

REVISION OF EARTH-BORING DUNG BEETLES FROM THE GENUS *Geotrupes* Latr. (COLEOPTERA, SCARABAEIDAE) OF ESTONIA

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Received 25 April 1997, accepted 24 September 1997

Abstract. On the basis of the available collection material and an analysis of the data drawn from scientific literature, the distribution and phenology of four *Geotrupes* Latr. species in Estonia was clarified. The species *G. spiniger* was recorded on the territory of Estonia for the first time. An identification key for five species distributed in the northern part of Europe is given.

Key words: Coleoptera, Scarabaeidae, *Geotrupes*, faunistics, phenology, key, Estonia.

The genus *Geotrupes* Latr. comprises the biggest (up to 28 mm) dung beetles of the Northern European fauna. Adults are coprophagous or saprophagous, feeding on dung or on decaying matter of animal or vegetable origin. Larvae feed upon dung or decaying vegetable matter stocked in the burrows by adults. The burrow may be more than 0.5 m deep, ending by several breeding cells filled with corresponding food storage. Usually both the male and the female are involved in digging and storing the food. The biology of *Geotrupes* species was studied in detail by Lengerken (1939, 1954) and Landin (1957).

Five *Geotrupes* species have been reported from the northern part of Europe. These are *G. mutator* (Marsham), *G. stercorarius* (Linnaeus), *G. spiniger* (Marsham), *G. stercorosus* (Scriba), and *G. vernalis* (Linnaeus) (see e.g. Silfverberg, 1992). So far three of them were known in Estonia – *G. stercorarius*, *G. stercorosus*, and *G. vernalis*. However, the phenology and distribution data on these species have not been published yet. The discovery of a new local species

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G. spiniger (Fig. 1) in 1991 on Vormsi Island instigated the authors to make a revision of the whole material on this interesting genus available in Estonia.

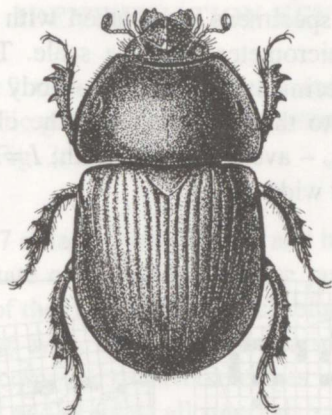


Fig. 1. *Geotrupes spiniger* (Marsh.).

All the museum specimens were checked in the collections of the Institute of Zoology and Botany (Tartu), Estonian Museum of Natural History (Tallinn), Zoological Museum of the University of Tartu, Estonian Agricultural University (Tartu), and Estonian Institute of Forestry and Nature Conservation (Tartu) and in the private collections of the authors as well as of K. Elberg, M. Heidemaa, T. Kesküla, M. Kruus, S. Laanet, A. Liiv, Ü. Luht, J. Luig, E. Merivee, E. Mäe, A. Männik, R. Pedmanson, A. Peterson, U. Roosileht, K. Sarv, A. Süda, P. Zingel, A. Tamm, R. Trummal, E. Õunap, and H. Õunap. We are much indebted to all the persons who kindly allowed an access to their collections or contributed to this paper in some other way.

The total material studied comprises 764 specimens from 184 UTM grid squares (10 × 10 km), collected from 1849 to 1994 (Fig. 2a). The authors' field observations were also taken into account when analysing the phenology and distribution of the species. Data on the distribution, phenology, and biology of the *Geotrupes* species found or likely to be found in Estonia are given below. In view of the fact that most of the material available in Estonia has been collected by amateur entomologists who have not carried out a special phenological study, a number of findings are given in phenograms instead of the number of specimens. A capture of one or more specimens at a place on a certain day is treated as one finding. The general distribution of the species is given after Horion (1958) with numerous specifications after Lindroth (1960), Yablokov-Khnzoryan (1976), Nikolaev (1975, 1987), Nikolaev & Puntsagdulam (1984),

and Lundberg (1986). Maps of the distribution of *Geotrupes* species in the northern part of Europe were compiled on the basis of published data with reference to the results of the present study. A key allowing reliable identifications of *Geotrupes* species distributed in the referred territory is given. The measurements of the specimens were taken with a compound microscope MBS-2 supplied with a micrometer eyepiece scale. The following notation is used: n – the number of specimens measured; L – body length measured from the front edge of the clypeus to the apical edge of the elytra; L_{av} – average body length; B – body width; B_{av} – average body width; $I = L_{av}/B_{av}$ – average ratio of the body length to the body width.

