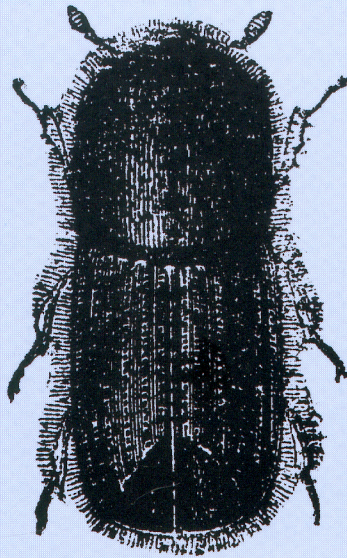


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# A centenary of The Norwegian Entomological Society

The Norwegian Entomological Society was founded one hundred years ago. In connection with the jubilee, a book on the history of entomology in Norway has been published. The present editorial gives a short review of some of the contents.

The establishment of the Society took place in May 1904 when ten enthusiastic entomologists met in Kristiania (later Oslo). The insect fauna of Norway was their common interest. The initiative came from Thomas G. Münster who was a geologist and director of mining. His great hobby was beetles, consuming all his spare time. Two of the founders were professional entomologists. Sig Thor was a specialist on mites, and Wilhelm M. Schøyen was the first so-called state entomologist of the country. He was responsible for research and information on pest insects in both agriculture and forestry. The other participants were Hans Warloe, Edvard Ellingsen, Ejnar Fischer, Axel C. Ullmann, Hans K. Hanssen, Fredrik V. Holmboe and Bjarne Lysholm.

The first accounts of insect from Norway were written by Erich Pontoppidan in 1753. He was bishop of Bergen, and his writing was a mixture of facts and fantasy. Hans Strøm, who was a priest at Sunnmøre, was more realistic in his accurate description of 393 species of insects in his articles from 1765 to 1788. The book «*Insecta Lapponica*» from 1840 by Swedish entomologist Johan W. Zetterstedt was another important contribution, and listed among others 463 species of Diptera from Norway.

Johan Heinrich Spalckawer Siebke is a great name in Norwegian entomology. He was the first curator of entomology at the Zoological museum in Kristiania. The results of his extensive collections were published in «*Enumeratio Insectorum Norvegicorum*» from 1874 to 1880, including more than 5000 species of insects. Unfortunately, Siebke died before all five volumes were published, but the last three ones were finished by his student H. J. Sparre Schneider.

The founding of The Norwegian Entomological Society was an important step for the investigation of Norwegian insect fauna. Throughout the years most of the members have had or have entomology as a hobby. They have contributed more information on insect biodiversity and distribution than the professional entomologists themselves.

The number of members of the Society increased slowly during the early years. In 1940 there were 50 members, the first hundred was passed in the 1960-ies, and at present the Society has more than 400 members. Compared to other Nordic entomological societies, this figure is not very impressive. One problem has been to maintain personal members.

The first issue of the Society's journal *Norsk entomologisk Tidsskrift* (later Norwegian Journal of Entomology) was published in 1921. Leif R. Natvig (1894-1975) was one of the first editors. He was also president of the Society for many years. As curator of the Zoological museum in Oslo he formed tight connections between the Society and the Museum. After Natvig retired in 1965, entomology had for some time lower priority, but in later years the meetings of the Society are again held at the Zoological Museum.

As pointed out in my editorial in *Norwegian Journal of Entomology* 50(1), the journal has had several publishers throughout the years, and the support from the authorities has varied. Presently, the journal is published by the Norwegian Entomological Society with support from the Norwegian Ministry of Environment.

In addition to the history of the Norwegian Entomological Society itself, the book has chapters on how entomology appeared and developed at the museums, universities and applied research institutions of the Norway. With the country's interest in fisheries, marine zoology was a field of priority. Insect collections, however, gradually increased in size. At the University of Oslo the oldest insect collections of the country are found at the Zoological Museum, and ecological



entomology has been taught at the Department of Biology. In Bergen the collections at the Zoological Museum were greatly increased when Astrid Løken became a curator in 1949. With the initiative of Hans Kauri, who was appointed professor in 1963, the University of Bergen became the most active centre of systematic and ecological entomology in Norway. Similarly, active entomological groups were formed at the universities of Trondheim (NTNU) and Tromsø, and at the Agricultural University of Norway at Ås.

From a single entomologist to take care of the entire field, institutes for applied entomology in agriculture and forestry have increased greatly in size from the 1960-ies. Household insects and bloodsucking species are dealt with at the National Health Institute. The importance of ecology and biodiversity are emphasized by research at the Norwegian Institute for Nature Research.

The 1970-ies to the 1990-ies were active years in the life of the Society. During this period the popular publication *Insekt-Nytt* appeared as a forum for membership information and articles of general interest. A number of local divisions of the Society were established throughout the country. The lar-

gest ones were in Trøndelag, Akershus, Drammen, Larvik and Sandnes. The meeting and excursions of the local divisions attracted large numbers of young entomologists. The special Norwegian Entomological Meetings were of greatest interests to student and professional entomologists, and international contacts were established through the Nordic Congresses of Entomology.

For reasons that are difficult to explain, the interest in local divisions and other meeting activities declined. Maybe the "media" directed life of our modern time does not have room for traditional activities of societies like ours. With the present low meeting activities, the Norwegian Journal of Entomology and *Insekt-Nytt* are the most important contacts between the Society and its members. Another problem is the continuous change of personal member. Presently, most of the activities of the Society are taken care of by entomologists connected to the Zoological Museum in Oslo. They also edit an Internet page with address [www.entomologi.no](http://www.entomologi.no). As a wish for the anniversary, the Society would like to have more and more stable members.

*Lauritz Somme*



Entomological excursion to Roverud, Kongsvinger 28 May 1912. From left: Thomas G. Münster, Tor Helliesen, Ejnar Fischer and Leif R. Natvig. *Photo: Fritz Jensen.*



# The distribution of horse flies (Diptera: Tabanidae) in North Norway

Robert Bergersen, Per Straumfors & Arne C. Nilssen

Bergersen, R., Straumfors, P. & Nilssen, A. C. 2004. The distribution of horse flies (Diptera: Tabanidae) in North Norway. *Norw. J. Entomol.* 51, 3-26.

Based on 2805 dry pinned specimens collected over the last 120 years, it was found that the Tabanidae in North Norway consisted of eighteen species within the genera *Chrysops* (3), *Hybomitra* (12), *Atylotus* (1), *Heptatoma* (1) and *Haematopota* (1). Of these, six species were regarded as being widespread and very common: *Chrysops nigripes*, *C. relictus*, *Hybomitra aterrima*, *H. kaurii*, *H. montana* and *Haematopota pluvialis*, while other species locally occurred in large numbers (e. g. *H. arpadi* in inner Finnmark). The records were plotted on maps, and the species' distribution was compared with reports from Europe, northern Russia and North America. Seven species were regarded as circumpolar: *Chrysops nigripes*, *Hybomitra polaris*, *H. sexfasciata*, *H. arpadi*, *H. nitidifrons*, *H. lurida* and *Atylotus sublunaticornis*. The North American *Hybomitra sexfasciata* and the European *H. kaurii* are suggested to be one variable species. In some species (*C. nigripes*, *H. kaurii*, *H. nigricornis*, *H. montana*), and in comparison with southern material, dark colours seemed common. In many species, morphological variation (either genetic or non-genetic) was found to be high. The main period of seasonal appearance was between 20 June and 15 August, with an overall peak in July. The paper reports the capture of males in CO<sub>2</sub>-baited traps.

Key-words: *Chrysops*, *Hybomitra*, *Atylotus*, *Heptatoma*, *Haematopota*, geographical distribution.

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## INTRODUCTION

The Norwegian horse fly fauna is only partly known, and published papers on this family from Norway are mainly those by Kauri (1951, 1958, 1964, 1968, 1976, 1996) and scattered notes (e. g. from North Norway: Davies 1954, Gaunitz 1972, Nilssen 1998, 2002, Straumfors 2002; South Norway: Davies et al. 1971, Andersen & Kauri 1977, Solem et al. 1990). Rognes (1980) also summarized the distribution of horse flies in Norway, but his article was not based on all the existing museum or private material, and was therefore incomplete. In the present paper, we examine available material from the three northernmost counties, Nordland, Troms and Finnmark (between 65°N and 71°N, Figure 1).

Since 1980, thousands of tabanids (of which 2200

are pinned) have been collected in North Norway. The second author (PS) has collected horse flies in the south part of Nordland since 1978, while ACN has caught tabanids in connection with field trappings of reindeer oestrids (Oestridae) since 1983. Through his work on an insect database project at Tromsø University Museum, RB has become familiar with the group. We are thus, as a team, able to present a survey of the tabanid fauna of North Norway.

## MATERIAL & METHODS

The material consists of 2805 dry pinned specimens from the natural history museums in Tromsø, Mo i Rana (Rana Museum), Bergen and Oslo, and from a few private collections (Table 1). Possible material stored at museums in other



**Table 1.** Specimens of North Norwegian pinned horse flies: present deposition.

Tromsø Univ. Museum	1624
Per Straumfors	468
Rana Museum	209
Tore Nielsen	155
Knut Rognes	144
Zool. Museum, Oslo	109
Zool. Museum, Bergen	86
Kai Berggren	10
<b>SUM</b>	<b>2805</b>

countries was not found (our requests indicated that there were no such specimens, but there may be some in private collections). Also, we have seen only a part of the material collected in 1978 by Rognes (1980). A collection of Tabanidae by L. R. Natvig from 1910 to 1920 is deposited in Zoological Museum in Oslo, but has never been revised.

Most of the specimens (87.7%) at Tromsø Museum were collected after 1982. The collection methods included trapping with CO<sub>2</sub> (Anderson & Nilssen 1996, 1998, Anderson et al. 2001) and 1-octen-3-ol (Nilssen 1998), and the catching of specimens attracted to humans. Only a few attracted to farm animals, but many attracted to cars, were caught. Several collectors have contributed to the material (Table 2), enabling us to cover most of North Norway. However, not all areas were well covered by sampling, and the islands in Vesterålen and Lofoten (NW Nordland) and in Finnmark, in particular, were poorly investigated. The areas sampled most frequently included those near Mo i Rana and Tromsø, Pasvik (SE Finnmark) and parts of Finnmarksvidda (Figure 1).

As the basic taxonomic literature we used, amongst others, Chvála et al. (1972). In a few cases, type material has been scrutinized. Antennae (n = 69) and frons (n = 76) of female specimens (incl. holo- and paratypes) that were either *Hybomitra kaurii* or *H. sexfasciata* were drawn using a camera lucida (38.75x), and four

**Table 2.** Main collectors of North Norwegian horse flies and their years of activity.

Arne C. Nilssen	1052	1975-2003
Per Straumfors	518	1978-2003
Robert Bergersen	166	1989-2000
Tron Soot-Ryen	161	1919-1948
Tore R. & I. Nielsen	155	1969-2002
Knut Rognes	144	1978
Reidar Mehl	63	1966
Karl Frafjord	49	1997
Kjell Arne Meyer	48	1989-2002
John R. Anderson	46	1984-1987
Paul Ardö	39	1947
Arild Fjeldså	26	1953-1989
Morten Halvorsen	25	2003
Bengt Christiansen	24	1959-1961
Kjetil Åsbakk	24	2002
Stig Lundmo	20	1972-1989
Arne Grønli	18	1926
Stefan Olberg	17	2000
Olav Myhre	13	1983-1993
Arne Fjellberg	13	1984-1989
J. Sparre Schneider	11	1885-1902

measurements were taken for analysis. Seasonal appearances were based on collection date, and are shown graphically for the 10 most abundant species. The distribution of each species was plotted on maps, and details of the most interesting finds and taxonomical remarks are given in the text. For the common species for which precise documentation is not presented in the list below, further details are available at Tromsø University Museum.

## LIST OF SPECIES

### *Chrysops sepulcralis* (Fabricius, 1794)

#### *Chrysops maurus* Siebke, 1863

**TRI** Målselv: Takelvdalen (EIS 154) 22 May 1916 1 F leg. L. R. Natvig; **NSY** Brønnøy: Hommelstø (EIS 114) 28 June 1946 1 F leg. T. Soot-Ryen (Map 1).

European species known to occur in Norway (Olsufjev 1977, Chvála 1988). Recorded in S

Norway (Siebke, 1863), Jämtland, Sweden (Ringdahl 1915, 1939), N Sweden (Kauri 1964) and in N Finland (Karvonen 1969). Also recorded in NW Russia (Olsufjev 1977), although not mentioned in Olsufjev & Poljakov (1985). Apparently a rare species everywhere.

### ***Chrysops nigripes* Zetterstedt, 1838**

Northern holarctic species (Teskey 1990) that is somewhat commoner in outer Troms and Finnmark than *C. relictus* (Map 2). The female type specimen is from FV Alta: Bossekop (EIS 173) 8 August 1821 (Zetterstedt 1838: 519).

### ***Chrysops relictus* Meigen, 1820**

Very common (Map 3). Former North Norwegian records of *C. rufipes* Meigen, 1820 and *C. viduatus* (Fabricius, 1794) (= *C. pictus* Meigen, 1820) (misidentifications) should all refer to *C. relictus*.

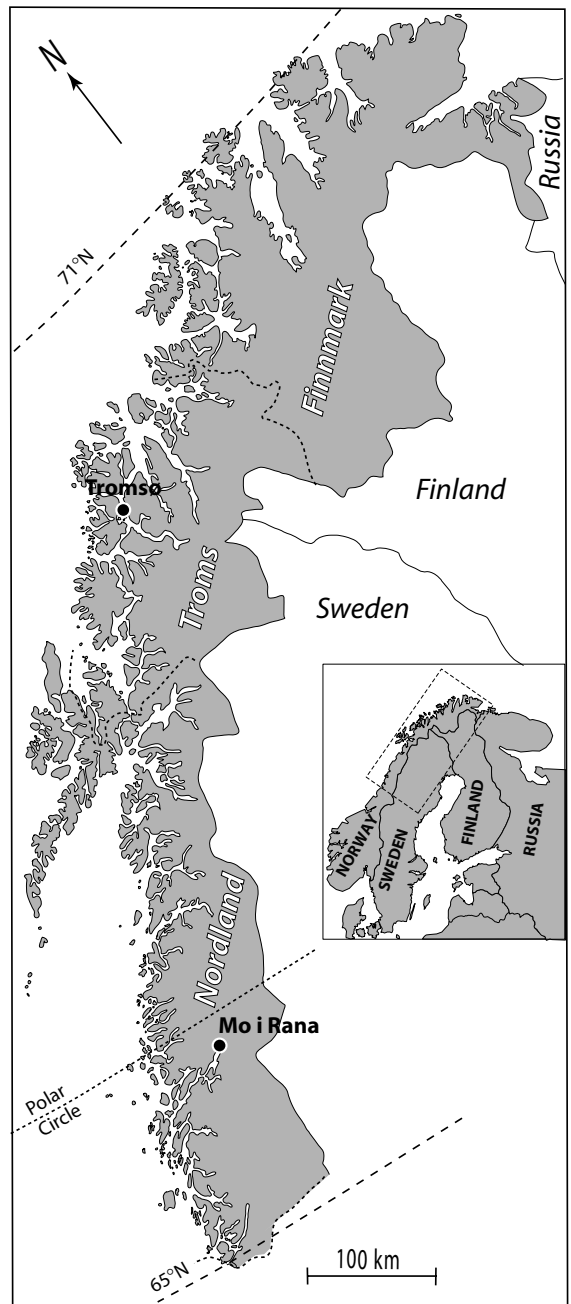
### ***Hybomitra tarandina* (Linnaeus, 1758)**

NSI Grane: Fallmoen (EIS 115) 30 June 1982 2 FF leg. P. Straumfors, Brenna (EIS 115) 11 & 13 June 2002 2 FF leg. P. Straumfors; NSY Bindal: Selfjord (EIS 110) 7 July 1985 1 F leg. W. Hjelmseth (Map 1). Previously reported from S Norway by Davies et al. (1971), Rognes (1980) and Solem et al. (1990).

### ***Hybomitra aterrima* (Meigen, 1820 p. 33)**

#### *Hybomitra auripila* (Meigen, 1820 p. 41)

Very common, constituting about 60% of the collected *Hybomitra* specimens, but not found in SE Finnmark (Map 4). The material belongs to *auripila*, which is now (Mally 1983, 1989, Schacht 1994, 1997) considered as a northern variant of *H. aterrima*. They are, however, two separate species in Chvála (1988) and Chvála & Jezek (1997). In Finland (Silfverberg 1980, Winqvist 2004) the species name *auripila* is retained. Andersson (1975) showed that only *H. auripila* had been found in Scandinavia, but did not discuss whether the two are conspecific. If they are, the name *aterrima* should be used, because of priority rules (considering Schacht (1994) as the first revisor) and since this name has long been used in Scandinavia (Wahlgren



**Figure 1.** Map of the study area: North Norway, with its counties Nordland, Troms and Finnmark.



1907, Ringdahl 1915, 1939, Kauri 1954, 1964, Davies et al. 1971). The lack of material from SE Finnmark seems to agree with Karvonen (1969) who found this species to be surprisingly rare in N Finland. Not known to occur in N Russia (Olsufjev & Poljakov 1985), but common in N Sweden (Kauri 1964). Synonymy between *aterrima* and *auripila* was suggested already by Löw (1858, p. 581).

### ***Hybomitra polaris* (Frey, 1915)**

?*Hybomitra astuta* (Osten-Sachen, 1876)

**FV** Alta: Isnestofthen (EIS 173) 14 August 1997 1 F leg. R. Bergersen (13-14 °C, near horse); **FN** Porsanger: Festningstuen (EIS 174) 30 July 1924 1 F leg. T. Soot-Ryen; **FI** Kautokeino: Suolovuopmi (EIS 165) 16 July 1993 1 F, 12-22 July 1989 3 FF & 20 July 1988 1 F leg. A. C. Nilssen, Suolovuopmi 10 August 1987 1 F leg. J. R. Anderson, Suolovuopmi 19-29 July 1985 11 MM & 4 FF leg. J. R. Anderson & A. C. Nilssen (males det. W. Schacht); **TRY** Karlsøy: Vannøya (EIS 171) 3 July 1925 1 M leg. T. Soot-Ryen. Not found in Nordland (Map 1).

Kauri (1976) considered *Hybomitra polaris* and the American *H. astuta* as separate species, and they are presented as such in Moucha (1976), whereas they are synonymous in Olsufjev (1977), Chvála (1988) and on the internet (Barkalov & Boldarueva 2004). Teskey (1990) and Burger (1995) present a Nearctic *astuta* and a Holarctic *polaris* as both occurring in North America.

### ***Hybomitra borealis* (Fabricius, 1781)**

*Hybomitra lapponica* (Wahlberg, 1848)

**TRY** Tromsø: Tønsvika (EIS 162) 1 July 2003 3 FF leg. A. C. Nilssen, Tønsvika 2 FF 15 July 1987 leg. R. Johannessen; **TRI** Nordreisa: Kvænangsfjellet (EIS 172) 1 F leg. A. C. Nilssen; **TRI** Balsfjord: Lanes (EIS 154) July 1961 1 F leg. B. Christiansen, Fjellfrøskvatn (EIS 154) 23-25 July 1926 2 FF leg. T. Soot-Ryen; **TRI** Målselv: Øverbygd (EIS 154) 26 July 1926 4 FF leg. T. Soot-Ryen; **NNV** Lødingen: Nordmannsdalen (EIS 138) 22 June 1987 1 F leg. P. Straumfors; **NNØ** Ballangen: Djupås (EIS 139) 11 July 1985 2 MF leg. P. Straumfors & H. Zahl-Hansen; **NSI**

Rana: Straumen (EIS 122) 1985-2002 12 FF leg. P. Straumfors, Plurdalen (EIS 123) 14 July 1997 2 FF leg. K. Frafjord, Svartvasshei (EIS 123) 1985-1993 3 FF leg. O. Myhre, Storsteinlia, Selfors & Selforslia (EIS 123) 1984-1991 4 FF leg. P. Straumfors, Stokkvik (EIS 123) 17 July 1948 2 FF leg. T. Soot-Ryen, Svartisdalen (EIS 123) 14 July 1948 1 F leg. T. Soot-Ryen; **NSI** Grane: Brenna (EIS 115) 11 June 2002 3 FF leg. P. Straumfors, Majavatn (EIS 111) 22 July 1946 2 FF leg. T. Soot-Ryen. Not found in Finnmark (Map 5).

Following Chvála & Lyneborg (1970) this species changed name from *lapponica* to *borealis* F., while *borealis* auct. (nec F.) was named *kaurii*. This was widely accepted by Chvála et al. (1972). Kauri (1958) synonymized *H. lapponica* (= *borealis* F.) with the North American *H. typhus* auct. (= *pechumani* Teskey & Thomas, 1979), a view that was rejected by Teskey & Thomas (1979). According to Leclercq (1985), *H. lapponica* (= *borealis* F.) is Holarctic, but it is not included in Teskey (1990) and Burger (1995).

### ***Hybomitra kaurii* Chvála & Lyneborg, 1970**

*Hybomitra borealis* auct. nec (Fabricius, 1781)

?*Hybomitra sexfasciata* (Hine, 1923)

Common species in both inland and coastal areas (Map 6). The records of the North American *H. sexfasciata* are somewhat arbitrary (see section below). The following list only comprises specimens tentatively identified as *H. sexfasciata* nec *kaurii*: **FN** Berlevåg: Goatto (EIS 189) (69°50'N, the northernmost tabanid of the world?) 11 July 1985 1 F leg. A. Fjellberg; **FØ** Sør-Varanger: Dagvatnet (EIS 160) 2 August 1996 1 F leg. J. Skartveit, Nyrud (EIS 160) 14 July 1966 2 FF leg. R. Mehl, Kjelmøy (EIS 178) 30 June 1937 1 F leg. T. Soot-Ryen, Kirkenes (EIS 169) 18 July 1891 4 FF leg. A. Wessel; **FV** Alta: Cævdne (EIS 173) 18 July 1924 1 F leg. T. Soot-Ryen, Jotkajavre (EIS 165) 19 & 21 July 1924 2 FF leg. T. Soot-Ryen; **FI** Kautokeino: Suolovuopmi (EIS 165) 10 July 1986 1 F leg. A. C. Nilssen; **TRI** Balsfjord: Skjåvikør (EIS 154)

26 July 1941 2 FF leg. T. Soot-Ryen; **NSI** Rana: Vatnadalen (EIS 119) 17 July 2003 1 F leg. P. Straumfors, Straumen (EIS 122) 15 July 2003 1 F leg. P. Straumfors. In addition, specimens were reported in Kauri (1951) (as *borealis* n. ssp. *anderi*), Gaunitz (1972) and Rognes (1980) (Map 6).

### ***Hybomitra arpadi* (Szilády, 1923)**

*Tabanus gracilipalpis* Hine, 1923

**FØ** Sør-Varanger: Svanhovd (EIS 169) 21 June 2002 1 F leg. T. Nielsen, Munkelv & Neiden (EIS 168) 17 July 1997 3 FF leg. R. Bergersen, Kirkenes (EIS 169) 6 July 1983 1 F leg. Thv., K. & T. R. Nielsen, Kirkenes 20 July 1894 1 F leg. A. Wessel, Lyngbukta, Gjøkvann, Skogly, Fiskevann & Grenseneset (EIS 160) 12–19 July 1969 11 FF leg. I. & T. Nielsen, Nyrud (EIS 160) 13 July 1966 2 FF leg. R. Mehl; **FI** Kautokeino: Suolovuopmi (EIS 165) 1985–1993 73 FF leg. A. C. Nilssen; **FN** Tana: 25 km N Utsjoki [= Sirbmá] (EIS 176) 13 July 1985 5 FF 2 MM leg. A. Fjellberg. Not found in Nordland and Troms (Map 7).

*H. arpadi* was first synonymized with *Tabanus gracilipalpis* by Philip (1960). Abundant in N Sweden (Kauri 1964, 1974, Gaunitz 1972), Russia (Olsufjev & Poljakov 1985) and in Canada (Smith et al. 1994, McElligott & Lewis 1998).

### ***Hybomitra nigricornis* (Zetterstedt, 1842)**

?*Tabanus alpinus* Zetterstedt, 1838

**FN** Båtsfjord: Båtsfjordfjellet (EIS 184) 12 July 2002 1 F leg. K. Berggren; **TRY** Tromsø: Prestvann (EIS 162) 26 July 1924 1 F leg. T. Soot-Ryen; **TRY** Karlsøy: Vannøya (EIS 171) 17 July 1925 1 F leg. T. Soot-Ryen; **NSY** Meløy: Ørnes (EIS 125) 30 July 1993 1 F leg. K. B. Strann; **NSY** Alstahaug: Tjøtta (EIS 117) 30 July 1946 1 F leg. T. Soot-Ryen; **NSY** Vevelstad: Forvik (EIS 114) 31 July 1946 1 F leg. T. Soot-Ryen. Zetterstedt's specimen of *alpinus* from «Raschstind insulae Schiervoe» (= **TRY**: Skjervøy) (27 July 1821 1 M) was not studied. There is also a record from **NSY** Meløy: Holandsfjorden (EIS 125) 4 August 1950 2 FF (Davies 1954). Apparently coastal (Map 8).

Except that face and cheeks are greyish (not yellowish) haired, the specimens agreed well with the description in Chvála et al. (1972). Differing mainly in the shape of frons and subcallus, they are similar to *H. montana* var. *flaviceps* (see below). However, not knowing how much the frons and subcallus can be distorted, e. g. in the drying process, we do not put *nigricornis* and *flaviceps* in subjective synonymy.

