



Systematic review to the genus *Liothorax* (Coleoptera: Scarabaeoidea: Scarabaeidae: Aphodiinae)

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Abstract

The genus *Liothorax* Motschulsky, 1859 is herein reviewed and considered to consist of 10 species. A key to species and diagnoses of each species are given to facilitate identification. Based on the study of type material, *Aphodius bytinskisalzi* Petrovitz, 1971 is placed as a junior synonym of *A. isikdagensis* Balthasar, 1952 and *Aphodius nigroclavus* Hinton, 1934 is placed as a junior synonym of *A. levatus* Schmidt, 1907. A lectotype is designated for *A. levatus* Schmidt, 1907. The following new combinations are formulated: *Liothorax alternatus* (Horn, 1870), *Liothorax consociatus* (Horn, 1887), *Liothorax isikdagensis* (Balthasar, 1952), *Liothorax kraatzi* (Harold, 1868), *Liothorax levatus* (Schmidt, 1907), *Liothorax rusakovi* (Gusakov, 2004), and *Liothorax subaeneus* (LeConte, 1857).

Key words: Aphodiinae, *Liothorax*, *Nialus*, nomenclature, systematics, taxonomy, new synonymies, new combinations

Introduction

The genus *Liothorax* Motschulsky contains ten species that occur in the Palaearctic and Nearctic Regions. They are mainly characterized by the head with frontal suture not tuberculate, the pronotum without basal border, the scutellum small and pentagonal, and the hind tibiae fimbriate with apical spinules of equal length. *Liothorax* species are small (3.0 to 6.0 mm in length) and are apparently detritivores. Specimens are usually not found in dung, but are taken in association with wet habitats such as pond margins and marshy areas. North American and Palaearctic species of *Liothorax* have similar food and habitat requirements.

Liothorax was considered to be a subgenus within the genus *Aphodius* Illiger until recently when Dellacasa *et al.* (2001a) elevated all of the subgenera within *Aphodius* to the generic level. Although some more recent authors continue to consider *Liothorax* to be a subgenus of *Aphodius*, we choose to follow the classification of Dellacasa *et al.* (2001a) and treat *Liothorax* as a genus. In the past, the North American species of *Liothorax* were classified as “group F” of *Aphodius* (originating with Horn 1887). Gordon (1977) discussed the North American members of Horn’s “group F”, and concluded that they are most similar to Old World species now considered to be in the genus *Liothorax*. This is unusual because, in most cases, Western Hemisphere species assigned to Old World genera are not actually congeneric. The purpose of this paper is to redefine the systematics and nomenclature of the taxa in this group and formally place them in the genus *Liothorax*. This follows up recent nomenclatural and taxonomic changes in the subtribe Aphodiina.

Specimens from the type series of *Aphodius isikdagensis* (now *Liothorax isikdagensis*), *A. bytinskisalzi* (now a synonym of *Liothorax isikdagensis*), *A. nigroclavus* (now a synonym of *Liothorax levatus*), and *A. levatus* (now *Liothorax levatus*) were examined. All other species in the genus are well known and easily identifiable.

Stebnicka (1985) described the species *Aphodius (Nialus) cobharensis* Stebnicka and hypothesized that it is closely related to *Liothorax kraatzi*. *Aphodius cobharensis* was later placed in synonymy with *Nialus jhavanicus* Balthasar (Stebnicka 1986). We examined type material of *Aphodius cobharensis* and *A. jhavanicus* and confirm the synonymy and placement of this species in the genus *Nialus* based on morphological characters.

Specimens examined

The material examined is preserved in the following collections:

- American Museum of Natural History, New York, NY, U.S.A. (AMNH)
- Canadian National Collection of Insects, Ottawa, Canada (CNCI)
- Dellacasa Collection, Genoa, Italy (DCG)
- Gordon Collection, Willow City, ND, U.S.A. (GWC)
- Henry and Anne Howden Collection, Ottawa, Canada (HAHC)
- Humboldt-Universität, Museum für Naturkunde, Berlin, Germany (HUMNB)
- Institute of Systematics and Experimental Zoology, Krakov, Poland (ISEZ)
- Instituto de Ecología, Xalapa, Veracruz, Mexico (IEX)
- Museo di Storia Naturale e del Territorio, Calci, Pisa, Italy (MSNTP)
- Museum of Comparative Zoology, Harvard University, Cambridge, MA, U.S.A. (MCZC)
- Muséum d'Histoire Naturelle, Geneva, Switzerland (MHNG)
- Naturhistoriska Riksmuseet, Stockholm, Sweden (NRS)
- United States National Museum, Washington, D.C., U.S.A. (USNM)
- Zoologiceskii Muzei moskovskogo Universiteta, Moscow, Russia (ZMMUM)
- Zoologisches Staatssammlung, Munich, Germany (ZSM)

Genus *Liothorax* Motschulsky, 1859

Liothorax Motschulsky 1859: 156, Ádám 1994: 14, Dellacasa *et al.* 2001a: 169
Aphodius (Liothorax); Bedel 1911: 74, Dellacasa 1983: 276
Ataeniomorphus Balthasar 1952: 22, Stebnicka 1990: 897 (as a synonym of *Liothorax*)

Type species: The type species of *Liothorax* is *Scarabaeus plagiatus* Linné, 1767 by subsequent designation (Dellacasa 1983). The type species of *Ataeniomorphus* is *Aphodius isikdagensis* Balthasar, 1952 by original designation.

Diagnosis: Small or medium sized species (length 4.0–6.0 mm), convex, cylindrical, elongate, glabrous, shiny or dull. Black or piceous-black, rarely with red or yellow spotted elytra or completely red or yellow elytra; sometimes elytra with alternating yellow and black interstriae; rarely elytra black with lateral margins yellow. Head anteriomedially moderately gibbose, punctured; clypeus either feebly sinuate or non-sinuate medially, rounded laterally, with thin margin; clypeal margin glabrous or with short bristles laterally. Genae obtusely rounded, sparsely fimbriate, usually protruding beyond eyes; eyes small; frontal suture usually obsolete, sometimes distinctly impressed (at least laterally), rarely elevated laterally. Epipharynx widely rounded laterally, strongly sinuate at front margin; epitorma conical or subelliptical; corypha usually with short spiculae rounded apically; pedia with reduced prophobae and with several stout spinules evenly scattered; chaetopedia short, stout, rather sparse; apophobae sparse, evenly scattered; apotormae weak. Pronotum moderately convex, with dual or even punctures; base with or without margin. Scutellum small, pentagonal, with straight sides parallel basally or rarely with sides curved, narrowly cordiform. Elytra elongate, usually parallel-sided; striae distinct, crenulate or not; interstriae flat, rarely convex, usually sparsely punctate. Fore tibiae distally

tridentate and proximally serrulate at outer margin; upper side smooth or almost smooth. Middle and hind tibiae with strong transverse carinae on outer face, apically fimbriate with spinules short and equal. Pygidium with short, rather dense, recumbent setae; apical margin with dense, somewhat elongate setae. Aedeagus with elongate parameres, parameres rounded and membranous apically; membranes rugulose.

Sexual dimorphism: Males with head distinctly gibbose at middle, with less dense punctation on pronotal disc than females; fore tibiae with apical spur often stouter and inwardly curved or hooked apically in males.

Distribution: Palaearctic Region, Nearctic Region, and Mexico.

