

## Abundance and distribution of *Geotrupes stercorarius* in Finland (Coleoptera, Scarabaeidae)

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Distribution maps based on the UTM grid are given for *G. stercorarius* for the periods before 1960, 1960–1979 and 1980 onwards. Records made in the 1980s with data on the abundance are given in 10 km × 10 km squares. Though still widely distributed in Finland, *G. stercorarius* is no longer a common species. Changes in livestock rearing, especially the loss of permanent pastures, are suggested to be the main reason for the decline of this dung beetle. The related species *G. stercorosus* is still common, but *G. vernalis* may have disappeared from Finland.

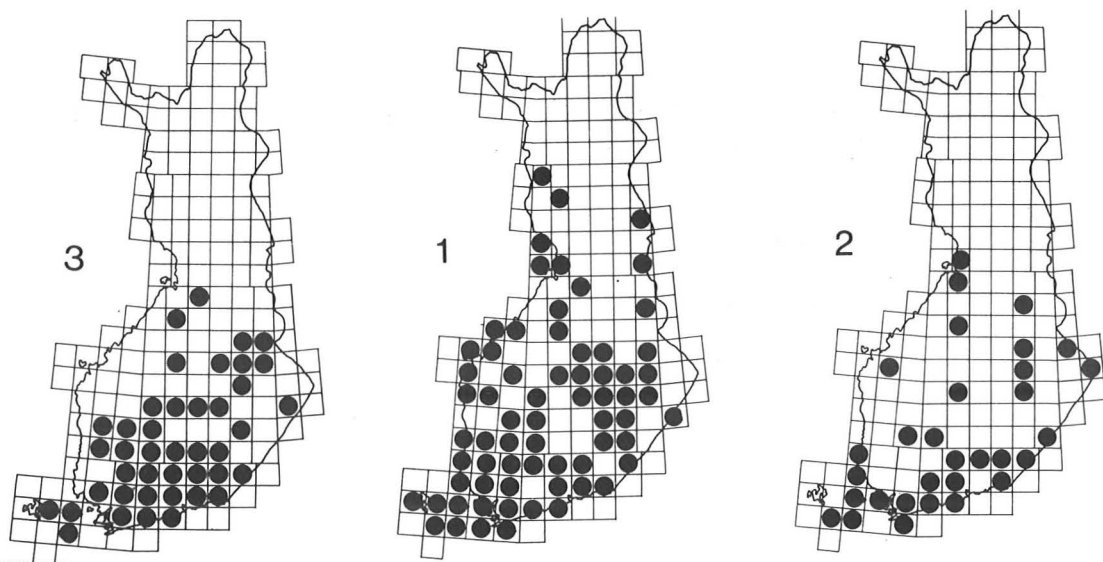
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During this century, the Finnish agricultural ecosystem has changed radically (Soininen 1974, Raatikainen 1986), causing marked alterations in the insect fauna (e.g. Väisänen 1988). An insect group suggested to have been strongly affected by these changes is the dung beetles, the most conspicuous species of which is *Geotrupes stercorarius* (Linnaeus). It is well known to older people and references to the species can be found even in the Finnish folklore. Since there has been much speculation about the decline of this species in Finland, it was desirable to gather the available old data and obtain information on the present distribution and abundance. The species has recently been considered to be in need of monitoring by the Committee for the Conservation of Threatened Animals and Plants in Finland (Rassi et al. 1986).

### Material and methods

The museum specimens of *G. stercorarius*, *G. stercorosus* (Scriba) and *G. vernalis* (Linnaeus) were checked in Helsinki (Zoological Museum and Department of Agricultural and Forest Zoology), Kuopio, Oulu and Turku. In addition, we had access to the private collections of several prominent coleopterologists. To obtain information on the species in the 1980s, questionnaires were sent to two large groups of naturalists; one to the members of the Finnish entomological societies and the other to the members of the Finnish Bird Ringing Association. The latter group was involved because *G. stercorarius* is known to be a nuisance to ornithologists who use nets on agricultural land. Uncertain records were mostly checked from collected specimens by the authors



Figs. 1–3. Distribution of *G. stercorarius* in Finland. Maps based on the UTM grid: 1 – before 1960, 2 – 1960–1979, 3 – 1980 onwards.

or other members of the national Coleoptera Recording Scheme. In addition, the authors made field observations on *G. stercorarius* at *Ta*: Kangasala Suomela (68204:3414).

