

## *Hypolagus brachygnathus* (Lagomorpha, Leporidae) from the Lower Pleistocene of the Taurida Cave in Crimea

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**Abstract**—Leporid fossils from the Lower Pleistocene deposits of the Taurida karstic cave discovered in 2018 in central Crimea (Zuya village, Belogorsk district) are referred to *Hypolagus brachygnathus* (Kormos, 1930). This species is characteristic of the interval from the early Pleistocene (late Villanyian, MN17) to the middle Pleistocene (latest Biharian, Q2) of Europe. It has not been previously observed in Crimea.

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In 2018, during the construction of the new federal Taurida Highway, a large karstic cave was discovered in Crimea, about 15 km east of Simferopol (Zuya village, Belogorsk district). In the cave, speleologists found a large number of vertebrate fossils. D. B. Startsev (Vernadsky Crimean Federal University), D. O. Gimranov (Institute of Plant and Animal Ecology, Ural Division, Russian Academy of Sciences), A. V. Lавrov, and K. K. Tarasenko (Borissiak Paleontological Institute, Russian Academy of Sciences, PIN) collected Pleistocene mammal and bird fossils, from which the main bone-bearing layers within the cave were dated to Early Pleistocene (1.8–1.5 Ma) [1].

Among the mammal fossils, there were jaw fragments, isolated teeth, and postcranial fragments of the hare *Hypolagus brachygnathus* (Kormos, 1930) [1].

*Hypolagus brachygnathus* is a medium-sized leporid, about the same size as the extant mountain hare *Lepus timidus* L., 1758 [2]. In Europe, this species is typical of the time interval from the early Pleistocene (late Villanyian, MN17) to the middle Pleistocene (latest Biharian, Q2) [3–5]; however, it has not been reported in Crimea previously [3, 6].

Below we describe the material referred to *H. brachygnathus* from the Taurida Cave. The terminology and dental morphotypes follow those in [2, 5, 7].

Order Lagomorpha Brandt, 1855

Family Leporidae Fischer von Waldheim, 1817

Subfamily Archaeolaginae Dice, 1929

Genus *Hypolagus* Dice, 1917

*Hypolagus brachygnathus* (Kormos, 1930)

*Lepus brachygnathus*: [8, p. 46].

*Hypolagus brachygnathus*: [9, p. 69].

*Hypolagus beremendensis brachygnathus*: [10, 11].

Neotype [2], MAFI (Geological Institute of Hungary, Budapest), no. Ob 3689, fragment of the left mandible with teeth; Hungary, Villány 3; Lower Pleistocene, upper Villanyian, MN17.

Description (Figs. 1–3). I<sup>1</sup> has a rounded ventral margin in cross-section, somewhat concave in the central part. The dorsal surface is dissected by a fairly wide V-shaped notch with a depth of about 21% of the dorsoventral length of the tooth. The labial lobe is rounded in outline, almost 1.5 times wider than the lingual lobe.

The unworn P<sup>2</sup> (Fig. 1) has a wide main anterior reentrant, the paraflexus (about 58% of the tooth length) and a mesoflexus that is approximately twice as short (lagicone morphotype B). The hypercone is somewhat concave, with a superficial hypoflexus (hypercone morphotype IV).

On the unworn P<sup>3</sup>–P<sup>4</sup> (Fig. 1), the hypostria length is approximately one-third of the width of the occlusal surface.

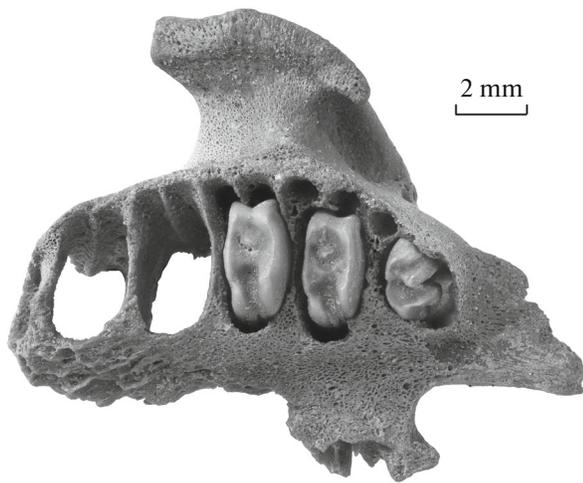
On the mandible (specimen PIN 5644/1, Fig. 2), the diastema length is somewhat greater than the alveolar length of the lower cheek tooth row, with the ratio of 105%. On the lingual surface, the alveolus of the lower incisor terminates posteriorly in line with the anterior margin of the alveolus of P<sub>3</sub>.

