

## REVIEW OF AFRICAN SPECIES OF THE GENUS *Pentodon* HOPE, 1837 (COLEOPTERA: SCARABAEIDAE: DYNASTINAE: PENTODONTINI)

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### ABSTRACT

For the last few decades, the genus *Pentodon* Hope, 1837 has been considered to be relatively well studied. However, research reports published in recent years, based on complex morphological analysis of adults, showed that this notion requires revision. After careful observation of morphological traits including the structure of male copulatory organs, African species of the genus *Pentodon* have been reevaluated. Seven taxa in this genus have been recorded so far from Africa, although the presence of two of them—*Pentodon bidens punctatus* (Villers, 1789) and *Pentodon bidens sulcifrons* Küster, 1848—needs to be confirmed with new data. The presence of the five remaining taxa has been documented in a credible manner and does not raise any doubts. Based on a diagnostic set of morphological traits and divergent structure of male copulatory organs, *Pentodon algerinus nubicus*, **new subspecies**, was identified from North Sudan. It occupies the southeastermost portion of the distribution of the species. The following report provides morphological descriptions of adults of all African taxa in addition to depicting the male genitalia. An identification key for the species and subspecies and a distributional checklist are also presented.

Key Words: rhinoceros beetles, morphology, distribution, new species, key, checklist

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### INTRODUCTION

The genus *Pentodon* Hope, 1837 is one of 14 Palearctic genera belonging to the tribe Pentodontini (Krell and Bezděk 2016). It is represented within the Palearctic by 26 species and subspecies distributed across a broad area ranging from France and Spain through the Mediterranean region and the shores of the Black Sea, the Middle East and Arabian Peninsula, southern Russia and Central Asia, as well as Mongolia and China. Individual species do occur further south, occupying enclaves in the northern part of the Oriental and Ethiopian regions. In Africa, the genus is represented by seven taxa of differing status and distribution. Remarks concerning particular taxa, as well as distributional data, were collected in the works of Endrődi (1969, 1974, 1985) and Baraud (1985). It might appear that after the publication of the above works that the genus *Pentodon* had been sufficiently well studied. The

recent works of Russian researchers (Abdurakhmanov *et al.* 2011; Shokhin 2015; Shokhin *et al.* 2016), however, which are based on traits hitherto insufficiently analyzed, demonstrated that this notion requires revision, especially in relation to isolated populations. Reassessment is also needed concerning the distribution of particular taxa, which is evidenced by new data from the Palearctic (Bunalski *et al.* 2015; Drumont and Dutto 2008; Drumont and Warzee 2000; Ziani *et al.* 2015) and Oriental regions (Abdel-Dayem *et al.* 2017; Drumont *et al.* 2010; Keith and Drumont 2004). In this paper, a review of the African species of the genus *Pentodon* Hope, 1837 is performed.

### MATERIAL AND METHODS

Morphological characteristics of adult specimens have been studied, including the parameres of the male aedeagus. Specimens of the genus *Pentodon*

stored in Polish entomological collections as well as in the first author's rich collection, deposited in the Department of Entomology and Environmental Protection at the University of Life Sciences, Poznań, have been analyzed. In total, over 240 specimens representing nearly all species herein discussed and a few affiliated taxa have been reviewed. The examined species come from various localities and demonstrate a wide range of morphological variability. They were compared against the original descriptions as well as descriptions and figures featured in the monographs of Endrődi (1969, 1974, 1985) and Baraud (1985). Only the analysis of *Pentodon algerinus tchadensis* Paulian was based solely on literature data.

The species distribution maps were created based on the data from the referenced publications. The images of *Pentodon a. algerinus* (Fuessly) and *Pentodon algerinus nubicus*, **new subspecies**, were captured with a Canon 60D camera with Canon EF 100-mm f/2.8L Macro IS USM lens and edited with the use of Helicon Focus 6.

The distribution of particular species within the area of Africa—from west to east—has also been provided, putting localities within given countries alphabetically. A key for identification of adults of African species of *Pentodon* as well as a distributional checklist are presented.