### ***Hybomitra lurida* (Fallén, 1817)**

**FØ** Sør-Varanger: Svanhovd (EIS 169) 21 June 2002 1 F leg. T. Nielsen, Nyrud (EIS 160) 13 July 1966 2 FF leg. R. Mehl; **FN** Porsanger: Stabbursnes (EIS 174) 15 July 1997 1 F leg. R. Bergersen; **FI** Kautokeino: Øvre Anarjåkka (EIS 151) 30 July 1975 2 FF leg. A. C. Nilssen; **TRI** Målselv: Nordmo (EIS 154) July 1902 1 F leg. J. S. Schneider; **TRY** Kvæfjord: Straumsbotn (EIS 144) 9 July 1998 1 F leg. A. C. Nilssen; **NNØ** Hamarøy: Brennvikvatnet (EIS 138) 13 June 1999 4 FF leg. A. C. Nilssen; **NSY** Bodø: Firampi (EIS 126) 8 July 1977 1 F leg. A. Fjeldså; **NSI** Saltdal: Saltdalen (EIS 127) n. d. 1 F leg. A. Hagemann; **NSI** Rana: Straumen (EIS 122) 8 June 2002, 5 July 1999 & 15 July 1993 3 FF leg. P. Straumfors, Plurdalen (EIS 123) 14 July 1997 1 F leg. K. Frafjord, Utskarpen (EIS 122) 9 June 1972 1 F leg. S. Lundmo; **NSI** Grane: Brenna (EIS 115) 11 June 2002 1 F leg. P. Straumfors. In addition, four specimens were reported by Rognes (1980), and two by Kauri (1964) from «Viekisa; Børslev» [= Børselv] (Map 9). The distribution is holarctic (Pechuman & Stone 1968, Teskey 1990, Burger 1995).

### ***Hybomitra nitidifrons* (Szilády, 1914)**

**FØ** Sør-Varanger: Vaggetem (EIS 160) 30 June 1977 1 F leg. I. & T. Nielsen, Fiskevann (EIS 160) 17 July 1969 3 FF leg. I. & T. Nielsen; Vaggatem, Ellenvann & Nyrud (EIS 160) 26 June 1 F, 29 June 2 FF & 13 July 1 F leg. R. Mehl; **FN** Tana: Levajok (EIS 176) 6 July 1977 2 FF leg. I. & T. Nielsen; **FV** Alta: Romsdal (EIS 173) 30 June 1924 2 FF leg. T. Soot-Ryen, Bossekop (EIS 173) n. d. 1 F leg. W. M. Schøyen; **FI** Karasjok: Karasjok (EIS 167) 7 July 1977 2 FF leg. I. & T. Nielsen; **FI** Kautokeino: Suolovuopmi (EIS 165)



12 July 1989 1 F leg. A. C. Nilssen; **TRI** Målselv: Frihetsli (EIS 148) 12 July 1922 1 F leg. T. Soot-Ryen, Lille Rostavatn (EIS 154) 5 July 1922 1 F leg. T. Soot-Ryen; **TRI** Balsfjord: Ingebretvatnet (EIS 154) 22 July 1942 1 F leg. T. Soot-Ryen; **NSI** Hemnes: Stormyra (EIS 118) 21 July 1992 1 F leg. P. Straumfors (not seen by RB; the specimen could not be found); **NSI** Grane: Majavatn (EIS 111) 22 July 1946 1 F leg. T. Soot-Ryen. In addition, nine females from Finnmark were reported by Rognes (1980) (Map 10).

All our specimens were identified as subspecies *confiformis* Chvála & Moucha, 1971 (Chvála & Moucha 1971). The N American ssp. *nuda* McDunnough, 1921 (Teskey 1990, p. 222) may deserve specific status (Philip & Lane 1984).

#### ***Hybomitra lundbecki* Lyneborg, 1959**

**FØ** Sør-Varanger: Svanhovd (EIS 169) 21 June 2002 2 FF leg. T. Nielsen, Skogfoss, Gjøkvann, Lyngbukta, Ødevann & Fiskevann (EIS 160) 11-23 July 1969 10 FF leg. I. & T. Nielsen, Brannvann & Ellenvann (EIS 160) 3 & 6 July 1966 3 FF leg. R. Mehl, Nyrud (EIS 160) 13 July 1966 8 FF leg. R. Mehl; **FI** Kautokeino: Øvre Anarjåkka (EIS 151) 30 July 1975 1 F leg. A. C. Nilssen; **NSI** Rana: Straumen (EIS 122) 4 July 2003 1 F leg. P. Straumfors, Straumen 8-29 June 2002 16 FF leg. P. Straumfors, Straumen 5 July 1999 2 FF leg. P. Straumfors, Straumen 7 July 1985 4 FF leg. P. Straumfors, Selfors (EIS 123) 11 June 2002 1 F leg. P. Straumfors, Plurdalen (EIS 123) 14 July 1997 5 FF leg. K. Frafjord, Utskarpen (EIS 122) 6 July 1980 1 F leg. S. Lundmo, Stokkvik (EIS 123) 17 July 1948 2 FF leg. T. Soot-Ryen; **NSI** Hemnes: Stormyrbassenget (EIS 118) 14 July 1997 1 F leg. K. A. Meyer; **NSI** Grane: Brenna & Svenningrud (EIS 115) 11 June 2002 6 FF leg. P. Straumfors. In addition, four females from Finnmark were reported by Rognes (1980). Not found in Troms and in outer coastal areas (Map 11).

#### ***Hybomitra montana* (Meigen, 1820)**

?*Hybomitra tropica* (Linnaeus, 1758)

*Tabanus flaviceps* Zetterstedt, 1842

Apart from *H. auripila*, *H. montana* is apparently the most common *Hybomitra* species (Map 12). The extensively darkened var. *flaviceps*, originally described from **NTI** Verdal 8 July 1840 (Rognes 1980), is distributed throughout the area of distribution of the nominate form (Chvála et al. 1972) but is considered to be rare, representing a melanistic variety without taxonomical value (Chvála et al. 1972). In North Norway the dark variety constitutes at least 50% of the *Hybomitra montana*. It was also very common in Jämtland, Sweden (Ringdahl 1915), Messaure, N Sweden (Kauri 1964), N Russia (Olsufjev & Poljakov 1985) and in Muonio, N Finland (Karvonen 1969).

About 18% of the specimens could be identified as *Hybomitra tropica* (L.), a species that we consider as a yellowish-haired morph of *H. montana*. According to Chvála et al. (1972), most recent authors record *tropica* as a subspecies of *montana*, whereas their sympatric distribution is an argument for conspecificity. In our material, the differences we could find in hair colour and antennal width appeared transitional. The following list comprises specimens tentatively identified as *H. tropica nec montana*: **TRY** Karlsøy: Måkeskjær (EIS 170) 22 July 1934 2 FF leg. T. Soot-Ryen; **TRY** Tromsø: Tromsø (EIS 162) 26 June 1909 1 F; **TRI** Balsfjord: Lanes (EIS 154) July 1961 1 F leg. B. Christiansen; **NNØ** Hamarøy: Tømmeråsen (EIS 138) 31 July 1996 1 F leg. A. C. Nilssen; **NNØ** Sørfold: Røsvik (EIS 131) 16 August 1923 1 F leg. T. Soot-Ryen; **NSY** Bodø: Falkflaug (EIS 126) 1953 1 F leg. A. Fjeldså; **NSI** Beiarn: Gjeterfjell (EIS 126) 23 July 1981 1 F leg. A. Fjeldså; **NSI** Rana: Straumen (EIS 122) 15 July 2003 1 F leg. P. Straumfors, Straumen 26 June - 10 July 2002 13 FF leg. P. Straumfors; **NSI** Hemnes: Holmholmen (EIS 118) 2 July 2002 1 F leg. K. A. Meyer; **NSI** Grane: Svenningrud (EIS 115) 11 June 2002 1 F leg. P. Straumfors. In addition, 23 other specimens were

identified as *H. tropica*. All 47 specimens had, however, brownish side markings on tergites 1-2 or 1-3 only (keys: *montana* 1-3 or 1-4; *tropica* 1-4 or 1-5), with black hairs. It is thus possible that our «cf. *tropica*» specimens are not *tropica* s. str., but an as yet unpublished yellowish-haired variety of *H. montana*.

For nomenclature and taxonomy see Lyneborg (1961), Olsufjev & Leclercq (1971), Chvála et al. (1972). If *tropica* and *montana* are conspecific, the name *montana* (Meigen, 1820) should be used (as in Leclercq & Olsufjev 1981). According to Leclercq (1985), *Hybomitra montana* is Holarctic, but it is not mentioned in Teskey (1990) and Burger (1995).

### ***Hybomitra bimaculata* (Macquart, 1826)**

*Tabanus tropicus* auct. nec Linnaeus, 1758

?*Hybomitra solstitialis* (Meigen, 1820)

NSY Bindal: Bøkestad (EIS 110) 26 & 28 July 1997 2 FF leg. R. Bergersen; NSY Brønnøy: Flatmo (EIS 114) 3 July 1946 1 F leg. T. Soot-Ryen (Map 13).

The specimens have narrow median stripe, more like that in *H. solstitialis*, which Leclercq & Olsufjev (1981) claimed was identical to *H. bimaculata* v. *collini* Lyneborg, 1959. *Hybomitra solstitialis* and *H. bimaculata* were regarded as colour variants of one same species in Schacht (1998, p. 165), but an official synonymization is not yet made. Solem et al. (1990) reported *H. bimaculata* from Høylandet, S Norway. Kauri (1954) reported *H. bimaculata* from N Sweden under the name *Tabanus tropicus* Panz.

### ***Atylotus sublunaticornis* (Zetterstedt, 1842)**

TRI Balsfjord: Fjellfrøskvatn (EIS 154) 30 July 1926 1 M leg. T. Soot-Ryen (Map 13). A few South Norwegian records exist. The species is common in Sweden north to Abisko (68-69°N) (Kauri 1968). Circumpolar distribution (Teskey 1990). Apparently autogenous, collected only on flowers (Mally 1989 p. 13, Chvála & Jezek 1997).

### ***Heptatoma pellucens* (Fabricius, 1776)**

NSI Rana: Yttraskardet (EIS 123) 21 June 1988 1 F leg. S. Lundmo, Selfors (EIS 123) July 1986 & July 1987 2 FF leg. P. Straumfors, Selforsfjell (EIS 123) 27 June 1985 2 FF leg. P. Straumfors (Map 13). Previously reported twice from S Norway (Kauri 1968, Solem et al. 1990).

### ***Haematopota pluvialis* (Linnaeus, 1758)**

The most common tabanid species (Map 14). More common than shown in the map since it is often excluded from sampling. Very common throughout Europe (Simon 1998).

## **VARIABILITY**

A high degree of morphological variation was observed in most species. Variation is thought to be the basis for selection (Mayr 1969). Below are four cases of variation which caused our attention.

### ***Hybomitra aterrima* var. *jacobi***

Although caught at Tverrråa in NTI Høylandet (Solem et al. 1990), 35 km south of the present study area, we include a short description of six silvery *Hybomitra* females caught in Malaise traps on 26 June & 1 July 1986: Eyes short greyish pubescent. Frons grey dusted, index 1:3.5, almost parallel sided. Lower callus brown, slightly wrinkled, touching the eye margins. Subcallus greyish dusted, dark brown in ground colour, slightly polished brown in middle. Face and cheeks grey, covered by long whitish and silvery hairs. Antenna brown, lighter brown at base of segment 3 which has a distinct dorsal tooth. Palpi brown, with darker brown and some silvery hairs. Thorax black, above with brown and silvery hairs, below with whitish longer hairs. Legs single coloured dark brown, fore legs brown haired, middle and hind legs silvery haired. Abdomen shining black, segment 2 slightly translucent brown at sides, all segments silvery haired. The specimens have very much in common with *Hybomitra aterrima* var. *auripila*; the big difference seems to be in colouration. Some of our var. *auripila* have the brown spots on tergite 2 (apparently not mentioned elsewhere in literature). Bouvier (1945, p. 425) named the





**Figure 2.** Wings of *Chrysops*: *C. relictus* with closed anal cells (upper left), open anal cells (upper right), open on one wing and closed on the other (lower left); *C. nigripes* with open versus closed anal cells (lower right). TSZD is the collection number series (TS = Tromsø University Museum, Z = Zoology, D = Diptera).

silvery *H. aterrima* from several localities in Switzerland var. *jacobi*, and we see no reason not to use that name.

### ***Chrysops relictus* and *C. nigripes***

In *Chrysops* there is interspecific variation in wing colouration and venation: according to the key in Chvála et al. (1972, p. 110), the anal cell is closed in the *relictus*-group, and open in the *rufipes*-group. In our material there was intraspecific variation: 32 of 84 *C. relictus* had closed anal cells, 46 had open anal cells, and 6 had closed cell on one wing and open on the other. Of 141 of our *C. nigripes*, 105 had closed anal cells, 28 had open anal cells, and 8 had closed cell on one wing and open on the other (Figure 2). In Nilssen (1998), *C. nigripes* was erroneously identified (by RB) as *C. relictus*.

### ***Hybomitra kaurii* and *H. sexfasciata***

*Hybomitra kaurii* was proposed by Chvála & Lyneborg (1970) as a new name for *borealis* sensu Meigen, 1820 and *borealis* sensu Löw, 1858, which are both different from *Hybomitra borealis* (Fabricius, 1781) (Chvála & Lyneborg 1970). Kauri (1951) described ssp. *anderi* as a northern subspecies of *borealis* sensu Meigen; later he (Kauri 1958) synonymized *anderi* with the North American *H. sexfasciata* (Hine, 1923), no longer considering *anderi* conspecific with *borealis* auct. (= *kaurii*). In the North Norwegian material, we found it very difficult to distinguish between *H. kaurii* and *H. sexfasciata*. The task was further complicated because *sexfasciata* is differently depicted in different works; it has an «*anderi*-like» antenna in Chvála et al. (1972, p. 201) and a «*kaurii*-like» antenna in Teskey (1990, p. 238).

In Chvála et al. (1972, p. 171), *Hybomitra sexfasciata* and *H. kaurii* are distinguished among other things by *sexfasciata* having slender antennae and a somewhat broader frons than *kaurii*. The measurements of the frons and antennae in our specimens (plus holo- and paratypes) are plotted in Figure 3. There is no obvious disruption in the distribution of these measurements, and most distributions are normal or nearly normal. Thus, the measurements did not indicate two different species.

Olsufjev (1977) depicts *sexfasciata* and *kaurii* as being rather similar, but separates them in the key by the colour of antennal segments 1-2. In our material, the colour of these segments varies from brown (as in *anderi* Kauri, 1951) via black on the outside to entirely black (as in *sexfasciata* Hine, 1923).

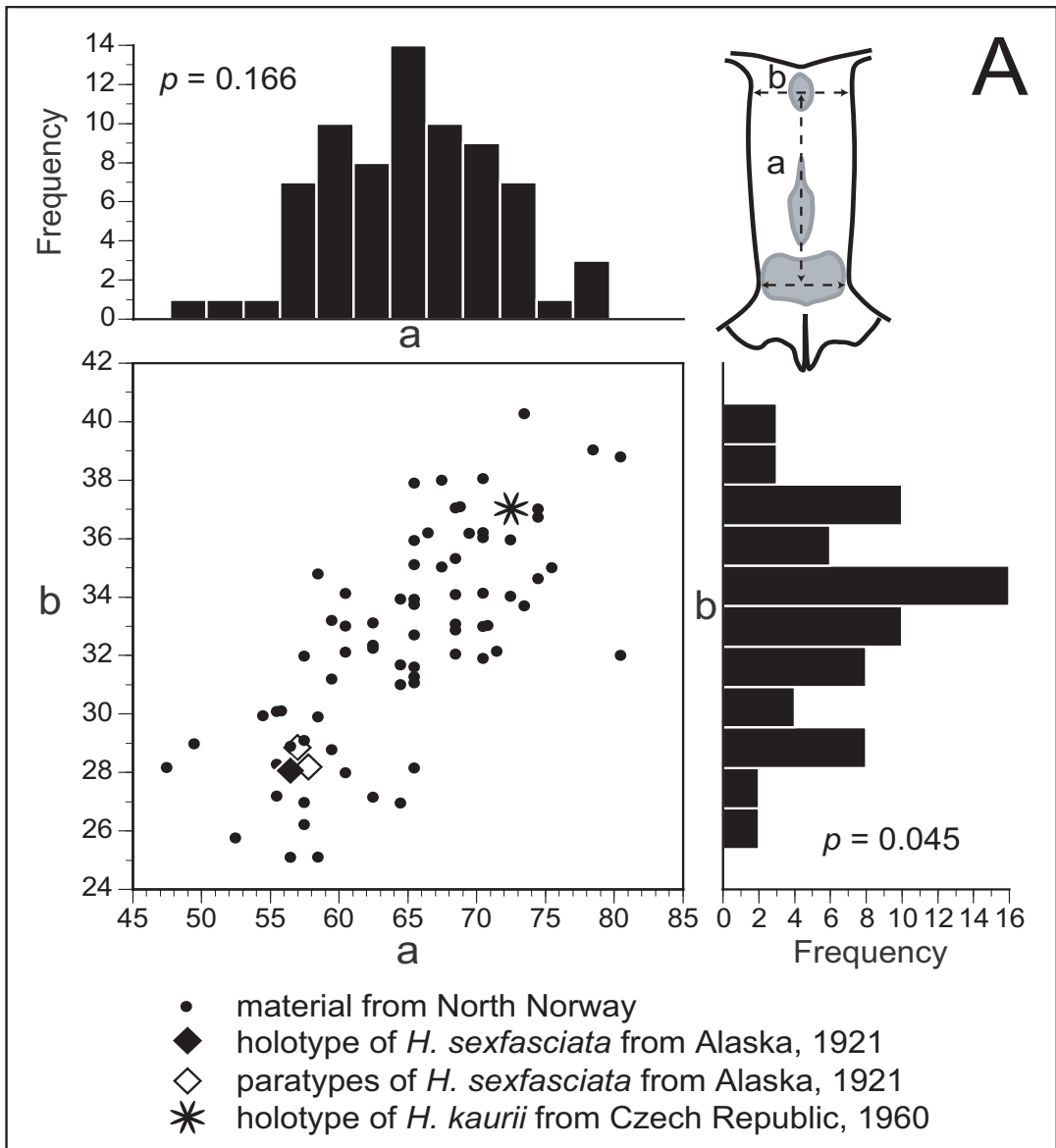
### ***Hybomitra arpadi* and *H. lundbecki***

We also found it difficult to distinguish between *H. arpadi* and *H. lundbecki*, and therefore considered it necessary to examine the type specimens, as we thought that the two might be one and the same species. However, in the types and in our material, *arpadi* is larger (ca. 16-17 mm vs 14-15 mm in *lundbecki*), the eyes are brownish pubescent (whitish in *lundbecki*), frons is only slightly widening above, the yellowish patches on tergites have many black hairs (few or none in *lundbecki*) and the palps are darker and more slender, agreeing with Szilády (1923) and Lyneborg (1959). Although we found the differences to be consistent, there seemed to be specimens with intermediate characters (e. g. Tromsø University Museum collection numbers TSZD 125, 157). In Nilssen (1998) and Anderson et al. (2001), *H. arpadi* was erroneously identified (by RB) as *H. lundbecki*.

## **SEASONAL APPEARANCE**

The illustration of dates of collection (Figure 4) has some limitations. It represents all areas and many years with a variety of climates, and abundant species will have greater chance of being found early or late in the season. Still, the illustration does depict some overall trends. Most tabanids appear between 20 June and 15 August. One observation is that tabanids were seldom found after 15 August, i. e. at a time when in most years temperatures are high. In a single year and/or in a single locality, the presence of adult tabanids is of course much more restricted than the graphs show. Observations not included in Figure 4 suggest that a single species is seldom found for more than 3-4 weeks, and that if it appears early in a particular year, it also disappears early.





**Figure 3.** *Hybomitra kaurii* and *H. sexfasciata*: Scatterplot of measurements taken on frons (**A**) and left antenna (**B**). One unit = 25.8 micrometers. In **A** (left), **a** and **b** are the length and width of the frons, respectively (see inserted figure). In **B** (right), **c** is the length and **d** the breadth of the antenna. The histograms show the frequency distribution of the measurements; *p*-values are the result of Lilliefors' test for normality: **a** is not significantly different from normal, whereas **b** and **c** have nearly normal distributions. Measure **d** deviates most from normality.



Although difficult to judge from the graphs, there may be indications that *Hybomitra aterrима* is an early species, whereas *Haematopota pluvialis* and *Chrysops relictus* are comparatively late. Similarly, Solem et al. (1990) found that the first *H. aterrима* appeared about two weeks before *H. pluvialis*. *Hybomitra lurida* and *H. lundbecki* may also be early, as found by Davies et al. (1971).

## CATCHES IN BAITED TRAPS

Of the 2805 investigated pinned specimens (1184 from Nordland, 665 from Troms, 956 from Finnmark), only 118 (4.2%) were males, with their proportion increasing northwards: 0.8% in Nordland, 2.9% in Troms, 9.3% in Finnmark.

*Chrysops nigripes* (93 FF), *Hybomitra aterrима* (310 FF), *H. polaris* (13 MM), *H. kaurii* (11 MM, 2 FF), *H. arpadi* (6 FF), *H. nitidifrons* (1 F), *H. montana* (17 MM, 7 FF) and *Haematopota pluvialis* (200 FF, 5 MM) were caught in CO<sub>2</sub>-baited flight traps (mostly in northern Troms and in Finnmark). *C. nigripes* (15 FF), *H. kaurii* (1 M only), *H. arpadi* (64 FF), *H. montana* (1 M, 1 F), *H. bimaculata* (2 FF) and *H. pluvialis* (107 FF) were caught in 1-octen-3-ol-baited flight traps (in Finnmark and in Nordland). Unbaited traps also attracted various *Chrysops* and *Hybomitra* species, but the use of octenol increased the catch about nine fold (Nilssen 1998). CO<sub>2</sub> was, however, a stronger attractant than octenol. During six days of trapping in June and July 1984 (northern Troms and inner Finnmark), 5514 tabanids were caught in CO<sub>2</sub>-baited traps, and the highest number of tabanids caught per trap per day was around 400 (Anderson et al. 2001).

## DISCUSSION

### Distribution

A total of 18 species were recorded in North Norway, compared to 16 in northernmost Russia (if *Hybomitra kaurii* and *H. sexfasciata* are synonymous) (Olsufjev & Poljakov 1985). Of the latter, 13 were recorded in the present study (the three missing were *Chrysops caecutiens*, *H.*

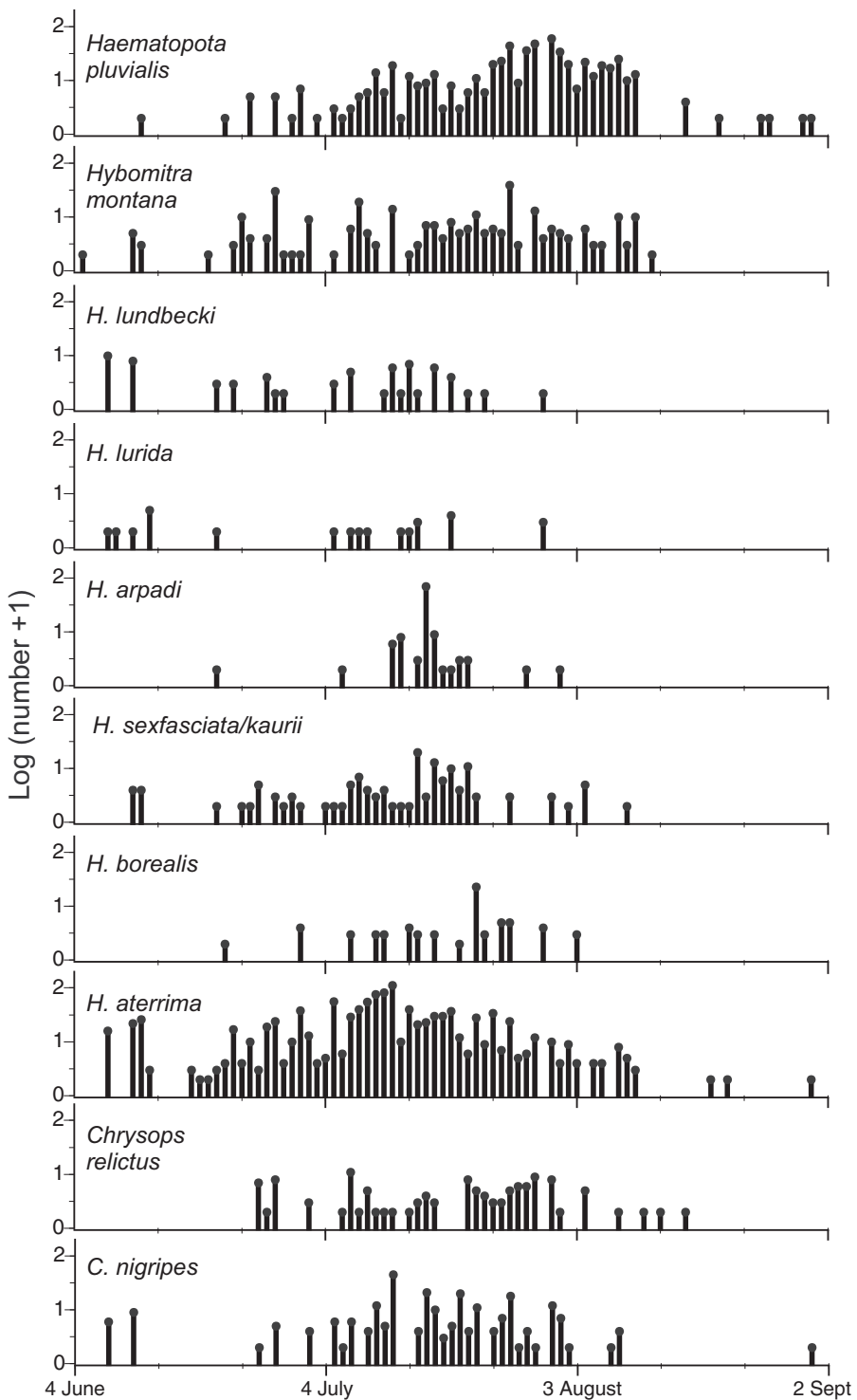
*aequetincta* and *H. olsoi*). The remaining five were *Chrysops sepulcralis* (though recorded in NW Russia in Olsufjev (1977)), *Hybomitra tarandina*, *H. aterrима*, *Atylotus sublunaticornis* and *Heptatoma pellucens*. The «missing» species (in our material) agrees with the absence of *C. caecutiens* and *H. olsoi* from the Murmansk and Arkhangelsk regions and *H. aequetincta* from the Murmansk region (Olsufjev & Poljakov 1985).