The occlusal surface of P<sub>3</sub> (Fig. 3) has the outline of a rounded trapezoid, with a deep hypoflexid and a moderate protoflexid. Anteroconid displays morphotype II, the anterior end raised, the anterolingual margin flattened, the anteroflexid absent, and the paraflexid not developed. The protoflexid wide, V-shaped, its depth about 20% of the total tooth width. The posterolingual side is very slightly concave, the occlusal

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**Fig. 1.** *Hypolagus brachygnathus* (Kormos, 1930), specimen PIN 5644/2, right maxilla fragment with P<sup>2</sup>–P<sup>4</sup> and alveoli of M<sup>1</sup>–M<sup>3</sup>; Taurida Cave, Crimea; Lower Pleistocene.

surface having a distinct nearly transversal depression in this region. The hypoconid is of morphotype d (with the rounded labial side), the depth of the hypoflexid is about 52% of the total tooth width; the hypoflexid is of morphotype D (the lingual part of the fold is wide, with a thick, somewhat crenulated enamel layer).

The hypoflexid on P<sub>4</sub>–M<sub>2</sub> (Fig. 3) with flat anterior and posterior margins, the lingual edge of the hypoflexid gently curved towards the anterior side of the tooth. The enamel on the posterior margin of the hypoflexid is very thin, the same as on the anterior margin of the trigonid.

Measurements in mm. The incisal surface of I<sup>1</sup>, 2.4 × 2.8 (specimen PIN 5644/4). Alveolar length P<sup>2</sup>–M<sup>2</sup>, 12.0 (specimen PIN 5644/2). The size of the upper cheek teeth (length × width): P<sup>2</sup>, 1.25 × 2.0; P<sup>3</sup>, 1.6 × 2.9; P<sup>4</sup>, 1.8 × 3.2 (specimen PIN 5644/2); P<sup>3</sup>, 1.5 × 2.9 (specimen PIN 5644/3).

Length of the mandibular diastema, 18.5; alveolar length P<sub>3</sub>–M<sub>3</sub>, 17.6; lingual depth of the mandible anterior to P<sub>3</sub>, 12.0; lingual depth behind M<sub>3</sub>, 15.3; incisal surface of I<sub>1</sub>, 4.2 × 3.2 (specimen PIN 5644/1).

Occlusal surface of the lower cheek teeth (length × width): P<sub>3</sub>, 3.4 × 3.5; P<sub>4</sub>, 3.3 × 3.7; M<sub>1</sub>, 3.5 × 3.8; M<sub>2</sub>, 3.3 × 3.5; alveolus of M<sub>3</sub> (length × width), 3.0 × 2.5 (specimen PIN 5644/1).

Maximum width of the distal end of the femur, 17.0. Maximum length of the tibia, 145.0, height of the tuberositas tibiae, 22.0, diaphysis width, 9.0, maximum mediolateral width of the distal end, 16.0.

Comparison and remarks. *H. brachygnathus* is characterized [2, 5] by the following dental and man-



**Fig. 2.** *Hypolagus brachygnathus* (Kormos, 1930), specimen PIN 5644/1, left mandible fragment with I<sub>1</sub>, P<sub>3</sub>–M<sub>2</sub> and alveolus of M<sub>3</sub> in labial, lingual and occlusal view (top to bottom); Taurida Cave, Crimea; Lower Pleistocene.

dibular characters: (1) P<sup>2</sup> with a simple enamel pattern, hypercone flattened or somewhat concave anteriorly (i.e., having a weakly developed hypoflexus, internal anterior reentrant), mesoflexus (external anterior reentrant) depth shallow or moderate (morphotypes III–IV predominate; morphotype B present); (2) length of the mandibular diastema is approximately equal to the alveolar length of the lower cheek tooth row (which makes up 95–105% of the alveolar length); P<sub>3</sub> elongated, (3a) trapezoid in outline, or (3b) triangular with an additional groove, or (3c) compact and rounded, with a flattened anterior margin; (4) P<sub>3</sub> protoflexid (anterior external reentrant) simple, deeper than in most Eurasian *Hypolagus* species, reaching up to 30% (usually 20–25%) of the width of the occlusal surface; (5) P<sub>3</sub> hypoflexid (posterior external reentrant) reaches up to 65% of the width of the occlusal surface; (6) P<sub>3</sub> anteroflexid (anterior reentrant) absent or, whenever present, forming a superficial depression; (7) P<sub>3</sub> paraflexid (anterior internal reentrant) shows as a wrinkle or a shallow groove (P<sub>3</sub> structure predominantly of morphotypes II–V and b–e). In its combination of characters 1 (morphotypes IV and B), 2, 3a, 4–7 (morphotypes II and d), as well as in its size, the described material from Crimea corresponds to *H. brachygnathus* and is distinguished from the other species of the genus. The

