NORSK
ENTOMOLOGISK
TIDSSKRIFT

NORWEGIAN JOURNAL OF ENTOMOLOGY

VOLUME 20 · NO. 1 · 1973

Studies on Scandinavian Bumble Bees (Hymenoptera, Apidae)

By Astrid Løken

UNIVERSITETSFORLAGET

Norsk Entomologisk Tidsskrift

Norwegian Journal of Entomology

PUBLISHER

Universitetsforlaget: P. O. Box 307, Blindern, Oslo 3, Norway.
P. O. Box 142, Boston, Massachusetts 02113, U.S.A.

CONTRIBUTIONS

These should be sent to the Editor. Authors are requested to follow the instructions on page 3 of the cover.
Artikler som ønskes trykt i tidsskriftet sendes redaktøren. Bidragsytere må følge anvisningen på omslagets tredje side.

SUBSCRIPTIONS

Non-members of the Norwegian Entomological Society should send their orders to Universitetsforlaget. The subscription price per volume (two issues annually) is U.S. $ 11.00 (N. kr. 55,—). Notice of change of address should be accompanied by the old address. Back volumes should also be ordered from Universitetsforlaget.

NORSK ENTOMOLOGISK FORENING

ser sin hovedoppgave i å fremme det entomologiske studium i Norge, og danne et bindeledd mellom de interesserte. Søknad om opptagelse i foreningen sendes formannen. Medlemskontingenten er for tiden kr. 20,— pr. år. Medlemmer får tidsskriftet fritt tilsendt.

NORSK ENTOMOLOGISK TIDSSKRIFT
VOLUME 20, NO. 1, 1973

Studies on Scandinavian Bumble Bees (Hymenoptera, Apidae)

BY
ASTRID LØKEN

UNIVERSITETSFORLAGET

Printed with a Grant

from Norges Almenvitenskapelige forskningsråd

Manuscript received 20 November 1971

Printed in Norway

A/S Nationaltrykkeriet & Forlagsbokbinderiet

In memory of
Ove Meidell (1903–1942)

CONTENTS

Studies on Scandinavian Bumble Bees (Hymenoptera, Apidae)

ASTRID LØKEN

Løken, A. 1973. Studies on Scandinavian Bumble Bees (Hymenoptera, Apidae). *Norsk ent. Tidsskr. 20*, 1–218.

A synopsis of the genus *Bombus* Latreille in Norway and Sweden is presented. Although primarily a taxonomic, phenotypic, and faunistic study, bionomic information is incorporated and post-glacial immigration routes are stressed.
A total of 29 species, divided into 34 subspecies, has been recognized. One new subspecies, *B. muscorum liepetterseni* (= *B. m. smithianus* auctt. nec White, in part), is described, and holotype ♀ is designated. The following types are also selected: *B. mastrucatus* Gerstaecker lectotype ♂; *B. martes* Gerstaecker lectotype ♀; *B. humilis hafsahlianus* Vogt lectotype ☿; *B. pascuorum sparreanus* nov. nom. (= *B. agrorum bicolor* Sparre Schneider, 1909 nec Friese, 1903) holotype ♀.

Astrid Løken, Zoological Museum, University of Bergen, N-5014 Bergen, Norway

PREFACE

The world-wide genus *Bombus* Latreille occurs in all zoogeographic regions with a great number of endemic species represented in holarctic, neotropical, and oriental regions (Skorikov 1922b). One species was recently recognized in the Ethiopian region (Tkalcu 1966) and four European species introduced into the Australian region, i.e. New Zealand (Gurr 1964). The species in this genus, i.e. the true bumble bees, are beneficial insects, pollinating a wide range of plants including those of great economic importance. They are, moreover, social bees and, being strongly polymorphic, they have been intensively studied from genetic, taxonomic, and zoogeographical points of view (Vogt 1909, 1911; Friese & Wagner 1909, 1912, etc.; Krüger 1928, 1931, 1940, 1950, etc.; Reinig 1936, 1939, 1965, etc.; etc.) besides being subject to basic and applied research devoted to their biology and ecology (references in Free & Butler 1959).

Floral ecological observations and preliminary pollination research (Løken 1949, 1950, 1958a, 1961b, 1962) emphasized the need for a taxonomic and faunistic study of Norwegian bumble bees. A revision of the collections was therefore started in the year 1962. To secure information for a better understanding of the species, the scope of the study was later widened to present a monograph of *Bombus* in Scandinavia, i.e. Norway and Sweden, the entire peninsula being a more well-defined unit. Though taxonomy, phenotypic variations, and distribution are the topics of the study, bionomic information has been added and the opportunity taken to refer to the world distribution of the species involved. To limit the subject, the work does not, however, deal with plant preference, which in fact was an essential aim in the author's field observations.

INTRODUCTION

Historical review

Linnaeus (1758) listed a total of seven *Bombus* species occurring in his home country Sweden, six of which are recognized as species, viz. those termed *Apis terrestris*, *A. lapidaria*, *A. muscorum*, *A. hypnorum*, *A. subterranea* and *A. alpina*, whereas the seventh designation, *A. aceruorum*, is a synonym of *A. subterranea*. All the species are in fact mentioned by Linnaeus in his *Acta Upsaliensis* (1736). Four more Swedish species were added by Linnaeus (1761) and named *Apis hortorum*, *A. pratorum*, *A. sylvarum* and *A. lucorum*. As many as 32 *Bombus* species are ascribed to Scandinavia by Dahlbom (1832), twenty of which are recognized as species. The remainder are synonyms, subspecies, or infrasubspecific forms ex-

cept one taxon, named *B. rosiellus* (Kirby), which refers to *Psithyrus campestris* (Panzer). The twenty species are (the synonyms used by Dahlbom in brackets): *B. ruderarius* (Müller) (= *B. rajellus* (Kirby)), *B. soroeensis* (Fabricius) (= *B. virginalis* (Kirby)), *B. balteatus* Dahlbom, *B. lapponicus* (Fabricius), *B. hyperboreus* Schönherr, *B. jonellus* (Kirby), *B. distinguendus* Morawitz (= *B. fragrans* (Kirby), *B. veteranus* (Fabricius) (= *B. autumnalis*: Dahlbom), *B. pascuorum* (Scopoli) (= *B. agrorum* (Fabricius)), *B. consobrinus* Dahlbom in addition to the ten species of Linneaus. Zetterstedt (1838) dealt with the species treated by Dahlbom (1832) as species or synonyms. Dahlbom did in fact include Zetterstedt's collection in his monograph since Zetterstedt had his manuscript finished by then, but printing was delayed (Ander 1967). This explains how both authors not only described the same new species but also gave them the same names, which are those written on the labels by Zetterstedt, viz. *B. ephippium*, *B. nivalis*, *B. tricolor* and *B. arcticus*. They are all revised as to synonyms or subspecies.

The most comprehensive Scandinavian monograph is that of Thomson (1872). It deals with a total of 22 *Bombus* spp., viz. *B. ruderatus* (Fabricius), *B. cullumanus* (Kirby) and *B. wurfleini* Radoszkowski (described as *B. brevigena* Thomson), and all the species mentioned by Dahlbom (1832) with exception of *B. lucorum*, which Thomson synonymizes with *B. terrestris*. In a key to the Swedish *Bombus* ssp., followed by short descriptions, Aurivillius (1903) keeps to the species recognized by Thomson (1872) except that *B. ruderatus* is omitted.

While the earliest information on Swedish bumble bees dates from Linnaeus, the first Norwegian records to my knowledge were reported by Sommerfelt (1824–27), who listed three species from Saltdalen in Nordland county, viz. *B. hortorum*, *B. hypnorum* and *B. terrestris*, the latter most probably referring to *B. lucorum*. In addition to the sparse material collected by Zetterstedt in Northern Norway (Dahlbom 1832, Zetterstedt 1838), the pioneer observations in this country were carried out by Siebke (1853, 1863, 1866, 1870, 1873). The first synopsis on the bumble bee fauna of Norway (Siebke 1880) presents a total of 18 species in the following sequence (synonyms used by Siebke in brackets): *B. consobrinus*, *B. hortorum*, *B. distinguendus*, *B. subterraneus*, *B. muscorum*, *B. pascuorum* (= *B. agrorum*), *B. sylvarum*, *B. ruderarius* (= *B. rajellus*), *B. lucorum* (= *B. terrestris*), *B. hyperboreus*, *B. balteatus* (= *B. nivalis*), *B. alpinus*, *B. soroeensis*, *B. lapidarius*, *B. pratorum*, *B. hypnorum*, *B. lapponicus* and *B. wurfleini* (= *B. brevigena*).

Basic contributions to the knowledge of the Norwegian bumble bees are the works of Sparre Schneider. His most comprehensive papers are based on records from the central mountains of Southern Norway, and observations in Northern Norway and the southeastern lowlands respectively (Sparre Schneider 1898, 1909, 1918). In addition to the 18 species listed by Siebke (1880), he distinguished *B. jonellus* and *B. humilis* Illiger (= *B. solstitialis* Panzer). Information on the bumble bees of Western Norway was furnished by Lie-Pettersen (1901, 1902, 1905, 1907). In a survey of the species occurring in the most southwestern part of the country, i.e. Rogaland county, Meidell (1934a) also included a synopsis of the bumble bee fauna of Norway. He added one species to those treated by Sparre Schneider, by separating *B. terrestris* and *B. lucorum*; neither of these, however, are true *B. terrestris*.

Supplementary contributions to the Norwegian and the Swedish bumble bees are otherwise referred to in the treatment of the individual *Bombus* species. According to the present revision, the Scandinavian bumble bees represent a total of 29 species divided into 34 subspecies.

Notes on the topography and climate

The great extension south to north of the Scandinavian peninsula, being situated between 55°20′ and 71°11′ N, presents great geographical and climatical variations (Figs. 1–2). The topography is dominated by the Caledonian mountain chain ranging from Southwestern Norway to the Arctic in the northeast. It is not a continuous range, but consists of undulating mountainous plateaux ('vidder') and mountainous massifs with peaks and glaciers, intersected by canyons and rather luxuriant valleys. The chain can roughly be separated in two parts by east-west-directed

wooded passes at approximately 63°30′ N: (1) A southern range occupying most of Southern Norway and from 61° N northwards also the adjacent border area of Sweden, the isolated mountains in Dalarne being included. (As to the location of counties mentioned in the text, vide Figs. 97–99.) The watershed divide is situated rather far west. The range consequently slopes much more gradually towards east than towards west, where the mountains reach the coast from where the fjords with very steep sides cut more or less far into the country. (2) A northern range extending in varying width along the Norwegian-Swedish border, with a shift of maximum elevation into Sweden between 67° and 68°30′ N, and further north continuing to the northern coast of Norway. The heights of the ranges, being 900–1200 m with peaks rising to a maximum altitude of 2468 m in the mountainous massif of Jotunheimen in Southern Norway, are in general lower on going north.

Norway is a pronounced mountainous country.

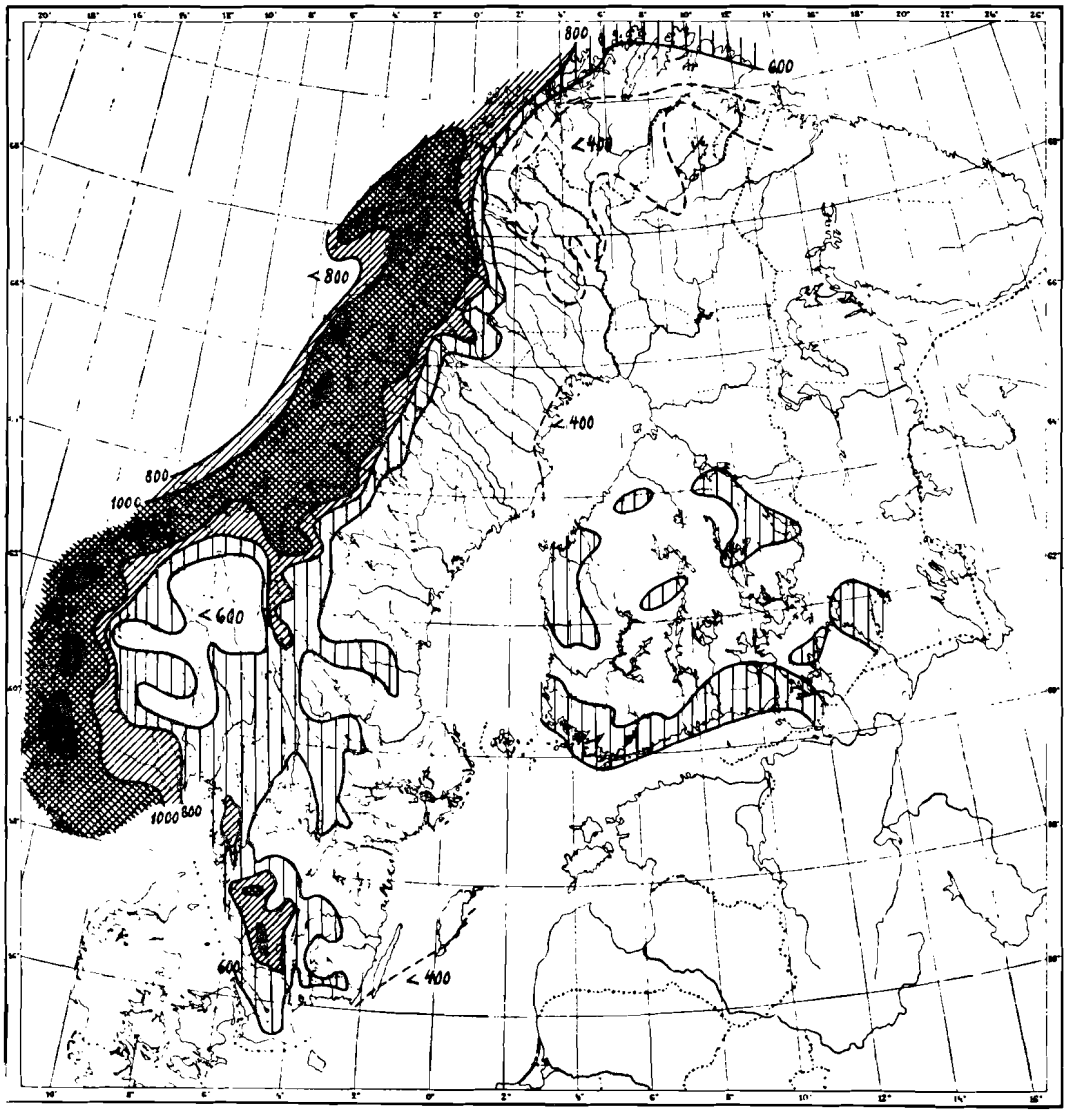


Fig. 1. The mean annual precipitation in Fennoscandia. Black area = > 2000 mm. (From Lindroth 1949, p. 486.)

Lowlands, defined by the 200 m contour, are merely restricted to (1) the southeastern part of the country, (2) a more or less narrow – in some places absent – zone along the coast, (3) a widened area around Trondheimsfjorden situated in Sör- and Nord-Tröndelag and (4) another wide area in Northern Norway, i.e. in the eastern district of Finnmark (Fö). The topography of Sweden is more uniform. East of the mountainous border area are terraced plateaux descending towards the Gulf of Bothnia. Further south, in Central and Southern Sweden, the lowlands are dominating, except for the woodland plateau with hills ranging between 200 m and 400 m in Småland. The landscape is otherwise characterized by the great lakes in Central Sweden.

Scandinavia is surrounded on the west by the Atlantic Ocean and on the east by the Baltic Sea. The conspicuous contrast in the climate is influenced by the Gulf Stream and predominating southwesterly winds, in addition to great altitudinal and latitudinal variations. Broadly speaking, a maritime climate prevails in the areas west of the mountain chain and on the west coast of Sweden. The remaining part of the peninsula has a more continental climate, producing wide differences in temperature during the day and during the course of the year. Striking contrasts in the climate are also illustrated by the local variations in the mean annual precipitation (Fig. 1).

Regional division

Owing to the variations in climate, structure, and topography, there are great local ecological differences throughout Scandinavia which impede a zoogeographical zonation, particularly of Norway. The classic division of Scandinavia was made by Ekman (1922), who mainly based it on the fauna of vertebrates. However, as pointed out by Lindroth (1949, p. 45ff), a regional division based on tree-limits is more useful for studies on the terrestrial fauna. The division used here (Fig. 2), i.e. a simple division into forest regions as defined by Swedish botanists, is taken from Lindroth (1949, pp. 436–438). The description of terms is somewhat amplified.

a) *Regio alpina/arctica.* Associated with the area above or beyond the continuous small copse birch woodland; in the lower belt for one thing characterized by lichen, *Cladonia rangiferina* group, *Ericaceae*, *Empetrum*, *Salix herbacea* L. and scattered growth of *Betula nana* L., *Salix spp.*, *Geranium silvaticum* L.

b) *Regio subalpina/subarctica (= regio betulina).* Associated with the area extending from the timberline, i.e. the economic forest limit of the coniferous forest belt, to *regio alpina/arctica;* in the lower belt it is characterized by *Betula pubescens* Ehrhart (= *B. tortuosa* Ledebour), tall *Salix* spp., *Juniper communis* L., and in the upper belt by rather continuous shrubs of *Betula nana*, *Salix* spp., *Ericaceae* and scattered or local growth of birch and juniper.

c) *Regio coniferina.* Associated with the high boreal forest belt, dominated by *Pinus* and *Picea.*

d) *Regio quercina.* Area extending from the northern limit of *regio fagina*, defined below, to the northern limit of *Quercus.*

e) *Regio fagina.* Associated with predominate growth of *Fagus silvatica* L., i.e. not extending to the northern limit of the species.

With the exception of *regio fagina*, the boundaries of the plant-geographical regions above refer to the approximate upper or northern limits of the tree species characterizing the zones (vide Hultén 1950). The term alpine applies to mountainous areas in non-arctic regions. In Fennoscandia there is, however, no distinct transition from *regio alpina/subalpina* to *regio arctica/subarctica*, the mountain chain ranging from extreme Southwestern Norway to the Arctic proper. The terms *arctica* and *subarctica* are here used for the actual zones north of 68° N. *Regio subarctica* extends to the coast and prevails through the archipelago, though locally *regio arctica* reaches the extreme northern coast.

The zonation is not very appropriate for Western Norway ('Vestlandet'), i.e. the area west of the watershed-divide in Southern Norway, where the steep mountains reach the extreme coast and the regional divisions, being extremely vertical, become diffuse. As the distance between alpine areas and the sea is short, alpine and subalpine plants and animals do locally occur at sea level, and vice-versa, the air-turbulence may cause a

drift of lowland species up to the alpine and subalpine biotopes. The term *regio quercina* for the part extending along the western coast (Fig. 2) is therefore somewhat misleading, but since this zone depicts the northern border area for a number of continental plants and animals, it is quite satisfactory for the present purpose.

MATERIAL

The present work is based upon a study of approximately 29,000 Norwegian and 27,700 Swedish specimens. It comprises old and recent collections preserved in institutions, three small personal collections, and material presented to the

Fig. 2. A simple regional division of Fennoscandia. Obliquely hatched = *regio fagina;* vertically hatched = *regio quercina;* white = *regio coniferina* (and *regio subalpina/subarctica*); stippled = *regio alpina/arctica*. The northern coniferous limit drawn in Eastern Fennoscandia only. The isolated northernmost coniferous forests black. (From Lindroth 1949, p. 437, somewhat remodelled.)

author by colloborating colleagues and students, in addition to approximately 18,000 individuals collected by me during the years 1939–1969 (in some years there were no collections).

Besides investigations throughout the season within limited areas in Southern Norway (Løken 1949, 1950) and observations in the northern counties Nordland, Troms, and Finnmark 28 June–8 August 1955, the author's most extensive field trips were undertaken during the years 1957–1961. The following counties were visited:

1957, 5 July–14 August: Oppland, Sogn og Fjordane, Möre og Romsdal, Sör-Tröndelag.

1958, 26–28 May: Östfold; 26 June–10 August: Östfold, Akershus, Hedmark, Vestfold, Buskerud, Telemark, Hordaland.

1959, 28 June–17 August: Oppland, Hordaland, Sogn og Fjordane, Sör-Tröndelag, Nord-Tröndelag, Nordland and Troms: Skånland.

1960, 28 June–6 August: Telemark, Aust-Agder, Vest-Agder, Rogaland.

1961, 26 June–5 August: Akershus, Oppland, Buskerud, Vestfold, Telemark, Aust-Agder, Vest-Agder, Rogaland.

Otherwise, my observations were mainly devoted to the lowlands along the west coast and subalpine/alpine areas in Southern Norway by shorter or longer trips at various times of the season, i.e. from the end of April to the end of September. During the investigations particular attention was paid to areas previously poorly or not at all investigated.

Museum collections

The following collections were revised (the name of collectors in brackets):

Norwegian institutions. Det Kongelige Norske Videnskabers selskab, Museet, Trondheim. Small Norwegian collection (Lysholm, Dahlby, etc.).

Stavanger Museum, Stavanger. Small Norwegian collection (Aksnes, Holgersen).

Tromsö Museum, Tromsö. Norwegian collections, 2400 specimens (mainly Sparre Schneider, otherwise Collett, Holmboe, Lysholm, Schøyen, Soot-Ryen, Storm, A. Strand, Wessel, etc.).

Zoologisk Museum, University, Bergen. Norwegian collections, 21,500 specimens (Lie-Petterssen, Løken and collaborators, O. Meidell, etc.). Swedish collections, 4000 specimens (Ander, Fridén, N. Johansson, Løken).

Zoologisk Museum, University, Oslo. Norwegian collections, 1300 specimens (Collett, Esmark, Grimsgaard, Hagemann, Kiær, Natvig, Schøyen, Siebke, E. Strand, etc.).

Swedish institutions. Göteborg Naturhistoriska Museet, Göteborg. Small Swedish collections (Gaunitz, Lohmander, Möller, Torsell, etc.; only a minor part of the large Lohmander's collection was however available).

Institutionen för Växtpatologi, Uppsala. Small Swedish collection (Ossiannilsson).

Naturhistoriska Riksmuseet, Stockholm. Norwegian specimens (Sparre Schneider, Boheman, etc.) scattered in Swedish collections, 9500 specimens (Aurivillius, Boheman, Bruce, Erlandsson, Forsslund, Gaunitz, Grape, Holm, Kjellander, Lundblad, Muchardt, Nerén, Ringdahl, Roman, Schönherr, Staudinger, Wahlberg, Wieslander, etc.).

Zoologiska Institutionen, University, Lund. Small Norwegian collections (Dahlbom, Schøyen, Sparre Schneider, Zetterstedt, etc.). Swedish collections, 13,000 specimens divided into a main collection (Ammitsböll, Ander, Bengtsson, Burrau, Brinck & Wingstrand, Dalenius, Gaunitz, Fahlander, Holm, Kemner, Muchardt, Nilsson, Ringdahl, Roth, Rosén, B. Tjeder, Wahlgren, etc.) and separate collections of Dahlbom, Jansson, Thomson and Zetterstedt. As the main collection was recently revised by G. Kruseman, not every individual in the large collections of some of the species, mainly those referring to Skåne and Öland, was examined. The classical collections, being rearranged and given additional specimens, are only partly labelled. Since for the time being K. Ander is studying them separately, these collections are not on the whole included here.

Zoologiska Institutionen, University, Uppsala. Small Swedish collections divided into old individual collections of Gyllenhal, Haeffner, Liljeborg, Marklin, Stenhammer, de Vylder (without data or at most with the county specified), and a recent collection (Bergwall, Brundin, Gaunitz, S. Jonsson, etc.) also comprising some Norwegian specimens (Wretlind).

Other European institutions. British Museum

Natural History, London. Scandinavian material in general collections, in the Pittioni collection, and in small unarranged collections (Benson, Holgersen, Sparre Schneider, British expeditions, etc.).

Zoölogisch Museum, University, Amsterdam. Norwegian and Swedish specimens in the general collection (Eyndhoven, Kruseman, Reusch, Toxopeus, etc.). Large Norwegian collection (Barca, Esmark, Hafsahl cf. below, Lie-Pettersen, Lysholm, Sparre Schneider, Schøyen, Storm, etc.), and Swedish collection (Bengtsson, Klaue, Roman, etc.) in Vogt collection, which also includes Krüger collection. Common Swedish species were not examined. Professor O. Vogt (1909, 1911, 1947) communicated with a great many entomologists and amateurs who furnished him with bumble bees. Specimens not being labelled by the collector were provided by Vogt with small red locality labels. The great number of individuals collected by the Norwegian medical doctor P. Hafsahl, who lived in Hamar about 100 km north of Oslo, all have the locality Hamar printed on those red labels. However, according to his nephew, Hafsahl collected bumble bees at various localities, mostly in the lowlands near by Hamar, but also in subalpine and alpine areas and even on his travels as far as Germany (A. A. Hafsahl in litt.). Indeed, his travels are reflected in his bumble bee collection, which represents taxa not otherwise known from Hamar, even species not reaching Norway. Owing to the erroneous labelling, the entire material of Hafsahl, part of which is referred to by Vogt (1909, 1911, 1947) and Krüger (1950, 1954, 1956) must unfortunately be considered unreliable and is therefore omitted.

Zoologisk Museum, University, Copenhagen. Small Norwegian collection (mainly labelled Mus. Drewsen and Mus. Schiødte).

American institutions. Cornell University, Dept. of Entomology, Ithaca, New York. Small Norwegian collection (Raffensperger).

U.S.D.A. Entomological Research Div., Logan, Utah. Small Norwegian collection (Bohart).

U.S. National Museum, Washington D.C. Small Norwegian collection (Sabrosky, Sparre Schneider).

Personal collections

Larsson, H., Uppsala, Sweden. Small collection from Norway: Sör-Tröndelag and Sweden: Skåne.

Semb-Johansson, A., Oslo, Norway. Small collection from SE Norway.

Tjeder, T., Rättvik, Sweden. Small collection from Sweden: Dalarne.

In addition to Scandinavian collections, several Finnish specimens kept at Zoologiska Museet, Helsingfors and Museum Zoologicum, Åbo, were revised.

METHODS

Taxonomy

Coincident with identification/revision of Norwegian collections, the data for the individual specimens were codified, punched on cards, and the species then sorted geographically by computer, except a minor material identified and added to the locality lists during the years 1968–1970. The specimens in the Swedish collections were catalogued by species and afterwards rearranged geographically.

Keys to the Scandinavian *Bombus* spp. are provided. In the subsequent treatment of the individual species they have not been fully described, but are given a fairly broad diagnosis. The sexes are treated separately. The female characteristics, presented in three sections viz., morphological features, colour pattern of the coat, and phenotypic variations, are introduced first and followed by those of the male. To save space, the description of the worker is included in that of the queen even though some of the features have less diagnostic value in that caste, being too diffuse or variable.

The species are treated in alphabetical order within the subgenera and the sequence of the subgenera are arranged according to Richards (1968). If more species are involved, each sex is given a subgeneric description in order to avoid needless repetition in the subsequent description of the species. If there is only one species in the sub-

genus, the description of the species includes subgeneric characteristics. The treatment of subspecies follows that of the species.

When preparing the keys, particularly papers presenting keys to the subgenera and/or European *Bombus* spp. were consulted (Krüger 1920; Richards 1927, 1931, 1968; Pittioni 1939a; Kruseman 1947; etc.).

Morphological terms, abbreviations. The terminology proposed by Michener (1944) is essentially followed. Exceptions are included in the list of additional terms and abbreviations below.

A_1: scapus, i.e. basal segment of antenna

A_{1-12} in female, A_{1-13} in male: individual segments of antenna

alutaceous: microsculpture of surface covered with minute cracks

chagrinated or chagreened: microsculpture of surface covered with closely-set roughness

collar: the anterior thoracic band of yellow or yellowish-brown hairs

colour, colour pattern: apply to the colour of the hairs, not the underlying surface

decumbent hairs: hairs sloping over the underlying surface, i.e. not standing erect

frons: supra antennal area

gaster: abdominal segments behind propodeum, i.e. first gastral segment corresponds to the second true abdominal segment

granulate: microsculpture of surface with grain-like elevated puncturing

interalar band: black band of hairs between the wings of an otherwise coloured dorsum of thorax

pappillate: microsculpture of surface with hairs arising from pustules

pile of face: hairs above and below antennal sockets

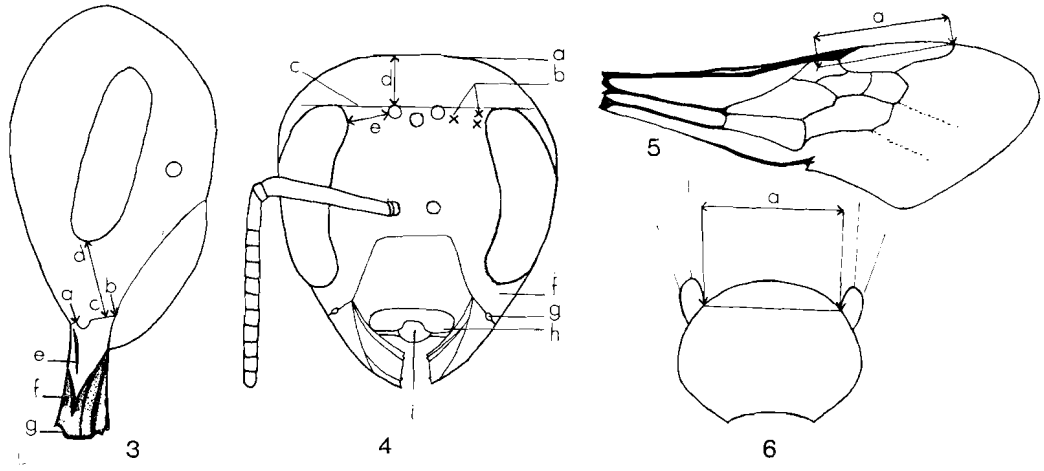
pubescence: closely appressed pilosity

striate-rugose: microsculpture of surface with closely-set more or less coalescing puncturing forming a rather striate appearance

St_{1-6} in female, St_{1-8} in male: individual gastral sternites

supra-orbital line: hypothetical line touching upon edge of both eyes (Fig. 4c)

T_{1-6} in female, T_{1-7} in male: individual gastral tergites



Figs. 3–6. Diagrams showing diagnostic characters. Fig. 3: Lateral view of female *Bombus* head (section *Odontobombus*). a–b distal width of malar area; c–d malar space; e basal keel; f sulcus obliquus; g incisura lateralis. Fig. 4: Facial view of female *Bombus* head (section *Anodontobombus*). a preoccipital ridge; b ocellar-orbital field, x = unpunctured area, xx = punctured band; c supra-orbital line; d distance from right ocellus to preoccipital ridge; e distance from ocellus to compound eye; f malar area; g posterior mandibular condyle; h labral tubercle; i labral lamella. Fig. 5: Right fore-wing. a 'radial length'. Fig. 6: Transverse section of thorax. a interalar width.

Measurements. The following queen measurements were taken: (a) right malar space (Fig. 3c–d); (b) 'radial length', i.e. the distance from the 'veinlet' in the middle of first R_1 cell (= first submarginal cell) to the distal end of second R_1 (= radial cell) (Fig. 5); this measurement not to be confused with the length of radial cell; (c) interalar width (Fig. 6); (d) distance from right ocellus to preoccipital ridge (Fig. 4d); (e) distance from right ocellus to nearest compound eye (Fig. 4e). The measurements a–c were taken for the queen of each species or subspecies, whereas those marked d–e apply to a few species only, the ratio d:e being used as a diagnostic character. Besides the diagnostic value, malar space can roughly be correlated with the tongue length which makes this measurement useful in the study of bumble bees and their plant preference. Measurement of interalar width was chosen as an indicator of the body size. The features a–c were moreover selected for triangular graphing, cf. below, and in one subgenus those marked d–e were used for the same purpose.

Least reliable measurements are those of the total length, viz. the distance from face of head to tip of abdomen when head is in vertical position and venter of abdomen in horizontal position. This character is subject to considerable variation, above all because it is dependent upon the degree of extension of the gastral segments which is difficult to measure accurately. Nonetheless each species or subspecies gives the impression of having a characteristic length which at any rate can be expressed in relative terms. Three categories are used (the corresponding average measurements of interalar width follow in brackets): Body of large size, the length exceeding 20 mm (interalar width exceeding 5.00 mm); body of medium size, the length 17–20 mm (interalar width 4.50–5.00 mm); body of small size, the length less than 17 mm (interalar width less than 4.50 mm).

As corresponding measurements of males are less meaningful in a broad diagnosis and are not needed for triangular graphing, they have been omitted. The male body size is, however, indicated by the following three size categories: Body of large size, length exceeding 18 mm; body of medium size, the length 14–18 mm; body of small size, the length less than 14 mm.

There is a distinct difference in size between alive and dried bumble bees, and very soon after death the shrinking of abdomen is particularly noticeable. As museum collections were the only available material in some of the species, all measurements were taken on dried specimens. The measurements were made with a Leitz-Wetzlar binocular, ocular 12.5×, objective 4×, i.e. 40× magnification, and a micrometer eyepiece with each unit equal to 0.05 mm, except that of interalar width, which was measured by vernier calliper and read to an accuracy of 0.05 mm. The features were measured once on each specimen except interalar width, which was measured twice and the mean value used. The measurements are presented for the queen of each species or subspecies by the number (N), area, mean, standard deviation, mean error, and range. Example: N = 15; SE Norway; malar space: 0.08 mm ($\pm$0.03 $\pm$0.01) range: 0.70–0.80 mm. Needless to say, the area representing the measured populations cannot all be the same owing to varying distribution of the taxa involved and/or the available queens as well.

Triangular graphing. Specific and subspecific position of certain closely related taxa are indicated by triangular graphing (Mayr 1969) based on the measurements of the features marked a–c above, or those marked b, d–e. By this method are plotted not the actual values, but their percentage contribution to the sum (= 100 per cent) of the characters which indicate the body proportions rather than the absolute size. Specific difference between two or more populations in general accords with difference in body proportion. This is illustrated by the measured populations occupying different areas on the triangular graph (Figs. 52, 53, 59, 66, 72), whereas conformity in body proportion corresponds to congruent spreading of the markings and favours conspecificity (Figs. 66, 81).

Melanism, geographical variations. Variability of colour is somewhat arbitrary and not suitable for statistical treatment. The rather large material at my disposal has nevertheless stimulated me to study melanism and clinal variations by a broad grouping of certain colour features. By dividing

the local population of a species into typical and melanic individuals, the percentage of melanic specimens was calculated, tabulated, and transferred to pie-charts (Figs. 69, 74, 88). The evaluation demonstrates, of course, more the tendency to melanism than it exactly reflects the local frequency. Other geographical variations were studied by grouping the local populations of a species according to certain colour features arranged in steps and in progression of shade. The percentage distribution of one of the features, for instance black, has been transferred to diagrams to illustrate possible clinal variations (Figs. 77, 78, 80, 83–84). The term local population as used above corresponds to the available material within a county or district thereof. Even though administrative units should be rejected in zoogeographical studies, a division of populations by counties does in this case roughly indicate geographic variations throughout Scandinavia.

Synonymy, references. Great variability in the colour pattern in some of the actual bumble bee species has given rise to a vast number of specific designations, many of which have been revised as to synonyms, subspecies, and infrasubspecific forms. Invalid designations and erroneous synomizing have caused great nomenclatural confusions. References to synonyms, given at the beginning of each treatment, do not pretend to be complete. Not all old names, in general listed by Dalla Torre (1896), have been included, but quite a large number of references for certain species which display great variations in the colour pattern is given to indicate the present status of the taxon.

Bibliographic references to the Scandinavian fauna have also been added. References to species involved in applied research are only listed if they present faunistic information based on collections revised by the late O. Meidell or myself. References to the Finnish *Bombus* spp. are restricted to recent papers (Elfving 1960, 1968). References to named infrasubspecific forms, aberrations, etc., have been mentioned under taxonomical remarks or in the subspecific discussion.

Types. Available information about the type follows the reference to each of the designations. Concerning the Linnaean types, however, it is debatable whether *Bombus* specimens in the Linnaeus collection in London are originals (Richards 1935). As Linnaeus never designated any specimen as type, original in this case refers to specimens originally preserved in the Linnaean collection and not added later. The documentary value of this collection is on the whole doubted (Mayr 1969). Specimens in the Linnaean collection referring to the Linnaean *Bombus* spp. treated in the present paper are mentioned and commented upon, but without stating them as types.

Distribution

For reference to the distribution of each Scandinavian species, locality records have been plotted on maps which also depict the known range in Finland (Elfving 1968) and in the remaining neighbouring countries according to literature indications. A few Finnish records, examined by me, have been added. On the maps, the radius in a dot corresponds to 10 km. Each dot represents one or more specimens collected at that locality or several collections made at nearby localities. All topographical names are mentioned in the list of localities except those within cities or large towns, which are only listed if being of particular interest.

To list detailed data from all specimens would take excessive space. The list of localities is therefore in general restricted to the locality and the institution where the records are kept. In the list of Norwegian localities the names are arranged alphabetically by rural district ('herred') and city within the different counties ('fylker') as follows: *Oppland (On):* Dovre: Dovrefjell 1000 m NRS ZMB ZMO, Fokstua 930 m ZMB ZMO, Toftemo, etc. The altitude is given for alpine localities if known. For some peripheral localities and in the lists of rather rare species, detailed data are presented as follows: *Oppland (On):* Dovre: Dovrefjell 1000 m ♂ 18 July 1832 (Rosenskiöld) DCL. The name in parentheses refers to the collector. The sequence of the counties and that of rural districts and cities follows Strand (1943) except that names and limits have been dated to 1969 (Figs. 97, 98). The author is aware of the disadvantage of using a geographical division based on administrative units, whose name

and limits can be altered. However, until another division has been generally accepted by entomologists I hesitate to leave such a well established system as that of Strand's (1943). It should be noticed that old specimens labelled Dovre are in the lists mentioned as *Oppland (On):* Dovre: Dovrefjell 1000 m, as those specimens obviously refer to the mountainous plateau and not to *On:* Dovre: Dovre, i.e. the administrative centre of the rural district situated in the valley about 500 m s.m.

In locality lists of the Swedish collections the topographical names were arranged alphabetically within the individual county ('landskap'). However, the sequence of the letters follows that of the Norwegian alphabet in which the letter å is placed at the end. The sequence of the counties, ranging from south to north, follows that practised in the Catalogus Insectorum Sueciae (publ. Opuscula Entomologica for inst. 1955, 1960). The counties are presented in the geographical division of Fennoscandia (Fig. 99).*

Localities of unrevised records, being published or received by personal communications, succeed the individual list of localities. However they have been added only if they contribute especially to the fauna and are considered reliable as well.

The world distribution of the species and the total distribution of Scandinavian subspecies have been indicated in separate sections with the references gathered at the end of the actual sections to save space-taking repetitions. Reference to Yarrow in litt. concerns his unpublished collections, mainly from Portugal, Spain, Egypt, Irak and Iran, kept in the British Museum, London, which he kindly allowed me to include.

The Norwegian locality names refer to those on topographical maps edited by Norges Geografiske Oppmåling, Oslo as far as they cover the locality in question. A great many names are otherwise listed in the index to the map attached to the Time-table for Norwegian Communications ('Rutebok for Norge'). The Swedish names are mostly listed in Svensk Ortsförteckning, ed. Kungl. Generalpoststyrelsen, Kungl. Telestyrelsen & Kungl. Järnvägsstyrelsen, Örebro, 1965 and/or in Svenska Turistföreningens Atlas över Sverige, I–III, A-B Kartografiska Institutt, Stockholm, 1923–25. Norwegian and Swedish names of counties, rural districts, cities etc. have been written in their native language. Most Finnish names arranged by counties (Fig. 99) have been listed by Elfving (1968). Otherwise geographical names outside Scandinavia follow essentially Grosvenor (1963).

* The Norwegian letter ø (=ö) has been used in topographical names between pp. 205—209 and in personal names throughout the text.

Abbreviations

A. Museums

AKÅ = Åbo Akademi Museum Zoologicum, Finland
BCL = Bank collection, London (BML)
BML = British Museum, Natural History, London
CCC = Copenhagen collection, Copenhagen (ZMC)
CIN = Cornell University, div. of Entomology, Ithaca, New York
CNO = Canadian National collection, Ottawa
DCL = Dahlbom collection, Lund (ZML)
GNM = Göteborg Naturhistoriska Museet, Göteborg
IVU = Institution för Växtpatologi, Uppsala
IZB = Institute f. spezielle Zoologie u. Zoologisches Museum, Berlin
JCL = Jansson collection, Lund (ZML)
KCC = Kiel collection, Copenhagen (ZMC)
KCL = Kirby collection, London (BML)
KMT = Kongelige Videnskabers Selskab, Museet, Trondheim
LSL = Linnaean Society, London
MAL = Zoological Museum, Academy of Science, Leningrad
MNP = Muséum National d'Histoire Naturelle, Paris
NMV = Naturhistorisches Museum, Vienna
NMW = U.S. National Museum, Washington, D.C.
NRS = Naturhistoriska Riksmuseum, Stockholm
PCL = Pittioni collection, London (BML)
SMS = Stavanger Museum, Stavanger
SCT = Spinola collection, Museo Zoologica, University, Torino
TCL = Thomson collection, Lund (ZML)
TRM = Tromsö Museum, Tromsö

USU = U.S.D.A., Entomological Research div., Logan, Utah
VCA = Vogt collection, Amsterdam (ZMA)
VCF = Valkeila collection, Hämenlinen, Finland
ZCL = Zetterstedt collection, Lund (ZML)
ZIK = Zoologisches Institut der Polnischen Akademie der Wissenschaften, Kraków, Poland
ZMA = Zoölogisches Museum der Universiteit, Amsterdam
ZMB* = Zoologisk Museum, University, Bergen
ZMC = Zoologisk Museum, University, Copenhagen
ZMH = Zoologiska Museet, University, Helsingfors
ZML* = Zoologiska Institutionen, University, Lund
ZMO = Zoologisk Museum, University, Oslo
ZMU = Zoologiska Institutionen, University, Uppsala

* In the list of Norwegian localities ZMB is omitted if the locality is represented by records from Zoologisk Museum, Bergen only. Likewise ZML is omitted in the lists of Swedish localities.

B. Personal collections

Joh = Professor dr. A. Semb-Johansson, Oslo
Lar = Agr. stud. H. Larsson, Uppsala
Tje = Landsfiskal T. Tjeder, Rättvik, Sverige

C. Certain collectors

B & W = Brinck, P. & K. G. Wingstrand
Erl = Erlandsson, S.
Lø = Løken, A.
Mei = Meidell, O.
Sch = Schneider, J. Sparre

D. Latin terms

in litt. (in litteris) = non-published information
m s.m. = metres supra mare
nomen dubium = a name not applicable to any known taxon
nomen novum = a new name replacing an already established name
nomen nudum = a name not legitimately published, i.e. has no standing in zoological nomenclature
nomen oblitum = a forgotten name, i.e. a designation that has remained unused as a senior synonym for more than fifty years
s.l. (sensu lato) = in a wider sense (if the name is also used to cover a taxon in a narrower sense)
s.s. (sensu stricto) = in a narrower sense (if the name is also used to cover a taxon in a wider sense)
! (autopsy) = specimen seen by the present author

CLASSIFICATION

A division of the large genus *Bombus* Latreille into subgenera was first announced by Vogt (1911) as a modest working hypothesis. It was merely based upon features in the male genitalia, a grouping of which was originally conceived by Radoszkowski (1884). A number of authors (Ball 1914; Skorikov 1914a, 1914b, 1922b; Krüger 1917, 1920; Frison 1927; Richards 1927, 1968; Pittioni 1939a; etc.) have amplified the strong homogeneity in Vogt's subgenera and also built up more subgenera. Several old names have tended to drop out because earlier subdivisions of Dalla Torre (1880) were adopted as subgenera (Sandhouse 1943; Richards 1968). Skorikov (1914a, 1914b, 1922b) went a step further and elevated the subgenera to generic level but splitting up a homogeneous group such as *Bombus* did not gain general approbation. Recently Milliron (1961) classified the bumble bees of the world into three genera, two of which with two subgenera individually divided into a number of species groups – an unsatisfactory system refuted by Richards (1968). By keeping to the prime objective, a supraspecific grouping to indicate the close relationship of certain species, the large genus is divided into well-defined subgenera, the definition of which is steadily improved by adding taxonomic and biological features.

Krüger (1917) divided *Bombus* in two sub-

sections, viz. *Odontobombus* and *Anodontobombus*, based upon a few selective characters, viz. the structure of the distal edge of the intermediate basitarsus in the female and the genitalia in the male. These sections and the actual subgenera have been included in the keys to the Scandinavian species presented below.

Biologically the subgenera of *Bombus* can broadly be divided into two groups, viz. 'pocket-makers' and 'pollen-storers', according to their method of feeding the larvae of second and succeeding broods (Sladen 1912). Generally speaking pocket-makers provide their larvae with solid pollen stuffed beneath them and stored in wax pockets built adjacent to the wax canopy surrounding them. Larvae of pollen-storers are fed with regurgitated suspension of nectar and pollen, the latter being stored in pollen-cylinders apart from the brood mass. This classification breaks down, however, in certain species (Hobbs 1964).

KEYS TO THE SCANDINAVIAN SPECIES OF *BOMBUS* LATREILLE

In bumble bees, variations in colour of the coat are remarkable, but this cannot be regarded as a basis for recognition of species. Some species display an identical colour pattern while others individually exhibit a wide range in their colouring. Specific recognition must rely on other characters. The colouring is, however, a useful supplement in distinguishing the species and in particular in regarding species from a limited area as, for instance, Scandinavia, a fact which is taken advantage of in the keys below.

Females

Antennae with twelve segments. Clypeus moderately covered with hairs which become sparse on the disc. Labrum with median furrow and lateral tubercles. Robust mandibles with truncate distal margin laterally toothed (more than laterally toothed in *B. wurfleini* Radoszkowski) and outer surface with distinct carinae. Hind tibia with corbicle, i.e. with outer surface flattened, distally grooved, and hairless except for anterior and posterior fringes. Mid- and hind basitarsi individually strong, flattened, about as long as remaining tarsi all together. Abdomen with six visible tergites, the hindmost pointed (truncate in *B. lapidarius* (Linnaeus)). Well-defined coat in various colour patterns.

The workers are far more variable and often lack the diagnostic characters of the females. They can nevertheless in general be identified by the key. Exceptions concern above all the subgenus *Bombus* s.s., where the worker caste often displays too diffuse characters for a reliable specific determination.

1. Mandible without basal keel (Figs. 7B, 8A, 10A, 15, 16A). Mid-basitarsus with posterior distal angle obtuse, more or less rounded (Fig. 12C) (more or less acute in *B. wurfleini* Radoszkowski (Fig. 7C)) ..... section *Anodontobombus* 2

   Mandible with basal keel (Figs. 20, 22B). Mid-basitarsus with posterior distal angle spined (Fig. 17B) or pointed ..... section *Odontobombus* 18

2. Malar space about half the distal width (Fig. 7A). Mandible strongly bent, distally strongly toothed (Fig. 7B). Mid-basitarsus with distal posterior angle acute (Fig. 7C) ..... *Alpigenobombus* Skorikov

   1 species, *B. wurfleini* Radoszkowski (p. 25)

   Malar space markedly longer than half the distal width. Mandible not strongly bent, distally only laterally toothed (Figs. 8A, 10A, 15, 16A). Mid-basitarsus with distal posterior angle right-rounded (Fig. 12C)..... 3

3. Malar space as long as distal width or nearly. Mandible without sulcus obliquus, with indistinct incisura lateralis (Fig. 8A). Ocellar-orbital field as in Fig. 8B. Ocelli transected by supra-orbital line (Figs. 8C–D). Hind basitarsus almost parallel-sided (Fig. 8E) ..... *Kallobombus* Dalla Torre

   1 species, *B. soroeensis* (Fabricius) (p. 31)

Malar space of variable length. Mandible with distinct sulcus obliquus and incisura lateralis (Fig. 10A), or either one of them (Figs. 15, 16A). Ocellar-orbital field not as in Fig. 8B. 4

4. Malar space slightly to markedly longer than distal width. Clypeus distinctly swollen .... *Alpinobombus* Skorikov 5

Malar space about as long as distal width or shorter. Clypeus evenly, slightly swollen or swollen at base and distally flattened 8

5. Malar space nearly 1½ times distal width. Moderate distal posterior process of hind tibia seen from inside (Fig. 9A). Hind basitarsus markedly longer than twice the greatest width (Fig. 9B). Piles on T_{3-6} black .... *B. hyperboreus* Schönherr (p.114)

Malar space shorter. Length of hind basitarsus about twice the greatest width. Piles on T_{4-6} not black .. 6

6. Malar space markedly longer than distal width. Interalar band present (except in melanic specimens). T_3 black, T_{4-6} ferruginous, dull yellow or whitish .... *B. balteatus* Dahlbom (p. 105)

Malar space hardly to slightly longer than distal width. Coat of thorax entirely black. At least T_{3-5} ferruginous 7

7. Surface of hind tibia and hind basitarsus strongly alutaceous. T_2 with at least black hairs on anterior edge, remainder of T_2, T_{3-6} ferruginous ..... *B. arcticus* (Kirby) (p. 101)

Mandible as in Fig. 10A. Prominent distal posterior process of hind tibia, seen from inside (Fig. 10B). Surface of hind tibia and hind basitarsus barely to moderately alutaceous. T_{2-6} ferruginous .... *B. alpinus* (Linnaeus) (p. 96)

8. Labral tubercles deeply depressed, angled at inner end (Fig. 12A). Mandible with distinct sulcus obliquus as well as incisura lateralis. Hind basitarsus posteriorly curved (Fig. 12D). Collar and T_2 yellow ... *Bombus* s.s. 9

Labral tubercles barely or not depressed. Mandible never with both sulcus obliquus and incisura lateralis well-defined. If yellow hairs on T_2, they are concentrated to the anterior lunate part (occasionally ranging wider in *B. pratorum*) 12

9. Malar space nearly as long as distal width. Ocellar-orbital field as in Fig. 11 or nearly so. Forewings elongated, strongly infuscate. Worker with interalar band, piles of T_1 yellow. In queens are yellow hairs of scutullum, T_1, usually reduced to singly hairs ..... *B. sporadicus* Nylander (p. 50)

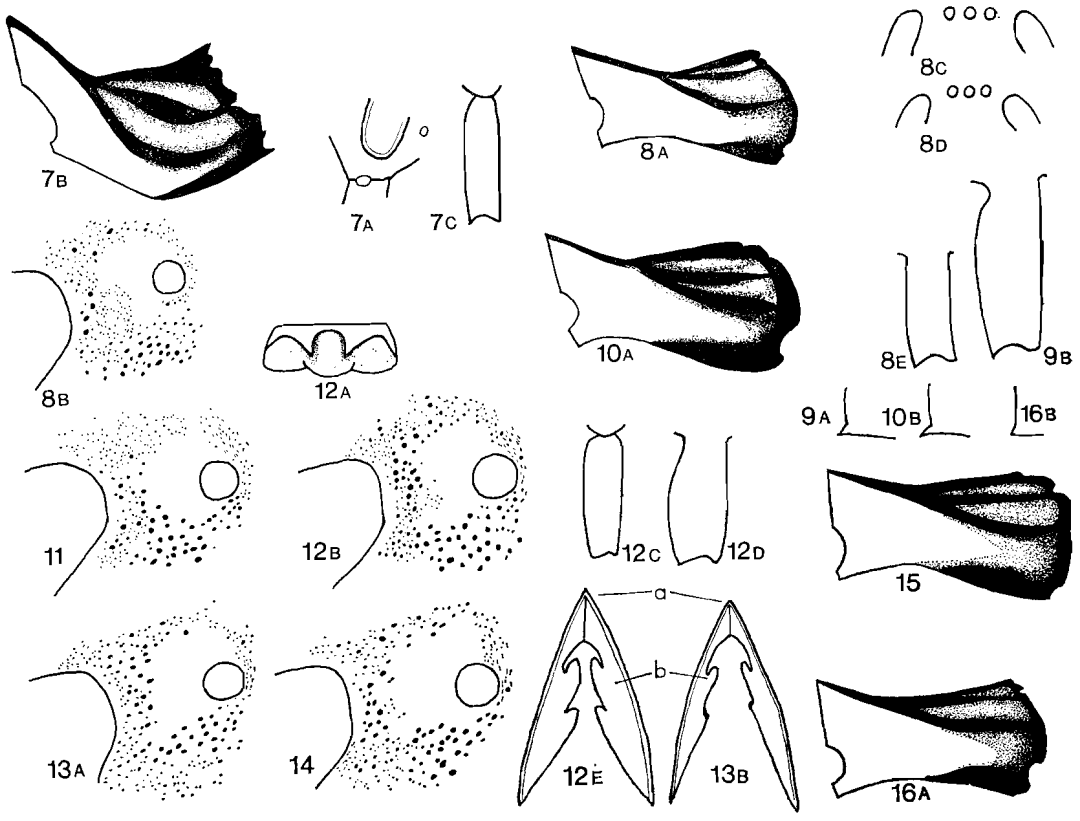
Malar space markedly shorter than distal width. Ocellar-orbital field as in Figs. 12B, 13A, 14. No interalar band. Forewings not elongated, moderately infuscate 10

10. Labrum as in Fig. 12A. Ocellar-orbital field as in Fig. 12B or nearly so. Mid-basitarsus as in Fig. 12C. Hind basitarsus as in Fig. 12D. At least surface of median posterior part of T_2 smooth, sparsely punctured. Inner thickening of sting sheath broad (Fig. 12E). Collar (often reduced to a narrow band), T_2 deep yellow..... ..... *B. terrestris* (Linnaeus) (p. 53)

Ocellar-orbital field usually as in Figs. 13A, 14. Surface of T_2 strongly chagrinated, densely punctured. Inner thickening of sting sheath not broad (Fig. 13B). Pile on collar, T_2, lemon yellow to rather dull, pale yellow... 11

11. Ocellar-orbital field as in Fig. 13A or nearly so. Distance from lateral ocellus to preoccipital ridge hardly longer than distance from ocellus to eye. Sting sheath as in Fig. 13B. Yellow collar including at most adjacent edge of episternum. .*B. lucorum* (Linnaeus) (p. 40)

Ocellar-orbital field as in Fig. 14 or nearly so. Distance from ocellus to preoccipital ridge slightly but disdinctly longer than distance from



Figs. 7–16. Section *Anodontobombus*. Fig. 7: *B. wurfleini* Radoszkowski ♀. A: Lateral view of lower part of head; B: Right mandible; C: Right mid-basitarsus. Fig. 8: *B. soroeensis* (Fabricius) ♀. A: Right mandible; B: Ocellar-orbital field; C–D: Position of ocelli, ♀ and ☿ respectively; E: Right hind basitarsus. Fig. 9: *B. hyperboreus* Schönherr ♀. A: Distal inner posterior process of hind tibia; B: Right hind basitarsus. Fig. 10: *B. alpinus* (Linnaeus) ♀. A: Right mandible; B: Distal inner posterior process of hind tibia. Fig. 11: *B. sporadicus* ♀. Ocellar-orbital field. Fig. 12: *B. terrestris* (Linnaeus) ♀. A: Labrum; B: Ocellar-orbital field; C: Right mid-basitarsus; D: Right hind basitarsus; E: Sting. a dorsal end of sting; b inner thickening of sting sheath. Fig. 13: *B. lucorum* (Linnaeus) ♀. A: Ocellar-orbital field; B: Sting. Fig. 14: *B. magnus* Vogt ♀. Ocellar-orbital field. Fig. 15: *B. lapidarius* (Linnaeus) ♀. Right mandible. Fig. 16: *B. lapponicus* (Fabricius) ♀. A: Right mandible; B: Distal inner posterior process of hind tibia.

ocellus to eye. Yellow collar broader, extending part way down episternum ..... *B. magnus* Vogt (p. 46)

12. Mandible with distinct sulcus obliquus and poorly to moderately developed incisura lateralis (Fig. 15). Hindmost tergites reddish or bright ferruginous 13

Mandible with inconspicuous sulqus obliquus and moderate to well developed incisura lateralis (Fig. 16A). T_{4-5} ferruginous, yellowish or whitish ..... *Pyrobombus* Dalla Torre 14

13. Malar space about as long as distal width. Labral furrow well defined, in width less than 1/3 labral width. Mandible as in Fig. 15. T_6 with central eminence in front of truncate apex (indistinct or lacking in workers).... ..... *Melanobombus* Dalla Torre 1 species, *B. lapidarius* (Linnaeus) (p. 89)

Malar space shorter than distal width. Labral furrow moderate, in width about 1/3 labral width. T_6 with indication of impressed median longitudinal line, distally not truncate..

.....*Cullumanobombus* Vogt
1 species, *B. cullumanus* (Kirby) (p. 56)

14. Disc of clypeus unevenly, rather strongly punctured. Mandible as in Fig. 16A. Inconspicuous distal posterior process of hind tibia, seen from inside (Fig. 16B). At least T_{2-3} ferruginous-haired .....
.....*B. lapponicus* (Fabricius) (p. 75)
2 subspecies

Disc of clypeus barely to moderately punctured. Piles on T_{2-3} not ferruginous 15

15. Malar space markedly shorter than distal width. Surface of tergites chagrinated, densely punctured, dull. Interalar band. Pile on collar, scutellum yellow.....*B. jonellus* (Kirby) (p. 69)

Malar space about as long as distal width or nearly. If interalar band present then piles of collar and scutellum yellowish-brown 16

16. Collar yellow, T_{4-6} ferruginous, otherwise black .....
.....*B. pratorum* (Linnaeus) (p. 82)

Other colourpattern 17

17. Labral furrow broad, nearly 1/3 labral width. T_6 with granulate coarse puncturing, shining. Dorsum of thorax yellowish-brown .....
.....*B. hypnorum* (Linnaeus) (p. 63)

Labral furrow narrower. T_6 with fine dense puncturing, chagrinated, dull. Dorsum of thorax yellowish-brown usually with more or less pronounced interalar band.....
.....*B. cingulatus* Wahlberg (p. 61)

18. Malar space 1 ½ times the distal width or longer. Frontal edge of eyes directed towards or below posterior mandibular condyle (Fig. 18A).....
.....*Megabombus* Dalla Torre 19

Malar space hardly to markedly longer than distal width, yet less than 1 ½ times this width (about 1 ½ times this width in *B. pomorum*). Frontal edge of eyes directed in front of posterior mandibular condyle (Fig. 19).. 21

19. Malar space about 1 ½ times the distal width. Disc of clypeus with sparse uneven puncturing. Parallel-sided interalar band. Collar, scutellum, T_1 deep yellow. Coat rather even, body robust.....*B. ruderatus* (Fabricius) (p. 135)

Malar space exceeding 1 ½ times the distal width. Disc of clypeus almost impunctate. Coat more or less shaggy, body slender..... 20

20. Malar space markedly shorter than twice the distal width. Supra-orbital line touching or just transecting lateral ocelli dorsally (Fig. 17A). Middle basitarsus as in Fig. 17B. Interalar band v-shaped posteriorly. Collar, crescent-shaped posterior part of scutellum, T_1 basal margin of T_2, lemon yellow (various degrees of melanism locally common).....
.....*B. hortorum* (Linnaeus) (p. 124)

Malar space about twice the distal width or nearly (Fig. 18A). Supra-orbital line above lateral ocelli (Fig. 18B). Dorsum of thorax yellowish-brown.....*B. consobrinus* Dahlbom (p. 119)

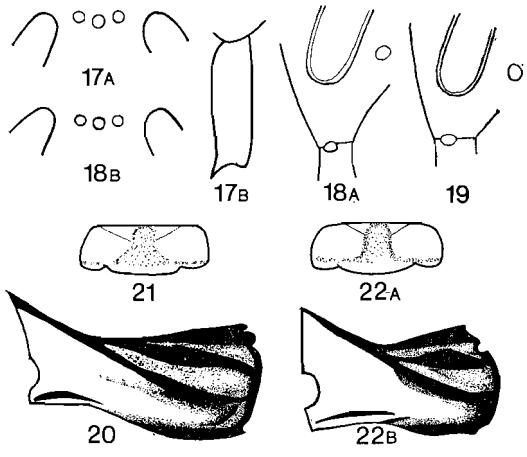
21. Labral furrow deep, broad, the width at the base about 1/3 labral width. Distal posterior process of mid-basitarsus rather inconspicuous, that of hind basitarsus pointed.....
.....*Subterraneobombus* Vogt 22

Labral furrow narrower. Distal process of mid-basitarsus spinose as in Fig. 17B, that of hind basitarsus spinose or pointed 23

22. Malar space slightly longer than distal width (Fig. 19). Outer surface of hind tibia alutaceous. Interalar band; otherwise coat of thorax and T_{1-5} olive-yellow .....
.....*B. distinguendus* Morawitz (p. 182)

Malar space markedly longer than distal width. Outer surface of hind tibia barely or not alutaceous. T_{4-5} usually with admixture of greyish-white or fuscous hairs, otherwise coat black.....*B. subterraneus* (Linnaeus) (p. 186)

23. Malar space about 1 ½ times the distal width. Ocellar-orbital field with large



Figs. 17–22. Section *Odontobombus*. Fig. 17: *B. hortorum* (Linnaeus) ♀. A: Position of ocelli; B: Right mid-basitarsus. Fig. 18: *B. consobrinus* Dahlbom ♀. A: Lateral view of lower part of head; B: Position of ocelli. Fig. 19: *B. distinguendus* Morawitz ♀. Lateral view of lower part of head. Fig. 20: *B. veteranus* (Fabricius) ♀. Right mandible. Fig. 21: *B. pascuorum* (Scopoli) ♀. Labrum. Fig. 22: *B. sylvarum* (Linnaeus) ♀. A: Labrum; B: Right mandible.

well-defined unpunctured area and the punctured band extremely narrow... ..... *Rhodobombus* Dalla Torre
1 species. *B. pomorum* (Panzer) (p. 189)
(*B. pomorum* has pile on T_{3-6} ferruginous and coat otherwise black).

Malar space less than 1½ times the distal width (nearly so in *B. pascuorum*). Ocellar-orbital field with well-defined unpunctured area of moderate size and the punctured band rather wide. If hindmost tergites ferruginous-haired, this applies to T_{4-5} or T_{4-6} not T_3 .... *Thoracobombus* Dalla Torre 24

24. Disc of clypeus distinctly flattened. Mandible slender, elongated (Fig. 20). Coat pale greyish-yellow with exception of broad not parallel-sided interalar band and variable admixture of black bristles on T_{3-5} .... *B. veteranus* (Fabricius) (p. 179)

Disc of clypeus more or less convex. Mandible not elongated (Fig. 22B). Other colour pattern. If with interalar band, T_{4-6} ferruginous 25

25. Malar space nearly 1½ times distal width. Labral furrow widened towards the front (Fig. 21). Coat shaggy. Dorsum of thorax and at least hindmost tergites yellowish-brown or orange-brown. *B. pascuorum* (Scopoli) (p. 154)
4 subspecies

Malar space shorter. Labral furrow widened towards the base or almost parallel-sided (Fig. 22A). T_6 with ferruginous or black hairs..... 26

26. Thorax dorsally black or with interalar band. T_{4-6} (or $_{4-5}$) ferruginous.. 27

Thorax dorsally yellowish-brown or orange-brown. T_{4-5} not ferruginous, T_6 black-haired..... 28

27. Labral furrow as in Fig. 22A. Lamella of labrum with knifelike edge, smooth, shiny. Mandible as in Fig. 22B. Surface of T_{4-6} smooth, shining, with sparse coarse puncturing. Broad interalar band, thorax otherwise pale yellowish-grey (melanic individuals with pattern similar to *B. ruderarius* common) .... *B. sylvarum* (Linnaeus) (p. 172)

Labral lamella with distal margin thickened, alutaceous, dull. Surface of T_{4-5} chagrinated, densely punctured. Thorax, T_{1-3} black. Corbicular fringes and T_{4-6} bright or dull ferruginous..... *B. ruderarius* (Müller) (p. 169)

28. Surface in front of lateral ocelli rather densely punctured. Distance from lateral ocellus to preoccipital ridge markedly longer than distance between lateral ocellus and eye. Lateral hairs of T_3 arising from pustules. T_{1-5} dull yellowish to greenish-yellow ..... *B. muscorum* (Linnaeus) (p. 145)
2 subspecies

Surface in front of lateral ocelli with disperse, coarse punctures. Distance from lateral ocellus to preoccipital ridge barely or not longer than distance between lateral ocellus and eye. Lateral hairs of T_3 arising

from coarse coalescing punctures. T_{1-5} yellowish-brown of various shades of which T_2 is the darkest, T_{3-5} with or without black bristles.. .....*B. humilis* Illiger (p. 139)

Males

Antennae with thirteen segments. Clypeus densely covered with hairs, except distally. Labrum even. Weak mandibles with oblique distal margin bifurcate (trifurcate in *B. wurfleini* Radoszkowski). Hind tibia with anterior and posterior fringes, the outer surface flattened or convex, hairless or moderately covered with more or less decumbent hairs. Mid- and hind basitarsi individually flattened, elongated, about as long or longer than remaining tarsi. Abdomen with seven visible tergites, the hindmost posteriorly rounded. Well-defined coat in various colour patterns.

1. Antennae short, A_{5-13} individually markedly less than twice their distal width (Figs. 28A, 29A, 31A, 32A, 34A, 35A) (exceptions: *B. soroeensis* (Fabricius), *Alpinobombus* Skorikov, *B. cullumanus* (Kirby) Figs. 23A, 26A, 30A). Genitalia as in Figs. 23D, 24A, 26C, 27B, 28C, 29C, 30D, 31C, 32C, 33B; gonostylus inwards at most produced into a small-pointed or finger-shaped process..... section *Anodontobombus* 2

   Antennae long, A_{5-13} individually twice their distal width or nearly so (Figs. 39A, 42A, 44A–49A). Genitalia as in Figs. 39D, 40B, 41, 42C, 43B, 44C–49C; gonostylus produced inwards into a large lamella or spine.. section *Odontobombus* 17

2. Penis valve not hooked at apex or with hooks turned outwards (Figs. 23D, 24C–26C, 27B, 28C, 29C)..... 3

   Penis valve with distal hooks turned inwards (Figs. 30D, 31C, 32C, 33B) 10

3. Antennae long, A_{5-13} individually about twice their distal width (Fig. 23A). Hind basitarsus distinctly narrowed towards the base (Fig. 23B). St_8 and genitalia as in Figs. 23C–D; apex of penis valve hooked outwards. Collar, T_{1-2} yellow, hindmost tergites whitish....*Kallobombus* Dalla Torre 1 species, *B. soroeensis* (Fabricius) (p. 31)

   Hind basitarsus not much narrowed towards the base (Figs. 24A, 25A). Penis valve inconspicuously or not hooked at apex..... 4

4. Malar space markedly longer than distal width. Fringes of hind tibia and hind basitarsus at least twice as long as respective distal width. Genitalia as in Figs. 24C–26C, 27B ....*Alpinobombus* Skorikov 5

   Malar space barely or not longer than distal width. Fringes of hind tibia less than twice the distal width, that of hind basitarsus shorter than distal width. Genitalia as in Figs. 28C–29C. Collar, at least visible hairs of T_2 yellow, those of hindmost tergites whitish.....*Bombus* s.s. 8

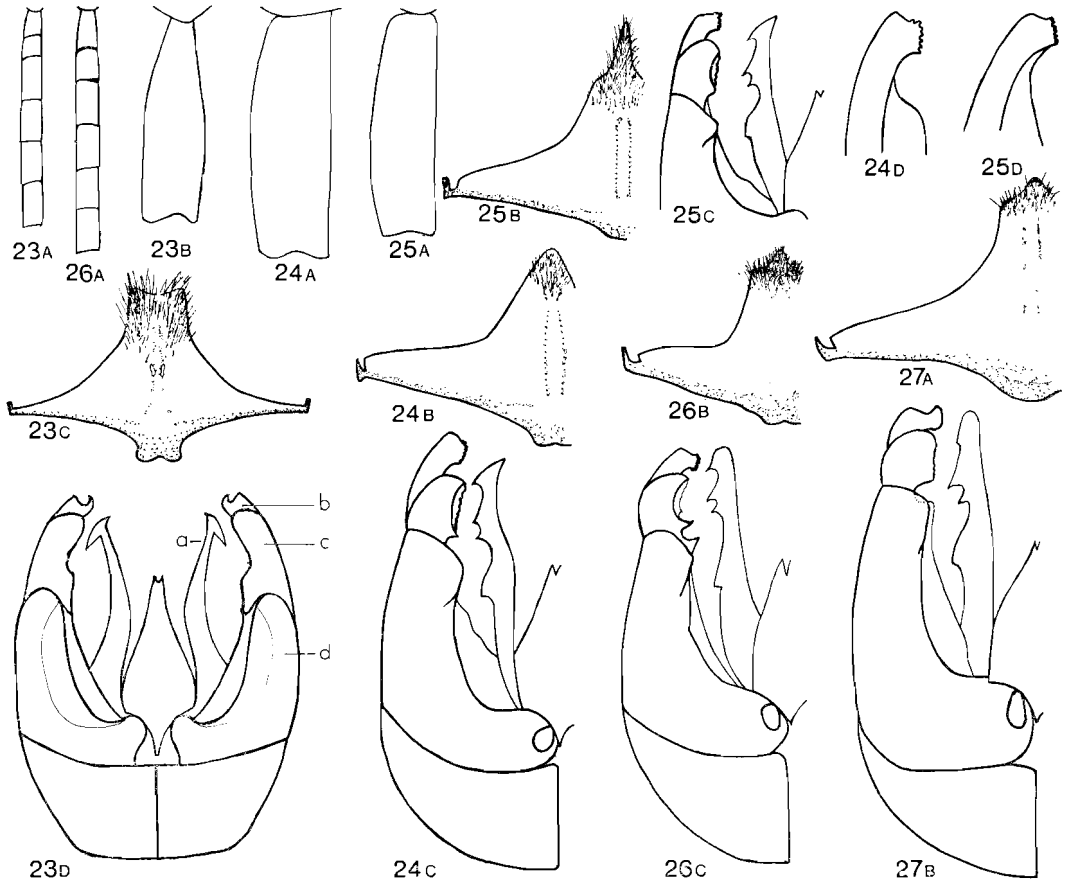
5. St_8 tapering towards apex (Figs. 24B–25B). T_{3-7} ferruginous..... 6

   St_8 subtruncate at apex with centre of distal margin somewhat produced (Figs. 26B, 27A). T_3 not ferruginous, T_{4-7} black, whitish or ferruginous... 7

6. Outer surface of hind tibia slightly or not alutaceous. Hind basitarsus about 3½ times longer than distal width or nearly (Fig. 24A). St_8 and genitalia as in Figs. 24B–C. Posterior part of volsella seen from beneath (Fig. 24D). T_{2-7} ferruginous, otherwise black... .....*B. alpinus* (Linnaeus) (p. 96)

   Outer surface of hind tibia strongly alutaceous. Hind basitarsus longer than 3½ times distal width (Fig. 25A). St_8 and genitalia as in Figs. 25B–C. Posterior part of volsella seen from beneath (Fig. 25D). T_1 and at least anterior part of T_2 black, remainder of tergites rather pale to pronounced ferruginous.....*B. arcticus* (Kirby) (p. 101)

7. A_{3-8} as in Fig. 26A. St_8 and genitalia as in Figs. 26B–C. Interalar band



Figs. 23–27. Section *Anodontobombus*. Fig. 23: *B. soroeensis* (Fabricius) ♂. A: Antennal segments 3–8; B: Right hind basitarsus; C: Sternite 8; D: Genitalia. a penis valve; b volsella; c gonostylus; d gonocoxite. Fig. 24: *B. alpinus* (Linnaeus) ♂. A: Right hind basitarsus; B: Right half of sternite 8; C: Right half of genitalia; D: Ventral view of posterior part of volsella. Fig. 25: *B. arcticus* Kirby ♂. A: Right hind basitarsus; B: Right half of sternite 8; C: Posterior right half of genitalia; D: Ventral view of posterior part of volsella. Fig. 26: *B. balteatus* Dahlbom ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia. Fig. 27: *B. hyperboreus* Schönherr ♂. A: Right half of sternite 8; B: Right half of genitalia.

(except in melanic specimens). T_{4-7} ferruginous, dull yellow or whitish.. .....*B. balteatus* Dahlbom (p. 105)

St_8 and genitalia as in Figs. 27A–B. Interalar band. T_{3-7} black ....*B. hyperboreus* Schönherr (p. 114)

8. A_3 slightly or not longer than A_4 (Fig. 28A). Wings elongated, strongly infuscate. St_8 and genitalia as in Figs. 28B–C; gonocoxite regularly converging towards apex; apex of volsella as in Fig. 28D. *B. sporadicus* Nylander (p. 50)

A_3 markedly longer than A_4 (Fig. 29A). Wings not elongated, moderately infuscate. Gonocoxite not regularly converging towards apex, slightly impressed inside..... 9

9. A_{3-8} as in Fig. 29A. Supra-orbital line touching or just transecting the ocelli dorsally. St_8 and genitalia as in Figs. 29B–C. Apex of volsella as in Fig. 29D. Coat rather even. Colour pattern distinct. Yellow hairs, being deep yellow, restricted to collar or part thereof and T_2..... .....*B. terrestris* (Linnaeus) (p. 53)

Supra-orbital line clearly transecting ocelli. Coat more or less shaggy. Yellow hairs lemon yellow or of a pale dull shade. Colour pattern either distinct as by *B. terrestris* or diffuse with additional variable admixture of yellow hairs in pile of face, on episternum, scutullum, T_1, and often with an admixture of greyish hairs.....
.....*B. lucorum* (Linnaeus) (p. 40)
.....*B. magnus* Vogt (p. 46)
(*B. magnus* cannot with certainty be distinguished from *B. lucorum*).

10. Volsella reaching far beyond gonostylus, which inside has a small protruberant process at its base (Figs. 30D, 31C, 32C)..... 11
Volsella hardly reaching beyond gonostylus, which is triangular with no evident process (Fig. 33B).....
.....*Pyrobombus* Dalla Torre 13

11. A_3 shorter than A_5 (Fig. 30A). Hind basitarsus somewhat narrowed towards the base (Fig. 30B). St_8 and genitalia as in Figs. 30C–D; volsella oblique at apex.....
.....*Cullumanobombus* Vogt
1 species, *B. cullumanus* (Kirby) (p. 56)
A_3 equal to A_5 or longer (Figs. 31A, 32A). Hind basitarsus not much narrowed towards the base. Volsella truncate or emarginated at apex (Figs. 31C, 32C)..... 12

12. Malar space markedly shorter than distal width. Mandible trifurcate. A_3 longer than A_5 (Fig. 31A). St_8 and genitalia as in Figs. 31B–C. T_{4-7} ferruginous..*Alpigenobombus* Skorikov
1 species, *B. wurfleini* Radoszkowski (p. 25)
Malar space about as long as distal width. Mandible bifurcate. A_3 about as long as A_5 (Fig. 32A). St_8 and genitalia as in Figs. 32B–C. T_{4-7} reddish
..... *Melanobombus* Dalla Torre
1 species, *B. lapidarius* (Linnaeus) (p. 89)

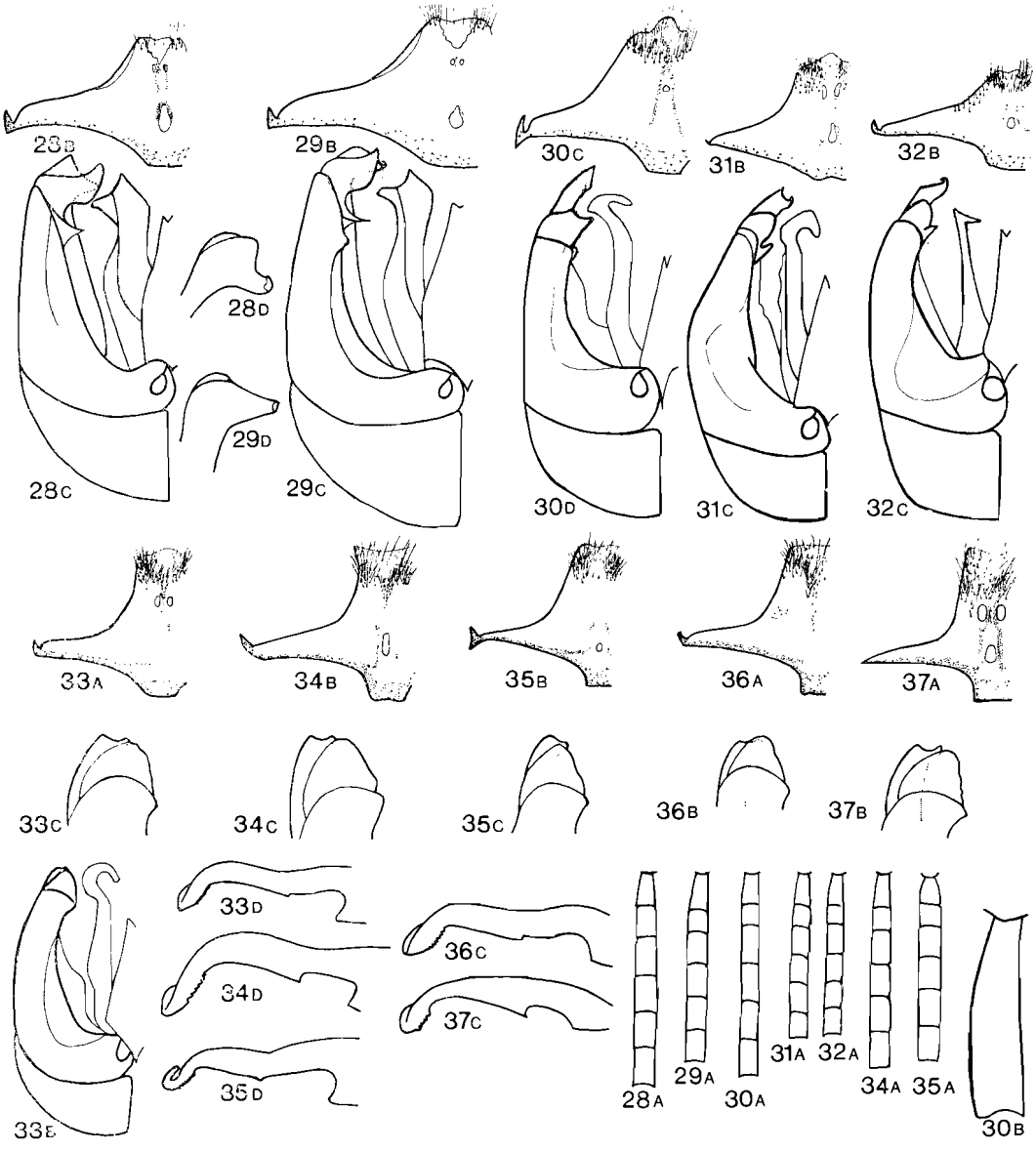
13. T_{5-7} whitish 14
T_{5-7} yellow or ferruginous 16

14. St_8 and genitalia as in Figs. 33A–B. Gonostylus as in Fig. 33 C. Penis valve with at most indication of tooth beneath (Fig. 33D). Parallel-sided interalar band...*B. jonellus* (Kirby) (p. 69)
Penis valve toothed beneath (Figs. 34D, 35D). Dorsum of thorax all yellowish-brown or with variable admixture of black hairs on the disc, eventually forming an interalar band 15

15. A_3 markedly longer than A_4, equal to A_5 or longer (Fig. 34A). Hind basitarsus with longest hairs of posterior fringes about as long as greatest width of the segment. St_8 as in Fig. 34B. Gonostylus as in Fig. 34C. Penis valve as in Fig. 34D. Dorsum of thorax all yellowish-brown.....
.....*B. hypnorum* (Linnaeus) (p. 63)
A_3 slightly or not longer than A_4, markedly shorter than A_5 (Fig. 35A). Hind basitarsus with longest hairs of posterior fringes exceeding the greatest width of the segment. St_8 as in Fig. 35B. Gonostylus as in Fig. 35C. Penis valve as in Fig. 35D. Dorsum of thorax with variable admixture of black hairs on the disc, occasionally forming an interalar band.....
.....*B. cingulatus* Wahlberg (p. 61)

16. Posterior fringes of hind tibia and hind basitarsus individually less than twice their greatest width. St_8 as in Fig. 36A. Gonostylus as in Fig. 36B. Penis valve as in Fig. 36C. Collar yellow, T_{4-7} ferruginous.....
.....*B. pratorum* (Linnaeus) (p. 82)
Posterior fringes of hind tibia and hind basitarsus individually at least twice their greatest width. St_8 as in Fig. 37A. Gonostylus as in Fig. 37B. Penis valve as in Fig. 37C. Either an interalar band or whole dorsum of thorax black. T_{2-3} ferruginous, T_{4-7} ferruginous or yellow.....
.....*B. lapponicus* (Fabricius) (p. 75)
2 subspecies

17. Frontal edge of eye directed towards or below posterior mandibular condyle. A_3 equal to A_5 or longer (Fig.



Figs. 28–37. Section *Anodontobombus*. Fig. 28: *B. sporadicus* Nylander ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia; D: Ventral view of distal part of volsella. Fig. 29: *B. terrestris* (Linnaeus) ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia; D: Ventral view of distal part of volsella. Fig. 30: *B. cullumanus* (Kirby) ♂. A: Antennal segments 3–8; B: Right hind basitarsus; C: Right half of sternite 8; D: Right half of genitalia. Fig. 31: *B. wurfleini* Radoszkowski ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia. Fig. 32: *B. lapidarius* (Linnaeus) ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia. Fig. 33: *B. jonellus* (Kirby) ♂. A: Right half of sternite 8; B: Right half of genitalia; C: Right gonostylus, volsella; D: Lateral view of right penis valve. Fig. 34: *B. hypnorum* (Linnaeus) ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right gonostylus, volsella; D: Lateral view of right penis valve. Fig. 35: *B. cingulatus* Wahlberg ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right gonostylus, volsella; D: Lateral view of right penis valve. Fig. 36: *B. pratorum* (Linnaeus) ♂. A: Right half of sternite 8; B: Right gonostylus, volsella; C: Lateral view of right penis valve. Fig. 37: *B. lapponicus* (Fabricius) ♂. A: Right half of sternite 8; B: Right gonostylus, volsella; C: Lateral view of right penis valve.

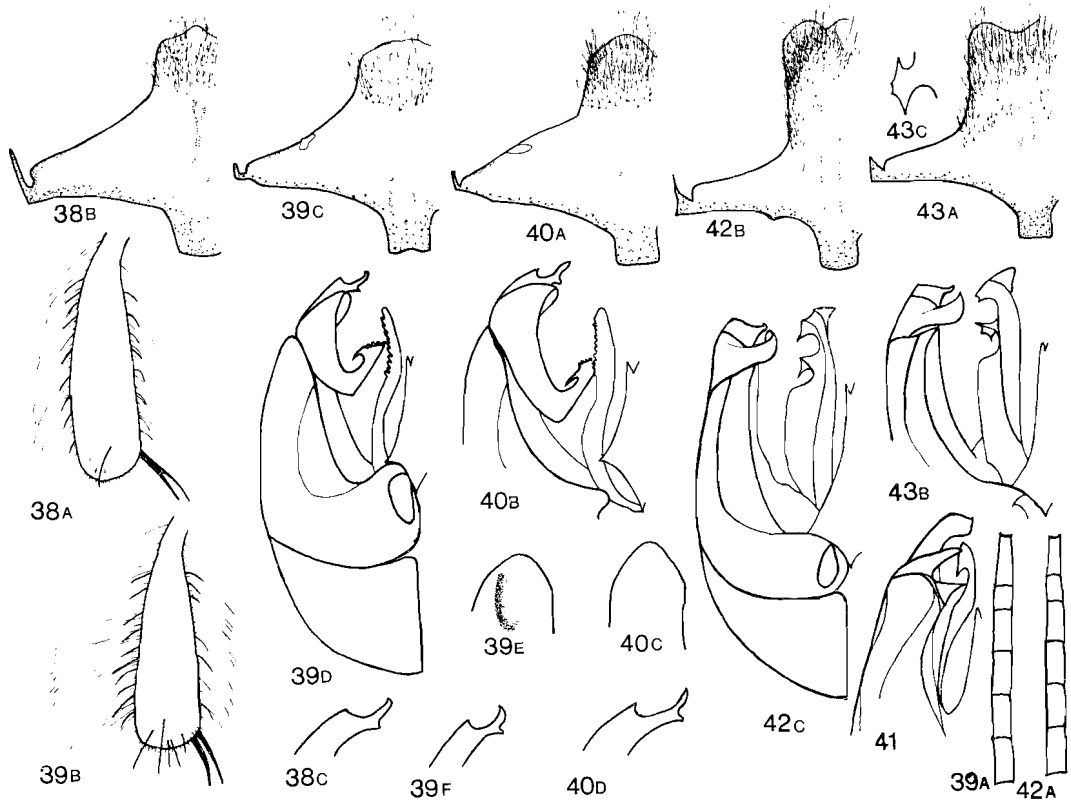
39A). Genitalia as in Figs. 39D, 40B ..... *Megabombus* Dalla Torre 18

Frontal edge of eyes directed in front of posterior mandibular condyle. A_3 equal to A_5 or shorter (Figs. 42A, 44A–49A)..... 20

18. Distal bristles of hind tibia sparse, barely or not exceeding the decumbent margin; fringes of hind tibia barely or not longer than greatest width of the segment (Fig. 38A). St_8 as in Fig. 38B. Boot-like tip of volsella more or less similar to Fig. 38C. Parallel-sided interalar band. T_{4-6} whitish..... *B. ruderatus* (Fabricius) (p. 135)

Distal margin of hind tibia with bristles exceeding the decumbent margin; fringes of hind tibia markedly longer than greatest width of the segments (Fig. 39B). If interalar band this is not parallel-sided 19

19. A_{3-8} as in Fig. 39A. Hind tibia as in Fig. 39B. St_8 and genitalia as in Figs. 39C–D; lateral depressions of gonostylus clearly defined (Fig. 39E); boot-like tip of volsella more or less



Figs. 38–43. Section *Odontobombus*. Fig. 38: *B. ruderatus* (Fabricius) ♂. A: Right hind tibia; B: Right half of sternite 8; C: Dorsal view of distal part of right volsella. Fig. 39: *B. hortorum* (Linnaeus) ♂. A: Antennal segments 3–8; B: Right hind tibia; C: Right half of sternite 8; D: Right half of genitalia; E: Lateral view of posterior part of right gonocoxite; F: Dorsal view of distal part of right volsella. Fig. 40: *B. consobrinus* Dahlbom ♂. A: Right half of sternite 8; B: Posterior right half of genitalia; C: Lateral view of posterior part of right gonocoxite; D: Dorsal view of distal part of right volsella. Fig. 41: *B. pomorum* (Panzer) ♂. Posterior right half of genitalia. Fig. 42: *B. distinguendus* Morawitz ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia. Fig. 43: *B. subterraneus* (Linnaeus) ♂. A: Right half of sternite 8. B: Posterior right half of genitalia; C: Preapical process of penis valve.

similar to Fig. 39F. Interalar band (except in strongly melanic forms). T_{4-5} whitish . . . *B.hortorum* (Linnaeus) (p. 124)

St_8 and genitalia as in Figs. 40A–B; lateral depressions of gonostylus poorly defined (Fig. 40C); boot-like tip of volsella more or less as in Fig. 40D. Whole dorsum of thorax yellowish-brown. T_{4-5} greyish with admixture of black hairs . . . . . *B. consobrinus* Dahlbom (p. 119)

20. A_3 as long as A_5 or nearly (exception: markedly shorter in *B. pomorum*). A_{5-13} individually parallel-sided or nearly (Fig. 42A). Outer surface of hind tibia sparsely to densely covered with short hairs. Genitalia as in Figs. 42C, 43B 21

A_3 markedly shorter than A_5, at least A_{7-13} more or less swollen underneath (Figs. 44A–49A). Genitalia as in Figs. 44C–49C . . . . . *Thoracobombus* Dalla Torre 23

21. Mandible without a beard. A_3 markedly shorter than A_5. Hind tibia with outer surface convex, densely covered with short hairs. Gonostylus transverse, outer edge curving obliquely inwards and ending in a stout acute process; volsella projecting well beyond gonostylus, moderately broad except expanded considerably inwards at the end (Fig. 41) . . . . . *Rhodobombus* Dalla Torre

1 species, *B. pomorum* (Panzer) (p. 189)

Mandible with well-developed beard. A_3 as long as A_5 or nearly (Fig. 42A). Outer surface of hind tibia with distal half flattened or slightly concave, rather sparsely covered with short hairs. Genitalia as in Figs. 42C, 43B. Gonostylus transverse, outer edge not curving obliquely inwards and not ending in acute process; volsella moderately projecting beyond gonostylus, broad, truncate distally with a narrow process projecting inwards . . . . . *Subterraneobombus* Vogt 22

22. A_{3-8} as in Fig. 42A. St_6 with distal lateral swellings. St_8 and genitalia as in Figs. 42B–C; preapical process of penis valve tridentate, usually only one tooth strongly projecting. Parallel-sided interalar band. T_7 black-haired, coat otherwise dorsally olive-yellow . . . . *B. distinguendus* Morawitz (p. 182)

St_6 without lateral swellings. St_8 and genitalia as in Figs. 43A–B; preapical process of penis valve tri- or quadridentate with lateral teeth strongly projecting (Fig. 43C) or bidentate with one strongly projecting tooth. Interalar band posteriorly v-shaped. Other colour pattern . . . . . *B. subterraneus* (Linnaeus) (p. 186)

23. Subapical process of volsella almost parallel-sided, but suddenly dilated and truncate at apex (Figs. 44C–46C). Dorsal of thorax all black or interalar band present 24

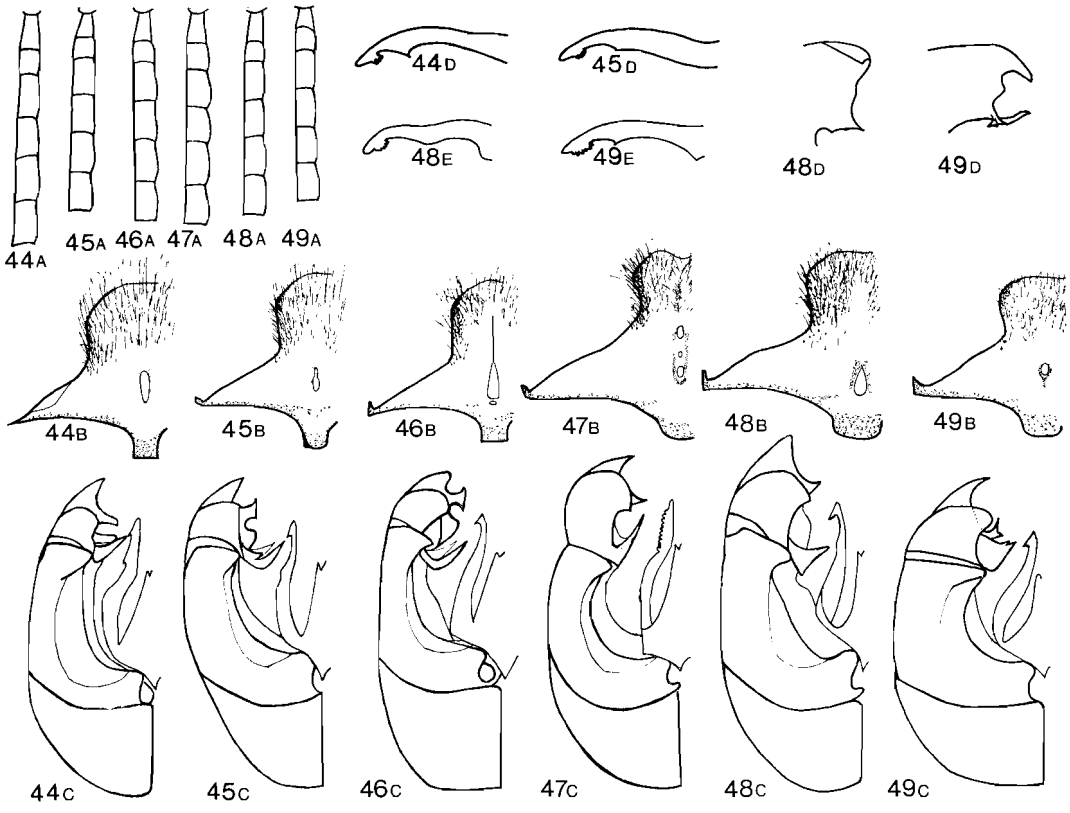
Subapical process of volsella differently shaped, never parallel-sided and truncate at apex. Dorsal of thorax neither all black (except in rare melanic forms) nor with interalar band 26

24. A_{3-8} as in Fig. 44A. St_8 and genitalia as in Figs. 44B–C; subapical process of volsella markedly longer than distal width; penis valve toothed underneath (Fig. 44D). Dorsal of thorax black, T_{4-7} ferruginous . . . . . *B. ruderarius* Müller (p. 169)

Genitalia as in Figs. 45C–46C; subapical process of volsella barely or not longer than distal width 25

25. A_3 barely longer than A_4, A_{7-13} swollen beneath (Fig. 45A). St_8 and genitalia as in Figs. 45B–C; penis valve without distinct tooth underneath (Fig. 45D). Broad interalar band; T_3 black, T_{4-6} ferruginous, otherwise pale yellowish-grey (melanic form with pattern as in *B. ruderarius* locally more common than the typical form) . . . . . *B. sylvarum* (Linnaeus) (p. 172)

A_3 markedly longer than A_4, A_{5-13} strongly swollen beneath (Fig. 46A). St_8 genitalia as in Figs. 46B–C. Inter-



Figs. 44–49. Section *Odontobombus*. Fig. 44: *B. ruderarius* (Müller) ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia; D: Lateral view of right penis valve. Fig. 45: *B. sylvarum* (Linnaeus) ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia; D: Lateral view of right penis valve. Fig. 46: *B. veteranus* (Fabricius) ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia. Fig. 47: *B. pascuorum* (Scopoli) ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia. Fig. 48: *B. muscorum* (Linnaeus) ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia; D: Ventral view of left volsella; E: Lateral view of right penis valve. Fig. 49: *B. humilis* Illiger ♂. A: Antennal segments 3–8; B: Right half of sternite 8; C: Right half of genitalia; D: Ventral view of left volsella; E: Lateral view of right penis valve.

alar band more or less pronounced. T_{4-7} usually with admixture of black bristles, otherwise coat pale yellowish-grey.....*B. veteranus* (Fabricius) (p. 179)

26. A_{5-13} strongly swollen beneath (Fig. 47A). St_8 and genitalia as in Figs. 47B–C; penis valve simple, serrate beneath. Dorsum of thorax and at least hindmost gastral tergites yellowish-brown or orange-brown..... .....*B. pascuorum* (Scopoli) (p. 154)
4 subspecies

A_{5-13} slightly to moderately swollen beneath (Figs. 48A–49A). Penis valve hooked at apex, not serrate beneath (Figs. 48C–49C)..... 27

27. A_{3-8} as in Fig. 48A. St_8 and genitalia as in Figs. 48B–C; distal margin of volsella with a broad not much projecting process and a broad subapical triangular tooth (Fig. 48D). Penis valve as in Fig. 48E. Dorsum of thorax yellowish-brown or orange-brown, T_{1-5} dull yellow..... .....*B. muscorum* (Linnaeus) (p. 145)

A_{3-8} as in Fig. 49A. St_8 and genitalia as in Figs. 49B–C; distal margin of volsella strongly projecting and

with a bidentate subapical process (Fig. 49D); penis valve as in Fig. 49E. Dorsum of thorax yellowish-brown, T_{1-5} yellowish of various shade of which T_2 is the darkest.....
.....*B. humilis* Illiger (p. 139)

SUBGENUS *ALPIGENOBOMBUS* SKORIKOV

Alpigenobombus Skorikov, 1914a, p. 128, type-species *Bombus mastrucatus* Gerstaecker, 1869.

(*Mastrucatobombus* Krüger, 1917, pp. 62, 66, type-species *Bombus mastrucatus* Gerstaecker. Monobasic.)

Nomenclatural, taxonomic remarks.

Sandhouse (1943) stated that the type of *Alpigenobombus* is '*Bombus lefebvrei* Lepeletier, 1836 "(= *B. mastrucatus* auct.)." (Original designation).' *B. lefebvrei* Lepeletier, 1836, holotype ♀ MNP, is, however, now revised to *B. pomorum* (Panzer), 1802–05, by Tkalcu (1969) and this species belongs to the subgenus *Rhodobombus* Dalla Torre, 1880. In his meagre description, Skorikov (1914a) wrote that he had gathered what he called all the endemic forms of '*B. lefebvrei* Lep. (= *B. mastrucatus* auct.)' occurring in the mountain fauna of Eurasia into one genus or subgenus, *Alpigenobombus*. As Skorikov obviously meant *B. mastrucatus*, this taxon is retained as type-species for *Alpigenobombus* in order to serve stability and uniformity of nomenclature.

According to Tkalcu (1969), *B. mastrucatus* is, however, a European subspecies of *B. wurfleini* Radoszkowski, 1859. Tkalcu examined the holotype of the latter but did not trace the type series of *B. mastrucatus* IZB, which unfortunately by then was at my disposal. The series consists of 2 ♀♀, 22 ♀♀, 14 ♂♂ of which a male, selected as lectotype by me, is labelled as follows: (1) Ober-Bayern, Kreuth Gerstaecker S (printed); (2) *mastrucatus* Gerst.* ♂ oper. Kreuth (handwritten ?original); (3) red label marked paratype; (4) *B. mastrucatus* Gerst. ♂ lectotype design. A. Løken 1965. The specimen was chosen because of the asterisk in the text of the second label as 'Diese Sternchen sind in unserer Sammlung zuverlässigere Indikatoren für Typen als die roten Etiketten' (Königsmann in litt. 1966). I have not seen the holotype (a male) of *B. wurfleini*, and have therefore not been able to compare this specimen with the type material of *B. mastrucatus* to confirm the conspecificity of the taxa. Radoszkowski (1884, p. 66) emphasizes the structural similarity in the males of *B. wurfleini* and *B. mastrucatus*, but maintains a specific difference in the females. However, he indicates that *B. mastrucatus* might be a variant of *B. wurfleini* = *B. alpigenus* Morawitz. Their conspecificity has been recognized in the past (Morawitz 1881, p. 71; Handlirsch 1888; Friese & Wagner 1909; Kruseman 1960; Reinig 1965, p. 117; etc.), but the priority of *B. wurfleini* has been ignored and the species treated as *B. mastrucatus*. The nominate form of *B. wurfleini* has a colouring of the coat completely different from that of *B. mastrucatus* and the taxa have, moreover, an allopatric distribution. The statement of Tkalcu (1969) is no doubt correct, i.e. *B. mastrucatus* Gerstaecker = *B. wurfleini mastrucatus* Gerstaecker.

B. wurfleini mastrucatus is the only Scandinavian representative of the subgenus.

BOMBUS (ALPIGENOBOMBUS) WURFLEINI RADOSZKOWSKI

Bombus wurfleini Radoszkowski, 1859, p. 482 No. 4, holotype ♂ ZIK, type area Caucasus (Tkalcu 1969).

(*Bombus levebvrei* auctt. nec Lepeletier, 1836; Strand 1901; Brinck & Wingstrand 1949. *Bombus mastrucatus* Gerstaecker, 1869, p. 326 No. 19, lectotype ♂ IZB! hereby selected cf. above. Type loc. Germany: Ober-Bayern: Kreuth; Sparre Schneider 1898, 1906, p. 183, 1909, 1918; Lie-Pettersen 1901, 1905, 1907; Friese 1902; Aurivillius 1903; Bengtsson 1904, 1908; Ringdahl 1915; Gaunitz 1929; Meidell 1934a, 1946; Løken 1949, 1950, 1958a, 1960, 1966c; Brinck 1951; Kruseman 1959; Elfving 1960, 1968; Ander 1963, 1965. *Bombus brevigena* Thomson, 1870, p. 255 No. 12, lectotype ♀ TCL! selected by Ander (1967), type loc. Sweden: Lapland (Lu. Lpm.): Kvikkjokk; Thomson 1872; Siebke 1880; Strand 1898a, 1898b. *Bombus alpigenus* Morawitz, 1873, p. 132, type area USSR: Dagestan.)

First Scandinavian records

Norway. Oppland (On) Dovre (Siebke 1880).

Sweden. Lapland (Lu. Lpm.): Kvikkjokk (Thomson 1870).

Distribution

Fennoscandia. Cf. the subspecies.

World distribution. Boreo-alpine. Europe (NW Spain; The Pyrenees; Northern Appennini; Jura; The Alps; Vosges; Germany north to Harz; The Balkan Mountains; Romania; Czechoslovakia; Poland; Fennoscandia)–Turkey–Caucasus–Urals (Dylewska 1957; Reinig 1965, p. 117; Tkalcu 1969; Yarrow in litt.).

BOMBUS WURFLEINI MASTRUCATUS GERSTAECKER

Queen, worker

Morphological characters. Head shorter than wide, occasionally as long as wide. Malar space strongly transverse, about half the distal width (Fig. 7A), just longer than A_5 and markedly shorter than A_3. Clypeus rather swollen, transverse, not shorter than 2/3 the distal width, with rather dense punctures of various size throughout and anteriorly with indistinct lateral impressions. Labral furrow deep and broad, in width about a third of labral width; labral tubercles coarsely punctured at base, anteriorly flattened or slightly depressed; labral lamella rather straight, laterally usually continuing in the side-wall of labral furrow. Mandible strongly bent, spoon-shaped, without basal keel, without sulcus obliquus or this being short and indistinct, with well-defined incisura lateralis and distally strongly toothed (Fig. 7B). Eyes directed in front of posterior mandibular condyle. Ocelli lying on an almost straight line, just in front of supra-orbital line, occasionally touching this line. A_3 about twice the distal width and about 5/6 as long as A_{4+5}; A_4 just shorter than A_5. Mid-basitarsus with posterior distal angle rather acute (Fig. 7C), the posterior and outer basal part of the segment with sparse hairing markedly longer than greatest width of the segment. Outer surface of hind tibia feebly alutaceous, dorsal inner distal angle, with rather distinct spinose process. Hind basitarsus with posterior distal angle rather obtusely spinose, anterior margin with bristles along the basal-half nearly as long as those of hind tibia, hairs in posterior fringe not exceeding half the greatest width of the segment. T_6 alutaceous, thickened at apex. St_6 without keel. Body robust, coat shaggy. Wings slightly, evenly infuscate.

Queen measurements: N = 20; SE Norway; malar space: 0.47 mm (± 0.03 ±0.01) range: 0.40–0.50 mm; 'radial length': 4.49 mm (±0.11 ±0.02) range: 4.20–4.65 mm; interalar width: 5.37 mm (±0.21 ±0.05) range: 4.85–5.80 mm. Body of large size.

There is a distinct difference in size between the queen and the worker caste.

Colour pattern. Hairs on distal edge of T_3, T_{4-6} ferruginous, hairs on St_{1-6} pale ferruginous; otherwise coat black.

Variation. Rarely slight admixture of yellow hairs on collar, scutellum, and T_2. Ferruginous hairs on T_3 ranging from a few hairs on extreme distal margin to covering about posterior half of the tergite. Occasionally workers with variable admixture of greyish-white hairs on collar and scutellum were observed, likewise those with hairs on thorax, tergites, corbicular fringes more or less tipped greyish-white. A few individuals with hindmost tergites clothed yellowish-white, by Meidell (1934a) mentioned as var. *fuscus*, accord with specimens with the colouring of the coat not fully developed.

Male

Morphological characters. Head, clypeus shorter than wide. Malar space strongly transverse, about as long as A_3. Mandible with three distal teeth of which the ventral is longer, sharper than mid- and dorsal tooth. Eyes directed in front of posterior mandibular condyle. A_3 about twice the distal width or nearly, hardly longer than A_5; A_4 as long as distal width, dorsally often just longer; A_{5-13} individually almost straight and about $1\frac{1}{2}$ times longer than distal width (Fig. 31A). Hind tibia widened distally, outer surface distally flattened, barely or not alutaceous and covered with

rather long hairs except for a large distal bare area; anterior and posterior fringes of hind tibia long, the longest hairs in the latter about twice the greatest width of the segment or longer. Longest hairs in posterior fringe of hind basitarsus about twice the greatest width of the segment or just shorter. T_7 slightly dimpled in front of apex. St_8 and genitalia (Figs. 31B–C), basic half of gonocoxite distinctly caved inside; gonostylus with well-defined finger-shaped process produced inwards; volsella reaching well beyond gonostylus, distally emarginated; penis valve distally broad with dorso-ventral flattened, sickle-shaped hooks turned inwards. Coat shaggy. Body of medium to large size.

Colour pattern. Pile of face below antennal sockets and pile of vertex predominantly yellow, encroached by black hairs. Collar, including at least adjacent margin of episternum, yellow-haired. Venter of thorax, distal part of scutellum with variable admixture of yellow hairs. T_{4-7}, lateral part of fringes of St_{4-6} ferruginous. Trochanters, parts of all femora, the remaining sternites with pale yellow to greyish-white hairs. Fringes of hind tibia and hind basitarsus whitish tinged. Otherwise coat black.

Variation. Yellow hairs on head and thorax more or less pronounced, occasionally T_1 with yellow hairs. T_3 distally with variable amount of ferruginous hairs. Fringes of St_{4-6} entirely ferruginous, usually of paler shade than that of the tergites. Fringes of hind tibia and hind basitarsus may be predominantly ferruginous.

Distribution (Fig. 50)

Norway. Widely distributed from the extreme southern coast and north to nearly 68° N. In the southeasternmost lowlands, however, not reaching the border area to Sweden, and only once recorded in Östfold county.

The frequency is locally high in woodland and subalpine valleys, occasionally also in adjacent lower alpine zone. Along the western coast it is sporadically recorded in the extreme archipelago. In Southern Norway recorded to 1300 m s.m.

Biotopes: Meadows, *leguminosae* fields, gardens, roadsides, pastures, *Aconitum* biotopes, *Vaccinium* heaths. Barren land and *Calluna* heather are avoided.

A total of about 2000 specimens was examined.

List of localities. *Östfold:* Råde: Tom ♀ 18 July 1958 (I. Meidell). *Akershus:* Asker: Brönnöy, Lushattdalen, Rustad; Bærum: Bråten; Oslo: Bonntjern, Hellerud, Maridal, Slemdal TRM NRS, Tåsen; Ullensaker: ?loc. ZMO; Eidsvoll: S Eidsvoll, Feiring. *Hedmark (HEs):* Kongsvinger: W Eidsberg; Åsnes: Åsen; Hamar: ZMO, Helgöya ZMO. *HEn:* Trysil: Dammen, Trysil, S Sjöenden, Vestby; Åmot: Glesubekken, Åmot; Stor-Elvdal: Snödöldalen 1000 m; Tynset: Haugsvangen, Tyldal; Tolga: Hodalen; Engerdal: Torhus. *Oppland (Os):* Gran: S Einavoll, Gjerdvika, Tingelstad; Östre Toten: Stubdalen; Söndre Land: Fluberg; Nordre Land: Dokka USU ZMB, Torpa; Lillehammer: Jörstadmoen; Etnedalen: Bruflat; Sör-Aurdal: Ellingseter 820 m, Skard; Nord-Aurdal: Dalen, Fagernes, Flya, Hovda, Sæbuöygard N Fagernes; Öyer: Aksjöseter 1000 m, Skåi, Öyer, Åstdalen 900 m; Ringebu: ?loc. ZMO, Flaksjöen. *On:* Vestre Slidre: Kinnholt 1000 m; Vang: Eidsbugarden 1100–1200 m, Tyin 1100 m USU ZMB, N Öye USU ZMB; Sel: Heidal TRM, Klakshaug, Leirflata, Mysuseter 900 m; Vågå: Gjendesheim 1000 m, Klones, Leirungen 1050 m, Randsverk TRM, Vågåmo; Lom: Bövertun 900 m, Galdesand, Gjendebu 1000 m, Leirdalen 900 m, Solell 1200 m; Skjåk: Skjåksetrene 800 m; Dovre: Dovrefjell 1000 m KMT NRS TCL ZMB ZMC ZMO, Fokstua 930 m ZMB ZMO, Toftemo ZMO, Vålåsjö ZMO. *Buskerud (Bö):* Hurum: Filtvedt TRM ZMB, Pinadalen; Drammen; Lier: Toverud; Ringerike: Hen; Krödsherad: Björkerud, Bråtån, Fagerheim, Glesne, Veikåker; Modum: Dignes; Flesberg: Lampeland, Öydegarden; Kongsberg: Lauerud, Lintvedt, Skollenborg. *Bv:* Sigdal: Kopseng, Nedre Eggedal, Sandsbråten, Sigdal; Nore og Uvdal: Flåtåseter 1000 m, Heggjeli 780 m, Nörstebö, Rödberg, Uvdal stavkirke, Uvdal; Flå: Grosland; Gol: Gol, Randalseter 940 m; Hemsedal: Holle bru, Kjölen 1000 m, Lykkja 900 m, Muren 730 m; Ål: ?loc. ZMO, Bergsjöstölen 1100 m, Tvist 1080 m, Vallehalle 1120 m, Vats 800 m; Hol: Geilo 800 m ZMA, Halfardokkistölen, Haugastöl 1000 m VCA ZMB, NW Haugastöl 1100–1200 m, Hovet, Kikut, Nygård 1000 m, S Olsenvann 1100 m, Sundalsfjord 750 m, Ustaoset 1000 m, Vikastölen 1000 m. *Vestfold:* Sande: S Sande; Botne: Angerskleiv. *Telemark (TEy):* Skien: Kikut; Bamble: Trosby, Åby; Nome: Damtjern; Drangedal: Nordbö, Nos, Omnes, Tomyra; Kragerö: Levang. *TEi:* Notodden: Gransherad; Bö: Sande, Vatnar; Seljord: Seljord, Svartdal, Vedfallsgrend; Kviteseid: Brunkeberg, Mostöl, Vrådal; Nissedal: Kyrkjebygda, Lauviki, Lia, Tjönnefoss, Treungen; Fyresdal: Moland; Tokke: Bandaksli, Holtet bro, Grimdalen, Mule gård, Åmdal Verk; Vinje: Bossböen

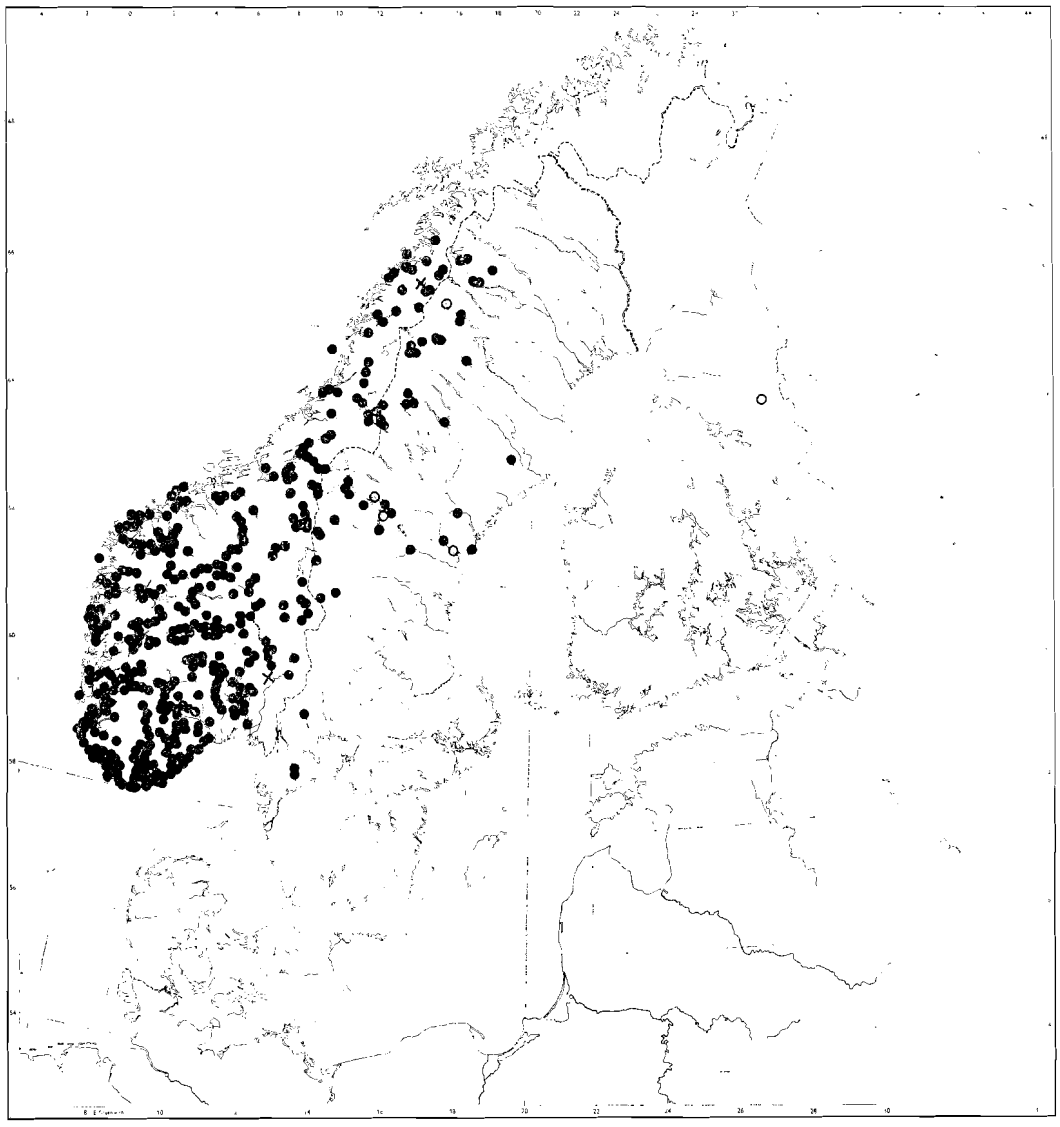


Fig. 50. *B. wurfleini* Radoszkowski. The distribution in Fennoscandia and neighbouring countries. ● one or several localities; ○ unrevised records (from literature or received in litt.); × inaccurate locality.

970 m, Krossen 700 m, Rauland kirke 700 m, Torvtjern 900 m, Urdbö 700 m, Vå 700 m, Åmot; Tinn: SE Borsjöen 1150 m, Fröystul 850 m, Tinn. *Aust-Agder (AAy):* Gjerstad: Fiane; Tverdestrand: Dypvåg, Eidbu, Nes Verk TRM; Arendal: ZMO; Austre Moland: Holmsund, Kilsund, Voje; Fjære: Fjære ZMO; Grimstad; Öyestad: Björbekk, Helle, Rykene; Froland: Svenes; Landvik: Eide skole, Enge, Havnevåg, Holvika, Hombor, Homborsund, Hörte, Molland, Tönnesöl; Lillesand: Kjöbmannsvik, Kjöstvedt, Kvivik, Kvåse, Langholmen, Melhagen, Natvik, Rosnes, Tröe, Ulvöen, Ulvöysund, Åmli; Birkenes: Sagen, Svaland; Iveland: Fosstveidt, Frikstad, Håvardstad, Ivedal. *AAi:* Evje og Hornes: Hornes, Lauvland, Syrtveit; Åmli: Gangsei, Gjövdal, Saurbekkflåt, Smedland, Öy st, Årli; Bygland: Löndal, Ose, Setesdal TRM; Valle: Hylestad, Kvestad, Rygnestad, Valle; Bykle: S Breivann 700 m, Breive 700 m, Bykle. *Vest-Agder (VAy):* Kristiansand: ZMO, Björnstad, Buane, Erkleiv, Kroodden, Morvik, Randesund, Strömme; Vennesla: Hageland; Övrebö ZMO; Sögne: Langeneset, Sögne, Åros; Mandal: Mandal, Sånum,

Tuftenes; Marnadal: Ask, Finsland, Gretteland, Röyseland, Solås, Utkjær, Öyslebö; Lindesnes: Ramsland, Reme, Spangereid; Lyngdal: Lyngdal TRM; Kvinesdal: Feda, Gjemlestad, Kvinesdal, Öye; Farsund: Fjelleså, S Hanangervannet, Lodshavn; Flekkefjord: Abelsnes; Ersdal, Espetveit, Loga, Nedre Fjeldså, Nuland, NW Sandvann; Audnedal: Sveindal; Hægebostad: Skeie; Åseral: Espelid, Rosseland, Åseral; Sirdal: Nedre Sirdal ZMO. *Rogaland (Ry):* Lund: Eikjelandsdalen, Moi; Sokndal: Hauge i Dalane, Nesvåg, Rekefjord; Eigersund: Birkeland, Eigeröyeidet, Nedre Hetland; Bjerkreim: Malmeim; Hå: Ogna, Salte bro; Klepp: Jæren, Klepp; Gjesdal: Ålgård; Sandnes: Hana; Sola: Rjoa; Stavanger: Lindöy; Strand: Tau; Rennesöy: Rennesöy; Vindafjord: Imsland; Tysvær: Nedstrand; Karmöy: Eide. *Ri:* Forsand: Lyse; Hjelmeland: Fister, Haugsli, Hjelmeland, Igland, Steinslandsvann, Årdal; Suldal: Bråtveit, Håvardstöl, Jelsa, Mostöl, Nesflaten, Sand, Suldalsosen, Svortebekk, Ullsneskvelven, Vetrhus, Våge; Sauda: Hellelandsbygd, Sauda, Saudasjöen. *Hordaland (HOy):* Bömlo: Mosterhavn; Sveio: N Austvik; Ölen: Dommersnes, Innbjoa; Fana: Blomsterdalen, Dolvik VCA, Fjösanger VCA ZMB, Hop, Minde VCA, Skipanes VCA ZMB, Skjold, Sörås, Titlestad, Tveiterås; Bergen: TRM VCA ZMB ZMO; Asköy: ? loc. VCA, Hegernes VCA, Herdla; Osteröy: Kleppe; Meland: Brakstad, Io; Radöy: Rosnesset; Vaksdal: Eidslandet; Lindås: Fosse, Herland, Sævråsvåg. *HOi:* Etne: Frette, Skånevik; Kvinnherad: Lio, Varaldsöy; Odda: Austmannli 800 m, Dalen gård 900 m, Midtleger 1150 m, Röldal, Seljestad, Valldal 900 m; Ullensvang: Alvsaker, Djönno, Espe, Fossli 750 m, Fresvik, Grythorgen 900 m, Hjölmo, Jåstad, Lofthus, Måbödalen, Sysendalen 750 m; Kvam: Kvamskogen; Voss: Kinne, Mjölfjell; Granvin: Eide VCA; Ulvik: Finse 1250 m, Gangdal 1000 m. *Sogn og Fjordane (SFy):* Hyllestad: Botn, Hyllestad, Risnes, Skivenes, Yttre Dale; Gulen: Takle; Höyanger: Lavik; Fjaler: Strandenes; Flora: Kinn; Naustdal: Frammarsvik, Naustdal; Jölster: Hamar, Vassenden; Gloppen: Sandane; Eid: Haugland, Kjölsdalen, Naustdal, Nordfjordeid; Selje: Ervik. *SFi:* Vik: Vik; Aurland: Kvammadal 950 m, Myrdal 870 m, Uppsete 850 m VCA ZMB, Vatnahalsen 800 m, Övstebö 800 m; Lærdal: Breistölen 1050 m, S Horgje; Sogndal: Slinde; Leikanger: Dalseter, Hermansverk; Balestrand: Brekka, Flesje, Kvamsöy; Luster: Fåbergstölene 600 m, SW Hallbreim, Jostedal, Skjolden, Turtagrö KMT NRS TRM VCA ZMB; Stryn: Flo, Hornindal, Skåre, Stryn, Vevik, Videdalen, Videseter 600 m. *Möre og Romsdal (MRy):* Sande: Gurskevåg, Åram; Vannylven: Thue; Ulstein: Flö, Vonheim; Örsta: Lyngstölvann, Öye; Heröy: Runde; Ålesund: VCA; Örskog: ZMO; Vestnes: Gjermundsnes, Vikebukt; Molde; Aukra: Aukra kirke, Falkehytta; Fræna: Bud; Eide: Vevang. *MRi:* Stranda: Kvanndalsætrene, Maråk, Vollset; Norddal: Indreeidet, Valldal; Surnadal: Kvanne ZMO, Melhus, Stangvik, Övre Surnadal; Rindal: Bölme. *Sör-Trøndelag (STy):* Rissa: Gafsetåsen. *STi:* Oppdal: Dalsbekk, Driva st., Drivstua 850 m ZMU, Gåvåli 975 m, Knutshö 1100–1300 m BML ZMB, Kongsvoll 900 m BML TRM ZMB ZMO ZMU, Skansen, Vårstigen 850 m; Rennebu: Rennebu; Ålen: Reitan, Umholtet; Röros: N Adamsvoll 820 m, Evavollen 700 m, Myrmoen 700 m, Naustervoll, Storelvvoll 800 m; Tydal: Mo bru, Sakrismoen, Vekterstua 600 m; Selbu: Medbus; Trondheim: VCA ZMB. *Nord-Trøndelag (NTy):* Næröy: Breiviken, Kvalviken, Teplingan. *NTi:* Meråker: Meråker, Tovmodal; Stjördal: Draveng, Hegra st., Tilleraunet; Levanger: Avdal; Verdal: Billingflaten, Sandvika, Sulstua, Stiklestad, Vuku; Inderöy: Kirkenesvåg, Skjelsvågen; Steinkjer: Sem, Snåsavann ZMA; Snåsa: Brönstad, Hegge, Leira bro; Lierne: Kvelia, Seterhaug, Småtjern; Höylandet: Skilleberget; Namskogan: Finnvollan; Röyrvik: Björkhaug. *Nordland (Nsy):* Vega: TRM; Gildeskål: Jelstad, Gildeskål kirke; Bodö: Falkflaugdalen, Frostmo, Löpsviken. *Nsi:* Grane: Båfjellmo, Majavann, Skomstad; Vefsn: Luktvann; Hemnes: Finneidfjord, Strömbotn; Rana: Randallsvollen, Rösvollheien; Beiarn: Gråtådalen; Saltdal: ?loc. ZMO, Storjordet TRM, Solvågfjell 800 m; Fauske: Fauske, Kjeldvann BML, Sulitjelma 600 m BML. *Nnö:* Sörfold: Bonnåsjöen.

Correction. Records from Buskerud (Bv): Ål (Strand 1898a) are revised to *B. lapidarius* (Linnaeus).

Sweden. Occurring from Dalsland, about 58° 30′ N north to Virihaure area in Lapland (Lu. Lpm.), nearly 67°20′ N and moreover sparsely distributed east to Gulf of Bothnia in Medelpad and Ångermanland.

A total of about 450 specimens was examined.

List of localities. *Dalsland:* Kroppefjäll NRS ZML, Köpmannebro, Rostock, Skållerud NRS. *Värmland:* Arvika. *Dalarne:* Fulufjäll NRS, Slagufjäll NRS, Särna ZMA. *Medelpad:* Liden NRS ZMB, Ånge. *Härjedalen:* ?loc. NRS, Hamrafjäll NRS ZML, Kesusjön NRS, Tänndalen NRS ZML. *Jämtland:* Berge DCL, Brattikkfjäll DCL, Brunflo, Bydalen, Frostviken NRS, Jormlien, Leipikvattnet NRS, Storlien, Svenstavik NRS, Undersåker NRS ZML, Östersund NRS, Åre TCL VCA ZMA ZML, Åreskutan DCL. *Ångermanland:* Bondsjö, Härnösand, Orsjön, Sollefteå NRS, Stennäs. *Lapland (Ås. Lpm.):* S Borgafjäll NRS, Fatmo, Fatmomakke, Njakafjäll, Satsfjäll NRS, Vilhelmina NRS. *Ly. Lpm.:* Ammarnäs GNM NRS ZMU, Björkfors, Tjulträsk BML GNM NRS ZMU, Tärna, Tärnasjön, Västansjö, Örnäs. *P. Lpm.:* Jäckvik, Peljekaise. *Lu. Lpm.:* Kvikkjokk TCL ZML, Njunjes VCA ZML, Sarek NRS ZML, Staloluokta, Tarradalen NRS.

The species has been confused with *B. lapidarius* (Linnaeus) and melanic *B. balteatus* Dahlbom. Unrevised records were not included here except the following (Ander in litt.): *Medelpad:* Kävstad. *Jämtland:* Nälden, Näs. *Lapland (P. Lpm.):* Vuoggatjålme.

Finland. Only a single queen (Ok: Suomussalmi ZMH) is recorded (Elfving 1968).

The total distribution of the subspecies, B. wurfleini mastrucatus Gerstaecker. Boreo-alpine. Europe (Northern Appennini; Jura; The Alps; Vosges; Germany north to Harz; The Balkan mountains; Romania; Czechoslovakia; Poland; Fennoscandia). With the exception of *B. w. pyrenaicus* Vogt confined to Spain and The Pyrenees, the species in Europe is represented by *B. w. mastrucatus.*

Zoogeographical remarks

The boreo-alpine distribution of *B. w. mastrucatus*, the northern area of which is restricted to Fennoscandia, indicates a post-glacial immigration into Scandinavia from the south. The suggestion disagrees with Reinig (1965, pp. 127, 138), who states a recent disjunct distribution in Scandinavia and, in referring to Vogt (1911), claims a tendency to melanism in the males of the population in Western Norway as a result of a survival of the last ice age (Würm) in refuges on the west coast. The present study of this non-arctic species disputes, however, the theory of Reinig. Geographic variations do not apply to the Scandinavian population, neither does a tendency to melanism necessarily favour a theory of interglacial survival. The recent distributional pattern, presenting a disjunction in the northern distributional area (Fig. 50) due to a single record in Finland, is, in my opinion, explained by post-glacial events only.

Biology

Nest. Nest entrances have been observed at the base of rocks, in between growth of *Aconitum septentrionale* (Koelle), in a tuft covered by *Vaccinium myrtillus* Linnaeus and always in sheltered, humid biotopes. The colonies are established below the surface of the ground, at various depths. Large colonies are produced. The meagre biological information (Friese & Wagner 1912; Reinig 1965, p. 117) may justify the following observations taken from notes of the late O. Meidell.

A nest, located in Stavanger 8 June 1934, was established in an abandoned mouse nest situated in between rocks in a levelled field at the base of a slope exposed to southeast. The entrance was hidden by grass and *Vaccinium myrtillus*. The nest cavity was about 20 × 20 cm and the nest material consisted of fragments of dry grass. No canopy covered the comb which was orderly arranged. The nest content is shown in Table I.

The nest was transferred to an observation box and the life inside the colony regularly watched until 24 July, when the colony was perishing. During this period a total of 11 more batches of broods were produced. The colony was, however, parasitized by unidentified Diptera and additionally a great number of larvae moulded. Table I reveals that during the observation period only 35 ♀♀ and 21 ♂♂ completed development. As many as 14 ♀♀ were raised from a single batch of 4th brood. No queens were raised, but the sex of the larvae in several batches remained unknown, as all individuals were parasitized and the cells successively cleaned of dead larvae by the workers.

As soon as an egg cell was built, a single pollen pellet was dropped by the queen into the cell before egg laying took place. Several pollen pellets were dropped in the latest built egg cells. One or two days after the larvae hatched, waxen pockets were built attached to the outer base of the batch. The founder as well as workers were observed scraping off their pollen-pellets by standing above or within the pollen-pocket, and immediately afterwards they eagerly stamped the pollen. The broods were left alone during the first larval stages and were later fed by workers regurgitating pollen into their cells. The pollen was then often taken from the pollen-pockets.

Even though the gap in time between the last emerging worker, viz. 26 June, and the first emerging male, viz. 4 July, may have been influenced by parasitism and moulding, the observation emphasizes the general development in a bumble bee colony (Table I). After production of sexual broods there is no more rearing of new

Table 1. Data from a colony of *B. w. mastrucatus* Gerstaecker excavated Norway: Rogaland (Ry): Stavanger: Stokke 8 June 1934 by O. Meidell and kept in observation box until 24 July 1934

Queen, founder of the nest			
Offspring 8 June:			
1st brood: workers	6	worker cocoons	6
2nd brood: worker	1	worker cocoon, 5 worker pupae	6
		3rd brood, 1st batch: 5 worker pupae	5
imagines	7	3rd brood, 2nd batch: 6 worker pupae	6
		4th brood, 1st batch: 9 worker larvae	9
		4th brood, 2nd batch: 14 worker larvae	14
		5th brood, 1st batch: eggs	?
		5th brood, 2nd batch: eggs	?
Total number of progeny			46 + eggs

1 honey-pot
Cocoons used as honey-pots
Offspring produced 8 June–24 July: 11 batches of broods
Imagines emerged 8–26 June: 35 workers
Imagines emerged 4–24 July: 21 males
Offspring present in the colony 24 July: 12 workers, 2 males, 0 pupae, a great number of moulded larvae, some healthy larvae and 2 batches of eggs

worker broods. The first male was, moreover, eagerly incubating until the nest was left on 10 July. The remainder of the males left the nest after a couple of days, several of which were also observed incubating.

