

## Species of the subgenus *Bodilus* (genus *Aphodius*) from Russia and adjacent countries (Coleoptera: Scarabaeidae)

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Species of the subgenus *Bodilus* Mulsant & Rey (genus *Aphodius*) from Russia and adjacent countries are reviewed and keyed. Two new species are described: *A. zarudnyi* sp. n. (Iran) and *A. inylchekensis* sp. n. (Kirgizia). Three new synonymies are established: *Bodilus* Mulsant & Rey, 1869 = *Paramelinopterus* Rakovič, 1984, syn. n., *A. lugens* Creutzer, 1799 = *A. apiceopacus* Petrovitz, 1959, syn. n., *A. punctipennis* Erichson, 1848 = *A. vartiani* Petrovitz, 1965, syn. n.

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In the material of *Aphodius* from the collection of the Zoological Institute (St. Petersburg), I found two species of the subgenus *Bodilus* that proved to be new. The goal of the present paper is to describe the new species and clarify the structure and diagnosis of the subgenus *Bodilus*. Since the *Aphodius* fauna of Russia and adjacent countries is still poorly studied and there is no comprehensive revision of the subgenus *Bodilus*, a key and notes on distribution of the *Bodilus* species inhabiting this area are given.

The material examined, including type specimens, is deposited at the Zoological Institute, St.Petersburg, unless indicated otherwise. Author's remarks to labels are in square brackets.

Subgenus ***Bodilus*** Mulsant & Rey, 1869

= subg. *Paramelinopterus* Rakovič, 1984, syn. n.

Type species: *A. lugens* Creutzer, 1799 (designated by Reitter, 1892).

*Description.* Length 4.0-8.5 mm. Head and pronotum shiny, brown to dark brown on disc with fore angles or sides lighter; in some species, pronotum yellowish brown with dark brown macula in center, or pronotum entirely yellowish brown. Clypeus feebly sinuate at middle, rounded at sides; head more or less densely punctate, not rugose or granulate. Frontal suture with

tubercles or not. Sides and base of pronotum bordered, hind angles obtusely rounded. Scutellum triangular, shiny, punctate in basal part. Elytra yellowish brown, shiny or shagreened, more or less pubescent; striae fine, punctate (in ♂ of *A. zarudnyi* sp. n. striae wider and matt, impunctate); elytral intervals flat or slightly convex. Fore tibiae of ♂ with spur located opposite medial to basal outer tooth; in some species, spur short and apical outer tooth of tibia with brush of dense setae on ventral side. Apical spurs of middle tibia slender and acute; lower spur longer than 2/3 of upper. Adjoining apical setae of hind tibiae of equal length, except for some outermost, or unequal. Ventral surface of body brown; legs slightly lighter. Disc of metasternum flat, more or less pubescent in both sexes. Width of eye in ventral view approximately equal to 2 minimum intervals between eye and gula. Aedeagus with long basal sclerite, therefore it is comparatively larger than in most other *Aphodius* subgenera (length of aedeagus up to 35% length of body in *A. gregarius* Harold). Apices of parameres more or less rounded in lateral view, rarely acute.

Sexual dimorphism, additional to shape of fore tibia and its spur, as follows: male with wider pronotum, sparser punctures on pronotum and head, denser pubescence of elytra and disc of metasternum, more pronounced tubercles on fron-

tal suture. In ♂ of *A. zarudnyi* sp. n., surface of genae and pronotum, except for disc, with distinct setae.

*Note.* The synonymy of *Paramelinopterus* is discussed under *A. insperatus*.

