Abundance and distribution of coprophilous Histerini (Histeridae) and *Onthophagus* and *Aphodius* (Scarabaeidae) in Finland (Coleoptera)

Olof Biström, Hans Silfverberg & Ilpo Rutanen

Biström, O., Silfverberg, H. & Rutanen, I. 1991: Abundance and distribution of coprophilous Histerini (Histeridae) and *Onthophagus* and *Aphodius* (Scarabaeidae) in Finland (Coleoptera). — Entomol. Fennica 2:53–66.

The distribution and occurrence, with the time-factor taken into consideration, were monitored in Finland for the mainly dung-living histerid genera *Margarinotus*, *Hister*, and *Atholus* (all predators), and for the Scarabaeidae genera *Onthophagus* and *Aphodius*, in which almost all species are dung-feeders. All available records from Finland of the 54 species studied were gathered and distribution maps based on the UTM grid are provided for each species with brief comments on the occurrence of the species today. Within the Histeridae the following species showed a decline in their occurrence: *Margarinotus purpurascens*, *M. neglectus*, *Hister funestus*, *H. bissexstriatus* and *Atholus bimaculatus*, and within the Scarabaeidae: *Onthophagus nuchicornis*, *O. gibbulus*, *O. fracticornis*, *O. similis*, *Aphodius subterraneus*, *A. sphacelatus* and *A. merdarius*. The four *Onthophagus* species and *A. sphacelatus* disappeared in the 1950s and 1960s and are at present probably extinct in Finland. Changes in the agricultural ecosystems, caused by different kinds of changes in the traditional husbandry, are suggested as a reason for the decline in the occurrence of certain vulnerable species.

Olof Biström & Hans Silfverberg, Finnish Museum of Natural History, Zoological Museum, Entomology Division, N. Järnvägsg. 13, SF-00100 Helsingfors, Finland
Ilpo Rutanen, Water and Environment Research Institute, P.O. Box 250, SF-00101 Helsinki, Finland

1. Introduction

In recent decades considerable changes have taken place in the Finnish agricultural landscape and in its ecosystems. As a result we can expect changes both in the composition of the fauna and in the abundance of different species living in an agricultural environment. Accordingly, the beetle fauna living in dung is also affected, as for instance shown in a monitoring study of the scarabaeid genus *Geotrupes* in Finland (Rassi & Väisänen 1990). For many years collectors of Coleoptera have discussed the possible decline in the occurrences of beetle groups living in dung. Many species seemed to have become distinctly rarer during the 1960s and 1970s, and some species even appeared to have disappeared completely. Because of this a special project was started by an unofficial group for monitoring threatened Coleoptera in Finland. This group consists of the following coleopterists (in alphabetical order): Olof Biström (Helsingfors), Tom Clayhills (Pargas), Eero Helve (Espoo), Esko Kangas (Hel-

Table 1. Number of records and ecological characterisation of examined species (see also Results). — A = accidental, C = cosmopolitan, E = eurytopic, O = oligotopic, P = predator, S = stenotopic.

	<1920	1920 –29	1930 –39	1940 –49	1950 –59	1960 –69	1970 –79	1980 –89	1990	Total	Ecological characterisation (mainly Horion 1949, Landin 1961)
Histeridae											
Margarinotus brunneus	8	5	13	12	11	16	4	11	1	81	P, carrion, dung
merdarius	1	1	8	6	12	8	4	5	3	48	P, carrion, dung
striola	44	14	70	91	76	59	47	120	1	522	P, carrion, dung
obscurus			1							1	P, carrion, dung
purpurascens	15	13	15	34	13	8	4	5		107	P, particularly dung
neglectus	14	3	6	18	8	4		2		55	P, carrion, dung
ventralis	7	2	2	11	12	1	1	31	4	71	P, particularly dung
Hister unicolor	24	10	29	28	22	31	21	35	1	202	P, carrion, dung
helluo					1		1			2	P,A, spec. *Agelastica alni*
funestus	25	7	23	22	9	3	2	7		98	P, particularly dung
bissexstriatus	11	2	9	22	5	2		1?		62	P, compost
Atholus bimaculatus	2	2	14	16		4	4	3	2	47	P, compost, dung
duodecimstriatus	16	2	13	28	9	19	12	3	1	108	P, compost, dung
corvinus				1						1	P,A?, carrion, dung
Scarabaeidae											
Onthophagus nuchicornis	17		2	3	1					23	S, exposed sandy habitats
gibbulus	2	1		2	1	1				7	S, exposed sandy habitats
fracticornis	2	1	2	2						7	S, exposed sandy habitats
similis	1	2								3	S, exposed sandy habitats
Aphodius erraticus	13	1	1	3	2		1	9		30	O, exposed habitats
subterraneus	35	9	45	55	11	10	1			166	E
fossor	20	5	29	42	31	23	10	39		199	O, exposed habitats
haemorrhoidalis	21	6	31	33	18	14	14	26	2	155	E
brevis			3	9	6	6	2	6		32	O, prefers forests
putridus				1	1					2	S, exposed sandy habitats
rufipes	70	9	41	53	82	97	72	113	2	539	E
depressus	70	7	26	33	24	16	15	55	2	258	O, shaded habitats
luridus	3									3	O, exposed habitats
pusillus	56	24	54	83	34	24	23	21	2	321	E
coenosus	8		2	2						12	O, exposed sandy habitats
contaminatus	1			5						6	E
conspurcatus	20	9	10	33	13	5	12	3		105	O, prefers forests
paykulli								1		1	O, prefers forests
distinctus	11	9	10	22	13	4	5	5		80	E
sabulicola	1	3	4	6			2	1		17	E
sphacelatus	18	10	41	40	21	2				132	E
prodromus	5	6	40	69	54	41	42	44	2	303	E
serotinus				?1		1				2	?
tomentosus	1									1	?, A?, exposed habitats
merdarius	11	5	8	24	19	12	14	2		95	O, exposed habitats
fimetarius	69	25	85	102	77	70	49	125		602	E
foetens	12	2	12	15	8	7	1	7		64	O, exposed sandy habitats
tenellus	29	8	12	29	13	7	15	45		158	O, prefers shaded habitats
ater	14	4	15	26	20	13	10	28	1	131	E
borealis	30	7	21	22	20	36	56	52	1	245	O, prefers shaded habitats
nemoralis	3	2	3	19	2	7	19	36	3	94	S, forests
lapponum	11	6	9	8	21	9	17	21	1	103	O, mountains, forests
piceus	24	7	25	28	35	5	19	29	1	173	E
sordidus	19	5	13	23	19	14	12	7		112	O, exposed sandy habitats
scybalarius	45	10	32	47	53	51	52	59	1	350	O, exposed habitats
ictericus	4	2	6	6	2	10		2		32	E, prefers exposed habitats
niger	36	9	17	28	7	2	2	5		106	not dung-feeder
plagiatus	15	8	9	17	4		4	1		58	not dung-feeder
lividus			2	4						6	C, A?
granarius	6	2	3	3	2	1				17	E
Total	870	265	786	1187	792	643	567	982	31	6123	

sinki), Ilpo Mannerkoski (Helsinki), Jyrki Muona (Oulu), Pertti Rassi, chairman (Helsinki), Ilpo Rutanen (Hyvinkää) and Hans Silfverberg (Helsingfors).

