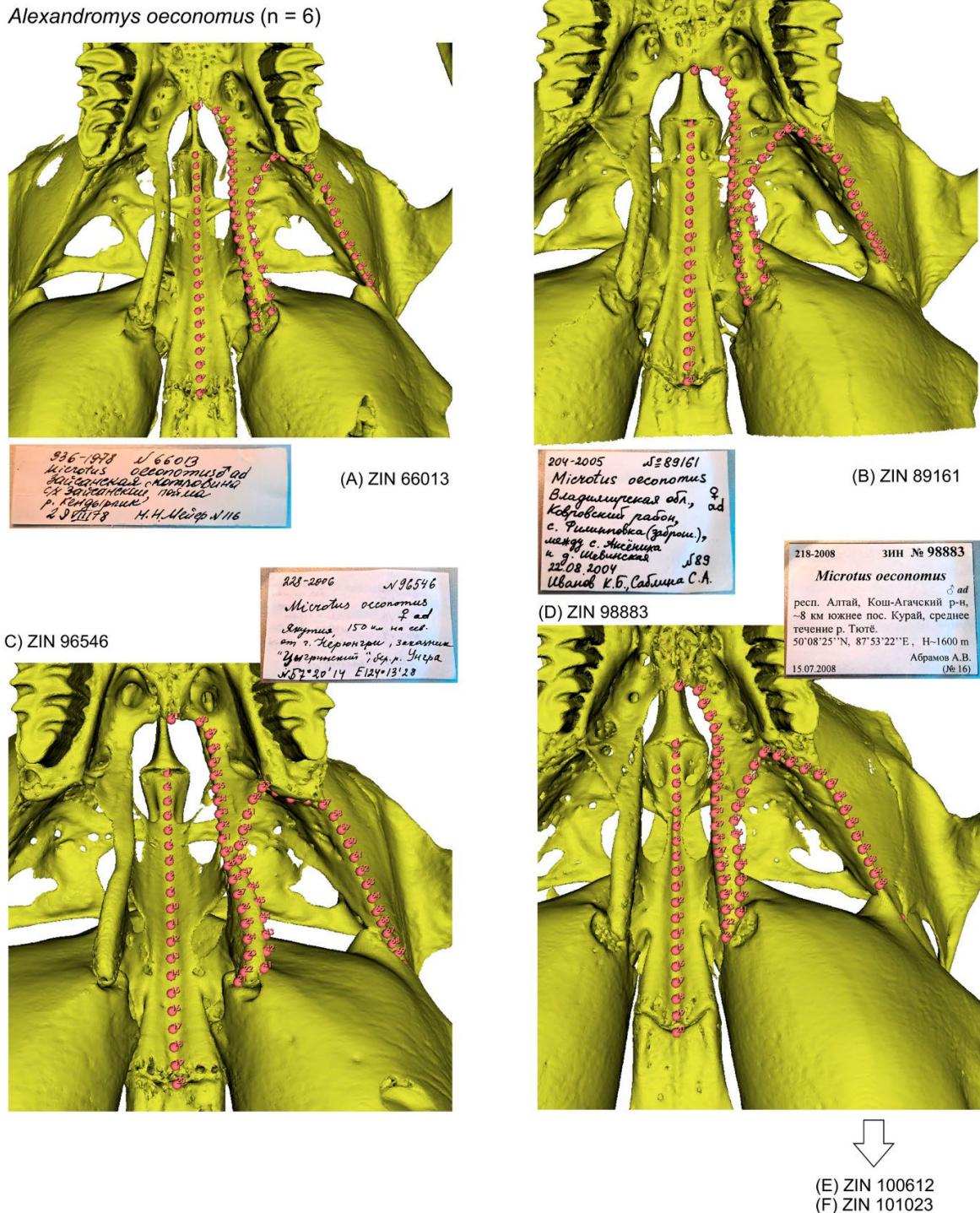
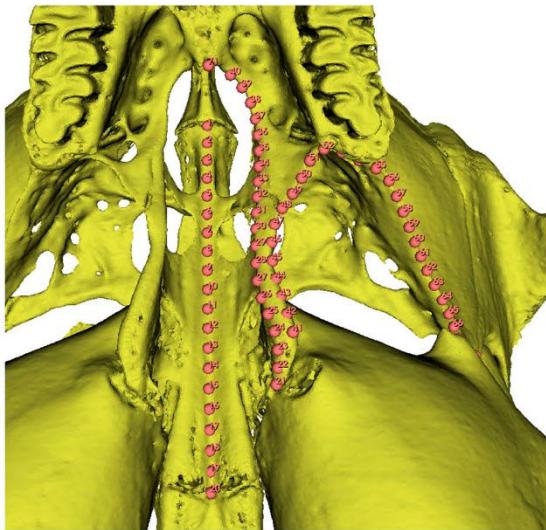


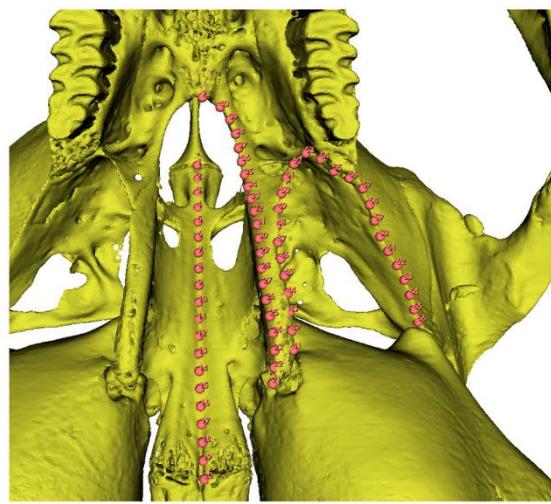
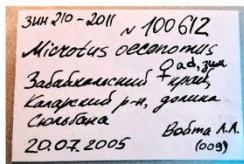
Figure S38. Continue.

Alexandromys oeconomus ($n = 6$)

(A) ZIN 66013 (B) ZIN 89161
(C) ZIN 96546 (D) ZIN 98883



(E) ZIN 100612



(F) ZIN 101023

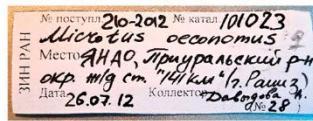


Figure S39. Screenshots of the PSP complex in subposterior view of four specimens of *Alticola argentatus* with landmark positions: (A) ZIN 77405; (B) ZIN 77458; (C) ZIN 77464; (D) ZIN 77489.

See figure S36 for details. Not scaled.

Alticola argentatus (n = 4)

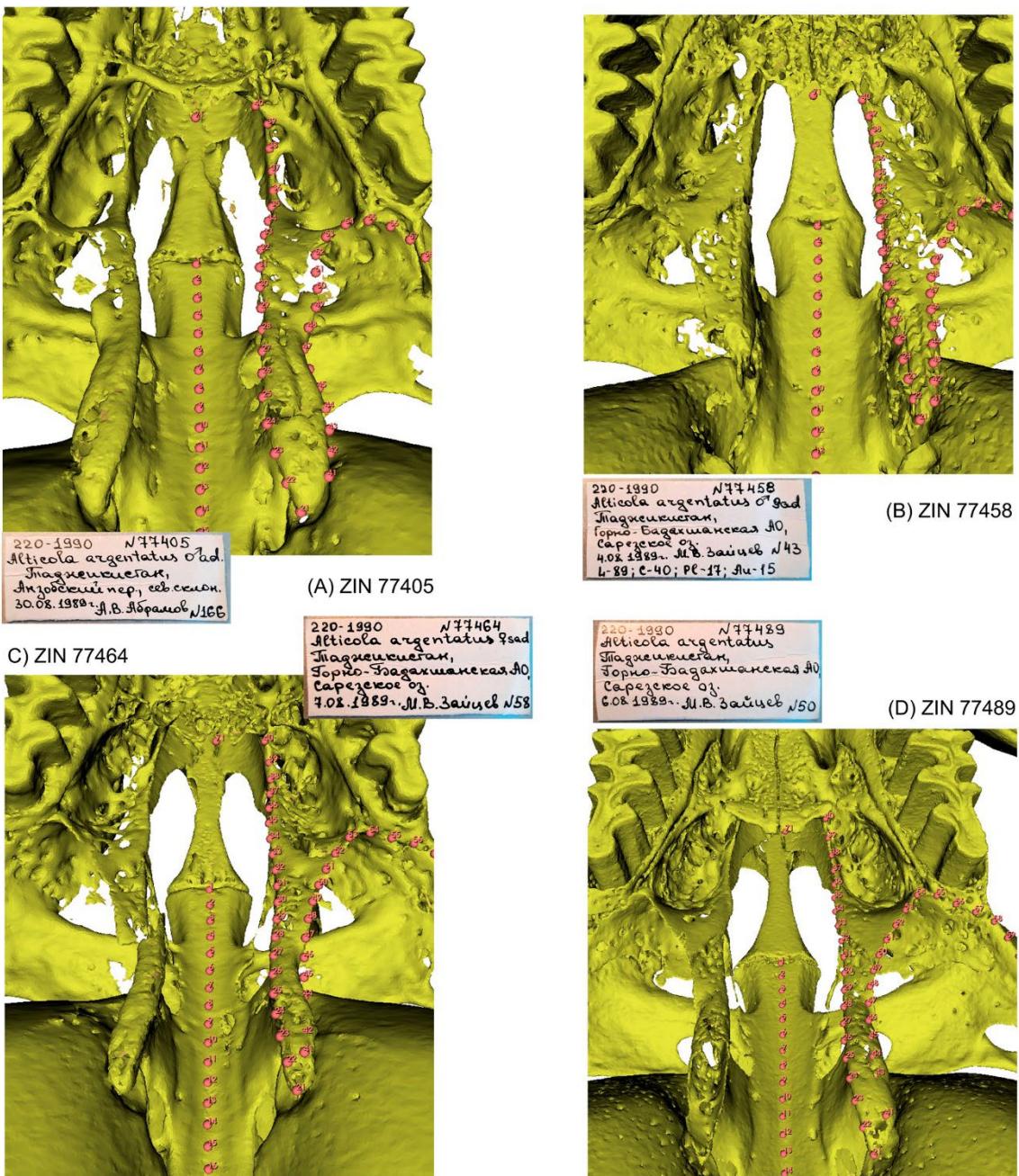


Figure S40. Screenshots of the PSP complex in subposterior view of two specimens of *Alticola lemminus* with landmark positions: (A) ZIN 101796; (B) ZIN 101797. See figure S36 for details. Not scaled.