The newly described subspecies was labeled with red and yellow labels—red for holotype, yellow for paratypes. Each holotype and paratype label was provided with a sex symbol (♂ or ♀) and “det. M. Bunalski, 2019”.

## TAXONOMY

### Genus *Pentodon* Hope, 1837

**Morphology.** Body stout, moderately convex, of brown-black to black color. Head trapezoidal, distinctly punctured; frontoclypeal suture well delineated, with one or two tubercles. External edges of mandibles with lobate teeth. Pronotum quite wide, evenly convex, its lateral edges carinate. Elytron punctate, with four flat ridges. Propygidium with very weak stridulatory bands at the base. Pygidium punctate, semicircular or triangular in outline. Front tibia short and wide, external edge with three large teeth, sometimes with additional teeth in front of basal denticle. Middle and hind tibiae massive, terminated with two spurs. Tarsi rather small, with two straight claws. Sexual dimorphism weakly delineated—the male apical abdominal ventrite arcuately emarginate whereas the female one rounded.

*Pentodon algerinus algerinus* (Fuessly, 1778)  
(Figs. 1, 2)

*Scarabaeus algerinus* Fuessly 1778: 40.

*Pentodon puncticollis* Burmeister 1847: 104.

*Pentodon bispinosus* Küster 1852: 36.

*Pentodon balearicus* Kraatz 1882: 60.

*Heteronychus cribratellus* Fairmaire 1893: cxlvi.

**Morphology.** Length 17–24 mm. Body convex, nearly black, shiny. Clypeus densely, coarsely punctate, rounded; anterior edge equipped with two distinct teeth separated by an impression, lateral edges raised in a ridge-shaped manner (Fig. 1). Frontoclypeal suture raised, convex, with distinct tubercle in the middle. Frons slightly more densely punctate than clypeus; vertex smooth posteriorly. Pronotum with lateral carinae. Disc of pronotum densely and distinctly punctate, decreasing posteriorly. Punctures near anterior angles of pronotum overlapping, giving the appearance of faint wrinkles. Scutellar shield triangular, impunctate. Striae of elytra flat, outlined with deep punctures. Sutural stria broader, slightly impressed posteriorly. Interstriae distinctly, but not densely, punctate. Pygidium almost triangular, evenly convex, finely and densely punctate, less numerous toward apex.

**Male Genitalia.** Parameres seen from above widened in the middle and at apex (Fig. 2); in lateral view almost triangular, upper edge straight, apices curved downward, tooth at lower edge located almost in the middle.

**Distribution** (Fig. 5A). MOROCCO: North and central, south to the Sahara; ALGERIA: North and central, south to Tuggurt; TUNISIA: North and central, south of Naftah, Qibili and Jerba; LIBYA: Tripoli; EGYPT: Nile Valley from Alexandria to Aswan.

