

***Sus* (Suidae, Mammalia) from the Upper Pliocene of the Northeastern Part of the Azov Region**

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Abstract—*Sus* cf. *strozzii* from the Khapry strata of the northeastern part of the Azov Region is described. The parameters and measurements of the tooth system correspond to those of *S. strozzii* in Western Europe. The specimens from the Khapry and Liventsovka localities suggest that this species is a typical member of the Late Pleistocene faunas of Eastern Europe.

INTRODUCTION

The Khapry Faunal Assemblage was distinguished by V.I. Gromov in 1933 on the basis of a large mammal fauna from the Khapry alluvial sands that forms a narrow band of more than 120 km long and 2 km wide along the northern coasts of the Taganrog Gulf of the Azov Sea and the right slope of the Don valley.

A number of outcrops of Khapry alluvium occur between Rostov-on-Don and Taganrog, the Matveev Kurgan, in some parts of the Miuskii Firth, and to the southwest between this region and Berdyansk. The stratotype of the Khapry Mammal Assemblage is a section near Khapry Station, the parastratotype is a sandy quarry located in the western outskirts of Rostov-on-Don near Liventsovka Station and developed between 1964 to 1976.

The Khapry alluvial strata are composed of sand; at the base, the layers are oblique and coarse-grained and include interbeds containing conglomerates; the higher layers consist mainly of medium-sized and fine grain sands and slope more gently. These sands are deposited on eroded Sarmatian and Pontian strata under Scythian clays and Quaternary loam and compose the earliest terrace of the lower reaches of the Don and the northeastern part of the Azov Region. Bone fossils of large mammals occur in the lower riverbed facies of Khapry alluvium.

Most fossil specimens of the members of this faunal assemblage were collected near Khapry and Liventsovka (Gromov, 1948, Baigusheva, 1971). The following large mammals were abundant in these localities: *Pliocrocuta perrieri* Croizet et Jobert, *Anancus alexeevae* Baigusheva, *Archidiskodon gromovi* Garutt et Alexeeva, *Equus livenzovensis* Baigusheva, *Stephanorhinus* ex gr. *megarhinus-jeanvireti*, *Paracamelus alutensis* Stefanescu, *Eucladoceros* cf. *dicranios* Nesti. The list of the Khapry Fauna also contains *Sus* sp. (Khokhlovkina, 1940, p. 83; Gromov, 1948, p. 45; Baigusheva, 1971, p. 11) or *Sus strozzii* (Alexeeva, 1977, p. 125).

The following specimens of pig were found in the Khapry and Liventsovka localities: RGU (collection of Rostov State University), no. 577, fragmentary lower left canine (Fig. 1b); GGM (Vernadskii State Geological Museum), no. 125-1/PV-556, cast of the lower jaw (Fig. 1a); RGU, no. 288, left lower molar M₃; and RGU, no. 678, fragmentary radius.

The examination of this material shows that the pig form from the Khapry layers is similar to the Villafranchian species, *Sus strozzii* Meneghini and can be referred to as *Sus* cf. *strozzii*. This species was found in the Late Pliocene and Early Pleistocene of Western and Southern Europe and in Israel.

DESCRIPTIONS AND COMPARISONS

The specimen RGU, no. 577, a fragmentary lower canine, belonged to an adult male, as it is trihedral in cross section (Fig. 1b). At the base, the tooth section is 26.4 mm long and 19 mm wide. The posterior and external planes are 18 and 25 mm wide, respectively. The surface of enamel is fine-ribbed.

Specimen GGM, no. 125-1/PV-556 housed at Vernadskii State Geological Museum is a cast of original lower jaw found by V.I. Gromov in 1935 in a quarry near Khapry Station (Alexeeva, 1977). The specimen consists of right and left horizontal rami of the jaw broken off behind M₃; the anterior part, symphysis, and incisors are not preserved (Fig. 1a). The cast allows an approximate idea of the jaw shape. The jaw ramus under M₁ is approximately 42.5 mm wide; under M₂, it is greater than 40–44 mm wide; and under M₃, it is at least 46 mm wide. Left P₂, P₃, M₂, and M₃ and right M₁ and M₂ are distinct in the cast. The other teeth are worn or damaged. The jaw between the lingual surfaces of M₃ is 56.5 mm wide.