The flight activity lasted during favourable weather conditions from about 4 a.m. to 10.30 p.m. which agrees with Løken (1949, p. 48), who moreover suggests that *B. w. mastrucatus* in general has a longer working day than other *Bombus* species occurring in the same area.

Flight season. From the beginning of May to the middle of September. Queen: 5 May–6 Sept.; worker: 5 June–13 Sept.; male: 14 June–11 Sept. The males were only once observed earlier than beginning of July.

SUBGENUS *KALLOBOMBUS* DALLA TORRE

Kallobombus Dalla Torre, 1880, p. 40, type-species *Bombus soroeensis* (Fabricius) by designation of Sandhouse (1943).

(Soroeensibombus Vogt, 1911, p. 63, type-species *Bombus soroeensis* (Fabricius) by monotypy.)

BOMBUS (KALLOBOMBUS) SOROEENSIS (FABRICIUS)

Apis soroeensis Fabricius, 1776, p. 246; Zimsen 1964, p. 415 No. 1077, lectotype ♀ CCC! selected by Løken (1966a), type loc. Denmark: Sjelland.

(Bombus soroeensis (Fabricius); Wahlberg 1854; Thomson 1870, 1872; Siebke 1880; Strand 1898a, 1898b; Friese 1902; Aurivillius 1903; Muchardt 1904; Bengtsson 1908; Sparre Schneider 1918; Meidell 1934a, 1946; Wexelsen & Skåre 1934; Løken 1949, 1950, 1958a, 1966c; Erlandsson 1950, 1960; Ander 1953a, 1963, 1965; Kruseman 1959; Elfving 1960, 1968; Fridén, Eskilsson & Bingefors 1962; Hasselrot 1962; Fridén 1967. *Apis neutra* Panzer, 1800–01, part 83 Teil 18, type not traced. *Bombus virginalis:* Dahlbom, 1832, p. 35 nec Geoffroy in Fourcroy 1785. *Bombus proteus* Gerstaecker, 1869, p. 325 No. 18, lectotype ♂ IZB! selected by Tkalcu (1969), type loc. Germany: Ober-Bayern: Kreuth. *Bombus hortorum* var. *soroeensis;* Siebke 1873.)

First Scandinavian records

Norway. Hedmark (HEs): Åmot (Siebke 1873).

Sweden. Skåne, Småland, Västergötland (Dahlbom 1832 cf. above).

Taxonomical remarks

The European population of *B. soroeensis* is generally divided into two geographically segregated groups, viz. the white tailed *B. s. soroeensis* and the red tailed *B. s. proteus* (Reinig 1939, p. 189ff). The border area of overlap unfortunately extends north to the type area, viz. Denmark: Sjelland (Fig. 51), where the population in addition to colour pattern typical for each of the two races presents all grades of intermediates, inclusive melanic forms. The type material happened to be melanic white tailed individuals (Løken 1966a), i.e. the type is an aberration of the yellow banded white-tailed form which therefore is the nominate form.

The species in Scandinavia is represented by the nominate subspecies. *B. s.* var. *laetus* Schmiedeknecht, 1878, considered as the main Norwegian form (Sparre Schneider 1918; Meidell 1934a; Løken 1950), is identical with the typical form. *B. s.* var. *rarus* Friese & Wagner, 1909, *B. s.* var. *bipunctatus* Friese & Wagner, 1909, *B. s.* var. *tricolor* Friese & Wagner, 1909, in addition to the designators mentioned for Scandinavia by Erlandsson (1950) and/or Løken (1950), are infrasubspecific forms.

Distribution

Fennoscandia. Cf. the subspecies.

World distribution. Europe (Western Europe except Ireland, Iceland, Greece; restricted to islets in NW Portugal (Yarrow in litt.), Spain, The Pyrenees, France, Italy and otherwise continuously distributed throughout central and northern parts of the continent to about 70° N in Scandinavia; Central European USSR) – Tunisia – Turkey – Iran – Caucasus – Transcaucasus – Southern Ural – Northern and Eastern Kazakhstan – Southern part of Western Siberia – Turkestan – Tien Shan – West of Lake Baykal – Northern Mongolia (Reinig 1939, p. 190; Panfilov 1957). The far more northern distribution in Europeen USSR (Dylewska 1957) disagrees with the statement of Panfilov (1957).

BOMBUS SOROEENSIS SOROEENSIS (FABRICIUS)

Queen, worker

Morphological characters. Head slightly longer than wide. Malar space transverse, at least exceeding 3/4 the distal width, longer than A_3 but shorter than A_{2+3}. Clypeus hardly or not longer than distal width, convex with rather dense distribution of punctures of various size except for a small impunctate area separating well-defined lateral impressions which are moderately punctured. Labral furrow shallow and narrow, the greatest width about 1/4 the labral width; the tubercles more or less punctured, anteriorly flattened or slightly raised; labral lamella inconspicuous, slightly or not wider than the furrow, with strongly curved margin. Mandible (Fig. 8A) without basal keel, without sulcus obliquus, with moderate to inconspicuous incisura lateralis and with most of basal area densely punctured. Eyes directed in front of posterior mandibular condyle. Ocellar-orbital field with impunctate area small and with the mainly fine punctured band broad and well-defined (Fig. 8B). Ocelli situated along an almost straight line, dorsally transected by supraorbital line in the upper half (usually in the lower half in workers) (Figs. 8C–D). A_3 at least $1\frac{1}{2}$ times longer than the distal width, markedly shorter than A_{4+5}. A_4 dorsally almost as long as A_5. Mid-basitarsus with distal posterior angle obtuse. Hind tibia with outer surface inconspicuously alutaceous and with dorsal inner distal angle slightly or not produced. Hind basitarsus almost parallel-sided, i.e. dorsal edge at most feebly curved, its dorsal distal angle rather acute (Fig. 8E). Surface of T_{2-5} smooth, rather evenly punctured. T_6 at least alutaceous at the basal half and with a small swelling just in front of the thickened apex. St_6 rather flattened, with inconspicuous distal keel. Coat rather even, wings evenly, moderately infuscate.

Queen measurements: N = 20; SE Norway; malar space: 0.55 mm (± 0.03 ± 0.01) range: 0.50–0.60 mm; 'radial length': 4.19 mm (±0.10 ±0.02) range: 3.90–4.30 mm; interalar width: 4.49 mm (±0.19 ±0.04) range: 3.95–4.90 mm. Body of medium to small size.

There is a distinct difference in size between the queen and the worker caste.

Colour pattern. Collar, extending to adjacent margin of episternum, and visible hairs of T_2 lemon yellow. T_{4-6}, lateral part of fringes of St_{4-5} whitish haired. Otherwise coat black.

Variation. T_1 with variable admixture of yellow hairs, occasionally entirely yellow-haired. Yellow band of T_2 more or less interrupted in the middle, i.e. yellow hairs replaced by a variable amount of black ones; additional black hairs often present at extreme anterior and posterior margins. Whitish hairs on anterior part of T_4 to various degrees replaced by black ones. Occasionally T_{4-6} clothed with yellowish-white or pinkish hairs. Sparre Schneider (1918, p. 13) indicates that only newly emerged individuals display a pale reddish to pink tail, but this colouring does occasionally occur also in older specimens.

Among a total of 9 ♀♀ and 2 ♂♂ preserved from a colony excavated in Rogaland county by the late Meidell, two females display a pronounced ferruginous colouring of T_{1-6}, a pattern approaching the yellow-banded variant of *B. soroeensis proteus*. A few queens, workers and males with colouring as this subspecies, were also examined from southernmost Sweden: Skåne: Surroundings of Hälsingborg, where typical and melanic white-tailed individuals occur as well, indicating the closeness of the intergrading area in Denmark.

Male

Morphological characters. Head about as long as wide. Malar space about as long as distal width, as long as A_{2+3}. Mandible bifid with a broad ventral and a small dorsal tooth. Eyes directed in front of posterior mandibular condyle. Antennae long, yet A_3 markedly shorter than A_5, equal to A_4 or barely longer; A_4 barely longer than distal width of the segment; A_{5-13} individually slightly bent and about twice as long as distal width (Fig. 23A). Outer surface of hind tibia flattened or slightly convex, with only sparse distribution of hairs of various length and with longest hairs in fringes about twice the greatest width of the segment. Hind basitarsus strongly narrowed towards the base (Fig. 23B), longest hairs in posterior fringe exceeding the greatest width of the segment. St_8 and genitalia as in Figs. 23C–D. Gonostylus, seen from above, about twice as long as wide; penis valve with distinct subapical tooth and with distal hooks turned outwards and produced into a point. Body of medium size.

Colour pattern. Pile of face black or with trace of yellow hairs admixed above and below the antennal sockets. Pile of vertex with variable mixture of yellow and black hairs. Collar, extending down entire episternum, T_{1-2} lemon yellow. Femora of all legs with variable mixture of yellow and black hairs. Posterior edge of T_4, T_{5-7} whitish. Coat otherwise black.

Variation. Venter of head with trace of yellow hairs. Femur of hind leg clothed with black hairs only. Whitish hairs of T_4 ranging from covering entire tergite to only the extreme posterior edge, occasionally whitish hairs replaced by pink or ferruginous ones, rarely T_4 entirely black. T_{5-7} with variable admixture of black hairs, T_7 occasionally with almost golden-brown hairs. A single black tailed specimen is examined. As mentioned above, also males of the *proteus* form occasionally occur in Sweden: Skåne: Hälsingborg area.

Distribution (Fig. 51)

Norway. Disperse, wide but local distribution throughout the country north to 70° N. Occurring from sea level to subalpine valleys and sporadically recorded in the lower alpine zone. In Southern Norway recorded 1050 m s.m.

Biotopes: Meadows, pastures, roadsides.

A total of about 1300 specimens was examined.

List of localities. *Östfold:* Hvaler: Asmalöy, Kirköy, Söndre Sandö; Onsöy: Rörvik, Torp; Sarpsborg: ZMO; Halden: VCA, Asak, Berg kirke, Blakkmose, Hakelund, Nordbakke, Sponvika, Veggesdal; Aremark: Gjeddetjern, Skodsberg, Stensbru; Marker: S Damholtet, Dypedal, Jåval, Rödenes; Rakkestad: Levernes, Rörvik; Råde: Fuglevik; Moss: Jelöy VCA; Trögstad: Bingen, Mönster bro, Båstad. *Akershus:* Ås: Vollebekk; Frogn: Degerud TRM, Dröbak VCA; Oppegård: Svartskog ZMO; Asker: Rustad, Sem; Bærum: ? loc. ZMO, Hövik ZMO; Oslo: NRS TRM VCA ZMB ZMO; Aurskog-Höland: Björklangen,

Mo; Fet: Björkflåten; Eidsvoll: Feiring. *Hedmark (HEs):* Eidskog: Bolfoss, Magnor SMS; Kongsvinger: Eidsberg; Hamar: ZMO. *HEn:* Åmot: Rena; Rendal: Solbakken SE Åsheim ZMO. *Oppland (Os):* Jevnaker: Randsfjord USU ZMB; Gran: Granvollen; Nordre Land: Dokka; Lillehammer: Jörstadmoen; Nord-Aurdal: Fagernes; Öyer: Aksjö 1000 m, Skåi, Steinseter 875 m, Öyer, Åstdalen 900 m; Ringebu: Ringebu. *On:* Vang: Öylo ZMO; Sel: Heidal kirke TRM ZMB, Leirflata 700 m; Vågå: Klones, Leirungen 1050 m, Skjerva-Jondalen 800 m, Vågåmo ZMO ZMB; Lom: Galdesand, Kvamme. *Buskerud (Bö).* Hurum: Filtvedt TRM, Storsand, Vannsbrekka; Lier: Drag, Lier; Krödsherad: Glesne. Veikåker; Modum: Modum TRM ZMO; Övre Eiker: Fiskum; Flesberg: Lampeland; Kongsberg: Komnes. *Bv:* Sigdal: Kopseng, Nedre Eggedal, Sigdal; Nes: Bergheim bro; Gol: Gol; Ål: ? loc. ZMO; Hol: Geilo 800 m VCA. *Vestfold:* Borre: Nykirke; Ramnes: Orrevål; Stokke: Langö; Nötteröy: Teie; Sandefjord: Austeröy, Årö; Hedrum: Hedrum; Tjölling: Tjölling; Larvik. *Telemark (TEy):* Nome: Tyri, Vommestöl; Drangedal:

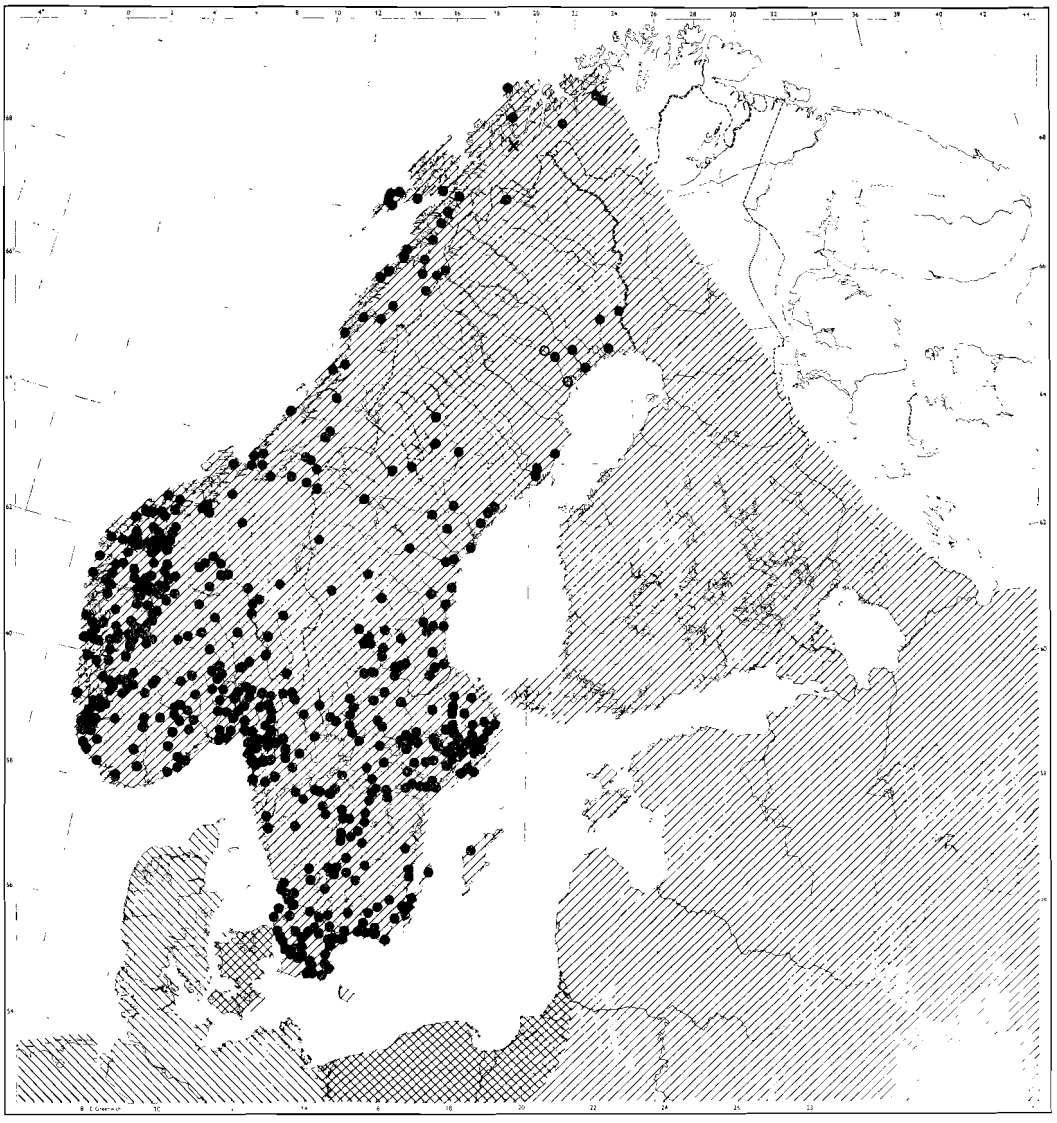


Fig. 51. *B. soroeensis* (Fabricius). Legend as in Fig. 50. Shaded areas outside Scandinavia refer to literature indications. Oblique up to the right: ssp. *soroeensis;* oblique up to the left: ssp. *proteus* Gerstaecker

Nos, Omnes, Tomyra. *TEi:* Notodden: Gransherad; Bö: Sauda; Seljord: Seljord, Vedfallsgrend; Kviteseid: Kviteseid, Vrådal; Nissedal: Treungen ZMO; Fyresdal: Hegglandsgrend, Moland; Vinje: Edland, Urdbö 700 m; Tinn: Våer, Vålen. *Aust-Agder (AAy):* Tvedestrand: Askeröy, Lyngör ZMO, Nes verk TRM; Tromöy: ZMB ZMO; Fjære: Fjære ZMO. *AAi:* Åmli: Krossbekk; Valle: Kvestad, Setesdal TRM, Rygnestad, Valle TRM ZMB; Bykle: Hovden. *Vest-Agder (VAy):* Marnadal: Finsland; Lyngdal: Lyngdal TRM. *VAi:* Åseral: Åseral. *Rogaland (Ry):* Soknedal: Hauge i Dalane, Vatland; Eigersund: Fotlandsvann; Bjerkreim: Ivesdal, Malmeim; Hå: Ogna, Fossfjellet; Klepp: Klepp; Gjesdal: Nese; Sandnes: Hommersåk, Todnheim, NW Ganddal; Sola: Solastrand; Stavanger: TRM ZMB, Lindöy; Finnöy: Sjernaröy; Rennesöy: Dale; Kalltveit; Karmöy: Vigsnes. *Ri:* Forsand: Lyse, Lysebotn, Meling; Hjelmeland: Fister, Hjelmeland, Årdal; Suldal: Bleskestadmoen 875 m, Bråtveit, Håvarstöl, Jonstöl 700 m, Kalltveit, Krokvassheia, Kyrkjesteindalen 800 m, Moen 600 m, Mostöl 600 m, Nesflaten, Roaldkvam, Sand, Sandsa TRM, Svortebekk, Vandvik, Våge, Åimjödlonuten 700 m; Sauda: Hellelandsbygd, Saudasjöen. *Hordaland (HOy):* Fitjar: ?loc.; Tysnes: Ånuglo; Os: Lysekloster, Mobergslia, Moldegård; Fusa: Övre Hålandsdal; Samnanger: Höyseter; Fana: Appeltun, Biol. st., Birkelundsbakken, Dolvik VCA, Fana kirke, Fantoft, Rådalen, Skjold, Steinsvik, Stend, Titlestad; Sund: Telavåg; Fjell: Selstö; Bergen: VCA ZMB ZMO; Asköy: ?loc. VCA, Ask, Herdla; Åsane: Golfbanen, Vinddalen; Osteröy: Greve, Kleppe; Vaksdal: Eidslandet. *HOi:* Etne: Oslandsvåg; Kvinnherad: Guddalsdalen, Prestvatn, Varaldsöy; Odda: Dalen gård, Odda, Röldal; Ullensvang: Aga, Börve, Djönno, Espe, Fossli 750 m, Fresvik, Grythorgi 900 m, Hjölmo, Jåstad, Kinsarvik, Kvanndal, Lofthus, Måbödalen, Nesheim, Sekse, Utne, Övre Eidfjord; Kvam: Kvamskogen, Nordheimsund, Valland, Vangdal, Viköy, Öystese; Voss: Bömoen, Hangursfjellet 800 m, Voss; Granvin: Eide VCA TRM, Trå; Ulvik: Rubbeliseter, Ulvik. *Sogn og Fjordane (SFy):* Hyllestad: Botn; Gulen: Midt-Takle; Höyanger: Lavik; Gaular: Slotten; Fjaler: Strandenes; Askvoll: Rauöy; Flora: Havrenesvåg; Naustdal: Övre Hella, Horstad; Förde: NE Flåten; Jölster: Hamar; Gloppen: Hope, Hyen, Lote, Lotsbergfjellet 700 m; Eid: Haugland, Heggjabygda, Kjölsdalen, Naustdal, Nordfjordeid, Vedvik; Vågsöy: Degnepollen. *SFi:* Vik: Ovrisdal 960 m, Skjellingen seter 1000 m, Vik; Aurland: Aurlandsdalen, Berekvam, Flåm, Gudvangen, Vassbygdi, Vatnahalsen 800 m; Lærdal: ? loc. ZMO; Sogndal: Kaupanger, Sogndal; Leikanger: Fosshagen, Hermansverk, Stavseter 780 m; Balestrand: Balholm NRS, Brekka, Flesje, Horpedalen, Kvamsöy, Mel, Mundalsdalen, Tuftedalen; Årdal: Årdalstangen; Luster: Dalsdalen, Fortun, Fåberg, Hafslo, Jostedalen NRS ZMB ZMO, Okkleviki, Skjolden, Urnes; Stryn: Briksdal, Flo, Gillesdal, Hornindal, Hornindalsætra, Mindresundet, Skåre, Stryn, Stöverstein, Vanberg, Videdalen, Övre Oldenvann. *Möre og Romsdal (MRy):* Volda: Björkedalsvann, Folkestad, Straumshavn; Örsta: Lyngstölvann, Urke, Öye; Ullstein: Vonheim; Ålesund: VCA, Åse; Örskog: Skodje ZMO, Örskog ZMO; Vestnes: Vikebukt; Molde: ZMO; Aukra: ? loc. *MRi:* Stranda: Bjordalsgårdene, Fivelstad, Geiranger NMW, Maråk, Nordaldalen, Vollset; Norddal: Valldal, Yttredal; Nesset: Nauste; Sunndal: Branstad, Jordalsgrend; Surnadal: Övre Surnadal. *Sör-Tröndelag (STy):* Hitra: Hamn; Agdenes: Lillevann SW Hambora; Rissa: ? loc. VCA, Sötvik; Örland: Hovde KMT. *STi:* Oppdal: Oppdal; Trondheim: KMT NRS ZMB. *Nord-Tröndelag (NTy):* Flatanger: Halmö TRM; Næröy: Skogenga. *NTi:* Meråker: Meråker; Stjördal: Hegra st.; Verdal: Stiklestad, Sulstua, Verdal, Vuku; Snåsa: Brönstad, Hegge. *Nordland (Nsy):* Sömna: Sandvåg TRM; Brönnöy: Rommelstö TRM; Alstahaug: TRM; Nesna: Hamaröy; Melöy: Kunna, Reipå; Gildeskål: Finnes, Gildeskål, Storvika; Bodö: Löpsviken, Planteskolen, Skau. *Nsi:* Hemnes: Finneidfjord; Rana: Rövassdal TRM; Saltdal: Drageid, Junkerdal; Fauske: Fauske, Kjeldvann BML, Sulitjelma BML. *Nnö:* Sörfold: Bonnåsjöen; Hammaröy: Sandnes; Tysfjord: Tysfjord kirke ZMO; Ballangen: Hesjeli. *Nnv:* Vestvågöy: Eggum, Haukland, Kvalnes, Skulbru, Stamsund; Vågan: Store Molla; Lödingen: Lödingen ZMO. *Troms (TRy):* Tromsö NRS TRM; Karlsöy: Hushattöy TRM. *TRi:* Balsfjord: ?loc. TRM; Nordreisa: Sappen. *Finnmark (Fi):* Alta: Bossekop ♀ Juni 1924 (A. Strand) TRM, Kåfjord ♀ Juni 1924 (A. Strand) TRM.

Correction. A worker specimen (Oppland (On): Dovre (Lysholm) NRS), labelled *B. soroeensis* var. *rarior* by Friese (Erlandsson 1950) is revised to *B. balteatus* Dahlbom. Moreover, no records confirm a distribution 'nordwärts bis zum Nordkap (Norwegen) . . .' (Friese & Wagner 1909, p. 28). Finnmark (Fv): Nordkapp is situated on the northernmost coast of Norway.

Sweden. Widely distributed throughout the country, but so far there are only a few records of this locally-occurring species from Lapland, and only a single specimen has in fact been collected as far north as T. Lpm.: Abisko, apparently owing to insufficient observations in forest biotopes.

A total of about 800 specimens was examined.

List of localities. *Skåne:* Barnakälla GNM, Björnstorp, Bokskogen, Brösarp, Bäckaskog, Bökeberg, Dalby, Fjelkinge, Glimminge, Hjularöd ZMB, Häggshult ZMB, Hälsingborg NRS VCA ZMB ZML, Häckberga, Hässleholm NRS, Ignaberga, Ilstorp, Klostersågen, Kullaberg, Kungshult, Kågeröd, Lund,

Löddeköpinge ZMB, Löderup, Maglehem NRS, Norra Melby ZMB, Norra Ugglarp, Nosaby, Pålsjö VCA, Raa, Sankt Olof NRS, Saxtorp NRS, Silvåkra, Simrishamn NRS, Skäralid, Skärnäs, Skånes, Södra Sandby, Sövdeborg ZMB, Torekov ZMU, Torup, Tvedöra GNM, Veberöd, Vitemölla NRS, Vånga, Ystad NRS, Örkelljunga NRS, Övedkloster, Åhus ZMB ZML. *Blekinge:* Karlskrona NRS, Möljeryd NRS, Mörrum, Ronneby NRS ZMB, Rödeby NRS, Sjöarp NRS, Sölvesborg ZMA ZMB, Torhamn NRS. *Halland:* Breared NRS, Enslöv NRS, Frösakull NRS, Getinge NRS, Halmstad, Laholm, Laxvik, Steninge NRS, Söndrum, Trönninge. *Småland:* Aneboda, Bergkvara NRS, Bränstorp, Emmaboda NRS, Eksjö NRS, Flisby NRS, Gasslanda, Gränna ZML ZMU, Hjorted NRS, Huskvarna NRS, Höreda NRS, Kalmar NRS, Lemnhult GNM, Ljungby, Markaryd, Nybro NRS, Osberg GNM, Oskarshamn, Påskallavik, Ryd NRS ZMB ZML, Smålandsstenar NRS, Sommen NRS, Tranås NRS, Villstad NRS, Vrigstad, Visingsö NRS, Värnamo NRS, Yxnanäs ZMA, Österkorsberga GNM ZMU. *Öland:* Böda, Ekerum ZMB, Hornsjö ZMB, Högsrum NRS, Kleveby, Mörbylånga NRS ZML, Skogsbyn. *Gotland:* Högklint. *Östergötland:* Borensberg ZMU, Gode gård ZMB, Krokek NRS, Kvarsebo NRS, Linköping ZMB ZML, Norrköping VCA, Rinna ZMB, Rystad, Stjärnorp ZMB, Skedevik NRS. *Västergötland:* Branstorp NRS, Gräs-torp NRS, Göteborg NRS, Höjentorp, Kymbo NRS, Leaby NRS, Skara GNM, Skinnarhult NRS, Skövde NRS ZML, Stenum NRS, Tengene NRS, Töreboda NRS, Vara, Vinninga NRS. *Bohuslän:* Bovallstrand NRS, Havstenssund NRS, Hunnebostrand NRS, Hålta NRS, Kareby NRS, Munkedal, Näverstad NRS, Rossöhamn NRS, Skee ZMB, Strömstad NRS ZML, Syd-Koster NRS, Tanumshed NRS, Ytterby NRS. *Dalsland:* Bengtsfors, Ellenö NRS, Gesäter ZMB, Köpmannebro, Rostock ZMB, Rörviken ZMB, Skåpafors NRS, Steneby GNM, Åmål NRS ZML. *Närke:* Askersund, Svennevad, Örebro NRS. *Södermanland:* Brandalsund NRS, Enhörna NRS, Fagersjö NRS, Fittja NRS, Helgarö, Muskö NRS, Mölnbo NRS, Nyköping NRS ZML, Nynäshamn NRS, Nävekvarn NRS, Oxelösund NRS, Rekarne NRS, Saltsjöbaden NRS, Salem NRS, Sparreholm NRS, Stockholm NRS, Stjärnhov NRS, Stora Sundby NRS, Svärdsö NRS, Tullinge NRS, Tunaberg NRS, Tyresö NRS, Uttran NRS, Utö NRS, Valla NRS, Vreta, Älta NRS, Ändebol NRS. *Uppland:* Almunge NRS, Angarn NRS, Brudnäs NRS, Dyvik NRS, Ekolsund NRS, Garnviken NRS, Gimo NRS, Hammarby NRS, Heby NRS, Häggeby NRS, Håbo Tibble NRS, Håtuna NRS, Kragsta NRS, Kungsängen NRS, Lennartsnäs NRS, Munsö NRS, Roslagen-Näsby NRS, Rydbo NRS, Rydboholm NRS, Rö NRS, Rådmansö NRS, Skokloster NRS, Stockholm NRS ZML ZMU, Stångberga NRS, Tälje NRS, Vendel NRS, Värmdö NRS ZML, Uppsala IVU NRS ZML, Östra Ryd NRS, Österskär, Österåker NRS ZMU. *Västmanland:* Arboga, Dingtuna NRS, Grindbo NRS, Guldsmedshyttan, Kvicksund NRS, Köping ZMB, Lindesberg NRS, Norbergklacken NRS. *Värmland:* Arvelsäter NRS, Arvika, Charlottenberg, Daglösen NRS, Eda NRS, Filipstad NRS, Grums NRS, Gustavsfors NRS, Gylleby NRS, Horrsjön NRS, Karlskoga NRS, Lesjöfors, Lungsund NRS, Långban NRS, Molkom NRS, Mölnbacka NRS ,Rottneros NRS, Rämmen, Storfors. *Dalarne:* Bingsjö NRS, Blyberg NRS, Brunnsvik NRS, Falun NRS, Floda NRS, Furudal ZMA, Hållstugan, Källslätten NRS, Leksand NRS Tje, Ludvika NRS ZML, Mora NRS, Nås NRS, Oxberg NRS, Rättvik NRS ZMA, Sandsjö, Siljanfors NRS ZML, Sjurberg NRS, Sollerö Tje, Stora Tuna, Sundborn, Särna, Tällberg NRS, Vikarbyn NRS, Västanvik NRS, Älvdal. *Gästrikland:* Gävle, Hille-Forsby NRS ZML, Ockelbo NRS ZMB, Trösken ZMB. *Hälsingland:* Bergvik, Bollnäs NRS, Delsbo, Fredrikfors NRS, Harmånger, Hudiksvall VCA ZMB, Kilafors, Söderhamn ZMB. *Medelpad:* Paljacka NRS, Skallböle NRS, Sundsvall NRS ZMB, Tuna NRS, Vifors NRS, Ånge. *Härjedalen:* Sveg, Tänndalen NRS ZML. *Jämtland:* Döda Fallet NRS, Mattmar, Ottsjön NRS, Ragunda, Storlien, Strömsund NRS. *Ångermanland:* Bjästa NRS, Bondsjö, Forsmo NRS, Härnösand, Ullånger NRS, Örnsköldsvik NRS. *Västerbotten:* Sikeå ZMB, Strömsör NRS, Västerhiske NRS. *Norrbotten:* Boden NRS, Kalix, Luleå, Älvsbyn NRS, Överkalix NRS, Övertorneå NRS. *Lapland (Ås. Lpm.):* Dorotea NRS, Vilhelmina NRS, Åsele NRS. *T. Lpm.;* Abisko ♂ 17 Aug. 1948 (Erl) NRS.

The species has been confused with *B. lucorum* and unrevised records were not included except the following: *Norrbotten:* Bredsel, Piteå (Ander in litt.).

Correction. A male from Lapland (T. Lpm): Bjørkliden (Kaiser) NRS (Erlandsson 1950) is revised to *B. lucorum*.

Finland. Occurring throughout the country north to nearly 64° N and in the western part reaching further north to Lapland (Erlandsson 1950; Elfving 1968).

The total distribution of the subspecies, B. s. soroeensis (Fabricius). Europe (British Isles except Ireland; Fennoscandia; Eastern Poland; the Baltic; Central European USSR) – Southern part of Western Siberia (Reinig 1939, p. 190).

Biology

Nest. Pollen-storer. Nest in the ground, producing rather small colonies (Hasselrot 1960, 1962).

Flight season. Middle of April to end of September. Queen: 16 April–1 Sept.; worker: 18 May –28 Sept.; male: 7 June–29 Sept.

SUBGENUS *BOMBUS* LATREILLE (s.s.)

Bombus Latreille, 1802a, p. 385, 1802b, p. 437. Proposed as a genus. Type-species *Apis terrestris* Linnaeus. Monobasic.

(*Bremus* Jurine, 1801, p. 164. Proposed as a genus. Type-species *Bremus terrestris* (Linnaeus) = *Bombus terrestris* (Linnaeus) by designation of Morice & Durrant, 1915. Generic name invalidated, Int. Com. Zool. Nomen., Opinion 135, 1939. *Leucobombus* Dalla Torre, 1880, p. 40, type-species *Bombus terrestris* (Linnaeus) by designation of Sandhouse (1943). *Terrestribombus* Vogt, 1911, p. 55, type-species *Bremus terrestris* (Linnaeus) = *Bombus terrestris* (Linnaeus) by designation of Frison (1927).)

Queen, worker

Head slightly shorter than wide, occasionally as long as wide. Malar space hardly to markedly shorter than distal width, about as long as A_3 (longer in *B. sporadicus* Nylander, just shorter than A_{2+3}). Disc of clypeus flattened anteriorly and just shorter than distal width, with rather dense punctures of various size throughout, with well-defined impressions produced inwards and almost meeting in the middle of anterior edge. Labral furrow well-defined, nearly one third as wide as labral width; labral tubercles deeply depressed (Fig. 12A), angled at inner end; labral lamella rather strongly curved (less so in *B. sporadicus*), slightly wider than furrow. Mandible without basal keel (indication of keel in *B. sporadicus*), with distinct sulcus obliquus and prominent incisura lateralis, being almost semicircular in unworn specimens. Eyes directed in front of posterior mandibular condyle. Supra-orbital line touching lateral ocelli or just transecting them dorsally. Mid-basitarsus with almost right rounded distal dorsal angle (Fig. 12C). Hind tibia feebly or not alutaceous, dorsal inner distal angle slightly to moderately produced; hind basitarsus about twice as long as greatest width of the segment (slightly longer in *B. sporadicus*), posterior edge more or less curved (Fig. 12D), longest hairs in posterior fringe markedly shorter than half the greatest width of the segment.

There is a distinct difference in size between the queen and the worker caste (Løken 1961a).

Male

Head slightly shorter than wide. Malar space hardly longer than distal width or equal to this width, longer than A_3 but shorter than A_{2+3}. Clypeus not longer than distal width. Mandible bifid with ventral tooth broader than dorsal one. Eyes directed in front of posterior mandibular condyle. Ocelli usually situated on a line. Antennae rather short, A_{5-13} individually 1½ times the distal width or hardly so, almost parallel-sided (Figs. 28A, 29A). Hind tibia slightly convex though outer surface flattened or somewhat impressed towards posterior margin, bare except for at most proximal third being covered with sparse hairs of various length; posterior and anterior fringes of the segment shorter than twice the distal width; posterior fringe of hind basitarsus shorter than distal width. St_8 and genitalia (Figs. 28B–D, 29B–D); gonostylus transverse with inwardly directed spine, penis valve twisted, distally convoluted, flaring.

Scandinavian species

The subgenus is represented by a total of four Scandinavian species, viz. *B. lucorum* (Linnaeus), *B. magnus* Vogt, *B. sporadicus* Nylander and *B. terrestris* (Linnaeus).

Taxonomical remarks

The four species present small sclerotic differences and display a fairly uniform yellow-banded colour pattern which mainly differs in the yellow shade, in details in the extension of yellow hairs and in the length of the hairs (Krüger 1950, 1954, 1956, 1958). Overlapping variations in diagnostic characters and fading of yellow hairs often prevent reliable determinations of workers and males. An exception is *B. sporadicus*, where sex and caste are identified by several stable features, cf. the description below.

The critical taxon is *B. magnus*, which was designated as a form of *B. lucorum* by Vogt (1911), given specific rank by Krüger (1954) and not recognized at all by Elfving (1960), Ander (1965, p. 138). According to Krüger (1954, p. 266) the female *B. magnus* is for one thing separated from *B. lucorum* by markedly broader yellow bands of which the collar band extends part way down episternum. A great number of such queens were traced in Norwegian and Swedish collections of *B. lucorum*. A total of 35 specimens were selected at random among those sorted out as *B. magnus* and the usual measurements, viz. malar space, 'radial length' and interalar width, were taken. Together with the corresponding data for *B. lucorum* and also for the remaining species involved, the percentage contribution to the sum of the three characters has been plotted on the graph (Fig. 52) to illustrate the interspecific relationship in the unit. The areas occupied by *B. terrestris*, *B. lucorum*, and *B. sporadicus* respectively confirm that they are well-defined species. Also the area occupied by *B. magnus* is well-defined but noteworthy. It is greatly intergrading with that of *B. terrestris* and *B. sporadicus*, but well separated from that of *B. lucorum*. Two more characters were therefore measured, viz. the distance from right ocellus to preoccipital ridge and likewise from the same ocellus to nearest eye (Fig. 4d–e). Body proportions based on these measure-

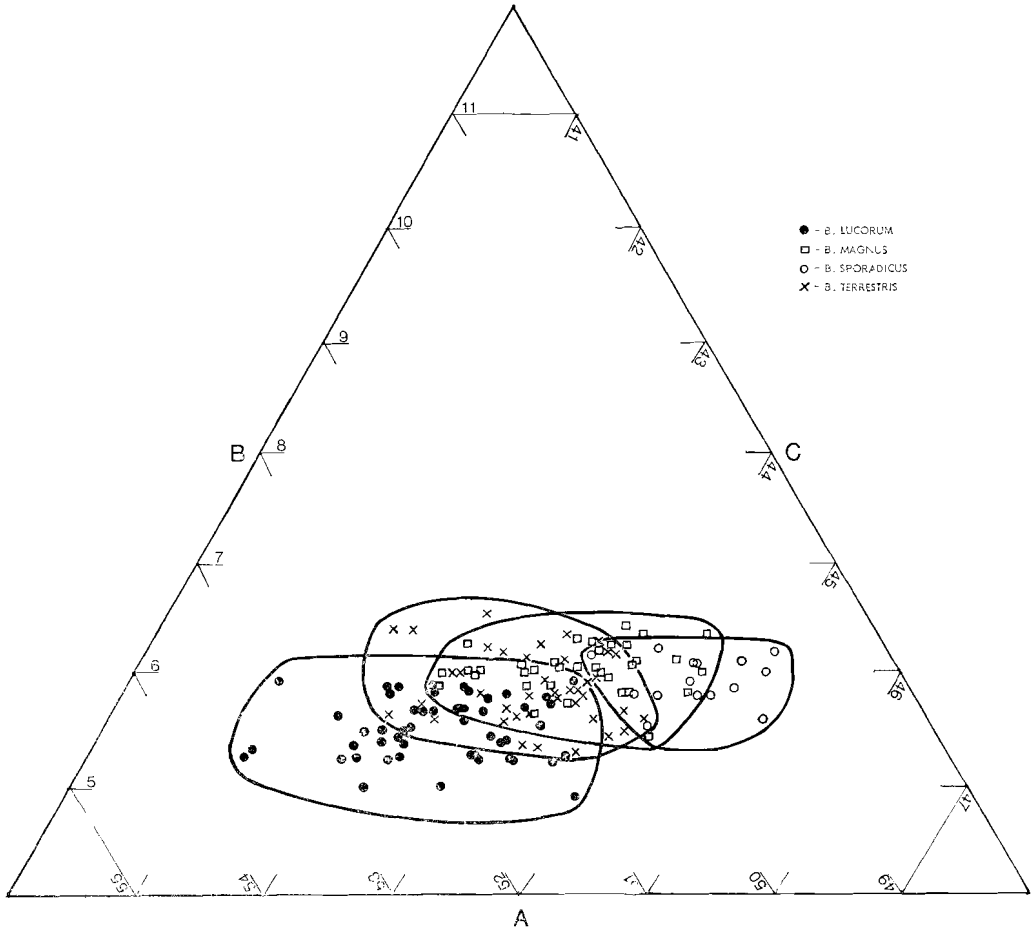


Fig. 52. Triangular graphing of malar space (A), 'radial length' (B) and interalar width (C) of four species of *Bombus* (s.s.).

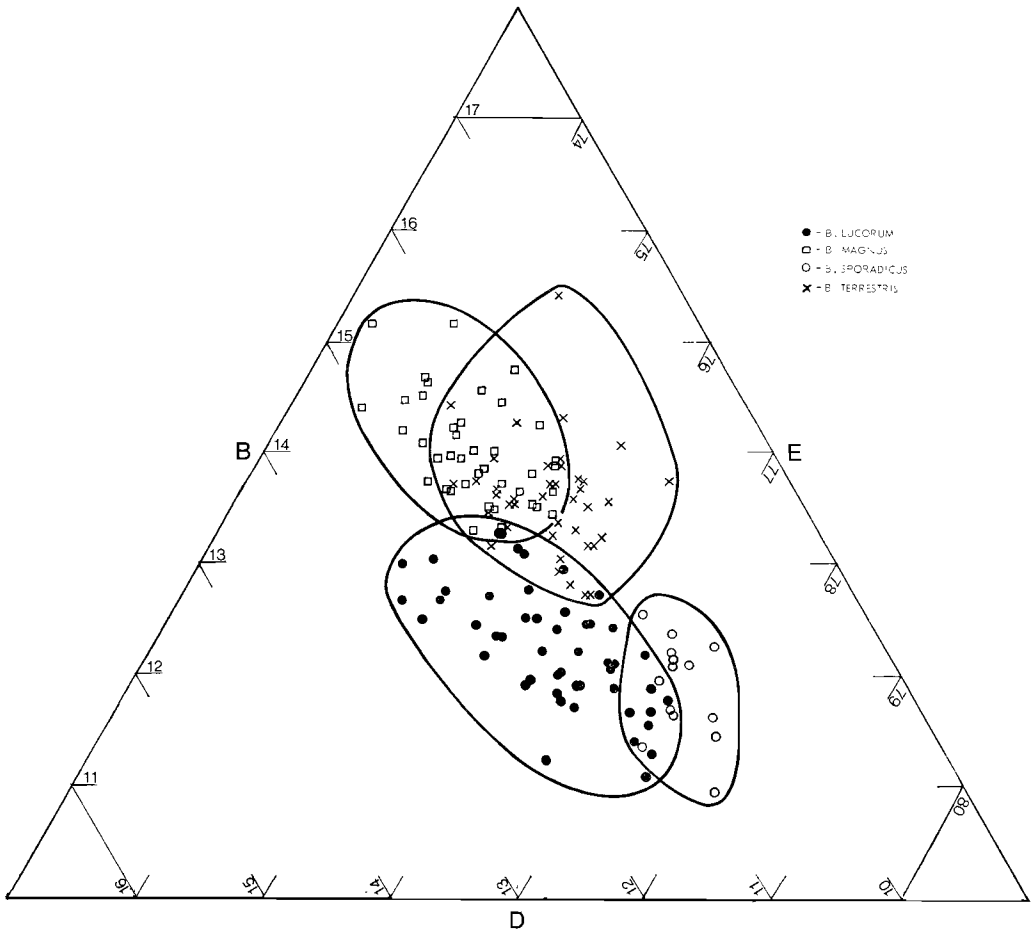


Fig. 53. Triangular graphing of 'radial length' (B), distance from lateral ocellus to preoccipital ridge (D) and distance from lateral ocellus to compound eye (E) of four species of *Bombus* (s.s.).

ments, together with those of 'radial length', give a better spreading of the markings (Fig. 53). Though again there is overlapping between *B. terrestris* and *B. magnus*, the area occupied by each of the four taxa is well-defined. The separate distribution of *B. lucorum* and *B. magnus* on either graph (Figs. 52–53) is of vital importance to indicate their specific difference, and thus confirms the statement of Krüger (1954).

As mentioned above, the queens of all four species were recognized whereas this was not the case in the males. I am in fact at present not able to distinguish *B. magnus* males. According to Krüger (1954) they are separated from *B. lucorum* males by longer hairs and certain details in the extension of yellow hairs, but owing to variability in those characters more information is needed. The Scandinavian *B. lucorum* males have so far been broadly separated into a 'dark' and a 'blond' form. Recent chemical analysis of odiferous compounds (Kullenberg et al. 1970) reveals however that each of the two forms, presented as *B. lucorum* 'dark' and *B. lucorum* 'blond', process different, characteristic secretion emanating from glands in the heads. This difference may favour a theory of two species being involved, i.e. the 'dark' form may refer to *B. magnus*.

B. terrestris males are in general distinguished from *B. lucorum* s.l. by several features, cf. the description below. In some specimens the diag-

nostic characters were too diffuse for separating the species with certainty. In this sex *B. terrestris* and *B. lucorum* are doubtless distinguished by the main component of the volatile content in the mandibular gland secretion (Bergström et al. 1968; Kullenberg et al. 1970).

Biology

The Scandinavian species in this subgenus produce in general larger colonies than those of the remaining subgenera (Dahlbom 1837; Thomson 1872; Hasselrot 1960, 1962; Løken 1961a; etc.).

BOMBUS (s.s.) *LUCORUM* (LINNAEUS)

Apis lucorum Linnaeus, 1761, p. 425 No. 1716, type area Sweden: Uppland. A male LSL! labelled *lucorum* agrees with the usual interpretation of the taxon.

(*Bombus terrestris* auctt. nec Linnaeus; Sommerfelt 1824–27; Dahlbom 1832, p. 34 (partim), 1837 (partim); Zetterstedt 1838; Boheman 1844, p. 95; Siebke 1853, 1863, 1870, 1873, 1880; Wahlberg 1854 (partim), 1855 (partim); Thomson 1870 (partim), 1872 (partim); Schøyen 1881; Aurivillius 1887, 1903; Sparre Schneider 1889, 1895b, 1906, 1909, 1910, 1918; Strand 1898a, 1898b, 1901, 1904; Lie-Pettersen 1901, 1905, 1907; Bengtsson 1904, 1908, 1931; Ringdahl 1915, 1921 (partim); Wahlgren 1915 (partim); Jansson 1922 (partim), 1925; Lundblad 1924; Soot-Ryen 1925; Gaunitz 1929; Hellén 1933; Meidell 1934a, 1946; Wexelsen & Skåre 1934. *Bombus lucorum* (Linnaeus); Dahlbom 1832, p. 42; Bengtson 1908; Meidell 1934a, 1946; Jansson 1935; Brinck & Wingstrand 1949; Løken 1949, 1950, 1958a, 1960, 1966c; Brinck 1951; Krüger 1950; Ander 1953a, 1953b, 1963, 1965; Kruseman 1959; Elfving 1960, 1968; Fridén, Eskilsson & Bingefors 1962; Hasselrot 1962; Fridén 1967. *Apis cryptarum* Fabricius, 1775, p. 379 No. 6, lectotype ♀ KCC! designated by Løken (1966a), type area Denmark: Copenhagen. *Bombus lucorum arcticus* Krüger, 1958, p. 324 nec Kirby, 1821 nec Dahlbom, 1832.)

First Scandinavian records

Norway. Nordland (Nsi): Saltdal (Sommerfelt 1824–27). Though there is no voucher specimen, the identification is considered correct as the species occurs abundantly in the area.

Sweden. Uppland (Linnaeus 1761).

Taxonomical remarks

The references above reveal that the Scandinavian population of *B. lucorum* in the past has been confused with *B. terrestris* cf. also taxonomical remarks to the latter. According to present revision those references may also include *B. magnus* Vogt.

The Scandinavian population belongs to the nominate subspecies. *B. lucorum arcticus*, designated to the northernmost population in Norway (Krüger 1958), cannot be recognized. It is described as a race which differs from the nominate form by broader yellow collar, narrower yellow abdominal band and longer coat. The present study indicates no tendency to geographic variations throughout Scandinavia. According to Sparre Schneider (1918, p. 11) the arctic specimens are 'mehr zottig behaart'. Though the hairlength is not measured, a slight clinal increase on going north does not alone favour a subspecific designation. *B. lucorum* var. *cryptarum* (Sparre Schneider 1918; Meidell 1934a) is a sporadically occurring infrasubspecific form.

Queen, worker

Morphological characters. Malar space shorter than distal width. Ocellar-orbital field (Fig. 13A), usually without but occasionally with 1–4 punctures in the anterior lateral sinuosity of the bare area. Distance from lateral ocellus to preoccipital ridge (d) hardly longer than distance from ocellus to eye (e) or equal to this length, mean d : e = 1.06; distance between ocelli varies, but is usually not shorter than $^2/_3$ the diameter of median ocellus. A_3 about $1\frac{1}{2}$ times the distal width and about $^2/_3$ the length of A_{4+5}. T_2 moderately to densely punctured, the puncturing less coarse than in *B.*

magnus, usually with chagrinated microsculpture also in the median posterior part of the disc. Inner sting sheet (Fig. 13B) markedly narrower than in *B. terrestris* (Fig. 12E). Dorsum of thorax with moderately long, somewhat uneven coat. Body less robust than in *B. terrestris* and *B. magnus*, wings rather infuscate.

Queen measurements: N = 20; Hordaland (HOy); malar space: 0.59 mm (±0.02 ±0.01) range: 0.55–0.65 mm; 'radial length': 4.45 mm (±0.14 ±0.03) range: 4.10–4.70 mm; interalar width: 5.40 mm (±0.17 ±0.04) range: 5.03–5.73 mm; body of large size.

Colour pattern. Collar, extending to the extreme adjacent margin of episternum, and T_2 except at base, lemon yellow. Hairs of distal half of T_4, entire T_5, variable part of T_6 and at least lateral fringes of St_{1-5} whitish. Otherwise coat black.

Variation. Yellow collar varying in width and rarely reduced to an inconspicuous band. Yellow band on T_2 also varying in width according to a variable amount of black hairs at base and distally. Occasionally the extreme posterior part of scutellum and median part of T_1 with a slight admixture of yellow hairs. The shade of the colour fades and therefore ranges from bright lemon yellow to yellowish-white. Occasionally corbicular fringes tipped whitish. Completely melanic specimens rarely recorded. Workers occasionally with black hairs of thorax whitish tipped.

The diagnostic characters are in the worker caste often too diffuse for reliable identification, i.e. a number of specimens cannot be distinguished from *B. magnus* or faded *B. terrestris*.

Male

Morphological characters. Area between eye and preoccipital ridge just outside genal furrow with rather distinct uneven mainly coarse puncturing. Ocelli dorsally transected by supra-orbital line. A_3 markedly longer than A_4, equal in length to A_5 or nearly so. T_7 usually not impressed distally. St_{7-8} and genitalia difficult to distinguish from those of *B. terrestris* (Fig. 29B–C); considering the variability in the shape of distal margin of St_{7-8} and slight variations in details of gonostylus, volsella, penis valve, etc. the specific differences in the features become indistinct, though genitalia of *B. lucorum* are usually less strongly chinitized than in *B. terrestris*. Coat in general longer than by *B. terrestris*, that of thorax more uneven. Body of medium to large size.

Colour pattern. The coat displays a colouring ranging from distinct to pronounced diffuse pattern. When distinct, pile of face black or with only singly yellow hairs admixed, T_{6-7} whitish haired, fringes of sternites mainly whitish, pile on femora, tibia with a mixture of black and whitish; otherwise pattern as in the female. This 'dark' form is usually separated from *B. terrestris* by the yellow band being of a paler shade, in newly emerged specimens usually lemon yellow, and by the white hairs of T_4 covering less than the posterior half of the segment. In the 'blond' form pile of face below and above antennal sockets, pile of vertex pale to lemon yellow with variable admixture of black; yellow collar often extending part way down episternum; hairs of scutellum and T_{1-2} predominantly or entirely yellow; black hairs on thorax and gastral tergites more or less whitish tipped; coat of venter whitish. Specimens of the 'blond' form were traced in *B. sporadicus* collections.

Variation. In addition to the variations mentioned above, collar varies in width and may continue all way down episternum; only rarely is collar reduced to a very narrow band. The pattern in the 'blond' form becomes particularly diffuse when black and yellow hairs are more or less replaced by greyish-white ones. The 'blond' form usually has a more shaggy coat than the 'dark' form.

Remarks on the description of males. As mentioned above more information must be gained to distinguish *B. magnus* and *B. lucorum* and one or several of the features above may be related to one of the species only.

Distribution (Fig. 54)

Norway. Abundantly distributed throughout the entire country, yet only occasionally observed in *reg. alpina*. In Southern Norway recorded to 1300 m s.m.

Biotopes: *Salix* biotopes, meadows, gardens,

orchards, *leguminosae* fields, pastures, *Calluna* heaths, *Vaccinium* heaths, mountain meadows etc.

A total of about 3350 specimens was examined.

List of localities. *Östfold:* Hvaler: ?loc. ZMO, Asmalöy, Herföl, Kirköy, Söndre Sandö; Kråkeröy: Tangen, Ödegård; Onsöy: Dypeklo, Lervik, Ramseklo, Rörvik, Torp; Fredrikstad: ZMO; Sarpsborg: ZMO; Halden: Asak, Blakmose, Hakelund, Halden NRS. Nordbakke, Sponvika, Veggesdal; Aremark: Aremark, Gjeddetjern; Rakkestad: Levernes, Rörvik; Marker: Damholtet, Dypedal, Rödenes, Örje; Varteig: Tomte SMS; Råde: Oven, Tom; Moss: Jelöy; Eidsberg: Holm; Trögstad: Bingen, Fransrud, Mönster bru, Vassbotn, Åsen. *Akershus:* Ås: Vollebekk; Frogn: Degerud TRM, Hallangen; Oppegård: Svartskog ZMB ZMO; Nesodden: Berger ZMO; Asker: Asker st., Brönnöy, Heggedal, Rustad; Bærum: Bråtan, Lysaker, Överland; Oslo: NMW TRM ZMB ZMO; Rælingen: Fjærdingsby; Aurskog-Höland: Björklangen, Gangsnes, Mo, Skogen, Östegård; Fet: Björkflåten, Fjellsrud; Skedsmo: Strömmen ZMO; Nes: Grinkelsrud, Vormsund; Eidsvoll: Feiring; Hurdal: Tömte ZMO. *Hedmark (HEs):* Eidskog: Bolfoss, Gjelaråsen; Kongsvinger: Eidsberg; Sör-Odal: Mårud ZMO; Stange: Sollia; Hamar: ZMB ZMO, Helgöya ZMO; Ringsaker: Vea. *HEn:* Trysil: Enga, Vestby; Åmot: Rena; Storelvdal: Nesset; Alvdal: Alvdal st.; Folldal: Dalen 800 m; Tynset: Tynset st., Ulsberg; Engerdal: Ånstjern, Risbakken. *Oppland (Os):* Jevnaker: Randsfjord USU; Gran: Granvollen, Korshagen; Östre Toten: Bilitt, Dal, Hvem, Skreia, Stubdalen; Nordre Land: Dokka USU, Torpa, Åmot; Lillehammer: Jörstadmoen, Lillehammer; Sör-Aurdal: Briskvollen 950 m, Ellingseter 820 m, Reinli, Skard; Nord-Aurdal: Fagernes, Hovda, Sæbuöygard, Åbjör; Gausdal: Gåsöya 875 m; Öyer: Aksjö 1000 m, Skåi, Steinsetra 875 m, Öyer ZMA ZMB, Åstdalen 900 m; Ringebu: Flaksjöen 910 m, Venabygd. *On:* Vestre Slidre: Kinnholt 1000 m, Storhögda 1050 m, Ölken; Öystre Slidre: Skammestein; Vang: Grunke 950 m, Tyin 1100 m USU ZMB, Öye USU; Sel: Leirflata, Mysuseter 900 m; Vågå: Gjendesheim 1000 m, Hindseter 900 m, Klones, Leirungen 1050 m, Randsverk 800 m, Sjodalsbu 950 m, Skjerva 900 m, Vågåmo ZMB ZMO, Övre Sjodalsvann 900 m; Lom: Elveseter, Galdesand, Gjendebu 1000 m, Leirdalen 900 m, Solell 1200 m; Skjåk: Polfoss; Dovre: Dovrefjell 1000 m ZMB ZML ZMO, Fokstua 930 m ZMB ZMO, Vålåsjö ZMO. *Buskerud (Bö):* Hurum: Filtvedt TRM, Pinadalen; Röyken: Åros; Lier: Drag, Lökke gård, Sylling, Toverud; Ringerike: Hen ZMO; Krödsherad: ?loc. ZMO, Glesne, Veikåker; Modum: ? loc. ZMO, Snarum; Flesberg: Hvila, Lampeland, Öydegarden; Kongsberg: Komnes, Lintvedt, Skollenborg. *Bv:* Sigdal: Flågan, Haglebu, Kopseng, Nedre Eggedal, Nordbygda, Sigdal; Nore og Uvdal: Gavlenseter 1120 m, Nörstebo, Rödberg, Solheimstul 1000 m, Sönstevann 1050 m, Tunnhovd 850 m, Uvdal, Uvdal stavkirke, Övre Hein 1160 m; Gol: Gol, Holteliseter 900 m, Raudalseter 940 m; Hemsedal: Holli bru, Kjölen 1000 m, Lykkja 900 m, Muren; Ål: ?loc. ZMO, Bergsjö 1100 m, Tvist 1080 m, Votnedalen; Hol: Geilo 800 m, Haugastöl 1000 m, Hol kirke, Hovet, N Lillevann 1150 m, Nygård 1000 m, Ustaoset 1000 m. *Vestfold:* Sande: Sande; Hof: Hof ZMO; Borre: Nykirke; Våle: Ryk; Ramnes: Kjær, Lunde, Orrevål; Lardal: Styrvoll; Andebu: Andebu, Kodal: Stokke: Langö, Sand, Sannåsen; Nötteröy: Teie; Tjöme: Kjære; Sandefjord: Austeröy, Årö; Hedrum: Hedrum, Kvelde; Brunlanes: Dolven, Helgeroa, Tronsröd; Larvik. *Telemark (TEy):* Skien: Kikut, Skien; Porsgrunn: Langangen, Mule, Nystrand; Bamble: Brevikstranda, Trosby, Åby; Drangedal: Nordbö, Nos, Omnes, W Sannidal, To-myra; Krageröy: Berg, Levang. *TEi:* Notodden: Elgsjöen, Tinnoset; Bö: Sauda; Seljord: Nörsteteig 720 m, Svartdal, Vedfallsgrend; Kviteseid: Eidstad, Kviteseid, Vrådal; Nissedal: Kyrkjebygda, Lauvviki, Lia, Tjönnefoss, Treungen ZMO; Fyresdal: Hegglandsgrend, Moland, Veum; Tokke: Grimdalen, Vråliosen, Åmdals verk; Vinje: Bossböen, Kromvika, Krossen, Åmot; Tinn: Börsjöen 1150 m, Miland, Mösvatndammen 900 m, Våer, Vålen. *Aust-Agder (AAy):* Gjerstad: Fiane; Risör: Nistevåg, Risör; Vegårdshei: Ljöstad, Vegerstöl; Tvedestrand: Askeröy, Boröy, Dypvåg TRM ZMB, Eidbu, Fianesvingen, Lyngör ZMO, Nes verk TRM, Skipvik ZMO, Stensöy ZMO, Strengereid, Österå; Arendal: ZMO, Salteröd; Moland: Hannholmen, Holmsund, Kilsund, Staubo, Tverrdalsöy, Voje; Tromöy: ZMB ZMO; Hisöy: ?loc. ZMO, Flödevigen, His; Fjære: ? loc. ZMO; Grimstad; Öyestad: Björbekk, Helle, Rykene; Landvik: Forsöksgården, Homborsund, Hörte, Molland, Tönnesöl; Lillesand: Hövåg, Kjöstvedt, Kvåse, Ulvöysund, Åmli; Birkenes: Birkeland, Langemyr, Sagen, Svaland; Iveland: Frikstad, Ivedal. *AAi:* Evje og Hornes: Hornes, Lauvland, Syrtveit; Åmli: Gangsei, Gjövdal, Saurbekkflåt, Smedland, Årli; Bygland: Löndal, Ose; Valle: Hylestad, Kvestad, Rygnestad, Valle TRM ZMB; Bykle: Breive 700 m, Breivann 900 m, Hovden. *Vest-Agder (VAy):* Kristiansand: Buane, Erkleiv, Kristiansand ZMO, Kro-odden, Strömme; Vennesla: Hægeland, Övrebö ZMO; Sögne: Langeneset, Sögne, Åros; Mandal: Mandal, Ramsö TRM, Sånum, Trægde; Marnadal: Ask, Utkjær; Lindesnes: Lindesnes; Lyngdal: ?loc. TRM; Kvinesdal: Gjemlestad, Öye; Farsund: Fjelleså, Lista fyr, Lodshavn, Ore, Tjörve, Vanse, Östhassel; Flekkefjord: Ersdal, Flikkeid SMS, Haugbom, Langevann, Sandvann, Solvang. *VAi:* Audnedal: Sveindal; Åseral: Espelid, Rosseland, Åseral; Sirdal: Dorgeseter, Dyngefjell 800–900 m, Sinnes, Ådneram. *Rogaland (Ry):* Lund: Eikjelandsdalen, Ljosvann, Moi; Sokndal: Bu, Hauge, Nesvåg, Rekefjord, Sogndal, Åmot; Eigersund: Eigeröyeidet, Fotlandsvann, Nedre Hetland; Bjerkreim: Asseimvann, Hovland, Ivesdal, Malmeim; Hå: Anisdal, Fossfjellet, Nærland, Ogna, Salte bru, Stölen, Söyland; Klepp: Bore bru, Börsheim, Gjeishaug, Klepp,

Orre, Orrevann, Orstad, Reve, Revtangen, Vik, Øksnevad; Sandnes: Brattebö, Bråstein, Dale, Flöysvik, Ganddal, Helgeland, Håpet, Höyland kirke, Riska; Sola: Gimre, Joa, Kolnes, Solastrand, Ölbergstranda; Randaberg: Kverneviken SMS, Sande; Stavanger: Auklendhöyden, Hinna, Lindöy, Stavanger SMS TRM ZMB; Finnöy: Sjernaröy; Rennesöy: Dale; Kvitsöy; Karmöy: Brekkevann, Indre Eide, Skudesneshavn, Vigsnes; Haugesund: SMS. *Ri:* Forsand: Forsand, Lysbotn, Lyse, Meling, Songedalen; Hjelmeland: Fister, Hjelmeland, Steinslandsvann, Årdal; Suldal: Bleskestadmoen, Bråtveit, Jelsa, Jonstöl, Kyrkjesteindalen, Leirdalen, Nesflaten, Mostöl, Roaldkvam, Sand, Sandsa TRM, Suldalsosen, Ullsneskvelen, Åimjödlonuten; Sauda: Birkeland, Hellelandsbygda, Sauda, Saudasjöen, Slettedalsvann, Övre Sandvann 1050 m. *Hordaland (HOy):* Bömlo: Goddö, Rolfsnes, Spissöy, Sörstokka; Ölen: Dommersnes; Stord: Föynöy, Storsöy; Fitjar: Agöy, Brendöy, Fitjar, Kolöyholmen, Risöy, Rubbestadnesset, Slåtteröy; Tysnes: Ånuglo; Austevoll: Ytteröy; Os: Forströno, Gullholmen, Lysekloster, Midtsetra, Mobergslia, Nordströno, Röd, Ulven; Samnanger: Höyseter; Fana: Biol. st., Birkelundsbakken, Blomster-

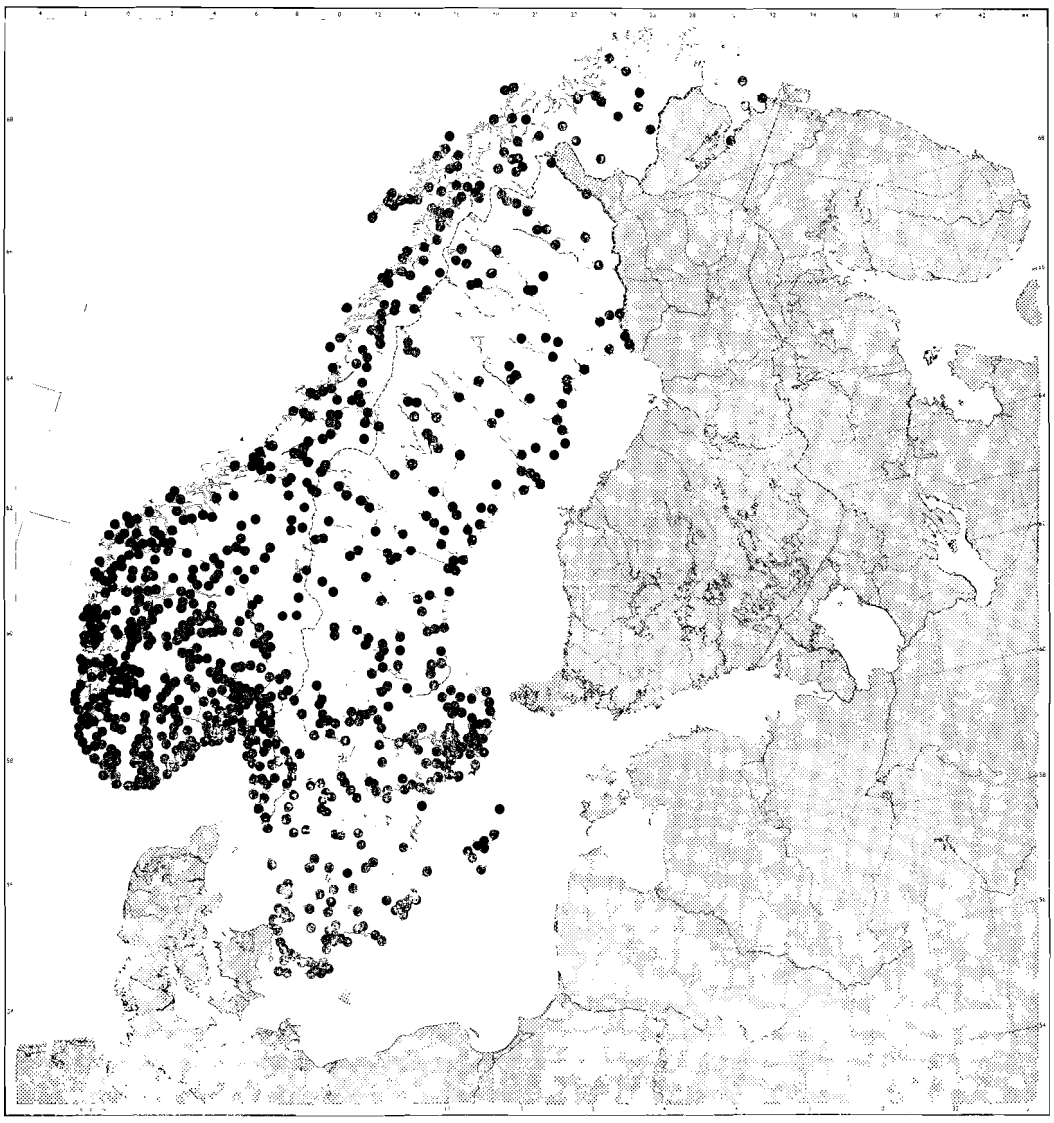


Fig. 54. *B. lucorum* (Linnaeus). Legend as in Fig. 50. Shaded areas refer to literature indications and comprises one or more subspecies.

dalen, Eggholmen, Fana kirke, Fantoft, Hamre, Hatlestad, Hjellestad, Korsnes, Mariholmen, Milde, Minde, Myravann, Rådalen, Saganes, Skeie, Skipanes, Skjold, Steinsvik, Stend, Storetveit, Sælöy; Sund: Bjelkaröy, Bokken, Leröy, Steinsland, Telavåg; Fjell: Bjoröya, Dala, Fossavann, Litleholmen; Laksevåg: Björndalspollen, Hilleren, Storingavika; Bergen: TRM ZMB; Asköy: Davanger, Hanöytangen, Herdla, Jacobsöy, Juvik, Lamöy; Åsane: Eidsvåg, Furubotten, Haukedal; Osteröy: Fotlandsvåg, Garnes, Havratun, Kleppe, Kvamme, Njåstad, Storevann; Vaksdal: Eidslandet; Meland: Brakstad, Dalstö, Landsvik, Meland, Setre; Öygarden: Ljosöy; Radöy: Kvalheim, Rosnesset; Lindås: Fyllingsnesset, Særvråsvåg. *HOi:* Etne: Frette, Oslandsvåg; Kvinnherad: Berget, Brandvikshorgi, Fjellhaugvann, Ljosmyr, Rosendal, Seimsfoss, Skeie, Yttre Netland; Odda: Austmannli 800 m, Breifonn, Dalen, Hordasvingene 1000 m, Mittlæger 1085 m, Odda, Röldal, Seljestad, Svandalsflona 1000 m, Valldal; Ullensvang: Aga, Berdöla, Djönno, Espe, Fossli, Fresvik, Hesthammer, Kinsarvik, Kvalvik, Lofthus, Måbödalen, Sekse, Skutenes, Tveito, Utne, Övre Eidfjord; Kvam: Kvamskogen, Nordheimsund, Steine, Valland, Viköy, Ålvik USU ZMB; Voss: Armot, Bulken, Bömoen, Hangurfjellet 800 m, Hjelle, Mjölfjell, Rong, Vikafjellet 1000 m, Voss; Granvin: Eide, Trå; Ulvik: Bergo, Löyningseter, Rubbeliseter, Ulvik. *Sogn og Fjordane (SFy):* Gulen: Innre Takle; Hyllestad: Eide, Hatleim, Hyllestad, Skivenes, Yttre Dale; Höyanger: Holmen in Fuglesetfjorden, Lavik ZMB ZMO; Gaular: Bygstad, Vikum; Fjaler: Dale, Strandenes; Askvoll: Einen, Raudöy; Flora: Askrova, Heia, Trollstua; Naustdal: Frammarsvik, Horstad, Övre Hella; Jölster: Lunde, Vassenden; Gloppen: Hope, Hyen, Lotsbergfjellet 700 m, Sandane; Eid: Haugland, Heggjabygda, Nordfjordeid; Vågsöy: Kråkenes, Refvik; Selje: Ervik. *SFi:* Vik: Hestavollen 1000 m, Håvås, Vik; Aurland: Aurlandsvangen, Berekvam, Flåm, Gudvangen, Kvamshagene, Nedre Aurlandsdal, Vassbygda, Vatnahalsen 800 m; Lærdal: Eggjestölen 700 m, Gröte, Lærdal ZMO, Maristova, Ystabö; Sogndal: Slinde, Sogndal; Leikanger: Hermansverk, Suphamar; Balestrand: Brekka, Flesje, Fjærland, Horpedalen, Kvamsöy, Mundalsdalen, Suphellen, Suphellesetra, Tuftedalen; Årdal: Holsbruvann 750 m; Luster: Skjolden; Stryn: Briksdal, Hornindal, Hornindalsetra, Skåre, Stryn, Videdalen, Videseter 700 m. *Möre og Romsdal (MRy):* Vanylven: Thue; Volda: Björkedalsvann, Folkestad; Ulstein: Ulsteinvik, Vonheim; Heröy: Djupsvik, Runde, Stokksund; Ålesund: Åse; Vestnes: Gjermundsnes, Vikebukt; Molde; Aukra: Aukra kirke, Kolsholmen, Seter; Fræna: Bud, Hollinholm. *MRi:* Örstad: Lyngstölvann, Urke, Viddal, Öye; Stranda: Bjordal, Fivelstad, Kvanndalsetrene 700 m, Maråk, Norangdalen; Norddal: Indreeidet, Valldal; Rauma: Veblungsnes, Åndalsnes NMW; Nesset: Nauste; Sunndal: Dalen; Surnadal: Melhus, Stangvik, Övre Surnadal. *Sör-Tröndelag (STy):* Hitra: Hamn; Agdenes: W Hambora; Rissa: Gafsetåsen, Hasselvika, Stadsbygd, Sötvik; Örland: Bakken; Bjugn: Kotengsvann; Åfjord: Mörreaune, Å. *STi:* Oppdal: Driva st., Gåvåli 975 m, Knutshö 1100–1300 m BML ZMB, Kongsvoll 900 m TRM ZMB ZMU, Oppdal st.; Ålen: Reitan; Röros: Myrmoen 700 m, Röros; Tydal: Sakrismoen; Selbu: Medbus, Selbu KMT; Trondheim: KMT TRM VCA ZMB ZML. *Nord-Tröndelag (NTy):* Flatanger: Bjoröya KMT, Einvik KMT; Namdalseid: Hovika KMT; Namsos: TRM; Næröy: Breiviken, Dalene, Kolvereid, Kvalviken, Saltbotn, Teplingan; Vikna: Rörvik. *NTi:* Meråker: Tovmodal, Vardetun; Stjördal: Draveng, Hegra st., Lånke; Leksvik: Storvann; Verdal: Billingflaten, Innsvann, Sandvika, Stiklestad, Vergåen KMT, Vuku; Inderöy: Kirkenesvåg, Skjelvågen; Steinkjer: Mære, Sem, Steinkjer VCA; Grong: Ekkerseter, Fjerdingen, Grong SMS, Trangen; Snåsa: Brönstad, Telnes; Lierne: Kvelia, Seterhaug, Valand KMT; Höylandet: Höylandet, Skilleberget, Skogenga; Namskogan: Brekkvasselv KMT, Finnvollan, Namskogan VCA ZMB, Äktejävre. *Nordland (Nsy):* Sömna: Sömnes TRM; Vega: TRM; Heröy: Syd-Heröy TRM; Luröy: Lovund TRM; Melöy: Glomfjord, Kunna, Reipå, Spilderen; Gildeskål: Finnes, Gildeskål kirke, Gilset, Inndyr, Jelstad, Skauvoll, Storvika; Bodö: BML ZMB, Elveleiet, Falkflaugdalen, Löpsviken, Planteskolen, Skau, WValnesvann, Uskarsdalen. *Nsi:* Grane: Grane, Majavann, Rotstokkmobekken; Vefsn: Luktvann, Ravasbakken, Ravnå ZMO; Hemnes: Bleikvassli, Finneidfjord, Korgen, Krokselvmoen, Strömbotn; Rana: Krokstrand TRM, Langvassgrend TRM, Rösvollheien, Rövassdal TRM, Åenget; Beiarn: Gråtådalen; Saltdal: ? loc. TRM ZMO, Junkerdalen, S Lönsdal, Storjordet TRM; Fauske: Fauske, Kjeldvann BML. *Nno:* Sörfold: Bonnå, Rösvik TRM; Hamaröy: Brennvik, Hamnes, Hansbakk, Innhavet, Oppeid, Rösvik, Sandnes, Tranöy; Tysfjord: Tysfjord ZMO; Ballangen: Bakkerud gård, Ballangen, Dyrhaug, Forså, Elvesletten, Heggemoen; Ankenes: Beisfjord ZMA, Bjerkvik, Trollviken; Narvik: ZMA ZMB; Evenes: Bogen ZMO, Dragvik, Jansbakk. *Nnv:* Moskenes: Sörvåga; Vestvågöy: Eggum, Knutstad, Skulbru, Stamsund, Torvdalsvann TRM, Valberg; Vågan: Store Molla, Svolvær ZMA ZMO, Örsvåg; Lödingen: Lödingen ZMO; Hadsel: Kongselv KMT; Andöy: Andenes TRM, Risöyhavn, Saura. *Troms (TRy):* Harstad; Kvæfjord: Borkenes; Bjarköy: ?loc. TRM; Tromsö: KMT TRM VCA ZMB ZML, Breivik SMS, Sommerhus in Hillesöy TRM, Tromsdal KMT TRM ZMB ZMO; Karlsöy: Bukhattöy TRM, Hushattöy TRM, Måkeskjær TRM. *TRi:* Skånland: Boltås, Lavangseid; Bardu: Bardu kirke, Hamran, Sætermoen, Spong bru, Steinsrud; Målselv: ? loc. TRM, Bjerkeng TRM, Kirkesdal, Neset, Nordmo TRM, Olsborg NMW, Rundhaug SMS, Sörli; Balsfjord: Lanes TRM, Malangen TRM; Storfjord: Skibotn SMS; Nordreisa: Nedrefoss, Sappen; Kvænangen: Kvænangsfjell. *Finnmark (Fy):* Hammerfest TRM; Kvalsund: Činkasjavrre. *Fi:* Alta: Arones, Bossekop TRM, Jotkajavrre TRM, Raipas, Stokkedal,

Talvik; Kautokeino: Kautokeino, Karasjok. *Fn:* Kistrand: Hamnbukt, Skoganvarre; Vadsö: Makkanes, Vadsö. *Fö:* Sör-Varanger: Grense-Jakobselv TRM, Kirkenes TRM, Tangenfoss ZMO.

Corrections. Records from Buskerud (Bv): Ål (Strand 1898a) were revised to *B. soroeensis*, *B. sporadicus* and *B. jonellus* respectively, those from Aust-Agder (AAy): Tvedestrand: Dypvåg (Strand 1898a) to *B. soroeensis* and records from Nordland (Nnö): Tysfjord (Strand 1901) partly to *B. soroeensis* and also *B. sporadicus*. Among a great number of specimens from Oslo: Slemdal (Sparre Schneider 1918) several ♀♀ ♀♀ ♂♂ were revised to *B. sporadicus*. A large nest from Rogaland (Ry): Klepp (Løken 1961a) has been revised to *B. magnus*.

Sweden. Abundantly distributed throughout the country.

A total of about 2700 specimens was examined.

List of localities. *Skåne:* Arkelstorp NRS, Barkåkra NRS, Bjärred, Blentarp NRS, Bokskogen ZMB, Bonderup ZMB, Bäckaskog NRS, Bökeberg ZMB, Dalby ZMB, Falsterbo NRS, Glimåkra NRS, Hittarp Lar, Hjärnarp NRS, Hälsingborg NRS, Hässleholm NRS, Höganäs NRS, Ivö ZMB NRS, Landskrona ZMB, Lerhamn Lar, Lund ZMB, Löddeköpinge ZMB, Löderup NRS, Maglarp, Malmö NRS ZMB, Norra Nöbbelöv, Röddinge NRS, Sandhammaren, Sankt Olof NRS, Simrishamn NRS, Sjöbo NRS, Skälderviken NRS, Smyghult Lar, Sövde NRS, Torekov NRS, Trelleborg GNM NRS ZMB, Tvedöra GNM, Tåssjö ZMU, Veberöd ZMB, Vegeholm Lar, Villands Vånga NRS, Vitemölla NRS, Vomb ZMB, Vä Lar, Ystad NRS, Åhus NRS ZMB. *Blekinge:* Backaryd NRS, Hällevik, Karlskorna NRS, Mjöleryd NRS, Ronneby NRS, Sibbaboda NRS, Sjöarp NRS, Sölvesborg NRS. *Halland:* Breared NRS, Dagsås GNM, Enslöv NRS ZML, Frösakull NRS, Haverdal NRS, Slättåkra NRS, Snöstorp NRS, Steninge NRS. *Småland:* Aneboda ZMB, Diö NRS, Eksjö NRS, Flisby NRS, Gasslanda ZMU, Gislaved, Hjorted NRS, Höreda NRS, Jära NRS, Järstorp NRS, Jönköping NRS, Kalmar NRS, Konga NRS, Ljungarum NRS, Ljungbyholm, Markeryd NRS, Nybro NRS, Nye NRS, Ryssby ZMU, Smålandsstenar NRS, Södra Ljungby ZML ZMU, Södra Sandbö, Växjö NRS, Österkorsberga GNM ZMU, Åboda ZMB. *Öland:* Borgholm NRS, Böda NRS ZMB, Ekerum ZMB, Gärdslösa NRS, Gårdby ZMB, Helludsviken ZMB, Hornsjö ZMB, Högsrum NRS ZMB, Kalkstad ZMB, Källa ZMB, Mörbylånga ZMU, Resmo ZMB. *Gotland:* Ardre NRS, Fardume NRS, Fårö NRS ZML, Kappelshamn NRS, Kyllej NRS, Ljugarn NRS ZMB, Lärbro NRS, Romakloster NRS, Tingstäde NRS, Ulla Hau, Fårö NRS, Visby NRS. *Gotska Sandö'n:* NRS. *Östergötland:* Borensberg, Godegård ZMB, Krokek NRS, Kvarsebo NRS, Lindö NRS, Linköping ZMB, Rodga, Sankt Anna NRS, Stjärnorp ZMB, Tjällmo ZMB, Väversunda ZMB. *Västergötland:* Broholm NRS, Erska, Falköping NRS, Grästorp NRS, Göteborg NRS, Halna, Hornborga, Höjentorp NRS, Karlsborg ZMB, Kymbo NRS, Läckö NRS, Nolhage NRS, Rångedala NRS, Sjömarken ZMU, Skövde NRS ZML, Stenum NRS, Tengene NRS, Töreboda NRS, Österplana ZMB. *Bohuslän:* Bovallstrand NRS, Dingle NRS, Edshultshall NRS, Havstenssund NRS, Hunnebostrand NRS, Höviksnäs GNM, Hålta NRS, Munkedal, Orust, Strömstad NRS ZML, Syd-Koster NRS, Tanumshede NRS, Ytterby NRS. *Dalsland:* Bengtsbro GNM, Bengtsfors NRS ZML, Ellenö NRS, Gesäter ZMB, Grinstad ZMB, Köpmannebro, Laxarby GNM, Marietorp NRS, Mustadfors ZMB, Nössemark ZMB, Rostock ZMB, Skåpafors NRS, Stenebynäs NRS, Stensberg, Tingvalla NRS ZMB, Valbo Ryr NRS. *Närke:* Bärsta NRS, Hovstad, Store Mellösa ZMB, Svennevad, Örebro NRS, Ängslätten NRS. *Södermanland:* Björnlunda NRS, Brandalsund NRS, Enhörna NRS, Fittja NRS, Huddinge ZMU, Häringe NRS, Kärrbo, Läggestad NRS, Mölnbo NRS, Nyköping NRS ZML, Nynäshamn NRS, Näshulta NRS, Nävekvarn NRS, Ornö GNM, Oxelösund NRS, Rekarne NRS, Saltsjöbaden NRS, Stjärnhov NRS, Trosa NRS, Tumba NRS, Tuna NRS, Turinge NRS, Tyresö NRS, Valle NRS. *Uppland:* Adelsö NRS, Angarn NRS, Björklinge NRS, Bogesund NRS, Brudnäs NRS, Börje ZMU, Bålsta NRS, Danderyd NRS, Dannemora NRS, Dyvik NRS, Eldgarn NRS, Finsta NRS, Garnviken NRS, Gimo NRS, Grisslehamn NRS, Hallkved NRS, Hammarby NRS, Harpabol NRS, Häggeby NRS, Håbo-Tibble NRS, Håtuna NRS, Kalmarsand NRS, Kragsta NRS, Kungsängen NRS, Lennartsnäs NRS, Ljusterö NRS, Munsö NRS, Norrtälje NRS, Roslags-Kulla NRS, Rungarn NRS, Rö NRS, Rådmannsö NRS, Sigtuna NRS, Singö NRS, Stavsnäs NRS, Stockholm GNM NRS ZMU, Stångberga NRS, Ullansjö, Uppsala IVU ZML ZMU, Vassunda IVU, Vindö NRS, Vissjön NRS, Väddö NRS, Värmdö NRS ZML, Östervåla ZMB, Österåker NRS, Övergran. *Västmanland:* Arboga ZMB ZML, Dingtuna NRS, Fellingsbro ZMB, Grundbo NRS, Guldsmedshyttan NRS ZML, Hjulsjö NRS, Hällefors NRS, Kolbäck NRS, Lindesberg NRS, Malmör ZMB, Saxhyttan NRS, Ås. *Värmland:* Alster NRS, Arvelsäter NRS, Arvika, Daglösen NRS, Deje NRS, Ed N Gullsprång, Eda NRS, Edsbjörke NRS, Filipstad NRS, Frykerud NRS, Grums NRS, Gylleby NRS, Gåsborn NRS, Horrsjön NRS, Kristinehamn NRS, Långban NRS, Molkom NRS, Nilsby, Torsby NRS. *Dalarne:* Avesta ZMB, Bingsjö NRS, Björka Tje, Brunnsvik NRS, Djurås, Enviken NRS, Falun NRS, Floda NRS Tje, Gruvriset NRS, Hedemora NRS, Hjortnäs NRS, Idre, Leksand NRS Tje, Lima NRS, Ludvika NRS, Mora NRS, Nittsjö NRS, Orsa NRS Tje, Oxberg NRS ZML, Rättvik NRS Tje, Sandsjö,

Siljansfors, Sjurberg NRS, Sundborn NRS ZML, Särna, Söderbärke NRS, Sången NRS Tje, Sångtorpet Tje, Transtrand NRS, Tällberg NRS, Vikarbyn NRS, Västanvik NRS. *Gästrikland:* Björke NRS, Gävle, Hamrångerfjärden, Hedesunda NRS, Hille-Forsby NRS, Högbo NRS, Trödje NRS, Trösken ZMB. *Hälsingland:* Bergvik, Delsbo NRS ZML, Fredriksfors NRS, Harmånger, Järvsö NRS, Kilafors, Orbaden NRS, Söderhamn NRS ZMB. *Medelpad:* Attmar NRS, Borgsjö NRS, Haverö NRS, Kölsillre NRS, Norrleringe NRS, Liden ZMB, Njurunda NRS, Ovansjö NRS, Palljacka NRS, Skallböle NRS, Sundsvall NRS ZMB, Tuna NRS, Tynderö NRS, Vifors NRS, Överturinge NRS. *Härjedalen:* Funäsdalen ZMB, Ljungdalen, Skalsfjäll NRS, Skorvdalsfjäll NRS, Sånfjäll NRS, Sveg NRS ZML, Tänndalen NRS ZML, Vemdalen NRS ZML. *Jämtland:* Bispgården NRS, Bräcke, Edsåsdalen NRS, Gäddede NRS, Hallen, Mattmar, Mullfjället, Ottsjön NRS, Ragunda, Stadforsen NRS, Storlien ZMB ZML, Strömsund NRS, Svenstavik, Undersåker NRS ZML, Åre IVU. *Ångermanland:* Härnösand NRS ZML, SW Hörnefors ZMB, Hånäs NRS, Kramfors NRS, Ramsele GNM, Sidensjö NRS, Sollefteå NRS, Stennäs, Säbrå, Ullånger NRS, Örnsköldsvik NRS. *Västerbotten:* Bergsbyn NRS, Bureå ZMU, Botsmark NRS, Byske NRS, Degerfors NRS, Gubböle NRS, Holmsund NRS, Jörn, Kroksjö NRS, Sikeå ZMB, 50 km SE Skellefteå ZMB, Umeå, Vindeln NRS, Vännäs NRS, Västerhiske NRS. *Norrbotten:* Anttis, Boden NRS, Bäverbäck NRS, Edefors NRS, Hirvijärvi NRS, Håkansö NRS, Kalix NRS ZML, Karungi NRS ZML, Kukkola NRS, Luleå, Mjölkudden NRS, Notvikslätten, Nybygget NRS, Pajala NRS, Piteå NRS, Pite havsbad ZMB, Strömsund NRS, Vändträsk NRS, Älvsbyn NRS, Överkalix NRS, Övertorneå NRS, Övre Svartlå NRS. *Lapland (Ås. Lpm.):* Avaträsk NRS, Bångnäs, Dorotea NRS, Ormsjö NRS, Risbäck NRS, Satsfjäll, Vilhelmina NRS, Åsele NRS. *Ly. Lpm.:* Björkfors, Gargnäs, Lycksele NRS, Sickelsberg NRS, Stensele, Tjulträsk BML, Tärna, Västansjö. *P. Lpm.:* Abborträsk, Arvidsjaur IVU ZML, Skattträsk. *Lu. Lpm.:* Aktse, 73 km E Arjeplog, Gällivare NRS ZML, Harsprånget, Killanjaure, Kutjaure NRS, Kvikkjokk, Malmberget, Muddus National Park NRS, Njunjes, Sarek National Park, Sjöfallet, Staloluokta NRS. *T. Lpm.:* Abisko NRS ZMA ZML, Björkliden NRS ZML, Jukkasjärvi NRS, Kaisepakte NRS, Karesuando NRS, Kiruna NRS ZMA, Kummavoipio NRS, Mell. Meräsjärvi, Nakerijärvi, Svappavaara NRS, Vietovare NRS.

Finland. Commonly distributed throughout the country (Elfving 1968).

World distribution. Europe (British Isles; from Northern Spain, Corsica, Sardinia, Italy, The Balkans and north to Arctic Fennoscandia; in European USSR south to districts of Podolsk, Kirkovgrad, Poltava, Kharkov, Stalingrad) – Turkey – Crimea – Caucasus – Transcaucasus – Northern and Eastern Kazakhstan – Turkestan (The mountains) – Siberia – Kamchatka – Sakhalin – Pamirs – Tibet – Northern and Central Mongolia – China (Kansu) (Panfilov 1957; Krüger 1958; Reinig 1967).

Biology

Nest. Pollen-storer. Nests were recorded in left rodent nests and in crevices, always below the surface of the ground. The access tunnel may reach 40–60 cm in length, occasionally more. In general producing large colonies (Hasselrot 1962).

Flight season. From end of March to the beginning of October. Queen: 18 March–6 Oct.; worker: 14 April–29 Sept.; male 10 June–4 Oct.

BOMBUS (s.s.) *MAGNUS* VOGT

Bombus (Terrestribombus) lucorum f. *magnus* Vogt, 1911, p. 56, syntypes VCA, type area Northern Scotland and Orkney Islands.

(*Bombus terrestris* var. *flavoscutellaris* Trautman, 1915, holotype ♀ VCA, type loc. Germany: Brandenburg: Eberswalde. *Bombus lucorum latocinctus* Krüger, 1939, p. 93, holotype ♀ VCA!, type locality Germany: Sylt: Kampen. *Bombus magnus* Vogt; Krüger 1954, 1958; Kruseman 1959, p. 50. *Bombus magnus latocinctus* Krüger, 1954; Kruseman 1960, p. 241.)

First Scandinavian records

Norway. ? locality (Krüger 1954, p. 266) treated as *B. m. latocinctus*. The record is based upon specimens in Vogt's collection of which three queens from Hordaland, labelled Bergen, Dolvik and Hardanger respectively (collector Barca), are the only reliable records. Specimens from Hamar (Krüger 1954, p. 271) refer to Hafsahl's collection, cf. p. 7.

Sweden. Skåne: Hälsingborg (Krüger 1954, p. 266).

Taxonomical remarks

Krüger (1954, p. 267) distinguishes *B. m. latocinctus* from the nominate subspecies by 'die kurze greisgelbe Grundbehaarung der Area centralis, des caudalen wie des oralen Teiles der Area triangulares. Zwar ist auch bei dem typischen *magnus* der orale Teil mit kurzen greisen Haaren versehen, aber nicht in so starkem Grade wie bei seiner Rasse *latocinctus*. Ausserdem ist bei dieser das Scutellum in grösserem oder geringerem Grad gelb bzw. weisslichgelb behaart.' In the examined Scandinavian material those characteristics of pile of face and scutellum are not much pronounced, sometimes lacking. The present knowledge of this critical species is in my opinion too meagre for subspecific designation of the Scandinavian population being treated as *B. m. latocinctus* by Krüger (1954, p. 271).

Queen

Morphological characters. Malar space markedly shorter than distal width. Ocellar-orbital field as in Fig. 14; the variations in the sculpturing tend towards that of *B. lucorum*. Distance from lateral ocellus to preoccipital ridge (d) about 5/4 longer than distance from ocellus to eye (e), mean value d:e = 1.24; distance between ocelli hardly to markedly longer than half the diameter of the median ocellus, usually about ⅔ this diameter. A_3 about 1½ times the distal width and about ⅔ the length of A_{4+5}. T_2 with distinct dense and coarse puncturing, usually with chagrinated microsculpture; the unhaired distal margin in the median part often narrower than in *B. lucorum*. Length and evenness of coat moderate, i.e. in general as for *B. lucorum*. Body more robust than in *B. lucorum*. Wings rather infuscate.

Queen measurements: N = 20: Hordaland (HOy): malar space: 0.65 mm (±0.04 ±0.01) range: 0.55–0.70mm; 'radial length': 4.69 mm (±0.10 ±0.02) range: 4.50–4.90 mm; interalar width: 5.48 mm (±0.14 ±0.03) range: 5.10–5.73 mm. Body of large size.

Colour pattern. Broad yellow collar extending about ¼ down the adjacent episternum and often projecting backwards below base of wing. Usually a few yellow hairs concealed by black ones at the extreme posterior part of scutellum. Median part of T_1 with variable amount of yellow hairs. T_2 entirely yellow-haired except perhaps black hairs at posterior margin concealed by yellow ones. Pile of almost distal half of T_4, entire T_5, variable part of T_6 tawny or yellowish-white with brownish base. Fringes of sternites brownish, occasionally lateral fringes of St_{4-5} coloured as hindmost tergites. Corbicular fringes brownish or tipped so. Otherwise coat black. The yellow tone in newly emerged specimens is less bright than in *B. lucorum*, but not as deep as in *B. terrestris*, i.e. it is neither lemon-yellow nor sulphurous-yellow. Faded specimens of *B. magnus* and *B. lucorum* may display the same yellow shade or the former is more dull.

Variation. Pile of face with a more pronounced dark brown appearance compared with the black pile in *B. lucorum*, and occasionally a minor part of the matted short pilosity is yellowish-grey. Yellow pile on scutellum is ranging from singly posterior hairs to covering almost entire crescent-shaped part of the segment. Individuals with entirely black-haired scutellum were examined. Yellow pile on T_1 ranges from single hairs in the centre to almost all hairs on the tergite, the shade is ranging from pronounced yellow to pale yellowish-grey. A few individuals have slightly narrower yellow-haired bands. T_5 may have an admixture of black hairs, preferably in the median part. T_6 is occasionally entirely black-haired.

Worker

Only individuals with a colour pattern as typical for the females were sorted out in *B. lucorum* collections. Additionally about 200 workers from a colony revised from *B. lucorum* (Løken 1961a) were studied, all of which display a yellow collar extending a little less than ¼ down episternum and slightly varying in width. Pile on scutellum and T_1 was moreover entirely black except in a very few specimens presenting a slight admixture of yellow hairs. As stated by Krüger (1954, p. 266) the hairs on the hindmost tergites in this caste are more whitish than those of the queens.

B. lucorum collections obviously contain workers of *B. magnus* which so far cannot be distinguished with certainty.

Male

As mentioned (p. 39), this sex is for the present not distinguished from *B. lucorum*. The following description is based on 65 males from the same nest as the workers above.

Morphological characters. Ocelli dorsally just transected by supra-orbital line. A_3 equal in length to A_5 or slightly shorter. T_7 not impressed distally. The characters and also St_{7-8} and genitalia do not differ from the corresponding features in *B. lucorum*, neither were other structural differences traced.

Colour pattern. Pile of face below and between antennal sockets with a mixture of black and yellow to yellowish-grey in the plumose short hairs as also in the long hairs, the yellow ones often predominant. Pile of face above antennal sockets predominantly black, the short hairs more often with an admixture of pale yellowish-grey than the long hairs. Pile of vertex predominantly yellow, usually anteriorly encroached by black hairs. Yellow broad collar extending about halfway down episternum or more. Yellow pile on scutellum ranging from single hairs at the extreme distal edge to covering almost entire distal part of the segment. T_1 slightly to predominantly yellow. Pile of T_2 entirely yellow. Extreme posterior margin of T_4, T_{5-7} tawny-haired, only in very few specimens the pile is predominantly whitish with dark base. Venter predominantly greyish-white or brownish. Posterior fringes of hind tibia usually tawny or yellowish-white tipped. Otherwise coat black. A few individuals with completely black posterior edge on T_4 and/or with variable admixture of black hairs on T_{5-7}, in particular on T_7, were examined.

The tawny colouring of hindmost tergites differs from that of the male *B. lucorum* which is clear whitish. Otherwise the variations above are all within the wide range of the colouring of *B. lucorum* males, yet not including the pattern at either end of this range. Thus specimens displaying the extreme 'dark' and the extreme 'blond' form in *B. lucorum* were not traced in this colony of *B. magnus*.

Distribution (Fig. 55)

Norway. Information so far indicates an occurrence along the coast north to almost 70° N.

A total of 195 specimens, i.e. 125 ♀♀, 70 ♀♀ and additionally inhabitants from a colony were examined.

List of localities. *Östfold:* Onsöy: Ramseklo. *Akershus:* Oslo: V Aker ZMO. *Vestfold:* Nötteröy: Teie. *Aust-Agder (AAy):* Tvedestrand: Hanto, Lyngör ZMO; Fjære: Temsevann; Grimstad; Landvik: Forsöksgården. *Vest-Agder (VAy):* Lyngdal TRM; Sögne: Langeneset, Åros; Lindesnes: Spangereid; Farsund: Hanangervann, Lodshavn. *Rogaland (Ry):* Klepp: Börsheim, Vik; Sandnes: Helgeland; Sola: Gimre; Stavanger: Hinnaskogen, Lindöy, Stavanger TRM ZMB. *Ri:* Forsand: Meling, Songedalen. *Hordaland (HOy):* Bömlo: Follesöyhavn, Gertrudsviken, Goddö, Rolfsnes, Röyksund, Sörstokka, Vika; Ölen: Dommersnes; Stord: Storsöy; Fitjar: Agöy, Brennöy, Kolöy, Risöy, Rubbestadnesset, Slåtteröy; Tysnes: Ånuglo; Austevoll: Hekjingen; Os: Lysekloster, Haugland, Nordströno, Ulven; Fana: Biol. st., Dolvik VCA, Eggholmen, Fantoft, Hatlestad, Korsnes, Krokeide, Milde, Nordevoll, Rådalen, Saganes, Skipanes, Skjold, Stend, Steinsvik, Titlestad; Sund: Leröy, Telavåg, Steinsland; Fjell: Bjoröya, Kolafjell; Laksevåg: Storingaviken; Bergen: VCA ZMB; Asköy: Davanger, Herdla, Jacobsöy; Åsane: Golfbanen, Haukedal; Osteröy: Kleppe, Njåstad, Skolmen; Vaksdal: Eidslandet; Radöy: Rosnesset; Lindås: Fyllingsnes, Vollom. *HOi:* Kvinnherad: Lio, Ljosmyr, Skeie, Skånevik, Varaldsöy; Ullensvang: Hardanger VCA, Skutenes; Voss: Bömoen; Kvam: Viköy. *Sogn og Fjordane (SFy):* Askvoll: Raudöy; Eid: Nordfjordeid; Vågsöy: Totland; Selje: Ervik. *SFi:* Leikanger: Hermansverk. *Möre og Romsdal (MRy):* Ulstein: Ulsteinvik; Heröy: Stoksund kirke; Molde. *Sör-Tröndelag (STy):* Fröya: Froan TRM; Hitra: Hamn. *Nord-Tröndelag (NTy):* Namsos TRM. *NTi:* Leksvik: Storvann; Höylandet: Skilleberget. *Nordland (Nsy):* Sömna: Sandvåg TRM; Brönnöy: Flatmo TRM; Heröy: Syd-Heröy TRM; Gildeskål: Finnes, Skavoll. *Nnö:* Hamaröy: NE Fjerdevann, Oppeid. *Nnv:* Vestvågöy: Eggum, Haukland, Skulbru; Vågan: Store Molla, Örsvål; Andöy: Dverberg, Saura. *Troms (TRy):* Kvæfjord: Borkenes; Tromsö: TRM.

Sweden. Dispersely distributed throughout the lowlands from Skåne north to about 60° N in Värmland. Single records in Dalarne, Ångermanland and Lapland may indicate a wider, more northern distribution, also inland, than known so far.

A total of 47 specimens, viz. 32 ♀♀ and 15 ♀♀, was examined.

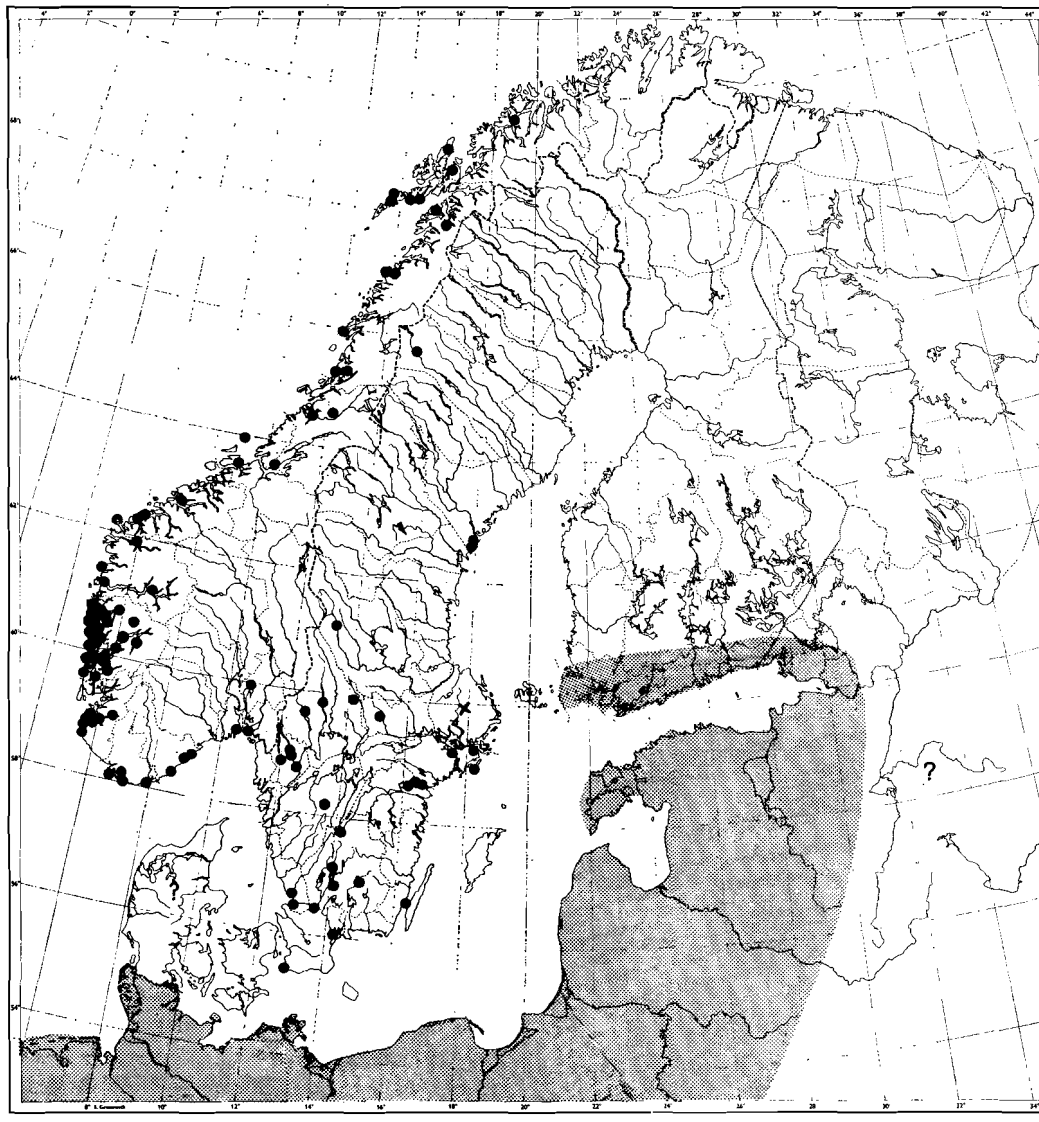


Fig. 55. *B. magnus* Vogt. Legends as in Figs. 50, 54.

List of localities. *Skåne:* Ljunghusen, Nosaby. *Halland:* Halmstad, Hasslöv. *Småland:* Järstorp NRS, Jönköping NRS, Kalmar NRS, Gasslanda, Markaryd, Ryssby ZMU, Värnamo NRS. *Östergötland:* Krokek NRS, Kvarsebo NRS, Norrköping ZMA. *Västergötland:* Mösseberg in Falköping NRS. *Dalsland:* Bengtfors NRS, Köpmannebro, Steneby NRS, Tingvalla NRS. *Södermanland:* Utö NRS, Viksberg NRS, Älta NRS. *Uppland:* ?loc. NRS. *Västmanland:* Guldsmedshyttan. *Värmland:* Arvika NRS, Gylleby NRS, Lesjöfors. *Dalarne:* Transtrand ☿ 10 Sept. 1955 (Lundblad) NRS. *Ångermanland:* Härnösand ♀ 9 Aug. 1931 (Fredlin), Säbnå ♀ 9 Sept. 1932 (Burrau). *Lapland (Ly. Lpm.):* Tärna ☿ 22–30 Sept. 1931 (?).

Correction. Records from Lapland (Krüger 1954, pp. 266, 271) refer to two specimens (Kola pen.: Umptek Mountains VCA) one of which is revised to *B. sporadicus* (Kruseman in litt.) and the other to *B. lucorum* by me.

Finland. According to Krüger (1958, p. 322) the species occurs in the southern part of the

country, whereas Elfving (1960) does not recognize the taxon. A few females kept at ZMH, revised by me, agree with the statement of Krüger.

World distribution. Europe (Northern Scotland; Orkney Islands; The Pyrenees; France; The Netherlands; Belgium; Germany; Switzerland; Poland; The Baltic; Fennoscandia) – Caucasus – Iran – Turkestan – Boro Hörö Uula – Northern Mongolia – Manchuria (Ussuri) – China (Kansu) (Krüger 1954, 1958; Kruseman 1969).

Biology

Nest. Pollen-storer. Nest in the ground. A single colony revised from *B. lucorum* (Løken 1961a) is so far recorded in Scandinavia.

Flight season. From beginning of May to the end of September. Queen: 1 May–28 Sept.; worker: 23 June–28 Sept.; male: ?. Even though a single female, Hordaland (HOy): Fana: Skjold ♀ 18 March 1960 (Kryvi), appeared in the early spring, a great number of newly emerged queens observed in Hordaland during May and first half of June nevertheless favours the statement of Krüger (1954, p. 465) that *B. magnus* appears later in the season than *B. lucorum.*

BOMBUS (s.s.) *SPORADICUS* NYLANDER

Bombus sporadicus Nylander, 1848, p. 233 No. 15, lectotype ♀ ZMH! designated by Tkalcu (1967), type loc. Finland: OM: Gamlakarleby.

(*Bombus sporadicus* Nylander; Wahlberg, 1852, 1854; Brinck & Wingstrand 1949; Løken 1949, 1960; Brinck 1951; Krüger 1956; Kruseman 1959; Elfving 1960, 1968; Ander 1965. *Bombus terrestris* var. *sporadicus* Nylander; Aurivillius 1903; Sparre Schneider 1909; Lundblad 1924. *Bombus terrestris* var. *d* Thomson 1872; Strand 1898a. *Bombus lucorum* var. *sporadicus* Nylander; Bengtsson 1931.)

First Scandinavian records

Norway. Records from Aust-Agder (AAy): Tvedestrand: Skipvik (Strand 1898a), published as *B. terrestris* var. *d* Thomson, were revised to *B. lucorum.* Two males from Troms (Tri): Målselv (Sparre Schneider 1909) were not traced. They have obviously been revised to *B. lucorum* as the description agrees with the light-coloured form of this species. First reliable record: Oppland (Os): Öyer (Løken 1949).

Sweden. Värmland: Rämmen and Lesjöfors (Wahlberg 1852). A worker labelled Vrml Wahlberg legit was examined.

Taxonomical remarks

The Scandinavian population belongs to the nominate subspecies which according to Tkalcu (1967) is confined to Europe. Owing to the meagre taxonomical information about the Russian and the Asiatic populations (Krüger 1956; Tkalcu 1967), a subspecific splitting of this species is avoided in the present study.

Queen, worker

Morphological characters. Malar space hardly shorter than distal width. Ocellar-orbital field as in Fig. 11. Distance from lateral ocellus to preoccipital ridge (d) not markedly longer than distance from ocellus to eye (e), mean d:e = 1.10; distance between ocelli varying but usually about ⅔ the diameter of median ocellus (longer in workers). A_3 just shorter than 1½ times the distal width of the segment, hardly longer than A_5. At least median posterior part of disc of T_2 with smooth, rather sparsely punctured microsculpture. Dorsum of thorax with rather long, uneven coat. Body rather robust. Wings elongated, strongly infuscate.

Queen measurements: N = 15; Southern Norway; malar space: 0.71 mm (±0.03 ±0.01) range: 0.65–0.75 mm; 'radial length': 5.30 mm (±0.11 ±0.03) range: 5.10–5.50 mm; interalar width: 5.92 mm (±0.14 ±0.04) range: 5.70–6.13 mm. Body of large size.

The workers are markedly more slender than in the remaining species of this subgenus.

Colour pattern. The shade in the yellow bands is lighter than in *B. terrestris* and often close to that of faded *B. lucorum.*

Queen: Pile of face black, usually with admixture of brownish in the short matted hairs. Yellow collar just reaching margin of episternum, scutellum posteriorly with slight admixture of yellow hairs. T_1 centrally with a variable amount of yellow hairs; visible hairs of T_2 yellow, i.e. black hairs on the extreme posterior margin usually concealed by yellow hairs. Posterior half of T_4, entire T_5, often lateral fringes of T_6 and at least lateral fringes of St_4-$_5$ whitish. Otherwise coat black. Worker: Crescent-shaped posterior part of scutullum and T_1 yellow-haired; interalar band. Otherwise colouring as in the female.

Variation. In the queens the amount of yellow hairs on scutellum and T_1 ranges from covering the crescent-shaped posterior part of scutellum, and entire T_1, to only single hairs in the centre of T_1. Otherwise colour-stable. Thus only a few of the examined queens display the prevailing pattern in workers characterized by interalar band.

Male

Morphological characters. Area between eye and preoccipital ridge, outside genal furrow, with distinct fine puncturing admixed with some coarse ones. Ocelli dorsally just transected by supraorbital line. A_3 just longer than A_4 and just shorter than A_5 (Fig. 28A). T_7 impressed in front of distal margin. St_8 and genitalia (Figs. 28B–C); gonocoxite not grooved inside but regularly converging towards apex; gonostylus wider than in *B. terrestris* and *B. lucorum;* apex of volsella usually as in Fig. 28D. Coat shaggy. Wings elongated, strongly infuscate. Body of large size.

Colour pattern. As in the workers.

Variation. Pile of face, pile of vertex with slight admixture of yellow hairs. Fringes of hind tibia may be whitish-tipped. The colouring is in general distinct, only very few specimens with slightly diffuse colour pattern were examined.

Distribution (Fig. 56)

Norway. Occurring from inner district of Aust-Agder approximately 58°30′ N north to about 66° N. A single queen from Troms, cf. the list below, is so far the only reliable record north of the Polar Circle. Another queen recorded in Hordaland, is the only observation outside the endemic spruce forest zone. In Southern Norway recorded to 1120 m s.m.

Biotopes: Pastures, roadsides and meadows.

A total of about 355 specimens was examined.

List of localities. *Östfold:* Eidsberg: Hole. *Akershus:* Bærum: Bråten; Oslo: TRM; Aurskog-Höland: Sotsjöen TRM; Fet: Björkflåten. *Hedmark (HEs):* Hamar: ZMO. *HEn:* Trysil: Dammen, Enga, Sjöenden, Vestby; Åmot: Glesubekken, Rena; Rendal: Solbakken SE Åsheim; Tynset: Tynset; Engerdal: Björköihl, Risbakken gård 750 m, Torhus. *Oppland (Os):* Jevnaker: Randsfjord USU ZMB; Gran: Einavoll, Lander; Östre Toten: Stubdalen; Söndre Land: Fluberg; Nordre Land: Dokka USU; Lillehammer: Jörstadmoen; Sör-Aurdal: Ellingseter 820 m, Skard 700 m; Öyer: Aksjö 1000 m, Skåi, Öyer, Åstdalen 900 m. *On:* Vang: Öye USU; Sel: Leirflata; Lom: Galdesand. *Buskerud (Bö):* Lier: Lökke gård; Krödsherad: Noresund; Kongsberg: Skollenborg. *Bv:* Sigdal: Kopseng, Nedre Eggedal; Nore og Uvdal: Gavlenseter 1120 m, Rödberg, Uvdal, Uvdal stavkirke; Gol: Gol; Ål: ? loc. ZMO. *Telemark (TEy):* Drangedal: Grova, Naksjö, Omnes, Tomyra. *TEi:* Notodden: Gransherad, Tinnoset; Seljord: Svartdal; Kvitseid: Vrådal; Nissedal: Lauvviki, Treungen ZMO; Fyresdal: Hegglandsgrend, Moland; Tokke: Holtet bro; Vinje: Krossen, Særengrend, Åmot; Tinn: Tinn, Austbygda. *Aust-Agder (AAi):* Evje og Hornes: Lauland; Bygland: Löndal; Valle: Kvestad, Valle TRM ZMB, Rygnestad. *Hordaland (HOi):* Kvinnherad: Skeie ♀ 22 July 1943 (Hans Tambs-Lyche). *Möre* og *Romsdal (MRy):* Vestnes: Gjermundnes. *Sör-Tröndelag (STy):* Rissa: Gafsetåsen. *STi:* Röros: Myrmoen; Trondheim. *Nord-Tröndelag (NTy):* Nærøy: Breiviken. *NTi:* Meråker: Tovmodal, Vardetun; Leksvik: Storvann; Verdal: Sandvika, Stiklestad; Inderöy: Kirkenesvåg; Overhalla: Gryten; Snåsa: Brönstad, Telnes; Lierne: Kvelia, Seterhaug, Småtjern; Höylandet: Höylandet; Namskogan: Brekkvasselv KMT, Finnvollan, Namskogan. *Nordland (Nsi):* Grane: Majavatn; Vefsn: Luktvann. *Troms (TRi):* Målselv: Olsborg ♀ 10 July 1955 (Lø).

Corrections. Records from Aust-Agder (AAy): Tvedestrand: Skipvik (Strand 1898a), published as *B. terrestris* var. *d*, were revised to *B. lucorum.*

Sweden. Wide, yet local distribution from Värmland, approximately 59° N, and northwards throughout the country. Three scattered records in Södermanland and Uppsala indicate the extreme south-eastern border area of the species.

A total of about 550 specimens was examined.

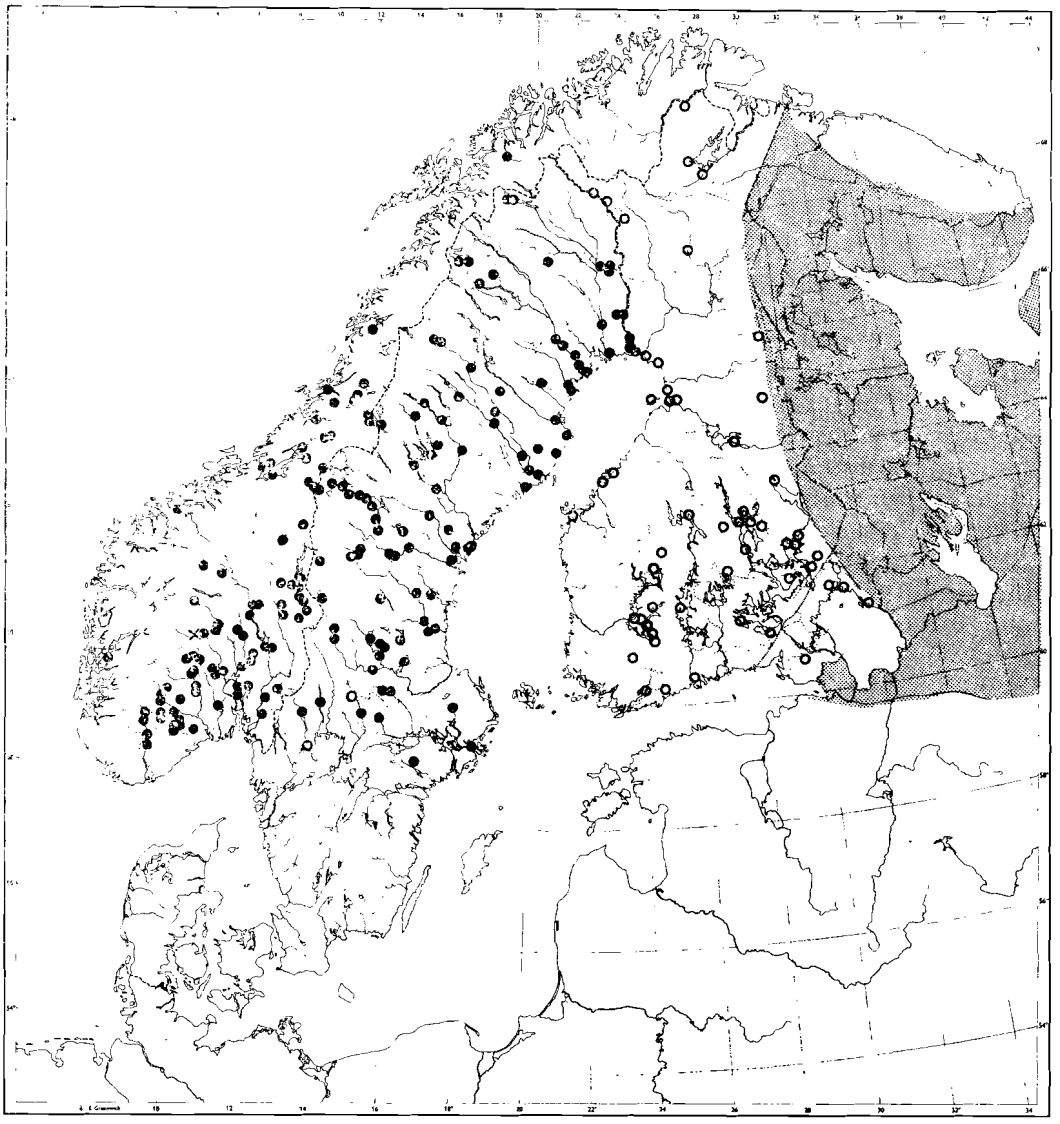


Fig. 56. *B. sporadicus* Nylander. Legends as in Figs. 50, 54.

List of localities: *Södermanland:* Valla ♀ July 1950 (Langlet) NRS. *Uppland:* Hammarby ♂ 11 July 1948 (Kruseman) ZMA, Stockholm ♀ July 1936 (Klaue) ZMA. *Västmanland:* Guldsmedshyttan, Hällefors NRS. *Värmland:* ? loc. (Wahlberg) NRS, Arvika, Gylleby NRS. *Dalarne:* Avesta ZMB, Bingsjö NRS ZML, Brunnsvik NRS, Floda NRS Tje, Fulufjäll NRS, Leksand NRS, Lima NRS, Ludvika, Mora NRS, Rättvik NRS, Sandsjö, Sjurberg, Smedjebacken, Sälen ZMA, Sångtorpet Tje, Toxen Tje, Töfsingdalens Nationalpark NRS, Vikarbyn NRS. *Hälsingland:* Bergvik, Bollnäs NRS, Delsbo NRS ZML, Fredriksfors NRS, Kilafors, Ljusdal. *Medelpad:* Köllsillre NRS, Ljustorp, Matfors, Paljacka, Överturinge NRS, Ånge. *Härjedalen:* Oxsjövålen NRS, Skorvdalsfjäll, Sånfjäll NRS. *Jämtland:* Bräcke, Duved ZMA, Gäddede NRS, Hallen, Mattmar, Mörsil ZMA, Oviken, Ragunda, Storlien, Strömsund NRS, Svenstavik, Undersåker NRS ZML, Åre ZMA ZML. *Ångermanland:* Bondsjö, Bångnäs ZMB, Hoting NRS, Härnösand, Ramsele GNM, Säbrå. *Västerbotten:* Bergsbyn NRS, Botsmark NRS, Degerfors NRS, Gubböle NRS, Sikeå ZMB, 50 km SE Skellefteå ZMB, Umeå ZMB ZML. *Norrbotten:* Anttis, Boden NRS, Edefors,

Erkheikki NRS, Haparanda ZMA ZML, Hirvijärvi NRS, Kalix, Karungi NRS ZML, Kukkola NRS, Luleå NRS ZML, Långträsk, Mjölkudden NRS, Nybygget NRS, Pajala NRS ZML, Peräjävaara, Piteå, Pite havsbad ZMB, Södra Sunderbyn, Överkalix NRS, Övertorneå, Övre Svartlå NRS. *Lapland (Ås. Lpm.):* Bångnäs, Dorotea NRS, Risbäck NRS, Vilhelmina NRS, Åsele NRS ZCL. *Ly. Lpm.:* Ammarnäs, Lycksele NRS, Malå ZMU, Sickselberg NRS, Sorsele ZMU, Stensele, Tjulträsk BML ZML. *Lu. Lpm.:* Aktse, Kvikkjokk, Malmberget, Njunjes, Sarek National Park, Staloluokta, Östansjö. *T. Lpm.:* Abisko NRS, Björkliden NRS ZML.

Unrevised records: *Värmland:* Rämmen, Lesjöfors (Wahlberg 1852) and Säffle ZML (Ander in litt.).

Correction. Records from Lapland (T. Lpm.): Abisko (Bengtsson 1931) were revised to *B. lucorum* (Linnaeus).

Finland. Widespread throughout the country except for Åland Isles and the extreme western part of the country (Elfving 1968).

World distribution. Europe (Fennoscandia; Northern European USSR south to districts of Leningrad, Kalinin, Ivanovo, Gorki, Kirov) – Siberia – Kamchatka – Sakhalin – Turkestan (Alma Ata) – Altai – Baykal – Northern Mongolia – Northern Manchuria – China (Koko Nor) (Panfilov 1957; Tkalcu 1967).

Biology

Flight season. From the beginning of May to last half of September. Queen: ?–25 Aug.; worker: 8 June–20 Sept.: male: 24 July–20 Sept.

BOMBUS (s.s.) *TERRESTRIS* (LINNAEUS)

Apis terrestris Linnaeus, 1758, p. 578 No. 30, type area Sweden: Uppland. A queen LSL! disagrees with the usual interpretation of the taxon cf. below.

(*Bombus terrestris* (Linnaeus); Dahlbom 1832, p. 34 (partim), 1837 (partim); Wahlberg 1854, 1855 (partim); Thomson 1870 (partim), 1872 (partim); Aurivillius 1903 (partim); Wahlgren 1915 (partim); Ringdahl 1921 (partim); Jansson 1922 (partim); Krüger 1956, 1958; Kruseman 1959; Elfving 1960, 1968; Fridén, Eskilsson & Bingefors 1962; Hasselrot 1962; Ander 1963, 1965; Fridén 1967. *Apis virginalis* Geoffroy in Fourcroy, 1785, p. 450).

Nomenclatural remarks

A female in the collection of the Linnaean Society of London, labelled *terrestris*, has been revised to *B. lucorum* and the two subsequent specimens in the same row, both of which are queens with no labels, were revised to *B. lucorum* and *B. terrestris* respectively. In referring to the documentary value of the Linnaean collection p. 10, and to secure stability in nomenclature, *B. terrestris*, in sensu passed and present authors (Sladen 1912; Schmiedeknecht 1930; Pittioni 1939a; Krüger 1950, 1954, 1956, 1958; Yarrow 1959; etc.), is kept. The species is not rare in Uppland county, the home area of Linnaeus which also is the type area.

First Scandinavian records

Norway. Hereby published for the first time.
Sweden. Uppland (Linnaeus 1758).

Taxonomical remarks

Norwegian records hitherto published as *B. terrestris* apply to *B. lucorum* (Løken 1960), cf. references to the synonymy of this taxon. According to present revision, they may also include *B. magnus*. The mention of *B. terrestris* in Sweden concerns *B. terrestris*, *B. lucorum*, possibly also *B. magnus* when referring to Southern Sweden, cf. authors (partim) in references to the synonymy above, but only *B. lucorum*, possibly *B. magnus*, when referring to Northern Sweden, cf. references to the synonymy of *B. lucorum*. Swedish *B. terrestris* and *B. lucorum* were quite recently distinguished, cf. references above.

Queen, worker

Morphological characters. Malar space markedly shorter than distal width. Labrum (Fig. 12A). Ocellar-orbital field (Fig. 12B). Distance from lateral ocellus to preoccipital ridge (d) about 5/4 longer than distance from ocellus to eye (e), mean d:f = 1.25; distance between ocelli

varies but is usually about ½ the diameter of median ocellus (longer in workers). A_3 hardly exceeding 1½ times the distal width, about ¾ the length of A_{4+5}. Mid- and hind basitarsus Figs. 12C–D. At least median posterior part of disc of T_2 smooth with rather fine, sparse puncturing. Inner sting sheet broad (Fig. 12E). Dorsum of thorax with rather short, even coat. Body robust, wings rather infuscate.

Queen measurements: N = 20; Sverige: Östergötland – Uppland; malar space: 0.65 mm (±0.04 ±0.01) range: 0.55–0.70 mm; 'radial length': 4.86 mm (±0.16 ±0.04) range: 4.40–5.10 mm; interalar width: 5.71 mm (±0.23 ±0.05) range: 5.40–6.05 mm. Body of large size.

Colour pattern. Collar just reaching adjacent margin of episternum, T_2 except posterior margin with deep sulphurous yellow hairs. Usually at least distal half of T_4, T_5, anterior part of T_6 and at least lateral fringes of St_{4-5} with whitish hairs. Otherwise coat black.

Variation. Yellow collar varies in width, a strongly reduced band is not rare and occasionally coat of thorax is entirely black. Corbicular fringes may be more or less faded, nearly whitish or tipped so. The yellow bands are in general less fading than in the remaining species of the subgenus, except in some workers which are difficult to identify.

On the whole the characters are more variable and diffuse in the worker caste. A number of specimens display, however, the typical accumulation of very fine punctures inside the punctured band in supra-orbital field (Fig. 12B). Moreover the short even coat is often well-defined. Faded individuals with also these characters being indistinct are difficult to distinguish from *B. lucorum* and *B. magnus*.

Male

Morphological characters. Area between eye and preoccipital ridge outside genal furrow with rather indistinct uneven puncturing. Ocelli dorsally touching supra-orbital line or just transecting it. A_3 markedly longer than A_4, equal in length to A_5 or just longer (Fig. 29A). T_7 more or less impressed in front of distal margin. St_8 and genitalia as in Figs. 29B–C. Inner margin of gonocoxite grooved; apex of volsella usually hooked as in Fig. 29D. Dorsum of thorax with rather even coat, markedly shorter than in the remaining species of the subgenus.

Colour pattern. Distinct. Hairs of T_2 usually entirely yellow. Pile on T_7 whitish. At least distal part of fringes of hind tibia more or less whitish-tipped. Otherwise colouring as in the female.

Variation. The variability in the structural characters may overlap that of corresponding features in *B. lucorum* and *B. magnus*. Additionally, yellow collar varies in width and occasionally exextends partly down episternum. Extreme posterior edge of T_2 may have variable admixture of black hairs. Fore-leg, occasionally also mid-leg, with hairs on tibia and femur more or less whitish-tipped. Fringes of sternites sometimes mainly whitish. The colour variations are not much pronounced.

The sex is usually separated from *B. lucorum* s. l. by the deep yellow shade in the colour pattern and the rather short hair length.

Distribution (Fig. 57)

Norway. So far only sporadically observed at the southeastern coast. The list below shows recent finds only. It might be asked whether this is due to insufficient investigations or a recent invasion of Norway by this continental species.

Biotope. Apparently rather arid areas.

A total of 14 specimens was examined.

List of localities.* *Östfold:* Onsöy: Lervik ☿ 18 July 1958 (Lø). *Akershus:* Ås: Vollebekk ☿ 7 Sept. 1968 (Raffensperger) CIN; Oslo: ☿ 26 July 1951, ♂ 26 Aug. 1957 (Östvold). *Vestfold:* Tjöme: Kjære ♀ 30 June 1968, 2♀♀ 16 June 1969 (Fjellberg), Mo ♀ 23 May 1965 (Fjellberg), Mostranda ♀ 3 July 1969 (Fjellberg), Tjöme ♀ 27 June 1968 and Sandö ☿ 29 June 1968 (Fjellberg); Sandar: Austeröy ☿ 28 July 1961 (Lø); Brunlanes: Dolven ☿ 29 July 1961 (I. Meidell). *Aust-Agder (AAy):* Moland: Holmsund ♀ 20 May 1964 (Lø).

Correction. A total of 72 ♀♀ from Hedmark (HEs): Hamar (Krüger 1956) refers to the col-

* Recent records (Hedmark (HE): Vang: Tomter 8 km NE Hamar 2♀♀ 23 and 24 May 1972 (A. Mjelde)) are the first reliable observations north of Oslo.