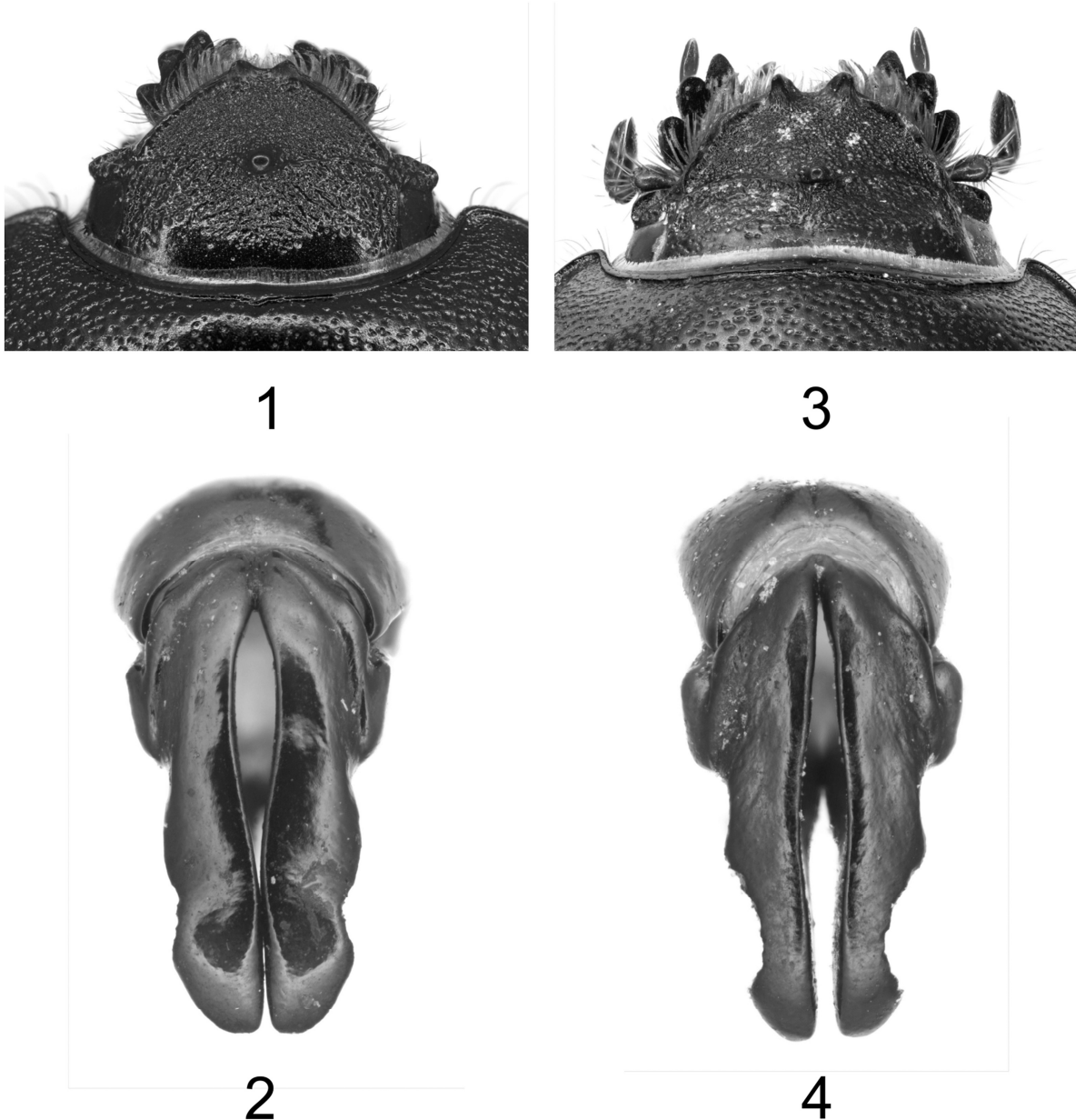
### *Pentodon algerinus nubicus* Bunalski and Śmiełowski, **new subspecies**

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(Figs. 3, 4)

**Type Locality.** Meroe near Dawab, Sudan.

**Type Material.** Holotype (male) and three paratypes (2 males and 1 female): SUDAN (Nubia) / Meroe ad Dawab / 16°57'N/33°47'E / 14 XI 2007 / leg. J. Śmiełowski. Paratype (1 female): SUDAN (Nubia) / Shemkhiya ad Abu Hamad / 19°27'N/32°58'E / 16 XI 2007 / leg. J. Śmiełowski. All specimens deposited in the collection of the Department of Entomology and Environmental Protection, University of Life Sciences, Poznań, Poland.

**Description of Holotype (Male).** Length 21 mm. Body moderately convex, brown-black, shiny. Clypeus semicircular, very finely and densely punctate, coarsely wrinkled; anterior edge equipped with two small teeth separated by an impression, lateral edges outlined by flat carina (Fig. 3). Frontoclypeal suture raised, convex, with distinct



**Figs. 1–4.** Diagnostic characters of *Pentodon algerinus*. 1–2) *P. a. algerinus*: 1) Dorsal view of head; 2) Dorsal view of parameres. 3–4) *P. a. nubicus*, **new subspecies**: 3) Dorsal view of head; 4) Dorsal view of parameres. Photos: T. Klejdysz.

tubercle in the middle. Frons slightly more densely punctate than clypeus; vertex smooth posteriorly. Pronotum with lateral carinae. Disc of pronotum finely, distinctly punctate, decreasing posteriorly. Punctures of anterolateral portions of pronotum overlapping, creating net-like wrinkles. Scutellar shield triangular, impunctate. Striae of elytra flat, outlined with flat punctures. Sutural stria narrow, not impressed posteriorly. Interstriae shallowly but distinctly punctured. Pygidium nearly triangular, strongly convex, finely and densely punctate, less numerous toward apex. Lateral parts in apical area with elongate indentations.