Key to species

- 1 North and Central American species 2
 - Palaearctic species 6
- 2 Base of pronotum without border 3
 - Base of pronotum with narrow but distinct border 4
- 3 Genae protruding beyond eyes (Fig. 54); second and fourth elytral interstriae usually roughly alutaceous, dull. Color black, clypeal margin and pronotum laterally red; pronotum with distinct aeneous tinge; elytra yellow, with irregular piceous stripes; elytra sometimes entirely black. Length 4.0–5.0 mm. Canada, U.S.A. *L. subaeneus* (LeConte)
 - Genae not protruding beyond eyes (Fig. 13); elytral interstriae entirely shiny. Color piceous, front angles of pronotum yellow, elytra piceous with humeral angle, sides, and apex yellow. Length 5.0–6.0 mm. U.S.A., Mexico *L. innexus* (Say)
- 4 Elytra elongate, subparallel-sided (Fig. 32), strongly convex, weakly shiny. Color piceous-black; clypeal margin, anterior angles of pronotum, and apex of elytra red. Length 5.0–5.5 mm. Mexico *L. levatus* (Schmidt)
 - Elytra moderately oblong and moderately convex with interstriae usually alternating dull and shiny, elytra rarely entirely shiny or entirely alutaceous 5
- 5 Pronotum with dual, coarse punctures (Fig. 8); all elytral interstriae finely alutaceous, with weak punctures; protibial apical spur, in males, slender and with abrupt apical hook directed inward. Color black; elytra yellow with first interstriae and sides widely piceous. Length 4.0–5.0 mm. U.S.A. (southern California) *L. consociatus* (Horn)
 - Pronotum evenly, finely, sparsely punctate (Fig. 1); elytral interstriae alternating dull and shiny, elytra rarely entirely alutaceous or entirely shiny. Color black; elytra with interstriae alternating yellow and piceous or elytra entirely yellow or piceous. Length 4.0–6.0 mm. Canada, U.S.A. .. *L. alternatus* (Horn)
- 6 Elytral interstriae narrow, very convex; pronotum with dual, sparse, irregular punctures (Fig. 26). Color black or piceous-black. Length 4.0–5.0 mm. Southeastern Europe, Asia Minor, Caucasus, Central Asia *L. kraatzi* (Harold)
 - Elytral interstriae wide, flat or weakly convex; pronotum with dual, dense, even punctures 7
- 7 Head with coarse punctures distally; scutellum with straight sides; elytra shiny, without metallic tinge; striae deep, with distinct punctures, strongly crenulate 8
 - Head with rugose, irregular punctures distally; scutellum suboval; elytral striae with fine, superficial punctures, feebly crenulate 9
- 8 Pronotum with strongly coarse and close punctures (Fig. 49); elytral interstriae feebly convex, with distinct punctures; metatibia with superior apical spur shorter than first tarsomere; protibial apical spur, in males, stout and strongly curved outwardly. Color shiny black. Length 4.5–5.5 mm. Russia, Ukraine, Kazakhstan *L. rusakovi* (Gusakov)
 - Pronotum with moderately coarse and moderately close punctures (Fig. 37); elytral interstriae almost flat, with superficial punctures; metatibia with superior apical spur about as long as first tarsomere; protibia

- with apical spur, in males, slender and feebly curved outwardly. Color black. Length 4.0–5.0 mm. Europe, Asia Minor, Central Asia, China (Tibet) *L. niger* (Illiger)
- 9 Epipleural carina faint at humeral angle; genae not auriculate; head and pronotum with sparser and moderately coarse punctures (Fig. 42); elytral interstriae faintly microreticulate, shiny; metatibia with superior apical spur slightly longer than first tarsomere, first tarsomere as long as following three combined. Color black; elytra with oblique red stripe (sometimes reduced to a small discal spot) or elytra entirely black with metallic tinge. Length 3.0–4.0 mm. Central and Southern Europe (except Italy), Tunisia, Israel, Jordan, Lebanon, Syria, Turkey, Iraq, Russia, Siberia, China *L. plagiatus* (Linné)
- Epipleural carina subdentiform at humeral angle; genae faintly auriculate; head and pronotum with denser and coarser punctures (Fig. 18); elytral interstriae distinctly microreticulate, dull; metatibia with superior apical spur slightly shorter than first tarsomere, first tarsomere as long as following two combined. Color black; elytra sometimes with irregular, yellow discal spot or entirely yellow or red. Length 3.5–5.0 mm. Greece, southeastern Turkey, Cyprus, Israel *L. isikdagensis* (Balthasar)

***Liothorax alternatus* (Horn, 1870), new combination**

(Figs. 1–7)

Aphodius alternatus: Horn 1870: 129, Horn 1887: 22, Gordon 1977: 164 (lectotype designation)

Aphodius (Volinus) alternatus: Schmidt 1913: 143, Schmidt 1922: 176; Hatch 1971: 454

Aphodius inermis: Robinson 1940: 147, Gordon 1977: 164 (as a synonym of *A. alternatus*), Dellacasa 1988: 236

Aphodius (Calamosternus) moclipsi: Hatch 1971: 457, Gordon 1977: 164 (as a synonym of *A. alternatus*), Dellacasa 1988: 335

Aphodius (Chilothorax) alternatus: Dellacasa 1988: 85

Type locality: California, U.S.A. (for *Liothorax alternatus*).

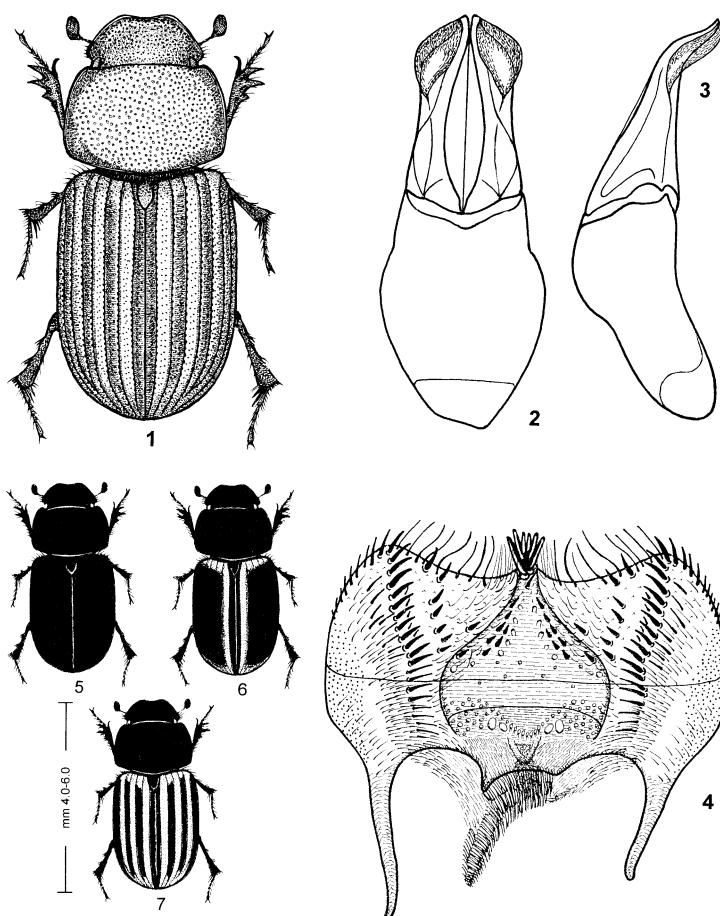
Type depository: Museum of Comparative Zoology, Harvard University, Cambridge, MA, U.S.A. (for *Liothorax alternatus*).

Redescription: Length 4.0–6.0 mm; body moderately elongate, convex, shiny, glabrous. Color black; clypeal margin red; pronotum with weak red coloration laterally, elytra with interstriae alternating yellow and black; legs reddish brown; antennal club piceous (Fig. 7); some individuals have black elytra with second interstria, basal and apical margins dark yellow (Fig. 6); some individuals have entirely black elytra (Fig. 5). Head anteriomedially moderately convex, with sparse, coarse, evenly spaced punctures; punctation more irregular, coarser distally. Clypeus weakly sinuate medially, widely rounded laterally, distinctly bordered; border weakly upturned; genae obtusely rounded with short setae, protruding beyond eyes; front with coarse, evenly spaced punctures. Pronotum moderately transverse with evenly spaced, moderately dense punctures; punctation denser laterally; lateral margins weakly arcuate with thin border; hind angles obtusely rounded; base arcuate with fine border, sometimes border obsolete medially. Scutellum weakly excavate, smooth, with fine punctures on basal half. Elytra almost parallel-sided; striae well defined with distinct punctures, subcrenulate; interstriae flat with irregular, distinct punctures. Hind tibiae with superior apical spur slightly longer than first tarsomere; first tarsomere longer than following two combined. Male fore tibiae with apical spur broad, evenly curved inward at apex; head and pronotum more transverse with less coarse, less dense punctures than in female. Female fore tibiae with apical spur evenly acuminate apically.

Distribution: Canada (British Columbia to Manitoba); U.S.A. (Washington to southern California, east to Michigan). In HAHC there is a specimen from Tacubaya (Mexico: Distrito Federal), 7.II.1974, Col. B. Kohlmann, ex coll. Martínez, “anegado alberca” [drowned in a cistern]. However, the identification of this specimen is doubtful because of it is a female and the pronotum has irregular, dual punctures instead of even punctures. Before we can state that this taxon occurs in Mexico, this collecting record needs to be confirmed with addition specimens.

Bionomy: This is a winter and early summer species, which is usually taken near margins of ponds and

streams. Specimens can be found around prairie sloughs and lakes either up on bordering vegetation or crawling on the ground (Gordon, personal observation). Larvae are sometimes found in golf turf (Hatch 1971) and are also observed on the surface of vernal pools and climbing on the stems of plants growing in the water (Rogers 1997). Massive congregations of this species are sometimes observed in flight.



FIGURES 1–7. *Liothorax alternatus* (Horn, 1870) (Salton Sea, California, U.S.A.): 1. habitus of male; 2–3. aedeagus, dorsal and lateral view; 4. epipharynx; 5–7. color variations.