On the grinding surface of the premolars, the dentine forms a curving band that narrows anteriorly and superiorly. M₁ and M₂ are strongly worn; however, enamel folds are distinguishable and the dentine ele-

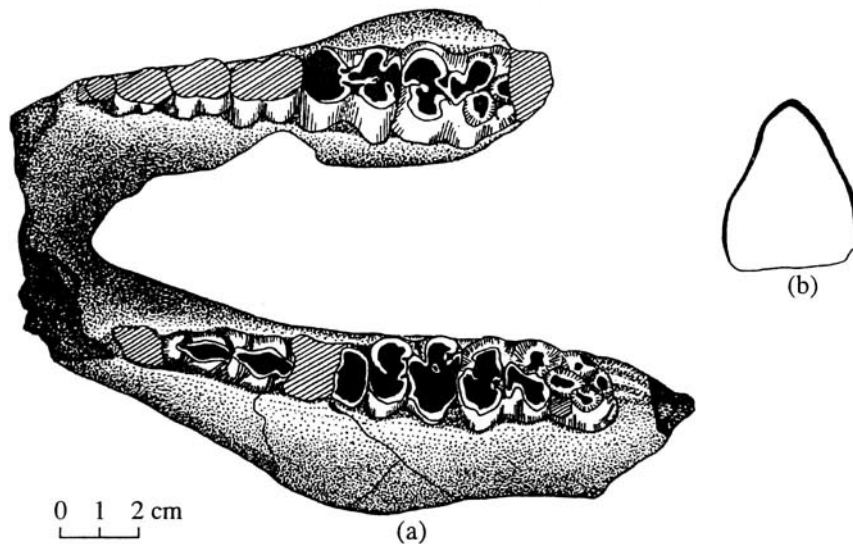


Fig. 1. *Sus* cf. *strozzii*: (a) GGM, no. 125-1/PV-556, lower jaw from the Khapry locality and (b) RGU, no. 577, cross section of the lower left canine from the Liventsovka locality.

ments are connected to each other by narrow bridges. On M_3 , the cusps of the first, second, and third orders are completely worn; the tooth surface is almost even although the boundaries between the cusp bases are still distinct.

The molars are brachiodont and bear four main cusps isolated from each other by deep folds. Enamel is strongly folded. The cingulum is distinctly developed. The tooth row consisting of P_2 – M_3 is greater than 129.5 mm long, the premolar row P_2 – P_4 is more than 43 mm long, and the molar row is approximately 90 mm long.

The apex of P_3 consists of one main cusp; the tooth crown expands somewhat posteriorly.

The main apex of P_4 is single and probably bears small anterior and posterior cusps; however, this cannot be stated with certainty as the tooth is very worn. The posterior part of the tooth is somewhat wider than the anterior part (15 and 13 mm, respectively).

M_1 is almost rectangular and very worn.

Both M_2 are rectangular and considerably worn. The tooth crown bears four main and two supplementary cusps. The supplementary cusps are located at the midline of the tooth in a valley behind the anterior and posterior pairs of the main cusps. There is a constriction between the paraconid–protoconid and metaconid–hypoconid.

M_3 bears well-pronounced main cusps. A supplementary cusp is located in the valley between the anterior (paraconid and protoconid) and posterior (metaconid and hypoconid) cusp pairs. Supplementary cusps are also developed on the talonid. A small flattened cusplet is observed on the external edge between the protoconid and the hypoconid. In the region of anterior cusps, the tooth is of approximately the same width as in the region of the posterior cusps and becomes nar-

rower in the talonid region. The talonid curves weakly laterally relative to the midline. The tooth crown is narrowed between anterior and posterior cusp pairs.

The left M_3 (RGU, no. 288) is without wear and possesses a strongly wrinkled enamel. The main apices are pyramidal. The cusp arrangement is similar to that of M_3 of the lower jaw considered above. The talonid is broken off. The crown lacks any trace of wear or effects of any kind of grinding. According to the technique age determination of recent pigs (Kozlo and Nikitenko, 1967), the absence of roots (as observed in the tooth considered) indicates that this was a two-year-old individual. The tooth is 19.8 mm high and more than 41.5 mm long, the greatest width is 22.2 mm; the enamel is 1.5–3.0 mm thick.

A fragmentary right radius (RGU, no. 678) consisting of the proximal end and a part of the diaphysis, is weakly weathered. The proximal articulation is 26.2 mm in transverse diameter. The maximal diameter of the proximal end is 29.1 mm. The medial facet of the proximal articulation is 26.5 mm wide. The diaphysis is more than 16.6 mm in diameter.

The specimens from the Azov Region were previously compared mainly with the Pliocene and Pleistocene species of the genus *Sus* from Eurasia. They were not compared with *S. tamanensis* Vereshchagin from the Tamanian Faunal Assemblage (Tsimbal and Kuchugury localities) found in the Taman Peninsula. *S. tamanensis* is represented by distal fragments of the lower jaws containing incisors (Vereshchagin, 1957). Some workers indicated that this form was similar to the Villafranchian *S. strozzii* (Aleksieva, 1977).