**Male Genitalia.** Parameres seen from above broadened in a tooth-shaped manner in the middle, then arcuately narrowed, and again weakly broadened toward the apex of parameres (Fig. 4); in lateral view almost triangular, the upper edge weakly concave in the middle, apices strongly curved downward, tooth at lower edge nearer to the base of parameres.

**Variability in Males.** The paratypes differ insignificantly in coloration and size, within the range of 19–21 mm. The pygidium of one of the males is equipped with a small, pointed tubercle.

**Sexual Dimorphism.** Similar to that in other species from the genus *Pentodon*.

**Distribution** (Fig. 5B). Northern Sudan, Nile region.

**Differential Diagnosis.** The new subspecies can be differentiated from *P. a. algerinus* using the following diagnostic characteristics: Clypeus very finely and densely punctured, much more finely than frons, its lateral edges with flat border (Fig. 2); punctures of the anterolateral part of pronotum overlapping, creating net-like wrinkles; sutural stria of elytron narrow and not impressed posteriorly; parameres of the aedeagus broadened in a tooth-shaped manner in the middle, then arcuately narrowed and weakly broadened at apex (Fig. 4).

**Etymology.** Derived from the name of the type locality, Nubia (Nile region, northern Sudan).

***Pentodon algerinus tchadensis* Paulian, 1954**

*Pentodon algerinus tchadensis* Paulian 1954: 1158.

**Morphology.** Length 18–22 mm. Body strongly convex, black and shiny. Clypeus rounded, densely and coarsely punctate; anterior edge equipped with two distinct teeth separated by an impression, lateral edges outlined with carina. Frontoclypeal suture raised, convex, with distinct tubercle in the middle. Frons punctured more deeply and less densely than clypeus; vertex smooth posteriorly. Pronotum carinate along lateral edges. Disc of pronotum distinctly and moderately densely punctate, decreasing posteriorly. Punctures near anterolateral angles of pronotum denser and forming weakly wrinkled sculpturing. Scutellar shield triangular, impunctate. Striae of elytra flat, outlined with rows of punctures. Interstriae punctured shallowly but distinctly. Pygidium semicircular, strongly convex, finely and densely punctate, less densely toward apex.

**Male Genitalia.** As in typical form.

**Distribution** (Fig. 5C). CHAD, ?SENEGAL.

**Note.** Endrődi (1974) recorded this species also from Senegal based on one individual specimen, claiming that the locality was doubtful.

***Pentodon bidens punctatus* (Villers, 1789)  
(Fig. 6)**

*Scarabaeus punctatus* Villers 1789: 40.

*Scarabaeus punctulatus* Rossi 1790: 9.

*Pentodon castaneus* Mulsant 1842: 384.

*Pentodon pimelioides* Costa 1853: 3.

*Pentodon testudinarius* Ragusa 1882: 279.

*Pentodon simplex* Depoli 1910: 306.

**Morphology.** Length 17–21 mm. Body strongly convex, black and shiny. Clypeus trapezoidal, densely and coarsely punctate; anterior edge equipped with two distinct teeth separated by a depression, lateral edges carinate. Frontoclypeal suture raised, with two tubercles separated from one another similarly to clypeal tubercles. Frons punctured similarly to clypeus; vertex smooth

posteriorly. Pronotum carinate along anterior and lateral edges. Disc of pronotum distinctly and not very densely punctate, denser toward anterior angles, decreasing in density posteriorly. Scutellar shield triangular, with a few punctures near apex. Striae of elytra weakly convex and very finely punctate, interstriae punctured quite densely and coarsely, fine punctation also present. Pygidium triangular, moderately convex, very dense and wrinkled punctation at the base, whereas punctures toward apex clearly less dense.