Alticola lemminus (n = 2)

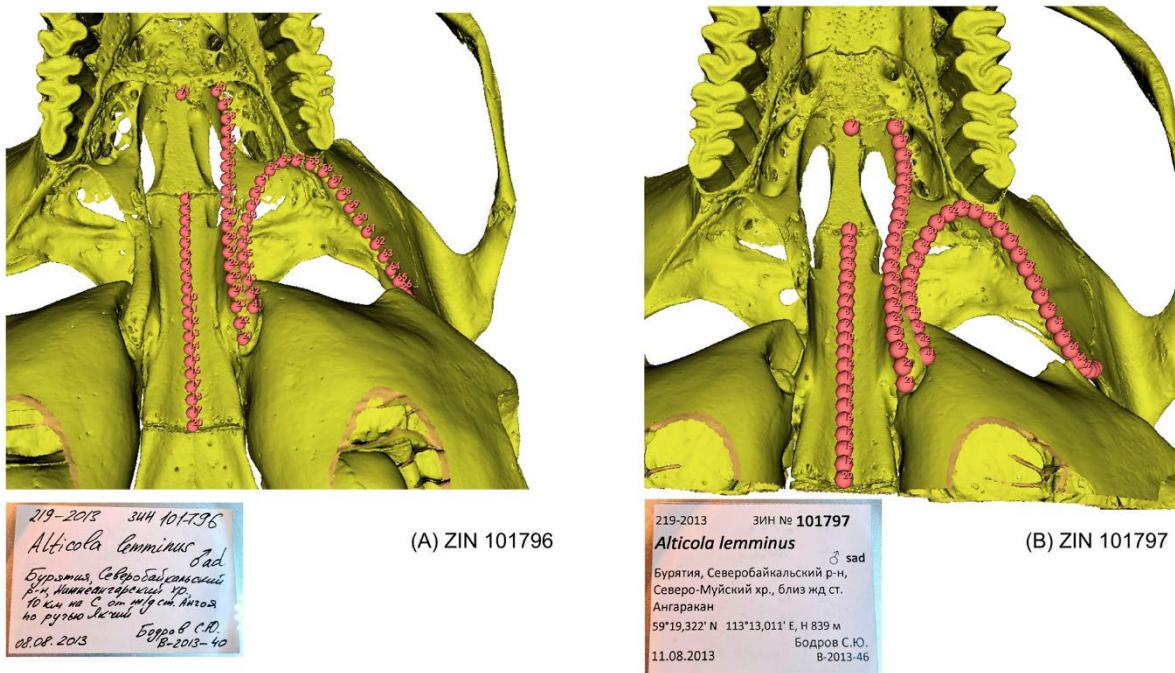


Figure S41. Screenshots of the PSP complex in subposterior view of three specimens of *Alticola macrotis* with landmark positions: (A) ZIN 102289; (B) ZIN 102307; (C) ZIN 99351. See figure S36 for details. Not scaled.

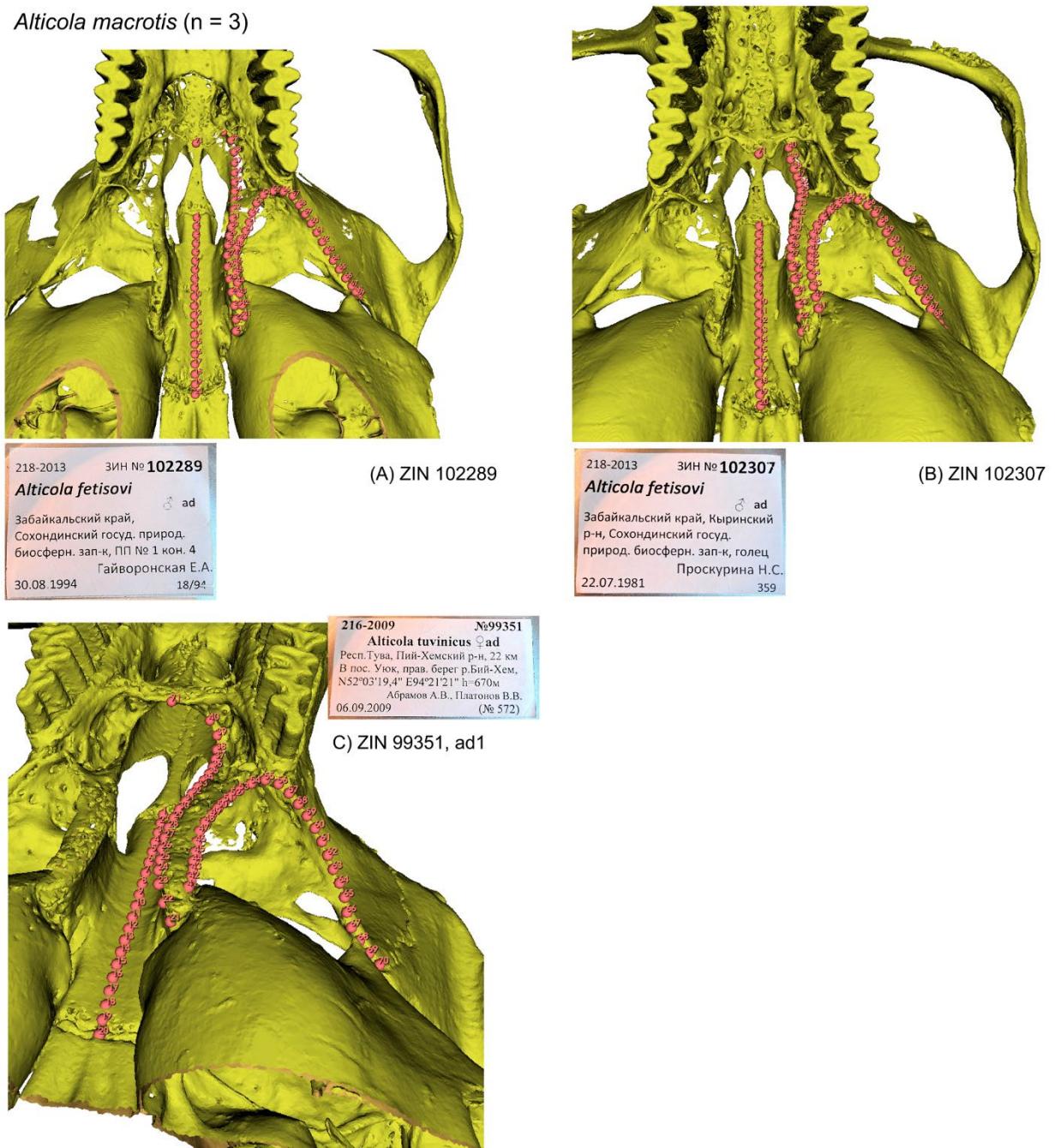
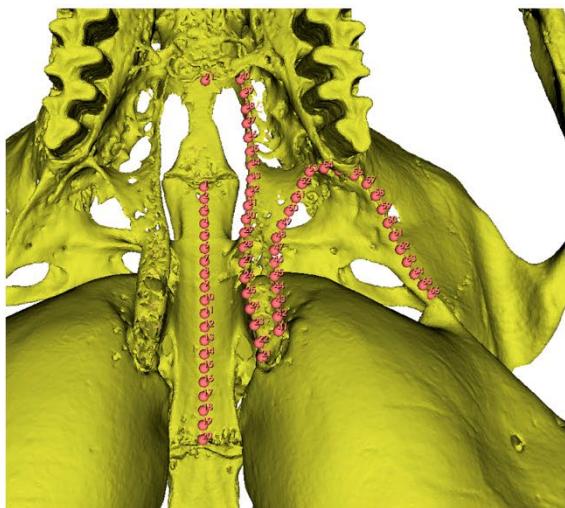


Figure S42. Screenshots of the PSP complex in subposterior view of two specimens of *Alticola semicanus* with landmark positions: (A) ZIN 107067; (B) ZIN 107068.

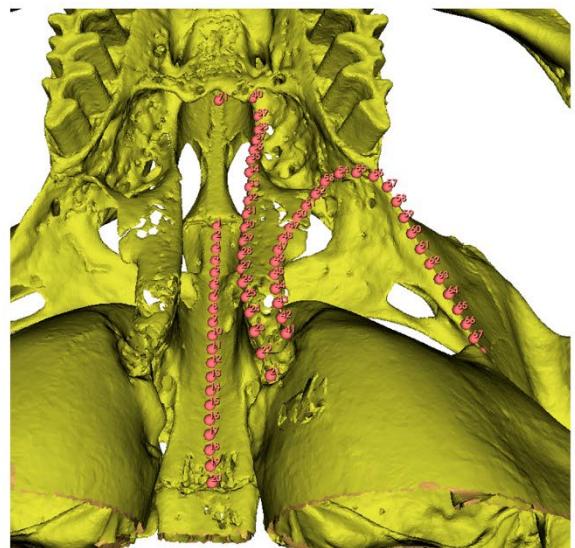
See figure S36 for details. Not scaled.

Alticola semicanus (n = 2)



(A) ZIN 107067

210-2021 ЗИН №107067
Alticola semicanus ♂ad
Республика Тыва, Эрзинский район, 8
км СЗ оз.Шара-Нур, 50,26444°N,
94,72449°E АВРГ-21-24
8.08.2021 Бодров С.Ю., Петрова Т.В. и др.



(B) ZIN 107068

210-2021 ЗИН №107068
Alticola semicanus ♀ad
Республика Тыва, Эрзинский район, 8
км СЗ оз.Шара-Нур, 50,26444°N,
94,72449°E АВРГ-21-32
8.08.2021 Бодров С.Ю., Петрова Т.В. и др.

Figure S43. Screenshots of the PSP complex in subposterior view of three specimens of *Arvicola amphibius* with landmark positions: (A) ZIN 10034; (B) ZIN 16365; (C) ZIN 45399. See figure S36 for details. Not scaled.

Arvicola amphibius (n = 3)

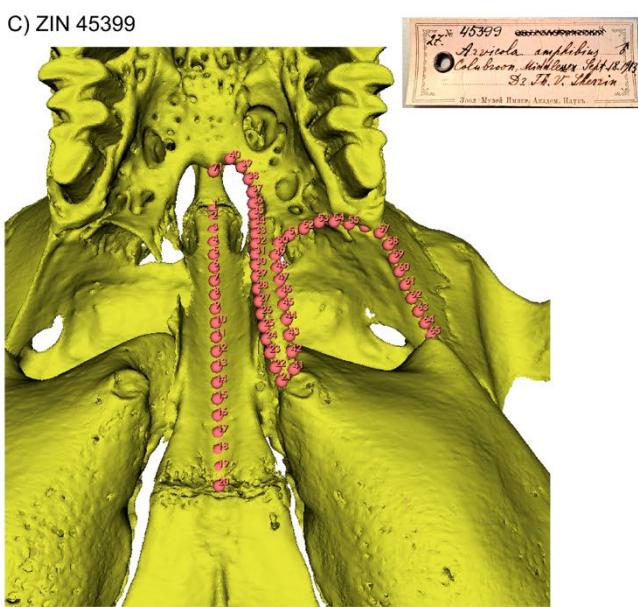
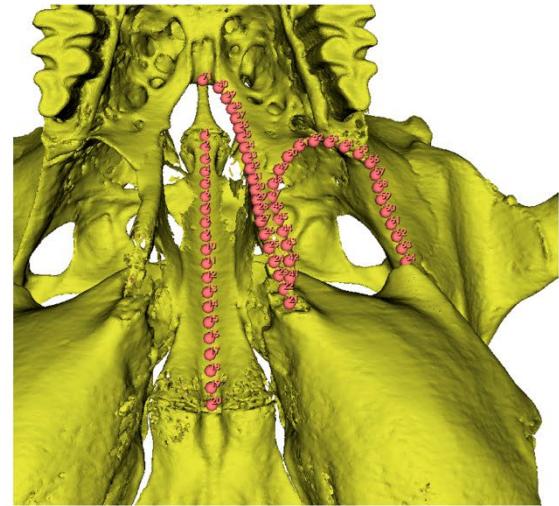
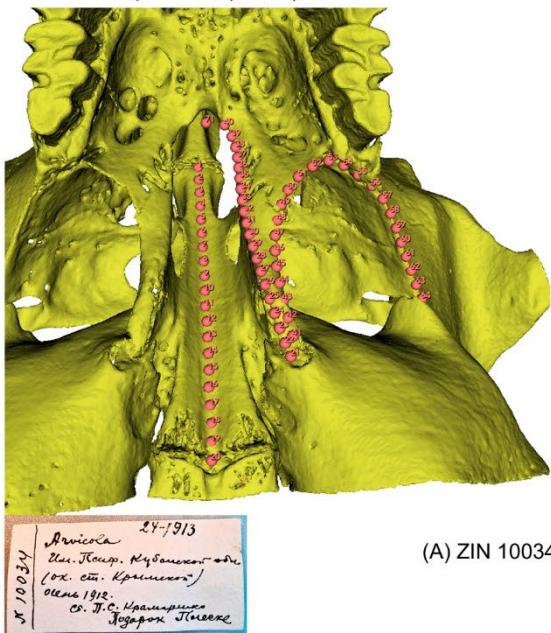
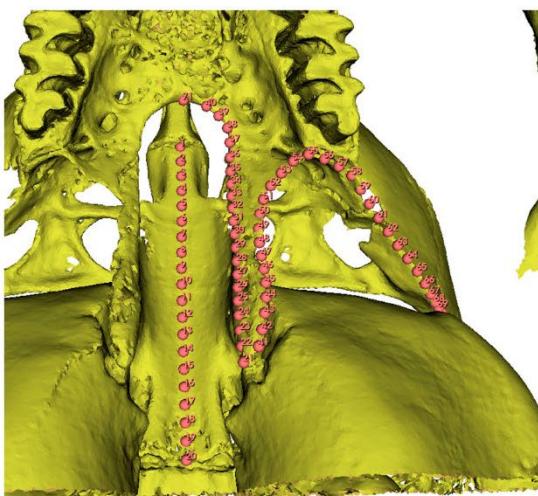