***Liothorax consociatus* (Horn, 1887), new combination**
(Figs. 8–12)

Aphodius consociatus: Horn 1887: 21, Gordon 1977: 162 (lectotype designation)

Aphodius (Volinus) consociatus: Schmidt 1913: 143, Schmidt 1922: 175

Aphodius (Chilothorax) consociatus: Dellacasa 1988: 113

Type locality: California, U.S.A.

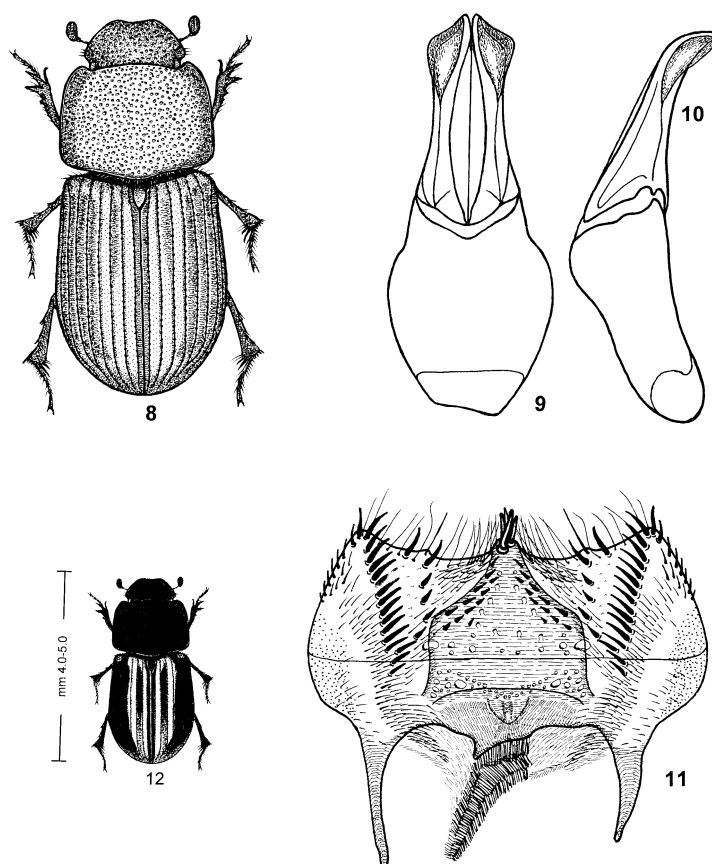
Type depository: Museum of Comparative Zoology, Harvard University, Cambridge, MA, U.S.A.

Redescription: Length 4.0–5.0 mm; body moderately elongate, convex, shiny, glabrous. Color black; elytra yellow with first interstriae and sides widely piceous; legs brownish-red; antennal club piceous. Head anteriorly at middle convex, with coarse and rather dense punctures, punctation coarser distally. Clypeus very weakly sinuate medially, rounded laterally, very thinly bordered, border weakly upturned; genae rounded, with short setae, weakly protruding beyond eyes; frontal suture obsolete; front with evenly spaced and rather sparse punctures. Pronotum moderately transverse, convex, with dual, coarse and moderately close punctures

throughout, large punctures two to three times larger than small; punctation somewhat denser and coarser laterally; lateral margins weakly arcuate anteriorly, near parallel posteriorly; with thin border; hind angles obtusely rounded; base faintly bisinuate, with thin but distinct border. Scutellum weakly excavate, shiny, impunctate. Elytra very convex, slightly widened posteriorly; striae rather fine, with deep punctures, moderately crenulate; interstriae flat, finely alutaceous, with irregular almost indistinct punctures. Hind tibiae with superior apical spur somewhat longer than first tarsomere; first tarsomere as long as following three combined. Male fore tibiae with apical spur slender, almost abruptly hooked inward at apex; head and pronotum with less coarse and more sparse punctures than in female. Female fore tibiae with apical spur evenly acuminate apically.

Distribution: Coastal southern California (from Los Angeles to San Diego).

Bionomy: This is an early spring species whose ecology is unknown. It is apparently endemic to coastal southern California, a region under intense human disturbance and alteration.



FIGURES 8–12. *Liothorax consociatus* (Horn, 1877) (Los Angeles Co., California, U.S.A.): 8. habitus of male; 9–10. aedeagus, dorsal and lateral view; 11. epipharynx; 12. habitus.

***Liothorax innexus* (Say, 1835)**

(Figs. 13–17)

Aphodius innexus: Say 1835: 177, Harold 1871: 270, Bates 1887: 85, Blackwelder 1944: 212, Dellacasa *et al.* 1998: 155

Aphodius flavocinctus: Harold 1860: 614, Harold 1871: 270 (as a synonym of *A. innexus*)

Aphodius circumcinctus: Germar in Harold 1871: 270 (*nomen nudum*)

Aphodius (Nialus) innexus: Schmidt 1913: 168; Dellacasa 1988: 144

Liothorax innexus: Dellacasa *et al.*, 2002: 166 (new combination)

Type locality: Mexico (for *Liothorax innexus*).

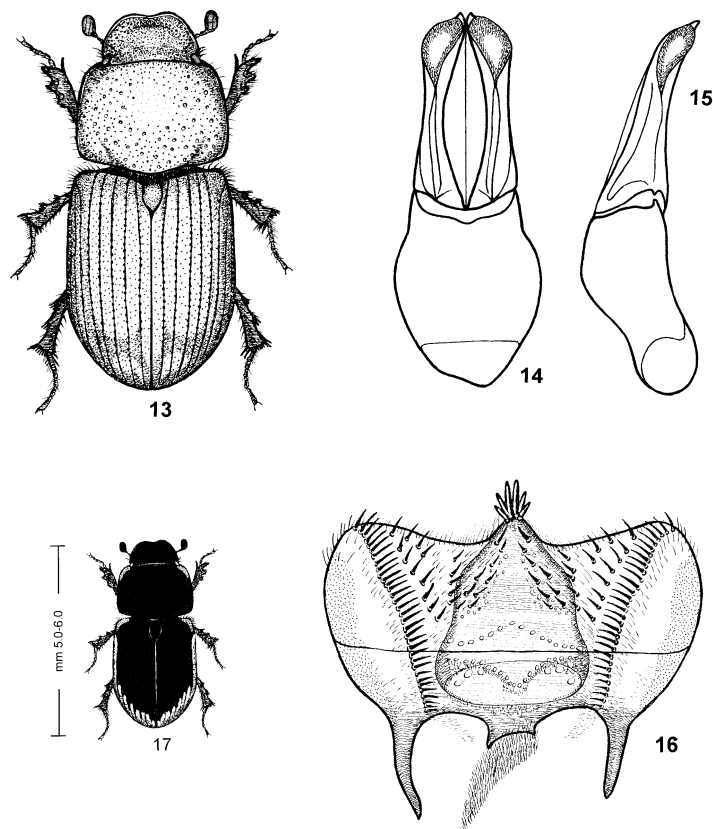
Type depository: Type series lost (for *Liothorax innexus*) (see Mawdsley 1993).

Redescription: Length 5.0–6.0 mm; body subelongate, parallel, convex, shiny glabrous. Color piceous; front angles of pronotum, humeral angle, sides and apex of elytra dirty yellow. Head anteriomedially gibbose, anteriorly with transverse weak carina, nearly smooth at center, with coarse punctures only toward clypeal margin. Clypeus sinuate medially, rounded laterally, finely bordered, border weakly upturned, glabrous; genae broadly rounded, with elongate setae, not protruding beyond eyes; frontal suture weakly gibbous. Pronotum transverse, with dual sparse punctures, nearly smooth on disc; lateral margins thinly bordered, border with elongate setae; base weakly bisinuate, not bordered. Scutellum with curved sides, smooth. Elytra subparallel-sided, distinctly striate; striae strongly crenulate; interstriae flat, with very fine and sparse punctures, sometimes punctures almost imperceptible. Hind tibiae with superior apical spur shorter than first tarsomere; first tarsomere nearly as long as following three combined. Male head with anterior carina more distinct than in female; pronotum almost parallel-sided. Female with pronotum weakly narrowed forward.

Distribution: Mexico (Aguascalientes, Distrito Federal, Guanajuato, Guerrero, Hidalgo, México, Michoacán, Oaxaca, Puebla).

Bionomy: This is a coprophagous species, which is found in summer and autumn. Other biological details are unknown.

Systematic remarks: This species has been recorded from California, U.S.A. (Harold 1860: 614) but this record was based on misidentified specimens.



FIGURES 13–17. *Liothorax innexus* (Say, 1835) (Lago Zumpango, env. San Juan Zitlaltepec, E.do México, Mexico): 13. habitus of male; 14–15. aedeagus, dorsal and lateral view; 16. epipharynx; 17. habitus.