The main purpose of the present survey was to gather all available information on the distribution and occurrence in Finland of histerids living in dung (the genera *Margarinotus*, *Hister* and *Atholus*), and among the Scarabaeidae the genera *Onthophagus* and *Aphodius*. Altogether the number of species studied was 54. One *Hister* species and two *Aphodius* species are included in the survey although they are not dung-living. For each species we present an UTM map of distribution, in which the time factor is also taken into consideration. Our main interest is to find out in which species a decline in occurrence can be observed, when the decline has happened, and which factors could have caused the decline. This survey is also meant to serve as a basis for forthcoming ecological research, which aims to elucidate the background in the decline in the occurrence of certain species.

2. Material and methods

For this survey all available insect collections in Finland, both private and those kept in different museums, were examined. Additional information on the occurrence of certain species in Finland was gathered from the literature. Some field work was also done in 1989, with the aim of receiving more data from areas where the sampling had previously been occasional. All coleopterists in Finland were also activated into collecting the beetle groups being surveyed, so that as much recent data as possible would be obtained.

3. Results

The results of the survey are shown in the UTM maps (Figs. 1-54) and for each species we give a brief estimation of its present status in Finland.

The distribution in time is presented in Table 1. The numbers given for each species per decade represent separate records, so that for each locality all specimens collected during one year are counted as one record. In this way it was hoped that the highly variable collecting intensity could be disregarded. Collections of material older than 1920 have been lumped as one column because the total amount is small compared with later years. Moreover, the abandonment of traditional agricultural methods was insignificant before 1920.

Histeridae

Margarinotus brunneus (Illiger)

M. impressus (Fabricius), *M. cadaverinus* (Hoffmann)

A fairly common species in Finland. The range of the species extends from the south northwards and covers more than half of the country. Most records are from the southern parts of Finland. No decline in the occurrence of *M. brunneus* was oberved. Fig. 1.

M. merdarius (Hoffman)

A comparatively rare species in Finland. Scattered samples exist from the southern parts of the country. No changes in the occurrence of the species were noted. Fig. 2.

M. striola (Sahlberg)

At least in southern Finland, by far the most commonly sampled species. The distribution of *H. striola* covers almost the whole country. In Lapland only known from one square. No decline was observed. Fig. 3.

M. obscurus (Kugelann)

M. stercorarius (Hoffmann)

Only one record is known from Finland, namely *N* Tvärminne 1939, Palmén leg. Permanent occurrence in Finland highly doubtful. Palmén (1944) considered the species a foreign element, which possibly had come to Finland by anemohydrochorous dispersal. Fig. 4.

M. purpurascens (Herbst)

A widely distributed and previously quite commonly sampled species in Finland. The range of the species covers the southern half of the country. Since the 1960s only recorded in the southwestern parts of Finland. This species was possibly adversely affected by changes in agricultural methods. Fig. 5.

M. neglectus (Germar)

Distribution and occurrence in Finland approximately as in *M. purpurascens*, but slightly rarer. Although a few recent records exist *M. neglectus* may be an endangered species today. Fig. 6.

M. ventralis (Marseul)

A fairly common species in the southern and eastern parts of Finland. Several recent records exist and it seems evident that no decline has taken place. Fig. 7.

Hister unicolor Linnaeus

A common species, which is distributed throughout Finland. No decline in the occurrence of the species was observed, except that there are few recent records from the north. Fig. 8.

H. helluo Truqui

Only two records exist of this species from Finland. The older record is from the province of *Al* Hammarland, 15.VIII.1950, E.Kangas leg., and the more recent record is from *Kb* Ilomantsi, 21.VI.1974, J.Muona leg. The species is probably accidental in Finland. In contrast to its congeners it is not a dung-living species, rather it is known as a predator on larvae of the leaf beetle species *Agelastica alni* (Horion 1949, Koch 1989). Fig. 9.

H. funestus Erichson

Previously a quite abundantly sampled species, the range of which covers the southern parts of Finland. From the 1950s on the records are much fewer, which indicates a distinct decline in the occurrence of this species in Finland. Fig. 10.

H. bissexstriatus Fabricius

This species was previously quite abundantly sampled in southern Finland. Only a few records exist from the 1960s and 1970s. Additionally the species is reported from *Ta* Ylöjärvi 1980, M.Pohjola leg, but this record has not yet been checked. A distinct decline in the occurrence of the species seems to have taken place in the 1960s. Fig. 11.

Atholus bimaculatus (Linnaeus)

A comparatively rare species in Finland. Almost all records are from the southwestern parts of the country, and most of them are from the 1930s and 1940s. Recent records of *A. bimaculatus* are rather few and it is possible that the species undergoes (–is undergoing??) fluctuation. Fig. 12.

A. duodecimstriatus (Schrank)

A fairly common species, which has been collected in the southern half of Finland. No decline in the occurrence of the species was observed. Fig. 13.

A. corvinus (Germar)

Only once recorded from Finland: *Sb* Tuusniemi, 1.VII.1941, E. Kangas leg. Probably an accidental species in Finland. Fig. 14.

Scarabaeidae

Onthophagus nuchicornis (Linnaeus)

The decline of this species is evident and today it is most probably extinct in Finland. The last certain record of the species is from *Ta* Lammi, 3.VI.1955, J.Kaisila leg. The record from *Ta* Ypäjä 1958 is unclear. Before the 1950s and 1960s *O. nuchicornis* occurred scattered but quite abundantly in the southern and southeastern parts of Finland. According to Landin (1958) the species generally occurs on sandy ground in cow and horse manure. Fig. 15.

O. gibbulus (Pallas)

This species has probably disappeared from Finland, too. The last record of it is from the province of *N* Mäntsälä 1961. Previously the distribution of *O. gibbulus* covered the southern part of Finland, where it generally appeared scattered and quite rare. At the beginning of the 20th century it was, however, sampled abundantly in the municipality of Hattula. According to Landin (1958) this species is also found on sandy ground in cow and horse manure. Fig. 16.

