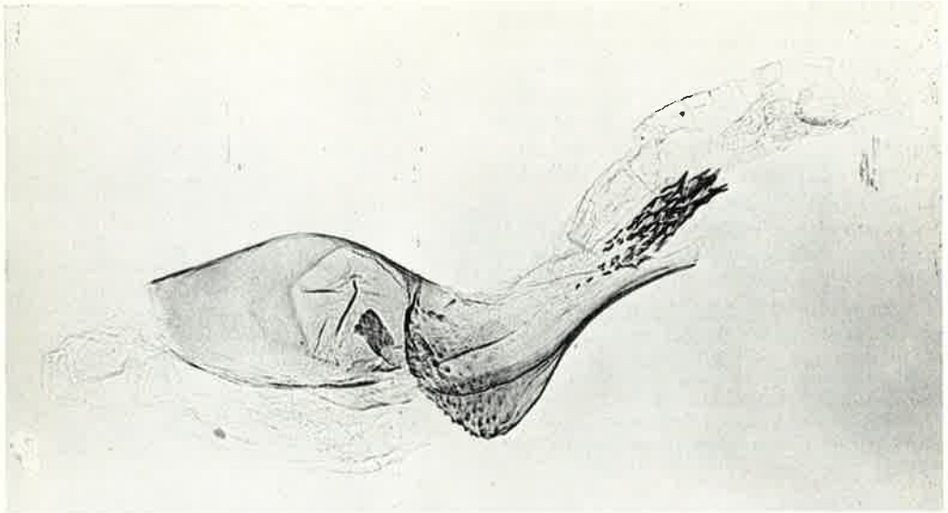

ABB. 4. Aedoeagus von *Monochroa simplicella* Lg. & Z., Lettland, Salaspils, 1977-06-07.

Kirja-arvostelu — Bokrecension

ROCKSTEIN, M. (Ed.) 1978: Biochemistry of Insects. — Academic Press, New York, San Francisco, London. 649 sid., 215 figs., 60 tab. Pris: USD 29.50.

Insekternas yttre struktur och utseende har länge studerats, främst ur systematisk synvinkel. Tittar man istället inuti en insekt hittar man ett myller av inre organ. Går man ett steg längre ned på molekylär nivå upptäcker man en helt ny dimension hos sina djur. Jag skall här kortfattad redogöra för innehållet i en bok som sammanfattar dagens kunskaper i biokemin hos insekter.

G. M. Chippendale diskuterar kolhydraterna med avseende på deras funktioner som näringsämnen, byggstenar, pigment och i flygmusklerna. Lipidbehovet, transport och biosyntes av lipider tas upp av R. G. H. Downer. Proteinernas olika funktioner behandlas av M. Agosin som bl.a. tar upp struktur proteiner, enzymer, cytokromerna (*c*, b_5 och *P*-450) och bioluminiscens. P. S. Chen beskriver proteinsyntesen med avseende på syntes och lagring av proteiner, reglering av syntesen och mutationer. De olika kemiska föreningarna i cuticulan tas upp av A. G. Richards. Kemin bakom och de olika funktionerna hos biokromerna diskuteras av A. E. Needham. Biokemin bakom de olika hormonerna och tillväxtregulatorerna behandlas av L. M. Riddiford och J. W. Truman. I två kapitel behandlar N. Weaver den kemiska kontrollen inom och mellan arter, där olika typer av feromoner respektive symbios mellan myror och bladlöss beskrivs. Olika metoder för att insamla och detektera feromoner tas upp av W. L. Roelofs, som även diskuterar olika typer av feromon-fällor. De kemiska försvarsämnena hos steklar sammanfattas av M. S. Blum, som även tar upp vilka olika föreningar som används som försvarssubstanser och varför, och hur insekterna undviker att förgifta sig själva. R. D. O'Brien beskriver olika typer av insecticiders verkan med avseende på funktion såsom nerv-, muskel- och metaboliska gifter. Avgiftningsprocessen, dvs hur skadliga insekticider omvandlas till för insekten ofarliga produkter diskuteras av W. C. Dauterman och E. Hodgson. Den kemiska genitiken och evolutionen sammanfattas av F. J. Ayala, som beskriver olika biokemiska metoder för att mäta den genetiska variationen inom arter och släktskap mellan arter.

Illustrationerna är klara och tydliga. Varje kapitel är försett med en lista över allmän och avancerad litteratur.

Till bokens nackdelar hör att titlar på uppsatserna ej finns i litteraturlistorna. Att Ayala endast har givit de engelska namnen på de organismer han tar upp (med undantag av *Drosophila)* är synd eftersom latinska namn brukar underlätta läsandet av böcker som ska nå utanför den engelskspråkiga världen.

En lämpligare sammanfattning av biokemin hos insekterna till detta låga pris det får man nog leta länge och väl efter. För alla som studerar entomologi borde denna bok vara en välkommen handbok, som ökar förståelsen för kemin inuti den lilla insekten.

Ulf Carlberg

Notulae Entomologicae 61:71—89, 1981.

Distribution of bumblebees (Hymenoptera, Apidae: Bombus and Psithyrus) in eastern Fennoscandia [1])

Antti Pekkarinen, Ilkka Teräs, Juha Viramo & Juhani Paatela

Abstract

PEKKARINEN, ANTTI, TERÄS, ILKKA, VIRAMO, JUHA & PAATELA, JUHANI: Distribution of bumblebees (Hymenoptera, Apidae: Bombus and Psithyrus) in eastern Fennoscandia. — Notulae Entomologicae 61:71—89. 1981.

The distribution of 26 bumblebee and 8 cuckoo bumblebee species of Finland and northwestern USSR are mapped according to the European UTM grid system. The species are grouped on the basis of their distribution patterns in the area studied. The limits of many species correlate with the isotherms of effective temperature sums and eight species have their northern or southern limit in a biogeographical transition zone running from the head of the Gulf of Bothnia to the southeast. *B. sylvarum* and *B. subterraneus* have greatly extended their range since the 1930s through the Karelian Isthmus to southern Finland. The effect of warming up of the climate and other ecological factors on the distribution area are treated. The distribution of cuckoo bumblebees and their bumblebee hosts as well as the relative abundances of different bumblebee species in some areas of northern Europe are compared.

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Introduction

The first accounts of bumblebee species in Finland were given by NYLANDER (1848, 1852). SAHLBERG (1889) published a catalogue of the occurrence of *Bombus* and *Psithyrus* species in the biogeographical provinces of Finland and later (1902) a general review of *Bombus* species in Finland. ELFVING (1960) has made a revision of Finnish species and later (1968) a more comprehensive account of their distribution and food plants. In her thorough taxonomic and faunistic monograph on Scandinavian bumblebees LØKEN (1973) has also treated Finnish fauna to some extent. PEKKARINEN & TERÄS (1977) have reviewed the biology, distribution and identification of Finnish species (in Finnish) and PEKKARINEN (1979) has elucidated some taxonomic and evolutionary problems of Fennoscandian bumblebees. The distribution of bumblebee species is consequently now relatively well known in Fennoscandia. However, the knowledge of the distribution in eastern Fennoscandia is far from complete and more detailed information on the distribution of these biologically and economically important animals is needed. In the course of this study we have especially tried to map out the distribution limits of the species which do not occur throughout Fennoscandia and also to evaluate possible changes in the limits during the last few decades. Furthermore, we have treated some zoogeographical aspects and abundance of the species.

1) Dedicated to the late Mr. Erkki Valkeila in recognition of the great entomologist and his magnificent work on Finnish Aculeata fauna.

Material and mapping

The material originates mainly from the collections of the Zoological Museums of the Universities of Helsinki, Oulu and Turku, the Department of Agricultural and Forest Zoology of the University of Helsinki, the Museums of Natural History in Forssa and Kuopio and the Zoological Institute of the Academy Sciences of the USSR in Leningrad. Some of the material has also been collected by the late Mr. Erkki Valkeila, the authors and others (see Acknowledgements). The literature concerning the bumblebees of Fennoscandia is also examined (referred to in the text). The number of specimens inspected is about 38 170 (cf. Table 1).

TABLE 1. The numbers of *Bombus* and *Psithyrus* (Finland) species in percentages in the material collected in Norway (No), Sweden (Sw) and Finland (Fi). The Scandinavian material (No and Sw) according to LØKEN (1973). Some casual species are excluded.

	No	Sw	Fi
Bombus			
wurflenii	6.9	1.6	—
soroeensis	4.5	2.9	2.9
lucorum	11.6	9.7	19.4
sporadicus	1.2	2.0	2.0
terrestris	0.0	3.1	—
cullumanus	—	0.1	—
cingulatus	0.3	0.8	2.5
hypnorum	5.3	4.3	6.8
jonellus	9.7	5.8	12.6
lapponicus	7.9	3.6	7.4
pratorum	9.3	7.9	7.6
lapidarius	3.2	10.8	6.8
alpinus	1.2	0.4	0.4
polaris	0.3	0.4	0.6
balteatus	2.8	1.9	2.2
hyperboreus	0.2	0.2	0.2
consobrinus	2.7	0.9	1.1
hortorum	10.0	11.5	4.4
ruderatus	—	0.5	—
humilis	1.4	4.5	1.3
muscorum	2.9	1.5	0.4
pascuorum	15.4	10.8	11.7
ruderarius	1.1	2.2	2.4
sylvarum	1.2	4.7	0.8
veteranus	—	1.4	2.8
distinguendus	0.6	4.3	2.2
subterraneus	0.1	2.2	1.3
n	28900	27700	33762
Psithyrus			
bohemicus			34.4
rupestris			11.6
campestris			6.4
barbutellus			2.0
flavidus			17.9
globosus			7.8
norvegicus			3.3
sylvestris			16.5
n			4408

Records from the eastern Fennoscandian areas of the Soviet Union are old. There are lot of records up to 1939 from the areas which became Soviet territory after the Second World War (provinces *Ik, Ka, Kl* and *Lps*). Records from eastern Karelia and Kola are sporadic. Most of the records have been made by the following persons (area and years in parentheses): A. Günther (*Kon, Kol:* Petrosavodsk area 1859—99), K. Edgren (Kola 1885, 1887), J. Sahlberg (Kola 1870), R. Envald (*Kk,* Kola 1880, 1883, 1887), K. M. Levander and J. A. Palmén (Kola 1887), B. Poppius (*Kon* 1896), R. Frey and W. Hellén (Kola 1913), W. Hellén, P. Kontkanen and P. Niemelä (*Kon, Kol* 1942—43).