## Results

The distribution of *G. stercorarius* is mapped using the UTM grid system in Figs. 1–3 and that of *G. vernalis* in Fig. 4. It seems probable that *G. stercorarius* has declined, at least in southernmost Finland, although this tendency is slightly masked by the increase in observation intensity. The distribution is relatively scattered in the 1980s (Fig. 5). Flourishing populations of *G. stercorarius* (3 or more individuals recorded) are known from the following localities: *Ab*: Nummi-Pusula, *N*: Inkoo, *Ka*: Virolahti, *St*: Kokemäki, *Ta*: Jokioinen, Kangasala, Ruovesi, Heinola mlk., *Tb*: Keuruu, Virrat, *Sb*: Nilsjä, Varpaisjärvi, *Kb*: Nurmes, *Kn*: Sotkamo. Single individuals were found at several localities, the northernmost record being from *Ob*: Utajärvi 1986. An absence of observations was commonly reported in the areas between, often with records of *G. stercorosus*, which is still common.

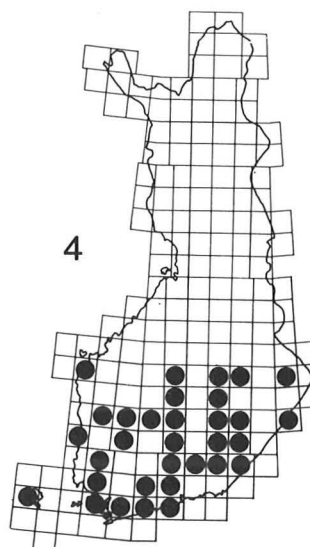


Fig. 4. Distribution of *G. vernalis* in Finland. All records made prior to 1960.

Although *G. vernalis* has been recorded from about 50 localities in Finland, most records are from the 1800s. No verified recent observations exist, the last record being from *Sa*: Puumala

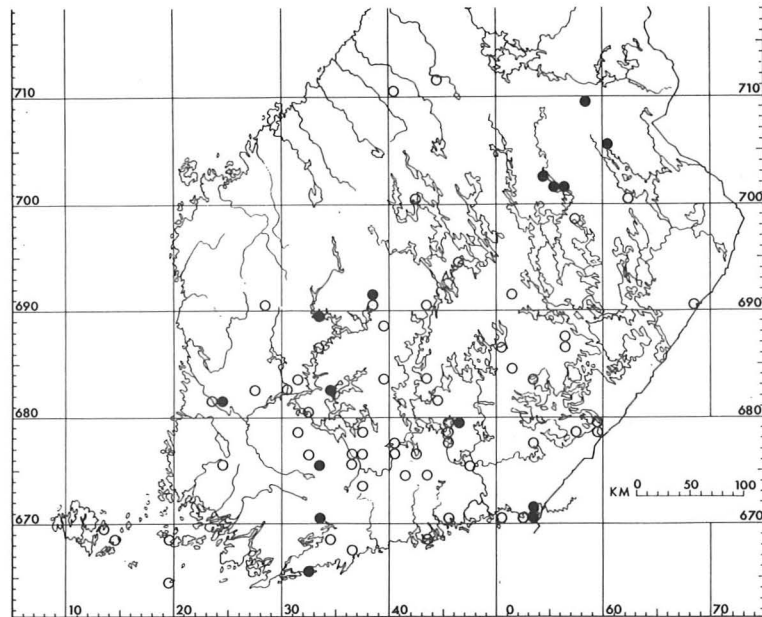


Fig. 5. Distribution of *G. stercorarius* in Finland in the 1980s mapped on the Finnish uniform grid with 100 km<sup>2</sup> squares. Open circles – 1–2 observations, black dots – 3 or more individuals recorded.

(exact year not known, but apparently prior to 1960).

The decline of *G. stercorarius* is most distinct on the southern coast and near cities. Recent records are mostly from the areas of traditional agriculture and often associated with the presence of permanent pastures. Outside these areas, only single individuals were found. A few observations are from compost heaps and a couple of slightly uncertain records from dung of deer and elk. At Kangasala, where the species is very abundant in an old pasture, the densities were highest on a stony slope (B) which cannot be ploughed (Fig. 6). The estimate for the population size, assuming an unbiased sex ratio, was approximately 6 000 individuals. Other characteristic species associated with the traditional agriculture in this locality are listed in Table 1.

Most records concerned individuals in flight or in cow dung. A few were found in light-trap catches (*N*: Riihimäki, *Ka*: Virolahti, *Ta*: Koski, *Jämsänkoski*, *Sb*: Juankoski). Although *G. stercorarius* may be abundant in bird nets (more than 50 individuals caught per year at Kangasala), only one new record was obtained by this means, from *Ab*: Korpo, Jurmo 1987.

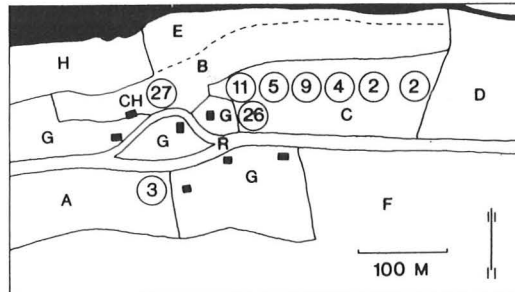


Fig. 6. Study site at *Ta*: Kangasala Suomela in 1988 with the number of the oviposition tunnels of *G. stercorarius* per 100 m<sup>2</sup> in the nine sample plots. Habitats of the species: A: temporary pasture (1986–), B: permanent pasture, C: temporary pasture (1982–), D: now field but temporarily pasture. Pastures A–C are fairly evenly grazed and the differences in pat densities are small (higher only in the case with 26 tunnels/100 m<sup>2</sup>). Surrounding habitats: E: wet permanent pasture, F: field, G: garden, H: deciduous forest, CH: cow-house, R: road.