#### Key to the *Bodilus* species from Russia and adjacent countries

1. Hind tarsi longer than hind tibiae. Head not tuberculate or with traces of tubercles. Pronotum light brown with dark macula in middle; macula occupies less than half the area of pronotum, its margin more or less distinct (Fig. 3) (except for *A. inylchekensis* sp. n., where some specimens have pronotum dark brown with yellowish brown sides (Fig. 1)) . . . . . 2
  - Hind tarsi shorter than or as long as hind tibiae. Head tuberculate in ♂, with distinct traces of tubercles in ♀. Pronotum brown to dark brown with lighter fore angles or sides; if pronotum with dark macula in middle, the macula occupies more than half the area of pronotum and its margins indistinct (Fig. 4) . . . . . 7
2. Apical tooth of fore tibia of ♂ with brush of dense setae on ventral side (Fig. 5, 6). Elytra entirely pubescent with dense setae in ♂ and sparser ones in ♀ (except for *A. insperatus*, which has elytral disc with sparse setae in ♂ and glabrous in ♀) . . . . . 3
  - Apical tooth of fore tibia of ♂ without brush of dense setae on ventral side. Elytral disc glabrous . . . . . 5
3. Elytra with dense setae in ♂ and with sparser but distinct setae in ♀ . . . . . 4
  - Elytral disc with sparse setae in ♂ and glabrous in ♀. Aedeagus as in Fig. 10 . . . . . *A. insperatus* Petrovitz
4. Apices of parameres curved upwards (Fig. 11) . . . . .
  - Apices of parameres not curved upwards (Fig. 12) . . . . . *A. rudii* Endroedi
  - . . . . . *A. gregarius* Harold
5. Fore tibial spur of ♂ attached opposite basal tooth of tibia; apical tooth of fore tibia acute (Figs 8, 9) . . . . 6
  - Fore tibial spur of ♂ attached opposite middle tooth of tibia; apical tooth of fore tibia widened (Fig. 7). Aedeagus as in Fig. 13 . . . . . *A. hastatus* Reitter
6. Inner margin of fore tibia of ♂ more or less convex (Fig. 8). Head and disc of pronotum dark brown. Aedeagus as in Fig. 14. . . . . *A. inylchekensis* sp. n.
  - Inner margin of fore tibia of ♂ straight or slightly concave (Fig. 9). Head and disc of pronotum light brown. Aedeagus as in Fig. 15 . . . . . *A. sordescens* Harold
7. Elytral intervals densely punctate and entirely pubescent with dense, long setae in ♂ and sparser, shorter setae in ♀ . . . . . 8
  - Elytral intervals sparsely punctate; elytral disc glabrous . . . . . 9
8. Elytral striae fine and shiny, distinctly punctate (diameter of punctures greater than width of striae). Surface of pronotum glabrous or with minute setae on sides. Aedeagus as in Fig. 16 . . . . .
  - Elytral striae of ♂ wider and matt, almost impunctate. Sides and base of pronotum of ♂ with distinct setae

- (setae may be abraded in some specimens). Aedeagus as in Fig. 17 . . . . . *A. zarudnyi* sp. n.
- 9. Smaller (4.0-5.5 mm). Apices of parameres broadly rounded in lateral view (Fig. 18) . . . . . *A. ictericus* (Laicharting)
- Longer (6.0-8.0 mm). Parameres of different shape. . . . 10
- 10. Frontal suture with 3 tubercles in ♂. Apices of parameres narrow in lateral view (Fig. 19). Central Asia (up to Altai Mts. in west) . . . . *A. longeciliatus* Reitter
- Frontal suture with central tubercle in ♂. Apices of parameres wide in lateral view (Fig. 20). Europe, Fore and Middle Asia (up to SW Kazakhstan in east) . . . . . *A. lugens* Creutzer

#### *Aphodius* (*Bodilus*) *longeciliatus* Reitter, 1887 (Fig. 19)

Central Asian species. In the collection of the Zoological Institute, there are specimens from the almost entire territory of Mongolia and from China (Burhan Budai Shan Mts. in Qinghai, Alashan Desert in Nei Mongol autonomous region). This species is most similar to *A. lugens* and can be separated from it by the paramere shape, stronger frontal tubercles, smaller average size, more convex body, and reddish colour.

Unfortunately, I could not examine the type of *A. crassus* A. Schmidt, described from northern Mongolia, but all the characters mentioned in the original description (Schmidt, 1916) completely fit the limits of variability of *A. longeciliatus*.