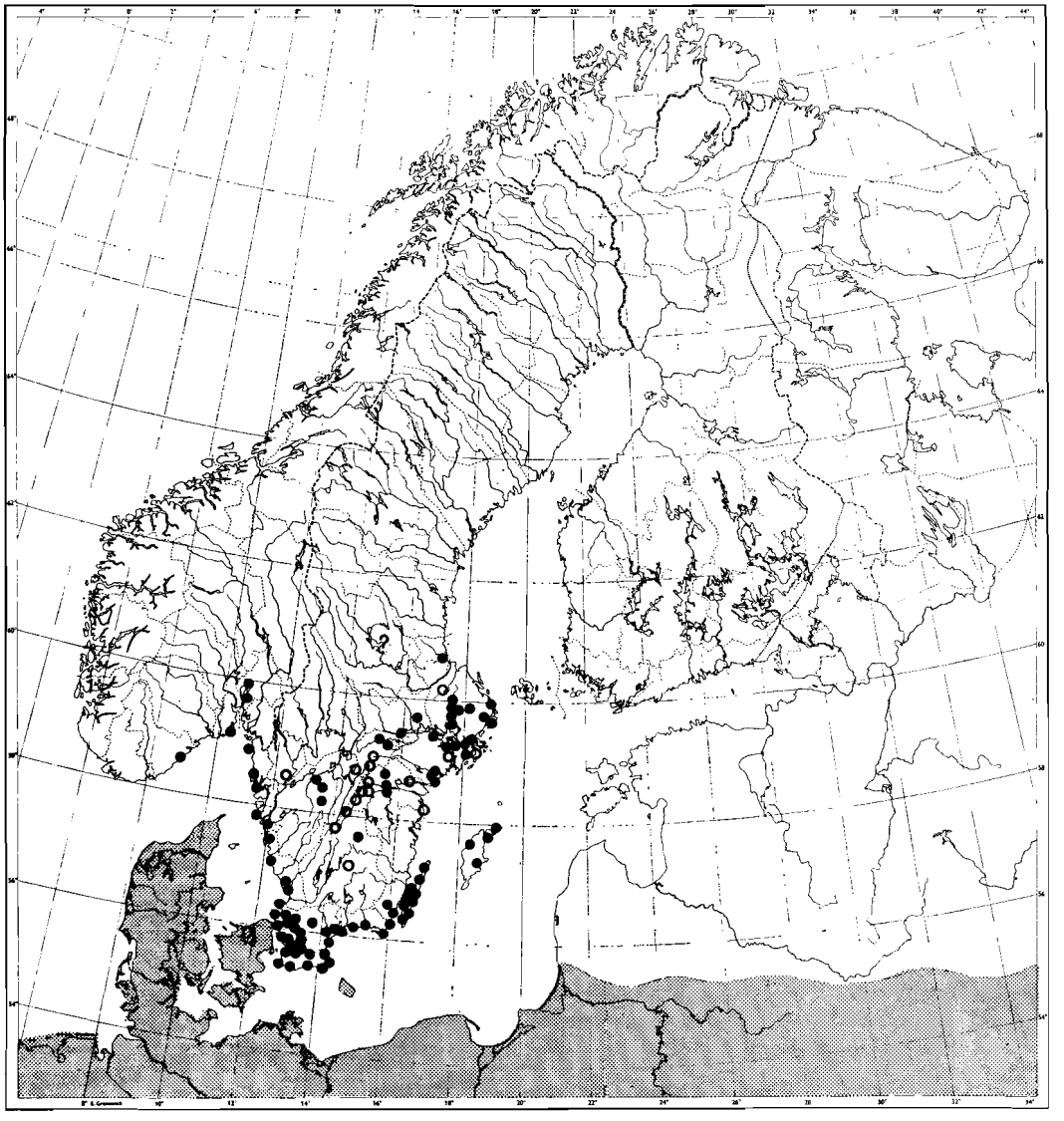


Fig. 57. *B. terrestris* (Linnaeus). Legends as in Figs. 50, 54.

lection of Hafsahl cf. p. 7, i.e. the labelling is not reliable.

Sweden. Widespread, local occurrence from the extreme southernmost coast northeast to about 60°30′ in Gästrikland. It is uncertain whether the absence inland in Southern Sweden, i.e. in Småland and in southern part of Västergötland, is due to insufficient investigations or indicates that *B. terrestris* is confined to the lowlands, areas below 200 m s.m.

Only recent finds in the northern border areas perhaps indicate a further moving of the northern limit of the species.

A total of about 850 specimens was examined.

List of localities. *Skåne:* Alnarp, Arlöv ZMA, Bokskogen ZMB, Bonderup ZMB, Bromølla ZMA, Brunnby, Bökeberg ZMB, Enslöv ZMB, Falsterbro

ZMB, Gislöv ZMB, Hovshallar NRS, Hyby ZMB ZML, Hälsingborg NRS VCA, Hässleholm NRS, Höganäs NRS, Håstad ZMB, Ivö NRS, Kristianstad NRS, Kävlinge, Landskrona ZMB ZML, Lund GNM NRS ZMA ZMB ZML, Löderup NRS ZML, Malmö NRS ZMB ZML, Maglarp ZMB, Marsvinsholm NRS, Mälarhusen NRS, Nöbbelöv ZMB, Revinge ZMB, Röddinge NRS, Råå, Sandhammar NRS, Sankt Olof NRS, Saxtorp NRS, Simrishamn NRS, Sjöbo GNM NRS, Svalöv IVU, Södra Sandby ZMB, Torekov NRS, Trelleborg GNM NRS ZMB ZML, Tvedöra GNM, Veberöd, Vitemölla NRS, Ystad NRS, Ängelholm NRS, Örtofta, Öved NRS, Åhus NRS. *Blekinge:* Karlshamn, Kristianopel NRS, Ronneby NRS, Sjöarp NRS, Sölvesborg NRS, Torhamn NRS. *Halland:* Frösakull NRS, Getinge NRS, Halmstad NRS ZML, Haverdal NRS, Kungsbacka GNM, Steninge NRS ZML, Varberg. *Småland:* Bergkvara NRS, Brånstorp NRS, Påryd. *Öland:* Algutsrum ZMB, Borgholm NRS, Bjärby GNM, Ekerum ZMB, Färjestaden NRS, Gårdby NRS ZMB, Hornsjö ZMB, Kalkstad ZMB, Källa ZMB, Mörbylånga NRS, N Resmo ZMB, Segerstad NRS, Torslunda ZMB, Ventlinge IVU, Vickleby NRS ZMB. *Gotland:* Fårö, Kyllej NRS, Lau NRS, Visby IVU ZML. *Östergötland:* Hällestad NRS, Linköping ZMB, Stjärnorp ZMB. *Västergötland:* Falköping NRS, Göteborg NRS, Stenum NRS, Österplana NRS. *Bohuslän:* Bovallstrand NRS, Hunnebostrand NRS, Koön NRS, Lysekil NRS, Syd-Koster NRS. *Närke:* Stora Mellösa ZMB, Örebro NRS ZMB ZML. *Södermanland:* Enhörna NRS, Nyköping NRS, Oxelösund NRS, Sjöa ZMB, Strängnäs ZMB. *Uppland:* Djurö NRS, Ekerö NRS, Elmsta ZMB, Funbo IVU, Hammarby NRS, Knutby ZMB, Läby NRS, Norrtälje NRS, Sigtuna NRS, Skokloster ZMB, Tensta ZMB, Uppsala IVU NRS ZMB ZMU, Västerhaninge ZMB, Yxlan ZMB. *Västmanland:* Arboga ZMB ZML, Kärrbo ZMB, Skultuna ZMB. ?*Dalarne:* Sjurberg in Rättvik ♀ 14 July 1964 (Erl) NRS. (Most probably the examined worker belongs to this species.) *Gästrikland:* Hille-Forsby 1952 5 ♀♀ (Fahlander).

Unrevised records are not included here except for the following (K. Ander in litt.): *Småland:* W Jönköping, Lammhult, Visingö. *Östergötland:* Gryt, Konungsund, Källstad, Normlösa, Omberg, Varv, Västra Ny. *Västergötland:* Tived. *Dalsland:* Bråland. *Närke:* Hammar, Åsbro. *Södermanland:* Järna. *Uppland:* Dalarö, Östervåla.

Finland. Not observed.

Correction. Three males from the southern coast (Elfving 1960, 1968) were revised to *B. lucorum* s.l. by me.

World distribution. Europe (British Isles; from Portugal, Spain, Mediterranean islands, Greece throughout the continent north up to Denmark, Southern Scandinavia, Poland; in European USSR north to districts of Minsk, Bryansk, Moscow, Penzensk, Kuibyshev) – Canary Islands – Algeria – Tunisia – Turkey – Caucasus – Transcaucasus – Southern Ural – Northern and Eastern Kazakhstan – Turkestan (Dylewska 1957; Panfilov 1957; Krüger 1958; Yarrow in litt.). Introduced to New Zealand (Gurr 1964).

Biology

Nest. Pollen-storer. Producing large colonies established in the ground (Hasselrot 1960, 1962).

Flight season. Beginning of May to the end of September. Queen: 5 May–24 Sept.; worker: 5 June–?; male: 2 Aug.–30 Sept.

SUBGENUS *CULLUMANOBOMBUS* VOGT

Cullumanobombus Vogt, 1911, p. 57, type-species *Bremus cullumanus* (Kirby) = *Bombus cullumanus* (Kirby) by designation of Frison (1927).

BOMBUS (CULLUMANUBOMBUS) CULLUMANUS (KIRBY)

Apis cullumana Kirby, 1802, p. 359 No. 102, holotype ♂ BML! labelled by Yarrow (1968), type locality England: E. Suffolk: Witnesham.

(Bombus cullumanus (Kirby); Thomson 1872; Aurivillius 1903; Kruseman 1959; Ander 1965. *Bombus burrellanus* Thomson, 1870 nec Kirby, 1802. *Bombus serrisquama* Morawitz, 1888, p. 224, type ♂ type area Kazakhstan: Semipalatinsk. *Bombus silantjewi* Morawitz, 1892, p. 132, type area Russia: Saratov. *Bombus apollineus* Skorikov, 1910, p. 412, type area Caucasus. *B. cullumanus serrisquama* Morawitz; Kruseman 1959, Tkalcu 1968.)

First Scandinavian record

Sweden: Skåne (Thomson 1870).

Taxonomical remarks

The complex *cullumanus – serrisquama – apollineus* individually designated as species, has recently been considered conspecific (Kruseman 1959; Tkalcu 1968; Yarrow in litt. 1971). The three taxa, having an allopatric distribution, are so far distinguished by the colour pattern only and the close relationship is emphasized by treating them as subspecies.

The Scandinavian population belongs to the nominate subspecies.

Distribution

Scandinavia. Cf. the subspecies.

World distribution. Europe (Southeastern England; Northern Spain; France; coast of the Netherlands, Germany; Denmark (Als ZMA, Bornholm VCA, ZMC); Southern Sweden; Poland; Hungary; in European USSR north to districts of Vitebsk, Moscow, Ivanovsk, Molotovsk and south to the northern limit of the arid stepped areas) – Northern Caucasus – Central and Southern Ural – Northern and Eastern Kasakhstan – southern part of Western Siberia – Turkestan (the mountains) – Afghanistan (Yarrow 1954; Panfilov 1957; Tkalcu 1968).

BOMBUS CULLUMANUS CULLUMANUS (KIRBY)

Queen, worker

Morphological characters. Head slightly longer than wide. Malar space about ¾ the distal width, as long as A_3 or barely longer. Clypeus just transverse, rather convex; disc of clypeus sparsely punctured in the centre, otherwise densely punctured except for the impunctate anterior area between well-defined coarsely punctured lateral impressions. Labrum coarsely punctured; labral furrow moderately defined, shallow, and in width about ⅓ the labral width; labral tubercles rather small, anteriorly flattened; labral lamella slightly to markedly wider than the furrow, the margin moderately curved. Mandible without basal keel, with distinct sulcus obliquus, moderate incisura lateralis, and with the basal area strongly alutaceous and dispersely punctured. Eyes directed in front of posterior mandibular condyle. Ocellar-orbital field with a broad band of coarse and fine punctures. Ocelli in front of supraorbital line. A_3 nearly twice as long as distal width, markedly shorter than A_{4+5}. A_4 about as long as distal width, hardly shorter than A_5. Mid-basitarsus with posterior distal angle rounded oblique, outside without tuft of long hairs near the base. Hind tibia with outer surface inconspicuously alutaceous and with dorsal inner distal angle distinct. Hind basitarsus with outer surface smooth, sparsely covered with short brownish pubescence, the posterior margin rather curved. Surface of T_{2-5} smooth with rather dense puncturing. T_6 granulate with a more or less pronounced median longitudinal furrow continuing backwards in a keel, often being concealed by hairs; the distal edge thickened. Keel of St_6 rather feeble. Wings hyaline except the infuscate distal ribbonless part. Coat rather even, short.

Queen measurements: N=6; Sweden: Skåne; malar space: 0.59 mm ($\pm$0.03 $\pm$0.01) range: 0.55–0.63 mm; 'radial length': 4.18 mm ($\pm$0.16 $\pm$0.07) range: 3.95–4.40 mm; interalar width: 5.04 mm ($\pm$0.16 $\pm$0.07) range: 4.78–5.28 mm. Body of medium to large size.

Colour pattern. Fringe of labrum and mandible brownish. T_{4-6}, St_{4-6} with reddish to bright ferruginous hairs, those of the sternites usually of paler shade. Otherwise coat black.

Variation. Extremely colour-stable. A single worker with predominantly ferruginous corbicular fringes was examined.

Male

Morphological characters. Head about as long as wide. Malar space about 4/5 shorter than distal width and about as long as A_3. Mandible bifid with a broad ventral and a small dorsal tooth. Eyes directed in front of posterior mandibular condyle. Antennae rather long Fig. 30A; A_3 about 4/5 shorter than A_5; A_4 equal in length to the distal width and about 3/5 as long as A_5.

A_{5-13} individually almost parallel-sided and about twice the distal width of the segment. Hind tibia with outer surface rather flattened, slightly alutaceous, almost bare and with longest hairs in posterior fringe shorter than twice the greatest width of the segment. Hind basitarsus narrowing towards the base (Fig. 30B), longest hairs in posterior fringe about as long as greatest width of the segment. St_8 and genitalia as in Figs. 30C–D; inner margin of gonostylus with protruding processes varying in shape; volsella long, distally not emarginated but obliquely truncate; hooks of penis valve turned inwards, almost sickle-shaped though a little pointed at the tip.

Colour pattern. Beard yellow. Pile of face below antennal sockets, pile of vertex and ventral part of head predominantly yellow; hairs of head otherwise black. Interalar band posteriorly curved including black hairs of scutellum. Lateral pile of propodeum, pile on T_3 black. Fore- and middle legs and all femora with a variable admixture of black hairs. T_{4-7} with reddish to bright ferruginous hairs. Otherwise coat yellow.

Variation. Hairs of venter of head predominantly black, interalar band more or less indistinct owing to variable admixture of yellow hairs in front and behind.

Distribution (Fig. 58)

Scandinavia. Restricted to southernmost Sweden. Rare.

Biotope: Apparently arid fields.

A total of 37 specimens was examined.

List of localities. *Skåne:* ?loc. ♂ DCL ♂ TCL, Hälsingborg 6♂♂ (Muchardt) VCA, Kävlinge ♂ TCL and ♀ 27 Aug. 1839 (Dahlbom) TCL, Lund ☿♂ TCL and ☿ 10–29 July 1957 (Kruseman) ZMA, Råby in Lund ♂ TCL, Vomb ♂ 14 July 1930 (Kemner). *Öland:* Bengtstorp ♂ 18 Sept. 1930 ♀♂ 24 Sept. 1930 ♂ 10 Sept. 1932 ☿♂ 14 Sept. 1933 (Nilsson), Kastlösa ☿ 10 July 1930 (Nilsson), Kleveby 3 ♀♀ 3 Aug. 1930 (Nilsson). Mörbylånga ☿ 21 July 1930 ♀ 31 July 1930 ♀ 2 ♂♂ 12 Sept. 1930 ♀ June 1932 ☿ 16 Aug. 1932 (Nilsson), Norra Alvaret ♂ 1–15 Aug. 1911 (Stovner), Segerstad ♀ 21 July 1932 (Wieslander) NRS, Skogsbyn ♂ 15 Aug. 1925 (Brinck), Vickleby ♂ 26 Aug. 1933 (Ehnbom), Väverstad ♂ 28 Aug. 1939 (Erl.) NRS.

Correction. There is no specimen from Norway Buskerud (Bv): Hol (Strand 1898a) traced in collections. The record is obviously due to misidentification. Occurrence in Gotland (Kruseman 1959) might moreover be due to misinterpretation of locality label. The information refers to a specimen kept ZML (Kruseman in litt.), but no records from Gotland were traced in the collections.

The total distribution of the subspecies, B. c. cullumanus (Kirby). Europe (Southeastern England; The Netherlands; Germany; Denmark (Als, Bornholm); Southern Sweden) (Yarrow 1954). Everywhere rare and restricted to coastal areas apparently associated with chalk.

Biology

Flight season. The meagre collecting data available indicate a flight period from the beginning of June to the end of September.

SUBGENUS *PYROBOMBUS* DALLA TORRE

Pyrobombus Dalla Torre, 1880, p. 40. Type-species *Bombus hypnorum* (Linnaeus). Monobasic.

(*Pratobombus* Vogt, 1911, p. 49, type-species *Bremus pratorum* (Linnaeus) = *Bombus pratorum* (Linnaeus) by designation of Frison (1927).)

Taxonomical remarks

The subgenus includes a large number of palearctic, tropical, and nearctic species presenting more morphological variations, for one thing in length of malar space and structure of male genitalia, than other subgenera of *Bombus*. The description below applies to the North European species of the subgenus. Discrepancies, variation in features when only associated with other species, are not included.

Queen, worker

Head about as long as broad or slightly longer. Malar space as long as distal width or shorter. Clypeus slightly convex, about as long as distal width or nearly, anterior lateral impressions well-

Fig. 58. *B. cullumanus* (Kirby). Legends as in Figs. 50, 54.

defined, coarsely punctured. Labral tubercles anteriorly flattened or feebly depressed; labral lamella semicircular, not much broader than labral furrow. Mandible without basal keel, with no sulcus obliquus or this being indistinct and with moderate to well-defined incisura lateralis (Fig. 16A). Eyes directed in front of posterior mandibular condyle. Supra-orbital line touching or just above lateral ocelli (often transecting lateral ocelli in workers). A_3 twice the distal width or hardly so, about ¾ as long as A_{4+5}. Distal margin of mid-basitarsus posteriorly rounded. Hind tibia slightly or not alutaceous, dorsal inner distal angle feebly or not produced (Fig. 16B); hind basitarsus with posterior margin straight or slightly curved. St_6 with short indistinct keel or no keel. Wings evenly, rather feebly infuscate.

There is a distinct difference in size between the queen and the worker caste.

Male

Head about as long as broad or slightly longer. Malar space one to almost 1½ times the distal width. Clypeus about as broad as distal width or just shorter. Mandible bidentate with a large ventral and a small dorsal tooth. A_{5-13} individually almost parallel-sided and shorter than twice the distal width of the segment (Figs. 34A, 35A). Hind tibia flattened to moderately convex, the outer surface sparsely to moderately covered with hairs of various length, occasionally with bare area in front of distal edge. St_6 feebly to moderately thickened distally (distinctly thickened in *B. lapponicus* (Fabricius)). St_8 and genitalia as in Figs. 33A–D, 34B–D, 35B–D, 36A–C 37A–C; volsella barely reaching beyond gonostylus, which is subtriangular without endite processes.

Scandinavian species

The subgenus is represented by a total of five Scandinavian species, viz. *B. cingulatus* Wahlberg, *B. hypnorum* (Linnaeus), *B. jonellus* (Kirby), *B. lapponicus* (Fabricius) and *B. pratorum* (Linnaeus).

The very close interspecific relationship in the unit is illustrated by triangular graph (Fig. 59). The fact that *B. pratorum* and *B. jonellus* display a separate spreading of the markings confirms their specific difference. They were for a period

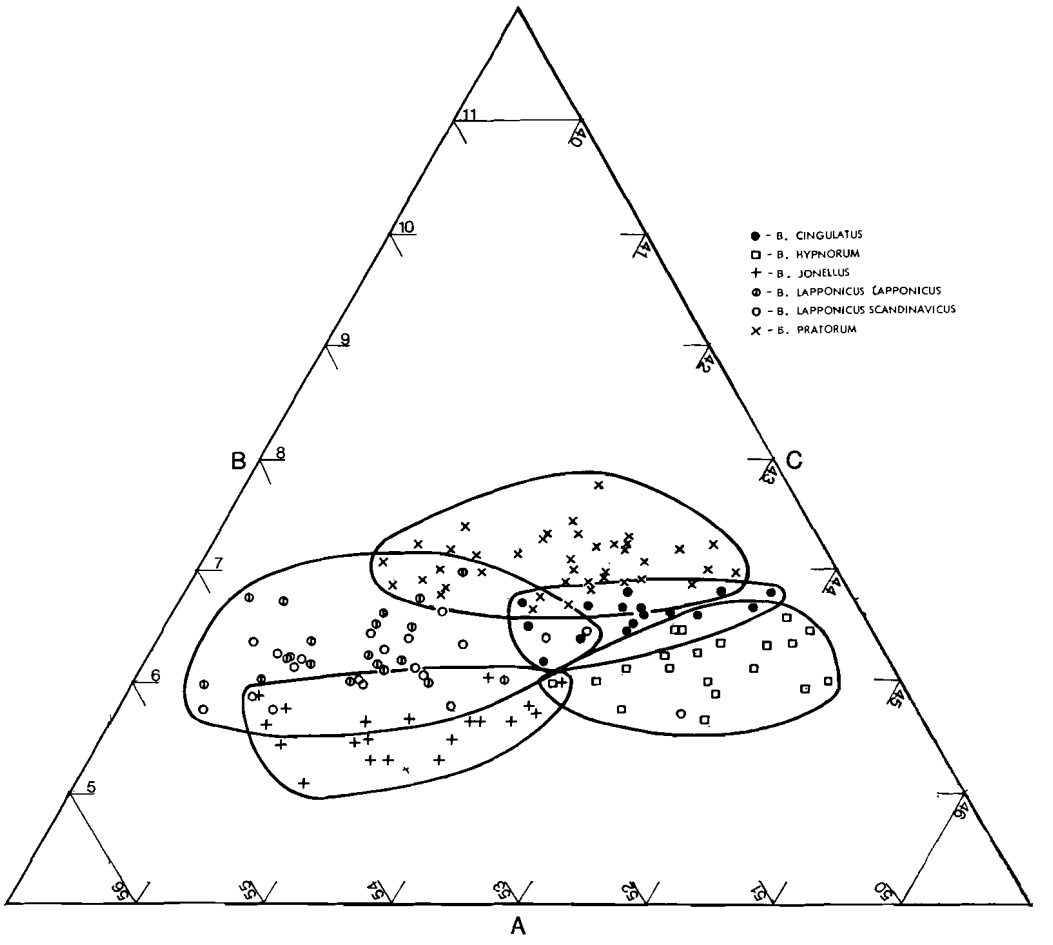


Fig. 59. Triangular graphing of malar space (A), 'radial length' (B) and interalar width (C) of five species of the subgenus *Pyrobombus* Dalla Torre.

treated as being conspecific, the latter considered as a subspecies of the former, cf. p. 69. The rather small, well-defined area on the chart occupied by *B. cingulatus* is moreover noteworthy and emphasizes the specific position of this taxon. *B. cingulatus* was, with exception of the designator and Boheman (1857), treated as a variety of *B. hypnorum* until Reinig (1936) re-established its specific rank.

BOMBUS (PYROBOMBUS) CINGULATUS WAHLBERG

Bombus cingulatus Wahlberg, 1854, pp. 207, 208–209, lectotype ♀ TCL! selected by Ander (1967). Type loc. Sweden: Norrbotten: Nederkalix: Yttermorajärv.

(*Bombus cingulatus* Wahlberg; Wahlberg 1855; Boheman 1857, p. 17; Reinig 1936; Kruseman 1959; Elfving 1960, 1968; Løken 1960; Ander 1965; *Bombus hyphorum* var. *c* Thomson 1872; Strand 1898a. *Bombus hypnorum* var. *cingulatus* Wahlberg; Friese 1902; Aurivillius 1903; Bengtsson 1903, 1904; Sparre Schneider 1909, 1918; Friese & Wagner 1912; Ringdahl 1915; Lundblad 1924; Soot-Ryen 1925; Meidell 1934a; Løken 1949, 1950.)

First Scandinavian records

Norway. Troms (TRi): Målselv: Nordmo (Sparre Schneider 1909).

Sweden. Norrbotten: Nederkalix: Yttermorajärv (Wahlberg 1854).

Queen, worker

Morphological characters. Malar space as long as distal width or just so, exceeding the length of A_3 but shorter than A_{2+3}. Disc of clypeus almost impunctate centrally, otherwise with singly coarse punctures in between some very fine ones and with well-separated lateral impressions which are broad and with sparse, coarse punctures. Labral furrow moderate, varying in width but narrower than ⅓ the labral width; labral tubercles usually densely punctured at the base, the microsculpture smooth or indistinctly alutaceous. A_4 just shorter than distal width or equal to it. Longest hairs in posterior fringe of hind basitarsus exceeding half the greatest width of the segment. Surface of T_{4-5} with more or less alutaceous microsculpture and moderate puncturing. T_6 strongly alutaceous, dull, the puncturing rather dense, even, often with indication of longitudinal median furrow and distally more or less dimpled. Coat shaggy, less dense than in *B. hypnorum*.

Queen measurements: N = 15; SE Norway; malar space: 0.58 mm (±0.02±0.01) range: 0.53–0.60 mm; 'radial length': 3.75 mm (±0.11 ±0.03) range: 3.50–3.90 mm; interalar width: 4.48 mm (±0.14±0.04) range: 4.18–4.65 mm. Body of small to medium size.

The smaller specimens of the workers were difficult to distinguish from *B. hypnorum*.

Colour pattern. Pile of vertex yellowish-brown encroached by black hairs; dorsum of thorax, including narrow adjacent edge of episternum, yellowish-brown except for a more or less pronounced interalar band not reaching the extreme posterior margin of mesonotum. Pile of T_1, anterior margin or anterior lunate part of T_2 yellowish-brown; about distal half of T_4, entire T_{5-6}, at least lateral part of fringes of St_{4-5}, St_6 whitish; otherwise coat black.

Variation. Pile of vertex predominantly or entirely black. Black hairs on dorsum of thorax ranging from a few single hairs on the disc to a well-defined interalar band. Occasionally, workers have no black hairs on dorsum thorax, and a well-defined interalar band is only observed in queens. Hairs on T_1 more or less replaced by black ones, preferably in lateral tufts. Occasionally hairs on T_{1-2} completely black. White hairs on T_4 ranging from covering about distal half of the tergite to a few hairs along the distal margin.

Male

Morphological characters. Malar space about as long as distal width and as long as A_{2+3}. Antennae short (Fig. 35A); A_3 about ¾ the length of A_5, equal to A_4 or just longer; A_4 as long as

distal width or just longer. Fringes of hind tibia not dense, longest hairs in the posterior fringe twice the greatest width of the segment or longer. Hind basitarus usually longer than three times the greatest width, longest hairs in posterior fringe distinctly exceeding this width. St_8 (Fig. 35B); gonostylus, volsella (Fig. 35C); penis valve (Fig. 35D). Coat shaggy, body of small size.

Colour pattern. Beard yellowish-brown. Pile of face at least below antennal sockets predominantly yellow; pile of vertex with variable admixture of pale yellow or pale yellowish-brown hairs. Dorsum of thorax yellowish-brown with variable admixture of black hairs on the disc, sometimes forming an indication of interalar band. Pile of T_1, anterior lunate part of T_2 yellowish-brown; hairs on T_{5-7} whitish. Genal area and venter of head, venter of thorax, trochanters, inner part of femora, gastral sternites with predominantly pale yellow to whitish hairs. Otherwise coat black.

Variation. A variable amount of light coloured hairs on head, episternum, venter may be replaced by black ones. Fringes of hind tibia and hind basitarsus pale yellowish-brown, whitish or tipped so. Otherwise variations as in the females.

Distribution (Fig. 60)

Norway. In the southeastern part of the country a widespread, local occurrence inland and furthermore dispersely distributed from the area around Trondheimsfjorden (STi) north to about 70° N. Only twice recorded at the western side of the mountain-chain in Central Norway, viz. in the inner districts of the counties Hordaland and Sogn og Fjordane. Finds on the extreme coast, viz. on a small island Hushattøy just north of 70° N. cf. the list below, are questionable as they concern three tiny workers which were difficult to distinguish from *B. hypnorum* workers collected the same day.

The species has only been sporadically observed outside *regio coniferina* (cf. Figs. 2 and 60). In Southern Norway recorded to 1000 m.s.m.

Biotopes: Meadows, pastures.

A total of 96 specimens was examined.

List of localities. *Akershus:* Nes: Grinkelsrud; Hurdal: Tömte. *Hedmark (HEs):* Elverum: Grunset ZMO. *Oppland (Os):* Gran: Einavold; Söndre Land: Fluberg; Nordre Land: Kinn, Åmot; Sör-Aurdal: Breidablikk, Reinli; Nord-Aurdal: Knutshaugen, Sæbuöygard N Fagernes, Åbjör; Öyer: Aksjö 1000 m, Öyer kirke, Åstdal 900 m; Ringebu: Ringebu. *Buskerud (Bö):* Krödsherad: Veikåker; Modum: ?loc. ZMO; Flesberg: Hvila, Öydegarden. *Bv:* Sigdal: Kopseng; Ål: ? loc. ZMO, Votnedalen. *Hordaland (HOi):* Ullensvang: Fossli 750 m ☿ 29 July 1943 (Lø). *Sogn og Fjordane (SFi):* Aurland: Berekvam sea level ☿ 8 July 1965 (Lø). *Sör-Tröndelag (STy):* Åfjord: Å. *STi:* Trondheim ZML. *Nord-Tröndelag (NTi):* Leksvik: Storvann; Verdal: Sandvika, Sulstua; Höylandet: Skilleberget. *Nordland (Nsi):* Grane: S Båfjellmo, Majavann; Vefsn: Ravasbakken; Saltdal: Drageid, S Lönsdal. *Troms (TRy):* Tromsö: Breivik SMS; ? Karlsöy: Hushattöy 3 ☿☿ 25 July 1935 (Soot-Ryen) TRM. *TRi:* Målselv: Bjerkeng TCL, Frihetsli TRM, Kirkesdal, Nordmo TRM ZMO, Sörli, Trosdal; Nordreisa: Nedrefoss, Sappen. *Finnmark (Fi):* Alta: Gargia. *Fö:* Sör-Varanger: Tangenfoss ZMO.

Unrevised record: *Troms (Try):* Tromsö ♀ (Sparre Schneider, 1918, p. 23).

Sweden. Widely distributed from Dalarne about 60° 40′ N and north throughout the country.

A total of 225 specimens was examined.

List of localities. *Dalarne:* Bingsjö NRS ZML, Fulufjäll NRS, Lima, Rättvik NRS Tje, Sandsjö, Stora Tandån NRS, Storvarden 775 m, Sälen ZMA. *Medelpad:* Köllsillre NRS, Överturinge NRS, Ånge. *Härjedalen:* Tänndalen NRS. *Jämtland:* Bispgården NRS, Döda-Fallet NRS, Hallen, Jormlien, Mattmar, Mullfjället, Oviken, Undersåker NRS. *Ångermanland:* Orsjön, Ramsele GNM, Stennäs. *Västerbotten:* Bodarna NRS, Degerfors NRS, Grimsmark ZMB, S Åbyn ZMB. *Norrbotten:* Boden NRS, Edefors NRS ZML, Kalix NRS, Karungi, Kengis ZMA, Korpilumbolo, Lillpite NRS, Långträsk, Nybygget NRS, Pajala NRS, Piteå, Roknäs NRS, Strömsund NRS, Töre ZMB, Yttermorajärv TCL, Övertorneå NRS. *Lapland (Ås. Lpm.):* Bångnäs, Dorotea NRS, Fatmomakke, Njakafjället, Saxnäs, Vilhelmina NRS. *Ly. Lpm.:* Ammarnäs, Ankarsund, Blattnicksele GNM, Björkfors, Brattfors NRS, Sickelsberg NRS, Stensele, Stensundforsen NRS, Tärna. *P. Lpm.:* Arvidsjaur IVU, Piteälv-Ljusselforsen. *Lu. Lpm.:* Malmberget. Njueravuolle NRS, Njunjes, Sarek, Tarradalen NSR. *T. Lpm.:* Abisko ZMA, Holmajärvi, Jukkasjärvi NRS, Kiruna NRS, Mell. Meräsjärvi NRS, Svappavaara NRS, Vittangi NRS.

Finland. Scattered occurrence in the eastern and northern part of the country, between 62° and 70° N. (Elfving 1968).

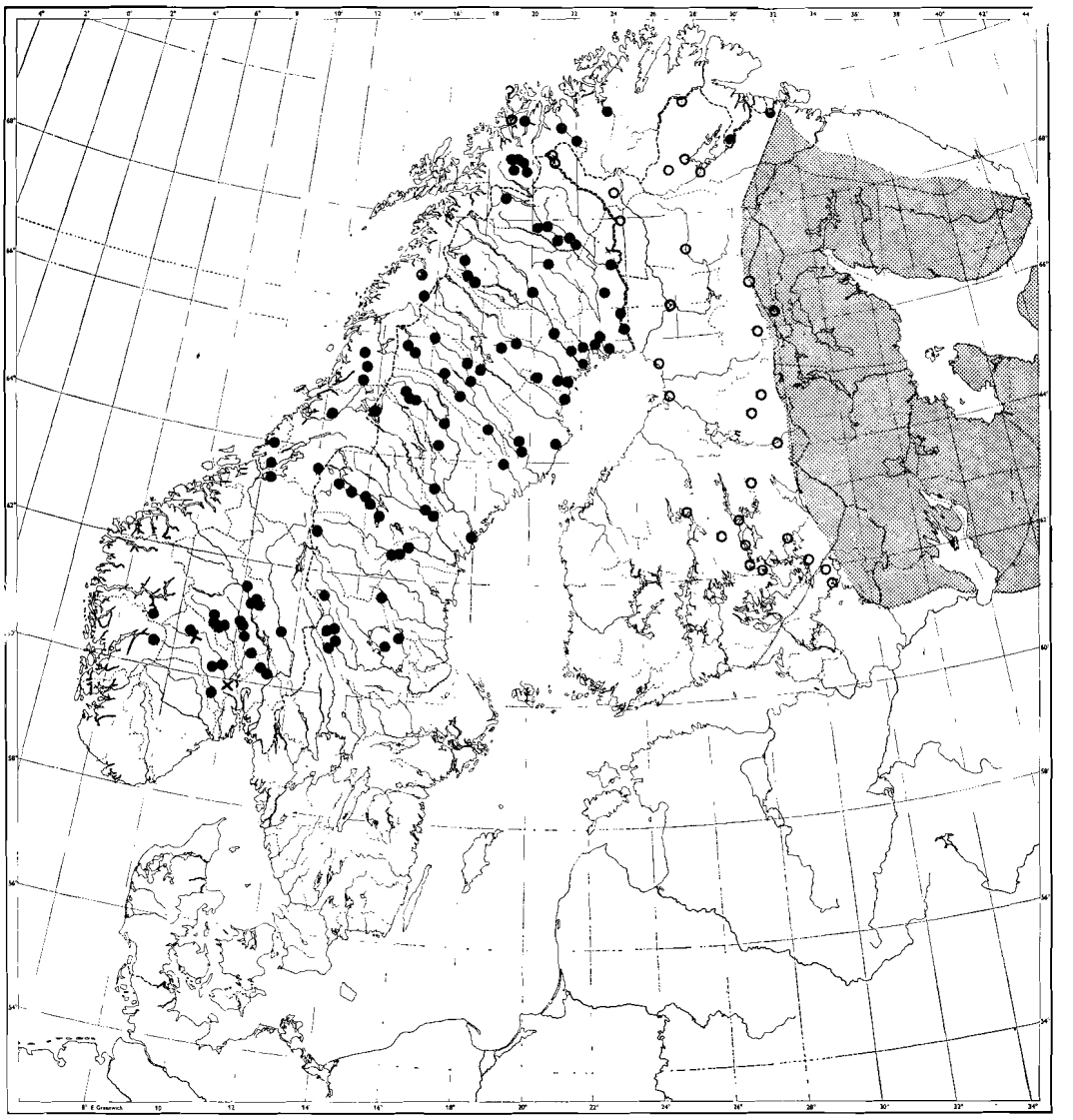


Fig. 60. *B. cingulatus* Wahlberg. Legends as in Figs. 50, 54.

World distribution. Europe (Fennoscandia; Northern part of European USSR – Northern Urals – Northern Siberia – Kamchatka. (Reinig 1939, p. 182; Panfilov in litt.).

Biology

Flight season. Beginning of May to beginning of September. Queen: 14 May – 7 Sept.; worker: ?–13 Aug.; male 12 June–12 Aug.

BOMBUS (PYROBOMBUS) HYPNORUM (LINNAEUS)

Apis hypnorum Linnaeus, 1758, p. 579 No. 33, type area Sweden: *Uppland.* A queen LSL, labelled *hypnorum*, disagrees with the usual interpretation of the taxon. It was recently revised to *B. lucorum* (Yarrow in litt. 1967).

(*Bombus hypnorum* (Linnaeus); Sommerfelt 1824–27; Dahlbom 1832, p. 50; Boheman 1844,

p. 95; Siebke 1853, 1870, 1873, 1880; Wahlberg 1854; Thomson 1870, 1872; Nerén 1892; Sparre Schneider 1895b, 1909, 1918; Roth 1897; Strand 1898a, 1898b, 1910; Lie-Pettersen 1901, 1907; Friese 1902; Aurvillius 1903; Bengtsson 1903, 1904, 1908, 1931; Muchardt 1904; Ringdahl 1915; Lundblad 1924; Soot-Ryen 1925; Gaunitz 1929; Hellén 1933; Meidell 1934a; Wexelsen & Skåre 1934; Reinig 1936; Løken 1949, 1950, 1954, 1958a, 1966c; Forsslund 1951; Tjeder 1954; Kruseman 1959; Elfving 1960, 1968; Erlandsson 1960; Fridén, Eskilsson & Bingefors 1962; Hasselrot 1962; Ander 1963, 1965; Fridén 1967. *Apis aprica* Fabricius, 1798, p. 273; Zimsen 1964, p. 416 No. 1089. A seriously damaged worker KCC! might be the type, but cannot be identified with certainty (Løken 1966a), type area Sweden: Lapland. *Bombus apricus* (Fabricius); Zetterstedt 1838. *Apis ericetorum* Panzer, 1800–01 part 75 Teil 19. *Apis meridiana* Panzer, 1800–01 part 80 Teil 19. *Bombus calidus* Erichson, 1851, p. 65 No. 141, holotype ♀ MAL type area Siberia. *Bombus hypnorum calidus* Erichson; Dalla Torre 1896.)

Nomenclatural remarks

As many as three specimens in the collection of the Linnaean Society of London, individually labelled *terrestris*, *lucorum* and *hypnorum*, have been revised to *B. lucorum*. It emphasizes the theory that specimens in this collection are not all originals, cf. p. 10. The actual taxon is clearly defined, and to serve stability in nomenclature, *Bombus hypnorum* sensu passed and present authors (Thomson 1872; Schmiedeknecht 1930; Pittioni 1939a; Kruseman 1947; Elfving 1960; etc.) is kept. The species is fairly frequent in Uppland, the home area of Linnaeus which is also the type area.

First Scandinavian records

Norway. Nordland (Nsi): Saltdal (Sommerfelt 1824–27). Though there is no voucher specimen the identification is considered to be correct.

Sweden. Uppland (Linnaeus 1758).

Taxonomical remarks

The Scandinavian population belongs to the nominate form. Thus *B. hypnorum* var. *frigidus* Friese, 1905 nec Smith 1854 (= *B. hypnorum* var. *hiemalis* Friese, 1911), *B. hypnorum* var. *calidus* Erichson, *B. hypnorum* ab. *luridus* Sparre Schneider, 1918 when mentioned as occurring in Scandinavia (Friese & Wagner 1909; Sparre Schneider 1918; Meidell 1934a; Hellén 1933), are infrasubspecific forms.

Distribution

Fennoscandia. Cf. the subspecies.

World distribution. Europe (ranging from NW Spain (Yarrow in litt.), The Pyrenees, France, Belgium, The Alps, The Balkans and north to Arctic Fennoscandia; in European USSR confined to taiga and deciduous forest) – Urals – Siberia – Kamchatka – Vladivostock – Sakhalin – Japan. (Reinig 1939, p. 183; Panfilov 1957; Sakagami & Ishikava 1969).

BOMBUS HYPNORUM HYPNORUM (LINNAEUS)

Queen, worker

Morphological characters. Malar space hardly as long as distal width, exceeding the length of A_3 but shorter than A_{2+3}. Disc of clypeus with disperse punctures of various size and with well-separated lateral impressions. Labral furrow deep and broad, the greatest width almost ⅓ the labral width; labral tubercles usually strongly alutaceous, with sparse coarse puncturing and anteriorly feebly depressed. A_4 barely longer than distal width or equal to it. Posterior fringe of hind basitarsus with the longest hairs about half the greatest width of the segment or nearly so. At least surface of T_{4-5} smooth, shiny with rather fine sparse puncturing. Hairs of T_6 partly arising from coarse shining pustules except in the chagreened, dull distal part which is usually somewhat protruberant. Body rather robust, coat shaggy.

Queen measurements: N = 20; SE Norway; malar space: 0.63 mm (±0.03±0.01) range: 0.58–0.68 mm; 'radial length': 4.44 mm (±0.13 ±0.03) range: 4.15–4.64 mm; interalar width: 5.15 mm (±0.18±0.04) range: 4.75–5.45 mm. Body of large size.

Colour pattern. Pile of vertex predominantly yellowish-brown. Dorsum of thorax and adjacent edge of episternum yellowish-brown. Hairs of T_1, anterior lunate part of T_2 predominantly yellowish-brown. At least posterior half of T_4, entire T_{5-6}, and at least lateral fringes of St_{4-5} (or $_{4-6}$) whitish-haired. Otherwise coat black.

Variation. Pile of T_1 ranging from entirely black to entirely yellowish-brown. Yellowish-brown hairs on T_2 more or less replaced by black ones, occasionally hairs on T_2 entirely black. A few individuals with the yellowish-brown part of coat replaced by dull clayish-brown or even dark brown hairs were examined.

A tendency to geographical variation in Scandinavia was not recognized. More queens with hairs of T_{1-2} entirely black were, however, examined from Northern Scandinavia than from the southern part of the peninsula.

Male

Morphological characters. Malar space as long as distal width or just longer, longer than A_3 but shorter than A_{2+3}. A_3 longer than A_4, equal in length to A_5 or just longer (Fig. 34A); A_4 as long as distal width or just longer. Longest hairs in posterior fringe of hind tibia varying from 1½ to almost twice the greatest width of the segment. Hind basitarsus about 3 times longer than the greatest width, longest hairs in posterior fringe about as long as this width. St_8 (Fig. 34B); gonostylus and volsella (Fig. 34C); penis valve (Fig. 34D). Coat shaggy. Body of medium size.

Colour pattern. Beard brownish. Pile of face below antennal sockets with variable admixture of dull yellow hairs. Pile of vertex entirely or predominantly yellowish-brown. Dorsum of thorax and at least adjacent part of episternum, T_1 at least anterior lunate part of T_2 yellowish-brown. Distal margin of T_4, T_{5-7} whitish-haired. Venter of head and thorax, trochanters, femora, and fringes of gastral sternites with variable admixture of whitish hairs. Otherwise coat black.

Variation. Hairs on T_{1-2} ranging from entirely black to entirely yellowish-brown. Whitish hairs on the tergites may be reduced to an admixture with black hairs on T_{6-7} only.

Distribution (Fig. 61)

Norway. Widely distributed throughout the country north up to about 70° N. In Southern Norway occurring from sea level to *regio subalpina* and sporadically also recorded in the lower belt of alpine zone. Further north confined to the conifer forest and only once observed on the extreme coast north of the Polar Circle, viz. on the small island of Hushattöy in the archipelago just north of 70° N. Also in Southern Norway the abundance is greater inland than along the coast. Recorded to 1000 m s.m.

Biotopes: Meadows, gardens, orchards, roadsides, pastures.

A total of about 1520 specimens was examined.

List of localities: *Östfold:* Hvaler: Asmalöy, Kirköy, Söndre Sandö; Kråkeröy: Tangen, Ödegård; Onsöy: Dypeklo, Rörvik, Torp; Sarpsborg: ZMO; Halden: Blakmose, Kuletjern, Sponvika; Aremark: Aremark, Gjeddetjern; Marker: Damholtet, Rödenes; Rakkestad: Rörvik; Råde: Fuglevik, Oven; Moss: VCA, Jelöy VCA; Eidsberg: Holm; Trögstad: Mönster bru. *Akershus:* Frogn: Dröbak TRM VCA; Asker: Lushattdalen; Bærum: Lysaker ZMO; Oslo: TCL TRM ZMB ZMO; Aurskog-Höland: Björklangen, Gangsnes, Mo, Stigen, Östegård; Fet: Björkflåten; Skedsmo: Strömmen ZMO; Hurdal: Tömte ZMO; Nes: Grinkelsrud; Eidsvoll: Eidsvoll ZMO. *Hedmark (HEs):* Eidskog: Bolfoss, Gjelaråsen; Kongsvinger: Eidsberg; Sör-Odal: ? loc. ZMO; Grue: Finnskog; Hamar: ZMB ZMO. *HEn:* Trysil: Dammen, Enga, Sjöenden, Vestby; Åmot: Glesubekken, Åmot, Åset ZMO; Rendal: Solbakken SW Åsheim ZMO; Tynset: Tyldal, Tynset, Ulsberg; Engerdal: Björköihl, Gutuliseter NE Drevsjö 700 m, Torhus. *Oppland (Os):* Jevnaker: Randsfjord USU; Gran: Gjervika, Granvollen, Rognstad; Östre Toten: Stubdalen; Nordre Land: Dokka USU ZMB; Lillehammer: Stor-Håve; Nord-Aurdal: Knutshaugen SE Fagernes, Leira, Åbjör; Gausdal: Gåsöya 875 m; Öyer: Aksjö 1000 m, Öyer, Åstdalen 900 m; Ringebu: Ringebu. *On:* Vestre Slidre: Ölken; Öystre Slidre: Skammestein 700 m; Vang: Öye USU ZMB; Sel: Heidal TRM ZMB, Leirflata, Mysuseter 900 m, Otta ZMO; Vågå:

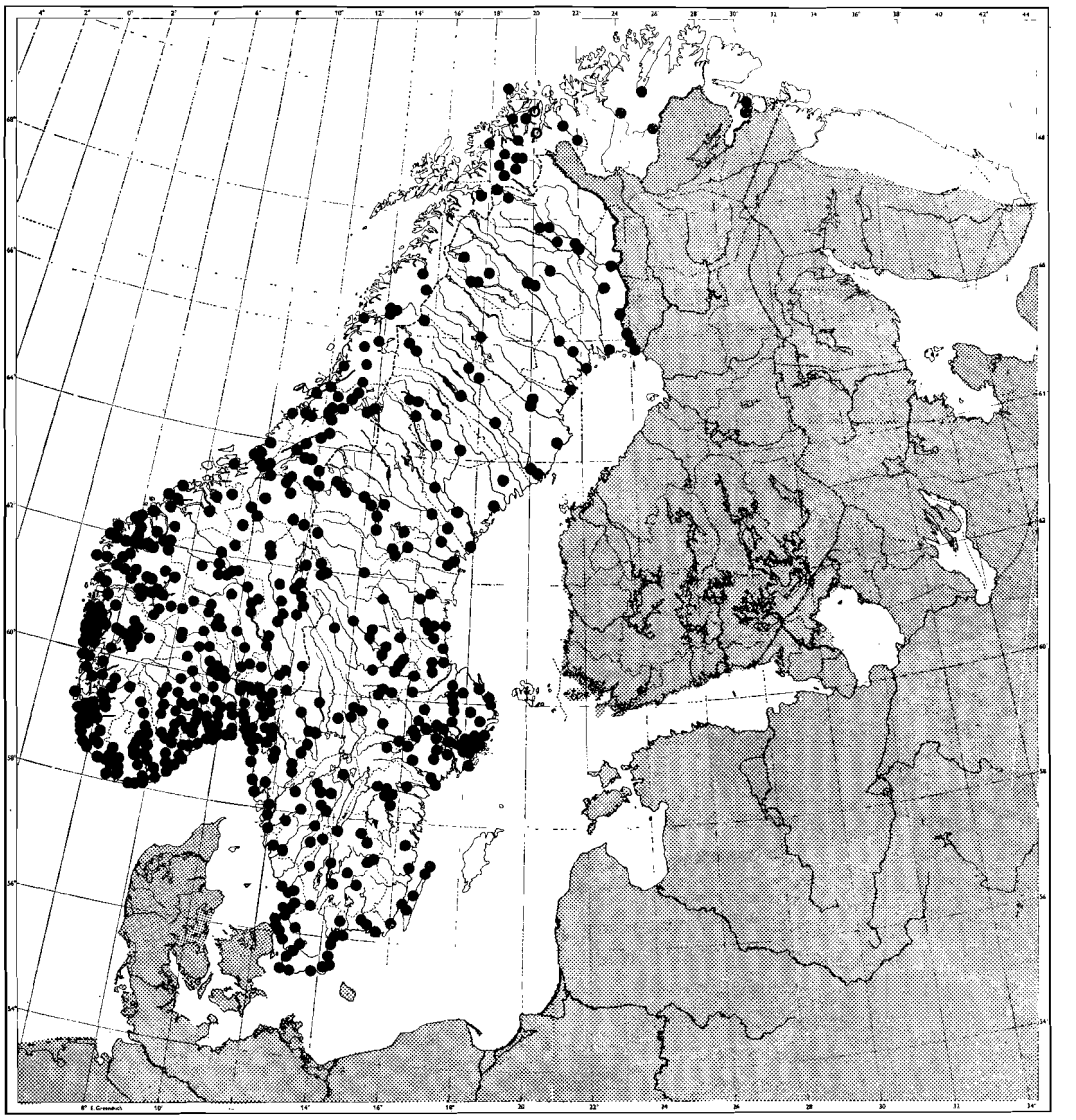


Fig. 61. *B. hypnorum* (Linnaeus). Legends as in Figs. 50, 54.

Klones, Randsverk 800 m TRM, Vågåmo ZMB ZMH ZMO; Lom: Galdesand, Lom; Dovre: Dombås ZMA, Vålåsjö 950 m ZMO. *Buskerud (Bö):* Hurum: Filtvedt TRM, Hurum, Pinadalen; Lier: Drag, Lökke gård, Sylling; Krödsherad: ?loc. ZMO, Glesne, Noresund; Modum: Modum ZMO, Snarum; Flesberg: Hvila, Lampeland; Kongsberg: TRM, Lintvedt. *Bv:* Sigdal: Kopseng, Nedre Eggedal, Prestfoss, Sigdal; Nore og Uvdal: Björkeflåtå, Nörstebö SE Geilo 700 m, Tunnhovd 850 m; Nes: Börtnes; Gol: Gol; Hol: Geilo 800 m, Hovet. *Vestfold:* Sande: Sande; Holmestrand: Angerskleiv, Bogen; Lardal: Styrvoll; Nötteröy: Teie; Tjöme: Kjære, Röd ZMO; Sandar: Eian-Austeröy; Hedrum: Hedrum, N Kvelde; Brunlanes: Tronsröd; Larvik. *Telemark (TEy):* Skien: Kikut, Skien; Porsgrunn: Nystrand; Bamble: Åby; Nome: Vommstöl; Drangedal: Drangedal, Naksjö, Nordbö, Nos, Omnes, Ringnes, Risdalen, To-myra, Åkredalen; Kragerö: Kammerfors, Kragerö. *TEi:* Notodden: Elgsjöen NE Notodden, Tinnoset; Sauherad: Liagrend SSW Notodden; Bö: Sauda, Vatnar; Seljord: Seljord, Svartdal, Vedfallsgrend; Kviteseid: Eidstad, Kviteseid, Vrådal; Nissedal: Kyrkjebygda, Tjönnefoss, Treungen; Fyresdal: Hegglandsgrend,

Moland; Tokke: Åmdals verk; Vinje: Krossen 700 m, Åmot; Tinn: Vålen, Våer W Rjukan. *Aust-Agder (AAy):* Gjerstad: Fiane; Vegårdshei: Ljostad; Tvedestrand: Eidbu, Nes Verk TRM, Strengereid; Arendal: ZMO; Moland: Dal, Holmsund, Tverrdalsöy, Voje; Tromöy: Bjelland, Grimstad; Landvik: Hörte, Molland, Tönnesöl; Lillesand: Blikksund, Kjöpmannsvik, Åmli; Birkenes: Langemyr, Rosseland; Iveland: Fosstvedt. *AAi:* Evje og Hornes: Hornes, Syrtveit; Gjövdal: Krossbekk, Saurbekkflåt, Årli; Bygland: Löndal, Ose; Valle: Kvestad, Valle; Bykle: Bykle. *Vest-Agder (VAy):* Kristiansand: Holskogen; Sögne: Langeneset, Sögne, Åros; Mandal: Mandal, Sånum, Tuftenes; Marnadal: Finsland, Röyseland, Utkjær; Lyngdal: TRM; Kvinesdal: Feda, Gjemlestad, Solås, Öye; Farsund: Fjelleså, Lista Fyr, Lodshavn; Flekkefjord: Ersdal, Espetveit, Flikkeid SMS. *VAi:* Audnedal: Sveindal; Åseral: Espelid, Rosseland, Åseral. *Rogaland (Ry):* Sokndal: Bu, Hauge i Dalane, Sogndal, Åna-Sira; Eigersund: Egersund, Eigeröyeidet, Skjerpe; Bjerkreim: Hovland, Malmeim; Hå: Ogna; Klepp: Börsheim, Klepp, Orre, Reve, Vik, Öksnevad; Time: Mossige; Gjesdal: Ålgård; Sandnes: Brattebö, Hana, Myrland, Sandnes; Sola: Gimre, Solastrand, Tannanger; Stavanger: Forus, Hinna, Lindöy, Stavanger SMS TRM ZMB, Sunde, Våland; Strand: Tau; Finnöy: Judaberget, Sjernaröy; Rennesöy: Dale; Kvitsöy; Karmöy: Sæveland. *Ri:* Forsand: Forsand, Meling; Hjelmeland: Hjelmeland, Kvamme, Vadda, Årdal; Suldal: Jelsa, Sand, Åimjödlonuten 700 m; Sauda: Sauda. *Hordaland (HOy):* Bömlo: Röyksund; Ölen: Dommersnes; Fitjar: Fitjar, Risöy; Austevoll: Karlsöy; Os: Gullholmen, Lepsöy, Lysekloster, Nordströno, Ravneberghaugen; Samnanger: Höyseter; Fana: Biol. st., Birkelundsbakken, Blomsterdalen, Engjavik, Espeland, Fantoft, Lönninghavn, Milde, Rådalen, Skeie, Skipanes, Skjold, Steinsvik, Stend, Storetveit, Sælöy, Titlestad, Övre Kråkenes; Sund: Bjelkaröy, Glesvær, Steinsland, Tyssöy; Fjell: Bjoröya, Eide, Solsvik; Laksevåg: Alvöy, Björndalspollen, Hilleren, Storingaviken; Bergen; Asköy: Ask, Davanger, Herdla, Marikova; Åsane: Haukedal, Åstveitskogen; Osteröy: Fitje, Hamre, Havratun, Kleppe, Lonevåg, Njåstad; Vaksdal: Eidslandet; Meland: Dalstö; Radöy: Vågsbotten; Lindås: Lauvås, Sævråsvåg, Veland. *HOi:* Etne: Oslandsvåg; Kvinnherad: Lio, Ljosmyr, Seimsfoss, Skeie, Varaldsöy; Ullensvang: Alvsaker, Espe, Fresvik, Jåstad, Kinsarvik, Lofthus, Tveito, Övre Eidfjord; Kvam: Kvamskogen, Nordheimsund, Steine, Öystese, Ålvik, Åsheim; Voss: Bömoen, Hjelle, Rong, Tyrlingen; Granvin: Granvin VCA ZMB, Trå; Ulvik: Bergo. *Sogn og Fjordane (SFy):* Gulen: Innre Takle; Hyllestad: Hyllestad, Lekva, Skivenes; Gaular: Bygstad, Vikum; Flora: Florö, Kinn, Reksta, Skorpeidet; Naustdal: Frammarsvik; Förde: Flåten, Hallbreim; Jölster: Hamar; Gloppen: Hjortset, Hope, Hyen; Eid: Heggjabygda, Kjölsdalen, Naustdal, Nordfjordeid, Stårheim, Vedvik; Vågsöy: Bryggja, Målöy, Röysen; Selje: Leikanger. *SFi:* Vik: Tistel, Vik; Aurland: Kvammadalen 950 m, Vatnahalsen 800 m; Lærdal: Bergstölen, Gröte; Sogndal: Kaupanger, Slinde, Sogndal; Leikanger: Hermansverk, Leikanger; Balestrand: Balestrand, Brekka, Fjærland, Flesje, Horpedal, Kvamsöy, Mundalsdalen; Luster: Jostedal, Skjolden; Stryn: Hornindal, Stryn, Videdalen. *Möre og Romsdal (MRy):* Volda: Björkedalsvann; Örsta: Lyngstölvann, Örstavik, Öye; Hareid: Hjörungavåg; Ulstein: Ulsteinvik; Ålesund: Åse; Vestnes: Gjermundsnes; Molde; Aukra: Falkehytta; Averöy: Vevang. *MRi:* Stranda: Geiranger NMW ZMB, Vollset; Norddal: Valldal; Sunndal: Jordalsgrend; Surnadal: Stangvik, Övre Surnadal. *Sör-Tröndelag (STy):* Hitra: Hamn; Rissa: ? loc. VCA, Gafsetåsen, Hasselvika, Stadsbygd, Sötvik; Örland: Bakken; Bjugn: Kotengsvann; Åfjord: Å. *STi:* Oppdal: Driva st., Oppdal; Rennebu: Sörflå; Midtre Gauldal: Stören; Ålen: Reitan; Röros: Myrvann 700 m; Selbu: Medbus; Trondheim: KMT VCA ZMB. *Nord-Tröndelag (NTy):* Flatanger: Sör-Flatanger; Otteröy: Hovika KMT; Namsos: TRM, Strandmoen; Næröy: Breiviken, Saltbotn. *NTi:* Meråker: Meråker, Tovmodal; Stjördal: Draveng, Hegra st.; Leksvik: Storvann; Verdal: Sandvika KMT ZMB, Stiklestad, Vuku; Inderöy: Kirkenesvåg, Skjelvågen; Steinkjer: ZMA, Sem; Namdalseid: Hovika KMT; Grong: Fjerdingen, Grong SMS, Trangen; Snåsa: Brönstad, Hegge, Telnes; Lierne: Seterhaug; Höylandet: Höylandet, Skilleberget, Skogenga; Namskogan: Brekkvasselv KMT, Finnvollan, Namskogan. *Nordland (Nsy):* Brönnöy: Flatmo TRM; Nesna: Hamaröy. *Nsi:* Grane: Båfjellmo, Majavatn, Rotstokkmobekken; Vefsn: Store Björnåvann; Sör-Rana: Bleikvassli; Rana: Åenget, Mo, Rövassdal TRM; Saltdal: ? loc. ZMO, Drageid, Junkerdalsura, Solvågfjell, Storjordet TRM. *Nnö:* Ankenes: Beisfjord ZMA. *Troms (TRy):* Lenvik: Finnsnes; Tromsö: TRM VCA, Breivik SMS; Karlsöy: Hushattöy 5 ♀♀ 25 July 1935 (Soot-Ryen) TRM. *TRi:* Bardu: Bardu, Strömsmo; Målselv: ? loc. VCA ZMB ZMO, Bjerkeng TRM ZMB, Kirkesdal, Moen TRM, Nordmo TRM VCA ZMB, Olsborg NMW ZMB, Rundhaug SMS ZMB ZMO; Balsfjord: ?loc. TRM, Storsteinnes VCA; Nordreisa: Nedrefoss, Sappen. *Finnmark (Fi):* Alta: Jotkajavrre TRM; Karasjok. *Fn:* Porsanger: Hamnbukt. *Fö:* Sör-Varanger: Kirkenes TRM, Langfjorddalen TRM.

Unrevised records are not included here except for the following: *Troms (TRi):* Lyngen: NE Jegervann, NW Furuflaten (Douglas in litt.).

Sweden. Widely distributed throughout the mainland except in *regio alpina/arctica.* Moreover, occurring in Öland but not recorded in Gotland.

A total of about 1200 specimens was examined.

List of localities. *Skåne:* Barkåkra, Bjärred, Bonderup ZMB, Bökeberg ZMB, Båstad, Falsterbo NRS,

Hjärnarp NRS, Hälsingborg NRS VCA ZML, Höganäs NRS, Kivik NRS, Kristianstad NRS, Kungshult, Landskrona ZMB, Listerum NRS, Ljungbyhed, Lund ZMA ZMB ZML, Malmö NRS ZML, Saxtorp NRS, Simrishamn NRS, Skälderviken, Skäralid, Trelleborg ZMB, Vallåkra, Vitemölla NRS, Väsby, Ystad NRS, Ängelholm NRS ZML, Åhus NRS ZMB. *Blekinge:* Backaryd NRS, Karlskrona NRS, Möljeryd NRS, Olofström, Sölvesborg NRS ZMB. *Halland:* Enslöv NRS, Fjärås, Frösakull, Halmstad, Laholm, Skedala NRS, Steninge NRS, Östra Karup. *Småland:* Aneboda ZMB, Brömsebro ZMB, Bränstorp NRS, Flisby NRS, Gasslanda ZMU, Hjorted NRS, Höreda NRS, Hörle NRS, Jönköping NRS, Kalmar NRS, Ljungarum NRS, Markaryd, Nye NRS, Oskarshamn, Ryssby ZMU, Tutaryd ZMU, Villstad NRS, Öreryd NRS, Österkorsberga GNM ZML. *Öland:* Böda NRS, Glömminge NRS, Helludsviken ZMB, Högsrum NRS, Mörbylånga NRS ZML, Stora Rör. *Östergötland:* Bjärka-Säby, Borensberg, Linköping, Rodga NRS, Rystad, Stjärnorp ZMB, Värna. *Västergötland:* Broholm NRS, Falköping NRS, Fredsberg NRS, Grästorp NRS, Göteborg NRS, Herrlungja NRS, Horred NRS, Horshaga, Händene NRS, Karleby NRS, Limmared, Skara GNM NRS, Skövde NRS ZMU, Sparresäter ZMU, Stenum NRS, Töreboda, Ulricehamn NRS ZML, Västra Bodarna, Öjehed. *Bohuslän:* Havstenssund NRS, Hunnebostrand NRS, Lyse NRS, Lysekil NRS, Munkedal, Strömstad, Ytterby NRS, Ödsmål NRS. *Dalsland:* Gesäter ZMB, Holm, Köpmannebro, Mellerud, Nössemark ZMB, Rostock ZMB, Skåpafors NRS, Åmål NRS. *Närke:* Stora Mellösa ZMB. *Södermanland:* Helgarö, Huddinge ZMU, Jättna, Läggestad NRS, Muskö NRS, Oxelösund NRS, Saltsjöbaden NRS, Stjärnhov NRS, Strängnäs ZMB, Stora Sundby NRS, Södertälje NRS, Valla NRS, Vreta NRS, Västerhaninge ZMB, Älta NRS. *Uppland:* Adelsö NRS, Brevik NRS, Danderyd ZMB, Dannemora, Djurö NRS, Dyvik NRS, Eldgarn NRS, Elmsta ZMB, Enköping NRS ZMU, Finsta NRS, Fogdö NRS, Grisslehamn NRS ZML, Havsvik, Harpabol NRS, Ingarö, Knutby ZMB, Ljusterö NRS, Roslags-Kulla NRS, Rungarn NRS, Skokloster ZMB, Stockholm GNM NRS ZML ZMU, Stocksund, Tensta ZMB, Tierp NRS, Träbygget NRS, Ullnasjö NRS, Uppsala BML IVU NRS ZML ZMU, Vassunda IVU, Vendel NRS, Vindö NRS, Värmdö NRS ZML, Yxlan ZMB, Österskär, Österåker ZMU. *Västmanland:* Arboga, Grindbo, Hällefors NRS, Kolbäck NRS, Kvicksund NRS, Kärrbo ZMB, Lindesberg NRS, Sala NRS, Skultuna ZMB. *Värmland:* Arvika ZML, Daglösen NRS, Grums NRS, Gylleby NRS, Horrsjön NRS, Lindfors ZMA, Molkom NRS, Säffle ZML. *Dalarne:* Avesta ZMB, Bingsjö NRS ZML, Bojsenburg, Borlänge ZMA, Falun ZMU, Floda NRS Tje ZML, Hjortnäs NRS, Hällsjön, Idre, Krylbo, Leksand NRS Tje, Ludvika NRS, Mora NRS, Noppikorski, Rättvik NRS Tje, Sandsjö NRS ZML, Siljansborg NRS, Sjurberg NRS, Smedjebacken, Stjärnsund, Städjan ZMA ZML, Sundborn NRS ZML, Sälen ZMA, Västanvik NRS, Älvdalen. *Gästrikland:* Gävle, Hamrångerfjärden, Högbo NRS, Hille-Forsby, Trösken ZMB. *Hälsingland:* Bergvik, Bollnäs NRS, Delsbo, Holmsveden NRS, Järvsjö NRS, Kilafors, Söderhamn ZMB. *Medelpad:* Kölsillre NRS, Liden NRS, Palljacka NRS, Sundsvall NRS, Tuna, Vifors NRS, Överturingen NRS, Ånge. *Härjedalen:* Sveg, Tänndalen NRS. *Jämtland:* Bräcke, Duved ZMB, Döda Fallet, Hallen, Jormlien, Mattmar, Oviken, Storlien, Svenstavik, Undersåker NRS ZMA ZML, Östersund, Åre ZMA. *Ångermanland:* Bondsjö, Härnösand, Ramsele GNM, Solleftea NRS, Stennäs, Säbrå, Örnsköldsvik NRS. *Västerbotten:* Grimsmark ZMB, Gubböle NRS, Jörn, Kusfors, Umeå ZMB ZML. *Norrbotten:* Boden NRS, Bäverbäcken NRS, Erkheikki NRS, Haparanda NRS ZML, Kalix NRS ZML, Karungi, Korpilumbolo NRS, Luleå NRS ZML, Pite havsbad ZMB, Ruskola NRS ZML, Övertorneå NRS ZML, Övre Svartlå NRS. *Lapland (Ås. Lpm.):* Bångnås, Dorotea NRS, Risbäck NRS, Saxnäs NRS, Vilhelmina NRS, Åsele NRS. *Ly. Lpm.:* Björkfors, Gargnäs GNM, Krämatjokko 1000 m, Lycksele NRS, Pansborg ZMU, Sorsele GNM ZMU, Stensele, Stensundforsen ZMU, Tjulträsk BML, Tärna. *P. Lpm.:* Arjeplog. *Lu. Lpm.:* Kvikkjokk NRS ZML, Malmberget NRS ZML, Muddus National Park, Njunjes, Porjus IVU, Rittak, Sarek. *T. Lpm.:* Abisko NRS ZML IVU, Juckasjärve, Kiruna NRS ZMA ZML, Masungbyn, Mell. Meräsjärvi NRS ZML, Svappavaara NRS, Vassijaure NRS.

Finland. Occurring throughout the country except Åland islands (Elfving 1968).

The total distribution of the subspecies, B. h. hypnorum (Linnaeus). Europe. Occurrence within Europe broadly specified in the world distribution of the species p. 64. Apparently intergrading with the asiatic subspecies, *B. h. calidus* Erichson, in the Urals (Panfilov in litt.).

Biology

Nest. The colonies are in general established in dark, sheltered locations above the ground, in hollow trees, abandoned swallow nests, in bird boxes set up in trees. They are moreover recorded in between walls in houses (Hasselrot 1962), in woollen blankets (Sparre Schneider 1909) and in other locations within houses (Fuglår 1963). The choice of nesting sites indicates a stronger preference for areas inhabited by man than the remaining Scandinavian *Bombus* spp. Produce larger colonies than the remaining

Scandinavian species of this subgenus (Bengtsson 1903; Hasselrot 1960 Table 21, 1962).

Flight season. From the end of March to the end of September. Queen: 25 March–24 Sept.; worker: 22 April–10 Sept.; male: 22 June–28 Sept.

BOMBUS (PYROBOMBUS) JONELLUS (KIRBY)

Apis jonella Kirby, 1802, p. 338 No. 90, holotype ♂ KCL! labelled type by Milliron (1960) and holotype by Yarrow (1968), type loc. England: London ('prope Londinum').

(Bombus jonellus (Kirby); Dahlbom 1832, p. 43; Strand 1901, 1910; Friese 1902; Aurivillius 1903; Muchardt 1904; Sparre Schneider 1906, 1909, 1918, p. 15; Wahlgren 1908; Ringdahl 1915, 1921; Lundblad 1924; Soot-Ryen 1925; Gaunitz 1929; Bengtsson 1931; Jansson & Sjöberg 1932; Hellén 1933; Meidell 1934a, 1946; Wexelsen & Skåre 1934; Barendrecht 1941; Brinck & Wingstrand 1949; Løken 1949, 1950, 1954, 1966c; Brinck 1951; Forsslund 1951; Elfving 1960, 1968; Erlandsson 1960; Ander 1963, 1965; Fridén 1967. *Apis scrimshirana* Kirby, 1802, p. 342 No. 92, ☿ KCL! selected as type by Milliron (1960), is disputed by Yarrow (1968). *Bombus scrimshiranus* (Kirby); Dahlbom 1832, p. 39; Boheman 1844, p. 96; Wahlberg 1852, 1854, 1855; Siebke 1870; Thomson 1870, 1872; Aurivillius 1887; Schøyen 1887; Nerén 1892; Sparre Schneider 1895b, 1898; Strand 1898a, 1898b; Lie-Pettersen 1901, 1905, 1907; Bengtsson 1904, 1908. *Bombus autumnalis:* Zetterstedt, 1838 nec Fabricius, 1793. *Bombus martes* Gerstaecker, 1869, p. 137 No. 4, lectotype ♀ IZB! hereby selected, the labels are as follows: 1) Ober-Bayern, Kreuth. 4–8. Gerstaecker S (printed); 2) red type label; 3) *martes* Gerst. ♂♀ (handwritten); 4) *B. jonellus* A. Løken det. 1965; 5) *B. martes* Gerst. lectotype designated A. Løken 1965. Type loc. Germany: Ober-Bayern: Kreuth. *Bombus hortorum:* Siebke 1880 (partim). *Bombus pratorum* var. *jonellus* (Kirby); Friese & Wagner 1909; Alfken 1913. *Bombus pratorum – jonellus* var. *suecicus* Friese, 1911, p. 572, type loc. Sweden: Norrbotten: Kolari. A queen IZB!, labelled Schweden: Malung 7.31 Pfeiffer, has a red type label attached. The locality (Dalarne: Malung) disagrees however with the type locality published together with the designation. *Bombus jonellus suecicus* Friese; Richards 1933. *Bombus jonellus subborealis* Richards, 1933, p. 64 (= *Bombus jonellus atrocarbiculosus* Vogt, 1911 (partim), holotype ♀ (Smith coll. originally named *nivalis* Dahlbom) BML!, type area Norway; Kruseman 1959).

First Scandinavian records

Norway: Finnmark (Fv): Alta: Bossekop (Dahlbom 1832, p. 39).

Sweden: Skåne, Småland, Västergötland, Lapland (Dahlbom 1832, p. 39, 43); queen and worker are treated as *B. scrimshiranus* and male as *B. jonellus*. Though voucher specimens so far have been traced from Lapland only, records from the remaining counties might be correct, except perhaps those from Västergötland, as this area was not represented in other collections being revised either.

Taxonomical remarks

The Scandinavian population is recognized as a subspecies, *B. jonellus subborealis* Richards.

B. j. var. *flavicolor* Friese, 1909, *B. j. suecicus* and the *sparreschneideranius* form of Vogt (1911), all of which designated to Scandinavian forms, are infrasubspecific. A number of colour forms presented to Sweden: Lapland (Lu.Lpm.): Virihaure (Brinck 1951), reflect the vast variations within a limited area as otherwise is the case almost everywhere throughout Scandinavia.

Distribution

Fennoscandia. Cf. the subspecies.

World distribution. Europe (British Isles; Iceland; on the continent ranging from NW Spain, France (the mountains), Belgium (Ardennes), the Alps, the Balkans and north to Arctic Fennoscandia; European USSR (most frequent in the

northern part)) – Turkey (Pontian mountains) – Southern Urals – Siberia – Altai – Amur region – Kamchatka (Richards 1933; Pittioni 1938; Panfilov 1957 and in litt.; Yarrow in litt.). *B. jonellus* is the only *Bombus* species occurring in Iceland (Petersen 1956).

BOMBUS JONELLUS SUBBOREALIS RICHARDS

The subspecies differs from the nominate form in merely one character, the black corbicular fringes. Those of the nominate subspecies are pale reddish.

Queen, worker

Morphological characters. Malar space about ¾ the distal width, equal in length to A_3 or just longer. Disc of clypeus almost impunctate, i.e. with a few coarse punctures in between some very fine ones, the lateral well-separated impressions with rather dense coarse puncturing. Labral furrow moderate, in width markedly less than ⅓ the labral width. A_4 hardly as long as distal width. Outer surface of hind tibia feebly alutaceous. Hind basitarsus with longest hairs in posterior fringe exceeding half the greatest width of the segment. Surface of T_{2-6} chagrinated with rather dense puncturing, the punctures more or less elevated to pustules. T_6 distally more or less dimpled and with indication of longitudinal median impression, the distal edge not much thickened. Coat fairly even.

Queen measurements: N = 20; SE Norway; malar space: 0.50 mm (±0.02±0.01) range: 0.45–0.55 mm; 'radial length': 3.67 mm (±0.10 ±0.02) range: 3.50–3.90 mm; interalar width: 4.72 mm (±0.18±0.04) range: 4.33–5.03 mm. Body of medium size.

Colour pattern. Pile of vertex with variable admixture of yellow; collar including adjacent margin of episternum, scutellum except for narrow anterior margin, T_1 and anterior lunate part of T_2 with yellow hairs. Distal margin of T_3, T_{4-6}, at least lateral part of fringes of St_{4-5} whitish-haired. Coat otherwise black. Interalar band usually broad, about twice the width of the collar.

Variation. Various amount of yellow hairs may be replaced by black ones. Extreme melanic specimens with yellow pile reduced to a few hairs on distal part of scutellum were examined. Corbicular fringes occasionally more or less ferruginous-tinged, yet of darker shade than typical for the nominate subspecies. The shade in yellow pile ranges from pale lemon- to sulphurous-yellow.

Male

Morphological characters. Malar space about as long as distal width, as long as A_{2+3}. A_3 markedly longer than A_4, hardly to distinctly shorter than A_5. A_4 about as long as distal width. Longest hairs in posterior fringe of hind tibia about 1½ times the greatest width of the segment. Longest hairs in posterior fringe of hind basitarsus nearly 1½ times the greatest width of the segment. St_8 and genitalia (Figs. 33A-B); gonostylus and volsella (Fig. 33 C); penis valve (Fig. 33 D). Coat shaggy. Body of medium to small size.

Colour pattern. Pile of face below antennal sockets predominantly yellow as also pile of vertex. Yellow collar extending at least half way down episternum. Hairs of scutellum, T_1, and anterior margin or lunate part of T_2 yellow. Hairs of distal part of T_4, T_{5-7} whitish, hairs of sternites, trochanters, femora predominantly whitish. Otherwise coat black. Parallel-sided interalar band.

Variation. Yellow collar varying in width, occasionally covering more than half the dorsum of thorax. Yellow hairs in anterior part of scutellum more or less replaced by black ones. Interalar band correspondingly varying in width and more or less posteriorly curved. Hairs on T_2 ranging from being all black to all yellow; when yellow, pile of venter and femora predominantly yellow and fringes of hind tibia and hind basitarsus usually becoming pronounced yellowish-brown or yellowish-white tinged. Whitish hairs of T_{4-7} often yellowish tinted, in particular in newly

emerged individuals, or more or less replaced by black ones. In melanic specimens hairs of venter and legs turn black and the amount of yellow hairs is more or less reduced.

Distribution (Fig. 62)

Norway. Widely distributed throughout the entire country, from the extreme southern and western archipelagoes to the arctic coast. In general confined to heather and adjacent meadows occurring from sea level to *regio alpina/arctica.* Cultivated areas are avoided and the species therefore only rarely recorded at the western side of Oslofjord. Sparre Schneider (1918, p. 15) and Meidell (1934a, p. 127) point out the absence of the species in southeastern lowlands. However, recent observations show frequent occurrences also in this part of the country, but restricted to biotopes left between agricultural areas. In Southern Norway recorded 1300 m s.m.

Biotopes: *Calluna* and *Vaccinium* heaths, meadows, pastures, mountains-meadows, etc.

A total of about 2800 specimens was examined.

List of localities. *Östfold:* Hvaler: Akeröy, Festningsöy, Herföl, Kirköy, Söndre Sandö; Onsöy: Dypeklo, Ramseklo, Torp; Halden: Asak, Blakmose, Hakelund, Halden, Kuletjern, Nordbakke, Veggesdal; Aremark: Damholtet, Gjeddetjern, Mymosetjern, Skodsberg; Marker: Damholtet, Dypedal, Flagghytta TRM, Jåval, Rödenes, Örje; Rakkestad: Levernes, Rörvik; Råde: Tom; Eidsberg: Holm. *Akershus:* Frogn: Dröbak VCA, Sönderstöa TRM; Asker: Lushattdalen; Bærum: Bråtan; Oslo: ZMA, Slemdal TRM; Rælingen: Fjerdingsby; Aurskog-Höland: Björklangen, Löken, Mo, Skogen, Östergård; Fet: Björkflåten; Nes: Grinkelsrud; Eidsvoll: Feiring. *Hedmark (HEs):* Eidskog: Bolfoss, Gjelaråsen; Kongsvinger: Eidsberg; Sör-Odal: ZMO; Hamar: ZMO. *HEn:* Trysil: Dammen, Enga, Sjöenden; Rendal: Solbakken SE Åsheim ZMO; Folldal: Dalen 800 m, Krokvik 750 m; Tynset: Dallvang SMS, Ulsberg; Tolga-Os: Hodalen 770 m; Engerdal: Björköihl, Gutuliseter 700 m, Jyltingsvola 850 m, Torhus. *Oppland (Os):* Gran: Einavold, Gjervika, Rognstad; Nordre Land: Dokka USU; Etnedal: Bruflat; Nord-Aurdal: Flya 850 m, Hovda 760 m, Sæbuöygard N Fagernes, Åbjör; Gausdal: Gåsöya 875 m; Öyer: Aksjö 1000 m, Öyer, Åstdalen 900 m, Åstdalshö 1100 m; Ringebu: Flaksjöen 910 m, Ringebu, Venabygd. *On:* Vestre Slidre: Kinnholt 1000 m; Öystre Slidre: Skammestein; Vang: Eidsbugarden 1100–1200 m, Grunke 950 m, Öye USU, Öylo ZMO; Fron: ? loc. ZMO, Eldåseter 950 m; Sel: Klakshaug, Mysuseter 900 m; Vågå: Gjendesheim 1000 m BML ZMB, Hindseter 900 m, Klones, Leirungen 1050 m, Lemonsjöen 860 m, Randsverk 800 m, Sjodalsbu 950 m, Skjerva-Jondal 800 m, Storhaugseter 900 m, Valdresflya 1150 m, Vågåmo ZMB ZMH, Övre Sjodalsvann 950 m; Lom: Galdesand, Kvamme, Leirdalen 900 m; Skjåk: Grotli 900 m, Skjåksetrene 800 m, Strynsfjellet 1100 m; Dovre: Dombås ZMU, Dovrefjell 1000 m VCA ZMO, Fokstua 930 m ZMB ZMO, Vålåsjö 950 m ZMO. *Buskerud (Bö):* Hurum: Pinadalen; Lier: Sylling; Modum: Snarum; Flesberg: Hvila NNW Kongsberg, Lampeland, Öydegarden NNW Kongsberg; Kongsberg: Skollenborg. *Bv:* Sigdal: Haglebu, Kopseng, Nedre Eggedal, Nordbygda; Nore og Uvdal: Gavlenseter 1120 m, Nörstebö, Solheimstul 1000 m, Sönstervann 1050 m, Tunnhovd 850m, Övre Hein 1160 m; Gol: Randalseter 940 m; Hemsedal: Kjölen 1000 m, Lykkja 900 m, Muren; Ål: ? loc. ZMO, Bergsjö 1100 m, Laudalseter 1150 m, Tvist 1080 m, Vallehalle 1120 m; Hol: Dagali 900 m NRS, Geilo 800 m VCA ZMB, E Halne 1150 m, Haugastöl 1000 m VCA ZMB, Kvasshögda 1200 m, N Lillevann 1200 m, Nygård 1000 m, Vikastölen 1100 m, Hovet, Nyestölen 1050 m, Olsenvann 1100 m, Ustaoset 1000 m. *Vestfold:* Lardal: Styrvoll; Tjöme: Havna, Kjære. *Telemark (TEy):* Bamble: Åby; Drangedal: Omnes. *TEi:* Seljord: Nörsteteig, Svartdal; Kviteseid: Eidstad, Vrådal; Nissedal: Treungen ZMO; Fyresdal: Hegglandsgrend, Moland, Veum; Vinje: Bossböen 950 m, Kromvika 930 m, Krossen 700 m, Rauland kirke 700 m, Urdbö 700 m; Tinn: Börsjöen 1150 m, Mösvatndammen 900 m, Sneiseli 960 m. *Aust-Agder (AAy):* Gjerstad: Fiane; Tvedestrand: Nes Verk TRM, Österå; Arendal; Moland: Voje; Tromöy: Bjelland; Fjære: Fjære kirke ZMO; Grimstad; Landvik: Holvika; Lillesand: Kvåse, Ulvöysund; Birkenes: Sagen; Iveland: Frikstad, Fosstveidt, Ivedal. *AAi:* Evje og Hornes: Hornes, Syrtveit; Bygland: Löndal, Ose, Setesdal TRM; Valle: Rygnestad, Valle TRM; Bykle: Breive 700 m, Breivann 900 m, Bykle, Hovde bro 700 m, Hovden. *Vest-Agder (VAy):* Kristiansand: ZMO, Strömme; Vennesla: Övrebö ZMO; Sögne: Sögne; Mandal: TRM ZMB, Hoggan-vik; Marnadal: Finsland, Gretteland, Utkjær; Lindesnes: Ramsland, Spangereid; Kvinnesdal: Förland, Gjemlestad, Solås, Öye; Farsund: Lodshavn; Flekkefjord: Espetveit, Flikkeid SMS, Langevatn, Sandvann, Temmerli. *VAi:* Audnedal: Sveindal; Hægebostad: Bryggesåk; Åseral: Espelid, Rosseland, Åseral; Sirdal: Dorgeseter, Dyngefjell 900 m, Handeland, Sinnes, Ådneram 800 m. *Rogaland (Ry):* Lund: Eikjelandsdalen, Ljosvatn, Moi; Sokndal: Nesvåg, Sogndal, Åmot; Eigersund: Fotlandsvann, Gydal, Klungland; Bjerkreim: Asseimvann, Hovland, Ivedal, Malmeim; Hå: Anisdal, Ogna, Salte bro, Sirevåg, Stölen, Vatnamo; Klepp: Börsheim, Orre, Orrevann, Reve, Vik, Öksnevad; Time: Melsvann, Time; Gjesdal: Ålgård; Sandnes: Bråstein, Flöysvik, Hommersåk, Myrland;

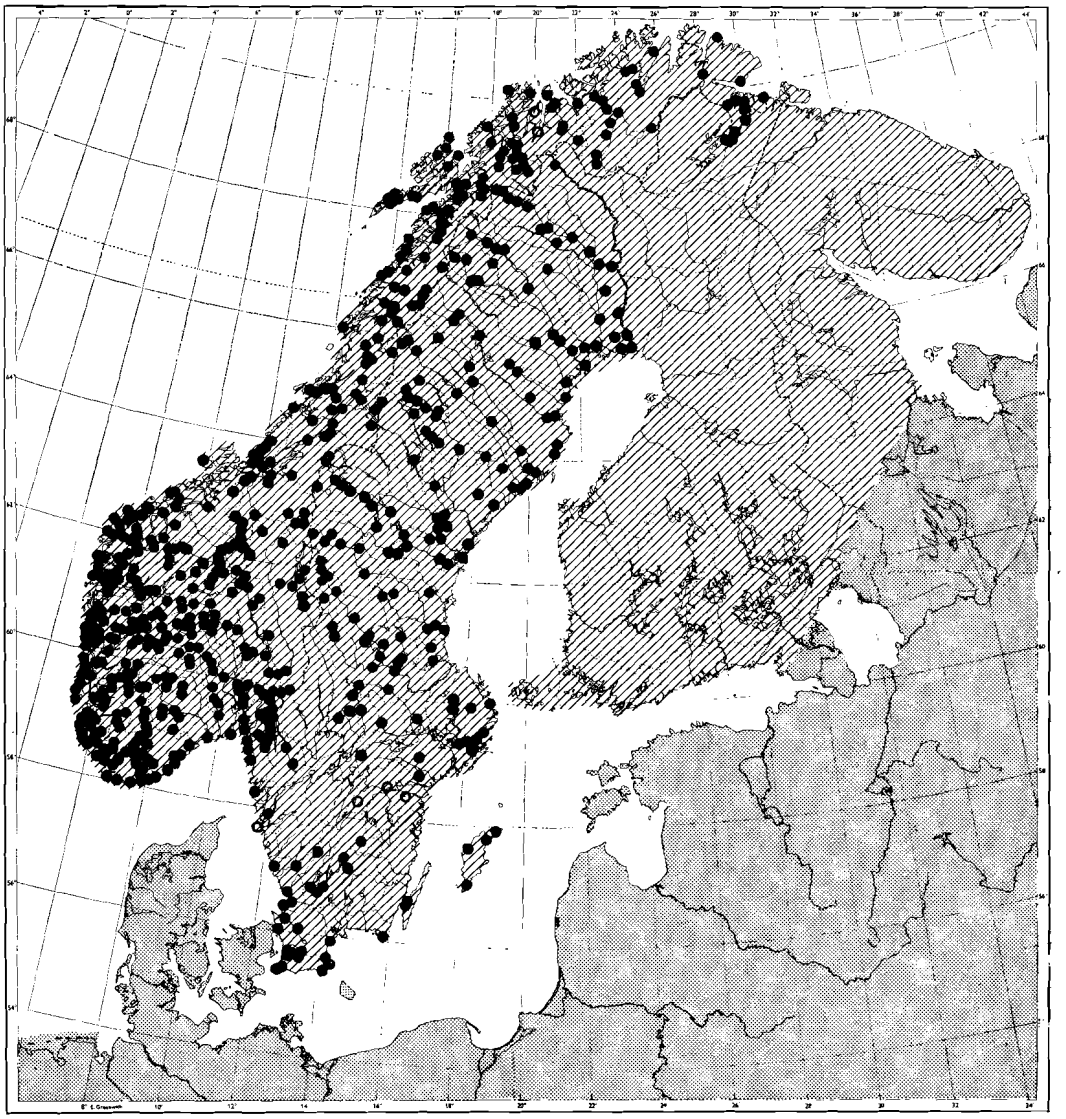


Fig. 62. *B. jonellus* (Kirby). Obliquely hatched: *B. j. subborealis* Richards. Legends as in Figs. 50, 54.

Sola: Gimre, Joa, Solastrand, Vigdal; Randaberg: Randaberg, Sande; Stavanger: Lindöy, Stavanger; Finnöy: Sjernaröy; Rennesöy: Bru; Karmöy: Risdal, Vigsnes; Haugesund: Haraldstötten. *Ri:* Fårsand: Fylgjesdal, Lerangsvann, Meling; Hjelmeland: Steinslandsvann, Årdal; Suldal: Bleskestadmoen, Heim, Jelsa, Jonstöl 700 m, Kalltveit, Leirdalen 700 m, Mostöl, Nesflaten, Roaldkvam, Sand, Svortebekk, Ullsneskvelven, Åimjödlonuten 700 m; Sauda: Hellelandsbygden, Saudasjöen. *Hordaland (HOy):* Stord: Storsöy; Bömlo: Follesöyhavn, Goddö, Rolfsnes, Sörstokka; Sveio: Förde; Ölen: Dommersnes; Fitjar: Risöy, Rubbestadnesset, Slåtteröy fyr; Tysnes: Ånuglo; Austevoll: Horgo, Inneröy, Karlsöy, Lunde, Ytteröy; Os: Gullholmen, Hatvik, Hegglandsdal, Halgjem, Lysekloster, Midtsæter, Mobergslia, Moldegård, Steindalsetra, Ulven; Fusa: Holdhus, Övre Hålandsdal; Samnanger: Höyseter; Fana: Biol. st., Blomsterdalen, Dolvik VCA, Eggholmen, Engjavik, Espeland, Fana kirke, Fantoft, Festervik, Korsnes, Krokeide, Milde, Minde VCA, Myravann, Rådalen, Saganes, Skipanes VCA, Skjold, Sedalen, Steinsvik, Stend, Titlestad; Sund: Bokken, Leröy, Steinsland, Telavåg, Tyssöy; Fjell: Bildöy, Dala, Fossavann,

Solsvik VCA; Laksevåg: Björndalspollen, Storingaviken; Bergen: TRM ZMB; Asköy: ?loc. VCA, Davanger, Erdal, Hanöytangen, Hegernes VCA, Herdla, Jacobsöy, Kleppestö, Åsebö; Åsane: Golfbanen, Haukedal, Jordalen, Steinestö, Tellevik; Osterøy: Fitje, Hamre, Kleppe, Kvamme, Njåstad, Rakaneset; Vaksdal: Eidslandet; Meland: Io, Kjeken; Öygarden: Buneset, Straumöy, Turöy; Lindås: Fosse, Fyllingsnes, Kolås, Lauvås, Mykevoll, Sævråsvåg, Vollom. *HOi:* Kvinnherad: Gjermundshamn, Jemtelandsvann, Ljosmyr; Odda: Austmannli 800 m, Dalen, Horra 1000 m, Mittleger 1150 m, Seljestad, Valldal 900 m; Ullensvang: Bjoreidalshytta 1100 m, Fresvik, Fossli 750 m, Gryteskard 850 m, Grythorgen 900 m, Hallaskard 1100 m, Hjölmodalen, Isdalen 850 m, Kvanndal, Måbödalen, Stavali 900 m, Storliseter 900 m, Sysendalen 750 m, Tindholen 1250 m, Veivann 1150 m, Viveli 820 m, Övre Eidfjord; Kvam: Djönne, Kleppfjell ZMO, Kvamskogen, Sjuseter, Ålvik USU, Åsheim; Voss: Armot, Bömoen, Hamlagrö 600 m, Hangurfjellet 800 m, Mjölfjell, Nesheim, Rong, Öyseter; Granvin: ?loc. VCA; Ulvik: Finse 1200 m VCA, Löyningseter, Ulvik. *Sogn og Fjordane (SFy):* Gulen: Takle; Solund: Færöy; Hyllestad: Botn, Eide, Hatleim, Hyllestad, Skivenes, Skor, Yttre Dale, Ålefjell; Höyanger: Lavik ZMB ZMO, Stöldalen; Gaular: Bygstad, Sande, Slotten, Vikum; Fjaler: Strandenes; Askvoll: Aralden, Raudöy, Rauöy; Flora: Askrova, Grindhólmen, Havrenesvåg, Kinn, Nekköyna, Rognaldsvåg, Skorpeidet, Trollstua; Naustdal: Furehaugstölen, Horstad, Naustdal; Förde: Flåten, Hallbreim; Jölster: Hamar, Vassenden; Gloppen: Hjortset, Hyen, Lote, Sandane; Eid: Nordfjordeid, Vedvik; Vågsöy: Hagen, Kråkenes, Kvalheim, Langenes, Måløy, Totland; Selje: Dalstö, Ervik, Lekanger, Sandvikseidet. *SFi:* Vik: Håvås, Vik; Aurland: Aurlandsvangen, Flåm, Steinbergdalhytta 1000 m, Vassbygdi, Vatnahalsen 800 m, Övstebö 800 m; Lærdal: Bergstölen 650 m, Breistölen 1050 m, Horgje, Lærdal ZMO, Maristova 800 m; Sogndal: Sogndal; Leikanger: Hermansverk; Balestrand: Brekka, Flesje, Tuftedalen; Luster: Fåberg, Fåbergstölene 600 m, Turtagrö 900 m TRM; Stryn: Hornindal, Hornindalseter, Stryn, Stöverstein, Videdalen, Videseter 600 m. *Möre og Romsdal (MRy):* Sande: Gurskevåg, Kobbervik, Larsnes, Åram; Volda: Björkedalsvann, Folkestad; Hareid: Hjörungavåg, Mork; Ulstein: Ulsteinsvik, Vonheim; Herøy: Djupsvik, Runde, Stokksund; Ålesund: Ålesund, Åse; Örskog: ? loc. ZMO; Vestnes: Gjermundnes; Molde; Aukra: Aukra kirke, Falkehytta, Lövik, Kolholmen, Rindaröy; Fræna: Gjendem, Hollinholm; Smöla: Andholmen. *MRi:* Stranda: Bjordal; Norddal: Valldal; Sunndal: Jordalsgrend; Surnadal: Övre Surnadal. *Sör-Tröndelag (STy):* Agdenes: W Hambora; Rissa: Gafsetåsen, Rissa VCA, Sötvik; Örland: Beian; Bjugn: Kotengsvann; Åfjord: Mölsletten, Mörreaune, Å. *STi:* Oppdal: Dalsbekk, Driva st., Drivstua 850 m ZMU, Gåvåli 975 m, Högsnydda 1150 m, Kongsvoll 900 m BML ZMB ZMO, Knutshö 1100–1300 m BML ZMB, Oppdal, Skansen; Ålen: Reitan; Röros: Adamsvoll 820 m, Evavoll 700 m, Myrmoen 700 m, Naustervoll 700 m; Trondheim VCA ZMB; Skaun: Sörnypvann KMT; Orkdal: Hemnekjölen KMT, Sognlia KMT, Sörvann KMT. *Nord-Tröndelag (NTy):* Flatanger: Björnöyvær KMT; Namsos: Strandmoen; Nærøy: Breiviken, Dalene, Garmannsviken, Kvalviken, Saltbotn. *NTi:* Stjördal: Hegra st.; Leksvik: Storvann; Verdal: Billingflaten, Sandviken, Vergåen KMT; Steinkjær: Seim; Grong: Ekkerseter, Fjerdingen, Trangen; Snåsa: Brönstad, Hegge; Lierne: Kvelia, Seterhaug, Småtjern; Höylandet: Höylandet, Skilleberget, Skogenga; Namskogan: Finnvollan, Namskogan; Röyrvik: Björkhaug. *Nordland (Nsy):* Herøy: Syd-Heröy TRM VCA; Melöy: Kunna, Reipå, Storglomvann TRM; Gildeskål: Finnes, Gildeskål, Gilset, Jelstad, Skauvoll, Storvika, Sör-Fuglöy; Bodö: Bodö BML, Falkflaugdalen, Karlsöyvær, Löpsviken, Skau. *Nsi:* Hatfjelldal: Krutvann; Grane: Båfjellmo, Grane, Majavatn, Rotstokkmobekken, Skomstad; Vefsn: Ravassbakken, Store Björnåvann; Hemnes: Finneidfjord, Krokselvmoen; Rana: Bjellånes ZMO, Krokstrand, Randallsvollen, Rövassdal TRM, Umskarstjern, Åenget; Beiarn: Gråtådalen TRM; Saltdal: ?loc. ZMO, Junkerdal, Junkerdalsura, Lönsdal, Semska, Storjordet TRM; Fauske: Fauske, Kjeldvann BML, Sulitjelma BML. *Nnö:* Sörfold: Bonnå, Tennvann; Hamaröy: Brennvik, Fjerdevann, Hamnes, Hansbakk, Haukås, Innhavet, Oppeid, Sandnes, Skutevik, Strinda, Tranöy; Tysfjord: ?loc. ZMO; Ballangen: Ballangen, Dyrhaug, Elvesletten, Forså, Heggemoen, Hesjeli, Myrbakk, Skarneselva; Ankenes: Beisfjord ZMA, Bjerkvik, Seterfjell; Evenes: Jansbakk. *Nnv:* Vestvågöy: Eggum, Knutstad, Skulbru, Stamsund, Storhella, Torvdalsvann, Ure, Valberg; Vågan: Store Molla, Svolvær ZMA; Andöy: Andenes SMS TRM, Björnskinn, Dverberg, Myre, Risöyhavn SMS ZMB. *Troms (TRy):* Kvæfjord: Borkenes, Vik; Bjarköy: ? loc. TRM; Lenvik: Finnsnes; Tromsö: Botnhamn SMS, Ramfjord TRM, Tromsdal VCA TRM ZMO, Tromsö BML TRM VCA ZMO; Karlsöy: Hushattöy TRM, Måkeskjær TRM, Vannö TRM; Skjervöy: Arnöy, Ravelseidet, Ulöybukt. *TRi:* Skånland: Boltås, Lavangseid; Gratangen: Gratangen ZMA; Bardu: Bardu, Dörum, Dypdal; Målselv: ? loc. TRM VCA ZMO, Andselv, Bjerkeng TRM ZMB, Frihetsli TRM, Kirkesdal, Mauken ZMO, Neset, Nordmo TRM ZMO, Olsborg, Rundhaug SMS ZMB ZMO, Sörli, Trosdal; Balsfjord: ? loc. TRM, Blåfjell TRM, Lanes TRM, Storsteinnes TRM, Takvann VCA ZMB; Nordreisa: Bakkeby, Gappruselv, Gapprusfjellet 700 m, Nedrefoss, Sappen; Kvænangen: Burfjord. *Finnmark (Fv):* Kvalsund: Činkasjavrre, unna Hatteras, Skaidi ZMA ZMB. *Fi:* Alta: Arones, Bossekop TCL TRM ZMB ZMO, Gargia, Jotkajavrre TRM, Raipas ZMO, Talvik; Kautokeino: Biggeluobal, Kautokeino, Suatte Fielbma, Suolovuobme; Karasjok: Karasjok TRM ZMA ZMB. *Fn:* Porsanger: Hamnbukt, Lakselv TRM ZMA ZMB ZMO, Stabbursnes, Store Tamsöy, Övre

Lakselv; Tana: Seida TRM; Berlevåg: SE Berlevåg; Vadsö: Makkanes W Vadsö, Vadsö. *Fö:* Sör-Varanger: ? loc. TRM, Elvenes TRM, Galgoaive TRM, Gjökbukta in Övre Passvik ZMO, Grense-Jakobselv TRM, Ivargamme ZMO, Kirkenes TRM, Langfjorddalen TRM ZMB, Neiden TRM ZMB, Strand TRM, Strömsbukt TRM, Svanvik, Tangenfoss ZMO, Vaggatem.

Unrevised records were not included here except for *Troms (TRi):* Lyngen: NE and NW Jegervann, NW Furuflaten (Douglas in litt.).

Sweden. Widely distributed throughout the country. The abundance is markedly smaller in Southern Sweden than further north. The available material includes in fact no specimens from Västergötland and recent records only from Östergötland.

A total of about 1600 specimens was examined.

List of localities. *Skåne:* Barkåkra NRS, Bjärred, Brunneby, Falsterbo NRS, Genarp, Hagestad NRS, Hälsingborg VCA ZML, Ljunghusen, Lund NRS, Norrviken NRS, Pålsjö, Revingehed ZMB, Sege, Silvåkra, Simrishamn NRS, Vitemölla NRS, Vomb, Åhus NRS ZMB. *Blekinge:* Torhamn NRS. *Halland:* Dagsås GNM, Enslöv, Gunnarp, Halmstad, Laholm, Skottorp, Östra Karup. *Småland:* Aneboda ZMB ZML, Bränstorp NRS, Bäraryd, Ljungby, Odensjö NRS, Unnen, Vrigstad. *Öland:* Mörbylånga NRS, Vickleby. *Gotland:* Burgsvik, Fårö NRS, Kyllej NRS, Snäckjärdet, Ulla hau NRS, Visby NRS. *Bohuslän:* Edshultshall NRS, Havstenssund NRS, Kareby NRS, Syd-Koster NRS. *Dalsland:* Bengtsfors, Köpmannebro. *Närke:* Tångeråsa. *Södermanland:* Tyresö NRS, Valla NRS, Ålberga ZMB. *Uppland:* Drottningholm ZMA, Elmsta ZMB, Knutby ZMB, Stockholm NRS, Tensta ZMB, Uppsala BML, Yxlan ZMB. *Västmanland:* Lindesberg NRS, Saxhyttan NRS, Skultuna ZMB. *Värmland:* Gåsborn NRS, Lesjöfors, Lindfors ZMA. *Dalarne:* Bingsjö NRS, Borlänge ZMA, Falun NRS, Floda NRS, Foskros NRS, Fulufjäll NRS, Idre, Hjortnäs NRS, Leksand Tje, Lima NRS ZML, Mora NRS, Nittsjö NRS, Njupsjön NRS, Rättvik NRS, Sandsjö, Siljan, Siljansborg NRS, Siljanfors NRS, Smedjebacken, Storsätern NRS, Stora Tandån NRS, Städjan, Sundborn NRS, Säfsen NRS, Sälen ZMA, Särna ZMA ZML, Sångtorpet Tje, Vikarbyn NRS, Älvdalen. *Gästrikland:* Högbo NRS, Ockelbo ZMB. *Hälsingland:* Bergvik ZML, Delsbo, Fredriksfors NRS, Kilafors, Los NRS, Söderhamn ZMB. *Medelpad:* SE Bispfors ZMB, Ede NRS, Kölsillre NRS, Leringe NRS, Liden NRS, Nedansjö NRS, Ovansjö NRS, Palljacka NRS, Skallböle NRS, Tuna NRS, Tynderö NRS, Överturinge NRS, Ånge. *Härjedalen:* Anåfjäll ZMB ZML, Fjällnäs ZMU, Funäsdalen ZMB, Hamrafjäll NRS, Sveg, Tänndalen NRS ZML, Vemdalen. *Jämtland:* Bispfors ZMB, Bräcke ZML, Hallen NRS ZML, Jormlien NRS, Järpen, Leipikvattnet NRS, Lockne, Mattmar, Mullfjället DCL, Sipmege NRS, Stadforsen NRS, Storlien, Strömsund NRS, Svenstavik NRS, Undersåker, Åre IVU ZML ZMU. *Ångermanland:* Aspeå NRS, Bondsjö, Härnösand NRS ZML, Hörnefors ZMB, Håknäs NRS, Kvarnbacken NRS, Orsjön, Ramsele GNM, Saluböle NRS, Västansjö Örnsköldsvik NRS. *Västerbotten:* Bergsbyn NRS, Degerfors NRS, Grimsmark ZMB, Gubböle NRS, Jörn, Klutmark, Sikeå ZMB, Skogfors NRS, Strömsör NRS, Västerhiske NRS, Åbyn. *Norrbotten:* Anttis, Boden NRS, Bredsel, Bäverbäck NRS, Edefors, Haparanda, Hirvijärvi NRS, Junosuando, Karungi NRS ZML, Kengis, Korpilumbolo NRS, Kukkola NRS, Lappträsk, Luleå NRS VCA ZML, Pajala NRS ZML, Piteå NRS, Rutijärvi ZMA, Råbäcken NRS, Selet NRS, Strömsund NRS, Säivis NRS, Töre ZMB, Yttermorajärv NRS, Öjebyn NRS, Överkalix NRS, Övertorneå NRS, Övre Svartlå NRS. *Lapland (Ås. Lpm.):* Avaträsk NRS, Bångnäs, Dorotea NRS, Fatmomakke, Fredrika DCL NRS, Hällefors, Kittelfjäll, Malgomaj NRS, Ormsjö NRS, Risbäck NRS, Saxnäs, Sandsjöbäcken ZMU, Vilhelmina NRS ZML, Åsele NRS DCL ZCL. *Ly. Lpm.:* Ammarnäs ZMU, Björkfors VCA ZML, Blattnicksele ZMU, Holmen GNM, Joeström, Lycksele NRS, Rautjärnmyran GNM NRS, Sandsjön ZMU, Sorsele NRS, Stensele NRS, Stensundforsen GNM, Tjulträsk BML, Tärna NRS ZML, Örnäs ZMU. *P. Lpm.:* Abborrträsk, Arjeplog, 61 km NW Arjeplog, Arvidsjaure, Jäckvik, Skatträsk. *Lu. Lpm.:* Gällivare NRS ZMA ZML, Harsprånget, Ketjaure NRS, Kvikkjokk NRS ZML, Malmberget, Muddus, Nikkojarnga NRS, Njunjes VCA, Porjus IVU ZML, Sarek NRS ZML, Satisjaure, Sitojaure, Sjitnjajarnga NRS, Sjöfallet, Virihaure area ZMU. *T. Lpm.:* Abisko NRS ZMA ZML ZMU, Björkliden NRS ZMA ZML, Jukkasjärvi NRS ZMA, Kaisepakte NRS, Kiruna ZMA, Kummavoipio NRS, Nakarijärvi NRS, Njuonjevare NRS, Stenbacken NRS, Svappavaara NRS, Torneträsk, Vassijaure NRS ZMA, Vietovare NRS, Vittangi NRS.

Unrevised records were not included here except the following (Ander in litt.): *Östergötland:* Omberg, Stjärnorp, Östra Ryd. *Bohuslän:* Öckerö.

Finland. Commonly occurring throughout the country (Elfving 1968).

The total distribution of the subspecies, B. jonellus subborealis Richards. Iceland – Fennoscandia – ? further east.

Remark on the geographical range

The subspecific status of the Russian populations is unknown. Consequently the inter-

grading zone and the territorial limmits of *B. j. subborealis* and the nominate subspecies (Fig. 62), the latter reaching north to Denmark and Baltic Sea, cannot be indicated.

Biology

Nest. Pollen-storer (Meidell 1934b, pp. 86, 113). It establishes nests in and below the surface of the ground and at various depths. Also recorded in abandoned bird nests built in trees. The size of the colonies is in general small. Meidell (unpublished) estimated the maximum number of workers produced in a colony as about 30 specimens. He states moreover that the species produces two generations in a season (Meidell 1968).

Flight season. From last half of April to the end of September. Queen: 19 April–28 Sept.; worker: 4 May–25 Sept.; male: 7 June–26 Sept.

BOMBUS (PYROBOMBUS) LAPPONICUS (FABRICIUS)

Apis lapponica Fabricius, 1793, p. 318 No. 13; Zimsen 1964, p. 415 No. 1078, lectotype ♀ CCC! selected by Løken (1966a). Type area Sweden: Lapland ('Lapponia Dom.de Paykull').

(*Apis lapponica:* Quensel in Acerbi 1802. *Bombus lapponicus* (Fabricius); Dahlbom 1832, p. 41; Zetterstedt 1838; Boheman 1844, p. 103; Wahlberg 1854, 1855; Thomson 1870, 1872; Siebke 1880; Sparre Schneider 1889, 1895a, 1895b, 1898, 1909; Strand 1898b, 1901, 1904, 1910; Lie-Pettersen 1901, 1907; Aurivillius 1903; Bengtsson 1904, 1908, 1931; Friese & Wagner 1912; Ringdahl 1915; Lundblad 1924; Soot-Ryen 1925; Forsslund 1929, 1951; Gaunitz 1929; Hellén 1933; Meidell 1934a; Barendrecht 1941; Pittioni 1942; Brinck & Wingstrand 1949; Løken 1949, 1950; Brinck 1951; Kruseman 1959; Elfving 1960, 1968; Ander 1965. *Bombus alpinus:* Dahlbom 1832, p. 32 (partim); Siebke 1880 (partim). *Bombus lapponicus* var. *lugubris* Friese, 1902, p. 495 nec Morawitz 1880, holotype ♀ TRM!, type area Norway: Troms (TRi): Målselv; Sparre Schneider 1906, 1909, 1910. *Bombus lapponicus* var. *scandinavicus* Friese, 1911, p. 684, type = holotype of *Bombus lapponicus* var. *lugubris;* Friese & Wagner 1912; Meidell 1934a; Løken 1949, 1950. *Bombus lapponicus scandinavicus* Friese; Pittioni 1942, 1943; Brinck 1951; Kruseman 1959; Elfving 1960; Reinig 1965; Løken 1966c. A bibliographic reference to the species is compiled by Pittioni 1942.)

First Scandinavian records

Norway. Troms (TRy): Skjervöy; Finnmark (Fi): Alta: Bossekop (Dahlbom 1832).

Sweden. Lapland (Fabricius 1793).

Taxonomical remarks

Apis lapponica mentioned by Quensel in Acerbi (1802) presumably refers to this species. A coloured drawing applies to the nominate form, but the hindmost gastral segments are described as 'apice albido'.

The great variability in the colour pattern of *B. lapponicus* throughout its range has been subject for studies from a genetical and zoogeographical point of view (Vogt 1909, 1911; Skorikov 1912; Körner & Zarapkin 1938; Pittioni 1943; Reinig 1965; etc.). A vast number of colour variants have been named and several subspecies recognized (Pittioni 1942, 1943), seven of which refer to Europe (Reinig 1965, p. 118).

Two Scandinavian subspecies were recognized, viz. *B. l. lapponicus* and *B. l. scandinavicus.* They are readily separated in their typical forms, cf. the description below, but there is a great range of intermediates and aberrants resulting in a number of designations. *B. l. var. praticola* Sparre Schneider, 1909 nec Kirby 1837, *B. l.* var. *ornatulus* Friese, 1911, *B. l.* var. *dissidens* Friese, 1911, *B. l.* var. *helveticus* Friese, 1911, *B. l.* var. *norvegicus* Friese, 1911, *B. l.* var. *noricus* Skorikov, 1912, *B. l. formolosus* Skorikov, 1912, *B. l.* var. *collaris* Hellén, 1933, *B. l.* var *melanarius* Hellén, 1933, one or several of which mentioned as occurring in Scandinavia by the designators and/or Friese & Wagner (1912),

Soot-Ryen (1925), Meidell (1934a), Løken (1949), Brinck (1951), are infrasubspecific forms. The latter author also mentions a number of colour forms (Sweden: Lapland (Lu. Lpm.): Virihaure) which reflect the variability in the population in the area of overlap.

B. lapponicus is considered as holarctic by European authors (Pittioni 1942) and the nearctic population, occurring in Alaska, Canada, Rocky Mountain states, is treated as a subspecies, *B. l. sylvicola* Kirby. For one thing, owing to the morphological differences in the male genitalia, I follow American authors (Krombein & Burks 1967) in giving the nearctic taxon specific rank, viz. *B. sylvicola*. Thus *B. lapponicus* is treated as a palearctic species.

Queen, worker

Morphological characters. Malar space just shorter than distal width, longer than A_3 but shorter than A_{2+3}. Disc of clypeus with uneven, rather strong puncturing except for a small almost impunctate, narrow and often slightly keeled area in between lateral impressions, which nearly meet in the middle of the anterior edge. Labral furrow moderate to well-defined, in width markedly less than ⅓ labral width. Mandible (Fig. 16 A). Outer surface of hind tibia rather alutaceous, dorsal inner distal angle almost without endite process (Fig. 16 B). The longest hairs in posterior fringe of hind basitarsus distinctly exceeding half the greatest width of the segment. T_6 distally dimpled. Coat somewhat shaggy. Queen measurements cf. the subspecies.

Colour pattern. T_{2-3} with ferruginous hairs, those of T_6 black. Otherwise cf. the subspecies.

Male

Morphological characters. Malar space about as long as distal width and hardly as long as A_{2+3}. A_3 just shorter than A_5, occasionally equally long. A_4 about as long as distal width. Hind tibia and hind basitarsus individually with longest hairs in posterior fringes exceeding twice the greatest width. Distal margin of St_6 thickened. St_8 (Fig. 37A); gonostylus and volsella (Fig. 37B); penis valve (Fig. 37C). Coat shaggy. Body of small size.

Colour pattern. T_{2-3} with ferruginous pile, otherwise cf. the subspecies.

Distribution (Fig. 63)

Norway. Widespread occurrence along the mountain chain and ranging from about 58°30′ N, viz. the inner districts of Aust-Agder, Vest-Agder and Rogaland, to the arctic coast. In general the dominant bumble bee in alpine/arctic and subalpine/subarctic zones and distributed in adjacent woodland as well. In Southern Norway locally reaching sea level in the western fjords and sporadically observed on islands off shore. The southernmost records are from the hills in outer district of Vest-Agder. In Northern Norway the abundance may be equally great inland and along the coast, even the outmost islands are frequently occupied. In Southern Norway recorded 1300 m s.m.

Biotopes: *Salix* biotopes, *Vaccinium* heaths, pastures, mountain-meadows.

A total of about 2300 specimens was examined.

List of localities. *Akershus:* Oslo: DCL. *Hedmark (HEs):* Elverum: Elverum ZMO; Hamar: ZMO; Ringsaker: Mesnalien. *HEn:* Trysil: S Sjöenden; Tynset: Dallvang SMS, Tyldal ZMB ZMO; Tolga-Os: Nörva 680 m. *Oppland (Os):* Jevnaker: Randsfjord USU; Östre Toten: Stubdalen; Nordre Land: Dokka USU, Kinn, Torpa; Etnedal: Bruflat, Os 715 m; Sör-Aurdal: ? loc. ZMO, Breidablikk, Reinli; Nord-Aurdal: Fagernes ZMO, Flya 850 m, Hovda 760 m, Knutshaugen, Sæbuöygard N Fagernes; Öyer: Aksjö 1000 m, Öyer, Åstdalen 900 m; Ringebu: ?loc. ZMO. *On:* Vestre Slidre: Kinnholt 1000 m, Svenskesetra 900 m, Ölken; Öystre Slidre: Skammestein 700 m, Smörkollen S Bygdin 1100 m; Vang: ? loc. ZMO, Bygdin hotel 1100 m, Eidsbugarden 1200 m BML ZMB, Grunke 950 m, Otrövann 1000 m, Tyin 1100 m USU ZMB, Öye USU ZMB, Öylo ZMO; Fron: ? loc. ZMO; Sel: Heidal TRM ZMB, Mysuseter 900 m; Vågå: Gjendesheim 1000 m BML ZMB, Hindseter 900 m, Klones, Leirungen 1050 m, Randsverk 800 m TRM ZMB, Skjerva 900 m, Valdresflya 1150 m, Vågåmo ZMB ZMO; Lom: Bövertun 960 m, Galdesand, Leirdalen 900 m; Skjåk: Breidalsvann 900 m, Grotli 900 m, Langevann 930 m, Skjåkseter 800 m, Strynsfjell 1100 m; Dovre: Dombås ZMO, Dovrefjell 1000 m NRS TCL VCA ZMB ZMC ZMO ZMU, Döråseter 1050 m, Fokstua 930 m ZMO ZMB,

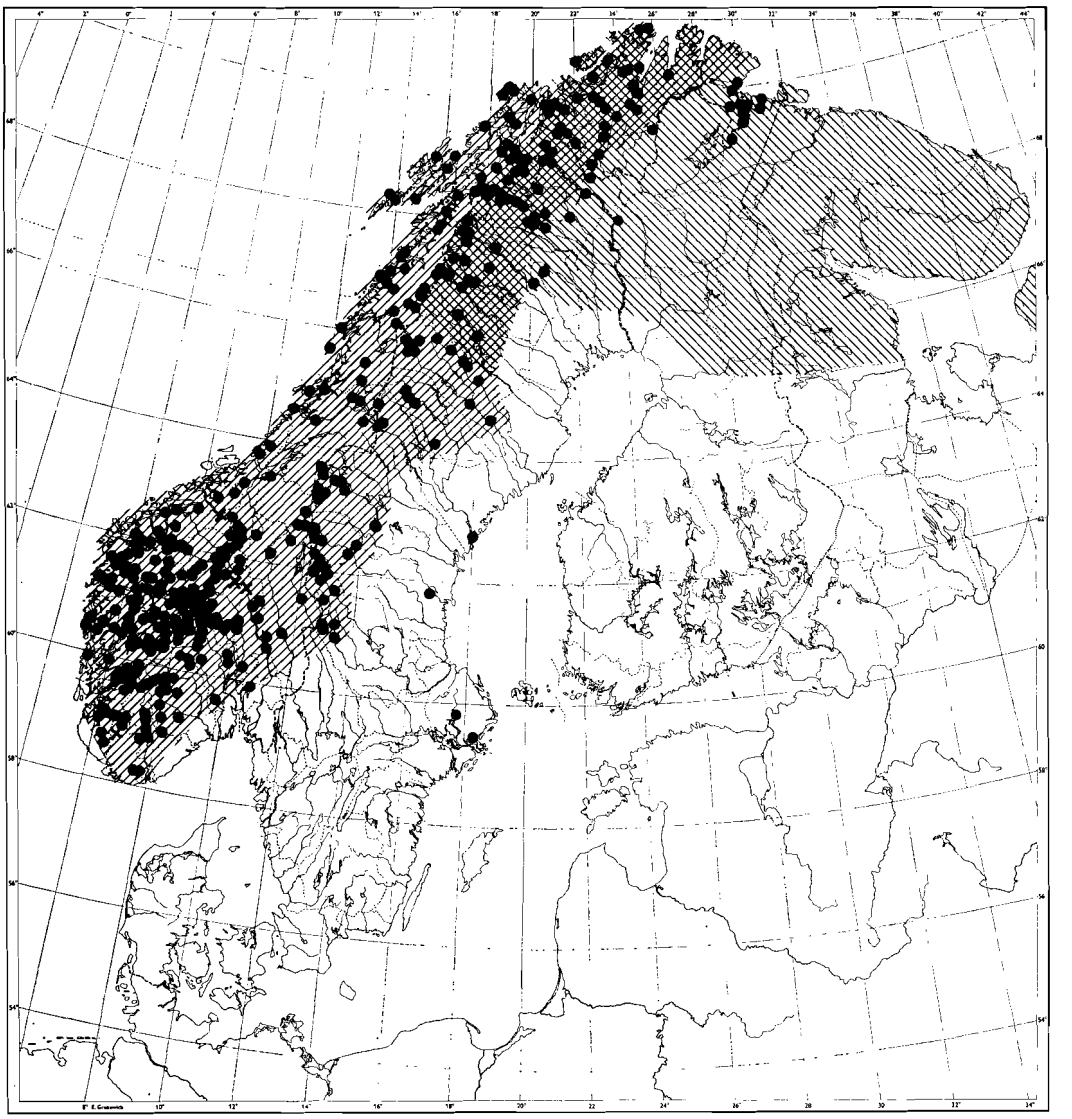


Fig. 63. *B. lapponicus* (Fabricius). Oblique up to the left hatching = *B. l. lapponicus* (Fabricius); oblique up to the right hatching = *B. l. scandinavicus* Friese. Legend as in Fig. 50.

Hjerkinn 950 m ZMO, Toftemo ZMO, Vålåsjö 950 m ZMO. *Buskerud (Bö):* Flesberg: Hvila; Kongsberg: ZMO. *Bv:* Sigdal: Haglebu, Kopseng, Nedre Eggedal, Nordbygda; Nore og Uvdal: Björkefåtå 600 m, Gavlenseter 1120 m, Nörstebö 700 m, Rödberg, Solheimstul 1000 m, Sönstevann 1050 m, Tunnhovd 850 m; Övre Hein 1120 m; Nes: Buglebjörk 900 m; Gol: Gol; Hemsedal: Kjölen 1000 m, Lykkja 900 m, Stöytestölen 950 m; Ål: Bergsjö 1100 m, Laudalseter 1100 m, Levell 700 m, Tvist 1080 m, Vallehalle 1120 m; Hol: Fagerheim 1150 m, Geilo 800 m VCA ZMB, Geitryggen 1220 m, E Halne 1150 m, Haugastöl 1000 m VCA ZMB ZMO, Kvasshögda 1200 m, Lillevann 1150 m, Nygård 1000 m, Vikastölen 1000 m, Hovet, Nyestölen 1050 m, Olsenvann 1100 m, Seim, Ustaoset 1000 m. *Telemark (TEy):* Drangedal: Omnes. *TEi:* Seljord: Svartdal; Fyresdal: Møland; Mo: Grimdalen; Vinje: Edland, Kromvika 930 m, Krossen 700 m, Rauland kirke 700 m, Særensgrend, Urdbö 700 m, Vå 700 m; Tinn: SE Börsjöen 1150 m, Mösvatndammen 900 m, Sneiseli 960 m. *Aust-Agder (AAi):* Åmli: Smedland; Bygland: Löndal, Ose;

Valle: Kvestad, Rygnestad, Valle; Bykle: Breivann 700 m, Breive. *Vest-Agder (VAy):* Marnadal: Mandalsheiene ♀ 26 May 1936 (Mei), Slöykedal ♀ 2 ♀♀ (R. Nordhagen). *VAi:* Åseral: Espelid; Sirdal: Dyngefjell 900 m, Handeland, Nedre Siredal ZMO, Sinnes. *Rogaland (Ry):* Lund: Eikjelandsdalen; Bjerkreim: Hovland, Malmeim. *Ri:* Forsand: Fylgjesdalen, Lysbotn, Lyse, Meling TRM ZMB, Tangen; Hjelmeland: Årdal; Suldal: Bleskestadmoen 875 m, Bråtveit, Jonstöl 700 m, Kvanndal, Kvannvann, Krokvasshei, Leirdalen 700 m, Mostöl 600 m, Moen, Nesflaten, Roaldkvam, Sandvann SMS, Steinkilen, Svortebekk, Suldal BML SMS, Ullsneskleiva, Våge, Övre Kringlevann, Åimjödlo BML; Sauda: Hellelandsbygda, Sauda, Saudasjöen, Slettedalen, Svandalen, Övre Sandvann 1050 m. *Hordaland (HOy):* Fitjar: Fitjar; Samnanger: Höyseter; Fana: Sanddalen, Tveiterås VCA; Fjell: Solsvik; Bergen; Asköy: Hegernes VCA, Herdla, Io; Osteröy: Kleppe; Vaksdal: Eidslandet. *HOi:* Kvinnherad: Övredal, Lio, Rosendal; Odda: Austmannli 800 m, Dalen 900 m, Hordasvingene 1000 m, Mittleger 1150 m, Röldal, Svanndalsflona 1000 m, Valldal 900 m; Ullensvang: Bersavikvatn 1230 m, Bjoreidalshytta 1100 m, Fossli 750 m, Fresvik, Grythorgi 1000 m, Hjölmo, Isdalen 835–1200 m, Kinsekvelv 1200 m, Lofthus, Måbödalen, Rjoto 1100 m, Skidtstölen 930 m, Stavali 900–1080 m, Storliseter 900 m, Sysendalen TRM VCA ZMB, Tindholen 1250 m, Veigvann 1175 m, Viveli 876 m VCA ZMB, Övre Eidfjord; Kvam: Djönne; Voss: Hangurfjellet 800 m, Mjölfjell 600 m, Rong, Sandfjell 1100 m, Vikafjellet 1000 m, Voss TRM ZMB; Ulvik: Finse VCA, E Mjölfjell 700 m. *Sogn og Fjordane (SFy):* Hyllestad: Botn, Eide, Hatleim; Höyanger: Fuglsetfjorden, Lavik; Gaular: Bygstad, Slotten, Haukelandsvann; Fjaler: Hellestrand; Flora: Sundaneset, Trollstua; Naustdal: Frammarsvik, Horstad; Förde: Flåten, Förde, Hallbreim; Jölster: Hamar, Vassenden VCA ZMB; Gloppen: Hjortset, Hope, Hyen, Lote, Lotsbergfjellet 700 m, Sandane; Eid: Heggjabygda. *SFi:* Vik: Brosliegen 1000 m, Hestavollen 900 m, Håvås, Målset 850 m, Arnafjell 1000 m; Aurland: Berekvam, Flåm, Kvammadal 950 m, Steinbergdalshytta 1000 m, Uppsete 850 m, Vassbygda, Vatnahalsen 800 m; Lærdal: Bergstölen 650 m, Breistölen 1050 m, Eggjestölen 700 m, Gröte, Maristova 800 m; Sogndal: Kaupanger, Sogndal; Leikanger: Hermansverk, Leikanger, Suphammer; Balestrand: Brekka, Dueskar, Fjærland, Flesje, Horpedalen, Kvamsöy, Mel, Mundalsdalen, Suphellesetra, Tuftedalen; Årdal: Holsbruvann 750 m, Årdalstangen; Luster: Dalsdalen, Fåberg, Fåbergstölen 600 m, Jostedal, Nigardsbreen 650 m, Okkleviki, Turtagrö 900 m TRM VCA; Stryn: Briksdal, Hjelledalen, Hornindal, Hornindalsetra, Stryn, Videdalen, Videseter 650 m. *Möre og Romsdal (MRy):* Volda: Björkedalsvann; Örskog: ?loc. ZMO; Vestnes: Gjermundnes, Vikebukt. *MRi:* Stranda: Bjordalen, NW Dalsnibba 950 m, Fivelstad, Kvanndalsetra 700 m, Norangdalen, Vollset; Norddal: Valldal; Sunndal: ? loc. KCL, Brandstad; Surnadal: Kvanne ZMO, Övre Surnadal. *Sör-Tröndelag (STy):* Rissa: Sötvik; Åfjord: Mörreaune. *STi:* Oppdal: Driva st., Dalsbekk, Drivstua 850 m ZMU, Grosmyra N Hjerkinn 1000 m, Gåvåli 975 m, Kaldvella 1100 m Lar, Knutshö 1100–1300 m BML ZMB ZMU, Kongsvoll 900 m BML TRM ZMB ZMO ZMU, W Kongsvoll 1050 m, Nystugudal 1000 m, Stroplsjö 1200 m Lar, Stölan 750 m; Röros: Evavoll 700 m, Myrmoen 700 m; Tydal: Svarttjern 830 m; Trondheim VCA ZMB; Orkdal: Hemnekjölen KMT. *Nord-Tröndelag (NTy):* Flatanger: Björöyvær KMT; Namsos: Strandmoen; Næröy: Dalene, Kvalviken. *NTi:* Verdal: Godbekktjern KMT, Vergåen KMT; Lierne: Kvelia, Nordli KMT, Småtjern; Namskogan: Finnvollan, Äktejärvi; Röyrvik: Björkhaug. *Nordland (Nsy):* Vega: TRM; Heröy: TRM; Melöy: Glomfjord, Kunna, Reipå, Storglomvann 500 m TRM; Gildeskål: Prestegården, Skauvoll, Storvika; Bodö: Falkflaugdalen, Löpsviken, Rönviksfjell, Skau. *Nsi:* Grane: Båfjellmo, Majavann; Vefsn: Ravnå; Rana: Bjellånes ZMO, Randallsvollen, Umskarstjern, Åenget; Saltdal: ? loc. TRM ZMO, Junkerdal, Junkerdalsura, Lönsdal, Semska 675 m, Storjordet TRM; Fauske: Kjeldvann S Sulitjelma BML, Laamivann 720 m BML, Sulitjelma BML. *Nnö:* Sörfold: Tennvann; Hamaröy: N Strinda, Fjerdevann; Tysfjord: ? loc. ZMO; Ballangen: Hesjeli; Ankenes: Björnfjell 500 m, E Seterfjell; Narvik. *Nnv:* Vestvågöy: Eggum, S Valberg; Vågan: Store Molla; Andöy: Risöyhamn. *Troms (TRy):* Kvæfjord: Borkenes, Vik; Bjarköy: ?loc. TRM; Tromsö: Bottnhamn SMS, Flöyfjell TRM VCA, Ramfjord TRM, Tromsdal NMW TRM VCA ZMO, Yttre Malangsfjord TRM; Karlsöy: Bukkhattöy TRM, Finnkirken TRM, Hushattöy TRM, Karlsöy, Måkeskjær TRM ZML, Vannö TRM; Skjervöy: Ravelseidet, Ulöybukt, Vaddas. *TRi:* Gratangen: Gratangsbotn ZMA; Bardu: Altevann, Setermoen; Målselv: ? loc. VCA ZMO, Bjerkeng VCA TRM, Čarač TRM, Frihetsli TRM, Kirkesdal, Kletten ZMO, Lille Rostavann TRM, Mauken TRM ZMO, Moen TRM TCL, Nordmo VCA TRM, Rundhaug ZMB ZMO, Råvann TRM, Sörli; Balsfjord: Blåfjell TRM, Takvann VCA TRM ZMB; Storfjord: Helligskogen; Nordreisa: Bakkeby, Bilto, Gapprusfjell 700 m, Javroaive 900 m, Nedrefoss, Sappen; Kvænangen: ? loc., Kvænangsfjell 400 m. *Finnmark (Fv):* Hasvik: Breivik; Hammerfest: TRM; Kvalsund: Činkasjavrre, unna Hatteras, Skaidi ZMA; Måsöy: Mageröy ZMO; Nordkapp: BML. *Fi:* Alta: VCA, Arones, Bossekop TRM ZMB ZML ZMO, Jotkajavrre 400 m TRM, Kvalfjord ZMO, Kåfjord TRM, Vina TRM, Raipas ZMO; Kautokeino: Biggeluobal, Kautokeino ZMO, Suatte Fielbma, Suolovuobme; Karasjok: TRM ZMA ZMB ZMO. *Fn:* Porsanger: ? loc. TCL VCA, Festningsstua TRM, Hamnbukt, Kistrand NMW VCA ZMO, Lakselv TRM ZMA ZMB ZMO, Skoganvarre, Stabbursnes TRM ZMB ZMO, Övre Lakselv ZMB; Lebesby: Adamsfjorddal BML; Vadsö: Jakobselv TRM, Vadsö BML. *Fö:* Sör-Varanger: ? loc. TRM ZMB, Bugöy-

nes TRM, Elvenes TCL, Galgoaivve KMT TRM, Gjöbukta in Övre Pasvik ZMO, Grense-Jakobselv, Kirkenes IZB KMT TRM ZMA ZMB, Karpefjell ZMO, Langfjorddal TRM VCA ZMB ZMO, Neiden TRM, Solheien TRM, Strand TRM, Svanvik, Övre Neiden TRM.