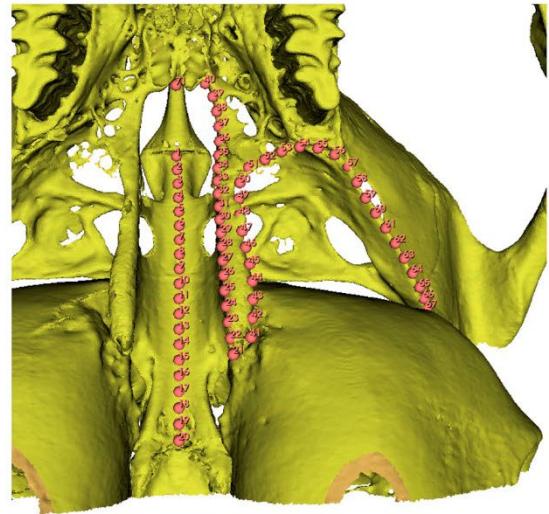
Figure S44. Screenshots of the PSP complex in subposterior view of three specimens of *Chionomys nivalis* with landmark positions: (A) ZIN 70703; (B) ZIN 71279; (C) ZIN 106369. See figure S36 for details. Not scaled.

Chionomys nivalis (n = 3)



219-1985 № 70703
Chionomys nivalis nivalis ♀ ad
Швейцария
Июнь 1985 от Vogel P.

(A) ZIN 70703



243-1985 71279
Chionomys nivalis
Центральный ♂
Колхоз ДАГ
гора БУЧАК №1
21.V.1985 М.Н.Майер

(B) ZIN 71279

C) ZIN 106369



203-2021 ЗИН №106369
Chionomys nivalis
Сев.Иран, Алам-Кух, 36°21.568' N
51°00.7' E, H=3196
Стекольников А.А.
27.06.2017 (№ 13)

Note: See the Supplementary Material (Figure S11: 13) for information on *Craseomys rufocanus*: <https://github.com/desmanazin-svg/The-cranial-morphology-of-the-arvicoline-voles/blob/main/JCZ-D-25-00219 AGE FIGURES-S01-S35.pdf>

Figure S45. Screenshots of the PSP complex in subposterior view of three specimens of *Dicrostonyx torquatus* with landmark positions: (A) ZIN 81169; (B) ZIN 81254; (C) ZIN 81552. See figure S36 for details. Not scaled.

Dicrostonyx torquatus (n = 3)

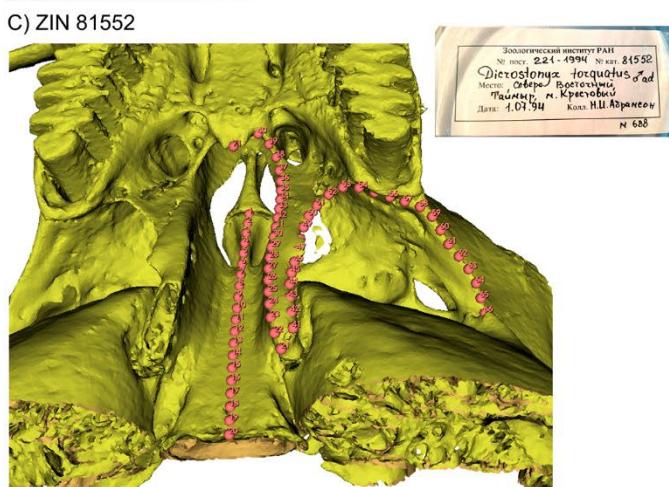
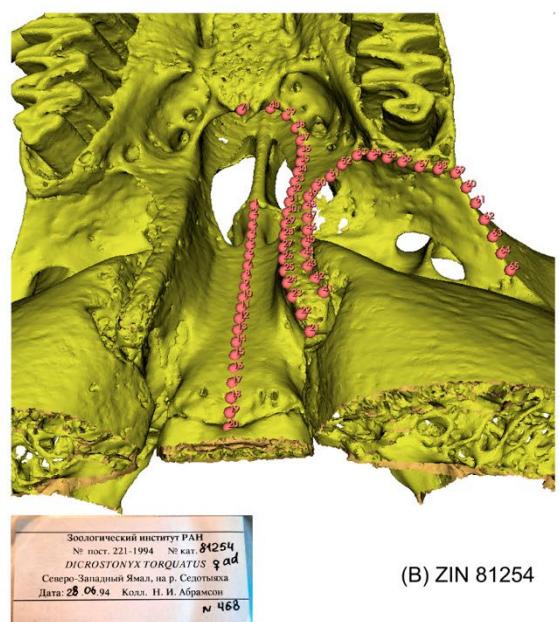
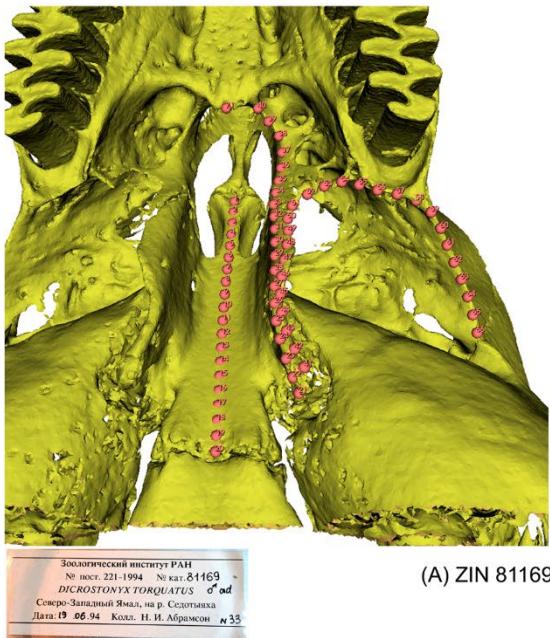


Figure S46. Screenshots of the PSP complex in subposterior view of two specimens of *Dinaromys bogdanovi* with landmark positions: (A) ZIN 34835; (B) ZIN 34887. See figure S36 for details. Not scaled.

Dinaromys bogdanovi ($n = 2$)

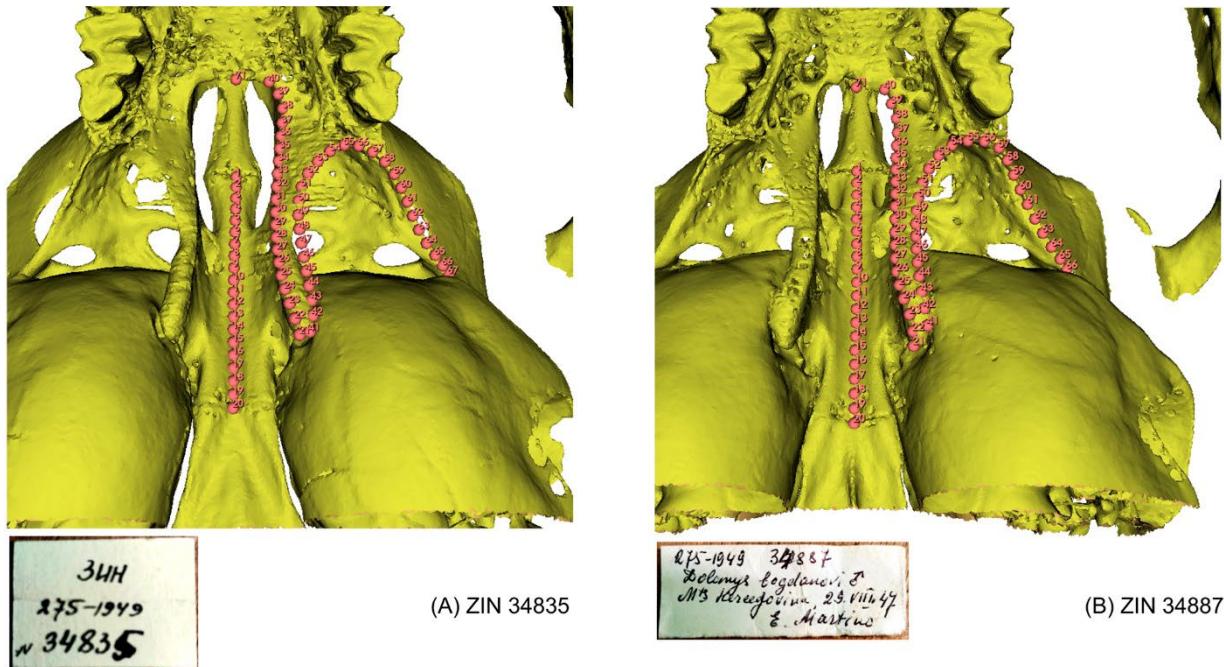
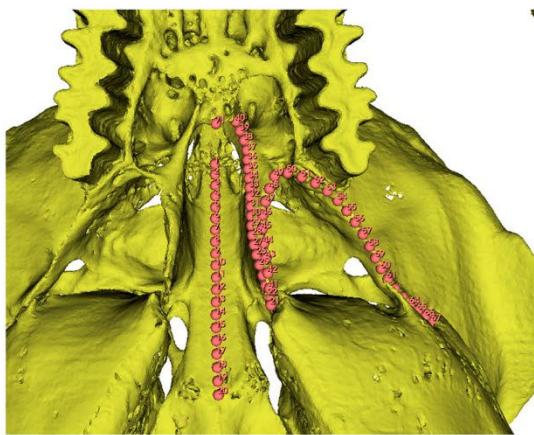


Figure S47. Screenshots of the PSP complex in subposterior view of four specimens of *Ellobius lutescens* with landmark positions: (A) ZIN 26607; (B) ZIN 83708; (C) ZIN 85284; (D) ZIN 85287.

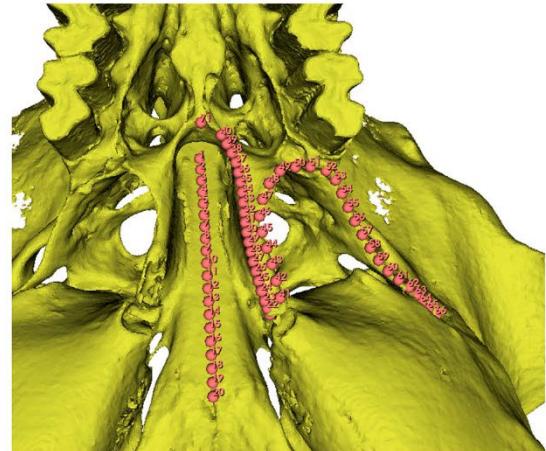
See figure S36 for details. Not scaled.