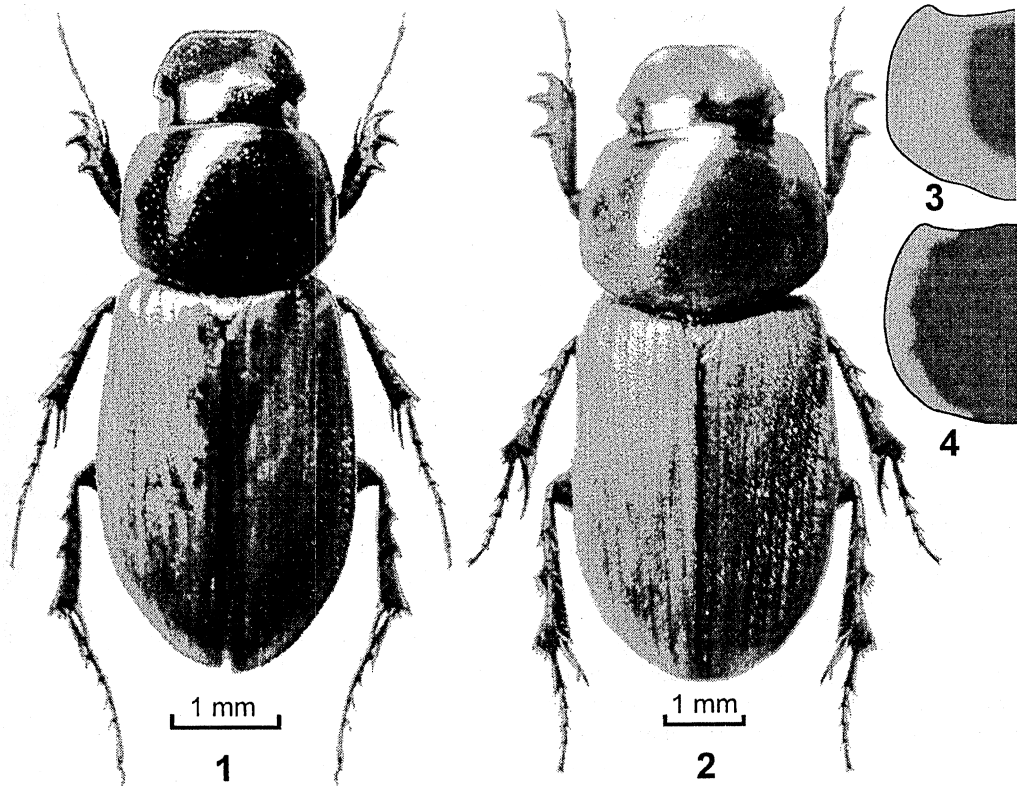
#### *Aphodius* (*Bodilus*) *lugens* Creutzer, 1799 (Figs 4, 20)

= *A. apiceopacus* Petrovitz, 1959, *syn. n.*

This species is widely distributed in the western Palaearctic Region, extending to eastern Kazakhstan in the northeast and the Tien Shan Mts. in the southeast. It can be easily separated from other species of the subgenus *Bodilus* by the shape of the parameres and relatively large size.

#### *Aphodius* (*Bodilus*) *ictericus* (Laicharting, 1781) (Fig. 18)

This species is widely distributed in the western Palaearctic Region, and its natural habitat includes entire Europe, Northern Africa, Asia Minor, Iran, Transcaucasia, northern Kazakhstan, and South Siberia. It can be separated from other *Bodilus* species by its smaller size and the shape of the parameres.



Figs 1-4. *Aphodius*. 1, 2, habitus, ♂: 1, *A. inylchekensis* sp. n.; 2, *A. zarudnyi* sp. n.; 3, 4, pronotum: 3, *A. gregarius*; 4, *A. lugens*.

***Aphodius (Bodilus) punctipennis* Erichson, 1848**  
(Fig. 16)

= *A. vartiani* Petrovitz, 1965, syn. n.