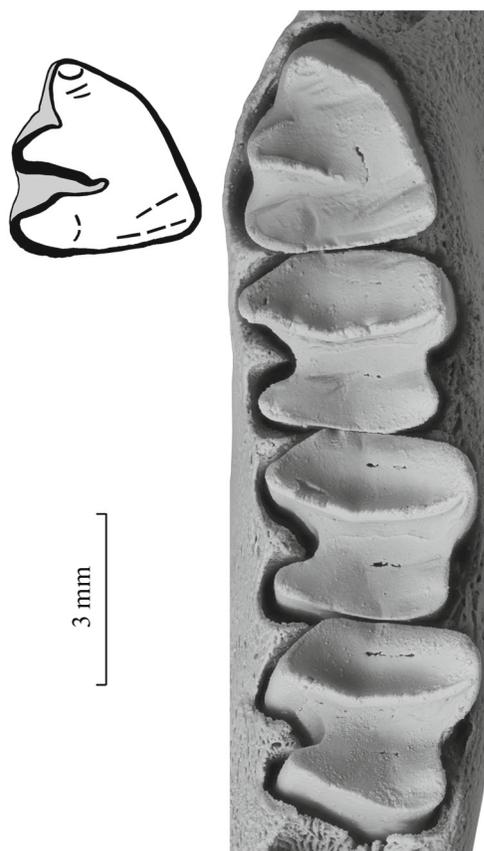


Fig. 3. *Hypolagus brachygnathus* (Kormos, 1930), specimen PIN 5644/1,  $P_3$ – $M_2$  and drawing of  $P_3$ ; Taurida Cave, Crimea; Lower Pleistocene.

mesoflexus on  $P^2$  appears extraordinarily deep because of the juvenile age of the specimen PIN 5644/2.

In the shape and structure of  $P_3$ , the Crimean form is identical to the neotype *H. brachygnathus* [5: Fig. 6, Aa] down to fine details (raised anterior end of the anteroconid and the presence of a nearly transversal depression at the posterolingual side of the occlusal surface).

*H. brachygnathus* typically has massive long bones, and their size in the Crimean material corresponds exactly to this species [2]. In general, the structure of limb bones in *Hypolagus* representatives shows adaptations to digging and running that are intermediate between rabbits of the genus *Oryctolagus* and hares of the genus *Lepus*; however, the Pleistocene *H. brachygnathus* exhibited a progressive adaptation to fast running [2, 10–12]. In the Pleistocene of Europe, *H. brachygnathus* coexisted with early members of the genus *Lepus*; competition may have been one of the reasons for the extinction of *Hypolagus* [9, 13].

Occurrence. Lower–Middle Pleistocene (MN17–Q2) of Europe.

Material. From the Taurida Cave, the right maxilla fragment with  $P^2$ – $P^4$  and alveoli of  $M^1$ – $M^3$  (specimen

PIN 5644/2); the right maxilla fragment with  $P^3$  and alveoli of  $P^4$ – $M^2$  (specimen PIN 5644/3); an isolated left  $I^1$  fragment (specimen PIN 5644/4); left mandible fragment with  $I_1$ ,  $P_3$ – $M_2$  and the alveolus of  $M_3$  (specimen PIN 5644/1); postcranial bones: isolated vertebrae, pelvic fragments, the proximal part of an ulna, the distal part of a femur, one complete tibia and four distal tibial fragments and more.

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#### COMPLIANCE WITH ETHICAL STANDARDS

The author declares that he have no conflict of interest. This article does not contain any studies involving animals or human participants performed by the author.

#### REFERENCES

1. Lopatin, A.V., Vislobokova, I.A., Lavrov, A.V., et al., *Dokl. Biol. Sci.*, 2019, vol. 485, no. 3, pp. 381–385.
2. Fostowicz-Frelik, L., *Ann. Zool.*, 2007, vol. 57, no. 3, pp. 541–590.
3. Averianov, A.O., *Paleontol. Zh.*, 2001, no. 2, pp. 84–92.
4. Maul, L., *Beitr. Geol. Thüringen.*, 2007, vol. 14, pp. 215–233.
5. Čermák, S., *Bull. Geosci.*, 2009, vol. 84, no. 3, pp. 497–524.
6. Averianov, A.O., *Tr. Zool. Inst. Ros. Akad. Nauk*, 1994, vol. 256, pp. 69–91.
7. Čermák, S., Angelone, C., and Sinitza, M.V., *Bull. Geosci.*, 2015, vol. 90, no. 2, pp. 431–451.
8. Kormos, T., *Allatani Közlemények*, 1930, vol. 27, pp. 40–62.
9. Kormos, T., *Allatani Közlemények*, 1934, vol. 31, pp. 65–78.
10. Fladerer, F.A. and Reiner, G., *Acta Zool. Cracov.*, 1996, vol. 39, no. 1, pp. 147–160.
11. Fostowicz-Frelik, L., *DEINSEA*, 2003, vol. 10, pp. 197–216.
12. Fladerer, F.A., *Beitr. Paläontol. Öster.*, 1984, vol. 11, pp. 71–148.
13. Sych, L., *Acta Zool. Cracov.*, 1965, vol. 10, no. 1, pp. 1–88.

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