The lower left canine (RGU, no. 577) is similar in outline to that of *S. strozzii* from Western Europe (Azzaroli, 1954); however, it is somewhat thinner. The

Measurements of the lower jaws and lower teeth of some members of the genus *Sus*

Nos.	Measurement	<i>Sus cf. strozii</i>		<i>Sus strozii</i>	<i>Sus scrofa</i> L.	<i>Sus minor</i>	<i>Sus minor</i>
		GGM, no. 125-1/PV-556, St. Khapry		based on figures (Azzaroli, 1954)	male, ad., Zool. Muz., Moscow State University	based on figures (Azzaroli, 1954)	Kvabeby (Vekua, 1972)
		sin	dex				
1	P ₂ -M ₃ length	>138.0	[140]	125.0-(130.7)-147.0	120.0-(124.1)-129.0	93.0	
2	P ₂ -P ₄ length	[50]	[45]	43.0-(43.2)-45.0	41.5-(42.9)-45.0	34.2	
3	M ₁ -M ₃ length	88.8	[89]	84.0-(86.3)-91.0	77.0-(81.2)-85.0	59.6	60.0-66.0
4	P ₂ length	-	[8.9]	11.6-(17.8)-18.0	12.0-(13.0)-13.8	11.0	12.0-13.5
5	P ₂ width	-	[8.0]	5.8-(6.0)-6.5	5.0-(5.3)-5.8	6.7	8.0-12.0
6	P ₃ length	15.2	15.2	16.0-(18.3)-19.5	14.5-(15.0)-15.8	14.5	13.5-15.0
7	P ₃ width	11.0	11.1	7.8-(9.03)-10.4	7.0-(7.7)-9.0	10.8	12.0-13.5
8	Ratio 7/6	72.4	73.0	45.6-(49.2)-53.3	46.0-(51.3)-57.0	74.5	82.8-100.0
9	P ₄ length	16.8	16.4	16.8-(17.4)-18.2	15.4-(15.8)-16.6	12.0	13.0-13.5
10	P ₄ width	>14.3	15.4	8.8-(11.6)-13.1	9.0-(10.0)-11.0	9.1	165.0-17.0
11	Ratio 10/9	85.1	98.1	52.4-(66.1)-74.0	57.3-(63.4)-68.75	75.8	122.2-130.9
12	M ₁ length	20.0	20.0	18.8-(19.5)-20.2	16.6-(17.5)-18.0	15.8	13.0-24.5
13	M ₁ width	[16]	17.8	13.5-(15.7)-19.2	12.0-(12.45)-13.0	14.5	17.0-21.0
14	Ratio 13/12	77.4	89.0	71.8-(80.7)-98.5	66.7-(71.3)-74.4	91.8	85.7-134.6
15	M ₂ length	25.0	26.0	27.0-(27.7)-28.5	23.0-(23.7)-24.8	19.5	22.0-24.0
16	M ₂ width	22.0	21.1	17.5-(17.9)-18.1	15.2-(16.25)-17.0	17.0	21.0-22.0
17	Ratio 16/15	88.0	81.2	63.2-(64.5)-65.6	64.1-(68.6)-72.3	87.2	87.5-100.0
18	M ₃ length	42.8	[44]	40.0-(44.2)-50.0	36.0-(40.8)-42.5	29.0	29.5-31
19	M ₃ width	24.8	22.9	21.3-(23.5)-30.0	16.3-(18.5)-19.8	17.3	20.0-22.0
20	Ratio 19/18	57.9	[52]	49.0-(51.3)-55.0	43.8-(45.4)-47.6	59.7	64.5-73.3
21	Interval between lingual surfaces of M ₃	56.5		34.5; 37.2; 39.3	37.0-(39.2)-41.5		

lower canines of a male *Sus minor* from Roussillon are smaller, the transverse section is 18-20 mm long and 15-16.2 mm wide. In *S. strozii* from the Seneze locality, the transverse section of the canine is 26.5-34.5 mm long and 20.5-24.6 mm wide (the measurements were made from the figures).

In the canine considered from the Liventsovka locality, enamel is observed on the tooth root, as in recent wild boars; this is not typical of females that are characterized by a well-pronounced boundary between the enamel layer and root cement of the tooth. In recent wild boars, enamel on the canines forms smaller transverse ribs than in *S. cf. strozii* from the Khapry locality. This is possibly attributable to smaller size.