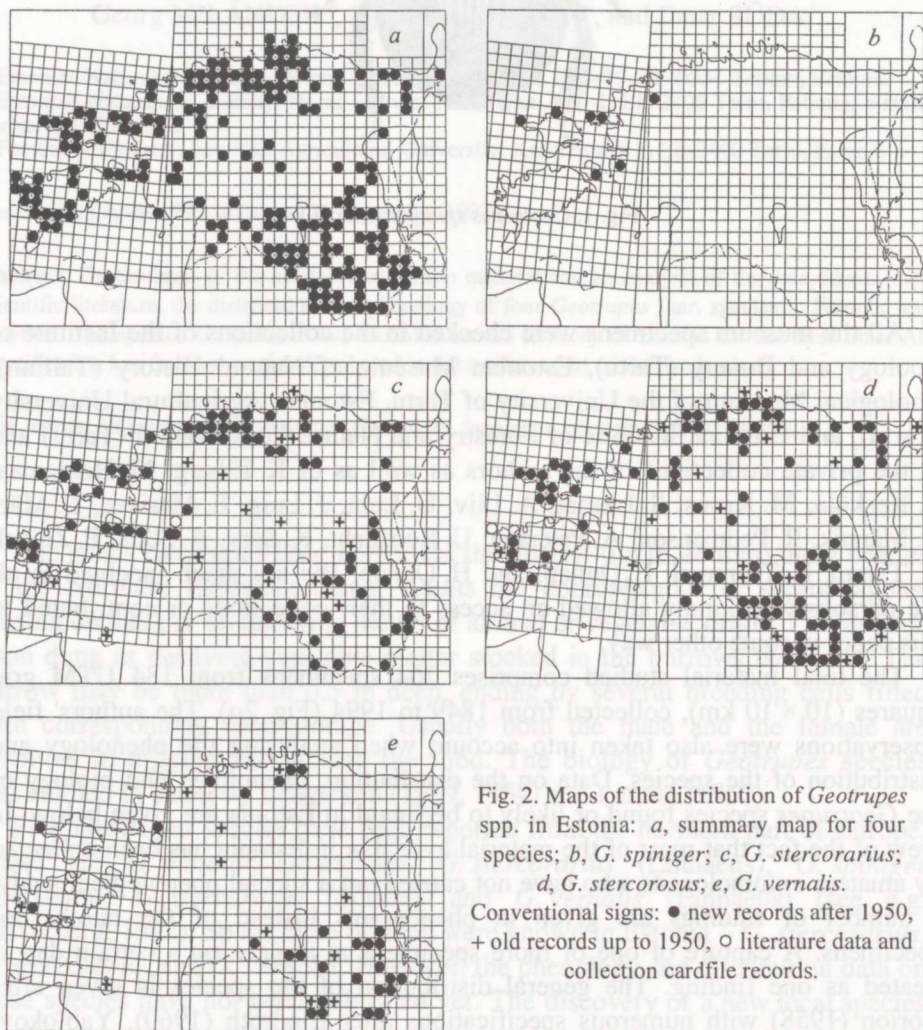


Fig. 2. Maps of the distribution of *Geotrupes* spp. in Estonia: a, summary map for four species; b, *G. spiniger*; c, *G. stercorarius*; d, *G. stercorosus*; e, *G. vernalis*. Conventional signs: ● new records after 1950, + old records up to 1950, ○ literature data and collection cardfile records.

All the figures are original, Figs. 1 and 3 were drawn by G. Miländer. The species found in Estonia are numbered consecutively.