***Liothorax isikdagensis* (Balthasar, 1952), new combination**

(Figs. 18–25)

Aphodius plagiatus var. *rutilipennis*: Baudi 1870: 67, Baudi 1891: 178 (color variation thus unavailable name)

Aphodius (Nialus) plagiatus var. *discus*: Reitter 1892: 204, Schmidt 1916: 96 (color variation thus unavailable name)

Aphodius (Nialus) plagiatus var. *discoides* Schmidt 1916: 96 (new name for *A. discus* Reitter, 1892 not *A. discus* Wiedemann, 1823, unavailable name)

Aphodius (Ataeniomorphus) isikdagensis: Balthasar 1952: 22

*Aphodius (Ataeniomorphus) ressl*i: Petrovitz 1962: 126, Stebnicka 1990: 897 (as a synonym of *Aphodius (Liothorax) plagiatus* Linné), Dellacasa *et al.* 2001a: 6 (as a synonym of *A. isikdagensis*)

Aphodius (Ataeniomorphus) cypricola: Balthasar 1971a: 57, Dellacasa *et al.* 2001a: 6 (as a synonym of *A. isikdagensis*)

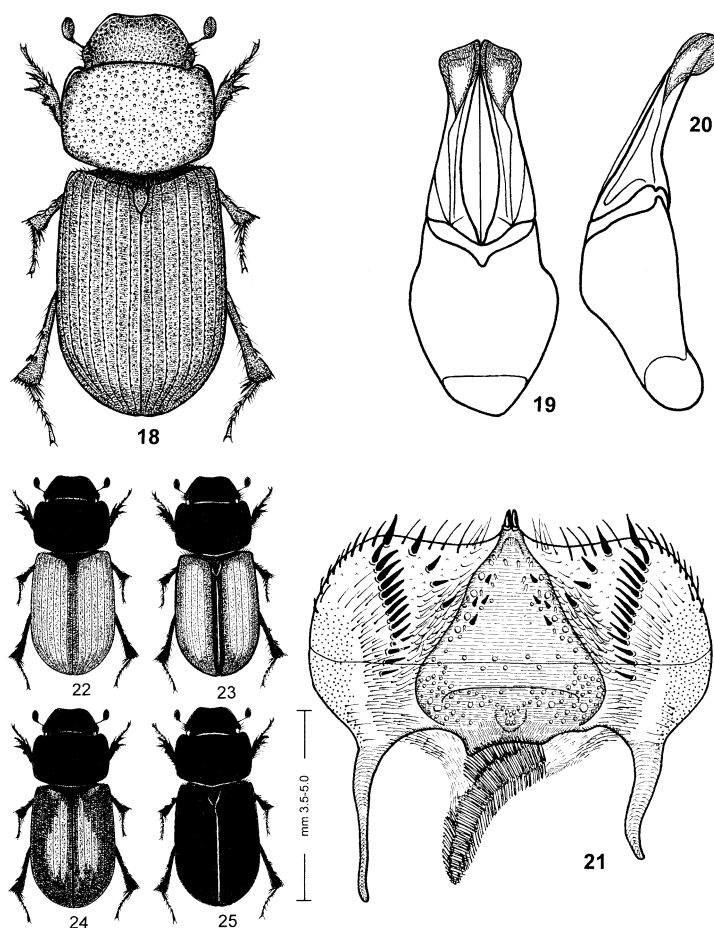
Aphodius (Nialus) bytinskisalzi: Petrovitz 1971: 219 (**new synonymy**)

*Aphodius (Liothorax) ressl*i: Ziani 1997: 25

Aphodius (Liothorax) isikdagensis: Dellacasa *et al.* 2001a: 6

Type locality: “Anatolien: Çamlidere in Isik Dağ” [Turkey] (for *Liothorax isikdagensis*).

Type depository: Národní Muzeum Přírodovědecké Muzeum. Praha (for *Liothorax isikdagensis*).



FIGURES 18–25. *Liothorax isikdagensis* (Balthasar, 1952) (Çamlidere, Isik Dağ, Vil. Ankara, Turkey): 18. habitus of male; 19–20. aedeagus, dorsal and lateral view; 21. epipharynx; 22–25. color variations.

Redescription: Length 3.5–5.0 mm; body elongate, subcylindrical, head and pronotum moderately shiny; scutellum and elytra strongly microreticulate thus rather dull; glabrous. Color black, elytra distally vaguely red; legs reddish brown; antennal club piceous (Fig. 25); some individuals have elytra entirely reddish brown (Fig. 23); some individuals have clypeal margin vaguely reddish brown and elytra with dirty yellow discal spot vaguely margined (Fig. 24); some individuals have clypeal margin pale yellow and elytra dirty yellow

with first interstriae and lateral margins vaguely brown (Fig. 22). Head rather large; at middle strongly gibbose, superficially microreticulate, with fine punctures on disc, punctures dual and coarser distally. Clypeus weakly sinuate medially, widely rounded laterally, thinly bordered, border glabrous; genae rounded, with short setae, weakly auriculate, weakly protruding beyond eyes; frontal suture obsolete, indicate only by an impunctate line somewhat gibbose laterally; front with distinct, evenly spaced punctures. Pronotum transverse, convex, nearly parallel-sided; with dual punctures; smaller punctures scattered throughout; large punctures, three to four times larger than small, slightly denser and coarser laterally; hind angles obtusely rounded; base with rather thick border to level of fifth elytral stria only, border thin medially. Scutellum small, with sides straight, parallel basally, distinctly microreticulate, with dense and coarse punctures on basal half. Elytra elongate, subcylindrical; epipleural carina distinctly subdentiform at humeral angle; striae fine, with superficial punctures, weakly crenulate; interstriae flat on disc, weakly convex apically, strongly microreticulate thus rather dull, with near imperceptible and sparse punctures. Hind tibiae with superior apical spur somewhat shorter than first tarsomere; first tarsomere as long as following two combined. Male head more strongly gibbose than in female; pronotum not narrowed anteriorly, with less dense and less coarse punctures than in female; elytral interstriae superficially microreticulate thus relatively more shiny than in female; metasternal plate concave. Female pronotum narrowed anteriorly.

Distribution: Greece, Turkey, Cyprus, Israel.

Bionomy: The few specimens examined were collected in April and May.

Nomenclatural remarks: The examination of the allotype of *Aphodius (Nialus) bytinskisalzi* Petrovitz, 1971, from Qneitra (Golan, Israel), preserved in the MHNG, revealed the synonymy of this species with *Liothorax isikdagensis* Balthasar, 1952. Dellacasa *et al.* (2001b) further discussed the systematics and nomenclatural problems regarding the *Aphodius* subgenus *Ataeniomorphus* Balthasar, 1952 as well as its type species *Aphodius isikdagensis* Balthasar, 1952 and the synonyms (*Aphodius cypricola* Balthasar, 1971 and *Aphodius ressl* Petrovitz, 1962).

***Liothorax kraatzi* (Harold, 1868), new combination**

(Figs. 26–31)

Aphodius kraatzi Harold, 1868: 84

Aphodius graecus: Motschulsky in Harold, 1871: 269 (*nomen nudum*)

Aphodius (Nialus) kraatzi: Reitter 1892: 203

Aphodius (Nialus) kraatzi ab. *castanopterus*: Endrödi 1955: 48 (unavailable name)

Aphodius (Liothorax) kraatzi: Dellacasa 1983: 278

Nialus haagi: Ádám 1994: 13

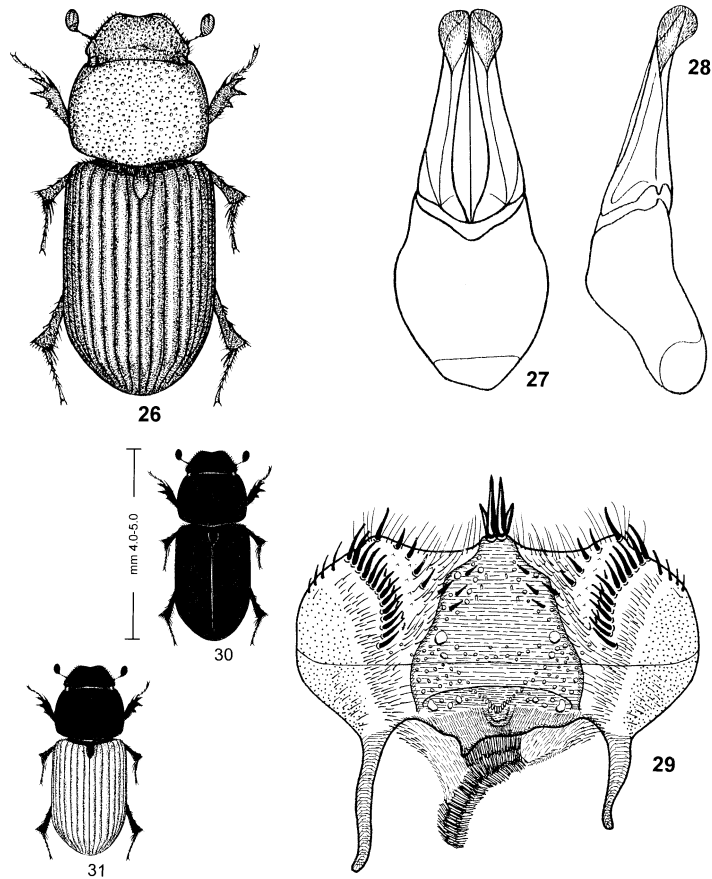
Type locality: Graecia [Greece] (for *Liothorax kraatzi*).