The absence of *H. aterrима* in northernmost Russia (Olsufjev & Poljakov 1985) and rareness in North Finland (Karvonen 1969) agrees with its apparent absence in SE Finnmark (Pasvik). *H. aterrима* is a European species extending into Russia (Olsufjev 1977). Chvála et al. (1972) give Spain (the Pyrenées) and the Carpathians as extremes of its distribution.

*Hybomitra aterrима* was often encountered in mountainous areas, often on roadsides. When species like *H. aterrима* and *Haematopota pluvialis* appear so abundant in areas where there are few mammals, one may wonder how they manage to obtain blood to develop eggs. Some tabanids in many parts of the world develop eggs without a blood meal, a phenomenon called *autogeny*. Tabanids may be categorized as obligate anautogenous, facultative autogenous, or obligate autogenous (McElligott & Lewis 1998). In Hokkaido, Japan, 12 of 25 species were autogenous in the first gonotrophic cycle, and 13 were anautogenous (Inaoka 1992). Some of the species reported from North Norway have been found to be autogenous in other areas, and it is therefore likely that some of these are able to develop autogenously also in North Europe. It would be interesting to do specific investigations to find the frequency of autogeny among the northernmost populations of tabanids.

The four other species (*Chrysops sepulcralis*, *Hybomitra tarandina*, *Atylotus sublunaticornis* and *Heptatoma pellucens*) not found in northernmost Russia have not been found in Finnmark (Maps 1 and 13), and may be regarded as southern. Typically northern species include *Chrysops nigripes*, although also found in NE China and even in Korea (Chvála et al. 1972), *Hybomitra polaris* and *H. nigricornis*. Other quite





**Figure 4.** Seasonal appearance of the ten most common tabanid species in North Norway. The figure is based on the collection dates (when stated) of all specimens used in this paper (Table 1). Note the logarithmic scale of the y-axis.

northern species are *H. arpadii*, *H. kaurii* and *H. borealis*; even if they are found as far south as Central Europe (see Chvála et al. 1972). The northerness of our species seems to be accompanied by yellow hairing (*H. aterrima* var. *auripila*, *H. tropica* (as part of *H. montana*)) and dark colours (*C. nigripes*, *H. sexfasciata* (as part of *H. kaurii*), *H. nigricornis* (nec *montana*), *H. montana* var. *flaviceps*). Our *H. kaurii* nec *sexfasciata* had dark spotless third tergites. Dark colours absorb radiation better, and may be an adaptation to low temperatures (see Forsman et al. 2002).

Of our 18 species, seven also occur in N America: *Chrysops nigripes*, *Hybomitra polaris* (as *H. polaris* and ?*H. astuta*), *H. kaurii* (as ?*H. sexfasciata*), *H. arpadii*, *H. nitidifrons* (as ssp. *nuda*), *H. lurida* and *Atylotus sublunaticornis* (see Burger 1995). Of these seven, only *A. sublunaticornis* has not been found in northernmost Russia (Olsufjev & Poljakov 1985). The first five (except maybe *H. kaurii* and *H. nitidifrons*) do not occur in S Europe; the latter two occur in S Europe only in the mountains (Chvála et al. 1972). There seems to be a correlation between how far north they occur and distribution on both sides of the North Atlantic. So why are there no tabanids in Iceland or Greenland? Maybe they crossed the Bering Strait: of the 16 species in Olsufjev & Poljakov (1985), nine occur in N America.

### Variability

Löw (1858) went into detail about how difficult it is to distinguish and describe tabanid species. Variation in colour (*H. aterrima* var. *jacobi*), wing venation (*Chrysops*), and shape of palpus and antenna (*H. arpadii* and *H. lundbecki*) and frons and antenna (*H. sexfasciata* vs *H. kaurii*) cause us to agree. Our measurements of characters mentioned in Chvála et al. (1972) as important in distinguishing between *H. sexfasciata* and *H. kaurii* showed (Figure 3) that there is no clear differentiation in these characters; instead they seem to have normal or near normal distributions. This, and the variable colour of antennal segments

1-2, suggests that the investigated specimens may be of one variable species rather than two overlapping ones. We think that *Hybomitra kaurii* and *H. sexfasciata* are conspecific, as suggested by Stone (1935, p. 18) who compared seven specimens of *borealis* Löw, 1858 (= *kaurii*) from Germany with 17 *sexfasciata* from Alaska.

Another very variable species is *Hybomitra montana*. The relationships between this species (including the darkened var. *flaviceps*), *H. tropica* and *H. nigricornis* are not clear. Leclercq (1985) lists it as Holarctic, a view not shared by Moucha (1976), Teskey (1990) and Burger (1995).

Tabanids are fast flyers with a wide flight range (Hocking 1953, Sheppard & Wilson 1976), and according to simple theory, one might thus expect a relatively rapid gene flow and low intraspecific morphological variation. Maybe too few species have been described? We do not think so. Most species names listed in Chvála et al. (1972) have many synonyms, representing species which, over time, have been lumped together. An equally possible explanation is that much variation is phenotypical (Andreeva 1999). Genetically, variation can be clinal (Mayr 1969). Our impression after years of consulting taxonomists and trying to identify specimens is that great variation is normal.

### Seasonal appearance

The main period for the appearance of adult tabanids in North Norway is from approximately 20 June to 15 August (Figure 4), but in some years they were found in early June, probably as a result of an early spring. Local climate also plays a part, so that in southern or lowland areas emergence will be earlier than further north and at higher altitudes. What is surprising is that the tabanid season ends so early, i. e. before mid-August (Figure 4), and before the summer is over. This could be explained by the seasonal activity of the collectors, but it is an experience that harassment by tabanids is more or less finished around 10 August (personal observation). It is interesting that a similar restricted period was found in subarctic Canada (McElligott & Lewis 1998).

## Catches in baited traps

It is well known that female horse flies, as well as females of other haematophagous Diptera, are attracted to CO<sub>2</sub> (Roberts 1971, Leprince et al. 1994) and 1-octen-3-ol (French & Kline 1989, Nilssen 1998, Kristensen & Sommer 2000). In our material, however, males of e. g. *Hybomitra kaurii*, *H. montana* and *Haematopota pluvialis* had also been caught in CO<sub>2</sub>-baited traps. This phenomenon was mentioned in Anderson et al. (2001). It is not known if the males had been attracted to the bait *per se* or had been chasing females prior to mating. Since males are not haematophagous, we hypothesize the latter.

In this study we have mapped the distribution of horse flies in a small part of Fennoscandia. It would be of interest to survey a larger area to get a better picture of the distribution of the northernmost species of this Diptera family.

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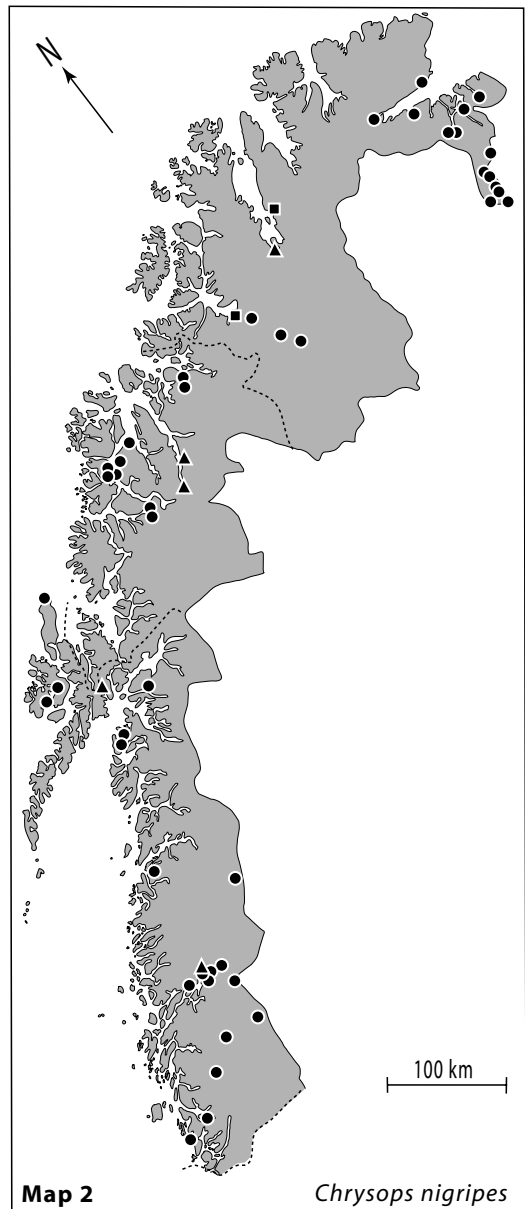
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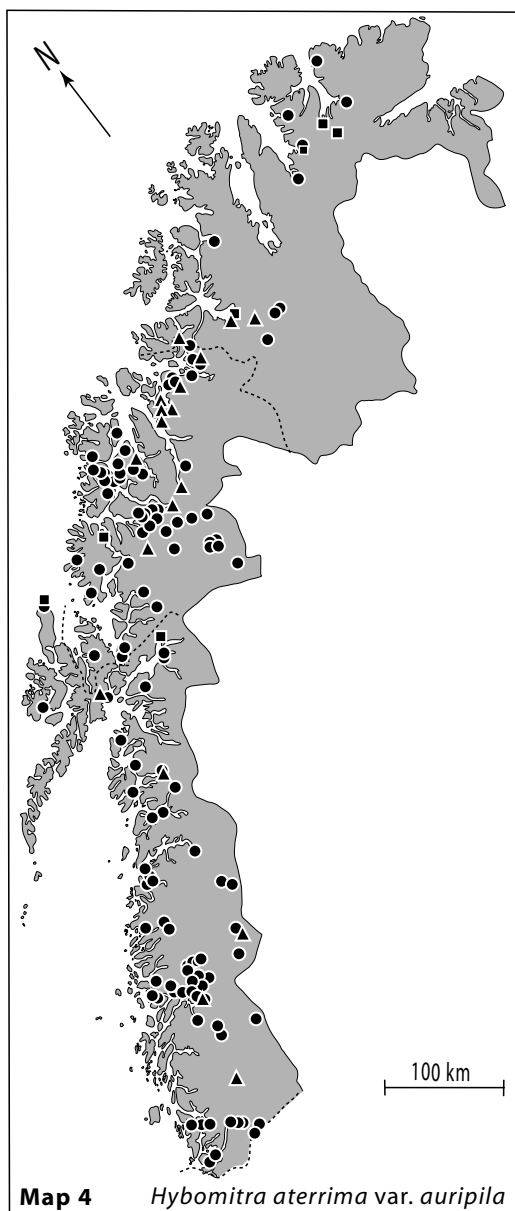
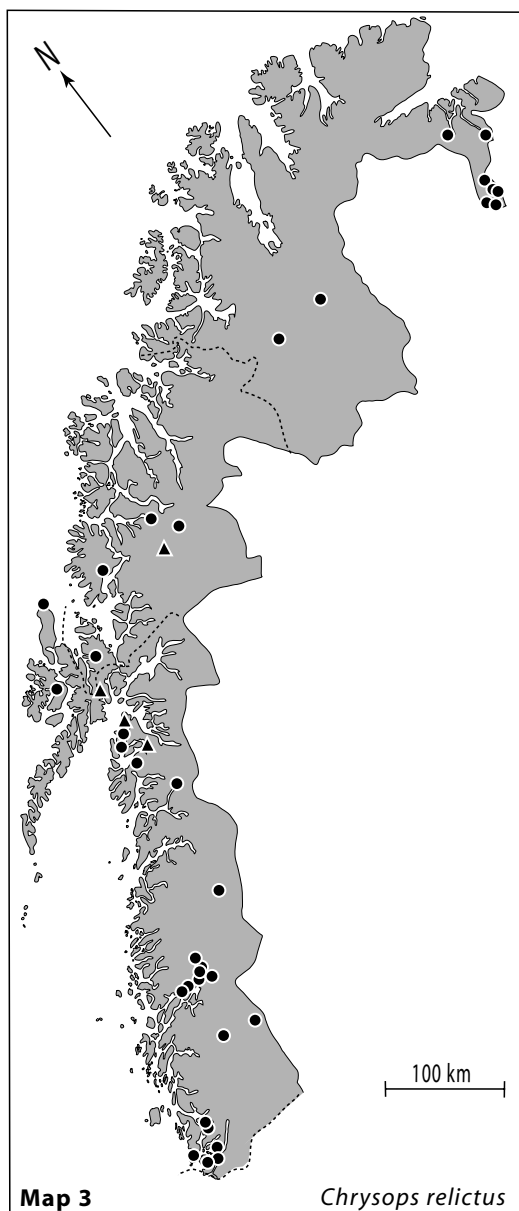
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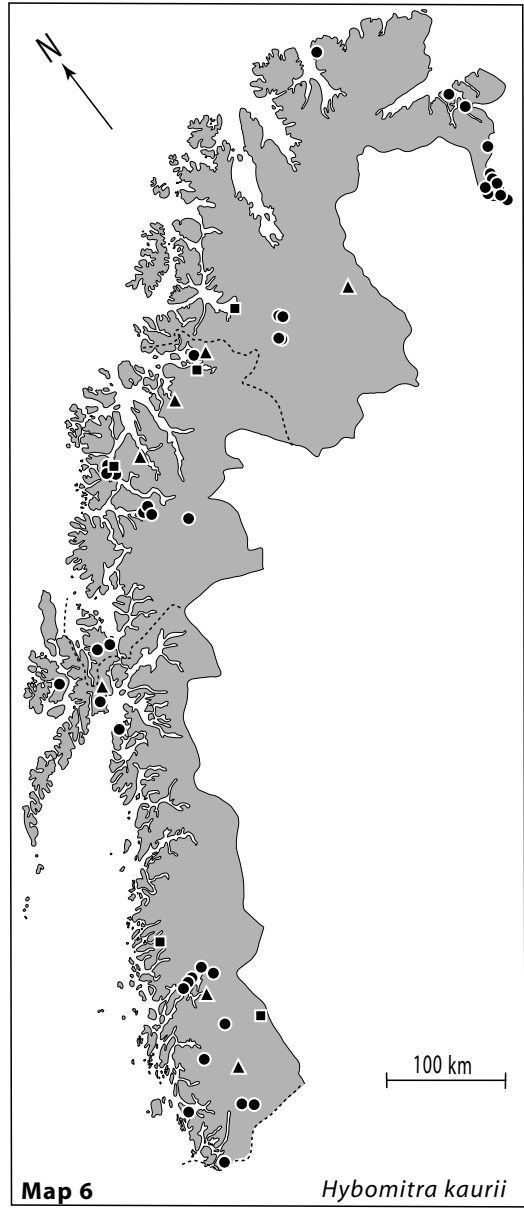
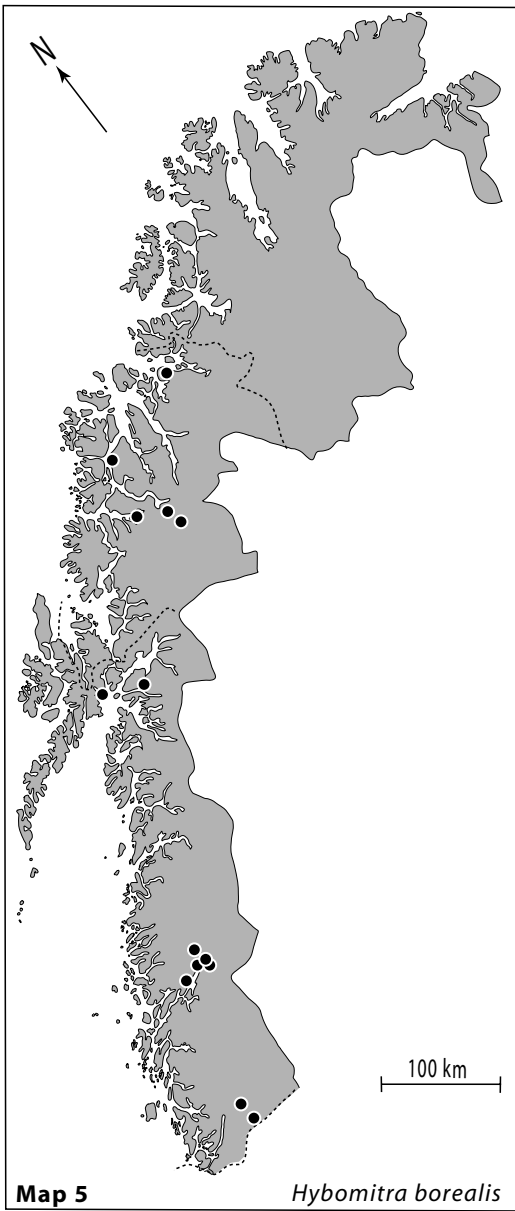


**Map 1 and Map 2.** Distribution of *Chrysops sepulcralis*, *C. nigripes*, *Hybomitra tarandina* and *H. polaris* in North Norway. Map 1: *Chrysops sepulcralis*, *Hybomitra tarandina* and *H. polaris* (all three unpublished in collections). Map 2 (*Chrysops nigripes*): ● unpublished data from collections; ▲ from Rognes (1980); ■ from literature earlier than 1980.





**Map 3 and Map 4.** Distribution of *Chrysops relictus* and *Hybomitra aterrima* var. *auripila* in North Norway. ● unpublished data from collections; ▲ from Rognes (1980); ■ from literature earlier than 1980.

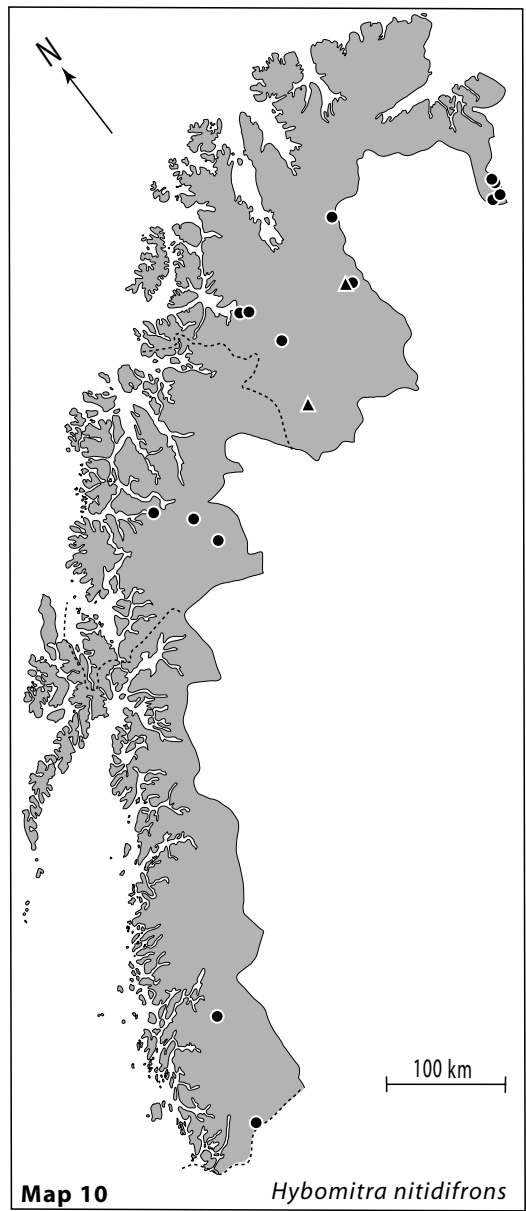


**Map 5 and Map 6.** Distribution of *Hybomitra borealis* and *H. kaurii* in North Norway. ● unpublished data from collections; ▲ from Rognes (1980); ■ from literature earlier than 1980.

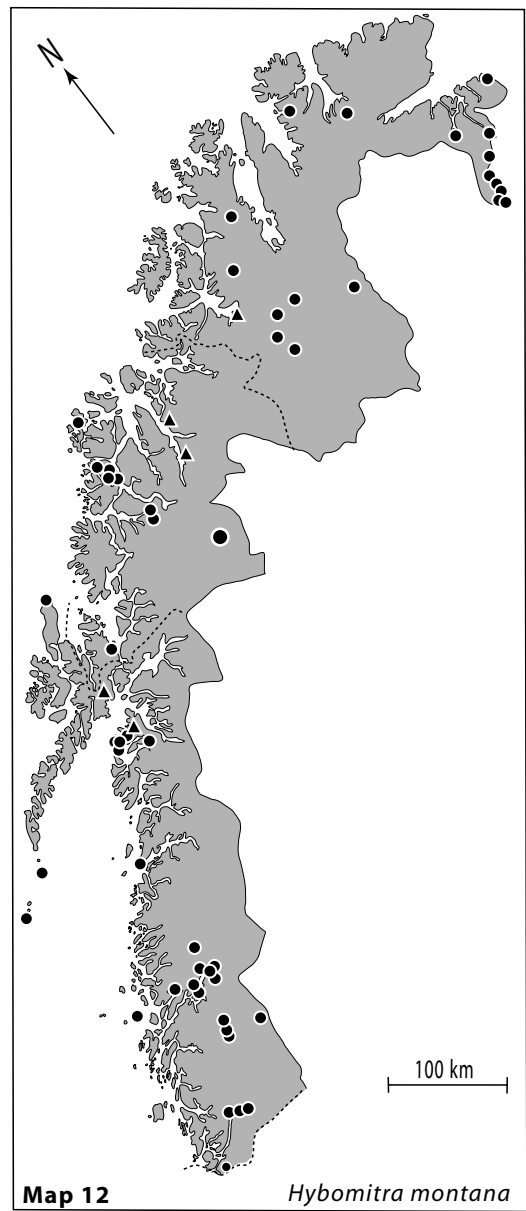


**Map 7 and Map 8.** Distribution of *Hybomitra arpadi* and *H. cf. nigricornis* in North Norway. ● unpublished data from collections; ■ from literature earlier than 1980.

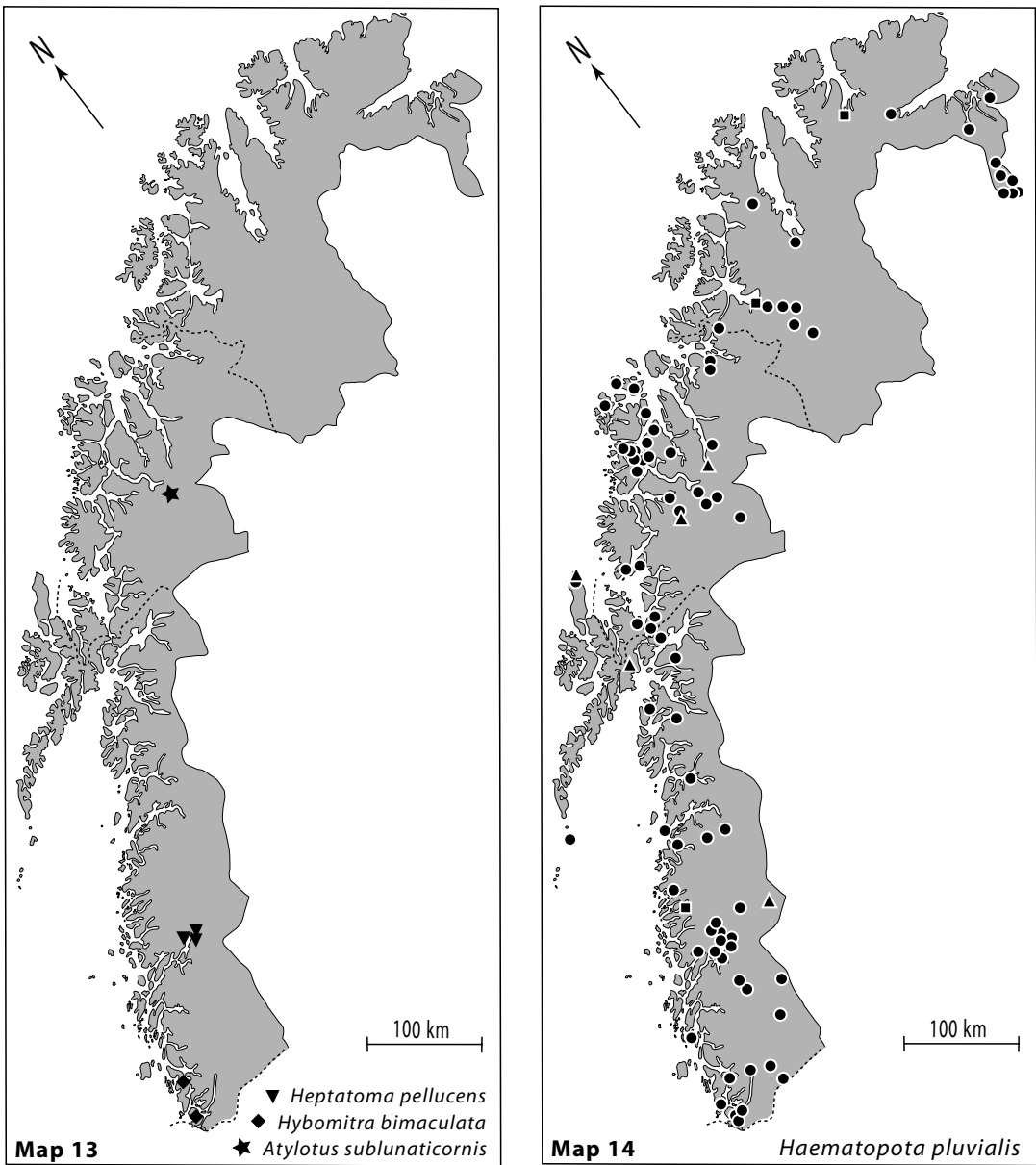




**Map 9 and Map 10.** Distribution of *Hybomitra lurida* and *H. nitidifrons* in North Norway. ● unpublished data from collections; ▲ from Rognes (1980); ■ from literature earlier than 1980.