IDENTIFICATION KEY

1(2) Each elytron with 9 striae between suture and humeral swelling. Dorsal surface dark metallic green. Centre of pronotum with fine and extremely sparse punctures (Fig. 3, 1).

G. mutator (Marsh.)

2(1) Each elytron with 7 striae between suture and humeral swelling.

3(8) Pronotum impunctate or with rather sparse punctation on centre (Fig. 3, 2–6). Dorsal side of the body usually black-blue, black-violet, or black.

4(7) Centre of pronotum with very fine and sparse punctation or impunctate. Meta-tibia with 3 complete transverse ridges in apical part (Fig. 3, 13)**. Elytral striae deep and regular, all intervals rather convex. Larger, 16.0–28.2 mm.

5(6) Middle part of abdominal sternites impunctate and without pubescence, at most with a single row of punctures nearing hind-margin of sternites. Third subapical spine of pro-tibia of male curved downwards (Fig. 3, 9). Tooth on the hind side of meta-femora of male larger than that on meta-trochanter. Pronotal punctation as in Fig. 3, 2.

1. *G. spiniger* (Marsh.) (Fig. 1)

6(5) Abdominal sternites with dense punctures and pubescent at full width. Pro-tibia of male with tooth and adjacent keel on ventral side**, its third subapical spine not curved downwards (Fig. 3, 10). Tooth on the meta-trochanter of male usually larger than that on the hind side of meta-femora. Pronotal punctation as in Fig. 3, 3, 4.

2. *G. stercorarius* (L.)

7(4) Pronotum with irregular punctures on disc, distinguishable on magnification $\times 4$ (Fig. 3, 5, 6). Meta-tibia with 2 complete transverse ridges in apical part, third ridge interrupted (Fig. 3, 12). Elytral striae fine and wrinkled, intervals flat. Smaller, 12.0–19.2 mm.

3. *G. stercorosus* (Scriba)

8(3) Pronotum with very dense double punctures (Fig. 3, 7, 8). Basal bead of pronotum obliterated on each side of the middle. Elytral striae extremely faint. Terminal spine of pro-tibia of male split apically (Fig. 3, 14). Dorsal surface of the body metallic green, metallic blue, or rarely black-blue.

4. *G. vernalis* (L.)

** Check for *G. stercorarius* f. *minor*. See systematics remarks on *G. stercorarius* in the next section.

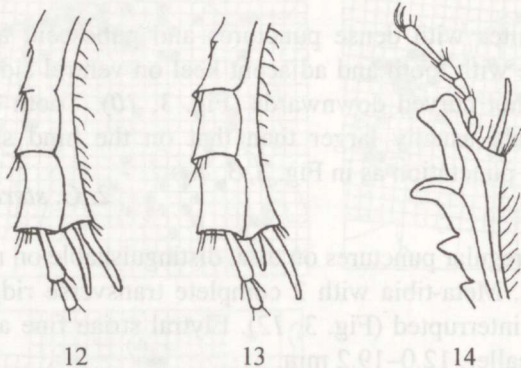
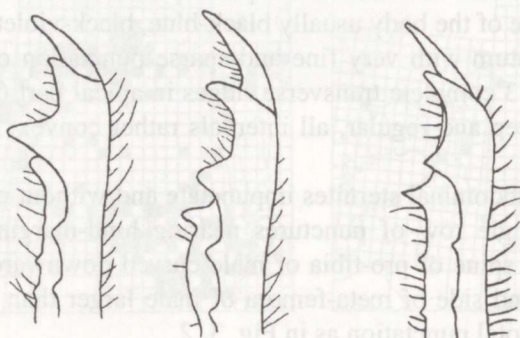
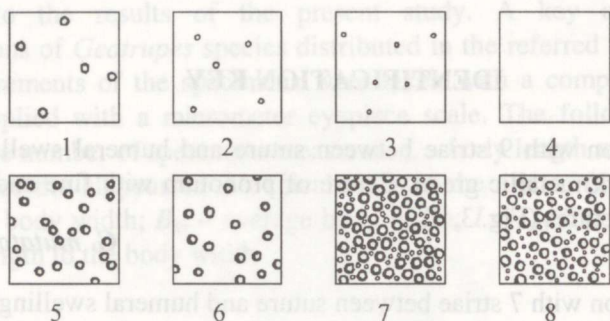