Type depository: Unknown to authors (for *Liothorax kraatzi*).

Redescription: Length 4.0–5.0 mm; body elongate, cylindrical, convex, shiny, glabrous. Color black; antennal club pale brown; legs reddish brown (Fig. 30); some individuals have color brownish red (Fig. 31). Head anteriorly at middle gibbose, with fine rather dense punctures. Clypeus weakly sinuate medially, rounded laterally; genae rounded, barely protruding beyond eyes; frontal suture faint, slightly raised medially. Pronotum convex, transverse; with dual, irregular, dense punctures; lateral margins with thin border; hind angles obtusely rounded; basal border interrupted medially. Scutellum with sparse punctures. Elytra elongate, parallel-sided; striae deep, with distinct punctures, not crenulate; interstriae narrow, convex, shiny, with superficial and sparse punctures. Hind tibiae with superior apical spur as long as first tarsomere; first tarsomere as long as following three combined. Male head with medial gibbosity distinct; frontal suture distinct, somewhat raised with trace of a central tubercle; pronotum on disc with punctures less dense than in female. Female head with medial gibbosity faint; frontal suture nearly obsolete.

Distribution: Southeastern Europe, Asia Minor, Caucasus, Central Asia.

Bionomy: This species is saprophagous and stenotopic and occurs in open habitats, mainly in damp soil at pond margins. Adults are active in late spring, summer, and autumn.



FIGURES 26–31. *Liothorax kraatzii* (Harold, 1868) (Lac Valthos, Euboea m., Greece): 26. habitus of male; 27–28. aedeagus, dorsal and lateral view; 29. epipharynx; 30–31. color variations.

***Liothorax levatus* (Schmidt, 1907), new combination**

(Figs. 32–36)

Aphodius levatus: Schmidt 1907: 568

Aphodius (Pseudacrossus) levatus: Schmidt 1913: 151, Schmidt 1922: 241

Aphodius nigroclavus: Hinton 1934: 188 (new synonymy)

Aphodius (Pseudagolius) levatus: Dellacasa 1988: 152

Aphodius (Pseudagolius) nigroclavus: Dellacasa 1988: 317

Type locality: Mexico (for *Liothorax levatus*).

Type depository: Naturhistoriska Riksmuseet, Stockholm (for *Liothorax levatus*).

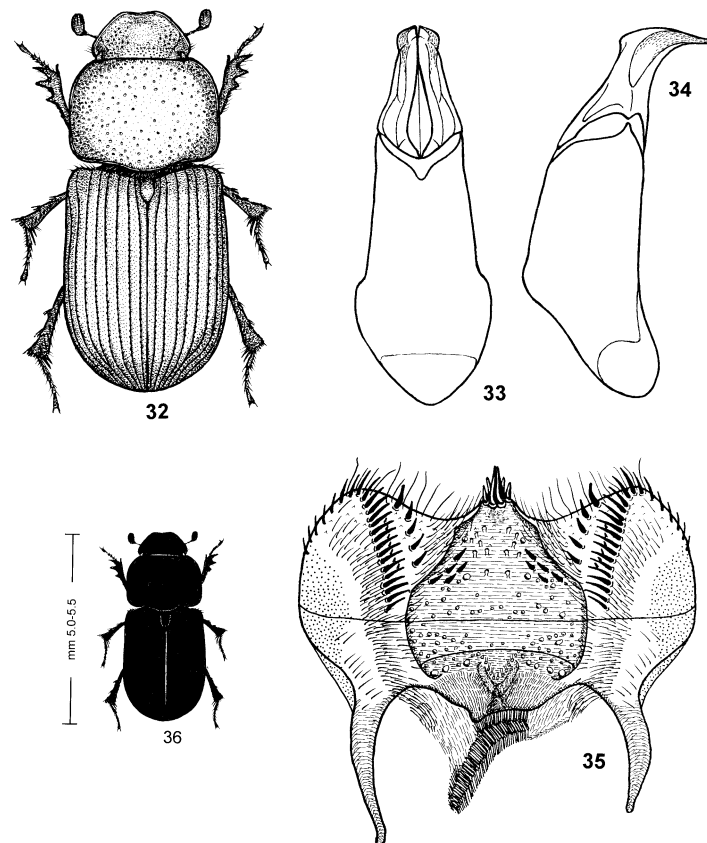
Redescription: length 5.0–5.5 mm; body elongate, parallel-sided, weakly shiny, glabrous. Color piceous black; clypeal margin, anterior pronotal angles and elytral apex pale red; legs brownish red; antennal club black. Head anteriorly at middle moderately convex, with fine, evenly spaced, sparse punctures throughout, laterally mixed larger and coarser punctures. Clypeus weakly sinuate medially, rounded laterally, with thin border; genae obtusely rounded, with short setae, weakly protruding beyond eyes; frontal suture obsolete; front with coarse, irregular punctures. Pronotum slightly transverse, with dual punctures, large coarse punctures, four to five times larger than small, irregularly scattered, sparser on disc and denser laterally; small superficial punctures extremely fine and throughout evenly sparse; lateral margins with thin border, almost parallel toward hind angles; hind angles obtusely rounded; base weakly bisinuate, with thin border. Scutellum

flat, with fine punctures basally. Elytra subcylindrical, weakly widened posteriorly; striae moderately deep, with coarse punctures, not crenulate; interstriae flat, somewhat alutaceous, with extremely fine and moderately sparse punctures. Hind tibiae with superior apical spur shorter than first tarsomere; first tarsomere as long as following three combined. Metasternal plate nearly flat, with vestiges of median longitudinal groove, finely microreticulate and with few large postero-lateral punctures. Male fore tibiae with apical spur cylindrical, obtusely hooked inward at apex; head more transverse and less convex than in female. Female fore tibiae with apical spur evenly acuminate toward apex.

Distribution: Mexico (Chiapas, Durango, Jalisco, México, Morelos, Oaxaca, Veracruz).

Bionomy: This is a coprophagous species, active all year around but mainly in autumn.

Nomenclatural remarks: The examination of both the primary types of *Aphodius levatus* Schmidt, 1907 (NRS) and of *Aphodius nigroclavus* Hinton, 1934 (USNM), is the basis for this synonymy. For *Aphodius levatus* Schmidt, 1907, we herein designate a lectotype (male specimen from the NRS) with the following labels: 1) white, printed: Mexico/ C. Höge; 2) white, handwritten: levatus/ type m.; 3) red, printed: TYPUS; 4) red printed: 292, handwritten: 71; 5) red, handwritten: *Aphodius levatus* / A. Schmidt, 1907 / lectotypus / Dellacasa M. des. 2004. In the NRS there is one male paralectotype with the following labels: 1) white, handwritten: Mexico; 2) red printed: 293; handwritten: 71; 3) red, handwritten: *Aphodius levatus* / A. Schmidt, 1907 / paralectotypus / Dellacasa M. des. 2004.



FIGURES 32–36. *Liothorax levatus* (Schmidt, 1907) (El Plano, San José Aguazuelas, E.do Veracruz, Mexico): 32. habitus of male; 33–34. aedeagus, dorsal and lateral view; 35. epipharynx; 36. habitus.