**Map 11 and Map 12.** Distribution of *Hybomitra lundbecki* and *H. montana* in North Norway. ● unpublished data from collections; ▲ from Rognes (1980).



**Map 13 and Map 14.** Distribution of *Hybomitra bimaculata*, *Atylotus sublunaticornis*, *Heptatoma pellucens* and *Haematopota pluvialis* in North Norway. Map 13: *Hybomitra bimaculata*, *Atylotus sublunaticornis* and *Heptatoma pellucens* (all three unpublished in collections). Map 14 (*H. pluvialis*): ● unpublished data from collections; ▲ from Rognes (1980); ■ from literature earlier than 1980.

## ***Corixa panzeri* (Fieber), a species new to Norway, and *Paracorixa concinna* (Fieber) (Hemiptera-Heteroptera, Corixidae), in Gjerstadvannet, Arendal**

Dag Dolmen

Dolmen, D. 2004. *Corixa panzeri* (Fieber), a species new to Norway, and *Paracorixa concinna* (Fieber) (Hemiptera-Heteroptera, Corixidae), in Gjerstadvannet, Arendal. Norw. J. Entomol. 51, 27-29.

Two and three specimens, respectively, of the water bugs *Corixa panzeri* and *Paracorixa concinna* were recorded from Gjerstadvannet, Tromøy in Arendal. *C. panzeri* has never before been reported from Norway, while *P. concinna* has only been recorded from a small area in the county of Østfold. The nearest localities for *C. panzeri* to the locality in Arendal, are in NW Denmark and SW Sweden.

Key words: *Corixa panzeri*, *Paracorixa concinna*, Heteroptera, brackish water, Norway.

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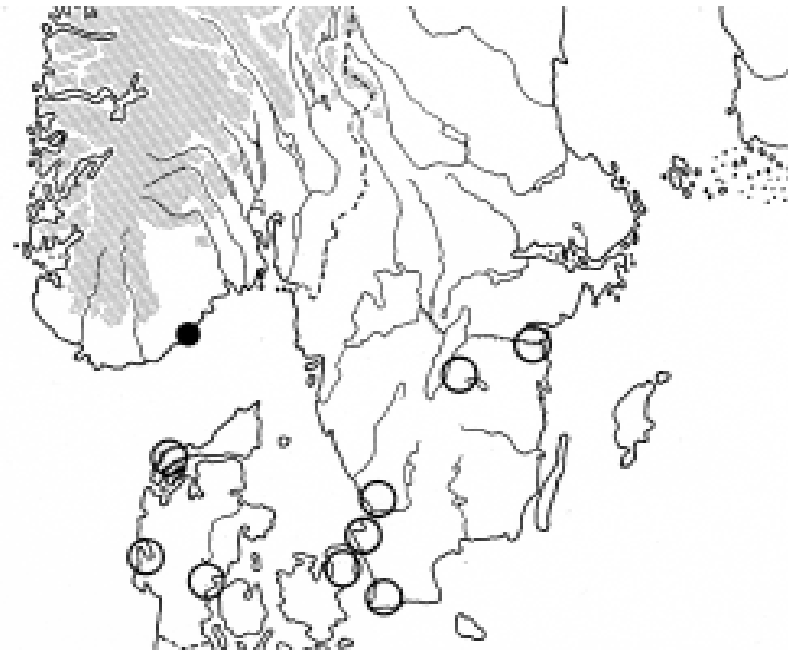
The water bug *Corixa panzeri* (Fieber, 1848) was recorded on two occasions, 23 September 2000 and 28 May 2001, in the lake Gjerstadvannet at Tromøy, Arendal, in the county of Aust-Agder, Southern Norway. Two specimens, both females, were collected during investigations of the invertebrate fauna of the lake. The species has not earlier been recorded in Norway (cf. Dolmen 1996, Coulianos 1998). While males of *C. panzeri* are easily identified to species, females may be mixed up with the closely related *C. affinis* (occurring in England and on the Continent as far north as the German/Danish border). The identification of my specimens is mainly based on Jansson's (1986, 1996) precise key, which emphasizes that in *C. panzeri*, the prenodal shiny area of costal margin is narrowing gradually – in contrast to *C. affinis*, where the prenodal shiny area is evenly broad for most of its length. Besides, *C. panzeri* is larger, 10–11 mm, against 8–10 mm for *C. affinis*. The sizes of my specimens were 10.5 and 10 mm, respectively.

I have also used Savage's (1989) key, which points out that in *C. panzeri*, the dark lines on hemelytra are generally broader than the light ones, while the opposite is the case in *C. affinis* (cf. Stichel 1955). In my specimens the dark lines are clearly broader. Sizes mentioned by Savage (1989) are 10.0–11.0 mm for *C. panzeri* and only 8.0–9.0 for *C. affinis*.

Gjerstadvannet (UTM: 32V MK 9079; EIS 6) is a deep, meromictic brackish-water lake with low salinity in the upper layers. Its connection to the open sea is a 100 m long, sluiced stream. In 2000 and 2001, salinities in the upper layers were measured at 1.8 ‰ and 1.2 ‰, respectively, while in 2002 it was 2.3 ‰ (Dolmen et al. 2003). In the deeper layers (6–8 m) the salinity is 33–34 ‰ (Kroglund 1998).

Around the lake, rocky outcrops characterise the shoreline, and some protrude into the water and are covered by Characea. More sheltered areas have substantial stands of telmatophytic vegetation, first





**Figure 1.** The known distribution of *Corixa panzeri* (Fieber) in Scandinavia. The new record at Arendal is indicated by a black dot. Open circles are based on Jansson (1986) (exact localities are not known).

of all *Phragmites australis*. Further details about the lake and its fauna can be found in Kleiven & Dolmen (2000) and Dolmen et al. (2003).

According to Coulianos & Ossianniilsson (1976) and Jansson (1986), a few records of *C. panzeri* have been made in the southernmost parts of Sweden: Skåne, Halland and Östergötland. It has also been recorded in Denmark, Northern Germany and The British Isles, but not in Finland and only one (?) record in The Baltic Countries. The Swedish records in Östergötland and the new Norwegian record represent the northernmost known populations of the species in Europe. The known distribution in Scandinavia is shown in Figure 1.

Among other corixids recorded in Gjerstadvannet, was also *Paracorixa concinna* (Fieber, 1848) (= *Callicorixa concinna*); three females were caught

on 28 May 2001. The species was reported new to Norway by Dolmen & Simonsen (1989) and is evaluated as vulnerable on the national red list (Størkersen 1999; cf. Ødegaard & Coulianos 1998). The few previous records of the species have all been made within a small area of Østfold, east of the Oslofjord. So this is the first report from southernmost Norway. Nieser (1978) and Barnes (1994) list *C. panzeri* and *P. concinna* and a few other corixids among species which may be found in brackish waters.

Other nepomorph water bugs (true aquatic bugs) recorded in the lake were: *Nepa cinerea*, *Ranatra linearis*, *Notonecta glauca*, *Sigara dorsalis/striata*, *S. striata*, *S. distincta*, *S. fossarum* and *Arc-tocorisa germari*. I visited the lake for extensive sampling on 27 August 2001 and 28 August 2002, but was not able to find additional specimens of *C. panzeri* or *P. concinna*.

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***Toxoneura venusta* (Loew, 1858)  
(Diptera, Pallopteridae) new to  
Norway**

**Lita Greve & Petter Jordan**

Greve, L. & Jordan, P. 2004. *Toxoneura venusta* Loew, 1858 (Diptera, Pallopteridae) new to Norway. *Norw. J. Entomol.* 51, 30.

One female of *Toxoneura venusta* (Loew, 1858) (Diptera, Pallopteridae) was collected in a Malaise trap at Lenvikmarka North / Snubba (NNØ Evenes) between 21 August and 16 September 2003. This is the first record from Norway.

Key words: *Toxoneura venusta*, Diptera, Pallopteridae, Norway.

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The family Pallopteridae was surveyed in Norway by Greve (1993) and 12 species were recorded. Since then several hundred specimens have been collected, but no additional species have been found (Greve, 2003). The family Pallopteridae is not rich in species in NW Europe. From Sweden, Andersson (1990) recorded 16 species of this family; Merz & Petersen (2001) listed 11 species from Denmark and Hackman (1980) 10 species from Finland.

The genus *Palloptera* s.l. as used by Andersson (1990) and Greve (1993) is now divided into three genera: *Palloptera* s.s., *Temnosira* Enderlein and *Toxoneura* Macquart, see Merz (1998). The anepisternum in the genus *Toxoneura* Macquart are characterized by the dark hairs or bristles. *Toxoneura venusta* superficially looks like many other pallopterids, however, it is separated by the combination of the wing pattern, colour of mesonotum and the distribution of silvery shine (microtrichia) on the posterior part of frons. The abdomen is black.

**Material**

NNØ Evenes: Lenvikmarka North - Snubba (EIS 145), Malaise trap, 21 August - 16 September 2003, 1 female, leg. P. Jordan. The trap was situated in a meadow 150 m a. s. l., in a cluster of deciduous forest, mostly birch (*Betula pubescens* Ehrh.) with some *Salix* sp. A forest of planted spruce (*Picea abies* L.) is situated near by. From the Scandinavian peninsula Andersson (1990) lists records of *T. venusta* from Skåne and Småland in southern Sweden, and from Lule Lappmark in the north, and notes it as rare in Sweden. He also mentions records from NW Russia. *P. venusta* has a restricted distribution in Central Europe with Poland as a center of distribution, and must be considered a rare or very rare species in this area (Merz, pers.comm.). Hence *T. venusta* is an interesting addition to the Norwegian fauna.

**Acknowledgements.** We are very grateful to Dr. B. Merz, Geneva who verified the determination, and gave information on the distribution in central Europe.

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# Communities and spatio-temporal patterns of epigeic beetles (Coleoptera) in high mountain habitats of the Central Norwegian Scandes, with special emphasis on carabid beetles (Carabidae)

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Within a comprehensive landscape ecological research project in the Central Norwegian high mountains, the beetle fauna (Coleoptera) of different alpine areas was investigated during the snow-free season of the year 2001 (June – October). The two research regions are situated at a latitude of approximately 62° N: one in the oceanic western part and one in the continental eastern part of Central Norway. In each region two small catchments were selected as representative investigation areas, located in the low alpine and in the middle alpine belt, respectively. Additionally, single study plots were examined in the subalpine belt and at the top of the highest mountain peaks. Epigeic beetles were caught using pitfall traps that were emptied fortnightly. 114 sites were investigated with 2 – 4 pitfall traps each. The total number of traps amounted to 300. During the vegetation period 3816 adult beetles of 16 families were caught. Rove beetles (Staphylinidae) were dominant (2770 individuals), followed by ground beetles (786 individuals). The most abundant and widespread phytophagous beetle family was the one of the weevils (Curculionidae) with 122 individuals. All other families appeared with less than 30 specimens. Community analyses were focused on the ground beetles (Carabidae) of which 17 species were recorded. Although the subalpine plots were investigated with the lowest intensity, the species richness of carabids there was highest (7 species in the oceanic west, 9 species in the continental east). The alpine areas had lower species numbers (5 or 6 species). In the investigation areas as well as in single ecotopes one or two species were dominant, the remaining species appearing only in considerably lower abundance. The number of hygrophilous species and their abundance is higher in the western oceanic region. Single species occurring both in low and middle alpine habitats showed differences in phenology and spatial distribution patterns between the two altitudinal levels. Several carabid species were characteristic of some of the investigated habitats. These habitats coincided, in some cases, with the patterns of vegetation classes. The fine-grained mosaic of ecotopes was not reflected on the same scale by the carabid fauna.

Key words: Carabidae, community structure, habitat preference, phenology, mountain habitat, alpine areas, activity patterns, Norway

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## **INTRODUCTION**

Landscape ecological research projects in high mountain areas often neglect zoological aspects, although – being a mobile element of the biosystem – the fauna is important especially regarding ecotope distinction and dynamics at different scales. In general, knowledge about ecosystem functioning, the relations between the ecosystem compartments, and their reactions on environmental changes are necessary for nature conservation purposes and the sustainable development of landscapes. This becomes more and more important also in high mountain areas (Kaltenborn 1999, Messerli & Ives 1997) because of an increasing human impact (e.g. Löffler 2000). But also for some other reasons, like the problem of climate warming, a good knowledge in alpine ecology is helpful (Gottfried et al. 1999). Consequences of a global change might be visible earlier in the sensitive mountain landscapes than in other ecosystems, making them suitable for appropriate monitoring projects (Epstein et al. 1998). It is obvious that studies documenting the present day altitudinal distribution of plants and animals will be an irreplaceable source for the estimation of ecological global warming effects. For example, investigating the flora of 26 mountain peaks in the Alps, Grabherr et al. (1994) verified an increasing upper distribution limit of numerous high alpine vascular plants. Additionally, Kullmann (2002) published data referring to the range-margin rise of several plant species in the Swedish Scandes. Since most animals are assumed to react faster on environmental changes than plants (Union of Concerned Scientists 2000), their potential to indicate changes in a hypothetically warmer future world may be even higher than it has already been shown for plants. Parmesan et al. (1999, 2000) discussed potential effects of global warming on the biocoenoses with special emphasis on the fauna. They noticed a range shift of certain animal species with a clear trend towards cooler regions.

In the South and Central Norwegian Scandes intensive entomological investigations were conducted in several areas above timberline, e.g. Hardangervidda (Finse) (Fjellberg 1972, Østbye

et al. 1978, Ottesen 1995, 1996 and others). As one result, Østbye & Hågvar (1996), Refseth (1980) and Thingstad (1987) confirmed for beetles that there is a strong regional variability in species composition within their respective communities. Consequently, it is not easy to estimate how far results are transferable from investigated areas to adjacent regions or even to neighbouring mountain massifs.

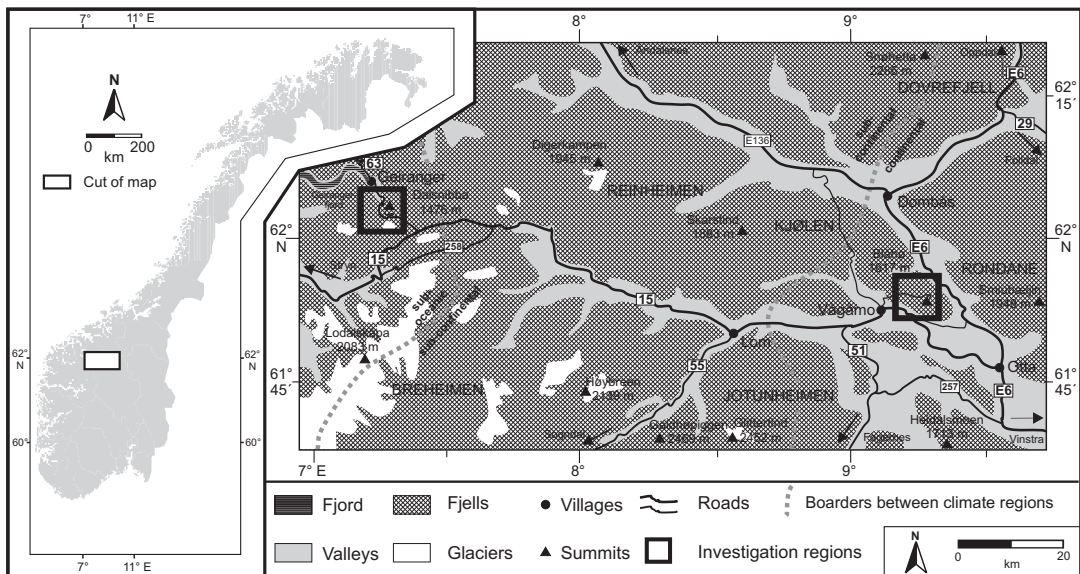
Since 2001 we have been integrating a zoological component into a comprehensive landscape ecological research project which is conducted in the Central Norwegian Scandes (Köhler et al. 1994, Löffler 1998, 2002, 2003, Löffler et al. 2001). The ecology of two high mountain regions of Central Norway is compared by investigating their abiotic and biotic components. The aims of the project are to analyse the dynamics in ecosystems and to evaluate differences in ecosystems along ecological gradients (Löffler et al. 2001). Of special interest are the abiotic process systems (mainly energy and water balance) and their influence on the biocoenosis, especially the zoocoenosis.

The investigations focus on the characteristic, fine-scaled mosaic of different ecotopes (Köhler et al. 1994, Moen 1999). Consequently the indicator groups chosen for the zoological investigations are epigeic arthropods, as they inhabit rather small areas in which almost their whole life cycle takes place.

This article presents the first zoological results from the project dealing with the fauna, more precisely with epigeic beetles (Coleoptera). The results are part of a diploma thesis (Naujok 2003) and focus on ground beetles (Carabidae), analysing their species diversity, their spatial distribution on different scales, their phenology and coenological aspects, with a special emphasis on changes along altitudinal gradients and along the oceanic-continental gradient from western to eastern Central Norway.

## **RESEARCH REGIONS AND INVESTIGATION AREAS**

As Central Norway shows a clearly defined oceanic-continental gradient from the western



**Figure 1.** The research regions in central Norway (according to Löffler et al. 2001).

coast to the eastern slope of the Scandes, during large-scale mappings using a method described by Löffler (1998) two mountain massifs in Central Norway were chosen along this gradient as research regions. In each region two small catchment areas were selected as representative investigation areas (one in the low alpine and one in the middle alpine altitudinal zone). Additionally, single study sites were located in the subalpine zone near the timberline and at the top of the highest peaks of each region.

The western research region (RR) – in the following called RR Stranda – is located near Geiranger (Stranda, Møre og Romsdal) approximately at  $62^{\circ}03'N$  and  $7^{\circ}15'E$  (Figure 1). It lies in the inner fjord region, where the climate is suboceanic. The annual precipitation is between 1500 – 2000 mm and the mean temperature amounts to around  $4 - 6^{\circ}C$  (Moen 1999). The mean temperature in July varies between  $8 - 12^{\circ}C$ , in January between  $-8 - -4^{\circ}C$ . In this region the timberline reaches an altitude of 700 – 800 m a.s.l. (Statens Kartverk 1973) and the upper limit of the low alpine belt lies between 1100 – 1200 m. The highest peak of the RR Stranda is the Mt. Dalsnibba (1476 m a.s.l.).

The other research region – in the following called RR Vågå – is located approximately 100 km further east near Vågå (Vågå, Oppland). It is situated around  $61^{\circ}53'N$  and  $9^{\circ}15'E$  in the most continental region of Norway. The annual precipitation is low (300 - 600 mm), the amount varying with the altitudinal level (Löffler 1998). The mean temperature is around  $-2 - 0^{\circ}C$  (Moen 1999) and above 1000 m it is below  $-2^{\circ}C$  (Löffler 1998). The mean temperature in July reaches  $8 - 12^{\circ}C$ , in January merely  $-8 - -12^{\circ}C$  (Moen 1999). Depending on the exposure the timberline reaches 900 – 1050 m a.s.l.. The low alpine belt has its upper limit at a maximum of 1350 m (Löffler 1998). The highest peak of the RR Vågå is the Mt. Blåhø (1617 m a.s.l.).

The investigation areas in these research regions are small catchments or parts of catchments with sizes between 2 and 6.3 ha. The small valleys are shaped more or less in an east-west-direction so that most parts of the slopes are either exposed to the north or to the south. The environmental conditions seem to be near-natural and except for hunting and an extensive sheep-grazing there are no direct anthropogenic influences visible.

**Table 1.** Characteristics of the studied plots in the investigation areas (a = block field, traps = number of traps, exp. = exposure, relief pos. = relief position (FS = foot-slope, LS = lower slope, MS = middle slope, US = upper slope). Vegetation classes and types are named after Löffler (1998), who classified them after Dahl (1956).

Plot	Traps	Exp.	Relief pos.	Vegetation class	Vegetation type	Remarks
BLAF 1	3		ridge	lichen heath	-	chionophobic
BLAF 2	3		ridge	bog vegetation	<i>Sphagnum-Rubus</i> -type	wet
BLAF 3	3	S	US	lichen heath	-	chionophobic
BLAF 4	3	N	US	lichen heath	-	chionophobic
BLAF 5	3	S	MS	dwarf-shrub heath	-	few lichens
BLAF 6	2	N	MS	dwarf-shrub heath	-	many lichens
BLAF 7	3	N	MS	lichen heath	-	-
BLAF 8	3	S	LS	dwarf-shrub heath	<i>Vaccinium myrtillus</i> -type	-
BLAF 9	2	N	LS	dwarf-shrub heath	<i>Vaccinium myrtillus</i> -type	-
BLAF 10	3	S	FS	dwarf-shrub heath	-	-
BLAF 11	2	N	FS	grass vegetation	-	near lake-shore
BLAF 12	3		valley floor	bog vegetation	<i>Sphagnum-Eriophorum</i> -type	extremely wet
BLAF 13	3		valley floor	bog vegetation	<i>Sphagnum-Eriophorum</i> -type	extremely wet
BLAF 14	3		valley floor	snowbed vegetation	-	extremely late snow free
BLAF 15	3		valley floor	dwarf-shrub bushes	<i>Salix</i> ssp.-type	-
BLAF 16	1	N	LS	dwarf-shrub heath	-	-
BLAF 17	1	N	FS	moss vegetation	-	-
DALS 1	3		ridge	lichen heath	-	chionophobic
DALS 2	3	S	US	lichen heath	-	chionophobic
DALS 3	3	S	US	lichen heath	-	chionophobic
DALS 4	3	N	US	lichen heath	-	chionophobic
DALS 5	3	N	US	lichen heath	-	chionophobic
DALS 6	3	S	MS	lichen heath	-	many dwarf-shrubs
DALS 7+a	3 + 3	S	MS	lichen heath	-	many dwarf-shrubs
DALS 8	3	S	MS	lichen heath	-	-
DALS 9	3	S	MS	grass vegetation	-	<i>A. odoratum</i> dominant
DALS 10	3	S	MS	moss vegetation	-	-
DALS 11	3	S	MS	moss vegetation	-	-
DALS 12	3	S	MS	snowbed vegetation	<i>Ranunculus glacialis</i> -type	-
DALS13+a	2 + 2	N	MS	moss vegetation	-	-
DALS 14	3	N	MS	snowbed vegetation	<i>Ranunculus glacialis</i> -type	-
DALS 15	3	S	LS	snowbed vegetation	<i>Salix herbacea</i> -type	-
DALS 16	3	S	LS	+/- free of vegetation	rock vegetation	block field
DALS 17	3	S	LS	moss vegetation	-	often wet
DALS 18	3	S	LS	snowbed vegetation	<i>Salix herbacea</i> -type	-
DALS 19	3	S	LS	moss vegetation	-	wet
DALS20+a	2 + 2	N	LS	moss vegetation	-	many stones
DALS21+a	2 + 2	S	FS	moss vegetation	-	many stones
DALS22+a	3 + 2		valley floor	snowbed vegetation	<i>Salix herbacea</i> -type	-
DALS 23	3		valley floor	moss vegetation	-	-
DALS 24	3	N	MS	snowbed vegetation	<i>Salix herbacea</i> -type	channel
DALS 25	2	N	MS	snowbed vegetation	-	moss snowbed
DALS 26	2	N	MS	snowbed vegetation	-	moss snowbed
DALS 27	2	N	MS	moss vegetation	-	ridge beside channel
DALS 28	1		ridge	lichen heath	-	slight depression
SALK 1	2		ridge	+/- free of vegetation	-	-
SALK 2+a	2 + 2	N	US	+/- free of vegetation	-	-
SALK 3+a	3 + 3	S	US	lichen heath	<i>Cetraria nivalis</i> -type	wet
SALK 4+a	2 + 2	S	US	lichen heath	<i>Cetraria nivalis</i> -type	dry
SALK 5+a	2 + 2	N	MS	+/- free of vegetation	-	-
SALK 6	3	S	MS	grass vegetation	<i>Carex bigelowii</i> -type	-
SALK 7+a	2 + 2	S	MS	snowbed vegetation	<i>Salix herbacea</i> -type	-
SALK 8	3	S	MS	grass vegetation	<i>Juncus trifidus</i> -type	-
SALK 9+a	2 + 2	S	MS	+/- free of vegetation	-	-
SALK10+a	3 + 3	N	LS	+/- free of vegetation	-	-
SALK 11	3	S	LS	+/- free of vegetation	-	-
SALK 12	3	S	LS	grass vegetation	<i>Juncus trifidus</i> -type	-
SALK13+a	2 + 2	N	FS	+/- free of vegetation	rock vegetation	-
SALK 14	3	S	FS	grass vegetation	<i>Deschampsia flexuosa</i> -type	-