The distribution maps of the European UTM grid system (see e.g. HEATH 1971) have been used and the squares are about 50×40—60 km. All records from the squares on the boundary of eastern Fennoscandia have been included. The records of very rare species (only a few records from the area) and the northernmost or southernmost records of more common species are given in the text using the Finnish uniform grid system (HEIKINHEIMO & RAATIKAINEN 1971) (whenever possible). The names of collectors or references in the literature are given in parentheses.

Abbreviations
C = central
E = east, eastern
N = north, northern
NW = northwest, northwestern
S = south, southern
SE = southeast, southeastern
SW = southwest, southwestern
W = west, western
For abbreviations of the provinces see the back cover.

Distribution of the species

Bombus wurflenii Radoszkowski, 1859 (*B. mastrucatus* Gerstaecker, 1869)

Only one record. *Ok:* Suomussalmi Ruhtinassalmi, ♀, 1926-06-30 (O. Sorsakoski). The species is widely distributed in Scandinavia (LØKEN 1973:28), but the nearest record (in Ångermanland) is as far as 450 km from Suomussalmi. The species has been intensively searched for during the last few years in N Finland, especially in the Kuusamo area, with no result. There are strong grounds to assume that the specimen in question is mislabelled (cf. LINDROTH 1945:174) and we have excluded this species from the fauna of E Fennoscandia.

B. soroeensis (Fabricius, 1776) (Map 1)

The northern limit of the distribution runs from the head of the Gulf of Bothnia to the southeast. The northernmost records: *Lk:* Kolari, ☿, 1946-07-22 (P. Niemelä); *Ob:* Ounasvaara (E. Kanervo), Kemi Karihaara 730:38 (A. Saarinen); *Ok:* Kuhmo (J. Paatela); *Kon:* Jalguba (A. Günther). Scarce.

B. lucorum (Linnaeus, 1761) (Map 2)

Distributed throughout E Fennoscandia. Very abundant, scarce only in the mountain biotopes of Lapland. *B. magnus* Vogt is evidently conspecific with *B. lucorum* and the specimens regarded as *B. magnus* queens perhaps correspond with large light males of *B. lucorum* (PEKKARINEN 1979). A closely allied species, *B. terrestris* (Linnaeus), occurs on the SE coast of Sweden to about 60°N (LØKEN 1973:55), where it is locally abundant. *B. terrestris* has not been found in E Fennoscandia, but its occurrence in SW Finland is possible. The specimens from S Finland, which G. Kruseman has determined as *B. terrestris* (ELFVING 1960), are *B. lucorum* specimens (cf. LØKEN 1973:56).

B. patagiatus Nylander, 1848 (Map 3)

Only three records. *Kon:* Kumsjärvi, ♀, (E. Thuneberg); *Kol:* Petrosavodsk, ♀, 1942-07-15 (P. Niemelä) and ♀, 1942-08-02 (A. Merisuo).

B. sporadicus Nylander, 1848 (Map 4)

Absent from Åland and perhaps from extreme N Lapland and N Kola. The southernmost records: *Ab:* Pargas (Ingelius), Karjalohja (U. Saalas); *N:* Espoo (B. Poppius), Porvoo (E. Suomalainen). The northernmost records: *Le:* Palojoensuu 758:33 (P. Niemelä); *Li:* Karigasniemi 771:46 (E. Valkeila). Very scarce in S Finland, abundant in E and N Finland. The records in SW Finland are old and the species is nowadays absent from wide areas of SW and S Finland.

B. semenoviellus Skorikov, 1910 (Map 5)

Only one record. *Kl:* Parikkala 682:63, ♂, 1964-07-24 (R. Elfving) (ELFVING 1965).

B. cingulatus Wahlberg, 1854 (Map 6)

Absent from S Finland and possibly from the western coast of the Gulf of Bothnia and N Kola. The southernmost records: *Tb:* Viitasaari (E. Valkeila); *Sb:* Rantasalmi (E. Pulliainen); *Kl:* Sortavala (O. Hulkkonen), Ruskeala (E. Rantalainen). Scarce, more abundant in E and N Finland.

B. hypnorum (Linnaeus, 1758) (Map 7)

Clearly absent only from N Kola; found also in Åland (cf. ELFVING 1960:36). Very abundant.

B. jonellus (Kirby, 1802) (Map 8)

Distributed throughout E Fennoscandia. Very abundant, rather scarce in S Finland, but more abundant in the southern archipelago.

B. lapponicus (Fabricius, 1793) (Map 9)

The southern limit of distribution extends to about 65°N in Finland. The southernmost records: *Ob:* Hailuoto Vesanniitty 722:39, ♂, 1966-07-11 (E. Valkeila), Pudasjärvi, several ☿ (C. Brander); *Ks:* Kuusamo, several records. Abundant.

B. monticola (Smith, 1849) sensu SVENSSON 1979 (Map 10)

B. lapponicus and *B. monticola* have been recognized as two species by SVENSSON (1979) (cf. PEKKARINEN 1981). Recorded from: *Le:* Kilpisjärvi area locally abundant; *Li:* Outakoski (E. Thuneberg); *Lps:* Liinahamari (E. Lindqvist); *Lmur:* Gavrilovo (W. Hellén); *Lp:* Ponoj (W. Hellén, J. Montell).

B. pratorum (Linnaeus, 1761) (Map 11)

Distributed throughout E Fennoscandia. Very abundant.

B. lapidarius (Linnaeus, 1758) (Map 12)

The northern limit of distribution runs from the head of the Gulf of Bothnia to the southeast. The northernmost records: *Ob:* Oulu, ♀, 1890 (K. Elfving), later several collectors; *Ok:* Kajaani 712:53, ☿, 1979-07-06 (A. Pekkarinen), Suomussalmi Ruhtinassalmi, 2 ♀, (O. Sorsakoski); *Ks:* Kuusamo Heikkilä 732:61, ☿, 1980-08-15 (J. Viramo). Very abundant in S Finland.

B. alpinus (Linnaeus, 1758) (Map 13)

Distributed over most of the arctic mountain and tundra area of N Fennoscandia. The southernmost records: *Li:* Ivalo, several ♀, (W. Hellén); *Lim:* Hibiny (LØKEN 1973:98). Quite scarce.

B. polaris Curtis, 1835 (*B. arcticus* Kirby, 1821) (Map 14)

Distribution about the same as that of *B. alpinus*, but the southern limit of the distribution extends farther in Finland (to about 68°N). The southernmost records: *Le:* Pallastunturi 756:37 (J. Kaisila); *Li:* Kivipää 759:52 (E. Valkeila); *Lim:* Hibiny (LØKEN 1973:104). Quite scarce.

B. balteatus Dahlbom, 1832 (Map 15)

The southern limit of the distribution in Finland runs from about 67°30′N in W *Lk* to about 65°15′N in E *Ok*. The southernmost records: *Lk:* Kittilä (R. Krogerus); *Ok:* Suomussalmi Ruhtinassalmi (O. Sorsakoski). Locally abundant.

B. hyperboreus Schönherr, 1809 (Map 16)

The following records from the northernmost part of E Fennoscandia: *Le:* regular occurrence in Kilpisjärvi area, Karesuvanto, ♀, 1924-07-20 (H. Lindberg); *Lim:* Hibiny, several ♀, 1933 (Pudolf); *Lmur:* Gavrilova, ☿, (R. Frey), Varsina, ♀, (R. Envald); *Lp:* Svjatoinos, 2 ☿, 1880-08-15 (R. Envald). In addition to the workers mentioned, two workers have been caught in Le: Kilpisjärvi, 2 ☿ 1967-07-19 (J. & H. Paatela). Only four workers have been recorded from Scandinavia (LØKEN 1973:117).

B. consobrinus Dahlbom, 1832 (Map 17)

The distribution is associated with the main food plant *Aconitum septentrionale* Koelle (LØKEN 1961, 1973:124). In Finland the largest stands of *Aconitum* are: *Kb:* Tohmajärvi Piilo-

vaara 690:67 and Kitee Papinniemi 688:65. These are also the only localities of *B. consobrinus* in Finland and the species occurs regularly in these places. Other records: *Kl:* Sortavala area (several collectors), Harlu (J. Kaisila, P. Niemelä), Ruskeala (E. Rantalainen), Impilahti (several collectors); *Kon:* Jalguba (A. Günther); *Lv:* Kusomen (W. Hellén); *Lp:* Ponoj (W. Hellén). Often abundant in its habitat. The species has been more scarce in Tohmajärvi Piilovaara during the last few years than in the 1960s.

B. hortorum (Linnaeus, 1761) (Map 18)
Throughout E Fennoscandia to 68°45′N in Finland; the information is too scanty for the determination of the northern limit of the distribution in Kola, USSR. The northernmost records: *Lk:* Muonio 754:36 (E. Valkeila); *Tl:* Karesuando (Sweden) (Løken 1978); *Li:* Ivalo 761:52 (several collectors); *Lps:* Pummanki, ☿, 1930-07-12, Yläluostari, ♀, 1930-07-15, Peuravuono, ☿, 1930-07-21 (O. Hulkkonen). Quite abundant, local, favours cultivated habitats.

B. humilis Illiger, 1806 (Map 19)
The northern limit of the distribution runs from about 61°N in SW Finland to about 62° 30′N in SE Finland. The northernmost record: *Kb:* Liperi, ☿, 1961-08-26 (R. Elfving). Scarce, very local.