O. fracticornis (Preyssler)

Approximately as *O. gibbulus*, but reaching further north in Finland. The last record of *O. fracticornis* is from *Sa*Joutseno, 1946, G.Blomquist leg. Ecology as *O. nuchicornis* and *O. gibbulus* (Landin 1958). Fig. 17.

O. similis (Scriba)

This species was apparently the rarest of the *Onthophagus* species formerly living in Finland, as there are only a few old records, and none after the 1920s. Ecologically it is similar to the two preceding species. Fig. 18.

Aphodius erraticus (Linnaeus)

A rare species in Finland, the distribution of which is restricted to the southern and southeastern parts of the country. Recent finds indicate that no decline of the populations of this species has taken place. Fig. 19.

A. subterraneus (Linnaeus)

The decline of this previously abundantly collected species is evident. The last record of *A. subterraneus* in Finland is from *Sa* Lemi (677:53), 21.V.1972, T.Clayhills leg. The former range of the species covered the southern half of the country. We cannot present any exact reason for the decline of this species, since according to Landin (1961) *A. subterraneus* is a eurytopic species, feeding on all kinds of dung, on debris, compost and on carrion. Fig. 20.

A. fossor (Linnaeus)

A common species in the southern half of Finland. No decline in populations observed. Fig. 21.

A. haemorrhoidalis (Linnaeus)

As *A. fossor* but rarer. Fig. 22.

A. brevis Erichson

A quite rare species in Finland, the main range of which is restricted to the southwestern part of Finland. The species is also known from a limited area in the eastern part of Finland (*Kb* Ilomantsi 1988-1989) and from *Oa* Bergö 1946 in western Finland. No decline of the species was observed. Fig. 23.

A. putridus (Geoffroy)

A. arenarius (Olivier), *A. rhododactylus* (Marsham)

A very rare species in Finland. Only two records of *A. putridus* are known, namely *Ab* Raisio 1964 and *Sa* Joutseno, 29.V.1954. Because of the few records it is not possible to give an estimate on its status. According to Landin (1961) this is a stenotopic species, restricted to pastures on open, sandy ground. Fig. 24.

A. rufipes (Linnaeus)

One of the most abundantly collected *Aphodius* species in Finland. So far not recorded from Lapland. No changes in the occurrence of the species were observed; the apparent increase in records during recent decades can probably be explained by its tendency to fly into light traps, which have been widely used during this period. Fig. 25.

A. depressus (Kugelann)

A fairly common and widely distributed species in Finland. Records from the most northern parts of Lapland are lacking. No decline in the occurrence of the species was observed. Fig. 26.

A. luridus (Fabricius)

Only a few 19th century records exist of this species from Finland. Because of this, it would seem that *A. luridus* is today extinct in Finland. The old records are located in the southwestern part of Finland. According to Landin (1961) this is an oligotopic species, mostly met with in exposed habitats, particularly in cow manure and sheep droppings. There are a few additional records from adjacent parts of the USSR. These are also from the 19th century. Fig. 27.

A. pusillus (Herbst)

A common species in the southern half of Finland. Records from Lapland are very few in number. No changes in the occurrence of this species was observed. Fig. 28.

A. coenosus (Panzer)

A. tristis (Zenker)

A rare species in Finland from where only scattered, rather old records exist, with none after the 1940s. The range of *A. coenosus* covered the southern part of the country. According to Landin (1961) this is an oligotopic species, preferring exposed sandy areas. Mostly found in sheep and cow droppings. The species has probably been adversely affected by changes in agriculture. Fig. 29.

A. contaminatus (Herbst)

This species is only known from the province of *Al* in the southwestern part of Finland. There are no recent records of it. The species was abundantly collected in the 1940s in the municipalities of Finström and Hammarland. Its occurrence today is unclear and in need of further study. Possibly to be considered as an endangered species in Finland. According to Landin (1961) this is a eurytopic species, occurring in all kinds of dung. Very often in horse droppings. Fig. 30.

A. conspurcatus (Linnaeus)

A fairly rare species, which is only known from the southern half of Finland. No definite changes in its occurrence could be observed. According to Landin (1961) an oligotopic species, mainly in forest localities. Fig. 31.

A. paykulli Bedel

A. tessulatus (Paykull)

A rare species, which was recently reported for the first time from Finland by Hanski & Kuusela (1983). So far only known from *Al* Föglö, 1980, I.Hanski leg. Fig. 32.

A. distinctus (Müller)

A comparatively rare species, which is known from the southern half of Finland. The records might indicate a slight decline during recent decades. Fig. 33.

A. sabulicola Thomson

A rare species, which exhibits a scattered distribution in the southern half of Finland. No certain decline was observed, but it is noteworthy that there are no records from the 1950-1960s. According to Landin (1961) a eurytopic species, occurring in all kinds of dung. Fig. 34.

A. sphacelatus (Panzer)

Besides *Onthophagus nuchicornis*, the most remarkable example of decline in the Scarabaeidae. Previously *A. sphacelatus* was one of the most abundantly sampled aphodiids in the southern half of Finland. The most recent records of this species are from *N* Espoo 11.V.1958, R.Iivarinen leg., *Ka* Vehkalahti, 1961, L.Tiensuu leg., and *Ab* Tenhola, 23.V.1965, T.Ilvessalo leg. According to Landin (1961) a eurytopic species, occurring in various habitats and in all kinds of dung. Today the species is most probably extinct in Finland, but the reason for its disappearance is unknown. Fig. 35.

A. prodromus (Brahm)

A rather common species in the southern half of Finland. On the basis of material in collections this species has become more common during recent years. According to Landin (1961) a highly polyphagous, eurytopic species. Fig. 36.

A. serotinus (Panzer)

A very rare species, of which two records exist from Finland: *Ab* Ruissalo, with sampling year unknown and *Sa*Joutseno, 1967, G.Blomqvist leg. The present occurrence of *A. serotinus* in Finland is unclear. Fig. 37.

A. tomentosus (Müller)

A. tomentosus is included in the Finnish fauna on the basis of one specimen, taken in *Kl*Uukuniemi by Niklander, who according to Elfving (1921) collected there in 1852 and 1853. This was probably a stray specimen from the area near Lake Ladoga inhabited by this species. Fig. 38.

A. merdarius (Fabricius)

A. merdarius in southern Finland is a widely distributed, but in recent years rather rarely collected species. Possibly to be regarded as a species that is threatened by changes in agriculture. According to Landin (1961) it is an oligotopic spe-

cies, which usually occurs in exposed pastures in all kinds of domestic animal dung. Fig. 39.