**Male Genitalia.** External edges of parameres almost straight and gradually narrowing toward apices; apices broadened, their posterolateral angles slightly acute (Fig. 6).

**Distribution** (Fig. 11D). MOROCCO: Tangier; ALGERIA.

**Note.** Recorded from Tangier by Endrődi (1969), although it has not been recorded from this area by other researchers. Data from Algeria also raise doubts and have not confirmed by specimens.

***Pentodon bidens sulcifrons* Küster, 1848**

*Pentodon sulcifrons* Küster 1848: 43.

*Pentodon xyphias* Baudi di Selve 1870: 78.

*Pentodon rugulosus* Reitter 1899: 35.

**Morphology.** Length 17–21 mm. Body strongly convex, black and shiny. Clypeus trapezoidal, very densely and coarsely punctate; anterior edge equipped with two distinct teeth separated by a broad depression, lateral edges outlined in a carina. Frontoclypeal suture raised, with two tubercles separated from one another by a lesser extent than clypeal tubercles. Frons punctured similarly to clypeus; vertex smooth posteriorly. Pronotum carinate along anterior and lateral edges. Disc of pronotum densely, distinctly punctate and wrinkled anteriorly, punctation decreasing posteriorly. Scutellar shield triangular, smooth. Striae of elytra almost flat and very finely punctate, interstriae quite densely and not coarsely punctate, fine punctation also present. Pygidium triangular, moderately convex, very densely punctate and wrinkled at the base, whereas punctures toward apex clearly less dense.

**Male Genitalia.** Parameres gradually narrowing from the base toward apex; apices broadened and evenly rounded (Fig. 7).

**Distribution** (Fig. 11E). ?EGYPT.

**Note.** Recorded vaguely from Egypt by Endrődi (1969). Considering its overly general published distribution, its distribution in North Africa requires confirmation.

***Pentodon idiota memnon* Jakovlev, 1902  
(Fig. 8)**

*Pentodon memnon* Jakovlev 1902: 271.

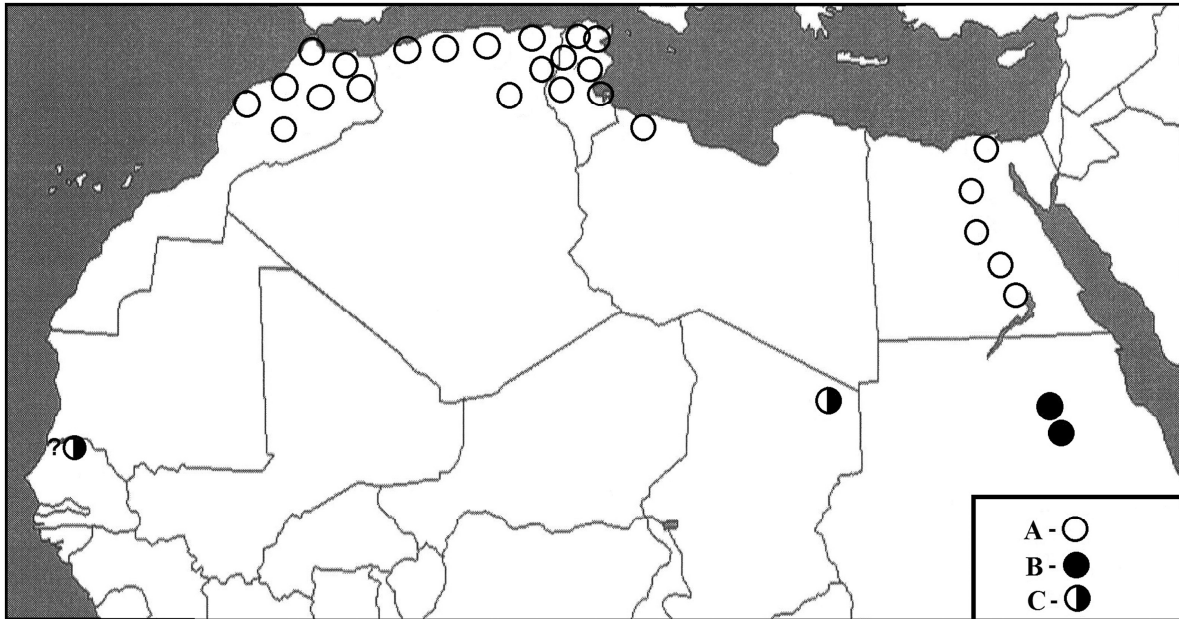


Fig. 5. Distribution of *Pentodon algerinus* in Africa. A) *P. a. algerinus*, B) *P. a. nubicus*, new subspecies, C) *P. a. tchadensis*.