Ellobius lutescens ($n = 4$)



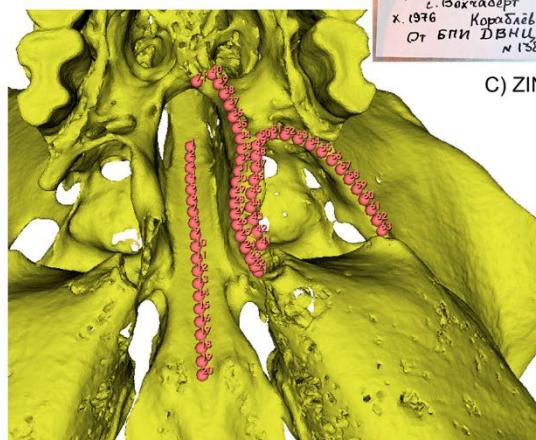
327-1957(1) oem. n 26607
Ellobius lutescens
Очаговом, Комицкий р-н
Армения, с. Серпухов
17.11.1988 Г. Гаспарян

(A) ZIN 26607



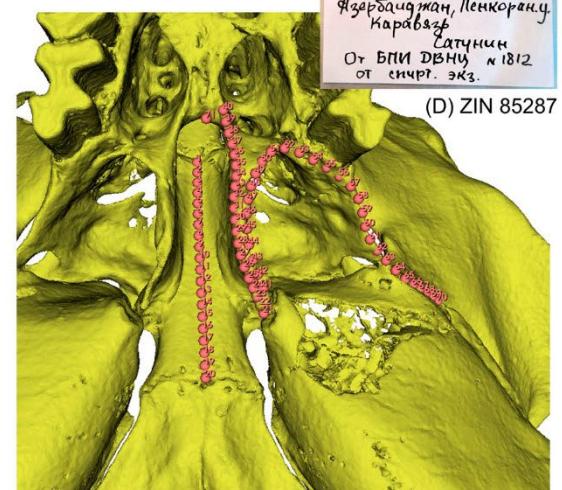
211-1998 N 83708
Ellobius lutescens ♀ ad.
Иран, пров. Луристан, 35 км к сев.-вост.
от Хорамабада, местн. Sarab-Taluk
25.11.1997 В.Г. Маликов
Ф.Н. Голенищев
N 144

(B) ZIN 83708



232-1992 n 85284
Ellobius Lutescens ♀ ad.
Армения, Абовянский р-н,
с. Вокчадер
x. 1976 Корабль
От БПИ ДВНЦ
n 15871

C) ZIN 85284



232-1992 n 85287
Ellobius Lutescens
Азербайджан, Ленкорань
Карабах
Случин
От БПИ ДВНЦ n 1812
от СИЧР. ЭКЗ.

(D) ZIN 85287

Figure S48. Screenshots of the PSP complex in subposterior view of five specimens of *Ellobius talpinus* with landmark positions: (A) ZIN 11763; (B) ZIN 35828; (C) ZIN 82955; (D) ZIN 84395; (E) ZIN 102342.

See figure S36 for details. Not scaled.

Ellobius talpinus (n = 5)

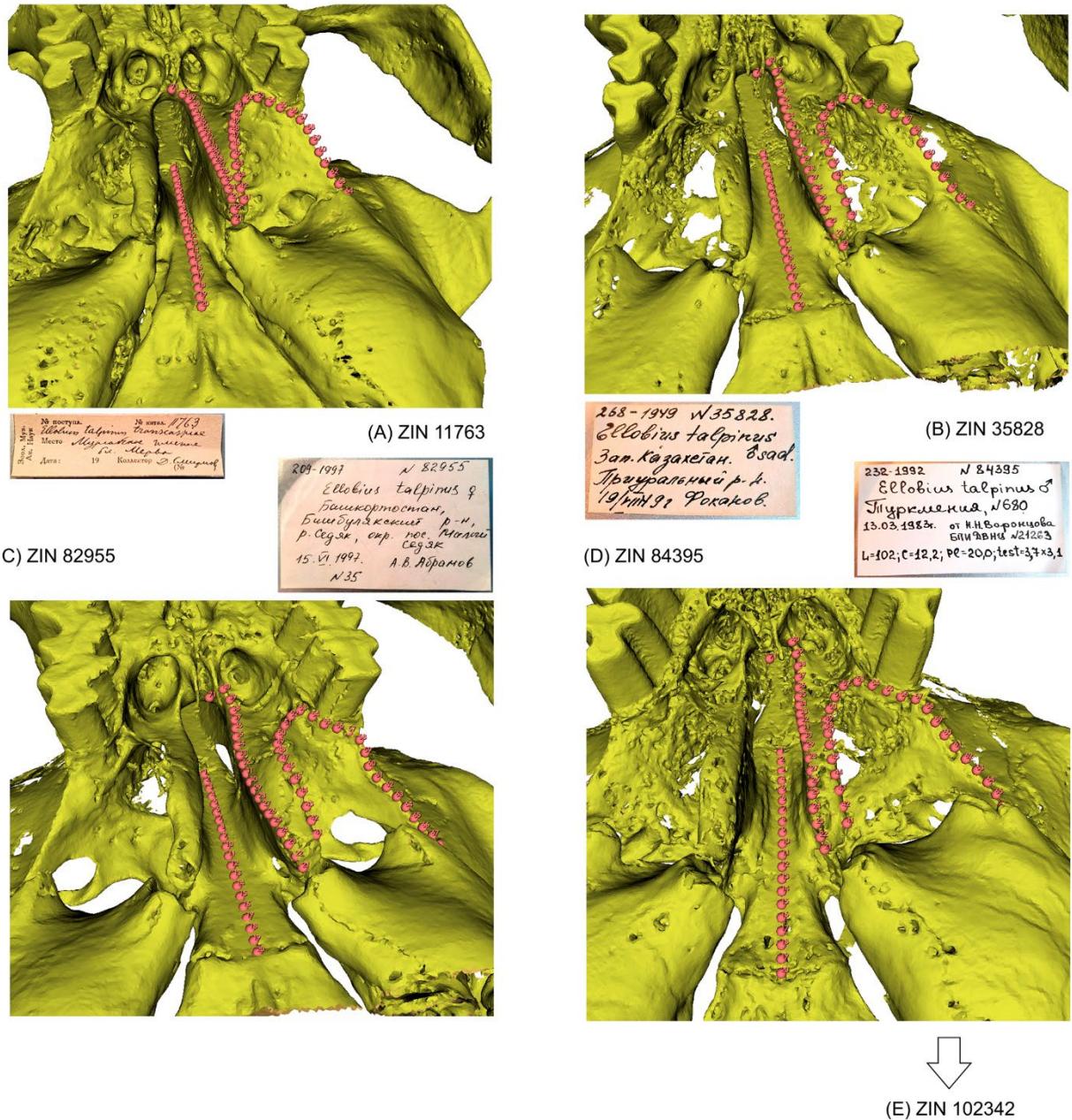


Figure S48. Continue.

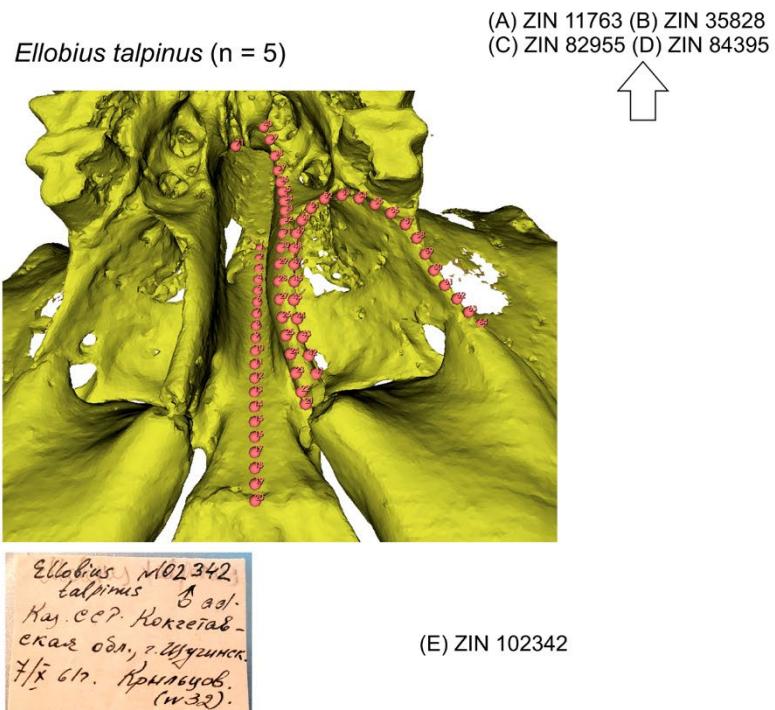


Figure S49. Screenshots of the PSP complex in subposterior view of two specimens of *Lagurus lagurus* with landmark positions: (A) ZIN 29170; (B) ZIN 57188. See figure S36 for details. Not scaled.

Lagurus lagurus ($n = 2$)

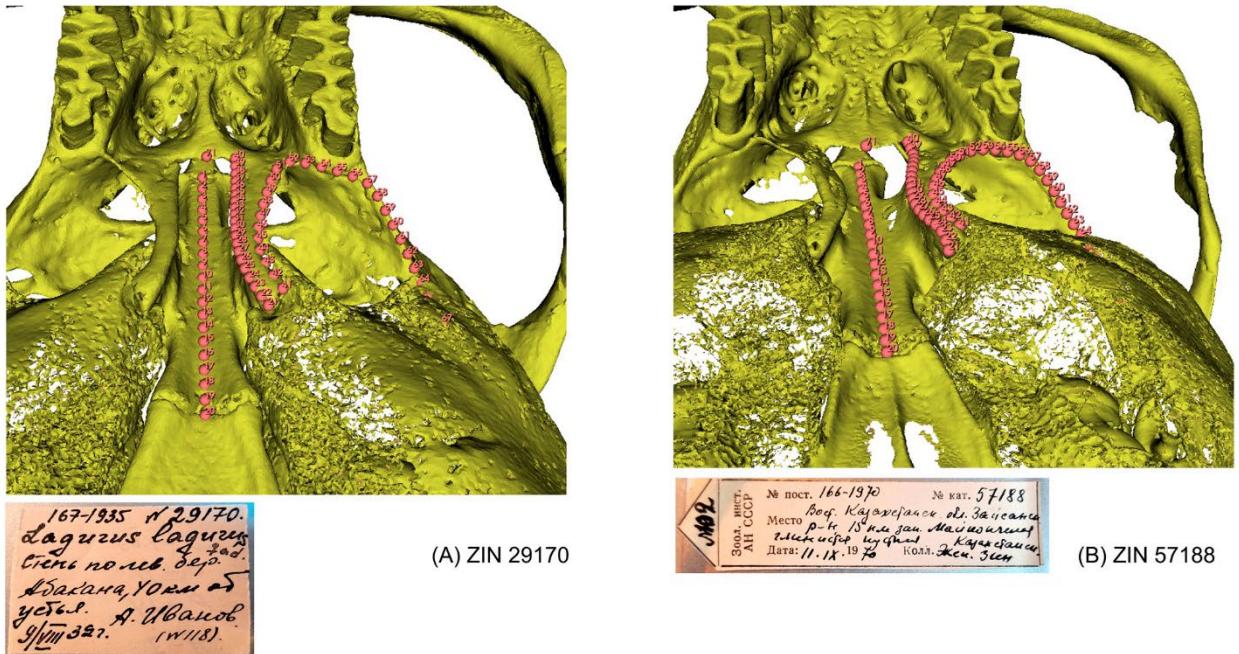


Figure S50. Screenshots of the PSP complex in subposterior view of two specimens of *Lasiopodomys brandtii* with landmark positions: (A) ZIN 82110; (B) ZIN 82114. See figure S36 for details. Not scaled.