A. fimetarius (Linnaeus)

Possibly the most abundantly collected *Aphodius* species in Finland. It is distributed throughout the country, except for the northernmost parts of Lapland. No decline of the species was observed. Fig. 40.

A. foetens (Fabricius)

A. aestivalis Stephens

A comparatively rare species scattered over the southern half of Finland. In the northern half of the country *A. foetens* is only recorded from one square. Although the species was only once recorded in the 1970s, some recent finds indicate that no essential changes in its occurrence have taken place. According to Landin (1961) an oligotopic species, which prefers exposed sandy areas. In all kinds of domestic animal dung, particularly in cow manure. Fig. 41.

A. tenellus Say

A. putridus (Herbst), *A. fasciatus* (Olivier)

A widely distributed but comparatively rare species in Finland. It exhibits a scattered distribution throughout the country. No changes in the occurrence of *A. tenellus* were observed. Fig. 42.

A. ater (Degeer)

A quite common species in Finland. The distribution of the species covers the southern half of the country. No decline in the occurrence of the species was observed. Fig. 43.

A. borealis Gyllenhal

This species has a scattered distribution throughout Finland. It is quite often sampled and appears to have become more abundant in more recent decades. Landin (1961) refers to it as a forest species, feeding particularly on sheep dung, but also deer dung, cow manure, etc. Its wide distribution in Finland indicates that it may here utilize elk dung, and the growing numbers of *A. borealis* records correspond well with the very strong increase of the elk population in Finland during the 1970s (Löyttyniemi & Lääperi 1988). Fig. 44.

A. nemoralis Erichson

A quite common and widely distributed species in Finland. The range of *A. nemoralis* covers the whole country, and it seems to have become more common in recent years. According to Landin (1961) it is a stenotopic species, restricted to forest habitats, and most often collected in elk droppings. The increase in the elk population has most probably affected the occurrence of this species. Fig. 45.

A. lapponum Gyllenhal

A widely distributed species, which is particularly abundant in the northern parts of the country. The range of the species covers the whole country. No change in its occurrence was observed. Fig. 46.

A. piceus Gyllenhal

A quite common species, the distribution of which covers the whole of Finland. Particularly common in Lapland. No decline in the populations of *A. piceus* was observed. Fig. 47.

A. sordidus (Fabricius)

A comparatively rare species, which is recorded from the southern half of the country. In comparison with the number of records in Finland before 1980, the recent records are rather few. On the basis of available information it is, however, impossible to estimate whether a decline in the occurrence of the species has taken place. According to Landin (1961) an oligotopic species, mostly occurring in exposed, sandy areas. In all kinds of domestic animal droppings. Fig. 48.

A. scybalarius (Fabricius)

A. rufus (Moll)

One of the most abundantly collected *Aphodius* species in southern Finland. The range of the species in Finland extends from the south northwards to the southern border of Lapland. There are no records of the species from Lapland. In Sweden it is recorded throughout the country

(Landin 1957, 1961). No decline in the occurrence of the species was observed. Fig. 49.

A. ictericus (Laicharting)

A. nitidulus (Fabricius)

A rare species in Finland, which exhibits a scattered distribution in the southern half of the country. There are only a few recent finds from Finland, but because of the rarity of the species, it is difficult to estimate whether *A. ictericus* is an endangered species or not. Fig. 50.

A. niger (Panzer)

According to Landin (1961) never in dung, but feeds on other decaying substances. The range of the species covers the southern half of Finland. The most recent records are from the southern part of the country. A decline in occurrence seems to have taken place, but the reason for this is unknown. Fig. 51.

A. plagiatus (Linnaeus)

Distribution, ecology and occurrence of the species almost totally agree with *A. niger*, only the number of records is smaller. Fig. 52.

A. lividus (Olivier)

Only a few scattered records exist of this species from Finland and these are concentrated in the southern parts of the country. The most recent record is from *Sa*Luumäki, 1949, C.von Numers leg. Landin (1961) considered the species an introduction in Sweden. A cosmopolitan species with uncertain permanent occurrence in Finland. Fig. 53.

A. granarius (Linnaeus)

There are only some scattered and comparatively old records of this species from Finland, and these are concentrated in the southwestern parts of the country. Because of the rarity of *A. granarius* in Finland it is difficult to estimate if changes in the occurrence of the species have taken place. The most recent record is from *Ab*Ruissalo, 1960, T.Ilvessalo leg. Fig. 54.