This species is distributed in southeastern Europe, Middle Asia, Iran, Afghanistan, southern Kazakhstan up to the Dzhungar Mts. in the northeast. In the collection of the Zoological Institute there are specimens from Russia (Stavropol Terr., Rostov, Volgograd, Astrakhan' provinces, Dagestan), Ukraine (Crimea, Poltava Prov.), Azerbaijan (Zuvant), Turkmenistan (Kara-Kala, Karlyuk, Ashkhabad), Uzbekistan (Kashkadar'ya and Surkhandar'ya provinces), Kazakhstan (Karaganda, Ural'sk, Aktyubinsk, Dzhabul, Akmola, Kzyl-Orda, and Alma-Ata provinces). The species is most similar to *A. zarudnyi* sp. n., and can be separated from it by the shape of aedeagus, glabrous surface of pronotum (only minute setae can be found on fore angles) and shiny elytral striae in males, and by the smaller average size and darker colour.

***Aphodius (Bodilus) zarudnyi* sp. n.**  
(Figs 2, 17)

*Type material.* Holotype ♂ labelled "Kerman: str. Sargad, 1.V.1901. N. Zarudnyi [in Cyrillic letters]". Paratypes: 6 ♂ and 11 ♀ with same data; ♂ with same data, but collected 5-6.V.1901; ♂ labelled "Persia, Vost. Khorasan, s. Charakhs, 25.IV.1898, N.A. Zarudnyi [in Cyrillic letters]"; 3 ♂ and 2 ♀ labelled "Persia, Vost. Khorasan, s. Avaz, 28.IV.1898, N.A. Zarudnyi [in Cyrillic letters]".

*Holotype.* Male. Head light brown, shiny, frons slightly darker than clypeus. Clypeus sparsely punctate (punctures separated by 3-4 times a puncture diameter), feebly sinuate at middle, rounded at sides. Frontal suture with central tubercle. Genae rectangular, protruding beyond eyes. Surface of head pubescent with minute, indistinct setae, except for genae, which are with distinct, relatively long setae. Pronotum brown on disc with sides and base lighter, shiny, densely, regularly punctate (punctures separated by 1-2 times a puncture diameter on disc, becoming

denser on sides). Surface of pronotum, except for disc, with distinct setae. Anterior margin of pronotum not bordered; sides and base finely bordered; hind angles obtuse. Scutellum triangular, light brown, finely punctate, pubescent in basal part. Elytra yellowish brown, without humeral teeth. Intervals flat, moderately shiny, densely punctate, uniformly pubescent with dense, long setae. Striae relatively wide, matter than intervals, almost impunctate. Apical spur of fore tibia relatively short and wide, curved downward, attached opposite middle tibial tooth. Apical spurs of middle tibia slender and acute; lower spur longer than 2/3 of upper. First segment of hind tarsi shorter than upper spur of tibia and nearly as long as 3 following segments together. Adjoining apical setae of hind tibiae of equal length, except for some outermost. Venter of body yellowish brown. Disc of metasternum flat, almost entirely pubescent with dense long setae. Apices of parameres dilated and flat, slightly curved downward (Fig. 14). Body length 8.5 mm.

*Female* can be separated from male by the narrower pronotum, denser punctures on pronotum and head, glabrous surface of pronotum and head, shorter and sparser setae on elytra, thinner shiny striae with distinct punctures, and smaller frontal tubercles.

*Paratypes.* Body length 7.0 to 8.0 mm. Pubescence of surface of pronotum and genae sparser in some specimens: only sides of pronotum possess distinct setae.

*Differential diagnosis.* The species is most similar to the widely distributed *A. punctipennis* and can be reliably separated from it only by the characters pronounced in males: more pubescent body (well visible, relatively long setae on the perimeter of pronotum and on the genae; longer setae on the elytra), wider elytral striae (they are matt, indistinctly punctate). The new species differs from *A. punctipennis* in the larger average size and lighter colour.