Lasiopodomys brandtii (n = 2)

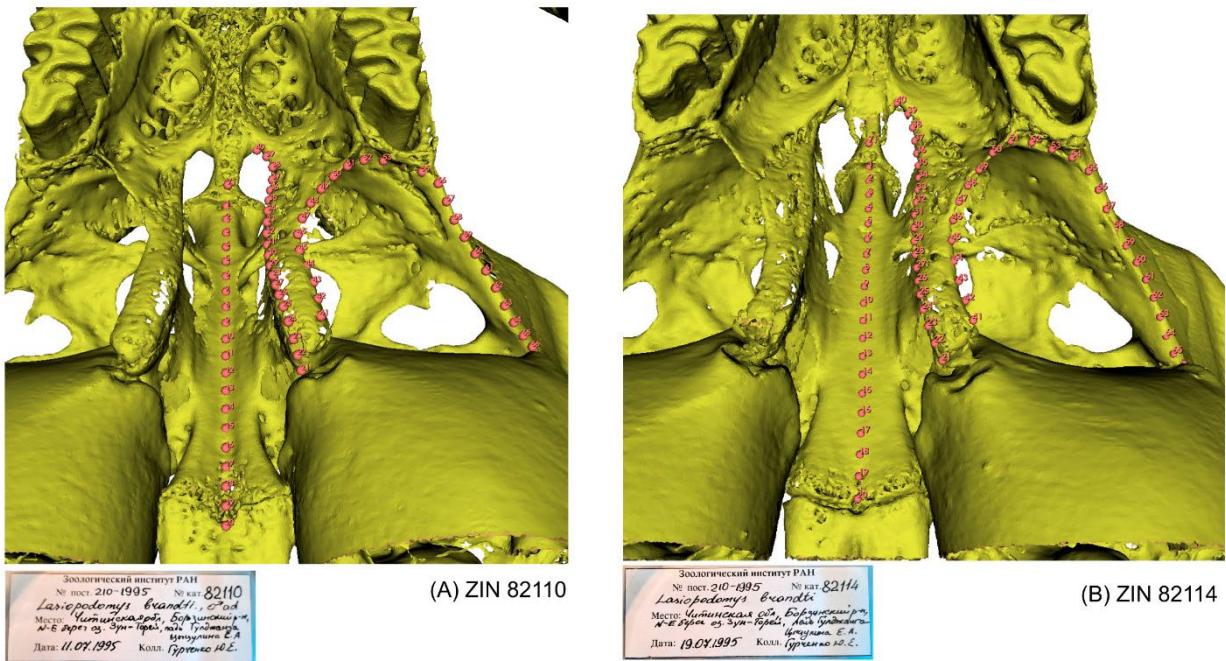


Figure S51. Screenshots of the PSP complex in subposterior view of four specimens of *Lasiopodomys gregalis* with landmark positions: (A) ZIN 15332; (B) ZIN 53120; (C) ZIN 96293; (D) ZIN 103094.

See figure S36 for details. Not scaled.

Lasiopodomys gregalis (n = 4)

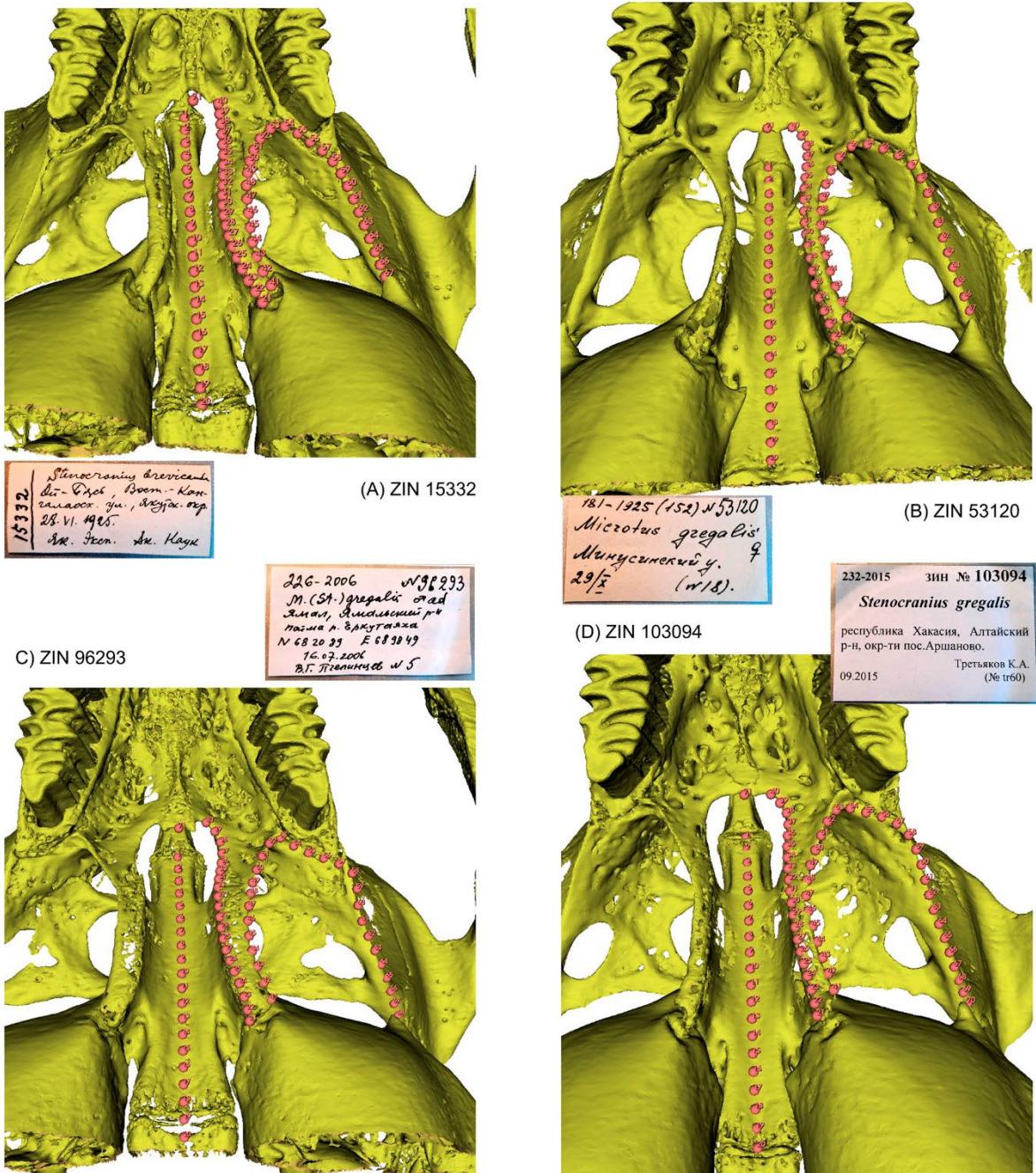


Figure S52. Screenshots of the PSP complex in subposterior view of two specimens of *Lasiopodomys mandarinus* with landmark positions: (A) ZIN 78327; (B) ZIN 78614. See figure S36 for details. Not scaled.

Lasiopodomys mandarinus (n = 2)

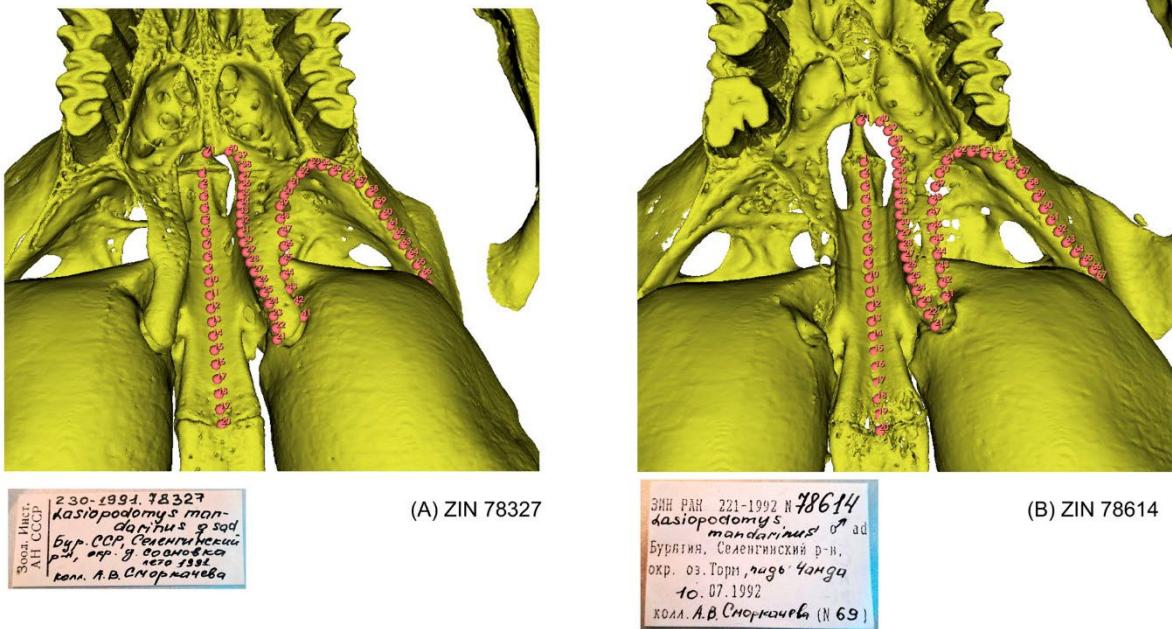
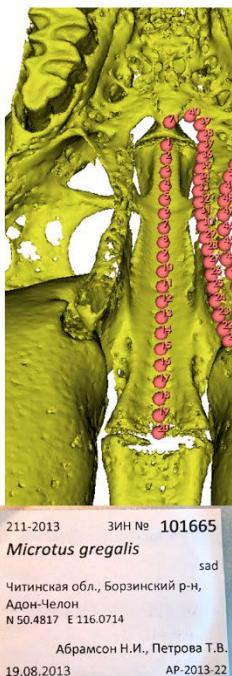


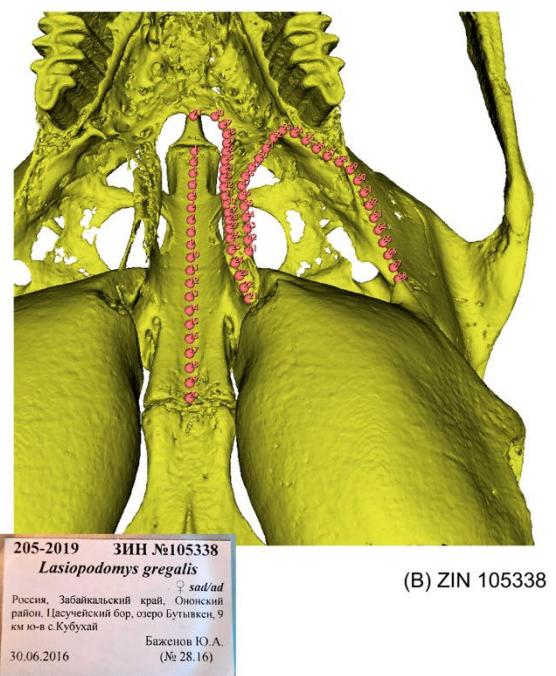
Figure S53. Screenshots of the PSP complex in subposterior view of four specimens of *Lasiopodomys raddei* with landmark positions: (A) ZIN 101665 (B) ZIN 105338; (C) ZIN 105341; (D) ZIN 105344.