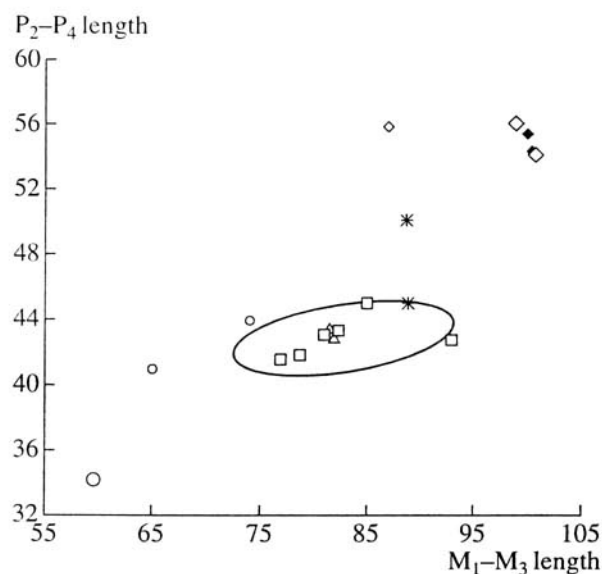
The lower jaw (GGM, no. 125-1/PV-556) is quite informative. Based on the technique for aging recent pigs (Kozlo and Nikitenko, 1967), I aged the individual under study as a 6-7-year-old animal. Recent wild boars of this age are characterized by substantially worn crowns of M₁ and M₂; in M₃, all cusps of the first, second and third orders are worn; however, the boundaries between the cusps are distinguishable. In older

animals, all teeth, including the molars, are strongly worn.

As far as could be determined on the basis of a cast, the mandible body in the specimen from the Khapry locality is wider than those of recent wild boars, in which the lower jaws under M₁, M₂, and M₃ are 26-32, 29-36, and 30-37 mm wide, respectively. *Sus apscheronicus* Burtchak-Abramovich et Dzafarov from the Binagady locality of Azerbaijan (Burtchak-Abramovich and Dzafarov, 1948) is also characterized by a relatively narrow jaw (under M₁, it is 29-32 mm wide).

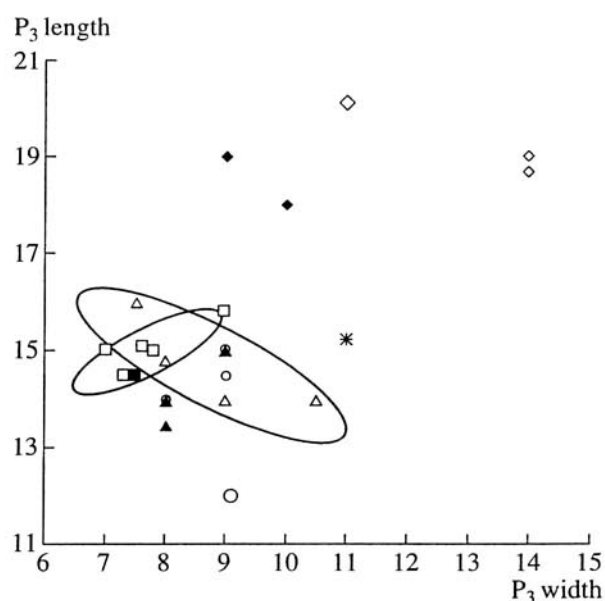
S. arvernensis Croizet et Jobert and *S. namus* Van der Made from Sardinia (Van der Made, 1989) are smaller than the considered *S. cf. strozii* from the Azov Region and possess a simple talonid of M₃ consisting of one cusp; in addition, the teeth of *S. namus* are more hypsodont. In these species, the premolar row is relatively longer than in large members of the genus *Sus*.

S. minor from Roussillon of Eastern Europe, considered by Azzaroli (1975) as an ancestor of *S. strozii*, is smaller than *S. cf. strozii* from the Azov Region (table). The teeth of these forms are similar in morpho-



- * *Sus cf. strozzii*, Khapry
- △ *S. strozzii* (Azzaroli, 1954)
- *S. scrofa*, MSU
- *S. minor* (Azzaroli, 1954)
- *S. minor*, Kvabeby
- ◇ *Propotamochoerus provincialis*, Kosyakino locality
- ◇ *Microstonyx major*, Taraklia, Moldova
- ◆ *M. major*, Grebeniky

Fig. 2. The ratios between the length of the molar row and the length of the premolar row in some members of the subfamily Suinae.