Fig. 3. Morphological details: 1-8, pronotum punctation; 9-11, pro-tibia of male; 12, 13, meta-tibia; 9-11, side view; 12-14, dorsal view.
 1, *G. mutator*; 2, 9, *G. spiniger*; 3, 4, 10, 11, 14, *G. stercorarius* (10, *G. stercorarius* f. *typica*;
 11, *G. stercorarius* f. *minor*); 5, 6, 12, *G. stercorosus*; 7, 8, 14, *G. vernalis*.

Geotrupes mutator (Marsham, 1802)

Not found in Estonia, but likely to be discovered. Very rare in Latvia, found in 1960 in the SE part of the country (Barševskis, 1993).

General distribution: West, Central, East, and South Europe, southern part of North Europe, the Caucasus, Asia Minor, Morocco, East China. Distribution in the northern part of Europe as in Fig. 4a.

1. *Geotrupes spiniger* (Marsham, 1802)

Material: 27 specimens from the western part of Estonia (Fig. 2b). Karuse, 1.09.1968, 2 ♂♂ (G. Miländer); Padise, cow dung, 4.09.1971, 1 ♀ (G. Miländer); Hiiumaa Island, Kaleste, 26.09.1987, 1 ♂ (A. Tamm); Hiiumaa Island, Kõpu, Suurepsi, 13.08.1990, 6 ♂♂, 6 ♀♀ (M. Kruus); Hiiumaa Island, Tahkuna, 15.08.1990, 1 ♂, 2 ♀♀ (M. Kruus); Hiiumaa Island, Kidaste, horse dung, 19.10.1990, 1 ♂ (G. Miländer); Vormsi Island, Hullo, 14.08.1991, 1 ♂ (V. Nagirnõi); Vormsi Island, Sviby, cow dung, 18.08.1991, 1 ♀ (V. Nagirnõi); Salevere, 12.09.1992, 1 ♂ (the Museum of Estonian Agricultural University); Vormsi Island, 1 km W of Suuremõisa, compost, 13.09.1993, 1 ♂, 1 ♀ (G. Miländer); Muhu Island, Liiva, cow dung, 4.09.1994, 2 ♂♂ (G. Miländer).***

Measurements: $n = 16$; $L = 19.0\text{--}24.0$; $L_{av} = 22.5$; $B = 10.8\text{--}13.1$; $B_{av} = 12.3$; $I = 1.83$.

This species was identified for the first time after two specimens from Vormsi Island by V. Nagirnõi. Further examination of the available collection material revealed 25 more specimens. All beetles were caught in August and September (Fig. 5a) mainly from cow or horse dung, on one single occasion from compost. All the 12 specimens from Suurepsi, Hiiumaa Island, were caught in flight at dusk-time.

This species keeps mainly to the open areas. Both adults and larvae feed invariably upon dung.

General distribution: West, Central, East, and South Europe, southern part of North Europe, the Caucasus, South-West Asia, Middle Asia. Distribution in the northern part of Europe as in Fig. 4b. Local and not very common species in this territory. To our knowledge Padise is the northernmost locality for *G. spiniger*.

*** Note: After the paper had been sent to the Editor, *G. spiniger* was found from two new localities in southern Estonia: Lutepää, horse dung, 24.07.1997, 1 ♂; Tsigumäe, horse dung, 5.08.1997, 2 ♀♀, 6 ♂♂; 21.08.1997, 1 ♀, 4 ♂♂, and from Abruka Island, cow dung, 16.07.1997, 1 ♀. All found by I. Süda.