***Liothorax niger* (Illiger, 1798), new combination**

(Figs. 37–41)

Aphodius niger: Illiger 1798: 24, Krell *et al.* 2003: 127, International Commission on Zoological Nomenclature 2005: 45

Aphodius limnophilus: Motschulsky in Harold 1871: 266 (*nomen nudum*)

Aphodius (Liothorax) niger: Bedel, 1911: 75

Aphodius (Liothorax) wilsonae: Maté & Angus 2005: 329, Dellacasa & Dellacasa 2005: 51 (as a synonym of *Liothorax niger* Illiger, 1798)

Liothorax muscorum: Ádám 1994: 6, Dellacasa & Dellacasa 2005: 51 (as a synonym of *Liothorax niger* Illiger, 1798)

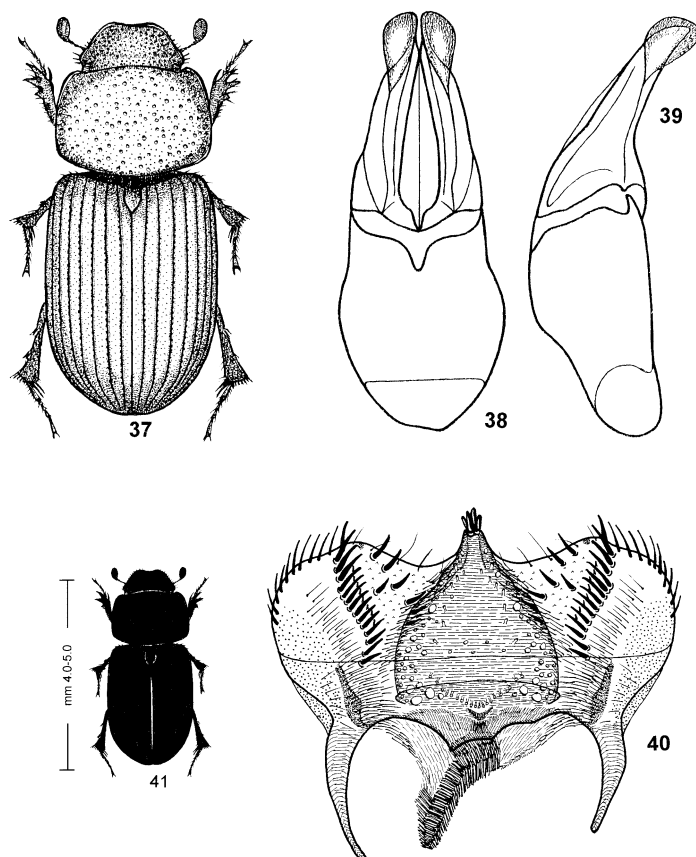
Type locality: Suec[ia] (Sweden) (for *Liothorax niger*).

Type depository: Humboldt-Universität. Museum für Naturkunde. Berlin (for *Liothorax niger*).

Redescription: Length 4.0–5.0 mm, body elongate, subcylindrical, slightly broadened toward apex of elytra, shiny, glabrous. Color black; legs piceous; antennal club black. Head anteriorly at middle gibbose, with fine punctures on disc, punctuation more irregular and more coarse distally. Clypeus weakly sinuate medially, rounded laterally; genae obtusely rounded, protruding beyond eyes; frontal suture nearly obsolete. Pronotum convex; with dual, evenly spaced punctures; large punctures, weakly umbilicate, two times larger than small punctures, somewhat irregularly sized; lateral margins with thin border; hind angles obtuse; basal border widely interrupted medially. Scutellum wide, with sparse punctures basally. Elytra oval-elongate; striae well defined, with distinct punctures, crenulate; interstriae flat, with fine, sparse punctures, apically alutaceous. Hind tibiae with superior apical spur as long as first tarsomere; first tarsomere as long as following three combined. Male head with medial gibbosity rather distinct; pronotum on disc with punctures more sparse than in female; metasternal plate concave. Female head with medial gibbosity almost obsolete; metasternal plate flat.

Distribution: Europe, Asia Minor, Central Asia, China (Tibet).

Bionomy: This species is active in late spring and summer and is saprophagous and stenotopic. It is exclusively from open areas mainly at pond margins and in damp soil or under rotting leaves from 1000 to 2000 m in elevation. This species also sometimes causes damage to golf turf (personal observation).



FIGURES 37–41. *Liothorax niger* (Illiger, 1798) (Appennino Ligure, Monte Penna: Caserma della Forestale, Val d'Aveto; Genova, Italy): 37. habitus of male; 38–39. aedeagus, dorsal and lateral view; 40. epipharynx; 41. habitus.

***Liothorax plagiatus* (Linné, 1767)**

(Figs. 42–48)

Scarabaeus plagiatus: Linné 1767: 559

Psammodius elongatus: Stephens 1830: 209, Dellacasa 1983: 435 (*Aphodius plagiatus* ab. *elongatus*)

Aphodius longulus: Ménériés 1847: 44, Harold 1871: 264 (as a synonym of *A. plagiatus*)

Aphodius plagiatus: Erichson 1848: 835

Liothorax plagiatus: Motschulsky 1859: 157, Ádám 1994: 14, Dellacasa *et al.* 2001a: 169

Aphodius (Nialus) plagiatus: Mulsant & Rey, 1870: 462, Reitter 1892: 204, Schmidt 1913: 168

Aphodius plagiatus ab. *bivittatus*: Everts 1903: 27 (unavailable name), Dellacasa 1995: 167 (as a synonym of *A. plagiatus*)

Aphodius (Liothorax) plagatus: Bedel 1911: 75 (incorrect subsequent spelling)

Aphodius (Nialus) jakutorum: Balthasar 1938: 213, Balthasar 1964: 422 (as a synonym of *A. plagiatus*)

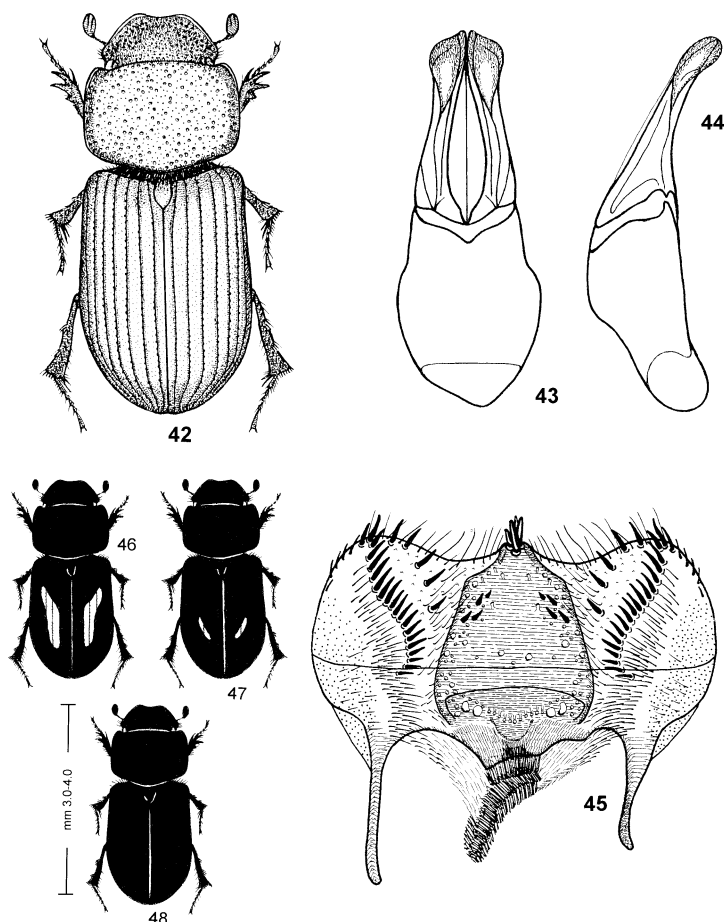
Aphodius plagiatus ab. *parvomaculatus*: Schmidt 1938: 43 (unavailable name)

Aphodius (Nialus) plagiatus hungaricus: Endrödi 1955: 48

Aphodius (Liothorax) plagiatus: Dellacasa 1983: 282, Dellacasa *et al.* 2001a: 8

Type locality: Europa (for *Liothorax plagiatus*).

Type depository: Probably in the Linnean Society collection, London (for *Liothorax plagiatus*).



FIGURES 42–48. *Liothorax plagiatus* (Linné, 1767) (Kharat, Irkutsk Prov., eastern Siberia, Russia): 42. habitus of male; 43–44. aedeagus, dorsal and lateral view; 45. epipharynx; 46–48. color variations.

Redescription: Length 3.0–4.0 mm; body elongate, subcylindrical, convex, glabrous; shiny, sometimes with metallic shine. Color black; clypeal margin and sides of pronotum vaguely brown; elytra with longitudinal elongate red spot; antennal club black; legs piceous with paler tarsi (Fig. 46); some individuals have elytra with small and short longitudinal red stripe (Fig. 47); some individuals have elytra entirely black with metallic tinge (Fig. 48). Head rather large; anteriorly at middle gibbose, with regular and dense punctures on disc,

punctuation rugose and coarse laterally. Clypeus weakly sinuate medially, rounded laterally; genae rounded, protruding beyond eyes; frontal suture almost faint. Pronotum moderately convex, with dual and irregular punctures, large punctures two times larger than small; lateral margins with thin border; hind angles obtusely rounded; base usually with border interrupted medially, rarely basal border of pronotum extremely thin but entire. Scutellum narrow, microreticulate, with sparse punctures. Elytra suboval; striae fine, with superficial punctures, not crenulate; interstriae flat, with sparse and superficial punctures. First tarsomere of hind tarsi weakly widened apically. Hind tibiae with superior apical spur as long as first tarsomere; first tarsomere longer than following three combined. Male head with medial gibbosity more distinct and pronotum on disc with more sparse punctures than in female; metasternal plate concave and finely pubescent. Female metasternal plate flat and glabrous.