Table 1 (continued)

Plot	Traps	Exp.	Relief pos.	Vegetation class	Vegetation type	Remarks
SALK 15	3	S	FS	snowbed vegetation	<i>Salix herbacea</i> -type	-
SALK16+a	2 + 2		saddle	lichen heath	<i>Cetraria nivalis</i> -type	-
SALK17+a	3 + 2	W	US	lichen heath	<i>Cetraria nivalis</i> -type	channel
SALK18+a	2 + 2	W	MS	lichen heath	<i>Cetraria nivalis</i> -type	channel
SALK 19	1		ridge	+/- no vegetation	rock vegetation	
VOLE 1	3		ridge	lichen heath	<i>Alectoria ochroleuca</i> -type	chionophobic
VOLE 2	3		ridge	lichen heath	<i>Alectoria ochroleuca</i> -type	chionophobic
VOLE 3	3		saddle	lichen heath	<i>Cetraria nivalis</i> -type	chionophobic
VOLE 4	3	S	US	lichen heath	<i>Cetraria nivalis</i> -type	chionophobic
VOLE 5	3	N	US	lichen heath	<i>Cetraria nivalis</i> -type	chionophobic
VOLE 6	3	S	MS	lichen heath	<i>Cladonia stellaris</i> -type	chionophobic
VOLE 7	3	S	MS	dwarf-shrub heath	<i>Vaccinium myrtillus</i> -type	early snow free
VOLE 8	3	S	MS	dwarf-shrub heath	<i>Calluna vulgaris</i> -type	early snow free
VOLE 9	2	N	MS	dwarf-shrub heath	<i>Vaccinium myrtillus</i> -type	early snow free
VOLE 10	3	N	MS	dwarf-shrub heath	<i>C. stellaris</i> – <i>B. nana</i> -type	early snow free
VOLE 11	3	S	LS	dwarf-shrub heath	<i>Calluna vulgaris</i> -type	early snow free
VOLE 12	3	N	LS	dwarf-shrub heath	<i>Vaccinium myrtillus</i> -type	early snow free
VOLE 13	4	S	FS	grass vegetation	<i>Nardus stricta</i> -type	late snow free
VOLE 14	3	N	FS	bog vegetation	<i>Sphagnum-Rubus</i> -type	wet
VOLE 15	3	N	FS	dwarf-shrub heath	<i>Vaccinium myrtillus</i> -type	early snow free
VOLE 16	2		valley floor	bog vegetation	<i>Sphagnum-Eriophorum</i> -type	very wet
VOLE 17	2		valley floor	bog vegetation	<i>Sphagnum-Eriophorum</i> -type	very wet
VOLE 18	3		valley floor	bog vegetation	<i>Sphagnum-Rubus</i> -type	wet
VOLE 19	3		valley floor	bog vegetation	<i>Sphagnum-Rubus</i> -type	wet
VOLE 20	3		valley floor	bog vegetation	<i>Sphagnum-Rubus</i> -type	wet
VOLE 21	3		valley floor	bog vegetation	<i>Sphagnum-Carex</i> -type	extremely wet
VOLE 22	4		valley floor	bog vegetation	<i>Sphagnum-Rubus</i> -type	with <i>B. nana</i> -shrubs
VOLE 23	3	W	MS + LS	dwarf-shrub bushes	<i>Salix ssp.</i> -type	
VOLE 24	4	W	US, MS + LS	lichen heath	<i>Cladonia stellaris</i> -type	
VOLE 25	3	N	US	dwarf-shrub bushes	<i>Betula nana</i> -type	
VOLE 26	3	NW	MS	dwarf-shrub bushes	<i>Betula nana</i> -type	
VOLE 27	4	S	US, MS + LS	dwarf-shrub bushes	<i>Betula nana</i> -type	
VOLE 28	3		valley floor	+/- no vegetation	rock vegetation	block field

The investigation areas (IA) of the RR Stranda are the IA BLÅF in the low alpine belt (~ 2 ha; approximately between 895 and 915 m a.s.l.) and the IA DALS in the middle alpine belt (~ 6.3 ha; between 1395 and 1435 m a.s.l.). The low alpine investigation area in the eastern research region is the IA VOLE (~ 3.1 ha; approximately between 1085 and 1095 m a.s.l.) and in the middle alpine belt, between 1420 and 1470 m a.s.l., the IA SALK (~ 3.8 ha). Intensive geo-ecological investigations involving VOLE and SALK have already been carried out since the early 1990<sup>ies</sup> (e.g. Köhler et al. 1994, Löffler 1998, Löffler & Wundram 1997, Wundram 1993). A detailed description of the eastern areas is given in Löffler (1998, 2002, 2003). By combining different data-sets

(vegetation, soil, water balance, exposure, inclination etc.) Löffler & Wundram (1997) denominated several ecotope types. Their classification scheme was used for selecting plots for the zoological component of the project. In the western areas plots for the zoological investigations were determined by the structural parameters vegetation, relief position, micro-scaled morphological surface structures, exposure and inclination. The total number of investigated ecotopes/plots is 96 including the sites in the subalpine belt and on the top of the highest peaks. In ecotopes characterized by the existence of both vegetation cover and block fields with almost no vegetation, both subplots were investigated separately (Table 1).



## MATERIALS AND METHODS

### Pitfall trapping

The epigeic beetles were caught with pitfall traps during the vegetation period 2001, between 2nd June and 2nd October. The traps were fairly similar to those used by Ellenberg et al. (1986) during the German IBP (International Biological Programme) project in Solling: a glass with a diameter of 5.5 cm at the rim and a depth of ~12 cm was screwed up with a PE-ring of 2.3 cm width. By means of this ring the glass was hung into a plastic tube that was permanently installed in the ground. The ring also carried a dull but transparent plexiglass plate (13.7 cm x 13.7 cm) fixed 5 cm above the opening of the glass as shelter against rain. The glasses held a 2.5 % formaldehyde solution (~ 100 ml) containing a detergent (Agepon®) used to reduce surface tension. The traps were emptied at a fortnightly interval. Thus, the whole trapping season was divided into nine trapping periods (TP). The ecotopes in each alpine investigation area were investigated in a representative manner and included most habitat types of the respective altitudinal belt (Table 1). A total of 300 traps were exposed during the investigation period.

### Species identification

At a family level the beetles were identified according to Freude et al. (1965). As far as possible the following groups were identified at species level using the mentioned literature: Byrrhidae (Paulus 1979), Carabidae (Dücker et al. 1997, Lindroth 1985, 1986), Chrysomelidae (Mohr 1966), Coccinellidae (Fürsch 1967), Curculionidae (Frieser 1981, Kippenberg 1981). The nomenclature follows this literature with the exception of *Otiorhynchus nodosus* (after Lundberg 1986, see Ottesen 1996).

### Data analysis

The *autochthony* of a species was estimated from the number of specimens collected in an area. Species were considered to be autochthonous, if the number of specimens was high and the environmental situation at the trapping position corresponded to the known species requirements.

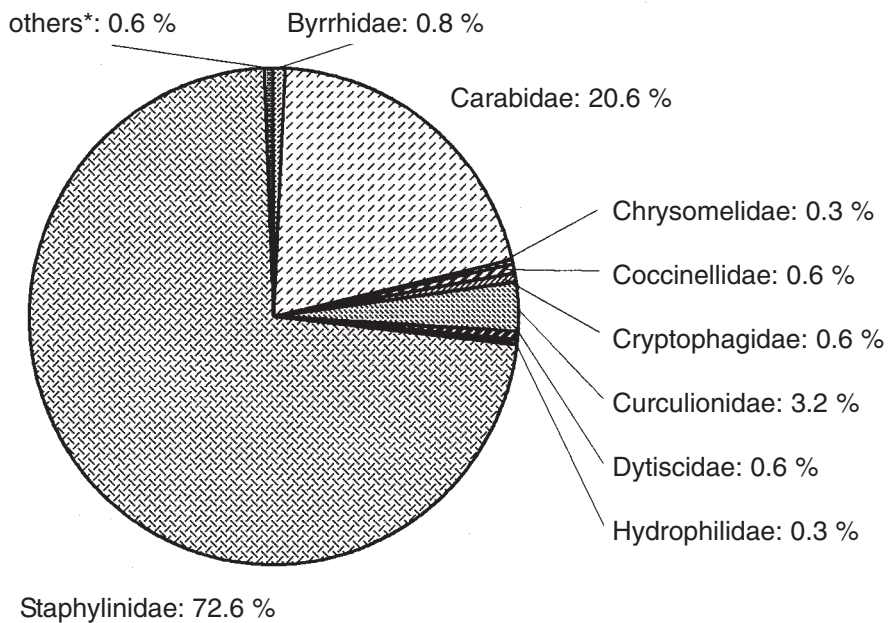
If species appeared within the traps only with a few individuals, further evidences of their indigeneity were searched. Such evidences were natural rareness, findings of larvae etc.

The *excellence of the investigation intensity* was estimated by analysing the cumulative species increase with a rising number of traps. Three graphs can be thus produced:

- 1) The pessimal graph was obtained by taking the trap with the lowest species number into consideration first, afterwards the trap with the next higher species number and so on.
- 2) To obtain the optimal graph the analyses started with the trap with the highest species number, afterwards the one with the second highest number and so on.
- 3) The random graph shows the cumulative species increase by taking the traps into consideration randomly. To obtain this graph a random number was assigned to each trap. Afterwards the traps were sorted and the species increase was analysed. Repeating this step ten times made calculations of means and standard deviations possible.

As a second procedure to analyse the excellence of the investigation intensity Jackknife analyses were used which, depending on the applied trapping method, estimate the “real” number of species detectable. By subtracting the number of species detected from the estimated “real species number” an estimate was obtained for the number of species that were potentially not observed.

The “1st-order Jackknife” procedure was used after Heltshe & Forrester (1983) and gives an estimate of the “real species number” within a certain investigation area by paying attention to the number of species only found in one trap (= “unique species”). The “2nd-order Jackknife” procedure (Palmer 1991) estimates the “real species number” by including also the number of species found in only two traps (= “duplicates”) into the calculation. The excellence of the investigation intensity was analysed only for ground beetles.



**Figure 2.** Dominance spectrum of beetle families in the investigated high mountain areas (in %, n = 3816). \* «others» include the following families with a dominance lower than 0.28 %: Anthicidae (0.03 %), Canthidae (0.21 %), Catopidae (0.21 %), Elateridae (0.03 %), Lathridiidae (0.03 %), Ptinidae (0.03 %) and Scarabaeidae (0.05 %).

*Dominance (D)* values obtained from pitfall trapping depend mainly on the species epigeic locomotion activity and the species-specific reaction at the rim of a trap. As the dominance is regularly calculated for catches with different totals of individuals, we calculated it mainly in order to facilitate comparisons with other investigations. Furthermore, dominance values are the basis for the Renkonen Index (see below).

The *preference* of a species for an ecotope was ascertained by an analysis of its activity. It expresses a mean individual number per trap and day: the total number of individuals is divided by the trap days (TD = added number of days of all traps displayed within one test site or ecotope) and multiplied with 100.

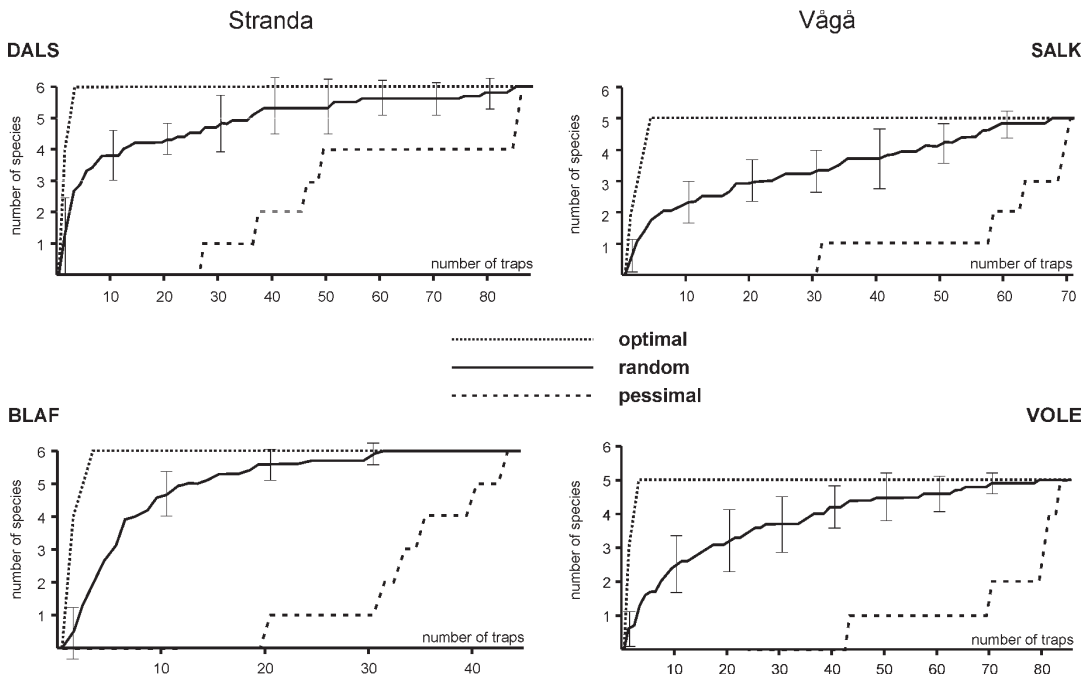
To identify *characteristic species* of a certain ecotope type, the species frequency within ecotopes was calculated. The frequency is the proportion of traps containing a certain species in relation to the total number of traps within one test site. Only species with a high frequency were considered to be characteristic, although species

with a low frequency can be characteristic, too. But, in this study i) the investigation period was too short to estimate how characteristic such species with a low frequency might be and ii) for practical reasons only those species should be classified as “characteristic” that are found within an ecotope with relatively high probability (Schultz & Finch 1996).

*Agrell’s index* was used to find characteristic species communities within the dataset. It expresses the proportion of traps of an investigation area containing two (or more) selected species (Balogh 1958). The results were compared with distribution maps.

Ecological resemblance was analysed using the Jaccard index after Legendre & Legendre (1998), which gives the proportion of species being present in both areas, as well as using the *Renkonen’s coefficient* (Re), which is a measure of dominance identity of two areas (Balogh 1958).

Only ecotopes being investigated with two or more traps were considered to be examined



**Figure 3.** Cumulative increase of species number in the four investigation areas estimated from different numbers of traps.

representatively. The catches from ecotopes where only one trap was installed were only considered during the analyses of species distribution, activity and dominance.

## RESULTS

### General results

During the trapping season altogether 3816 individuals of 16 beetle families were caught. The rove beetles were dominant (Staphylinidae) with 2770 specimens followed by the ground beetles (Carabidae, 786 specimens) and weevils (Curculionidae, 122 specimens) (Table 2, Figure 2). The other families occurred with less than 30 individuals each. Staphylinidae, that were not identified at species level during this part of the project, were the spatially most widespread family: they occurred in almost every ecotope of the four investigation areas. Even in the block fields they were caught more or less regularly.

The dominance relations between the families were similar within single investigation areas. There were minor deviations just in a few cases. For example, lady beetles (Coccinellidae) and diving beetles (Dytiscidae) were found only in the low alpine IA VOLE. Byrrhidae were most abundant in the middle alpine IA DALS, whereas just single individuals were caught at the other sites.

Apart from ground beetles and leaf beetles (Chrysomelidae), within the families identified to species level only one species was dominant and others only appeared with one single or few specimens. For example, within the 122 caught weevils *Otiorhynchus nodosus* was dominant (119 ind.) and occurred in the subalpine birch forest as well as above timberline. None of the identified species is very rare in Norway or mentioned in the Norwegian Red Data Book (Direktoratet for Naturforvaltning 1999).

Within the carabid beetles a total of 17 species were recorded (Table 2). This is approximately 6.3 % of the carabid species known in Norway (Ottesen 1993). Fourteen species occurred in the RR Vågå. Six of them were not found in the RR Stranda. In Stranda 11 species were recorded, three of which were exclusive. Within a single investigation area five or six species were caught. Two species were observed on the highest peaks, whereas the number of species was highest (seven species in the west, nine in the east) in the subalpine sites, although here only three pitfall traps were exposed at each site.

### Excellence of investigation intensity

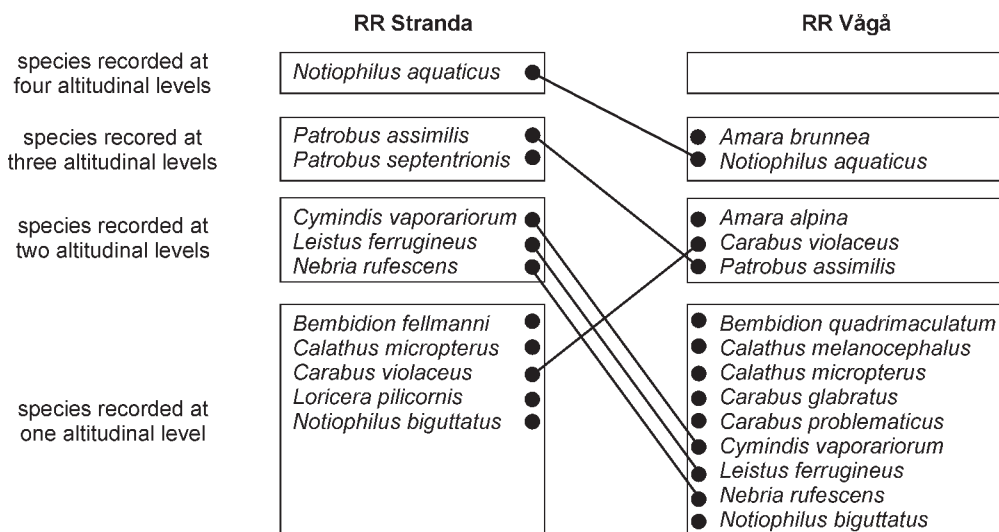
For carabids the excellence of the investigation intensity was judged for the research regions as well as for single investigation areas. Cumulative species-graphs indicated the number of traps per investigation area as being large enough to detect most of the species present (Figure 3). This is not valid for the subalpine sites and those at the highest peaks, where a single plot was investigated with only three traps, paying too little attention to the structural richness in these altitudinal belts.

Taking VOLE as an example, it can be shown that the optimal graph describes an unrealistic case.

After displaying three traps, all observed species would have been caught. The pessimal graph also describes an unrealistic scenario, but one could assume that the number of traps used during this study was not too large. If just a few traps less had been installed in the field, some of the species probably would not have been found at all. On the other hand, the random graph seems to describe a quite realistic situation. Approximately 50 % of the species present would have been detected with a number of ten traps randomly displayed. After a hypothetical installation of 40 traps about 80 % of the species would have been caught, and it would have required a minimum of 79 traps to detect all species.

Similar statements can be made for the other areas, lower trap numbers usually yielding higher percentages of species within the western areas than in the eastern areas, thus suggesting differences in the activity patterns.

Statistically, estimated maximum species numbers detectable with pitfall traps are just a little higher than the total number of species recorded in most investigation areas (Table 3). A possible exception is SALK, where the Jackknife calculation estimated further 3 – 6 species.



**Figure 4.** Distribution of carabid beetles along the altitudinal gradient described by the two research regions (RR).



**Table 2.** List of Coleoptera families and identified species (D = dominance - only given for the identified species of the respective family, IA = investigation area, indet. = not identified species, RR = research region, TL = subalpine site near tree-line, Top = site at the highest peaks; for carabids additionally: G = altitudinal generalist, h = hygrophilous, o/r = occasional/regional, S = altitudinal specialist, x = xerophilous).

Family	RR Stranda				RR Vågå				Sum D
	TL	IA BLÅF	IA DALS	Top	TL	IA VOLE	IA SALK	Top	
	<b>Number of traps</b>								
	<b>Species</b>								
<b>Anthicidae</b>									
<b>Byrrhidae (sum)</b>									
	1	2	24	1				1	1
<i>Byrrhus fasciatus</i> (Forster, 1771)		2	24	1				1	29
indet.	1								28
									96.6
<b>Cantharidae</b>									
<b>Carabidae (sum)</b>									
	16	60	234	6	1	3	206	5	786
<i>Absidia schoenherrii</i> (Dejean, 1837)		4			42	217	189		362
<i>Amara alpina</i> (Paykull, 1790)					5	8	1		14
<i>A. brunnea</i> (Gyllenhal, 1810)									1.8
<i>Bembidion fellmanni</i> Mannerheim, 1823			34						34
<i>B. quadrimaculatum</i> (L., 1761)							1		1
<i>Calathus melanocephalus</i> (L., 1758)					8				8
<i>C. micropterus</i> (Duftschmid, 1812)	3				3				6
<i>Carabus glabratus</i> Paykull, 1790					3				3
<i>C. problematicus</i> Herbst, 1786							1		1
<i>C. violaceus</i> L., 1758	2				6	1			9
<i>Cymindis vaporariorum</i> (L., 1758)		1	1			2			4
<i>Leistus ferrugineus</i> (L., 1758)	1	3			2				6
<i>Loricera pilicornis</i> (Fabricius, 1775)	1								1
<i>Nebria rufescens</i> (Strom, 1768)		14	13					2	29
<i>Notiophilus aquaticus</i> (L., 1758)	2	4	90	2	1		30	3	132
<i>N. biguttatus</i> (Fabricius, 1779)	5				3				8
<i>Patrobus assimilis</i> Chaudoir, 1844	2	28	2	4	11	17			60
<i>P. septentrionis</i> Dejean, 1828		10	94						108
									13.7

Table 2 (continued)

Family	RR Stranda			RR Vågå			Sum D
	TL	IA BLÅF	IA DALS Top	TL	IA VOLE	IA SALK Top	
	3	44	87	3	85	70	4
	<b>Number of traps</b>						
	<b>Species</b>						
<b>Catopidae</b>	2	2		2	2		8
<b>Chrysomelidae (sum) 3 species</b>		6	1		4	4	11
<i>Chrysomela collaris</i> L., 1758			1				5
<i>Goniocтена arctica</i> (Mannerheim, 1853)		2					2
<i>G. pallida</i> (L., 1758)		4					4
<b>Coccinellidae</b>					22		22
<i>Coccinella trifasciata</i> (L., 1758)					2		22
<b>Cryptophagidae</b>	1	30	39	8	41	2	122
<b>Curculionidae (sum) 4 species</b>	1	30	38	7	40	2	119
<i>Otiorynchus nodosus</i> (O.F. Müller, 1764)				1			1
<i>Polydrusus ruficornis</i> (Bonsdorff, 1785)					1		1
<i>Orbittis cyaneus</i> (L., 1758)							1
indet.			1				1
<b>Dytiscidae</b>					21		21
indet.		1					1
<b>Elateridae</b>		2	2		3	4	11
<b>Hydrophilidae</b>				1			1
<b>Lathridiidae</b>							1
<b>Ptinidae</b>			1				1
<b>Scarabaeidae (sum) 2 species</b>				2			2
<i>Aphodius rufipes</i> (L., 1758)				1			1
<i>A. lapponum</i> Gyllenhal, 1806				1			1
indet.	102	318	835	250	775	472	2770
<b>Staphylinidae</b>	122	445	1136	306	1086	688	3816
<b>Coleoptera (sum)</b>							16

**Table 3.** Maximum species number estimated using the Jackknife Indexes (B + D and V + S = estimated “real species number“ of the whole alpine region; jack1 = “1st order Jackknife“-procedure, jack2 = “2nd order Jackknife“-procedure, TL = subalpine site near tree-line).

IA/plot	Stranda				Vågå			
	TL	BLÅF	DALS	B + D	TL	VOLE	SALK	V + S
Species recorded	7	6	6	7	9	5	5	8
Estimated species number ( $S_{\text{jack1}}$ )	9.0	6.9	6.9	7.0	11.0	5.9	7.9	10.9
Estimated species number ( $S_{\text{jack2}}$ )	9.3	7.0	7.0	5.0	1.3	6.0	10.8	12.9

### Spatial distribution of carabid beetles

Five of the 17 species were caught only in the subalpine belt, five appeared in the subalpine as well as in the alpine areas, and seven species were restricted to the alpine altitudinal level (Table 2).

Eight species were recorded in both research regions along the oceanic-continental gradient. The overlap in the species spectrum was high when comparing the subalpine sites, but when comparing the investigation areas of the alpine belts there was just a little overlap. Two species (*C. vaporariorum* and *P. assimilis*) were common in both low alpine investigation areas, and only one species (*N. aquaticus*) was present in both middle alpine areas (Table 2). A comparison of the investigation areas in each research region showed that there was a comparatively little overlap of the species spectrum along the altitudinal gradient in the eastern areas. Only *A. alpina* and *A. brunnea* were found in both VOLE and SALK. The species spectra of the western areas BLÅF and DALS were more similar. Five species occurred in both areas, while *L. ferrugineus* was caught only in BLÅF and *B. fellmanni* was caught exclusively in DALS (Figure 4).

The activity of all beetles in the investigation areas BLÅF, SALK, and VOLE was quite similar (results around 10 ind.\*100/TD; see Table 4). In the middle alpine IA DALS beetles were more active (about 15 ind.\*100/TD). The total activity of ground beetles was similar in DALS and SALK

(~ 3 ind.\*100/TD). In VOLE it was lower (~ 2 ind.\*100/TD) and in BLÅF it was clearly lowest only slightly exceeding 1 ind.\*100/TD.