Sweden. Widely distributed from about 61° N in Dalarne north throughout Lapland. Single records in the eastern lowlands, from Uppland, and northwards, are noteworthy.

A total of about 1000 specimens was examined.

List of localities. *Uppland:* Vassunda ♀ 28 June 1951 (Torsell) IVU, Österåker ☿ 17 July 1908 (Wretlind) ZMU. *Dalarne:* Fulufjäll NRS, Hundfjäll, Idre, Lima, Långfjället NRS, Nipfjället NRS, Slagufjäll NRS, Storvätteshågna NRS, Stora Tandån NRS, Städjan, Sälen ZMA, Särna NRS, Töfsingdalen National Park NRS. *Hälsingland:* Delsbo ☿♂ 1903 VCA. *Härjedalen:* Girtibauna, Hamrafjäll NRS ZML, Skatfjäll NRS, Sånfjäll NRS, Tänndalen NRS ZML. *Jämtland:* Brattikfjäll, Enafors NRS ZML, Gäddede, Handöl, Leipikvattnet NRS, Mullfjäll, Snasahögarna NRS, Stalltj. stugan, Storlien, Svenstavik NRS, Undersåker ZML ZMU, Åre IVU ZML ZMU, Åreskutan ZML. *Ångermanland:* Härnösand ♂ 1 July 1942 (Fredlin). *Norrbotten:* ? loc. ZMU. *Lapland* (*Ås. Lpm.*)*:* Bångnäs, Dorotea NRS, Fatmomakke, Njakafjäll, Satsfjäll ZML NRS, Saxnäs NRS ZML. *Ly. Lpm.:* Ammarnäs GNM, Björkfors VCA ZML, Gargnäs NRS, Grevattnet in Sorsele NRS, Grundforsen, Häggås GNM NRS, Iltebursfors NRS, Kvärnbäcken NRS, Laxfjäll, Lycksele VCA, Norra Storfjället NRS, Oltokjaure, Sorsele NRS, Tjulträsk, Tärna NRS, Tärnasjön, Vännäs NRS, Västansjö, Örnäs NRS. *P. Lpm.:* Arjeplog, Jäckvik, Peskehaure ZMU, Svalesjaure. *Lu. Lpm.:* Gällivare NRS, Kutjaure NRS, Kvikkjokk NRS ZMA ZML, Malmberget, Markovaare NRS, Meatajaure NRS, Muddus National Park NRS, Njunjes ZMA, Ruotjajaure NRS, Sarek National Park NRS ZML, Sjitnjajarnga NRS, Sjöfallet, Tarradalen NRS, Vaisaluokta NRS, Virihaure area (Birnapakk ZMU – Killanjaure ZML). – Rapasäter ZMU – Staloluokta NRS ZML – Stora Titir ZMU *T. Lpm.:* Abisko NRS ZMA ZML ZMU, Björkliden NRS ZMA ZML, Jukkasjärvi NRS ZML, Kaisepakte NRS, Karesuando NRS, Karsavaggejokk, Kesajärvi NRS, Kiruna NRS ZMA, Kummavoipio NRS, Kurravaara NRS, Nakerijärvi NRS, Njuolja IVU, Njuorajaure NRS, Nuonjevare NRS, Pältsa NRS, Sarvajokk NRS, Sinnukasjärvi ZMU, Stenbacken NRS ZML, Stordalen NRS, Torneträsk area ZMA, Vadvetjokko National Park ZMA, Vassijaure NRS ZMA, Vietovare NRS, Vittangi NRS.

Finland. Widely distributed from about 65° 30′ N north to the arctic coast (Elfving 1968).

World distribution. Arcto-alpine. Europe (in British Isles restricted to Southwestern England, Wales, Northern England, Scotland; NW Portugal; NW Spain; The Pyrenees; The Appennines; The Alps; The Balkan mountains; Greece (Olympus); Fennoscandia; Northern European USSR incl. Kola pen., Novaya Zemlya) – Northern Siberia – Kamchatka – Altai – Pamirs – Tien Shan (Pittioni 1942, pp. 194–198; Reinig 1966; Yarrow 1959 and in litt.).

Zoogeographical remarks

B. lapponicus is divisible into two Fennoscandian subspecies on the basis of the yellow pile extension of the vesture. The subspecies described below meet and intergrade in part of Northern Scandinavia in a zone tentatively illustrated on the map (Fig. 63). The distribution of the subspecies indicates immigration into Scandinavia from two directions, viz. the paler coloured *B. l. lapponicus* invading arctic areas from east and the darker *B. l. scandinavicus* immigrating from south. Kruseman (1959) indicates that the latter might be an interglacial relict. Reinig (1965, pp. 124–126) suggests that the strongly variable appearance in the area of overlap is caused by intergrading of three populations, viz. (1) *B. l. lapponicus* immigrating from east; (2) *B. l. scandinavicus* invading Norway from south in interglacial period and developing strongly melanic appearance while isolated in the western refuges during Würm; (3) an additional post-glacial population immigrating from south. However, the melanic appearance of *B. l. scandinavicus* does not necessarily favour a theory of glacial survival and the recent distribution of the subspecies may be explained by post-glacial immigration only.

Biology

Nest. Pollen-storer. A number of nests have been recorded, all of which are situated on or just below the surface of the ground, preferably in vacated rodent nests. The colonies are rather small, the number of workers produced in a

colony established in Northern Norway (Troms (TRi): Målselv: Andsfjell) is estimated to 'rund zwei dutzend' (Reinig 1965, p. 115), the date of excavation and the number of broods not mentioned. Meidell (unpublished) located two colonies (Rogaland (Ri): Suldal: Ullsnes 750 m) established in separate abandoned mouse nests at the base of the same tuft of *Vaccinium myrtillus* and *V. uligonosum*, both of which were already finished on 4 July.

Flight season. From beginning of May till beginning or end of September. Queen: 6 May–24 Sept.; worker: 3 June–2 Sept.; male: 15 June–1 Sept. A total of six workers recorded at sea level in the western fjords as early as 19–30 May illustrates that the emergence of queens is related to the local conditions, i.e. *B. lapponicus* hibernating at lower altitude may appear in the middle of April.

Biological remarks

The early appearing males and the early completed colonies observed by Meidell above, emphasize a rapid cycle. Considering the length of the flight period, one may ask whether the successive emergence of hibernating queens extends for an unusually long period and lengthens the season accordingly, or whether the species in at least some seasons produces two generations, as stated for *B. jonellus* in both the lowlands and in subalpine/alpine regions (Meidell 1968), and moreover indicated for other species of this subgenus (Hobbs 1967, p. 1286). However, a rapid cycle does not agree with a colony raised in an observation box (Hasselrot 1960, Table 8), where, for instance, the pre-imaginal stages lasted at least about ⅓ longer than for other species raised under the same conditions. It is uncertain to what degree the development was influenced by artificial conditions.

BOMBUS LAPPONICUS LAPPONICUS (FABRICIUS)

The nominate subspecies is distinguished from *B. l. scandinavicus* by yellow hairs on T_1, T_{4-5}.

Queen, worker

Queen measurements: N = 20; Norway: Finnmark (Fö): Sör-Varanger; malar space: 0.58 mm (±0.03 ±0.01) range: 0.50–0.63 mm; 'radial length': 3.72 mm (±0.11 ±0.02) range: 3.50–3.90 mm; interalar width: 4.87 mm (±0.18 ±0.04) range: 4.35–5.5 mm. Body of medium size.

Colour pattern. Pile of vertex with variable admixture of yellow; hairs of collar, posterior crescent-shaped part of scutellum, lateral tufts of T_1, T_{4-5} yellow. Pile of T_{2-3} ferruginous. Otherwise coat black. Interalar band posteriorly v-shaped, i.e. including black hairs of scutellum.

Variation. The yellow-haired collar just reaches posterior lobe of pronotum or covers the lobe and adjacent margin of episternum as well, occasionally the lobe is covered with a mixture of yellow and black hairs. Corbicular fringes pale yellow, pale ferruginous or tipped so. T_{4-5} with variable admixture of ferruginous hairs, occasionally T_5 with variable admixture of black hairs.

Male

Colour pattern. Pile of face below antennal sockets predominantly yellow, likewise pile of vertex. Collar extending down episternum, crescent-shaped posterior part of scutellum, T_1 and T_{4-7} yellow-haired. Venter and all femora with yellow hairs, usually of paler shade. Fringes of hind tibia and hind basitarsus predominantly yellow. Hairs on T_{2-3} ferruginous. Coat otherwise black. Interalar band usually not broader than collar and posteriorly v-shaped.

Variation. Slight variations in the extension of yellow hairs, e.g. on fore- and mid-legs. T_{4-7} with variable admixture of ferruginous hairs.

Distribution (Fig. 63)

Norway. Restricted to the northeasternmost part of the country, viz., the eastern part of Finnmark.

Sweden. Restricted to northeastern part of Lapland.

Table II. The frequency of *B. l. lapponicus* (Fabricius) in Fennoscandia-Petsamo. Areas suggested as being occupied by this subspecies in italics. Figures in ( ) refer to queens only.* Mainly based on collection ZMH revised by Elfving

Area	Number of specimens				*B. l. lapponicus* in per cent	
	total		*B. l. lapponicus*			
Norway	♀☿♂	(♀)	♀☿♂	(♀)	♀☿♂	(♀)
Troms (TRy)	134	(59)	21	(13)	16	(22)
Troms (Tri)	188	(89)	43	(22)	23	(25)
Finnmark (Fv)	19	(7)	7	(3)	37	(43)
Finnmark (Fi): Alta	51	(32)	33	(25)	65	(78)
Finnmark (Fi): Kautokeino-Karasjok	39	(4)	31	(4)	79	(100)
Finnmark (Fn)	112	(27)	70	(24)	63	(89)
Finnmark (Fö)	86	(32)	79	(29)	92	(91)
	629	(250)	284	(120)		
Sweden						
Lapland (Ås. Lpm.)	41	(41)	3	(3)	7	(7)
Lapland (Ly. Lpm.)	72	(47)	10	(4)	14	(9)
Lapland (P. Lpm.)	6	(3)	4	(3)	67	(100)
Lapland (Lu. Lpm.): Virihaure	47	(20)	10	(6)	21	(30)
Lapland (Lu. Lpm.): Malmberget	111	(44)	103	(41)	93	(93)
Lapland (T. Lpm.): Torneträsk area – Karesuando	230	(54)	113	(18)	49	(33)
	507	(209)	243	(75)		
Finland*-Petsamo						
Lapponia (Le): Kilpisjärvi	122		86		70	
Remaining areas north of polar circle	245		230		94	
South of Polar circle	many		all		100	

Finland. This subspecies apparently occupies the entire area of the distribution of the species except the westernmost area, viz. Lapland (Le), cf. Table II.

The total distribution of the subspecies, B. l. lapponicus (Fabricius). Northeastern Fennoscandia – Kola pen. – Northern Russia – Northern Siberia to Anadyr Bay (Pittioni 1943, p. 29).

Faunistic remarks

The distribution of the nominate subspecies, reaching northeasternmost part of Norway, agrees with Sparre Schneider (1906, 1909) but disagrees with Reinig (1965, p. 120, the map). The latter considers Kola pen. as the western border area of this subspecies and Northeastern Norway and Northern Finland as an intergrading zone. Consequently, he includes Swedish Lapland, the type area of the species, in the area occupied by *B. l. scandinavicus.*

The more westerly occurrence of the nominate subspecies indicated herein is based on a phenotypical study of the collections, and the frequency distribution of this subspecies is presented in Table II. By keeping to the so-called 75 per cent rule, the districts suggested as occupied by the nominate subspecies are indicated. The western border line (Fig. 63), based on the figures in Table II, is of course artificial and tentatively indicated. By using the frequency presented in brackets, referring to the more colour-stable queens only, the western limit should be moved a bit further west, i.e. *B. l. lapponicus* would occupy more of Finnmark. Larger material is, however, needed to adjust the indicated limits of the transitional area.

BOMBUS LAPPONICUS SCANDINAVICUS FRIESE

Description of holotype (Friese 1902, p. 495): 'Segment 2–6 rot behaart ohne gelbe Behaarung'.

Supplementary description of the holotype: Indication of yellow collar (barely seen by naked eye) laterally reaching posterior lobe of pronotum. A few yellow hairs admixed in lateral fringes of scutellum. Hairs on T_{2-5} and lateral fringes of T_6 rather bright ferruginous. Lateral part of fringes of St_3, fringes of St_{4-6} pale ferruginous. Coat otherwise black.

The subspecies is distinguished from the nominate form by the absence of yellow hairs on gaster. Queen and workers with no trace of yellow hairs at all are separated from workers of *B. alpinus* (Linnaeus) and *B. arcticus diabolicus* Friese by the shorter malar space, different microsculpture in ocellar-orbital field and indistinct inner distal posterior process of hind tibia (Fig. 16B).

Queen, worker

Queen measurements: N = 20; Norway: Oppland; malar space: 0.58 mm ($\pm$0.03 $\pm$0.01) range: 0.50–0.60 mm; 'radial length': 3.83 mm ($\pm$0.09 $\pm$0.02) range: 3.80–3.95 mm; interalar width: 4.96 mm ($\pm$0.20 $\pm$0.05) range: 4.45–5.23 mm. Body of medium size.

Colour pattern. Cf. description of holotype.

Variation. Coat of thorax entirely black or with more or less pronounced yellow-haired collar and scutellum; if pronounced, collar reaches adjacent margin of episternum and entire crescent-shaped posterior part of scutellum is yellow-haired; interalar band includes black hairs of scutellum, i.e. posteriorly v-shaped. T_1 with variable admixture of ferruginous hairs; ferruginous hairs on T_2 anteriorly more or less replaced by black ones, occasionally T_2 entirely black-haired. Anterior part of T_6 with variable admixture of ferruginous hairs.

A tendency to pronounced yellow collar and scutellum is less frequent outside the intergrading zone, and everywhere is more often present in workers than in queens.

Male

Colour pattern. Pile of face below antennal sockets pronounced yellow. Pile of vertex with variable admixture of yellow. Yellow collar reaching posterior lobe of pronotum, crescent-shaped part of scutellum yellow-haired. Pile of episternum, trochanters, femora with variable admixture of yellow. Fringes of hind tibia, hind basitarsus pale yellow. Hairs on T_{2-7} ferruginous. St_{2-6} pale yellowish fringed. Coat otherwise black. Interalar band posteriorly v-shaped.

Variation. Yellow collar varies in width and may extend part of the way down the episternum, occasionally yellow pile strongly reduced. Yellow hairs on head, scutellum, and gastral sternites undergo slight variations. Fringes of hind tibia and hind basitarsus may be pale ferruginous. Extreme anterior margin of T_2 with some black hairs, occasionally anterior lunate part of this tergite black-haired. Individuals with ferruginous colouring of gaster reduced to hindmost segments rarely observed, and then distinguished from *B. pratorum* by the penis valve (cf. Figs. 36C, 37C) and by the longer fringes of hind tibia and hind basitarsus.

Distribution (Fig. 63)

Norway. The species is represented by *B. l. scandinavicus* in Southern Norway and in Northern Norway north to about 70° 15′ N. and east to 19° E.

Sweden. Distributed north to approximate 66° N in Lapland.

Total distribution of the subspecies, B. lapponicus scandinavicus Friese. Scandinavia. The border to the intergrading zone (Fig. 63) is merely indicated.

BOMBUS (PYROBOMBUS) PRATORUM (LINNAEUS)

Apis pratorum Linnaeus, 1761, p. 424, No. 1711, type area Sweden: Uppland. A small ♀ LSL! labelled *pratorum* agrees with the usual interpretation of the taxon.

(*Bombus pratorum* (Linnaeus); Dahlbom 1832, p. 36; Nylander 1848, 1852; Wahlberg 1854, 1855; Siebke 1870, 1873, 1880; Thomson 1870, 1872; Sparre Schneider 1895b, 1898, 1909, 1918; Nerén 1892; Strand 1898a,1898b, 1901, 1904; Lie-Pettersen 1901, 1905, 1907; Friese 1902; Aurivillius 1903; Bengtsson 1904, 1908, 1931; Ringdahl 1915; Wahlgren 1917–18; Lundblad 1924; Gaunitz 1929; Soot-Ryen 1925; Jansson & Sjöberg 1932; Hellén 1933; Meidell 1934a, 1946; Wexelsen & Skåre 1934; Brinck & Wingstrand 1949; Løken 1949, 1950, 1958a, 1966c; Brinck 1951; Ander 1953a and b, 1963, 1965; Tjeder 1954; Kruseman 1959; Elfving 1960, 1968; Erlandsson 1960; Fridén, Eskilsson & Bingefors 1962; Hasselrot 1962; Fridén 1967. *Apis fidus* Harris, 1776, p. 134 No. 4. The description is provided with a colour-drawing of a queen which is regarded as the type. Type area Great Brittain. *Apis subinterrupta* Kirby, 1802, p. 356 No. 99, holotype ♀ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Apis donovanella* Kirby, 1802, p. 357 No. 100, holotype ♀ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Apis burrellana* Kirby, 1802, p. 358 No. 101, holotype ♂ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Bombus subinterruptus* (Kirby); Dahlbom 1832, p. 35. *Bombus ephippium* Dahlbom, 1832, p. 37 No. 10, lectotype ♀ ZCL! designated by Ander (1967) type loc. Lapland (T. Lpm.): Jukkasjärvi; Zetterstedt 1838. *Bombus burrellanus* (Kirby); Dahlbom 1832, p. 43. ? *Bombus arbustorum:* Zetterstedt 1838, p. 473 (partim) nec Fabricius 1776. *Bombus lullianus* Nylander, 1848, p. 236 No. 21, holotype ♂ ZMH!, type area Finland: Uleåborg. *Bombus pratorum ephippium* Dahlbom; Kruseman 1959.)

First Scandinavian records

Norway. Oppland (On): Vang; Buskerud (Bö): Ringerike; Krödsherad (Siebke 1870).

Sweden. Uppland (Linnaeus 1761).

Taxonomical remarks

The Scandinavian population belongs to the nominate form.

The *sparreschneideri* form designated by Vogt (1909) as a long-haired form occurring in northeasternmost Norway, i.e. Finnmark (Fö): Sör-Varanger, cannot be recognized as a subspecies. The hair length was not measured but presents apparently only a very slight clinal increase directed from Southern to Northern Norway. The difference in size between the southern and northern Norwegian population, characterized by the difference in malar space, 'radial length', and interalar width in the female, is presented in Table III. It reveals no significant difference between the southern population and that restricted to Finnmark (Fö): Sör-Varanger (Table III column A and B). Between the southern population and that of northernmost Norway in a wider sense (Table III column A and C) there is a significant difference in one feature, the interalar width. The populations display, moreover, identical colour pattern with the same variations; perhaps specimens with yellow hairs on T_2 more often occur in the northern population. Thus there is no basis for subspecific discrimination.

The population in Swedish Lapland is treated as *B. p. ephippium* without comments by Kruseman (1959). It is, however, identical with the

Table III. *B. pratorum* (Linnaeus). Average measurements in mm of (A) 20 ♀♀ from Southern Norway: Akershus and Oppland (Os) 60°–61°15′ N, (B) 9 ♀♀ from Northern Norway: Finnmark (Fö): Sör-Varanger 69°40′ N, (C) 20 ♀♀ from Northern Norway: Finnmark and Troms 69°–69°40′ N of which ♀♀ from B included

	A		B		t_{A-B}test	C		t_{A-C}test
	mean	s	mean	s		mean	s	
Malar space	0.60	±0.02	0.59	±0.01	1.63	0.61	±0.02	1.24
'Radial length'	3.62	±0.08	3.57	±0.08	1.35	3.61	±0.09	0.18
Interalar width	4.36	±0.12	4.33	±0.18	0.44	4.49	±0.20	2.42

populations elsewhere in Scandinavia and the subspecific status must therefore be suppressed.

B. p. var. *fidus*, *B. p.* var. *burrellanus*, *B. p.* var. *subinterruptus* (= *B. p.* var. *b* Thomson, 1872), *B. p.* var. *donovanellus*, *B. p.* var. *citrinus* Schmiedeknecht, 1878, *B. p.* var. *decoloratus* Alfken, 1898 (= *B. p.* var. *styriacus* Hoffer, 1883), *B. p.* f. *bimaculatus* Skorikov, 1911 (Wahlberg 1854; Sparre Schneider 1909, 1918; Hellén 1933; Meidell 1934a; Løken 1949; Brinck 1951) refer to infrasubspecific forms. A black aberrant (Meidell 1934a), named *B. p.* var. *melanopygus*, is a nomenclatural misunderstanding. *B. melanopyge* Nylander, 1848 (= *B. lapponicus* var. *melanopygus* Nylander; Friese & Wagner 1912 = *Pratibombus melanopygus* (Nylander); Skorikov 1937 = *Bombus (Pyrobombus) melanopygus* Nylander; Krombein & Burks 1967) is a nearctic species.

Queen, worker

Morphological characters. Malar space about as long as distal width, longer than A_3 but shorter than A_{2+3}. Disc of clypeus with rather sparse fine puncturing except for anterior impunctate area between lateral well-separated impressions. Labral furrow moderate, in width less than ¼ the labral width. A_4 varies in length from being as long as distal width and distinctly shorter than A_5 to slightly longer than distal width and almost as long as A_5. Hind basitarsus with longest hairs of posterior fringe slightly or not exceeding half the greatest width of the segment. At least T_{4-5} with smooth microsculpture and rather sparse, fine puncturing. T_6 with dense, fine puncturing, dimpled and distally truncate, protuberant. Coat rather shaggy.

Queen measurements: N = 20; SE Norway; malar space: 0.60 mm (±0.02±0.01) range: 0.58–0.65 mm; 'radial length': 3.62 mm (±0.08 ±0.02) range: 3.45–3.75 mm; interalar width: 4.36 mm (±0.12±0.03) range: 4.13–4.65 mm. Body of small to moderate size.

Colour pattern. Broad lemon yellow collar usually including adjacent narrow margin of episternum. Pile of T_{4-6}, lateral part of fringe of St_4, fringe of St_5 and pile of St_6 ferruginous. Coat otherwise black.

Variation. Yellow collar variable in width. T_{1-2} with variable admixture of yellow hairs, on T_2 occasionally concentrated to lateral patches of various size or expanded to the entire tergite. Corbicular fringes mainly ferruginous or tipped so. A single female (Sweden: Dalsland: Billingsfors GNM) with black hairs of scutellum entirely replaced by whitish hairs was examined.

Male

Morphological characters. Malar space hardly longer than distal width, as long as A_{2+3} or nearly so. A_3 equal in length to A_5 or nearly. A_4 about as long as distal width. Longest hairs in fringe of hind tibia not exceeding twice the greatest width of the segment, those of hind basitarsus not exceeding 1½ times the greatest width of the segment. St_8 (Fig. 36A); gonostylus and volsella (Fig. 36B); penis valve (Fig. 36C). Coat shaggy, Body of small to moderate size.

Colour pattern. Pile of face below and above antennal sockets, pile of vertex with variable admixture of yellow. At least distal half of T_4, T_{5-7} with ferruginous hairs. Fringes of sternites greyish-white except that of St_6 being ferruginous. Otherwise colouring as in the females.

Variation. This sex undergoes considerable variation in the pattern. Pile of face and vertex ranging from entirely black to predominantly yellow, gena and venter of head with variable admixture of pale yellow hairs. Yellow collar varying greatly in width and extending half way down episternum; black hairs of scutellum more or less replaced by yellow ones. Ferruginous piles on T_{4-7} reduced to cover T_{6-7} only, occasionally just T_7. Individuals with T_{1-7} black-haired were observed. Fringes of St_{2-5} with variable admixture of black hairs, occasionally all black. The intensity of ferruginous hairs is subject to variations, also in fresh specimens. Fringes of hind tibia and hind basitarsus may be greyish-white tinged.

Distribution (Fig. 64)

Norway. Widely distributed throughout the entire country. The abundance is particularly

great in woodland and in subalpine/subarctic zone, less so in the western archipelago and in alpine/arctic regions. In Southern Norway recorded to 1200 m.

Biotopes: Meadows, orchards, gardens, roadsides, pastures, *Vaccinium* heaths.

A total of about 2700 individuals was examined.

List of localities. *Östfold:* Hvaler: Asmalöy, Kirköy, Söndre Sandö; Kråkeröy: Tangen, Ödegård; Onsöy: Dypeklo, Ellingård, Lervik, Ramseklo, Rörvik, Torp; Sarpsborg: ZMO; Halden: ZMA, Asak, Berg, Blakmose, Hakelund, E Kuletjern, Nordbakke, Sponvika, Veggesdal; Aremark: Gjeddetjern, Mymosetjern, N Skodsberg; Marker: Damholtet, Dybedal, Jåval, N Rödenes; Rakkestad: Levernes, Rörvik; Råde: Fuglevik, Oven, Tom; Moss: Jelöy ZMA ZMB; Eidsberg: Holm; Trögstad: V Bingen, Fransrud, Mönster bro, Vassbotn. *Akershus:* Ås: ?loc. ZMO, Vollebekk; Frogn: Dröbak TRM; Oppegård: Svartskog; Asker: Lushattdalen, Rustad; Bærum: E Bråtan, Fornebo ZMO; Oslo: NMW TRM ZMA ZMB ZMO; Lörenskog: Elvåga ZMB ZMO; Ræl-

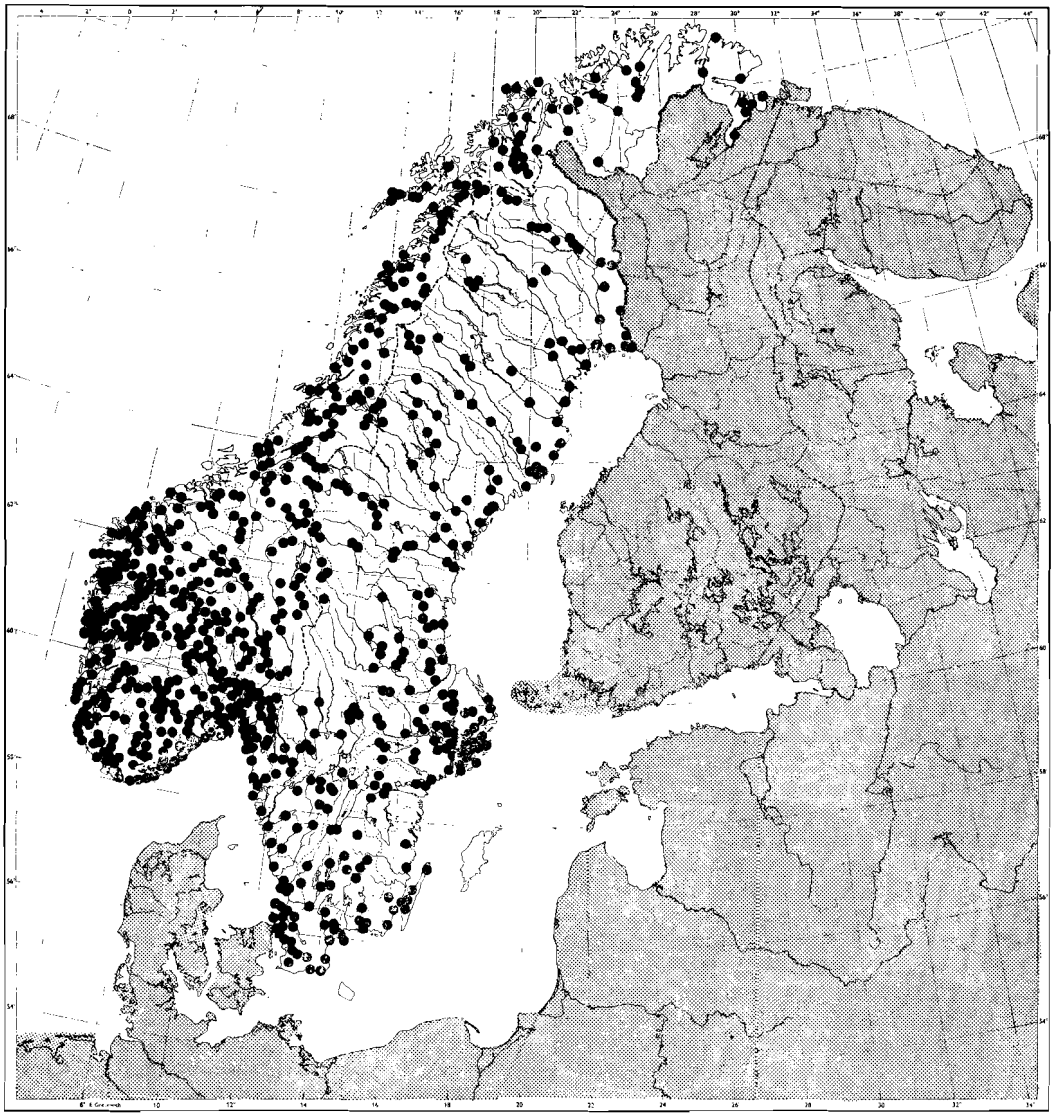


Fig. 64. *B. pratorum* (Linnaeus). Legends as in Figs. 50, 54.

ingen: Fjæringsby; Aurskog-Höland: Gangnes, NW Mo, Östergård; Fet: Björkflåten; Nes: N Grinkelsrud; Eidsvoll: S Eidsvoll, Feiring; Hurdal: Tömte ZMO. *Hedmark (HEs):* Eidskog: Bolfoss, Gjelaråsen; Kongsvinger: Eidsberg; Sör-Odal: Mårud gård ZMO; Elverum: Grundset ZMO; Hamar: ZMO. *HEn:* Trysil: Dammen, Enga, S Sjöenden, Vestby; Åmot: Glesubekken, Åmot ZMO, Åset ZMO; Rendal: Solbakken SE Åsheim ZMO; Tynset: N Tyldal, Ulsberg; Tolga-Os: Hodalen, Növa; Engerdal: Björköihl, Torhus. *Oppland (Os):* Jevnaker: Randsfjord USU; Gran: S Einavoll, Gjervika, Korshagen, Lander, N Rogstad, Tingelstad; Östre Toten: NW Skreia, Stubdalen; Söndre Land: Fluberg; Nordre Land: W Dokka USU ZMB, Kinn, Torpa; Lillehammer: Jörstadmoen, Lillehammer; Etnedal: Fladöydegard; Sör-Aurdal: Breidablikk, Briskvollen 950 m, Reinli, Strömmen; Nord-Aurdal: Fagernes, Flya, Knutshaugen, Sæbuöygarden N Fagernes, Åbjör; Gausdal: Gåsöya; Öyer: Aksjö 1000 m, Brettadalen 950 m, Skåi, Öyer, Åstdalen 900 m; Ringebu: Ringebu, Venabygd 900 m. *On:* Vestre Slidre: Kinnholt; Östre Slidre: Skammestein 700 m; Vang: Eidsbugarden 1200 m, Grunke 950 m, NE Otrövann 1000 m, Vang ZMO, N Öye USU ZMB, Öylo ZMO; Sel: Heidal TRM ZMB, Hövringen 960 m, Klakshaug, Mysuseter 900 m; Vågå: Gjendesheim 1000 m, Klones, Randsverk 800 m, Skjerva 800 m, Vågåmo ZMB ZMO; Lom: Galdesand, Gjendebu 1000 m, Kvamme; Skjåk: Skjåksetrene 800 m; Dovre: ?loc. ZMO, Dombås ZMA. *Buskerud (Bö):* Hurum: Hurum, Pinadalen, N Storsand; Drammen: ZMB ZMO; Lier: Drag, Lökke gård, Sylling; Krödsherad: ?loc. ZMO, Glesne, Noresund; Modum: SE Dignes, Modum ZMO; Flesberg: Hvila, Lampeland, Öydegarden; Kongsberg: TRM, Komnes, Lauerud, Lintvedt, SE Skollenborg. *Bv:* Sigdal: Haglebu 1000 m, Kopseng, Nedre Eggedal, Nordbygda, W Sigdal; Nore og Uvdal: SW Björkeflåtå, Nörstebö 700 m, Rödberg, E Sönstevann 1050 m, Tunnhovd, Uvdal stavkirke; Nes: Bergheim bro, Eidal, Smedsgården; Gol: Gol, Randalseter 940 m; Hemsedal: Holli bru, Lykkja, Kjölen; Ål: ?loc. ZMO, Gullhagen, Votnedalen; Hol: Geilo VCA ZMB, Haugastöl 1000 m VCA ZMB, Halfardokkistölen 860 m, Hol kirke, Hovet, Lillevann 1150 m, Nyestölen 1000 m, Nygård 1000 m, Seim, Skurdalen 830 m, Vikastölen 1000 m. *Vestfold:* Sande: SW Sande; Holmestrand: Angerskleiv, W Bogen; Borre: Nykirke; Ramnes: Orrevål; Lardal: N Styrvoll; Andebu: E Kodal; Stokke: Langö, Veierland; Nötteröy: Teie; Tjöme: Kjære; Hedrum: N Kvelde; Tjölling: Tjölling. *Telemark (TEy):* Skien: Kikut, Skien; Porsgrunn: Langangen, Nystrand; Bamble: Trosby, S Åby; Nome: Damtjern, Vommestöl; Drangedal: Holmane, Holmen, Naksjö, Nordbö, Nos, Omnes, Tomyra, Ringnes, Åkredalen; Kragerö. *TEi:* Notodden: Elgsjön, Gransherad, Tindegrend, Tinnoset; Sauherad: Liagrend; Bö: Vatnar; Seljord: Nörsteteig 720 m, Svartdal; Kviteseid: Eidstad, Kviteseid, Vrådal; Nissedal: S Tjönnefoss, Treungen; Fyresdal: Hegglandsgrend, Moland, Veum; Tokke: Bandaksli, Grimdalen, N Holtet bru; Vinje: Bossböen 970 m, Krossen 700 m, Særengrend, Torvtjern 900 m, Urdbö 700 m, S Åmot; Tinn: SE Borsjöen 1150 m, Mösvatndamm 900 m, Sneiseli 960 m, Våer, Vålen. *Aust-Agder (AAy):* Gjerstad: Fiane; Vegårdshei: Ljostad, Myra; Tvedestrand: Askeröy, Dypvåg, Eidbu, Nes Verk TRM, Tvedestrand, Strengereid, Österå; Arendal: Arendal, Salteröd; Moland: Dal, Holmsund, Kilsund, Tverrdalsöy, NE Voje; Tromöy: Bjelland, Tromöy; Hisöy: His TRM; Fjære: Fjære ZMO; Grimstad; Öyestad: NE Rykenes; Froland: Svenes; Landvik: Eide TRM, Hörte, Tönnesöl; Lillesand: Kjöbmannsvik, Kvåse, Melhagen, Åmli; Birkenes: Rosseland, Sagen, Svaland; Iveland: Frikstad, Håvardstad, Ivedal. *AAi:* Evje og Hornes: Hornes, Lauland, Syrtveit; Gjövdal: Krossbekk, Saurbekkflåt, Smedland, Öy st.; Bygland: Löndal, Ose, Setesdal TRM; Valle: S Kvestad, Rygnestad, Valle; Bykle: Breive 700 m, S Breivann 700 m, Bykle. *Vest-Agder (VAy):* Kristiansand: ZMO, N Holskogen, Randesund ZMO; Vennesla: W Hægeland, Övrebö ZMO; Sögne: Langeneset, Sögne, Åros; Mandal: TRM ZMB, Hogganvik, Ramsö TRM, Tregde, Tuftenes; Marnadal: Ask, Finsland, Röyseland; Lindesnes: Spangereid; Lyngdal: Lyngdal TRM; Kvinesdal: Feda, Gjemlestad, Hardbakke, S Kvinesdal, W Solås, Svinland, Öye; Flekkefjord: Espetveit, Ersdal, Fedåk, Flikkeid, Haugbom, NW Sandvann, Sireosen ZMO, Solvang, Temmerli. *VAi:* Audnedal: W Sveindal; Hægebostad: Bryggesåk; Åseral: Espelid, Rosseland, Åseral; Sirdal: Rekevik, Ådneram. *Rogaland (Ry):* Lund: Moi; Sokndal: Bu, Sogndal, Åmot; Helleland: NE Gydal st., Klungland st.; Eigersund: Eikjelandsdalen; Bjerkeim: Hovland, Ivesdal, Malmeim; Hå: Ogna, Saltebro; Klepp: Börsheim, Klepp, Vik; Gjesdal: Ålgård; Sandnes: Bråstein, Håpet, Kjellingland, Todnheim; Solå: Rjoa, Slettehi, Solastrand; Randaberg: Randaberg, Vistehulen; Stavanger: Forus, Hinna, Lindöy, Madla ZMO, Stavanger SMS ZMB, Tananger; Strand: Tau, Vatne; Finnöy: Judabjerget, Sjernaröy; Rennesöy: Rennesöy; Karmöy: Fotvann, Skudeneshavn, Vigsnes; Haugesund: Haraldstötten. *Ri:* Forsand: Fylgjesdalen, Lyse, Meling; Hjelmeland: Igland, Kvamme, Steinslandsvann, Årdal; Suldal: Bleskestadmoen 875 m, Bråtveit, Håvardstöl, Jelsa, Kalltveit, Mostöl, Roaldkvam, Sand, Ullsneskvelven, Vandvik; Sauda: Birkeland, Hellelandsbygda, Sauda, Saudasjöen, Slettedalen. *Hordaland (HOy):* Ölen: Dommersnes; Stord: Degenessund, Storsöy; Tysnes: Ånuglo; Os: Berge, Bjånes, Gullholmen, Hagavik, Hegglandsdalen, Inneröy, Lepsöy, Lysekloster, Moldegård, Steindalsseter, Nordströno; Fusa: Eikjelandsosen, Övre Hålandsdal; Samnanger: Höyseter; Fana: Biol. st., Birkelundsbakken, Blomsterdalen, Dolvik VCA, Eggholmen, Engjavik, Fana kirke, Fantoft, Flesland, Grimseid, Hatlestad, Hjellestad, Klokkero, Knatten, Krokeide, Lönninghavn, Mariholmen, Milde, Minde VCA, Rådalen, Skipanes VCA, Sedalen, Skjold, Smöråsen, Skeie, Steinsvik, Stend, Storetveit,

Sælöy, Troldhaugen, Titlestad; Sund: Bokken, Telavåg; Fjell: Solsvik; Laksevåg: Alvöen, Björndalspollen, Helleren, Storingaviken; Bergen: TRM ZMB; Asköy: Davanger, Hegernes VCA, Herdla, Jacobsöy; Åsane: Eidsvågsnesset, Golfbanen, Haukedal, Jordalen, Steinestö, Tellevik, Tuft, Åstveit; Osteröy: Fitje, Hamre kirke, Kleppe, Njåstad; Vaksdal: Eidslandet, Stamneshella; Meland: Brakstad, Io; Lindås: Fosse, Fyllingsnes, Kolås, Lauvås, Seim, Sævråsvåg, Veland, Vollom. *HOi:* Kvinnherad: Dimmelsvik, Gjermundshamn, Guddalsdalen, Hatlestrand, Hölen, Lio, Ljosmyr, Löfallstrand, Rosendal, Seimsfoss; Odda: Dalen gård, Hordasvingene 1000 m, Röldal, Seljestad; Ullensvang: Aga, Alvsaker, Djönno, Fossli 750 m, Fresvik, Grythorgi 900 m, Hesthammer, Kinsarvik, Kvalvik, Lofthus, Måbödalen, Rjoto 1000 m, Stavali 900 m, Sysendalen 750 m, Övre Eidfjord; Kvam: Kvamskogen, Nordheimsund, Sjuseter, Öystese, W Ålvik; Voss: N Armot, Bulken, Bömoen, Hamlagrö 600 m, Hangurfjellet 800 m, Mjölfjell, Nesheim, Rong, Tyrlingen; Granvin: Eide TRM, Skjervet, Trå; Ulvik: Bergo, Finse 1200 m ZMA, Gangdal 1000 m, E Mjölfjell, W Rubbeliseter. *Sogn og Fjordane (SFy):* Gulen: Takle; Hyllestad: Botn, Yttre Dale, Hyllestad, Lekva, Skivenes, Skor; Höyanger: Gare bro, Stöldalen; Gaular: Bugstad, Sande, Slotten, Vikum; Fjaler: Dale, Strandenes; Flora: Florö, NE Heia, Kinn, Sundaneset, Trollstua, Verpevik; Naustdal: Frammarsvik, Furehaugstölen, Horstad, Naustdal, Övre Hella; Förde: NE Flåten, Förde VCA, SW Hallbreim; Jölster: Vassenden, Ålhus; Gloppen: Hjortset, Hope, Lote, Sandane; Eid: Kjölsdalen, Nordfjordeid, W Stårheim, Vedvik; Vågsöy: Bryggja, E Kjölstad, Målöy, W Totland. *SFi:* Vik: Havås, Langedalen 850 m, Seljedal, Vik; Aurland: Flåm, Vassbygda, Vatnahalsen 800 m, Övstebö 800 m; Lærdal: Bergstölen 650 m, Horgje, Maristova 800 m; Sogndal: Kaupanger; Leikanger: Hermansverk, Leikanger, Stavseter, Suphammer; Balestrand: Balholm NMW, Brekka, Flesje, Eitodn, Horpedalen, Kvamsöy, Mel, Suphellesetra; Årdal: Övre Årdal; Luster: Dalsdalen, Fåberg, Fåbergstölen, Jostedal, Okkleviki, Turtagrö 900 m; Stryn: Flo, Gillesdal, Hornindal, Hornindalseter, Skåre, Stryn, W Vanberg, Videdalen, Videseter 600 m. *Möre og Romsdal (MRy):* Vannylven: Thue; Volda: Björkedalsvann, SE Folkestad; Örsta: Lyngstölvann, Örstavik, Öye; Hareid: Hjörungavåg, Mork; Ulstein: Flö; Heröy: Djupvik, Rödvik; Ålesund: VCA; Örskog: Skodje ZMO; Vestnes: Gjermundnes: Vikebukt; Molde: TRM ZMB; Aukra: Rindaröy; Fræna: Gjendem. *MRi:* Stranda: Bjordalsgårdene, Fivelstad, Fredheim, Norangdalen, Vollset; Norddal: Indreeidet, Krike bru, Valldal, Ytredal; Nesset: Nauste; Sunndal: Dalen, Jordalsgrend; Surnadal: Lahjell, Melhus, Stangvik, Övre Surnadal; Rindal: Bölme. *Sör-Tröndelag (STy):* Rissa: Gafsetåsen, Nordseter gård, Rissa VCA, Stadsbygd, Sötvik; Bjugn: Kotengsvann; Åfjord: Mölsletten, Mörreaune, Å. *STi:* Oppdal: Dalsbekk, Driva st., Drivstua 850 m ZMU, Knutshö 1200 m KMT ZMB, Kongsvold BML ZMB ZMO, Oppdal; Mittre Gauldal: Rogstadöy; Holtålen: Holtdalen; Ålen: Reitan; Röros: Evavoll 700 m, Naustervoll 700 m, N Storelvvoll 800 m; Tydal: Mo bro, Sakrismoen; Trondheim: KMT VCA ZMB; Melhus: Benna; Skaun: Sörnypvann KMT; Orkdal: Sognlia KMT. *Nord-Tröndelag (NTy):* Namdalseid: Hovika KMT; Namsos: TRM; Nærøy: Breiviken, Dalene, Garmannsviken, Saltbotn, Teplingan. *NTi:* Meråker: Gudåen KMT TRM VCA, Tovmodal; Stjördal: Draveng; Leksvik: Storvannet; Levanger: Avdal; Verdal: Sandvika KMT ZMB, Stiklestad, Sulstua, Verdal KMT, S Vuku; Inderöy: Kirkenesvåg, Skjelvågen; Steinkjer: Sem ZMA ZMB; Overhalla: Gryten, W Sellotören, Strandmoen; Grong: Ekkerseter, Fjerdingen, Trangen; Snåsa: Brönstad, Hegge, Strindmoen, S Telnes; Lierne: Kvelia, Nordli, Seterhaug, Småtjern; Höylandet: Höylandet, Skilleberget, Skogenga; Namskogan: Brekkvasselv ZMA, Finnvollan, Namskogan VCA ZMA ZMB, Äktejävre; Röyrvik: Bjerkhaug, Namsvatn KMT. *Nordland (Nsy):* Sömna: Sandvåg TRM, Sömnes TRM; Brönnöy: Nevernes ZMA; Vevelstad: Aursletten TRM; Melöy: Dalen, Glomfjord, Reipå, Storglommvann TRM; Gildeskål: Finnes, Gildeskål, Gilset, Inndyr, Jelstad, Skauvoll, Storvika, Sör-Fuglöy; Bodö: Bodö, Falkflaugdalen, Frostmo. *Nsi:* Hattfjelldalen: Björkåsen brygge; Grane: S Båfjellmo, Majavatn, Rotstokkmobekken; Vefsen: Luktvann, Ravasbakken, Store Björnåvann; Hemnes: Bleikvassli, Finneidfjord, Krokselvmoen, Strömbotn KMT; Rana: Bjellånes ZMO, Dunderland st., Krokstrand TRM ZMB, Randallsvollen, Ravnå ZMO, Rösvollheien, Rövassdal TRM, Stokkvik TRM; Beiarn: Gråtådalen; Saltdal: ? loc. TRM ZMO, Junkerdalsura, S Lönsdal, Solvågfjell, Storjordet TRM, Vensmoen; Fauske: Fauske, Vargåsen. *Nnö:* Sörfold: Bonnå, Bonnåsjöen, Tennvann; Hamaröy: Brennvik, NE Fjerdevann, Innhavet, Kråkmo SMS, Oppeid, Sandnes, N Strinda; Tysfjord: ? loc. ZMO; Ballangen: Bakkerud gård, Ballangen, Dyrhaug, Elvesletten, Forså, Hesjeli; Ankenes: Beisfjorden ZMA, E Seterfjell, Trollviken; Narvik; Evenes: Dragvik, Jansbakk. *Nnv:* Vestvågöy: Eggum, Finstad, Knutstad, Skulbru; Vågan: Store Molla, Svolvær ZMA ZMO; Hadsel: Kongselv KMT. *Troms (TRy):* Kvæfjord: Borkenes; Lenvik: Finnsnes; Tromsö: TRM VCA, Breivik SMS, Tromsdal TRM ZMB; Karlsöy: Hushattöy TRM, Karlsöy, Nordfuglö TRM, Vannö TRM; Skervöy: Ravelseidet, Vaddas. *TRi:* Skånland: Boltås, Lavangseid; Bardu: Bardu kirke, Rotvoll; Målselv: ? loc. ZMO, Bjerkeng TRM, Elvevoll, Frihetsli TRM, Kirkesdal, Kletten ZMO, Moen, Nordmo TRM VCA ZMO, Olsborg, Rundhaug, Sörli; Balsfjord: Laksvatn SMS, Lanes TRM, Takvann TRM; Storfjord: Signaldalen; Nordreisa: Bilto, Mollifossen; Kvænangen: Burfjord, Kvænangfjell. *Finnmark (Fv):* Kvalsund: Činkasjavrre, unna Hatteras. *Fi:* Alta: Bossekop TRM ZMB, Arones, Jotkajavrre TRM, Kvalfjord ZMO, Kåfjord TRM; Kautokeino: Kautokeino TRM. *Fn:* Porsan-

ger: Hamnbukt, Kistrand ZMB ZMO, Stabbursnes, Övre Lakselv; Berlevåg: SE Berlevåg; Vadsö. *Fö:* Tana: Seida TRM; Sör-Varanger: ? loc. TRM ZMO, Elvenes TRM ZMB, Haganes TRM, Galgoaive TRM, Grense-Jacobselv, Jarfjord TRM, Langfjorddalen TRM VCA, Solheim TRM, Strand TRM, Strömsbukt TRM.

Sweden. Widely distributed throughout the mainland and in Öland, but not recorded in Gotland.

A total of about 2200 specimens was examined.

List of localities. *Skåne:* Arkelstorp NRS, Barkåkra NRS, Billeberga, Bokskogen NRS ZMB, Bonderup ZMB, Bäckaskog NRS, Bökeberg, Båstad, Dalby NRS ZMB, Eljaröd NRS, Glimåkra NRS, Hjärnarp NRS, Hälsingborg NRS ZML, Härslöv ZMB, Höganäs NRS, Knutstorp, Kristianstad NRS, Landskrona ZMB, Ljungbyhed NRS, Lund ZMB ZML, Löderup NRS, Markiehage GNM, Nyhamnsläge, Sandhammaren NRS, Sankt Olof NRS, Silvåkra, Sjöbo NRS, Skälderviken NRS, Skäralid NRS ZML, Södra Sandby ZMB, Tåssjön ZMU, Vallåkra, Vanås, Villands Vånga NRS, Vitemölla NRS, Väderö, Ystad NRS ZML, Åhus NRS ZMB. *Blekinge:* Backaryd NRS, Brömsebro ZMB, Hällevik, Möljeryd NRS, Sjöarp, Sölvesborg NRS. *Halland:* Breared NRS, Bygget NRS, Dagsås GNM, Enslöv NRS ZML, Fjärås, Getinge NRS, Halmstad, Haverdal NRS, Slättåkra NRS, Snöstorp, Steninge NRS ZML. *Småland:* Aneboda ZMB, Barkaryd NRS, Bränstorp NRS, Dångebo NRS, Flisby NRS, Förhultsjön ZMB, Gasslanda ZMU, Hjorted NRS, Höreda NRS, Hörle NRS, Jära NRS, Järstorp NRS, Jönköping NRS, Kalmar NRS, Ljungarum NRS, Ljungby, Markeryd, Mohemmet ZMU, Nybro NRS, Nye NRS, Oskarshamn, Ryssby GNM ZMU, Tutaryd NRS, Villstad NRS, Vrigstad NRS ZML, Värnamo NRS, Värnarum, Österkorsberga ZMU. *Öland:* Borgholm NRS, Böda NRS, Ekerum ZMB, Glömminge NRS ZML, Högsrum NRS ZMU, Mörbylånga NRS, Ullevi NRS, Vickleby. *Östergötland:* Borensberg GNM ZMU, Högby ZMB, Kvarsebo NRS, Malmslätt NRS, Rinna ZMB, Stjärnorp ZMB, Tjällmo ZMB. *Västergötland:* Alingsås ZMU, Borås NRS, Broholm NRS, Falköping NRS, Grästorp NRS, Göteborg NRS, Horred NRS, Händene NRS, Höjentorp NRS, Karleby NRS, Karlsborg ZMB, Kymbo NRS, Läskö NRS, Skinnarhult NRS, Skövde NRS ZML, Stenum NRS, Tengene NRS, Töreboda ZML, Ulricehamn, Västra Bodarna ZMU. *Bohuslän:* Bovallstrand NRS, Edshulthall NRS, Grebbestad NRS, Munkedal, Strömstad, Syd-Koster NRS, Sämstad NRS, Tjuvkil NRS, Uleberghamn NRS, Älgön NRS. *Dalsland:* Bengtsfors NRS ZML, Billingsfors GNM, Dals Grindstad ZMB, Ellenö NRS, Gesäter ZMB, Holm, Köpmannebro, Rostock ZMB, Skållerud NRS, Skåpåfors NRS, Stenbynäs NRS, Åmål. *Närke:* Bärsta NRS, Stora Mellösa ZMB, Svennevad, Örebro NRS ZMB. *Södermanland:* Anderviken, Brandalsund NRS, Enhörna NRS, Helgarö, Huddinge ZMU, Häringe NRS, Läggestad NRS, Nackanäs NRS, Nynäshamn NRS, Nyköping NRS ZML, Näshulta NRS, Nävekvarn NRS, Ornö GNM, Salem NRS, Sjösa ZMB, Strängnäs ZMB, Tosterön NRS, Trosa, Tyresö NRS, Uttran NRS, Valla NRS, Viksberg NRS, Vällinge NRS, Västerhaninge ZMB, Vreta, Älta NRS. *Uppland:* Almunge NRS, Angarn NRS, Bogesund NRS, Danderyd ZMB, Djurö NRS, Dyvik NRS, Ekolsund NRS, Elmstad ZMB, Enköping ZMU, Fogdö NRS, Grisslehamn NRS ZML, Gustavsberg NRS, Häggeby NRS, Håtuna, Jumkil NRS, Knutby ZMB, Kragstad NRS, Lennartnäs NRS, Ljusterö NRS, Malmby NRS, Munsö NRS, Roslags-Kulla NRS, Roslags-Näsby NRS, Rungarn NRS, Stockholm NRS, Stocksund, Stångberga NRS, Tensta ZMB, Träbygget, Uppsala IVU ZMA ZML ZMU, Vendel NRS, Vindö NRS, Visinge NRS, Väddö NRS, Värmdö NRS ZML, Yxlan ZMB, Östervåla ZMB, Åkersberga NRS. *Västmanland:* Guldsmedshyttan, Lindesberg NRS, Kärrbo ZMB, Rundskär ZMB, Sala NRS, Saxhyttan NRS, Skultuna ZMB, Vittinge IVU. *Värmland:* Arvika, Daglösen NRS, Filipstad NRS, Forsvik, Grums NRS, Gylleby in Sunne NRS, Horrsjön NRS; Säffle, Ölme. *Dalarne:* Avesta ZMB, Bingsjö NRS, Enviken NRS, Falun NRS, Floda NRS Tje, Fulufjäll NRS, Gruvriset NRS, Hjortnäs NRS, Idre NRS, Karlsbyn, Leksand NRS Tje, Ludvika NRS, Mora NRS, Nittsjö NRS, Norrbärke NRS, Råttvik NRS, Sandsjö, Siljansborg NRS, Sjurberg NRS, Smedjebacken, Storsätern, Städjan, Sundborn NRS ZML, Sångån NRS, Sångtorpet NRS, Vikarbyn NRS. *Gästrikland:* Hamrångerfjärden NRS ZML, Hedesunda NRS, Hille-Forsby NRS, Högbo NRS, Ockelbo ZMB ZML, S Sandviken ZMB. *Hälsingland:* Bergvik, Bollnäs NRS, Delsbo NRS VCA ZML, Fredriksfors NRS, Järvsjö NRS, Kilafors, Orbaden NRS, Söderhamn NRS ZMB. *Medelpad:* Attmar NRS, Borgsjö NRS, Ede NRS, Haverö NRS, Kölsillre NRS, Leringe NRS, Ljustorp, Ovansjö NRS, Paljacka NRS, Skallböle NRS, 25 km S Sundsvall ZMB, Vifors NRS, Överturingen NRS, Ånge. *Härjedalen:* Fjällnäs ZMU, Hamrafjäll NRS, Oxsjövålen NRS, Tänndalen NRS ZML, Vemdalen. *Jämtland:* Bispgården NRS, Bispfors ZMB, Brattickfjäll NRS, Hallen, Jormlien, Leipikmoen NRS, Mattmar, Oviken, Storlien, Strömsund NRS, Svenstavik, Undersåker NRS ZML, Östersund NRS, Åre ZML ZMU. *Ångermanland:* Aspele NRS, Aspeå NRS, Bjästa NRS, Björna NRS, Bondsjö, Hoting NRS, Hörnefors ZMB, Näske NRS, Ramsele GNM, Sollefteå NRS, Stennäs, Ullånger NRS, Örnsköldsvik NRS. *Västerbotten:* Botsmark NRS, Bergsbyn NRS, Degerfors NRS, Grimsmark, Gubböle NRS, Hällnäs NRS, Jörn, Sikeå ZMB, Strömsör NRS, Täfteå ZMU, Umeå ZMB, Vindeln NRS, Västerhiske NRS, Åbyn ZMB. *Norrbotten:* Anttis, Boden NRS, Edefors NRS, Erkheikki NRS, Haparanda, Kalix, Karungi NRS ZML, Kengis, Korpilumbolo NRS ZMA, Kukkola NRS,

Mjölkudden NRS, Luleå NRS ZML, Pajala NRS ZML, Peräjävaara, Pite havsbad ZMB, Strömsund NRS, Töre ZMB, Överkalix NRS, Övertorneå NRS ZML, Övre Svartlå NRS, Älvsbyn NRS. *Lapland (Ås. Lpm.):* Bångnäs, Dorotea NRS, Kittelfjäll, Ormsjö NRS, Risbäck NRS, Vilhelmina NRS. *Ly. Lpm.:* Ammarnäs NRS ZMU, Björkfors, Forsvik, Lycksele NRS, Sorsele, Stensele ZMU, Stensundforsen NRS, Strömnäs NRS, Tjulträsk BML, Tärna NRS ZML, Tärnasjö, Umfors. *P. Lpm.:* Skatträsk. *Lu. Lpm.:* Gällivare NRS, Kvikkjokk, Malmberget, Muddus NRS, Njunjes ZMA ZML, Sarek, Tarradalen NRS. *T. Lpm.:* Abisko NRS ZML, Björkliden, Jukkasjärvi NRS ZML, Kaisepakte NRS, Kauppinen, Masugnbyn, Mell. Meräsjärvi, Nuolja, Njuonjevare NRS, Svappavaara NRS, Tornehamn ZMU, Vietovare NRS, Vittangi NRS.

Finland. Abundantly distributed throughout the country (Elfving 1968).

World distribution. Europe (British Isles; on the continent ranging from NW Spain, The Pyrenees, Italy, The Balkans and north to Arctic Fennoscandia; entire European USSR) – Turkey – Northern Iran – Crimea – Caucasus – Transcaucasus – Ural – Southern Siberia (Panfilov 1957; Yarrow 1959 and in litt.; Tkalcu 1960; Reinig 1968).

Biology

Nest. Pollen-storer. Nests were recorded in and below the surface of the ground, in abandoned bird nests, in nest-boxes for birds set out at various heights above the ground, in between walls in houses, etc. The nesting sites range from humid to dry biotopes and agree with the unconventional choice of dwellings generally known for the species (Free & Butler 1959, p. 7). The size of the colony is rather small. Meidell (unpublished) estimates the maximum number of workers produced in colonies excavated in Rogaland at about 40 individuals.

Flight season. From the end of March to the middle of September. Queen: 29 March–5 Sept.; worker: 25 April–25 Sept.; male: 29 May–15 Sept.

Biological remarks

This early-appearing species produces sexual offspring early in the summer and the life cycle is correspondingly completed during relatively short time. In England the colonies are finished by mid-July or even earlier (Free & Butler 1959, p. 32; Alford 1969), yet according to Yarrow (in litt.) *B. pratorum* is sporadically recorded during August-October, which indicates that the season is occasionally lengthened. Alfken (1913) states that the season of this species ends near the middle of August in Northern Germany: Bremen: 'Sie erscheint wie ihre Rasse *B. jonellus* sehr zeiting, verschwindet aber bedeutend früher als diese.' Workers and males were recorded in the Austrian Alps at the end of August (Løken 1964). In Norway, the frequency is strongly reduced after middle of August, as far as I could observe. The local variations in seasonal length are noteworthy. Sex and caste occurring August–September may be the progeny of late-appearing hibernating females or perhaps offspring from those emerging from colonies completed June-July, i.e. *B. pratorum* in favourable seasons may produce two generations as stated for *B. jonellus* (Meidell 1968.)

SUBGENUS *MELANOBOMBUS* DALLA TORRE

Melanobombus Dalla Torre, 1880, p. 40, type-species *Bombus lapidarius* (Linnaeus) by designation of Sandhouse (1943).

(*Lapidariobombus* Vogt, 1911, p. 58, type-species *Bombus lapidarius* (Linnaeus) by designation of Sandhouse (1943).)

BOMBUS (MELANOBOMBUS) LAPIDARIUS (LINNAEUS)

Apis lapidaria Linnaeus, 1758, p. 579 No. 31, type area Sweden: Uppland. A small ♀ LSL! labelled *lapidaria* agrees with the usual interpretation of the taxon.

(*Bombus lapidarius* (Linnaeus); Dahlbom 1832, p. 30, 1837; Zetterstedt 1838 (partim); Siebke 1853, 1863, 1870, 1873, 1880; Wahlberg 1854; Thomson 1870, 1872; Nerén 1892; Strand 1898a,

1898b, 1901, 1904; Lie-Pettersen 1901, 1905, 1907; Friese 1902; Aurivillius 1903; Wahlgren 1915, 1917-18; Sparre Schneider 1918; Ringdahl 1921; Meidell 1934a; Wexelsen & Skåre 1934; Løken 1949; Ander 1953b, 1963, 1965; Tjeder 1954; Kruseman 1959; Elfving 1960, 1968; Erlandsson 1960; Fridén, Eskilsson & Bingefors 1962; Hasselrot 1962; Fridén 1967. *Apis arbustorum* Fabricius, 1776, p. 246; Zimsen 1964, p. 416 No. 1086, lectotype ♂ CCC! selected by Løken (1966a), type area Denmark; Zetterstedt 1838 (partim).)

First Scandinavian records

Norway. Oppland: Lillehammer to Sel (Siebke 1853). No voucher specimen is traced and Siebke has apparently confused the species with *B. w. mastrucatus.* First reliable records: Akershus: Oslo; Hedmark (HEs): Sör-Odal; Oppland (Os): Nord-Aurdal: Valdres (Siebke 1880).

Sweden. Uppland (Linnaeus 1758).

Taxonomical remarks

The Scandinavian population belongs to the nominate form.

Distribution

Fennoscandia. Cf. the subspecies.

World distribution. Europe (British Isles; on the continent ranging from Spain, Sicilia, Greece north to Fennoscandia; in European USSR north to 60° N and east to Volga) – Tunisia – Turkey – Armenia – Caucasus (Reinig 1939, p. 193; Panfilov 1957 and in litt.).

BOMBUS LAPIDARIUS LAPIDARIUS (LINNAEUS)

Queen, worker

Morphological characters. Head slightly longer than wide. Malar space as long as distal width, longer than A_3 but shorter than A_{2+3}. Clypeus hardly shorter than distal width, flattened; disc of clypeus with rather even, fine puncturing except for almost impunctate area between anterior, lateral feeble impressions which are slightly more densely punctured than on the disc. Labral furrow deep and well-defined, forming almost a semicircle seen from above, in width less than ⅓ the labral width; labral tubercles strongly alutaceous (except in some workers), coarsely punctured, anteriorly more or less flattened; labral lamella barely wider than the furrow, with rather strongly curved margin. Mandible (Fig. 15) without basal keel, with distinct sulcus obliquus, inconspicuous incisura lateralis and rather indistinct puncturing of the basal area, the latter being slightly or not alutaceous. Eyes directed in front of posterior mandibular condyle. Ocelli, usually situated along an almost straight line, touching or just in front of supra-orbital line (usually transecting this line in workers). A_3 about twice as long as distal width and slightly shorter than A_{4+5}; A_4 about as long as distal width, just shorter than A_5. Mid-basitarsus with posterior distal angle rounded oblique, outside with tuft of long hairs near the base. Hind tibia with alutaceous outer surface and dorsal inner distal angle inconspicuously or not produced. Hind basitarsus with outer surface rather alutaceous and covered with dense brownish pubescence, the posterior margin nearly straight. Surface of T_{2-5} smooth, though densely, evenly punctured. T_6 with central evenly punctured eminence in front of apex (indistinct or absent in workers); in newly emerged specimens the eminence is covered by dense short hairs which are soon worn off; basal part T_6 strongly granulated. St_6 with rather short keel, often concealed by dense decumbent hairs. Wings evenly hyaline. Coat rather short, velvet-like.

Queen measurements: N = 20; SE Norway; malar space: 0.75 mm ($\pm$0.03$\pm$0.01) range: 0.70–0.80 mm; 'radial length': 4.51 mm ($\pm$0.09 $\pm$0.02) range: 4.35–4.65 mm; interalar width: 5.30 mm ($\pm$0.18$\pm$0.04) range: 5.00–5.63 mm. Body large size.

There is a distinct difference in size between the female and the worker caste.

Colour pattern. Fringe of labrum bright brown-

ish. T_{4-6}, fringes of St_{4-6} bright reddish, the latter usually of a lighter shade. Otherwise coat black.

Variation. Extremely colour-stable.

Male

Morphological characters. Head about as long as wide. Malar space about as long as distal width, longer than A_3 but shorter than A_{2+3}. Mandibles bifid with a broad ventral and a small dorsal tooth. Eyes directed in front of posterior mandibular condyle. Antennae rather short (Fig. 32A); A_3 equal to A_5 or just longer; A_4 just transverse to hardly longer than distal width about ⅔ as long as A_5; A_{6-13} individually almost parallel-sided and about 1½ times longer than distal width of the segment. Outer surface of hind tibia rather convex, alutaceous, and with sparse distribution of hairs of various length except for an usually well-defined bare area on the inner distal part of the segment; longest hairs in posterior fringe about twice the greatest width of the segment in unworn specimens; hind basitarsus only slightly narrowed towards the base, longest hairs in posterior fringe about 1½ times the greatest width of the segment. St_8 and genitalia (Figs. 32B—C); gonostylus rounded transverse with a small fingerlike process near the inner base; volsella long, emarginated at apex; hook of penis valve turned inwards and produced into a sharp point. Body of medium size.

Colour pattern. Beard dark brownish. Pile of face between and below antennal sockets yellow, pile of vertex with variable admixture of yellow. Collar lemon to greenish-yellow, episternum with variable admixture of black and yellow hairs. T_{4-7} bright reddish, St_{4-6} (or $_{5-6}$) reddish to ferruginous; the remainder of venter, ventral part of mid- and hind femora with predominantly yellowish to pale yellowish-grey hairs. Mid- and hind tibia, mid- and hind basitarsus fringed reddish or yellowish. Otherwise coat black.

Variation. Yellow collar varying in width. The proportion of black and yellow hairs in pile of vertex, episternum, and venter varying. Scutellum, T_1 with variable admixture of yellow hairs. Tibia and basitarsus of fore-leg occasionally reddish fringed, red piles of mid- and hind basitarsus and tibia more or less replaced by black hairs. Some individuals have the black coat more or less whitish-tipped.

Distribution (Fig. 65)

Norway. Confined to southeastern lowlands and the extreme coast north to 61° N, i.e. not observed north of Sognefjord. Moreover accidently observed inland further north. It is questionable, however, whether a queen was collected near the Polar Circle, being far north of the present known distribution, or the record is due to erroneous labelling. To my knowledge the collector, Frits Jensen, did not always make notes during the collecting trips, but relied on his memory having returned home. The species is locally frequent. Recorded 500 m s.m. and once 950 m s.m. cf. below.

Biotopes: Meadows, gardens, roadsides, pastures.

A total of about 940 specimens was examined.

List of localities. *Östfold:* Hvaler: ?loc. ZMO, Akeröy, Asmalöy, Herföl, Kirköy, Söndre Sandö; Onsöy: Dypeklo, Ellingård, Lervik, Ramseklo, Rörvik, Skjælöy, Torp; Sarpsborg: ZMO ZMB; Halden: NRS, Asak, Berg kirke, Hakelund, Sponvika; Marker: Dybedal, Rödenes; Råde: Fuglevik, Oven, Tom; Moss: VCA, Jelöy VCA ZMB; Eidsberg: Holm; Trögstad: Mönster bro, Rud. *Akershus:* Ås: Vollebekk; Frogn: Dröbak VCA ZMB; Asker: Brönnöy; Bærum: ? loc. TRM, Egne Hjem, Hövik ZMO, Kolsås, Lysaker ZMO, Ostöy; Oslo: NMW TRM VCA ZMB ZMO; Rælingen: Fjerdingby; Aurskog-Höland: Björklangen, Gangsnes; Fet: Björkeflåten; Skedsmo: Strömmen ZMO; Nes: Grinkelsrud, Vormsund. *Hedmark (HEs):* Eidskog: Magnor SMS; Sör-Odal: Mårud gård ZMO; Grue: Finnskog; Hamar: ZMB ZMO. *Oppland (Os):* Gran: Granvollen; Lillehammer; Nord-Aurdal: Valdres ZMO; Öyer: Skåi; Ringebu: Ringebu. *On:* Dovre: Hjerkinn 950 m ♀ 1902 (Lysholm) KMT. *Buskerud (Bö):* Hurum: Hurum, Pinadalen, Sagene, Storsand, Vannsbrekka; Drammen: ZMO; Lier: Lökke gård; Flesberg: Öydegarden; Kongsberg KMT TRM, Skollenborg. *Bv:* Sigdal: Nedre Eggedal; Nore og Uvdal: Uvdal stavkirke 500 m; Ål: Ål ZMO. *Vestfold:* Borre: Adal, Nykirke; Ramnes: Kjær, Lunde, Orrevål; Andebu: Kodal; Stokke: Langö, Sand, Veierland; Tönsberg: Presterödkilen; Nötteröy: Teie; Tjöme: Brötsöy, Kjære,

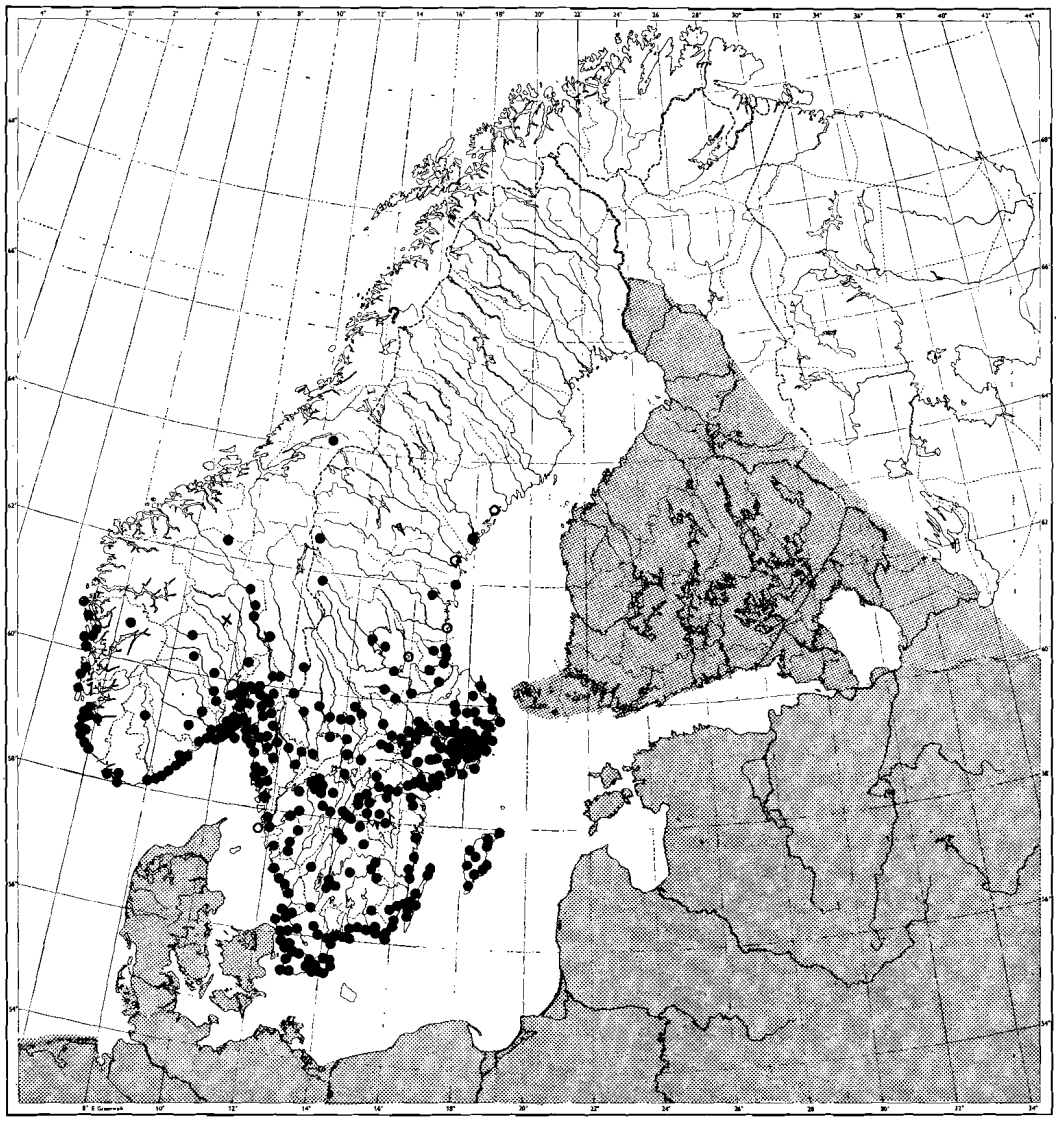


Fig. 65. *B. lapidarius* (Linnaeus). Legends as in Figs. 50, 54.

Mostranda, Vasskalven; Sandefjord: Austeröy, Lindholmen, Årö; Hedrum: Hedrum; Tjölling: Tjölling, Viksfjord; Brunlanes: Berg, Dolven, Helgeroa, Stavern; Larvik. *Telemark (TEy):* Porsgrunn: Mule, Nystrand; Bamble: Brevikstranda, Trosby; Drangedal: Nos; Kragerö: Kragerö, Levang. *TEi:* Sauherad: Liagrend. *Aust-Agder (AAy):* Tvedestrand: Askeröy, Dypvåg, Lyngör ZMO, Nes verk TRM, Österå; Arendal: Salteröd; Moland: Kilsund; Tromöy; Hisöy: Gjervoldsöy, His; Grimstad; Landvik: Havnevåg, Holvika, Hombor, Molland; Lillesand: Kvivik, Langholmsund, Natvik. *AAi:* Valle: Valle TRM. *Vest-Agder (VAy):* Kristiansand: ZMO, Morvik, Randesund; Lindesnes: Lindesnes; Lyngdal: Lyngdal TRM; Farsund: Fjelleså, S Hanangervann, Lista fyr, Ore, Tjörve. *Rogaland (Ry):* Eigersund: Eigeröyeidet, W Fotlandsvann; Hå: Ogna ZMB ZMO, Salte bro; Klepp: Börsheim, Klepp, Orre, Orrevann, Reve, Sele; Time: TRM; Sola: Ölbergstranda; Randaberg: Tungenes; Stavanger: TRM ZMB, Ullandhaug; Rennesöy: Bru, Dale; Karmöy: Vigsnes. *Ri:* Forsand: Meling. *Hordaland (HOy):* Bömlo: Langevågen, NE Röyksund, Vika; Austervoll: Hekjingen; Fana: Dolvik VCA, Grimseid VCA, Minde VCA, Skipanes

VCA; Sund: Glesvær, Telavåg; Fjell: Litleholmen; Bergen: TRM VCA ZMB; Asköy: Herdla; Fedje; *HOi:* Voss: Voss. *Nord-Tröndelag (NTy):* Snåsa: Finså ♀ 2 July 1951 (Bakke) ZMO. ?*Nordland (Nsi):* Rana: Mo ♀ 28 June 1934 (Jensen).

Corrections. Records from Oppland (On): Dovre: Toftemo; Hordaland (HOy): Bergen; Möre og Romsdal (MRy): Ørskog (Siebke 1880) were revised to *B. w. mastrucatus*, likewise several of those from Buskerud (Bv): Ål (Strand 1898b).

Sweden. Wide, abundant distribution in the lowlands, along the eastern coast reaching 63° 30′ N in Ångermanland.

A total of about 3000 specimens was examined.

List of localities. *Skåne:* Andrarum ZMB, Arlöv ZMA, Barkåkra NRS, Barsebäckhamn ZMB, Bjärred, Björnstorp, Bonderup ZMB, Bokskogen ZMB, Bromölla ZMA ZML, Bulltofta ZMA, Bäckaskog NRS, Bökeberg, Dalby ZMB ZML, Falsterbo NRS ZMB, Grimslöv IVU, Haväng NRS, Herrevad Kloster GNM, Hjärnarp NRS, Hovs hallar NRS, Hälsingborg NRS VCA, Hässleholm NRS, Höganäs NRS, Håslöv, Ilstorp, Ivö NRS, Kivik NRS, Kristianstad NRS, Kullaberg, Kyrkheddinge, Kävlinge, Landskrona, Ljungbyhed NRS, Lomma IVU, Lund GNM NRS ZMA ZMB ZML, Löderup NRS, Löddeköpinge ZMB, Maglarp ZMB, Malmö NRS ZMB ZML, Mälarhusen NRS, Norra Mellby, Nosaby, Nymömossor ZMB, Röddinge NRS, Sandhammaren NRS, Silvåkra, Simrishamn NRS, Sjöbo NRS, Stenshuvud NRS, Svalöv IVU, Södra Sandby ZMA ZMB, Sövdeborg NRS, Teckomatorp NRS, Torekov NRS, Tosterup NRS, Trelleborg GNM ZMB, Vallåkra, Veberöd, Vik NRS, Vinslöv, Ystad NRS ZML, Öved ZMA ZML, Ängelholm NRS, Åhus NRS ZMB ZML. *Blekinge:* Aspö NRS, Bräckne-Hoby ZMA, Hörviken, Jämjöslätt ZMU, Karlshamn NRS ZML, Karlskrona NRS, Kristianopel NRS ZML, Ronneby NRS, Rödeby NRS, Sibbaboda NRS, Sandhamn NRS, Sölvesborg ZMA, Torhamn NRS, Ängelholm NRS. *Halland:* Falkenberg, Fjärås, Frösakull NRS, Getinge NRS, Halmstad NRS ZML, Laxvik, Röskär NRS, Snöstorp NRS, Steninge NRS, Trönninge, Tylösand NRS. *Småland:* Almvik NRS, Aneboda ZMB, Bergkvara NRS, Blå Jungfrun NRS, Brånstorp NRS, Dörarp NRS, Eksjö NRS ZMU, Gränna NRS ZMU, Hullaryd NRS, Höreda NRS, Järsnäs NRS, Kalmar NRS, Ljungarum NRS, Ljungby NRS, Ljungbyholm, Markaryd, Misterhult, Nye NRS, Oskarshamn NRS ZML, Påryd, Påskallavik, Ryssby ZMU, Skirö NRS, Smålandsstenar NRS, Sommen NRS, Södra Ljunga NRS, Tranås NRS, Visingö NRS, Österkorsberga NRS, Yxnanäs ZMA, Åseda NRS. *Öland:* Algutsrum ZMB, Borgholm NRS, Byrum NRS, Byxelkrok NRS, Böda NRS ZMB, Ekerum NRS ZMB, Grankulla ZMB, Gårdby ZMB, Halltorp NRS, Hornsjö ZMB, Högsby NRS ZMU, Högsrum NRS, Kalkstad ZMB, Kastlösa NRS, Källa ZMB, Mörbylånga NRS, Skogsbyn NRS, Torslunda ZMB, Vickleby ZMB. *Gotland:* Ardre NRS, Austers NRS, Burgsvik, Burs, Fardume NRS, Fröjel, Fårö NRS, Gammelgarn, Kappelshamn NRS, Kyllej NRS, Ljugarn NRS, Roma NRS, Slite, Sudersand NRS, Ulla Hau NRS, Visby NRS, Vämlingbo. *Östergötland:* Alvastra NRS, Bohyttan ZMB, Borensberg GNM NRS, Borsjön NRS, Fjuk NRS, Harg NRS, Hästholmen ZMA, Högby ZMB, Kimstad NRS, Kisa NRS, Klinga NRS, Krokek NRS, Kvarsebo NRS, Linköping NRS ZMB ZML, Malmslätt NRS, Norrköping NRS ZMA, Norsholm, Ringarum NRS, Skönberga NRS, Stavsjö NRS, Stjärnorp ZMB, Ulrika NRS, Vadstena NRS, Vretakloster ZMB, Väversunda NRS. *Västergötland:* Alingsås ZMU, Brandstorp NRS, Brastorp, Falköping NRS, Grästorp NRS, Göteborg NRS, Hornborg sjö, Karleby NRS, Kinnahult, Kymbo NRS, Läckö NRS, Nolhaga NRS, Råbäck NRS, Skara GNM NRS, Skinnarhult in Borås NRS, Skövde NRS ZML ZMU, Stenum NRS, Töreboda NRS ZML, Vartofta ZMB, Vinninga NRS, Vättlösa NRS, Vårnb, Vårgårda ZMU. *Bohuslän:* Bovallstrand NRS, Brastad, Dingle NRS, Grebbestad NRS, Kareby NRS, Munkedal, Strömstad NRS, Syd-Koster NRS, Tanum NRS, Tjörn GNM, Ytterby NRS. *Dalsland:* Bengtsfors GNM NRS ZML, Gesäter ZMB, Köpmannebro, Nössemark ZMB, Skållerud NRS, Skåpafors NRS, Åmål NRS. *Närke:* Laxå NRS, Stora Mellösa ZMB, Örebro NRS ZMB. *Södermanland:* Björnlunda NRS, Botkyrka NRS, Brandalsund NRS, Enhörna NRS, Fittja NRS, Handen NRS, Herrhamra NRS, Julita NRS, Mölnbo NRS, Nygärdet NRS, Nyköping NRS ZML, Nynäs ZMB, Nynäshamn NRS, Nävekvarn NRS Oxelösund NRS, Rekarne NRS, Salem NRS, Sjösa ZMB, Sparreholm NRS, Stjärnhov NRS, Stora Sundby NRS, Strängnäs ZMB, Svärdsö NRS, Södertälje NRS, Torshälla NRS, Torö NRS, Trosa, Tullgarn NRS, Turinge NRS, Tyresö NRS, Uttran NRS, Utö NRS, Valla NRS, Viksberg NRS, Västerhaninge ZMB, Ålberga NRS ZMB. *Uppland:* Adelsö NRS, Almunge NRS, Angarn NRS, Björklinge NRS, Bondkyrkja NRS, Brudnäs NRS, Bålsta NRS, Danderyd ZMB, Djurö NRS, Drottningholm VCA, Ekerö NRS, Eldgarn NRS, Enköping NRS, Gimo NRS, Garnviken NRS, Grisslehamn NRS, Gräddö NRS, Håbö-Tibble NRS, Håtuna NRS, Ingarö, Knutby ZMB, Kolström NRS, Kungsängen NRS, Lennartnäs NRS, Ljusterö NRS, Länna NRS, Möja NRS, Norrviken NRS, Penningby NRS, Rimbo NRS, Roslagen-Kulla NRS, Rö NRS, Rådmansö NRS, Sigtuna NRS, Skokloster NRS ZMB, Stavsnäs NRS, Stockholm GNM IVU NRS VCA ZMB ZML ZMU, Tensta ZMB, Träbygget NRS, Täljö NRS, Uppsala BML IVU NRS ZMA ZML ZMU, Vallentuna NRS, Valsätra IVU, Vassunda IVU, Vaxholm NRS, Vindö NRS, Väddö NRS, Värmdö NRS, Yxlan ZMB, Öregrund ZMB, Össeby-garn s:n NRS, Österskär, Östra Ryd NRS. *Västmanland:* Arboga NRS ZML, Ding-

tuna NRS, Fanthyttan NRS, Fellingsbro ZMB, Grindbo NRS, Kolbäck NRS, Kvicksund NRS, Kärrbo ZMB, Lindesberg NRS, Munktorp, Saxhyttan NRS, Skultuna ZMB, Västerås NRS, Äs. *Värmland:* Arvika, Daglösen NRS, Deje NRS, Forsvik, Hammarö NRS, Horrsjön NRS, Kristinehamn NRS, Lindfors ZMA, Långban NRS, Molkom NRS, Rottneros NRS, Årås. *Dalarne:* Avesta ZMB, Borlänge ZMA, Idre ♀ 10 July 1901 (Bengtsson), Ludvika NRS, Mora NRS, Rättvik NRS, Sjurberg NRS, Store Tuna, Söderbärke NRS, Vikarbyn NRS. *Gästrikland:* Björke NRS, Gävle NRS ZML, Hamrångerfjärden, Hedesunda NRS, Hille-Forsby NRS ZML, Ockelbo NRS, Trödje NRS, Trösken ZMB. *Hälsingland:* Broby NRS, Delsbo. *Härjedalen:* Tänndalen ♀ 30 July 1957 (Christiansen) NRS. *Ångermanland:* Bondsjö ♂ 23 July 1931 (Fredlin).

Ander (in litt.): *Bohuslän:* Ockerö. *Dalarne:* Svärdsjö. *Hälsingland:* Söderhamn area. *Medelpad:* Sundsvall. *Ångermanland:* Nätra.

Finland. Occurring throughout the country north to about 66° N and in the western part of the country reaching the northernmost part of Gulf of Bothnia (Elfving 1968).

The total distribution of the subspecies, B. l. lapidarius (Linnaeus). Europe (British Isles; on the continent ranging from France, Northern half of Italy, The Balkans north to Fennoscandia; European USSR north to about 60° N and east to Volga) – Turkey (Anatolia) (Reinig 1939, p. 193, 1968; Panfilov in litt.).

Biology

Nest. Pollen-storer. Nests recorded in the ground at various depths, in stone fences, occasionally in lofts, underneath roofs (Dahlbom 1837; Lie-Pettersen 1901; Settman 1918). Large colonies are generally produced (Hasselrot 1960, 1962).

Flight season. From about mid-May to the end of September. Queen: 10 May–28 Sept.; worker: 14 June–15 Sept.; male: 22 July–15 Sept.

SUBGENUS *ALPINOBOMBUS* SKORIKOV

Alpinobombus Skorikov, 1914a, p. 123, type-species *Bremus alpinus* (Linnaeus) = *Bombus alpinus* (Linnaeus) by designation of Frison (1927).

Queen, worker

Head longer than wide. Malar space slightly to markedly longer than distal width (occasionally as long as this width in *B. alpinus*). Disc of clypeus convex, about as long as distal width or slightly longer. Labral furrow usually well-defined, in width less than ⅓ labral width, occasionally equal to it; labral lamella only slightly wider than the furrow, the margin curved. Mandible (Fig. 10A) without basal keel, with moderate to well-defined sulcus obliquus and distinct incisura lateralis, the latter almost semi-circular in unworn specimens (less so in *B. balteatus*). Eyes directed in front of posterior mandibular condyle. Ocelli usually situated along an almost straight line. Mid-basitarsus with distal dorsal angle almost right rounded. St_6 with indication of a keel or no keel. Wings moderately infuscate.

There is a distinct difference in size between the queen and the worker caste.

Male

Head longer than wide. Malar space longer than distal width. Mandible bifid with broad ventral tooth and rather small dorsal tooth. Eyes directed in front of mandibular condyle. Ocelli just transected by supra-orbital line, or touching it dorsally. Outer surface of hind tibia convex with large bare area extending throughout central and distal part of the segment; posterior fringes of hind tibia and hind basitarsus individually about twice the greatest width of the respective segments or longer. Distal margin of St_6 thickened, truncate or feebly emarginated. St_8 and genitalia (Figs. 24B–D, 25B–D, 26B–C, 27A–B). Coat long, rather shaggy.

Scandinavian species

The subgenus is represented by four Scandinavian species, viz. *B. alpinus* (Linnaeus), *B. arcticus* Kirby, *B. balteatus* Dahlbom, and *B. hyperboreus* Schönherr.

Taxonomical remarks

The interspecific relationship in the unit is indicated in a triangular graph (Fig. 66) based on Scandinavian material. The spreading of the markings indicates clearly the specific position of the four taxa involved, even though there is a rather pronounced overlapping between *B. alpinus* and *B. arcticus*. The European occurrence of *B. arcticus* was overlooked until it was recognized by Richards (1931). The graph moreover includes eight *B. arcticus* ♀♀ from Artic Canada to illustrate the taxonomic position of the Canadian and the European population, viz. *B. a. arcticus* and *B. a. diabolicus* Friese (= *B. a. alpiniformis* Richards) respectively. The fact that both populations occupy the same area on the graph favours their conspecific status. The available Canadian material thus confirms the subspecific rank of the European population and consequently refutes its elevation to a species as suggested by Pittioni (1939b).

Biological remarks

Owing to the very few records of workers and the absence of information about nests, it has been suggested that colonies of *Alpinobombus* species, all of which are confined to arctic and

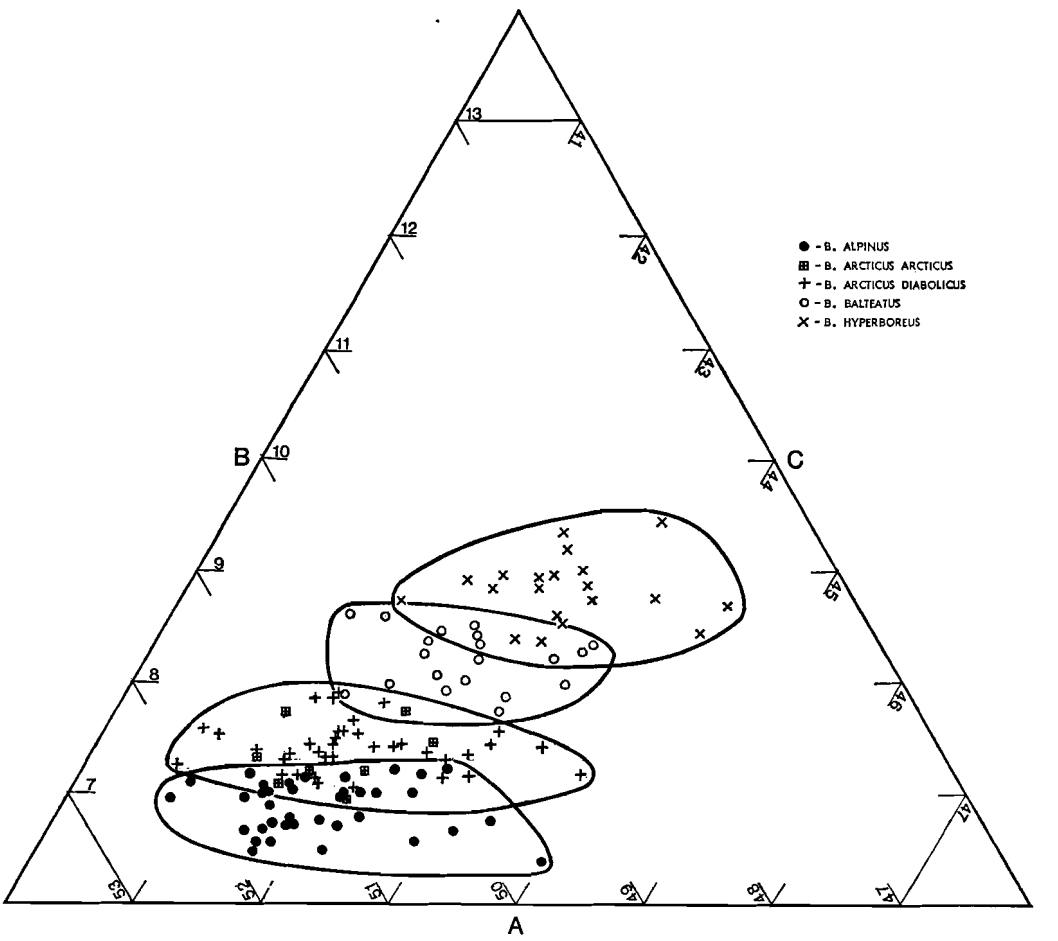


Fig. 66. Triangular graphing of malar space (A), 'radial length' (B) and interalar width (C) of four species of the subgenus *Alpinobombus* Skorikov.

alpine regions, are strongly reduced in size. The season is short and in order to complete the life cycle the number and size of worker broods would be reduced or even omitted (Friese 1902, p. 490 in referring to Sparre Schneider in litt.; Sparre Schneider 1909, p. 88; Friese & Wagner 1912, p. 194; Skorikov 1922, p. 79; Richards 1931, p. 22; Pittioni 1942, pp. 178, 185). *B. hyperboreus* and *B. balteatus* are primarily said to be adapted to temporary solitary living, locally producing workers under favourable conditions. Recent contributions to the biology of the subgenus (Løken 1961a; Hobbs 1964; Milliron & Oliver 1966), and the present study, reveal, however, that the species regularly produce workers with the exception of *B. hyperboreus*, the biology of which is still insufficiently known.

BOMBUS (ALPINOBOMBUS) ALPINUS (LINNAEUS)

Apis alpina Linnaeus, 1758, p. 579 No. 39. neotype ♀ ZML! selected by Løken (1963), type area Sweden: Lapland (Lu.Lpm.): Virihaure.

(Apis alpina: Quensel in Acerbi, 1802. *Bombus alpinus* (Linnaeus); Dahlbom 1832, p. 32 (partim); Zetterstedt 1838 (partim); Siebke 1853, 1863, 1866, 1870, 1873, 1880; Wahlberg 1854, 1855; Thomson 1870, 1872 (partim); Sparre Schneider 1895a, 1895b, 1898, 1906, 1909, 1910; Strand 1898a, 1898b; Lie-Pettersen 1901, 1907; Friese 1902; Aurivillius 1903; Bengtsson 1904, 1908, 1931; Lundblad 1924; Soot-Ryen 1925; Esmark 1930; Richards 1931; Hellén 1933; Meidell 1934a; Pittioni 1942; Brinck & Wingstrand 1949; Brinck 1951; Kruseman 1959; Elfving 1960, 1968; Ander 1965, Bergwall 1970. A bibliographic reference to the species is compiled by Pittioni 1942.)

First Scandinavian records

Norway. Troms (TRi): Lyngen: Lyngentind; Kvænangen: 'Jockelfjeld'. Finnmark (Fi): 'Alten et Kautokeino inventus.' (Dahlbom 1832, p. 32). The individuals were collected by Zetterstedt. Specimen from Lyngentind cannot be found. A female, labelled Jöckulfj in Zetterstedt' collection, is correctly identified. The name apparently refers to Jökelfjord (modern spelling) situated at sea level as there is no mountain ('fjeld') by that name in the area. Another female labelled 'inter Alten et Kautokeino' in Thomsons' collection is revised to *B. arcticus diabolicus* Friese.

Sweden. Lapland (Linnaeus 1758).

Queen, worker

Morphological characters. Head slightly longer than wide. Malar space about as long as distal width or just longer, as long as A_{3+4}. Clypeus with rather dense, uneven puncturing except for the impunctate (or almost so) small anterior area between the wide, well-defined and coarsely punctured lateral depressions. Mandible (Fig. 10A). Ocelli dorsally touching or just transecting supraorbital line. A_3 about 1½ times longer than distal width, and about $^2/_3$ the length of A_{4+5}; A_4 about as long as distal width, slightly shorter than A_5. Surface of vertex and frons smooth, shiny in between distinct puncturing. Outer surface of hind tibia scarcely alutaceous, shiny. Distal inner dorsal process of hind tibia prominent (Fig. 10B). The length of hind basitarsus about twice the greatest width or slightly longer. T_{4-5} densely punctured, chagrinated. Body robust, coat rather uneven.

Queen measurements: N = 20; Northern Norway; malar space: 0.81 mm ($\pm$0.03 $\pm$0.01) range: 0.75–0.85 mm; 'radial length': 5.02 mm ($\pm$0.17 $\pm$0.04) range: 4.70–5.25 mm; interalar width: 6.13 mm ($\pm$0.14 $\pm$0.03) range: 5.83–6.40 mm. Body of large size.

Colour pattern. T_{2-5}, at least anterior part of T_6, at least lateral part of fringes of St_{4-5} bright ferruginous, the latter often of paler shade. Otherwise coat black.

Variation. Colour-stable. Lateral patches of T_1 may have a variable admixture of ferruginous hairs, occasionally a few black hairs at the extreme anterior edge of T_2.

Male

Morphological characters. Head just longer than wide. Malar space slightly longer than distal

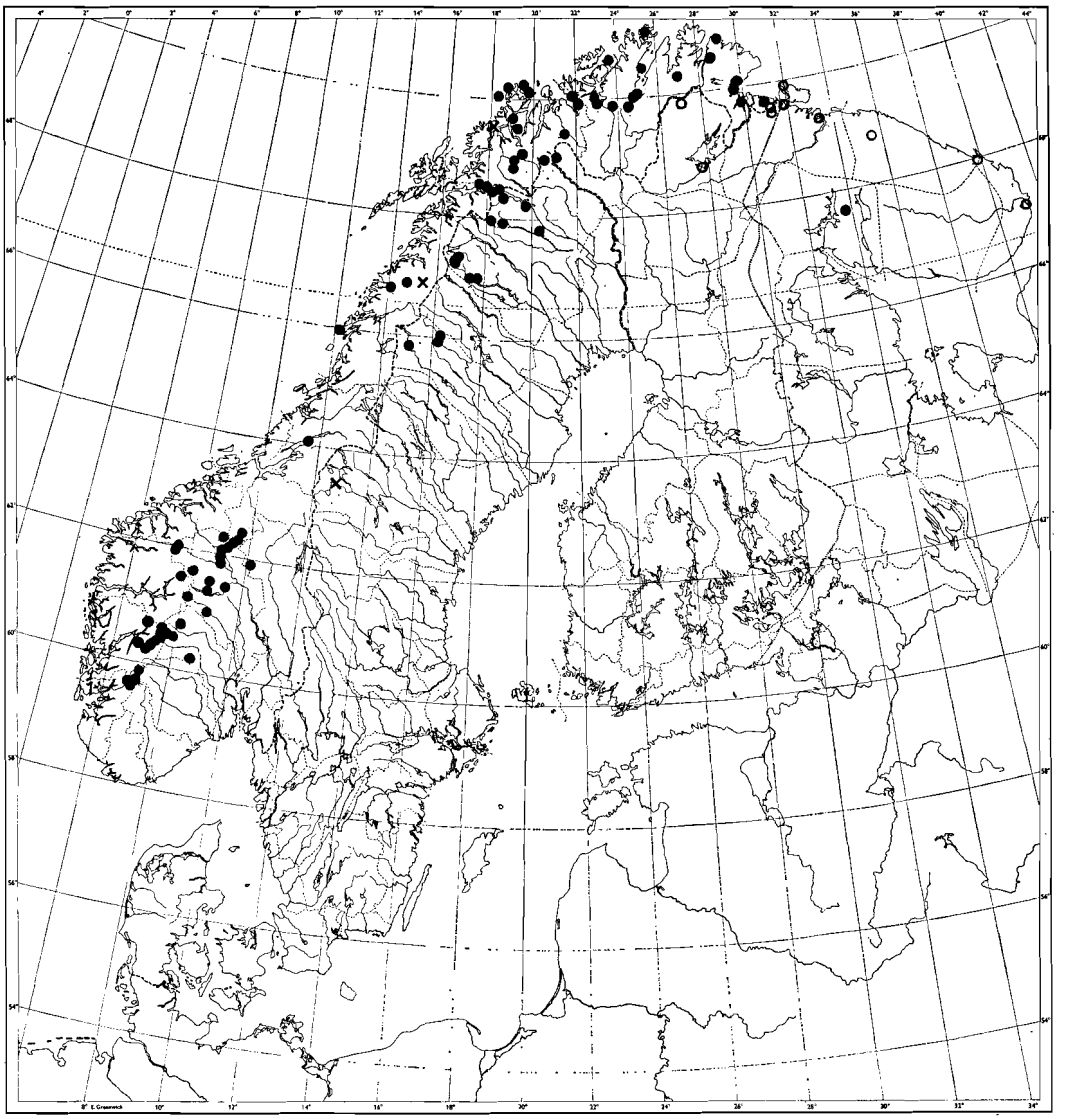


Fig. 67. *B. alpinus* (Linnaeus). Legend as in Fig. 50.

width, about as long as A_{2+3}. A_3 as long as A_4 or just longer; A_4 about as long as distal width; A_{5-13} individually almost straight and nearly twice as long as distal width. Outer surface of hind tibia scarcely or not alutaceous. Hind basitarsus 3 to 3½ times longer than distal width (Fig. 24A). St_8 and genitalia (Figs. 24B–C); distal part of St_8 more or less regularly tapering towards apex, which is usually rounded, rarely pointed; apex of volsella, seen from beneath (Fig. 24D); penis valve with subapical tooth. Body of moderate to large size.

Colour pattern. Hairs of T_{2-7} ferruginous. Posterior fringe of hind tibia, hind basitarsus ferruginous or tipped so. Otherwise coat black.

Variation. A few individuals with a slight admixture of yellow hairs in pile of vertex and/or with indication of yellow collar were examined.

Distribution (Fig. 67)

Norway. In Southern Norway ranging from about 59°30′ N in Rogaland to the northern fringe of Dovrefjell 62°30′ N, confined to *regio alpina* and occasionally observed in adjacent subalpine zone. In Northern Norway dispersely occurring from about 66° N to the extreme north, locally reaching the coast and also inhabiting islands off shore. In Southern Norway recorded to 1400 m s.m.

Biotopes: *Salix* biotopes, *Vaccinium* heaths, mountain meadows.

A total of 346 specimens, i.e. 137 ♀♀ 165 ⚥ 44 ♂♂, was examined.

List of localities. *Hedmark (HEn):* Folldal: Eriksrud 710 m ZML. *Oppland (On):* Vestre Slidre: Kinnholt 1000 m; Vang: E Bygdin 1100 m, Nystova 1100 m ZMO, Tyin 1100 m USU; Fron: Kampeseter 865 m ZMU; Vågå: Gjendesheim 1000 m, Skjerva-Jondalen 900 m, Storhaugseter 900 m, Vågåmo 400 m; Lom: Leirdalen 900 m; Skjåk: Langevann 930 m, Strynsfjellet 1100 m; Lesja: Skamsdalen 1000 m Lar; Dovre: Dombås 700 m ZMO, Dovrefjell 1000 m KMT NMW NRS TRM VCA ZMA ZMB ZMC ZMO, Fokstua 930 m ZMB ZMO, Hjerkinn 950 m ZML ZMO, Vålåsjö 950 m ZMB ZMO. *Buskerud (Bv):* Nore og Uvdal: Gavlenseter 1120 m, Hegnum seter 850 m, Sönstervann 1050 m; Ål: Vallehalle 1120 m; Hol: Hallingskarven 1400 m, Haugastöl 1000 m ZMA ZMB, Kvasshögda 1200 m, Lillevann 1100 m, Nygård 1000 m, Krekja 1150 m, Ustaoset 1000 m. *Rogaland (Ri):* Suldal: Jonstöl 700 m, Kvanndalen, Kyrkjesteindalen 800 m, Leirdalen 800 m, Steinkilen 700 m, Steinkilnuten 900 m. *Hordaland (HOi):* Odda: Austmannli 800 m, Mittleger 1150 m; Ullensvang: Bersavikvann 1230 m, Dyranut 1250 m SMS, Gröndalen 1075 m, Hallaskard 1100 m, Isdalen 1000 m, Kinsekvelv 1200 m, Omkjelvann 1200 m, Rjoto 1000 m, Stavali 1000 m, Sysendalen 750 m, Veigvann 1175 m, Viveli 875 m; Ulvik: Finse 1200 m ZMA. *Sogn og Fjordane (SFi):* Aurland: Uppsete 850 m; Luster: Turtagrö 900 m TRM VCA. *Sör-Tröndelag (STi):* Oppdal: Gåvåli 975 m, Knutshö 1300 m, Kongsvoll 900 m TRM ZMB ZMO ZMU. *Nord-Tröndelag (NTi):* Snåsa: Semstua ⚥ 14 July 1840 (Dahlbom) DCL. *Nordland (Nsy):* Heröy: Sör-Heröy TRM; Melöy: Storglomvann 510 m TRM. *Nsi:* Beiarn: Reingard; Saltdal: ? loc. ZMO. *Nnö:* Ankenes: Bjerkvik, Björnfjell 500 m. *Troms (TRy):* Tromsö: TRM VCA, Fagernes TRM, Tromsdal TRM ZMO, Yttre Malangsfjord TRM; Karlsöy: Hushattöy TRM, Måkeskjær TRM, Måsvær TRM, Tjuvholmen TRM, Torsvik TRM, Vannö NMW TRM. *TRi:* Målselv: Kirkesdal, Mauken TRM, Nordmo TRM; Balsfjord: Takvann TRM; Nordreisa: Gapprusfjellet 700 m; Kvænangen: Jökelfjord ZCL, Kvænangsfjellet. *Finnmark (Fv):* Hammerfest NMW TRM; Måsöy: Mageröy ♀ 22 July 1947 (Tjönneland & Lönnöy). *Fi:* Alta: Jotkajavrre 400 m TRM, Kåfjord TRM. *Fn:* Porsanger: Festningsstua TRM, Hamnbukt, Kistrand ZMO, Lakselv TRM; Lebesby: Adamfjorddal BML; Tana: Nastejavrre ENE Leirpollen; Berlevåg: SE Berlevåg ♀ 3 ⚥⚥ 18 July 1970 (Brinck); Vadsö: 18 km W Vadsö. *Fö:* Sör-Varanger: Bugöynes TRM, Grense-Jakobselv TRM, Kirkenes TRM.

Corrections. Records from Finnmark (Fi): Alta-Kautokeino (Dahlbom 1832; Zetterstedt 1838) and also records identified as *B. alpinus* var. *diabolicus* Friese and *B. a.* var. *pretiosus* Friese (Friese 1911, p. 571; Friese & Wagner 1912; Soot-Ryen 1925; Richards 1931; Hellén 1933; Meidell 1934a) were revised to *B. arcticus diabolicus*. Records from Möre og Romsdal (MRy): Örskog (Siebke 1866, p. 380) and those from Buskerud (Bv): Ål and Hol (Strand 1898a) were revised to *B. lapponicus scandinavicus*.

As *B. alpinus* have been confused with *B. arcticus diabolicus* and *B. lapponicus scandinavicus*, unrevised records were not included herein.

Sweden. Disperse distribution restricted to the mountainous Lapland from about 66° N and northwards. Singly recorded in Jämtland.

A total of 99 specimens, viz. 37 ♀♀ 48 ⚥⚥ 14 ♂♂ was examined.

List of localities. *Jämtland:* ? loc. ⚥♂ (Boheman) NRS. *Lapland (Ly. Lpm.):* Ammarnäs BML, Björkfors, Marsivagge BML. *Lu. Lpm.:* Kvikkjokk, Njunjes ZMA, Sallujaure NRS, Tarradalen NRS, Virihaure (Staloluokta BML ZMA ZML ZMU – Stora Titir ZMU – Unna Titir). *T. Lpm.:* Abisko BML ZMA ZML, Björkliden ZMA, Kebnekaise NRS, Kiruna ZMA, Låktatjokka NRS, Pältsa GNM, Selkavaara BML, Torneträsk BML ZMA, Vassijaure NRS ZMA.

Correction. Records from *Lapland (Ly. Lpm):* Björkfors (Bengtsson 1904) were revised to *B. arcticus diabolicus* and *B. lapponicus scandinavicus* respectively.

Finland. Scattered occurrence in Lapland (Elfving 1968).

World distribution. The Alps. Fennoscandia – Kola pen. Records outside these areas are due to misidentifications or misinterpretations (Pittioni 1942). Records from Kola pen. (Fig. 67) were taken from Pittioni (1942) except Umptek mountains – Hibiny ZMA.

Biology

Nest. Pittioni (1942, p. 178) states that nests of *B. alpinus* are not recorded at all, which may justify the mention of the three colonies below.

A nest was located in *regio alpina* in Southern Norway (Buskerud (Bv): Hol: 1.5 km NW Haugastöl 1150 m 23 July 1967). The nesting site, slightly sloping towards northwest, was characterized by growth of *Betula nana* Linnaeus, *Vaccinium myrtillus* Linnaeus and *Empetrum hermaphroditum* Hagerup. The colony was founded in an old rodent nest situated just below the surface of the ground, the length of the access tunnel being only about 2 cm. The entrance to the nest was in between two rocks, one of which partly covered the colony. The nest material consisted of fragments of hay with some leaves of *Empetrum* admixed, partly plastered together by wax. The queen and most of the workers of first brood were captured on returning from the field loaded with pollen, i.e. the founder still took part in the field activity. The remaining workers, a few of which had just emerged, were taken as they issued from the nest or on the comb.

The data obtained from the colony are summarized in Table IV. Two first brood workers were missing. The cocoons from the third and fourth broods were opened and revealed that several individuals from each of the batches were ready to emerge. Thus females and males would occur simultaneously in this colony. The eggs were distributed in three egg cells individually built on the top of one female and two male cocoons. The egg cells contained 6, 6, and 5 eggs respectively. If the healthy colony was not destroyed, all stages of young, including the eggs, might fulfil the development, emerging to queens or males. The total number of the progeny would then reach 67, 18 ☿☿, and 49 ♀♀ and ♂♂ respectively.

Pollen bread stored beneath and adjacent to lower layers of masses of worker brood and, moreover, stuffed beneath some of the cocoons above, indicates that *B. alpinus* is a pocket-maker. However, a big lump of pollen, formed as pollen cylinder, placed directly on the ground just apart from the comb, indicates that the young were fed a mixture of pollen and nectar as well. The behaviour of the species may perhaps be as mentioned by Hobbs (1964) for another species og the subgenus, *B. balteatus* Dahlbom: '. . . a pocket-maker when rearing worker larvae to the last instar and a pollen-storer when rearing last instar larvae, male, and queen larvae'.

A palynological survey of the colony, set out in Table V, reflects the unusually delayed vegetation period that season. *Salix* was the predominating food plant up to the time the nest was excavated on 23 July. Pollen loads from corbicula of worker number 1 and worker number 8 indicate the start of a preference for *Vaccinium* and *Lotus corniculatus* Linnaeus, that is, a change in food plants. *V. myrtillus* Linnaeus and *V. uli-*

Table IV. Contents of a colony of *B. alpinus* (Linnaeus) excavated in Norway: Buskerud (Bv): 1.5 km NW Haugastöl 1150 m s.m. 23 July 1967

Queen, founder of the nest			
Offspring:			
1st brood: workers	8	worker cocoons	10
2nd brood: workers	8	worker cocoons	8
imagines	16	3rd brood: male pupae	6
		4th brood, 1st batch: male prepupae/pupae	12
		4th brood, 2nd batch: queen prepupae/pupae + 1 emerged queen	6
		5th brood, 1st batch: queen or male larvae	8
		eggs in 3 batches	17
Total number of progeny			67

14 cocoons used as honey-pots
Large pollen-cylinder on the ground apart from the comb

Table V. Palynological data in per cent from a colony of *B. alpinus* (Linnaeus) excavated in Norway: Buskerud (Bv): 1.5 km NW Haugastöl, 1150 m, 23 July 1967. (Prepared by K. Fægri)

	Salix	*Ericaceae*	*Vaccinium*	*Lotus*	*Pedicularis*
Pollenload, hibernating ♀	99	1			
Pollenload, worker No. 1	34		66		
Pollenload, worker No. 2	99+	1÷			
Pollenload, worker No. 5	99+	1÷			
Pollenload, worker No. 8	7		7	80	6
Faeces in web in, old ♀ cocoon	100				
Nectar stored in, old cocoon	97		3		
Pollenlump stored, apart from comb	84		15		2

gonosum Linnaeus were by then only locally in full bloom while *Lotus corniculatus* growing at a few localities at a distance from the nest, was barely in bloom as far as I observed. The percentage of *Pedicularis* may coincide with my observations of the collecting bumble bees. *P. lapponica* Linnaeus, growing abundantly in the area, was not visited much by bumble bees. The bees were more attracted by dispersed *Vaccinium* and *Lotus* in bloom.

Table V also reveals that the pollen in faeces, deposited between layers in worker cocoon, consists of 100 per cent *Salix*, which is expected. Within the actual area *Salix* spp. is the only food plant in bloom at the very beginning of the season except for dispersed growth of *Arctostaphylos alpina* (Linnaeus) and *A. uva-ursi* (Linnaeus). The proportion of *Salix* pollen and *Vaccinium* pollen in the analyzed nectar may, however, not quite correspond with the proportion of nectar-collecting bumble bees visiting these plants, as nectar collected from *Salix* generally includes more pollen than that from *Vaccinium*.

The year 1967 was considered as a poor season for bumble bee activity in the Haugastöl area. A tremendous precipitation of snow during the winter and spring lasting till the end of May, even several snowstorms during the first half of June, delayed the blooming of food plants and the emergence of hibernating queens, and prevented flying activity as well. The meteorological data, regularly registered at Haugastöl railway station, show that the mean temperature in June was 1.4° below the normal mean for the month, that of July was 2.6° below. The developmental stage of the excavated nest indicates that the colony was initiated the first half of June. The queen left hibernation and hunted for the sparse-blooming *Salix* and for a nesting site long before the snow in large drifts melted. In spite of the unfavourable seasonal conditions it is noteworthy that two worker broods were produced.

Another nest was recorded in the Virihaura area (Sweden: Lapland (Lu. Lpm.): Staloluokta 650 m s.m. 1 July 1944). It was established in an old rodent nest situated between the logs in a hut (Brinck 1951). When it was destroyed 8 August, the total number of imagines produced was estimated as 20 large and 10 small workers, some males, and 12 young queens. The number of worker broods is not mentioned and the comb was not kept, but a total of about 30 workers indicates surely that more than two broods of this caste were produced.

A third colony was excavated in the same area 31 July 1964 (Bergwall 1970 and in litt.). It was located on a heathery mountainous plateau about 20 cm below the surface of the ground and beneath a rock overgrown by *Betula nana*. The access tunnel was about 75 cm. The inhabitants consisted of an injured queen, 11 workers, 5 males, and some larvae in various developmental stages. Though the bumble bee activity was slowed down for most of the season by poor weather conditions, at least two broods were produced.

Flight season. From the middle of May to end of August. Queen: 8 May–28 Aug.; worker: 19 June–28 Aug.; male: 12 July–4 Sept.

Biological remarks

No nests were located in Northern Norway. The total number of recorded workers, viz. 213

Norwegian and Swedish specimens, comprises, however, 25 individuals from the two northernmost counties in Norway, i.e. Troms and Finnmark. At least two worker broods raised in each of the colonies above and the number of workers observed throughout Scandinavia indicate that *B. alpinus* regularly produces worker caste and to the northern limit of its distribution.

BOMBUS (ALPINOBOMBUS) ARCTICUS KIRBY

Bombus arcticus Kirby, 1821, p. ccxvi nec Dahlbom 1832 nec Zetterstedt 1838. Type ♀ BML!, type area Arctic Canada: Boothia.

(*Bombus arcticus* Kirby; Meidell 1934a, p. 124; *Bombus alpinus:* Dahlbom 1832, p. 32 (partim); Zetterstedt 1838 (partim); *Bombus polaris* Curtis, 1835, p. lxiii No. 7, type ♀ BML!, type area Arctic Canada: Boothia. *Bombus alpinus* var. Thomson 1872. *Bombus balteatus* var. *kirbiellus:* Aurivillius 1890, p. 28 nec Curtis 1835. *Bombus kirbyellus:* Friese 1935 nec Curtis 1835. *Bombus alpinus* var. *diabolicus* Friese, 1911: 571 No. 21, holotype ♀ IZB!, type area USSR: Kola pen. *Bombus alpinus* var. *pretiosus* Friese, 1911, p. 571 No. 22 holotype ♂ IZB! labelled Kirkenes (ex coll. Sparre Schneider). The author designated Norway: Finnmark (Fn): Nordkapp as type locality cf. below. *Bombus arcticus* var. *alpiniformis* Richards, 1931, p. 13, holotype ♂ ZMO!, type area Norway: Oppland (On): Dovre; Løken 1960; Bergwall 1970. *Alpinobombus tristis* (Sparre Schneider) *nomen nudum* cf. below; Skorikov 1937. *Bombus alpiniformis* Richards; Pittioni 1939b; Elfving 1960, 1968; *Bombus polaris alpiniformis* Richards; Kruseman 1959; Ander 1965. *Bombus arcticus diabolicus* Friese; Løken 1966a.)

Nomenclatural remarks

The type area of *B. alpinus* var. *pretiosus* being Nordkapp while Kirkenes, i.e. Finnmark (Fö): Sör-Varanger: Kirkenes, the locality written on the label attached to the holotype, is due to confusing topographical information, as Friese only examined one specimen (Friese & Wagner 1912). Sparre Schneider communicated lively with Friese and supplied him with material. To my knowledge Sparre Schneider and his colleagues never collected in Nordkapp but spent several seasons in Sör-Varanger. Though there are no records from Nordkapp situated at the northernmost coast approx. 71° N and roughly about 210 km northwest of Kirkenes, the species may, however, reach that far north.

Alpinobombus tristis is a *nomen nudum* as Sparre Schneider never published the name.

First Scandinavian records

Norway. Finnmark (Fv): Nordkapp (Friese 1911) published as *B. alpinus* var. *pretiosus* cf. above.

Sweden. Lapland (Kruseman 1959), mentioned as Arctic Sweden.

Taxonomical remarks

The Scandinavian population is recognized as a subspecies *B. arcticus diabolicus*, presenting a colouring of the coat entirely different from that of the nominate form. The latter has pile on collar, scutellum and T_{1-2} ochrous-yellow to dull yellow, hairs on T_{4-6} either black or ferruginous, coat otherwise black. The colouring of *B. arcticus diabolicus* is described below.

B. alpinus var. *pretiosus* is revised to an infrasubspecific form of *B. arcticus diabolicus*. Richards (1931) mentions five workers (Norway: Oppland (On): Dovre TRM) belonging to a black-tailed form, *B. arcticus* var. *friesei* Skorikov, 1908, described from Northeast Siberia. The individuals were not traced and other specimens of this form were not recorded in Scandinavia.

Distribution

Fennoscandia. Cf. the subspecies.

World distribution. Circumpolar. Europe (Fennoscandia; Kola pen.; Kolguyev) – Novaya Zemlya – Northern Siberia – Kamchatka – Arctic America – Greenland (Skorikov 1937).

BOMBUS ARCTICUS DIABOLICUS FRIESE (= *B. arcticus alpiniformis* Richards)

Queen, worker

Morphological characters. Head slightly or not longer than wide. Malar space slightly longer than distal width, about as long as A_{3+4}. Clypeus with dense or rather dense puncturing except for a small almost impunctate area in between the wide, well-defined lateral impressions. Microsculpture of labral tubercles alutaceous. Ocelli dorsally touching or just transecting supra-orbital line. A_3 about 1½ times longer than distal width and about ⅔ the length of A_{4+5}; A_4 about as long as distal width and usually distinctly shorter than A_5. Microsculpture of vertex, at least above supra-orbital line, alutaceous with rather indistinct puncturing, admixed with scattered coarse punctures. Outer surface of hind tibia strongly alutaceous, dull; distal inner dorsal process of hind tibia distinctly spined as in *B. alpinus* (Fig. 10B) or less so (more or less distinct in workers). Length of hind basitarsus slightly exceeding twice the greatest width of the segment. T_{4-5} densely punctured, chagrinated. Body in general less robust than in *B. alpinus*. Coat rather uneven.

Queen measurements: N = 20; Northern Norway; malar space: 0.82 mm (±0.03±0.01) range: 0.75–0.90 mm; 'radial length': 4.64 mm (±0.19±0.04) range: 4.25–4.90 mm; interalar width: 5.58 mm (±0.19±0.04) range: 5.23–5.90 mm. Body of large size.

Colour pattern. At least extreme anterior edge of T_2 with variable admixture of black hairs; remainder of T_2, T_{3-6}, at least lateral part of fringes of St_{4-5}, St_6 with rather bright ferruginous pile in newly emerged specimens. Otherwise coat black. Particularly in dry specimens the shade of ferruginous is often more dull, faded than in *B. alpinus*.

The diagnostic features are often so indefinite in workers that the individuals cannot with certainty be separated from *B. alpinus*.

Variation. The extension of black hairs on T_{2-3} ranges from only a few hairs at median anterior edge of T_2 to covering entire T_{2-3}. Individuals with admixture of ferruginous pile on T_1 were also examined. T_6 and St_6 occasionally with variable admixture of black hairs, particularly distally.

Male

Morphological characters. Head just longer than wide. Malar space slightly longer than distal width, about as long as A_{2+3}. A_3 hardly longer than A_4. A_4 about as long as distal width. A_{5-13} individually nearly twice as long as distal width. Outer surface of hind tibia alutaceous. Hind basitarsus 3½ to 4 times longer than distal width of the segment (Fig. 25A). St_8 and genitalia (Figs. 25B–C); distal part of St_8 suddenly converging to a more or less pointed apex; apex of volsella seen from beneath (Fig. 25D); penis valve with subapical tooth. Body of moderate to large size.

Colour pattern. Fringes of hind tibia varying from pale ferruginous to pale yellowish or tipped so. Otherwise colouring as in the female.

Variation. Pile of vertex and collar (rarely also scutellum and T_1) with variable admixture of yellow hairs, otherwise variations as in the female.

Distribution (Fig. 68)

Norway. In Southern Norway related to the mountainous massif and extending from the northern fringe of Hardangervidda 60°30′ N to the northern fringe of Dovrefjell 62°30′ N. In Northern Norway scattered distribution north of Polar Circle. The species occurs within the same areas as *B. alpinus* but has a more restricted alpine/arctic distribution; for instance, it is only rarely recorded at the coast. In Southern Norway recorded 1400 m s.m.

Biotopes: *Salix* biotopes, *Vaccinium* heaths, mountain meadows.

A total of 99 specimens, viz. 64 ♀♀ 23 ☿☿ 12 ♂♂ was examined.

List of localities. *Oppland (On):* Vang: Eidsbugarden 1200 m BML; Fron: ? loc. ZMO; Skjåk: Grotli 900 m, Langevann 930 m; Lesja: Lesjahorungene Lar; Dovre: Dovrefjell 1000 m NRS TCL ZMO. *Buskerud (Bv):* Hol: Fagerheim 1150 m. *Hordaland (HOi):* Ulvik: Finse 1200–1300 m. *Sogn og Fjordane*

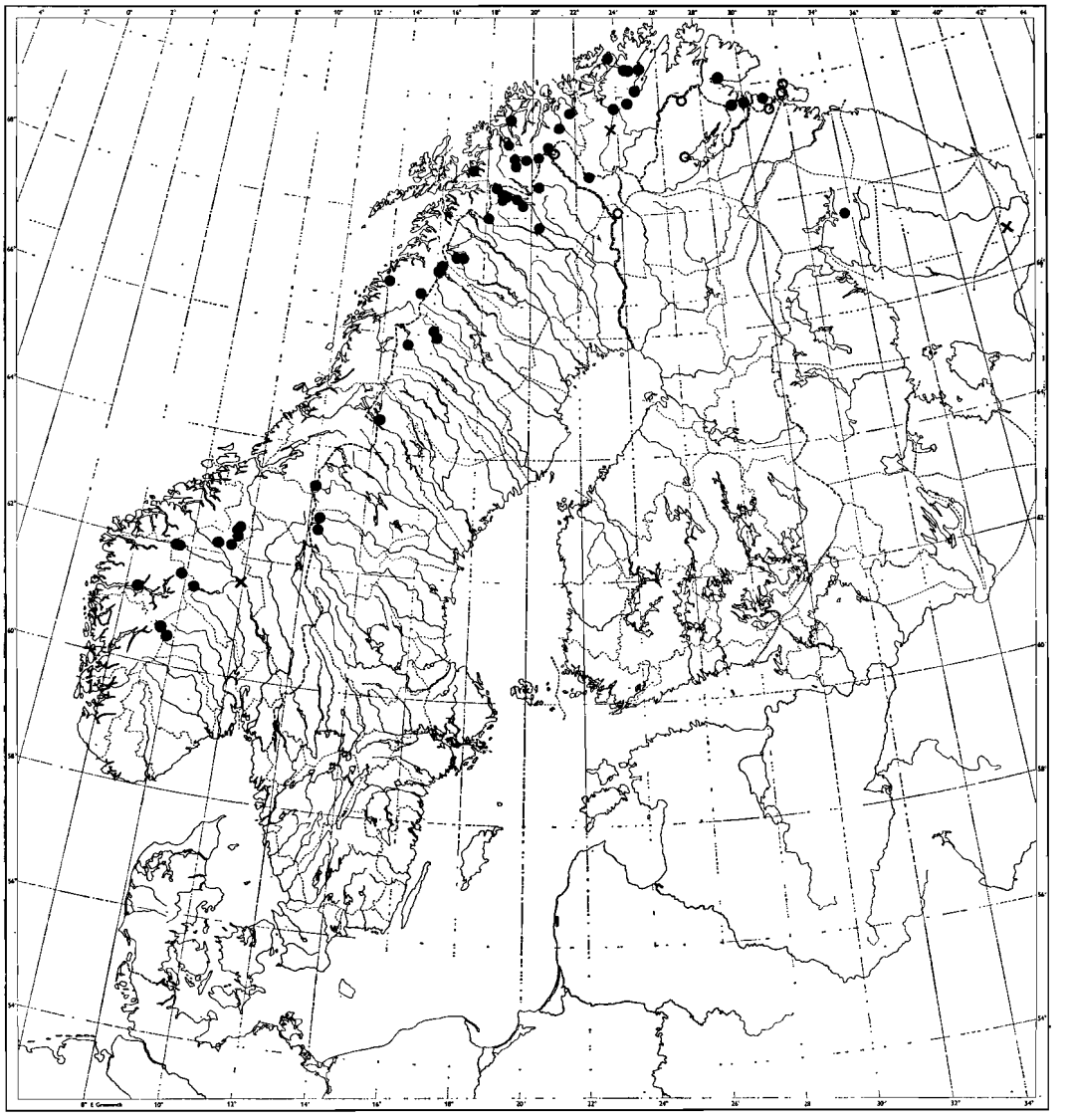


Fig. 68. *B. arcticus diabolicus* Friese. Legend as in Fig. 50.

(SFi): Balestrand: Dueskard SW Balestrand 600 m; Luster: Turtagrö 900 m TRM. *Sör-Tröndelag (STi):* Oppdal: Gåvåli 975 m, Jerosbekken 920 m, Knutshö 1300 m BML ZMB, Kongsvoll 900 m BML ZMB, Stölåhollen 1400 m. *Nordland (Nsy):* Melöy: SE Glomfjordbreen 300 m. *Nsi:* Saltdal: S Lönsdal st. 330 m; Fauske: Blåmannsisen N Sulitjelma 950 m BML, Duoldakapjavrre NE Sulitjelma 810 m BML. *Troms (TRy):* Tromsö TRM ZMA, Tromsdal TRM ZMA. *TRi:* Gratangen: Myrland; Målselv: Čarač TRM, Kirkesdal, Mauken ZMO; Balsfjord: Orta TRM; Storfjord: Helligskogen; Nordreisa: Javroaive SW Sappen 900 m; Kvænangen: Navetdalen. *Finnmark (Fv):* Hammerfest TRM ZMO; Kvalsund: Skaidi, unna Hatteras. *Fi:* Alta: Jotkajavrre 400 m TRM; Alta-Kautokeino DCL. *Fn:* Porsanger: Festningsstua TRM, Kistrand TCL ZMO, Lakselv ZMO; Nesseby: Mortensnes ZMC. *Fö:* Sör-Varanger: Grense-Jakobselv TRM, Kirkenes TRM IZB, Neiden TRM.

Sweden. Scattered occurrence along the mountain chain from Härjedalen and north throughout Lapland.

A total of 109 specimens, viz. 69 ♀♀ 28 ☿☿ 12 ♂♂, was examined.

List of localities. *Härjedalen:* Axhögen NRS, Tänndalen. *Jämtland:* Brattickfjäll DCL ZCL, Storlien. *Lapland (Ly. Lpm.):* Ammarnäs BML, Björkfors, 'Lap nemens' DCL, Skjellejokk near Ammarnäs BML. *Lu. Lpm.:* St. Titir in Virihaure ZMU, Sarek NRS. *T. Lpm.:* Abisko BML NRS ZMA ZML, Björkliden ZMA ZML, Kaisepakte NRS, Kiruna ZMA, Loupatha ESE Abisko NRS, Nissontjårro BML, Nuolja, Satnjarastjårro BML, Selkavaara BML, Sinnukasjärvi ZMU, Tuipal, Torneträsk NRS BML ZMA, Vassijaure BML ZMA.