B. muscorum (Linnaeus, 1758) (Map 20)
Scattered occurrence in the archipelago of SW Finland, on the coast of *Oa:* Vaasa, ♀, (B. Lingonblad); *Ob;* and White Sea: Onega (outside E Fennoscandia). Also recorded inland: *Kb:* Ilomantsi, 1865-07-13 (E. Grönvik) (uncertain record); *Ok:* Vaala Säräisniemi 714:48, ☿, 1980-07-08 (J. Viramo); *Ob:* Vaala Järvikylä, ☿, 1979-07-28, Pudasjärvi Korvenkylä 725:51, 2 ☿, 1980-07-09, Syväoja 724:48, ☿, 1980-08-13 (J. Viramo), Ylitornio, ♀, 1946-08-03 (P. Niemelä); *Le:* Kilpisjärvi, 2 ♀, 1939 (E. Kivirikko). The specimens in these localities have a dark coat on the episternum and venter and no distinct local differences can be seen in the colour of the coat. The Finnish specimens greatly resemble the specimens from Norway, which have been named as a subspecies, *B. m. liepetterseni,* by Løken (1973:146), and also resemble the specimens from NW Russia (cf. Popov 1930 and Pekkarinen 1979). The specimens from *Ik:* Muolaa, ♀, 1936-07-26 and 2 ♀, 1938-08-11 (P. Niemelä) have a yellow episternum and venter and they are identical with the nominate form occurring on the SW coast of Norway, S Sweden and C Europe. The subspecific status of dark specimens in Finland is uncertain and a comparative revision of the colour forms in N Europe is necessary. Usually scarce, found abundantly in *Ob:* Hailuoto 721:39. Very local, restricted to damp, mainly coastal meadows rich in flowers, also on the fields with swampy ground and with fireweed *(Epilobium angustifolium* L.).

B. pascuorum (Scopoli, 1793) (Map 21)
Clearly absent only from N *Li* and N Kola. The northernmost records in Finland: *Le:* Kilpisjärvi area, abundant; *Li:* Ivalo 761:52 (E. Valkeila), 762:52 (A. Albrecht). Subspecific delimitation in Fennoscandia, see Løken (1973) and Pekkarinen (1979).

B. ruderarius (Müller, 1776) (Map 22)
The northern limit of the distribution runs from the head of the Gulf of Bothnia to the southeast. The northernmost records: *Ob:* Oulu about 1890 (K. Elfving); *Kb:* Nurmes (A. Saarinen); *Kon:* Karhumäki (J. Carpelan). Quite scarce, locally abundant in S Finland.

B. sylvarum (Linnaeus, 1761) (Map 23)
The northern limit of the distribution runs from about 61°15′N in SW Finland to about 62°45′N in SE Finland. The westernmost and northernmost records: *Ab:* Turku Ruissalo 671:23, ☿, 1975-08-18 (A. Pekkarinen); *Ta:* Lempäälä 681:31, ☿, 1977-08-14 (M. Raekunnas); *Kb:* Kontiolahti 696:64, ♀, 1978-06-03 (M. Raekunnas), Ilomantsi Mekrijärvi 696:70, ♀, 1978-06-09 and ♀, 1979-06-11 (E. Ranta). The species has immigrated to Finland through the Karelian Isthmus during the last 40 years (cf. Niemelä 1947 and the progress of the distribution in Map 23). Scarce, locally abundant in SE Finland.

B. veteranus (Fabricius, 1793) (Map 24)
The northern limit of the distribution runs from the head of the Gulf of Bothnia to the southeast. The northernmost records: *Ob:* Oulu 721:42, ♀, 1978-07-09 (J. Viramo); *Sb:* Iisalmi 705:50, several ☿, 1980 (E. Pankakoski); *Kb:* Nurmes 705:60, ♂, 1979-08-10 (P. Hakala). Rather scarce.

B. distinguendus Morawitz, 1869 (Map 25)
The northern limit of the distribution in Finland runs from about 68°30′N in S *Le* to the southeast (to about 65°15′N in E Finland). The northernmost records: *Le:* Karesuvanto, 2 ♀, (Løken 1978); *Lk:* Muonio, ☿, 1946-08-03 (P. Niemelä); *Ok:* Suomussalmi Ruhtinassalmi, 2 ♀, (O. Sorsakoski); *Kon;* Karhumäki (J. Carpelan). Quite scarce.

B. subterraneus (Linnaeus, 1758) (Map 26)
Recorded from: *Ik:* Uusikirkko, ♀, 1938-06-06 (P. Niemelä); *N:* the rural district of Helsinki 668:39, about 30 specimens, 1959-07-31 . . . 08-15 (M. Markkula), later found regularly and locally abundant in the Helsinki area; *Kl:* Parikkala 682:63, 2 ♀, 1962-07-09 (R. Elfving); *Ta:* Janakkala 676:36, ♀, 1968-07-01 and later in the Hämeenlinna area some specimens in different years (E. Valkeila); *Sa:* Lappeenranta 6771:561, 2 ☿, 1977-07-27 (E. Valkeila); *Ka:* Anjalankoski Myllykoski 674:48, ♀, 1977-06-12 (M. Viitasaari). Sahlberg (1889) has notified the species from the following localities: *Ik:* Isthmus Karelicus; *Sa:* Kangasniemi; *Oa:* Wasa, but these records are uncertain. The species has evidently immigrated into Finland through the Karelian Isthmus during the last few decades.

Psithyrus bohemicus (Seidl, 1837) (Map 27)
The northern limit of the distribution in Finland extends to about 68°40′N. The northernmost records: *Le:* Ounastunturit, ♀, 1951-07-24 (J. Kaisila); *Li:* Ivalo 761:52, ♂, 1979-08-12 (E. Sirjola). The most abundant *Psithyrus* species in S Finland.

P. rupestris (Fabricius, 1793) (Map 28)
The northern limit of the continuous distribution in Finland extends to about 62°30′N. The northernmost records: *Oa:* Tjock (P. Niemelä); *Kb:* Tohmajärvi (A. Pekkarinen); isolated record from *Ks:* Kuusamo Jyrkänkoski 733:61, ♂, 1979-09-06 (J. Viramo). Scarce, locally abundant in southernmost Finland, often in cultivated and urban biotopes.

P. campestris (Panzer, 1800) (Map 29)
The northern limit of the distribution in Finland extends to about 63°N. The northernmost record: *Sb:* Nilsiä (K. Levander). Scarce.

P. barbutellus (Kirby, 1802) (Map 30)
The northern limit of the distribution runs from about 60°30′N in SW Finland to about 62°N in SE Finland. The northernmost records: *Sa:* Rantasalmi (A. Vesterlund); *Kl:* Suistamo (E. Hammarström). Very scarce.

P. flavidus Eversman, 1852 *(lissonurus* Thomson, 1872) (Map 31)
Absent from wide areas of S Finland, but the southern limit of the distribution is uncertain. The southernmost records: *Oa:* Kristinestad; *Ta:* Keuruu (S. Sulkava); *Kl:* Parikkala (E. Valkeila), Sortavala area, several specimens (E. Rantalainen); *Kol:* Mäkrätjärvi and Vaaseni (P. Niemelä). The most abundant *Psithyrus* species in N Finland.

P. globosus Eversman, 1852 (Map 32)
The northern limit of the distribution runs from about 61°N in SW Finland to about 63°N in E Finland and *Kon.* The northernmost records: *Sb:* Kuopio (A. Vesterlund, R. Elfving); *Kon:* Tiutia and Tulvoja (B. Poppius). Scarce.

P. norvegicus Sparre Schneider, 1918 (Map 33)
The northern limit of the distribution in Finland is uncertain; found in several localities up to 63°N and some specimens in *Ks:* Oulanka 737:60, 737:61, 1977—78 (J. Viramo). Scarce.

P. sylvestris (Lepeletier, 1833) (Map 34)
The northern limit of the distribution extends to about 66°30′N. The northernmost records: *Ob:* Rovaniemi (E. Rantalainen); *Ks:* Oulanka, several specimens 1977—80 (J. Viramo). Abundant.

Distribution patterns

The *Bombus* and *Psithyrus* fauna of E Fennoscandia comprises 34 species (26 *Bombus* and 8 *Psithyrus* species). This is about the half of all the species found in Europe and about 10 % of the world figure. The corresponding number in Scandinavia is 38 (29 *Bombus* and 9 *Psithyrus).* The Scandinavian species which have not been found in E Fennoscandia are: *B. wurflenii* Radoszkowski, *B. terrestris* (L.), *B. cullumanus* (Kirby), *B. ruderatus* (Fabricius), *B. pomorum* (Panzer) and *P. vestalis* (Geoffroy). These all have a southern distribution in Scandinavia, except *B. wurflenii,* which is a boreoalpine species (cf. Løken 1973) (a single uncertain record of *B. wurflenii* from E Finland is excluded from this study, see p. 72). The E Fennoscandian species absent from Scandinavia are *B. patagiatus* and *B. semenoviellus,* both of which have an eastern distribution.

Distribution maps often reflect the collecting activity in different areas, too. Maps 35 and 36 reveal superficial collecting activity in wide and relatively continuous areas of S Finland and Lapland. The highest number of species is recorded from the grids on the southern coast of Finland in the Helsinki area and in southeastern Finland in the Parikkala area where thorough collections have been made. This number (23) is about 68 % of all the species in the whole of E Fennoscandia. A relatively high number (16) has been recorded from the Kuusamo area, where several southern and northern species occur.

We have made intensive collections in the marginal areas of the distribution of different species, especially in *Ob* and *Ks* N Finland. We therefore suppose that our maps approximately reveal the boundaries of the distribution in Finland, despite the existence of superficially investigated areas. The records from the Soviet part of E Fennoscandia are sporadic except for the

provinces of *Ik, Kl* and *Kol*, but the information on this area is also useful for some conclusions concerning the limits of the distribution.

The species can be grouped according to their recent distribution in E Fennoscandia as follows:

(1) Species with southern distribution (15 species): *B. soroeensis, B. lapidarius, B. humilis, B. muscorum, B. ruderarius, B. sylvarum, B. veteranus, B. distinguendus, B. subterraneus, P. rupestris, P. campestris, P. barbutellus, P. sylvestris, P. norvegicus* and *P. globosus*. The distribution of most of these species is restricted southwards from the level of the head of the Gulf of Bothnia (about 65°45'N). In some cases the distribution extends notably more northwards, mainly in the valley of the Tornio river *(B. soroeensis, B. muscorum* and *B. distinguendus)* or in the Kuusamo area *(B. lapidarius, P. rupestris* and *P. norvegicus)*.