- * *Sus cf. strozzii*, Khapry
- △ *S. strozzii* (Azzaroli, 1954)
- *S. scrofa*, Recent (MSU)
- *S. minor* (Azzaroli, 1954)
- *S. minor*, Kvabeby
- ◇ *Propotamochoerus provincialis*, Kosyakino
- ◆ *Microstonyx major*, Grebeniky
- ◇ *M. major*, Taraklia, Moldova
- ▲ *S. apscheronicus*, Binagady
- *S. scrofa attila*, Azerbaijan

Fig. 3. The ratios between the parameters of the lower premolars P_3 in some members of the subfamily Suinae.

logical pattern. In the taxon from Roussillon, M_3 is 29–33 mm long, and the tooth row is 83–101 mm long (Azzaroli, 1975).

In *Propotamochoerus provincialis* from Kvabeby (Vekua, 1972), assigned by Azzaroli (1975) to *S. minor*, the molar row M_1 – M_3 is 64–66 mm long, i.e., it is substantially smaller than in the specimen from the Khapry locality. In the taxon from the Roussillon of the Caucasus, the talonid of M_2 is well-pronounced. M_3 is up to 44 mm long; however, the talonid of M_3 is more complex in structure, and the lower jaw is higher and narrower.

The parameters of the tooth system in the lower jaw considered correspond to those in *S. strozzii*. P_2 is incompletely preserved and does not permit measurements; therefore, only P_3 , P_4 , and molars were compared.

P_3 of the specimen examined is wider than those of *S. strozzii* from the Upper Valdeganga, Senez, and Olivola, *S. scrofa*, and *S. apscheronicus* (Fig. 3). The length and width of the P_4 crown corresponds to extreme values of these parameters in *S. strozzii* (Fig. 4). The ratios between the width and the length of M_1 and M_2 of the specimens considered (Figs. 5, 6) are similar to those in earlier members of the subfamily (*Propotamo-*

choerus and *Microstonyx*); these teeth are relatively wider than those of *S. strozzii* and *S. scrofa*.

In recent 6–7-year-old wild boars, the lower tooth row ranges from 116 to 129 mm long; in females, this measurement is 105 to 123 mm. The lower jaw from the Khapry strata is approximately 129.5 mm long, i.e., only slightly longer than those of recent males.

The length of the tooth row and the parameters of M_3 are similar to those of *S. strozzii* and *S. scrofa* (table, Fig. 7). The ratio between the length of premolars P_2 – P_4 and the length of the molars in the specimen considered is also similar to those in the above species (Fig. 2). The length of the premolar row in the specimen from the Khapry locality (taking into account damaged P_2) is approximately 48% of the length of molars. In *S. strozzii*, *S. minor*, and *S. scrofa*, this parameter is approximately 50.0–52.5, 57.0, and 51.4–55.8%, respectively.

Based on the measurements and the number and arrangement of the cusps, the lower molar M_3 (RGU, no. 283) can be also referred to as a form similar to *S. strozzii*.

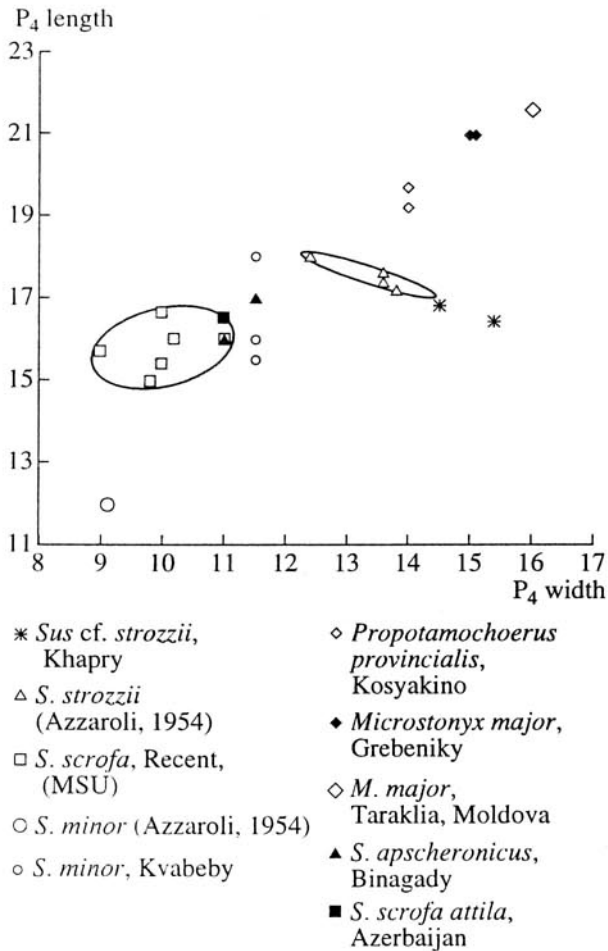


Fig. 4. The ratios between the parameters of the lower pre-molars P₄ in some members of the subfamily Suinae.