Corrections. In the collection of *B. arcticus* from Greenland ZMA is a queen of the nominate form labelled Tlp. 12 July 1903 Rn, with additional label Vassijaure, Lapland 1903 Roman. Another specimen, labelled Julianehaab August 1899, appears to be *B. balteatus* ♂. *B. a. arcticus* is not recorded in Sweden and *B. balteatus* does not occur in Greenland, the labels may have been changed. I have therefore labelled both *indicium loci videtur dubium.*

Finland. Confined to Lapland. Rather rare. Localities (Fig. 68) were taken from Elfving (1968) except for Le: St Oiwe (Wahlberg) NRS TCL being revised from *B. alpinus.*

Total distribution of the subspecies, B. arcticus diabolicus Friese. Fennoscandia – Kola pen. The localities outside present Fennoscandia (Fig. 68) were taken from Elfving (1968) except for Kola pen.: Umptek-Hibinä ZMA and Kola pen.: ?loc IBZ referring to the holotype. Skorikov (1937) states that the subspecies occurs in eastern part of Kola pen. without listing the localities.

Biology

Nest. The following four nests may be the only colonies of *B. a. diabolicus* recorded so far:

A nest located 70°26′ N Lat. (Norway: Finnmark (Fv): Kvalsund about 50 km ESE Hammerfest 200 m 30 July 1955) in the soil on the surface of the ground. In spite of extremely unfavourable weather conditions throughout the season at least two worker broods were produced (Løken 1961a).

Another nest was just initiated when found at the northern edge of the mountainous plateau Dovrefjell in Central Norway (Sör-Tröndelag (STi): Oppdal: Knutshö 1200 m 16 June 1967). It was located on the southwestern slope of the mountain, established in a vacant rodent nest about 10 cm below the surface of the ground, covered with growth of *Betula nana* and *Cladonia rangifer.* The access tunnel was about 15 cm long, sloping downwards about 5 cm before making a right angle and continuing slightly downwards to the nest. The female was caught returning to the nest heavily loaded with pollen. A small pollen lump in the centre of the cavity of fragments of hay indicated she was establishing a colony.

A third nest was located just north of Hardangerjökulen in Central Norway (Hordaland (HOi): Ulvik: Nordnut at Finse 1300 m 23 Aug. 1968 (Kauri et al.) ZMB). The colony was established in an abandoned rodent nest *(Lemmus lemmus* (Linnaeus)) underneath a fallen telephone post. The comb was not analyzed, only the founder and two ☿☿ were collected.

A queen, 13 workers, and the comb from the fourth colony (Sweden: Lapland (T. Lpm.): Selkavaara W Kebnekaise July 1955 (Pringle) BML) were kept without comments.

Flight season. From middle of May to the beginning of September. Queen: 15 May–15 Aug.; worker: 28 June–23 Aug.; male: 13 Aug.–7 Sept.

Biological remarks

Løken (1961a) indicates that *B. arcticus diabolicus* is a pocket-maker. The development of the analyzed colony was, however, interrupted before the sexual broods were raised. It might be questioned whether the species alters to 'pollen-storer' behaviour at a later stage of the development, as suggested for other species of this subgenus, cf. p. 99.

A total of 51 Norwegian and Swedish workers including those from the colonies above, 3 Finnish workers (Elfving 1968), worker broods developed in colonies of *B. a. arcticus* located in Northern Ellesmere Island 81°49′ N (Milliron & Oliver 1966), and some workers of the nominate form traced in collections, attest that *B. arcticus* regularly produces worker caste, cf. p. 96.

BOMBUS (ALPINOBOMBUS) BALTEATUS DAHLBOM

Bombus balteatus Dahlbom, 1832, p. 36 No. 8. The description is based upon a single queen which has not been traced. Lectotype ♀ designated by Milliron (1960) not valid (Ander 1967). Type area Finland: Lapland (Le): Enontekis.

(*Bombus balteatus* Dahlbom; Siebke 1863, 1870; Richards 1931; Hellén 1933; Meidell 1934a; Barendrecht 1941; Pittioni 1942; Brinck & Wingstrand 1949; Løken 1949, 1950, 1966c; Brinck 1951; Kruseman 1959; Elving 1960, 1968; Ander 1965. *Bombus nivalis* Dahlbom, 1832, p. 40 No. 16, lectotype ♀ ZCL! designated by Milliron (1960), type area Sweden: Lapland (T. Lpm.): Lake Torneträskarea; Dahlbom 1837; Zetterstedt 1838; Boheman 1844, p. 103, 1857, p. 22; Wahlberg 1854, 1855; Siebke 1863, 1880; Thomson 1870, 1872; Sparre Schneider 1889, 1895b, 1898; Strand 1898a, 1898b; Lie-Pettersen 1901, 1907; Bengtsson 1908; Ander 1967. *Bombus tricolor* Dahlbom, 1832, p. 41 No. 17, lectotype ♂ ZCL! designated by Ander (1967), type loc. Sweden: Lapland (T. Lpm): Karesuando; Zetterstedt 1838. *Bombus kirbiellus* Curtis, 1835, p. lxii No. 6 = *Bombus kirbyellus* Curtis, type not traced, type area Arctic Canada: Boothia; Aurivillius 1903; Bengtsson 1904, 1931; Sparre Schneider 1909; Friese & Wagner 1912; Ringdahl 1915; Soot-Ryen 1925; Forsslund 1929; Gaunitz 1929. A bibliographic reference to the species is presented by Pittioni 1942.)

First Scandinavian records

Norway. Oppland (On): Dovre: Hjerkinn and Sör-Tröndelag (STi): Oppdal: Drivstua and Kongsvoll (Siebke 1863) published as *B. balteatus* and also as *B. nivalis.*

Sweden. Lapland (T. Lpm.): Torneträsk and Karesuando (Dahlbom 1832) published as *B. balteatus, B. nivalis* and *B. tricolor.*

Taxonomical remarks

The Fennoscandian population belongs to the nominate subspecies.

The unstable colouring of the coat has given rise to a vast number of designations (Pittioni 1942). Scandinavian variants mentioned as *B. balteatus* var. *nivalis* Dahlbom, *B. kirbyellus* var. *tristis* Friese, 1902 nec Seidl 1837 (= *B. kirbyellus* var. *similis* Friese, 1911), *B. kirbyellus* var. *pyropygus* Friese, 1902, *B. nivalis* var. *lysholmi* Friese, 1905, and *B. kirbyellus* var. *gmelini* Skorikov, 1914a (Friese & Wagner 1912; Skorikov 1914a; Soot-Ryen 1925; Richards 1931; Meidell 1934a; Løken 1949, 1950; Brinck 1951) are infrasubspecific forms only. Aurivillius (1903) moreover mentions a black-tailed variety resembling *B. hyperboreus.* It might correspond to the *friesei* form revised by Richards (1931) to *B. arcticus,* to which, however, no Fennoscandian specimens were traced, cf. p. 101.

Queen, worker

Morphological characters. Head slightly longer than wide. Malar space markedly longer than distal width, yet less than 1½ times this width, about as long as A_{3+4}. Clypeus centrally almost impunctate or with very fine puncturing, otherwise with rather sparse uneven puncturing except for the small impunctate anterior area between moderately defined, coarsely punctured lateral impressions. Ocelli just in front of supra-orbital line, occasionally touching this line. A_3 at least 1½ times longer than distal width and about ⅔ the length of A_{4+5} or nearly so. A_4 about as long as distal width, slightly shorter than A_5. Surface of vertex near and above supra-orbital line smooth with sparse, coarse puncturing admixed with very fine ones. Outer surface of hind tibia slightly to moderately alutaceous; distal inner dorsal process of hind tibia usually moderately produced. Hind basitarsus longer than twice its greatest width but shorter than 2½ times this width. T_{4-5} slightly to strongly chagrinated with rather fine dense puncturing. Body rather robust, coast shaggy.

Queen measurements: N = 20; Northern Norway; malar space: 0.96 mm (±0.04±0.01) range: 0.88–1.00 mm; 'radial length': 5.00 mm (±0.14±0.03) range: 4.75–5.25 mm; interalar width: 5.80 mm (±0.17±0.04) range: 5.38–6.10 mm. Body of large size.

Colour pattern. Broad collar, crescent-shaped posterior part of scutellum, T_{1-2} deep and dull yellow-haired. Pile on T_{4-5}, anterior part of T_6 ferruginous, yellowish or whitish respectively. Otherwise coat black. Interalar band posteriorly curved, including black hairs of scutellum.

Variation. Unstable colouring. Pile of vertex occasionally with slight admixture of yellow hairs. Collar varying slightly in width, the shade in hairs of collar and T_{1-2} ranging from dull rather dark yellow to yellowish-white. Individuals with more lemon-yellow banded appearance occasionally recorded. Pile on T_{4-6} displays a range of colour shades: bright ferruginous – faded ferruginous – dull yellow as the thoracic bands – yellowish-white – whitish. A tendency to melanism is additionally locally common, cf. below.

Male

Morphological characters. Head slightly, yet distinctly longer than wide. Malar space twice the distal width or nearly, about as long as A_{3+4}. Antenna long (Fig. 26A); A_3 about 1½ times longer than distal width, A_4 just longer than distal width; A_{5-13} individually twice as long as distal width or nearly. Outer surface of hind tibia scarcely or not alutaceous; hind basitarsus almost 4 times longer than distal width of the segment. St_8 and genitalia (Figs. 26B–C); the sides of St_8 forming a rectangular or acute angle with the truncate apex, which in the middle tapers to a point; inner edge of gonostylus forming a basal tooth; apex of volsella, seen from beneath, much produced inwards; penis valve with subapical tooth. Body of medium to large size.

Colour pattern. Pile of vertex with variable admixture of yellow. Hairs of episternum, venter usually predominantly pale yellow to whitish. T_7 coloured as T_6. Otherwise colouring as in the female.

Variation. Pile of face with variable admixture of yellow. Episternum with a variable admixture of black hairs, occasionally entirely black-haired. Otherwise variation as in the female.

Discussion on melanism

In addition to the variation mentioned above, a melanic appearance locally contributes to the range of the colour pattern of the coat. Various degrees of melanism occur, from individuals with a variable amount of yellow hairs replaced by black ones to specimens with entirely black coat except that on T_{4-6}. The tendency to melanism throughout Fennoscandia is evaluated by a study of the collections. The material comprises 815 Norwegian and 525 Swedish specimens besides 297 Finnish specimens from the only two Finnish counties (Le, Lkm) where melanics have been recorded. A total of 432 observed but not captured Norwegian specimens, quoted by me as typical or melanic individuals, has also been considered.

The material reveals a proportion of melanism as illustrated on the pie chart (Fig. 69), based on the figures set out in Tables VI, VII. Individuals with no yellow thoracic hairs visible by naked eye and with hairs on T_{1-2} either entirely black or presenting a reduced yellow band, are grouped as melanics. In Table VI collected and observed but not collected material are kept in separate columns. The frequency presented on the pie chart is based on collected specimens only.

The most reliable frequencies concern those from Norway: Oppland (Os) and Hordaland (HOi), as they are the only figures chiefly based on continuous observations throughout the season (Løken 1949, 1950). Table VI shows that the proportion of melanism in these districts, i.e. Os and HOi, although 30% and 37% when based on preserved material only, is reduced to 17% and 16% respectively if observed but not collected individuals are added. This is due to the fact that melanic specimens were more often captured than the easily recognized non-melanic ones in order to secure correct identification. It is uncertain to what degree this also applies to the actual collections from the remaining areas. Therefore, the present study indicates the local tendency to melanism more than it exactly reflects the proportion of melanism. Generally speaking, the available material sufficiently illustrates a pronounced tendency to melanism in Southern Norway which is strongly

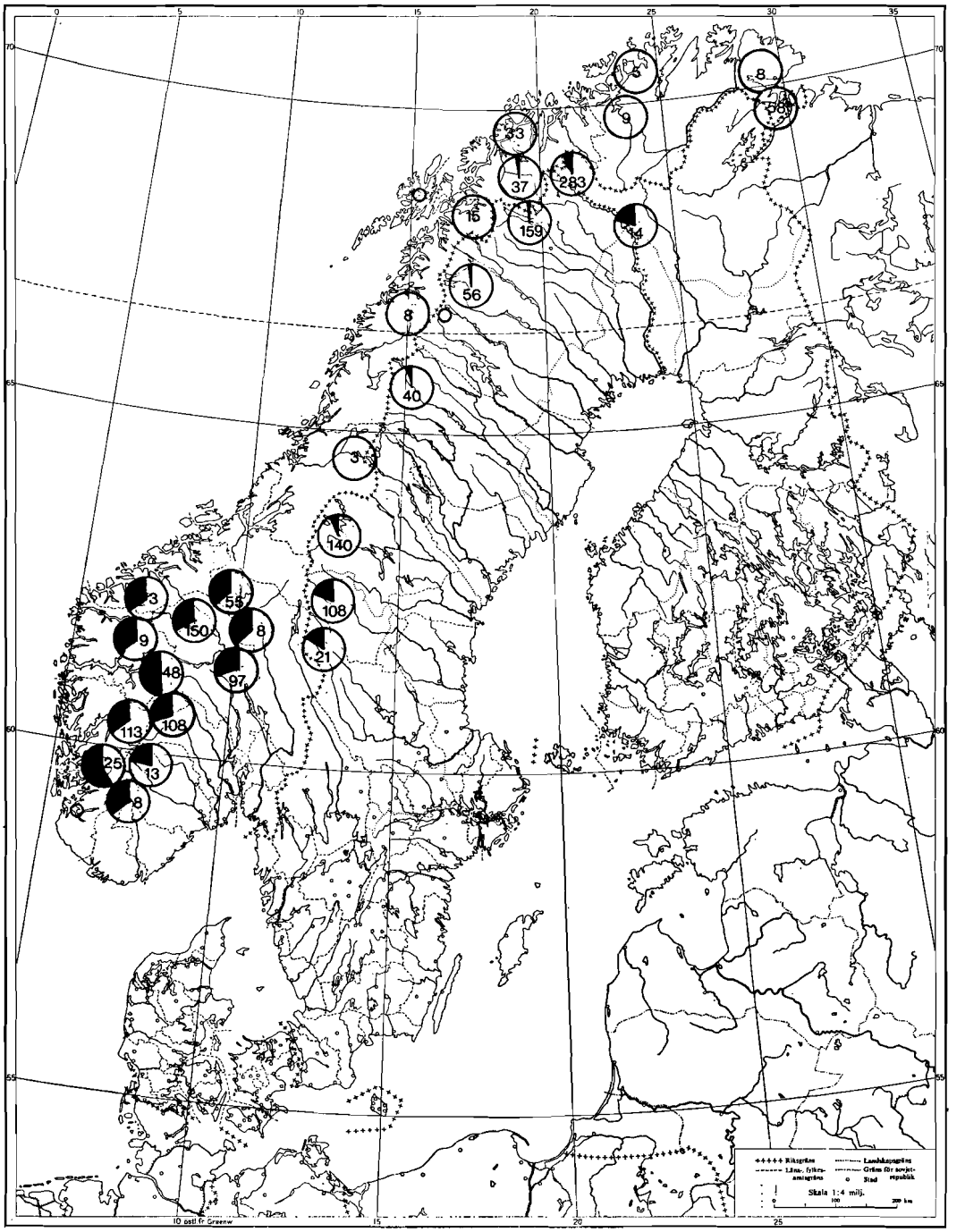


Fig. 69. *B. balteatus* Dahlbom. Proportion of melanism. The figures refer to the total number of examined records within a county or district thereof. Black = proportion of melanics. Small circle = single record.

Table VI. *B. balteatus* Dahlbom. Proportion of melanism throughout Norway. Area = district of county (cf. Fig. 99); coll. = examined collections; obs. = observed, not collected material

	Number of individuals				Total number		Per cent melanic form	
	typical form		melanic form					
Area	coll.	obs.	coll.	obs.	coll.	obs.	coll.	coll. + obs.
HEn	5	–	3	–	8	–	38	–
Os	68	152	29	16	97	168	30	17
On	105	2	45	1	150	3	30	31
Bv	77	9	31	3	108	12	29	28
TEi	10	–	3	–	13	–	23	–
AAi	5	–	3	–	8	–	38	–
Ry	1	–	0	–	1	–	0	–
Ri	10	–	15	–	25	–	60	–
HOi	71	226	42	15	113	241	37	16
SFy	6	–	3	2	9	2	33	46
SFi	23	5	25	1	48	6	52	48
MRi	2	–	1	–	3	–	33	–
STi	36	–	19	–	55	–	35	–
NTi	3	–	0	–	3	–	0	–
Nsi	8	–	0	–	8	–	0	–
Nnö	15	–	0	–	15	–	0	–
Nnv	1	–	0	–	1	–	0	–
TRy	33	–	0	–	33	–	0	–
TRi	36	–	1	–	37	–	3	–
Fi	9	–	0	–	9	–	0	–
Fv	5	–	0	–	5	–	0	–
Fn	8	–	0	–	8	–	0	–
Fö	58	–	0	–	58	–	0	–
	595	394	220	38	815	432		

Table VII. *B. balteatus* Dahlbom. Proportion of melanism throughout Sweden and Finland. The figures are based on collections. Area = county or district thereof (cf. Fig. 99)

	Number of individuals			Per cent
Area	typ. form	mel. form	Total number	mel. form
Sweden:				
Dlr.	18	3	21	14
Hjd.	89	19	108	18
Jmtl.	131	9	140	6
Ly. Lpm.	39	1	40	3
P. Lpm.	1	0	1	0
Lu. Lpm.	55	1	56	2
T. Lpm.	156	3	159	2
	489	36	525	
Finland:				
Le	262	21	283	7
Lk	11	3	14	21
	273	24	297	

reduced on going north. There is, however, a slight increase in melanism in Finland exemplified by the rather large collection from Finland (Le: mainly Kilpisjärvi area) comprising 7 per cent melanics compared with that from Sweden (T. Lpm.: mainly Torneträsk area) of 2 per cent melanics only (Table VII). The high frequency of melanism in Finland (Lk: mainly Pallastunturi), viz. 21 per cent, is even more striking, but based on a small collection only.

It is noteworthy that the most reliable frequencies, i.e. those referring to Oppland (Os) and Hordaland (HOi), are about the same, viz. 17 per cent and 16 per cent respectively (Table VI). The actual areas are situated in the rather lower mountainous area linking southeastern lowlands to the mountain chain (Os: mainly Öyer: Aksjö area) and at the western slope of the elevation of the mountain chain (HOi: mainly Ullensvang: Fossli – Sysendalen i.e. the northwestern slope of Hardangervidda), i.e. areas presenting different macroclimate emphasized, for instance, by the great difference in precipitation (Fig. 1). As far as accumulation of melanic alleles is influenced by humidity, the frequency of melanism which is about the same along either side of the mountain chain in Southern Norway, may, however, be more related to local ground moisture and humidity near the ground than the actual amount of precipitation.

Pittioni (1943, pp. 4–6) states that sex and caste in *B. balteatus* display a difference in the variability of colour pattern, characterized by the tendency to melanism being more pronounced in queens than in males and not recorded in workers. Melanic individuals examined by Elfving (1960) were males only. However, in the material at my disposal, sex and caste exhibit the same wide range in the colouring, including melanism. The statement is exemplified by the records from Oppland (Os) and Hordaland (HOi) where the frequency of melanism, set out in in Table VIII, clearly asserts that melanic queens, workers and males are equally produced. Thus the great variability in the colour pattern locally accentuated by pronounced tendency to melanism is not sex-linked.

Distribution (Fig. 70)

Norway. In Southern Norway widely distributed along the mountain chain from 59°N in Aust-Agder – Rogaland to 62°40′N in Sör-Tröndelag and further north occurring from about 64°30′N to Arctic proper. The species is confined to alpine/arctic and subalpine/subarctic zones and locally observed in adjacent conifer forest as well. It is also singly recorded at sea level in the inner part of the western fjords and locally reaches the coast in the northernmost part of the country, yet so far only rarely observed on islands off shore. *B. balteatus* has a wider distribution than the remaining species of this subgenus. The abundance is moreover greater and the frequency higher.

Biotopes: *Salix* biotopes, *Vaccinium* heaths, mountain meadows, mountain pastures.

Table VIII. *B. balteatus* Dahlbom. Frequency of melanism in sex and caste

	♀		☿		♂		Total	
	No.	per cent	No.	per cent	No.	per cent	No.	per cent
Oppland (Os)								
Typical form:	11	92	46	70	11	58	68	70
Melanic form:	1	8	20	30	8	42	29	30
	12	100	66	100	19	100	97	100
Hordaland (HOi)								
Typical form:	10	53	42	72	19	53	71	63
Melanic form:	9	47	16	28	17	47	42	37
	19	100	58	100	36	100	113	100

A total of 818 specimens was examined, viz. 207 ♀♀ 485 ☿☿ and 126 ♂♂.

List of localities. *?Akershus (AK):* Oslo: ♂ 21 July 1844 DCL, 2 ☿☿ (Siebke) ZMO. *Hedmark (HEn):* Stor-Elvdal: Snödöldalen 1000 m; Tynset: Tyldal 600 m. *Oppland (Os):* Nord-Aurdal: Flya 850 m; Östre-Gausdal: Gausdal sanatorium 780 m ZMO; Öyer: Aksjö 1000 m, Brettdalen 950 m, Öyer kirke, Åstdalen 900 m. *On:* Vestre Slidre: Kinnholt 1000 m; Vang: ? loc. ZMO, Eidsbugarden 1200 m, Nystova 1000 m ZMO, Tyin 1100 m USU; Sel: Mysuseter 900 m; Vågå: Hindseter 900 m, Klones 400 m, Valdresflya 1150 m, Vågåmo 400 m, Övre Sjodalsvann 950 m; Lom: Lom 400 m; Skjåk: Breidalsvann 900 m, Skjåksetrene 800 m, Strynsfjellet 1100 m; Dovre: Dovrefjell 1000 m BML KMT TCL TRM VCA ZML ZMO, Döråseter 1050 m, Fokstua 930 m ZMB ZMO, Hjerkinn 950 m ZMO, Vålåsjö 950 m ZMO, Svanå 1200 m. *Buskerud (Bv):* Nore og Ulvdal: Dagali 900 m NRS, Gavlenseter 1120 m, Övre Hein 1160 m; Hemsedal: Lykkja 900 m, Muren 730 m; Ål: Vallehalle 1120 m; Hol: ? loc. ZMO, Geilo 800 m, E Halne 1120 m, Haugastöl 1000 m VCA ZMB, NW Lillevann 1150 m, Nygård 1000 m, Vikastölen 1000 m, Prestholt 1250 m, Ustaoset 1000 m. *Telemark (TEi):* Vinje: Bossböen 970 m, Krossen 700 m, Torvtjern 900 m;

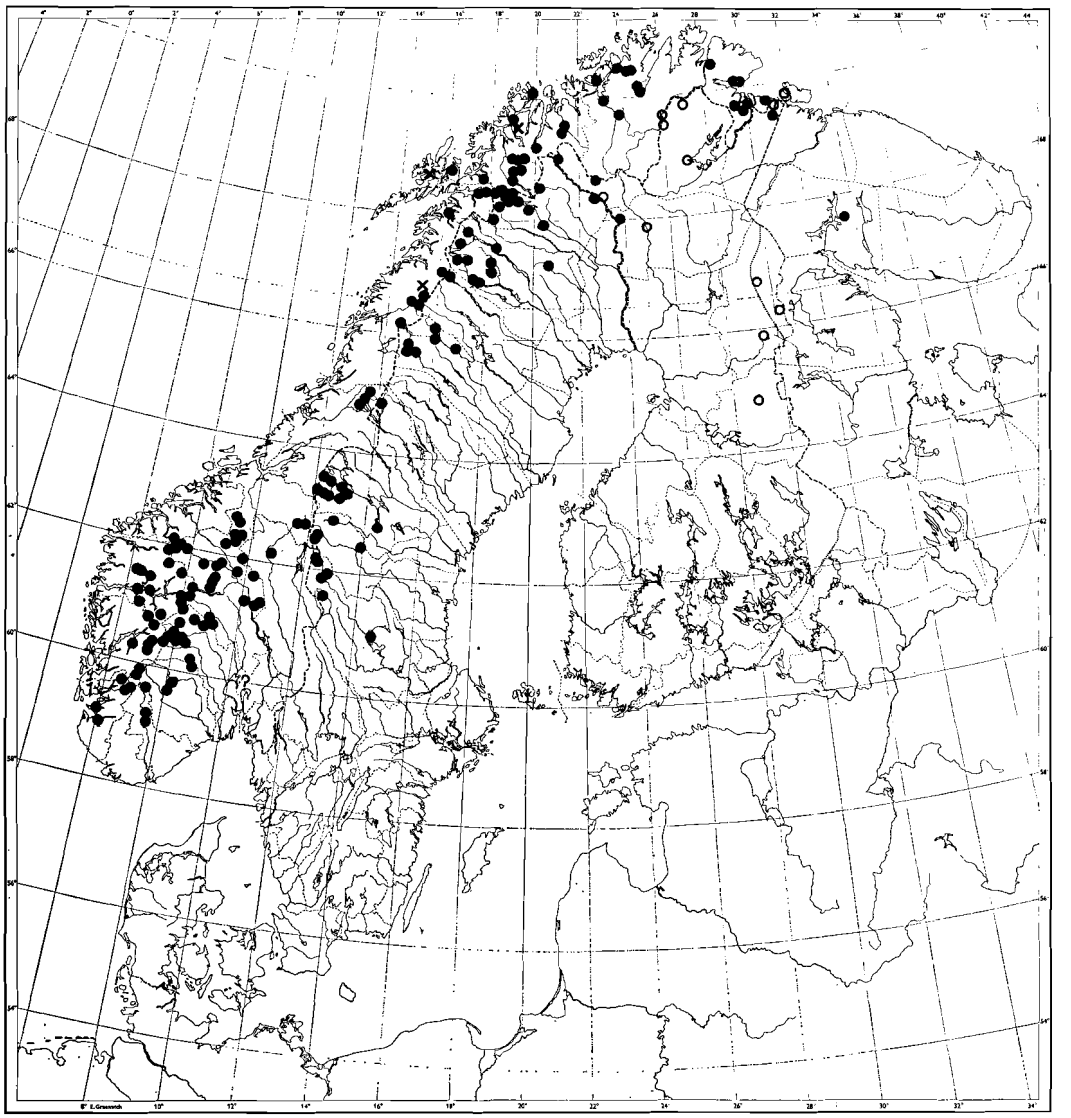


Fig. 70. *B. balteatus* Dahlbom. Legend as in Fig. 50.

Tinn: Borsjöen 1100 m. *Aust-Agder (AAi):* Valle: Kvestad, Rygnestad; Bykle: Breive 700 m. *Rogaland (Ry):* Hjelmeland: Fister sea level ♀ 27 Aug. 1933 (Mei). *Ri:* Forsand: Meling sea level ☿ 16 July 1931 (Mei); Suldal: Bråtveit, Jonstöl 700 m, Kyrkjesteindalen 900 m, Mostöl 600 m, Mosskar 700 m, Steinkilen, Ullsneskvelven 750 m, Åimjödlonuten 700 m; Sauda: Övre Sandvann 1100 m. *Hordaland (HOi):* Odda: Mittleger 1150 m, Valldal 900 m; Ullensvang: Berdöla 725 m, Bjoreidalshytta 1100 m, Fossli 750 m, Grythorgi 900 m, Grytskardseter 850 m, Hedlo 1000 m, Hjölmo, Lofthus sea level ♀ 23 June 1949 (Lø), Rjoto 1000 m, Storliseter 900 m, Sysendalen 750 m TRM ZMB, Viveli 875 m; Ulvik: Finse 1200 m VCA ZMB. *Sogn og Fjordane (SFy):* Gaular: Slotten; Jölster: Hamar. *SFi:* Vik: Hestavollen 1000 m, Kråktjern 850 m; Aurland: Uppsete 850 m, Övstebö 800 m; Lærdal: Breistöl 650 m, Eggestöl 700 m, Maristova 800 m; Leikanger: Hermansverk sea level ♀ 30 May 1948 (Lø); Balestrand: Dueskard W Balholm 600 m, Horpedalen; Luster: Fåbergstölen 600 m, Turtagrö 900 m TRM ZMB; Stryn: Videdalen 400 m, Videseter 600 m. *Möre og Romsdal (MRi):* Stranda: Kvanndalsetra 700 m. *Sör-Tröndelag (STi):* Oppdal: Dalsbekk 600 m, Gravbekken KMT, Gåvåli 975 m, Jerosbekken 920 m BML ZMB, Knutshö 1200–1400 m BML ZMB, Kongsvoll 900 m TRM VCA ZMB ZML ZMO ZMU; Röros: Evavoll 700 m, Myrmoen 700 m. *Nord-Tröndelag (NTi):* Namskogan: Äktejävre; Röyrvik: Björkhaug, Namsvann KMT. *Nordland (Nsi):* Rana: Bjellånes ZMO, Krokstrand, Randalsvollen, Umskarstjern SE Mo; Saltdal: ? loc. ZMO, Lönsdal; Fauske: Duoldakapjavre NE Sulitjelma 810 m BML, Sulitjelma 600 m BML. *Nnö:* Tysfjord: Tysfjord sea level ZMO; Ankenes: Seterfjell; Narvik. *Nnv:* Sortland: ? loc. TRM. *Troms (TRy):* Kvæfjord: Borkenes; Tromsö: TCL TRM VCA ZMO, Tromsöysund TRM VCA ZMO; Karlsöy: Vannö TRM. *TRi:* Gratangen: Gratangen ZMA; Bardu: Altevann, Strömsmo VCA ZMO; Målselv: Bjerkeng, Kirkesdal, Kletten ZMO, Mauken TRM ZMO, Nordmo TRM; Balsfjord: ? loc. TRM; Storfjord: Signaldalen; Nordreisa: Gapprusfjell 700 m, Sappen. *Finnmark (Fv):* Talvik: Kvalfjord ZMO; Kvalsund: Kvalsund TRM, Skaidi, unna Hatteras. *Fi:* Alta: Bossekop TRM ZML ZMO, Jotkajavrre TRM, Kvalfjord ZMO. *Fn:* Porsanger: Hamnbukt, Lakselv TRM ZMB, Stabbursnes ZMO; Tana: ENE Leirpollen; Vadsö: Makkanes W Vadsö, Vadsö BML NMW. *Fö:* Sör-Varanger: ? loc. TRM ZMO, Grense-Jacobselv TRM, Kirkenes NRS TRM VCA ZMB, Neiden TRM, Ropelv TRM.

Records from Oslo are questioned. The male, labelled 'Chria 1844' (= Oslo), is a specimen Dahlblom apparently obtained while attending a meeting of naturalists held in Oslo that year. The workers are both labelled (1) Kristiania; (2) Siebke. The modern spelling of the city name proves a labelling of the specimens after Siebke died in 1875 and the record is therefore not reliable.

Corrections. Records from the southern coast, viz. Aust-Agder (AAy): Tvedestrand: Skipvik, Stensöy (Strand 1898a) were revised to *B. lucorum* which agrees with previous revision (Sparre Schneider 1909, p. 146). The tendency to melanism in Arctic Norway discussed by Sparre Schneider (1909) is based on misidentification of three dark males from Troms (TRy): Tromsö: Flöyfjell TRM. Two of the specimens were revised to *B. arcticus diabolicus* and the third one is not traced but might also belong to this taxon. Another announcement of melanic arctic individuals (Richards 1931) is due to misinterpretation of localities being situated in Southern Norway.

Non-melanic form of *B. balteatus* has been confused with *B. jonellus* and melanic ones with *B. mastrucatus* and melanic *B. hortorum*. Unrevised records are therefore not included herein.

Sweden. Occurring from 61°30′ N in Dalarne and northwards throughout Lapland with a disjunction corresponding to that separating the southern and northern part of the mountain chain. Confined to montane areas and locally also occurring in adjacent forest zone.

A total of 525 specimens was examined, viz. 235 ♀♀ 194 ☿☿ and 96 ♂♂.

List of localities. *Dalarne:* Idre, Harrsjön NRS, Mora ☿ 12 July 1947 (Erlandsson) NRS, Slagufjäll NRS, Städjen, Töfsingdal National Park NRS. *Härjedalen:* Hamrafjäll NRS ZML, Ljungdalen, Skorvdalsfjäll NRS, Tänndalen NRS ZML. *Jämtland:* Enafors, Handöl NRS ZML, Leipikv. NRS, Skalstugan NRS, Stalltjärnstugan DCL, Storlien, Svenstavik NRS, Undersåker, Vallistafjäll, Åre NRS ZML ZMU. *Lapland (Ly. Lpm.):* Aitelnafors NRS, Björkfors, Joeström, Sorsele mountains NRS ZML, Tjulträsk BML NRS ZML ZMU, Tärna NRS ZML, Vindeldalen NRS, Vännäs NRS, Västansjö. *P. Lpm.:* Peskehaure ZMU. *Lu. Lpm.:* Gällivare, Kvikkjokk NRS ZML, Malmberget ZML, Meatajaure NRS, Nuonjes VCA ZML, Sallojaure NRS, Sarek NRS, Situojavre, Sjöfallet, Tarradalen NRS, Virihaure (Kä ZMU – Rapa ZMU – Staloluokta ZML ZMU – unna Titir). *T. Lpm.:* Abisko BML IVU NRS ZMA ZML ZMU, Björkliden NRS ZMA ZML, Jebrenjokk, Kaisepakte NRS, Karesuando, Kiruna, Kopparåsen BML, Nakerijärvi NRS, Selkavaare BML, Sinnukasjärvi ZMU, Sjangeli 900 m BML, Sjanglitjåkko 1000 m BML, Tjuonatjokko

NRS, Torneträsk BML VCA ZML, Vassijaure NRS ZMA.

Finland. Locally abundant in Lapland and moreover dispersely recorded in the eastern part of the country south to about 64° 50′ N.Localities (Fig. 70) were taken from Elfving (1968) except Lk: Pallastunturi NRS TCL and Le: St. Oiwe TCL.

World distribution. Fennoscandia – Kola pen. (Petsamo ZMA ZMH ZML, Umptek – Hibinä ZMA) – Northern Siberia – Kamchatka – Northwestern Mongolia – Alaska – Arctic Canada – USA (along the Rocky Mountains states) (Pittioni 1942; Krombein & Burks 1967).

Zoogeographical remarks

The unstable colour pattern in the Scandinavian *B. balteatus*, characterized by a tendency to melanism being reduced on going north and by the coat of hindmost tergites ranging from ferruginous via dull yellow to white, gives reason to discuss post-glacial invasions of two or more populations. Pittioni (1943, pp. 69–72) suggests immigration of an eastern white-tailed population and a southern ferruginous-tailed population, the latter descending from white-tailed North-asiatic populations being forced south during the glaciation and then following the Würm ice on the retreat northwards. Pittioni (1943, pp. 4–6) moreover states that the white-tailed 'morphe *nivalis*' and the ferruginous-tailed 'morphe *balteatus*' individually accumulate a maximum of melanic alleles in the mountainous Southern Norway and emphasizes a strong correlation between 'klima-ökologische Fundortindices' and 'indices der Melanisationsintensität', illustrated by diagrams. Pittioni was, however, not aware of the pronounced variability in the local populations which often comprise all shades of ferruginous to white-tailed melanics, and typical forms as well. Consequently, white- and ferruginous-tailed individuals cannot be treated separately, and his correlations are therefore of no use. As the present study shows no geographical segregation concerning the colouring of hindmost tergites, I hesitate to follow the theory of white-tailed and ferruginous-tailed populations individually invading Scandinavia.

The correlation stated by Pittioni above does, however, agree with the general assumption that accumulation of melanic alleles in mountainous areas is related to local temperate and humid conditions (Lattin 1967, p. 433). In my opinion, attention should be drawn to the fact that the frequency of melanism is strongly reduced on going north, melanic individuals being unrecorded in northernmost Norway (Fig. 69). In addition to climatic conditions this may possibly be due to genetically different populations. If so, *B. balteatus* may consist of a population with gene-pole light, i.e. with no melanic traits, in post-glacial time invading Northern Scandinavia from east, and another population with gene-pole dark, i.e. with melanic traits, reaching Scandinavia along a more southerly immigration route. I think, however, a theory of double immigration based on the present information is rather speculative.

It should be pointed out that in the Eastern Hemisphere the tendency of *B. balteatus* to melanism is confined to the extreme western and the extreme eastern fringes of the area of distribution, viz. Fennoscandia and Kamchatka, representing mountainous areas influenced by oceanic climate (Skorikov 1937; Pittioni 1943). There are no reliable records of melanic individuals in the intervening areas (Panfilov in litt. 1968).

Biology

Nest. The following three nests have been located in Scandinavia.

A colony, located underneath a large rock (Norway: Hordaland (HOi): Ullensvang: Sysendalen 750 m), was not excavated (Lie-Pettersen 1901).

Another nest (Norway: Rogaland (Ri): Sauda: Övre Sandvann 1050 m 7 July 1936) was excavated by the late O. Meidell. Two queens and nine workers were kept ZMB. The absence of records of colonies in the Eastern Hemisphere (Pittioni 1942, p. 185) may justify the following extract from notes left by Meidell.

The nesting site was a tuft of grass on a

heathery hillside exposed to the southeast. The colony was established in an abandoned rodent nest about 15 cm below the surface of the ground. A roof, consisting of fibrous fragments of plants plastered together with wax, covered the comb, which had a disorderly appearance. The data of the nest content are shown in Table IX. One of the queens and all the workers display a predominantly melanic appearance, the queen with hindmost tergites whitish-haired while those of the workers being pale ferruginous-haired. The second queen displays a typical, though strongly faded colour pattern. She was found dead in the nest, away from the comb, and might have been an intruder. The dark queen and the workers of the first brood were captured on returning to the nest. The former had no pollen and the latter had their corbicles only partly filled with pollen. The remaining five workers, two of which had just emerged, were found on the comb.

The honey-pots, being larger in size than the cocoons but of similar shape, were all built at the same level and adjacent to the first brood. Additionally five of the vacated cocoons were used as honey-pots. A rather large pollen-cylinder, also termed pollen-pot, was built adjacent to the third brood, though detached from the cluster of cells. It contained only a little pollen. The dipterous cocoons listed in Table IX were in separate cocoons of the second bumble bee brood.

A Swedish nest recorded by Boheman (Wahlberg 1854, p. 202) contained melanic and non-melanic individuals, but is otherwise not commented upon.

In addition to the nests above, Hasselrot (1960 Table pp. 158–162) succeeded in getting a queen to establish a colony in an observation box. The colony was initiated 19 June and kept under observation until 1 October when the development was almost completed. The total number of offspring was 8 ☿☿ 3 ♂♂ 3 ♀♀ and one unhatched worker pupa. Only one worker brood was raised. The author does not comment upon the long period of development.

Flight season. From last half of May to end of August. Queen: 16 May–27 Aug.; worker: 15 June–28 Aug.; male: 4 July–23 Aug.

Biological remarks

Hobbs (1964) succeeded in getting hibernating queens to establish nests in hives set out in the

Table IX. Content of a colony of *B. balteatus* Dahlbom, excavated in Norway: Rogaland (Ri): Sauda: Övre Sandvatn, 1050 m s.m., 7 July 1936 by O. Meidell

Queen, founder of the nest			
Queen, intruder			
Offspring:			
1st brood: workers	4	worker cocoons	5
2nd brood, 1st batch: workers	3	4 worker cocoons, 2 worker pupae	6
2nd brood, 2nd batch: workers	2	3 worker cocoons, 3 worker pupae	6
imagines	9	3rd brood, 1st batch: 2 halfgrown separated worker larvae on top of cocoon 1st brood	2
		3rd brood, 2nd batch: 1 halfgrown worker larvae on top of cocoon 2nd brood, 1st batch	1
		4th brood, 1st batch: 2 small larvae on top of cocoon 2nd brood, 1st batch	2
		4th brood, 2nd batch: 2 small larvae on top of cocoon 2nd brood, 1st batch	2
		5th brood, 1st batch: 7 eggs in cell on top of cocoon 2nd brood, 2nd batch	7
Total number of progeny			31

5 honey-pots
1 pollen-cylinder
Parasites: 2 dipter cocoons *?Brachycoma devia* (Fallén)

mountains of Southern Alberta, Canada. He concluded that the species during the life cycle alters from being a pocket-maker when rearing worker larvae up to the last instar, to a pollen-storer when rearing last-instar larvae and all instars of male and female larvae. The observation of Meidell above may favour the statement of Hobbs. The presence of only one pollen-cylinder, see Table IX, may indicate that the colony altered to pollen-storer behaviour shortly before the nest was excavated.

A total number of 411 workers were examined of which 55 individuals were recorded in Norway: Troms and Finnmark. The frequency of workers throughout the country and at least three worker broods raised in the colony investigated by Meidell indicate that *B. balteatus* regularly produces workers. Hobbs (1964) stated that workers were produced in all colonies analyzed by him. The information therefore contradicts the theory that the species is temporarily adapted to solitary living, cf. p. 96.

BOMBUS (ALPINOBOMBUS) HYPERBOREUS SCHÖNHERR

Bombus hyperboreus Schönherr, 1809, p. 57, holotype ♀ NRS! is labelled as follows: (1) 40 (printed); (2) Lapponia D: Grape (handwritten); (3) lectotype ♀ *Bombus hyperboreus* Schön. I. E. Milliron 1960; (4) holotype ♀ *B. hyperboreus* Schönherr A. Løken 1965. The description is based on a single individual and therefore erronously designated lectotype by Milliron (1960). Type area Finland: Lapland (Le): Enontekis. ('Lapponia enontekis').

(*Apis arctica* Quensel in Acerbi, 1802; *Bombus hyperboreus* Schönherr; Dahlbom 1832, p. 42, 1837; Zetterstedt 1838; Wahlberg 1854, 1855; Siebke 1863, 1880; Thomson 1870, 1872; Schøyen 1881; Sparre Schneider 1895a, 1895b, 1909, 1918, p. 5; Strand 1898b; Friese 1902; Aurivillius 1903; Bengtsson 1904, 1931; Friese & Wagner 1912; Gaunitz 1929; Esmark 1930; Richards 1931; Hellén 1933; Meidell 1934a; Brinck & Wingstrand 1949; Brinck 1951; Kruseman 1959; Elfving 1960, 1968; Ander 1965. A bibliographic reference to the species is compiled by Richards 1931.)

Nomenclatural and taxonomical remarks

Schönherr (1809) describes the taxon as follows: 'Hirsutus ater, thorace antice posticeque abdomineque antice fulvo. *Apis Arctica*, Acerbi Travels through Sweden;' In addition to a coloured illustration Acerbi (1802, p. 253, plate 1) presents his *Apis Arctica* by the following description of Quensel: 'nigra – thorace antice posticeque fulvo, abdomines supra fascilis flavi fulvisque.' In the drawing at least T_{1-4} are fulvo, but the colour in the pile of T_{5-6} is uncertain as the abdominal tip is covered by left forewing. *B. hyperboreus* is however characterized by T_{3-6} being black-haired. Even though the drawing is deceptive and the description of *Apis arctica* Quensel in Acerbi = *Apis arctica* Acerbi nec Kirby 1821 nec Dahlbom, 1832 is not quite corresponding to that of *B. hyperboreus*, I think they are identical taxa. A remark (Dahlbom 1837) that *B. hyperboreus* was discovered by Acerbi attests the synonymy. Only rarely has *B. arcticus* been applied to this taxon (Richards 1931) and to my knowledge not at all in the last 50 years, while the junior synonym *B. hyperboreus* is regularly used since the designation in 1809. To avoid nomenclatural confusion *B. hyperboreus* is kept and *B. arcticus* (Quensel in Acerbi), also being a homonym cf. above, is considered as *nomen oblitum.*

First Scandinavian records

Norway. Troms (TRi): Kvænangen: 'Jockelfjeld' (?Jökelfjord cf. p. 96) (Dahlbom 1832).
Sweden. Lapland (Acerbi 1802, p. 252).

Queen, worker

Morphological characters. Head markedly longer than wide. Malar space nearly 1½ times longer than distal width, shorter than A_{2+3+4} but

longer than A_{3+4}. Clypeus with rather even, dense distribution of coarse and fine punctures except a small, almost impunctate area between wide, well-defined impressions. Ocelli usually dorsally touching supra-orbital line. A_3 at least 1½ times longer than distal width, and about ⅔ the length of A_{4+5}. A_4 about as long as distal width, slightly shorter than A_5. Outer surface of hind tibia alutaceous; distal inner dorsal process of hind tibia moderately produced (Fig. 9A). Length of hind basitarsus about 2½ times the greatest width of the segment (Fig. 9B). T_{4+5} smooth or inconspicuously alutaceous, with rather sparse puncturing. Body robust, coat long and somewhat shaggy.

Queen measurements: N = 20; Southern Norway; malar space: 1.14 mm (±0.03±0.01) range: 1.05–1.20 mm; 'radial length': 5.53 mm (±0.16±0.04) range: 5.20–5.85 mm; interalar width: 6.20 mm (±0.17±0.04) range: 5.75–6.53 mm. Body of larger size than any other Scandinavian *Bombus* species.

Colour pattern. Collar, scutellum, T_{1-2} deep orange to ochrous-yellow. Otherwise coat black. Parallel-sided interalar band not wider than the broad collar.

Variation. Extremely colour-stable. Only minute variations in the extension of collar, the width of interalar band, etc.

Male

Morphological characters. Head markedly longer than wide. Malar space exceeding 1½ times the distal width, about as long as A_{4+5}. A_3 hardly longer than A_4; A_4 as long as distal width or just longer; A_{5-13} individually straight, nearly twice as long as distal width. Outer surface of hind tibia scarcely alutaceous. Hind basitarsus about 3½ times longer than distal width. St_8 and genitalia (Figs. 27A–B); inside of volsella, seen from beneath, strongly projecting inwards; subapical tooth of penis valve absent or much reduced. Body of large size.

Colour pattern. Pile of vertex predominantly orange to ochrous-yellow; otherwise colouring as in the female.

Variation. As in the female.

Distribution (Fig. 71)

Norway. Scattered occurrence in Southern Norway restricted to part of the mountainous massive ranging from Jotunheimen to the northern fringe of Dovrefjell and in Northern Norway to 'islets' north of Polar Circle. Scarce. In Southern Norway once recorded 400 m s.m., otherwise occurring 900–1300 m. s.m.

Apparently confined to limestone biotopes.

A total of 72 specimens, i.e. 44 ♀♀ 1 ☿ 27 ♂♂ was examined.

List of localities. *Oppland (On):* Vågå: Gjendesheim 1000 m ♂ 15 Aug. 1959 (I. Meidell), Jondalen 900 m 2 ♂♂ 12 July 1953 (Hackman, Lø), Vågåmo 400 m ♂ 12 July 1953 (Kontuniemi) ZMH, Övre Sjodalsvann 950 m ♀ 9 Aug. 1957 (Lø); Dovre: Dovrefjell 1000 m ♂ 18 July 1832 (ex coll Smith) BML ♀ 1902 (Lysholm) KMT 2 ♀♀ 4 ♂♂ July 1832 (Boheman) NRS ♀ 1902 (Lysholm) TRM ♂ (Esmark) VCA ♀ 21 June 1926 (ex coll Mei) ZMB 3 ♂♂ (Mus Drews) ZMC 4 ♀♀ 2 ♂♂ July 1832 (Rosenskiöld) DCL TCL 4 ♀♀ 5 ♂♂ ☿ July 1832 (Esmark) ZMO 2 ♀♀ (Moe) ZMO ♀ 2 ♂♂ (Siebke) ZMO ♀ 1877 (Schøyen) ZMO 2 ♀♀ July 1832 (Boheman & Rosenskiöld) ZMU, Fokstua 930 m ♂ 6 July 1933 (Nordström) ZML, Vålåsjö 950 m ♂ 14 July 1953 (Bakke) ZMO. *Sör-Tröndelag (STi):* Oppdal: Drivdalen ♀ 29 Aug. 1948 (Knaben), Kaldvelldalen 1200 m ♀ 26 July 1968 (Alendal), Knutshö 1200–1300 m 2 ♀♀ 1954 (Holaker) ♀ 20 June 1967 (Lø) ZMB ♀ 16 July 1909 (Wretlind) ZMU, Kongsvoll 900 m ♀ 1 July 1910 (Sch) TRM ♀ 8 July 1934 (Nordhagen) ♀ 17 June 1967 (Lø) ♂ 7 July 1933 (Nordström) ZML ♀ 20 July 1906 (Wretlind) ZMU. *Nordland (Nsi):* Saltdal: ?loc. 2 ♀♀ (Schøyen) ZMO ♀ (Sch) VCA. *Troms (TRi):* Bardu: Altevann 500 m 4 ♀♀ 18–21 July 1893 (Sch) TRM; Nordreisa: Gapprusfjell 700 m 3 ♀♀ 22 July 1955 (Lø), Javroaivve 900 m ♂ 12 Aug. 1968 (Ryvarden), Kvænangen: Jökelfjord ♀ ?sea level (Zetterstedt) ZML. *Finnmark (Fn):* Kistrand: Festningsstua 500 m 3 ♀♀ July 1924 (A. Strand) TRM.

Unrevised records: *Troms (TRy):* Tromsö: Flöyfjell ♀ and *Finnmark (Fö):* Sör-Varanger: Jacobselv ☿ (Sparre Schneider 1909, p. 89). *Oppland (On):* Jotunheimen and Rondane, sex and number of specimens not mentioned (Meidell 1934a).

Sweden. Except for an isolated occurrence in Jämtland the species has only been recorded in restricted areas in the mountainous Lapland (Ly. Lpm – T. Lpm.).

A total of 57 specimens, viz. 43 ♀♀ 3 ☿☿ 11 ♂♂ was examined.

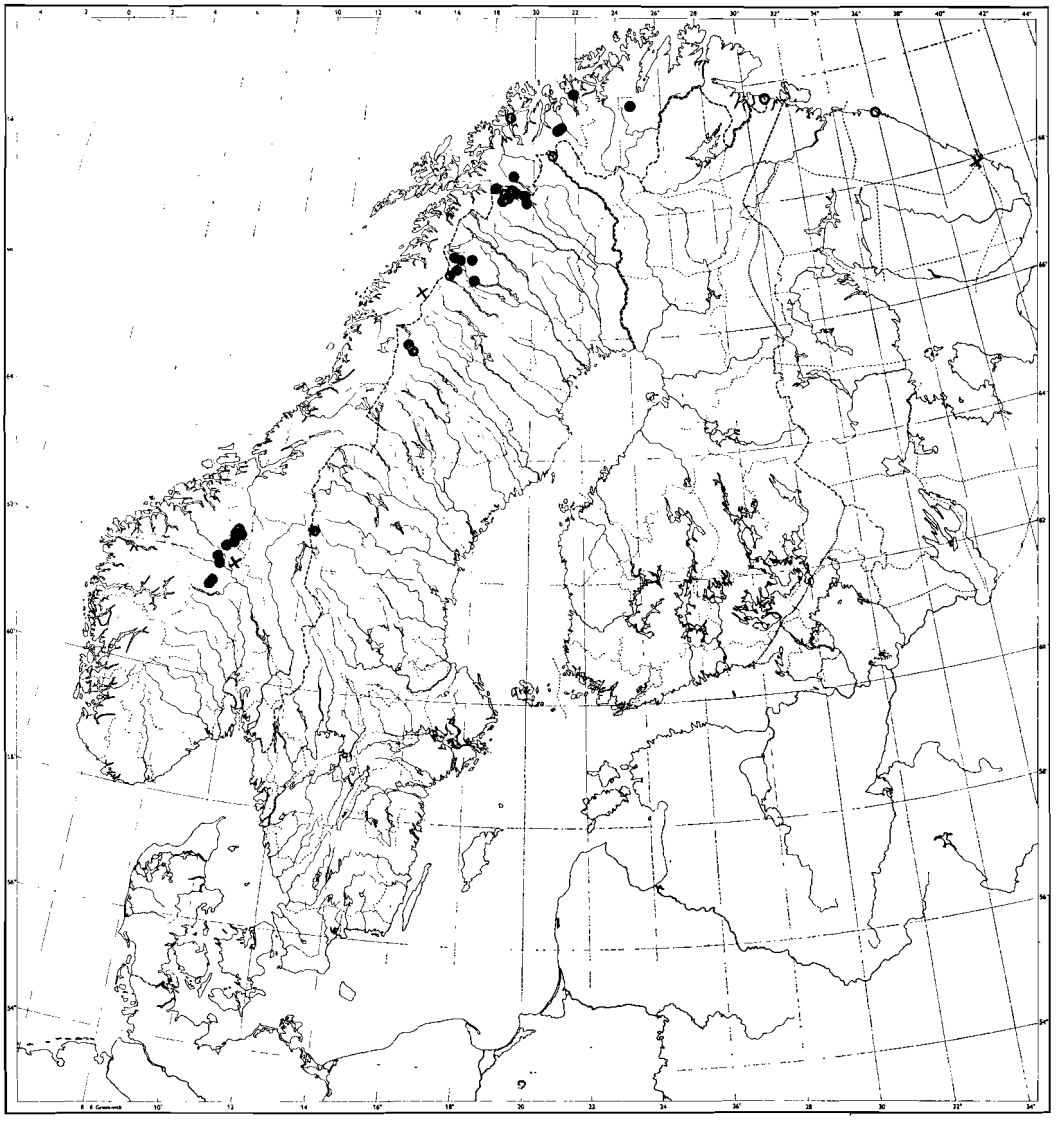


Fig. 71. *B. hyperboreus* Schönherr. Legend as in Fig. 50.

List of localities. *Härjedalen:* Hamrafjäll 3 ♂♂ July 1930 (Winblad). *Lappland:* ?loc. ☿ (Smith) BML, ♀ holotype (Grape) NRS. *Ly. Lpm.:* Laxfjäll ♀ 1927 (Nordström), Västansjö ♀ 23 July 1903 (Bengtsson). *P. Lpm.:* Peskehaure ♀ 16–22 June 1963 (Hägner) ZMU. *Lu. Lpm.:* Njunjes 3 ♀♀ 2–9 July 1914 (?) VCA, Virihaure area (Eltivare 800 m ♀ 18 July 1944 (B & W) – Ketjaure 670 m 2 ♀♀ 5 July 1944 (B & W) – Pieti 600 m 3 ♀♀ 7 July 1944 (B & W) – Staloluokta 650 m 2 ♀♀ 7–8 Aug. 1944 (B & W) ♀ 1928 (Gaunitz) 4 ♀♀ 7–28 July 1964 (Bergwall) ZMU – Vehejokk 800 m ♀ 28 July 1944 (B & W)), Sarek ☿ (?) NRS, unna Tokivaare ♂ 13 Aug. 1939 (Selander) NRS. *T. Lpm.:* Abisko 700–1000 m ♀ 3–11 Aug. 1961 (Dowling & Taylor) BML 2 ♀♀ 3 July 1927 23 June 1928 (Brundin) NRS ♀ 14 July 1931 (Erl.) NRS 2 ♀♀ 4 July 1917 ♀ July-Aug. 1930 (Bengtsson) ♀ 4 July 1917 2 ♀♀ 20 July 1918 (Ringdahl) ♀ July 1957 (Kuchlein) ZMA ♂ 30 July 1931 (Erl.) ZMA, Björkliden ♀ 9 July 1955 (Piet) ZMA, Jebrenjokk ♀ 22 July 1926 (Ringdahl), Nuolja ♀ (Brundin) ZML, Pessivaare ♂ 17 Aug. 1931 (Erl.) NRS, Ortojokk ♀ 26 June 1948 (Erl.) NRS, Riksgränsen – Jarpa Karpel ♀ 21 July 1957 (Gardiner) BML, Ripasjaure ♀ 21 July 1942 (Erl.) NRS, Torneträsk ♀♂ July

1923 (Winblad) ♀ (Malaise), Torneträsk – Vassijaure 2 ♀♀ 8, 12 Aug. 4 ♂♂ 13–20 Aug. ☿ 14 Aug. 1908 (Roman) NRS, Vassijaure ♀ 6 Aug. 1927 (Erl.) NRS.

Unrevised records: *Lapland (Lu. Lpm.):* Virihaure area: Hildomvare ♀, Kappaluobal ♀, Vuolle Poulejaure ♀ (Brinck 1951).

Finland. Recorded in Lapland (Le): Kilpisjärvi area only. A total of about 60 ♀♀ and ♂♂ so far observed (Elfving 1968).

World distribution. Circumpolar. Fennoscandia – Kola pen. – Arctic Russia – Novaya Zemlya – Arctic Siberia – Alaska – Arctic Canada – Greenland (Richards 1931; Skorikov 1937).

Correction. *B. hyperboreus* workers from Greenland (Aurivillius 1890) referred to by Sparre Schneider 1909, p. 90) concern four specimens from Nordenskiölds Exp. The only individual so far traced NRS has been revised to *B. a. arcticus* and the description of Aurivillius indicates that the remaining individuals also belong to this species.

Biology

Nest. There are no reliable records of the *B. hyperboreus* colony.

Flight season. Middle of June to the end of August. Queen: 17 June–29 Aug.; worker: ?; male: 7 July–15 Aug.

Biological remarks

The suggestion that nests are established deep in the ground (Friese & Wagner 1912, p. 162ff; Pittioni 1942, p. 185) is apparently based upon observations from Novaya Zemlya (Friese 1904, p. 413 referring to Jacobsen in litt.). As, however, only entrances were observed, there is no way of controlling whether these were virtually associated with colonies of *B. hyperboreus*. A total of 30 bumble bees from the expedition of Jacobson (1899) were revised by Friese (1908) and comprised no workers of this species. In a survey of the bumble-bee fauna of Novaya Zemlya (Friese 1923), the worker caste of *B. hyperboreus* is not mentioned.

A nest located on Greenland (Vegasund 17 Aug. 1930 (Knaben) ZMO), identified as *B. hyperboreus* by Friese (1935), is revised by me to a colony of *B. a. arcticus* usurped by *B. hyperboreus*. According to Knaben (in litt. 1968) the colony contained eight imagines, all of which were captured. Five individuals were traced, viz. *B. hyperboreus* ♀ and *B. a. arcticus* 4 ☿☿ ZMO. Two colonies of *B. a. arcticus* located in Northern Canada (Northern Ellesmere Island 10–13 Aug. 1961) were likewise usurped by *B. hyperboreus* (Milliron & Oliver 1966) and additionally a colony of *B. jonellus* (Sweden: Lapland (Lu. Lpm.): Staloluokta in Virihaure 23 July 1964) was invaded by this species (Bergwall 1970).

The phenomenon of usurpation presented above supports the suggestion of Milliron & Oliver (1966) that '. . . the short season is not the only reason for the absence, or paucity, of workers in *hyperboreus*'. That is, a total of four records of usurpation so far gives reason to question whether the theory of adaptation to solitary living in species of the subgenus *Alpinobombus* (cf. p. 96) applies to *B. hyperboreus* either. The workerless condition may instead be due to interspecific usurpation. Usurpation, being interspecific or intraspecific, does, however, occasionally occur in *Bombus* spp., generally producing a worker-caste (Free & Butler 1959; Hobbs 1967, p. 1288). It is therefore uncertain whether the records above are due to casual events or to *B. hyperboreus* being a facultative but not obligatory inquiline, the latter being the rule in the genus *Psithyrus*. The fact that a total of four Scandinavian workers were examined, that one worker was mentioned by Sparre Schneider (1909), and that supposed specimens of this caste have also been recorded outside Fennoscandia (Kola pen. Svjätio, the number not given (Enwald 1881, p. 255), Gavrilovo ☿ ZMH (Elfving 1960); ?Novaya Zemlya cf. above; with no data 2 ☿☿ (Skorikov 1922b, p. 79); Russian Lapland number not given (Friese 1923)) proves that workers are at least occasionally produced.

Within its entire area of distribution *B. hyperboreus* occurs in irregularly spaced 'islets', generally presenting a dispersed growth of food plants. Flying activity is consequently scattered except perhaps where the early blooming *Salix*

may gather locally the queens emerging from hibernation. It is just good fortune if a worker is observed in the field and even more so a nest.

SUBGENUS *MEGABOMBUS* DALLA TORRE

Megabombus Dalla Torre, 1880, p. 40, type-species *Bombus ligusticus* Spinola, 1805 = *Apis argillacea* Scopoli, 1763. Monobasic.

(*Hortobombus* Vogt, 1911, p. 56, type-species *Bombus hortorum* (Linnaeus) by designation of Sandhouse (1943).)

Queen, worker

Head, tongue, malar space extremely elongated, the latter 1½ to twice the distal width, and at least as long as A_{2+3+4}. Clypeus elongated, at the base with a median longitudinal punctured depression more or less pronounced. Labral furrow rather narrow and shallow, in width markedly less than ⅓ the labral width. Mandible with basal keel, well-defined sulcus obliquus and inconspicuous to moderate incisura lateralis. Eyes directed towards or beyond posterior mandibular condyle (Fig. 18A). A_3 as long as A_{4+5} or nearly. Distal margin of mid-basitarsus produced into a posterior spine (Fig. 17B), that of hind basitarsus sharply pointed. Hind tibia with distinct inner distal dorsal process. T_6 more or less coarsely granulate. St_6 with distinct keel. Wings evenly infuscate.

Male

Head, tongue, malar space extremely elongated, the latter almost twice the distal width or longer, at least as long as A_{2+3+4}. Disc of clypeus with median anterior area impunctate, otherwise uneven, densely punctured. Mandible bidentate with broad ventral and a small dorsal tooth. Eyes directed beyond posterior mandibular condyle. Antennae long (Fig. 39A), A_3 at least as long as A_5, A_4 about $^1/_2$ as long as A_5 or nearly, A_{5-13} individually slightly curved and about twice as long as distal width. Outer surface of hind tibia flattened except for the weakly concave distal part, smooth or distinctly alutaceous, almost hairless except for long anterior and posterior fringes. St_8 and genitalia (Figs. 38B–C, 39C–F, 40A–D); penis valve rodlike with about distal half serrate on outer edge. Wings evenly, rather feebly infuscate.

Scandinavian species

The subgenus is represented by three Scandinavian species, viz. *B. consobrinus* Dahlbom, *B. hortorum* (Linnaeus), and *B. ruderatus* (Fabricius).

Taxonomical remarks

The interspecific relationship in the unit is revealed in the triangular graph (Fig. 72), where the taxa occupy separate areas and thus confirm well-defined species. The graph also includes twelve queens of *B. gerstaeckeri* Morawitz from the Alps to illustrate that this taxon occupies the same area on the graph as that of the Scandinavian *B. consobrinus* – this would favour their conspecific status. Differences in some morphological characters (Tkalcu 1969) claim, however, a specific discrimination. *B. gerstaeckeri* has in general been given specific rank (Krüger 1920; Schmiedeknecht 1930; Pittioni 1938; Tkalcu 1969; etc.), but is also treated as a subspecies, *B. consobrinus gerstaeckeri* (Kruseman 1959; Reinig 1965, p. 130). In addition to the conformity in body proportions (Fig. 72), zoogeographic evaluations, cf. below, indicate a subspecific recognition of the two taxa. No characters unequivocally designate categorical rank, but in general it is preferable to treat allopatric populations of doubtful rank as subspecies to emphasize the very close relationship. However, some structural details in labral furrow, ocellar-orbital field, A_4 in the female, and in male genitalia distinguishing the actual taxa (Tkalcu 1969) would nevertheless justify specific ranking of *B. gerstaeckeri.*

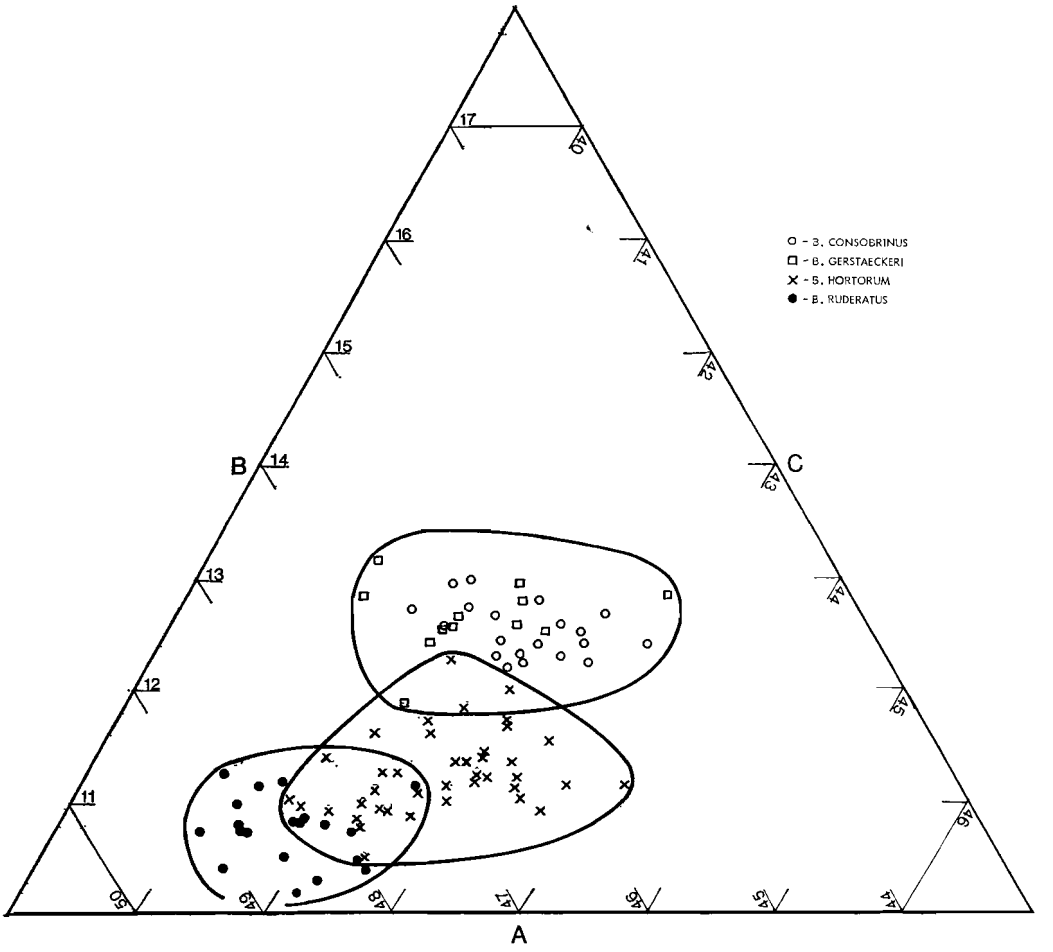


Fig. 72. Triangular graphing of malar space (A), 'radial length' (B) and interalar width (C) of four species of the subgenus *Megabombus* Dalla Torre.

BOMBUS (MEGABOMBUS) CONSOBRINUS DAHLBOM

Bombus consobrinus Dahlbom, 1832, p. 49 No. 30, neotype ♀ ZML! selected by Løken (1966b), type area Sweden: Lapland (Lu. Lpm.): Virihaure.

(*Bombus consobrinus* Dahlbom; Dahlbom 1837; Wahlberg 1854, 1855; Boheman 1857, p. 22; Siebke 1863, 1870, 1880; Thomson 1870, 1872; Aurivillius 1887, 1903; Sparre Schneider 1895b, 1898, 1909, 1918; Strand 1898a, 1898b; Lie-Pettersen 1907; Friese 1902; Bengtsson 1904, 1908; Vogt 1909, 1911; Skorikov 1914b; Ringdahl 1915; Lundblad 1924; Gaunitz 1929, 1938; Meidell 1934a; Brinck & Wingstrand 1949; Løken 1949, 1950, 1960, 1961b; Kruseman 1959; Elfving 1960, 1968; Ander 1965. *Bombus hortorum* var. *l.* Morawitz, 1881, p. 240. *Bombus hortorum* var. *consobrinus* Dahlbom; Lie-Pettersen 1901; Friese & Wagner 1912. *Bombus consobrinus sahlbergi* Skorikov, 1914b; Brinck 1951.)

First Scandinavian records

Norway. Oppland (On): Dovre: Fokstua and Sör-Tröndelag (STi): Oppdal: Drivdalen (Siebke 1863).

Sweden. Lapland (Dahlbom 1832 cf. Løken 1966b).

Taxonomical remarks

The Scandinavian population represents the nominate subspecies and therefore the designation of *B. c. sahlbergi* to this population (Skorikov 1914b) must be due to nomenclatural misunderstanding (Løken 1966b). Two Scandinavian variants, named by Skorikov (1914b) *nigromaculatus* and *norvegicus*, the latter also mentioned by Brinck (1951), are infrasubspecific forms.

Distribution

Fennoscandia Cf. the subspecies.

World distribution. Europe (Fennoscandia; European USSR south to districts of Leningrad, Novgorod, Moscow, Gorki) – Ural – Siberia (in the taiga south of 60° N) – Altai – Northern Mongolia – China (Manchuria, S. Kansu) – Vladivostock – Sakhalin – Kamchatka – Japan (Skorikov 1914b, 1922b, p. 155; Panfilov 1957; Sakagami & Ishikawa 1969).

To my knowledge, the distribution of *B. consobrinus* is everywhere within that of the genus Aconitum (Rapaics 1908), the main food source of this bumble bee.

Zoogeographical remarks

The origin of *B. consobrinus* may be Eastern Asia, from where the species migrated to Europe by two principal routes: (1) a northwestern way through Siberia to Scandinavia, and (2) a westerly route somewhere branched off from the northwestern one and successively reaching the Balkan mountains, Alps, and the Pyrenees.

The phenotypical study of Skorikov (1914b), the distribution of *Aconitum* spp. (Rapaics 1908), the examined European collections, and the sparse Asiatic material at my disposal favour this theory. Clinal variations during migrations in two directions have then created well-defined taxa at each of the extreme western ends of the routes, viz. *B. c. consobrinus* in Scandinavia, and *B. gerstaeckeri* (= *B. c. gerstaeckeri* cf. above) in the Alps and Pyrenees. The fact that *B. gerstaeckeri* or the *gerstaeckeri* group, which also occurs in Yugoslavia, the Balkan mountains (Pittioni 1938), in Abruzzi in Italy (Tkalcu 1960), and in the Carpathians (May 1959) is phenotypically closer to the examined Caucasian individuals BML' than to the Fennoscandian populations of *B. consobrinus*, also supports the suggestion of invasion to Europe by two principal routes.

The disjunct Fennoscandian distribution of *B. consobrinus* (Fig. 73) provides a difficult problem. I think it is due to post-glacial invasion, with subsequent changes in climatic conditions being responsible for the recent disjunction. The theory contradicts that of Fries (1949, p. 28ff) who suggests that *Aconitum septentrionale* Koelle (Fig. 73) is an interglacial relict surviving the last glacial period (Würm) on the western coast of Norway. If so, the Scandinavian *B. consobrinus* might also be an interglacial relict, since it is so closely related to this food plant (Løken 1961b). The general distributional pattern of the taxon disputes, however, this theory. A glacial survival is not indicated by Reinig (1965, p. 130ff) who states that the disjunct distribution of *B. consobrinus* in Northern Europe, and also the recent occurrence of *B. gerstaeckeri* confined to conifer forest in separated mountain ranges in Central- and Southern Europe, is due to post-glacial events.

BOMBUS CONSOBRINUS CONSOBRINUS DAHLBOM

Queen, worker

Morphological characters. Malar space twice the distal width or nearly (Fig. 18A) exceeding the length of A_{3+4+5}. Disc of clypeus almost impunctate except for anterior, lateral impressions which are narrow and well separated. Supra-orbital line usually above lateral ocelli (Fig. 18B) (in workers often touching those ocelli). A_4 about as long as distal width. Outer surface of hind tibia slightly or not alutaceous.

Microsculpture of T_{4-5} rather smooth with fine puncturing. Body slender, coat shaggy, long-haired.

Queen measurements. N = 20; SE Norway; malar space: 1.44 mm (±0.03±0.01) range: 1.40–1.50 mm; 'radial length': 4.82 mm (±0.09 ±0.02) range: 4.65–5.00 mm; interalar width: 5.27 mm (±0.06±0.01) range: 5.15–5.35 mm. Body of large size.

Workers vary greatly in size, the largest ones being difficult to distinguish from the queens.

Colour pattern. Pile of vertex with variable mixture of black and yellowish-brown. Dorsum of thorax, at most dorsal third of episternum, T_{1-2} (except laterally) with yellowish-brown hairs; remainder of thorax, hind femur, T_{4-5} with variable mixture of black and greyish-white hairs. Fringes of sternites predominantly greyish-white. Otherwise black.

Variation. Black hairs of head more or less replaced by yellowish-brown ones. Lateral black patches of T_2 more or less pronounced, occasionally the hairs of T_2 entirely black or entirely yellowish-brown. Hairs of episternum (except for yellowish-brown pile on the dorsal part), and T_{4-5}, are individually ranging from entirely greyish-white or pale greyish-yellow to entirely black. Corbicular fringes with an admixture of yellowish-brown hairs or tipped so.

Male

Morphological characters. Malar space usually exceeding twice the distal width and about as long as A_{3+4+5}. Longest hairs in pile of face about as long as antennal scape or longer. Hind tibia with bristles exceeding the distal decumbent hairs of margin; longest hairs in posterior fringes about twice the greatest width of the segment or nearly. Hind basitarsus slightly or not wider distally than at base. St_8 and genitalia (Figs. 40A–B); lateral depressive of gonocoxite moderate (Fig. 40C); gonostylus larger than in *B. hortorum*, its posterior margin, seen from behind, being almost straight; boot-like apex of volsella (Fig. 40D) varying in shape but usually more or less different from that of *B. hortorum* (Fig. 39F). Coat shaggy. Body in general of large size.

Colour pattern. Pile of vertex with variable mixture of black and yellow or yellowish-brown. Episternum and T_1 predominantly yellow, T_7 black-haired. Otherwise colouring as in the female.

Variation. Individuals with hairs of T_{3-7} entirely or predominantly black. Otherwise variations as in the female.

Distribution (Fig. 73)

Norway. Widely distributed inland between 59° and 68°30′ N. Only north of Trondheimsfjord, i.e. north of 63°30′ N, reaching the extreme coast. In Southern Norway confined to the eastern subalpine elevation along the mountain chain and adjacent forest zone, and occasionally reaching the lower alpine belt. Occurring in a few canyons west of the watershed divide, locally reaching sea level in the inner part of several fjords which are the western limit of the distribution. Moreover, extending throughout the southeastern lowlands where the population is, however, decreasing, probably because of intensive cultivation and industrialization in the last decades. *B. consobrinus* and the main food plant *Aconitum septentrionale* are locally eradicated and the southern limit of their distribution is consequently on the retreat. Locally frequent. In Southern Norway recorded to 1300 m s.m.

Biotopes: *Aconitum* biotopes and adjacent fields.

A total of about 770 specimens was examined.

List of localities. *Östfold:* Eidsberg: Holm; Trögstad: Mönster bro, Åsen. *Akershus:* Asker: Lushattdalen; Oslo: Slemdal TRM. *Hedmark (HEs):* Hamar: Helgöya ZMO. *HEn:* Trysil: Enga, Vestby; Amot: Glesubekken; Tynset: Haugsvangen gård, Tyldal; Tolga-Os: Hodalen 700 m; Engerdal: Risbakken 750 m. *Oppland (Os):* Gran: S Einavold, Gjervika, Lander; Östre Toten: Nærum, Stubdalen; Söndre Land: Fluberg; Nordre Land: Kinn; Etnedal: Fladöydegard; Sör-Aurdal: Breidablikk, Ellingseter 820 m, Reinli, Skard 700 m; Nord-Aurdal: Knutshaugen, Sæbuöygard N Fagernes, Åbjör; Öyer: Aksjö 950 m, Skåi 500 m, Öyer; Ringebu: ? loc. ZMO. *On:* Öystre Slidre: Skammestein 700 m; Vang: Eidsbugarden 1150 m, Nystova 1000 m ZMB ZMO, NE Otrövann 1000 m, Tyin 1100 m, Öye USU; Fron: ?loc. ZMO; Sel: Heidal kirke, Klakshaug, Leirflata, Mysuseter

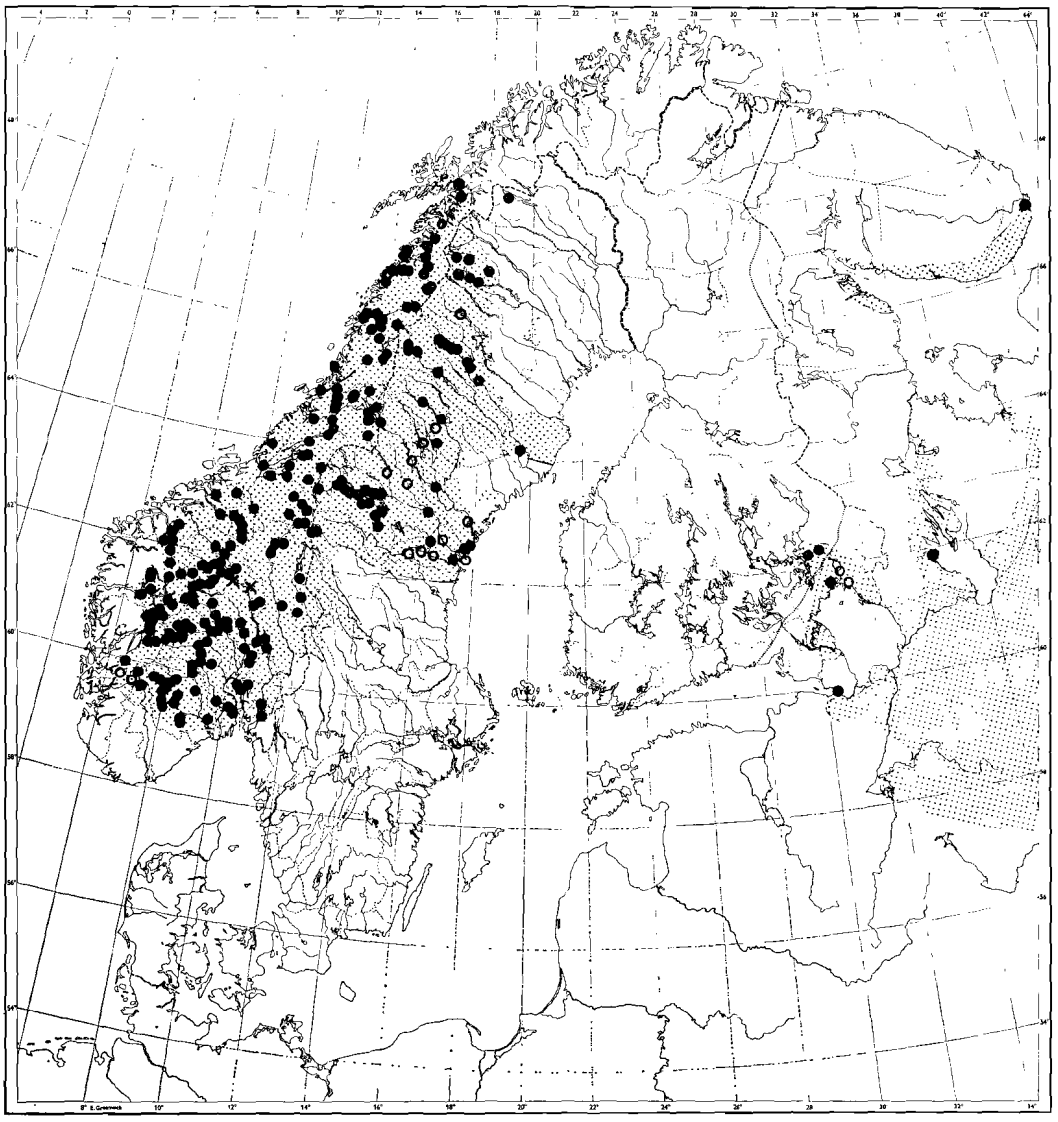


Fig. 73. *B. consobrinus* Dahlbom. Legend as in Fig. 50. Shaded areas = distribution of *Aconitum septentrionale* Koelle (based on Fries 1949, Plate II).

900 m; Vågå: Gjendesheim 1000 m, Klones, Randsverk 800 m TRM ZMB, Vågåmo ZMB ZMO, Övre Sjodalsvann 950 m; Lom: Galdesand, Gjendebu 1000 m ZMB ZMO, Leirdalen 900 m, Solell 1200 m; Lesja: Lesja KMT; Dovre: Dovrefjell 1000 m NRS VCA ZMC ZMO ZMU, Toftemo ZMO. *Buskerud (Bö):* Lier: Toverud; Kongsberg: Lintvedt. *Bv:* Sigdal: Nordbygda; Nore-Uvdal: Björkeflåtå, Heggjeli 780 m, Numedal NRS, Nörstebö 700 m, Tunnhovd 850 m; Nes: Eidal; Gol: Holteliseter 900 m, Randalseter 940 m; Hemsedal: Lykkja; Ål: Bergjsöstölen 1100 m, Levell 700 m, Nyseliseter 980 m, Votnedalen 525 m; Hol: Geilo 800 m, Hallfardokkistölen 800 m, E Halne 1150 m, Haugastöl 1000 m VCA ZMB, Nygård 1000 m, Seim, Ustaoset 1000 m. *Vestfold:* Sande: SW Sande; Holmestrand: Angerskleiv. *Telemark (TEy):* Skien: Kikut; Drangedal: Grova, Tomyra. *TEi:* Notodden: Gransherad; Seljord: Svartdal; Kviteseid: Brunkeberg; Tokke: Holtet bro, Åmdals verk; Vinje: Bossböen 970 m, Krossen 700 m, Rauland kirke 700 m, Torvtjern 900 m, Urdbö 700 m, Vå 700 m, Åmot; Tinn: Börsjöen 1150 m, Fröystul 850 m, Tinn,

Vålen. *Aust-Agder (AAi):* Bykle: Breive 700 m. *Hordaland (HOi):* Odda: Austmannli 800 m, Seljestad; Ullensvang: Hardangervidda VCA, Hjölmo, Fossli 750 m, Isdalen 840 m, Måbödalen, Sysendalen 750 m; Ulvik: N Osa, Rubbeliseter. *Sogn og Fjordane (SFi):* Vik: Vik; Aurland: Berekvam, Kvammadal 950 m, Uppsete 850 m VCA ZMB, Vatnahalsen 800 m, Övstebö 800 m; Lærdal: Gröte, Horgje, Lærdal TRM; Leikanger: Hermansverk; Balestrand: Fjærland, Horpedalen, Suphellesetra; Luster: Dalsdalen, Fåbergstölen, Turtagrö NRS TRM VCA ZMB ZMO; Stryn: Videdalen, Videseter 600 m. *Möre og Romsdal (MRi):* Stranda: Kvanndalsetrene 700 m, Vollset; Norddal: Indreeidet, Krike bru; Sunndal: Gröa; Surnadal: Stangvik; Rindal: Bölme. *Sör-Tröndelag (STy):* Rissa: Stadsbygd; Åfjord: Mölsletten. *STi:* Oppdal: Dalsbekk, Driva st., Drivstua 850 m ZMO ZMU, Knutshö 1200–1300 m, Kongsvoll 900 m VCA TRM ZMB ZMO ZMU, Kvammen 1200 m, Oppdal st., Skansen, Vårstigen 900 m; Rennebu: Sörflå; Ålen: Berglund; Röros: Evavollen 700 m, Myrmoen 700 m; Tydal: Mo bro, Sakrismoen, Vekterstua; Selbu: Heggset bro; Trondheim: VCA ZMB. *Nord-Tröndelag (NTy):* Nærøy: Saltbotn, Skogenga, Teplingan. *NTi:* Meråker: Meråker; Stjördal: Jullum; Levanger: Bergsve; Verdal: Sandvika, Stiklestad, Verdalsöra DCL; Steinkjer: Sem; Overhalla: Gryten; Grong: Trangen; Snåsa: Hegge, Leråbro, Åsmulen; Lierne: Kvelia, Seterhaug, Sörli KMT; Höylandet: Höylandet, Skilleberget; Namskogan: Brekkvasselv KMT, Finnvollan; Röyrvik: Namsvatn KMT. *Nordland (Nsy):* Sömna: Sömnes TRM, Vik; Nesna: Nesna, Oldersletten; Melöy: Dalen; Gildeskål: Finnes, Gildeskål, Jelstad, Storvika; Bodö: Falkflaugdalen, Frostmo, Planteskolen, Löpsviken. *Nsi:* Hattfjelldalen: Björkåsen brygge; Grane: Båfjellmo, Grane; Vefsn: Store Björnåvann; Hemnes: Bleikvassli, Finneidfjord, Korgen ZMA; Nord-Rana: Dunderland st., Krokstrand NRS TRM, Steinkjönnli TRM, Strömbotn, Umskarstjern; Saltdal: ? loc. TRM ZMO, Drageid, Junkerdalen, Junkerdalsura TRM, Saltsjö near Setså VCF, Solvågfjell 800 m, Storjordet TRM VCA ZMO, Vensmoen; Fauske: Fauske. *Nnö:* Sörfold: Bonnå, Bonnåsjöen, Rösvik; Hamaröy: Sandnes; Ballangen: Bakkerud, Hesjeli, Myrbakk. *Troms (TRi):* Skånland: Lavangseid.

Unrevised records: *Rogaland (Ri):* Suldal: Kvandal; Sauda: Slettedalen (Meidell 1934a).

Corrections. Records from Aust-Agder (AAy): Tvedestrand: Lyngör, Stensöy and Buskerud (Bv): Ål (Strand 1898a) are all revised to *B. pascuorum* (Scopoli). Five specimens in Vogt's collection, captured by Sparre Schneider 1896, were wrongly labelled Tromsö and may have contributed to the misunderstanding that *B. consobrinus* is an Arctic species (Friese & Wagner 1912; Pittioni 1938, p. 49; etc.). The labels, apparently written by Friese, are a misinterpretation of the name Turtagrö, being written on the original labels attached to adjacent specimens. Tromsö is situated at 69°40′ N, i.e. about 150 km beyond the northern limit of the distribution of the species. *B. consobrinus* is well known from Turtagrö, being situated in Southern Norway, viz. Sogn og Fjordane (SFi): Luster: Turtagrö, and was, moreover, visited by the collector in 1896 (Sparre Schneider 1898).

Sweden. Occurring from Jämtland north to Virihaure in Lapland (Lu. Lpm.) and together with *Aconitum* extending east to the Gulf of Bothnia within restricted areas in Medelpad – Västerbotten. A specimen from Lapland (T. Lpm.): Abisko, is the only record outside the distribution of *Aconitum.*

A total of about 250 specimens was examined.

List of localities. *Medelpad:* Jäckvissle NRS, Sundsvall. *Härjedalen:* Hamrafjäll NRS, Tänndalen. *Jämtland:* Berge in Alsen TCL, Berge, Bugården DCL, Bydalen, Döda Fallet NRS ZML, Faxälv TCL DCL, Gäddede NRS, Hallen, Hålland NRS ZML, Jormlien, Mörsil TCL, Nyland DCL, Oviken ZMB ZML, Sandven DCL, Storlien ZMB ZML, Storsjön, Säter, Undersåker NRS ZML, Åre TCL, Åreskutan DCL. *Ångermanland:* Bångnäs SW Härnösand, Härnösand, Ramsele GNM. *Västerbotten:* Vindeln NRS. *Lapland (Ås. Lpm.):* Bångnäs, Dorotea NRS, Vilhelmina NRS. *Ly. Lpm.:* Ammarnäs NRS ZML ZMU, Björkfors, Fårkammaren in Sorsele NRS, Gargnäs, Giltjaur NRS, Häggås NRS, Järnforsen GNM, Laxfjäll NRS ZML, Rödingsbäck NRS, Slussfors, Sorsele NRS, Tjulträsk GNM NRS ZMU, Tärna NRS ZML, Vindelforsen ZMU, Vuvosbäcken, Vännäs NRS, Västansjö ZMA ZML, Örnäs NRS. *Lu. Lpm.:* Kvikkjokk ZMC ZML, Lammeholm, Njunjes ZMA, Sarek National Park, Tarradalen NRS, Tjeurak NRS, Virihaure National Park ZML ZMU. *T. Lpm.:* Abisko ♀ 20 July–10 Aug. 1950 (Dalenius).

Unrevised records (Ander in litt.): *Medelpad:* S Erikslund, Fränsta, Liden, Tynderö, Stöde, Åstö. *Jämtland:* Föllinge, Hammerdal, NW Strömsund. *Lapland (Ås. Lpm.):* Granliden 40 km SSW Vilhelmina. *P. Lpm.:* Jäckvik.

Finland. Isolated occurrence NW Ladoga. In present Finland observed only in *Aconitum* biotopes in Northern Karelen (Kb).

List of localities. Kb: Kitee ZMB, Tohmajärvi ZMA ZMB; Kl: Sortavala ZMA ZMH. These localities are also listed by Elfving (1968).

The total distribution of the subspecies, B. consobrinus consobrinus Dahlbom. Fennoscandia and adjacent Russian Karelian – Southern part of Kola pen. (Skorikov 1914b). Examined records outside Fennoscandia: Kola pen.: Ponoy ZMH; at lake Onega: Jalguba ZMH; Leningrad NRS.

Faunistic remarks

B. consobrinus is usually recorded together with *B. hortorum* but has a more restricted distribution. Recent records underline the theory of Løken (1961b) stating that the distribution agrees with that of the main foodplant *Aconitum septemtrionale* Koelle. A single specimen (Lapland (T. Lpm.): Abisko) is in fact the only Scandinavian record outside the area of distribution of this plant.

Biology

Flight season. From end of May to the end of August. Queen: 29 May–16 Aug.; worker: 17 June–27 Aug.; male: 21 July–26 Aug.

BOMBUS (MEGABOMBUS) HORTORUM (LINNAEUS)

Apis hortorum Linnaeus, 1761, p. 424 No. 1710, type area Sweden: Uppland. A female LSL! labelled *hortorum* agrees with the usual interpretation of the taxon.

(*Bombus hortorum* (Linnaeus); Sommerfelt 1824–27; Dahlbom 1832, p. 38, (partim), 1837 (partim); Boheman 1844, p. 95; Siebke 1853, 1863, 1870, 1873, 1880; Wahlberg 1854, 1855; Thomson 1870, 1872; Aurivillius 1887, 1903; Nerén 1892; Adlerz 1893; Sparre Schneider 1895b, 1898, 1909, 1918; Strand 1898a, 1898b, 1901; Lie-Pettersen 1901, 1905, 1907; Friese 1902; Bengtsson 1904, 1908; Muchardt 1904; Ringdahl 1915; Lundblad 1924; Soot-Ryen 1925; Gaunitz 1929; Meidell 1934a, 1946; Wexelsen & Skåre 1934; Løken 1949, 1950, 1958a, 1960, 1966c; Ander 1953a, 1963, 1965; Kruseman 1959; Elfving 1960, 1968; Erlandsson 1960; Fridén, Eskilsson & Bingefors 1962; Hasselrot 1962; Fridén 1967. *Apis autumnalis* Fabricius, 1793, p. 324 No. 43 nec Dahlbom 1832; Zimsen 1964, p. 416 No. 1099. Lectotype ♀ KCC! designated by Løken (1966a), type area Germany.)

First Scandinavian records

Norway. Nordland (Nsi): Saltdal (Sommerfelt 1824–27), no voucher specimen. The identification is considered as correct since the species is abundant in the area.

Sweden. Uppland (Linnaeus 1761).

Taxonomical remarks

The Scandinavian population belongs to the nominate form.

Vogt (1909) states that a 'länger haarigen Varietät *hirtus*' occurs in Northern Norway and in Scotland. This has at least no nomenclatural status as far as Norwegian population concerns. It is obviously a slight increase in hair length directed to northernmost Norway and in size as well. The hairlength is not measured. The difference in size between the northern and the

Table X. *B. hortorum* (Linnaeus). Average measurements in mm of (A) 20 ♀♀ from Southern Norway: Östfold and Akershus, 59°–60° N, (B) 20 ♀♀ from Northern Norway: Nordland and Troms, 67°–70° N

	A		B		
	mean	s	mean	s	t test
Malar space	1.24	±0.04	1.26	±0.05	1.08
'Radial length'	4.59	±0.11	4.67	±0.11	2.28
Interalar width	5.11	±0.18	5.33	±0.14	4.31

southern Norwegian populations is revealed in Table X. It is significant in two of the measured features, viz. 'radial length' and interalar width. These apparently clinal variations do not support subspecific designations.

A possible difference between the northern and southern Scandinavian population characterized by the ability to produce melanic individuals, is discussed on p. 135.

B. hortorum var. *fidens* (Harris) (= *Apis fidens* Harris 1776), *B. hortorum* var. *harrisellus* (Kirby) (= *Apis harrisella* Kirby 1802), *B. hortorum* var. *nigricans* Schmiedeknecht 1878 (= *B. hortorum* var. *c* Thomson 1872), *B. hortorum* ab. *quasifidens* Vogt 1909 and *B. hortorum* f. *balticus* Scholz 1924, one or several of which mentioned as race or variety occurring in Scandinavia (Sparre Schneider 1898, 1918; Lie-Pettersen 1901, 1905, 1907; Friese & Wagner 1909; Vogt 1909; Meidell 1934a; Løken 1949, 1960; Erlandsson 1960) concern infrasubspecific forms only. Two of the designations need to be discussed: (1) the description of *Apis fidens*, supplemented with a colour-drawing (Harris 1776, p. 130, Table 38 Fig. 3) presents a red-tailed bumble bee with yellow collar, scutellum and interrupted band on T_2. The identification is uncertain. The name is wrongly applied to the completely black form of *B. hortorum*. Dalla Torre (1896) re-established its specific rank, but considered the taxon as a dark form according to his list of references. Since then a number of authors, cf. above, have treated *Apis fidens* as a melanic form of *B. hortorum*, but the colouring and the shape of the body in the original drawing refer better to a form of *B. pratorum* than to the slender *B. hortorum*. (2) *Apis harrisella* is a melanic form of *B. ruderatus* (Fabricius) and the name is therefore erroneously applied to *B. hortorum*.

Queen, worker

Morphological characters. Malar space markedly less than twice the distal width, occasionally hardly exceeding 1½ times this width, about as long as A_{2+3+4}. Disc of clypeus almost impunctate except for rather sparse, coarse puncturing of feeble anterior lateral impressions. Supraorbital line usually touching lateral ocelli dorsally (Fig. 17A) (in workers often just transecting the ocelli). A_4 transverse. Anterior median hairless field of scutellum small, usually dull. Mid-basitarsus (Fig. 17B). Outer surface of hind tibia slightly or not alutaceous. Body slender, coat rather shaggy.

Queen measurements. N = 20; SE Norway; malar space: 1.24 mm ($\pm$0.04$\pm$0.01) range: 1.20–1.35 mm; 'radial length': 4.59 mm ($\pm$0.11 $\pm$0.02) range: 4.40–4.80 mm; interalar width: 5.11 mm ($\pm$0.18$\pm$0.04) range: 4.90–5.70 mm. Body of large size.

The workers vary greatly in size, the largest ones being difficult to distinguish from the queens.

Colour pattern. Collar extending to adjacent margin of episternum, crescent-shaped posterior part of scutellum, T_1, basal margin or anterior lunate part of T_2 lemon yellow-haired. Extreme posterior margin of T_3, T_{4-5} and variable part of fringes of St_{4-6} (or $_{3-6}$) whitish-haired. Coat otherwise black. Interalar band posteriorly curved or v-shaped, i.e. including black hairs of scutellum.

Variation. Yellow collar varies in width, amount of black hairs on anterior part of scutellum and that of whitish hairs on posterior edge of T_3 display some variations. The striking variation is, however, the tendency to melanism which is discussed below.

Male

Morphological characters. Malar space about twice the distal width or nearly, shorter than A_{3+4+5} but longer than A_{2+3+4}. Longest hairs in pile of face about as long as antennal scape. A_{3-8} (Fig. 39A). Hind tibia with a few bristles exceeding the distal decumbent hairs of margin; fringes of hind tibia markedly longer than the greatest width of the segment (Fig. 39B). Hind basitarsus not much wider distally than at the base. St_8 and genitalia (Figs. 39C–D); lateral depressive of gonocoxite well-defined (Fig. 39E); distal margin of gonostylus, seen from behind, curved; boot-like, apex of volsella (Fig. 39F) varying slightly in shape. Coat shaggy. Body of moderate to large size.

Table XI. *B. hortorum* (Linnaeus). Proportion and degree of melanism throughout Norway. Area = county or district thereof (cf. Fig. 99); coll. = examined collections; obs. = observed, not collected material

	Number of individuals						Total number		Per cent					
	typical form		incomplete melanic form		complete melanic form				typical form		incomplete melanic form		complete melanic form	
Area	coll.	obs.	coll.	obs.	coll.	obs.	coll.	obs.	coll.	coll.+obs.	coll.	coll.+obs.	coll.	coll.+obs
Ö	69	21	11	–	9	–	89	21	78	82	12	10	10	8
AK	95	12	29	–	30	–	154	12	62	64	19	18	20	18
HEs	29	6	6	–	8	–	43	6	67	71	14	12	19	16
HEn	35	2	2	–	0	–	37	2	95	95	5	5	0	0
Os	110	616	10	9	11	2	131	627	84	96	8	3	8	2
On	61	3	6	–	3	–	70	3	87	88	9	8	4	4
Bö	43	15	3	–	3	–	49	15	88	91	6	5	6	5
Bv	108	15	9	–	7	–	124	15	87	89	7	6	6	5
VE	233	20	11	–	18	–	262	20	89	90	4	4	7	6
TEy	6	4	1	–	1	–	8	4	75	83	13	8	13	8
TEi	36	7	4	–	11	–	51	7	71	74	8	7	22	19
AAy	29	2	8	1	10	–	47	3	62	62	17	18	21	20
AAi	10	–	3	–	1	–	14	–	71	–	21	–	7	–
VAy	19	5	6	–	16	–	41	5	46	52	15	13	39	35
VAi	0	–	0	–	0	–	0	–	0	–	0	–	0	–
Ry	100	106	36	57	368	195	504	358	20	24	7	11	73	65
Ri	6	2	5	3	25	30	36	35	17	11	14	11	69	78
HOy	186	71	46	9	129	6	361	86	52	58	13	12	36	30
HOi	73	110	17	1	43	1	133	112	55	75	13	7	32	18
SFy	95	43	1	–	0	–	96	43	99	99	1	1	0	0
SFi	126	194	2	–	3	–	131	194	96	99	2	1	2	1
MRy	61	16	0	–	0	–	61	16	100	100	0	0	0	0
MRi	26	1	0	–	0	–	26	1	100	100	0	0	0	0
STy	15	4	3	–	0	–	18	4	83	86	17	14	0	0
STi	50	9	1	–	4	–	55	9	91	92	2	2	7	6
NTy	6	1	0	–	0	–	6	1	100	100	0	0	0	0
NTi	123	48	0	–	0	–	123	48	100	100	0	0	0	0
Nsy+nv	34	12	0	–	0	–	34	12	100	100	0	0	0	0
Nsi+nö	66	20	0	–	0	–	66	20	100	100	0	0	0	0
TRy	45	2	0	–	0	–	45	2	100	100	0	0	0	0
TRi	18	1	0	–	0	–	18	1	100	100	0	0	0	0
F	1	–	0	–	0	–	1	–	100	–	0	–	0	–
	1914	1368	220	80	700	234	2834	1682						

Colour pattern. Pile of vertex with variable mixture of black and yellow. Yellow collar extending more or less down episternum. Basal part of T_6, St_{2-5} whitish-haired, remainder of T_6, T_7 black-haired. Otherwise colouring as in the female.

Variation. In general as in the female.

Discussion on melanism

Melanic forms occur locally, with the typical form throughout Scandinavia except for the northern part of the peninsula. All degrees of melanism have been observed, from individuals with variable amount of yellow hairs replaced by black ones to completely black specimens. The frequency and the degree of melanism throughout the peninsula are illustrated on the pie chart (Fig. 74) based on the figures set out for the examined collections in Table XI, XII. Specimens with trace of yellow hairs are grouped as incomplete melanics. Entirely black or brownish-black individuals as well as those with no trace of yellow hairs visible by naked eye, but with hindmost tergites presenting a variable amount of whitish hairs, are grouped as complete melanics. The pie chart demonstrates a more pronounced melanism in the population inhabiting the Swedish islands Öland and Gotland than in the neighbouring mainland. There is, moreover, a distinct, apparently clinal, decrease in melanism

Table XII. *B. hortorum* (Linnaeus). Proportion and degree of melanism throughout Sweden, based on collections. Area = county or district thereof (cf. Fig. 99)

Area	Number of individuals			Total number	Per cent		
	typ. form	incompl. mel. form	compl. mel. form		typ. form	incompl. mel. form	compl. mel. form
Sk.	392	9	5	406	97	2	1
Bl.	16	0	1	17	94	0	6
Hall.	21	0	1	22	96	0	5
Sm.	253	12	11	276	92	4	4
Öl.	86	40	19	145	59	28	13
Gtl.	10	18	13	41	24	44	32
Ög.	38	1	2	41	93	2	5
Vg.	69	2	0	71	97	3	0
Boh.	41	0	1	42	98	0	2
Dlsl.	150	9	5	164	92	6	3
Nrk.	226	2	0	228	99	1	0
Sdm.	273	4	1	278	98	1	0
Upl.	333	5	3	341	98	1	1
Vstm.	137	0	0	137	100	0	0
Vrm.	78	15	8	101	77	15	8
Dlr.	123	5	4	132	93	4	3
Gästr.	8	0	0	8	100	0	0
Hls.	10	0	0	10	100	0	0
Med.	46	0	0	46	100	0	0
Hrj.	11	0	0	11	100	0	0
Jmt.	212	1	1	214	99	1	1
Ång.	68	0	0	68	100	0	0
Vb.	20	0	0	20	100	0	0
Nb.	137	2	0	139	99	1	0
Ås. Lpm.	13	0	0	13	100	0	0
Ly. Lpm.	20	0	0	20	100	0	0
P. Lpm.	9	0	0	9	100	0	0
Lu. Lpm.	55	0	0	55	100	0	0
T. Lpm.	14	0	0	14	100	0	0
	2869	125	75	3069			

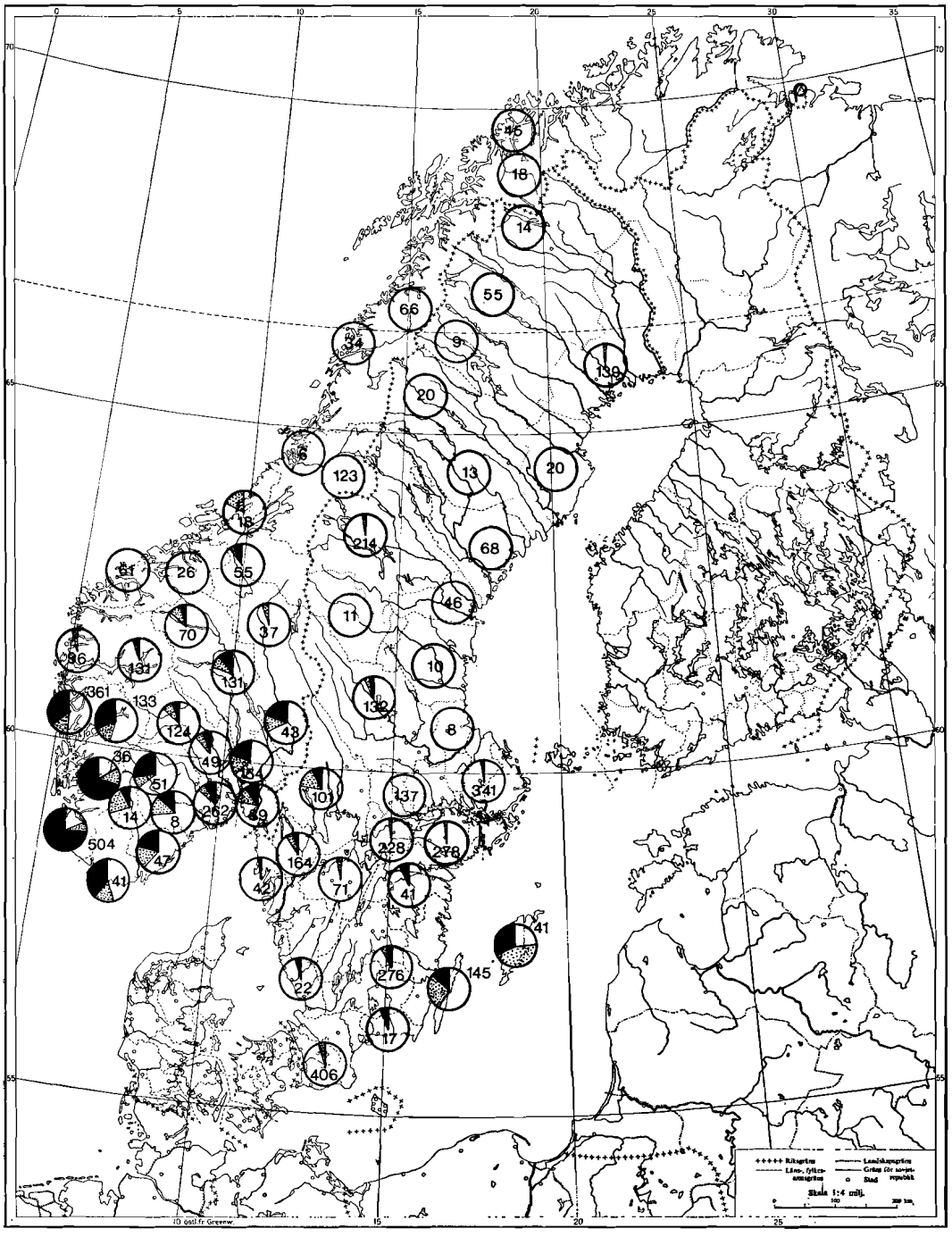


Fig. 74. *B. hortorum* (Linnaeus). Proportion of melanism. The figures refer to the total number of examined records within a county or district thereof. Black = proportion of complete melanics; stippled = proportion of incomplete melanics. Small circle = single record.

from the southwestern coast of Norway towards northeast, i.e. from an atlantic to a more continental climate. Yet the frequency of melanics cannot clearly be correlated with climatical gradients; compare, for instance, the precipitation (Fig. 1). The proportion of melanism in the rather continental Southeastern Norway is noteworthy, whereas dark coloured specimens have not been observed along the western coast north of about 61° N.

The evaluation of melanism is based on a study of 2834 Norwegian and 3069 Swedish collected specimens. A total of 1682 observed, but not collected Norwegian individuals quoted by O. Meidell (minor part) and me as belonging to the typical, incomplete, or complete melanic form, has also been considered. As the available material was not recorded at random, the strikingly dark individuals may have been collected more often than those of the commonly known typical form. The proportion of melanism based on the total of collected and observed, but not collected material figured in separate columns of Table XI, XIII–XIV, favours this suggestion, i.e. the frequency distribution of the melanic forms presented in collections is in general higher than in the actual population.

The only at random study was carried out between 31 July–4 Aug. 1963 and 5–7 Aug. 1966 in various fields in Jæren in Rogaland (Ry), an area where the proportion of melanism reaches a maximum (Fig. 74). Every observed specimen of *B. hortorum* was then counted and quoted as belonging to the typical form, incomplete or complete melanic form respectively. In order to save the beneficial insects, only a part of the records was collected and kept. The result is demonstrated in Table XIII, which also includes the corresponding data for the remaining material (not recorded at random) from the outer district of Rogaland. The frequency registers of the total of collected, and observed but not collected individuals should reflect fairly well the frequency and degree of melanism in the local population. The difference in the proportion of incomplete melanics, i.e. 6% and 7% in 1963 and 1966 respectively, in relation to otherwise 13%, may partly be due to subjective judgement in grouping, particularly of recorded

Table XIII. *B. hortorum* (Linnaeus). Proportion and degree of melanism in Norway: Rogaland (Ry). Jæren comprises the rural districts Hå, Klepp, Sola, Stavanger (Madla), Randaberg. Coll. = examined collections; obs. = observed, not collected material

Area	Year	Number of individuals						Total number		Per cent					
		typical form		incomplete melanic form		complete melanic form				typical form		incomplete melanic form		complete melanic form	
		coll.	obs.	coll.	obs.	coll.	obs.	coll.	obs.	coll.	coll.+obs.	coll.	coll.+obs.	coll.	coll.+obs.
Jæren	1963	1	29	1	6	17	58	19	93	5	27	5	6	89	67
Jæren	1966	5	45	1	12	15	113	21	170	24	26	5	7	71	67
Ry (excl. Jæren 1963, 1966)	1931–1967	94	32	34	39	336	24	464	95	20	23	7	13	72	64
Rogaland (Ry)		100	106	36	57	368	195	504	358	20	24	7	11	73	65

but not captured individuals. This does not, however, influence the correlation between the frequencies of typical and melanic records registered (at random) in Jæren 1963, 1966, and (not at random) in the entire district (Ry) 1931–1967, where the typical form represents 27%, 26%, and 23% respectively, i.e. roughly ¼ of the local population. The evaluation therefore indicates that the proportion of melanism presented on the pie chart (Fig. 74), based on kept specimens only, is fairly representative of Rogaland (Ry), the frequency of the typical form being 20% (against 24% by adding observed but not collected specimens, cf. Table XIII). Another problem is whether the pronounced melanism at the southwestern coast, previously emphasized (Lie-Pettersen 1901; Sparre Schneider 1918; Meidell 1934a) and discussed above, also indicates that the typical and melanic forms in that district occur in a state of balanced polymorphism.

The pie chart (Fig. 74) reveals only sporadic occurrence of melanic individuals in the inner part of Southern Norway. Table XIV demonstrates that a total of 758 collected and observed but uncollected records from Oppland (Os) represents only 5% melanic individuals, divided into 3% incomplete and 2% complete melanics respectively. As many as 101 collected and 586 observed but uncollected individuals were recorded in the rural district Öyer during observations throughout three seasons (Løken 1949). The proportion of melanism, being a total of 4% divided into 2% incomplete and 2% complete melanics, may be considered as representative of the area. It agrees well with that of the entire district. The slightly higher proportion of melanism in the collections, viz. 8% incomplete melanics and 8% complete melanics from Oppland (Os) according to Table XIV, only emphasizes the indication above that in the field more attention has been paid to the accidently occurring striking melanics than to the commonly known typical form.

The discussion indicates that the tendency of Scandinavian *B. hortorum* to melanism is broadly speaking reflected by the frequency presented on the pie chart (Fig. 74) based on the collections.

The tendency to melanism in *B. hortorum* is,

Table XIV. *B. hortorum* (Linnaeus). Proportion and degree of melanism in Norway: Oppland (Os). Records from Öyer are based on observations throughout the seasons 1939–41. Coll. = examined collection; obs. = observed, not collected material

Area	Number of individuals						Total number		Per cent					
	typical form		incomplete melanic form		complete melanic form				typical form		incomplete melanic form		complete melanic form	
	coll.	obs.	coll.	obs	coll.	obs.	coll.	obs.	coll.	coll.+obs.	coll.	coll.+obs.	coll.	coll.+obs.
Os: Öyer	85	575	6	9	10	2	101	586	84	96	6	2	10	2
Os (excl. Öyer)	25	41	4		1		30	41	83	93	13	6	3	1
Oppland (Os)	110	616	10	9	11	2	131	627	84	96	8	3	8	2

moreover, a non-sex-associated variation, yet the frequency of melanic males is higher than that of the females. The proportion of melanism, based on the representative material from Oppland (Os) and Rogaland (Ry) (cf. above), and the great number of records from the fairly well investigated Hordaland (HOy), is set out in Table XV and demonstrates that melanism is produced in sex and caste. The queen/worker/male ratio of complete melanics being 5/4/33 in Oppland (Os), 70/69/93 in Rogaland (Ry), and 32/29/51 in Hordaland (HOy) is noteworthy and emphasizes the statement above. The frequency of melanics in per cent is everywhere about the some in queens and workers, and markedly higher in males. A difference in sex is also accentuated by the degree of melanism being more pronounced in males. By definition, individuals grouped as complete melanics comprise those with a black coat with various amounts of whitish hairs on hindmost segments admixed, and entirely black specimens. The proportion of completely black individuals is, however, larger in males than in females; entirely black queens and workers have, in fact, rarely been recorded. The observations agree with those of Lie-Pettersen (1901) and Sparre Schneider (1918), who both observed a non-sex-limited local tendency to melanism characterized, however, by a high frequence of strikingly black males.

Distribution (Fig. 75)

Norway. Widely distributed from the extreme southern coast north to about 70° N. In Southern Norway occurring from sea level to subalpine valleys and occasionally penetrating the lower belt of alpine zone. In Northern Norway confined to luxuriant subarctic biotopes. The frequency is locally high. In Southern Norway recorded 1300 m s.m.

Biotopes: Gardens, orchards, *leguminosae* fields and other biotopes providing proper foodplants as *Aconitum*, *Galeopsis*, *Vicia*, etc. Heather and barrens are avoided.

A total of about 2900 specimens was examined.

List of localities. *Östfold:* Hvaler: Herföl, Kirköy, Söndre Sandö; Kråkeröy: Ödegård; Onsöy: Ellingård, Ramseklo, Skjælöy; Sarpsborg: ZMO; Halden: Sponvika; Marker: Dybedal, Rödenes; Rakkestad: Rörvik; Råde: Oven, Tom; Moss: VCA, Jelöy VCA ZMB; Eidsberg: Holm; Trögstad: Mönster bro, Båstad. *Akershus:* Ås: Vollebekk; Frogn: Dröbak;

Table XV. *B. hortorum* (Linnaeus). Frequency of melanism in sex and caste

	♀		☿		♂		Total	
	No.	per cent	No.	per cent	No.	per cent	No.	per cent
Oppland (Os)								
Typical form	30	81	69	91	11	61	110	84
Incompl. mel. f.	5	14	4	5	1	6	10	8
Compl. mel. f.	2	5	3	4	6	33	11	8
	37	100	76	100	18	100	131	100
Rogaland (Ry)								
Typical form	34	22	61	23	5	6	100	20
Incompl. mel. f.	13	8	22	8	1	1	36	7
Compl. mel. f.	110	70	184	69	74	93	386	73
	157	100	267	100	80	100	504	100
Hordaland (HOy)								
Typical form	60	56	91	57	35	37	186	51
Incompl. mel. f.	13	12	22	14	11	12	46	13
Compl. mel. f.	34	32	47	29	48	51	129	36
	107	100	160	100	94	100	361	100

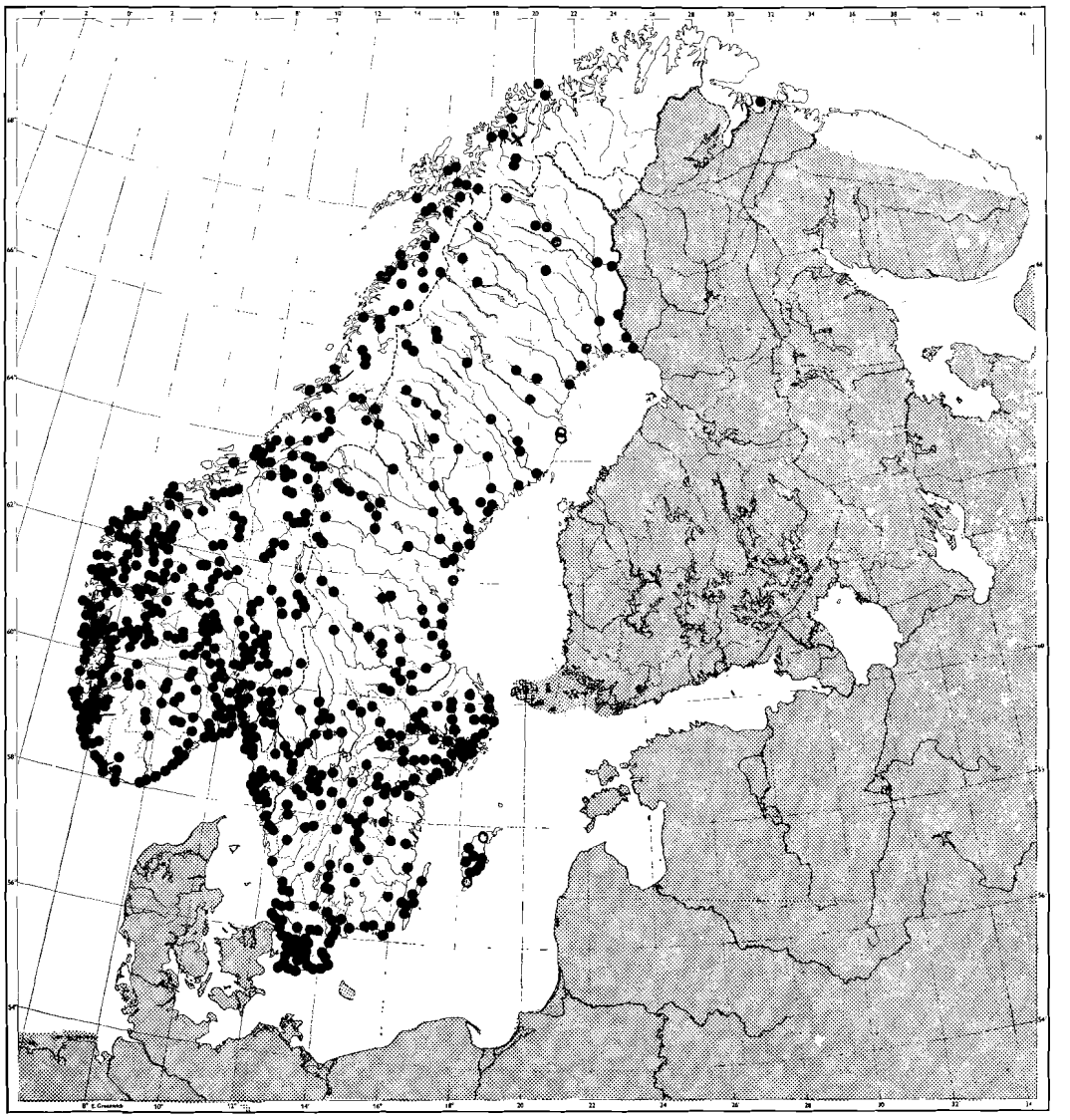


Fig. 75. *B. hortorum* (Linnaeus). Legends as in Figs. 50, 54.

Oppegård: Svartskog; Asker: Lushattdalen, Rustad; Bærum: ? loc. ZMO; Oslo: TRM VCA ZMB ZML ZMO; Aurskog-Höland: Björklangen, Gangsnes; Fet: Björkflåten; Eidsvoll: S Eidsvold, Feiring; Hurdal: Tömte ZMO. *Hedmark (HEs):* Eidskog: Gjelaråsen; Kongsvinger: Eidsberg; Sör-Odal: Mårud gård ZMO; Grue: Finnskog; Hamar: TRM ZMB ZMO, Helgöya ZMO; *HEn:* Trysil: Dammen, Enga, S Sjöenden, Vestby; Åmot: ?loc. ZMO, Glesubekken; Stor-Elvdal: Koppang; Alvdal: Alvdal; Tynset: Haugsvangen gård, N Tyldal; Tolga-Os: Hodalen 770 m; Engerdal: Risbakken gård 770 m, Torhus. *Oppland (Os):* Jevnaker: Randsfjord; Gran: S Einavold, Gjervika, Granvollen, Lander, Tingelstad kirke; Östre Toten: Hveem, Nærum, Skreia, Stubdalen; Söndre Land: Fall, Fluberg; Nordre Land: ? loc., Kinn; Lillehammer: Stor-Hove; Sör-Aurdal: Ellingseter 820 m; Nord-Aurdal: Flya 850 m, Hovda, Knutshaugen, Sæbuöygard N Fagernes; Öyer: Aksjö 1000 m, Skåi, Öyer kirke, Åstdalen 900 m. *On:* Vestre Slidre: ? loc. ZMO, Kinnholt 1000 m; Öystre Slidre: Beitostölen 750 m, Skammestein 700 m; Vang: Eidsbugarden 1200 m, Grindaheim, Tyin 1100 m, Valdresflya 1100 m ZMO, Öye USU ZMB; Sel: Heidal kirke, Klakshaug, Leirflata, Mysuseter 900 m; Vågå: Hindseter 900 m, Klones, Randsverk TRM, Vågåmo ZMB

ZMO; Lom: Galdesand, Solell 1200 m; Lesja: Lesja, KMT; Dovre: Dovrefjell ZMC ZML. *Buskerud (Bö):* Hurum: Filtvedt TRM, Pinadalen, Storsand; Röyken: Åros; Drammen: ZMB ZMO; Ådal: Hen; Krødsherad: Björkerud, Bråtån, Fagerheim, Glesne, Veikåker; Modum: ? loc. ZMO, Snarum; Flesberg: Lampeland, Öydegården; Kongsberg: TRM ZMO, Komnes, Lintvedt, Skollenborg. *Bv:* Sigdal: Kopseng, Nedre Eggedal, Nordbygda, Prestfoss, Sandsbråten, Sigdal; Nore-Uvdal: Hegnum seter, Nörstebö 700 m, Tunnhovd, Uvdal stavkirke; Flå: Kve gård; Nes: Bergheim bro, Börtnes, Eidal; Gol: Gol, Randalseter 940 m; Hemsedal: Lykkja 900 m; Ål: ? loc. ZMO; Hol: Geilo 800 m VCA ZMB, Haugastöl 1000 m VCA ZMB, Nygård 1000 m, Seim, Ustaoset 1000 m, Vikastöl 1000 m. *Vestfold:* Sande: SW Sande; Holmestrand: Angerskleiv; Borre: Adal, Nykirke; Våle: Ryk; Ramnes: Lunde; Lardal: Styrvoll; Andebu: Andebu; Stokke: Langö, Sand, Veierland; Nötteröy: Teie; Tjöme: Kjære, Tjöme; Sandefjord: Austeröy; Hedrum: Ringdal; Brunlanes: Dolven, Helgeroa; Larvik. *Telemark (TEy):* Skien: Kikut; Porsgrunn: Mule; Bamble: Åby; Nome: Damtjern; Drangedal: Drangedal, To-myra. *TEi:* Notodden: Gransherad, Tinnoset; Seljord: Svartdal; Kviteseid: Brunkeberg, Morgedal; Nissedal: Kyrkjebygda, Lauvviki; Tokke: Åmdals verk; Vinje: Bossböen 970 m, Krossen 700 m; Tinn: Miland, Tinn, Vålen. *Aust-Agder (AAy):* Gjerstad: Fiane; Tvedestrand: Eidbu, Nes verk TRM, Österå; Moland: Dal, Holmsund, Kilsund; Arendal: ZMO; Hisöy: His; Grimstad; Landvik: Hombor; Lillesand: Kvåse, Langholmsund, Natvik, Rosnes, Tröe. *AAi:* Bygland: Löndal; Valle: ? loc. TRM, Kvestad, Rygnestad; Bykle: Breive 700 m. *Vest-Agder (VAy):* Kristiansand: ZMO, Mövik; Sögne: Åros; Lindesnes: Lindesnes, Ramsland; Lyngdal: TRM; Kvinesdal: Gjemlestad; Farsund: Fjelleså, Lista fyr, Lodshavn, Vanse; Flekkefjord: Hidra. *Rogaland (Ry):* Sokndal: Bu, Hauge i Dalane, Nesvåg, Rekefjord, Vatland, Åmot; Eigersund: Birkeland, Eigeröyeidet, Fotlandsvann, Klungland st., Leidland, Nedre Hetland, Skerpe, Tengs; Bjerkreim: Malmeim; Hå: Anisdal, Bjelland, Brusand, Nærland, Ogna ZMB ZMO, Opstad, Salte bro, Sirevåg, Stölen, Varhaug, Vigrestad; Klepp: Börsheim, Bore bro, Innre Reve, Gjeishaug, Horpestad, Jæren TRM ZMB, Kåsen, Orre, Orrevann, Reve, Skarsheim, Vik, Öksnevad; Time: Kartevold, Mossige, Time, Tjåland; Gjesdal: Nese; Sandnes: Figgjo, Ganddalen, Hana, Hommersåk, Ims, Kjellingland, Myrland; Sola: Reke, Slettehei, Solastrand, Tananger, Ölbergstranda; Randaberg: Randaberg, Sande; Stavanger: Hafrsfjord, Hinna, Lindöy, Madla ZMB ZMO, Sunde; Strand: Tau, Vatne; Finnöy: Reilstad, Sjernaröy SMS; Rennesöy: Dale; Kvitsöy; Karmöy: Eide, Risdal, Sandve, Sæveland, Vigsnes, Vikre, Åkra; Vindafjord: Frövik; Tysvær: Leiranger, Nedstrand. *Ri:* Forsand: Forsand, Meling; Hjelmeland: Fister, Haugsli, Igland, Kvamme, Steinslandsvann, Vadda, Årdal; Suldal: Leirdalen 700 m, Nesflaten, Åimjödlonuten 700 m; Sauda: Sauda. *Hordaland (HOy):* Bömlo: Mosterhavn; Sveio: Förde; Ölen: Dommersnes; Fitjar: Kolöyholmen, Rubbestadnesset, Sörfonno; Austevoll: Karlsöy, Lunde, Ytteröy; Os: Berge, Hauglandsdal, Kvalsund, Lysekloster, Moldegård, Nordströno, Röd; Fusa: Övre Hålandsdal; Samnanger: Höyseter, Ådland; Fana: Biol. st., Bjånes, Blomsterdalen, Dolvik VCA, Fana kirke, Fjösanger VCA, Flesland, Grimstadnesset, Hjellestad, Krokeide VCA, Milde, Minde VCA, Nesttun VCA, Skipanes VCA ZMB, Skjold, Smöråsen, Stend, Titlestad; Sund: Bokken, Telavåg, Tyssöy; Fjell: Eide, Fjell, Fossavann, Landro; Laksevåg: Storingaviken; Bergen: TRM VCA ZMB ZMO; Asköy: ? loc. VCA, Herdla VCA ZMB; Åsane: Haukedal; Osteröy: Gjerstad, Havratun, Haus, Kleppe, Njåstad, Rakanesset, Skolmen; Meland: Brakstad, Io, Jacobsöy, Kjeken, Landsvik; Radöy: Kvalheim, 'Skjærgården' VCA TRM ZMB; Lindås: Fosse, Lauvås, Vollom; Fedje. *HOi:* Etne: Oslandsvåg, Skånevik TRM ZMB; Kvinnherad: Berget, Guddalsdalen, Lio, Ljosmyr, Prestvannet, Rosendal, Varaldsöy; Odda: Dalen gard, Röldal, Valldal 900 m; Ullensvang: Djönno, Espe, Fossli 750 m, Fresvik, Grythorgen 900 m, Hardangervidda VCA, Hjölmo, Kinsarvik, Lofthus, Måbödalen, Sysendalen 750 m, Tveito, Utne VCA, Viveli 875 m, Övre Eidfjord; Kvam: Omastrand, Strandebarm ZMO, Vaiiand, Åsheim; Voss: Gossland, Kinne, Rogn, Voss VCA ZMB; Granvin: Eide VCA, Granvin, Holven; Ulvik: Berge, Ulvik. *Sogn og Fjordane (SFy):* Gulen: Austgulen, Innre Brekke; Hyllestad: Hatleim, Hyllestad, Skivenes, Ålefjell; Höyanger: Lavik ZMB ZMO; Gaular: Bygstad, Eldalsosen; Fjaler: Dale, Strandenes; Askvoll: Aralden, Askvoll, Grytöyri; Flora: Florelandet, Florö, Kinn, Nekköyna, Rindemyr, Verpevik; Naustdal: Horstad, Naustdal; Förde: Flåten, Hallbreim; Jölster: Ålhus; Gloppen: Hjortset, Hope, Lotsberg, Lote, Sandane; Eid: Kjölsdalen, Naustdal, Nordfjordeid, Sletta, Stårheim; Vågsöy: Kjölstad, Refvik; Selje: Ervik, Lekanger. *SFi:* Vik: Vik; Aurland: Berekvam, Flåm, Gudvangen, Kvamshagen, Nedre Aurlandsdal, Sinjarheim 650 m, Uppsete 850 m VCA ZMB, Vassbygda; Lærdal: Lærdal ZMO, Ystabö; Sogndal: Slinde; Leikanger: Fosshagen, Hamrestöl, Hermansverk, Leikangerseter; Balestrand: Flesje, Fjærland, Horpedalen, Suphellen, Suphellesetra; Luster: Fortun TRM, Fåberg, Gaupne, Jostedal, Skjolden, Turtagrö TRM ZMB; Stryn: Flo, Hjelledalen, Hornindal, Olden, Stryn, Videdalen, Videseter 700 m, Övre Oldenvann. *Möre og Romsdal (MRy):* Volda: Björkedalsvann, Straumshavn; Hareid: Hjörungavåg; Ulstein: Flö, Ulsteinvik, Vonheim; Heröy: Leikanger, Runde; Ålesund: VCA; Vestnes: Gjermundnes; Molde; Aukra: Aukra kirke, Röd; Fræna: Bud. *MRi:* Örsta: Viddal, Öye; Stranda: Fivelstad, Geiranger NMW, Vollset; Norddal: Indreeidet, Valldal ZMB ZMO; Rauma: Veblungsnes, Åk ZMO, Åndalsnes; Nesset: Torhus; Surnadal: Lahjel, Melhus, Stangvik, Övre Surnadal; Rindal: Bölme. *Sör-Tröndelag (STy):* Hitra: Hamn; Rissa: ?loc. VCA, Sötvik; Örland:

Brekstad KMT; Bjungen: Kotegnsvann; Åfjord: By KMT, Mörreaune. *STi:* Oppdal: Dalsbekk, Driva st., Drivstua 850 m ZMO, Knutshö 1200–1300 m, Kongsvoll 900 m TRM ZMO, Oppdal st.; Ålen: Umholtet; Röros: Evavollen 700 m, Myrmoen 700 m, Naustervoll 700 m, Storelvvoll 800 m; Tydal: Vekterstua; Selbu: Medbus, Rolset; Trondheim: KMT TRM VCA ZMB, Valene KMT. *Nord-Tröndelag (NTy):* Nærøy: Breiviken, Dalene, Garmannsviken. *NTi:* Meråker: Meråker; Stjördal: Hegra st., Jullum, Lånke, Stjördalshalsen ZMA, Tilleraunet; Leksvik: Storvann; Levanger: Avdal, Bergsve; Verdal: Sandvika, Stiklestad, Sulstua, Vuku; Inderöy: ? loc. ZMO; Kirkenesvåg, Skjelvågen; Verran: Sela; Steinkjer: Sem ZMA ZMB; Overhalla: Gryten; Grong: Grong; Snåsa: Brönstad, Hegge, Leråbro, Snåsa; Lierne: Kvelia; Höylandet: Skilleberget; Namskogan: Finnvollan; Röyrvik: Björkhaug. *Nordland (Nsy):* Sömma: Vik; Nesna: Hamaröy, Nesna; Melöy: Dalen, Kunna, Spilderen; Gildeskål: Finnes, Prestegården, Gilset, Jelset, Skauvoll; Bodö: Bodö, Frostmo, Löpsviken, Skau. *Nsi:* Grane: Båfjellmo, Grane, Trofors; Vefsn: Ravassbakken; Hemnes: Finneidfjord, Korgen ZMA; Rana: Bjellånes, Dunderland st., Rössvollheien, Åenget; Beiarn: Gråtådalen; Saltdal: Drageid, Junkerdalsura TRM, Storjordet TRM; Fauske: Fauske, Kjeldvannet BML. *Nnö:* Sörfold: Bonnå, Rösvik TRM; Hamaröy: Oppeid, Skutevik; Tysfjord: Tysfjord ZMO; Ballangen: Bakkerud gård, Dyrhaug; Narvik; Evenes: Bogen, Dragvik, Jansbakk. *Nnv:* Vågan: Store Molla. *Troms (TRy):* Harstad; Kvæfjord: Borkenes, Vik; Lenvik: Gibostad; Tromsö: TRM VCA ZMB; Karlsöy: Fuglöy TRM; Skjervöy: Arnöy. *TRi:* Skånland: Boltås, Lavangseid; Målselv: Kirkesdal, Nordmo TRM; Balsfjord: ? loc. TRM, Malangen TRM. *Finnmark (Fö):* Sör-Varanger: Grense-Jakobselv ♀ 6 Sept. 1891 (?) TRM.