**Morphology.** Length 17–21 mm. Body convex, black, and weakly shining. Clypeus trapezoidal, very densely and coarsely punctate; anterior edge is slightly thickened, without tubercles, lateral edges with delicate carina. Frontoclypeal suture raised, with blunt tubercle in the middle. Frons punctured more densely than clypeus; vertex smooth posteriorly. Pronotum carinate along anterior and lateral edges. Disc of pronotum distinctly punctate, densely punctate and wrinkled in the front, decreasing in density posteriorly. Scutellar shield triangular, with a few punctures near apex. Striae of elytra almost flat and very finely punctate, interstriae punctured shallowly and not densely. Elytra finely punctate, slightly dull. Pygidium triangular, moderately convex, densely punctate and wrinkled at the base, decreasing distinctly anteriorly.

**Male Genitalia.** Parameres distinctly narrowing toward apex; apices broadened and evenly rounded with plate-like ridges ventrally (Fig. 8).

**Distribution** (Fig. 11F). MOROCCO: Casablanca, Fes, Ifrane, Tangier; ALGERIA: Alger, Batna, Bou Saada, Ghardaia, Oran, Tazoult, Theniet el Had; TUNISIA: Al Fimanah, Al Kaf, Maksar, Oued Zarga, Tunis.

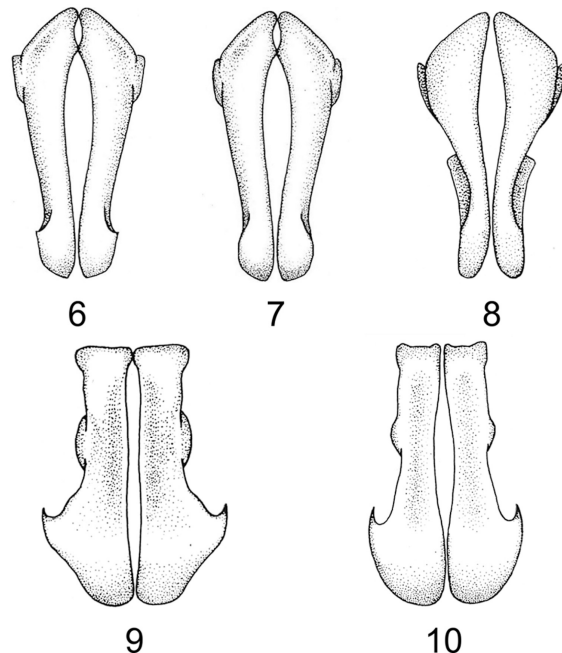
*Pentodon variolopunctatus deserti* (Heyden, 1900)  
(Fig. 9)

*Heteronychus deserti* Heyden 1900: 253.