Distribution: Central and Southern Europe (except Italy); Tunisia, Israel, Jordan, Lebanon, Syria, Turkey, Iraq, Russia, Siberia, China.

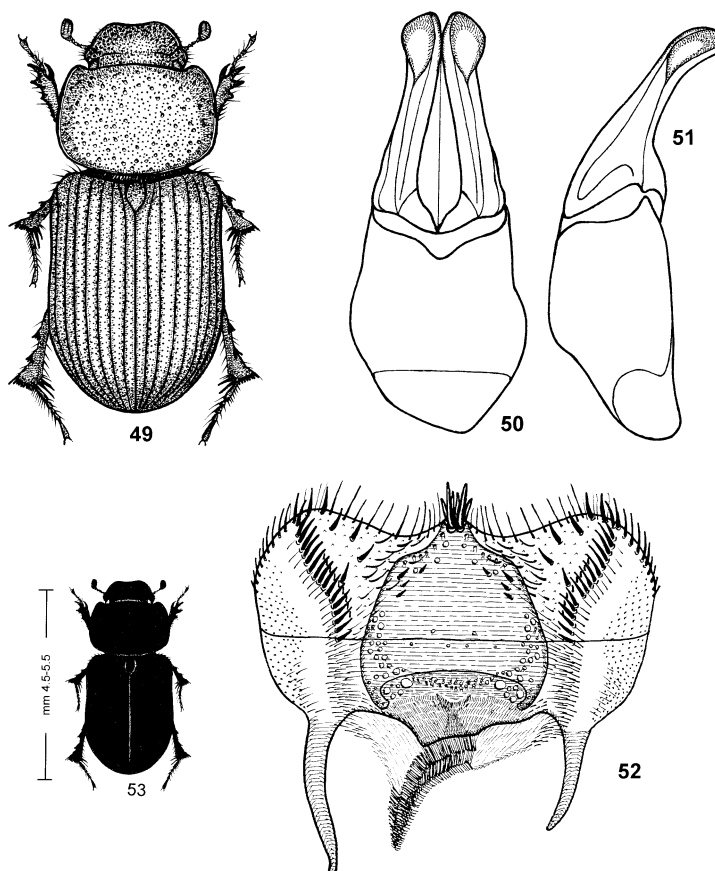
Bionomy: This species is phytosaprophagous and probably eterotopic, in southern areas probably stenotopic. Adults can be found from spring to autumn but mainly in late spring. This species is found exclusively in swampy open habitats and larvae often occur near salty coastal swamps.

***Liothorax rusakovi* (Gusakov, 2004), new combination**
(Figs. 49–53)

Aphodius (*Liothorax*) *rusakovi*: Gusakov 2004: 6

Type locality: Orenbugsk[aya]. obl[ast'], 120 km YuYuZ Orenburga, razliv r. ilek, Sudkhorechka (Russia).

Type depository: Zoologiceskii Muzei moskovskogo Universiteta, Moscow.



FIGURES 49–53. *Liothorax rusakovi* (Gusakov, 2004) (Ul'yansovsk Area, Radishchev Distr., Vyazovica Vill., Bank of Volga Riv.): 49. habitus of male; 50–51. aedeagus, dorsal and lateral view; 52. epipharynx; 53. habitus.

Redescription: Length 4.5–5.5 mm; body subcylindrical, faintly widened basally, shiny, glabrous. Color black; clypeal margin and legs pitch-brown; antennal club piceous. Head anteriorly at middle gibbose, with evenly spaced punctures on disc, punctuation somewhat coarser and denser distally. Clypeus weakly sinuate medially, rounded laterally; genae obtusely rounded, with short setae, protruding beyond eyes; frontal suture not tuberculate, distinctly impressed laterally, widely interrupted medially; front with somewhat irregularly spaced coarse punctures. Pronotum transverse, convex, with dual evenly spaced punctures, large punctures, four times larger than small, lacking on disc; lateral margins weakly arcuate, with distinct border; basal border extremely thin medially. Scutellum weakly depressed basally, with distinct and irregularly spaced punctures on basal half. Elytra elongate, almost parallel-sided; striae well defined, with distinct punctures, slightly crenulate; interstriae weakly convex, with distinct almost fine punctures arranged laterally in regular longitudinal belt; punctuation denser toward apex. Hind tibiae with superior apical spur shorter than first tarsomere; first tarsomere as long as following three combined. Male pronotum on disc with punctures less coarse than in female; fore tibiae with apical spur stouter and strongly outward curved; metasternal plate deeply excavate. Female fore tibiae with apical spur slender and weakly outward curved; metasternal plate almost flat.

Distribution: Russia, Ukraine, Kazakhstan.

Bionomy: All specimens examined were collected in May.

***Liothorax subaeneus* (LeConte, 1857), new combination**

(Figs. 54–60)

Aphodius subaeneus: LeConte 1857: 41, Horn 1887: 21, Gordon 1977: 159 (lectotype designation)

Aphodius (Volinus) subaeneus: Schmidt 1913: 43, Schmidt 1922: 176, Hatch, 1971: 454

Aphodius gentneri: Hatch 1971: 457, Gordon 1977: 159 (as a synonym of *A. subaeneus*), Dellacasa 1988: 335

Aphodius perpolitus: Gordon 1973: 439, Gordon 1977: 159 (as a synonym of *A. subaeneus*), Dellacasa 1988: 236

Aphodius (Chilothorax) subaeneus: Dellacasa 1988: 203

Type locality: San Francisco, California, U.S.A. (for *Liothorax subaeneus*).

Type depository: Museum of Comparative Zoology, Harvard University, Cambridge, MA. U.S.A. (for *Liothorax subaeneus*).

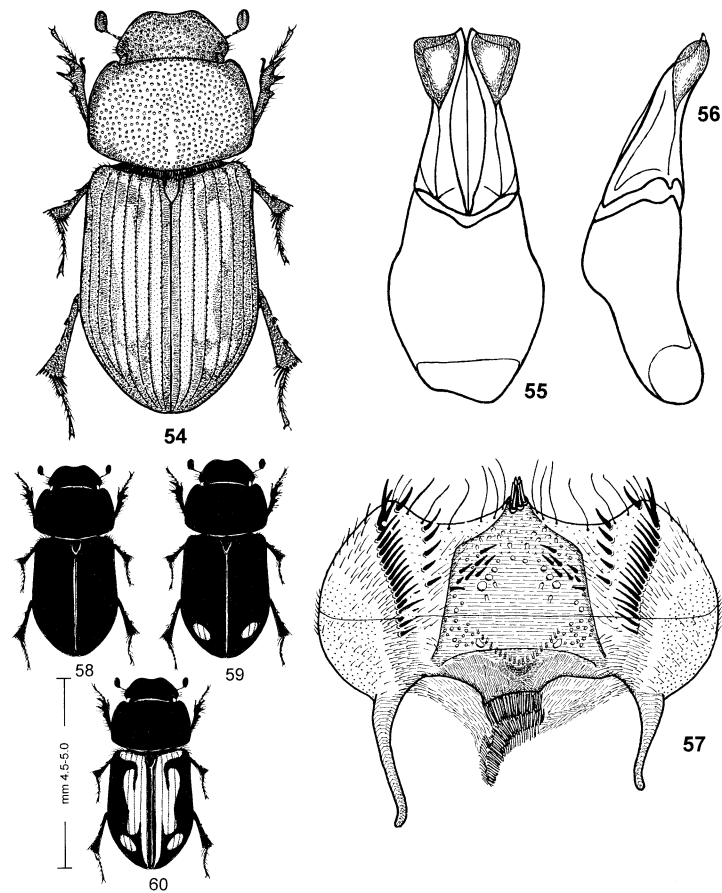
Redescription: Length 4.0–5.0 mm; body oblong, moderately convex, weakly shiny except second and fourth elytral interstriae roughly alutaceous so strongly dull, glabrous. Color black; clypeal margin and pronotal sides weakly red; pronotum with aeneous tinge; elytra widely dirty yellow on disc with first interstria and lateral margin black; antennal club piceous; legs rufo-piceous (Fig. 60); some individuals have elytra black with dirty yellow rounded spot on preapical declivity (Fig. 59); some individuals have elytra entirely black (Fig. 58). Head anteriorly at middle moderately convex, with coarse evenly spaced punctures, punctuation denser distally. Clypeus moderately sinuate medially, widely rounded laterally, with thin border, border weakly upturned; genae widely rounded, with short setae, protruding beyond eyes; frontal suture obsolete; front with coarse evenly spaced punctures. Pronotum transverse, convex, with evenly spaced coarse moderately dense punctures throughout but with a smooth median longitudinal line; lateral margins weakly arcuate anteriorly, subparallel posteriorly, with distinct border; hind angles obtuse; base evenly arcuate with vestiges of border near hind angles. Scutellum weakly excavate, alutaceous, with fine and sparse punctures. Elytra oval-elongate, finely striate; striae with fine and close punctures, not crenulate; interstriae flat, second and fourth roughly alutaceous so strongly dull, other polished, all with small punctures irregularly spaced. Hind tibiae with superior apical spur nearly as long as first tarsomere, first tarsomere somewhat longer than following two combined. Male fore tibiae with apical spur hooked inward at apex; pronotum more transverse, less convex and with punctures more sparse than in female. Female fore tibiae with apical spur evenly acuminate apically.