Correction. Records from Buskerud (Bv): Ål (Strand 1898a) were partly revised to *B. jonellus.*

Sweden. Widely distributed throughout the country, yet only sporadically recorded in alpine biotopes.

A total of about 3200 specimens was examined.

List of localities. *Skåne:* Alnarp, Bara, Bjärred, Bjärsjö NRS, Björnstorp, Blentarp, Bokskogen ZMB, Bonderup ZMB, Brantevik NRS, Bäckaskog NRS, Bärslöv ZMB, Bökeberg, Båstad, Dalby ZMB ZML, Degeberga, Eljeröd NRS, Fjälkinge, Genarp ZMB, Gislöv, Hardeberga, Hasslorp, Haväng NRS, Huggelske NRS, Hyby, Häckeberga, Hägghult ZMB, Hälsingborg ZMA ZML, Hörby NRS, Höör, Ivö NRS, Klostersågen, Kristianstad NRS, Kungshult, Kyrkheddinge, Kävlinge, Kåseberga NRS, Lerhamnsläge, Lund ZMB ZML, Löddeköpinge ZMB, Löderup NRS, Maglarp ZMB, Malmö NRS ZML, Marsvinsholm NRS, Mölle, Norra Mellby, Norra Nöbbelöv, Ormanäs, Ravlunda, Reslöv, Sege, Simrishamn NRS, Sjöbo NRS, Skarshult, Skäralid, Skärsnäs, Södra Sandby ZMB ZML, Sövdeborg ZMB, Torekov, Torna-Hällestad, Torup, Trelleborg ZMB ZML, Vallåkra ZMB ZML, Veberöd, Vik NRS, Vinninge, Vinslöv, Väderön, Väsby, Ystad NRS, Örtofta, Östra Torp, Övedskloster, Åhus ZMB ZML. *Blekinge:* Jämshög GNM, Karlshamn, Karlskrona NRS, Kristianopel GNM, Ronneby ZMB, Rödeby NRS, Torhamn NRS, Viö NRS. *Halland:* Breared NRS, Dagsås GNM, Getinge NRS, Halmstad NRS, Snöstorp NRS, Steninge NRS, Varberg NRS, Östra Karup. *Småland:* Aneboda ZMB, Brånstorp NRS, Dörarp NRS, Eksjö NRS, Flisby NRS, Gasslanda ZMU, Gränna GNM ZMU, Hjorted NRS, Hullarydsby, Höreda NRS, Jönköping NRS, Kalmar NRS, Korsberga GNM ZMU, Ljungby ZMU, Markaryd, Nybro NRS, Nye NRS, Oscarshamn, Ryssby ZMU, Tranås NRS, Villstad NRS, Vimmerby, Värnamo NRS, Österkorsberga GNM ZML ZMU. *Öland:* Bengtstorp, Glömminge NRS ZML, Gårdby NRS, Högsrum NRS, Kastlösa, Mörbylånga NRS ZML, Persnäs alvar, Resmo, Skogsbyn NRS, Vickleby NRS ZML. *Gotland:* Alskog ZMA ZML, Garda, Högklint, Klinte, Ljugarn ZMA ZML, Lojsta, Romakloster ZMA, Stånga, Visby NRS ZML, Vänge GNM ZML. *Östergötland:* Borensberg GNM, Frösta, Harg NRS, Högby ZMB, Klinga NRS, Linköping NRS, Mjölby NRS, Norrköping NRS, Norsholm, Skönberga NRS, Stavsjö NRS, Stjärnorp ZMB, Tjällmo ZMB. *Västergötland:* Alingsås ZMU, Erska, Falköping NRS, Forsvik, Grästorp NRS, Göteborg NRS, Hökensås NRS, Karleby NRS, Kinna, Kinnekulle, Landvetter, Läckö NRS, Mariestad, Råbäck NRS, Rångedala NRS, Skara NRS, Skövde NRS, Ulricehamn NRS, Vara, Vinninga NRS, Öjahed. *Bohuslän:* Bovallstrand NRS, Brastad, Dingle NRS, Edshultshall NRS, Morlanda NRS, Munkedal, Näverstad NRS, Rossöhamn NRS, Skaftö, Strömstad NRS ZML, Syd-Koster NRS, Tjörn GNM, Ytterby NRS, Ödsmål NRS. *Dalsland:* Bengtsfors NRS ZML, Ed NRS, Ellenö NRS, Holm, Köpmannebro, Rostock ZMB, Skållerud NRS, Skåpafors NRS, Stenebynäs NRS, Sundby, Tösse, Valbo-Ryr NRS, Vänersborg, Åmål NRS ZML. *Närke:* Askersund, Bärsta, Store Mellösa ZMB, Örebro NRS. *Södermanland:* Björnlunda NRS, Brandalsund NRS, Huddinge ZMU, Häringe NRS, Jättna, Mölnbo NRS, Nynäs ZMB, Riksten NRS, Sjösa ZMB, Sparreholm NRS, Strängnäs ZMB, Södertälje NRS ZML, Trosa, Turinge NRS, Tyresö NRS, Valla NRS, Vendelsö GNM, Viksberg, Vreta, Västerhaninge NRS ZMB, Yttereneby NRS, Ålberga ZMB ZML. *Uppland:* Adelsö NRS, Bogesund NRS, Danderyd ZMB, Elmsta ZMB, Estuna ZMU, Garnviken, Gimo NRS, Grisslehamn NRS, Hammarby NRS, Harpabol NRS, Håtuna NRS, Ingarö, Jumkil, Järlåsa NRS, Knutby ZMB, Lennartnäs, Ljusterö NRS, Läby NRS, Rimbo NRS, Rydboholm NRS, Rö NRS, Rådmansö NRS, Skokloster ZMB, Stockholm NRS ZML ZMU, Tensta ZMB, Ultuna IVU, Uppsala BML NRS ZMB

ZML, Valsätra IVU, Vassunda IVU, Vindö NRS, Väddö NRS, Yxlan ZMB, Össebygarn NRS, Östra Ryd NRS. *Västmanland:* Arboga ZMB ZML, Fanthyttan NRS, Fellingsbro ZMB, Guldsmedshyttan, Hällefors NRS, Kolbäck NRS, Kärrbo ZMB, Lindesberg NRS, Sala NRS, Skultuna ZMB, Äs NRS. *Värmland:* Arvelsäter NRS, Arvika, Frykerud NRS, Gylleby in Sunne NRS, Hammarön NRS, Horrsjön NRS, Långban NRS, Molkom NRS, Nilsby, Säffle NRS, Ölme. *Dalarne:* Aspeboda NRS, Avesta ZMB, Brunnsvik NRS, Blyberg NRS, Bingsjö NRS, Idre, Leksand NRS, Ludvika NRS ZML, Mora NRS, Rättvik NRS, Sandsjö, Sjurberg NRS, Smedjebacken, Stjärnsund, Store Tuna, Sundborn NRS, Särna, Säter NRS, Transtrand NRS, Vikarbyn NRS, Västanvik NRS. *Gästrikland:* Hamrångerfjärden NRS, Hille-Forsby NRS, Högbo NRS, Trödje. *Hälsingland:* Bollnäs, Gnarp NRS, Holmsveden NRS, Los NRS, Njutånger NRS, Orbaden NRS, Söderhamn NRS. *Medelpad:* Liden ZMB, Mattfors, Stavreviken NRS, Sundsvall, Ånge. *Härjedalen:* Hamrafjäll, Ljungdalen, Tänndalen NRS ZML. *Jämtland:* Bydalen, Döda Fallet NRS, Eldsåsdalen NRS, Frösön NRS, Gäddede NRS, Hallen, Jormlien, Järpen, Mattmar, Mullfjäll, Ottsjön NRS, Oviken, Snasahögarna NRS, Storlien, Svenstavik NRS, Undersåker NRS ZML, Östersund NRS, Åre, Åreskutan. *Ångermanland:* Bjästa NRS, Björna NRS, Bondsjö NRS ZML, Forsmo NRS, Håknäs NRS, Kramfors NRS, Ramsele GNM, Sollefteå NRS ZML, Sidensjö NRS, Säbrå, Örnsköldsvik NRS. *Västerbotten:* Bodarna NRS, Degerfors NRS, Hällnäs, Jörn, Umeå NRS ZML. *Norrbotten:* Anttis, Haparanda, Kalix NRS ZML, Karungi NRS ZML, Luleå NRS ZML, Långträsk, Munksund NRS, Nybygget NRS ZML, Pajala NRS, Råneå, Överkalix NRS, Övertorneå. *Lapland (Ås. Lpm.):* Bångnäs, Dorotea NRS, Fattmomakke NRS ZML, Frederika NRS, Hunneberg, Vilhelmina NRS, Åsele NRS. *Ly. Lpm.:* Ammarnäs NRS, Björkfors, Lycksele NRS, Sorsele, Tärna, Vindelforsen NRS, Västansjö. *P. Lpm.:* Skattträsk. *Lu. Lpm.:* Gällivare NRS, Kvikkjokk, Malmberget, Njunjes, Sarek National Park, Sitasjaure. *T. Lpm.:* Abisko NRS, Jukkasjärvi NRS, Kiruna NRS, Svappavaara NRS.

Ander in litt.: *Gotland:* Fide, Lärbro. *Västerbotten:* Hökmark, Lövanger.

Finland. Commonly occurring throughout the country north up to the Polar Circle and sporadically observed further north, yet not recorded in Lapland (Le) (Elfving 1968).

World distribution. Europe (British Isles; entire West European continent; European USSR, except semi-desert areas north of Sea of Azov and the Caspian Depression) – Algeria – Turkey – Iran – Caucasus – Transcaucasus – Northern and Eastern Kazakhstan – Western Siberia – Transbaykal – Baykal – Jakutia – Northern Mongolia (Panfilov 1957 and in litt.; Reinig 1968). Introduced to New Zealand (Gurr 1964).

Zoogeographical remarks

The tendency to melanism confined to only part of Scandinavia justifies the question whether *B. hortorum* consists of two Scandinavian populations: (1) a northern post-glacial population with gene-pool light, immigrating from the east and (2) a southern population with gene-pool dark, i.e. with melanic traits, invading the peninsula from south. The theory is favoured by the fact that a tendency to melanism along the eastern migration route has not been observed (Panfilov in litt.), whereas it is recorded, but the frequency not estimated, on the continent south of Scandinavia (Alfken 1913; Stoeckert 1933; Schmiedeknecht 1930; etc.). The present information about the identity of the northern and southern Scandinavian populations is meagre; anyway, a difference as regards presence and absence of melanic traits does not qualify for subspecific division of the Scandinavian *B. hortorum.*

Biology

Nest. Pocket-maker. Nests were recorded at various depths from 50 cm to just below the surface of the ground. Produces large colonies (Dahlbom 1837; Lie-Pettersen 1901; Hasselrot 1962).

Flight season. From middle of April to end of September. Queen: 1 May–9 Sept.; worker: 10 May–27 Sept.; male: 3 July–27 Sept. Two males collected 10 May 1908 (Akershus: Moss: Jelöy (Barca) ZMA) illustrate that unfertilized eggs are accidently laid in the first batch of brood.

BOMBUS (MEGABOMBUS) RUDERATUS (FABRICIUS)

Apis ruderata Fabricius, 1775, p. 380 No. 7, lectotype ♀ BCL! selected by Richards according to Zimsen (1964, p. 415 No. 1074). Type area Madeira.

(*Bombus ruderatus* (Fabricius); Zetterstedt 1838; Thomson 1872; Muchardt 1904; Kruseman 1959; Ander 1963, 1965. *Apis tunstallana* Kirby, 1802, p. 346 No. 94, holotype ♀ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Apis harrisella* Kirby, 1802, p. 373 No. 110, holotype ♀ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Bombus hortorum:* Dahlbom 1832, p. 38 (partim), 1837 (partim). *Bombus hortorum* var. *ruderatus* (Fabricius); Friese & Wagnar 1909. *Bombus ruderatus eurynotus* Kriechbaumer; auctt. *Bombus ruderatus eurynotus* Dalla Torre, 1882. *Bombus ruderatus eurynotus* Vogt, 1909, pp. 60, 74.)

Nomenclatural remarks

B. r. eurynotus Kriechbaumer and *B. r. eurynotus* Dalla Torre are both *nomen nudum*. Kriechbaumer never published the designation and Dalla Torre (1882) only refers to Kriechbaumer. The description of Vogt, though meagre, is the first to satisfy Art. 16 in Int. Code Zool. Nomenclature.

First Scandinavian record

Sweden. ? loc. (Zetterstedt 1838). Rare in Southern Sweden (Thomson 1872).

Taxonomical remarks

Reinig (1939, p. 193) considers *B. ruderatus* and *B. argillaceus* (Scopoli), the latter occurring in Southeastern Europe, as being conspecific and representing two subspecies. The taxa are otherwise treated as separate species (Dalla Torre 1896; Krüger 1920; Pittioni 1939a; Tkalcu 1960, 1969; etc.). Pittioni & Schmidt (1942), in maintaining their specific status, emphasize, however, that both taxa occur in Austria: Niederdonau, where they possibly interbreed. Until more information is available, I think it is best to retain the specific position of *B. ruderatus*.

The species is in Scandinavia represented by the subspecies *B. r. eurynotus* Vogt.

Distribution

Fennoscandia. Cf. the subspecies.

World distribution. Europe (England; Southern Scotland; throughout the continent from Portugal, Spain, France, Italy, Yugoslavia, Romania and north to Denmark, Southern Sweden, Poland; in European USSR north to districts of Moscow, Vitebsk, Tatar, east to Volga and south to Kharkov, Southern Ukraina) – Madeira – Marocco – Algeria (Reinig 1939; Knechtel 1955; Dylewska 1957; Panfilov 1957). Introduced to New Zealand (Gurr 1964). As indicated above, the distribution extends further east than illustrated by Reinig (1939, p. 192).

BOMBUS RUDERATUS EURYNOTUS VOGT

Queen, worker

Morphological characters. Malar space barely or not exceeding 1½ times the distal width, just exceeding the length of A_{2+3+4}. Disc of clypeus with sparse to rather dense distribution of very fine and coarse punctures, except for a small impunctate area in between anterior lateral impressions. Labral tubercles usually angled at inner end. Supra-orbital line just above lateral ocelli. A_4 transverse. Hairless field on anterior median part of scutellum well-defined compared with that of *B. hortorum*, also with more shining smooth microsculpture. Outer surface of hind tibia slightly alutaceous. Body robust, coat rather even and short.

Queen measurements. N = 20; Sweden: Skåne; malar space: 1.31 mm ($\pm$0.05$\pm$0.01) range: 1.20–1.38 mm; 'radial length': 4.97 mm ($\pm$0.12$\pm$0.03) range: 4.80–5.20 mm; interalar width: 5.90 mm ($\pm$0.14$\pm$0.03) range: 5.73–6.13 mm. Body of large size.

Only a few workers were examined; all were markedly smaller in size than the queens.

Colour pattern. Collar including adjacent edge of episternum, scutellum, at least posterior part of T_1, extreme anterior margin of T_2 with deep yellow hairs. Distal lateral part of T_3, entire T_{4-5}, and at least lateral part of fringes of St_{3-5},

whitish-haired. Otherwise coat black. Interalar band parallel-sided.

Variation. Yellow collar varying somewhat in width, yellow hairs of T_1 ranging from a slight admixture in lateral patches to the entire tergite. White on T_3 more or less pronounced, particularly distal part of T_5 with variable admixture of black hairs. However, variations are minute, i.e. Scandinavian ♀♀ and ☿☿ are colour-stable.

Male

Morphological characters. Malar space nearly twice the distal width and about the length of A_{2+3+4}. Longest hairs in pile of face usually shorter than antennal scape. Hind tibia with only very few bristles, none of which exceed in general the decumbent hairs at the distal margin; longest hairs in fringes of hind tibia barely or not exceeding the greatest width of the segment (Fig. 38A). Hind basitarsus wider distally than at the base. St_8 (Fig. 38B). Apex of volsella (Fig. 38C) varying slightly in shape. Body of moderate to large size.

Colour pattern. Pile of vertex usually pronounced yellow, anteriorly and laterally encroached by black hairs. Collar, usually extending down episternum, T_1, median anterior lunate part of T_2 yellow-haired. Entire or the main part of T_6, St_{1-5} and lateral patches of St_{6-7} whitish-haired; remainder of St_{6-7} with black hairs. The colouring otherwise as in the female.

Variation. Gena and venter of head with a variable admixture of whitish hairs, otherwise variations as in the female.

Distribution (Fig. 76)

Scandinavia. Restricted to southernmost Sweden, which is the northern limit of the distribution of the species.

Biotope: Apparently prefers rather arid areas.

A total of about 135 specimens was examined.

List of localities. *Skåne:* Alnarp, Bjärred, Björnstorp, Blentarp, Bulltofta, Bökeberg, Dalby, Eslöv, Falsterbo, Glimslöv, Hohög, Hälsingborg NRS ZML, Håslöv, Klostersågen, Knästorp ZMB, Krageholm, Kungshult, Kyrkheddinge, Kävlinge TCL ZML, Kåselberga, Lund GNM ZMB ZML, Löddeköpinge, Löderup NRS ZML, Malmö, Nosaby, Nytorp, Näsum GNM, Ravlunda, Råå, Simrishamn NRS, Sjöstorp, Skarhult, Södra Sandby ZMB ZML, Torekov, Trelleborg GNM ZML, Veberöd, Vellinge, Villands Vånga, Vinninge, Vitemölla, Ystad NRS, Örtofta, Östratorp, Öved NRS ZML, Åhus, Ålabodarna. *Blekinge:* Hällevik, Kristianopel GNM. *Halland:* Falkenberg, Halmstad, Östra Karup, Åkulla GNM.

The total distribution of the subspecies, B. ruderatus eurynotus Vogt. Europe (cf. the world distribution of the species) with exception of the Iberian peninsula and the Mediterranean isles (Pittioni & Schmidt 1942).

Biology

Flight season. From the middle of May to the end of September. Queen: 12 May–26 Sept.; worker: ?–21 Aug.; male: 24 July–22 Sept.

SUBGENUS *THORACOBOMBUS* DALLA TORRE

Thoracobombus Dalla Torre, 1880, p. 40, type-species *Bombus sylvarum* (Linnaeus) by designation of Sandhouse (1943).

(Chromobombus Dalla Torre, 1880, p. 40, type-species *Bombus muscorum* (Linnaeus) by designation of Sandhouse (1943). *Agrobombus* Vogt, 1911, p. 52, type-species *Bombus agrorum* (Fabricius), 1787 nec Schrank, 1781 by designation of Sandhouse (1943). *Ruderariobombus* Krüger, 1920, p. 350, type-species *Bombus ruderarius* (Müller) by designation of Yarrow (1971). *Adventoribombus* Skorikov, 1922a, type-species *Bombus sylvarum* (Linnaeus) by designation of Yarrow (1971), who refutes the designation of Sandhouse (1943), viz. *Agrobombus (Adventoribombus) adventor* Skorikov, 1922 (= *Agrobombus adventor* Skorikov, 1914a), as being invalid.)

Queen, worker

Head longer than wide. Clypeus, malar space hardly to markedly longer than respective distal width, yet less than 1½ times this width (occasio-

Fig. 76. *B. ruderatus* (Fabricius). Legends as in Figs. 50, 54.

nally only as long as this width in *B. veteranus* (Fabricius), *B. muscorum* (Linnaeus) and *B. ruderarius* (Müller)). Labral furrow in width less than ⅓ labral width, labral lamella nearly straight, about ⅔ as wide as labral width. Mandible with basal keel, distinct sulcus obliquus and indistinct incisura lateralis (Figs. 20, 22B). Ocellar-orbital field with well-defined impunctured area, and the punctured band rather wide. Eyes directed in front of posterior mandibular condyle. Supra-orbital line usually at or above lateral ocelli. A_3 at least ¾ as long as A_{4+5} but not more than equally long. Distal margin of mid-basitarsus produced into a posterior spine. Hind tibia with outer surface smooth, shining, inner dorsal distal angle distinctly produced. Distal margin of hind basitarsus spined or pointed. T_6 feebly granulate. Wings evenly, usually slightly infuscate.

Workers vary greatly in size; the biggest ones

are often difficult to distinguish from the queens, particularly in *B. pascuorum* (Scopoli).

Male

Head longer than wide. Clypeus, malar space slightly to markedly longer than respective distal width. Mandible bidentate with dorsal tooth smaller than ventral tooth. Eyes directed in front of posterior mandibular condyle. A_3 markedly shorter than A_5, A_{5-13} individually about twice the distal width or nearly so, at least A_{7-13} slightly to strongly swollen underneath (Figs. 44A, 45A, 46A, 47A, 48A, 49A). Outer surface of hind tibia usually convex with sparse to rather dense distribution of more or less decumbent hairs of various length throughout; longest hairs in posterior fringes of hind basitarsus not exceeding the greatest width of the segment. St_8 and genitalia as in Figs. 44 B–D, 45B–D, 46B–C, 47B–C, 48B–E, 49B–E.

Scandinavian species

The subgenus is represented by six Scandinavian species, viz. *B. humilis* Illiger, *B. muscorum* (Linnaeus), *B. pascuorum* (Scopoli), *B. ruderarius* (Müller), *B. sylvarum* (Linnaeus) and *B. veteranus* (Fabricius).

BOMBUS (THORACOBOMBUS) HUMILIS ILLIGER

Bombus humilis Illiger, 1806, p. 171, No. 48 nec Yarrow 1968, type ♀ IBZ!, type area Germany: Nürnberg.

(*Bombus muscorum:* Dahlbom 1832, p. 46 (partim), 1837 (partim); Wahlberg 1854 (partim); Thomson 1870 (partim), 1872 (partim); Aurivillius 1903 (partim). *Bombus humilis* Illiger; Tjeder 1954; Fridén, Eskilsson & Bingefors 1962. *Bombus solstitialis* Panzer, 1805 or 1806, part 99 Teil 17, type not traced; Sparre Schneider 1918; Erlandsson 1948; Ander 1953a, 1963, 1965; Elfving 1960, 1968; Hasselrot 1962; Fridén 1967. *Bombus helferanus* Seidl, 1837, p. 66, type lost. *Bombus variabilis* Schmiedeknecht in Radoszkowski, 1877, p. 199, type lost; Schmiedeknecht 1878, p. 424, Bengtsson 1907, 1908; Meidell 1934a; Krüger 1940. *Bombus solstitialis* var. *auranticus* Dalla Torre, 1882; Sparre Schneider 1918. *Bombus variabilis* var. *staudingeri* Dalla Torre, 1882; Meidell 1934a. *Bombus helferanus hafsahli* Vogt, 1909, p. 36, type ♀ VCA, type area Austria: Tirol. *Bombus variabilis hafsahli* Vogt; Krüger 1940, pp. 281, 386. *Bombus humilis hafsahli* Vogt; Løken 1960. *Bombus humilis hafsahlianus* Vogt, 1947, p. 4, lectotype ♀ VCA! hereby selected. Labels: (1) Dröbak; (2) 26 h; (3) collecti C. et O. Vogt; (4) lectotype *B. humilis hafsahlianus* Vogt design. A. Løken 1969. Type loc. Norway: Akershus: Frogn: Dröbak; Kruseman 1959. *Bombus humilis hafsahloides* Vogt, 1947, p. 4; Kruseman 1959.)

Nomenclatural remarks

According to Sherborn (1902–1933) the date of *B. solstitialis* Panzer, Fn. Germ. part 99 No. 17 is 1805 or 1806 whereas Horn & Schenkling (1928) gave the date of parts 97–108 as 1806–1809. The year 1794 for this designation, as stated by Erlandsson (1948), is due to misunderstanding, as the author confused number 17 with part 17 published 1794. Though it is uncertain whether *B. solstitialis* or *B. humilis* is the senior synonym, the latter is kept for this strongly variable taxon, because the identity refers to preserved type. *B. humilis* is, moreover, used by a number of European taxonomists (Knechtel 1955; Yarrow 1959; Kruseman 1958b, 1959, 1960; etc.). The species has been confused with *B. pascuorum* and *B. muscorum*, and the great nomenclatural confusion of the three taxa is illustrated in references listed by Dalla Torre (1896, pp. 504, 535, 560).

First Scandinavian records

Norway. Akershus: Bærum (Sparre Schneider 1918).

Sweden. Dalsland. Södermanland, Värmland

(Bengtsson 1907, p. 99) are the first reliable records. However, some specimens (ex coll Dahlbom and from Värmland and Uppland: Stockholm (Wahlberg) NRS) were traced in the *B. muscorum* collection, cf. the synonymy above.

Subspecific discussion

Phenotypical variations have above all been studied by Krüger (1940) and Vogt (1947), who indicated that the taxon displays a maximum of colour variations in Central Europe from where race-forming populations radiate. The Scandinavian population, treated as a subspecies, *B. humilis hafsahli*, identical with that of Austria (Vogt 1909; Krüger 1940; Løken 1960), was divided by Vogt (1947) into a light-coloured form named *hafsahloides* and a darker form named *hafsahlianus*, of which the latter only was given subspecific rank.

The available material agrees with Vogt's theory. It is a geographic variation in the colour pattern which shows a clinal shift in a number of colour features such as pile of face, episternum, T_2, femur, corbicular fringes, absence or presence of black bristles on T_{3-5}, and from the palest in southernmost Sweden to the darkest in the northern border areas. Variations in five of the characters were examined on females from counties ranging from southernmost Sweden throughout the eastern part of the country to the northern border area at the Gulf of Bothnia and likewise along the western coast to the border area in Norway. The data gained (Tables XVI, XVII) demonstrate clinal variabilities (Figs. 77, 78) with a levelling at the northern end which would qualify for subspecific designation. Though the dark-coloured populations, extending from the southernmost coast of Norway northeast to the Gulf of Bothnia display a vast number of minute variations, these fringing populations are considered as subspecifically identical, all belonging to *B. humilis hafsahlianus* Vogt.

It might be discussed whether or not the paler-coloured population in Southern Sweden, the '*hafsahloides*' form, should be considered as a subspecies. It is in fact more uniform than *B. h. hafsahlianus* from which it is distinguished as

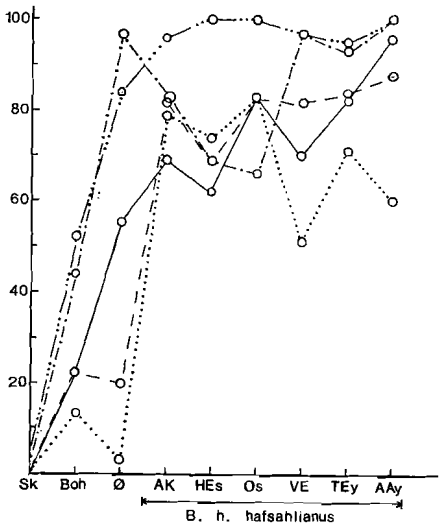


Fig. 77. *B. humilis* Illiger. Percentage of females with mainly to all black pile of face (_____) and corbicular fringes (__.__), black-haired episternum (.....) and hind femur (_ _ _ _), and black bristles on 3rd to 5th gastral tergite (____...____) plotted against counties ranging from Sweden: Skåne to Norway: Aust-Agder (cf. Table XVI).

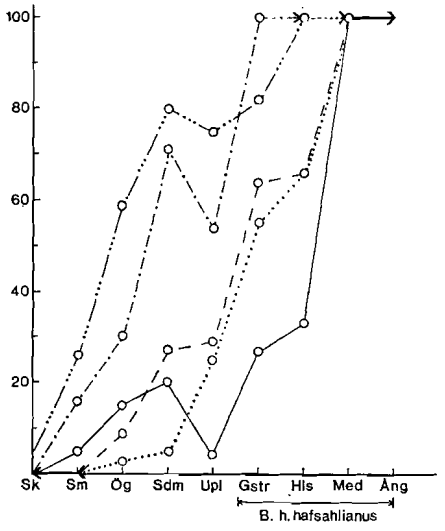


Fig. 78. *B. humilis* Illiger. Percentage of females with mainly to all black pile of face (_____) and corbicular fringes (__.__), black-haired episternum (.....) and hind femur (_ _ _ _), and black bristles on 3rd to 5th gastral tergite (____...____) plotted against counties ranging from Skåne to Ångermanland in Sweden (cf. Table XVII).

follows: Pile of face, episternum, hind femur, and corbicular fringes pale yellow to yellowish-white. Yellowish-brown hairs on dorsum of thorax of paler shade. T_2 only slightly darker-haired than T_3; occasionally hairs on T_{2-3} display the same shade of colour. T_{3-5} without black bristles. The figures from Skåne (Tables XVI, XVII) emphasize the stable colouring. All the individuals examined present entirely yellowish-white hairs on episternum, femur, and corbicular fringe, and only 5 per cent of the individuals display black bristles on one or several of the tergites T_{3-5}. The available material from Northern Germany reveals, however, a close affinity between the 'hafsahloides' form in Skåne and the so-called '*staudingeri*' group (Krüger 1940) in Germany, thus supporting the theory that Southern Sweden is a transitional area. Therefore only one Scandinavian subspecies is recognized, viz. *B. humilis hafsahlianus*.

Queen, worker

Morphological characters. Malar space markedly longer than distal width, about as long as A_{3+4}. Clypeus hardly longer than distal width, on the disc with fine uneven puncturing except for a small impunctate area between lateral, coarsely punctured impressions. Labral furrow more or less widened towards the base, labral lamella with dull fine sculpturing and moderately sharp edge. Frons with rather sparse coarse puncturing, almost impunctate near visible part of frontal line. Distance from lateral ocellus to preoccipital ridge hardly longer than distance from lateral ocellus to eye. T_{2-3} laterally with striate-rugose microsculpture at least in the posterior half of the individual segments, i.e. hairs arising from coarse coalescing punctures. Distal keel of St_6 moderate. Dorsal coat of thorax markedly shorter and less shaggy than

Table XVI. Percentage of female *B. humilis* Illiger exhibiting certain characters of colour pattern in populations ranging from Southern Sweden to southern coast of Norway. Area = county or district thereof (cf. Fig. 99)

Area	Sk.	Boh.	Ö	AK	HEs	Os	VE	TEy	AAy	VAy
Number of specimens	56	23	33	43	16	6	35	44	25	3
Pile of face										
Yellow	98	48	3	2			6			
Mainly yellow	2	30	42	29	38	17	24	18	4	
Mainly to all black		22	55	69	62	83	70	82	96	100
Episternum										
Yellowish-white	100	52	36				11			
Mainly yellowish-white		13	45	2	13		6	9	16	
Mainly black		22	15	19	13	17	32	20	24	
Black		13	3	79	74	83	51	71	60	100
Hind femur										
Yellowish-white	100	61	42	2	6					
Mainly yellowish-white			15	5	13	17	15	9		
Mainly black		17	21	12	13		3	7	12	
Black		22	21	81	68	83	82	84	88	100
Corbicular fringes										
Yellow	98	26					3			
Tipped yellow/yellowish-brown		30	3	16	31	34		7		
Mainly to all black	2	44	97	84	69	66	97	93	100	100
3rd to 5th tergite										
Without black bristles	95	48	18	4			3	5		
With black bristles	5	52	82	96	100	100	97	95	100	100

in *B. pascuorum*, but longer, less dense, and more uneven than in *B. muscorum*. For measurements, cf. the subspecies.

Colour pattern. Dorsum of thorax with yellowish-brown hairs. Pile of T_{1-5} yellow of various shade; the shade on T_2 is the darkest, often turning to dark brown. T_6 mainly black haired. For further details cf. the subspecies.

Male

Morphological characters. Malar space markedly longer than distal width and about as long as A_{3+4}. A_4 hardly or not longer than distal width. A_{5-13} individually moderately swollen beneath (Fig. 49A), occasionally also A_4. Posterior fringe of hind tibia slightly or not longer than greatest width of the segment. St_8 and genitalia (Figs. 49B–C); distal part of gonocoxite much produced inwards; gonostylus inwardly produced into a broad bifid lamella; volsella with rather narrow strongly projecting distal process and with a bifid or tridentate subapical process (Fig. 49D); penis valve hooked at apex and with moderate subapical tooth (Fig. 49E). Coat shaggy. Body of small size.

Colour pattern. T_7 with black hairs, otherwise generally speaking a colouring as in the female or more diffuse. For details cf. the subspecies.

Distribution (Fig. 79)

Norway. Scattered distribution in southeastern lowlands and along the southern coast west to the southernmost point of the country (Vest-Agder (VAy): Lindesnes). Records from Oppland (On): Dovre, cf. the list below, are note-

Table XVII. Percentage of female *B. humilis* Illiger exhibiting certain characters of colour pattern in populations ranging from Southern Sweden northeast to Ångermanland. Area = county or district thereof (cf. Fig. 99)

Area	Sk.	Sm.	Ög.	Sdm.	Uppl.	Gästr.	Hls.	Med.	Ång.
Number of specimens	56	19	24	18	24	11	3	3	7
Pile of face									
Yellow	98	79	70	40	33	36			
Mainly yellow	2	16	15	40	63	36	66		
Mainly to all black		5	15	20	4	27	33	100	100
Episternum									
Yellowish-white	100	84	71	44	17	9			
Mainly yellowish-white		16	24	27	33	27	33		
Mainly black			3	24	25	9			
Black			3	5	25	55	66	100	100
Hind femur									
Yellowish-white	100	95	79	53	38	18			
Mainly yellowish-white			9	10	25				
Mainly black		5	3	10	8	18	33		
Black			9	27	29	64	66	100	100
Corbicular fringes									
Yellow	100	67	31	7	13				
Tipped yellow/yellowish-brown		16	38	22	33				
Mainly to all black		16	30	71	54	100	100	100	100
3rd to 5th tergite									
Without black bristles	96	74	41	20	25	18			
With black bristles	4	26	59	80	75	82	100	100	100

worthy and indicate that the species occasionally reach *regio subalpina.*

Biotopes: Meadows, *leguminosae* fields.

A total of about 400 specimens was examined.

List of localities. *Östfold (Ö):* Hvaler: ? loc. ZMO, Herföl, Kirköy; Sarpsborg: ZMO; Halden: NRS VCA, Hakelund, Sponvika; Marker: Dybedal; Råde: Tom; Moss: Jelöy VCA; Trögstad: Mönster bro. *Akershus (AK):* Ås: Vollebekk; Frogn: Dröbak VCA, Tusse TRM; Bærum: ? loc. TRM, Hövik ZMO; Oslo: DCL TRM ZMB ZMO. *Hedmark (HEs):* Grue: Finnskog; Hamar: ZMB ZMO; Ringsaker: Vea. *Oppland (Os):* Gran: Lander; Östre Toten: NW Skreia; Öyer: Skåi, Öyer. *On:* Dovre: Dovrefjell 2 ♀♀ ☿ (Schiödte) ZMC, ☿ 1910 (Wretlind) ZMU. *Buskerud (Bö):* Hurum: Filtvedt TRM; Drammen; Modum: Modum ZMO, Snarum. *Vestfold (VE):* Andebu: Kodal; Stokke: Langö, Stokke, Veierland; Nötteröy: Teie; Hedrum: Hedrum; Brunlanes: Dolven, Helgeroa; Larvik: Byskogen. *Telemark (TEy):* Bamble: Brevikstranda, Trosby, Åby; Nome: Damtjern, Nos, Risdalen, Åkredalen; Kragerö: Levang. *TEi:* Notodden: Tindegrend; Sauherad: Liagrend. *Aust-Agder (AAy):* Risör: Nistevåg; Tvedestrand: Dypvåg, Laget, Nes Verk TRM ZMO; Arendal: Salteröd; Hisöy: Gjervoldsöy, His; Öyestad: Björbekk, Helle. *Vest-Agder (VAy):* Kristiansand: ZMO; Lindesnes: Ramsland. *VAi:* Åseral: Rosseland.

Sweden. Widely distributed throughout the lowlands northeast to nearly 64° 30′ N in Västerbotten and penetrating *reg. subalpina* in Dalarne. Moreover occurring in Gotland, but not recorded in Öland.

A total of about 1250 specimens was examined.

List of localities. *Skåne:* Barkåkra NRS, Bjuv, Bjärred, Björnstorp ZMB ZML, Blentarp, Brösarp NRS ZML, Bulltofta, Dalby, Degeberga NRS ZML, Drakemöllen NRS, Falsterbo, Fågelsång, Glimåkra NRS, Gärdslöv, Hannäs ZMU, Höllviksnäs, Kristianstad NRS, Kyrkheddinge, Kävlinge, Lackalänga, Ljunghusen, Lund NRS ZML, Löddeköpinge, Löderup NRS ZML, Maglehem NRS ZML, Norra Uglarp, Nosaby, Näsum NRS, Revingehed, Sandhammaren NRS, Silvåkra, Sjöbo NRS, Skivarp, Södra Sandby ZMB ZML, Torna-Hällestad, Trelleborg ZMB, Veberöd, Vinslöv, Ystad, Åhus NRS ZMU. *Blekinge:* Bräckne-Hoby, Hemsjö, Hällevik NRS ZML, Jämjöslätt, Karlskrona NRS, Kristianopel GNM NRS, Mörrum, Sandbäck, Sjöarp NRS, Torhamn NRS ZML. *Halland:* Fagered, Falkenberg, Fjärås, Halmstad NRS ZML, Harplinge NRS, Mellbystrand, Trönninge, Tylösand NRS, Varberg. *Småland:* Brånstorp NRS, Eksjö NRS, Häradsäter GNM, Högsby NRS, Höreda NRS, Jönköping NRS, Kalmar NRS, Ljungarum NRS, Ljungby, Misterhult ZMU, Myresjö NRS, Nye, Oskarshamn, Påryd, Ryssby ZML ZMU, Sommen NRS ZML, Traneryd ZML, Tranås NRS, Vimmerby, Österkorsberga NRS ZML ZMU. *Gotland:* ? loc. JCL, Atlingbo GNM, Boge GNM. *Östergötland:* Aska NRS, Borensberg ZML ZMU, Boxholm, Fröstad, Harg NRS, Hällestad NRS, Högby NRS, Kimstad NRS, Kisa, Kvarsebo NRS, Linköping NRS ZMB ZML, Malmslätt NRS, Mjölby NRS, Norrköping NRS, Norsholm, Skönberga NRS, Stjärnorp ZMB, Svärtinge NRS, Vadstena NRS, Valdemarsvik GNM NRS, Östra Skrukeby. *Västergötland:* Askim, Falköping NRS, Göteborg NRS, Hjo NRS, Horred NRS, Händene NRS, Jonsered NRS, Kinnekulle, Läckö NRS, Mölndal, Skara GNM NRS, Skinnarhult NRS, Skövde NRS, Töreboda NRS, Vinninga NRS, Öjahed. *Bohuslän:* Bovallstrand NRS, Bro NRS, Dingle NRS, Edshultshall NRS, Fiskebäckskil, Hålta NRS, Munkedal, Naverstad, Rossöhamn NRS, Strömstad NRS ZML, Syd-Koster NRS, Tanumshede NRS, Ulebergshamn NRS, Ytterby NRS, Ödsmål. *Dalsland:* Ed NRS, Fröskog GNM, Gesäter ZMB, Holm, Köpmannebro, Rostock ZMB, Råggärd ZMB, Skållerud NRS, Skåpafors NRS, Stenebynäs NRS, Tösse, Åmål NRS ZML. *Närke:* Askersund, Stora Mellösa ZMB, Örebro. *Södermanland:* Björnlunda NRS, Brandalsund NRS, Fagersjö NRS, Fittja NRS, Handen NRS, Ludgo NRS, Mjölnbo NRS, Muskö NRS, Nacka, Nyköping NRS ZML, Näshulta NRS, Ornö GNM, Sparreholm NRS ZML, Stjärnhov NRS, Strängnäs ZMB, Trosa, Tullgarn NRS, Tullinge NRS, Tyresö NRS, Valla NRS, Viksberg NRS, Vreta, Älta NRS, Ålberga ZMB ZML. *Uppland:* Adelsö NRS, Almunge NRS, Björklinge NRS, Björknäs NRS, Gustavsberg NRS, Hammarby NRS, Harpabol, Håbo Tibble NRS, Häggeby, Håtuna, Ingarö, Jumkil NRS, Järlåsa NRS, Lennartsnäs NRS, Rimbo NRS, Roslagen ZMU, Rö NRS, Skokloster ZMB, Stockholm NRS ZML ZMU, Tensta ZMB, Tierp NRS, Täljö NRS, Ultuna ZML IVU, Uppsala BML IVU NRS ZML ZMU, Vassunda IVU NRS, Värmdö, Össebygarn NRS, Österskär, Östra Ryd NRS. *Västmanland:* Arboga ZMB ZML, Fellingsbro ZMB, Guldsmedshyttan NRS, Kolbäck NRS, Kärrbo ZMB, Köping ZMB, Lindesberg NRS, Skultuna ZMB, Valsta ZMB. *Värmland:* Alster NRS ZML, Arvelsäter NRS, Arvika NRS ZML, Daglösen NRS, Dalby, Forsvik, Frykerud NRS, Gylleby in Sunne NRS, Hammarö NRS, Långban NRS, Molkom NRS, Munkfors NRS, Mölnbacka NRS, Niklasdamm NRS, Odenstad NRS, Ransby, Rottneros NRS, Säffle NRS, Ölme. *Dalarne:* Blyberg NRS, Brunnsvik NRS, Falun ZMU, Finngärdet, Hedemora, Häggesundet NRS, Ludvika NRS, Mora, Smedjebacken, Stora Tuna NRS ZML, Sundborn, Söderbärke NRS, Torsång NRS, Tällberg Tje. *Gästrikland:* Björke NRS, Gävle, Hamrångerfjärden, Hille-Forsby NRS ZML, Ockelbo NRS, Torsåker, Trödje NRS. *Hälsingland:* Delsbo NRS ZML, Kilafors NRS, Söderhamn NRS. *Medelpad:* Bergeforsen

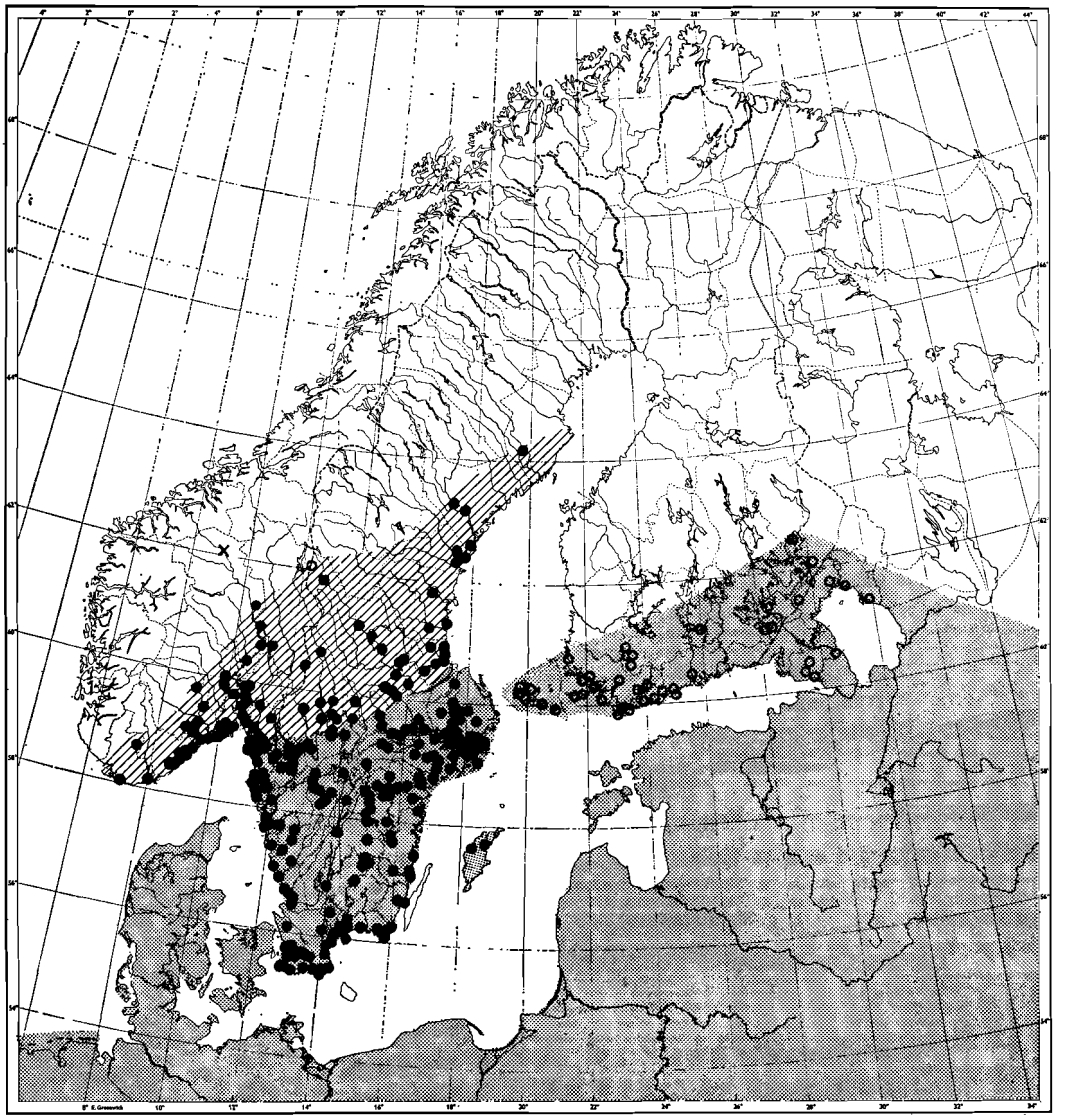


Fig. 79. *B. humilis* Illiger. Obliquely hatched: *B. h. hafsahlianus* Vogt. Legends as in Figs. 50, 54.

NRS, Sundsvall NRS, Tynderö NRS. *Ångermanland:* Forsmo NRS, Härnösand NRS, Överlännäs NRS. *Västerbotten:* ♀ 24 June 1951 (Forsslund) Degerfors NRS.

Unrevised records were not included here except Dalarne: Storsätern 700 m (Ander in litt.).

Finland. Occurring from southwestern archipelago northeast to about 62°30′ N. Records plotted on the map (Fig. 79) were taken from Elfving (1968).

World distribution. Europe (England; on the continent from NW Spain, Mediterranean north to Fennoscandia; European USSR north to districts of Leningrad, Tatar, Bashkir and south to districts of Vinnitsa, Kharkov, Stalingrad) – Crimea – Turkey – Iran – Caucasus – Transcaucasus – Southern Urals – Northern Kazakhstan – Tien Shan – Baykal – Northern Mongolia (Krüger 1940, p. 385; Panfilov 1957; Reinig 1968; Yarrow in litt.).

Biology

Flight season. From beginning of May till end of August. Queen: 14 May–?; worker: 20 May–22 Aug.; male: 22 June–24 Aug.

BOMBUS HUMILIS HAFSAHLIANUS VOGT

Queen, worker

Queen measurements. N = 20; SE Norway; malar space: 0.81 mm (±0.04±0.01) range: 0.75–0.90 mm; 'radial length': 3.57 mm (±0.08 ±0.02) range: 3.45–3.75 mm; interalar width: 4.63 mm (±0.14±0.03) range: 4.28–4.90 mm. Body of medium to small size.

Colour pattern. Pile of face with variable mixture of black and yellow, or entirely black. Pile of vertex yellowish-brown or with slight admixture of black. Dorsum of thorax, at most dorsal third of episternum pronounced yellowish-brown to orange-brown. Episternum otherwise black-haired as also venter, or with variable admixture of yellowish-white hairs. Fringes of sternites black or greyish-white. All legs black, occasionally trochanters and hind femur with variable admixture of pale yellow hairs. Corbicular fringes black or dark yellowish-brown, occasionally tipped so. T_1 usually with yellowish-brown pile, occasionally with lateral black patches or more scattered admixture of black hairs. Pile of T_2 dark yellowish-brown to brownish-black except for posterior margin being fringed yellowish-brown. T_{3-5} dull yellow-haired with variable admixture of black bristles, occasionally yellow hairs replaced by yellowish-brown ones, particularly on anterior part of each of T_{3-4}. T_6 black-haired, occasionally with admixture of yellowish-brown hairs.

Male

Colour pattern. Pile of face, episternum, venter, trochanters, femora usually predominantly pale yellow. Fringes of sternites whitish. T_6 black-haired with variable admixture of yellow or yellowish-brown hairs. Pile of T_7 black. Otherwise colouring as in the female though often of a lighter shade.

Variation. Vast minute variations in addition to the general variations included above.

Distribution (Fig. 79)

Scandinavia. Confined to the northern border areas of the distribution of the species in Scandinavia. Smooth clinal variations and rather sparse material from some of the districts make it difficult to indicate the southern limit of the distribution of the subspecies which of course in any case is artificial.

Total distribution of the subspecies, B. humilis hafsahlianus Vogt. Scandinavia.

BOMBUS (THORACOBOMBUS) MUSCORUM (LINNAEUS)

Apis muscorum Linnaeus, 1758, p. 579 No. 32, type area Sweden: Uppland. A female LSL! labelled *muscorum* disagrees with the usual interpretation of the taxon.

(Bombus muscorum (Linnaeus) in sensu Fabricius 1775, nec Yarrow 1968; Dahlbom 1832, p. 46 (partim), 1837 (partim); Wahlberg 1854 (partim); Thomson 1870 (partim), 1872 (partim); Siebke 1870, 1880; Roth 1897; Strand 1898a, 1898b; Aurivillius 1903 (partim); Wahlgren 1908, 1915; Ringdahl 1921; Meidell 1934a, 1946; Wexelsen & Skåre 1934; Kruseman 1959, 1964; Elfving 1960, 1968; Erlandsson 1960; Løken 1960; Ander 1963, 1965. *Bombus cognatus* auctt. nec Stephens, 1846 (partim). *Bombus smithianus* auctt. nec White, 1851; Friese 1902; Sparre Schneider 1902; Richards 1935; Yarrow 1959; Elfving 1960, 1968. *Bombus alpinus smithianus* auctt. nec White; Lie-Pettersen 1901. *Bombus cognatus* var. *smithianus* auctt. nec White; Lie-Pettersen 1905; Sparre Schneider 1906. *Bombus muscorum* var. *smithianus* auctt. nec White; Lie-Pettersen 1907; Sparre Schneider 1909, 1910; Friese & Wagner 1909, 1912; Hellén 1933; Meidell 1934a. *Bombus muscorum smithianus* auctt. nec White; Løken 1960. *Agrobombus*

smithianus auctt. nec White; Popov 1930. *Bombus muscorum* grex *muscorum* (Linnaeus) and *Bombus muscorum* grex *smithianus* ssp.; Kruseman 1964.)

Nomenclatural remarks

A queen in the Linnaean collection, London labelled *muscorum*, is ascribed to *B. humilis* Illiger (Richards 1935). It is, however, highly doubtful whether this is an original specimen, cf. p. 10. To secure stability of nomenclature, *B. muscorum* (Linnaeus) sensu Fabricius is kept. The taxon extends north to Uppland, the home area of Linnaeus, which is also the type area.

B. cognatus Stephens is a *nomen nudum* teste Sherborn (1902–33).

B. smithianus White refers to *B. pascuorum smithianus* White = *B. arcticus* Dahlbom and the name has therefore erroneously been applied to dark populations of *B. muscorum*, cf. p. 154. As, however, the '*smithianus*' form of *B. muscorum* comprises several subspecies, cf. below, the name needs no replacement.

First Scandinavian records

Norway. Throughout the country (Dahlbom 1832, p. 47). Specimens confirming this statement have not been traced. Moreover, neither records from Buskerud (Bö): Ringerike nor from Oppland (On): Vang (Siebke 1870) can be found. Both authors confused the species with *B. humilis* and *B. pascuorum*. First reliable records were Oslo and Bergen (Siebke 1880).

Sweden. Uppland (Linnaeus 1758).

Subspecific discussion

Two Scandinavian subspecies were previously recognized (Løken 1960), viz. *B. m. muscorum* and *B. m. smithianus* auctt. nec White, the latter being treated as identical with populations in Shetland, Hebrides, and Northwestern Scotland (Richards 1935). As many as three subspecies were suggested by Kruseman (1964): (1) *B. m. muscorum;* (2) '*B. m.* ssp.: Norge'; (3) '*B. m.* ssp.: Dalarne (Suede)'. The study below maintains two well-defined subspecies, viz. *B. m. muscorum* and *B. m. liepetterseni* nov. ssp. (= '*B. m.* ssp.: Norge'), whereas the taxonomical position of the isolated records from Sweden: Dalarne is considered uncertain, cf. p. 153.

The Norwegian populations display a striking shift in the colour pattern on going north. Corresponding with the dorsal yellowish-brown pile of thorax becoming brighter and darker, the pale dull-yellow ventral coat turns to black. Four features contributing to the change in the colouring have been examined and grouped in progression from the palest to the darkest. The data (Table XVIII), presented graphically (Fig. 80), demonstrate a clinal variability with levelling

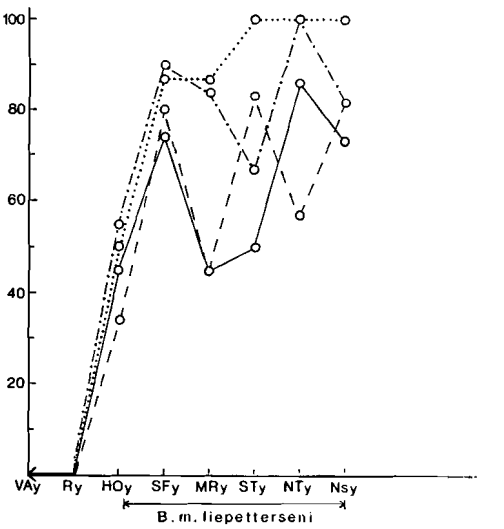


Fig. 80. *B. muscorum* (Linnaeus). Percentage of females with black pile of face (_____), black-haired episternum (.....), hind femur (_ _ _ _) and corbicular fringes (__.__) plotted against outer districts of counties ranging from Vest-Agder (VAy) to Nordland (Nsy) in Norway (cf. Table XVIII).

at either end which supports subspecific designations, viz. *B. m. muscorum* in the south, confined to Vest-Agder and Rogaland, and *B. m. liepetterseni* in the north occurring from northern part of Hordaland and northwards. The intergrading area, being in Hordaland, presents a greater number of extreme forms than inter-

mediates (Table XVIII) which show clinal variations in steps.

The Swedish population belongs to the nominate subspecies except the occurrence in Dalarne.

Taxonomical remarks on the subspecies

The dark populations occurring in the British Isles, Scandinavia, Finland and European USSR have been recognized in turn as a distinct species, *B. smithianus* auctt. nec White (Forsius 1925; Popov 1930; Richards 1935; Elfving 1960, 1968), as several subspecies of *B. muscorum* (Kruseman 1964; Yarrow 1967), and as a single subspecies of *B. muscorum* (Reinig 1970, p. 71). Popov (1930) claims the specific position of the dark populations, the '*smithianus*' group, from the shade of the colouring of the coat and the shape of the male St_8. Specimens examined by me agree with those studied by Richards (1935), i.e. the male St_8 in the dark populations and that of typical *B. muscorum* display so many variations in shape that this feature has no specific significance. In addition to the phenotypical study above, the triangular graph (Fig. 81), based on measurements of malar space, 'radial length', and interalar width, illustrates clearly the subspecific position of the dark Scandinavian populations. *B. m. muscorum*, *B. m. liepetterseni*, and the specimens from Dalarne present a congruent spreading of the markings on the graph, which emphasizes their conspecific identity.

Thus it seems likely that *B. muscorum* produces darker forms in northwestern and northern border areas and in the south, viz. *B. m. pereziellus* Skorikov in Corsica (Yarrow 1967). Further information is needed to estimate whether the subspecies, designated to the 'fringed' populations, qualify for that rank, should be split, or reduced to infrasubspecific forms. The subspecific position of *B. m. liepetterseni* is well

Table XVIII. Percentage of female *B. muscorum* (Linnaeus) exhibiting certain characters of colour pattern in populations along the coast of Norway. Area = county or district thereof (cf. Fig. 99)

Area	VAy	Ry	HOy	SFy	MRy	STy	NTy	Nsy
Number of specimens	7	25	58	30	31	12	7	22
Pile of face								
Yellow	100	92	24					
Mainly yellow		8	10	3	3			
Mainly black			21	24	52	50	14	27
Black			45	73	45	50	86	73
Episternum								
Yellow	100	100	31					
Mainly yellow			2	3				
Mainly black			17	10	13			
Black			50	87	87	100	100	100
Hind femur								
Yellow	100	100	33					
Mainly yellow			2	7				
Mainly black			31	13	55	17	43	18
Black			34	80	45	83	57	82
Corbicular fringes								
Yellow	57	64	22					
Mainly yellow	43	36	14	3				
Mainly black			9	7	16	33		18
Black			55	90	84	67	100	82

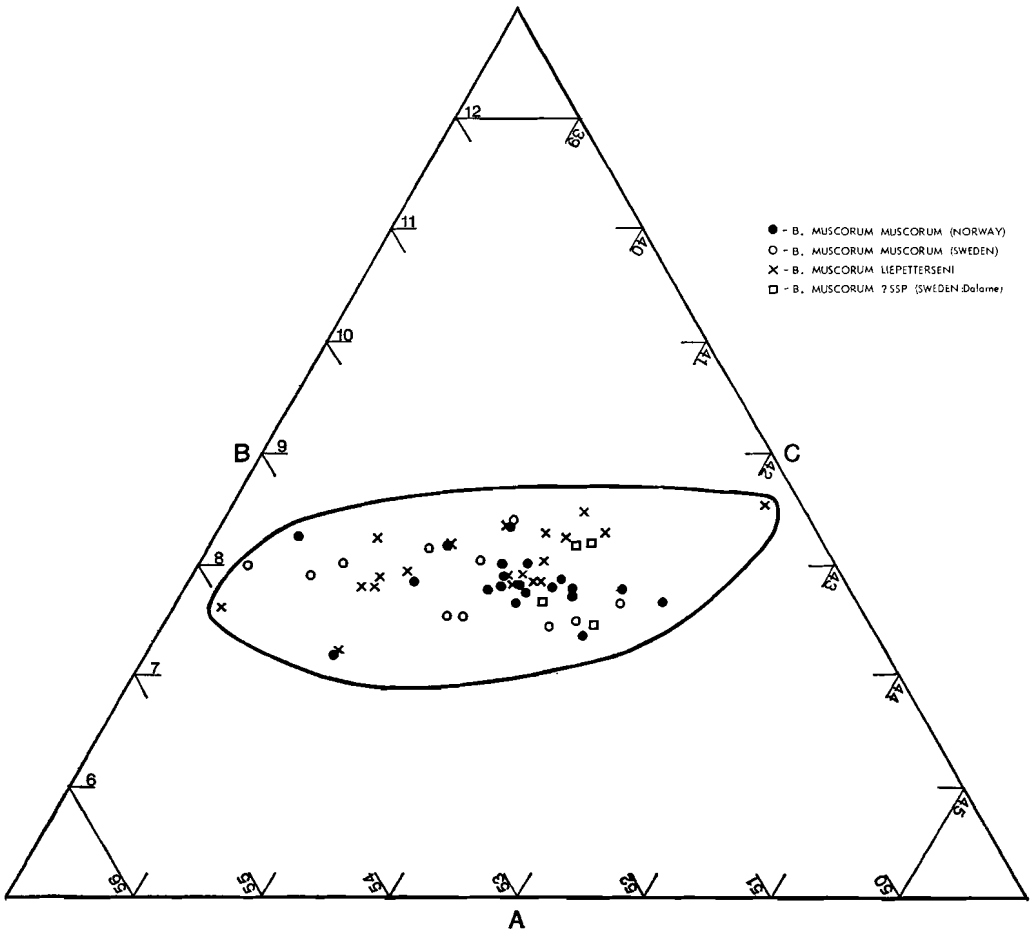


Fig. 81. Triangular graphing of malar space (A), 'radial length' (B) and interalar width (C) of *B. muscorum* (Linnaeus).

established. The dark British populations (Yarrow 1967) and the present knowledge of the Finnish populations discussed below, indicate that additional subspecies are involved in the '*smithianus* group'.

Queen, worker

Morphological characters. Clypeus, malar space barely longer than respective distal width, the latter about as long as A_{3+4}. Disc of clypeus with fine puncturing except for the small flattened and impunctate anterior area between lateral coarsely punctured impressions. Labral furrow more or less widened towards the base, labral lamella rather chagreened, dull, with moderately sharp distal edge. Frons rather densely punctured though sparser towards frontal line. Distance from lateral ocellus to preoccipital ridge markedly longer than from lateral ocellus to eye. T_2-$_3$ laterally with rather papillate microsculpture, hairs arising from pustules. Keel of St_6 conspicuous. Coat dense, that of dorsum of thorax even, short on the disc and anteriorly and posteriorly fringed by longer hairs. For measurements, cf. the subspecies.

Colour pattern. Dorsum of thorax orange-brown. T_{1-5} dull yellow to greenish-yellow, otherwise cf. the subspecies.

Male

Morphological characters. Malar space slightly longer than distal width, about as long as A_{2+3}. A_4 hardly longer than distal width of the segment. A_{5-13} moderately swollen beneath (Fig. 48A). Posterior fringes of hind tibia longer than greatest width of the segment. St_8 and genitalia as in Figs. 48B–C; distal part of gonocoxite produced inwards; gonostylus inwardly produced into simple jointed, strongly projecting lamella; distal margin of volsella with a broad not much projecting process and a broad subapical triangular tooth (Fig. 48D); penis valve hooked at apex, without or with indication of tooth beneath (Fig. 48E). Coat rather even. Body of medium size.

Colour pattern. Resembles the female, for details cf. the subspecies.

Distribution (Fig. 82)

Norway. Restricted to coastal areas from the southernmost point of the country, viz. Vest-Agder (VAy): Lindesnes, north to nearly 68° N. Single records from southeastern lowlands., viz. Oslo area and Buskerud (Bö): Kongsberg, concern old finds and it is doubtful whether the species exists in these areas nowadays.

Biotopes: *Erica* marshes, sandy fields with growth of *Leguminosae*.

A total of about 820 specimens was examined.

List of localities. *Akershus:* Oslo: ♀2☿☿2♂♂ (Siebke) ZMO. *Buskerud (Bö):* Kongsberg: ♀ Aug. 1902 (ex. coll. Schneider) TRM. *Vest-Agder (VAy):* Lindesnes: Lindesnes; Farsund: Fjelleså, Lista fyr, Lodshavn, Tjörve, Vanse; Flekkefjord: Hidra. *Rogaland (Ry):* Sokndal: Hauge i Dalane, Nesvåg, Sogndal, Vatland; Eigersund: Eigeröeidet, Fotlandsvann, Klungland st., Leidland, Lysevann; Hå: Anisdal, Brusand, Fossfjellet, Fuglset, Nærland TRM, Ogna, Opstad, Salte bru, Stölen, Varhaug, Vigrestad, Vatnamo; Klepp: ? loc. TRM, Börsheim, Gjeishaug, Horpestad, Klepp, Kåsen, Orre, Orrevann, Reve; Time: Time; Sandnes: TRM, Hana; Sola: Solastrand, Tananger, Ölbergstranda; Randaberg: Sande; Stavanger: Lindöy; Rennesöy: Dale; Kvitsöy; Karmöy: Ferkingstad, Fotvann, Risdal, Sæveland, Söndenå, Vigsnes; Utsira: SMS. *Ri:* Forsand: Meling. *Hordaland (HOy):* Bömlo: Gjertrudsviken, Rolfsnes, Goddö; Fitjar: ? loc., Klaksöy, Risöy; Tysnes: Vernöy; Austevoll: Inneröy, Horgo, Karlsöy, Ytteröy; Fana: Dolvik VCA, Krokeide VCA, Minde VCA, Skipanes VCA; Sund: Leröy, Steinsland, Telavåg; Fjell: Eide, Landro, Mövik, Solsvik, Ölveset; Laksevåg: Storingavika; Bergen: TRM VCA ZMB ZMO; Asköy: Davanger, Hanöytangen, Hedlesund, Herdla VCA ZMB, Horsöya, Lamöy, Odlandsvik VCA; Åsane: Salhus VCA; Meland: Bratshaug VCA, Io, Sætre VCA ZMB; Öygarden: Njupsholmen, Rongöy VCA, Straumöy; Radöy: ? loc. VCA TRM ZMB, Fedje. *Sogn og Fjordane (SFy):* Solund: Færöy, Ospa; Hyllestad: Hatleim, Hyllestad, Skivenes; Askvoll: Aralden, Einen, Grytöyri; Flora: Askrova, Florelandet, Kinn, Nekköyna, Reksta, Rindemyr; Eid: Haugland; Vågsöy: Degnepollen, Hagen, Kråkenes, Kvalheim, Målöy, Refvik, Röysen; Selje: Dalsbo, Ervik, Lekanger. *Möre og Romsdal (MRy):* Sande: Gurskevåg, Kobbevik, Larsnes, Åran; Hareid: Hjörungavåg; Ulstein: Flö, Ulsteinvik, Vonheim; Heröy: Djupsvik, Runde; Ålesund: VCA; Aukra: Falkhytta, Kolsholmen, Rindaröy, Röd; Fræna: Bud, Gjendem, Gule Bru, Viken; Eide: Vevang; Smöla: Andholmen KMT, Edöy KMT. *Sör-Tröndelag (STy):* Fröya: Fröan VCA TRM, Halten KMT; Hitra: ? loc. TRM, Hamn; Örland: ? loc. KMT, Bakken, Beian, Hovde KMT. *STi:* Trondheim: KMT TRM VCA. *Nord-Tröndelag (NTy):* Flatanger: Björöyvær KMT, Halmö TRM; Næröy: Garmannsviken. *Nordland (Nsy):* Vega: TRM VCA; Heröy: Syd-Heröy TRM; Luröy: ZMO, Lovund TRM; Melöy: Kunna, Storglomvann 500 m ZMO; Gildeskål: Sör-Fuglöy; Bodö: Bodö, Karlsöyvær, Löpsviken, Store Hjartöy.

Corrections. Records from Buskerud (Bv): Ål (Strand 1898a) were revised to *B. distinguendus* Morawitz and *B. pascuorum* Scopoli respectively. Those from Finnmark (Fi): Alta: Jotkajavrre and Kåfjord (Hellén 1933) were revised to *B. pascuorum smithianus* White. Records from Hedmark (HEs): Vang: Hjellum (Wexelsen & Skåre 1934) were revised to *B. humilis* Illiger by Meidell (unpublished). Occurrence in Troms (TRy): Hillesöy situated at 69°35′ N (Popov 1930, p. 97 in referring to Sparre Schneider 1910) is due to linguistic misunderstanding.

As the species has been confused with *B. humilis* and *B. pascuorum*, unrevised records are not included here.

Sweden. Locally rather frequent in Öland, Gotland, and in southernmost part of the main-

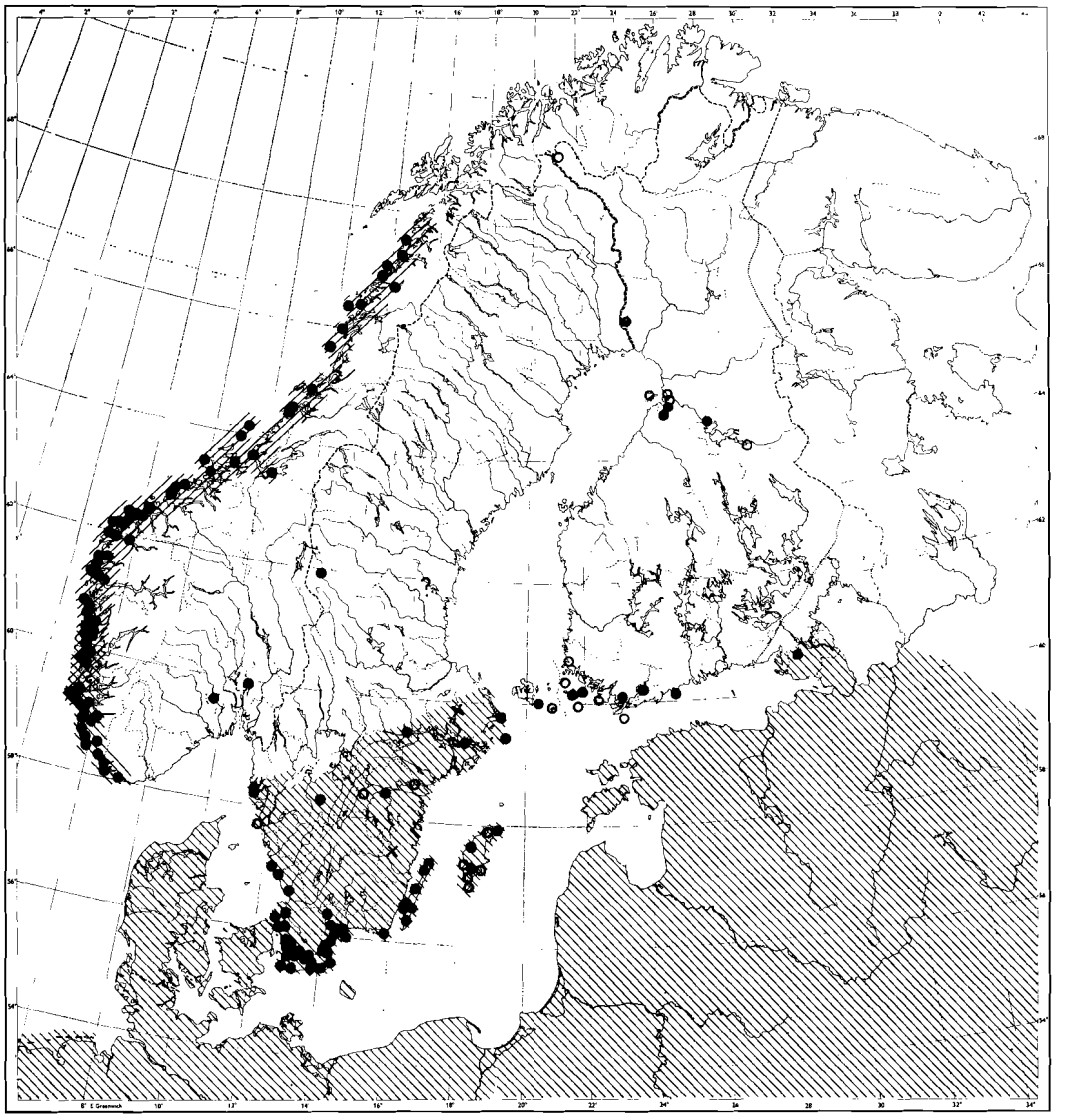


Fig. 82. *B. muscorum* (Linnaeus). Oblique up to the left hatching = *B. m. muscorum;* oblique up to the right hatching = *B. m. liepetterseni* nov. ssp. Legend as in Fig. 50.

land. Sparsely distributed further northeast to nearly 60° N in Uppland. The isolated occurrence in Dalarne: Idre, nearly 62° N is noteworthy, cf. below.

A total of about 430 specimens was examined.

List of localities. *Skåne:* Allerum Lar, Andrarum DCL, Arkelstorp NRS, Arlöv ZMA, Billeberga, Bjällerup Lar, Bjärred, Blentarp, Bokskogen ZMB ZML, Bäckaskog GNM NRS, Bökeberg, Dalby, Degeberga NRS, Fotevik GNM, Fårhult Lar, Genarp ZMB, Glimåkra NRS, Gärslöv, Hannäs NRS ZMU, Hjarnarp NRS, Hälsingborg VCA, Höganäs NRS, Ilstorp, Ivö NRS, Knästorp ZMB, Krageholm, Kristianstad NRS, Kyrkheddinge, Kävlinge NRS TCL ZML, Lerhamn Lar, Ljunghusen, Lund TCL ZML, Löddeköpinge ZMB ZML, Löderup NRS, Maglehem NRS ZML, Mälarhusen NRS, Ravlunda, Rebbelberga, Revingehed ZMB, Rögle Lar, Saxtorp, Simrishamn NRS, Smyghult Lar, Södra Sandby ZMB ZML, Trelleborg GNM, Vegeholm Lar, Vitemölle NRS,

Vä Lar, Ystad NRS, Örtofta GNM, Övedkloster ZMA ZML, Åhus NRS ZML. *Blekinge:* Gammelstorp GNM, Hällevik, Torhamn. *Halland:* Falkenberg, Halmstad NRS. Varberg GNM. *Småland:* ? loc. GNM NRS TCL. *Öland:* Bengtstorp, Färjestaden, Hornsjö ZMB, Högsby NRS, Köping ZMB, Möckelmose NRS, Mörbylonga NRS ZML, Norra alvaret, Resmo NRS, Stenåsa alvar NRS ZML, Stora alvaret NRS. *Gotland:* Austers NRS, Burs, Fårö DCL, Mölner, Ulla Hau DCL, Visby NRS. *Östergötland:* Linköping ♀♂ ZMB ZML. *Västergötland:* Falköping ♀ NRS. *Bohuslän:* Kristineberg, Skaftö NRS. *Uppland:* ? loc. ♀ (old specimen, no data) NRS, Nassa 70 km E Stockholm ♀ 30 July 1951 (Nordström) NRS, Stockholm ♂ (Boheman) NRS, Söderarm 30 km E Norrtälje 2 ♀♀ 13 Aug. 1932 (? leg.). *Västmanland:* Malmör E Köping ♀ 28 June 1929 (Ander) ZMB. *Dalarne:* Idre 3 ♀♀ 10 July 1907 ♀ 14 July 1907 (Bengtsson).

Unrevised records are not included here except the following (Ander in litt.): *Gotland:* Fide, Fidenäs, Fleringe, Hamrashage, Holmhallar, Hörte, Närshamn. *Bohuslän:* Öckerö. *Östergötland:* Bråviken, Tåkern.

Corrections. Records from Värmland: Dalby and Ransby in Klarälvdalen (Wahlgren 1908) were revised to *B. humilis*. As regards records from Dalarne: Mora and Hälsingland: ? loc. (Kruseman 1964 the map) the first was revised to *B. humilis* while the latter, being questioned on the map (Fig. 82) was not traced.

Finland. Observations so far indicate one population confined to the southwestern coastal areas, preferably inhabiting the archipelago, and another population restricted to the coast around 65° N. The very disperse additional records, even as far north as Lappland (Le): Kilpisjärvi (Elfving 1968), are noteworthy.

Revised and unrevised records (Fig. 82) refer to Elfving (1968) except the following: Al: Klåvskär AKÅ; N: Lappvik and Lojo AKÅ; Om: Ruukki ZML; Ok: Vaala ZMA and Sotkamo (Popov 1930, p. 98); Ob: Aavasaxa NRS.

World distribution. Europe (British Isles; Corsica; on the continent from Spain, Mediterranean north to Fennoscandia; European USSR, in north locally penetrating the taiga almost to Polar Circle and in the south avoiding semi-desert areas) – Turkey – Caucasus – Transcaucasus – Kazakhstan – Northern Tien Shan – Southern part of Western Siberia – Baykal area – Yakutsk – Southern Primorsky – Northern Mongolia – Manchuria (Panfilov 1957 and in litt.; Kruseman 1964; Yarrow 1967).

Zoogeographical remarks

The islet records in Southeastern Norway, in Sweden: Dalarne and in Northern Finland (Fig. 82) may refer to relic occurrence indicating a wider distribution of *B. muscorum* throughout Fennoscandia in earlier post-glacial periods. According to Popov (1930) the dark populations fringing the British Isles, Western Scandinavia, and dispersely occurring in Sweden, Finland, Northern Russia, is a European subarctic species relic in the recent fauna. As indicated in the subspecific discussion above, these populations refer to *B. muscorum* producing darker forms in some range of its extreme border areas.

Biology

Nest. Pocket-maker. Nest on the surface of the ground is recorded in grass fields, in moss and in marshy *Erica – Calluna* heaths. The colonies are small and often infested by parasites. The total number of imagines and young at the peak of the season has not exceeded 40 individuals in investigated colonies (Lie-Pettersen 1901 1905, 1907; Løken 1961a).

Flight season. From middle of May to last half of September. Queen: 13 May–18 Sept.; worker: 18 June–15 Sept.; male: 28 July–20 Sept.

BOMBUS MUSCORUM MUSCORUM (LINNAEUS)

The subspecies is distinguished from *B. m. liepetterseni* by the dull rather pale yellow episternum and venter.

Queen, worker

Queen measurements. N = 20; Norway: Rogaland; malar space: 0.76 mm ($\pm$0.04 $\pm$0.01) range: 0.70–0.85 mm; 'radial length': 3.95 mm ($\pm$0.11 $\pm$0.02) range: 3.75–4.10 mm; interalar width: 5.03 mm ($\pm$0.12 $\pm$0.03) range: 4.85–5.23 mm. Body of medium to large size.

Colour pattern. Pile of face, pile of vertex and along preoccipital ridge yellow, remainder of head with hairs varying from being predominantly black to entirely yellow. Dorsum of thorax orange-brown, anteriorly and posteriorly often fringed yellow. Dorsal edge of episternum orange-brown, usually of a lighter shade than dorsum of thorax; remainder of episternum, at least fringes of gastral sternites, trochanters, and femora pale yellow to whitish except for black hairs inside fore- and mid-femora. Tibiae and tarsi black or brownish-haired except for the pale yellow corbicular fringes with shorter black bristles. T_{1-5} dull yellow, yet T_2 often of darker shade, occasionally brownish. T_6 with black hairs.

Variation. Corbicular fringes with a variable admixture of dark hairs. Individuals with pronounced dark episternum and venter were recorded together with the typical form in Gotland: Fårö and Bohuslän: Skaftö. A queen and two workers from the extreme coast of Uppland county display a similar appearance. Otherwise the colour pattern displays only minute variations.

Male

Colour pattern. Pile on T_6 coloured as T_5. T_7 black-haired, otherwise colouring as in the female.

Variation. Colour-stable. A male from Skåne: Landskrona with dark brown dorsal thorax, fringed yellow in front and behind, was examined.

Distribution (Fig. 82).

Norway. Occurring along the coast in Vest-Agder and Rogaland, i.e. the subspecies is confined to the extreme southwestern coast.

Sweden. Dispersely distributed in Southern Sweden northeast to Uppland and also occurring on Öland, Gotland. However, only singly recorded inland. Thus, the Swedish population is treated as this subspecies with exception of the isolated records from Dalarne.

The total distribution of the subspecies, B. m. muscorum (Linnaeus). Europe (on the continent west to the English Channel, south to the Alps, north to Southern Scandinavia, the Baltic (perhaps the extreme southeast coast of Finland); the eastern and southeastern limits, being in USSR, are uncertain (Richards 1935; Panfilov in litt; Elfving 1968).

Zoogeographical remarks

Though geographically separated, the light-coloured population in Southern Norway is considered identical with the Swedish population, i.e. the nominate form, which may indicate a continuous distribution in earlier periods. The Norwegian population differs from that of Sweden by slightly greater size and a slightly longer coat, the difference in length of hairs on disc of thorax being estimated at about 0.25 mm.

BOMBUS MUSCORUM LIEPETTERSENI NOV. SSP.

'*B. m.* ssp.: Norge' Kruseman, 1964 = *B. muscorum smithianus* auctt. nec White (partim) is hereby named *B. muscorum liepetterseni* in honour of O. J. Lie-Pettersen.

The subspecies is distinguished from the nominate subspecies by black-haired episternum and venter.

Type material

Holotype: ♀ Nord-Tröndelag (NTy): Nærøy: Garmannsviken 8 July 1959 (Lø) ZMB. Paratypes: ☿ data as holotype ZMB; 2 ♀♀ 3 ☿☿ NTy: Nærøy: Garmannsviken 8 July 1959 (I. Meidell) ZMB; 3 ♂♂ Möre og Romsdal (MRy): Herøy: Runde 23–25 Aug. 1959 (Myklebust) ZMB. Type loc. Norway: Nord-Tröndelag (NTy): Nærøy.

Description of holotype: Malar space: 0.75 mm; 'radial length': 4.00 mm; interalar width: 5.20 mm. Pile of face black with a few yellow hairs admixed below antennal sockets. Pile of vertex yellowish-brown, laterally and anteriorly fringed black. Dorsum of thorax and adjacent edge of episternum deep orange-brown, lateral

fringes of propodeum black with slight admixture of yellowish-brown in the dorsal part. T_1 anteriorly black-haired, otherwise dull yellow. T_{2-5} dull yellow. Otherwise coat black.

Queen, worker

Queen measurements. N = 20; Norway: Nordland: Malar space: 0.82 mm (±0.03±0.01) range: 0.75–0.85 mm; 'radial length': 4.09 mm (±0.09±0.02) range: 3.80–4.20 mm; interalar width: 5.27 mm (±0.14±0.03) range: 4.90–5.53 mm. Body of large size.

Colour pattern. Cf. the holotype.

Variation. Pile of face, fringes of propodeum entirely black or with a few yellow hairs admixed. Femur, corbicular fringes with singly yellow hairs, occasionally the latter tipped yellowish-brown. Fringes of sternites with slight admixture of greyish hairs. Pile on T_2 occasionally of a somewhat darker shade than the subsequent tergites. A few individuals with single black hairs in the middle of anterior edge of T_2 were examined. The variations are rather minute.

Male

Colour pattern. Pile of face with variable admixture of yellow, occasionally predominantly yellow. Pile of vertex predominantly yellow or yellowish-brown. Dorsum of thorax and at least dorsal third of episternum yellowish-brown. Extreme anterior part of T_1 black as occasionally also lateral patches, otherwise hairs on this tergite yellow. Hairs on T_{2-6} dull yellow. At least fringes of St_{3-5} predominantly yellow. Otherwise coat black.

Variation. Ventral part of episternum ranging from entirely black to predominantly pale yellow. Hind femur with slight admixture of yellow hairs. T_7 occasionally with single pale yellow hairs admixed.

Distribution (Fig. 82)

Norway. Restricted to the extreme coast from 60° N and northwards.

The total distribution of the subspecies, B. muscorum petterseni n. ssp. Norway.

BOMBUS MUSCORUM ? SSP.

The subspecific status of 4 ♀♀ from an isolated location Sweden: Dalarne: Idre by, altitude 450 m, erroneously identified as *B. pascuorum smithianus* White (= *B. agrorum arcticus* Dahlbom) by Bengtsson (1908, p. 242), and revised to unnamed subspecies of *B. muscorum* grex *smithianus* by Kruseman (1964), is in my opinion uncertain. The colour pattern of the somewhat faded specimens is atypical and neither coincides with that of the nominate form nor with *B. m. liepetterseni*. The striking difference is the colouring of the abdominal coat. Pile of T_{1-4} is yellowish-brown except for lateral black patches, and T_5 is black-haired. Yet one specimen presents entirely black-haired T_1 while another has entirely black-haired T_4. Thus, instead of the dull yellow coat on T_{1-5} being typical of *B. muscorum*, the abdomen has the same yellowish-brown colour as thorax and additionally a pronounced admixture of black hairs. The coat is, moreover, longer and much more shaggy than typical for the species. The appearance is in fact closer to *B. pascuorum* than to *B. muscorum*, which explains the misidentification of Bengtsson. The specimens should for the moment be considered as aberrants.

The isolated records in Finnish Lapland (Le): Kilpisjärvi 2 ♀♀ (Elfving 1968) are striking. As for the remaining 'islet' occurrence of dark specimens in Finland (Forsius 1925; Elfving 1968), it is distinguished from *B. m. liepetterseni* by markedly shorter coat, smaller size and a few yellow hairs admixed in pile of face and episternum. The scattered records of dark specimens from the coast of Uppland in Sweden across Gulf of Bothnia to Åland Isles and southwestern mainland of Finland, and those from Northern Finland, are in fact more related to each other than to *B. m. liepetterseni* and the nominate subspecies. The sparse material is insufficient to indicate their taxonomical status but may favour the theory of relic post-glacial distribution mentioned on p. 151.

BOMBUS (THORACOBOMBUS) PASCUORUM (SCOPOLI)

Apis pascuorum Scopoli, 1793, p. 306 No. 819, no type exists, type area Yugoslavia: 'Carolia'. *(Bombus pascuorum* (Scopoli); Elfving 1968. *Apis senilis* Fabricius, 1775, p. 382 No. 26, Zimsen 1964, p. 417 No. 1102, lectotype ♂ KCC! designated by Løken (1966a), type area Denmark. *Apis mniorum* Fabricius, 1776, p. 247, Zimsen 1964, p. 416 No. 1095, no reliable type material (Løken 1966a), type loc. Germany: Kiel. *Apis agrorum* Fabricius, 1787, p. 301 No. 23 nec Schrank, 1781; Zimsen 1964, p. 416 No. 1090, syntypes KCC! (Løken 1966a). *Bombus agrorum* (Fabricius); Dahlbom 1832, p. 47, 1837; Wahlberg 1854, 1855; Siebke 1870, 1873, 1880; Thomson 1870, 1872; Sparre Schneider 1889, 1895b, 1906, 1909, 1918; Nerén 1892; Strand 1898a, 1898b, 1901, 1904, 1910; Lie-Pettersen 1901, 1905, 1907; Friese 1902; Aurivillius 1903; Bengtsson 1904, 1908, 1931; Muchardt 1904; Wahlgren 1908; Ringdahl 1915; Lundblad 1924; Soot-Ryen 1925; Krüger 1928, 1931; Gaunitz 1929; Meidell 1934a, 1946; Wexelsen & Skåre 1934; Barendrecht 1941; Brinck & Wingstrand 1949; Løken 1949, 1950, 1958a, 1960, 1966c; Brinck 1951; Ander 1953a and b, 1963, 1965; Tjeder 1954; Kruseman 1958a, 1959; Elfving 1960; Fridén, Eskilsson & Bingefors 1962; Hasselrot 1962; Fridén 1967. *Apis floralis* Linnaeus in Gmelin, 1790, p. 2785 No. 125, no type exists. *Apis pygmaea* Fabricius, 1793, p. 324 No. 46, a single ☿ KCC! in poor condition, impossible to confirm agreement with the description, type loc. Germany: Kiel. *Apis francillonella* Kirby, 1802, p. 319 No. 75, holotype ☿ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Apis sowerbiana* Kirby, 1802, p. 322 No. 77, holotype ♂ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Apis beckwithella* Kirby, 1802, p. 323 No. 78, holotype ♀ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Apis curtisella* Kirby, 1802, p. 324 No. 79, holotype ♂ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Bombus curtisellus* (Kirby); Dahlbom 1832, p. 49. *Apis forsterella* Kirby, 1802, p. 325 No. 80, holotype ☿ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Bombus arcticus* Dahlbom, 1832, p. 50 No. 32 nec Quensel in Acerbi, 1802 nec Kirby, 1821, lectotype ♀ ZCL! designated by Kruseman (1950), type loc. Norway: Nordland (Nnö): Ankenes: Bjerkvik; Dahlbom 1837; Zetterstedt 1838; Boheman 1844, p. 96, 104; Siebke 1863, 1870; Ander 1967. *Bombus smithianus* White, 1851, p. 158 nec auctt. *Bombus agrorum* var. *bicolor* Sparre Schneider, 1909, p. 130 nec Friese, 1903, type not traced, type loc. Norway: Hordaland: Bergen. *Bombus agrorum* var. *barcai* Vogt, 1909, p. 76, holotype ♀ VCA!, type loc. Sweden: Hälsingland: Delsbo. *Bombus agrorum* var. *romani* Vogt, 1911, p. 55, holotype ♀ VCA! type loc. Sweden: Uppland: Uppsala. *Bombus agrorum* f. *pallidofacies* Vogt, 1911, p. 55, holotype ♀ VCA!, type area Sweden: Uppland. *Bombus agrorum erlandssoni* Kruseman, 1950, p. 46, holotype = lectotype of *Bombus arcticus* Dahlbom. *Bombus agrorum gotlandicus* Erlandsson, 1953, p. 78, holotype ♀ NRS, type loc. Sweden: Gotland: Tingstäde. *Bombus agrorum* var. *b–g* Thomson, 1872, correspond to *B. a. mniorum* = var. *b*, *B. a. gotlandicus* = var. *c*, *B. a. bicolor* = var. *d–f* and *B. a. arcticus* = var. *g*. For bibliographic references to the Scandinavian fauna cf. also the subspecific discussion.)

Nomenclatural remarks

B. arcticus (Quensel in Acerbi), is a *nomen oblitum*, cf. p. 114. The designation has been confused with *B. arcticus* Dahlbom (Friese 1902; Sparre Schneider 1906; Friese & Wagner 1909, 1912).

When White (1851) proposed the name *B. smithianus* to replace the junior synonym *B. arcticus* Dahlbom, a 'Lapland species of a Bumble-bee' from Shetland was simultaneously misidentified as this species. The name has ever since been related to the species identical with the Shetland species, recognized in turn as *B. smithianus* and *B. muscorum smithianus*, cf. p. 146. The erroneous use of the name has been overlooked until it was recently detected by Yarrow (in litt.) and the correct synonomy: *B. smithianus* White, 1851 = *B. arcticus* Dahlbom, 1832 nec

Kirby 1821 is hereby re-established. The taxon is a subspecies, *B. pascuorum smithianus* White.

First Scandinavian records

Norway. Nordland (Nnö): Ankenes: Bjerkvik (Dahlbom 1832) published as *B. arcticus.*

Sweden. Central Sweden and Västergötland, published as *B. agrorum* and *B. curtisellus* respectively (Dahlbom 1832).

Subspecific discussion

B. pascuorum exhibits a great variability of colour pattern within the entire range of its distribution, locally and among inhabitants in a colony, yet geographic variations, some of which form clines, are recognized. A vast number of European forms were designated (Kirby 1802; Vogt 1909, 1911; Krüger 1928, 1931; Pittioni 1939a; etc.), some of which are segregated into geographic subspecies while others are only infrasubspecific forms.

Three Norwegian subspecies have been recognized in the passed, viz. *B. pascuorum smithianus* White (= *B. agrorum erlandssoni* Kruseman), *B. p. sparreanus* nov. nom. (= *B. a. bicolor* Sparre Schneider) and *B. p. barcai* Vogt, considered as arctic, western and southeastern subspecies respectively (Løken 1960). They have been singly or together previously treated as races or local varieties (Schøyen 1881; Sparre Schneider 1895b, 1906, 1909, 1918; Friese 1902; Bengtsson 1904; Friese & Wagner 1909; Vogt 1909; Krüger 1928, 1931; Soot-Ryen 1925; Meidell 1934a; Løken 1950). The local variation is moreover reflected by the division in variants *a* to *g* of Thomson (1872) followed by Siebke (1880) and Strand (1898a, 1898b).

A total of five subspecies have so far been designated in Sweden: (1) *B. p. smithianus* occurring in Lapland (Boheman 1844; Wahlberg 1854; Thomson 1872; Aurivillius 1903; Bengtsson 1904, 1931; Ringdahl 1915; Lundblad 1924; Barendrecht 1941; Brinck 1951; Kruseman 1958a, 1959; Ander 1963). (2) *B. p. sparreanus* extending from Dalarne to Norrbotten (Brinck 1951; Kruseman 1958a, 1959; Ander 1963, 1965). (3) *B. p. romani* Vogt restricted to Uppland county (Krüger 1928, p. 366, 1931, p. 170). (4) *B. p. barcai* confined to Southern Sweden with clinal variations directed north to Norway: Oslo area (Krüger 1931, p. 163; Kruseman 1958a) and additionally to the Swedish counties Dalarne and Hälsingland (Kruseman 1958a). (5) *B. p. gotlandicus* by Thomson (1872) mentioned as *B. agrorum* var. *francillonella*, restricted to Gotland (Erlandsson 1953).

Four Scandinavian subspecies are hereby recognized, viz. *B. p. smithianus*, *B. p. sparreanus*, *B. p. pallidofacies* Vogt nov. status and *B. p. gotlandicus*, based on the study below.

Generally speaking, the Scandinavian populations display a shift in the colouring of the coat from the palest in Southern Sweden to the darkest in Northern Scandinavia. Parallel with the change of greyish-white to black hairs on episternum and venter, the dorsum becomes a shade of brighter yellowish-brown and turns to orange-brown. An increase in hair length on going north has not been measured, but the difference between the southern- and northernmost population in length of the coat of thorax dorsally is estimated at 0.50 mm.

Striking features of clinal variability, viz. the colour in pile of face, episternum and hind femur, have been studied to evaluate the taxonomic position of the populations. The data, being grouped in steps and in progression from the palest to the darkest, prove that each of the characters form clines directed from southernmost Sweden to the western coast of Norway (Table XIX) and north to inner part of Gulf of Bothnia as well (Table XX). The result is presented graphically (Figs. 83–84) and indicates a correlation of the features. The levelling of the clines at either end may justify subspecific designations, viz. *B. pascuorum pallidofacies* Vogt, herewith designated to the population in Southern Sweden cf. below, and *B. p. sparreanus* extending from western coast of Norway northeast to the Gulf of Bothnia (Fig. 86). The subspecific identity of the populations occurring in Hordaland (Fig. 83) and in Medelpad-Norrbotten (Fig. 84) is confirmed by a study of the same three features on individuals from counties ranging in between Hordaland and Norrbotten. The result (Table XXI) shows only slight local

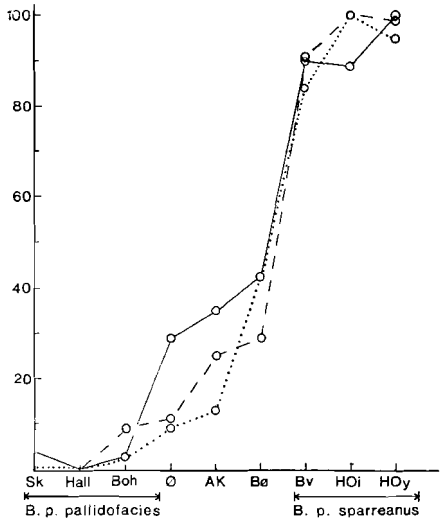


Fig. 83. *B. pascuorum* (Scopoli). Percentage of females with black pile of face (_____), black-haired episternum (.....) and hind femur (_ _ _ _) plotted against counties ranging from Sweden: Skåne to Norway: Hordaland (HOy) (cf. Table XIX).

variations. If the darker two steps, mainly black and black, were grouped together, isophens can be drawn from Hordaland to Norrbotten. As the populations along the isophens do not display other distinct phenotypical differences, possibly except for a small decrease in hairlength directed east, they represent the same subspecies, viz. *B. p. sparreanus*.

The striking difference between *B. p. sparreanus* and the northern population is the colour in hairs on T_1 and T_{2-4}. The two features were studied, in addition to those above, on populations ranging along the coast from Hordaland to Troms (Table XXII). As in the case above, isophens can be drawn for the three features colour in pile of face, episternum, and hind femur. There is, however, a marked difference in the two remaining features, viz. the colouring of hairs on T_1 and T_{2-4}, this being graphically illustrated (Fig. 85). The stepped clines promote the subspecific designation of the northern population, *B. p. smithianus*.

The fourth Scandinavian subspecies is *B. pascuorum gotlandicus*, the isolated population in Gotland.

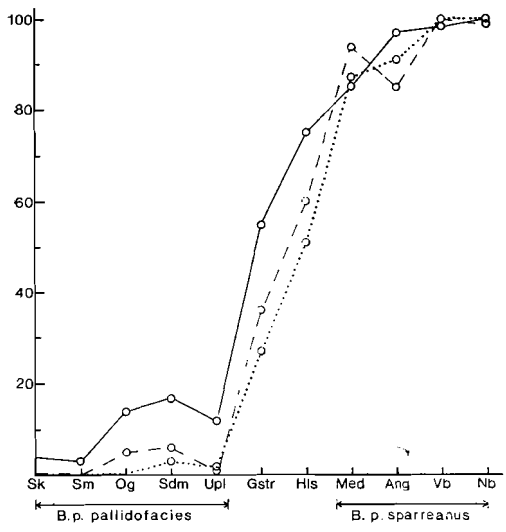


Fig. 84. *B. pascuorum* (Scopoli). Percentage of females with black pile of face (_____), black-haired episternum (.....) and hind femur (_ _ _ _) plotted against counties ranging from Sweden: Skåne to Norrbotten (cf. Table XX).

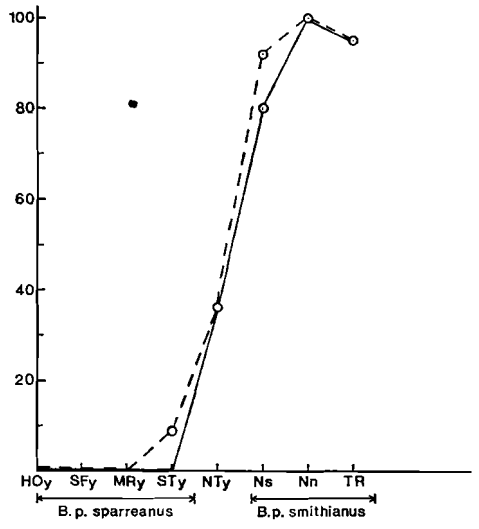


Fig. 85. *B. pascuorum* (Scopoli). Percentage of females with orange-brown hairs on 1st gastral tergite, T_1 (_____), and on 2nd to 4th gastral tergite, T_{2-4} (_ _ _ _), plotted against counties ranging along the coast from Hordaland (HOy) to Troms in Norway (cf. Table XXII).

Table XIX. Percentage of female *B. pascuorum* (Scopoli) exhibiting certain characters of colour pattern in populations ranging from Southern Sweden to western coast of Norway. Area = county or district thereof (cf. Fig. 99)

Area	Sk.	Hall.	Boh.	Ö	AK	Bö	Bv	HOi	HOy
Number of specimens	90	10	34	44	52	7	31	35	100
Pile of face									
Yellow	28	20	3		2				
Mainly yellow	49	50	48	14	13				
Mainly black	19	30	45	57	50	57	10	11	
Black	4		3	29	35	43	90	89	100
Episternum									
Greyish-white	78	40	17	16	10	29	6		
Mainly greyish-white	20	50	56	30	31	14			
Mainly black	2	10	24	45	46	14	10		5
Black			3	9	13	43	84	100	95
Hind femur									
Greyish-white	100	100	85	64	52	14	6		
Partly greyish-white			6	25	23	57	3		2
Mainly to all black			9	11	25	29	91	100	98

Table XX. Percentage of female *B. pascuorum* (Scopoli) exhibiting certain characters of colour pattern in populations ranging from Southern to Northern Sweden. Area = county (cf. Fig. 99)

Area	Sk.	Sm.	Ög.	Sdm.	Upl.	Gstr.	Hls.	Med.	Ång.	Vb.	Nb.
Number of specimens	90	65	43	36	91	11	55	53	34	55	61
Pile of face											
Yellow	28	11	2	3	2						
Mainly yellow	49	55	35	30	36		2	4			
Mainly black	19	31	49	50	49	45	23	11	3	2	
Black	4	3	14	17	12	55	75	85	97	98	100
Episternum											
Greyish-white	78	60	23	19	18		2				
Mainly greyish-white	20	38	58	61	45		6	6			
Mainly black	2	2	19	17	35	73	41	7	9		
Black				3	2	27	51	87	91	100	100
Hind femur											
Greyish-white	100	98	86	83	72	45	17	2	6		
Partly greyish-white		2	9	11	27	18	23	4	9		2
Mainly to all black			5	6	1	36	60	94	85	100	98

Table XXI. Percentage of female *B. pascuorum* (Scopoli) exhibiting certain characters of colour pattern in populations ranging from western coast of Norway to Gulf of Bothnia. Area = county or district thereof (cf. Fig. 99)

Area	HOy	SFi	On	HEn	STi	Hrj.	Jmt.	Vb.	Nb.
Number of specimens	100	26	33	14	40	7	9	55	61
Pile of face									
Mainly black		12	6	14				2	
Black	100	88	94	86	100	100	100	98	100
Episternum									
Mainly greyish-white		4	6	7					
Mainly black		23	6	14	5				
Black	100	73	88	79	95	100	100	100	100
Hind femur									
Greyish-white		8	3	7					
Partly greyish-white	2	8	9	7	2				
Mainly to all black	98	85	88	86	98	100	100	100	98

Table XXII. Percentage of female *B. pascuorum* (Scopoli) exhibiting certain characters of colour pattern in populations ranging along the coast from Hordaland to Troms. Area = county or district thereof (cf. Fig. 99)

Area	HOy	SFy	MRy	STy	NTy	Ns	Nn	TR
Number of specimens	100	13	4	22	17	50	12	38
Pile of face								
Mainly black		15		9		2		
Black	100	85	100	91	100	98	100	100
Episternum								
Mainly black	5	8	25	9	6			
Black	95	92	75	91	94	100	100	100
Hind femur								
Partly greyish-white	2		25		6	4		
Mainly to all black	98	100	75	100	94	96	100	100
First tergite								
Yellowish-white			25	4				
Mainly yellowish-white	37	8		9	18			
Mainly black	43	69	50	64	23			
Black	20	23	25	23	23	20		5
Mainly to all orange-brown					36	80	100	95
2nd to 4th tergite								
Variable pattern of black and orange-brown	99	100	100	91	65	8		5
Orange-brown	1			9	35	92	100	95

The designations *B. pascuorum barcai* Vogt and *B. p. romani* Vogt concern transitional populations, i.e. they are suppressed as subspecies for the following reasons:

According to Vogt (1909), *B. pascuorum* var. *barcai* occurs in 'Mittleres Sweden und Christiania (und weitere Umgebung).' In addition to the holotype, labelled Delsbo, the type material consists of 7 ♀♀ 5 ☿☿ 7 ♂♂ from Sweden: Hälsingland: Delsbo and 5 ♀♀ 11 ☿☿ 7 ♂♂ from Norway: Akershus: Oslo and Östfold: Halden; Moss. According to the present study, Östfold, Akershus, Hälsingland are situated in intergrading areas (Tables XIX, XX; Figs. 83, 84, 86), the former perhaps in the periphery of the distribution of *B. p. pallidofacies*, the latter almost reaching the area of *B. p. sparreanus*. The type material from Hälsingland, including the holotype, is all intermediates with close affinity to *B. p. sparreanus*. As stated by Ander (1963), the light-coloured individuals in southernmost Sweden do not agree at all with the description of *B. p. barcai*. Revisions reveal that the Norwegian form of *barcai* concerns intermediates between *B. p. sparreanus* and *B. p. pallidofacies*, while Swedish *B. p. barcai* concerns either intermediates or *B. p. pallidofacies*.

Vogt (1911) states that *B. p.* var. *romani* occurs in 'Uppsala. Gouv. Petersburg.' However, the type locality, viz. Uppland: Uppsala, concerns the intergrading area or the peripheral northern occurrence of the subspecies *B. p. pallidofacies* (Table XX, Fig. 84). The holotype belongs to the darker individuals of the local population. Pile of face black, episternum with a few greyish-white hairs admixed with the black ones, hairs of T_1 predominantly yellowish-white, those of femora partly greyish. *Romani* is an intermediate form between *B. p. sparreanus* and *B. p. pallidofacies*.

As demonstrated in Table XXIII, the four Scandinavian subspecies recognized in this study are fairly colour-stable within their central area of distribution.

Taxonomical remarks

It might be questioned whether the subspecific designation *B. p. pallidofacies* should be suppressed and the population in Southern Sweden treated either as a transitional form linking *B. p. sparreanus* with the subspecies further south, or perhaps included in this subspecies (Reinig 1939, p. 194 the map). In my opinion the subspecific status of the population in Southern Sweden should at least be kept until the subspecific status of populations in Germany and adjacent areas has been studied further.

Queen, worker

Morphological characters. Malar space nearly 1½ times the distal width, longer than A_{3+4} but shorter than A_{2+3+4}. Clypeus markedly longer than distal width (except in some workers); disc of clypeus moderately punctured except for anterior impunctate area in between lateral, coarsly punctured impressions. Labral furrow widened towards the front (Fig. 21); labral lamella shining, with knife-sharp margin. St_6 with distinct distal keel. Coat shaggy. Queen measurements, cf. the subspecies.

Colour pattern. The species is in general distinguished by the following characters: Dorsal of thorax with yellowish-brown hairs. Pile on T_1 ranging from entirely black to entirely yellowish-white, yellow, or yellowish-brown; one or several of midmost gastral tergites mainly black-haired; at least T_{5-6} with yellowish-brown hairs. Corbicular fringes black. The colours frequently encroach upon another and exhibit a great number of variations. Further details are given in the description of the subspecies.

Male

Morphological characters. Malar space markedly longer than distal width, hardly longer than A_{3+4}. A_3 hardly 1½ times the distal width, A_4 usually as long as distal width, A_{5-13} (or A_{4-13}) strongly swollen beneath (Fig. 47A). Posterior fringe of hind tibia markedly longer than the greatest width of the segment. St_8 and genitalia (Figs. 47B–C); gonostylus inwardly produced into a long narrow tooth, distal

Table XXIII. Percentage of female *B. pascuorum* (Scopoli) presenting diagnostic characters of the four Scandinavian subspecies. Area = county or district thereof (cf. Fig. 99)

Area	*B. pascuorum pallidofacies* Sweden Skåne	*B. pascuorum sparreanus* Norway: Hordaland (HOy)	*B. pascuorum smithianus* Norway: Troms	*B. pascuorum gotlandicus* Sweden: Gotland
Number examined	90	100	38	20
Pile of face				
Yellow	28			65
Mainly yellow	49			25
Mainly black	19			10
Black	4	100	100	
Episternum				
Greyish-white	78			60
Mainly greyish-white	20			35
Mainly black	2	5		5
Black		95	100	
Hind femur				
Greyish-white	100			75
Partly greyish-white		2		25
Mainly to all black		98	100	
First tergite				
Yellowish-white	100			
Mainly yellowish-white		37		
Mainly black		43		
Black		20	5	
Black/orange-brown			5	5
Orange-brown			90	95
2nd to 4th tergite				
Variable pattern	92	99	5	
Orange-brown	8	1	95	100

rounded process of volsella strongly projecting; penis valve simple, rod-like. Coat shaggy.

Colour pattern. Generally as in the female, for details cf. the subspecies.

Distribution (Fig. 86)

Norway. Dense, wide distribution throughout the entire country north to 70° N, and sporadically recorded in luxuriant biotopes further north. In Southern Norway occurring from sea level to subalpine valleys, occasionally reaching lower belt of alpine zone, where recorded 1200 m s.m.

Biotopes: Meadows, *leguminosae* fields, gardens, orchards, roadsides, etc. Avoiding heather and moors.

A total of about 4450 specimens was examined.

List of localities. *Östfold:* Hvaler: ?loc. ZMO, Asmalöy, Herföl, Kirköy, Söndre Sandö; Kråkeröy: Tangen, Ödegård; Onsöy: Dypeklo, Ellingård, Lervik, Ramseklo, Rörvik, Skjælöy, Torp; Sarpsborg: ZMO; Halden: Asak, Berg, Blakmose, Doktorsetra, Hakelund, Kuletjern, Nordbakke, Sponvika, Veggesdal; Aremark: Aremark, Gjeddetjern, Mymosetjern, Skodsberg, Stensbru; Rakkestad: Rörvik; Marker: Damholt, Dypedal, Jåval, Rödenes; Råde: Tom; Moss: Jelöy; Eidsberg: Holm; Trögstad: Bingen, Mönster bro, Åsen. *Akershus:* Ås: Vollebekk; Dröbak: Degerud TRM, Dröbak ZMB ZMO, Hallangen, Holtbråten; Oppegård: Svartskog ZMB ZMO; Asker:

Asker, Brönnöy, Rustad; Bærum: ? loc. TRM, Bråtan, Fornebo ZMO, Hövik ZMO, Lysaker ZMB ZMO, Oslo: TRM ZMB ZMO; Rælingen: Fjerdingsby; Aurskog-Höland: Björklangen, Gangsnes, Löken, Skogen, Östegård; Fet: Björkflåten; Hurdal: Tömte; Feiring: Feiring. *Hedmark (HEs):* Eidskog: Bolfoss, Gjelaråsen, Magnor SMS; Kongsvinger: Eidsberg; Sör-Odal: Mårud ZMO; Hamar: ZMB ZMO; Ringsaker: Gaupen, Vea. *HEn:* Trysil: Enga, Egernesset, Vestby; Åmot: Glesubekken; Rendal: Solbakken SE Åsheim ZMO; Alvdal: Alvdal; Engerdal: Risbakken 750 m. *Oppland (Os):* Jevnaker: Randsfjord USU ZMB; Gran: Granvollen; Kolbu: Dal; Östre Toten: Hveem, Skreia, Stubdalen; Söndre Land: Fluberg; Nordre Land: Dokka USU, Torpa; Lillehammer: Jörstadmoen, Lillehammer, Stor-Håve; Etnedal: Bruflat; Sör-Aurdal: Begndal, Ellingseter 820 m, Skard, Strömmen; Nord-Aurdal: Knutshaugen, Sæbuöygard N Fagernes; Gausdal: Follebu, Gåsöya; Öyer: Aksjösetra 1000 m, Skåi, Öyer ZMB ZMO, Åstdalen 900 m; Ringebu: Ringebu ZMB ZMO, Venabygd. *On:* Vestre Slidre: Kinnholt 1000 m, Uppslidre; Öystre Slidre: Kvithovd 800–1000 m ZMO; Vang: ?loc. ZMO, Öye USU ZMB; Sel: Heidal TRM ZMB, Laurgård ZMO, Mysuseter 900 m, Otta ZMO; Vågå: Gjendesheim 1000 m, Hindseter 900 m, Klones, Leirungen 1050 m, Randsverk TRM ZMB, Vågåmo ZMB ZMO, Övre Sjodalsvann; Lom: Galdesand, Lom ZMO; Dovre: Dovrefjell 1000 m ZMO, Fokstua 930 m, Hjerkinn 950 m, Toftemo ZMO, Vålåsjö 950 m ZMO. *Buskerud (Bö):* Hurum: Filtvedt TRM, Holmsbu, Hurum, Pinadalen, Sagene, Storsand, Vannsbrekka; Röyken: Åros; Drammen: ZMB ZMO; Lier: Lier, Lökke gård, Spikkestad, Sylling, Toverud; Ringerike: Smedrud; Krödsherad: Bråtån, Fagerheim, Glesne; Modum: ?loc. ZMO, Snarum; Flesberg: Hvila, Lampeland, Öydegarden; Kongsberg: Komnes, Lintvedt, Skollenborg. *Bv:* Sigdal: Flågan, Hagle, Haglebu, Kopseng, Nedre Eggedal, Nordbygda, Sigdal; Nore og Uvdal: Nörstebö, Rödberg, Solheimstul 1000 m, Tunnhovd, Uvdal; Flå: Grosland; Nes: Eidal, Langeslet; Gol: Gol; Hemsedal: Lykkja; Ål: ? loc. ZMO, Levell 700 m; Hol: Geilo VCA ZMB,Halfardokkistölen 860 m, Hovet, Krisle, Nyestölen 1000 m. *Vestfold:* Sande: Sande kirke; Holmestrand: Angerskleiv, Bogen, Holmestrand ZMO; Borre: Adal, Nykirke; Våle: Ryk; Ramnes: Kjær, Lunde, Orrevål; Lardal: Styrvoll; Andebu: Andebu kirke, Kodal; Stokke: Langö, Sand, Stokke, Veierland; Tönsberg: Preströdkilen; Nötteröy: Teie; Tjöme: Kjære, Solvang; Sandefjord: Austeröy; Hedrum: Kvelde, Ringdal; Tjölling: Viksfjord; Brunlanes: Berg, Dolven, Helgeroa, Tronsröd; Larvik. *Telemark (TEy):* Skien: Fjelldalen, Kikut; Porsgrunn: Langangen, Mule, Nystrand; Bamble: Trosby, Åby; Nome: Damtjern, Tyri, Vommstöl; Drangedal: Drangedal, Holmen, Naksjö, Nordbö, Nos, Omnes, To-myra, Åkredalen; Kragerö: Kragerö, Levang. *TEi:* Notodden: Gransherad, Tindegrend, Tinnoset; Sauherad: Liagrend; Bö: Lifjell, Sande, Vatnar; Seljord: Seljord, Svartdal; Kviteseid: Brunkenberg, Eidstad, Kviteseid, Morgedal, Vrådal; Nissedal: Kyrkjebygda, Lauvviki, Lia, Tjönnefoss, Treungen ZMB ZMO; Fyresdal: Hegglandsgrend, Moland, Veum; Tokke: Bandaksli, Grimdalen, Vråliosen, Åmdals verk; Vinje: Bosböen 970 m, Edland, Haukeligrend, Krossen, Rauland kirke, Særengrend, Vå, Vågsli, Åmot; Tinn: Austbygda, Börsjöen 1100 m, Mösdammen, Tinn. *Aust-Agder (AAy):* Gjerstad: Fiane; Risör: Bråten; Vegårdshei: Ljöstad; Tvedestrand: Askeröy, Boröy, Dypvåg, Eidbu, Fiane, Hanto, Laget, Lyngör ZMO, Nes verk TRM, Stensö ZMO, Strengereid, Tvedestrand, Österå; Arendal: Arendal ZMB ZMO, Salteröd; Moland: Dal, Hannholmen, Holmsund, Kilsund, Staubo, Tverrdalsöy, Voje; Tromöy: ZMO; Hisöy: Flödevigen, Gjervoldsöy, Hisöy ZMB ZMO; Fjære: Fjære kirke ZMO; Grimstad; Öyestad: Björbekk, Helle, Rykene; Froland: Hynnekleiv, Svenes; Landvik: Havnevåg, Hörte, Molland, Tönnesöl; Lillesand: Blikksund, Hæstad, Hövåg, Kjöstvedt, Kvåse, Langholmsund, Natvik, Tröe, Ulvöy, Åmli; Birkenes: Sagen, Svaland; Iveland: Frikstad, Ivedal. *AAi:* Evje og Hornes: Hornes, Lauvland, Syrtveit; Gjövdal: Gangsei, Gjövdal, Smedland, Åmli, Årli; Bygland: Austad ZMO, Löndal, Ose, Setesdal TRM; Valle: Hylestad, Kvestad, Rygnestad, Valle; Bykle: Breive 700 m, Breivann 900 m, Bykle. *Vest-Agder (VAy):* Kristiansand: Buane, Erkleiv, Holskogen, Kristiansand, Mövik, Strömme; Marnadal: Ask, Finsland, Gretteland, Röyrås, Röyseland, Solås; Sögne: Langeneset, Sögne, Åros; Mandal: Kvisla TRM, Mandal TRM ZMB, Ramsö TRM, Sånum, Tregde; Lindesnes: Ramsland, Reine; Lyngdal: Rom; Kvinesdal: Feda, Gjemlestad, Kvinesdal, Solås, Öye; Farsund: Fjelleså, Hanangervann, Lodshavn, Ore, Vanse; Flekkefjord: Dragöy, Ersdal, Fedåk, Langevann, Loga, Nordheim, Nuland, Sandvang, Solvang. *VAi:* Hægebostad: Skeie; Åseral: Espelid, Rosseland, Åseral; Sirdal: Rekevik, Sinnes, Ådneram 800 m. *Rogaland (Ry):* Lund: Moi; Sokndal: Bu, Hauge i Dalane, Nesvåg, Rekefjord, Sogndal, Vatland, Åmot; Eigersund: Egersund, Eigeröyeidet, Fotlandsvann, Sjånes, Skjerpe, Tengs; Bjerkreim: Asseimvann, Hovland, Ivesdal, Malmeim; Hå: Anisdal, Brusand, Ogna, Salte bro, Sirevåg; Klepp: Börsheim, Klepp, Orre, Orrevann, Orstad, Revtangen, Vik, Öksnevad; Time: Mossige; Gjesdal: Madland SMS Nese; Sandnes: Austrått, Bergsagel, Dale, N Ganddal; Sola: Gimre, Reke, Slettehei, Tananger; Randaberg: Kverneviken; Stavanger: TRM SMS ZMB, Lindöy; Strand: Vatne; Finnöy: Reilstad, Sjernaröy; Rennesöy: Dale; Karmöy: Eide, Indre Eide, Risdal, Sandve, Sæveland, Vikre; Vindafjord: Imsland; Tysvær: Nedstrand. *(Ri):* Forsand: Forsand, Fylgjesdalen, Lysebotn, Meling, Songedalen; Hjelmeland: Fister, Igland, Kvamme, Årdal; Suldal: Berge, Håvarstöl, Jelsa, Jonstöl, Krokvassheia, Kvanndal, Mostöl, Nesflaten, Roaldkvam, Svortebekk, Ullsneskvelvene, Aimjödlonuten; Sauda: Hellandsbygda, Saudasjöen, Slettedalen. *Hordaland (HOy):* Bömlo: Espevær, Goddö, Langevågen, Rubbestadnesset, Röyksund;

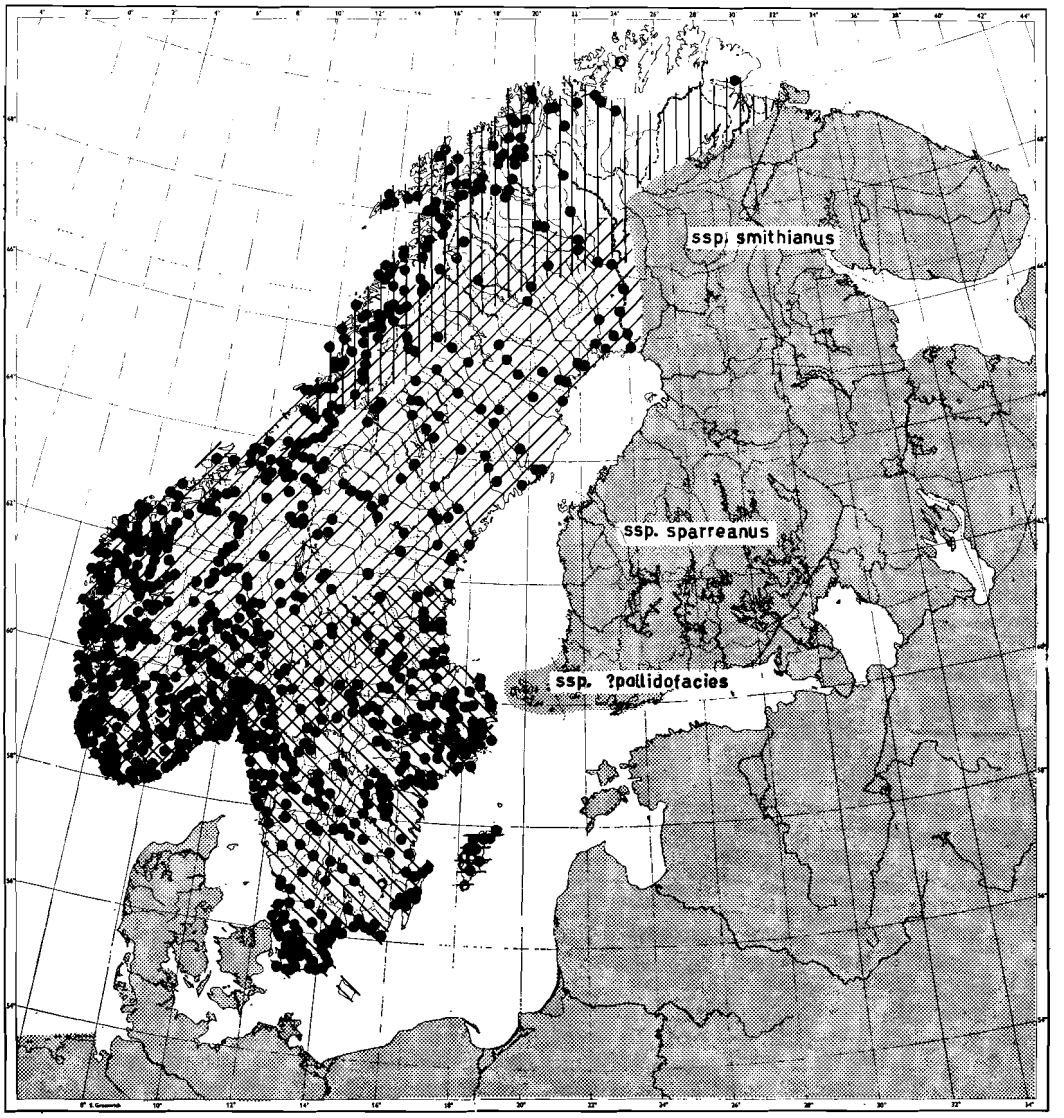


Fig. 86. *B. pascuorum* (Scopoli). Hatching: vertical = *B. p. smithianus* White; oblique up to the right = *B. p. sparreanus* nov. nom.; oblique up to the left = *B. p. pallidofacies* Vogt; horisontal = *B. p. gotlandicus* Erlandsson. Legends as in Figs. 50, 54.

Sveio: Austvik, Dommersnes, Drange, Førde; Stord: Storsöy; Fitjar: Slåtteröy fyr; Tysnes: Ånuglo; Austevoll: Karlsöy, Ytteröy; Os: Berge, Brunsholmen, Gullholmen, Halgjem, Hatvik, Hegglandsdal, Lepsöy, Lysekloster, Midtsetra, Moldegård, Nordströno, Sandven, Söfteland, Ulven; Fusa: Eikelandsosen, Övre Hålandsdal; Samnanger: Höyseter; Fana: Appeltun, Biol. st., Birkelundsbakken, Blomsterdalen, Bontvedt, Dolvik VCA, Eggholmen, Engjavik, Espeland, Fana kirke, Fantoft, Flesland, Grimseid, Hamre, Hatlestad, Hjellestad, Hop, Korsnes, Lönninghavn, Mariholmen, Milde, Minde VCA, Olderhaug, Paradis, Rådalen, Saganes, Sanddalen, Skipanes VCA ZMB, Skjold, Smöråsen, Steinsvik, Stend, Sælöy, Trollhaugen, Tveiterås; Sund: Bokken, Glesvær, Klokkarvik, Leröy, Telavåg, Tyssöy; Fjell: Brattholmen, Fossavann, Litleholmen, Solsvik; Laksevåg: Alvöen, Hilleren, Kongshögda, Storingavika; Bergen: TRM VCA ZMB ZMO; Asköy: Ask, Davanger, Erdal, Herdla, Jakobsöy, Kleppstö; Åsane: Eidsvåg, Furubotten, Golfbanen, Haukedal, Steinestö; Osteröy: Bruviksnipa, Fitje, Fotlandsvåg, Haus, Kleppe, Njå-

stad; Meland: Brakstad, Lansvik, Meland; Öygarden: Straumöy; Radöy: Kvalheim; Lindås: Alversund bro, Herland, Lauvås, Romarheim, Sævråsvåg, Vollom; Fedje. *HOi:* Etne: Fjæra, Oslandsvåg, Skånevik; Kvinnherad: Fossberg, Gamlestölen, Gjermundshamn, Grönningseter, Guddalsdalen, Ljosmyr, Prestvann, Rosendal, Seimsfoss, Skeie, Varaldsöy; Odda: Dalen gård, Hordasvingen 1000 m, Röldal, Seljestad; Ullensvang: Aga, Börve, Djönno, Espe, Fossli, Fresvik, Grythorgen 900 m, Hjölmo, Kinsarvik, Lofthus, Måbödalen, Nesheim, Sekse, Storliseter 900 m, Tveito, Utne VCA ZMB; Kvam: Djönne, Kvamskogen, Mundheim, Norheimsund, Omastrand, Vangdal, Öystese, Ålvik USU ZMB, Åsheim; Voss: Armot, Bulken, Bömoen, Hangurfjellet 800 m, Kinne, Liland, Mjölfjell, Vossevangen; Granvin: Granvin, Skjervet, Vindal; Ulvik: Ulvik. *Sogn og Fjordane (SFy):* Gulen: Austgulen, Takle; Hyllestad: Dale, Hatleim, Hyllestad, Risnes, Skivenes, Skor, W Ålefjell; Höyanger: Gare bro, Lavik ZMB ZMO, Stöldalen; Gaular: Bygstad, Slotten; Fjaler: Dale, Hellestrand: Strandenes; Askvoll: Aralden, Askvoll, Einen; Flora: Florelandet, Nekköyna, Skorpeidet, Verpevik; Naustdal: Frammarsvik, Furehaugstölen, Heia, Horstad, Trollstua, Övre Hella; Förde: Flåten, Hallbreim; Jölster: Hamar, Ålhus; Gloppen: Hjortset, Hope, Hyen, Lote, Lotsbergfjell 700 m, Sandane; Eid: Haugland, Naustdal, Nordfjordeid, Stårheim; Davik: Kjölstad, Kjölsdalen. *SFi:* Vik: Seljedal, Vik; Aurland: Flåm, Gudvangen, Vassbygda; Lærdal: Gröte, Lærdal ZMO, Ystadbö; Sogndal: Slinde; Leikanger: Hermansverk, Leikanger, Suphamar; Balestrand: Balestrand NMW, Fjærland, Flesje, Horpedalen, Mel, Suphellen; Luster: Dalsdalen, Fortun TRM, Skjolden; Jostedal: Fåberg, Fåbergstölene 600 m, Hafslo, Okkleviki; Stryn: Flo, Gillesdal, Heggjabygda, Hornindal, Hornindalsetra, Olden, Stryn, Stöverstein, Vedvik, Videdalen, Övre Oldenvann. *Möre og Romsdal (MRy):* Sande: Gurskevåg, Åram; Vanylven: Thue; Volda: Björkedalsvann, Folkestad, Straumshamn; Hareid: Mork; Heröy: Djupsvik, Runde; Ålesund: BML VCA, Åse; Örskog: Skodje ZMO; Vestnes: Gjermundnes, Vikebukt; Molde: TRM ZMB ZMO; Aukra: Julnesset, Nord-Aukra; Fræna: Gjendem, Hollinholm; Averöy: Vevang. *MRi:* Örsta: Lyngstölvann, Urke, Örstavik, Öye; Stranda: Fivelstad, Fredheim, Geiranger NMW ZMB, Norangdalen, Sunnylven ZMO, Vollset; Norddal: Indre-eidet, Valldal, Ytterdal; Rauma: Åndalsnes NMW ZMB; Nesset: Torhus; Sunndal: Brandstad, Jordalsgrend, Sunndal BML; Surnadal: Kvanne ZMO, Melhus, Stangvik, Övre Surnadal; Rindal: Bölme. *Sör-Tröndelag (STy):* Hitra: Hamn, Lya KMT; Agdenes: W Hambora; Rissa: Gafsetåsen, Sötvik; Örland: Beian; Bjugn: Kotengsvann, Ryvann, Sæter KMT; Åfjord: Mölsletten, Mörreaunet. *STi:* Oppdal: Dalsbekk, Driva st., Gåvåli 975 m, Högsnydda 1150 m, Knutshö 1200 m BML, Kongsvoll 900 m BML TRM ZMB ZML ZMO, Oppdal st., Skansen; Midtre Gauldal: Aune; Ålen: Reitan; Röros: Adamsvoll 820 m, Myrmoen 700 m, Naustervoll 700 m, Storelvvoll 800 m; Tydal: Mobro, Sakrismoen; Selbu: Medbus; Trondheim: KMT TRM VCA ZMB ZML ZMO; Skaun: Hestjo, Sörnypan KMT. *Nord-Tröndelag (NTy):* Namsos: TRM, Strandmoen; Næröy: Breiviken, Dalene, Garmannsviken, Kvalviken, Saltbotn; Vikna: Rörvik. *NTi:* Meråker: Meråker, Tovmodal; Stjördal: Draveng, Hegra st., Lånke, Tilleraunet, Vikan KMT; Frosta: Holmberget; Leksvik: Storvatn; Levanger: Avdal; Verdal: Billingflaten KMT ZMB, Godbekktjern KMT, Sandvika KMT ZMB, Stiklestad, Sulstua, Vuku; Sandvollan: Inderöy ZMO, Kirkenesvåg, Skjelvågen; Verran: Sela; Steinkjer: ZMA; Kvam: Sem, Snåsavann ZMA; Namdalseid: Hovlia KMT; Overhalla: Sellotören; Grong: Ekkerseter, Fjerdingen, Grong SMS ZMB; Snåsa: ?loc. TRM, Brönstad, Hegge, Snåsa, Strindmoen, Telnes; Lierne: Kvelia; Höylandet: Höylandet, Skilleberget; Namskogan: Brekkvasselv KMT ZMA, Finnvollan, Namskogan ZMA ZMB. *Nordland (Nsy):* Brönnöy: Flatmo TRM, Nevernes ZMA, Sandvåg TRM, Sömna TRM; Vega: TRM ZMB; Vevelstad: TRM; Alstahaug: TRM; Heröy: Syd-Heröy TRM VCA; Nesna: Hamaröy, Oldersletten; Luröy: ZMO; Melöy: Dalen, Kunna, Spilderen, Storglomvann ZMO; Gildeskål: Finnes, Gildeskål, Gilset, Inndyr, Jelstad, Skauvoll, Storvika, Sör-Fuglöy; Bodö: Bodö BML, Falkflaugdalen, Frostmo, Löpsviken, Planteskolen, Skau, Urskarsdalen. *Nsi:* Grane: Grane, Majavatn, Rotstokkmobekken, Skomstad; Vefsn: Fustvann, Luktvann, Ravassbakken, Ravnå ZMO, Store Björnåvann; Hemnes: Finneidfjord, Korgen ZMA, Krokselvmoen, Strömbotn; Rana: Dunderland st., Mo ZML, Rösvoll, Rövassdal TRM, Stokkvik TRM, Storforshei, Umskarstjern, Åenget; Beiarn: Gråtådalen; Saltdal: ?loc. TRM ZMO, Drageid, Lönsdal, Solvågtind 800 m, Storjordet TRM ZMB, Vensmoen; Fauske: Fauske, Kjeldvatn BML, Sulitjelma 600 m BML, Vargåsen. *Nnö:* Sörfold: Bonnåsjöen ZMA ZMB, Rösvik TRM, Tennvann; Hamaröy: Brennvik, Hamaröy, Hamnes, Hansbakk, Innhavet, Kildetoppen 850 m BML, Kråkmo SMS ZMB, Skutevik, Tranöy; Tysfjord: ? loc. ZMO; Ballangen: Ballangen kirke, Dyrhaug, Heggemoen, Myrbakk; Ankenes: Bjerkvik ZML, Seterfjell; Narvik: ZMA ZMB; Evenes: Jansbakk. *Nnv:* Vestvågöy: Knutstad, Skulbru, Stamsund, Valberg; Vågan: Store Molla, Svolvær BML ZMA ZMO, Örsvåg; Sortland: ?loc.; Andöy: Dverberg, Risöyhamn SMS ZMB. *Troms (Try):* Kvæfjord: Borkenes, Vik; Bjarköy: TRM; Lenvik: Finnsnes; Tromsö: Breivik SMS, Tromsdal NRS TRM, Tromsö KMT NRS PCL TRM VCA ZMB; Karlsöy: Karlsöy, Vannö TRM; Skjervöy: Ravelseidet-Langslet. *Tri:* Skånland: Lavangseid; Gratangen: Gratangen ZMA; Bardu: Altevann, Bardu, Dypdal, Seternes; Målselv: ? loc. TRM, Alapmo, Andselv, Bjerkeng TRM, Kirkesdal, Kjellmo, Moen-Olsborg DCL ZMB, Rundhaug TRM ZMB ZMO; Balsfjord: ? loc. NRS TRM, Laksvatn SMS, Sjåvikör TRM, Takvatn TRM, Tamok TRM; Nordreisa: Bakkeby, Sappen;

Kvænangen: Burfjord TRM ZMB. *Finnmark (Fi):* Alta: ? loc. ZMO, Arones, Bossekop BML TRM ZMB ZMO, Jotkajavrre TRM, Kåfjord TRM, Raipas TRM, Talvik. *Fn:* Vadsö: ♂ (Chapman) BML.