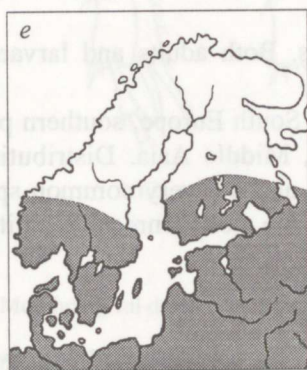
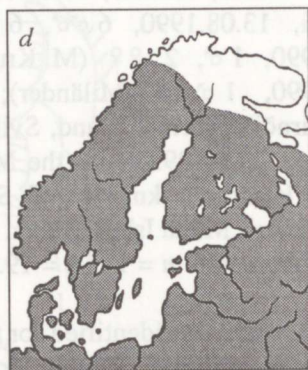
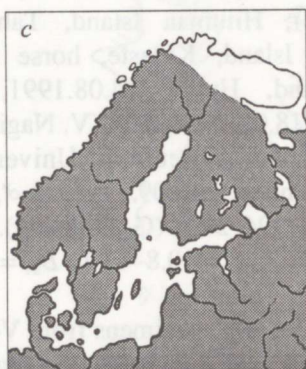
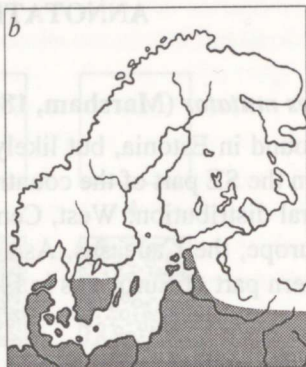
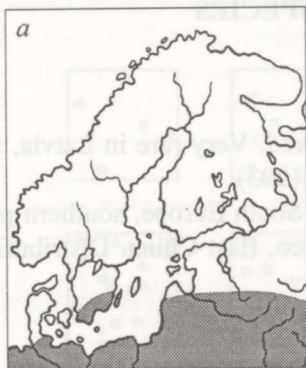


Fig. 4. Maps of the distribution of *Geotrupes* spp. in the northern part of Europe: a, *G. mutator*; b, *G. spiniger*; c, *G. stercorarius*; d, *G. stercorosus*; e, *G. vernalis*.