### Discussion

The results show that today *G. stercorarius* is at least a very local, if not a rare species. The exten-

Table 1. Other characteristic uncommon species associated with traditional agriculture and co-occurring with *G. stercorarius* in a pasture at Ta: Kangasala Suomela. Species declining in Finland are indicated by \* and expansive species by +.

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Carabidae	<i>Amara littorea</i> Thomson *
	<i>Perigona nigriceps</i> (Dejean) +
Hydrophilidae	<i>Cercyon laminatus</i> Sharp
Ptiliidae	<i>Ptilium minutissimum</i> (Ljungh) *
Catopidae	<i>Catops fuscus</i> (Panzer) *
Staphylinidae	<i>Philonthus discoideus</i> (Gravenhorst) *
	<i>P. pseudovarians</i> Strand
	<i>P. longicornis</i> Stephens *
	<i>P. parvicornis</i> (Gravenhorst) *
	<i>Dinothenarus pubescens</i> (Degeer) *
	<i>Leptacinus batychnus</i> (Gyllenhal) *
	<i>Gauropterus fulgidus</i> (Fabricius)
	<i>Astenus pulchellus</i> (Heer)
	<i>Rugilus scutellatus</i> (Motschulsky)
	<i>Pseudomedon obscurella</i> (Erichson)
	<i>Lithocaris ochracea</i> (Gravenhorst) *
	<i>Oxytelus migrator</i> Fauvel +
	<i>Tachinus marginatus</i> Gyllenhal *
	<i>T. lignorum</i> (Linnaeus)
	<i>Atheta xanthopus</i> (Thomson)
	<i>A. coriaria</i> (Kraatz)
	<i>Acrotoma pusilla</i> (Brundin) *
	<i>Bohemiellina flavipennis</i> (Cameron) +
	<i>Thecturota marchii</i> (Doderö) +
Histeridae	<i>Margarinotus ventralis</i> (Marseul) *
	<i>Hister funestus</i> Erichson *
	<i>Atholus bimaculatus</i> (Linnaeus) *
	<i>A. duodecimstriatus</i> (Schränk) *
Nitidulidae	<i>Carpophilus marginellus</i> Motschulsky +
	<i>C. hemipterus</i> (Linnaeus) +
Monotomidae	<i>Monotoma bicolor</i> Villa
Cucujidae	<i>Ahasverus advena</i> (Waltl) +
Cryptophagidae	<i>Cryptophagus laticollis</i> Lucas
	<i>Caenoscelis subdeplanata</i> Brisout de Barneville
Latridiidae	<i>Thes bergrothi</i> (Reitter)

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sively circulated questionnaires revealed the existence of only a handful of more abundant populations. However, the distribution is still relatively wide, though scattered, in Finland. The liability to extinction is high in small local populations. If the changes in the agricultural ecosystem continue in the same direction, it can be predicted that in the future *G. stercorarius* will be found only around a few stables and traditionally managed cowsheds. *G. stercorosus*, which is still common, has a wider range of habitats, including forests. It is not strictly associated with livestock rearing. *G. vernalis*, which is mainly associated with sheep and prefers dry sandy sites, may have disappeared from Finland. The drastic decline of this species happened considerably earlier than that of *G. stercorarius*.

The monitoring of *G. stercorarius* can most easily be carried out by checking dung pats in suitable pastures. Light traps can only occasionally provide additional information on the distribution. Bird nets, which have seldom been used in entomology (e.g. Gärdenfors et al. 1978), may be useful locally in obtaining phenological data.

Johnson (1962) attributed the changes in the scarab fauna of Lancashire and Cheshire to urban development and industrialization. Similar factors have surely affected *G. stercorarius* in Finland. The changes in the numbers of cattle and their present more concentrated distribution obviously also affect the abundance and distribution of dung beetles (Hanski 1986). In particular, the drastic decrease in the number of horses in the 1950s and 1960s (e.g. Raatikainen 1986) has surely affected *G. stercorarius*. The recent observations suggest that the chief reasons for the decline of the species include other changes in livestock rearing, especially the loss of long-term and permanent pastures and the end of cow grazing in traditional forest pastures. *G. stercorarius* needs a relatively stable agricultural environment, i.e. dung should be constantly available and the grazing tradition should not be interrupted for years without other suitable habitats in the vicinity. In addition, the quality of cow droppings may have changed, due to the use of modern cow feed with additives.

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