The activity of ground beetles and of all Coleoptera at the highest elevations of each research region showed almost no differences. The subalpine sites differed, as activity was much higher in the eastern continental subalpine site.

The dominance identity shows that the most similar investigation areas were the eastern areas SALK and VOLE (Table 5). Their Renkonen identity was 84.5 %. Although the western areas BLÅF and DALS have a similar spectrum of species, the dominance identity was quite low.

Nilsson et al. (1993) mentioned 15 of the carabid species recorded in this study: Four species are considered to be altitudinal specialists, seven are altitudinal generalists and four are “occasional/regional species” (Table 2). *Bembidion quadrimaculatum* and *Calathus micropterus* were not mentioned by Nilsson et al. (1993). Both research regions were fairly similar regarding the species distribution of altitudinal specialists and generalists (Figure 5). Within the RR Stranda the three groups occurred with almost the same species numbers and there was no significant difference to the RR Vågå ( $\chi^2 = 1.006$ ,  $p = 0.8$ ). In both regions a few altitudinal specialists were the most abundant. Numbers of individuals in the different classes differ significantly between both regions, with a higher proportion of altitudinal specialists in Vågå ( $\chi^2 = 50.52$ ,  $p < 0.001$ ).

**Table 4.** Total activity of all coleoptera and of carabids within the investigation areas and at the additional sites (TD = trap days, TL = subalpine site near tree-line, activity = ind.\*100/TD; total TD Vågå = 17633, total TD Stranda = 13044).

	IA/plot	TD	Total Coleoptera	Activity of Coleoptera	Total Carabidae	Activity of Carabidae
Vågå	Vågå TL	360	306	85.0	42	11.7
	VOLE	9773	1086	11.1	217	2.2
	SALK	7124	688	9.7	206	2.9
	Vågå Top	376	16	4.3	5	1.3
Stranda	Stranda TL	348	122	35.1	16	4.6
	BLÅF	4488	445	9.9	60	1.3
	DALS	7832	1136	14.5	234	3.0
	Stranda Top	376	17	4.5	6	1.6

**Table 5.** Trellis diagram based on the species identity (Jaccard Index; lower left half) and dominance identity (Renkonen Index; upper right half) of the investigation areas.

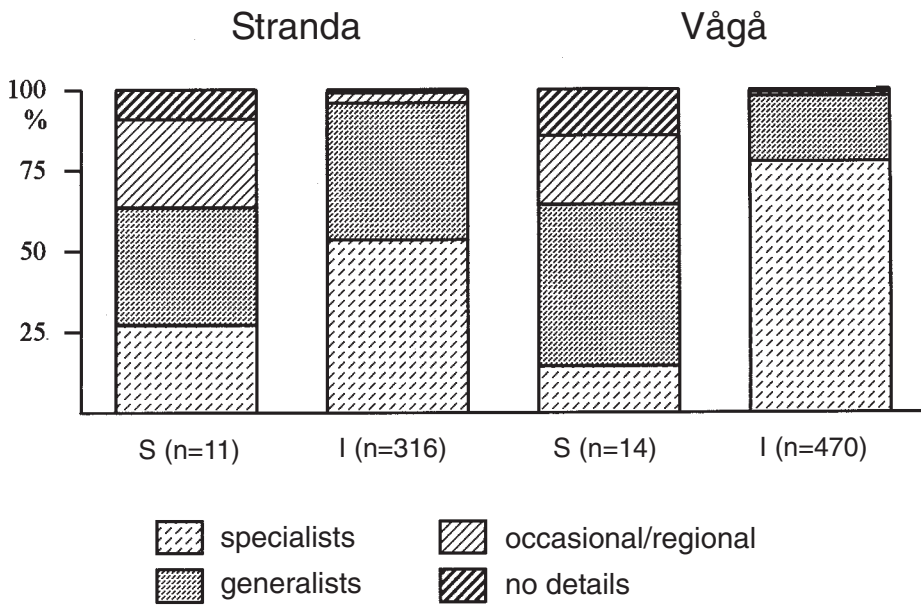
IA	VOLE	SALK	BLÅF	DALS
VOLE		84.5	8.8	1.3
SALK	25		6.7	14.6
BLÅF	20	10		30.3
DALS	20	10	70	

Hygrophilous and xerophilous species were classified according to the data of Koch (1989), Lindroth (1945, 1985, 1986), Nilsson et al. (1993) and Wachmann et al. (1995). Six species are considered to be hygrophilous and eight are xerophilous. For the remaining three species data were not available or were very contradictory (Table 2). Regarding the distribution of hygrophilous and xerophilous species, both research regions are clearly differentiated (Figure 6). In the oceanic RR Stranda most species were hygrophilous, while the number of xerophilous species was highest in the continental RR Vågå. Unfortunately, due to the overall small number of species, these differences were not significant ( $\chi^2 = 3.16$ ,  $p = 0.2$ ). The proportions of individuals in the different groups changed significantly along the oceanic-continental gradient ( $\chi^2 = 509.38$ ,

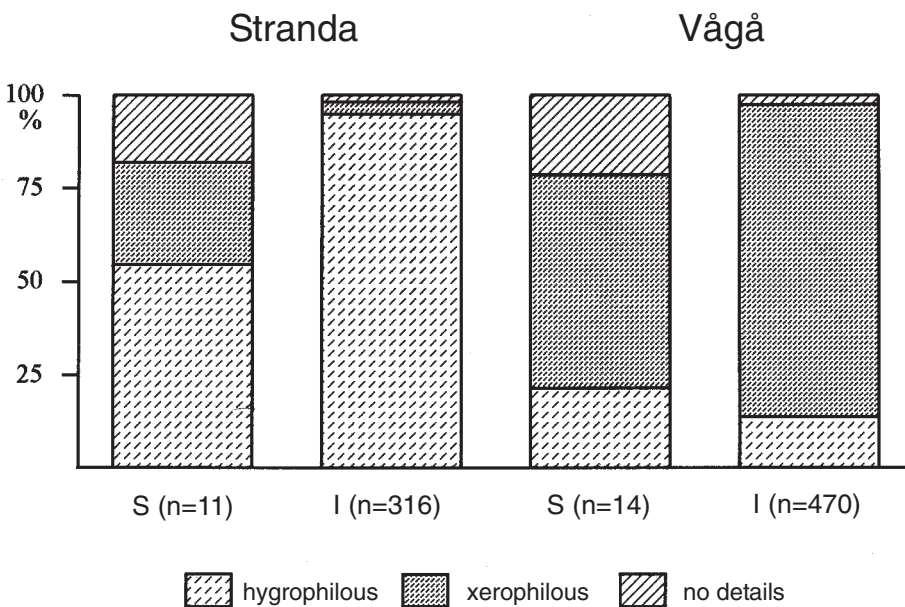
$p < 0.001$ ). In Stranda the hygrophilous species totalled up to 95 % of the individuals, whereas, in Vågå, they contributed only to 14 % of the total catch. Xerophilous species made up only 3 % of the catch in the oceanic west, but were the predominant group in the continental region (83 %).

### Characteristic species and carabid communities

Activity analyses together with frequency calculations made it possible to define characteristic species of certain larger spatial units, which in some cases reflect the spatial distribution of vegetation classes (see Table 1). But the very fine-grained patch configuration of ecotopes in the high mountain ecosystems is not reflected by similar fine-grained distribution patterns of carabids. In most cases the distribution patterns of ground beetles corresponded well to the known species requirements and most species caught within a single investigation area were considered to be autochthonous there. Only *A. brunnea* and *B. quadrimaculatum* might not be autochthonous in SALK. Both species are not typical inhabitants of middle alpine areas. Calculations with Agrell's index showed that more ecotopes accommodated communities with two or more species in the oceanic region than those in the continental region, where in numerous ecotopes only one species



**Figure 5.** Percentages of altitudinal specialists, altitudinal generalists and occasional/regional carabid beetles (S = species, I = individuals).



**Figure 6.** Percentages of hygrophilous and xerophilous carabid beetles (S = species, I = individuals).



occurred. In the following, characteristic carabid species and communities of certain habitats will be described.

*Oceanic low alpine area (IA BLÅF)*

Within the oceanic low alpine area two species were characteristic of certain habitats (Table 6). *N. rufescens* was the characteristic species of the moss dominated ecotopes, over skeletal soil in the vicinity of a brook. *P. assimilis* was most characteristic of ecotopes in lower slope positions and at the valley bottom with 50 – 70 cm high dwarf-shrub vegetation dominated by *Salix* spp.. *P. assimilis* and *P. septentrionis* formed the most characteristic community, which occurred mainly in the ecotopes mentioned above.

*Oceanic middle alpine area (IA DALS)*

The widespread species *N. aquaticus* and *P. septentrionis* and their co-occurrence were most characteristic within the ecotopes - especially the south-exposed - with dense lichen or/and dwarf-shrub vegetation (Table 7).

*B. fellmanni*, which also often occurred together with one or both of the species mentioned above, was more characteristic within ecotopes in slope positions with a sparse moss and lichen vegetation or in *Salix herbacea*- and *Ranunculus glacialis*-snowbeds, respectively. Additionally, *N. rufescens* can be defined as characteristic species of valley bottoms dominated by wet moss.

*Continental low alpine area (IA VOLE)*

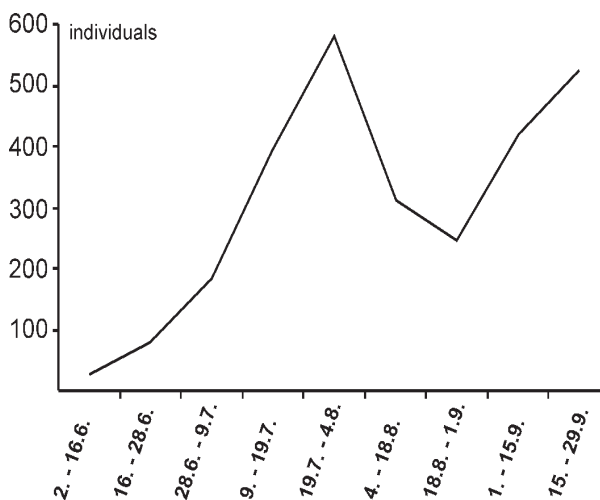
*A. alpina* was the characteristic species of lichen-heaths and lichen-rich dwarf-shrub vegetation types at higher relief positions, especially on the ridges and their surroundings (Table 8). It was stenotopic within these habitats, which are snow free early in spring or even during the whole winter.

*P. assimilis* was highly frequent and relatively abundant in dwarf-shrub dominated vegetation types of lower slope positions and valley bottoms with a higher humidity (e.g. *Vaccinium myrtillus*-heaths and *Betula nana*-stands).

A clear spatial separation of *A. alpina* and *P. assimilis* existed within the continental low alpine

**Table 6.** Communities of carabid beetles and frequency values of species in single studied plots of the oceanic low alpine area (IA BLÅF) (for further details see Table 1).

Plot	<i>C. vaporariorum</i>	<i>L. ferrugineus</i>	<i>N. rufescens</i>	<i>N. aquaticus</i>	<i>P. assimilis</i>	<i>P. septentrionis</i>
BLÅF 1	-	-	-	-	-	-
BLÅF 2	-	-	-	-	100	-
BLÅF 3	-	-	-	-	-	-
BLÅF 4	-	-	-	-	33	67
BLÅF 5	-	-	-	-	33	-
BLÅF 6	-	-	-	50	50	50
BLÅF 7	33	-	-	-	-	-
BLÅF 8	-	-	33	-	67	33
BLÅF 9	-	-	-	-	-	-
BLÅF 10	-	-	-	-	100	-
BLÅF 11	-	-	-	-	50	-
BLÅF 12	-	-	-	-	67	33
BLÅF 13	-	-	-	-	-	-
BLÅF 14	-	-	100	33	-	33
BLÅF 15	-	67	33	33	100	33



**Figure 7.** Phenology of rove beetles (Staphylinidae).

**Table 7.** Communities of carabid beetles and frequency values of species in single studied plots of the oceanic middle alpine area (IA DALs) (for further details and explanations see Table 1 and 6).

Plot	<i>B. fellmanni</i>	<i>C. vaporariorum</i>	<i>N. rufescens</i>	<i>N. aquaticus</i>	<i>P. assimilis</i>	<i>P. septentrionis</i>
DALS 1	67	-	-	67	33	67
DALS 2	-	-	-	67	-	100
DALS 3	-	-	-	33	-	100
DALS 4	-	-	-	100	-	67
DALS 5	-	-	-	67	-	100
DALS 6	-	33	-	100	33	100
DALS 7	33	-	-	100	-	100
DALS 7a	67	-	-	-	-	-
DALS 8	33	-	-	100	-	67
DALS 9	-	-	-	100	-	100
DALS 10	100	-	-	100	-	33
DALS 11	100	-	-	-	-	67
DALS 12	67	-	33	-	-	-
DALS 13	100	-	-	50	-	-
DALS 13a	-	-	-	-	-	-
DALS 14	33	-	33	-	-	-
DALS 15	100	-	-	100	-	67
DALS 16	-	-	-	-	-	-
DALS 17	33	-	-	33	-	67
DALS 18	33	-	-	33	-	100
DALS 19	100	-	-	-	-	33
DALS 20	50	-	-	-	-	-
DALS 20a	-	-	-	-	-	-
DALS 21	-	-	-	-	-	50
DALS 21a	-	-	-	-	-	-
DALS 22	-	-	-	-	-	33
DALS 22a	-	-	-	-	-	-
DALS 23	33	-	100	-	-	67
DALS 24	-	-	-	-	-	67
DALS 25	-	-	-	-	-	-
DALS 26	-	-	-	-	-	50
DALS 27	-	-	-	-	-	-

area. Furthermore, *A. alpina* and *A. brunnea* formed a characteristic community within lichen-rich vegetation types at ridges and south-exposed upper slopes.

### Continental middle alpine area (IA SALK)

In the continental middle alpine area only *A. alpina* and *N. aquaticus* were observed with more than one individual. Here, in contrast to the continental low alpine area (see above), *A. alpina* was more widespread and eurytopic (Table 9). Although it seemed to prefer early snow-free habitats at the ridge and north-exposed upper slope with sparse lichen vegetation, it was also highly frequent and active in other ecotopes (e.g. the north-exposed lower slope with sparse moss- and *Cassiope hypnoides*-vegetation, south-exposed middle slope areas with dense grass vegetation or *Salix herbacea*-snowbeds). Only within very moist habitats and in south-exposed foot-slope positions *A. alpina* was not observed.

*N. aquaticus* was the characteristic species at south-exposed foot-slope positions with dense *Salix herbacea* vegetation and within the south-exposed middle slope with dense grass vegetation dominated by *Carex bigelowii*.

### Phenology

The adults of most beetle families showed highest activity during spring time (e.g. Byrrhidae, Coccinellidae). Cryptophagidae were summer active. As all of these families were only sparsely recorded they are not presented in detail.

The dominant rove beetles (Staphylinidae) showed a high activity during summer and autumn (Figure 7). In contrast, carabid beetles were also spring active. A good example is *Amara alpina* (Figure 8) which occurred at both continental investigation areas. This species was most active at the beginning of July. In the second half of the vegetation period the number of individuals caught during one trapping period increased slightly. Despite an overall small number of individuals it seems that in the middle alpine IA SALK this increase took place one trapping period earlier (period between the beginning and the middle of August) than in the low alpine IA VOLE (middle of August until beginning of September) (Figure 9).

Changes in phenological patterns along the altitudinal gradient were observed for the

**Table 8.** Communities of carabid beetles and frequency values of species in single studied plots of the continental low alpine area (IA VOLE) (for further details and explanations see Table 1 and 6).

Plot	<i>A. alpina</i>	<i>A. brunnea</i>	<i>C. violaceus</i>	<i>C. vaporariorum</i>	<i>P. assimilis</i>
VOLE 1	100	33	-	33	-
VOLE 2	100	-	-	-	-
VOLE 3	100	-	-	-	-
VOLE 4	100	33	-	-	-
VOLE 5	100	-	-	-	-
VOLE 6	67	33	-	-	-
VOLE 7	100	-	-	33	-
VOLE 8	-	-	-	-	-
VOLE 9	100	-	-	-	-
VOLE 10	67	-	-	-	-
VOLE 11	-	-	-	-	33
VOLE 12	100	-	-	-	-
VOLE 13	-	-	-	-	-
VOLE 14	-	-	-	-	33
VOLE 15	-	-	-	-	-
VOLE 16	-	-	-	-	100
VOLE 17	-	-	-	-	-
VOLE 18	-	-	-	-	-
VOLE 19	-	-	-	-	-
VOLE 20	-	-	33	-	-
VOLE 21	-	-	-	-	-
VOLE 22	-	25	-	-	100
VOLE 23	-	-	-	-	33
VOLE 24	75	-	-	-	-
VOLE 25	33	-	-	-	-
VOLE 26	-	-	-	-	-
VOLE 27	-	-	-	-	50
VOLE 28	-	-	-	-	-

Curculionidae, with the dominant species *Otiorhynchus nodosus*, which comprises 97.5 % of the total catch (Figure 10). In the low alpine areas BLÅF and VOLE the activity was highest in one of the first trapping periods, but only in VOLE the activity continued to be relatively high

**Table 9.** Communities of carabid beetles and frequency values of species in single studied plots of the continental middle alpine area (IA SALK) (for further details and explanations see Table 1 and 6).

Plot	<i>A. alpina</i>	<i>A. brunnea</i>	<i>B. quadrimaculatum</i>	<i>C. problematicus</i>	<i>N. aquaticus</i>
SALK 1	100	-	-	50	-
SALK 2	100	-	-	-	-
SALK 2a	50	-	-	-	-
SALK 3	67	-	-	-	-
SALK 3a	33	-	-	-	-
SALK 4	50	-	50	-	-
SALK 4a	-	-	-	-	-
SALK 5	50	-	-	-	-
SALK 5a	50	-	-	-	-
SALK 6	33	-	-	-	100
SALK 7	100	-	-	-	-
SALK 7a	50	-	-	-	-
SALK 8	100	-	-	-	-
SALK 9	100	-	-	-	100
SALK 9a	-	-	-	-	-
SALK 10	100	-	-	-	-
SALK 10a	-	-	-	-	-
SALK 11	33	33	-	-	-
SALK 12	-	-	-	-	-
SALK 13	50	-	-	-	-
SALK 13a	-	-	-	-	-
SALK 14	-	-	-	-	67
SALK 15	67	-	-	-	100
SALK 16	-	-	-	-	-
SALK 16a	-	-	-	-	-
SALK 17	67	-	-	-	-
SALK 17a	-	-	-	-	-
SALK 18	100	-	-	-	-
SALK 18a	100	-	-	-	-

until the middle of the season. In the middle alpine IA DAL S *O. nodosus* was summer active with quite a high activity until the beginning of September.



**Figure 8.** *Amara alpina* was the dominant carabid beetle in this study. It was recorded only in low and middle alpine altitudes of the continental research region (Photo: O.-D. Finch).

## DISCUSSION

### Species richness and numbers of individuals

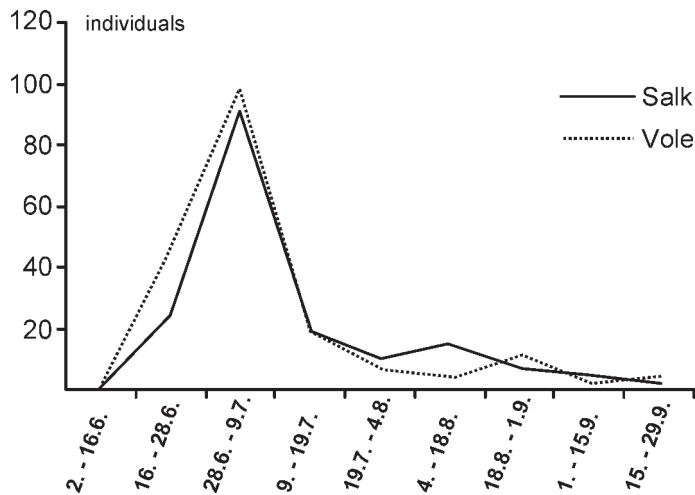
In relation to the high intensity of the investigation (altogether 300 pitfall traps with a total of 30677 trap days) the total number of adult beetles caught was quite low (3816 trapped individuals). Ottesen (1995), for example, caught 8380 individuals with 133 pitfall traps during a snow free season in different middle alpine habitats of the Hardangervidda. The number of beetle families recorded per research region (Vågå = 14, Stranda = 11) was only slightly lower compared to the number from the Hardangervidda (16 families; Ottesen 1996). Such values seem to be typical of alpine regions of Fennoscandia, and they are low when compared with investigations at lower altitudinal levels. Krogerus (1960), for example, investigated Fennoscandian bogs and mentioned 11 beetle families in the subalpine and alpine region. In contrast, he observed 28 families at the altitudinal level of the boreal coniferous forest.

In both research regions the number of families decreased from the low to the middle alpine belt. In both low alpine areas (9 – 10 families) and in both middle alpine areas (5 – 7 families), respectively, the number of families was similar.

Regarding the observed number of species we estimated the excellence of the investigation as being high for the main investigation areas. Thus, the investigations can be assumed as being sufficiently representative. Despite a lot of criticism (e. g. Topping & Sunderland 1992, Sunderland et al. 1995 and others), especially in high mountain entomology pitfall trapping bears its advantages (see also Bell & Wheeler 2001): Besides epigeic taxa in the low vegetated habitats also many species living mainly on plants are caught in quite high numbers. Also, several Norwegian authors who assessed the spectrum of arthropods in alpine habitats confirmed the usefulness of this method (Hågvar et al. 1978, Ottesen 1996).

The number of traps used per investigation area during this study seems to be sufficient (Figure 3), and the Jackknife analyses suggests that the number of carabid species that may have been overlooked was quite low, at least within three investigation areas (Table 3). The diverging result for SALK seems to be unrealistic and obviously influenced by the calculation method of the Jackknife procedures in which unique species and duplicates are most important for the estimation. In SALK three out of five species were unique species, but at least two of those (*Amara brunnea* and *Bembidion quadrimaculatum*) were possibly allochthonous. None of these two species are typical of middle alpine regions, both are small and long-winged, and flight activity was observed (Turin 2000). They might be drift material as defined by Janetschek (1974). Thus, in SALK the number of overlooked species is probably overestimated by the Jackknife procedure.

For ground beetles the total number of species and caught individuals were low for single investigation areas (e.g. DAL5: 6 species, 234 individuals). Such low species numbers are not untypical within Norwegian high mountain



**Figure 9.** Phenology of *Amara alpina* in both continental investigation areas.

ecosystems where no endemic carabid species exist. They are in strong contrast to the Italian Alps and Apennines, for example, where the alpine zones are inhabited by at least 180 ground beetle species (Brandmayr et al. 2003). For all of Scandinavia and Finland Lindroth (1944) mentioned 354 carabid species, 72 of these species being present in alpine regions. In conformity with our results, Ottesen (1996) also observed a low species richness at a single site in alpine regions of the Hardangervidda (13 species). Østbye & Hågvar (1996) recorded seven carabid species in low alpine habitats of the International Biological Programme (IBP) sites in the Hardangervidda during the early 1970ies. Quite rich in species (14 species) were the carabid communities in low alpine areas in the Sjødalen (Jotunheimen) investigated by Refseth (1980); as in the present study, also single or few species dominated the ground beetle communities, while the remaining species occurred in low number. Trying to interpret the low carabid species richness in the Scandes, Brandmayr et al. (2003) concluded that this mountain chain is clearly at an early stage of faunal colonisation in comparison to other alpine regions.

The well-known decline in species number from lower to higher altitudinal levels (Pianka 1966, Sømme 1989) just becomes obvious in our data when the results from the subalpine sites and the low alpine areas are compared. Strikingly, by investigating a single site using only three traps, more species were recorded than in the intensively examined alpine investigation areas with a number of traps between 44 and 87 per site. As already mentioned by Ottesen (1996), no rapid decline of species numbers was observed for carabid beetles above tree line.

The decrease of species numbers from eastern to western Norway in the investigation areas above timberline amounted to only two species, comprising a species loss of about 20 % along this continental to oceanic gradient. If, as already suggested, *Bembidion quadrimaculatum* is not autochthonous above timberline in the eastern region, this trend is lost nearly totally.

#### **Distribution and activity of carabid beetles**

Ottesen (1996) mentioned that carabid species might have an unusually high locomotory activity in suboptimal habitats, because they should move



more intensively while searching for food or an optimal surrounding. However, during this study the recorded carabid beetles showed predominantly a high activity in habitats that correspond quite well to their environmental requirements known from literature. So our data seemed not to be strongly affected by this phenomenon. *Notiophilus aquaticus*, usually preferring drier habitats (Lindroth 1985, Nilsson *et al.* 1993), was found to be more hygrophilous in our data set. In the continental middle alpine area its distribution was mainly limited to wetter south-exposed foot-slope positions. In contrast to this, it was widespread in the oceanic middle alpine area, where it often occurred together with *Bembidion fellmanni* and *Patrobus septentrionis*, both being considered hygrophilous as well.

The distribution of hygrophilous and xerophilous species and their respective proportion of individuals differed between eastern and western Central Norway. For example, the xerophilous *Amara alpina* was only found in the continental region, whereas the hygrophilous *Bembidion fellmanni* and *Patrobus septentrionis* were recorded in the oceanic region only. This could be explained by the extreme climatic differences between eastern and western Norway. The investigation of Refseth (1980) in the Sjødalen area (Jotunheimen; 61°30'N, 8°50'E), situated

well between the two regions investigated during our study (geographically as well as regarding the oceanic-continental gradient), is useful for comparison in this context. There, in the transition zone between the oceanic and the more continental parts of Central Norway, *A. alpina* and *P. septentrionis* were observed together, sometimes even in the same habitat.