(2) Species with eastern or southeastern distribution (3 species): *B. semenoviellus, B. patagiatus* and *B. consobrinus*.

(3) Species absent from SW Finland (3 species): *B. sporadicus, B. cingulatus* and *P. flavidus*.

(4) Species with arctic or subarctic distribution (6 species): *B. lapponicus, B. monticola, B. alpinus, B. polaris, B. balteatus* and *B. hyperboreus*.

(5) Species distributed throughout E Fennoscandia, or the distribution reaches at least to the arctic mountain or tundra area (7 species): *B. lucorum, B. hypnorum, B. jonellus, B. pratorum, B. hortorum, B. pascuorum* and *P. bohemicus*.

Some possible factors determining the distribution limits

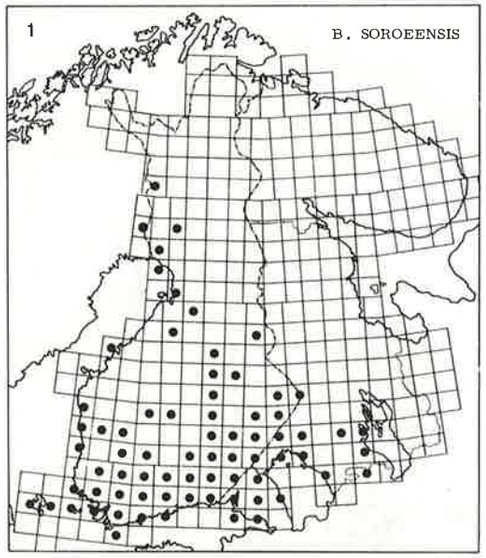
The northern limit of the distribution of many southern insect species correlates with isotherms (e.g. LINDROTH 1949). A consequence of the social life of bumblebees is an exceptionally long and intensive seasonal activity compared with most other insects, and therefore an ambient temperature obviously plays an important role in many biotic and abiotic factors determining the distribution of bumblebees. The temperature of the whole season is important to bumblebees and therefore isotherms describing thermal conditions during the whole summer perhaps correlate best. There is a correlation between the northern limit of the species with southern distribution (group 1) and the isotherms of effective temperature sums in Finland (Map 37) (such correlation is evident in Scandinavia, too).

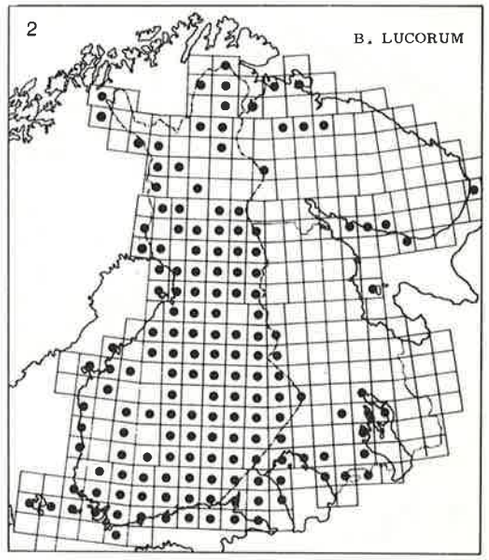
The northern limit of five southern species *(B. soroeensis, B. lapidarius, B. ruderarius, B. veteranus* and *B. distinguendus)* runs approximately from the head of the Gulf of Bothnia to the southeast. This line forms an important biogeographical transition zone which is associated with the southern border of the "Lapp" climate type in Finland. This limit is reflected e.g. by some taxonomic relations of the mammal and bird fauna of Finland, such as closely related allopatric species, subspecies meeting secondarily, zones of primary intergradation and clines (VOIPIO 1956). The ratio clines of polymorphic species are well-known indicators of the ecological conditions of a habitat (e.g. HALKKA et al. 1967) and the line mentioned above is the northern limit of the light morphs in the polymorph cline of *B. lucorum* in Finland (PEKKARINEN 1979). Moreover, the southern limit of the two subarctic species, *B. lapponicus* and *B. balteatus*, is approximately on this transition zone.

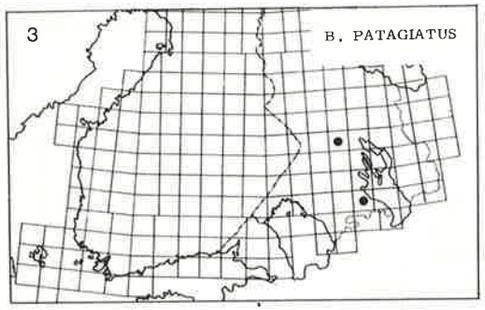
An advantageous local climate in the valley of the Tornio river may be the reason for northern occurrences of *B. soroeensis* and *B. distinguendus* in this area. The records of *B. lapidarius, P. rupestris* (the nest parasite of *B. lapidarius)* and *P. norvegicus* from Kuusamo are of particular interest. For the present it is impossible to decide whether these occurrences are due to new extension of distribution or old isolated populations. In Sweden, *B. lapidarius*

Table 2. The percentage distribution of Bombus individuals counted in some field studies in Fennoscandia and northern Germany.

Bombus	N Sweden TL: Abisko 1971-72 (LUNDBERG 1975)	N Finland Ks: Värriö 1978-79 (PULLIAINEN 1979)	N Finland Ks: Kuusamo 1978 (VIRAMO et al. unpubl.)	S Finland Sa: Puumala 1968 (TERÄS 1976 and RANTA et al. 1981)	S Finland Sa: Mikkeli 1972-74 (TERÄS unpubl.)	S Finland Ta: Lammi 1975-76 (TERÄS unpubl.)	NW Germany Cuxhaven 1959-69 (WAGNER 1971)	S Germany Erlangen 1943-50 (POSTNER 1951)
soroeensis	-	-	-	1.5	30.0	0.6	0.4	-
lucorum	6.8	20.9	24.6	14.5		27.9	7.3	8.3
sporadicus	-	0.5	3.6	-	-	-	-	-
terrestris	-	-	-	-	-	-	23.7	23.4
cingulatus	-	5.0	20.9	-	-	-	-	-
hypnorum	0.9	12.9		0.9	8.2	4.9	16.1	6.5
jonellus	18.5	20.5	39.0	-	0.4	0.1	0.4	-
lapponicus	39.6	32.8	-	-	-	-	-	-
pratorum	10.5	2.7	9.8	14.5	17.5	5.7	10.2	-
lapidarius	-	-	-	5.8	8.3	23.7	13.8	38.1
alpinus	1.2	-	-	-	-	-	-	-
polaris	0.5	-	-	-	-	-	-	-
balteatus	10.7	4.6	-	-	-	-	-	-
hyperboreus	3.6	-	-	-	-	-	-	-
hortorum	-	-	-	3.3	2.0	5.9	5.4	4.1
ruderatus	-	-	-	-	-	-	-	1.0
humilis	-	-	-	-	-	-	0.1	0.5
muscorum	-	-	-	-	-	-	1.4	0.1
pascuorum	7.8	0.1	2.0	58.3	29.2	26.6	12.4	10.0
ruderarius	-	-	-	1.0	0.9	0.9	3.7	0.1
sylvarum	-	-	-	-	0.0	0.3	-	3.0
veteranus	-	-	-	-	2.4	3.5	1.1	-
distinguendus	-	-	-	0.1	0.1	0.0	4.1	-
n	2459	739	1211	7383	16099	13972	4430	8654