4. Discussion

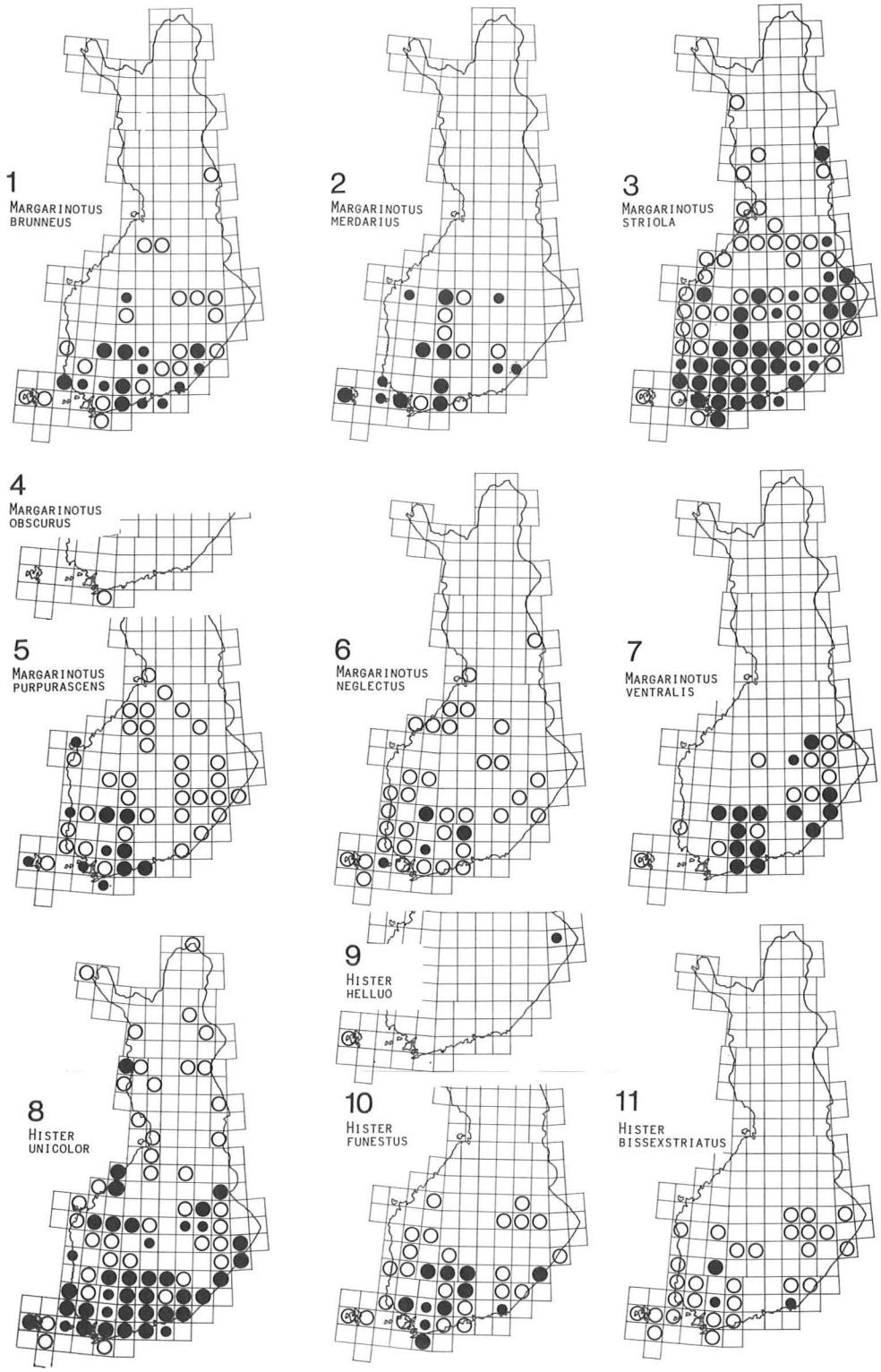
The present survey of histerids and scarabaeids living in dung clearly shows that a decline in the occurrences of some species has taken place in Finland. Such species among the histerids studied are *Margarinotus purpurascens*, *M. neglectus*, *Hister funestus*, *H. bissexstriatus* and *Atholus bimaculatus* and among the scarabaeids all four *Onthophagus* species, *Aphodius subterraneus*, *A. sphacelatus* and *A. merdarius*. The *Onthophagus* species and *A. sphacelatus* are today extinct in Finland, and should therefore be added to the list of disappeared species kept by the Finnish Ministry of the Environment. The decline started in the 1960s and 1970s, except for the *Onthophagus* species, in which it started as early as the 1950s (Table 1).

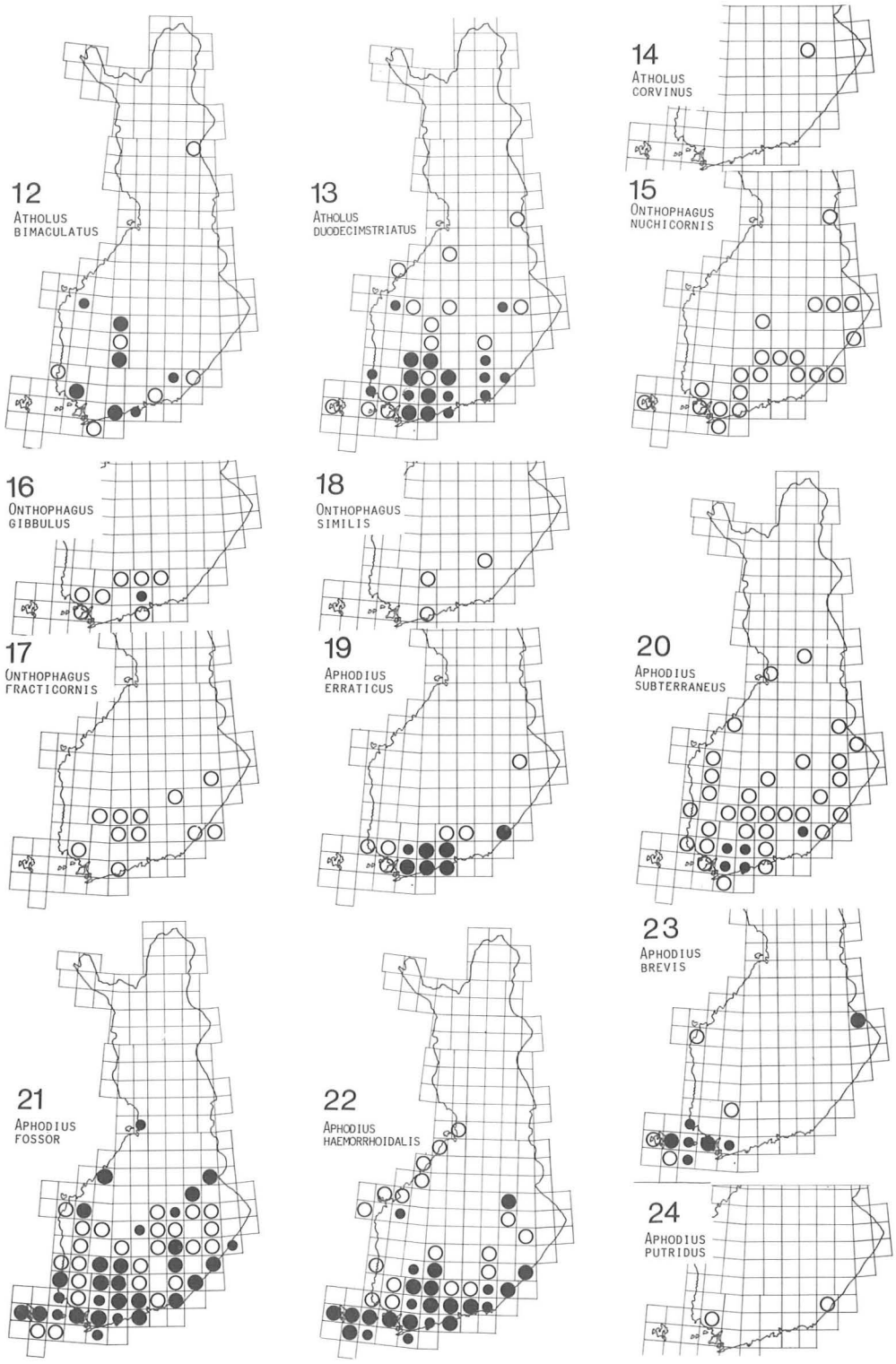
Although the decline of certain species is evident one should remember that there is a risk in monitoring occurrences using qualitatively sampled museum material. One reason for incorrect interpretation is the uneven sampling by which the museum material has been collected, another the fact that the sampling has been concentrated in certain geographic regions, occasionally in different ones in different periods. When a large number of species is studied, it is always possible to compare the trend found for one species with the total number of records; if the results differ markedly we may assume that a trend independent of sampling bias has been found.