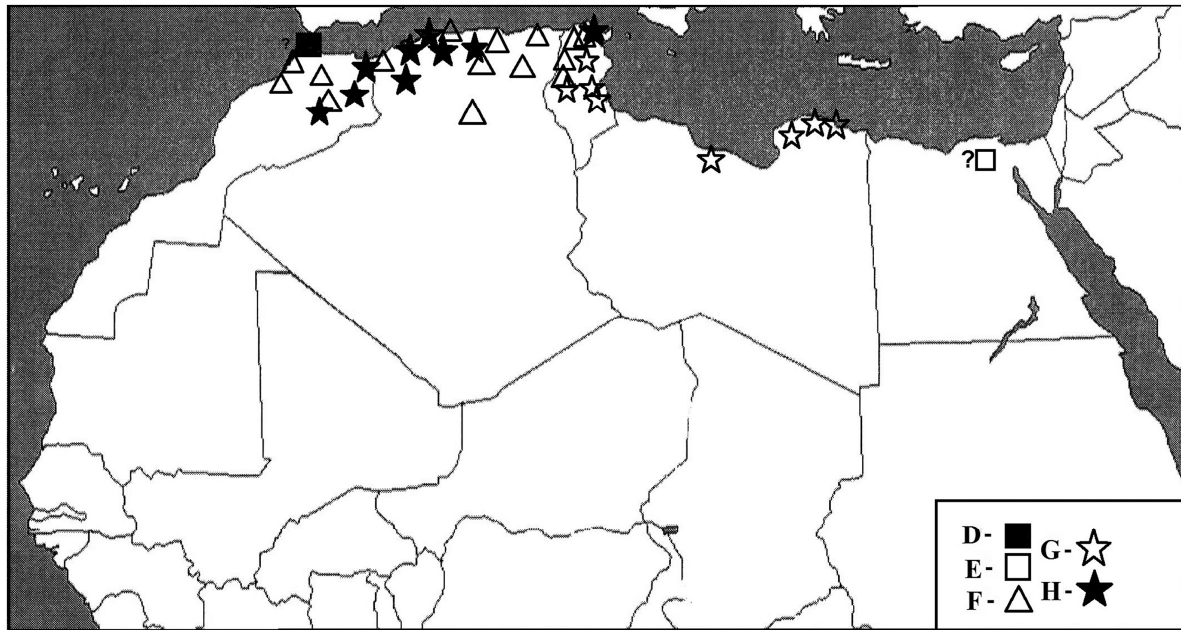
*Pentodon milini* Mikšić 1962: 23.

**Morphology.** Length 14–18 mm. Body strongly convex, black, and shiny. Clypeus triangular, densely and coarsely punctate; anterior edge equipped with two small teeth that are very

approximate, sometimes almost overlapping, lateral edges carinate. Frontoclypeal suture raised, with two approximate tubercles in the middle. Frons punctured similarly to clypeus; vertex smooth posteriorly. Pronotum carinate along anterior and lateral edges. Disc of pronotum distinctly punctate, densely punctate and wrinkled anteriorly, punctuation decreasing poste-



Figs. 6–10. Dorsal view of *Pentodon* parameres (modified from Baraud 1985). 6) *P. bidens punctatus*; 7) *P. bidens sulcifrons*; 8) *P. idiota memnon*; 9) *P. variolopunctatus deserti*; 10) *P. v. variolopunctatus*.



**Fig. 11.** Distribution of *Pentodon* species in Africa. D) *P. bidens punctatus*, E) *P. bidens sulcifrons*, F) *P. idiota memnon*, G) *P. variolopunctatus deserti*, H) *P. v. variolopunctatus*.

riorly. Front tibia with four external teeth—two apical teeth and, significantly separated from these, two teeth at tibial midlength; tibial spines well delineated. Scutellar shield triangular, smooth. Striae of elytra flat and very distinctly punctate, interstriae densely and deeply punctate, fine punctation also present. Pygidium triangular, moderately convex, with two tubercles anterior to middle; densely punctate and wrinkled anteriorly, distinctly less densely toward apex.

**Male Genitalia.** Parameres almost rhomboid at the base, broadened in a tubercle-shaped manner at midlength, apices strongly broadened triangularly and their posterolateral angles acutely extended backwards (Fig. 9).

**Distribution** (Fig. 11G). TUNISIA: El Hamma, Gabes, Gafsa, Thelepte; LIBYA: Al-Bajda, Bir al Gharbi, Darnah, Wadi Fruten; EGYPT: Cairo.

*Pentodon variolopunctatus variolopunctatus*  
Fairmaire, 1879  
(Fig. 10)

*Pentodon variolopunctatus* Fairmaire 1879: 172.  
*Pentodon pygidialis* Kraatz 1882: 61.