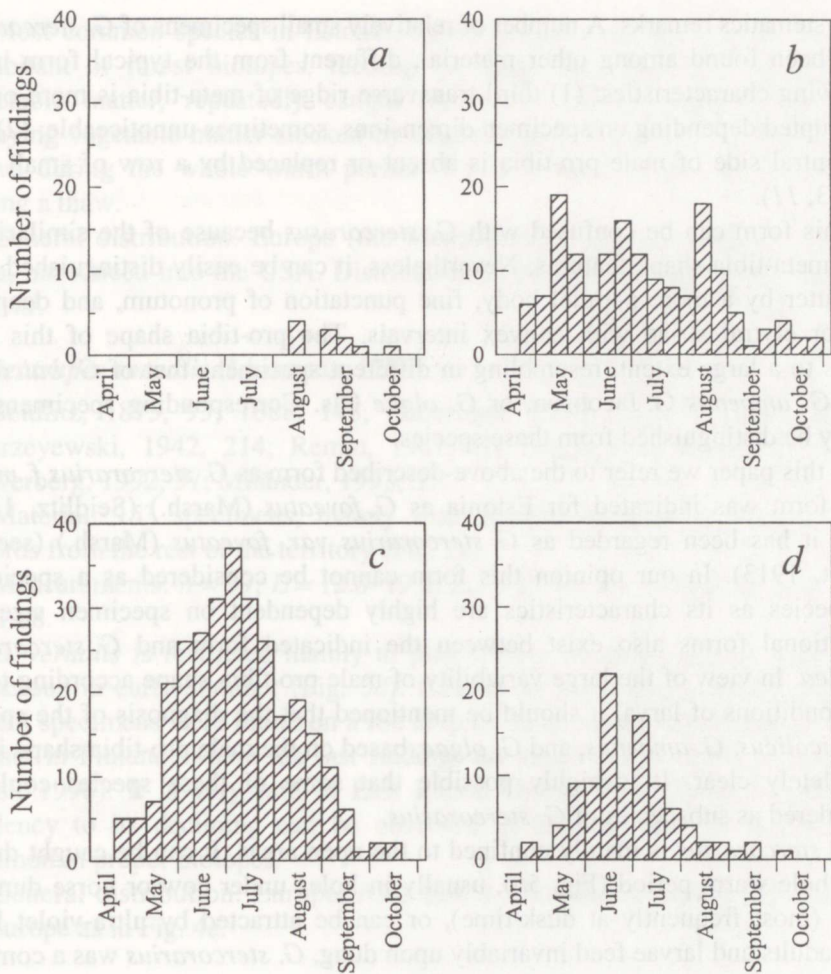


Fig. 5. Phenograms: a, *Geotrupes spiniger*; b, *G. stercorarius*; c, *G. stercorosus*; d, *G. vernalis*.

2. *Geotrupes stercorarius* (Linnaeus, 1758)

Seidlitz, 1875, 92 (*putridarius* Er.); 1888, 147; Sumakov, 1931, 8; Haberman, 1936, 21; 1950, 461; 1985, 174; 1993, 40; Szeliga-Mierzeyewski, 1942, 214; Remm, 1967, 76; Merivee & Remm, 1973, 105; Silfverberg, 1992, 37; Miländer, 1993, 33.

Material: 204 specimens from the entire territory (Fig. 2c).

Measurements: $n = 72$; $L = 16.0-28.2$; $L_{av} = 22.25$; $B = 9.1-14.0$; $B_{av} = 12.22$; $I = 1.82$.

Systematics remarks. A number of relatively small specimens of *G. stercorarius* have been found among other material, different from the typical form in the following characteristics: (1) third transverse ridge of meta-tibia is more or less interrupted depending on specimen dimensions, sometimes unnoticeable; (2) keel on ventral side of male pro-tibia is absent or replaced by a row of small teeth (Fig. 3, 11).

This form can be confused with *G. stercorosus* because of the similarity of their meta-tibia shape features. Nevertheless, it can be easily distinguished from the latter by a more parallel body, fine punctation of pronotum, and deep and regular elytral striae with convex intervals. The pro-tibia shape of this form varies to a large extent, resembling in different specimens that of *G. baicalicus* Rtt., *G. amoenus* G. Jacobson, or *G. olgae* Ols. Corresponding specimens can hardly be distinguished from these species.

In this paper we refer to the above-described form as *G. stercorarius f. minor*. This form was indicated for Estonia as *G. foveatus* (Marsh.) (Seidlitz, 1891). Later it has been regarded as *G. stercorarius var. foveatus* (Marsh.) (see e.g. Kuhnt, 1913). In our opinion this form cannot be considered as a species or subspecies as its characteristics are highly dependent on specimen size and transitional forms also exist between the indicated form and *G. stercorarius f. typica*. In view of the large variability of male pro-tibia shape according to the life conditions of larva, it should be mentioned that the diagnosis of the species *G. baicalicus*, *G. amoenus*, and *G. olgae*, based on the male pro-tibia shape is not completely clear. It is highly possible that some of these species could be considered as subspecies of *G. stercorarius*.

G. stercorarius is mainly confined to the open areas. It can be caught during the whole warm period (Fig. 5b), usually in holes under cow or horse dung, in flight (most frequently at dusk-time), or can be attracted by ultra-violet light. Both adults and larvae feed invariably upon dung. *G. stercorarius* was a common species in Sweden and Finland in the first half of this century (Hellen, 1947). While it has recently been shown to decline in Finland due to the changes in livestock rearing (Väisänen & Rassi, 1990), it is a rather common species in Estonia.

General distribution: West, North, Central, and East Europe (east to Moscow district), South European mountains. In the eastern part of Europe and Siberia replaced by a close species *G. baicalicus*. Introduced into East Canada. Distribution in the northern part of Europe as in Fig. 4c.