*Etymology.* The species is named in honor of N.A. Zarudny, who led (on behalf of Russian Geographical Society) several expeditions to Iran at the end of the nineteenth and beginning of the twentieth centuries, and who gathered vast entomological collections, including the type series of the new species.

*Distribution.* Known from south-eastern (Serkhed upland region) and north-eastern

(Zirkukh Mts.) Iran. This species is probably distributed throughout eastern Iran and replaces *A. punctipennis* there.

***Aphodius (Bodilus) sordescens* Harold, 1869**  
(Figs 9, 15)

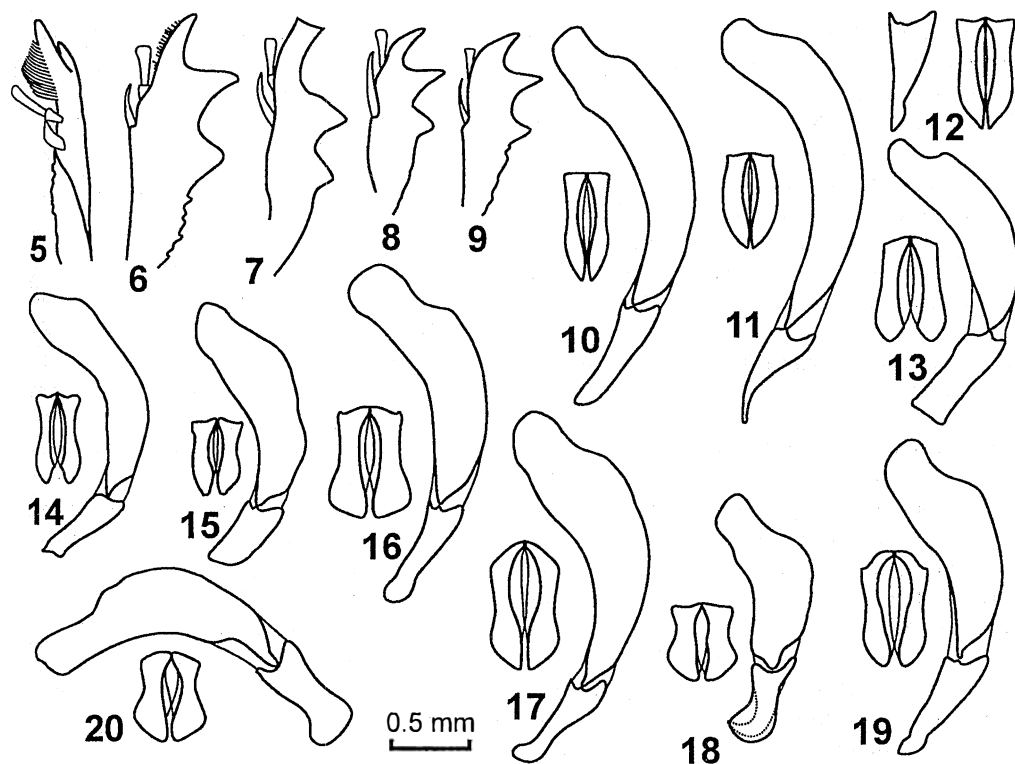
The species is widely distributed in Central Asia, extending to north-eastern Kazakhstan in the northwest and the Kunlun mountains in the southwest. It is known from all the territory of Mongolia and from adjacent regions of South Siberia. In the collection of Zoological Institute, there are also specimens from China (Alashan desert, Burhan Budai Shan Mts., Karasai, Shargoldzhin River valley in Nan-Shan, Langzhou). This species is most similar to *A. inylchekensis* sp. n. and can be separated from it by the colour of head and pronotum, sparser and shorter setae on elytra, and paramere shape.

***Aphodius (Bodilus) inylchekensis* sp. n.**  
(Figs 1, 8, 14)

*Holotype.* ♂, Kirgizstan, 5 km S of Inylchek, 2100 m, 5-10.VIII.1994, leg. Saldaitis.