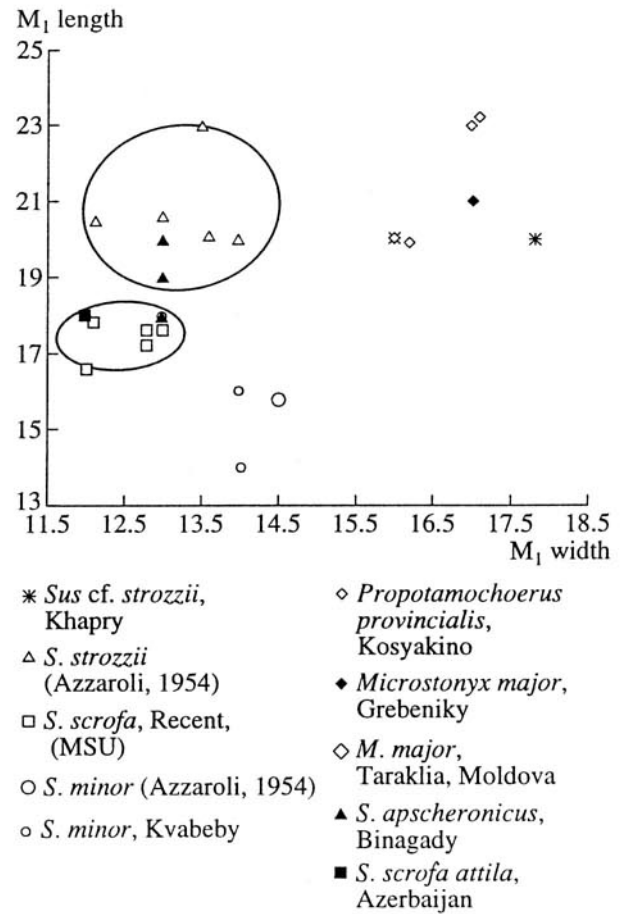


Fig. 5. The ratios between the parameters of the lower molars M₁ in some members of the subfamily Suinae.

Judging from the figure, the radius of *S. strozzii* from Senezé is approximately 24.6 mm in maximal diameter, i.e., is smaller than this measurement in the fragmentary radius from the Liventsovka locality.

The single-cone structure of the main cusp of P₄ distinguishes the specimen from the Khapry locality from the genera *Palaeochoerus*, *Hyotherium*, and *Dicoryphochoerus* that are characterized by a double-cone main apex. A single-cone structure of P₄ was recorded in *Sivachoerus*, *Tetraconodon*, *Propotamochoerus*, and *Potamochoerus*; however, the premolars of these forms are increased in relation to molars, and the talonid is more complex (Trofimov, 1949). *Propotamochoerus provincialis* from the Stavropol Region (PIN, no. 225/159) is similar to the specimens from the Khapry locality in measurements, but it is distinguished by a complicated talonid of M₂ and a narrower body of the lower jaw. In a pig from the Kosyakinskii quarry, the anterior edges of the protoconids and paraconids of M₂ and M₃ bear basal cuspules, which are not observed in the lower jaw from the Khapry locality. *Propotamochoerus hysudricus* from the Upper Pliocene of the Siwalik Range (Tro-

fimov, 1951) is distinguished from the specimen from the Khapry locality by a shorter tooth row P₂-M₃ (102 mm) and a higher ratio between the length of pre-molars P₂-P₄ and the length of the molars (88%).

In *Microstonyx major* from the Grebeniky locality, the teeth are larger than those in the form from the Khapry locality. The labial and lingual cusps and the supplementary cusp located posterolaterally to the lingual cusp are well developed on P₄ of *Microstonyx major*, whereas in the specimens from the Azov Region, they are not observed. In *Microstonyx major*, the ratio between the length of the premolar row and the molar row is 55%.

The specimen from the Khapry locality and *Microstonyx* are similar in the shape of the mandible and in the shape of the mandibular region behind M₃; however, in the first, the distance between the left and right horizontal jaw rami is greater than in *Microstonyx*; this is possibly a result of deformation.

The canines of *Microstonyx* are extremely small, the cross section is 11.0-13.0 mm long and 7.6-8.0 mm wide.