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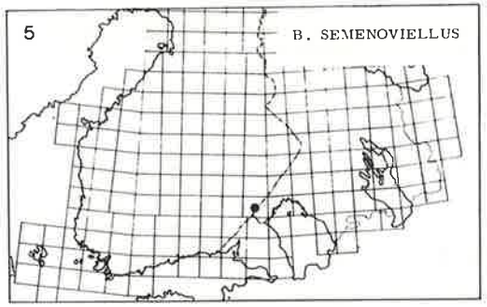
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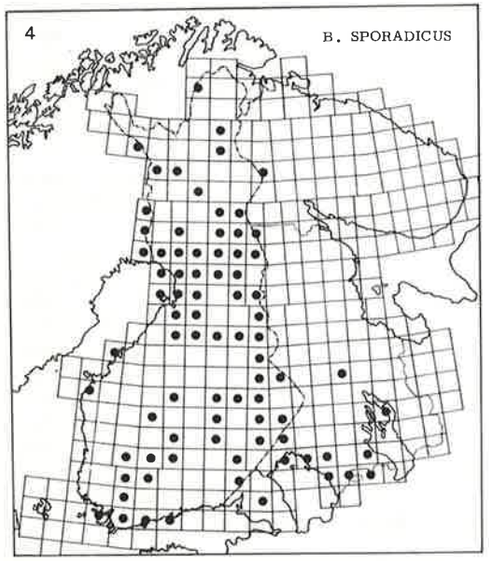
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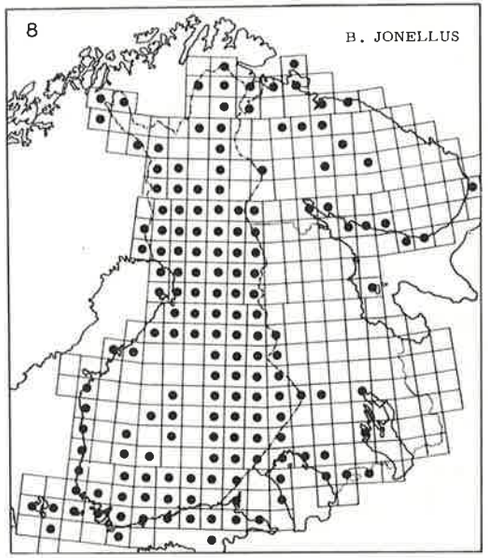
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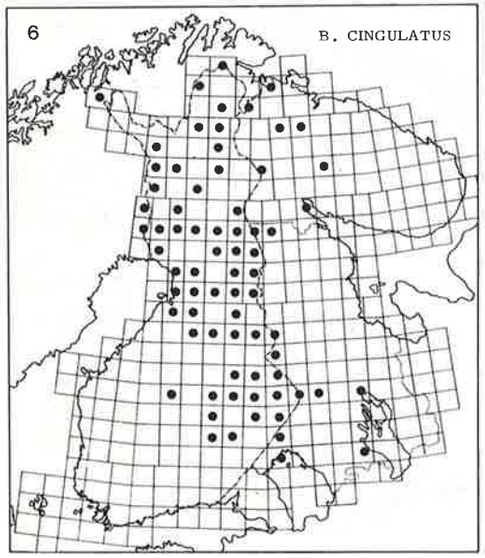
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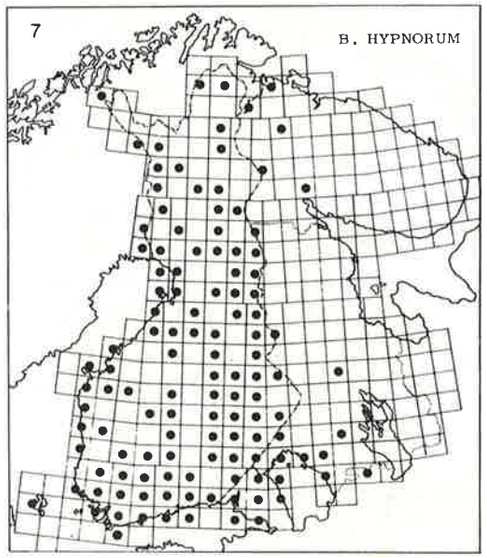
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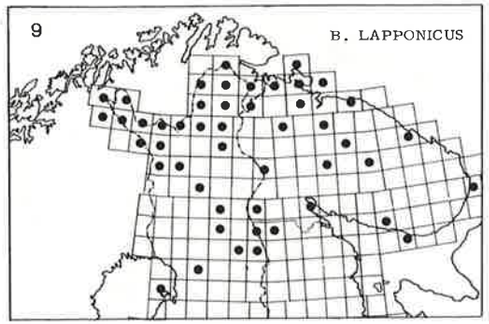
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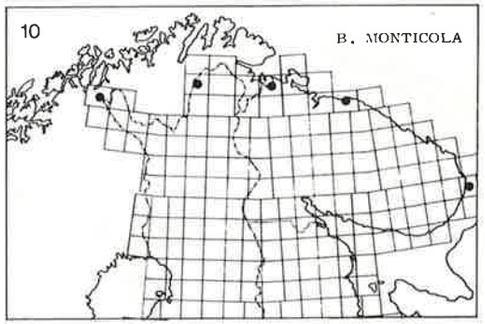
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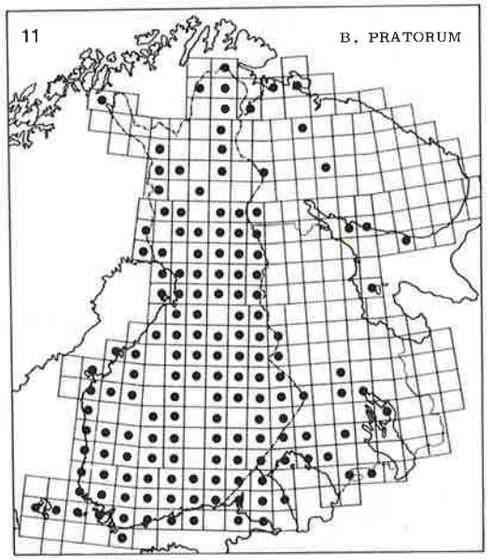
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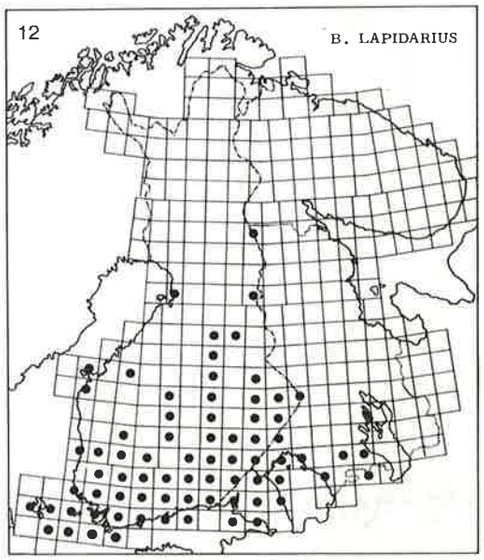
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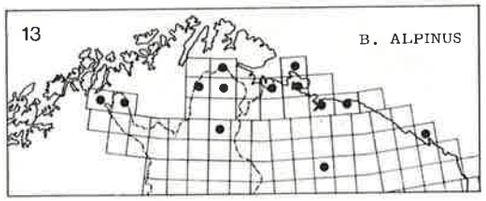
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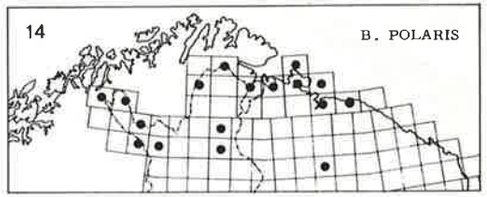
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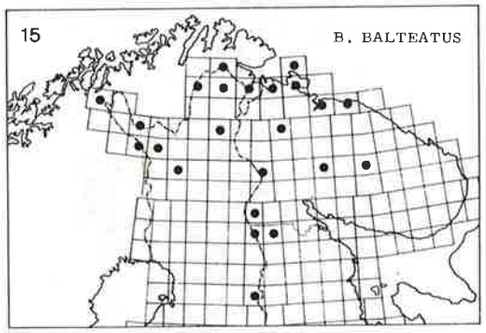
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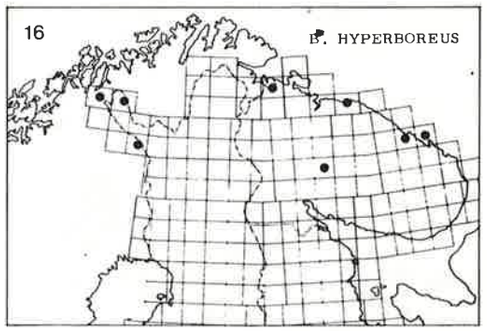