*Paratypes.* Kirgizstan: 2 ♂ and 1 ♀ with the same data as holotype; 1 ♂ and 1 ♀, E lower Inylchek vall., 2600-2700 m, 22-25.VII.1989, Businsky.

*Holotype.* Male. Head dark brown, shiny, not tuberculate; frontal suture indistinct. Clypeus feebly sinuate at middle, rounded at sides, sparsely punctate (punctures separated by 2-3 times a puncture diameter). Genae rectangular, protruding beyond eyes. Pronotum brown on disc with sides and part of base lighter, shiny, densely, irregularly punctate. Anterior margin of pronotum not bordered; sides and base finely bordered; hind angles obtuse. Scutellum triangular, shiny, light brown, finely punctate. Elytra yellowish brown, shiny, without humeral teeth. Striae fine, distinctly punctate. Intervals flat, sparsely punctate. Elytra with long setae on apices and sides and with short, sparse setae on disc. Apical spur of fore tibia relatively slender and acute, attached opposite basal tibial tooth, reaching middle of second tarsal segment (Fig. 8). Apical spurs of middle tibia slender and acute; lower spur longer than 2/3 of upper. First segment of hind tarsi as long as upper spur of tibia and slightly shorter than 3 following segments together. Adjoining apical setae of hind tibiae relatively long and unequal. Venter of body brown. Disc of metasternum



Figs 5-20. *Aphodius*. 8, 14, *A. inylchekensis* sp. n.; 17, *A. zarudnyi* sp. n.; 5, 6, 12, *A. gregarius*; 7, 13, *A. hastatus*; 9, 15, *A. sordescens*; 10, *A. insperatus*; 11, *A. rudii*; 16, *A. punctipennis*; 18, *A. ictericus*; 19, *A. longeciliatus*; 20, *A. lugens*. 5-9, fore tibia, ♂ (5, medial view; 6-9, dorsal view); 10-20, parameres in dorsal view and aedeagus in lateral view (12, parameres in dorsal and lateral view).

num with sparse setae on the perimeter. Aedeagus as in Fig. 14. Body length 6.0 mm.

*Female* can be separated from male by the narrower pronotum, denser punctures on the pronotum and head, and shorter apical spur of the fore tibia, attached opposite the middle tibial tooth.

*Paratypes*. Body length 7.0 to 8.0 mm. Colour of pronotum varies slightly; one specimen with base of pronotum yellowish brown.

*Differential diagnosis*. The species is most similar to *A. sordescens*, which is widely distributed in Central Asia, and can be separated from it by the darker colour of the head and pronotum, longer and denser setae on the elytra, and the shape of the parameres.

*Etymology*. The name is derived from Inylchek Range in eastern Kirgizstan, where the type specimens were collected.

#### *Aphodius* (*Bodilus*) *hastatus* Reitter, 1892 (Figs 7, 13)

*Material examined*: holotype ♂ labelled "Buchara", "A. hastatus m. 1893"; ♂ labelled "Buchara", "Type", "A. hastatus Rtt." [not the name-bearing type]; Turkmenistan: Ashkhabad, 3 spm., Imam-Baba, 26.IV.1912, 13 spm. (W. Koshantschikov); Uzbekistan: 70 km S Tamdybulak, 14.V.1965, 1 spm. (G. Medvedev); Kazakhstan: Dzhambul.

This rare species can easily be separated from other *Bodilus* species by the widened apical tooth of the fore tibia in males.

#### *Aphodius* (*Bodilus*) *gregarius* Harold, 1871 (Figs 3, 5, 6, 12)

This species was described from Sarepta (outskirts of Volgograd) and is widely distributed in Kazakhstan and Middle Asia. In the collection of Zoological Institute, there are specimens from

Russia (Volga region), Kazakhstan (Gur'ev, Ural'sk, Aktyubinsk, Kzyl-Orda, Karaganda, Semipalatinsk, Alma-Ata and Taldy-Kurgan provinces), Mongolia (Gov'-Altaj, Bajanhongor, Hovd aimaks) and Xinjiang Uygur autonomous region of China (1 spm. from environs of Hami). The species was recorded from Pakistan (Swat, Rawalpindi) by Stebnicka (1989). However, judging from the figures of the aedeagus in her article, this reference belongs rather to *A. rudii* or to undescribed species.