**Morphology.** Length 14–18 mm. Body strongly convex, black, and shiny. Clypeus triangular, very densely and coarsely punctate; anterior margin equipped with two distinct teeth that are very approximate, almost overlapping and creating one entity, lateral margins carinate. Frontoclypeal suture raised, with two approximate tubercles medially. Frons punctured similarly to clypeus; vertex smooth posteriorly. Pronotum carinate along anterior and lateral edges. Disc of

pronotum distinctly punctate, densely punctate and wrinkled anteriorly, punctation decreasing posteriorly. Front tibia with four external teeth—two apical teeth and, significantly separated from these, two teeth at tibial midlength; tibial spines poorly delineated. Scutellar shield triangular, smooth. Striae of elytra flat and distinctly punctate, interstriae densely punctate, fine punctation also present. Pygidium triangular, moderately convex, with two tubercles anterior to middle; densely punctate and wrinkled anteriorly, becoming less densely punctate toward apex.

**Male Genitalia.** Parameres almost rhomboid at the base, broadened in a tubercle-shaped manner at midlength, apices weakly broadened, their posterolateral angles acutely extended backwards (Fig. 10).

**Distribution** (Fig. 11H). MOROCCO: from Oujda and Berguent to Haut Atlas Mts.; ALGERIA: Ain Sefra, Bou Saada, Le Kreider, Oran, Theniet el Had; TUNISIA: Tunis.

**TAXONOMIC KEY TO AFRICAN *PENTODON***

1. Pygidium with two large subapical tubercles ..... 2
- 1'. Pygidium regularly convex, without tubercles ..... 3
2. External basal tooth of front tibia poorly developed; parameres as in Fig. 9 .....  
..... *P. variolopunctatus deserti* (Heyden)
- 2'. External basal tooth of front tibia clearly visible; parameres as in Fig. 10 .....  
..... *P. v. variolopunctatus* Fairmaire

3. Frontoclypeal suture with two tubercles ..... 4  
 3'. Frontoclypeal suture with one tubercle ..... 5  
 4. Teeth at apex of clypeus well developed and separated by deep emargination; parameres as in Fig. 7 ..... *P. bidens sulcifrons* Küster  
 4'. Teeth at apex of clypeus poorly developed and separated by shallow indentation; parameres as in Fig. 6 ..... *P. bidens punctatus* (Villers)  
 5. Apex of clypeus rounded and weakly raised; elytra weakly shining, with satin luster; parameres as in Fig. 8 ..... *P. idiota memnon* Jakovlev  
 5'. Apex of clypeus indented and equipped with two teeth; elytra shining ..... 6  
 6. Clypeus very finely and densely punctate, its lateral edges outlined with flat carina (Fig. 3); sutural stria of elytron narrow and not impressed posteriorly; parameres as in Fig. 4 ..... *P. algerinus nubicus* Bunalski and Śmiełowski, n. ssp.  
 6'. Clypeus more densely punctate, lateral edges with a ridge-shaped carina (Fig. 1); sutural stria broader, slightly impressed posteriorly; parameres as in Fig. 3 ..... 7  
 7. Populations from North Africa ..... *P. a. algerinus* (Fuessly)  
 7'. Populations from Chad and Senegal ..... *P. algerinus tchadensis* Paulian

DISTRIBUTIONAL CHECKLIST OF AFRICAN *PENTODON*

<i>Pentodon algerinus algerinus</i> (Fuessly, 1778)	N Morocco, N Algeria, N and C Tunisia, NW Libya
<i>Pentodon algerinus nubicus</i> Bunalski and Śmiełowski, n. ssp.	N Sudan
<i>Pentodon algerinus tchadensis</i> Paulian, 1954	NE Chad, ?Senegal
<i>Pentodon bidens punctatus</i> (Villers, 1789)	N Morocco
<i>Pentodon bidens sulcifrons</i> Küster, 1848	?Egypt
<i>Pentodon idiota memnon</i> Jakovlev, 1902	?N Morocco, ?N Algeria, W Tunisia
<i>Pentodon variolopunctatus deserti</i> (Heyden, 1900)	N and C Tunisia, NE Libya
<i>Pentodon variolopunctatus variolopunctatus</i> Fairmaire, 1879	NE Morocco, NW Algeria, N Tunisia

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