3. *Geotrupes stercorosus* (Scriba, 1791)

Seidlitz, 1875, 92; 1888, 148 (*sylvaticus* Panz.); Haberman, 1936, 21; 1950, 461; 1971, 321; Szeliga-Mierzejewski, 1942, 214; Remm, 1967, 76; Merivee & Remm, 1973, 106; Silfverberg, 1992, 37; Miländer, 1993, 33.

Material: 380 specimens from the entire territory (Fig. 2d).

Measurements: $n = 64$; $L = 12.0-19.2$; $L_{av} = 16.41$; $B = 7.4-10.8$; $B_{av} = 9.43$; $I = 1.74$.

Most common species in Estonia, spread all over the territory. It is mainly inhabitant of forest biotopes, feeding on fungi, wild animal dung, decaying vegetable matter, repeatedly caught on animal corpse. Larvae feeds upon decaying vegetable matter stocked by adults in deep burrows. *G. stercorosus* is active during the whole warm period (Fig. 5c), once caught on 24 February during a thaw.

General distribution: Europe (the Mediterranean region excluded), Western Asia, introduced into the USA. Distribution in the northern part of Europe as in Fig. 4d.

4. *Geotrupes vernalis* (Linnaeus, 1758)

Seidlitz, 1875, 93; 1888, 148; Haberman, 1936, 21; 1971, 321; Szeliga-Mierzeyewski, 1942, 214; Remm, 1967, 76; Merivee & Remm, 1973, 106; Silfverberg, 1992, 37; Miländer, 1993, 33.

Material: 153 specimens, mainly from South-East Estonia, only scattered records from the rest of the territory (Fig. 2e).

Measurements: $n = 39$; $L = 12.8-19.8$; $L_{av} = 17.12$; $B = 7.8-12.0$; $B_{av} = 10.19$; $I = 1.68$.

G. vernalis is restricted mainly to pine forests on sandy soil. It is the most numerous in early summer (Fig. 5d). Caught on horse dung, rotting products, once 4 specimens were found on a roe corpse. This species has probably become extinct in Finland, where the last findings are dated before 1960 (Väisänen & Rassi, 1990). It is very rare in East Latvia (Barševskis, 1993). However, no tendency to its declining can be observed in Estonia. Here it is still rather common in proper biotopes.

General distribution: Europe, Asia Minor. Distribution in the northern part of Europe as in Fig. 4e.

REFERENCES

- Barševskis, A. 1993. *Austrumlatvijas vaboles*. Saule, Daugavpils.
- Haberman, H. 1936. Andmed Kuusnõmme bioloogiajaama ümbruse mardikalistest. *Eesti Loodus-teaduse Arhiiv, II seeria*, **16**, 1, 1-32.
- Haberman, H. M. 1950. Beetles of the coastal zone of the Estonian SSR (An ecological-zoogeographic study). Dr. habil. thesis. Tartu-Leningrad (in Russian).
- Haberman, H. 1971. Lääne-Eesti laialehiste lehtmetsade mardikalistest. *Faunistilisi märkmeid*, (Tartu), **1**, 4/5, 303-327.
- Haberman, H. 1985. Mardikalised (Coleoptera). In *Matsalu - rahvusvahelise tähtsusega märgala* (Kumari, E., ed.). Valgus, Tallinn, 168-181.
- Haberman, H. 1993. Järvelja mardikalistest (Coleoptera). In *Eesti Looduseuurijate Seltsi Aasta-raamat*, **74**. Järvelja ürgmetsa loodusest. Valgus, Tallinn, 33-48.
- Hellen, W. 1947. *Enumeratio Insectorum Fenniae et Suiciae. II. Coleoptera*. Oy. Tilgman Ab., Helsinki.
- Horion, Ad. 1958. *Faunistik der mittel-europäischen Käfer. B. VI. Lamellicornia (Scarabaeidae-Lucanidae)*. Überlingen-Bodensee.