See figure S36 for details. Not scaled.

Lasiopodomys raddei ($n = 4$)

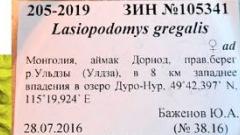


(A) ZIN 101665



(B) ZIN 105338

C) ZIN105341



(D) ZIN 105344



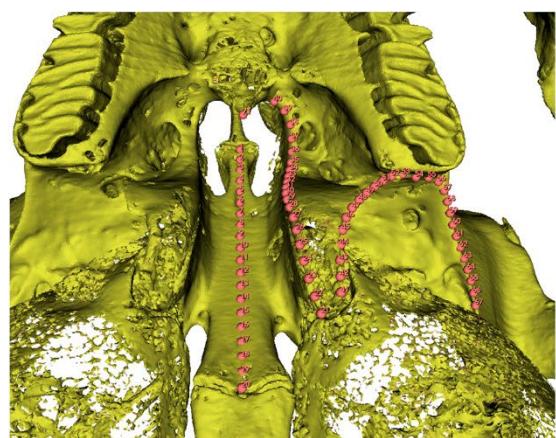
Figure S54. Screenshots of the PSP complex in subposterior view of three specimens of *Lemmus sibiricus* with landmark positions: (A) ZIN 64159; (B) ZIN 81239; (C) ZIN 81241. See figure S36 for details. Not scaled.

Lemmus sibiricus (n = 3)



213-Ф42 64/59
Lemmus obensis ♂
11-05 Тюмень, пос.город
на р. Тоболец 15. VIII 1976 Р.С.Полухин
25

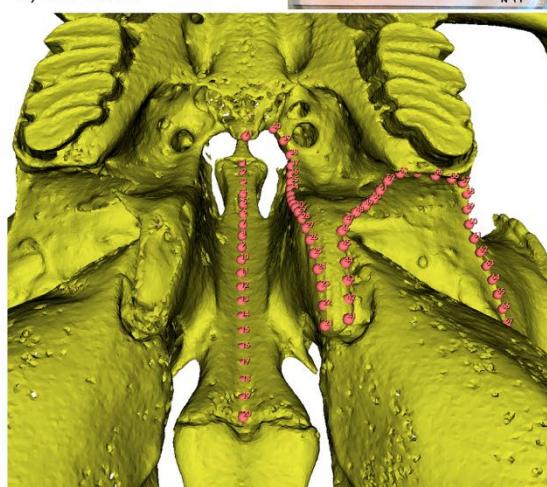
(A) ZIN 64159



Зоологический институт РАН
№ пост. 221-1994 № кат. 81239
LEMMUS SIBIRICUS ♂ ad
Северо-Западный Янтарь, на р. Северная
дата: 19.06.94 Колл. И.И. Абрамсон
№ 27

(B) ZIN 81239

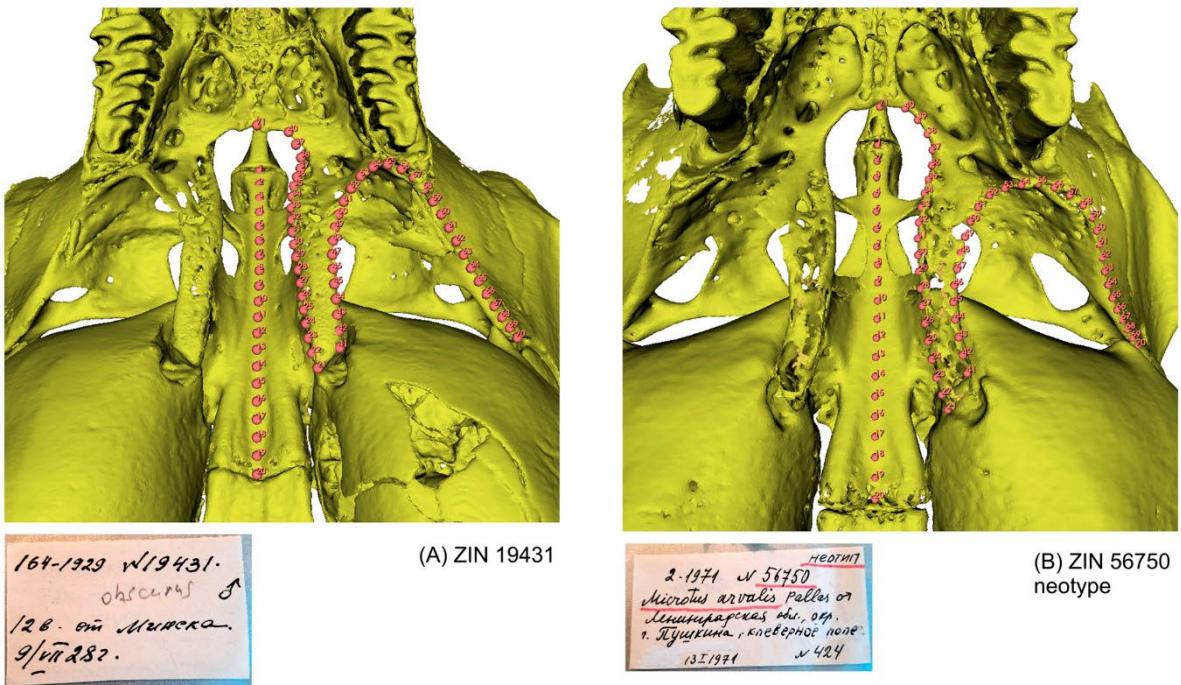
C) ZIN 81241



Зоологический институт РАН
№ пост. 221-1994 № кат. 81241
LEMMUS SIBIRICUS ♂ ad
Северо-Западный Янтарь, на р. Северная
дата: 19.06.94 Колл. И.И. Абрамсон
№ 27

Figure S55. Screenshots of the PSP complex in subposterior view of two specimens of *Microtus arvalis* with landmark positions: (A) ZIN 19431; (B) ZIN 56750 (neotype). See figure S36 for details. Not scaled.

Microtus arvalis (n = 2)



Note: See the Supplementary Material (Figure S23: 26) for information on *Mynomes miurus*:

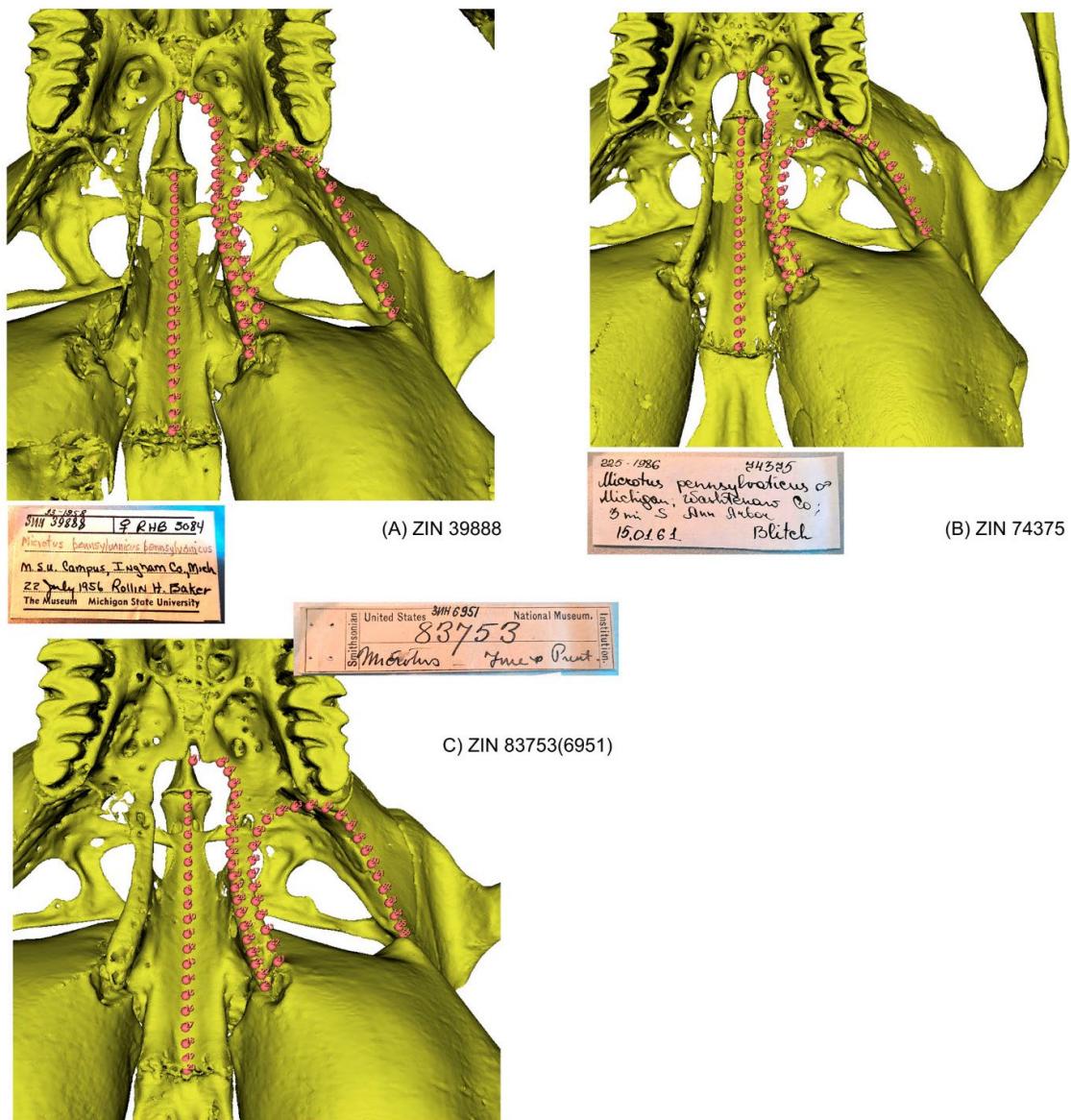
<https://github.com/desmanazin-svg/The-cranial-morphology-of-the-arvicoline-voles/blob/main/JCZ-D-25-00219 AGE FIGURES-S01-S35.pdf>

Note: See the Supplementary Material (Figure S24: 27) for information on *Mynomes ochrogaster*: <https://github.com/desmanazin-svg/The-cranial-morphology-of-the-arvicoline-voles/blob/main/JCZ-D-25-00219 AGE FIGURES-S01-S35.pdf>

Figure S56. Screenshots of the PSP complex in subposterior view of three specimens of *Mynomes pennsylvanicus* with landmark positions: (A) ZIN 39888 (B) ZIN 74375; (C) ZIN 83753(6951).

See figure S36 for details. Not scaled.