Record from literature: *Finnmark (Fn):* Hammerfest 2 ♀♀ (Sparre Schneider 1918, p. 21 in referring to Handlirsch 1888, p. 219). The individuals from this northernmost record of the species, supposedly kept at K. K. Naturhistorisches Museum, Vienna, have so far not been traced (Fischer in litt.).

Sweden. Widely distributed throughout the country, yet only sporadically observed in alpine biotopes.

A total of about 3000 specimens was examined.

List of localities. *Skåne:* Arkelstorp NRS, Baskemölla NRS, Billeberga, Bjärred, Björnstorp, Bokskogen ZMB, Bonderup, Broby, Brunnby, Bäckaskog NRS, Bökeberg, Dalby, Degeberga GNM, Eljaröd NRS, Eslöv ZMB, Falsterbo NRS, Fågelsång, Genarp ZMB, Herrevadkloster GNM, Hyby, Hägghult ZMB, Hälsingborg NRS ZML, Hässleholm NRS, Höganäs NRS, Höör, Ivö NRS, Kivik NRS, Klagstorp GNM, Klostersågen, Kristianstad NRS, Kyrkheddinge, Kågeröd NRS ZML, Kåseberga NRS, Landskrona ZMB, Lund, Löddeköpinge ZMB, Löderup NRS, Maglehem ZMU, Malmö, Mölle, Norra Mellby ZMB, Nyhamnsläge, Oppmanna Söderby NRS, Pålsjö ZMA, Röddinge NRS, Råå NRS, Sandhammaren NRS, Sankt Olof NRS, Saxtorp NRS, Silvåkra, Simrishamn NRS, Sjöbo NRS, Skäralid NRS, Södra Sandby, Sövdeborg ZMB, Torekov NRS ZML, Torna-Hällestad, Trelleborg ZMB, Trolle-Ljungby, Trollenäs NRS, Vallåkra, Veberöd ZMB ZML, Vik NRS, Villands Vånga, Vitemölla NRS, Västra Vram, Ystad NRS, Ängelholm NRS, Örtofta, Övedskloster NRS, Åhus NRS ZMB. *Blekinge:* Backaryd NRS, Karlskrona NRS, Ronneby NRS ZMB, Sjöarp NRS, Sölvesborg NRS ZMB, Torhamn NRS, Viö NRS. *Halland:* Breared NRS, Enslöv, Getinge NRS, Frösakull NRS, Haverdal NRS, Slättåkra NRS, Steninge NRS, Östra Karup. *Småland:* Aneboda ZMB, Bergkvara NRS, Blackstad NRS, Blå Jungfrun NRS, Dörarp NRS, Bränstorp NRS, Bäraryd, Färgerud, Gasslanda ZMU, Gislaved, Hindsen NRS, Hjorted NRS, Hullarydsby NRS, Höreda NRS, Hörle NRS, Järstorp NRS, Jönköping NRS, Kalmar NRS, Lemnhult, Ljungarum NRS, Markaryd NRS ZML, Nybro NRS, Nye NRS, Påskallavik, Ryd ZMB, Ryssby GNM ZMU, Sommen NRS, Söderåkra NRS, Södra Sandsjö NRS, Södra Vi ZMU, Tenhult NRS, Timsfors, Toftaholm, Tolg, Tranås NRS, Vimmerby, Visingsö NRS, Vrigstad NRS, Värnamo NRS, Österkorsberga ZML ZMU. *Öland:* Boda NRS, Byrum NRS, Ekerum NRS ZMB, Gårdby ZMB, Helluddsviken ZMB, Hornsjön NRS ZMB, Högsrum NRS, Langlöt NRS, Mörbylånga NRS, Resmo ZMB, Torslunda ZMB, Vickleby NRS. *Gotland:* Ardre NRS ZMB, Fardume NRS, Follingbo ZMB, Fårö NRS, Fårösund NRS, Hemse ZMB, Ireviken NRS, Klintehamn NRS, Ljugarn NRS, Lärbro NRS, Nyhamn fiskeläge NRS, Romakloster NRS, Sudersand NRS, Tingstäde NRS, Visby NRS, Vamlingbo NRS, Västerheide NRS. *Östergötland:* Boka, Borensberg ZML ZMU, Duseborg, Godegård ZMB, Harg NRS, Högby ZMB, Kisa NRS ZML, Krokek NRS, Kvarsebo NRS, Linköping ZMB ZML, Norrköping NRS, Nykil ZMB, Rimforsa, Rinna ZMB, Rodga, Sankt Anna NRS, Stjärnorp ZMB, Stora Åby ZMB, Tjällmo ZMB, Tolstorp, Vretakloster ZMB, Västra Ny ZMB. *Västergötland:* Alingsås ZMU, Brandstorp NRS, Broholm NRS, Falköping NRS, Gräfsnäs, Grästorp NRS, Gökhem ZMB, Horred NRS, Händene, Höjentorp NRS, Karleby NRS, Kinnekulle, Kymbo NRS, Lilleskog NRS, Luttra NRS, Lyrestad NRS, Läckö NRS, Marka ZMB, Nolhaga NRS, Råbäck NRS, Rångedala NRS, Skara GNM NRS, Skövde NRS, Stenum NRS, Svenljunga, Tengene NRS, Töreboda NRS, Ulricehamn NRS, Vara, Vinninga NRS, Västra Bodarna ZMU, Vättlösa NRS. *Bohuslän:* Bovallstrand NRS, Dingle NRS, Edshultshall NRS, Eldsviken NRS, Fiskebäckskil NRS, Grebbestad NRS, Hålta NRS, Lyse NRS, Lysekil NRS, Morlanda NRS, Munkedal, Näverstad NRS, Nösund NRS, Skee ZMB, Strömstad NRS, Syd-Koster NRS, Tjörn GNM, Uddevalla, Ytterby NRS. *Dalsland:* Bengtsfors NRS, Ed NRS, Ellenö NRS, Frändefors, Grinstad ZMB, Köpmannebro, Mustadfors ZMB, Nössemark ZMB, Rostock, Råggärd ZMB, Skållerud NRS, Skåpafors NRS, Stenebynäs NRS, Tösse, Vensborg. *Närke:* Bärsta NRS, Stora Mellösa ZMB, Örebro, Östra Mark. *Södermanland:* Botkyrka NRS, Brandalsund NRS, Enhörna NRS, Fittja NRS, Huddinge ZMU, Häringe NRS, Läggestad NRS, Muskö NRS, Mölnbo NRS, Nackanäs NRS, Nyköping NRS, Nynäshamn NRS, Nävekvarn NRS, Oxelösund NRS, Rekarne NRS, Salem NRS, Sjösa ZMB, Sparreholm NRS, Stjärnhov NRS, Strängnäs NRS ZMB, Svärdsö NRS, Södertälje NRS, Tullinge NRS, Tumba NRS, Tyresö NRS, Uttran NRS, Utö NRS, Viksberg NRS, Vändelsö NRS, Västerhaninge ZMB, Älta NRS, Ändebol NRS, Ålberga NRS. *Uppland:* Adelsö NRS, Björklinge NRS, Bro NRS, Bromma NRS, Brudnäs NRS, Börje ZMU, Danderyd NRS ZMB, Djurö NRS, Dyvik NRS, Ekerö NRS, Eldgarn NRS, Elmsta-Väddö ZMB, Enköping NRS, Gimo NRS, Grisslehamn, Gräsö NRS, Gustavsberg NRS, Hammarby NRS, Harpabol NRS, Heby NRS, Häggeby NRS, Håtuna NRS, Ingarö, Jumkil ZMU, Järlåsa NRS, Kalmarsand NRS, Knutby ZMB, Kragsta NRS, Kungsängen NRS, Lennartsnäs NRS, Lidingö NRS, Ljusterö NRS, Läby NRS, Malmby NRS, Möja NRS, Norrviken NRS, Roslagen ZMU, Rungarn NRS, Rydboholm NRS, Rö NRS, Rådmansö NRS, Sigtuna NRS, Skokloster ZMB, Stockholm IVU NRS ZMU, Stångberga NRS, Tensta ZMB, Uppsala BML IVU NRS VCA ZMB ZML ZMU, Vallentuna NRS, Vassunda IVU, Vindö, Vira bruk NRS, Väddö NRS, Vänge

ZMU, Värmdö NRS ZML, Yxlan ZMB, Öregrund ZMB, Ösbeby-garn NRS, Österskär, Östervåla ZMB, Österåker NRS ZMU, Övergran NRS. *Västmanland:* Arboga ZMB ZML, Dingtuna NRS, Fanthyttan NRS, Fellingsbro ZMB, Guldsmedshyttan NRS ZML, Hjulsjö NRS, Hällefors NRS, Kolbäck NRS, Kolsva ZMB, Kärrbo ZMB, Köping ZMB ZML, Lindesberg NRS, Malmön ZMB, Nora stad, Nordbergsklacken NRS, Runskär ZMB, Sala NRS, Saxhyttan NRS, Skultuna ZMB. *Värmland:* Arvika, Dalby, Ed, Filipstad NRS, Forsvik, Frykerud NRS, Grums NRS, Gustavsfors NRS, Gylleby NRS, Gåsborn NRS, Karlstad NRS, Kil ZMU, Lesjöfors, Långban NRS, Molkom NRS, Nilsby, Odenstad, Rämmen, Torsby NRS. *Dalarne:* Avesta ZMB, Bingsjö NRS, Blyberg NRS, Brunnsvik NRS, Elvdalen, Falun NRS, Floda NRS, Fulufjäll NRS, Hjortnäs Tje, Hällsjön NRS, Idre, Leksand NRS Tje, Lima NRS, Ludvika NRS ZML, Mora NRS, Nittsjö NRS, Rättvik NRS Tje, Sandsjö, Siljansborg NRS, Sjurberg NRS Tje, Smedjebacken, Sollerö Tje, Stjärnsund, Stollen NRS, Stora Tandån NRS, Stora Tuna, Storsäter NRS, Städjan, Sundborn NRS ZML, Svärdsjö NRS, Säfsen NRS, Sälen ZMA, Särna NRS ZMA ZML, Säter NRS, Söderbärke NRS, Sångån Tje, Transtrand NRS, Tällberg Tje, Vikarbyn NRS. *Gästrikland:* Björke, Hille ZMB, Hille-Forsby NRS, Gävle, Hamrångerfjärden, Hedesunda NRS, Ockelbo ZMB, Storvik NRS, Trödje NRS. *Hälsingland:* Bergvik, Bollnäs NRS ZML, Delsbo VCA ZML, Fredriksfors NRS, Järvsö NRS, 25 km N Hudiksvall ZMB, Kilafors, Ljusdal NRS, Orbaden NRS, Söderhamn NRS ZMB. *Medelpad:* Bergeforsen NRS, Haverö NRS, Kölsillre NRS, Leringe NRS, Liden NRS ZMB, Sundsvall NRS ZMB, Tuna NRS, Viforsen NRS, Överturinge NRS, Ånge. *Härjedalen:* Anåfjäll NRS, Funäsdalen ZMB, Ljungdalen, Storvarden, Sveg NRS ZML, Tänndalen NRS ZML. *Jämtland:* Bispfors ZMB, Bispgården NRS, Bräcke, Döda Fallet NRS, Hallen, Hammerdal, Handsjö NRS, Jormlien, Järpen, Leipikvatten NRS, Mattmar, Ottsjön NRS, Oviken, Ragunda, Snasahögarne NRS, Stadsforsen NRS, Storlien, Strömsund NRS, Undersåker NRS ZML, Östersund ZMA ZML, Åre NRS ZMA ZML, Åreskutan ZML. *Ångermanland:* Aspele NRS, Aspeå NRS, Bindsjö, Borgsjö, Graninge NRS, Gärsta, Hoting NRS, Härnösand NRS ZML, Hörnefors NRS, Håknäs NRS, Lugnvik NRS, Näske NRS, Orsjön, Ramsele GNM, Sollefteå NRS ZML, Stennäs, Säbrå, Ullånger NRS, Örnsköldsvik NRS, Överlännäs NRS. *Västerbotten:* Bodarna NRS, Botsmark NRS, Degerfors NRS, Hällnäs NRS, Jörn, Kroksjö NRS, Lillekågeträsk NRS, Piparböle NRS, Strömsör NRS, Täfteå ZMU, Umeå, Västerhiske NRS, Åbyn ZMB. *Norrbotten:* Anttis, Boden NRS, Edefors NRS, Gammelstadviken, Gäddvik, Haparanda, Kalix NRS ZML, Karungi NRS ZML, Kukkola NRS, Lappträsk, Lillpite, Luleå NRS ZML, Nybygget NRS, Pajala NRS VCA ZML ZMU, Pello NRS, Peräjävaara, Piteå NRS ZML, Storsund NRS ZML, Södra Sunderbyn, Töre ZMB, Vitå NRS, Överkalix NRS, Övertorneå NRS ZML, Övre Svartlå NRS. *Lapland (Ås. Lpm.):* Bångnäs, Dorotea NRS, Frederika NRS, Hällefors in Bångnäs, Kittelfjäll, Malgomaj NRS, Njakafjäll, Ormsjö NRS, Risbäck NRS, Saxnäs, Vilhelmina NRS ZML, Åsele NRS. *Ly. Lpm.:* Björkfors VCA ZML, Brattikkfjäll, Lycksele NRS ZML, Myrliden NRS, Rusksele ZMU, Sickelsberg NRS, Sorsele NRS ZML, Stensele, Tjulträsk BML, Tärna, Umfors, Vännäs GNM, Västansjö NRS. *P. Lpm.:* Abborrträsk, Arvidsjaur IVU ZML, Balkovare NRS, Brattfors, Skatträsk. *Lu. Lpm.:* Jokkmokk, Kutjaure NRS, Kvikkjokk, Malmberget, Muddus NRS, Virihaure area (Killanjaure – Staloluokta ZML ZMU). *T. Lpm.:* Abisko NRS ZMA ZML, Björkliden NRS ZMA ZML, Jebrenjokk NRS, Kiruna NRS, Masungbyn VCA, Mell. Merasjärvi, Njuonjevare NRS, Ortojokka NRS, Vassijaure NRS, Vietovare NRS, Vittangi ZML, Övre Sopporo NRS.

Correction. Records from Dalarne: Idre (Bengtsson 1908, p. 242) treated as *B. p. arcticus* were revised to *B. muscorum*.

Finland. Commonly occurring throughout the country (Elfving 1968).

World distribution. Europe (British Isles; Sicilia; Corsica; entire continent except in European USSR not occurring south of districts of Moldavia, Kharkov, Stalingrad, Tsjkalov) – Turkey – Iran – Northern Kazakhstan – Siberia (Southern part of Western Siberia, Southern Yakutsk) – Baykal – China (Kansu) (Reinig 1939, p. 194; Panfilov 1957; Yarrow in litt.).

Biology

Nest. Pocket-maker. Nests on the surface of the ground, recorded in grass of hayfields, in moss, accidently in decayed stumps of trees, etc. Produce colonies of various size, the number of workers may surpass 100 (Dahlbom 1837; Lie-Pettersen 1907; Meidell 1934b; Hasselrot 1960, 1962).

Flight season. From the middle of April to first half of October. Queen: 16 April–14 Oct.; worker: 2 May–11 Oct.; male: 18 June–11 Oct.

BOMBUS PASCUORUM SMITHIANUS WHITE

(= *Bombus agrorum erlandssoni* Kruseman)

The subspecies is distinguished from *B. p. sparre-*

anus by hairs of T_{1-6} being continuously bright orange-brown except for small black lateral patches on anterior tergites.

Queen, worker

Queen measurements: N = 15; Norway: Troms; malar space: 0.93 mm (±0.03±0.01) range: 0.85–0.95 mm; 'radial length': 4.10 mm (±0.08±0.02) range: 4.00–4.20 mm; interalar width: 4.98 mm (±0.14±0.06) range: 4.65–5.15 mm. Body of medium to large size, pronounced long-haired coat.

Colour pattern. Pile of vertex entirely yellowish-brown to orange-brown or predominantly so, i.e. with variable admixture of black hairs concentrated to the anterior and lateral portions. At most the dorsal third of episternum, dorsum of thorax, T_{1-6} (except small lateral black patches of at most T_{1-4}) bright orange-brown. Sternites often fringed greyish. Coat otherwise black.

Variation. T_1 with variable admixture of black hairs, occasionally all hairs black. Lateral black patches of gastral tergites vary in size, occasionally trochanters with admixture of greyish hairs.

Male

Body of medium size.

Colour pattern. Plumose short hairs in pile of face below antennal sockets more or less pale yellowish. Fringes of gastral sternites more often greyish than black as also hairs on trochanters. Otherwise colouring as in the female.

Variation. As in the female.

Distribution (Fig. 86)

Norway. Confined to the area north of Polar circle and moreover extending along the coast south to about 65° N.

Sweden. Restricted to inner part of Lapland north of 67° N.

Finland. In Lapland (Elfving 1960).

Total distribution of the subspecies, Bombus pascuorum smithianus White. From Northern Fennoscandia to the southern coast of Kola pen. – Novaya Zemlya – Arkangelsk (Panfilov in litt.).

BOMBUS PASCUORUM SPARREANUS NOV. NOM.

(= *Bombus agrorum bicolor* Sparre Schneider)

The subspecific designation *bicolor* Sparre Schneider is a junior homonym, cf. p. 154, and hereby replaced with a new name. *B. pascuorum sparreanus.*

The subspecies is distinguished from *B. p. smithianus* by the variable pattern on T_{2-4} usually displaying a black band of varying width. It is separated from *B. p. pallidofacies* by the black or predominantly black pile of face, episternum, trochanter and femur, and also by a longer coat.

Type material

As the type of *B. p. bicolor* Sparre Schneider is not traced, the following types have been selected for *B. p. sparreanus* and labelled accordingly: Holotype ♀ Norway: Hordaland (HOy): Bergen July 1900 (ex coll Lie-Pettersen) ZMB. Paratypes: 2 ♀♀ Bergen 30 June 1896 (ex coll Sparre Schneider) ZMB; 2 ♀♀ Bergen May 1909 and 2 ♂♂ Bergen July 1900 and July 1901 (ex coll Lie-Pettersen) ZMB; ♂ Bergen: Museumshagen 19 July 1952 (Løken) ZMB; 2 ♀♀ Asköy: N. Erdal 28 May 1954 and Davanger 21 May 1959 (Løken) ZMB. Type loc. Hordaland (HOy): Bergen.

Description of holotype. Measurements: Malar space: 0.90 mm; 'radial length': 4.10 mm; interalar width: 4.85 mm.

Pile of face black, yet below and between antennal sockets singly long pale yellow hairs and some short pale yellow plumose hairs. Pile of vertex yellowish-brown, laterally and anteriorly encroached by black hairs. Dorsum of thorax and adjacent almost third of episternum yellowish-brown. Pile on T_1 black with admixture of greyish-white hairs, particularly in lateral patches. Pile om T_2 black with a narrow lunate anterior part mainly yellow and with a few yellow hairs

on the disc. Pile on T_3 yellowish-brown with distinct lateral black patches. Pile on T_{4-6} yellowish-brown, gastral sternites with mainly greyish fringes. Otherwise coat black.

Queen, worker

Queen measurements: N = 15; Norway: Hordaland (HOy); malar space: 0.89 mm (±0.03 ±0.01) range: 0.85–0.95 mm; 'radial length': 4.07 mm (±0.08±0.02) range: 3.95–4.20 mm; interalar width: 4.84 mm (±0.15±0.04) range: 4.65–5.18 mm. Body of moderate to large size.

Colour pattern. Cf. description of holotype.

Variation. Pile of black. Pile of vertex with variable mixture of yellowish-brown and black. Occasionally dorsum of thorax with single black hairs on the disc. Hairs on T_1 ranging from entirely black to predominantly greyish-white or yellowish-white. Anterior lunate part of T_2 varying in size, varying in colour from yellow to yellowish-brown, occasionally T_2 entirely black or entirely yellowish-brown. Hairs on T_{3-4} forming a black band of various width, otherwise yellowish-brown; occasionally black hairs reduced to small lateral patches or expanded to entire tergites. Hind femur with a slight admixture of greyish hairs, and the fringes of sternites varying from black to greyish-white. The shade of yellowish-brown varying but usually darker, brighter than *B. p. pallidofacies*. Three ☿☿ (Rogaland (Ry): Klepp: Orre 3–4 Aug. 1963 (Lø)) are completely brownish-black with exception of T_1 and anterior lunate part of T_2 having pale yellow hairs.

Male

Body usually of medium size.

Colour pattern. T_7 with yellowish-brown hairs, fringes of sternites predominantly greyish or pale yellowish. Colouring otherwise as in the female.

Variation. Short plumose hairs in pile of face with variable admixture of pale yellow hairs. Pile of vertex black or almost so. Episternum, venter, proximal segment of legs more or less pronounced greyish-haired. Hairs of T_1 entirely greyish or yellowish-white. Rarely T_{1-7} all black-haired. Otherwise variations as in the female.

Meidell (1934a) describes a melanic male (Rogaland (Ry): Rennesöy 24 Aug. 1931) being almost black except for reddish-yellow hairs on T_{4-6}. He indicates a local occurrence of *B. pascuorum* var. *mniorum* (Fabricius), a common form in Denmark. Together with the dark workers mentioned above, the record indicates, however, only a sporadic melanism at the extreme south-western coast.

Distribution (Fig. 86)

Scandinavia. From the west coast of Norway across the mountains eastwards throughout the conifer forest to Gulf of Bothnia.

Finland. According to the description of the colouring of the coat (Elfving 1960), and the material examined by me, this subspecies prevails throughout the country except Lapland and apparently the extreme southern coast.

Total distribution of the subspecies, B. p. sparreanus nov. nom. Fennoscandia. ? Further east into the taiga in USSR.

BOMBUS PASCUORUM PALLIDOFACIES VOGT NOV. STAT.

(= *Bombus agrorum barcai* Vogt (partim))

The *pallidofacies* form of Vogt (1911), considered by Krüger (1928, p. 366) and Reinig (1939, p. 194 the map) as a transitional form between *B. p. romani* Vogt and the subspecies on the continent *B. p.* ? ssp = *B. agrorum* typicus Vogt nec Fabricius, is herewith given subspecific rank.

The subspecies is distinguished from *B. p. sparreanus* by predominantly light yellow pile of face, entirely or predominantly whitish-haired episternum, venter, hind femora, and a shorter coat.

Type material

Holotype = type of *B. p.* f. *pallidofacies* Vogt = ♀ Uppland 17 July 1909 (Roman) VCA!. Paratypes herewith selected: Sweden: Skåne: 3 ♀♀

Lund 25 May 1924 resp. 3–4 June 1930 (Ander) ZMB, 3 ♀♀ Genarp 1 May 1924 resp. 6–8 June 1929 (Ander) ZMB, 3 ♀♀ Bökeberg 5 June 1930 (Ander) ZMB. Type area Sweden: Uppland.

Original description (Vogt 1911): 'Wie *romani* aber Gesicht, Thorax-seiten und Unterseite vorherrschen grau behaart. Durch Übergänge mit *romani* verbunden. Von Gleichen Fundorten'.

Supplementary description of holotype: Measurements: Malar space: 0.85 mm; 'radial length': 4.00 mm; interalar width: 4.48 mm.

Pile of face mainly pale yellow, pile of vertex yellowish-brown with black hairs concentrated to lateral and frontal margins; head otherwise black except for a few ventral greyish-white hairs. Dorsum of thorax rather dull yellowish-brown as also adjacent edge of episternum. Episternum otherwise with greyish-white hairs admixed with some black ones in the portion adjoining the yellowish-brown hairs at upper edge. Venter, trochanters with greyish-white hairs. Fore- and mid-femur with a mixture of black and greyish-white hairs, hind femur greyish-white, hairs of legs otherwise black. Pile on T_1 greyish-white, pile on T_2 black with broad anterior lunate part yellowish-brown. Hairs on T_3 black, T_{4-6} yellowish-brown except for lateral black patches on T_4. T_5 laterally with sparse black hairs, fringes of T_6 mainly black.

The colour pattern of the type agrees with the general appearance of the population in the central area of its distribution, i.e. Southern Sweden. This will justify this designation to be selected for the subspecies, though the type is from the peripheral area of its distribution.

Queen, worker

Queen measurements: N = 15; Sweden: Skåne; malar space: 0.80 mm ($\pm$0.03 $\pm$0.01) range: 0.75–0.85 mm; 'radial length': 3.84 mm ($\pm$0.09 $\pm$0.02) range: 3.70–4.00 mm; interalar width: 4.37 mm ($\pm$0.16 $\pm$0.04) range: 3.98–4.65 mm. Body small to medium size.

Colour pattern. Cf. description of holotype.

Variation. Pile of face ranges from being entirely pale yellow to predominantly black. Pile of vertex occasionally predominantly pale yellow. Dorsum of thorax admixed with single black hairs either on the disc or laterally. Except for yellowish-brown hairs at narrow dorsal edge pile of episternum ranges from entirely greyish-white or yellowish-white to predominantly black; the latter, however, only rarely observed. Colour in hairs of T_{2-4} encrouches upon another and displays variations similar to that of *B. p. sparreanus*. The shade of yellowish-brown on an average paler than in the remaining Scandinavian subspecies. Strongly melanic specimens were examined, cf. below.

Male

Body small to medium size.

Colour pattern. In general as for the female or more diffuse.

Variation. Pile of vertex occasionally entirely black. Tibia with admixture of pale yellow hairs. A few 'ciliate' individuals were examined, i.e. specimens with fringes of several gastral tergites pale yellow.

Remarks on melanism

The subspecies does not show pronounced tendency to melanism in spite of the closeness to Denmark, where there are strongly melanic populations, that of Sjelland treated as *B. p. mniorum* (Fabricius) by Krüger (1940). However, some 'tricuspoide' specimens, i.e. with triangular black spot on disc of thorax, and also some more pronounced melanic individuals, were examined, all recorded on the extreme west coast of Skåne, from Hälsingborg and northwards.

Distribution (Fig. 86)

Scandinavia Southern Sweden.

Total distribution of the subspecies, Bombus pascuorum pallidofacies Vogt. Denmark (Bornholm) – Southern Sweden – ? further east (Kruseman 1958). The subspecies extends apparently to the extreme southern coast of Finland and further east into adjacent part of Russia, from where a few individuals were examined.

BOMBUS PASCUORUM GOTLANDICUS ERLANDSSON

Distinguished from *B. p. sparreanus* and *B. p. pallidofacies* by pile on T_{1-6} being continuous orange-brown except lateral patches of T_{1-2}. Separated from *B. p. smithianus* by venter being predominantly greyish-haired. Shorter, less shaggy coat than the remaining Scandinavian subspecies.

Queen, worker

Queen measurements: N = 15; Gotland; malar space: 0.83 mm (±0.03±0.01) range: 0.80–0.90 mm; 'radial length': 3.82 mm (±0.06 ±0.02) range: 3.70–3.95 mm; interalar width: 4.41 mm (±0.10±0.02) range: 4.25–4.60 mm. Body of small to medium size.

Colour pattern. Pile of face yellow, occasionally with slight admixture of black hairs. Pile of vertex orange-brown. Dorsum of thorax, at most dorsal third of episternum, T_{1-6} with orange-brown hairs except for pale yellow lateral patches of T_1 and black lateral patches of T_2. Ventral part of episternum greyish-white-haired, usually with slight admixture of black hairs. Venter, trochanters, hind femur with greyish-white hairs. Pile on fore- and mid-femora entirely black or the proximal parts greyish-white. Otherwise coat black.

Variation. In addition to the small variations above, pile of vertex may anteriorly and laterally be encroached on by black hairs. All femora occasionally greyish-white; corbicular fringes tipped orange-brown or with admixture of orange-brown hairs. T_1 rarely with admixture of black hairs. Otherwise colour-stable.

Male

Body of small size.

Colour pattern. Pile of face with great admixture of black, otherwise colouring as in the female.

Variation. As in the female.

Distribution (Fig. 86)

Sweden. Gotland.

BOMBUS (THORACOBOMBUS) RUDERARIUS (MÜLLER)

Apis ruderaria Müller, 1776, p. 165 No. 1922, no type exists, type area not mentioned. Denmark: Sjelland hereby designated.

(Bombus ruderarius (Müller); Sparre Schneider 1918; Gaunitz 1931; Wexelsen & Skåre 1934; Tjeder 1954; Løken 1958b; Kruseman 1959; Elfving 1960, 1968; Erlandsson 1960; Fridén, Eskilsson & Bingefors 1962; Hasselrot 1962; Ander 1963, 1965; Fridén 1967. *Apis derhamella* Kirby, 1802, p. 363 No. 105, holotype ♂ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Bombus derhamellus* (Kirby); Dahlbom 1832, p. 44 (partim); Boheman 1844; Aurivillius 1903; Wahlgren 1915; Meidell 1934a; Løken 1949. *Apis raiella* Kirby, 1802, p. 367 No. 107, holotype ♀ KCL! labelled by Yarrow (1968), type loc. England: E. Suffolk: Barham. *Bombus rajellus* (Kirby); Dahlbom 1832, p. 33; Siebke 1863, 1880; Thomson 1870, 1872; Strand 1898b; Lie-Pettersen 1901, 1907.)

First Scandinavian records

Norway. Sör-Tröndelag (STi): Oppdal: Drivdalen (Siebke 1863). The record is doubted (Sparre Schneider 1918) and no voucher specimen is traced. First reliable records were Akershus: Oslo and Hedmark (HEs): Sör-Odal (Siebke 1880).

Sweden. According to Dahlbom (1832, pp. 33, 44) *B. rajellus* is rare in Skåne, Småland, Västergötland and *B. derhamellus* is not frequent in Småland, Östergötland, Västergötland, Uppland and only once recorded in'Lapponia'. In the present Dahlbom collection no specimens are arranged as *B. derhamellus*, and those arranged as *B. rajellus* demonstrate confusion with melanic *B. sylvarum*. First reliable record is from Norrbotten: Heden (Boheman 1844).

Taxonomical remarks

The Scandinavian population belongs to the nominate form. *B. ruderarius* var. *integer* Alfken, 1913 (Sparre Schneider 1918) is an infrasubspecific form.

Queen, worker

Morphological characters. Malar space hardly longer than distal width, occasionally equal to it, about as long as A_{2+3}. Clypeus hardly or not longer than distal width, on the disc with rather fine, dense uneven puncturing except for a very small anterior impunctate area between rather narrow lateral impressions which are moderately to coarsely punctured. Labral furrow moderate, slightly widened towards the base; margin of labral lamella thickened, dull. Surface on T_{4-6} chagrinated, rather densely punctured. St_6 with inconspicuous keel. Posterior edge of hind basitarsus slightly curved, slightly broader at base than distally. Coat somewhat shaggy.

Queen measurements. N = 20; Norway: Rogaland; malar space: 0.75 mm ($\pm$0.03 $\pm$0.01) range: 0.70–0.80 mm; 'radial length': 3.65 mm ($\pm$0.10 $\pm$0.02) range: 3.50–3.80 mm; interalar width: 4.90 mm ($\pm$0.17 $\pm$0.04) range: 4.60–5.25 mm. Body of medium size.

Colour pattern. Hairs on T_{4-6}, St_{4-6} bright ferruginous. Corbicular fringes predominantly ferruginous or tipped so. Otherwise coat black.

Variation. Workers may have anterior lunate part of T_2 more or less predominantly dull yellow-haired. A single queen with indication of yellow-haired collar, scutellum was examined. In general minute variations only.

Male

Morphological characters. Malar space slightly longer than distal width, about as long as A_{3+4} or nearly. A_3 at least $\frac{2}{3}$ the length of A_5. A_4 about as long as distal width, A_{7-13} slightly swollen beneath (Fig. 44A). Longest hairs in fringe of hind tibia about as long as greatest width of the segment, rarely slightly longer. St_8 and genitalia (Figs. 44B–C); gonostylus inwardly produced into a long broad toothlike process with a soft posterior appendix easily recognized in fresh specimens; subapical process of volsella nearly parallel-sided, markedly longer than distal width and dilated, truncate at apex; penis valve distally hooked and toothed beneath (Fig. 44 D). Body of small to medium size.

Colour pattern. T_1 with dull yellow hairs or entirely black-haired. At least anterior half of T_2 dull yellow to pale brownish-haired. Fringes of mid- and hind tibia dark ferruginous, occasionally with variable admixture of black. Otherwise pattern as in the female.

Variation. Collar, scutellum occasionally mainly or entirely dull yellowish-grey-haired.

Distribution (Fig. 87)

Norway. Restricted to the southeastern lowlands and the extreme southern and southwestern coast, i.e. extending from the border to Sweden and westwards to islands in Bokkenfjord in Rogaland county. A record of this continental species at 70° N, cf. the list below, is indeed so striking that the reliability of the labelling must be questioned. Local occurrences. The frequency is observed as particularly high in the sand-dunes at Jæren in Rogaland county. The disperse records in the eastern valleys were confined to open cultivated fields.

Biotopes: Meadows, *leguminosae* fields, gardens.

A total of about 325 specimens was examined.

List of localities. *Østfold:* Hvaler: ? loc. ZMO; Onsöy: Onsöy kirke; Sarpsborg: ZMO; Halden: Asak; Rakkestad: Rörvik; Moss: VCA. *Akershus:* Frogn: Dröbak TRM; Asker: S Asker; Bærum: ? loc. KMT ZMO, Hövik ZMO; Oslo: TRM ZMB ZMO; Aurskog-Höland: Björklangen; Eidsvoll: Feiring. *Hedmark (HEs):* Hamar: ZMO; Sör-Odal: Månud ZMO. *Oppland (Os):* Jevnaker: Randsfjord USU ZMB; Östre Toten: Hveem, Skreia; Lillehammer: ZMC, Stor-Håve; Öyer: Prestegården. *On:* Sel: Heidal TRM, Otta ZMO; Vågå: Vågåmo ZMB ZMO. *Buskerud (Bö):* Hurum: Filtvedt TRM, Hurum kirke; Röyken: Åros; Drammen; Lier: ? loc., Spikkestad; Kongsberg: Komnes, Skollenborg. *Vestfold (VE):* Ramnes: Lunde; Andebu: Andebu; Stokke: Langö, Veierland; Nötteröy: Teie; Tjöme: Mostranda. *Telemark (TEy):* Eidanger. *Aust-Agder (AAy):* Tvedestrand: Nes Verk TRM. *Vest-Agder (VAy):* Kristiansand: Randesund ZMO; Farsund: Hanangervann, Lista fyr, Tjörve. *Rogaland (Ry):* Hå: Brusand, Ogna, Opstad; Klepp: Börsheim, Jæren TRM ZMB, Orre, Reve, Salte, Vik; Time: ? loc. TRM; Sandnes: Hana; Sola: Solastrand; Stavanger: TRM; Finnöy: Reilstad; Rennesöy: Bru, Dale. *Ri:* Forsand: Meling. *?Finnmark (Fi):* Alta: Bossekop ♀ 1878 (Schøyen) ZMO ?erroneous labelling.

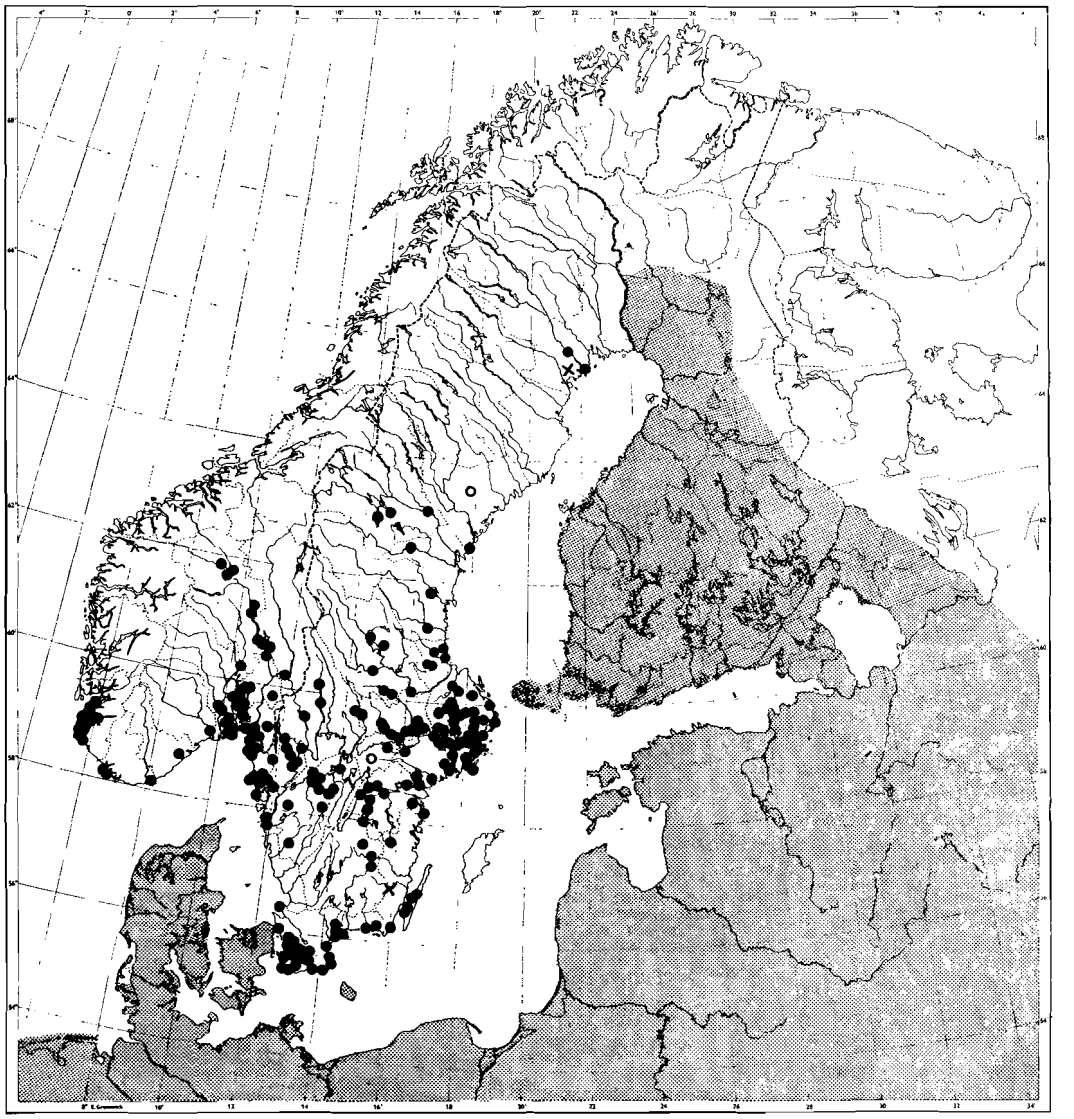


Fig. 87. *B. ruderarius* (Müller). Legends as in Fig. 50, 54.

Corrections. A worker (Oppland (On): Dovre (Schöyen) ZMO) previously revised to *B. ruderarius* by Sparre Schneider (1918) is a melanic *B. sylvarum*. *B. ruderarius* has in fact been confused with *B. w. mastrucatus* and melanic *B. balteatus* in addition to *B. sylvarum*. Unrevised records were therefore not considered.

Sweden. Widely distributed throughout the lowlands from the southernmost coast northeast to nearly 66° N in Norrbotten. Apparently avoiding the wooded hills in Southern Sweden. Occurring in Öland but not observed in Gotland.

A total of about 600 specimens were examined.

List of localities. *Skåne:* Baskemölla NRS, Benestad, Blentarp, Bokskogen ZMB, Bonderup ZMB, Bäckaskog NRS, Degeberga, Fågelsång, Hälsingborg VCA ZML, Ivö NRS, Kyrkheddinge ZMB ZML, Kämpinge GNM, Kävlinge, Linhamn, Lund ZMA ZMB ZML, Lyckås NRS, Löderup NRS, Malmö ZMB, Markiehage GNM, Nytorp, Reslöv, Sege,

Simrishamn NRS, Södra Sandby, Sövde NRS, Torekov NRS, Torna-Hällestad, Trelleborg ZMB, Veberöd NRS ZML, Villands Vånga, Vinninge, Ystad NRS, Örtofta, Övedskloster. *Blekinge:* Kristianopel GNM, Ronneby NRS, Rödeby NRS, Sölvesborg NRS. *Småland:* Bränstorp NRS, Höreda NRS, Tranås NRS, Vimmerby, Österkorsberga ZMU. *Öland:* Högsrum NRS, Kalkstad ZMB, Mörbylånga NRS, Runsten GNM NRS ZMU. *Östergötland:* Borensberg NRS, Boxholm NRS, Gryt GNM, Kvarsebo NRS, Linköping ZMB ZML, Malmslätt NRS, Mjölby NRS, Motala NRS, Norrköping NRS ZMA, Ringarum NRS, Rinna ZMB, Väversunda NRS. *Västergötland:* Erska, Falköping NRS, Gräfsnäs, Höjentorp NRS, Kinna, Kinnekulle, Lyrestad NRS, Läckö NRS, Råbäck NRS, Skara GNM NRS, Skövde NRS ZMU ZML, Stenum NRS, Österplana. *Bohuslän:* Bovallstrand NRS, Brastad NRS, Dingle NRS, Edshultshall NRS, Munkedal, Naverstad NRS, Rossöhamn NRS, Tjuvkil NRS, Strömstad, Syd-Koster NRS, Uddevalla, Ulebergshamn NRS, Ytterby NRS. *Dalsland:* Bengtsfors GNM NRS, Gesäter SSW Ed ZMB, Köpmannebro, Mellerud, Skållerud NRS, Skåpafors NRS, Stenebynäs GNM, Vårvik GNM, Åmål. *Närke:* Stora Mellösa ZMB. *Södermanland:* Brandalsund NRS, Helgarö, Julita NRS, Muskö NRS, Mölnbo NRS, Norrköping, Nyköping NRS, Sjösa ZMB, Strängnäs ZMB, Tosterön NRS, Trosa, Tyresö NRS, Utö NRS, Vreta, Västerhaninge ZMB, Älta NRS, Ålberga ZMB ZML. *Uppland:* Adelsö NRS, Almunge NRS, Björklinge NRS, Bromma NRS, Danderyd ZMB, Dannemora NRS ZML, Ekolsund NRS, Elmsta ZMB, Enköping NRS, Funbo NRS, Gimo NRS, Gustavsberg NRS, Hammarby NRS, Håtuna NRS, Jumkil NRS, Järlåsa NRS, Knutby ZMB, Kragsta NRS, Lidingö NRS, Ljusterö NRS, Läby NRS, Munsö NRS, Rimbo NRS, Rydboholm NRS, Rö NRS, Rådmansö NRS, Skokloster ZMB, Spånga ZMA, Stockholm NRS ZML ZMU, Stångberga NRS, Tensta ZMB, Tierp NRS, Ultuna IVU, Uppsala BML IVU NRS VCA ZMA ZML ZMU, Valsätra IVU, Vårdsätra IVU, Yxlan ZMB, Österskär, Österåker ZMU, Östra Ryd NRS. *Västmanland:* Arboga ZMB, Dingtuna NRS, Fanthyttan NRS, Fellingsbro ZMB, Kolbäck NRS, Kärrbo ZMB, Köping ZMB, Lindesberg NRS, Munktorp NRS, Saxhyttan NRS, Skultuna ZMB, Strö ZMB. *Värmland:* Arvika, Gylleby in Sunne NRS, Horrsjön NRS, Långban NRS, Torsby NRS. *Dalarne:* Avesta ZMB, Brunnsvik NRS, Floda NRS, Härnäs NRS, Ludvika NRS, Mora NRS, Rättvik NRS, Söderbärke NRS. *Gästrikland:* Björke, Hamrångerfjärden, Hille-Forsby NRS, Ockelbo NRS, Trösken ZMB. *Hälsingland:* Delsbo VCA, Kilafors. *Medelpad:* Ånge. *Jämtland:* Lockne, Oviken, Ragunda. *Ångermanland:* Bondsjö, Säbrå. *Norrbotten:* Heden ♂ 26 Aug. 1843 (Wahlberg) TCL, Luleå ☿ 31 Aug. 1929 (Roman) NRS, Norrland: ? loc. ♀ TCL.

Unrevised records are not included here except the following (Ander in litt.): *Närke:* Asbro. *Ångermanland:* Långsele.

Correction. Records from Öland (Wahlgren 1915) are all revised to melanic *B. sylvarum* (Ander in litt.).

Finland. Occurring throughout the country north to about 64° N and in the western areas reaching further north to the inner coast of Gulf of Bothnia (Elfving 1968).

World distribution. Europe (British Isles; on the continent from Mediterranean north to Fennoscandia; in European USSR north to districts of Leningrad, Kostroma, Kirov and south to districts of Kemenets Podolskiy, Kharkov, Tambov, Bashkir) – Turkey – Caucasus – Southern part of Western Siberia – Northern Kazakhstan – Baykal area (Pittioni 1938; Panfilov 1957; Yarrow 1959; Tkalcu 1960).

Biology

Nest. Nests on the ground, in moss and grass in pastures, hayfields, etc. (Lie-Pettersen 1901; Sparre Schneider 1918). Lie-Pettersen, in 1899 locating as many as 48 colonies on a single farm in Jæren in Rogaland county, states that the nests are small, on an average containing 25–30 individuals, whereas Hasselrot (1962) indicates a greater number of offspring being produced.

Flight season. From the end of April to the end of August. Queen: 29 April–21 Sept.; worker: 11 May–24 Aug.; male: 3 July–?.

BOMBUS (THORACOBOMBUS) SYLVARUM (LINNAEUS)

Apis sylvarum Linnaeus, 1761, p. 425 No. 1713, type area Sweden: Uppland. A queen (or large worker) LSL! labelled *sylvarum* agrees with the usual interpretation of the taxon.

(Bombus sylvarum (Linnaeus); Dahlbom 1832, p. 44; Zetterstedt 1838; Thomson 1870, 1872; Siebke 1880; Roth 1897; Strand 1898b; Aurivillius 1903; Sparre Schneider 1918; Meidell 1934a; Wexelsen & Skåre 1934, Erlandsson 1951, 1960; Kruseman 1959; Elfving 1960, 1968; Løken 1960, 1962; Fridén, Eskilsson & Bingefors 1962;

Hasselrot 1962; Ander 1963, 1965; Fridén 1967. *Bombus derhamellus:* Dahlbom 1832, p. 44 (partim). *Bombus sylvarum* var. *b* Thomson, 1872; Siebke 1880; Strand 1898b. *Bombus sylvarum* var. *nigrescens* Pérez, 1879, p. 121, lectotype ♀ MNP!, type area the Pyrenees; Gaunitz 1931; Løken 1958b, 1960; Erlandsson 1960; Kruseman 1960; Ander 1963. *Bombus nigrescens* Pérez; Kruseman 1958b; Faester 1959.)

First Scandinavian records

Norway. Akershus: Oslo (Siebke 1880).
Sweden. Uppland (Linnaeus 1761).

Taxonomical remarks

The Scandinavian population belongs to the nominate subspecies.

Though Thomson (1872) describes a melanic form as var. *b*, the dark Swedish individuals were nevertheless later misidentified as *B. ruderarius* until they were recognized by Gaunitz (1931) and treated as *B. s.* var. *nigrescens*. Though Siebke (1880) and Strand (1898b) listed var. *b* Thomson as occurring in Norway, the melanic specimens were all found under *B. ruderarius* in the collections when recognized by Løken (1958b).

Pérez (1879) designated, however, *B. s.* var. *nigrescens* as the melanic form of the Pyrenees, where it likewise occurs together with non-melanic forms, and therefore Kruseman (1958b) doubtfully recognized it as an endemic species, *B. nigrescens*. Corresponding dimorph forms also occur in Denmark where Faester (1959), stating that intermediates were never observed, likewise gave the melanic form specific rank, *B. nigrescens*. However, inhabitants from two *B. sylvarum* colonies (Sweden: Skåne: Norra Nöbbelöv in Lund 1932 (Kemner) ZML) present both typical and melanic forms, which proves the conspecific status. The preserved material consists of the old ♀, 5 ☿☿ 4 ♂♂ of the typical form and 4 melanic ☿☿ from one colony while 4 typical ☿☿ and 4 melanic ☿☿ from the second colony. In both colonies several of the melanic workers have some pale hairs on episternum and/or the first tergite, and one worker displays a pronounced intermediate colouring. The designation *nigrescens* Pérez is, moreover, erroneously used for the North-European population but needs no replacement as far as the melanic form does not qualify for nomenclatural rank.

B. sylvarum produces dimorphic infrasubspecific forms with sympatric occurrence not only in the Pyrenees, Scandinavia and Denmark but also apparently in other fringes of its distribution, e.g. in the Caucasus (Schmiedeknecht 1883, p. 87 (337)). A few melanic specimens are also recorded in England (Mortimer 1922; Yarrow 1959).

Queen, worker

Morphological characters. Malar space slightly longer than distal width, about as long as A_{3+4}. Clypeus hardly longer than distal width; disc of clypeus convex with rather fine, dense puncturing except for anterior, usually impunctate area between well-defined lateral impressions, which are rather coarsely punctured. Labral furrow moderate to well-defined, almost parallel-sided, queer (Fig. 22A); labral lamella smooth, shining with the edge knife-sharp. Mandible short (Fig. 22B). Surface of T_{4-5} smooth, shining with moderate to rather sparse puncturing. Distal keel of St_6 usually reduced to a point. Hind basitarsus almost parallel-sided. Coat rather short, rather even.

Queen measurements. N = 20; SE Norway; malar space: 0.77 mm ($\pm$0.03 $\pm$0.01) range: 0.70–0.80 mm; 'radial length': 3.36 mm ($\pm$0.09 $\pm$0.02) range: 3.15–3.50 mm; interalar width: 4.53 mm ($\pm$0.13 $\pm$0.03) range: 4.23–4.78 mm. Body of small to moderate size.

Colour pattern. Pile of face yellowish-grey, more or less encroached by variable mixture of black. Pile of vertex with mixture of yellowish-grey and black, occipital ridge otherwise black-haired; hairs on head otherwise ranging from mainly grey to predominantly black. Thorax clothed yellowish-grey with exception of broad interalar band encroached with yellowish-grey hairs in front, laterally and behind, and additio-

nally single black hairs admixed on collar and scutellum. Pile on T_{1-2} pale yellowish-grey, often T_1 with variable admixture of black hairs, occasionally T_2 predominantly black except for pale yellowish-grey or ferruginous fringe. Pile on T_3 black, except for posterior pale yellowish-grey or ferruginous fringe. T_{4-6} ferruginous-haired, yet posterior fringes of T_{4-5} usually of a paler shade, or yellowish-grey. At least fringes of sternites greyish or pale yellowish-grey as also trochanters. Fore- and mid-femora usually predominantly pale yellowish-grey except for black hairs inside; hind femur pale yellowish-grey and likewise corbicular fringes except for short black bristles; remainder of legs predominantly ferruginous with variable admixture of black hairs or bristles.

Variation. In addition to the variations included above the species displays a pronounced tendency to melanism with an appearance as follows: Queen: Posterior fringe of T_3, T_{4-6} and at least tip of corbicular fringes ferruginous. Trochanters with variable admixture of black and greyish hairs. Otherwise coat black. Worker: Pile on T_3 usually entirely black, otherwise variations as in the female.

Male

Morphological characters. Malar space longer than distal width, occasionally almost 1½ times this width, hardly as long as A_{3+4}. A_3 varying slightly in length, usually just longer than A_4 and at most ⅔ the length of A_5; A_4 transverse. A_{7-13} slightly swollen beneath (Fig. 45A). Longest hairs in fringes of hind tibia usually slightly exceeding the greatest width of the segment. St_8 and genitalia (Figs. 45B–C); gonostylus inwardly produced into a bifid process with a long narrow anterior tooth and a short, broad posterior tooth, the latter prolonged by a soft narrow appendix being as long as the anterior tooth; subapical process of volsella about as long as distal width and laterally emarginated, distally dilate and truncate; penis valve hooked at apex, not toothed beneath (Fig. 45D). Body usually of small size.

Colour pattern. T_7 with ferruginous hairs, otherwise colouring as in the female.

Variation. Admixture of black hairs on T_2 less common than in the female. Ferruginous hairs may be of paler shade or replaced by yellowish-grey ones, resulting in a rather diffuse pattern. Typical melanic individuals have the following pattern: Pile on episternum black or dull greyish. T_{4-7} ferruginous-haired. Fringes of sternites, trochanters greyish. Pile on fore- and mid-tibia, basitarsus with variable admixture of ferruginous. Hind tibia and hind basitarsus predominantly ferruginous fringed. Otherwise coat black.

Rather few specimens, mostly males, were observed to be intermediates, i.e. dark individuals with variable admixture of dull yellowish-grey hairs slightly indicating the pattern of the typical form.

Discussion on melanism

The melanic and typical form occur freely together and locally they may alternate in being the dominating form. The frequency of melanism throughout Scandinavia is demonstrated on the pie chart (Fig. 88) based on figures set out in the Tables XXIV XXV. Rather dark intermediates, i.e. individuals with yellowish-grey hairs strongly reduced and barely seen by naked eye, were grouped together with melanic individuals. The pie chart shows a reduced melanism in the northern border areas in Sweden, while the melanic form not only dominates the typical form in Norway but has a wider distribution. In fact with the exception of records in Östfold, the typical form has so far rarely been observed in Norway, cf. Table XXIV.

The study is based on collections comprising a total of 341 Norwegian and 1219 Swedish specimens. Even though the number of records from some counties is small, in particular at the border area, the material nevertheless reflects the general tendency to melanism. It includes only a minor part of the large collection of *B. sylvarum* from Skåne and Öland kept ZML. According to Ander (in litt.) approximately 400 typical and 550 melanic individuals from Skåne,

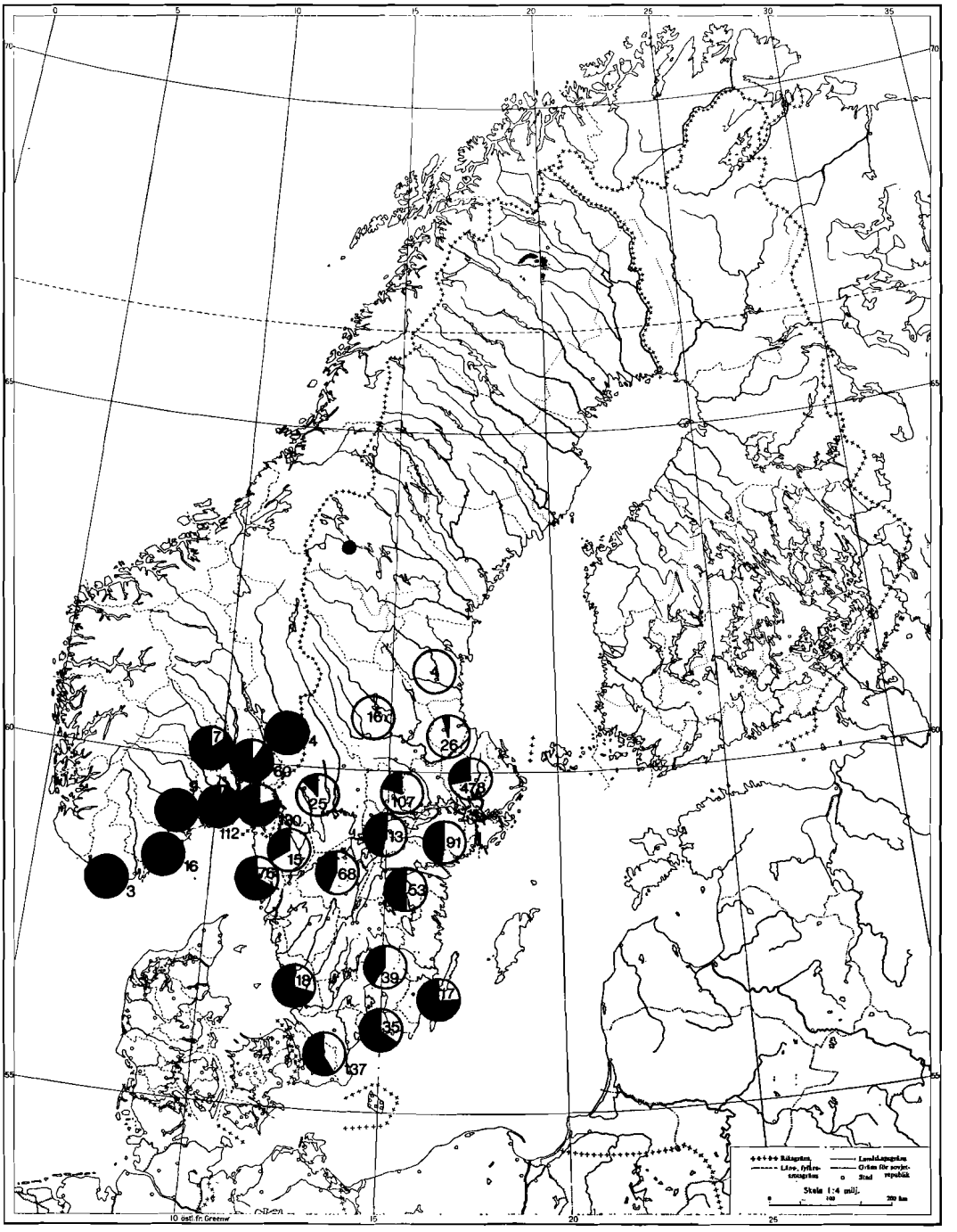


Fig. 88. *B. sylvarum* (Linnaeus). Proportion of melanism. The figures refer to the total number of records within a county or district thereof. Black = proportion of melanics. Small circle = single record.

6 typical and approximately 650 melanic individuals from Öland were not revised by me. This material added up shows that the proportion of melanism in Skåne (based on 56+400 typical and 81+550 melanic individuals) is roughly 58 per cent, and in Öland (based on 4+6 typical and 13+650 melanic individuals) roughly 98 per cent, indicating that the frequency of the melanic presented in Table XXV is more representative of Skåne than of Öland, where typical form has only rarely been recorded.

The study emphasizes the Scandinavian population as a subspecies producing dimorph infrasubspecific forms. The variation is, moreover, not sex-associated. The distribution in percentage of melanic queens, workers and males in the

Table XXIV. *B. sylvarum* (Linnaeus). Proportion of melanism throughout Norway, based on collections. Area = county or district thereof (cf. Fig. 99)

Area	Number of individuals		Total number	Per cent mel. form
	typ. form	mel. form		
Ö	21	109	130	84
AK	4	56	60	93
HEs	0	4	4	100
Bö	1	6	7	86
VE	3	109	112	97
TEy	0	9	9	100
AAy	0	16	16	100
VAy	0	3	3	100
	29	312	341	

Table XXV. *B. sylvarum* (Linnaeus). Proportion of melanism throughout Sweden, based on collections. Area = county (cf. Fig. 99)

Area	Number of individuals		Total number	Per cent mel. form
	typ. form	mel. form		
Sk.	56	81	137	59
Bl.	12	23	35	66
Hall.	5	13	18	72
Sm.	23	16	39	41
Öl.	4	13	17	76
Ög.	26	27	53	51
Vg.	38	30	68	44
Boh.	26	50	76	66
Dlsl.	10	5	15	33
Nrk.	7	6	13	46
Sdm.	47	44	91	48
Upl.	350	128	478	27
Vstm.	86	21	107	20
Vrm.	22	3	25	12
Dlr.	16	0	16	0
Gstr.	25	1	26	4
Hls.	4	0	4	0
Jmt.	0	1	1	100
	757	462	1219	

Table XXVI. *B. sylvarum* (Linnaeus). Frequency of melanism in sex and caste

	♀		☿		♂		Total	
	No.	per cent	No.	per cent	No.	per cent	No.	per cent
Skåne								
Typical form	15	45	33	42	8	32	56	41
Melanic form	18	55	46	58	17	68	81	59
	33	100	79	100	25	100	137	100
Uppland								
Typical form	46	79	230	73	74	69	350	73
Melanic form	12	21	83	27	33	31	128	27
	58	100	313	100	107	100	478	100

examined material from Sweden: Skåne and Uppland set out in Table XXVI, clearly demonstrates that melanism is almost equally produced in both sexes and castes.

Distribution (Fig. 89).

Norway. Restricted to the southeastern lowlands and the extreme southern coast west to Vest-Agder (VAy): Farsund. A specimen labelled 'Dovre, Schøyen', misidentified to *B. ruderarius* by Sparre Schneider (1918), is noteworthy, being the only record from a subalpine or alpine locality. Pronounced local distribution.

Biotopes: Pastures, *leguminosae* biotopes, roadsides, etc.

A total of 341 specimens was examined.

List of localities: *Östfold (Ö):* Hvaler: Åkeröy, Asmalöy, Herföl, Kirköy, Söndre Sandö; Onsöy: Dypeklo, Ellingård, Lervik, Ramseklo, Rörvik, Skjælöy; Halden: Asak, Hakelund, Halden, Sponvika; Marker: Rödenes; Rakkestad: Rörvik; Råde: Oven, Tom; Moss: Jelöy VCA ZMB; Trögstad: Mönster bro, Rud, Vassbotn. *Akershus (AK):* Ås: Vollebekk; Frogn: Dröbak; Bærum: ? loc., Hövik; Oslo: TRM ZMB ZMO; Aurskog-Höland: Björklangen; Skedsmo: Strömmen ZMO. *Hedmark (HEs):* Hamar: ZMB ZMO; Ringsaker: Gaupen. *Oppland (On):* Dovre ☿ (Schöyen) ZMO. *Buskerud (Bö):* Hurum; Röyken: Åros; Drammen; Kongsberg: Skollenborg. *Vestfold (VE):* Våle: Ryk; Ramnes: Kjær, Lunde, Orrevål; Lardal: Styrvoll; Andebu: Andebu, Kodal; Stokke: Langö, Stokke, Veierland; Tönsberg: Preströdkilen; Nötteröy: Teie; Tjöme: Eidene, Mo, Mostranda, Vasskalven Joh; Sandefjord: Austeröy; Hedrum: Hedrum; Tjölling: Viksfjord; Brunlanes: Berg, Dolven, Helgeroa; Larvik. *Telemark* (TEy): Porsgrunn: Mule; Bamble: Trosby; Kragerö. *TEi:* Nissedal: Kyrkjebygda. *Aust-Agder (AAy):* Gjerstad: Fiane; Moland: Dal; Hisöy: Gjerdvoldsöy, His; Landvik: Havnevåg, Homborsund; Lillesand: Natvik. *Vest-Agder (VAy):* Kristiansand: Strömme; Farsund: Tjörve.

Sweden. Widely distributed on the mainland from the extreme southern coast northeast to nearly 62° N in Hälsingland. Moreover, abundant in Öland whereas the occurrence in Gotland is questionable. (Two ☿☿ of the typical form, labelled Gl, from Liljeborg' collection ZMU may be from this island and then the only specimens traced so far.) The distribution agrees roughly with that presented by Erlandsson (1951). A single worker recorded as far north as in Jämtland, cf. the list below, is noteworthy.

A total of about 1300 specimens was examined.

List of localities. *Skåne:* Arild, Arkilstorp NRS, Barkåkra NRS, Baskemölla NRS, Benestad, Bjärred, Björnstorp, Blentarp, Bokskogen ZMB, Brantevik NRS, Brunnby, Bäckaskog NRS, Bökeberg ZMB ZML, Båstad, Degeberga ZML ZMU, Eriksdal, Falsterbo NRS ZML, Glimåkra NRS, Görslöv, Haväng NRS, Herrevadkloster GNM, Hohög, Hälsingborg NRS VCA ZML, Höganäs NRS, Håslöv, Ignaberga, Kivik NRS, Klagstorp GNM, Klippan NRS, Krapperup, Kristianstad NRS, Kullaberg, Kyrkheddinge, Kämpinge GNM, Kävlinge, Kågeröd, Limhamn, Listerum NRS, Ljungholm, Lund GNM ZMA ZMB ZML, Löddeköpinge ZMB ZML, Löderup NRS, Maglarp ZMB, Maglehem ZMU, Malmö NRS ZML, Mälarhusen, Mölle NRS ZML, Nosaby ZML, Nyby, Nyhamnsläge, Nymö mosser ZMB, Näsum NRS,

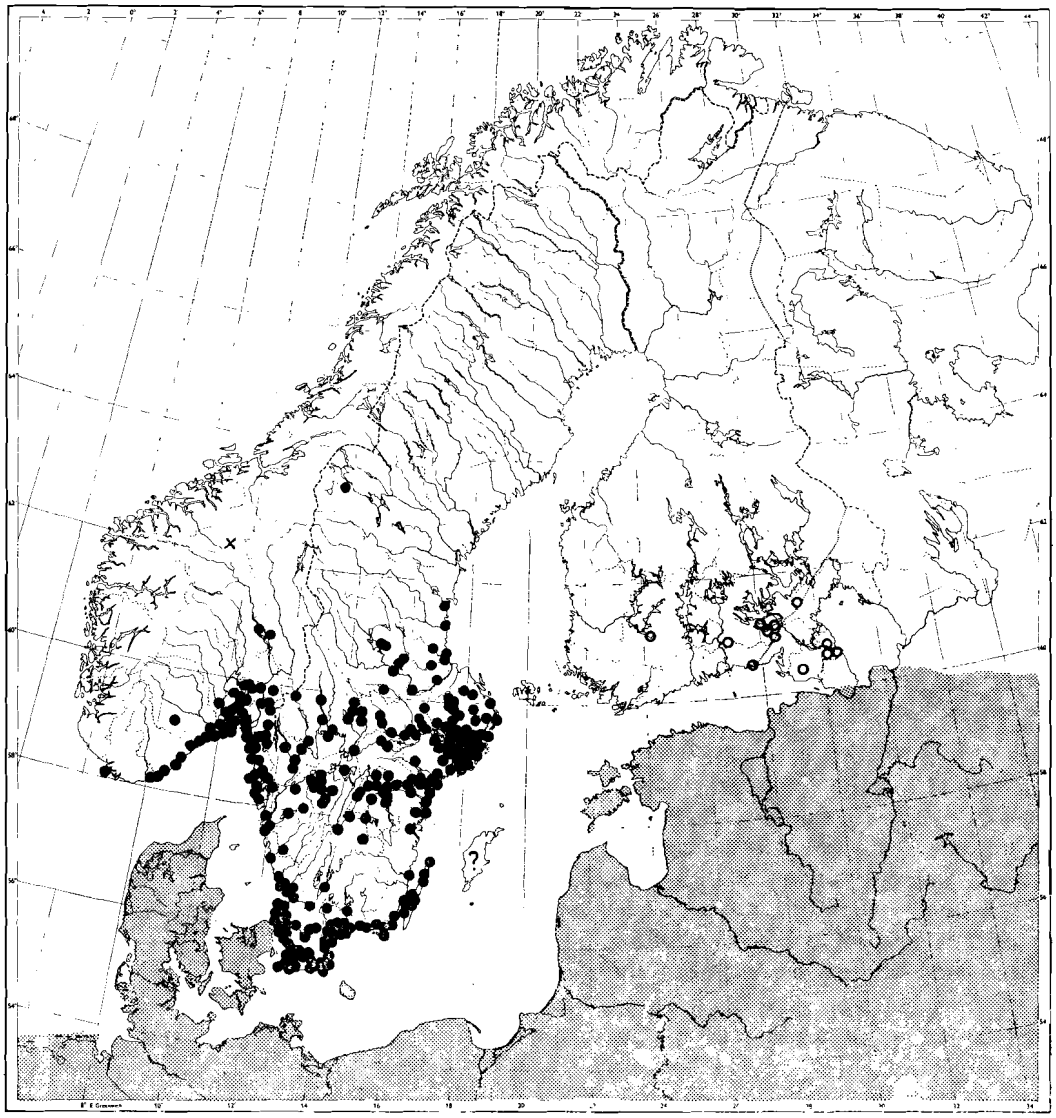


Fig. 89. *B. sylvarum* (Linnaeus). Legends as in Fig. 50, 54.

Ormanäs, Råå, Sandhammaren NRS, Saxtorp NRS, Sege, Silvåkra, Simrishamn NRS, Sjöbo NRS, Skanör, Skäralid, Sösdala, Södra Sandby, Torekov GNM NRS, Torna-Hällestad, Trelleborg GNM, Uppåkra, Vallåkra, Veberöd, Vik NRS, Vinninge, Vinslöv, Vitemölla NRS, Väderö, Västra Vram, Ystad NRS ZML, Ängelholm NRS, Östra Sönnarslöv, Övedkloster, Åhus NRS ZMB. *Blekinge:* Bräckne-Hoby ZMA, Jämjöslätt, Karlshamn NRS, Kristianopel GNM ZML, Kylinge NRS, Lister-Mjällby ZMB, Ronneby NRS ZMB, Rödeby NRS, Sölvesborg NRS ZMA, Torhamn NRS. *Halland:* Enslöv NRS ZML, Falkenberg, Getinge NRS, Halmstad, Laxvik, Snöstorp, Steninge NRS, Trönninge, Tylösand NRS, Varberg GNM NRS, Veinge NRS. *Småland:* Bergkvara NRS, Eksjö NRS, Gamleby GNM, Gränna GNM NRS ZMU, Höreda NRS, Järstorp NRS, Jönköping NRS, Kalmar NRS, Ljungarum NRS, Ljungby NRS ZMA ZMU, Markaryd, Påskallavik, Ryd, Tranås NRS, Tryserum GNM. *Öland:* Byrum ZMB, Ekerum, Glömminge ZMB, Grankulla ZMB, Gårdby NRS, Helludsviken ZMB, Hornsjö ZMB, Högsrum NRS, Kalkstad ZMB, Källa ZMB ZMU, Mörbylånga NRS ZML, Resmo NRS, Skogsbyn NRS.

Östergötland: Borensberg GNM ZMU, Borghamn NRS, Borsjön NRS, Gryt GNM, Heda ZMB, Hällestad NRS, Kvarsebo NRS, Linköping NRS ZMB ZML, Malmslätt NRS, Mjölby NRS, Motala NRS ZMB, Norrköping NRS VCA, Sankt Anna GNM, Slaka, Stjärnarp ZMB, Söderköping, Tjällmo ZMB, Tollstorp, Uggelö GNM, Valdemarsvik GNM, Vinnerstad ZMB, Vretakloster ZMB, Väversunda, Vånga ZMB. *Västergötland:* Alingsås NRS, Askim, Falköping NRS, Grästorp NRS, Göteborg GNM, Herrljunga NRS, Horred NRS, Karleby NRS, Kinnekulle, Lidköping NRS, Råbäck NRS, Skara GNM NRS, Skövde NRS, Töreboda NRS, Vinninga NRS, Vättlösa NRS, Öjehed. *Bohuslän:* Bovallstrand NRS, Dingle NRS, Edshultshall NRS, Havstenssund NRS, Hunnebostrand NRS, Hällevadsholm NRS, Lysekil NRS, Munkedal, Nösund NRS, Strömstad NRS ZML, Syd-Koster NRS, Tanum NRS, Tanumshede NRS, Tjuvkil NRS, Uddevalla, Ulebergshamn NRS, Ytterby NRS. *Dalsland:* Bengtfors NRS, Köpmannebro, Rostock NRS, Skållerud NRS, Åmål NRS. *Närke:* Lärbro NRS ZML, Stora Mellösa ZMB, Örebro NRS ZMB, Åtorp NRS. *Södermanland:* Brandalsund NRS, Enhörna NRS, Fittja NRS, Handen NRS, Häringe NRS, Läggestad NRS, Muskö NRS, Mölnbo NRS, Nyköping NRS ZML, Nynäs ZMB, Nävekvarn NRS, Oxelösund NRS, Sjösa ZMB, Stjärnholm NRS, Strängnäs ZMB, Svärdsö NRS, Svärtagård NRS, Södertälje NRS, Trosa, Turinge NRS, Uttran NRS, Viksberg NRS, Visvass ZMB, Västerhaninge ZMB, Älta NRS, Ålberga ZMB. *Uppland:* Adelsö NRS, Bogesund NRS, Brudnäs NRS, Dannemora, Dyvik NRS, Ekolsund NRS, Elmstad ZMB, Enköping ZMU, Estuna ZMU, Gimo NRS, Häggeby NRS, Håbo-Tibble NRS, Håtuna NRS, Ingarö, Jumkil NRS, Knutby ZMB, Kungsängen NRS, Lennartsnäs NRS, Lidingö NRS, Lovön NRS, Munsö NRS, Mörby NRS, Norrtälje, Norrviken NRS, Rimbo NRS, Roslags-Näsby NRS, Rö NRS, Rådmansö NRS, Skokloster ZMB, Stockholm IVU NRS VCA ZMA ZML ZMU, Svartsjö, Tensta ZMB, Ulltuna IVU, Uppsala BML IVU NRS VCA ZML, Vallentuna NRS, Vassunda NRS, Yxlan ZMB, Össebygarn NRS, Österskär, Östra Ryd NRS. *Västmanland:* Arboga ZMB ZML, Fanthyttan NRS, Fellingsbro ZMB, Guldsmedshyttan NRS, Hällefors NRS, Kolback NRS, Kvicksund NRS, Kärrbo ZMB, Lindesberg NRS, Malmör ZMB, Munktorp NRS, Sala, Saxhyttan NRS, Skultuna ZMB, Ås NRS. *Värmland:* Alster NRS, Charlottenberg NRS, Daglösen NRS, Gylleby in Sunne NRS, Hammarö NRS, Kil NRS, Långban NRS, Persberg NRS, Säffle NRS. *Dalarne:* Avesta ZMB, Borlänge ZMA, Karlsbyn, Ludvika NRS, Rättvik NRS, Sjurberg, Sundborn, Vikarbyn NRS. *Gästrikland:* Björke, Hedesunda NRS, Hille-Forsby NRS ZMB ZML, Ockelbo NRS, Trödje NRS. *Hälsingland:* Njutånger NRS, Söderhamn NRS. *Jämtland:* Åre ♀ 13 July 1957 (Hedström) ZMU.

Finland. Confined to southeastern part of the country. Rather rare. Records (Fig. 89) were taken from Elfving (1968), also those southeast of present Finland.

World distribution. Europe (British Isles; on the continent ranging from NW Spain, the Pyrenees, Italy, the Balkans north to Southern Fennoscandia; in Central European USSR north to districts of Leningrad, Kostroma and Bashkir) – Turkey – Iran – Caucasus – Transcaucasus – Southern Ural – Altai – ? Siberia east to Transbaykal. (Reinig 1937, 1968; Pittioni 1938; Panfilov 1957; Yarrow 1959 and in litt.; Tkalcu 1960). An occurrence in Siberia (Reinig 1937, p. 78) is questioned, not being stated by Panfilov (1957, in litt. 1968).

Biology

Nest. Nests on the ground, producing colonies of moderate size (Hasselrot 1962). Queen and worker are in the field distinguished from other *Bombus* spp. by their nervous, restless flight and a distinctly higher tune in their buzzing.

Flight season. From middle of April to end of September. Queen: 17 April–?; worker: 23 May–13 Sept.; male: 20 July–26 Sept.

BOMBUS (THORACOBOMBUS) VETERANUS (FABRICIUS)

Apis veterana Fabricius, 1793, p. 324 No. 45; Zimsen 1964, p. 417 No. 1104, lectotype ♀ KCC! selected by Løken (1966a), type loc. Germany: Kiel.

(Bombus equestris auctt. nec Fabricius 1793; Thomson 1870; Kruseman 1959; Elfving 1960, 1968; Erlandsson 1960; Hasselrot 1962; Ander 1963, 1965. *Bombus autumnalis:* Dahlbom, 1832, p. 45 nec Fabricius 1793. *Bombus arenicola* Thomson, 1872, p. 31 No. 9, lectotype ♀ TCL! selected by Ander (1967), type area Sweden: Skåne; Schenck 1875; Auŗivillius 1903; Muchardt 1904.)

First Scandinavian record

Sweden. Skåne (Dahlbom 1832), treated as *B. autumnalis* and traced under this name in Dahlbom's collection.

Taxonomical remarks

B. equestris (Fabricius) is a *nomen dubium* (Løken 1966a). Schenck (1875) synomized *B. B. arenicola* (= *B. equestris* Schiödte nec Fabricius) with *B. veteranus*, a fact which was overlooked by Løken (1966a) stating the combination as nov. syn.

Queen, worker

Morphological characters. Malar space equal to distal width or just longer, about as long as A_{2+3}. Clypeus as long as distal width; disc of clypeus markedly flattened, with a few coarse punctures admixed with rather sparse fine puncturing throughout – except the impunctate, often keeled, median anterior area between lateral indistinct impressions, having sparse fine and coarse punctures. Labral furrow well-defined, slightly or not widened towards the base. Mandible slender (Fig. 20), the dorsal base projecting in an acute angle; sulcus obliquus nearly parallel to the posterior edge, incisura lateralis inconspicuous. Microsculpture of T_{4-5} smooth, shining, and rather sparsely punctured. Distal keel of St_6 rather inconspicuous. Coat rather short, somewhat shaggy.

Queen measurements. N = 20: Sweden: Skåne: malar space: 0.74 mm ($\pm$0.03 $\pm$0.01) range: 0.70–0.80 mm; 'radial length': 3.80 mm ($\pm$0.09 $\pm$0.02) range: 3.65–4.00 mm; interalar width: 4.83 mm ($\pm$0.15 $\pm$0.03) range: 4.60–5.08 mm. Body of moderate size.

Colour pattern. Pile of vertex and genal area adjacent to eyes with admixture of black, head otherwise with pale yellowish-grey hairs. Interalar band more or less diffuse, i.e. pale yellowish-grey and black hairs encroaching upon each other in front and behind; it is posteriorly curved, i.e. including black hairs of scutellum, and centrally equal in width to the broad collar. T_{3-5} (or T_{2-5}) with black bristles scattered or forming a narrow band in the middle of one or several of the respective tergites. Pile of T_6 predominantly black or brownish. Fore tibia with brown hairs, fringe of mid-tibia partly pale yellowish-grey, remainder of mid-tibia, all tarsi with predominantly brownish hairs and bristles. Coat otherwise pale yellowish-grey.

Variation. Minute variations in addition to those mentioned above.

Male

Morphological characters. Malar space barely longer than distal width, about as long as A_{2+3}. A_3 at least as long as $\frac{2}{3}$ of A_5, A_4 at most as long as distal width of the segment, A_{6-13} strongly swollen beneath (Fig. 46A). Longest hairs in fringes of hind tibia exceeding the greatest width of the segment. St_6 and genitalia (Figs. 46B–C); gonostylus inwardly produced into narrow tooth, with posterior soft, fleshy appendix of almost the same shape; subapical process of volsella dilated, truncate at apex, usually shorter than distal width; penis valve hooked at apex and with indistinct to moderate tooth beneath. Body of small to moderate size.

Colour pattern. T_7 black-haired, otherwise colouring as by the female.

Distribution (Fig. 90)

Sweden. Restricted to the southernmost part of the country.

Biotopes: Sandy fields.

A total of about 375 specimens was examined.

List of localities. *Skåne:* Barkåkra NRS, Bjärred, Bärslöv ZMB, Dalby, Görslöv (25 ♀♀ from a colony 24 July 1932 (Kemner)), Hälsingborg NRS ZML, Höganäs NRS, Krapperup, Kyrkheddinge, Landskrona ZMB, Listerum NRS, Lund GNM NRS ZMB ZML, Löddeköpinge ZMB, Marsvinsholm, Mölle, Nordanå, Norra Ugglarp, Nymö mossor ZMB, Raus, Råå VCA ZML, Silvåkrå, Södra Sandby ZMB, Torekov NRS, Trelleborg GNM, Vallåkra, Väsby, Ystad, Ängelholm NRS, Örtofta. *Halland:* Falkenberg, Laxvik, Melbystrand, Steninge NRS, Trönninge. *Små-*

Fig. 90. *B. veteranus* (Fabricius). Legends as in Figs. 50, 54.

land: Markaryd. *Västergötland:* Utbynäs in Göteborg ♀ 24 Aug. 1938 (Lewin).

Unrevised records are not included here except the following (Ander in litt.): *Skåne:* Blentarp, Björnstorp, Bökeberg, Hällestad, Kävlinge, Nosaby, Sege, Vinninge, Östra Sönnarslöv, Åhus.

Corrections. Occurrence in Östergötland (Aurivillius 1903) and a distribution of the species north to the southern border area of *regio coniferina* (Kruseman 1959, Hasselrot 1962) are due to misidentifications. Revision supports Ander (1965), who states that the species has been confused with *B. sylvarum* (Linnaeus) and also *B. distinguendus* Morawitz.

Finland. Sparsely distributed in Southern and Central Finland, recorded in all counties south of 64° N (Elfving 1960, 1968). The following records, plotted on the map (Fig. 90), were revised: Ab: Lojo ZML. Kl: Sordavala ZML. Oa: Vasa ZMH. Sb: Kupio ZMH. Kb: Ham-

maslahti ZMH, Liperi ZMH, Tohmajärvi ZMH, Vimaharju ZMH.

World distribution. Europe (west to the British Channel, south to the Alps, Romania and north to Southern Sweden, Finland; in European USSR north to districts of Leningrad, Vologda, Kirov, Molotovsk and south to districts of Poltava, Kharkov) – Northern and Eastern Kazakhstan – Southern part of Western Siberia – Northern Tien Shan – Predbaykalje – Northern Mongolia (Ball 1914; Schmiedeknecht 1930, p. 856; Knechtel 1955; Dylewska 1957; Panfilov 1957; May 1959).

Biology

Nest. Nests on the ground, producing rather small colonies (Hasselrot 1962).

Flight season. Apparently from May to the middle of September. A female caught 23 May and a male 17 September were examined.

SUBGENUS *SUBTERRANEOBOMBUS* VOGT

Subterraneobombus Vogt, 1911, p. 62, type - species *Bremus subterraneus* (Linnaeus) = *Bombus subterraneus* (Linnaeus) 1758, by designation of Frison (1927).

Queen, worker

Head, malar space longer than wide, the latter shorter than 1½ times the distal width. Clypeus just longer than distal width, occasionally square; disc of clypeus centrally almost impunctate, anterior lateral impressions weakly to moderately defined. Labral furrow well-defined, broad and widened towards the base, the greatest width about one third of labral width; labral tubercles usually flattened anteriorly, though angled at inner end; labral lamella rather curved, hardly wider than labral furrow. Mandible with basal keel, well-defined sulcus obliquus, moderate incisura lateralis. Eyes directed in front of posterior mandibular condyle (Fig. 19). Ocellar-orbital field with broad fine-punctured band. Supra-orbital line dorsally touching or just transecting lateral ocelli. A_3 equal to A_{4+5} or nearly. Distal margin of mid-basitarsus posteriorly produced into a moderate rather broad spine, that of hind basitarsus pointed. Dorsal inner distal process of hind tibia acute, well-defined. St_6 with distinct keel.

There is a distinct difference in size between the queens and the worker caste.

Male

Head longer than wide. Malar space about 1½ times the distal width, about the length of A_{3+4}. Mandible bidentate with a broad ventral and a small dorsal tooth. Eyes directed in front of posterior mandibular condyle. Antenna long (Fig. 42A), A_3 equal to A_5 or nearly. A_{5-13} individually almost parallel-sided or feebly emarginated, about twice as long as distal width. Outer surface of hind tibia with distal half flattened or weakly concave, covered with sparse short decumbent hairs. Anterior fringe of hind tibia markedly shorter than posterior fringe, the latter being shorter than greatest width of the segment. Posterior fringe of hind basitarsus even and extremely short, i.e. barely or not longer than decumbent hairs on the outer surface of the segment. St_8 and genitalia (Figs. 42B–C, 43A–C); gonostylus transverse; volsella moderately projecting beyond gonostylus, broad, truncate distally with a narrow process inwards; apex of penis valve irregular and broadly dilated.

Scandinavian species

The subgenus is represented by two Scandinavian species, viz. *B. distinguendus* Morawitz and *B. subterraneus* (Linnaeus).

BOMBUS (SUBTERRANEOBOMBUS) DISTINGUENDUS MORAWITZ

Bombus distinguendus Morawitz, 1869, p. 32 No. 6, syntypes ♀ ♂ MAL (Ponomareva in litt. 1964), type loc. USSR: Leningrad.

(*Apis pratorum* Fabricius, 1793, p. 322 No. 34

nec Linnaeus, 1761. *Bombus pratorum* (Fabricius); Zetterstedt 1838. *Apis fragrans* Kirby, 1802, p. 329 No. 83 nec Pallas, 1771. *Bombus fragrans* (Kirby); Dahlbom 1832, p. 46; Siebke 1853, 1870; Wahlberg 1854; Thomson 1870. *Bombus distinguendus* Morawitz; Thomson 1872; Siebke 1880; Nerén 1892; Strand 1898a, 1898b, 1910; Lie-Pettersen 1901, 1907; Aurivillius 1903; Bengtsson 1903; Ringdahl 1915; Sparre Schneider 1918; Meidell 1934a; Wexelsen & Skåre 1934; Perkins 1942; Løken 1949; Kruseman 1959; Elfving 1960, 1968; Erlandsson 1960; Fridén, Eskilsson & Bingefors 1962; Hasselrot 1962; Ander 1953b, 1963, 1965; Fridén 1967.)

First Scandinavian records

Norway. Oppland (On): Fron: Storfjellet (Siebke 1853). No specimen is traced, but the identification of the easy recognisable species might have been correct. Specimens from Oslo; Hedmark (HEs): Sör-Odal; Oppland (On): Sel and Dovre; Telemark (TEy): Skien (Siebke 1880) are kept ZMO.

Sweden. Skåne, Småland, Östergötland, Västergötland (Dahlbom 1832).

Queen, worker

Morphological characters. Malar space hardly longer than distal width (Fig. 19), just exceeding length of A_{2+3}. Clypeus rather flattened towards the base. Outer surface of hind tibia moderately to strongly alutaceous. T_6 laterally and distally rather granulate, densely haired, while centrally and anteriorly smooth to feebly alutaceous with fine sparse puncturing. Coat even, rather short. Body slender, wings evenly infuscate.

Queen measurements. N = 20; SE Norway; malar space: 0.96 mm ($\pm$0.04$\pm$0.01) range: 0.90–1.00 mm; 'radial length': 4.40 mm ($\pm$0.09 $\pm$0.02) range: 4.30–4.60 mm; interalar width: 5.18 mm ($\pm$0.12$\pm$0.03) range: 5.00–5.43 mm. Body of large size.

Colour pattern. Plumose short hairs in pile of face predominantly pale yellow, pile of vertex with a variable mixture of black and pale yellow to olive-yellow. Collar, scutellum (except black hairs at anterior margin), T_{1-5} olive-yellow haired of which T_{3-5} usually is of lighter shade. Hairs on episternum predominantly pale yellow, fringes of sternites pale yellow to whitish. Otherwise coat black except interalar band laterally with an admixture of pale yellow hairs. Collar broad, about as wide as interalar band which is posteriorly slightly curved, i.e. including black hairs of scutellum. The transition collar to interalar band indistinct, i.e. black and olive-yellow hairs more or less encroaching.

Variation. Ventral and posterior hairs of episternum ranging from entirely black to dull pale yellow or whitish. Trochanters, femora particularly ventrally with variable admixture of whitish hairs. Individuals with a few black bristles on T_{4-5} were examined. In general rather minute variations.

Male

Morphological characters. Antennae (Fig. 42 A). St_6 distally gently rounded, with distinct lateral swellings. St_8 and genitalia (Figs. 42B–C); preapical process of penis valve usually bidentate with one tooth strongly projecting forwards; if tridentate, still only one strongly projecting tooth. Coat rather even, moderately long. Body slender and of medium size.

Colour pattern. Venter of head, trochanter, at least ventral part of femora predominantly whitish-haired. T_7 entirely or predominantly black-haired. Otherwise colouring as in the female.

Variation. More or less diffuse interalar band. T_{4-6} with variable admixture of black hairs.

Distribution (Fig. 91)

Norway. Wide, local distribution in south-eastern lowlands and sporadically recorded in adjacent subalpine vallies. Also observed in the lowlands north of the mountainous massive, viz. in the inner districts of Sör-Tröndelag and Nord-Tröndelag north to nearly 64°20′ N. It is uncertain whether an isolated population on

the southwestern coast, i.e. in Rogaland still exists, cf. below. The frequency is nowhere high. Recorded to 1000 m s.m.

Biotopes: Meadows, *leguminosae* fields, pastures.

A total of 162 specimens was examined.

List of localities. *Östfold:* Marker: Rödenes; Moss: VCA, Jelöy VCA; Eidsberg: Holm; Trögstad: Rud. *Akershus:* Ås: ? loc. ZMO, Vollebekk; Oslo: TRM ZMO; Asker: Brönnöy ZMO; Bærum: ? loc. ZMO; Aurskog-Höland: Björklangen. *Hedmark (HEs):* Sör-Odal: Mårud ZMO; Hamar: TRM ZMB ZMO; Ringsaker: Vea. *Oppland (Os):* Lillehammer: Stor-Hove; Nord-Aurdal: Fagernes ZMO; Öyer: Skåi, Öyer. *On:* Sel: Heidal TRM, Laurgård ZMO; Vågå: Vågåmo; Dovre: Dombås ZMU, Dovrefjell 1000 m ♀ (Sie) ZMO, Toftemo ZMO. *Buskerud (Bö):* Hurum: Filtvedt TRM; Drammen; Modum: Modum ZMO. *Bv:* Nes: Bergheim; Ål: ? loc. ZMO. *Vestfold (Ve):* Stokke: Langö, Sand, Stokke, Veierland; Nötteröy: Teie. *Telemark (TEy):* Skien: Gjemsö ZMO. *Rogaland (Ry):* Klepp: Jæren 2 ♀♀ July 1899 (Lie-Petter-

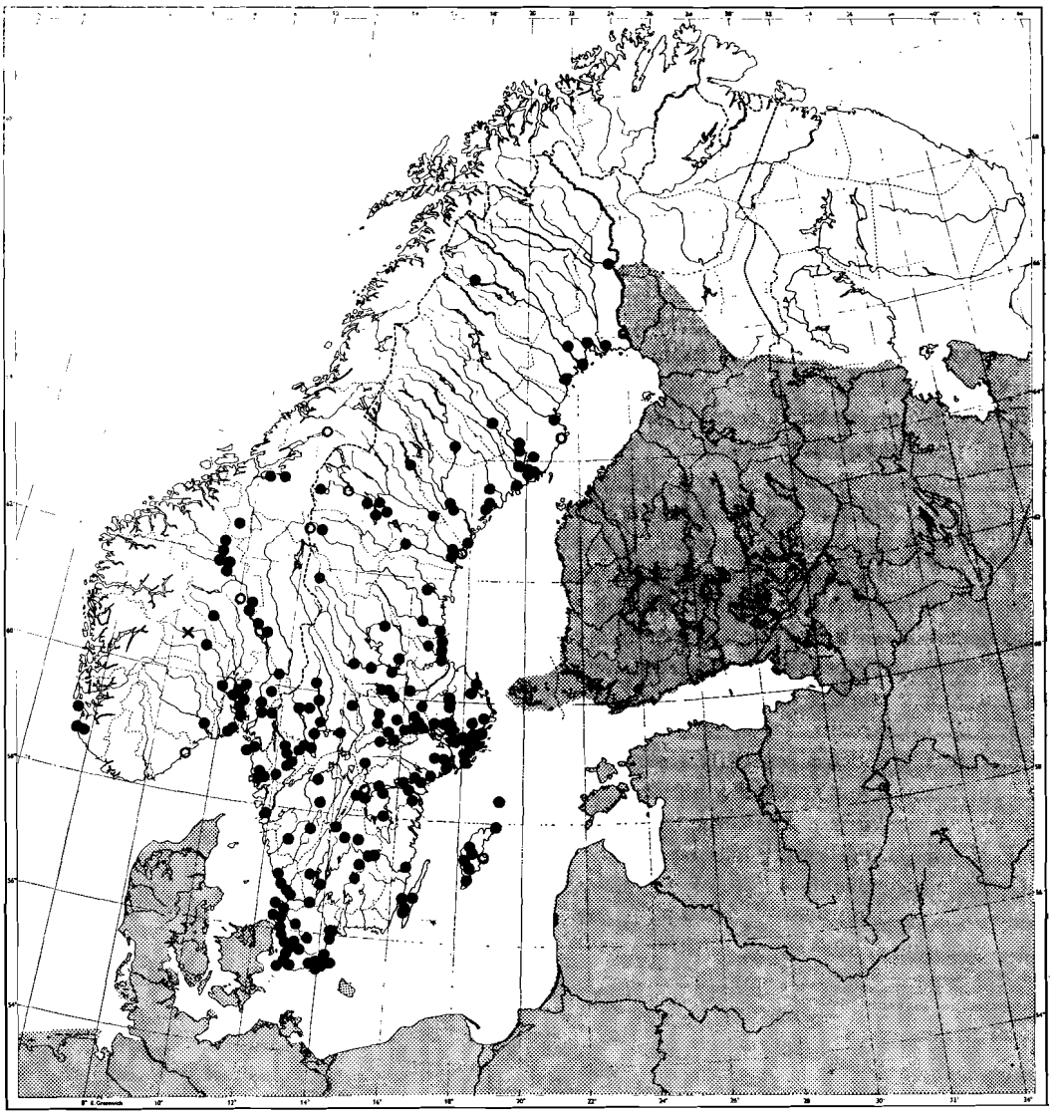


Fig. 91. *B. distinguendus* Morawitz. Legends as in Figs. 50, 54.

sen), Time: ? loc. ♀ TRM; Kvitsöy: ♀ June 1930 (Mei). *Sör-Tröndelag (STi):* Oppdal: Driva st.; Trondheim: VCA ZMB. *Nord-Tröndelag (NTi):* Stjördal: Lånke.

Unrevised records: *Oppland (Os):* Gausdal 760 m ♀ and *Nord-Tröndelag (NTi):* Snåsa 2 ♀♀ (Sparre Schneider 1918); *Aust-Agder (AAy):* Tvedestrand (Meidell 1934a).

Sweden. Widely distributed from the southernmost coast throughout the lowlands northeast to the Finnish border. Singly recorded in subalpine zone from northern part of Dalarne to Lapland.

A total of about 1200 specimens was examined.

List of localities. *Skåne:* Alnarp, Balsby, Barselbäckhamn ZMB, Björnstorp, Brunnby, Bärslöv ZMB, Bökeberg ZMB ZML, Dalby, Falsterbo NRS, Fjälkinge, Fulltofta, Grevie NRS, Görslöv, Hardeberga, Herrevadskloster GNM, Hyby, Hälsingborg, Håstad ZMB, Järrestad NRS, Krageholm, Krapperup, Kronovall, Kungshult, Kyrkheddinge, Löddeköpinge ZMB, Löderup NRS, Norra Nöbbelöv, Nyhamnsläge, Reslöv, Romele klint, Sandhammaren NRS, Sege, Silvåkra, Simrishamn NRS, Skarhult, Skälderviken, Skåre ZMB, Svalöv IVU, Södra Sandby ZMB ZML, Torup, Trelleborg GNM, Vallåkra, Veberöd, Vegeholm, Viderup, Vik NRS, Vitemölla NRS, Vomb ZMB, Väderön, Vällinge, Väsby, Örtofta, Åhus NRS ZML ZMU. *Halland:* Falkenberg, Getinge NRS, Halmstad NRS, Trönninge. *Småland:* Alingsås, Barkaryd NRS, Eksjö ZMU, Gasslanda ZMU, Järsnäs NRS, Jönköping NRS, Kalmar NRS, Ljungarum NRS, Ljungby ZMU, Markaryd ZMU, Nye NRS, Påskallavik, Österkorsberga GNM NRS ZMU. *Öland:* Bengtstorp, Langlöt, Mörbylånga. *Gotland:* Fide, Fårö, Högklint, Klintehamn, Roma NRS, Stånga. *Gotska Sandön. Östergötland:* Borensberg GNM ZMU, Borghamn NRS, Högby ZMB, Kisa, Kungsängen NRS, Kvarsebo NRS, Linköping, Norrköping NRS, Ringarum NRS, Väversunda NRS. *Västergötland:* Finnekumla NRS, Kinna, Kinnekulle, Södra Kirketorp, Öjehed. *Bohuslän:* Brastad, Dingle NRS, Munkedal, Naverstad NRS, Syd-Koster NRS, Ytterby NRS. *Dalsland:* Bengtsfors, Ellenö NRS, Köpmannebro, Rostock ZMB, Stenebynäs NRS, Vensborg, Åmål NRS. *Närke:* Askersund, Skråmstad, Skölberga NRS, Örebro. *Södermanland:* Björnlunda NRS, Muskö NRS, Mölnbo NRS, Nyköping, Trosa, Tyresö NRS, Vreta, Västerhaninge ZMB, Ålberga. *Uppland:* Ekolsund NRS, Eldgarn NRS ZML, Enköping ZMU, Gimo NRS, Hammarby NRS, Håbo-Tibble NRS, Håtuna NRS, Ingarö, Ljusterö NRS, Munsö NRS, Norrtälje NRS, Rö NRS, Skokloster ZMB, Stockholm NRS ZML ZMU, Tensta ZMB, Ultuna IVU ZMB, Uppsala IVU, NRS ZMB ZML ZMU Öregrund ZMB, Österskär, Österåker ZMU. *Västmanland:* Arboga ZMB ZML, Dingtuna NRS, Fanthyttan NRS, Fellingsbro ZMB, Guldsmedshyttan, Kolbäck NRS, Kolsva ZMB, Kärrbo ZMB, Köping ZMB, Munktorp NRS, Sala NRS, Skultuna ZMB, Ås. *Värmland:* Arvelsäter NRS, Arvika, Brunskog NRS, Ed, Forsvik, Gylleby NRS, Långban NRS, Nilsby, Säffle NRS ZML, Torsby NRS, Ölme. *Dalarne:* Avesta ZMB, Falun, Floda NRS, Furudal NRS, Harnäs NRS, Idre, Ludvika NRS ZML, Smedjebacken, Store Tuna, Söderbärke NRS, Vangsbro. *Gästrikland:* Hamrångerfjärden NRS, Hille NRS, Ockelbo NRS, Trödje NRS. *Hälsingland:* Bollnäs NRS, Delsbo, Söderhamn NRS. *Medelpad:* Sundsvall NRS ZML, Timrå NRS, Ånge. *Härjedalen:* Funäsdalen ZMB. *Jämtland:* Döda-Fallet NRS, Frösön NRS, Hallen, Lockne, Oviken, Snasahögarne NRS, Strömsund NRS, Östersund NRS. *Ångermanland:* Bjästa NRS, Björna NRS, Forsmo NRS, Härnösand NRS, Håknäs NRS, Sollefteå NRS, Örnsköldsvik NRS. *Västerbotten:* Bergsbyn NRS, Bodarna NRS, Degerfors NRS, Hällnäs NRS, Kroksjö NRS, Piparböle NRS, Vindeln NRS, Vännäs NRS, Västerhiske NRS. *Norrbotten:* Boden NRS ZML, Kalix NRS, Karungi NRS, Luleå NRS ZML, Nybygget NRS, Pajala NRS, Piteå NRS, Vitå NRS. *Lapland:* ? loc. ♂ (Wahlb.) NRS. *Ås. Lpm.:* Åsele NRS. *Ly. Lpm.:* Lycksele NRS. *Lu. Lpm.:* Kvikkjokk ♀ 1843 (Andersson).

Unrevised records: *Östergötland:* Skänninge (Nerén 1892). *Jämtland:* Edsåsen (Ringdahl 1915). *Gotland:* När; *Medelpad:* Tynderö; *Härjedalen:* Fjällnäs; *Västerbotten:* Lövånger (Ander in litt.).

Finland. Occurring throughout the country north to about 67° N, yet nowhere frequent. (Elfving 1960, 1968).

World distribution. Europe (British Isles; on the continent ranging from Central Europe, Transylvanian Alps and north to Fennoscandia; in European USSR extending from White Russia, districts of Kursk, Voronezh, Kuybyshev, Tsjkalov and north throughout the taiga, almost reaching the tundra) – Western and Southern Siberia – Northern Kazakhstan – Tien Shan – Altai – Primorskiy – Sakhalin (Knechtel 1955; Panfilov 1957; Yarrow 1959).

Taxonomic and faunistic remarks

Meidell (1934a) asserted that the isolated population restricted to the outmost sandy coast of Rogaland, viz. Jæren and a few islands north of Stavanger, might be a maritime form. He found the individuals larger, more robust than those of the eastern Norwegian population. His

theory cannot be evaluated, however, as only a queen and three workers were traced in the collections, and the species has not been observed in that area in recent years. The measurements of the queen, viz. malar space: 0.95 mm, 'radial length': 4.35 mm and interalar width: 5.35 mm, are, however, all within the range of the corresponding data for the population in SE Norway, cf. above.

It is on the whole uncertain whether *B. distinguendus* occurs sporadically along the coast from Oslofjord to the islands north of Stavanger. No specimens were recorded during recent investigations. The areas, being at the extreme northern limit of the distribution of the species, present the worst living conditions for the bumble bee. These unfavourable conditions have obviously increased with the changes in landscape during the last decades. Intensive cultivation of Jæren, for instance, may share the responsibility for the local population being reduced or possibly wiped out.

The northernmost record in Norway, i.e. on the southern side of Trondheimsfjord and in Snåsa further north, may indicate an invasion from Sweden through east-west-directed passages in the gap between the southern and the northern part of the mountain chain. Single finds at the southern and northern fringe of Dovrefjell, i.e. in Oppland (On): Dovre and Sör-Tröndelag (STi): Oppdal, cf. the list above, do not, however, exclude the possibility that *B. distinguendus* may pass the mountainous plateau, altitude about 1000 m.

Biology

Nest. Nests in the ground. A parasitized colony, analyzed on 8 August 1900 (Bengtsson 1903), contained 22 queen cocoons and 35 worker/male cocoons of which 13 queens and 7 worker/male cocoons had not yet hatched. Thus the total number of inhabitants produced must have surpassed 57 as the oldest cocoons were broken down.

Flight season. From beginning of May to middle of September. Queen: 3 May–9 Aug.; worker: 3 June–13 Sept.; male 15 July–2 Sept.

BOMBUS (SUBTERRANEOBOMBUS) SUBTERRANEUS (LINNAEUS)

Apis subterranea Linnaeus, 1758, p. 579 No. 35, type area Sweden: Uppland. A female LSL! labelled *subterranea* agrees with the usual interpretation of the taxon.

(*Bombus subterraneus* (Linnaeus); Dahlbom 1832, p. 32; Wahlberg 1854; Thomson 1870, 1872; Siebke 1880; Nerén 1892; Roth 1897; Strand 1898a, 1898b; Aurivillius 1903; Muchardt 1904; Wahlgren 1915; Sparre Schneider 1918; Meidell 1934 a; Wexelsen & Skåre 1934; Tjeder 1954; Kruseman 1959; Elfving 1960, 1968. Erlandsson 1960; Fridén, Eskilsson & Bingefors 1962; Hasselrot 1962; Ander 1963, 1965; Fridén 1967; *Apis aceruorum* Linnaeus, 1758, p. 579 No. 34, type area Sweden: Uppland. *Apis latreillella* Kirby, 1802, p. 330 No. 84, holotype ♂ KCL! labelled by Yarrow (1968), type area England: E. Suffolk: Barham. *Bombus latreillellus* (Kirby); Dahlbom 1832, p. 39; Wahlberg 1854; Schenck 1873; Lie-Pettersen 1901, 1905, 1907. *Bombus soroeensis:* Dahlbom 1832, p. 38.)

First Scandinavian records

Norway. Akershus: Oslo (Siebke 1880). Other localities contemporaneously mentioned must be due to misidentifications as also indicated by Sparre Schneider (1918).

Sweden. Uppland (Linnaeus 1758).

Taxonomical remarks

The Scandinavian population belongs to the nominate form. The female agrees with the Linnaean description and the male with the *latreillellus* form of Kirby. When Sparre Schneider (1918) indicated that the Norwegian population is a melanic race related to *B. subterraneus* var. *borealis* Schmiedeknecht, 1878, and Meidell (1934a) followed him, they were not aware of the fact that the dark female and worker represented the nominate form.

Queen, worker

Morphological characters. Malar space marked-

ly longer than distal width, about as long as A_{2+3}. Clypeus bending towards the base. Outer surface of hind tibia barely or not alutaceous. T_6 rather coarsely granulated. Coat even, very short. Body robust, wings evenly infuscate.

Queen measurements. N = 15; Sweden: Skåne; malar space: 1.05 mm ($\pm$0.05$\pm$0.01) range: 1.00–1.15 mm; 'radial length': 4.38 mm ($\pm$0.11$\pm$0.02) range: 4.25–4.55 mm; interalar width: 5.47 mm ($\pm$0.18$\pm$0.05) range: 5.23–5.73 mm. Body of large size.

Colour pattern. T_{4-5} with variable mixture of black and greyish-white or pale dull fuscous hairs. Otherwise coat black or brownish-black.

Variation. Individuals with indication of yellow collar, often reduced to lateral yellow patches, were examined, likewise those with some yellow hairs on scutellum. Workers with yellow hairs on T_1 were also traced.

Male

Morphological characters. St_8 distally gently rounded and even, i.e. without lateral swellings. St_8 and genitalia (Figs. 43A–B); flattened preapical process of penis valve tri-or quadridentate with lateral teeth strongly projecting (Fig. 43C), occasionally bidentate with only one tooth strongly projecting. Coat rather even, moderately long. Body of medium size.

Colour pattern. Pile of vertex ranging from all black to predominantly yellow. Collar, scutellum (except for a small black-haired anterior median area), T_1, lunate anterior part of T_2 with pale yellow hairs. At least fringes of T_{3-6} yellowish-white or whitish. Episternum, mid- and hind femora with variable but usually predominant admixture of whitish hairs. Sternites usually whitish-haired. Otherwise coat black. Interalar band, broad, occupying more than half of mesonotum, posteriorly more or less curved, i.e. including black hairs of scutellum.

Variation. Gastral tergites individually with a variable mixture of dark and light hairs, often fringed whitish. Occasionally T_{2-3} predominantly black-haired and/or T_{4-5} entirely yellowish-white. Slightly melanic individuals were also examined.

Distribution (Fig. 92)

Norway. Rare. With exception of two queens from the western coast I have only examined specimens from scattered localities in the south-eastern lowlands, in fact restricted to the areas around Oslofjord. The list below reveals no recent records and the present distribution is uncertain.

It is unlikely that the abundance of *B. subterraneus* has ever been great in the extreme western archipelago northwest of Bergen as indicated by Lie-Pettersen (1905, p. 10). The author must have confused the species with melanic *B. hortorum* even though he pointed out that both occurred together in the actual area. No *B. subterraneus* individuals were traced in his collection.

A total of 23 specimens was examined.

List of localities. *Östfold:* Moss: Jelöy ♀ 24 May 1908 (Barca) VCA. *Akershus:* Ås: Vollebekk ♀ July 1949 (?); Oslo: ♀ 27 July 1844 (Dahlbom) ZML 3 ♀♀ (Siebke) ♀ ☿ (Esmark) ZMO, Slemdal ♀ 30 May 1910 (Sch.) TRM, Töyen 4 ♀♀ (Siebke) ZMO, V. Aker 2 ♀♀ (Siebke) ZMO. *Buskerud (Bö):* Hurum: Filtvedt 3 ☿☿ ♂ 8 Aug. 1910 (Sch.) TRM. *Vestfold:* Nötteröy: Teie ☿ 25 Aug. 1934 ☿ 2 Aug. 1935 (Bache). *Hordaland (HOy):* Fana: Skipanes ♀ 28 July 1907 (Barca) VCA. *HOi:* Etne: Etne ♀ 21 June 1923 (Mei.).

Unrevised records: *Vest-Agder (VAy):* Flekkefjord: Loga and *Hordaland (HOi):* Ullensvang: Ullensvang (Meidell 1934a) are questioned (Fig. 92). It is uncertain whether the author, who obviously recognized the species, examined the actual individuals himself.

Correction. Records from Hedmark (HEs): Odalen and Sör-Tröndelag (STi): Oppdal: Drivstua (Siebke 1880) were revised to *B. hortorum* and those from Buskerud (Bv): Ål (Strand 1898a) likewise to *B. hortorum* and *B. sporadicus* respectively. Record from Hedmark (HEs): Vang: Hjellum (Wexelsen & Skåre 1934) was revised to *B. hortorum* (Meidell unpublished).

Sweden. Widely distributed throughout the lowlands northeast to 60°30′ N in Uppland, also occurring in Öland and Gotland. The present study agrees with Kruseman (1959) that the northern border area coincides with that of *regio quercina* (cf. Figs. 2 and 92). Therefore a record of this species in Dalarne, in the forest belt of Härjehågna mountains, cf. the list below, is

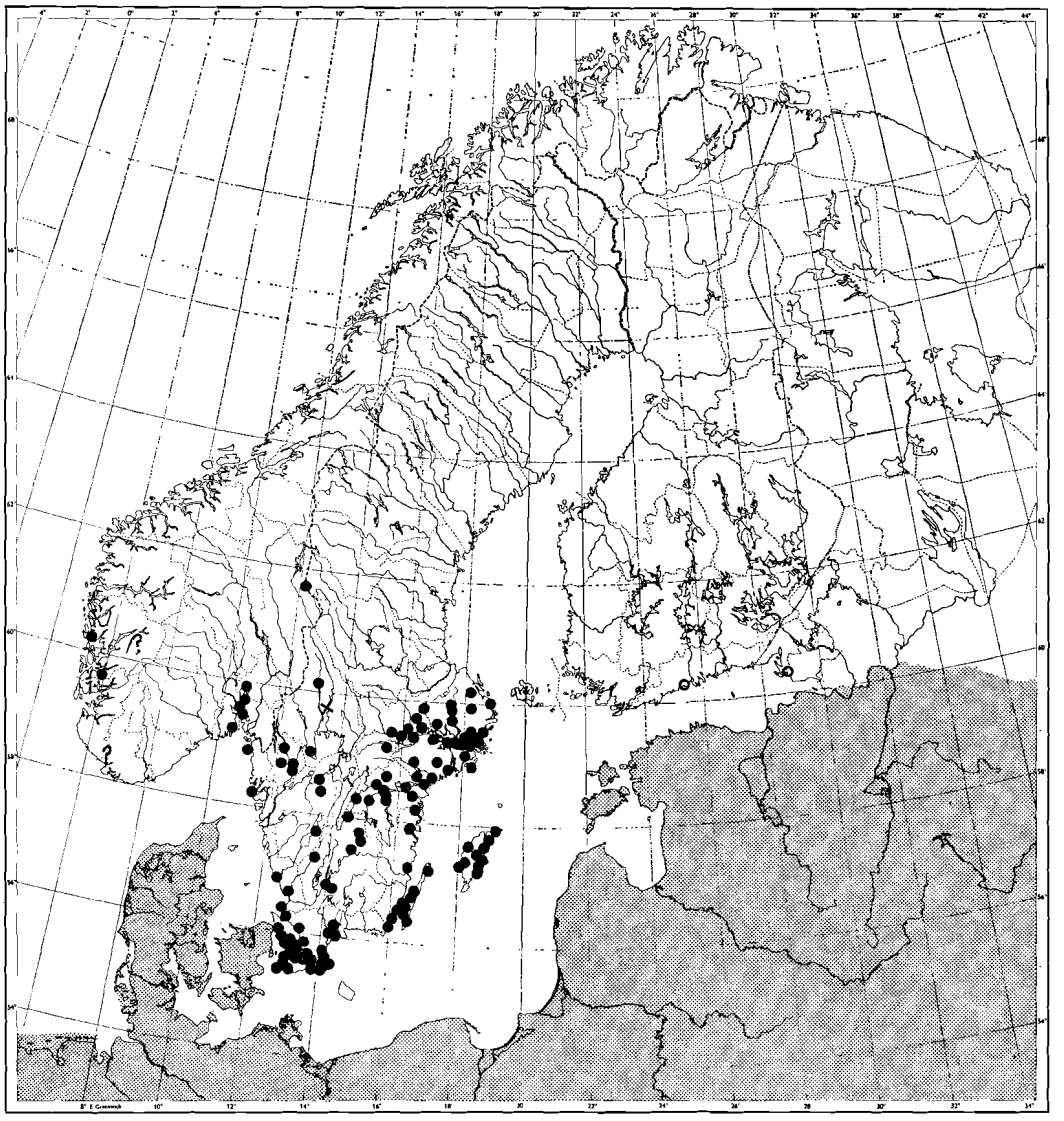


Fig. 92. *B. subterraneus* (Linnaeus). Legends as in Figs. 50, 54.

indeed striking. Erroneous labelling is inconceivable (Forsslund in litt.).

Biotopes: Meadows, *Trifolium pratense* fields.

A total of about 600 specimens was examined.

List of localities. *Skåne:* Arlöv ZMA, Balsby, Barkåkra NRS, Blentarp, Bokskogen ZMB, Brösarp, Bulltofta, Bäckaskog NRS ZML, Båstad, Dalby, Falsterbo NRS, Genarp ZMB, Gislöv, Haväng NRS, Hälsingborg NRS ZMA ZML, Hyby, Järrestad NRS, Kyrkheddinge, Kävlinge, Kåselberga, Lund GNM ZMA ZML, Löderup NRS ZML, Malmö NRS ZML, Nosaby, Ormanäs, Reslöv, Röddinge NRS, Sandhammaren, Saxtorp NRS, Simrishamn NRS, Skäralid ZMA ZML, Stavstensudde ZMB, Södra Sandby ZMB ZML, Torna-Hällestad ZMA, Trelleborg ZMB ZML, Vallåkra, Vellinge, Vik NRS, Villands Vånga, Vitemölla NRS, Vomb,Ystad NRS ZML, Ängelholm, Örtofta, Övedskloster. *Blekinge:* Kristianopel GNM. *Halland:* Falkenberg, Halmstad NRS ZML. *Småland:* Bergkvara NRS, Brånstorp NRS, Flisby NRS, Gammelby GNM, Gislaved, Gränna GNM NRS, Häckelbo NRS, Kalmar NRS, Ljungby NRS, Oskarshamn,

Sävsjö NRS, Värnanäs. *Öland:* Bengtstorp, Borgholm NRS, Böda NRS, Högsrum NRS, Kleveby, Mörbylånga NRS ZML ZMU, Norra alvaret, Segerstad NRS, Skogsbyn NRS, Vickleby NRS. *Gotland:* Austers NRS, Fårö NRS ZML, Garda, Högklint, Klinte, Kyllei NRS, Lilla Karlsö, Ljugarn ZMA, Romakloster NRS, Slite NRS, Sudersand, Visby NRS, Vänge. *Östergötland:* Alvastra NRS, Borensberg GNM, Dagsberg NRS, Hällestad NRS, Högby ZMB, Linköping NRS ZMB ZML, Ljung NRS, Malmslätt NRS, Norrköping NRS ZMA, Skönberga NRS, Slaka, Tollstorp, Valdemarksvik NRS. *Västergötland:* Finnekumla NRS, Råbäck NRS, Skara GNM. *Bohuslän:* Skaftö NRS, Syd-Koster NRS. *Dalsland:* Bengtsfors, Bäckefors, Köpmannebro, Mellerud. *Närke:* Stora Mellösa ZMB. *Södermanland:* Mölnbo NRS, Nyköping, Nävekvarn NRS, Rekarne NRS, Sjösa ZMB, Strängnäs NRS ZMB, Trosa, Utö NRS, Valla NRS, Västerhaninge ZMB, Ålberga ZMB ZML. *Uppland:* Adelsö NRS, Angarn NRS, Danderyd NRS ZMB, Elmsta ZMB, Enköping ZMU, Gimo NRS, Hammarby NRS, Knutby ZMB, Lidingö NRS, Lovö-Drottningholm NRS, Rydbo, Skokloster ZMB, Stockholm NRS ZMA ZML ZMU, Tensta ZMB, Ultuna IVU, Uppsala IVU NRS ZMA ZMB ZML ZMU, Värmdö, Yxlan ZMB, Österskär, Österåker ZMU. *Västmanland:* Arboga ZMB ZML, Fellingsbro ZMB, Kärrbo ZMB, Munktorp NRS, Sala, Skultuna ZMB. *Värmland:* ? loc. NRS, Forsvik, Torsby NRS. *Dalarne:* Härjeån, Härjehågna ♀ 27 July 1927 (Forsslund) NRS.

Specimens from Hälsingland (Hasselrot 1962) were not traced. Owing to confusion with melanic *B. hortorum*, unrevised records were not included here.

Finland. Restricted to the extreme southern coast. Rare. Records (Fig. 92) were taken from Elfving (1968).

World distribution. Europe (Southern England; on the continent ranging from France, Italy, Albania, Yugoslavia, Bulgaria north to Southern Fennoscandia; in European USSR extending from districts of Kamenets – Podolskiy, Poltava, Kharkov, Voronezh, Saratov, Kirovgrad and north to districts of Leningrad, Yaroslavl, Perm; Crimea) – Turkey – Caucasus – Transcaucasus – Southern Ural – Northern and Eastern Kazakhstan – Tien Shan – Altai – Baykal – Northern Mongolia (Sagemehl 1882; Panfilov 1957; Yarrow 1959; Tkalcu 1960, 1969; Reinig 1967, 1968). Introduced to New Zealand (Gurr 1964).

Biology

Nest. Nests well below the surface of the ground (Thomson 1872), producing rather large colonies (Hasselrot 1962). Yet a colony (Sweden: Skåne: Norra Nöbbelöv in Lund 8 ♀♀ 24 ☿☿ 3 ♂♂ 6 Aug. 1931 (Ander & Kemner) ZML) was established in the moss (Ander in litt.). The total number of individuals raised is unknown.

Flight season. From beginning of May until the end of September. Sweden: Skåne – Öland; Queen: 16 May–5 Sept.; worker: 20 May–26 Sept.; male: 13 July–14 Sept.

SUBGENUS RHODOBOMBUS DALLA TORRE

Rhodobombus Dalla Torre, 1880, p. 40, type-species *Bremus pomorum* Panzer = *Bombus pomorum* (Panzer) by designation of Sandhouse (1943).

(*Pomobombus* Krüger, 1917, p. 65, type-species *Bombus pomorum* (Panzer) = *Bremus pomorum* Panzer by designation of Sandhouse 1943.)

BOMBUS (RHODOBOMBUS) POMORUM (PANZER)

Bremus pomorum Panzer, 1802–1805, part 86 Teil 18, type not traced.

(*Bombus lefebvrei* Lepeletier, 1836, p. 461, holotype ♀ MNP, type loc. France: Gray; Tkalcu 1969.)

First Scandinavian record

It is with doubt that *B. pomorum* is hereby published for the first time and from Sweden: Östergötland: Åtvidaberg about 58°10′ N and 16° E. The record is based on a single small worker kept at Zoologiska Institutionen Lund, and has the following labels: (1) Ö Åtvid. vid sjöstranden 12-7-11; (2) det. Bgtsn; (3)

Bombus pomorum (Panz.) ♀; (4) det. Kruseman. The collector was H. Nordenström, a medical doctor, and the first three labels are in his handwriting (Ander in litt.). If the locality label is reliable, a record that far north is striking. The distance to the nearest occurrence of the species is at least 400 km, viz. in Poland, where the taxon is widely distributed (Dylewska 1957). It is about 500 km southwest to the nearest occurrence in Denmark, viz. Jylland: Uldum (Bengtsson 1907) and Jelling (Hammer & Holm 1970).

One might ask whether the recorded specimen was accidently introduced or possibly refers to a relic occurrence.

The diagnosis below is based on German specimens.

Queen, worker

Morphological characters. Head, malar space longer than wide, the latter about 1½ times the distal width and almost as long as A_{3+3+4}. Clypeus rather convex; disc of clypeus with very fine puncturing, anterior part almost impunctate and with anterior lateral impression well-defined, small and narrow. Labral furrow shallow, rather broad; labral lamella wider than labral furrow, the edge gently curved. Mandible with indistinct basal keel, well-defined sulcus obliquus and with no incisura lateralis. Eyes directed in front of mandibular condyle. Ocellar-orbital field with large bare area and very narrow punctured band. Supra-orbital line just in front of lateral ocelli. A_3 about as long as A_{4+5} or nearly so. Distal margin of mid-basitarsus posteriorly acutely spined, that of hind basitarsus also spined.

Colour pattern. In general T_{3-6} ferruginous-haired and coat otherwise black. The examined German specimens occasionally have a few yellow hairs on collar and scutellum.

Male

Morphological characters. Head and malar space longer than wide, the latter about as long as A_{3+4}. Mandible without a beard, with broad ventral and a small dorsal tooth. Frontal edge of eye directed in front of mandibular condyle. Antennae long, A_3 longer than the transverse A_4, but shorter than A_5. A_{5-13} individually almost parallel-sided and almost twice the distal width. Outer surface of hind tibia convex, covered with dense short hairs; posterior fringe not dense, shorter than greatest width of the segment. Genitalia as in Fig. 41; outer edge of gonostylus curved obliquely inwards and ending in a stout acute process; volsella projecting well beyond gonostylus, moderately broad except expanded considerably inwards at the end.

Colour pattern. The examined German individuals have dull pale yellowish coat on thorax, dorsally with a variable amount of black hairs which occasionally display a diffuse interalar band. T_1 and venter with pale yellowish hairs, pile on T_{2-7} ferruginous.

Distribution

World distribution. Europe (from Belgium, the Alps, Yugoslavia, Albany, the Balkans, and north to Denmark (Southeast Jylland), ? Sweden (cf. above), Poland; in European USSR extending north to White Russia, districts of Kaluga, Moscow, Ryazan, Perm and south to districts of Chernovtsy, Kamenets-Polidskiy, Poltava, Voronezh, Tsjkalov) – Southern Urals – Turkey (Anatolian) (Ball 1914; Pittioni 1938; Dylewska 1957; Panfilov 1957; Reinig 1968; Tkalcu 1969).

THE DISTRIBUTION PATTERN OF *BOMBUS* SPP. OCCURRING IN SCANDINAVIA

The bumble bee fauna of the world comprises 250 to 300 species of which 50 to 55 species occur in Europe. Even though new species have been added, revisions are reducing the total number by Skorikov (1922b, p. 135) counted to 307 species including 58 European ones. Regarding the pleistocene glaciations, the relatively small territory, and the northern position of Scandinavia, the bumble bee fauna of the peninsula is rich. A total of 29 *Bombus* spp. presented

here comprises more than half the number of European species. It exceeds that of the neighbouring countries of which Finland is represented by 25 species (present revision), comprising 24 Scandinavian ones in addition to the rarely recorded *B. semenoviellus* Skorikov, and Denmark is occupied by 19 species (Hammer & Holm 1970), all of which occur in Scandinavia.

Although some areas are still insufficiently investigated and further observations could improve the knowledge of the distribution of some of the species, the present study reflects to a great extent the composition of the Scandinavian bumble bee fauna. The distribution, illustrated on the dot maps, refers, however, to more than hundred years of collecting, which might give rise to the question whether it corresponds to the recent occurrence of the individual species. The large collections from the very last decades have, however, in general implied an extension of area, which indicates that the dot maps could well depict the actual distribution. In two cases only, viz. in *B. distinguendus* and *B. subterraneus*, peripheral records of older date, not being confirmed during recent observations, indicate possible faunistic changes of negative nature. Those cases do not, however, influence a broad zoogeographical grouping of the species outlined below.