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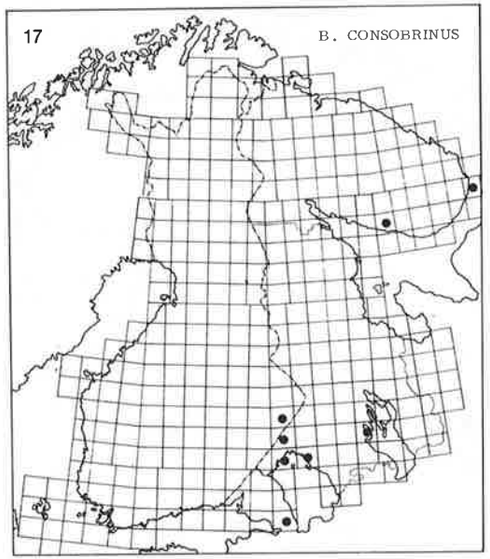
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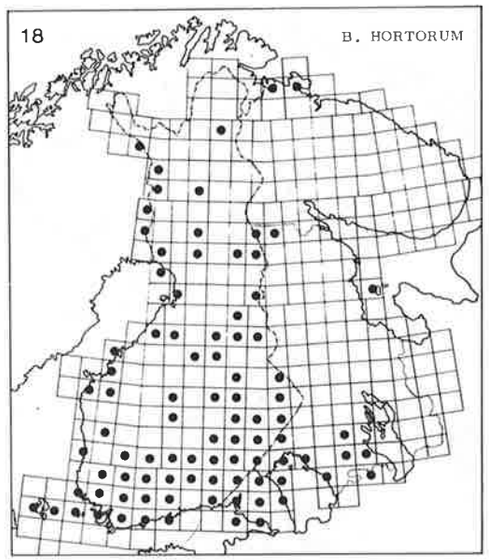
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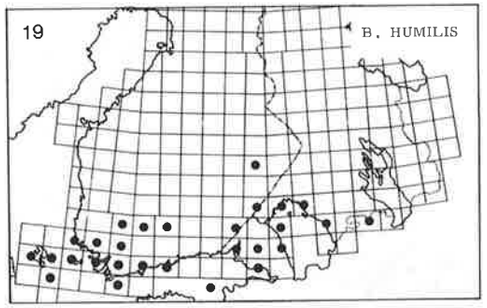
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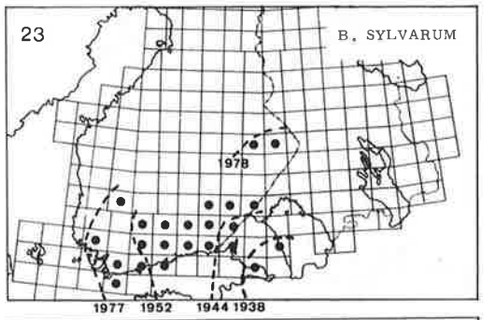
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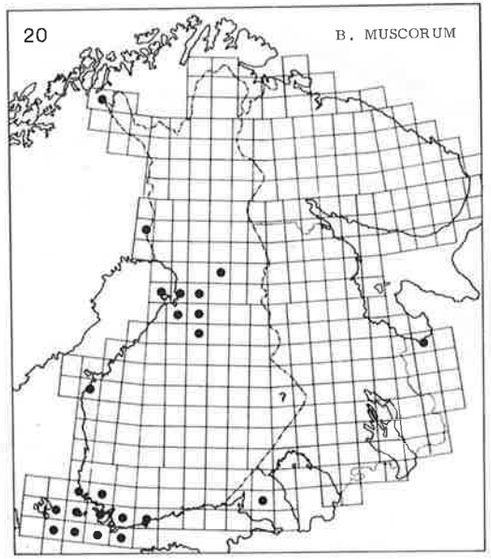
1977
1952
1944
1938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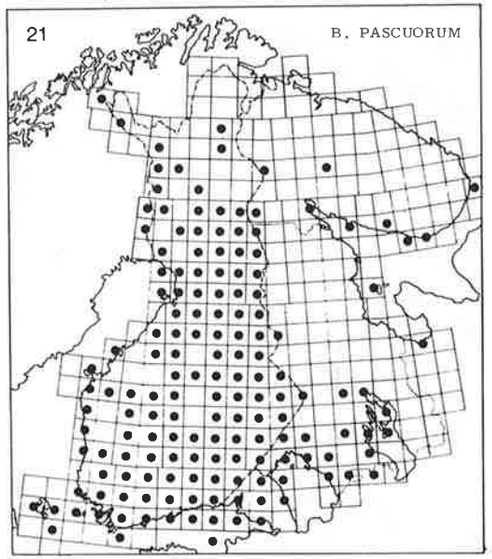
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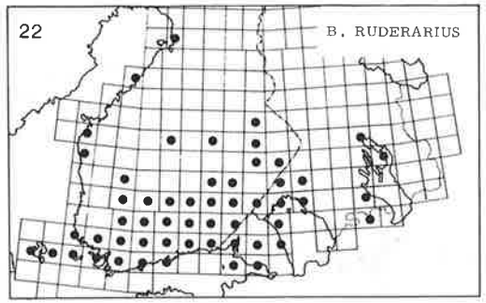
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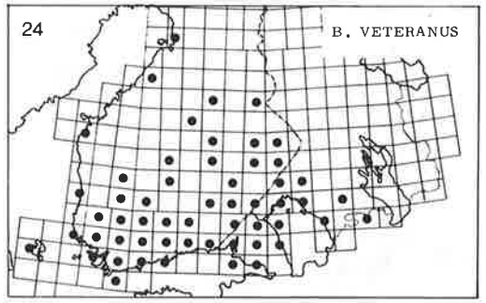
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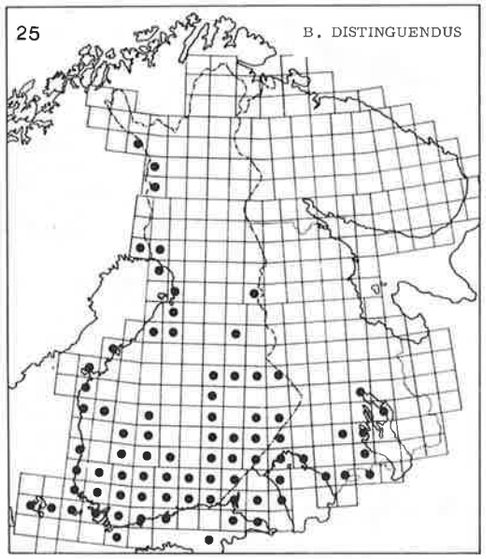
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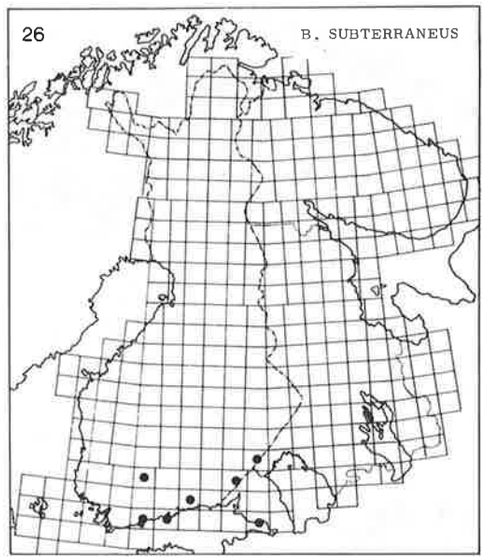
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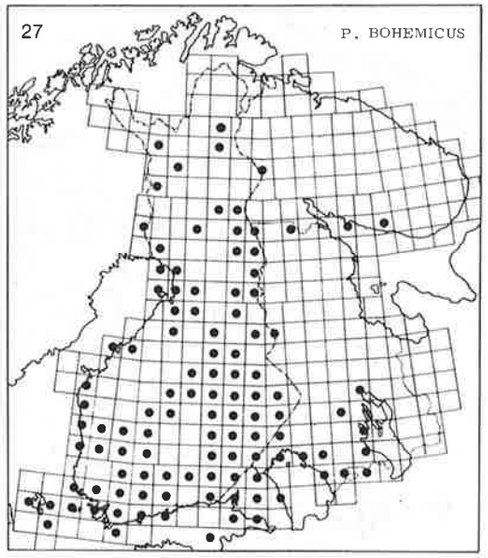
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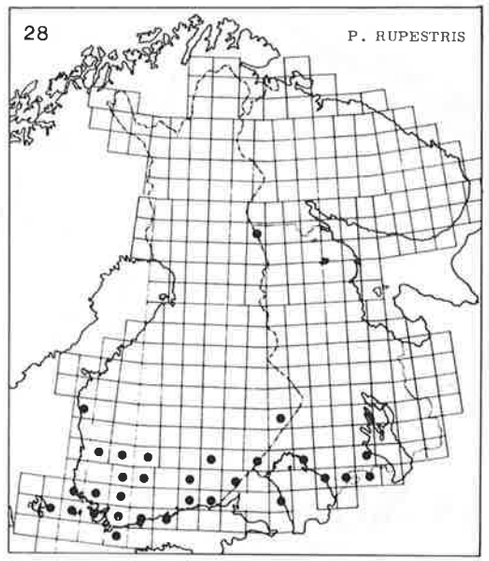
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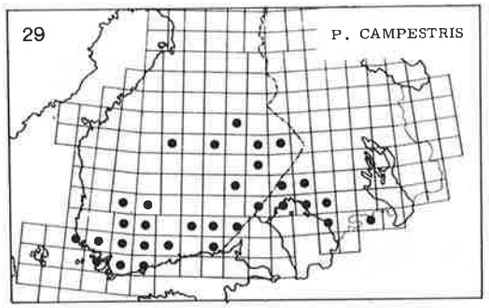