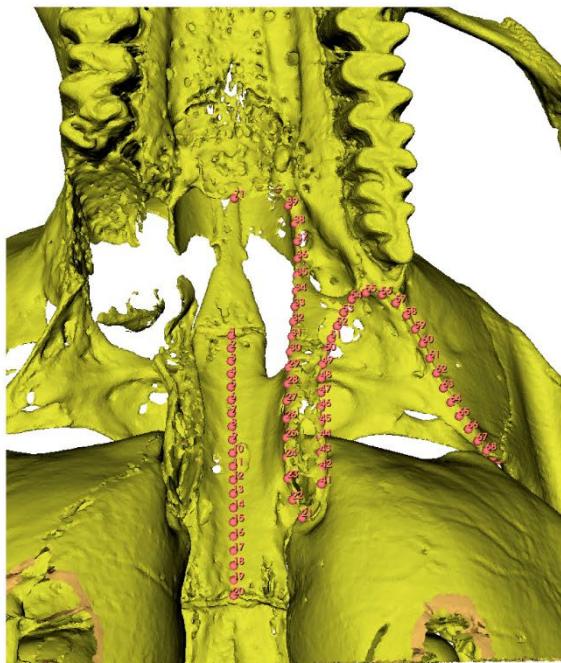
Mynomes pennsylvanicus (n = 3)



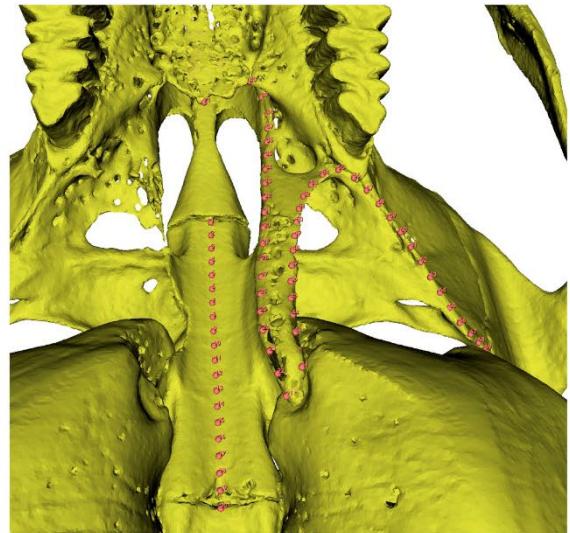
Note: See the Supplementary Material (Figure S26: 29) for information on *Mynomes richardsoni*: <https://github.com/desmanazin-svg/The-cranial-morphology-of-the-arvicoline-voles/blob/main/JCZ-D-25-00219 AGE FIGURES-S01-S35.pdf>

Figure S57. Screenshots of the PSP complex in subposterior view of two specimens of *Clethrionomys centralis* with landmark positions: (A) ZIN 21254; (B) ZIN 107137. See figure S36 for details. Not scaled.

Myodes centralis ($n = 2$)



(A) ZIN 21254



(B) ZIN 107137



Note: See the Supplementary Material (Figure S28: 31) for information on *Clethrionomys glareolus*: <https://github.com/desmanazin-svg/The-cranial-morphology-of-the-arvicoline-voles/blob/main/JCZ-D-25-00219 AGE FIGURES-S01-S35.pdf>

Figure S58. Screenshots of the PSP complex in subposterior view of four specimens of *Clethrionomys rutilus* with landmark positions: (A) ZIN 20967; (B) ZIN 20974; (C) ZIN 20978; (D) ZIN 20984.

See figure S36 for details. Not scaled.

Myodes rutilus (n = 4)

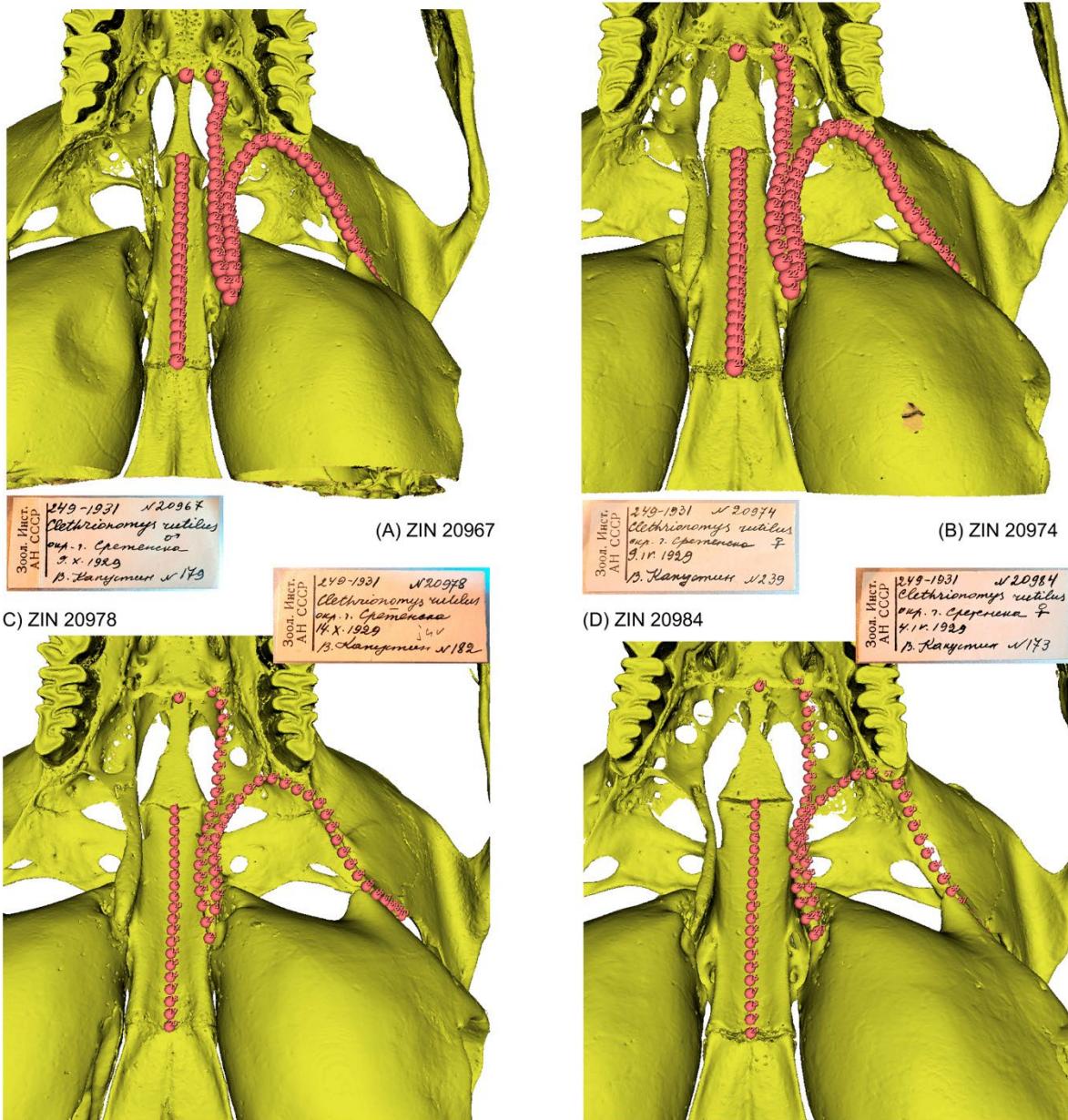


Figure S59. Screenshots of the PSP complex in subposterior view of two specimens of *Myopus schisticolor* with landmark positions: (A) ZIN 100554; (B) ZIN 103730. See figure S36 for details. Not scaled.

Myopus schisticolor (n = 2)

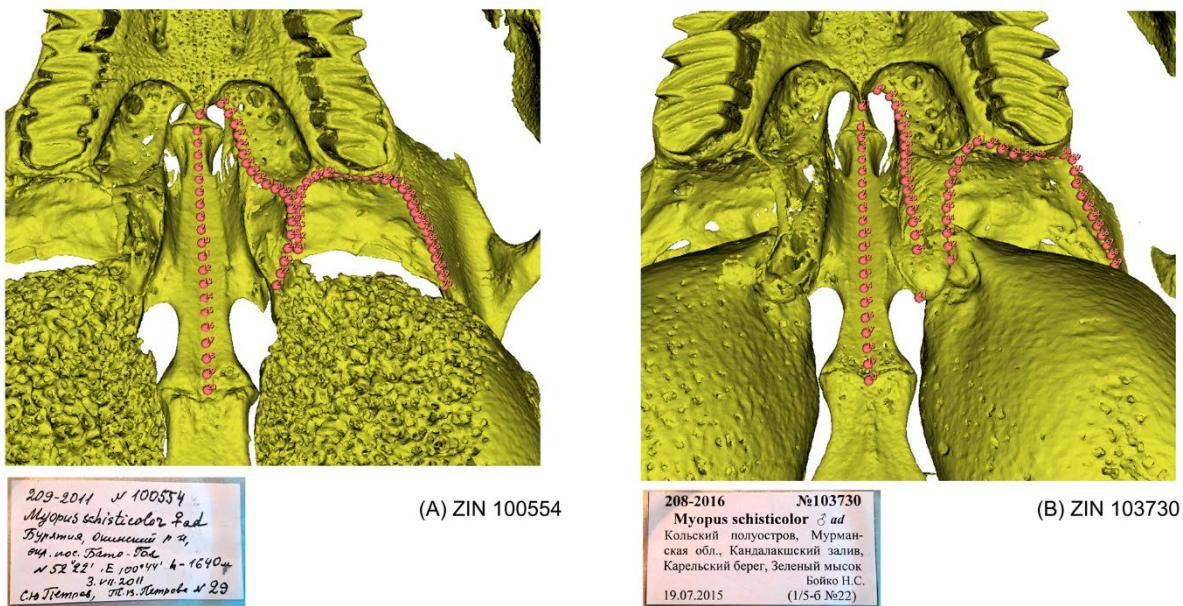
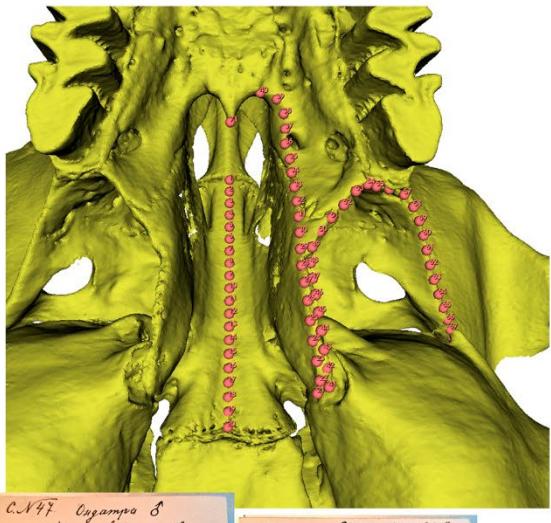


Figure S60. Screenshots of the PSP complex in subposterior view of three specimens of *Ondatra zibethicus* with landmark positions: (A) ZIN 32560; (B) ZIN 69584; (C) ZIN 84176. See figure S36 for details. Not scaled.