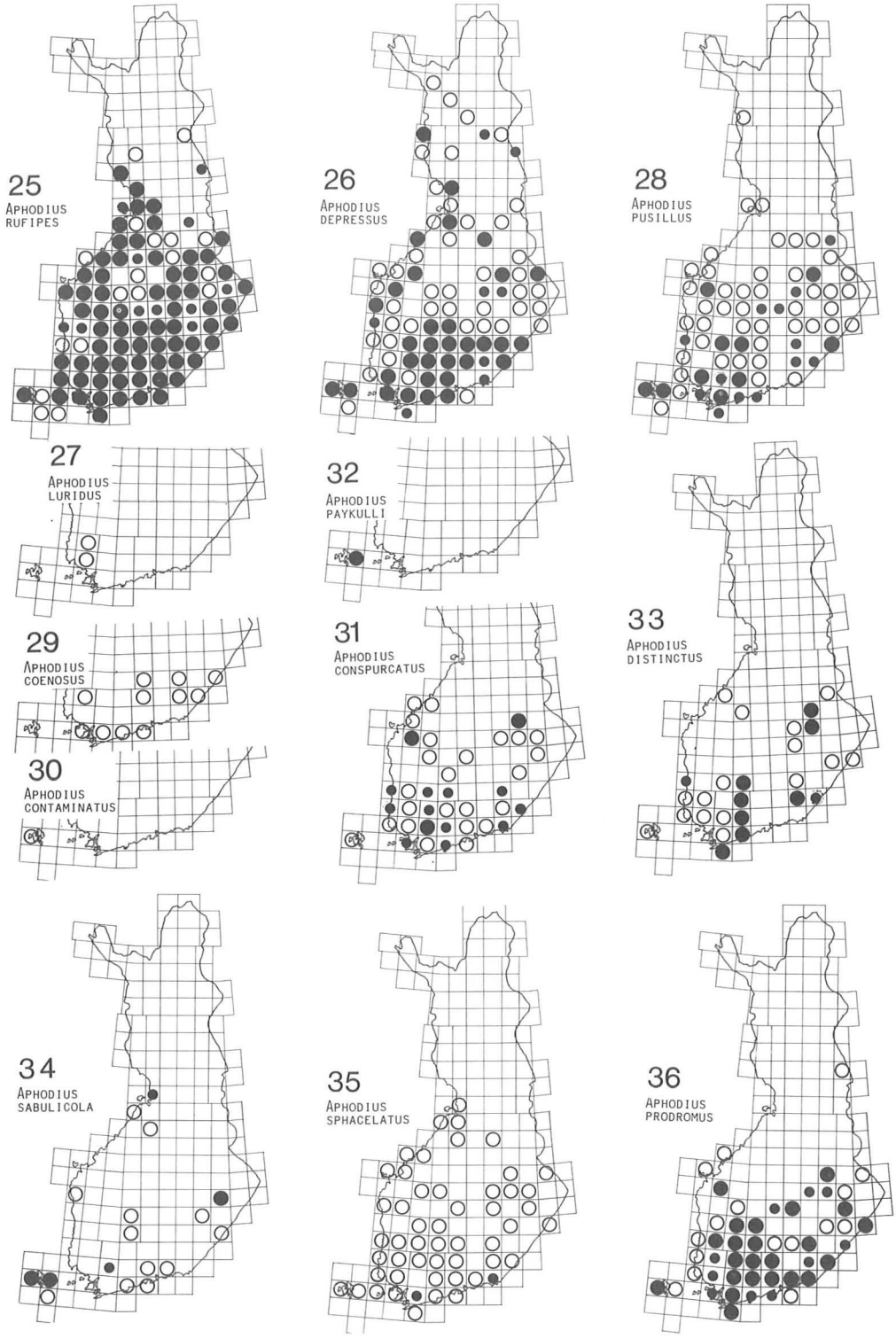
Since the collecting has not been evenly spread it is possible that many species have a range extending further north than the maps would indicate. Additionally some species seem to exhibit fluctuations in occurrence although they may in fact have had stable populations. On the other hand, the total disappearance of previously common species can hardly be explained by anything but a drastic decline in the occurrence of the species in question.

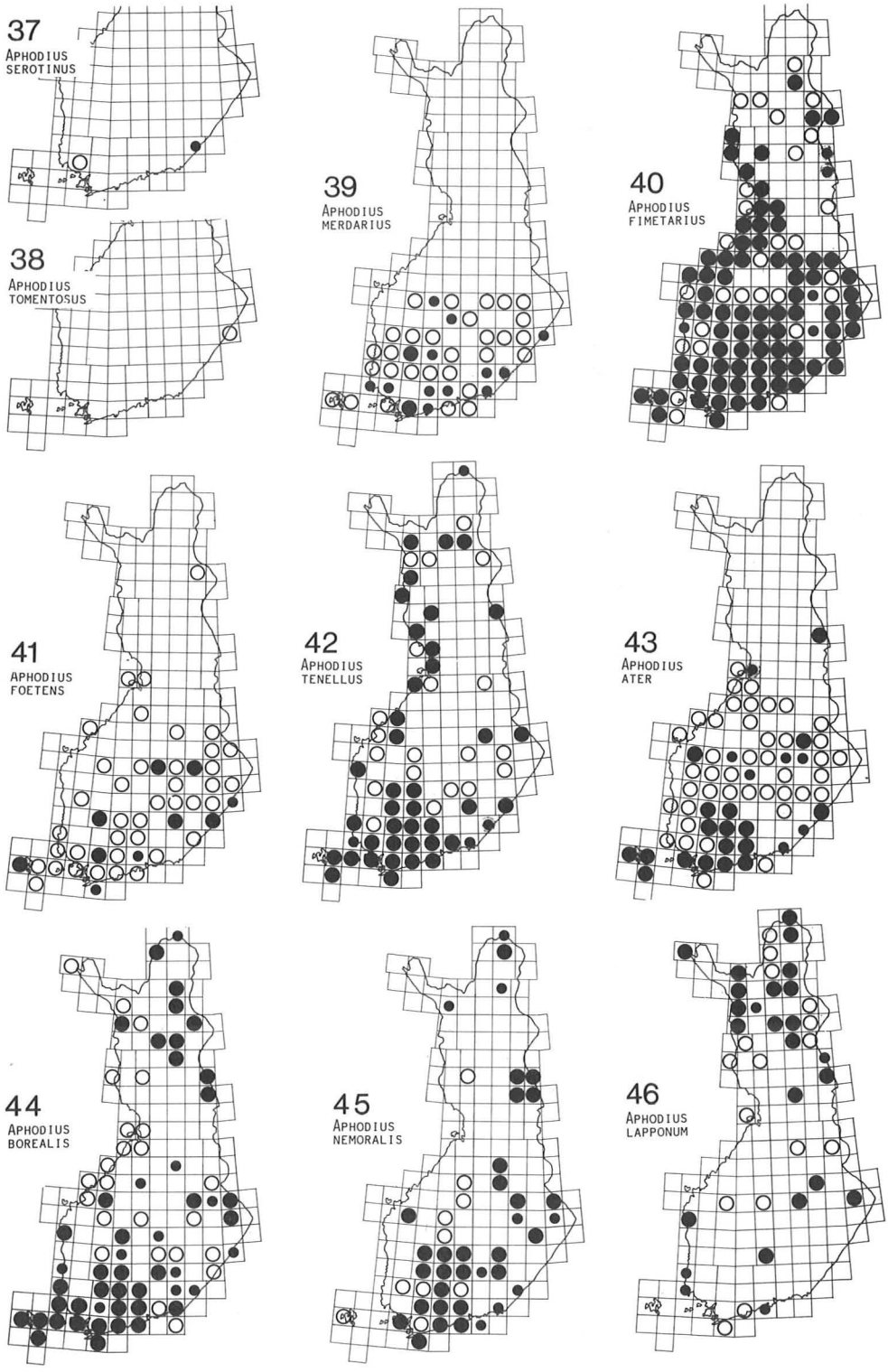
We cannot present any exact reasons for the decline of certain species, but briefly discuss various speculative factors which could conceiv-