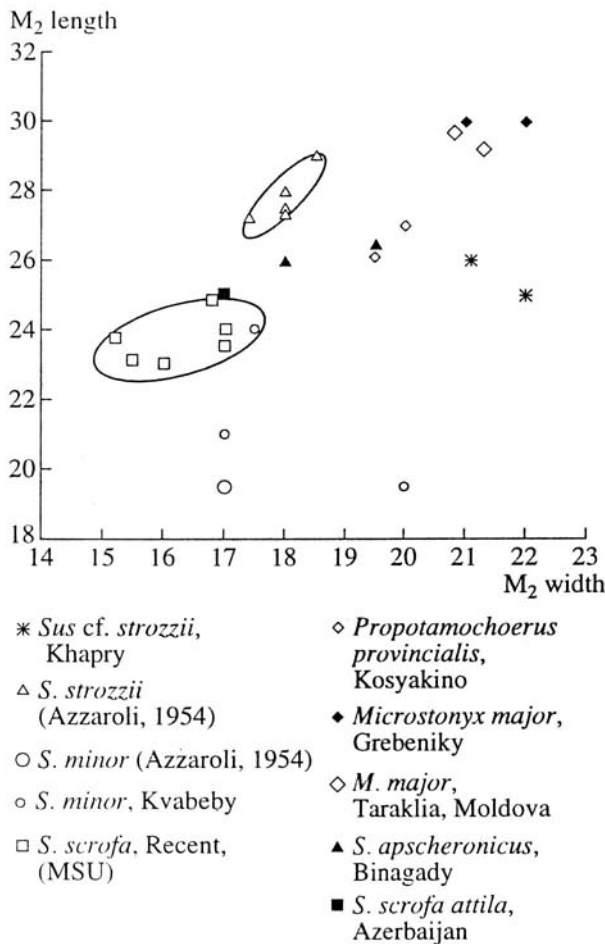


Fig. 6. The ratios between the parameters of the lower molars M_2 in some members of the subfamily Suinae.

The specimen from the Azov Region is distinguished from *Conohyus* by larger size, strongly wrinkled enamel, and a small difference in the width of the anterior and posterior parts of the premolars and molars.

Warthogs (*Phacochoerus*) are distinguished by the tooth formula and smaller teeth, the grinding surface of which consists of many columns. The arrangement and proportions of the main and supplementary cusps essentially differ from those of pigs. The canines of warthogs are smaller, narrower, and bear longitudinal enamel ribs, whereas the genus *Sus* is characterized by transverse ribs.

DISCUSSION

The finds of *Sus cf. strozzii* in the south of Eastern Europe substantially enlarge the range of *Sus strozzii*.

Opinions differ as to the predominant stratigraphic position of *S. strozzii*. This species was recorded in deposits aged zones MN16b to MQ20. Eisenmann *et al.* (1983) believe that *S. strozzii* is a typical compo-

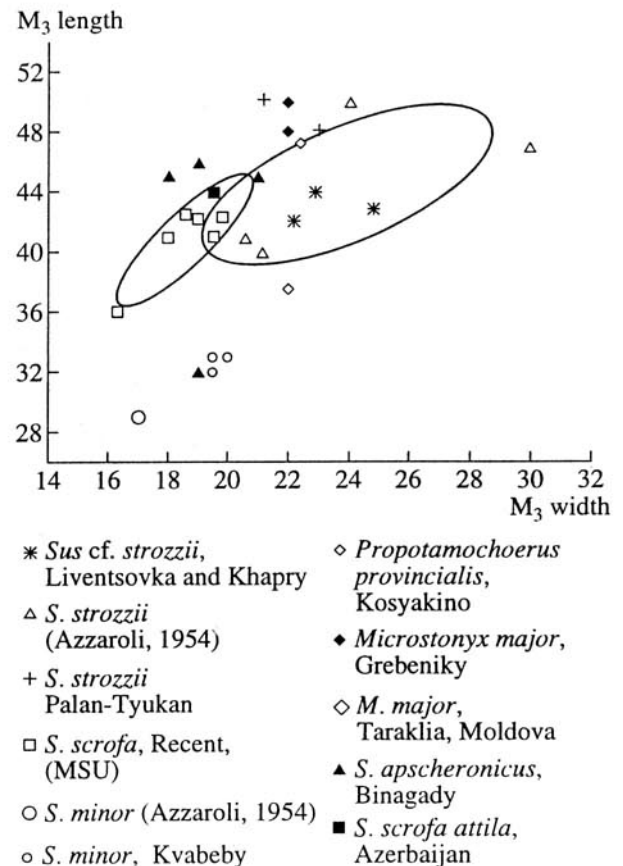


Fig. 7. The ratios between the parameters of the lower molars M_3 in some members of the subfamily Suinae.

nent of zone MQ19. Meon *et al.* (1979) assigned this species to zone MQ18. In the review by Torre *et al.* (1992), *S. strozzii* was considered to emerge at the beginning of MN17.

S. strozzii was recorded in the Valdeganga II (Spain), Damatria (Greece), Red Crag, and Nodule Bed (Great Britain) localities aged zone MN16b (Van der Made, 1989).