Species with restricted southern distribution

This group includes four species, viz. *B. cullumanus*, *B. ruderatus*, *B. veteranus* and *B. pomorum*, of which the three former are confined to southernmost Sweden (Fig. 93). The population of *B. cullumanus* (Figs. 58, 93 A) is restricted to southernmost Skåne and Öland. The species has a disjunct distribution in Europe and West Asia. The Scandinavian population belongs to the nominate subspecies which has a relic distribution in Europe, being confined to Southeastern England and the extreme coast from the Netherlands to East Germany. The main occurrence of the species is represented by *B. c. serrisquama* extending from Central Russia, east to western part of Southern Siberia and southeast to eremials in Turkestan and Afghanistan. *B. cullumanus* is otherwise recorded in Northern Spain, France, Poland, Hungary and Northern Caucasus. *B. ruderatus* (Figs. 76, 93 B), occurring mainly along the coast from Halland in west to Blekinge in east, is a Mediterranean fauna element with a Euromediterranean distribution. It is widely distributed throughout the European continent except in the southeastern part, and moreover reaches the British Isles, Madeira, and Northwest Africa. *B. cullumanus* and *B. ruderatus* are restricted in Fennoscandia to southernmost Sweden, while *B. veteranus* (Figs. 90, 93 C) also scantily occurs throughout Southern and Central Finland. The latter has a southern Eurosiberian distribution, ranging from the British Channel throughout Central Europe east to Predbaykalje and Northern Mongolia. Owing to a single specimen of *B. pomorum*, which according to the label was caught in Östergötland: Åtvidaberg, this species is added here. It is a Mediterranean species with recent westpalearctic distribution ranging throughout Central Europe east to the Southern Urals and southeast to the Balkans. It is also known from Turkey.

Northerly advanced southern species

The term 'northerly advanced southern species' as used here, applies to species with recent distribution in Southern Scandinavia, i.e. broadly speaking the area represented by *regio fagina* and *regio quercina* (Fig. 2). If also advanced further north, the species does not occur in *regio alpina/arctica*.

As many as ten species are included here. The consecutive northern limits of nine of them are noteworthy (Fig. 94 A–I), more or less forming the same contours. Starting from the coast of Norway, the boundaries run close together and then spread fan-like across Central Sweden before joining to enter a southern and northern group framing the Gulf of Bothnia; further east most of them converge into Russia. This characteristic undulating belt of northern border areas, comprising the northern limits of a number of terrestrial animals (Lindroth 1956) and plants (cf. Hultén 1950, the maps) is a tension zone due to a complex of ecological factors, of which climatic ones play an important role.

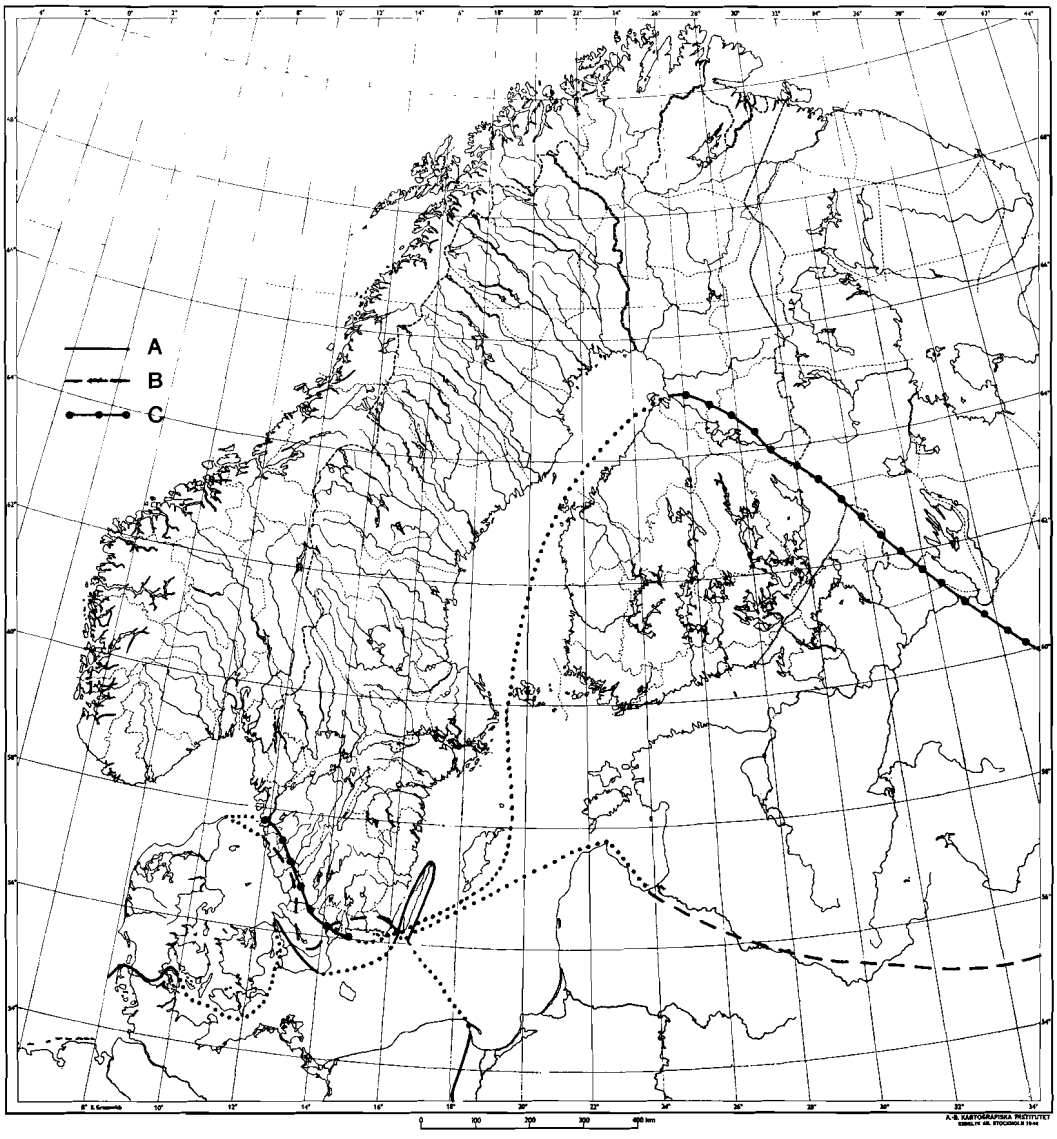


Fig. 93. The average northern limits of A: *B. cullumanus* (Kirby); B: *B. ruderatus* (Fabricius); C: *B. veteramus* (Fabricius).

The mountain range as a natural barrier is clearly demonstrated by some of the species, extending along the extreme south and west coast of Norway. The species are divided into two subgroups according to the position of the northern limits crossing the southern end of Gulf of Bothnia or passing north of it.

Species with northern limit crossing the southern end of Gulf of Bothnia (Fig. 94 A–F). *B. muscorum*, *B. terrestris*, *B. subterraneus*, *B. magnus*, *B. sylvarum* and *B. humilis* are included here. The disjunct Scandinavian distribution of *B. muscorum* (Figs. 82, 94 A) is remarkable. The species in Norway is restricted to the extreme coast from the southernmost point of the country north to nearly 68° N, while in Sweden mainly occurring in the southernmost part of the country and scantily recorded northeast to 60° N in

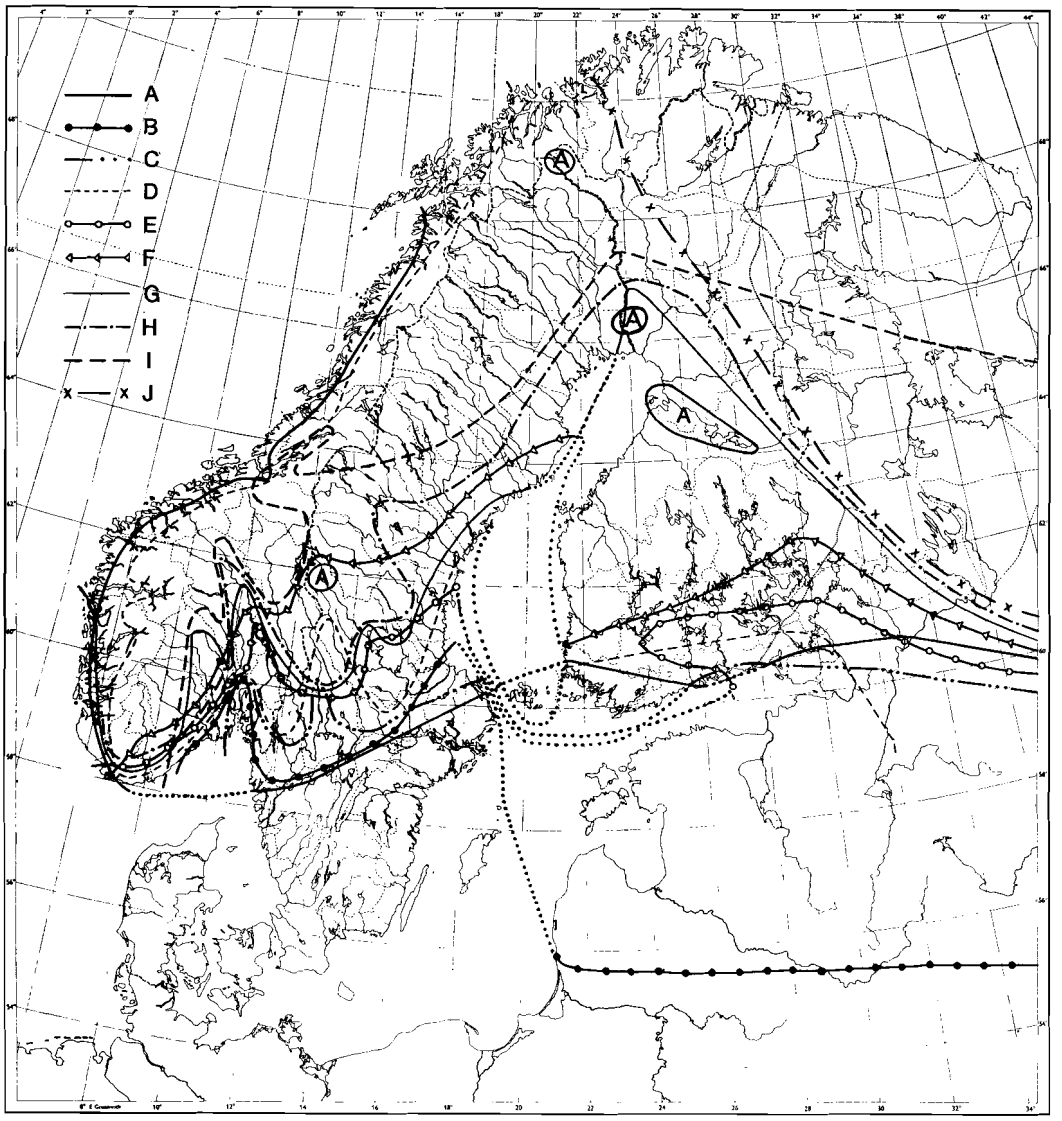


Fig. 94. The average northern limits of A: *B. muscorum* (Linnaeus); B: *B. terrestris* (Linnaeus); C: *B. subterraneus* (Linnaeus); D: *B. magnus* Vogt; E: *B. sylvarum* (Linnaeus); F: *B. humilis* Illiger; G: *B. lapidarius* (Linnaeus); H: *B. ruderarius* (Müller); I: *B. distinguendus* Morawitz; J: *B. soroeensis* (Fabricius).

Uppland. This atlantic type of distribution is emphasized by the subspecific splitting of the Scandinavian species (Fig. 82) of which *B. m. liepetterseni* is adapted to the atlantic climate on the Norwegian west coast. However, owing to a few relic occurrences north of the indicated boundary (Fig. 94 A), that of Finland: Le: Kilpisjärvi situated in the mountain region as far north as 69° N, *B. muscorum* apparently proceeded further towards the north during more favourable climatic conditions in earlier postglacial period than at present. Outside Fennoscandia the species occurs in the British Isles and ranges throughout the European continent northeast to almost the Polar Circle in Russia and with relic occurrences north to 69° N. Further east it occurs in Kazakhstan, Northern Tien Shan, Southern Siberia, Northern Mongolia

east to Manchuria, and is also known from Turkey, Transcaucasus, and the Caucasus.

Another species apparently having an atlantic type of distribution is the critical species *B. magnus* (Figs. 55, 94 D). At least information so far indicates a continuous distribution along the Norwegian coast north to 70° N, and a disperse occurrence in Southern Scandinavia northeast to 63° N on the coast of Gulf of Bothnia. It is known from the southernmost part of Finland and outside Fennoscandia is so far recorded in Scotland, the Orkneys, the Pyrenees, throughout Central Europe north to the Baltic Sea, and, moreover, in scattered areas in Asia east to Manchuria and China (Kansu).

The four remaining species in this subgroup present a continental type of distribution in Scandinavia, reaching rather far north in Eastern Sweden, but in Norway confined to the southeastern lowlands. *B. terrestris* (Figs. 57, 94 B), in Norway only recorded in the environs of Oslofjord and in Sweden widely distributed northeast to about 60°30′ in Gästrikland, is an expansive species. There are only recent finds from the northern border areas, which partly include previously quite well investigated localities. It is a Mediterranean species, outside Scandinavia having a wide Euromediterranean distribution, occurring in British Isles, Canary Islands, Northwest Africa, throughout Central and Southern Europe, Caucasus east to Kazakhstan and reaching the eremial in Turkestan.

As mentioned in the treatment of *B. subterraneus* (Figs. 92, 94 C) the distribution of this species in Norway is uncertain. It is concluded that if it still exists, the population is apparently withdrawn to the southeasternmost part of the country, occurring in areas which lately have been poorly investigated. *B. subterraneus* is in Sweden widely distributed northeast to 60°30′ in Uppland, while in Finland it is only singly recorded on the south coast. The species outside Fennoscandia occurs in Southern England, throughout the continent south to France, Italy, the Balkans, throughout Central Russia and east to Northern Mongolia. It is also known from Turkey and Caucasus.

B. sylvarum (Figs. 89, 94 E), in Norway reaching to the southeasternmost lowlands and the extreme southern coast, is in Sweden widely distributed northeast to nearly 62° N in Hälsingland. It is recorded in southeasternmost Finland. *B. sylvarum* outside Fennoscandia occurs in the British Isles and on the continent ranges from NW Spain, Italy, the Balkans, north to 60° N in NW Russia, and east to the southern Urals. It occurs in Altai, but the Asiatic information is meagre. It is known from Turkey, Caucasus and the eremial in Iran.

The distributional pattern of *B. humilis* (Figs. 79, 94 F) is rather like that of *B. sylvarum* except that the former ranges markedly further north, e.g. along the coast of Gulf of Bothnia recorded north to about 64° N in *Västerbotten*. Both species have almost the same Eurasian distribution except that so far *B. humilis* is known to have a wider Asiatic distribution, reaching east to Baykal and Northern Mongolia.

Species with northern limit running north of Gulf of Bothnia (Fig. 94 G–J). Four species, viz. *B. lapidarius*, *B. ruderarius*, *B. distinguendus* and *B. soroeensis* belong to this subgroup of which the three former have a continental type of distribution. *B. lapidarius* (Figs. 65, 94 G) in Norway is distributed in the southeastern lowlands, penetrates some of the adjacent valleys and moreover extends along the extreme coast north to 61° N. In Sweden the species is so far observed northeast to nearly 63°30′ N in Ångermanland. Thus it is a question whether the hiatus in Västerbotten and Norrbotten is real or due to insufficient investigations, i.e. it is uncertain whether the Swedish population by now is linked to the Finnish population in the northern end of the Gulf of Bothnia. *B. lapidarius* is a Mediterranean species, outside Fennoscandia ranging throughout Europe, in Russia reaching north to 60° N and east to the Volga. It moreover occurs in Tunisia and penetrates the eremial in the area ranging from Turkey to Caucasus.

B. ruderarius (Figs. 87, 94 H) in Norway is restricted to the southeastern lowlands and the extreme south and southwestern coast. It is distributed throughout Sweden northeast to Norrbotten, where the species is connected with the Finnish population. *B. ruderarius* outside Fennoscandia extends throughout Europe northeast to 60° N in Russia, and ranges east to Lake Baykal.

It is also known from Tunisia, Turkey and the Caucasus.

As mentioned in the treatment of *B. distinguendus* (Figs. 91, 94 I) the population on the southwestern coast of Norway might have disappeared. The recent investigations indicate a distribution limited to Southeastern Norway and to the inner part of Trondheimsfjord, the latter apparently connected to Sweden in Jämtland. The Swedish population is otherwise widely distributed throughout the country, but only sporadically recorded in Lapland. Outside Fennoscandia it occurs in the British Isles, in Central and Northern Europe, in fact almost reaches the tundra in Russia. Further east it ranges throughout Northern Kazakhstan, Altai, Western and Southern Siberia, reaches Sakhalin, and occurs in Tien Shan. *B. distinguendus* at least in Europe has a more northern distribution than the remaining species hitherto mentioned and might be a Siberian fauna element.

It is with doubt that the last species, viz. *B. soroeensis* (Figs. 51, 94 J) is included in this group. It has expanded wider and further north than the remaining southern species; in fact it is dispersely distributed north to 70° N on the Norwegian coast. It occurs throughout Sweden yet nowhere reaches the high mountainous region. The species ranges throughout Finland except in the northeastern part. *B. soroeensis* has expanded wider and further north than previously noted (Reinig 1939; Erlandsson 1950), and must be considered as a dynamic southern species no longer being peculiar to the southern Scandinavian fauna. Outside Fennoscandia, it occurs in England, Scotland and on the continent, is continuously distributed throughout Central Europe east to Northern Mongolia. It has additionally a complex of disjunct ranges in Southern Europe, Northern Africa, Turkey, and the Caucasus from where it penetrates the eremial south of Caspian Sea. It is remarkable that the species has expanded north to 70° N in Norway.

Eastern species

Three species, viz. *B. sporadicus*, *B. cingulatus* and *B. consobrinus* are termed 'eastern' according to their occurrence in Scandinavia and their total area of distribution. They all have their main distribution in *regio coniferina* (Fig. 2), and thus are broadly characterized by their absence from Southern Scandinavia, the high mountainous regions, and the extreme western and northern coast (Fig. 95). They are northern Eurosiberian species, representing the taiga species of the Siberian elements.

B. sporadicus (Figs. 56, 95 C) is locally frequent and widely distributed in the forest east of the mountain chain in Southern Norway, reaches the coast in the wooded areas in Sör-Tröndelag and Nord-Tröndelag and is, moreover, scantily recorded north as far as the Polar Circle. The species in Sweden is widely distributed throughout the forest from the northern part of Dalsland and northwards. Outside Scandinavia it occurs throughout the taiga east to the Pacific coast and at least in Finland, extending north to 70° N. It ranges south to Altai and Northern Mongolia and is distributed along the coast from Northern Manchuria to Kamchatka.

B. cingulatus (Figs. 60, 95 B), locally few in number, is in Norway distributed in the southeastern forest and adjacent subalpine zone, and scantily occurs further north to 70° N. In Sweden it is dispersely observed from Dalarne and northwards throughout the country. The species is confined to the northern and eastern part of Finland and further east the distribution is more northerly than that of *B. sporadicus*. The southern limit is in Siberia running north of Lake Baykal, and its occurrence along the Pacific coast ranges from the area east of Amur north to Anadyr.

The Scandinavian distributional pattern of *B. consobrinus* (Figs. 73, 95 A) accords with that of the main food source *Aconitum septentrionale*, both of which are distributed in conifer forest and adjacent subalpine zone. In Norway, the species ranges between 59° and 68°30′ N, and locally reaches the inner end of some western fjords and the extreme coast north of Trondheimsfjord. The Swedish population ranges from Härjedalen to Lapland (Lu. Lpm.) and extends east to the Gulf of Bothnia in Medelpad. *B. consobrinus* has a disjunct North-European distribution related to that of *Aconitum*. Outside Scandinavia it is confined to Northern Karelia

Fig. 95. The average limits for the Fennoscandian distribution of A: *B. consobrinus* Dahlbom; B: *B. cingulatus* Wahlberg; C: *B. sporadicus* Nylander.

in Finland and to several separated areas north of Leningrad – Moscow – Gorki in Russia; it is even recorded on the east coast of Kola pen. Further east the bumble bee ranges throughout the Siberian taiga south of 60° N and is known from Altai, Northeast China, Japan, Sakhalin and Kamchatka.

Western species

This group, characterized by a westerly distribution in Scandinavia and its absence east of Fennoscandia, is represented by one species only, viz. *B. wurfleini* (Fig. 50). In Norway, the species has a dense and wide distribution in

conifer forest and adjacent subalpine zone north to nearly 68° N, and also occurs along the southern and western coast. In Sweden, it ranges from Dalsland north to Lapland (Lu. Lpm.) and occurs scattered east to the Gulf of Bothnia. *B. wurfleini* is a boreo-alpine species. With the exception of a single record in Finland, it is in the north restricted to Scandinavia. The southern distributional area displays disjunct occurrences confined to mountain ranges and adjacent forests in Central and Southern Europe, Turkey, the Caucasus, and the Urals.

Arctic and subarctic species

The fauna in alpine/arctic regions of Scandinavia is distinguished by five tundra elements three of which, viz. *B. hyperboreus*, *B. arcticus* and *B. balteatus*, are the only holarctic species in Scandinavia while the remaining two species, viz. *B. alpinus* and *B. lapponicus*, have a palearctic arcto-alpine distribution. The members of this group have a disjunct distribution related to the southern and northern part of the mountain chain (Fig. 96). The most arctic species is the rather rare *B. hyperboreus* (Figs. 71, 96 A) with the southern area of distribution restricted to scattered localities ranging from Jotunheimen to Dovrefjell in Norway and a local mountainous occurrence in Härjedalen in Sweden. The northern distributional area is confined to several localities in the mountainous Lapland and northernmost Norway. It is a circumpolar species with islet occurrences in the arctic fringe of both hemispheres, inclusive Novaya Zemlya and Greenland.

B. arcticus, in Fennoscandia and Kola pen. represented by the subspecies *B. a. diabolicus* (Figs. 68, 96 B), has a disperse distribution in the mountainous massif in Southern Norway and adjacent mountains in Sweden, i.e. in Härjedalen and Jämtland. The northern distribution area refers to a scattered occurrence along the northern part of the mountain chain with a wider distribution in northernmost Norway. *B. a. diabolicus* extends east throughout Northern Finland to Kola pen. and *B. arcticus* is otherwise distributed in Arctic Siberia, Novaya Zemlya, Kamchatka, Arctic America and Greenland.

With exception of a rather narrow gap in the area separating the southern and the northern part of the mountain chain, *B. balteatus* (Figs. 70, 96 D) is widely distributed in *regio alpina/arctica* and *regio subalpina/subarctica* from the southern elevation of the mountain range to the northern coast. It is also recorded locally in adjacent spruce forest and at sea level in the inner part of the western fjords. It is distributed throughout Northern Finland, occurs in Northern Siberia, Kamchatka, Alaska, western part of Arctic Canada, along the mountain range in the Rocky Mountain States, and has a relic occurrence in Mongolia.

In Scandinavia, the arcto-alpine *B. alpinus* (Figs. 67, 96 C) possesses a clearly disjunct distribution related to the southern and the northern part of the mountain chain, and in Northern Norway has expanded to the extreme coast. It is a European species, in the north restricted to Fennoscandia and the Kola pen., and in the south to the Alps.

The distributional pattern of the arcto-alpine *B. lapponicus* (Figs. 63, 96 E), the dominant bumble bee in the mountains, is noteworthy. The species is continuously distributed in *regio alpina/arctica* and regio *subalpine/subarctica* throughout Scandinavia and frequently observed in adjacent forest as well. In Norway, it locally reaches the extreme western and northern coast, in Sweden approaching the Gulf of Bothnia and moreover singly recorded as far southeast as in Uppland. Owing to its wide distribution, there is no clear gap corresponding to the hiatus between the southern and northern part of the mountain chain. The species in Finland is confined to the northern part of the country and further east it extends throughout northern Russia and Siberia to Bering Strait, and Kamchatka. The southern area of distribution is related to Scotland, Western England, and disjunct ranges in the mountains of Central and Southern Europe. Relic occurrences are moreover recorded in Altai, Pamirs, and Tien Shan. *B. lapponicus* has a wider distribution than the remaining Scandinavian tundra elements and is often mentioned as a subarctic species.

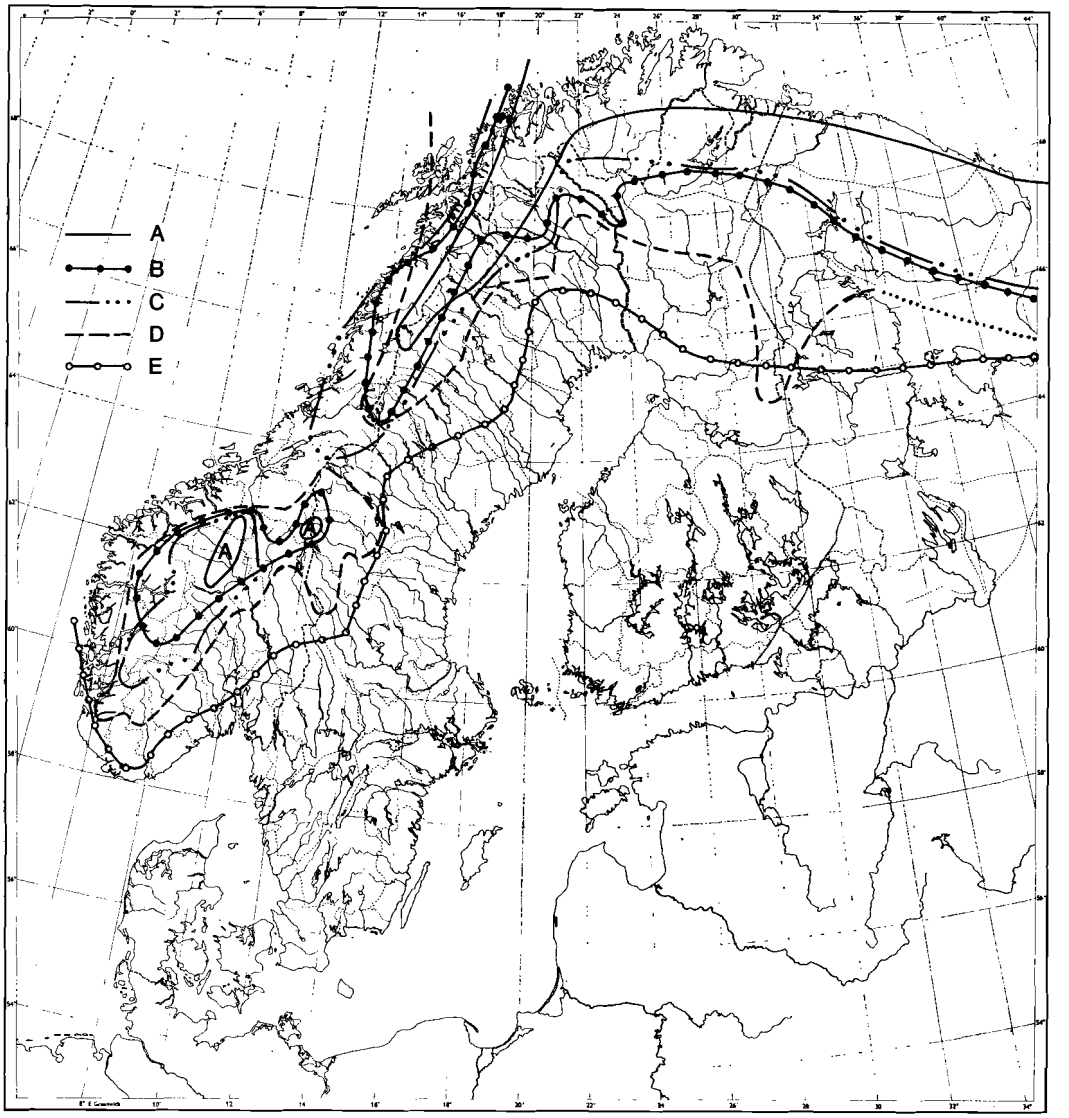


Fig. 96. The average limits for the Fennoscandinavian distribution of A: *B. hyperboreus* Schönherr; B: *B. arcticus* Kirby; C: *B. alpinus* (Linnaeus); D: *B. balteatus* Dahlbom. The southern limit of E: *B. lapponicus* (Fabricius).

Species widely distributed throughout Scandinavia

This group comprises a total of six species, viz. *B. lucorum*, *B. hypnorum*, *B. jonellus*, *B. pratorum*, *B. hortorum*, and *B. pascuorum*, all of which are widely distributed throughout the entire Scandinavian peninsula, i.e. from east to west and from south to at least 70° N. Their vertical distribution in Southern Norway ranges from sea level to *regio subalpina;* only *B. jonellus* and *B. pratorum* are also frequent in *regio alpina* and north of 70° N. *B. jonellus* (Fig. 62) is the only species occurring in Iceland. It is distributed in British Isles, Central and Northern Europe, Western and Southern Siberia, Altai, Amur, and has been recorded in Turkey. *B. pratorum* (Fig. 64), *B. hortorum* (Fig. 75), and *B. pascuorum* (Fig. 86) are outside Fennoscandia

widely distributed in British Isles, throughout the European continent, and eastwards at least to Lake Baykal. They are known from Turkey. *B. pratorum* and *B. hortorum* moreover reach the eremial in Iran and the latter also occurs in Algeria. *B. lucorum* (Fig. 54) has a wide Eurasian distribution, outside Fennoscandia extending throughout Europe and ranging throughout Siberia and adjacent southern countries east to Manchuria, Sakhalin, and Kamchatka. It is known from Northern Turkey, Pamirs, and Tibet. The ubiquitous species comprise a group of minor zoogeographical interest except for the latter species, viz. *B. hypnorum* (Fig. 61), which should be commented upon. Though widely distributed throughout Fennoscandia, it displays a great affinity to the forest. This is clearly illustrated by its scattered occurrence in Northern Norway, everywhere being related to the conifer forest (cf. Figs. 61 and 2), and by the fact that the species is less frequent along the west coast than inland and not at all recorded in Gotland or the Åland islands. *B. hypnorum* is a Siberian fauna element, expanding the taiga far throughout Central Europe until the Channel constitutes the barrier to the British Isles. It is widely distributed throughout Siberia and on the Pacific coast ranges from Japan north to Anadyr. The species is treated by Reinig (1965, p. 131) as a sub-boreal taiga element.

REMARKS ON THE SCANDINAVIAN FAUNA

The zoogeographical survey above articulates the mixture of elements constituting the composition of the Scandinavian bumble bee fauna. It reflects the great variability in ecological conditions, the contrast in topography and climate, and the position of the peninsula, extending from 55°20′ to 71°11′ N and forming the northwest corner of the Eurasian continent. Not only the various fauna elements but also the number of species constitute the faunal composition. A total of twenty species represented in Southern Sweden constitutes the bulk of the Scandinavian *Bombus* spp. and comprises the fourteen southern species in addition to the six ubiquitous ones. A decline in number of species and a change in fauna elements on going north is to be expected, but as many as 14 species occur in northernmost Norway, i.e. the counties Troms and Finnmark, and reflect the fairly favourable living conditions that far north. In addition to the ubiquitous species and the southern *B. soroeensis*, the five tundra elements, viz. *B. hyperboreus*, *B. arcticus*, *B. balteatus*, *B. alpinus*, *B. lapponicus*, and the taiga species *B. sporadicus* and *B. cingulatus*, are represented. However, the fauna in *regio arctica* is limited to the five tundra elements besides the ubiquitous *B. jonellus* and *B. pratorum*, a composition corresponding to that of *regio alpina* in Southern Norway.

Of particular interest is the zonation along the west coast of Southern Norway being included in *regio quercina* (Fig. 2). A total of twelve species is represented, viz. all the ubiquitous species in addition to *B. muscorum*, *B. magnus*, *B. lapidarius*, *B. soroeensis*, *B. wurfleini* and *B. lapponicus*. With exception of the two latter, they are southern species and defend the rather awkward use of *regio quercina* applied to the west coast. However, occurrence of the tundra element *B. lapponicus* and the fact that *B. muscorum* is represented by the atlantic subspecies *B. m. liepetterseni* clearly distinguish this northern part of *regio quercina* from the more typical southern fauna in the remaining part of this region.

IMMIGRATION ROUTES OF SCANDINAVIAN BUMBLE BEES

The quaternary glaciations of Northeast Europe exterminated the flora and fauna of Scandinavia, and, in the geological time scale, plants and animals now distributed throughout the peninsula are young immigrants. Thus it should be easier to survey the natural history of Scandinavia than that of other parts of the world – the main problem being related to the biological effect of the last glaciation (Würm), timing,

and direction of post-glacial immigration. Since the end of the last century, the question has risen as to whether the last glaciation completely covered Scandinavia or left possibilities for glacial survivors, owing to the fact that recent distribution of a number of plants and animals cannot be explained by post-glacial invasion. Theories on survival throughout Würm in ice-free refuges on the west coast of Norway have been suggested, favoured, and refuted by biographers and geologists respectively (cf. Lindroth 1949, 1962). During the past decade survival through the 'Younger Dryas period' only, has been discussed (Lindroth 1969).

The scope of the present work has been to compile facts on taxonomy, phenotypic variations, and distribution of Scandinavian *Bombus* spp. to serve as a basis for further investigation. The ecological claims governing its distribution and faunal history have been stressed. As to the latter, the distributional pattern of the Scandinavian *Bombus* spp. indicates that the recent fauna is compounded by post-glacial elements only. In the treatment of *B. wurfleini*, *B. lapponicus*, and *B. consobrinus*, theories of interglacial relicts were disputed by me. The view of principal immigration routes tentatively indicated below, is based on zoogeographical information summed up in previous chapters.

Southern immigrants

The term southern immigrants embraces species invading Scandinavia from south, mainly over Denmark to Southern Sweden. The species included here can be subdivided into three categories:

(1) Species with recent distribution confined to Southern Scandinavia, i.e. with the northern limits crossing the southern end of the Gulf of Bothnia or running further south. The subgroup comprises a total of nine species, viz. the extreme south-swedish species *B. cullumanus*, *B. ruderatus*, *B. veteranus* (Fig. 93) and the northerly advanced southern species *B. muscorum*, *B. magnus*, *B. terrestris*, *B. subterraneus*, *B. sylvarum* and *B. humilis* (Figs. 94 A–F). Invasion of a tenth species, viz. *B. pomorum*, is doubtful, as the single Swedish record might be due to accidental anthropochore introduction.

(2) Species with 'double' immigration (Lindroth 1949), i.e. species which have invaded Scandinavia from two or more directions, viz. from south over Denmark and from east over Finland. This subgroup contains the northerly advanced species with the northern limits running north of Gulf of Bothnia viz. *B. lapidarius*, *B. ruderarius*, *B. distinguendus* and *B. soroeensis* (Fig. 94 G–J) and additionally the ubiquitous species, viz. *B. lucorum*, *B. hypnorum*, *B. jonellus*, *B. pratorum*, *B. hortorum* and *B. pascuorum*. These species first invaded Scandinavia from the south. On approaching northeast to Norrbotten, the populations were met by Finnish populations spreading over to Sweden round the Gulf of Bothnia. Regarding *B. lapidarius*, there may still be a ± gap between the Swedish and Finnish populations. The Scandinavian and Finnish populations are in general not phenotypically distinguished, and are treated as identical populations. Exceptions are perhaps *B. hortorum* and *B. pascuorum*. As mentioned in the treatment of *B. hortorum*, the species displays a pronounced tendency to melanism in Southern Norway while melanic specimens are not all observed in Northern Scandinavia. It is suggested that a population with gene-pole dark might have invaded Scandinavia from south while another population with gene-pole light reached the peninsula from the east. Subspecific evaluation of *B. pascuorum*, based on clinal variations, indicates as many as three subspecies being confined to the Scandinavian mainland, which might give reason to suggest post-glacial invasion from three principal routes: *B. p. pallidofacies* invading Scandinavia from south, *B. p. sparreanus* from east round Gulf of Bothnia, and *B. p. smithianus* reaching northernmost Norway from the northeast. The intergrading areas could then have been reached by populations presenting clinal variations in opposite directions. However, lack of information about populations east of Finland make this suggestion rather hypothetical. At any rate, the widely distributed *B. pascuorum* has invaded Scandinavian from south and east as well.

(3) Boreo-alpine and arcto-alpine species. The

boreo-alpine *B. wurfleini* and the arcto-alpine *B. alpinus* and the subspecies *B. lapponicus scandinavicus* refer to this subgroup. It seems likely that they lived at the edge of the ice during the last glaciation and when the ice retreated they followed northwards, i.e. they are southern post-glacial immigrants. The earlier faunal history of these species is not commented upon here.

Eastern immigrants

The term eastern immigrants of Lindroth (1949) is used for all species in post-glacial time invading Scandinavia east of the Baltic Sea. Thus the species mentioned as southern immigrants under the heading 'double' immigration, are eastern immigrants as regards the invasion over Finland. Otherwise eastern immigrants refer to the tundra elements *B. hyperboreus*, *B. arcticus*, *B. balteatus* and *B. l. lapponicus* (Fig. 96 A–B, D–E) and to the taiga elements, viz. *B. sporadicus*, *B. cingulatus* and *B. consobrinus* (Fig. 95). In the treatment of *B. balteatus*, attention is directed to a possible double immigration, based on the great phenotypical variability including a pronounced tendency to melanism in Southern Norway – yet mentioned only as a speculative theory. However, double immigration of *B. lapponicus*, represented by two subspecies (Fig. 63), is obvious. The nominate subspecies is a north-eastern immigrant while *B. l. scandinavicus* is a southern invader and consequently is included above as a southern immigrant.

B. consobrinus (Figs. 73, 95 C) is the only puzzling member of the Scandinavian bumblebees owing to its recent disjunct distribution in Fennoscandia, presenting a wide gap in Finland. Clinal variations along an immigration route extending from Eastern Asia, throughout the taiga in Siberia, and west into Scandinavia, is mentioned in the treatment of the species. The very close morphological and phenotypical relationship between the separated populations in Scandinavia, Finland, and adjacent part of U.S.S.R., emphasize their subspecific identity and gives reason to surmise a former continuous distribution in post-glacial time.

ACKNOWLEDGMENTS

I am under heavy obligation to a number of persons, institutions and supporting agencies that have made this study possible.

I owe the late Ove Meidell deep gratitude for introducing me to apidological research. Stimulating discussions shortly before his early death in 1942 and access to his numerous unpublished notes, some of which are included here, have contributed greatly to my general knowledge of the subject.

I am very much obliged to Dr. G. Kruseman, Professor O W. Richards and Dr. I. H.H. Yarrow for profitable discussions on taxonomic and nomenclatural problems, for confirming my identifications of some aberrant specimens, and otherwise providing me with information about types and classical collections. As the work was written directly in English, Professor Richards and Dr. Yarrow kindly corrected the language in the major part of the manuscript. The latter also generously allowed me to refer to his unpublished records whenever they contributed to the world distribution of *Bombus* spp. treated here.

I am especially grateful to Dr. K. Ander for his never-failing interest in this study. His efforts to provide me with detailed information about old and recent collections, with permission to include his unpublished records, greatly helped to complete the Swedish part of this work.

I have profited much by communication with the following professors and doctores regarding certain phyto- and zoogeographical aspects and/or locating of types, interpretations of labels in classical collections, etc.: A. M. Antonova, Moscow; R. Y. Berg, Oslo; R. Delmas, Monpellier, France; S. Erlandsson, Stockholm; K–H. Forsslund, Stockholm; H. Kauri, Bergen; the late N. Knaben, Oslo; C. H. Lindroth, Lund; H. E. Milliron, Ottawa; H. Olsen, Bergen; D. V. Panfilov, Moscow; B. Petersen, Copenhagen; T. Soot-Ryen, Oslo; A. Strand, Oslo; B. Tjeder, Lund; B. Tkalcu, Prague.

Professor K. Fægri kindly made a few pollen analyses.

I am most grateful to Mrs. Inger Meidell Tambs-Lyche for her untiring efforts as assistant in the continuous and tedious field work

during the years 1957–61, resulting in a considerably larger research material than originally planned. She also made the left-over material of her husband O. Meidell available by preparing specimens, arranging and typing notes, etc.

I wish to thank the following collaborators who generously supplied me with material, partly from areas not otherwise investigated: E. Alendal, Ø. Alfsen, K. Ander, A.Bakke, J. and the late R. Benson, K. R. Bjørklund, P. Brinck, I. Bryhni, E. Christiansen, I. Dacie, T. Dalland, S. Dommersnes, J. M. Douglas, A. Eide, A. Eliassen, P. Eriksen, K. Fauchald, J. Fjelddalen, A. Fjellberg, A & J. Fjeldså, F. Fridén, O. Gjærevoll, the late C. Godske et al., J. Gullaksen, I. & J. Haugsbø, J. Huseby, F. James et al., A & K. B. Jensen, L. Greve Jensen, R. Rosendahl Knudsen, P. G. Krüger, H. Kryvi, V. Kvarstein, L. Langhelle, A. Larsen, T. Lorvik, C. C. Lous, C. F. Lühr, T. Lund, A. Lønnå, B. Midttun, O & P. St. & S–R. Myklebust, A. Mørch, A. & T. Nielsen, the leader of scout exp. H. Nilssen, A. & M. Orheim, T. Ouren, A. R. Pettersen, L. Ryvarden, G. Sandve, P. Solemdal, T. Solhøy, H. Soot-Ryen, O. Sotavalta, E. Stølen, P. Størmer, E. Sundt, V. Søndenå, H. & H. Tambs-Lyche, A. Tjønneland, P. Valeur, S. Ødegården, T. Øgrim, G. & J. Østvold.

My sincere appreciation is extended to the following authorities who generously placed on loan or otherwise permitted me to examine collections pertinent to this study and provided me with facilities during my stay in their institutions: G. E. Bohart, U.S.D.A. Entomological Research Div., Logan, Utah; B. Christiansen, Tromsö Museum, Tromsö; the late R. Elfving, Kupio, Finland; M. Fischer, Naturhistorisches Museum, Vienna; W. Hackman and A. Pekkarinen, Zoologiska Museet, Helsinki; H. Holgersen, Stavanger Museum, Stavanger; S. Jonsson, Zoologiska Institutionen Uppsala; the late E. Kjellander and P. I. Persson, Naturhistoriska Riksmuseum, Stockholm; K. V. Krombein, U. S. National Museum, Washington D. C.; G. Kruseman, Zoölogisches Museum, Amsterdam; E. Königsmann, Institute f. speziell Zoologie u. Zoologisches Museum, Berlin; E. K. Lahtiperas, Museum Zoologicum, Univ. Turkensis, Åbo; H. Larsson, Uppsala; C. H. Lindroth and H. Andersson, Zoologiska Institutionen, Lund; L. R. Natvig and A. Lillehammer, Zoologisk Museum, Oslo; F. Ossiannilsson, Institutionen för Växtpatologi, Uppsala; the late A. Ponomareva, Academy of Science, Leningrad; A. Semb-Johansson, Zoologisk Laboratorium, Oslo; E. Sivertsen, Kongelige Videnskabers Selskab, Museet, Trondheim; H. Skults, Åbo Akademi, Åbo; T. Tjeder Rättvik; S. L. Tuxen and B. Petersen, Zoologisk Museum, Copenhagen; E. Valkeila, Hämenlinen, Finland; H. Waldén, Göteborg Naturhistoriska Museum, Göteborg; I. H. H. Yarrow, British Museum (Natural History), London.

I am indebted to K. Fløisand, manager of the computer centre at the University, Bergen, for patient help in getting the Norwegian part of the material punched and computed as the data were gradually coded.

For various technical assistance, my thanks are especially due to Miss Sisel Dommersnes, and to Mrs. Inger Berentsen, Mrs. Alis Eliassen, Mr. Jan Haugsbø, Miss Ellen Irgens, Mrs. Marit H. Jacobsen, Mrs. Ragnhild Rosendahl Knudsen, Miss Unni Schøyen and Mrs. Nini Wågsberg.

The field work was financially supported by A/S Varekrigsforsikrings Fond. My stay in foreign institutions, and expenses related to codification of data, were partly paid for by funds from the University of Bergen and by Norges Almenvitenskapelige Forskningsråd. To these institutions I express my grateful thanks.

Last but not least my sincerest gratitude goes to Professor H. Kauri for stimulating discussions, advice, and criticism which have improved the manuscript. Without his encouragement the present work, which for various reasons has been interrupted several times, would perhaps never have been published.

SUMMARY

The aim of this study is to present a synopsis of the genus *Bombus* in Scandinavia (= Norway and Sweden).

1. A historical review is given, beginning with Linnaeus, who described ten valid *Bombus* spp. from his home country Sweden. The subsequent

pioneer contributions to the knowledge of the Scandinavian bumble bee fauna are briefly summarized. The topography and climate in Scandinavia are then shortly commented upon, followed by a simple regional division based on ecological conditions and expressed by tree limits.

2. The main areas investigated by me during the years 1939–1969 with several years of intervals are reviewed, and the museum and private collections under revision are listed. About 56,700 specimens were examined altogether.

3. Procedures related to the treatment of bibliography, taxonomy and distribution of the Scandinavian species are described.

4. Classification is commented upon and the strong homogeneity in the subgenera of *Bombus* is in particular emphasized.

5. Keys to the Scandinavian species of *Bombus* are given.

6. The main part of this work is devoted to the study of the Scandinavian species, arranged by subgenera. An attempt is made to provide valid designations and synonyms with information about the type and the type area. The treatment of each species deals with the following items (some of which are for convenience assigned to the actual subgenus or subspecies): List of synonyms also including bibliographic references to the Scandinavian fauna; first record in Norway and Sweden respectively; nomenclatural and/or taxonomical remarks, e.g. listing named infrasubspecific forms; diagnostic descriptions (morphological characters, colour pattern, variations); distribution in Norway and Sweden respectively, showed by dot maps, and detailed list of localities; distribution in Finland and general occurrence throughout the world; biology. In several species, phenotypic variations, distribution, and biology are subject to remarks or discussion.

A total of 29 species, divided into 34 subspecies, is recognized, of which 25 species (28 subspecies) occur in Norway, while all the species (33 subspecies) are recorded in Sweden.

The study of the subgenus *Bombus* s.s. supports specific recognition of the critical taxon *B. magnus*. The male of this species is, however, not distinguished from the male *B. lucorum*. The subgenus is represented by four species, viz. *B. lucorum*, *B. magnus*, *B. sporadicus* and *B. terrestris* of which the latter is new to Norway.

The subgenus *Pyrobombus* is represented by five species, of which *B. lapponicus* is divisible into two subspecies, viz. *B. l. lapponicus* and *B. l. scandinavicus*. As a result of a phenotypic study it is stated that the distribution of the nominate subspecies extends west to northeasternmost Sweden and Norway. Regarding the rapid cycle of *B. jonellus*, *B. lapponicus* and *B. pratorum* the seasonal length is noteworthy, lasting to the beginning or end of September. In addition to late-emerging queens lengthening the season, it is indicated that under favourable conditions *B. lapponicus* and *B. pratorum* possibly produce two generations, as recently suggested for *B. jonellus*.

A total of four species is distinguished in the arctic subgenus *Alpinobombus*. The conspecificity of the Canadian *B. a. arcticus* and the Scandinavian *B. a. diabolicus* (= *B. alpiniformis*) is evaluated and maintained, i.e. a specific ranking of the latter is refuted. The unstable colouring, including melanism, of *B. balteatus* is studied. It is concluded that the great range of variations are not geographically segregated except for those related to melanism. As to the latter, the frequency of recorded melanics, being high in mountainous Southern Norway, is markedly reduced on going north; a tendency to melanism is in fact not observed at all in northernmost Norway. The theory of arctic species being adapted to solitary living is moreover disputed. A great number of collected workers, and records of colonies, prove that *B. alpinus*, *B. arcticus* and *B. balteatus* regularly produce a worker caste. Regarding *B. hyperboreus*, the revision reveals no reliable records of colonies in its entire geographical range. Although few in number, workers have, however, been observed in Scandinavia and further east. Recent observations of *B. hyperboreus* usurping colonies of *B. arcticus* in the western hemisphere and a colony of *B. jonellus* in Scandinavia indicate that this high-arctic species is a facultative inquiline rather than (even temporarily) adapted to solitary living.

The subgenus *Megabombus* is represented by three species. The information acquired about

the occurrence of *B. consobrinus* only confirms the relation to its main food source *Aconitum septentrionale*, i.e. all recent records also refer to the distributional area of this plant. In the widely distributed *B. hortorum* a pronounced tendency to melanism, confined to the southerly part of Scandinavia, is evaluated. In Norway, it is characterized by a maximum of melanic records on the southwestern coast (roughly 75% melanism in the outer district of Rogaland) and an apparently clinal decrease towards northeast (5% melanism in southern district of Oppland). In Sweden there is a pronounced tendency to melanism in Öland and Gotland islands compared with that of the mainland. There is no tendency to melanism in Northern Scandinavia nor in Finland, which favours a theory of two Scandinavian populations: A southern population with gene-pole dark in the post-glacial period invading the peninsula from south, and a northern population with gene-pole light immigrating from the east.

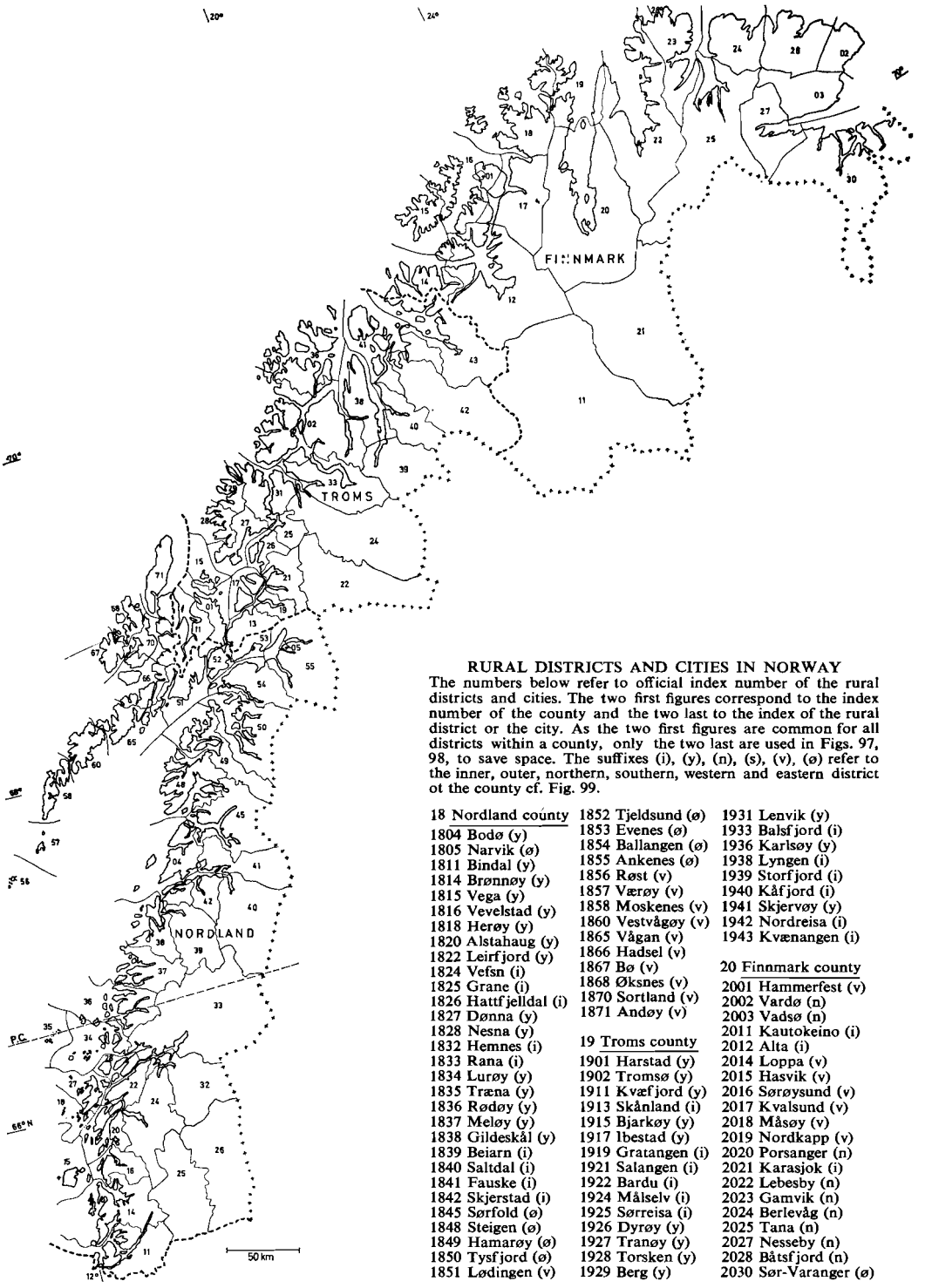
As many as six species represent the subgenus *Thoracobombus*. Clinal variations in three of the species have been estimated by a broad grouping of certain colour characters, and the following subspecies were recognized: *B. humilis hafsahlianus*, *B. m. muscorum*, *B. m. liepetterseni* nov. ssp. (= *B. m. smithianus* auctt. nec White (partim)), *B. pascuorum smithianus* White (= *B. agrorum erlandssoni* Kruseman), *B. p. sparreanus* nov. nom. (= *B. agrorum bicolor* Sparre Schneider), *B. p. pallidofacies* Vogt. nov. status and *B. p. gotlandicus*. The subspecific position of *B. p. barcai* and *B. p. romani* is supressed, both of which are transitional forms only. In a fourth species of this subgenus, viz. *B. sylvarum*, the frequency of melanism has been estimated, and it is concluded that the Scandinavian population produces dimorph infrasubspecific forms divided into a typical and a strongly melanic form.

Humidity and effect of isolation of populations are merely traced as factors influencing the accumulation of melanic alleles. Melanic specimens are produced in both sexes and castes which proves that the tendency to melanism is not sex-associated. A sexual dimorphism is, however, generally known in a number of *Bombus* spp. In the Scandinavian species or subspecies such a dimorphism is easily recognized in, for instance, *B. wurfleini mastrucatus*, *B. cullumanus*, *B. lapponicus scandinavicus*, *B. lapidarius* and *B. subterraneus*, where pile of head and thorax is black in females, while having a variable admixture of yellow (confined to pile of face and/or vertex collar, episternum and scutellum) in males.

7. In a survey of the distributional pattern, *Bombus* spp. are arranged according to their Scandinavian distribution as follows: (1) Four species with restricted southern distribution; (2) ten northerly advanced southern species; (3) three eastern species; (4) one western species; (5) five arctic and subarctic species; (6) six species widely distributed throughout Scandinavia.

8. The composition of the Scandinavian fauna is traced. As expected, Southern Scandinavia is represented by the bulk of the species, comprising 14 southern and 6 ubiquitous species. The composition in northernmost Norway, making a total of 14 species, is characterized by the five tundra elements, viz. 4 species of *Alpinobombus* in addition to *B. lapponicus* and two taiga species, viz. *B. sporadicus* and *B. cingulatus*. The remaining species reaching that far north are the six ubiquitous species and the southern species, *B. soroeensis*, yet the latter is observed only along the Norwegian coast north to 70° N. However, the bumble bee fauna in Arctic proper is limited to the tundra elements in addition to the ubiquitous *B. jonellus* and *B. pratorum*, and corresponds to the fauna in the mountainous massif of Southern Norway.

9. Finally the immigration routes are indicated. Although the disjunct Fennoscandian distribution of *B. consobrinus* is a puzzling zoogeographic problem, it is concluded that the recent distribution of all the Scandinavian *Bombus* species is due to post-glacial invasion only.



RURAL DISTRICTS AND CITIES IN NORWAY

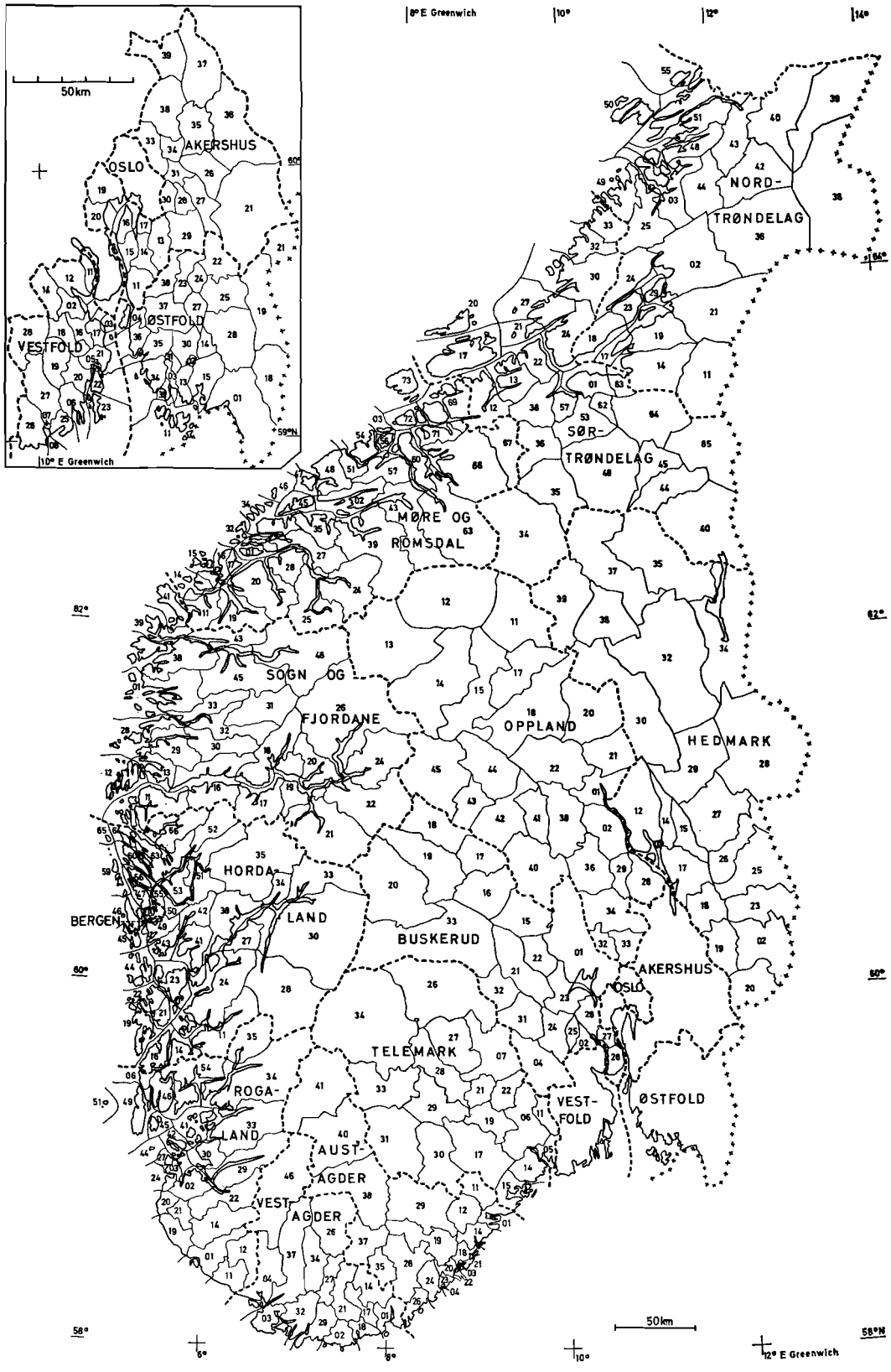
The numbers below refer to official index number of the rural districts and cities. The two first figures correspond to the index number of the county and the two last to the index of the rural district or the city. As the two first figures are common for all districts within a county, only the two last are used in Figs. 97, 98, to save space. The suffixes (i), (y), (n), (s), (v), (ø) refer to the inner, outer, northern, southern, western and eastern district ot the county cf. Fig. 99.

18 Nordland county
1804 Bodø (y)
1805 Narvik (ø)
1811 Bindal (y)
1814 Brønnøy (y)
1815 Vega (y)
1816 Vevelstad (y)
1818 Herøy (y)
1820 Alstahaug (y)
1822 Leirfjord (y)
1824 Vefsn (i)
1825 Grane (i)
1826 Hattfjelldal (i)
1827 Dønna (y)
1828 Nesna (y)
1832 Hemnes (i)
1833 Rana (i)
1834 Lurøy (y)
1835 Træna (y)
1836 Rødøy (y)
1837 Meløy (y)
1838 Gildeskål (y)
1839 Beiarn (i)
1840 Saltdal (i)
1841 Fauske (i)
1842 Skjerstad (i)
1845 Sørfold (ø)
1848 Steigen (ø)
1849 Hamarøy (ø)
1850 Tysfjord (ø)
1851 Lødingen (v)
1852 Tjeldsund (ø)
1853 Evenes (ø)
1854 Ballangen (ø)
1855 Ankenes (ø)
1856 Røst (v)
1857 Værøy (v)
1858 Moskenes (v)
1860 Vestvågøy (v)
1865 Vågan (v)
1866 Hadsel (v)
1867 Bø (v)
1868 Øksnes (v)
1870 Sortland (v)
1871 Andøy (v)

19 Troms county
1901 Harstad (y)
1902 Tromsø (y)
1911 Kvæfjord (y)
1913 Skånland (i)
1915 Bjarkøy (y)
1917 Ibestad (y)
1919 Gratangen (i)
1921 Salangen (i)
1922 Bardu (i)
1924 Målselv (i)
1925 Sørreisa (i)
1926 Dyrøy (y)
1927 Tranøy (y)
1928 Torsken (y)
1929 Berg (y)
1931 Lenvik (y)
1933 Balsfjord (i)
1936 Karlsøy (y)
1938 Lyngen (i)
1939 Storfjord (i)
1940 Kåfjord (i)
1941 Skjervøy (y)
1942 Nordreisa (i)
1943 Kvænangen (i)

20 Finnmark county
2001 Hammerfest (v)
2002 Vardø (n)
2003 Vadsø (n)
2011 Kautokeino (i)
2012 Alta (i)
2014 Loppa (v)
2015 Hasvik (v)
2016 Sørøysund (v)
2017 Kvalsund (v)
2018 Måsøy (v)
2019 Nordkapp (v)
2020 Porsanger (n)
2021 Karasjok (i)
2022 Lebesby (n)
2023 Gamvik (n)
2024 Berlevåg (n)
2025 Tana (n)
2027 Nesseby (n)
2028 Båtsfjord (n)
2030 Sør-Varanger (ø)

Fig. 97. Division of Northern Norway. Names and limits dated to 1969. Ø=Ö.


50km
AKERSHUS
OSLO
ØSTFOLD
VESTFOLD
10° E Greenwich
59°N
8° E Greenwich
10°
12°
14°
NORD-
TRØNDELAG
SØR-
TRØNDELAG
MØRE OG
ROMSDAL
SOGN OG
FJORDANE
OPPLAND
HEDMARK
HORDA
LAND
BERGEN
BUSKERUD
AKERSHUS
OSLO
TELEMARK
ROGA-
LAND
AUST-
AGDER
VEST-
AGDER
VEST-
FOLD
ØSTFOLD
82°
62°
60°
58°
64°
50km
58°N
6°
8°
10°
12° E Greenwich

RURAL DISTRICTS AND CITIES IN NORWAY

The numbers below refer to official index number of the rural districts and cities. The two first figures correspond to the index number of the county and the two last to the index of the rural district or the city. As the two first figures are common for all districts within a county, only the two last are used in Figs. 97, 98, to save space. The suffices (i), (y), (n), (s), (v), (ø) refer to the inner, outer, northern, southern, western and eastern district of the county of Fig. 99.

01 Østfold county
0101 Halden
0102 Sarpsborg
0103 Fredrikstad
0104 Moss
0111 Hvaler
0113 Borge
0114 Varteig
0115 Skjeberg
0118 Aremark
0119 Marker
0121 Rømskog
0122 Trøgstad
0123 Spydeberg
0124 Askim
0125 Eidsberg
0127 Skiptvet
0128 Rakkestad
0130 Tune
0131 Rolvsøy
0133 Kråkerøy
0134 Onsøy
0135 Råde
0136 Rygge
0137 Våler
0138 Hobøl

02 Akershus county
0211 Vestby
0213 Ski
0214 Ås
0215 Frogn
0216 Nesodden
0217 Oppegård
0219 Bærum
0220 Asker
0221 Aurskog-Høland
0226 Sørum
0227 Fet
0228 Rælingen
0229 Enebakk
0230 Lørenskog
0231 Skedsmo
0233 Nittedal
0234 Gjerdrum
0235 Ullensaker
0236 Nes
0237 Eidsvoll
0238 Nannestad
0239 Hurdal

0301 Oslo

04 Hedmark county
0401 Hamar (s)
0402 Kongsvinger (s)
0412 Ringsaker (s)
0414 Vang (s)
0415 Løten (s)
0417 Stange (s)
0418 Nord-Odal (s)
0419 Sør-Odal (s)
0420 Eidskog (s)
0423 Grue (s)
0425 Åsnes (s)
0426 Våler (s)
0427 Elverum (s)
0428 Trysil (n)
0429 Åmot (n)
0430 Stor-Elvdal (n)
0432 Rendalen (n)
0434 Engerdal (n)
0435 Tolga-Os (n)
0437 Tynset (n)
0438 Alvdal (n)
0439 Folldal (n)

05 Oppland county
0501 Lillehammer (s)
0502 Gjøvik (s)
0511 Dovre (n)
0512 Lesja (n)
0513 Skjåk (n)
0514 Lom (n)
0515 Vågå (n)
0517 Sel (n)
0518 Fron (n)
0520 Ringebu (s)
0521 Øyer (s)
0522 Gausdal (s)
0528 Østre Toten (s)
0529 Vestre Toten (s)
0532 Jevnaker (s)
0533 Lunner (s)
0534 Gran (s)
0536 Søndre Land (s)
0538 Nordre Land (s)
0540 Sør-Aurdal (s)
0541 Etnedal (s)
0542 Nord-Aurdal (s)
0543 Vestre Slidre (n)
0544 Østre Slidre (n)
0545 Vang (n)

06 Buskerud county
0601 Ringerike (ø)
0602 Drammen (ø)
0604 Kongsberg (ø)
0615 Flå (v)
0616 Nes (v)
0617 Gol (v)
0618 Hemsedal (v)
0619 Ål (v)
0620 Hol (v)
0621 Sigdal (v)
0622 Krødsherad (ø)
0623 Modum (ø)
0624 Øvre Eiker (ø)
0625 Nedre Eiker (ø)
0626 Lier (ø)
0627 Røyken (ø)
0628 Hurum (ø)
0631 Flesberg (ø)
0632 Rollag (v)
0633 Nore og Uvdal (v)
07 Vestfold county
0702 Holmestrand
0703 Horten
0705 Tønsberg
0706 Sandefjord
0707 Larvik
0708 Stavern
0711 Svelvik
0713 Sande
0714 Hof
0716 Våle
0717 Borre
0718 Ramnes
0719 Andebu
0720 Stokke
0721 Sem
0722 Nøtterøy
0723 Tjøme
0725 Tjølling
0726 Brunlanes
0727 Hedrum
0728 Lardal

08 Telemark county
0805 Porsgrunn (y)
0806 Skien (y)
0807 Notodden (i)
0811 Siljan (y)
0814 Bamble (y)
0815 Kragerø (y)
0817 Drangedal (y)
0819 Nome (y)
0821 Bø (i)
0822 Sauherad (i)
0826 Tinn (i)
0827 Hjartdal (i)
0828 Seljord (i)
0829 Kviteseid (i)
0830 Nissedal (i)
0831 Fyresdal (i)
0833 Tokke (i)
0834 Vinje (i)

09 Aust-Agder county
0901 Risør (y)
0903 Arendal (y)
0904 Grimstad (y)
0911 Gjerstad (y)
0912 Vegårshei (y)
0914 Tvedestrand (y)
0918 Maland (y)
0919 Fraland (y)
0920 Øyestad (y)
0921 Tromøy (y)
0922 Hisøy (y)
0923 Fjære (y)
0924 Landvik (y)
0926 Lillesand (y)
0928 Birkenes (y)
0929 Åmli (i)
0935 Iveland (y)
0937 Evje og Hornnes (i)
0938 Bygland (i)
0940 Valle (i)
0941 Bykle (i)

10 Vest-Agder county
1001 Kristiansand (y)
1002 Mandal (y)
1003 Farsund (y)
1004 Flekkefjord (y)
1014 Vennesla (y)
1017 Songdalen (y)
1018 Søgne (y)
1021 Marnardal (y)
1026 Åseral (i)
1027 Audnedal (y)
1029 Lindesnes (y)
1032 Lyngdal (y)
1034 Hægebostad (i)
1037 Kvinesdal (i)
1046 Sirdal (i)

11 Rogaland county
1101 Eigersund (y)
1102 Sandnes (y)
1103 Stavanger (y)
1106 Haugesund (y)
1111 Sokndal (y)
1112 Lund (y)
1114 Bjerkreim (y)
1119 Hå (y)
1120 Klepp (y)
1121 Time (y)
1122 Gjesdal (y)
1124 Sola (y)
1127 Randaberg (y)
1129 Forsand (i)
1130 Strand (y)
1133 Hjelmeland (i)
1134 Suldal (i)
1135 Sauda (i)
1141 Finnøy (y)
1142 Rennesøy (y)
1144 Kvitsøy (y)
1145 Bokn (y)
1146 Tysvær
1149 Karmøy (y)
1151 Utsira (y)
1154 Vindafjord (y)

12 Hordaland county
1211 Etne (i)
1214 Ølen (y)
1216 Sveio (y)
1219 Bømlo (y)
1221 Stord
1222 Fitjar (y)
1223 Tysnes (y)
1224 Kvinnherad (i)
1227 Jondal (i)
1228 Odda (i)
1239 Ullensvang (i)
1233 Ulvik (i)
1234 Granvin (i)
1235 Voss (i)
1238 Kvam (i)
1241 Fusa (y)
1242 Samnanger (y)
1243 Os (y)
1244 Austevoll (y)
1245 Sund (y)
1246 Fjell (y)
1247 Askøy (y)
1248 Laksevåg (y)
1249 Fana (y)
1250 Arna (y)
1251 Vaksdal (y)
1252 Modalen (y)
1253 Osterøy (y)
1255 Åsane (y)
1256 Meland (y)
1259 Øygarden (y)
1260 Radøy (y)
1263 Lindås (y)
1264 Austrheim (y)
1265 Fedje (y)
1266 Masfjorden (y)

1301 Bergen (y)

14 Sogn og Fjordane county
1401 Flora (y)
1411 Gulen (y)
1412 Solund (y)
1413 Hyllestad (y)
1416 Høyanger (y)
1417 Vik (i)
1418 Balestrand (i)
1419 Leikanger (i)
1420 Sogndal (i)
1421 Aurland (i)
1422 Lærdal (i)
1424 Årdal (i)
1426 Luster (i)
1428 Askvoll (y)
1429 Fjaler (y)
1430 Gaular (y)
1431 Jølster (y)
1432 Førde (y)
1433 Naustdal (y)
1438 Bremanger (y)
1439 Vågsøy (y)
1441 Selje (y)
1443 Eid (y)
1445 Gloppen (y)
1448 Stryn (i)

15 Møre og Romsdal county
1501 Ålesund (y)
1502 Molde (y)
1503 Kristiansund (y)
1511 Vanylven (y)
1514 Sande (y)
1515 Herøy (y)
1516 Ulstein (y)
1517 Hareid (y)
1519 Volda (y)
1520 Ørsta (i)
1524 Norddal (i)
1525 Stranda (i)
1527 Ørskog (y)
1528 Sykkylven (y)
1532 Giske (y)
1534 Haram (y)
1535 Vestnes (y)
1539 Rauma (i)
1543 Nesset (i)
1545 Midsund (y)
1546 Sandøy (y)
1547 Aukra (y)
1548 Fræna (y)
1551 Eide (y)
1554 Averøy (y)
1556 Frei (y)
1557 Gjemnes (y)
1560 Tingvoll (y)
1563 Sunndal (i)
1566 Surnadal (i)
1567 Rindal (i)
1569 Aure (y)
1571 Halsa (y)
1572 Tustna (y)
1573 Smøla (y)

16 Sør-Trøndelag county
1601 Trondheim (i)
1612 Hemne (y)
1613 Snillfjord (y)
1617 Hitra (y)
1620 Frøya (y)
1621 Ørland (y)
1622 Agdenes (y)
1624 Rissa (y)
1627 Bjugn (y)
1630 Åfjord (y)
1632 Roan (y)
1633 Osen (y)
1634 Oppdal (i)
1635 Rennebu (i)
1636 Meldal (i)
1638 Orkdal (i)
1640 Røros (i)
1644 Ålen (i)
1645 Haltdalen (i)
1648 Midtre Gauldal (i)
1653 Melhus (i)
1657 Skaun (i)
1662 Klæbu (i)
1663 Malvik (i)
1664 Selbu (i)
1665 Tydal (i)

17 Nord-Trøndelag county
1702 Steinkjer (i)
1703 Namsos (y)
1711 Meråker (i)
1714 Stjørdal (i)
1717 Frosta (i)
1718 Leksvik (i)
1719 Levanger (i)
1721 Verdal (i)
1723 Mosvik (i)
1724 Verran (i)
1725 Namdalseid (i)
1729 Inderøy (i)
1736 Snåsa (i)
1738 Lierne (i)
1739 Røyrvik (i)
1740 Namsskogan (i)
1742 Grong (i)
1743 Høylandet (i)
1744 Overhalla (i)
1748 Fosnes (y)
1749 Flatanger (y)
1750 Vikna (y)
1751 Nærøy (y)
1755 Leka (y)

Fig. 98. Division of Southern Norway. Names and limits dated to 1969. Ø=Ö.

Fig. 99. Division of Fennoscandia. For abbreviations of counties, see p. 209. Ø=Ö.

Abbreviations of counties

Norvegia

AA	= Aust-Agder	O	= Oppland
AK	= Akershus (incl. Oslo)	R	= Rogaland
B	= Buskerud	SF	= Sogn og Fjordane
F	= Finnmark	ST	= Sør-Trøndelag
HE	= Hedmark	TE	= Telemark
HO	= Hordaland (incl. Bergen)	TR	= Troms
MR	= Møre og Romsdal	VA	= Vest-Agder
N	= Nordland	VE	= Vestfold
NT	= Nord-Trøndelag	Ø	= Østfold

The suffixes (small letters) mean:

i = indre (inner)	n = nordre (northern)	v = vestre (western)
y = ytre (outer)	s = søre (southern)	ø = østre (eastern)

Fennoscandia orientalis

Ab	= Regio aboënsis	Lk	= Lapponia kemensis
Al	= Alandia	Lm	= Lapponia murmanica
Ik	= Isthmus karelicus	Lp	= Lapponia ponojensis
Ka	= Karelia australis	Lps	= Lapponia petsamoënsis
Kb	= Karelia borealis	Lt	= Lapponia tulomensis
Kk	= Karelia keretina	Lv	= Lapponia Varsugae
Kl	= Karelia ladogensis	N	= Nylandia
Kol	= Karelia olenetsensis	Oa	= Ostrobottnia australis
Kon	= Karelia onegensis	Ob	= Ostrobottnia borealis
Kpoc	= Karelia pomorica occidentalis	Ok	= Ostrobottnia kajanensis
Kpor	= Karelia pomorica orientalis	Om	= Ostrobottnia media
Ks	= Kuusamo	Sa	= Savonia australis
Kton	= Karelia transonegensis	Sb	= Savonia borealis
Le	= Lapponia enontekiensis	St	= Satakunta
Li	= Lapponia inarensis	Ta	= Tavastia australis
Lim	= Lapponia Imandrae	Tb	= Tavastia borealis

Suecia

Bl.	= Blekinge	Jmt.	= Jämtland	T.Lpm.	= Torne Lappmark
Boh.	= Bohuslän	Lu.Lpm.	= Lule Lappmark	Upl.	= Uppland
Dlr.	= Dalarne	Ly.Lpm.	= Lycksele Lappmark	Vb.	= Västerbotten
Dlsl.	= Dalsland	Med.	= Medelpad	Vg.	= Västergötland
G.Sand.	= Gotska Sandön	Nb.	= Norrbotten	Vrm.	= Värmland
Gstr.	= Gästrikland	Nrk.	= Närke	Vstm.	= Västmanland
Gtl.	= Gotland	P.Lpm.	= Pite Lappmark	Ång.	= Ångermanland
Hall.	= Halland	Sdm.	= Södermanland	Ås.Lpm.	= Åsele Lappmark
Hls.	= Hälsingland	Sk.	= Skåne (Scania)	Ög.	= Östergötland
Hrj.	= Härjedalen	Sm.	= Småland	Öl.	= Öland

Lapland (Lpl.) is divided into five Lappmarks.

Dania

1 = Jylland 2 = the main islands 3 = Bornholm

REFERENCES

Acerbi, J. 1802. *Travels through Sweden, Finland and Lapland to the North Cape in the Years 1798 and 1799.* 2, 380 pp., Gillet, London.

Adlerz, G. 1893. I hvilken ordning tager djurvärlden en ur havet uppdykande ö i besittning. *Ent. Tidskr. 14*, 131–144.

Alfken, J. D. 1898. Zwei neue Färbungen von *Bombus pratorum* L. *Ent. Nachrichten 24*, 158.

Alfken, J. D. 1913. Die Bienenfauna von Bremen. *Abh. naturw. Ver. Bremen 22*, 1–220 (1914).

Alford, D. V. 1969. A study of the hibernation of bumblebees (Hymenoptera: Bombidae) in Southern England. *J. Anim. Ecol. 38*, 149–170.

Ander, K. 1953a. Insektliv i Dalsland, pp. 146–152 in *Natur i Dalsland.* Almqvist & Wiksell, Uppsala.

Ander, K. 1953b. Från insektlivet på Kinnekulle. pp. 56–65 in Bergquist, H.: *Kinnekulle. Berget som föddes ur havet.* 107 pp., Nordstedt & Söner, Stockholm.

Ander, K. 1963. Om humlor och snylthumlor. Notiser om gaddsteklar (Hym.) 3. *Opusc. ent. 28*, 189–195.

Ander, K. 1965. Über die Verbreitung der Hummeln in Schweden (Hym., Apidae). *Opusc. ent. 30*, 135–139.

Ander, K. 1967. Designation of lectotypes in *Bombus* and *Psithyrus* described by Swedish authors. *Opusc. ent. 32*, 184–187.

Aurivillius, C. 1887. Über die Blüte und die Befruchtung von Aconitum Lycoctonum L. *Bot. Cbl. 21*, 125–128.

Aurivillius, C. 1890. Grönlands Insektfauna. *Bih. K. svenska VetenskAkad. Handl. 15*, IV (1), 1–34.

Aurivillius, C. 1903. Steklar. Hymenoptera. 1. Gaddsteklar. Aculeata. *Svensk Insektfauna 13*, 1–90.

Ball, F.-J. 1914. Les Bourdons de la Belgique. *Annls. Soc. ent. Belg. 58*, 77–108.

Barendrecht, G. 1941. Hommels uit het Noorden. *Ent. Ber. 10*, 331–335.

Bengtsson, S. 1903. Studier och iakttagelser öfver humlor. *Ark. Zool. 1*, 197–222.

Bengtsson, S. 1904. Reseberättelse för en zoologisk resa till Umeå Lappmark 1903. *K. svenska VetenskAkad. Årsb.* pp. 117–131.

Bengtsson, S. 1907. Meddelande från sällskapet i Lund. *Ent. Tidskr. 28*, 92–108. (Sammanträdet den 10 december 1904, pp. 99–100.)

Bengtsson, S. 1908. Berättelse övfer en resa i entomologisk syfte till mellersta Sverige sommaren 1907. *K. svenska VetenskAkad. Årsb.* pp. 237–246.

Bengtsson, S. 1931. In Sjöstedt, Insektfaunan inom Abisko Nationalpark. II. 3. Humlor-Bombinae. *Svenska VetenskAkad. Skr. Naturskydd.* No. 17, 1–3.

Bergström, G., Kullenberg, B., Ställberg-Stenhagen, S. & Stenhagen, E. 1968. Studies on natural odoriferous compounds. II. Identification of a 2,3-dihydrofarnesol as the main component of the marking perfume of male bumble bees of the species *B. terrestris* L. *Ark. Kemi 28*, 453–468.

Bergwall, H.-E. 1970. Ekologiska iakttagelser över några humlearter (Bombus Latr.) vid Staloluokta inom Padjelanta nationalpark, Lule lappmark. *Ent. Tidskr. 91*, 3–23.

Boheman, C. H. 1844. Resa i Lappland. *Öfvers. K. VetenskAkad. Förh. I*, 95–105 (1845).

Boheman, C. H. 1857. Till Lapplands Entomologi. *Öfvers. K. VetenskAkad. Förh. 14*, 15–24 (1858).

Brinck, P. 1951. In Brinck, P. & Wingstrand, K. G.: The mountain fauna of the Virihaure area in Swedish Lapland. II. Special account. Hymenoptera Aculeata. *Acta Univ. lund N. F. avd. 2. 46* No. 2, 60–68.

Brinck, P. & Wingstrand, K. G. 1949. The mountain fauna of the Virihaure area in Swedish Lapland. *Acta Univ. lund. N. F. avd. 2, 45* No. 2, 1–69.

Curtis, J. 1835. Insects. Fam.- Apidae, pp. lxii–lxiv in Ross, J.: *Appendix to the Narrative of a Second Voyage in Search of a North-West Passage and of a Residence in the Arctic Regions during the Years 1829–1833.* 2. 120+cii+1 pp. Webster, London.

Dahlbom, G. 1832. *Bombi Scandinaviae. Monographice tractati et iconibus illustrati.* 55 pp. Berling, Londini Gothorum (Lund).

Dahlbom, G. 1837. *Kort underrättelse om scandinaviska insekters allmännare skada och nytta i hushållningen.* 370 pp. Berling, Lund.

Dalla Torre, K. W. 1880. Unsere Hummel-(Bombus) Arten. *Die Naturhistoriker 2*, 30 and 40–41.

Dalla Torre, K. W. 1882. Bemerkungen zur Gattung Bombus Latr. II. 3. Zur Synonymie und geographischen Verbreitung der Gattung Bombus Latr. *Ber. naturw.-med. Ver. Innsbruck 12*, 14–31.

Dalla Torre, K. W. 1896. *Catalogus Hymenopterorum.* 10. Apidae (Anthophila). 643 pp., Leipzig.

Dylewska, M. 1957. The distribution of the species of genus *Bombus* Latr. in Poland. *Acta Zool. cracov. 2*, 259–278.

Ekman, S. 1922. *Djurvärldens utbredningshistoria på scandinaviska halvön.* 615 pp., Bonnier, Stockholm.

Elfving, R. 1960. Die Hummeln und Schmarotzerhummeln Finnlands. *Fauna fenn. 10*, 1–43.

Elfving, R. 1965. Bombus semenoviellus Skor. (Hym., Apoidea) in Finnland gefunden. *Notul. ent. 45*, 101–104.

Elfving, R. 1968. Die Bienen Finnlands. *Fauna fenn. 21*, 1–69.

Enwald, R. 1881. Bombus hyperboreus Schönh., en för Finlands fauna ny humla. *Meddn. Soc. Fauna Flora fenn. 6*, 255.

Erichson, W. F. 1851. (Hymenoptera, Diptera, Nevroptera, nov. species) in Ménétriés, E.: Insecten, pp. 60–69, in Middendorf, A. Th. (ed.): *Reise in den äussersten Norden und Osten Sibiriens während der Jahre 1843 und 1844 auf Veranstaltung der Kais. Akademie der Wissensch. zu St. Petersburg . . .* 2. Zoologie. 516 pp. St. Petersb. (not seen).

Erlandsson, S. 1948. Bombus solstitialis Panzer (Hym.) en bortglömd art i vår fauna. *Ent. Tidskr. 69*, 106–112.

Erlandsson, S. 1950. Bombus soroeensis Fabr. (Hym.)

en mindre känd art i vår fauna. *Ent. Tidskr. 71*, 20–26.

Erlandsson, S. 1951. Drag ur våra humlors och bins utbredning. *Fältbiologen 5*, 36–39.

Erlandsson, S. 1953. Bombus agrorum F. ssp. gotlandicus n. ssp. (Hym.). *Ent. Tidskr. 74*, 76–80.

Erlandsson, S. 1960. Notes on Hymenoptera. I. Investigations of the bee-fauna in south-eastern Sweden. *Ent. Tidskr. 81*, 123–130.

Esmark, L. 1930. Zoologiske bemærkninger paa en reise i Norge (1832). *Norsk ent. Tidsskr. 2*, 318–329.

Fabricius, J. C. 1775. *Systema Entomologiae*. 832 pp., Flensbyrgi et Lipsiae (Flensburg).

Fabricius, J. C. 1776. *Genera insectorum*. 310 pp., Chilonii (Kiel).

Fabricius, J. C. 1787. *Mantissa insectorum*. 1. xx+348 pp., Hafniae (K. havn).

Fabricius, J. C. 1793. *Entomologia Systematica*. 2. i–viii+519 pp., Hafniae (K. havn).

Fabricius, J. C. 1798. *Entomologiae Systematicae. Suppl.* 572 pp., Hafniae (K. havn).

Faester, K. 1959. In Dänemark getroffene Arten von Bombus und Psithyrus (Hym., Apidae). *Ent. Meddr. 29*, 152–153.

Forsius, R. 1925. Über Bombus smithianus White in Finland. *Meddn. Soc. Fauna Flora fenn. 49*, (1922–1923), 9–11.

Forsslund, K.-H. 1929. En tur til Våmhusfjällen. *Sveriges Natur 20*, 94–100.

Forsslund, K.-H. 1951. Insektfynd på fjället Härjehågna. *Norsk ent. Tidsskr. 8*, 196–202.

Fourcroy, A. F. 1785. *Entomologia Parisiensis, sive catalogus Insectorum quae in agro Parisiensis reperiuntur* . . . (new species added by Geoffroy). 544 pp., Paris (not seen).

Free, J. B. & Butler, C. G. 1959. *Bumblebees*. 208 pp. Collins, London.

Fridén, F. 1967. Fortsatta undersökningar rörande insektpollination. *Meddn. Sver. Fröodlförb.* No. 8, 65–109.

Fridén, F., Eskilsson, L. & Bingefors, S. 1962. Bumblebees and red clover pollination in Central Sweden. I. Int. symposium on pollination, 1960. *Meddn. Sver. Fröodlareförb.* No. 7, 17–26.

Fries, M. 1949. Den nordiska utbredningen av Lactuca alpina, Aconitum septentrionale, Ranunculus platanifolius och Polygonatum verticillatum. *Acta Phytogeographica Suecica. 24*, 1–80.

Friese, H. 1902. Die arktischen Hymenopteren, mit Ausschluss der Tenthrediniden. *Fauna arct. 2*, 439–498.

Friese, H. 1903. Neue Bombus-Arten aus der neotropischen Region (Hym.). *Z. syst. Hymenopt. Dipterol. 3*, 253–255.

Friese, H. 1904. Über die Hummelleben im arktischen Gebiete. (Hym.). *Allg. Z. Ent. 9*, 409–414.

Friese, H. 1905. Neue oder wenig bekannte Hummeln des russischen Reiches (Hymenoptera). *Esheg.-zool. Mus. 9* (1904), 507–523.

Friese, H. 1908. Über die Bienen der russischen Polarexp. 1900–1903 und einiger anderen arktischen Ausbeuten. *Mem. Acad. Sci. St. Petersb. (Sci, math., phys., nat.) 18*, 1–17.

Friese, H. 1909. Neue Varietäten von Bombus (Hym.). *Dt. ent. Z.* pp. 673–676.

Friese, H. 1911. Neue Varietäten von Bombus (Hym.) II–III, 456–457, 571–572. Zur Synonymie der Bombus-Arten p. 684. *Dt. ent. Z.*

Friese, H. 1923. Hymenoptera. Apidae, pp. 3–9 in *Norwegian Expedition to Novaya Zemlya 1921. Report of the Scientific Results*. 1, No. 14. Publ. by Videnskapsselskapet i Kristiania (Oslo).

Friese, H. 1935. Apiden aus Nordost-Grönland. *Skr. Svalbard Ishavet* No. 65, 1–10.

Friese, H. & Wagner, F. 1909. Zoologische Studien an Hummeln. I. Die Hummeln der deutschen Fauna. *Zool. Jb. Abt. Syst., Ök, Geogr. 29*, 1–104 (1910).

Friese, H. & Wagner, F. 1912. Zoologische Studien an Hummeln. II. Die Hummeln der Arktis, des Hochgebirges und der Steppe. *Zool. Jb. suppl. 15, 1*, 155–210.

Frison, T. H. 1927. A contribution to our knowledge of the relationship of the Bremidae of America north of Mexico (Hymenoptera). *Trans. Am. ent. Soc. 53*, 51–78.

Fuglår, T. 1963. 'Nöd lærer naken kvinne å spinne' *Naturen 87*, 311.

Gaunitz, D. 1929. Gadd-och guldsteklar från Sorsele, Lycksele lappmark. *Ent. Tidskr. 50*, 196–202.

Gaunitz, D. 1931. Gaddstekelnotiser. *Ent. Tidskr. 52*, 221–227.

Gaunitz, D. 1938. Smärre meddelanden och notiser. Tre gynandromorfa bin. *Ent. Tidskr. 59*, 246–249.

Gerstaecker, A. 1869. Beiträge zur näheren Kenntnis einiger Bienen-Gattungen. *Stettin. ent. Ztg. 30*, 139–184, 315–367.

Grosvenor, M. B. 1963. *National Geographic Atlas of the World*. 300 pp. Wash. D.C.

Gurr, L. 1964. The distribution of bumblebees in the south island of New Zealand. *N. Z. Jl. Sci. 7*, 625–642.

Hammer, K. & Holm, Sv. N. 1970. Danske humblebier og snyltehumler. *Natur og Museum, 14* No. 2–3, 3–22.

Handlirsch, A. 1888. Die Hummelsammlung des K. k. naturhistorischen Hofmuseums. *Annln. naturh. Mus. Wien 3*, 209–250.

Harris, M. 1776. *An Exposition of English Insects*. 166 pp., London.

Hasselrot, T. B. 1960. Studies on Swedish bumblebees. (Genus *Bombus* Latr.). *Opusc. ent. suppl. 17*, 1–192.

Hasselrot, T. B. 1962. Humlor och bin i fröodlingen. Våra vanligaste humlor. *Hushålln. sällsk. Förb. Småskr.* No. 51, 8–11.

Hellén, W. 1933. Hymenoptera aculeata aus Finnmarken in Norwegen. *Notul. ent. 13*, 41–43.

Hobbs, G. A. 1964. Ecology of species of *Bombus* Latr. (Hymenoptera: Apidae) in Southern Alberta. I. Subgenus *Alpinobombus* Skor. *Can. Ent. 96*, 1465–1470.

Hobbs, G. A. 1967. Ecology of species of *Bombus* (Hymenoptera: Apidae) in Southern Alberta. VI. Subgenus *Pyrobombus*. *Can. Ent. 99*, 1271–1292.

Hoffer, E. 1883. Die Hummeln Steiermarks. II. *J. ber. steiermarkischen Landes-Oberrealschule in Graz. 32*, 1–98.

Horn, W. & Schenkling, S. 1928. *Index litteraturae entomologicae 3*, 705–1056. Berlin-Dahlem.

Hultén, E. 1950. *Atlas över växternas utbredning i Norden*. 512 pp. Gen-stabs lit. anst. Stockholm.

Illiger, J. C. W. 1806. William Kirbys Familien der bienenartigen Insecten mit Zusätzen, Nachweisungen u. Bemerkungen. *Magazin für Insektenkunde 5*, 28–175.

Jacobson, G. 1899. Compte rendu de l'expédition envoyée par l'academie imperiale des sciences à l'ile de Novaja Zemlia en été 1896. Apidae. *Zap. imp. Akd. Nauk. 8*, 189–190.

Jansson, A. 1922. Faunistiska och biologiska studier över insektlivet vid Hornsjön på norra Öland. *Ark. Zool. 22*. No. 23, 1–81.

Jansson, A. 1925. *Die Insekten-, Myriopoden- und Isopodenfauna der Gotska Sandön*. 182 pp. Örebro.

Jansson, A. 1935. Supplement till Die Insekten-, Myriopoden- und Isopodenfauna der Gotska Sandön. *Ent. Tidskr. 56*, 52–87.

Jansson, A. & Sjöberg, O. 1932. Bidrag till kännedomen om insektfaunan i Hamra Nationalpark. *K. svenska VetAkad. skr. i naturskyddsärenden* No. 20, 1–88.

Jurine, L. 1801. 'Erlangen List'. *Intelligenzblatt der Litteratur-Ztg. 1*, 160–165 (not seen).

Kirby, W. 1802. *Monographia Apum Angliae*. 2. 387 pp., Ipswich.

Kirby, W. 1821. *Land Invertebrate Animals. Supplement to the Appendix of Captain Parry's Voyage for the Discovery of a North-west Passage in the Years 1819–20*. 310 pp., London (Hymenoptera pp. ccxvi–xix) (1824).

Kirby, W. 1837. *Fauna boreali-Americana* . . . Part IV: Insects. Longman, London (not seen).

Knechtel, W. K. 1955. *Hymenoptera. Subfamilia Alpinae*. Fauna Republicii populare romîne, Insecta. 9. 111 pp., Bucuresti.

Krombein, K. W. & Burks, B. D. 1967. *Hymenoptera of America North of Mexico*. Synoptic catalog. 584 pp., USDA. Wash. D.C.

Krüger, E. 1917. Zur Systematik der mitteleuropäischen Hummeln (Hym.). *Ent. Mitt. 6*, 55–66.

Krüger, E. 1920. Beiträge zur Systematik und Morphologie der mittel-europäischen Hummeln. *Zool. Jb. Abt. Syst. 42*, 289–464.

Krüger, E. 1928. Über die Farbenvariationen der Hummelart Bombus agrorum Fabr. *Z. Morph. Ökol. Tiere. Abt. A. 11*, 361–464.

Krüger, E. 1931. Über die Farbenvariationen der Hummelart Bombus agrorum Fabr. II. *Z. Morph. Ökol. Tiere. Abt. A. 24*, 148–237 (1932).

Krüger, E. 1939. Die Hummeln und Schmarotzerhummeln von Sylt und dem benachbarten Festland. *Schr. naturw. Ver. Schlesw. Holst. 23*, 28–123.

Krüger, E. 1940. Über die Farbenvariationen der Hummelart Bombus variabilis. *Z. Morph. Ökol. Tiere. 37*, 276–386.

Krüger, E. 1950. Phänoanalytische Studien an einigen Arten der Untergattung Terrestribombus O. Vogt (Hymen. Bomb.). I. *Tijdschr. Ent. 93*, 142–197 (1951).

Krüger, E. 1954. Phaenoanalytische Studien an einigen Arten der Untergattung Terrestribombus O. Vogt (Hymenoptera, Bombidae). II. *Tijdschr. Ent. 97*, 263–298.

Krüger, E. 1956. Phaenoanalytische Studien an einigen Arten der Untergattung Terrestribombus O. Vogt (Hymenoptera, Bombidae). IIct. *Tijdschr. Ent. 99*, 75–105.

Krüger, E. 1958 . Phaenoanalytische Studien an einigen Arten der Untergattung Terrestribombus O. Vogt (Hymenoptera, Bombidae). *III. Tijdschr. Ent. 101*, 283–344.

Kruseman, G. 1947. Tabellen tot het bepalen van de Nederlandsche soorten der Genera *Bombus* Latr. en *Psithyrus* Lep. *Tijdschr. Ent. 88* (1945), 173–188.

Kruseman, G. 1950. Note sur quelques races de Bombus agrorum (F.) nec Gmel. *Ent. Ber. 13*, 43–47.

Kruseman, G. 1958a. Bombus agrorum (F.) in Sweden. *Opusc. ent. 23*, 76.

Kruseman, G. 1958b. Notes sur bourdons pyrénéens du genre Bombus dans les collections néerlandaises. *Beaufortia 6*, 161–170.

Kruseman, G. 1959. Enkele zoögeografische opmerkingen over de hommelfauna van Sweden (Hym., Apid.). *Ent. Ber. 19*, 49–51.

Kruseman, G. 1960. Over regionale convergentie bij Hommels (Hym., Bomb.). *Ent. Ber. 20*, 241–243.

Kruseman, G. 1964. Bombus muscorum et ses sous-espèces de la Manche (Hymenoptera). *Ent. Ber. 24*, 245–247.

Kruseman, G. 1969. Bombus magnus Vogt ook in België. *Ent. Ber. 29*, 164.

Kullenberg, B., Bergström, G. & Ställberg-Stenhagen, S. 1970. Volatile components of the cephalic marking secretion of male bumble bees. *Acta Chem. Scand.* 24, 1481–1483.

Körner, L. & Zarapkin, S. 1938. Über gerichtete Variabilität. VII. Die Färbungsvariation bei Bombus lapponicus Fabr.-Weibchen. *Morph. Ökol. Tiere. Abt. A.* 34, 739–753.

Lattin, G. 1967. *Grundriss der Zoogeographie*. 602 pp., Fischer, Stuttgart.

Latreille, P. A. 1802a. *Histoire naturelle des fourmis*. xvi+445 pp. Paris (April 1802).

Latreille, P. A. 1802b. *Histoire naturelle, générale et particulière des crustacés et des insectes*. 3. xii+468 pp., Paris.

Lepeletier, A. L. M. 1836. *Histoire naturelle des insectes. Suites à Buffon. Hyménoptères*. I. 547 pp., Paris.

Lie-Pettersen, O. J. 1901. Bidrag til kundskaben om

Vestlandets Bombus- & Psityrus-arter. *Bergens Mus. Årb. 1900* No. 3, 1–19.

Lie-Pettersen, O. J. 1902. Biologische Beobachtungen an norwegischen Hummeln. *Bergens Mus. Årb. 1901* No. 6, 1–10.

Lie-Pettersen, O. J. 1905. Entomologiske bidrag til skjærgaardsfaunaen i det vestlige Norge. *Bergens Mus. Årb. 1904* No. 11, 1–25.

Lie-Pettersen, O. J. 1907. Neue Beiträge zur Biologie der norwegischen Hummeln. *Bergens Mus. Årb. 1906* No. 9, 1–42.

Lindroth, C. H. 1949. Die fennoskandischen Carabidae. Eine tiergeographische Studie. 3. *Gbgs. K. Vet. Vitt. Samh. Handl. 6. F. serien B 4* (3), 1–911.

Lindroth, C. H. 1956. Movements and changes of area at the climatic limit of terrestrial animal species. pp. 226–230 in: *Zoological Papers in Honour of Bertil Hanström's Sixty-Fifth Birthday November 20th, 1956.* Berling, Lund.

Lindroth, C. H. 1962. Om istidsrefugier i Skandinavien. *Sveriges Natur Årsb. 1962*, 119–136.

Lindroth, C. H. 1969. The theory of glacial refugia in Scandinavia. Comments on present opinions. *Notul. ent. 59*, 178–192.

Linnaeus, C. 1758. *Systema Naturæ*. I. 10th ed. 824 pp., Holmiæ.

Linnaeus, C. 1761. *Fauna svecica*. 2nd ed. 578 pp., Stockholmiae.

Linnaeus, C. 1790. In Gmelin, J. F.: *Systema Naturae*. 13th ed. 1, 2225–3020, Lipsiae (Leipzig).

Løken, A. 1949. Bumble bees in relation to Aconitum septentrionale in Central Norway (Öyer). *Nytt Mag. Naturv. 87*, 1–60.

Løken, A. 1950. Bumble bees in relation to Aconitum septentrionale in Western Norway (Eidfjord). *Norsk ent. Tidsskr. 8*, 1–16 (1951).

Løken, A. 1954. Observations of bumble bee activity during the solar eclipse June 30, 1954. *Univ. Bergen Årb. 1954. Nat. rekke* No. 13, 1–6 (1955).

Løken, A. 1958a. Pollination studies in apple orchards of Western Norway. *Xth Int. Congr. Ent. 1956. 4*, 961–965.

Løken, A. 1958b. *Bombus sylvarum* v. *nigrescens* Pérez new to Norway *(Hymenoptera, Apidae)*. *Norsk ent. Tidsskr. 10*, 236–238.

Løken, A. 1960. Preliminary notes on Norwegian species of *Bombus* (Hymenoptera, Apidae). *Norsk ent. Tidsskr. 11*, 107–110.

Løken, A. 1961a. Observations on Norwegian bumble bee nests (Hymenoptera, Apidae, *Bombus*). *Norsk ent. Tidsskr. 11*, 255–268.

Løken, A. 1961b. Bombus consobrinus Dahlb., an oligolectic bumble bee (Hymenoptera, Apidae). *XIth Int. Congr. Ent. 1960. 1*, 598–603.

Løken, A. 1962. Occurrence and foraging behaviour of bumble-bees visiting Trifolium pratense L. in Norway. Proc. I. Int. Symposium on pollination. *Meddn. Sver. Fröodl. Förb.* No. 7, 52–59.

Løken, A. 1963. The neotype of Bombus alpinus (Linnaeus, 1758). *Opusc. ent. 28*, 187–188.

Løken, A. 1964. Bumble bees from Austria (Hymenoptera, Apidae). *Norsk ent. Tidsskr. 12*, 246–250.

Løken, A. 1966a. Notes on Fabrician species of Bombus Latr. and Psithyrus Lep., with designations of lectotypes (Hym., Apidae). *Ent. Meddr. 34*, 199–206.

Løken, A. 1966b. The neotype of *Bombus consobrinus* Dahlbom 1832. (Hym.). *Opusc. ent. 31*, 203–204.

Løken, A. 1966c. Ekskursjonsberetning. Insekter og arachnoider samlet under det 13. Nordiske Entomologmötets ekskursjon til Flåm (SFi: Aurland) 13–16. august 1965. *Norsk ent. Tidsskr. 13*, 371–386.

Lundblad, O. 1924. Några ord om aculeat- och tubuliferfaunan i Lycksele lappmark. *Ent. Tidskr. 45*, 17–28.

May, J. 1959. *Čmelaci v ČSR jejich bionomie, chow a hospodářský význam.* 170 pp., Praha.

Mayr, E. 1969. *Principles of Systematic Zoology.* 428 pp., McGraw-Hill, New York.

Meidell, O. 1934a. Bier og humler i Rogaland (Apidae, Hym.). *Stavanger Mus. Årsh. 43* (1932–33), 85–133.

Meidell, O. 1934b. Fra dagliglivet i et homlebol. *Naturen* 58, 85–95, 108–116.

Meidell, O. 1946. Notes on the pollination of Melampyrum pratense and the 'honeystealing' of humblebees and bees. *Bergens Mus. Årb. 1944*. Nat. rekke No. 11, 1–12.

Meidell, O. 1968. Bombus jonellus (Kirby) (Hym., Apidae) has two generations in a season. *Norsk ent. Tidsskr. 14*, 31–32.

Michener, C. D. 1944. Comparative external morphology, phylogeny, and a classification of the bees (Hymenoptera). *Bull. Am. Mus. Nat. Hist. 82*, 151–326.

Milliron, H. E. 1960. Recognition of bumblebee type specimens, with notes on some dubious names (Hymenoptera: Apidae). *Bull. Brooklyn ent. Soc. 55* 87–99.

Milliron, H. E. 1961. Revised classification of the bumblebees – a synopsis (Hymenoptera: Apidae). *J. Kans. ent. Soc. 34*, 49–61.

Milliron, H. E. & Oliver, D. R. 1966. Bumblebees from Northern Ellesmere Island, with observations on usurpation by *Megabombus hyperboreus* (Schönh). (Hymenoptera: Apidae). *Can. Ent. 98*, 207–2 3.

Morawitz, F. 1869. Die Bienen des Gouvernments von St. Petersburg. *Trudy russk. ént. Obshch 6*, 27–71.

Morawitz, F. 1873. Die Bienen Daghestans. *Trudy russk. ént. Obshch. 10*, 129–189.

Morawitz, F. 1880. Ein Beitrag zur Bienenfauna Mittel-Asiens. *Bull. Acad. Sci. St. Petersb. 26*, 337–389 (= *Melanges Biol. 10*, 443–518).

Morawitz, F. 1881. Die russischen Bombus-Arten in der Sammlung der Kaiserlichen Academie der Wissenschaften, St. Petersb. *Bull. Acad. Sci. St. Petersb. 27*, 213–265 (= *Melanges Biol. 11*, 69–144).

Morawitz, F. 1888. Hymenoptera aculeata nova. *Trudy russk. ént. Obshch. 22*, 224–302.

Morawitz, F. 1892. Hymenoptera aculeata rossica nova. *Trudy russk. ént. Obshch. 26*, 132–181.

Morice, F. D. & Durrant, J. H. 1915. The authorship and first publication of the 'Jurinean' genera of Hymenoptera, etc. *Trans. ent. Soc. Lond.* (1914), 339–436.

Mortimer, C. H. 1922. New British Bombus nigrescens (Pérez) from Sussex. *Entomologist's mon. Mag. 8*, 16–17.

Muchardt, H. 1904. Bidrag till humlornas och snylthumlornas utbredelse. *Ent. Tidskr. 15*, 204.

Müller, O. F. 1776. *Zoologiae Danicae prodromus seu animalium Daniae et Norwegiae indigenarum characteres, nomina, et synonyma imprimis popularium.* 282 pp., Hafniae (K. havn).

Nerén, C. H. 1892. Entomologiska sommarstudier. *Ent. Tidskr. 13*, 97–116.

Nylander, W. 1848. Adnotationes in expositionem monographicam Apum borealium. *Acta Soc. Sci. fenn. 2* (1847), 165–282 (Notiser 1, 1848).

Nylander, W. 1852. Revisio synoptica apum borealium, comparatis speciebus Europae mediae. *Acta. Soc. sci. fenn. 3* (1852), 225–286 (Notiser 2, 1852).

Panfilov, D. V. 1957. Bumblebees (Bombidae) in district of Moscow. (In Russian.) *Uchen. Zap. mosk. obl. pedagog. inst. 65*, 191–219.

Pallas, P. S. 1771. *Reise durch verschiedene Provinzen des Russischen Reiches in den Jahren 1768–1774.* Vol. 1. St. Petersburg (Leningrad).

Panzer, G. W. F. 1800–1809. *Fauna insectorum Germaniae Initia, 7* parts 73–84 (1800–1801), *8* parts 85–96 (1802 (?1801)–1805), *9* parts 97–109 (1806 (?1805)–1809). Felssecker, Nürnberg.

Pérez, J. 1879. Contribution à la faune des apiaires de France. *Act. Soc. Lin. Bordeaux 33*, 119–229.

Perkins, J. F. 1942. Hymenoptera. Aculeata captured in Southern Skåne, Sweden 1938. *Ann. Mag. nat. Hist. London series 11, 9*, 192–202.

Petersen, B. 1956. Hymenoptera. *Zool. Iceland 3* (49–50), 1–176.

Pittioni, B. 1938. Die Hummeln und Schmarotzerhummeln der Balkan-Halbinsel. *Mitt. K. naturw. Inst. Sofia 11*, 12–69.

Pittioni, B. 1939a. Die Hummeln und Schmarotzerhummeln der Balkan-Halbinsel. II. *Mitt. K. naturw. Inst. Sofia 12*, 49–115.

Pittioni, B. 1939b. Neue und wenig bekannte Hummeln der Paläarktis (Hymenopt., Apidae). *Konowia 17* (1938), 244–263.

Pittoni, B. 1942. Die boreoalpinen Hummeln und Schmarotzerhummeln (Hymen., Apidae, Bombinae). I. *Mitt. K. naturw. Inst. Sofia 15*, 155–218.

Pittoni, B. 1943. Die borealpinen Hummeln und Schmarotzerhummeln (Hymen., Apidae, Bombinae). II. *Mitt. K. naturw. Inst. Sofia 16*, 1–77.

Pittioni, B. & Schmidt, R. 1942. *Die Bienen des südöstlichen Niederdonau.* I. Niederdonau/Natur und Kultur. 69 pp., Kühne, Wien-Leipzig.

Popov, V. V. 1930. Note on Agrobombus smithianus White (Hymenoptera, Bombidae). *Russk. ent. Obozr. 24*, 95–99.

Quensel. 1802. In Acerbi cf. above.

Rapaics, R. 1908. Die Pflanzengeographie der Gattung Aconitum. *Növény. Közl. 7*, 21–28.

Radoszkowsky, O. 1859. Sur quelques Hyménoptères nouveaux ou peu connus de la collection du Musée de l'Académie des Sciences St. Petersbourg. *Buyll. mosk. Obshch. Ispyt. prir. 32*, 479–486.

Radoszkowski, O. 1877. Essai d'une nouvelle méthode pour faciliter la détermination des espèces appartenant au genre Bombus. *Buyll. mosk. Obshch. Ispyt. prir. 52*, 169–219.

Radoszkowski, O. 1884. Révision des armures copulatrices des males du genre Bombus. *Buyll. mosk. Obshch. Ispyt. prir. 59*, 51–92.

Reinig, W. F. 1936. Bombus cingulatus Wahlb. (Hym. Apid.). *Sber. Ges. naturf. Freunde Berl. Jahrg. 1936*, 130–138 (1937).

Reinig, W. F. 1937. *Die Holarktis.* 124 pp., Fischer, Jena.

Reinig, W. F. 1939. Die Evolutionsmechanismen, erläutert an den Hummeln. *Zool. Anz., suppl. 12*, 170–206.

Reinig, W. F. 1965. Die Verbreitungsgeschichte zweier für die Apenninen neuer boreoalpiner Hummelarten mit einem Versuch der Gliederung boreoalpiner Verbreitungsformen. *Zool. Jb. Syst. 92*, 103–142.

Reinig, W. F. 1966. Bombus lapponicus (Fabricius 1793), ein für den Olymp neues Eiszeitrelikt. *NachrBl. bayer. Ent. 15*, 81–85.

Reinig, W. F. 1967. Zur Kenntnis der Hummelfaunen einiger Gebirge West-Kleinasiens (Hym. Apidae). *NachrBl. bayer. Ent. 16*, 81–91.

Reinig, W. F. 1968. Über die Hummeln und Schmarotzerhummeln Nordwest-Anatoliens (Hym., Apidae). *NachrBl. bayer. Ent. 17*, 101–112.

Reinig, W. F. 1970. Bastardierungszonen und Mischpopulationen bei Hummeln (Bombus) und Schmarotzerhummlen (Psithyrus) (Hymenopt., Apidae). *Mitt. Münchner ent. Ges. 59*, 1–89.

Richards, O. W. 1927. The specific characters of the British humble-bees (Hymenoptera). *Trans. R. ent. Soc. Lond. 75*, 233–268.

Richards, O. W. 1931. Some notes on the humble-bees allied to Bombus alpinus, L. *Tromsö Mus. Årsh. 50* (1927), No. 6, 1–32.

Richards, O. W. 1933. Variation in Bombus jonellus Kirby (*Hymenoptera*, Bombidae). *Ann. Mag. nat. Hist. 12*, 59–66.

Richards, O. W. 1935. *Bombus muscorum* (Linnaeus) and *B. smithianus* White (Hym.). *Trans. Soc. Br. Ent. 2*, 73–85.

Richards, O. W. 1968. The subgeneric divisions of the genus *Bombus* Latreille (Hymenoptera: Apidae). *Bull. Br. Mus. nat. Hist. (Ent.) 22*, 211–276.

Ringdahl, O. 1915. Entomologiska dagboksanteckningar från Västra Jämtland. *Ent. Tidskr. 36*, 1–18.

Ringdahl, O. 1921. Bidrag till kännedomen om de

skånska stranddynernas insektfauna. *Ent. Tidskr. 42*, 21–40, 65–92.

Roth, C. D. E. 1897. Bidrag till en bild af Skånes insektfauna. *Ent. Tidskr. 18*, 127–138.

Sagemehl, M. 1882. Verzeichnis der in Est-, Liv- und Curland bisher gefundenen Bienen. *Arch. Naturk. Liv-, Ehst-, Kurlands, 2 Serie 8*, 451–468.

Sakagami, S. F. & Ishikawa, R. 1969. Note préliminaire sur la répartition géographique des bourdons japonais, avec descriptions et remarques sur quelques formes nouvelles ou peu connues. *J. Fac. Sci. Hokkaido Univ. series VI, Zoology 17*, 152–196.

Sandhouse, G. A. 1943. The type species of the genera and subgenera of bees. *Proc. U.S. natn. Mus. 92*, 519–619.

Schenck, A. 1873. Über einige streitige und zweifelhafte Bienen-Arten. *Dt. ent. Z. (= Berl. ent. Z.) 17*, 243–259.

Schenck, A. 1875. Aus der Bienen-Fauna Nassau's. *Dt. ent. Z. (= Berl. ent. Z.) 19*, 321–332.

Schmiedeknecht, O. 1878. Monographie der in Thüringen vorkommenden Arten der Hymenopteren-Gattung Bombus. *Jena Z. Naturw. 12*, 303–429.

Schmiedeknecht, O. 1883. *Apidae Europaeae.* I. 1071 pp., Gumperae et Berolini, Sachsen (Genus Bombus Latr. pp. 251–383) (1882–84).

Schmiedeknecht, O. 1930. *Die Hymenopteren Nord- und Mitteleuropas.* 1062 pp., Fischer, Jena.

Schneider, J. Sparre 1889. Entomologiske udflugter i Tromsö omegn. *Ent. Tidskr. 10*, 193–215.

Schneider, J. Sparre 1895a. En entomologisk udflugt til Bardodalen og Altevand i juli 1893. *Ent. Tidskr. 16*, 225–248.

Schneider, J. Sparre 1895b. Humlerne og deres forhold til flora'en i det arktiske Norge. *Tromsö Mus. Årsh. 17* (1894), 133–143.

Schneider, J. Sparre 1898. Insektlivet i Jotunheimen. *Tromsö Mus. Årsh. 19* (1896), 113–146.

Schneider, J. Sparre 1902. Coleoptera og Lepidoptera ved Bergen og i nærmeste omegn. *Bergens Mus. Årb. 1901* No. 1, 1–223.

Schneider, J. Sparre 1906. Sydherö. Et lidet bidrag til kundskaben om den arktiske skjærgaards malakologiske og entomologiske fauna. *Tromsö Mus. Årsh. 27* (1904), 170–205.

Schneider, J. Sparre 1909. Hymenoptera aculeata im arktischen Norwegen. *Tromsö Mus. Årsh. 29* (1906), 81–160.

Schneider, J. Sparre 1910. Hillesö. Et litet supplement. *Tromsö Mus. Årsh. 31–32* (1908–09), 123–142.

Schneider, J. Sparre 1918. Die Hummeln der Kristiania-Gegend. *Tromsö Mus. Årsh. 40* (1917), 1–45.

Scholz, J. R. 1924. Die Rassen des Bombus soroeensis Fbr. und einige andere Färbungserscheinungen bei Hummeln. *Neue Beitr. syst. Insektenk. 3*, 3–8.

Schrank, F. 1781. *Enumeratio Insectorum Austriae indigenorum.* 548 pp., Vindelicor (Augsburg).

Schönherr, C. H. 1809. Entomologiska anmärkningar och beskrifningar på några för svenska fauna nya insecter. *K. svenska VetenskAkad. Handl. 30*, 48–58.

Schøyen, W. M. 1881. Bemærkninger til H. Siebke's Enumeratio insectorum Norvegicorum, fasciculus V, pars 1 (Hymenoptera phytophaga & aculeata), ed. J. Sp. Schneider. *Forh. Videnskselsk. Krist. 1880* No. 10, 1–15.

Schøyen, W. M. 1887. Supplement til H. Siebke's Enumeratio Insectorum Norvegicorum, fasc. V, pars 1 (Hymenoptera phytophaga & aculeata). *Forh. Videnskselsk. Krist. 1887* No. 5, 3–11.

Scopoli, J. A. 1763. *Entomologia Carniolia.* 420 pp., Vindobonae (Wien).

Seidl, W. B. 1837. Die in Böhmen vorkommenden Hummelarten. pp. 65–73 in Weitenweber, W. R.: *Beiträge zur gesamten Natur- und Heilwissenschaft. 2.* Prag.

Settman, T. 1918. Om sammanslutning mellan idel arbetshumlor och om övervintrade humlehonors minne av sitt fjolårsbo. *Ent. Tidskr. 39*, 329–332.

Sherborn, C. D. 1902–1933. *Index animalium 1801–1850.* London.

Siebke, H. 1853. Beretning om en i sommeren 1850 foretagen entomologisk reise i en deel af Gudbrandsdalen. *Nytt Mag. Naturv. 7*, 253–306.

Siebke, H. 1863. Beretning om en i sommeren 1861 foretagen entomologisk reise. *Nytt Mag. Naturv. 12*, 105–192.

Siebke, H. 1866. Entomologisk reise i Romsdals amt i sommeren 1864. *Nytt Mag. Naturv. 14*, 375–388.

Siebke, H. 1870. *Om en i sommeren 1869 foretagen entomologisk reise gjennem Ringerike, Hallingdal og Valders.* 71 pp., Gundersen, Christiania (Oslo).

Siebke, H. 1873. Bidrag til Norges insektfauna. Beretning om en i Österdalen foretagen reise i 1870. *Nytt Mag. Naturv. 19*, 39–102.

Siebke, H. 1880. *Enumeratio Insectorum Norvegicorum. Catalogum hymenopterorum continentem.* Auctore defuncto H. Siebke, ed. Schneider, J. Sparre, 5 (1). 95 pp., Broegger, Christianiae (Oslo).

Skorikov, A. S. 1908. Formes nouvelles des bourdons (Hymenoptera, Bombidae). (In Russian.) *Russk. ent. Obozr. 7* (1907), 111–113.

Skorikov, A. S. 1910. Nouvelles formes des bourdons (Hymenoptera, Bombidae). (In Russian.) *Russk. ent. Obozr. 9* (1909), 409–413.

Skorikov, A. S. 1911. *Bombus pratorum* (L.) et ses formes (Hymenoptera, Bombidae). (In Russian.) *Russk. ent. Obozr. 11*, 380–382.

Skorikov, A. S. 1912. *Bombus lapponicus* (F.) et ses formes (♀♀ et ☿☿) (Hymenoptera, Bombidae). (In Russian.) *Russk. ent. Obozr. 12*, 95–102.

Skorikov, A. S. 1914a. Les formes nouvelles des bourdons (Hymenoptera, Bombidae). (In Russian.) *Russk. ent. Obozr. 14*, 119–129.

Skorikov, A. S. 1914b. *Hortobombus consobrinus* (Dahlb.) et ses variations (Hymenoptera, Bombidae). (In Russian.) *Russk. ent. Obozr. 14*, 283–286.

Skorikov, A. S. 1922a. Faunae Petropolitanae catalogus. (In Russian.) *Petrograd agron. Inst. ent. Sta. Fauna Petrograd 2* No. 11, 1–51 (not seen).

Skorikov, A. S. 1922b. Les bourdons de la fauna

paléarctique. (In Russian.) *Bull. Sta. rég. Prot. Plantes, Petrograd 4* No. 1, 1–160.
Skorikov, A. S. 1937. Die grönländischen Hummeln im Aspekte der Zirkumpolarfauna. *Ent. Meddr. 20*, 37–64.
Sladen, F. W. L. 1912. *The Humble-bee*. 283 pp., MacMillan, London.
Smith, F. 1854. *Catalogue of Hymenopterous Insects in the Collection of the British Museum*. II. Apidae. pp. 199–465. London.
Sommerfelt, S. Chr. 1824–1827. Physisk-oeconomisk beskrivelse over Saltdalen i Nordlandene. Insecter. *Kgl. N. Vid. Selsk. Skr. 2*, 1824–1827, 98–100.
Soot-Ryen, T. 1925. Entomologische Notizen I. Hymenoptera aculeata und tubulifera aus dem nördlichen Norwegen. *Tromsö Mus. Årsh. 47* (1924), 1–15.
Spinola, M. 1805. *Fauna liguriae fragmenta*. 21 pp., Genuae (not seen).
Stephens, J. F. 1846. Hymenoptera & Strepsiptera. pp. 1–18, 41–47 in: *Illustrations of British Entomology. Suppl.*, Bohn, London.
Stoeckert, F. K. 1933. Die Bienen Frankens (Hym., Apid.). *D. Ent. Z.* 1932, *Beiheft 78*, iii–viii+1–294.
Strand, A. 1943. Inndeling av Norge til bruk ved faunistiske oppgaver. *Norsk ent. Tidsskr. 6*, 208–224.
Strand, E. 1898a. Coleopterologische und hymenopterologische Untersuchungen in Hallingdal und Lyngör (Norwegen) 1897. *Ber. naturw. Ver. Regensburg 1896–1897* No. 6, 1–19.
Strand, E. 1898b. Enumeratio hymenopterorum norvegicorum. *Ent. Tidskr. 19*, 71–112.
Strand, E. 1901. Orthoptera og Hymenoptera samlede i 1900. *Arch. Math. Naturv. 23* No. 6, 1–7.
Strand, E. 1904. Hymenopterologisk bidrag til Norges fauna. *Forh. Videnskselsk. Krist. 1903* No. 8, 1–8.
Strand, E. 1910. Neue Beiträge zur Arthropoden-Fauna Norwegens. III. Hymenoptera Anthophila und Fossores. *Nytt Mag. Naturv. 48*, 332–343.
Thomson, C. G. 1870. Öfversigt af Sveriges humlor. *Opusc. ent. 2*, 251–261.
Thomson, C. G. 1872. *Hymenoptera Scandinaviae*. 2. 286 pp., Berling, Lundae (Lund).
Tjeder, B. 1954. Östskånska insekter. II. *Opusc. ent. 19*, 205–209.
Tkalcu, B. 1960. Zur Hummelfauna der Apenninen (Hymenoptera, Bombinae). *Mem. Museo civ. Stor. nat. Verona 8*, 23–68.
Tkalcu, B. 1966. Megabombus (Fervidobombus) abditus sp. n. aus Äquatorial-Afrika. *Cas. morav. Mus. 51*, 271–274.
Tkalcu, B. 1967. Sur deux espèces de bourdons décrites par William Nylander (Hymenoptera, Apoidea: Bombus). *Bull. soc. ent. Mulhouse 1967*, 41–58.
Tkalcu, B. 1968. Beiträge zur Kenntnis der Fauna Afghanistans. Bombinae, Apoidea, *Hym. Cas. morav. Mus. 53 (Supplementum)*. 189–210.
Tkalcu, B. 1969. Ergebnisse der Albanien-Expedition 1961 des deutschen entomologischen Institutes. 78. Beitrag. Hymenoptera: Apidae IV (Bombinae). *Beitr. Ent. 19*, 887–916.
Trautmann, G. & W. 1915. Bombus terrestris L. var. nov. flavoscutellaris. *Int. ent. Z. 9*, 96.
Vogt, O. 1909. Studien über das Artproblem. Über das Variieren der Hummeln. I. *Sber. Ges. naturf. Freunde Berl. 1909*, 28–84.
Vogt, O. 1911. Studien über das Artproblem. Über das Variieren der Hummeln. II. *Sber. Ges. naturf. Freunde Berl. 1911*, 31–74.
Vogt, O. 1947. Ethnos, ein neuer Begriff der Populations-taxionomie. *Naturwissenschaften 34*, 45–52.
Wahlberg, P. F. 1852. Lapska insekters nedstigande til Wermland. *Öfvers. K. VetenskAkad. Handl. 9*, 183–187 (1853).
Wahlberg, P. F. 1854. Iakttagelser och anmärkningar öfver de nordiska humlorna. *Öfvers. K. VetenskAkad. Handl. 11*, 199–211 (1855).
Wahlberg, P. F. 1855. Iakttagelser öfver de nordiska humlorna. *Förh. Skand. naturf. 6. möte Stockholm 1851. Bilagen C*, 230–233.
Wahlgren, E. 1908. Bidrag til kännedomen om öfre Klarälfdalens entomogeografi. *Ark. Zool. 4* No. 13, 1–32.
Wahlgren, E. 1915. Det ölandske alvarets djurvärld. I. *Ark. Zool. 9* No. 19, 1–135.
Wahlgren, E. 1917–1918. Det ölandska alvarets djurvärld. II. *Ark. Zool. 11* No. 1, 1–129.
Wexelsen, H. & Skåre, S. 1934. Rödklöverens blomstring og bestövning. *Tidsskr. norske Landbr. 41*, 63–89.
White, A. 1851. Note on the natural history of Shetland. *Proc. Linnean Soc. 2*, 157–158.
Yarrow, I. H. H. 1954. Some observations on the genus *Bombus*, with special reference to *Bombus cullumanus* (Kirby) (Hym. Apidae). *J. Soc. Br. Ent. 5*, 34–39.
Yarrow, I. H. H. 1959. The distribution of the British species of *Bombus* and *Psithyrus*, pp. 185–189 in Free, J. B. & Butler, C. G.: *Bumblebees*. 208 pp., Collins, London.
Yarrow, I. H. H. 1967. The aculeate Hymenoptera of the isles of Scilly. *Entomologist's Mon. Mag. 103*, 63–65.
Yarrow, I. H. H. 1968. Kirby's species of British bees: designation of holotypes and selection of lectotypes. Part 1. Introduction and the species of *Apis* Linnaeus now included in the genera *Bombus* Latreille and *Psithyrus* Lepeletier. *Proc. R. ent. Soc. Lond. (B) 37*, 9–15.
Yarrow, I. H. H. 1971. The author and date of certain subgeneric names in *Bombus* Latreille (Hymenoptera: Apidae). *J. Ent. (B) 40*, 27–29.
Zetterstedt, J. W. 1838. *Bombus*. Fabr. pp. 472–476 in Zetterstedt, J. W.: *Insecta Lapponica descripta*. 1139 pp., Voss, Lipsiae (Leipzig) (1838–1840).
Zimsen, E. 1964. *The Type Material of I. C. Fabricius*. 656 pp., Munksgaard, Copenhagen.

INDEX

Valid names in roman types. Synonyms, homonyms, infrasubspecific forms, etc., in italics. Only those pages referring to description or taxonomic status are indexed.

A free drawing by G. Langhelle, from Skorikov 1922b.

Instructions to Authors

Norsk Entomologisk Tidsskrift

publishes papers in English, occasionally in French, German, and Norwegian. When preparing manuscripts for submission, authors should consult current copies of the journal and follow its style as closely as possible.

MANUSCRIPTS

Manuscripts must be typewritten, double spaced throughout, on one side of the paper, with a wide margin. Authors should submit the original manuscript (preferably with two copies) to the editor, whose address is shown on page 2 of the cover.

Separate sheets should be used for the following: 1) title page, with the author's name and institution; 2) an abstract not exceeding 11 lines (770 letters and spaces) with the name and full postal address of the author underneath; 3) references; 4) Tables with their headings; 5) legends to Figures.

In the case of articles submitted in a language other than English, the abstract, Table headings and Figure legends must also be translated into English.

Brief *Acknowledgements* of grants and other assistance, if any, will be printed at the end of the text.

FIGURES AND TABLES

All illustrations are to be considered as Figures. Each graph, drawing or photograph should be numbered in sequence with arabic numerals, and should be identified on the back by the name of the journal, the author's name, and the Figure number. The top should be indicated. The Figures should be the original drawings. The columns of *Norsk Entomologisk Tidsskrift* are 67 mm broad, and the size of the original drawings should be in proportion. Lines must be thick enough to allow for reduction. Letters and numbers should not be less than 2 mm high in the printed illustration. Photographs should be submitted as unmounted glossy enlargements showing good details.

Tables are to be numbered consecutively with Roman numerals. Each Table should be typed on a separate sheet, with a descriptive heading that makes the Table self-explanatory.

All Figures and Tables should be referred to in the text by their number. Their approximate position should be indicated in the margin of the manuscript.

REFERENCES TO LITERATURE

In the text, Brown (1957), Brown & White (1961). If more than two authors, Brown et al. (1963). Multiple references: 'As several authors have reported (Brown 1957, Brown & White 1961, Green et al. 1963)', i. e. chronological order, no commas between names and year.

Lists of References are to be unnumbered and in alphabetical order. The international alphabetical order of Scandinavian and German vowels should be observed: Å = AA, Æ and Ä = AE, Ø and Ö = OE, Ü = UE. Indicate 1st, 2nd, 3rd, etc. works by the same author in the same year by a, b, c, etc. (White 1966a). No ditto marks should be used. Titles of journals should be abbreviated according to *World List of Scientific Periodicals.*

Examples:

Løken, A. 1964. Social wasps in Norway (Hymenoptera, Vespidae). *Norsk ent. Tidsskr. 12*, 191-218.

Schwarts, R. J. 1955. *The Complete Dictionary of Abbreviations.* 211 pp., T. Y. Cromwell Co., New York.

Whitman, L. 1951. The arthropod vectors of yellow fever. pp. 229-298 in Strode, K. (ed.) *Yellow Fever.* McGraw-Hill, New York and London.

PROOFS

Two copies of the first proof will be sent (page proof). One copy should be returned duly corrected with the least possible delay. All technical parts of the article, including references, names, figures (numbers, formulae), illustrations and so on, are the responsibility of the author. Authors will be required to pay for any major alterations they may make.

REPRINTS

Seventy-five reprints of each article will be supplied free. Additional reprints can be ordered at a charge.

A/S Nationaltrykkeriet & Forlagsbokbinderiet