Ondatra zibethicus (n = 3)

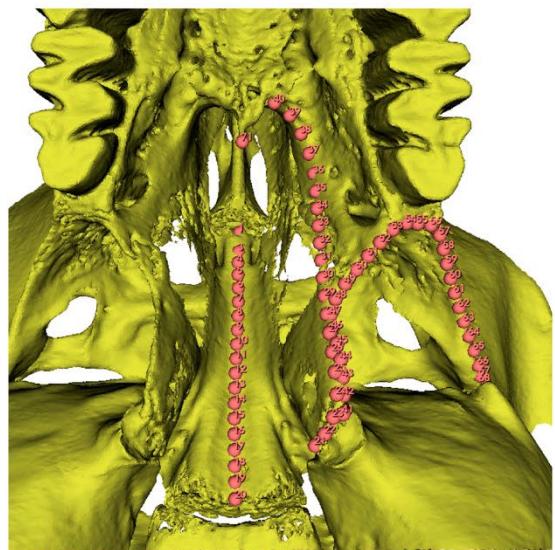


C. N. 47 Овчарка ♂
Fiber zibethicus L.
28.6.1938г. река Борода
Бурзянский район
№ 19, село Г. Бурзян.

Млоступ. ЗИН 41-1983
№ кот. ЗИН 32560

C) ZIN 84176

(A) ZIN 32560



246-1983
№ 69584

29.6.1983
№ 69584

(B) ZIN 69584

#119 C
Muskrat
Ondatra zibethica Spring
30 Utah
Col. F. Fitz



232-1992 84176
Ondatra zibethicus
Молдавская ССР
Зима 1971-1972 гг. Л.Мартынова
от Н.Н.Воронцова ГПИ ДВНЦ

Figure S61. Screenshots of the PSP complex in subposterior view of two specimens of *Prometheomys schaposchnikowi* with landmark positions: (A) ZIN 31495; (B) ZIN 74487. See figure S36 for details. Not scaled.

Prometheomys schaposchnikowi ($n = 2$)

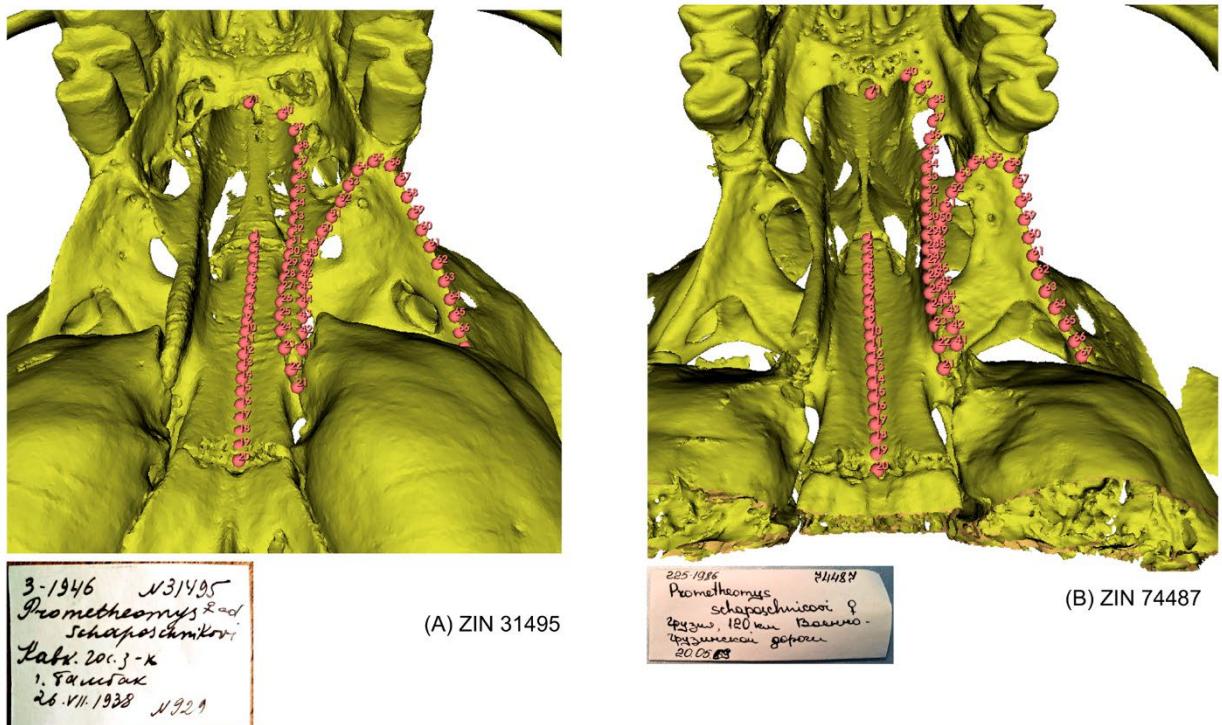


Figure S62. Screenshots of the PSP complex in subposterior view of three specimens of *Terricola subterraneus* with landmark positions: (A) ZIN 74969; (B) ZIN 80937; (C) ZIN 84244.

See figure S36 for details. Not scaled.

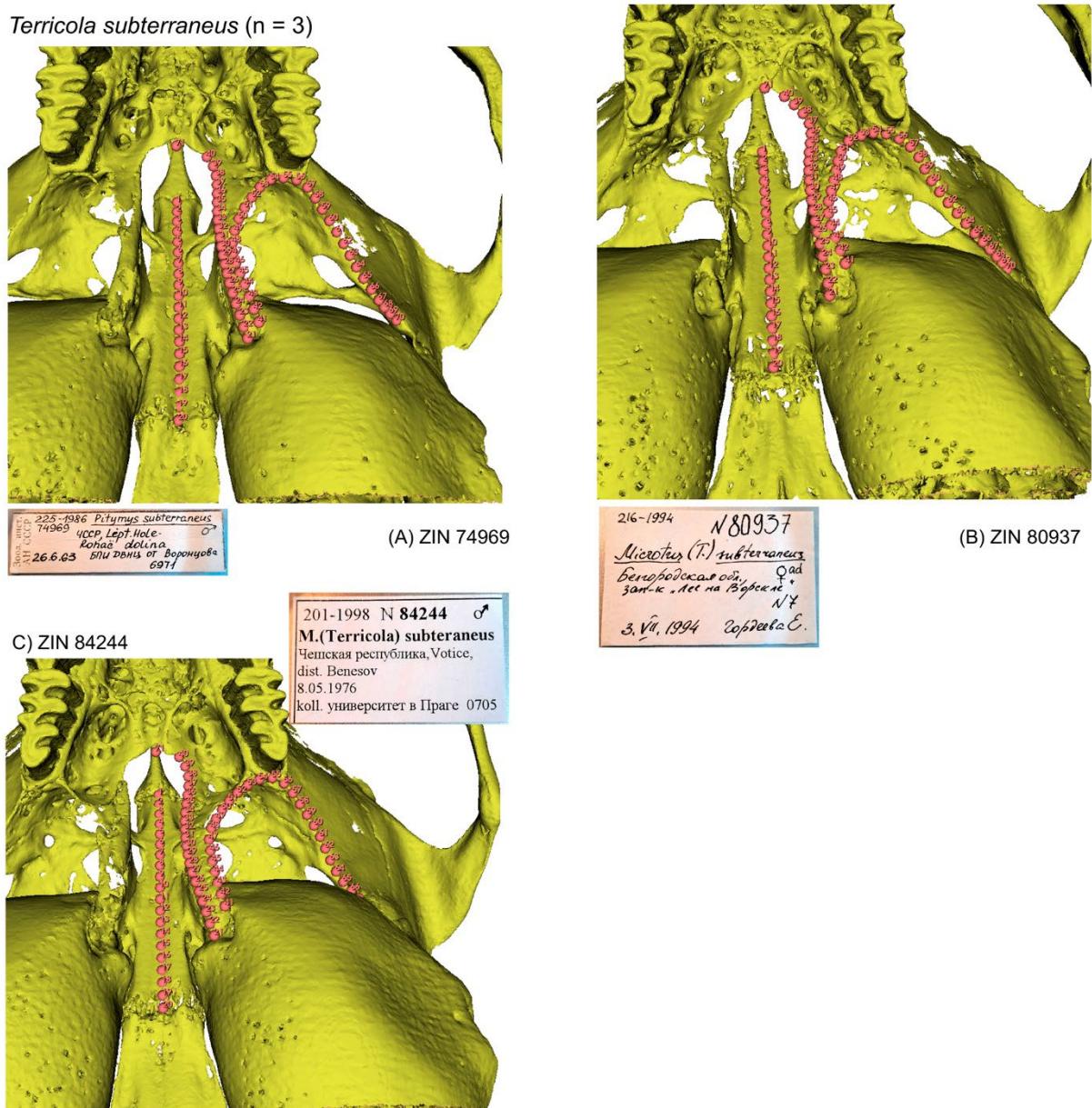
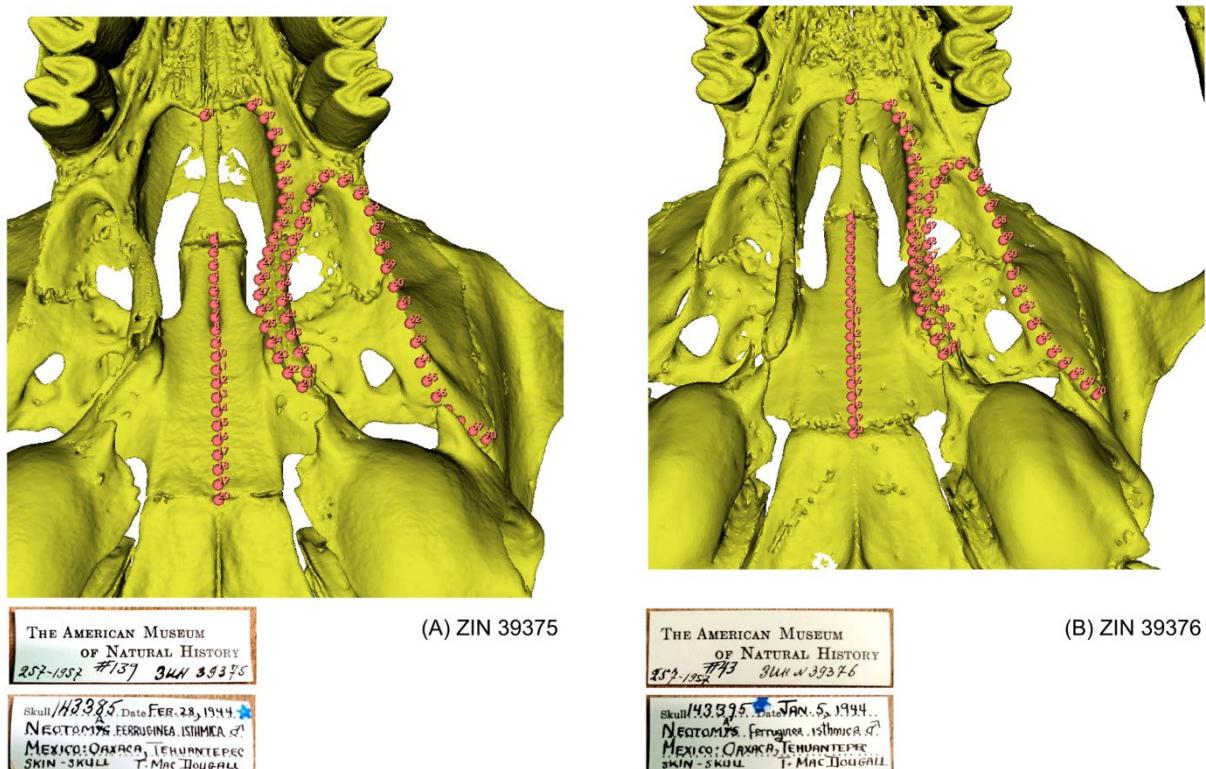


Figure S63. Screenshots of the PSP complex in subposterior view of two specimens of *Neotoma mexicana* with landmark positions: (A) ZIN 39375; (B) ZIN 39376. See figure S36 for details. Not scaled.

Neotoma mexicana ($n = 2$)



Note: See the Supplementary Material (Figure S35: 38) for information on *Cricetulus barabensis*: <https://github.com/desmanazin-svg/The-cranial-morphology-of-the-arvicoline-voles/blob/main/JCZ-D-25-00219 AGE FIGURES-S01-S35.pdf>