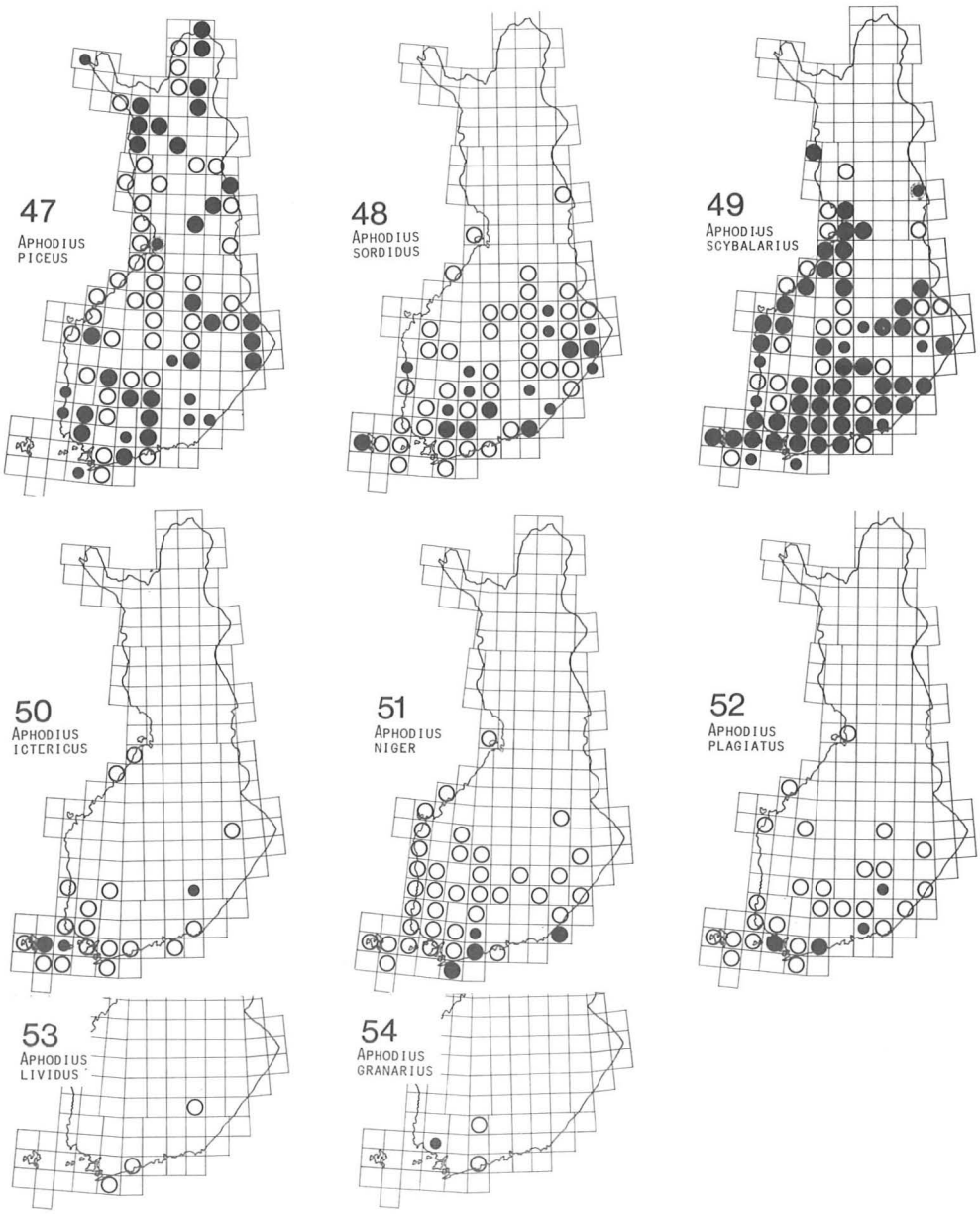
Figs. 1–54. UTM maps of the surveyed Histeridae and Scarabaeidae species. — Open circle = latest record before 1960; small black dot = latest record from the 1960s and 1970s; large black dot = records from 1980 on.