Distribution: Canada (Vernon, British Columbia) and U.S.A. (from northern Oregon to southern California).

Bionomy: This species is active in spring and early summer and is collected at pond margins (Gordon, per-

sonal observation).

Systematic remarks: This is a polymorphic species varying in elytral sculpture and color. These morphological characters overlap, and Gordon (1977) considered them as simple variations of the same taxon.



FIGURES 54–60. *Liothorax subaeneus* (LeConte, 1857) (Modesto, California, U.S.A.): 54. habitus of male; 55–56. aedeagus, dorsal and lateral view; 57. epipharynx; 58–60. color variations.

Checklist of species

Genus *Liothorax* Motschulsky, 1859

Ataeniomorphus Balthasar, 1952

1. *L. alternatus* (Horn, 1870) Canada (Alberta, British Columbia, Manitoba), U.S.A. (Washington to southern California, east to Michigan)
 - L. inermis* (Robinson 1940)
 - L. moclipsi* (Hatch, 1971)
2. *L. consociatus* (Horn, 1887) coastal southern California (from Los Angeles to San Diego)
3. *L. innexus* (Say, 1835) Mexico (Distrito Federal, Guerrero, México, Michoacán)
 - L. flavocinctus* (Harold, 1860)
4. *L. isikdagensis* (Balthasar, 1952) Greece, Turkey, Cyprus, Israel
 - L. bytinskisalzi* (Petrovitz, 1971)
 - L. cypricola* (Balthasar, 1971)
 - L. resslie* (Petrovitz, 1962)

5. *L. kraatzii* (Harold, 1868) southeastern Europe, Asia Minor, Caucasus, Central Asia
6. *L. levatus* (Schmidt, 1907) Mexico (Durango, Jalisco, Morelos, Oaxaca, Veracruz)
 L. nigroclavus (Hinton, 1934)
7. *L. niger* (Illiger, 1798) Europe, Asia Minor, Central Asia, China (Tibet)
 L. muscorum Ádám, 1994
 L. wilsonae (Maté & Angus, 2005)
8. *L. plagiatus* (Linné, 1767) Central and southern Europe (except Italy); Tunisia, Israel, Jordan,
 Lebanon, Syria, Turkey, Iraq, Russia, Siberia, China
 L. elongatus (Stephens, 1830)
 L. jakutorum (Balthasar, 1938)
 L. longulus (Ménétriés, 1847)
9. *L. rusakovi* (Gusakov, 2004) Russia, Ukraine, Kazakhstan
10. *L. subaeneus* (LeConte, 1857) Canada (British Columbia), U.S.A. (from northern Oregon to southern
 California)
 L. gentneri (Hatch, 1971)
 L. perpolitus (Gordon, 1973)

Additional species examined

Nialus jhavanicus (Balthasar, 1971), new combination (Figs. 61–65)

Aphodius (*Nialus*) *jhavanicus*: Balthasar 1971b: 18

Aphodius (*Nialus*) *cobharensis*: Stebnicka 1985: 363, Stebnicka 1986: 38 (as a synonym of *jhavanicus*)

Type locality: Jhawani, Rapti-Tal. Nepal (for *Nialus jhavanicus*).

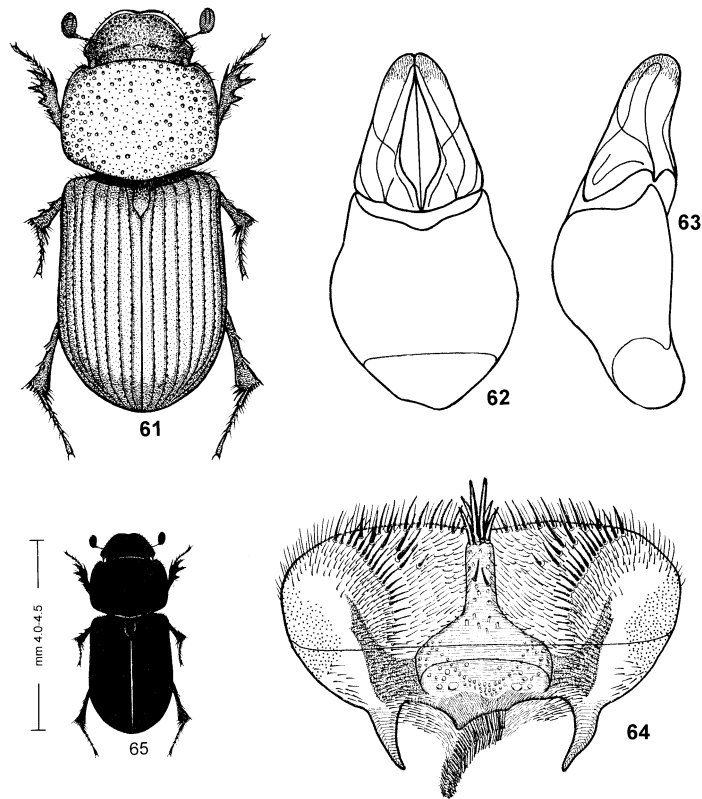
Type depository: Zoologisches Staatssammlung, München (for *Nialus jhavanicus*).

Redescription: Length 4.0–4.5 mm; body elongate, convex, subparallel-sided, shiny, glabrous. Color black or piceous; clypeal margin and legs reddish-brown, legs with tarsi paler; antennal club testaceous. Head anteriorly at middle moderately convex, with irregularly spaced punctures, punctuation fine and sparse on disc, larger and deeper distally. Clypeus weakly sinuate medially, rounded and widely arcuate laterally; clypeal border fine and weakly upturned, with sparse and short setae; genae rounded, with short setae, faintly protruding beyond eyes; frontal suture slightly cariniform with median tubercle; front with fine but rather evenly spaced punctures. Pronotum convex, subquadrate, with dual punctures; fine punctures regularly scattered throughout, large punctures, three to four times larger than small, sparse on disc, closer on sides; lateral margins weakly arcuate, with thin border; hind angles broadly rounded; base faintly bisinuate, not bordered. Scutellum flat, with irregularly spaced and coarse punctures on basal half. Elytra moderately convex, faintly widened just behind the middle; striae fine, with superficial punctures, subcrenulate; interstriae flat with fine, sparse punctures. Hind tibiae apically fimbriate with short and equal spinules; with superior apical spur one third shorter than first tarsomere; first tarsomere somewhat shorter than following three combined. Male frontal suture with tubercle stronger; punctuation of head and pronotum sparser than in female.

Distribution: Nepal, India

Material examined: NEPAL: Rapti Tal, Jhawani, 200 m; V.1967, Dierl-Forster-Schacht leg. (holotype male and 67 paratypes, ZSM); Arun Valley, Sultibari, 500 m, 1/14.VI.1988, Lebish & Prost leg., 1 ex. (DCG); Narayani Zone, Chitawan Distr., Chitawan Nat. P., Sahuraha-Thati-Bagh Mara, 200/500 m, 17/21.V.1996, P. Cechovsky leg., 1 ex. (DCG); INDIA: Bhalukpog, South Arunachal Pradesh, 11/14.V.1999, E. Kucera leg., 1 ex. (DCG).

Systematic remarks: Based on the characters outlined in the description, this species should be placed in the genus *Nialus*. Previously, Stebnicka (1985) hypothesized that this species might be closely related to *Lio-*



FIGURES 61–65. *Nialus jhavanicus* (Balthasar, 1971) (Arun Valley, Sultibari, Nepal): 61. habitus of male; 62–63. aedeagus, dorsal and lateral view; 64. epipharynx; 65. habitus.

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