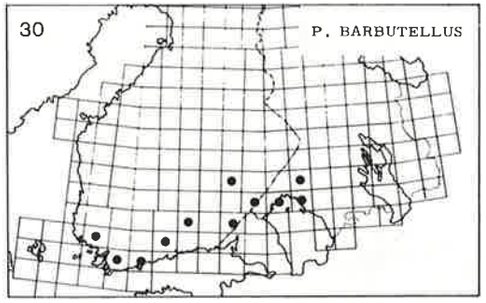

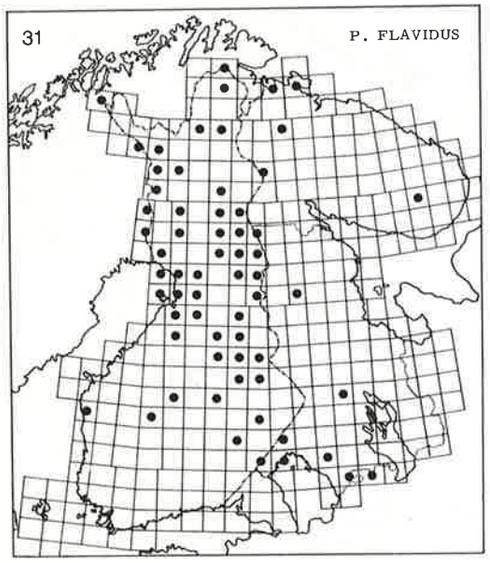

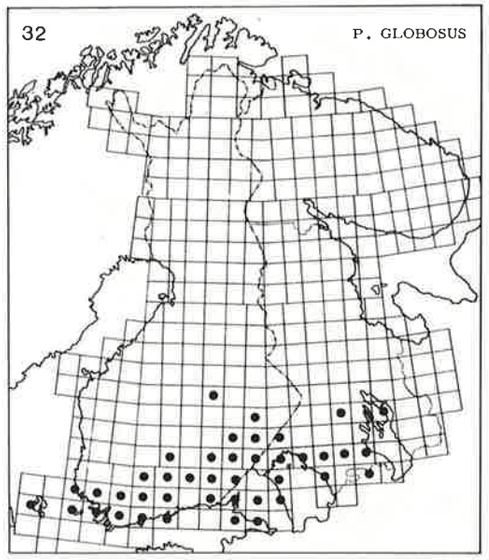

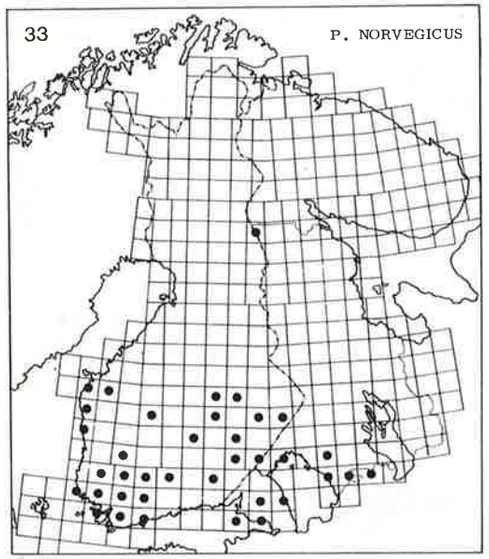

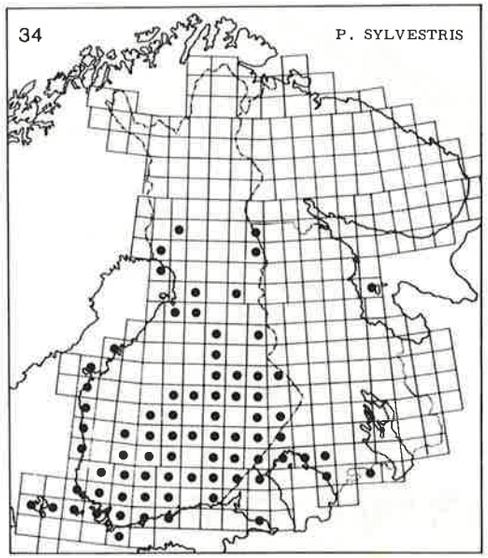

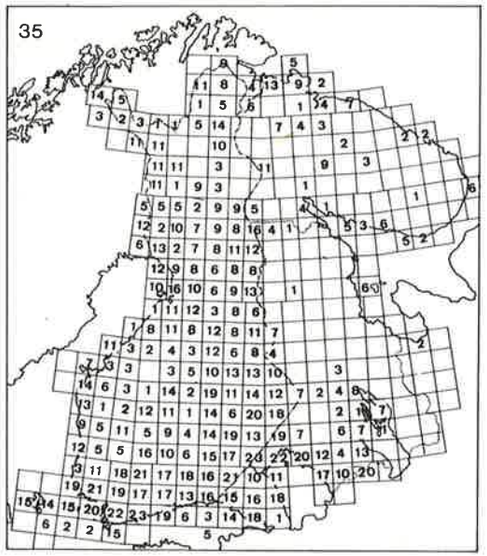

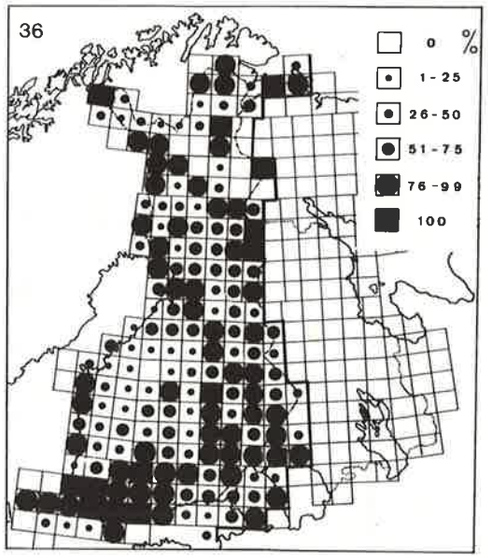

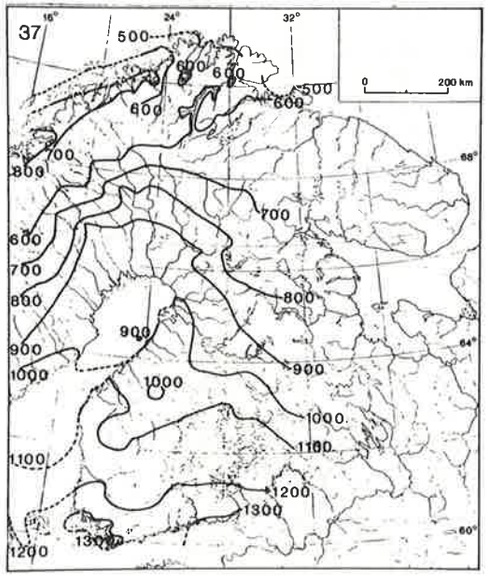

Maps 1-34. The distribution of Bombus and Psithyrus species in eastern Fennoscandia.

Map 35. The numbers of Bombus and Psithyrus species recorded in eastern Fennoscandia according to the European UTM grid system.

Map 36. The numbers of Bombus and Psithyrus species recorded (Map 35) as a percentage of the probable total numbers in different UTM squares.

Map 37. Effective temperature sums in Finland and northeastern Scandinavia in 1921-1950 (after LAAKSONEN 1979).

Table 3. The distribution of Bombus and Psithyrus species in the biogeographical provinces of eastern Fennoscandia (cf. the map on the back cover). Sol = Solovetsk (situated outside eastern Fennoscandia).

	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	Lk	Le	Ll	Kol	Kon	Kton	Knor	Kpoc	Kk	Lim	Lv	Lp	Lps	Lt	Lmur	(Sol)
1 B. soroeensis	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	-	Lk	-	-	Kol	Kon	-	-	-	-	Lim	Lv	-	-	-	-	-
2 B. lucorum	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	Lk	Le	Ll	Kol	Kon	Kton	Knor	-	-	Lim	Lv	Lp	Lps	Lt	-	(Sol)
3 B. patagiatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Kol	Kon	-	-	-	-	-	-	-	-	-	-	-
4 B. sporadicus	-	Ab	N	-	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	Lk	Le	Ll	Kol	Kon	-	-	Kpoc	-	-	-	-	-	-	-	-
5 B. semenovielius	-	-	-	-	-	-	-	-	Kl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6 B. cingulatus	-	-	-	-	-	-	-	Sa	Kl	-	Tb	Sb	Kb	-	Ok	Ob	Ks	Lk	Le	Ll	Kol	-	-	-	-	-	Lim	-	-	Lps	Lt	-	-
7 B. hypnorum	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	Lk	Le	Ll	Kol	-	-	-	Kpoc	-	Lim	-	-	Lps	-	-	-
8 B. jonellus	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	Lk	Le	Ll	Kol	Kon	-	-	-	-	Lim	Lv	Lp	Lps	Lt	Lmur	(Sol)
9 B. lapponicus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Ob	Ks	Lk	Le	Ll	-	-	-	-	-	-	Lim	Lv	Lp	Lps	Lt	Lmur	-
10 B. monticola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Le	Ll	-	-	-	-	-	-	-	-	Lp	Lps	-	Lmur	-
11 B. pratorum	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	Lk	Le	Ll	Kol	Kon	-	-	Kpoc	-	Lim	Lv	-	Lps	Lt	-	(Sol)
12 B. lapidarius	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	-	-	-	Kol	-	-	-	-	-	-	-	-	-	-	-	-
13 B. alpinus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Le	Ll	-	-	-	-	-	-	Lim	-	-	Lps	-	Lmur	-
14 B. polaris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Ll	-	-	-	-	-	-	Lim	-	-	Lps	-	Lmur	-
15 B. balteatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Ok	-	Ks	Lk	Le	Ll	-	-	-	-	-	-	Lim	Lv	-	Lps	Lt	Lmur	-
16 B. hyperboreus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Le	-	-	-	-	-	-	-	-	-	Lp	-	-	-	-
17 B. consobrinus	-	-	-	-	-	-	-	-	Kl	-	-	-	Kb	-	-	-	-	-	-	-	-	Kon	-	-	-	-	Lim	Lv	Lp	-	-	Lmur	-
18 B. hortorum	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	Lk	-	Ll	Kol	-	-	-	-	-	-	-	-	Lps	-	-	(Sol)
19 B. humilis	Al	Ab	N	Ka	Ik	-	Ta	Sa	Kl	-	-	-	Kb	-	-	-	-	-	Le	-	Kol	-	-	-	-	-	-	-	-	-	-	-	-
20 B. muscorum	Al	Ab	N	-	Ik	-	-	-	-	Oa	-	?	-	-	Ok	Ob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21 B. pascuorum	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	Lk	Le	Ll	Kol	Kon	Kton	-	-	-	Lim	Lv	-	Lps	-	-	(Sol)
22 B. ruderarius	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	-	Ob	-	-	-	-	Kol	Kon	-	-	-	-	-	-	-	-	-	-	-
23 B. sylvarum	-	Ab	N	Ka	Ik	-	Ta	Sa	Kl	-	Tb	-	Kb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24 B. veteranus	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	-	Ob	-	-	-	-	Kol	-	-	-	-	-	-	-	-	-	-	-	-
25 B. distinguendus	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	-	Lk	-	-	Kol	Kon	-	-	-	-	-	-	-	-	-	-	-
26 B. subterraneus	-	-	N	Ka	Ik	-	Ta	Sa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 P. bohemicus	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	Lk	Le	Ll	Kol	Kon	-	-	-	Kk	Lim	Lv	-	-	-	-	-
28 P. rupestris	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	-	Sb	Kb	-	-	-	Ks	-	-	-	Kol	-	-	-	-	-	-	-	-	-	-	-	-
29 P. campestris	-	Ab	N	Ka	-	St	Ta	Sa	Kl	-	Tb	Sb	Kb	-	-	-	-	-	-	-	Kol	-	-	-	-	-	-	-	-	-	-	-	-
30 P. barbutellus	-	Ab	N	-	-	-	-	Sa	Kl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Kpoc	-	-	-	Lp	Lps	Lt	-	-
31 P. flavidus	-	-	-	-	-	-	-	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	Lk	Le	Ll	Kol	Kon	-	-	-	-	-	-	-	-	-	-	-
32 P. globosus	Al	Ab	N	Ka	Ik	-	Ta	Sa	Kl	-	-	Sb	Kb	-	-	-	-	-	-	-	Kol	Kon	-	-	-	-	-	-	-	-	-	-	-
33 P. norvegicus	-	Ab	N	-	Ik	St	Ta	Sa	Kl	Oa	-	Sb	Kb	-	-	-	Ks	-	-	-	Kol	-	-	-	-	-	-	-	-	-	-	-	-
34 P. sylvestris	Al	Ab	N	Ka	Ik	St	Ta	Sa	Kl	Oa	Tb	Sb	Kb	Om	Ok	Ob	Ks	-	-	-	Kol	-	-	-	-	-	-	-	-	-	-	-	(Sol)

has recently been recorded as far north as Abisko (68°22′N) (Løken 1978). The scattered distribution of *B. muscorum* is possibly due to a wider post-glacial distribution and some isolated populations have perhaps become extinct in Scandinavia during the last few decades (Løken 1973). The dark form of *B. muscorum* in Scandinavia and Finland is restricted mainly to coastal habitats and the abundant local occurrence on the eastern coast of the head of the Gulf of Bothnia and eastwards inland is worthy of mention.

The biotopes of *B. lapponicus* in Scandinavia and Lapland are mainly mountain heaths and meadows (cf. Løken 1973:76). The record of *B. lapponicus* in Hailuoto (a large island on the eastern coast of the Gulf of Bothnia) implies that coastal meadows are also suitable biotopes for this species. Some single records from the lowlands of C Sweden (Løken 1973:77) indicate the possibility of a wider distribution on the eastern coast of the Gulf of Bothnia, which has been superficially investigated (cf. Map 36). The abundant occurrence of *B. jonellus* in the southern archipelago of Finland is also worthy of note and indicates the boreal character of biotopes in the outer archipelago.