1
MARGARINOTUS
BRUNNEUS
2
MARGARINOTUS
MERDARIUS
3
MARGARINOTUS
STRIOLA
4
MARGARINOTUS
OBSCURUS
5
MARGARINOTUS
PURPURASCENS
6
MARGARINOTUS
NEGLECTUS
7
MARGARINOTUS
VENTRALIS
8
HISTER
UNICOLOR
9
HISTER
HELLUO
10
HISTER
FUNESTUS
11
HISTER
BISSEXSTRIATUS


12
ATHOLUS
BIMACULATUS
13
ATHOLUS
DUODECIMSTRIATUS
14
ATHOLUS
CORVINUS
15
ONTHOPHAGUS
NUCHICORNIS
16
ONTHOPHAGUS
GIBBULUS
17
ONTHOPHAGUS
FRACTICORNIS
18
ONTHOPHAGUS
SIMILIS
19
APHODIUS
ERRATICUS
20
APHODIUS
SUBTERRANEUS
21
APHODIUS
FOSSOR
22
APHODIUS
HAEMORRHOIDALIS
23
APHODIUS
BREVIS
24
APHODIUS
PUTRIDUS


25
APHODIUS
RUFIPES
26
APHODIUS
DEPRESSUS
28
APHODIUS
PUSILLUS
27
APHODIUS
LURIDUS
32
APHODIUS
PAYKULLI
29
APHODIUS
COENOSUS
31
APHODIUS
CONSPURCATUS
33
APHODIUS
DISTINCTUS
30
APHODIUS
CONTAMINATUS
34
APHODIUS
SABULICOLA
35
APHODIUS
SPHACELATUS
36
APHODIUS
PRODROMUS


37
APHODIUS
SEROTINUS
38
APHODIUS
TOMENTOSUS
39
APHODIUS
MERDARIUS
40
APHODIUS
FIMETARIUS
41
APHODIUS
FOETENS
42
APHODIUS
TENELLUS
43
APHODIUS
ATER
44
APHODIUS
BOREALIS
45
APHODIUS
NEMORALIS
46
APHODIUS
LAPPONUM



ably have caused the decline (cf. Väisänen & Rassi 1990).

Agricultural environments in Finland have changed during this century, and particularly during the last three decades (Soininen 1974, Raatikainen 1986). It seems therefore reasonable to assume that this can also be seen in the composition of the fauna as changes in the frequencies of vulnerable species.

In the case of dung beetles the concept 'specialized species' may be divided and defined as follows: Oligotopic species prefer, but do not exclusively live in, certain kinds of habitats while stenotopic species are restricted to a single kind of environment (Landin 1961). None of the species which exhibited the most distinct declines are classified as stenotopic species. They can merely be considered as oligotopic species and

at least *A. sphacelatus* even as a eurytopic species, which inhabits different kinds of dung heaps in all kinds of localities. This indicates that other explanations for the decline must also be taken into consideration than the direct disappearance of a certain kind of habitat. According to Landin (1961) the distribution of dung beetles in different habitats does not depend on the kind of dung, but on climatic factors. Most dung beetle species feed on a dung substratum independent of the kind of dropping. Where the substitute sources of food are less favourable for the species in question, we may see this in the lower numbers of specimens collected, or as a reduced number of different finds. For the more vulnerable species the disappearance of their most preferred habitat may lead to extinction. Suitable habitats for successful breeding may be too sparse to maintain an occurrence of vulnerable species.

Changes in husbandry are, for instance, the decline in the total number of domestic animals, resulting in less food available for the dung beetles. Cows were formerly kept in pastures in forests and in areas close to water, but nowadays they are kept primarily in open and more concentrated areas, or even indoors for the entire year. The relatively fast removal of dung from the pastures, the partial absence of long-time pastures today, and possible changes in the composition of dung, caused by variations in the consistency of modern cow feed with its additives may also affect the dung beetle fauna. Another important factor is the decrease in the number of sheep, which were formerly kept on poorer pasturage.

Contrasting with the disappearance of forest pasturage, the high increase of the elk population has offered new resources for dung feeding species. Apparently only some of the species can utilize this resource efficiently.

The histerids living in dung are as far as is known predominantly predators. In comparison with the scarabaeids in droppings, which are dung-feeders, no quite so drastic declines were observed in the histerids studied. It is probable that the histerids living in dung, being predators, find substitute food sources more easily than some of the dung-feeding species.

Acknowledgements. We express our sincere thanks to Mr. Markku Heinonen, Mr. Risto Iivarinen, Mr. Touko Ilvessalo, Mr. Jaako Kangas, Mr. Yrjö Kangas, Mr. Jaakko Kullberg, Mr. Erkki Laurikainen, Mr. Veli-Matti Mukkala, Mr. Pentti Muukari, Mr. Marko Nieminen, Professor Matti Nuorteva, Mr. Mauno Pohjola, Mr. Yrjö Ranta, Mr. Juha Siitonen, Mr. Pekka Turunen, Mr. Pekka Valtonen, and Mr. Hannu Viljamaa, who kindly provided us with information of various kinds for the present survey.

References

Elfving, F. 1921: Societas pro Fauna et Flora Fennica 1821–1921. — Acta Soc. Fauna Flora Fennica 50:1–279.

Hanski, I. & Kuusela, S. 1983: Dung beetle communities in the Åland archipelago. — Acta Entomol. Fennica 42:36–42.

Horion, A. 1949: Faunistik der mitteleuropäischen Käfer. Band II. Palpicornia — Staphylinoidea (ausser Staphylinidae). — Vittorio Klostermann, Frankfurt am Main. 388 pp.

Koch, K. 1989: Die Käfer Mitteleuropas. Ökologie. 1. — Goecke & Evers, Krefeld. 440 pp.

Landin, B.-O. 1957: Fam. Scarabaeidae. Skalbaggar, Coleoptera. Bladhorningar, Lamellicornia. — Svensk Insektfauna 9. Stockholm. 155 pp.

— 1961: Ecological studies on dung-beetles. — Opuscula Entomol., Suppl. 19:1–228.

Löyttynieni, K. & Lääperi, A. 1988: Moose in Finnish Forestry. (In Finnish with English summary) — Univ. Helsinki, Dept. Agric. Forest Zool., Publ. 13:1–56.

Palmén, E. 1944: Die anemohydrochore Ausbreitung der Insekten als zoogeographischer Faktor mit besonderer Berücksichtigung der baltischen Einwanderungsrichtung als Ankunftsweg der fennoskandischen Käferfauna. — Ann. Zool. Soc. Zool.-Bot. Fennicae Vanamo 10(1):1–262.

Raatikainen, M. 1986: Muutokset Suomen peltoekosysteemissä. — Memoranda Soc. Fauna Flora Fennica 62:89–101.

Soininen, A.M. 1974: Vanha maataloutemme. — J. Scient. Agric. Soc. Finland 46, Suppl. 459 pp.

Väisänen, R. & Rassi, P. 1990: Abundance and distribution of Geotrupes stercorarius in Finland (Coleoptera, Scarabaeidae). — Entomol. Fennica 1:107–111.

Received 9.XI.1990, revised 15.III.1991