A fragmentary lower jaw of *S. cf. strozzii* containing P_2 and an upper incisor was found in the Late Pleistocene Bethlehem locality, Israel (Hooijer, 1958; Faure and Guerin, 1984). *S. strozzii* was also found in Quercia, Il Tasso, Olivola, Mugello (Italy), Seneze, Le Coupet (France), and in a number of small localities of France (such as Montevarchi, etc.) also aged zones MN17–MQ18.

This species was revealed in the Upper Villafranchian localities, such as Tegelene, Netherlands (Azzaroli, 1954); Gerkarou 1, Greece (Koufos, 1986); and Ubeidiya, Israel (Eisenmann *et al.*, 1983). It occurred in the Upper Valdarno locality (Italy) aged MQ19 (Faure and Guerin, 1984).

In Eastern Europe, *S. cf. strozzii* was recorded in the pebble talus in the Psekups River Valley (Northern Caucasus) and in the Palan-Tyukan locality (Transcaucasia, Azerbaijan) aged MN18 (Alekseeva, 1977; Sablin, 1990).

The composition of the fauna from the Khapry strata and other characteristics of the above-mentioned localities enable one to consider this species as a typical animal of the Late Pliocene (Middle Villafranchian) of Eastern Europe.

Taking into account the viewpoint of some researchers considering the Khapry Fauna as an earlier assemblage than "the Seneze Faunal Unit" (Torre *et al.*, 1992) and the assumption that the members of the genus *Sus* came to Eastern Europe from Asia in the Villafranchian (Alekseeva, 1977), one can propose that *Sus strozzii* appeared in Eastern Europe in the subzone MN16b or at the onset of zone MN17.

As cranial material is not available, there is no way to substantiate with certainty that the fossils from the Azov Region belonged to typical *S. strozzii* recorded in the Upper Valdarno, Seneze, and Olivola.

The members of the genus *Sus* are characterized by a wide range of geographical, population, and individual variation. This concerns Recent *S. scrofa* (Sokolov and Tembotov, 1993) and early species of this genus. Thus, the lower jaws and teeth of *S. strozzii* from the Upper Valdarno, Seneze, Olivola, Tegelene, and Valdeganga II vary in many characters, including the shape of the lower jaw, the extent of cusp development, the ratios between the measurements of teeth and tooth row, etc. (Azzaroli, 1954; Van der Made, 1989). This is probably attributable to evolutionary plasticity of this species of pig.

The main evolutionary trends characteristic of the tooth system of *Sus* are extension of the tooth row, especially the molar row, and shortening of the premolar row. The diagrams show that the lower jaw of the pig from the Azov Region is characterized by a progressive feature, extended molar row combined with the features characteristic of early forms (*S. apscheronicus*, *S. minor*, *Propotamochoerus provincialis*, and *Microstonyx major*), i.e., relatively large and wide crowns of P₃, P₄, M₁, and M₂. Recent pigs show the other tendency, the tooth row is extended by the extension of particular teeth rather than by a general increase in tooth size. *S. strozzii* from Western Europe is also characterized by extended teeth (except for P₄); however, this is developed to a lesser extent than in *S. scrofa*, *S. strozzii*, *S. scrofa*, *S. cf. strozzii* from the Khapry Assemblage; *Microstonyx*, and *Propotamochoerus* are especially similar in the parameters of the posterior molars, M₃. This is attributable to the fact that, in primitive pig forms, the molar row is extended mainly by an increase in the M₃ size or by a complication of the talonid of M₃.

P₄, M₁, and M₂ of *S. cf. strozzii* from the Azov Region are relatively shorter than those of Western

European *S. strozzii*; however, P₃ is relatively large. This is probably attributable to the fact that pigs from the Khapry Assemblage represented a transitional stage characterized by weakly reduced premolars, but increased M₃ similar to those in advanced forms. However, it is not inconceivable that the specimens from the Khapry deposits were primitive members of a lateral evolutionary branch of the lineage *S. minor*-*S. strozzii*.

The presumable habitats of *S. strozzii* were reconstructed on the basis of morphological comparisons with Recent pigs (Faure and Guerin, 1984). Late Pleistocene pigs inhabited alternating rarefied forests and meadows. *S. strozzii* dwelt under the conditions of greater humidity and higher temperatures than *S. scrofa* that are characterized by a propensity for semiarid conditions. This is corroborated by the composition of the Khapry Fauna indicating that, in the Late Pliocene of the Azov Region, forest-steppe landscapes prevailed, and vast steppe areas alternated with flood-plain and ravine forests (Baigusheva, 1971).

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