The finds of the eastern palaearctic species *B. patagiatus* and *B. semenoviellus* in E Fennoscandia are very isolated, on the basis of their records from N Russia (Tkalcu 1967, Elfving 1965), but this may also be due to superficial collecting activity in vast areas east of Finland. The distribution history of *B. consobrinus* in Fennoscandia is puzzling. *B. consobrinus* is dependent on its main food plant *Aconitum septentrionale* and the distributions of the bee and the plant are practically identical in N Europe (Løken 1961). The isolated Scandinavian distribution of *Aconitum* is possibly of preglacial origin (Fries 1949) and a separate distribution of *Aconitum* (and *B. consobrinus*) in Kola is relatively closely connected with the distribution in Karelia, where the range of *Aconitum* extends as far as Onega on the coast of the White Sea. Thus the distribution of *B. consobrinus* in Scandinavia perhaps originates from one or more glacial refuge populations (cf. Pekkarinen 1979). The distribution of the group 3 species in Fennoscandia is associated with the area of coniferous forests (regio coniferina) as Løken (1973:195) has emphasized in connection with *B. sporadicus* and *B. cingulatus*. These species are representatives of the Palaearctic taiga element and they are absent from wide areas of S Scandinavia and the western and northern Atlantic coast.

The Finnish climate has become warmer during the last hundred years. According to Heino (1978) the increase in the mean annual temperature culminated around the 1940s when it was 1.5°C higher than 50 years earlier in Helsinki. The warming up has been most pronounced in the spring temperature, amounting to a rise of about 2°C by the 1930s, after which the average spring temperatures have remained unchanged. A consequence of the temperature rise is that May isotherms moved 100—200 km northwards from 1901—30 to 1931—60 (and remained nearly stable in 1961—75). June isotherms have moved continuously as much as 300—400 km northwards in some places in Finland from 1901—30 to 1961—75 (Järvinen & Väisänen 1979). Kaisila (1962) used a large amount of material to show that the phases of extension and abundance of many (at least 70) Lepidoptera species in Finland correspond precisely to the periods of warm summers in this century. The extensions of the distribution of *B. sylvarum* and *B. subterraneus* since the end of the 1930s through the Karelian Isthmus to Finland are possibly associated with the warming up of the climate. On the other hand, *B. subterraneus* has a great affinity for red clover (*Trifolium pratense* L.) and extensive cultivation of this plant during

this century has possibly aided the extension of *B. subterraneus*. No distinct extensions of the ranges are noticeable for other species. Old northern records from about 1890 concerning *B. soroeensis* and *B. veteranus* in Kuopio (about 63°N) and *B. lapidarius, B. ruderarius* and *B. distinguendus* in Oulu (about 65°N) reveal that the northern limits of these species have not changed much during the last 90 years. However, some of the new northern records of these species mentioned above may be due to a recent extension. *B. terrestris* has recently extended its range northwards in Scandinavia (LØKEN 1973: 194), as have some solitary bees and the beewolf *(Philanthus triangulum* F.) in Finland (NIEMELÄ 1947, VÄLKEILA 1953 and VIITASAARI 1975).

There is a notable correspondence between the northern limits of many southern *Bombus* species and summer isotherms both in Scandinavia and Finland (cf. the limits of ranges in LØKEN 1973 and fig. 14 in LAAKSONEN 1979). *B. veteranus* is an exception. This species has occurred for a long time in S Scandinavia, but only in extreme SW Sweden. The absence of the species from other parts of S Scandinavia is an interesting zoogeographical problem.

Knowledge of the hosts of different *Psithyrus* species is incomplete and many reports indicate that some *Psithyrus* species possibly have several hosts and that areal differences in the host specificity are possible, too. Therefore, only some tentative conclusions can be drawn from the distribution of *Psithyrus* species compared with their potential hosts. The most probable hosts of *Psithyrus* species in E Fennoscandia are, according to the literature (HAMMER & HOLM 1970, POUVREAU 1973, ALFORD 1975, CEDERBERG 1976 etc.), the observations of the late Erkki Valkeila and our own observations, as follows (very uncertain hosts are in parentheses):

Nest parasite	Host
P. bohemicus	*B. lucorum*
P. rupestris	*B. lapidarius*
P. campestris	?*(B. humilis, B. pascuorum)*
P. barbutellus	?*(B. hortorum)*
P. sylvestris	?*(B. pratorum, B. jonellus)*
P. flavidus	*B. jonellus*
P. norvegicus	*B. hypnorum*
P. globosus	*B. ruderarius*

The greatest conformity of distributions occurs between *P. bohemicus* and *B. lucorum, P. rupestris* and *B. lapidarius, P. campestris* and *B. humilis, P. flavidus* and *B. jonellus,* and *P. globosus* and *B. ruderarius*. The isolated records of *B. lapidarius* and *P. rupestris* in Kuusamo confirm their host-parasite relation. *B. lapponicus* is often assumed to be the host of *P. flavidus,* but the range of *P. flavidus* extends much further to the south than that of *B. lapponicus* and *B. jonellus* is the most probable host of *P. flavidus* on the basis of their habitats and distributions. It is also worth noting that *B. jonellus* is scarce in the wide area of SW Finland from which *P. flavidus* is absent.

Abundance

The evaluation of abundance of the species is a complicated problem and in this context we can only compare the relative abundances between different species. The material in Table 1 is mostly based on public collections, and, of course, forms no random sample of Fennoscandian bumblebees. Nonetheless, the percentages of different species in this large amount of material give a very rough idea of the relative abundance of bumblebee species in Finland and Fennoscandia. The species distributed practically all over the Fennoscandia *(B. lucorum, B. pratorum, B. hortorum* and *B. pascuorum)* are among the most abundant species in the materials of the three Fennoscandian countries. These species are also the most abundant species in the random materials from the several areas in N Europe (Table 2).

Local and habitat differences in the abundance of different species are large (e.g. REINIG 1972). Thus the material in Table 2 reflects the composition of a local fauna very imperfectly and only tentative comparisons are possible between different areas of Fennoscandia and N Germany. *B. lucorum, B. pratorum, B. lapidarius, B. hortorum* and *B. pascuorum* are among the most abundant species in S Finland, N Germany and England (Table 2 and INT. BEE RES. ASSOC. 1980). *B. lucorum* and *B. pascuorum* are the most abundant species in the material from S Finland, but *B. lucorum* is distinctly more scarce in N Germany, where the closely related species *B. terrestris* is the most abundant species. In N Europe, *B. terrestris* is a more anthropochorous species than *B. lucorum* (ANDER 1963, HAESELER 1972 and PEKKARINEN 1979: 9) and these species do not occur abundantly in the same habitat (WAGNER 1971). In N Fennoscandia *B. hypnorum* and *B. cingulatus,* and *B. alpinus* and *B. polaris* (in alpine and arctic areas) are closely related species, but no distinct habitat differentation has been observed between the members of these species pairs.

No comprehensive study has been made of the temporal variation in the abundance of different bumblebee species in N Europe. Yearly fluctuations are obviously great and vary in different species. The following observations were made on red clover in the same locality in Helsinki (668:39) in 1966 (07-22, 07-26), 1967 (08-04) and 1980 (07-22, 07-31) (values in percentages):

	1966	1967	1980
B. soroeensis	—	—	0.3
lucorum	34.1	7.7	0.6
lapidarius	13.7	17.1	49.6
hortorum	6.2	9.4	13.3
pascuorum	6.7	0.6	4.2
ruderarius	1.8	1.1	3.1
sylvarum	0.3	—	0.3
veteranus	4.1	2.2	2.5
distinguendus	2.9	14.9	0.6
subterraneus	30.2	47.0	25.5
n	981	181	353

The material reveals a great change in the abundance of *B. lucorum, B. lapidarius* and *B. distinguendus*. On the other hand, the abundances of *B. hortorum, B. pascuorum* and *B. subterraneus* seem to be more stable. The great and stable abundance of *B. subterraneus* is worthy of note, since this species is a newcomer to Finland. *B. lucorum* and *B. lapidarius* (workers) are the species with a short tongue and thus they are not efficient foragers on red clover. Variation in the abundances of other nectar flowers is one possible explanation for their abundance fluctuations on red clover (cf. TERÄS 1976a).

Modern agriculture and urbanisation have presumably changed the habitats and abundance of bumblebees. Regrettably, we have very little exact information concerning the human influence on these useful animals and long-term studies on this subject are important.

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Selostus

Kimalaisten levinneisyys Itä-Fennoskandiassa

26:n kimalais- ja kahdeksan loiskimalaislajin levinneisyys on kartoitettu UTM Grid -ruutujärjestelmän mukaisesti Suomessa ja Neuvostoliiton luoteisosissa. Lajit on ryhmitelty käyttäen perusteena niiden levinneisyyttä tutkimusalueella. Useiden lajien levinneisyysraja seuraa tehoisten lämpötilasummien isotermejä ja kahdeksan lajin pohjois- tai eteläraja on eliömaantieteellisellä vaihettumisvyöhykkeellä, joka kulkee Pohjanlahden pohjukasta kaakkoon. *Bombus sylvarum* ja *B. subterraneus* ovat levittäytyneet 1930-luvulta lähtien Karjalan kannaksen kautta Etelä-Suomeen. Kirjoituksessa tarkastellaan lisäksi ilmaston lämpenemisen ja eräiden muiden ympäristötekijöiden vaikutusta kimalaisten levinneisyyteen, loiskimalaisten ja niiden isäntien levinneisyyttä sekä kimalaislajien suhteellista runsautta muutamilla alueilla Pohjois-Euroopassa.

Referat

Humlornas utbredning i Östfennoskandien

Utbredningen för våra 26 arter humlor och 8 snylthumlor har karterats med UTM rutsystemet för Finland och nordvästra Sovjetunionen. Arterna har grupperats utgående från deras utbredning i det undersökta området. Flere arters utbredningsgräns följer isotermerna för den effektiva värmesumman, och 8 arter har sin nord- eller sydgräns på den biogeografiska övergångszonen, som löper från bottnen av Bottniska Viken mot sydost. *Bombus sylvarum* och *B. subterraneus* har spritt sig över Karelska Näset till södra Finland sedan 1930-talet. Vidare diskuteras effekten av temperaturstegring och några andra miljöfaktorer på humlornas utbredning, snylthumlors och deras värdarters utbredning jämförs och humlearternas relativa abundans på vissa områden i Nordeuropa presenteras.