Xerophilous species are probably under-represented in the western oceanic region, because there even sites that are commonly well drained, on ridge and slope positions, are mostly wet as a result of the high precipitation. In comparison, hygrophilous species are quite well represented in the continental region, where wetter habitats persist even during the driest summer months. There, moisture might also be an important factor influencing the small-scaled distribution of species, and might be responsible for the spatial separation of *A. alpina* and *P. assimilis* in VOLE. According to Ottesen (1996), apart from temperature moisture is the most important factor determining the distribution of Coleoptera. Important factors for the distribution of alpine plants (e.g. snow-cover during winter, time of snow-melt, morphodynamics) seem to be less important for the mobile animals (Ottesen 1996). However, our results suggest that snow-cover might influence species activity. A beetle activity

**Table 10.** Characteristic carabid beetles of certain high mountain habitats.

	Recorded at	Occurrence	Vegetation
<i>Amara alpina</i>	continental region: low alpine middle alpine	stenotopic at ridges & slopes widespread	lichen heath/ lichen-rich dwarf-shrub veg. also: sparse veg., snow-bed & grass dominated veg.
<i>Notiophilus aquaticus</i>	middle alpine: continental oceanic	almost ubiquitous	<i>Salix herbacea</i> snow beds & grass dominated veg.
<i>Patrobus septentrionis</i>	oceanic region: low alpine middle alpine	widespread	dwarf-shrub veg.
<i>Nebria rufescens</i>	mainly in oceanic region		preferred mossy veg. over skeletal soil
<i>Patrobus assimilis</i>	mainly in low alpine areas		moist dwarf-shrub veg.

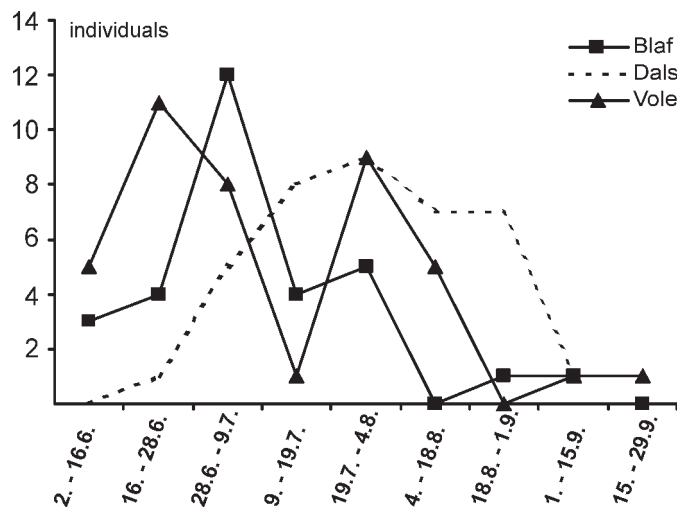


Figure 10. Phenological patterns of the Curculionidae at two different altitudes.

decreasing from early snow-free to late snow-free habitats was observed at north-exposed slopes in the snow-rich western middle alpine area.

#### Classification of alpine habitats by means of the carabid fauna

Within each investigation area the results of the frequency analyses (Tables 6–9) and the activity of species revealed the denomination of characteristic species (Table 10) and – in some cases – characteristic species communities. But some of the species also had different spatial distribution patterns depending on the investigation areas, and in some cases they preferred different ecotopes.

Most of the carabids recorded during our study are more or less widespread in Fennoscandia. Whether they are useful as indicators for the average humidity of the ecotopes, will be tested during further analyses. So far, it has to be noticed that the distribution patterns correspond rather well with the known humidity requirements of each species.

The character species presented in Table 10 are hitherto only valid for the investigation areas. Whether they are valid for larger spatial units (e.g.

whole alpine altitudinal sub-belts) or whether they are peculiarities of single sites, remains to be ascertained during further investigations.

Habitat types within single investigation areas can be differentiated by means of the carabid fauna, but compared to the ecotope concept after Löffler (1998), this is feasible only at a level of larger spatial units that – in some cases – reflect the distribution patterns of vegetation classes (see also Ottesen 1996). The fine-grained mosaic of different ecotopes within these alpine ecosystems is not reflected by the distribution patterns of the carabid fauna. On one hand, differences in the activity of characteristic species can be observed within ecotopes of one type, on the other hand, however, it cannot yet be estimated in how far this is caused by population dynamics. Furthermore, as the carabids in general display a relatively high locomotory activity, a “species leakage” between the ecotopes situated closely to one another may be assumed as described by Hauge & Ottesen (2002) for spider communities in alpine habitats. Perennial investigations are needed in this context. A fine-grained classification and differentiation of alpine ecotopes by means of the fauna seem only to be

possible when other arthropod groups with a higher species-richness are included (e.g. Staphylinidae, Araneae).

A classification of alpine and subalpine habitats by means of carabids or the coleopteran fauna and a definition of characteristic beetle coenoses were made for the Norwegian Scandes by Østbye & Hågvar (1996), Refseth (1980) and Thingstad (1987), but because of a strong variability of regional species compositions the defined communities may be valid only for a limited area. Østbye & Hågvar (1996) defined carabid and staphylinid communities for rough vegetation classes in low alpine areas of the northern Hardangervidda (Finse). Thingstad (1987) compared the carabid fauna of five different fennoscandian mountain regions and noticed that there is not always a correlation of carabid communities and vegetation types.

Refseth (1980) defined *A. alpina* and *P. assimilis* as characteristic species in similar habitats like we did. Thingstad (1987) considered these species to be the dominant ones in low alpine heaths. But, not having distinguished different types of heath communities, the difference in the habitat spectrum of both species detected in our study was not elucidated. The low alpine distribution of *N. rufescens* along brooks is also mentioned by Østbye & Hågvar (1996). Moreover, they investigated a low alpine “pioneer ground” which lies in front of a glacier and is characterized by a maximum vegetation cover of approximately 70 % (Østbye et al. 1978). In this habitat *A. alpina* was the dominant ground beetle (Østbye & Hågvar 1996). In the low alpine areas of this study similar habitats do not exist, but the conditions seem to resemble the ones in some continental middle alpine habitats where *A. alpina* was also dominant.

Generally it has to be mentioned that a habitat characterization by means of animal communities will always be difficult and former approaches that tried a zoosociological delimitation of habitats similar to that known from phytosociology (Rabeler 1965), are not pursued nowadays. The main reason for this is the greater difficulty in

detecting zoocoenoses (Kratochwil & Schwabe 2001), caused for example by the high species diversity, variable regional species pools, complex inter-relationships, and, last but not least, the mobility of animals.

## Phenology

Most of the observed beetle families were spring active (e.g. Carabidae, Chrysomelidae, Cryptophagidae) and often the period of high activity was relatively short. Summer and autumn activity was mainly recorded for Staphylinidae. Their phenology (except in the IA BLÅF) showed two maxima, one in the middle and one at the end of the trapping season. These maxima are caused by species of different subfamilies with a diverging phenology (Ottesen 1996).

The phenology of *Otiorhynchus nodosus* (Curculionidae) varied between the investigation areas. Possibly, the rough climate conditions in the middle alpine area caused a shift in the seasonal activity.

On one hand, the phenology is a species-specific adaptation to the environmental conditions within a habitat and is controlled by key factors (e.g. according to Refseth (1986) the seasonal reproduction rhythm of carabids is controlled by light and temperature conditions). On the other hand, phenological patterns might be influenced by interspecific interactions: a seasonal niche segregation of related species or guilds that depend on similar resources could minimize interspecific competition (Ottesen 1996).

In practice, documentations about the first appearance of species each year can provide important data for the estimation of changes induced by global warming, although phenological studies went out of fashion during the 20<sup>th</sup> century (Hepper 2003). It is expected that the reported rise of atmospheric temperature will change the phenological patterns of species. Such phenomena may become obvious earlier than the shift of species' distribution ranges or the loss of plant or animal species (Sømme 1993, Hepper 2003, Schwartz 2003).

## Phenology of certain carabid species

Activity maxima of most carabid species were found in one of the first three trapping periods during June and July. Such activity peaks are usually coincided with the period of reproduction (Thiele 1977, De Zordo 1979, Refseth 1986, 1988). It is possible to ascertain this phase by investigating the development of female gonads and it is known that the day length acts as a key-factor for the induction of their development. Using this method, Refseth (1986) was able to show that the development of female gonads in many Norwegian high mountain carabid species starts in early spring. The known shift to spring breeding in cold areas, observed also for usually autumn active species, may be necessary in order to get at least three months for development before the beginning of the winter (Ottesen 1995).

In high mountain ecosystems the time of high carabid beetle activity during spring is short and the activity is very low during the rest of the season, but some species also show a small activity increase in the second half of the season. For example, during our study *A. alpina* showed this pattern. Although in this case the increase during the second half of the season was only small, it does not seem to have been accidental. A similar phenology was also documented by other authors (Østbye & Hågvær 1996, Refseth 1988) and may be motivated by the searching for habitats suitable for overwintering or by the appearance of a new generation at the end of the season (De Zordo 1979). Furthermore, and although it was just supported by low catching rates, the delay of this phenomenon in the low alpine habitats, as observed during our study, might be caused by the more moderate climatic conditions.

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**Koster, Sjaak & Sinev, Sergey. 2003. Microlepidoptera of Europe. Volum 5. Momphidae s.l.** 387 s. 15 fargeplansjer. Innbundet. Apollo Books, Kirkeby Sand, DK-5771 Stenstrup, Denmark. ISBN 87-88757-66-8. DKK 720,- + porto. Ved abonnement på serien gis 10% rabatt.

Boka behandler alle artene i Europa, Nord-Afrika og Det Nære Østen av familiene Momphidae, Batrachedridae, Stathmopodidae, Agonoxenidae, Cosmopterigidae og Chrysopeleidae. Alle disse familiene tilhører den store overfamilien Gelechioidea, men de utgjør ikke en sluttet systematisk enhet. De har tidligere vært slått sammen til én familie, Momphidae, karakterisert ved de meget smale vingene med lange frynser. Imidlertid har også andre familier i Gelechioidea, som Elachistidae, Scythrididae og Coleophoridae, lignende smale vinger.

I mange år (siden 1969) har Europas microlepidopterologer tydd til polakken Tadeusz Riedls *Matériaux pour la connaissance des Momphidae...* (Riedl 1969) for bestemmelse av disse små sommerfuglene. Riedl dekket nøyaktig det samme geografiske området og nøyaktig de samme taksonomiske gruppene. Det er fristende å sammenligne: Riedls utdelige svart/hvitt fotos av de voksne og skjematisk tegninger av genitaliene, er nå erstattet med glimrende fargeakvareller og meget forseggjorte og detaljerte genitalfigurer. Riedl hadde 99 arter, Koster og Sinev har 163. I tillegg kommer at kunnskapen om mange taxa nå er mye større, og at flere artsgrupper i mellomtiden har gjennomgått taksonomiske revisjoner. Likevel, Riedls arbeid var relativt avansert for sin tid og danner en del av grunnlaget for arbeidet som her anmeldes. Nå har ytterligere en gruppe av vår verdensdels små sommerfugler blitt lettere å gå til, og interessen for dem vil helt sikkert øke.

Boka har en kort innledning der gruppas (eller mer korrekt: gruppenes) systematiske historie diskuteres, og der det gis råd om innsamling og genitalpreparering. Deretter følger en sjekklister over alle artene.

For hver familie som behandles, er det en generell beskrivelse under punktene morfologi, biologi, utbredelse og systematikk. Her er det også figurer av ribbenettet, hannlige genitalier og hunnlige genitalier hos en typisk representant for familien. Disse figurene er utstyrt med navn på de ulike delene slik at leseren kan finne forklaringer på faguttrykk brukt i omtalen av den enkelte slekt og art.

I den systematiske delen defineres hver slekt, og for hver art beskrives utseende (diagnose), hanngenitalier, hunn-genitalier, utbredelse og biologi; noen ganger er det et eget avsnitt der det gjøres rede for nye synonymiseringer. Genitalfigurene er svært viktige, for mange arter kan tross de gode fargebildene ikke bestemmes sikkert uten ved genitalpreparering. Bestemmelsesnøkler er kun benyttet innenfor en del store slekter. Mange arter, spesielt i slekten *Mompha*, har larver som lager artstypiske spinn, galler eller miner på næringsplanten. Av disse finnes det figurer i teksten.

I boka beskrives det én ny slekt og 10 nye arter. Det er en stor tabell der det vises i hvilke land artene er registrert. Det er lett å finne fram i boka. Hver art har fått et nummer som også er benyttet på alle figurene av arten.

Det er all grunn til å gratulere forfattere og forlag med et vellykket prosjekt, og vi gleder oss til neste bind i serien om Europas småsommerfugler!

#### Litteratur

Riedl, T. 1969. *Matériaux pour la connaissance des Momphidae paléarctiques (Lepidoptera)*, 9. Revue des Momphidae européennes, y compris quelques espèces d'Afrique du Nord et du Proche-Orient. *Pols. Pismo Ent.* 39, 635-919.

*Leif Aarvik*

## Surface-active spiders (Araneae) in ley and field margins

Reidun Pommeresche

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Surface-active spiders were sampled from a ley and two adjacent field margins on a dairy farm in western Norway, using pitfall traps from April to June 2001. Altogether, 1153 specimens, representing 33 species, were found. In total, 10 species were found in the ley, 16 species in the edge of the ley, 22 species in the field margin “ley/forest” and 16 species in the field margin “ley/stream”. *Erigone atra*, *Bathyphantes gracilis*, *Savignia frontata* and *Collinsia inerrans* were the most abundant species in the ley. *C. inerrans* was not found in the field margins. This species is previously recorded only a few times in Norway. *Diplocephalus latifrons*, *Tapinocyba insecta*, *Dicymbium tibiale*, *Bathyphantes nigrinus* and *Diplostyla concolor* were most abundant in the field margin “ley/forest”. *D. latifrons*, *D. tibiale* and *Pardosa amentata* were most abundant in the field margin “ley/stream”, followed by *E. atra* and *B. gracilis*. The present results were compared to results from ley and pasture on another farm in the region, recorded in 2000. A Detrended Correspondence Analyses (DCA) of the data sets showed that the spider fauna from the leys were more similar, independent of location, than the fauna in ley and field margins on the same locality. The interactions between cultivated fields and field margins according to spider species composition, dominance pattern and habitat preferences are discussed.

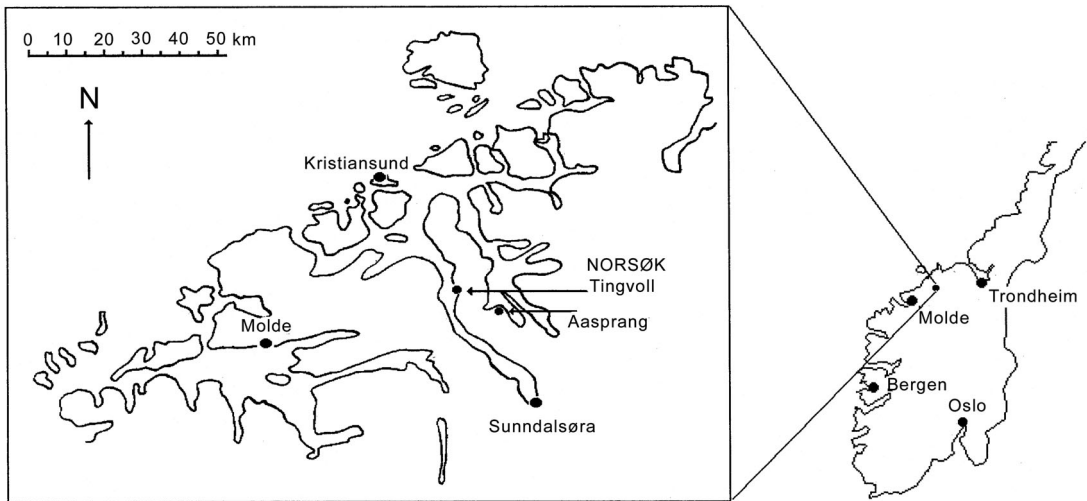
Key words: Araneae, biodiversity, organic farming.

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### INTRODUCTION

In cultivated areas, a mosaic landscape of small-sized cultivated fields and semi-natural habitats increases and maintains a higher arthropod diversity as compared to larger cultivated fields with less areas for field margins (Duelli et al. 1990, Dennis et al. 2000). Species richness has also been shown to decrease with increased intensity of land use, such as numbers and types of grass cuttings, grazing intensity, tillage intensity and pesticide use (Downie et al. 1998, Marc et al. 1999). Increased spider diversity was found in cultivated fields by use of non-cropped stripes, intercropping, undergrowth, partial weediness, mulching and reduced tillage in various studies, reviewed by Sunderland & Samu (2000).

Small pioneer species that have good ability of dispersal, are characteristic for frequently disturbed areas like ley and cereal fields, and have been called agrobiont species (Luczak 1979). The most important disturbances in cultivated fields influencing the spider fauna are soil tillage, use of pesticides, harvesting and grazing. Differences in the spider fauna between cultivated fields and adjacent field margins or other habitats have been studied in various systems (Bishop & Riechert 1990, Kromp & Steinberger 1992, Sunderland & Samu 2000). When the spider fauna in the cultivated fields is disturbed, e.g. because of soil tillage, a re-establishment of the fauna may occur by species and individuals surviving in the field margins. Hence, the field margins serve as a source



**Figure 1:** The location of the study area at Aasprang (2001 data set) and at Tingvoll (2000 data set), western Norway.

of re-invading species. Both for insects and spiders, the adjacent field margins have been shown to contribute to a higher biodiversity in the field, with the diversity declining from the field margins into the cereal fields (Dennis et al. 2000). Habitats in which the vegetation cover is structurally comparable to the cultivated fields, are often better sources of spider species abundant in the main fields, than habitats that are structurally more different (Stevenson & Dindal 1980, Duelli et al. 1990). A study of the importance of long-distance (aerial dispersal by ballooning) versus short-distance (walking on the ground) dispersal of spiders re-colonising the cultivated fields, indicated that ballooning was the main mode of dispersal (Bishop & Riechert 1990). In organically managed leys in western Norway, *Bathyphantes gracilis*, *Erigone atra*, *Oedothorax fuscus* and *Savignia frontata* were the most abundant species (Pommeresche 2002), whereas *E. atra*, *E. dentipalpis* and *O. apicatus* were the most abundant in conventionally grown barley fields from different parts of Norway (Andersen 1990). All these species mainly disperse by ballooning.

Spiders are an important part of the fauna in cultivated areas, especially because they prey on other arthropods. Organic farming systems are dependent on the local conditions to a much larger extent than conventional systems. As a consequence, basic biological knowledge is of large importance in organic farming, which aims at a high biodiversity and well balanced self-regulating agroecosystems. Organic farming has been shown to have positive effects on floral and faunal diversity, as reviewed by Stoltze et al. (2000). In general, the knowledge of spiders in Norwegian cultivated areas is scarce, and only one study of spiders in organically managed ley and pasture has been conducted (Pommeresche 2002).

The present study presents spider species found in a ley and two adjacent field margins during one season. Spider species composition, dominance patterns and habitat preferences are discussed to reveal possible interactions between the spider fauna in field margins and in the cultivated field. The study is one of a series of investigations into the spider fauna in Norwegian agricultural fields, adjacent field margins and semi-natural habitats.

## METHODS AND MATERIAL

### Site description

The study area was located on the dairy farm Aasprang at Meisingset, western Norway, EIS 85, MRY, Tingvoll (Figure 1). Since 2000, the farm is under conversion to organic management. In 2001 spiders were collected in a 4 year old ley, and in two of the adjacent field margins. The ley was a mixture of timothy (*Phelum pratense* L.), fescue grass (*Festuca pratensis* Huds.) and white clover (*Trifolium repens* L.). In the year of establishment, 1998, herbicide was used once, but no pesticides have been used later. Both animal manure and mineral fertiliser have been used on the ley. Twice a year the ley is harvested for silage, and in the autumn grazed by cows. Total precipitation in 2001 was 1320 mm, and the yearly mean temperature was 5.6 °C (max + 25.5 °C, min –17.5 °C).

The site called “ley middle” (**LM**) was located in the central part of the ley, and the site called “ley edge” (**LE**) was in the edge of the ley, 3 m from the field margin along a stream. The two field margins are called “field margin forest” (**FMF**) and “field margin stream” (**FMS**). It is a small stream, about 1.5 m wide, with high and dense vegetation along the stream banks. The water flow is very low during the summer. Both field margins were 3–5 m wide and located along opposite sides of the ley. The vegetation in both field margins consisted of stinging nettle (*Urtica dioica* L.), raspberry (*Rubus idaeus* L.), meadowsweet (*Filipendula ulmaria* (L.) Maxim.), cow-parsley (*Anthriscus sylvestris* (L.) Hoffm.) and high grasses like reed canarygrass (*Phalaris arundinacea* L.) and couch grass (*Elytrigia repens* (L.) Nevski). On FMF also tussock-grass (*Deschamsia caespitosa* (L.) PB.) was found, and on FMS cocksfoot (*Dactylis glomerata* L.) and timothy. FMF borders a row of large larch trees (*Larix* sp) undergrown with buckthorn (*Prunus padus* L.), and is more shady than FMS. Another field margin, and another ley are located on the other side of both field margins. Pesticides have never been used in the field margins.

The results are compared to a study from an organic dairy farm located 15 km away, at Tingvoll, conducted in 2000 (Figure 1). At Tingvoll a young ley (**YL**), established in 1999 and an old ley (**OL**) established in 1997 were studied, in addition to a permanent pasture (**PA**). YL, OL and PA were all sampled for spiders in the middle (**M**) and in the edge (**E**). More details about this study are found in Pommeresche (2002).

### Sampling and identification

Spiders were collected in pitfall traps consisting of plastic jars 6.5 cm  $\phi$ , 1/3 filled with 50 % propylene glycol and 1–3 droplets of soap as detergent. On each site, seven traps were placed 2 m apart in a row. In the sampling period, lasting from 30 April to 18 June 2001, the traps were emptied twice. Catches from each site were accumulated and treated as one sample. Only few juveniles (1.5 %) were found, and only adult spiders were identified to species and discussed in this paper. Pitfall trapping is the most commonly used sampling method for spiders (Hänggi et al. 1995). The method samples mostly surface-active spiders and is a measure of the activity-density of spiders, rather than of the total density (Tretzel 1955, Uetz & Unzicker 1976). The identification keys of Roberts (1993a; 1993b) and Nentwig et al. (2003) were used, and nomenclature and taxonomy are in accordance with Platnick (2003). The author names of the spider species are found in Table 1.

### Data analysis

To detect patterns in the spider fauna from different sites, an ordination technique of multivariate analysis was used (ter Braak 1995). This “Detrended Correspondence Analysis” (DCA) was run by CANOCO 4.5 software. The analysis arranges the data so that sites close together in the plots are similar in species composition, while those that are further apart are less similar. The analysis is based on the spider species and the number of specimens within each species found on each site.



**Table 1.** Spider species and number of individuals from ley and field margins: ley middle (LM), ley edge (LE), field margin ley/forest (FMF) and field margin ley/stream (FMS). Spiders sampled in pitfall traps from April to June 2001 at Aasprang Farm.