***Aphodius (Bodilus) rudii*** Endroedi, 1968, sp. dist. (Fig. 11)

This species was described from Mongolia (Dornod aimak). It is distributed throughout Central Asia and to NE Tibet. I have examined numerous specimens from Mongolia (Dornod, Uverhangaj, Umnegov, Bajanhongor aimaks) and northern China (Xinjiang Uygur and Nei Mongol autonomous regions).

Nikolajev and Puntsagdulam (1984) considered *A. rudii* a junior synonym of *A. gregarius*. However, there is a clear difference in the paramere shape between the two species. *A. rudii* can also be separated from *A. gregarius* by its smaller average size. Females are difficult to separate.

***Aphodius (Bodilus) insperatus*** Petrovitz, 1967 (Fig. 10)

The species was described from Pakistan (Kwetta). I have examined the holotype (♂) and the paratype (♀) deposited in Naturhistorisches Museum Wien and the following material from Iran (collected by N.A. Zarudny): East Horasan, Avaz, 26-29.IV.1898, ♂; Mazenderan, Bender-Gez, 14.IX.1903, ♂; Sistan, Serkhed upland region, Noukabad, 1.IV.1901, ♂ and ♀. The species is similar to *A. gregarius* and *A. rudii* and can be separated from them by the sparser pubescence of the elytra and the shape of the parameres.

Rakovič (1984) described *A. longipennis* from a male specimen from Afghanistan (Kalat-Mukur) and established the monotypic subgenus *Paramelinopterus* for it. It can be inferred from the original description of the species that it differs from *A. insperatus* only in the darker colour of head and pronotum, which may be within the limits of variation of one species. Unfortunately,

I could not examine the type of the species, but it undoubtedly shares all the characters of the subgenus *Bodilus* (group *gregarius*), and there seems to be no reasons to establish a separate subgenus for it. Therefore, the new synonymy (*Bodilus* Mulsant & Rey, 1869 = *Paramelinopterus* Rakovič, 1984) is here established.

## Discussion

Although species involved constitute a monophyletic group, the subgenus is not homogeneous. According to morphological characters of species involved, they can be grouped into a few groups: (1) group *lugens*: *A. lugens*, *A. longeciliatus*, *A. ictericus*; (2) group *punctipennis*: *A. punctipennis*, *A. zarudnyi* sp. n.; (3) group *sordescens*: *A. sordescens*, *A. inylchekensis* sp. n., *A. hastatus*; and (4) group *gregarius*: *A. gregarius*, *A. insperatus*, *A. rudii*.

From examination of these species, some preliminary conclusions about the phylogeny of the subgenus can be made. If one consider the modification of fore tibia and its spur in the male (characters of sexual dimorphism, which are found in different variations in many *Aphodius* species) as an apomorphic state, and "normal" or "typical" state as plesiomorphic, the ancestral form of the group might be close to the recent species *A. longeciliatus*. During speciation, the ancestral form diverged in a few daughter lineages, corresponding here to groups of species. In *A. lugens* and *A. ictericus*, weakly deviated from the ancestral form, the apices of the parameres are widened in lateral aspect, therefore they lost their primordial dorso-ventral flatness. In the group *punctipennis*, which preserves the main characters of the ancestral form, including the shape of aedeagus, a comparatively denser pubescence of the body developed (especially on the elytra, disc of metasternum, and sides of pronotum). The third lineage includes the group *sordescens*, which is characterized by the lighter colour, distinct macula on the disc of pronotum, fore tibial spur attached opposite basal tooth of tibia in male, and by the not tuberculate head. The most deviated lineage includes the group *gregarius*, which is characterized by the features of the previous group, and additionally by some more specific characters expressed in males: fore tibiae with heavily shortened spur and brush of dense setae on ventral surface of apical tooth.

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