- Kuhnt, P. 1913. *Illustrierte Bestimmungs-Tabelle der Käfer Deutschlands*. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.
- Landin, B. O. 1957. *Svensk Insektfauna 9, Coleoptera–Lamellicornia, Fam. Scarabaeidae*. Stockholm.
- Lengerken, H. von. 1939. *Die Brutfürsorge- und Brutpflege – Instinkte der Käfer*. Akad. Verlags G.m.b.H., Leipzig.
- Lengerken, H. von. 1954. *Die Brutfürsorge- und Brutpflege – Instinkte der Käfer. II Auflage*. Leipzig.
- Lindroth, C. H. 1960. *Catalogus Coleopterorum Fennoscandiae et Daniae*. Lund.
- Lundberg, S. 1986. *Catalogus Coleopterorum Sueciae*. Entomologiska Föreningen i Stockholm och Naturhistoriska Riksmuseet, Stockholm.
- Merivee, E. & Remm, H. 1973. *Mardikate määraja*. Valgus, Tallinn.
- Miländer, G. 1993. Hiiumaa mardikalised (Coleoptera). *Pirrujaak*, 2. Biosfääri Kaitseala Hiiumaa Keskus, Kärdla.
- Nikolaev, G. V. 1975. Review of the section *Geotrupes s. str.* (Coleoptera, Scarabaeidae). In *Insects of Mongolia*. Vol. 3. Nauka, Leningrad, 110–113 (in Russian).
- Nikolaev, G. V. 1987. Lamellicorn beetles (Coleoptera, Scarabaeidae) of Kazakhstan and Middle Asia. Nauka, Alma-Ata, 232 (in Russian).
- Nikolaev, G. V. & Puntsagdulam, Zh. 1984. Lamellicornia (Coleoptera, Scarabaeidae) of the Mongolian People's Republic. In *Insects of Mongolia*. Vol. 9. Nauka, Leningrad, 90–294.
- Remm, H. 1967. *Putukate välimääräja II. Mardikalised*. Tartu Riiklik Ülikool, Tartu.
- Seidlitz, G. 1875. *Fauna Baltica. Die Käfer (Coleoptera) der Ostseeprovinzen Russlands*. Archiv für Naturkunde Liv-, Ehst- und Kurlands, 2. Ser., Bd. 5. Dorpat.
- Seidlitz, G. 1887–1891. *Fauna Baltica. Die Käfer (Coleoptera) der Deutschen Ostseeprovinzen Russlands*. II. Königsberg (*Geotrupes* – Lief. 2, 1888).
- Silfverberg, H. 1992. *Enumeratio Coleopterorum Fennoscandiae, Daniae et Baltiae*. Helsingin Hyönteisvaihtoyhdistys, Helsinki.
- Sumakov, G. G. 1931. Beiträge zur Fauna der Coleopteren von Estland. *Arch. Naturk. Estl.*, Ser. II (Tartu), 13, 2, 1–15.
- Szeliga-Mierzewski, W. v. 1942. Verzeichnis der Käfer Ösels in meiner Insektensammlung. *Korrespondenzbl. Naturt.* (Riga), 64, 180–230.
- Väisänen, R. & Rassi, P. 1990. Abundance and distribution of *Geotrupes stercorarius* in Finland (Coleoptera, Scarabaeidae). *Entomol. Fenn.*, 1, 2, 107–111.
- Yablokov-Khnozoryan, S. M. 1976. *Lamellicornia (Scarabaeidae). Fauna of Armenian SSR*. Vol. 6. Erevan. Acad. Sci. Arm. SSR (in Russian).

EESTI PÖRNIKLASED PEREKONNAST SITIKAS (*Geotrupes* Latr.) (COLEOPTERA, SCARABAEIDAE)

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Olemasoleva kollektsoonimaterjali ja teaduskirjanduses leidunud andmete analüüsi põhjal on välja selgitatud perekonna sitikas (*Geotrupes* Latr.) nelja liigi levik ja fenoloogia Eestis, kusjuures liigi *G. spiniger* esinemist Eestis on märgitud esmakordselt. Uuritud perekonna Euroopa põhjaosas levinud viie liigi eristamiseks on toodud määramistabel.