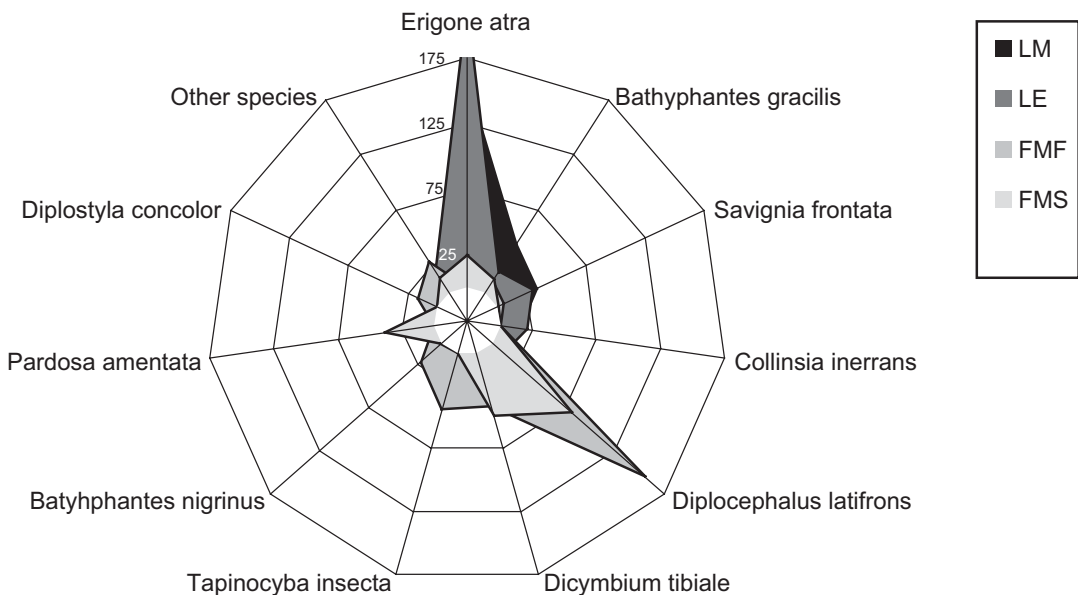
Family/species	Ley middle LM	Ley edge LE	Fieldm. forest FMF	Fieldm. stream FMS
<b>Linyphiidae</b>				
<i>Erigone atra</i> (Blackwall)	158	217	1	25
<i>Bathyphantes gracilis</i> (Blackwall)	45	19	11	13
<i>Savignia frontata</i> Blackwall	34	30	5	2
<i>Collinsia inerrans</i> (O.P.-Cambridge)	15	21		1
<i>Diplocephalus latifrons</i> (O.P.-Cambr.)	6	11	156	81
<i>Dicymbium tibiale</i> (Blackwall)	1	2	42	49
<i>Tapinocyba insecta</i> (L.Koch)			45	
<i>Bathyphantes nigrinus</i> (Westring)		1	23	2
<i>Diplostyla concolor</i> (Wider)			17	
<i>Erigone dentipalpis</i> (Wider)	3	7		
<i>Centromerus arcanus</i> (O.P.-Cambr.)			6	1
<i>Ceratinella brevipes</i> (Westring)			7	1
<i>Astenargus paganus</i> (Simon)			2	
<i>Jacksonella falconeri</i> (Jacson)			2	
<i>Tapinocyba pallens</i> (O.P.-Cambridge)			2	1
<i>Tenuiphantes cristatus</i> (Menge)			2	1
<i>Gonatium rubellum</i> (Blackwall)			1	
<i>Tenuiphantes alacris</i> (Blackwall)			1	
<i>Tenuiphantes zimmermanni</i> (Bertkau)			1	
<i>Micrargus herbigradus</i> (Blackwall)	1	2		
<i>Oedothorax fuscus</i> (Blackwall)	1	4		
<i>Meioneta affinis</i> (Kulczynski)		1		
<i>Meioneta saxatilis</i> (Blackwall)		1		
<i>Erigonella hiemalis</i> (Blackwall)				1
<i>Tenuiphantes mengei</i> (Kulczynski)				3
<b>Lycosidae</b>				
<i>Pardosa amentata</i> (Clerck)	6	6		40
<i>Pardosa nigriceps</i> (Thorell)		1		5
<i>Pardosa pullata</i> (Clerk)		2		1
<i>Pardosa lugubris</i> (Walckenaer)			1	
<b>Other families</b>				
<i>Cryphoeca silvicola</i> (C.L.Koch)		2	1	
<i>Tetragnatha</i> sp			1	
<i>Xysticus audax</i> ((Schrank)			1	
<i>Zora spinimana</i> (Sundevall)			1	
<b>number of specimens</b>	<b>270</b>	<b>327</b>	<b>329</b>	<b>227</b>
<b>number of species</b>	<b>10</b>	<b>16</b>	<b>22</b>	<b>16</b>

## RESULTS

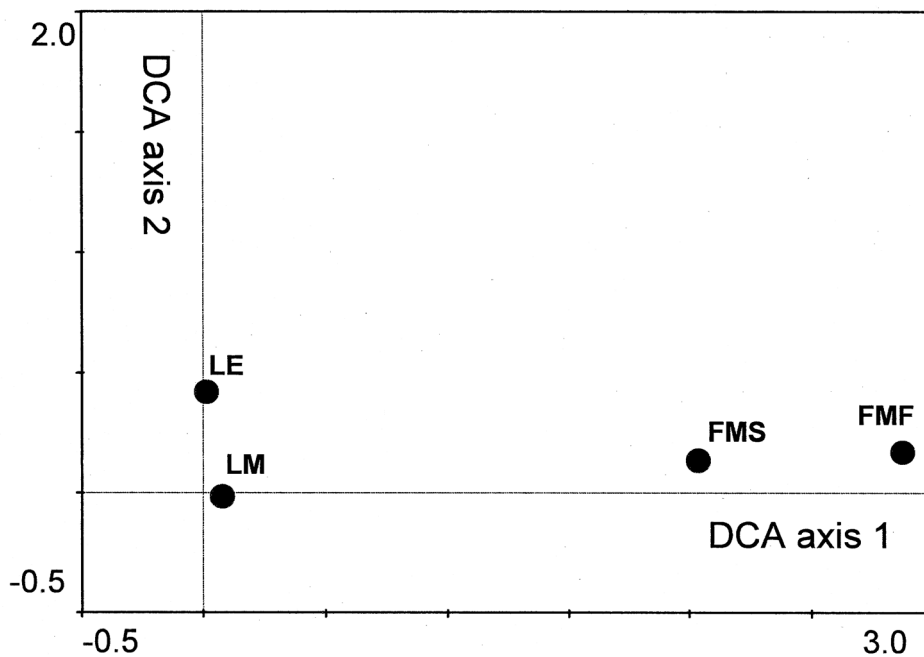
Altogether 1153 specimens, representing 33 species, were found at Aasprang (Table 1). Most of the species (76 %) and individuals (94 %) belonged to the Linyphiidae family. The diversity of spiders increased from the middle of the ley towards the margins. Ten different species were found in the LM, 16 in LE, 16 in FMS and 22 species in FMF. The number of specimens was 270 in LM, 327 in LE, 227 in FMS and 329 in FMF. LM was dominated by *Erigone atra* (59 % of the individuals), followed by *Bathyphantes gracilis* (17 %), *Savignia frontata* (13 %) and *Collinsia inerrans* (3 %). The same species dominated in LE, but with *B. gracilis* less dominant (6 %). In both the field margins, *Diplocephalus latifrons* was the most abundant species, represented by 47 % of the individuals in FMF and by 36 % in FMS. In FMS the other dominating species were *Dicymbium tibiale* (22 %), *Pardosa amentata* (18 %) and *E. atra* (11 %), and in FMF *Tapinocyba insecta* (14 %), *D. tibiale* (13 %) and *Bathyphantes nigrinus* (7 %).

Five species were found in all the four sites, *E. atra*, *B. gracilis*, *S. frontata*, *D. latifrons* and *D. tibiale*, but very unevenly distributed. *E. atra*, *B. gracilis* and *S. frontata* were most dominant in the ley and *D. latifrons* and *D. tibiale* most dominant in the field margins. The various dominance pattern of these main species, as well as the differences in the total species composition between the sites, caused a clear difference in the spider fauna found in LM and LE as compared to the ones found in FMS and FMF (Table 1, Figure 2). These results demonstrate the importance of field margins for the total biodiversity in an agricultural system.

The results of the DCA are shown in Figure 3. The first ordination axes explained 74 % and the second another 4 % of the total variability. The first DCA-axis indicates difference between spider communities in the ley sites and the field margins. There is a gradient in the similarity of the fauna from LE and LM, via FMS to FMF. The distribution along the second axis cannot be attributed to any obvious gradient.



**Figure 2:** The dominance pattern of the spider fauna found in ley and field margins at Aasprang. Values along the radials are the number of individuals of each spider species. The area of the spider fauna at the different sites overlap, especially on LM and LE. For details and further details use Table 1.



**Figure 3:** DCA ordination diagram of spider communities from ley and field margins at Aasprang. Spider species and numbers of specimens within each species are used as the basis of the analysis. For further details use Table 1.

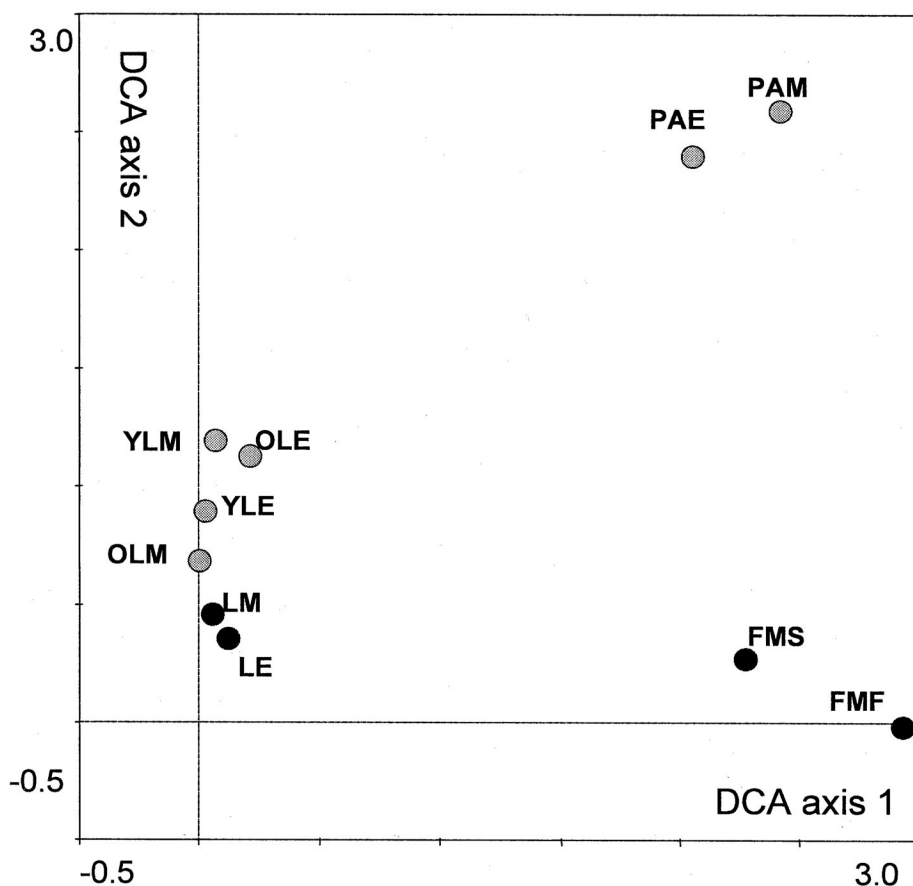
A DCA comparing results from Aasprang with results from Tingvoll showed that the spider communities from leys at different locations (farms) were more similar than the communities in ley and field margins on the same farm (Figure 4). The spider communities in pasture (PAE, PAM) at Tingvoll differ much from the ones in the field margin (FMS, FMF) at Aasprang, as can be seen along the second DCA-axis. A high number of individuals of *Silometopus elegans*, only found in PAE and PAM, and a much higher number of *P. amentata* in the pasture sites as compared to the field margins, explain most of the difference. The first ordination axes explained 38 % and the second another 12 % of the total variability.

*C. inerrans* was found in the leys and in the edge of the leys both at Aasprang and Tingvoll, but only one individual was found in the field margins and none in the pasture. This species has previously only been recorded a few times from Norway, and

was suggested as a Red-listed species by Aakra & Hauge (2000). However, it seems to be less rare than expected.

## DISCUSSION

The composition of the spider fauna was quite similar in the ley sites at Aasprang, but clearer differences were found between the ley and the field margins. Agrobiont and other pioneer species dominated in LM and LE. Most abundant were *E. atra*, *B. gracilis* and *S. frontata*. These species were also very frequent in the leys at Tingvoll. All these species perform aerial dispersal by ballooning (Duffey 1956, Weyman 1993, Weyman et al. 1995), something which explains the high numbers of these species in the ley. The similarity in species composition between the young ley at Tingvoll and the older leys at Tingvoll and Aasprang, may be explained by the yearly



**Figure 4:** DCA ordination diagram of spider communities found in different agricultural sites and field margins on two dairy farms. Spiders from one ley (LM, LE), and two field margins, ley /forest (FMF) and ley /stream (FMS) at Aasprang 2001 (black dots). Spiders found in young ley (YL), old ley (OL) and permanent pasture (PA) at Tingvoll in 2000 (grey dots). One site is located in the middle (M) and one nearer the edge (E) of the leys and the pasture. Spider species and numbers of specimens within each species are used as the basis of the analysis.

disturbances of harvesting and grazing. These yearly disturbances seemed to influence the resident spider fauna so much, that a potential effect of age of the ley was not evident from the composition of spider fauna. The importance of vegetation structure, rather than the age of the plant species, explains these results.

Although the FMF only bordered a line of threes and no real forest, some species mainly preferring forest habitats were found there, like *D. latifrons*,

*Diplostyla concolor* and *Gonatium rubellum*. This indicates that even small areas with forest-like vegetation may create suitable habitats for some forest species.

*P. amentata* was represented with 40 individuals in FMS and with 6 in both LM and LE, but none in FMF at Aasprang. This species is found in a very wide range of habitats both in Norway and Europe, including natural habitats like riverbanks, littoral areas and forest edges, but also cultivated

areas like pastures and cereal fields (Kjetil Aakra pers. comm. 2004, Hänggi et al. 1995). This species' preference for more open and wet habitats was also reflected in a very high number of individuals in the pasture (290 individuals in PAM, 185 individuals in PAE) at Tingvoll. There was less migration of *P. amentata* into the ley at Aasprang than could have been expected from the high abundance in FMS. This may be explained by the species preference for space and the lack of aerial dispersal behaviour (Richter 1970).

*B. gracilis* was found at all sites, both at Aasprang and Tingvoll. This indicates that the field margins may serve as a site of survival for this species during disturbances in the ley. *B. gracilis*, and also *E. atra*, may originate from the field margins, but also from other fields in the surrounding areas, or more distant field margins, because they perform aerial dispersal (Duffey 1956, Weyman 1993, Weyman et al. 1995). Both these species have also been shown to survive soil cultivation (Duffey 1978). *B. gracilis* always anchor their web in the vegetation, whereas *E. atra* use small depressions in bare soil to anchor their webs, or hunt prey without using nets (Alderweireldt 1994). This may explain the high number of both these species in the leys. These different hunting strategies may also partly explain a higher frequency of *B. gracilis* than *E. atra* in the pasture and field margins. The FMF was obviously not attractive to *E. atra*, possibly because of few available places to anchor their webs.

*C. inerrans* has been suggested as a Red-listed species by Aakra & Hauge (2000), perhaps more because of lack of search for this species in agricultural areas in Norway than because of rarity. The species is not frequently reported in European studies, found in only ten out of 1382 species lists checked by Hänggi et al. (1995), there in reed beds (4 localities) and different cultivated areas (6 localities). *C. inerrans* seems to be connected with frequently disturbed areas in the present study. It is possible that this species invades cultivated fields from other cultivated areas, disturbed at another time, rather than from field margins or pastures. The connection of this species to agricultural areas, as found in this study,

is supported by other studies (Andersen 1990, Rushton & Eyre 1992, Feber et al. 1998), and by closer study of the autecology of *C. inerrans* (Klapkarek & Riecken 1995).

Some of the most abundant species found in the leys, such as *E. atra*, *B. gracilis*, *Oedothorax* spp. and *E. dentipalpis*, have also been found in comparable grass and cereal fields in England and Denmark (Thomas & Jepson 1997, Feber et al. 1998). *Meioneta rurestris* and *Tenuiphantes tenuis* were abundant in English grass and cereals fields (Thomas & Jepson 1997, Feber et al. 1998), and *M. rurestris* and *O. apicatus* in Danish barley fields (Toft 1989). However, these were all absent in our leys, except for one specimen of *M. rurestris* found at Tingvoll. In contrast, *S. frontata* and *C. inerrans* were found in our leys in quite high numbers, but not in the English and Danish studies. In many studies *S. frontata* seems to have preference for moist habitats like moist meadows and litteral areas (Hänggi et al. 1995). Both Tingvoll and Aasprang are located close to the fjord (water) and this may partly explain the high element of this species in the leys. *M. rurestris* and *O. apicatus* are both more frequently reported in studies from the central parts of Europe than from Scandinavian studies (Hänggi et al. 1995) and there may be a biogeographical explanation to the lack of these species in the present study.

The DCA showed that the spider fauna from the leys was more similar, independent of locations, than the fauna in ley and field margins on the same locality (Figure 4). This is in accordance with Sunderland and Samu (2000), who found that the spider fauna in a cultivated field consists of some typical agrobiont species, similar in the same crop over a larger area, and additionally some species from the field margins, depending on the natural habitat types and mosaic of habitats in the area. The same species dominated the leys at both Tingvoll and Aasprang. This reflects the importance of the typical agrobiont species in the composition of the spider fauna in the leys. The high number of *Oedothorax fuscus* found in both OL and YL at Tingvoll, suggest that this species is an agrobiont and one of the dominant species in these leys. The very low frequency of this



species at Aasprang is difficult to explain other than a local patchiness. High numbers of this species have also been found in English studies of different grasslands and cereal fields (Rushton & Eyre 1992, Feber et al. 1998), while very few specimens were found in a study of 10 different cereal fields in Norway (Andersen 1990).

Better knowledge about the spider fauna in Norwegian agricultural areas may ensure a more sustainable management and conservation of biodiversity in agricultural areas, and may also serve as a basis for biological pest-control. With more knowledge about interactions of spiders between different habitats, the relative importance of field margins and different mosaic of the cultivated fields in regards to biodiversity in the cultivated fields and in the landscape, will be revealed.

**Acknowledgements.** I express my gratitude to Anne-Kristin Løes, NORSØK, Kjetil Aakra, Midt-Troms Museum, and Erling Hauge, University of Bergen, for discussions and valuable comments on the manuscript.

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# A new genus and species of Tortricidae (Lepidoptera) from Africa

Leif Aarvik

Aarvik, L. 2004. A new genus and species of Tortricidae (Lepidoptera) from Africa. *Norw. J. Entomol.* 51, 67-70.

*Sambara sinuana* gen. nov., sp. n. from Tanzania, eastern Africa, is described. It belongs in the subfamily Olethreutinae and displays characters of both the tribe Olethreutini and Eucosmini.

Key words: Lepidoptera, Tortricidae, Olethreutinae, new genus, new species.

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## INTRODUCTION

The fauna of Microlepidoptera of tropical Africa has been little studied. The number of undescribed genera and species is high, and most described species are misplaced in European genera. The author has begun the study of the taxonomy of African Tortricidae. Among specimens of this family borrowed from the Zoological Museum, University of Copenhagen (ZMUC), two males belonging to an apparently undescribed genus were discovered. The new genus and species is described below. The material was collected at light in 1995 in Mazumbai Forest Reserve, Western Usambara Mountains, eastern Tanzania.

The Usambara Mountains is a part of the Eastern Arc (Wasser & Lovett 1993), a disjunct range of ancient crystalline mountains in southeastern Kenya and eastern Tanzania. The forests of these mountains was characterised as a hot-spot by Myers (1990), indicating that they feature exceptional concentration of endemic species (Myers 1988). Today only fragments remain of the rain forests of the Usambaras. The tortricid described in the present paper is a striking addition to the threatened fauna of this area.

## METHODS AND TERMINOLOGY

After maceration the genitalia were dissected under a stereoscopic microscope and embedded in euparal on a glass slide. Photos of the genitalia were taken using a Leica DC 200 digital camera. The digital images were manipulated with Adobe Photoshop 6.0. The colour figure of the moth was obtained by projecting a dias photo on paper, and then the contours of the moth, including wing pattern, were painted on the paper. Subsequently all details were painted by comparing with the specimen under a stereoscopic microscope.

The terminology of the pattern elements in the forewing, venation and genitalia is the one used in standard taxonomic works on Tortricidae, e.g. Razowski (2004).

## SYSTEMATICS

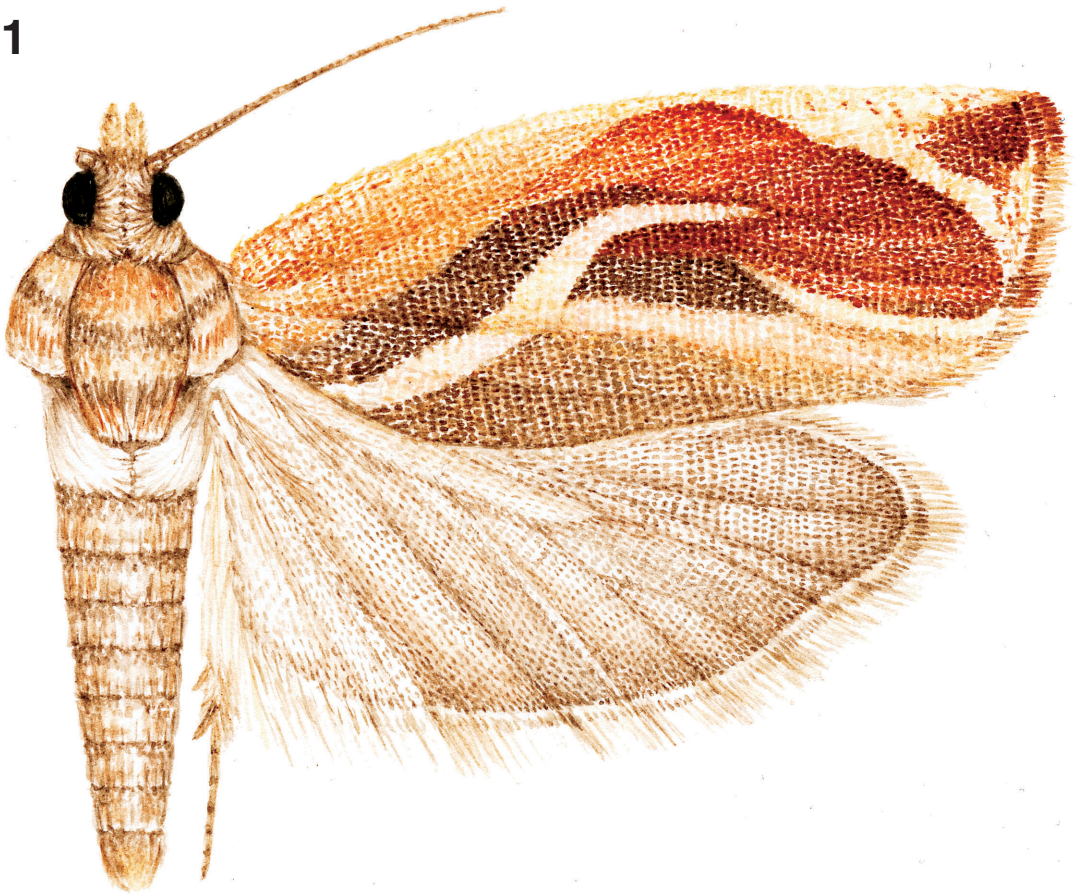
### *Sambara* gen. nov.

Type species: *Sambara sinuana* sp. n.

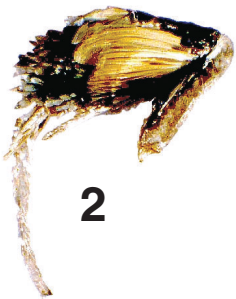
### *Description*

Labial palp twice the diameter of eye; head rough scaled; antennae fasciculate. Thorax posteriorly with double crest. Hind tibia (Figure 2) with oval plate of sex-scales, inner surface with pencil of

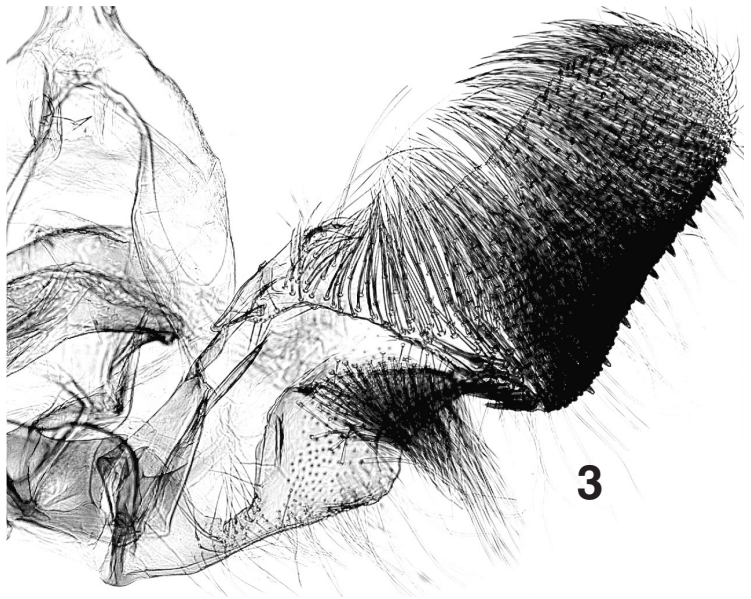
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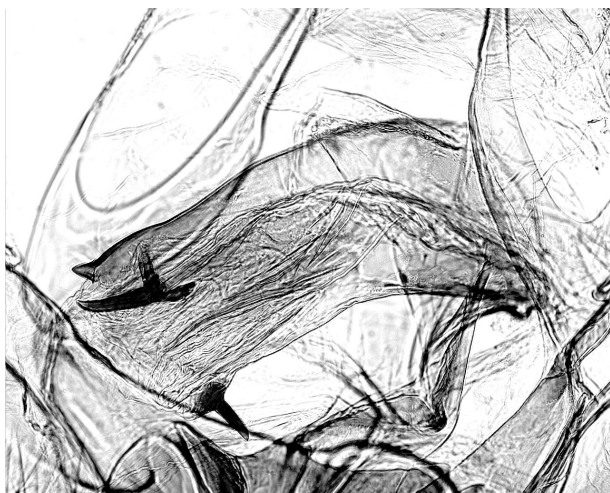


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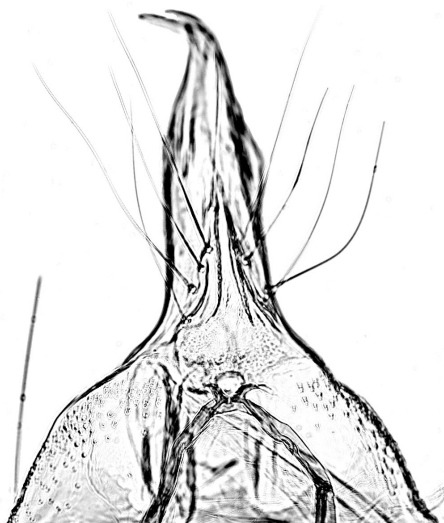




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5



**Figures 1-5.** *Sambara sinuana* gen. nov., sp. n. 1. Adult. 2. Hind leg. 3-5. Male genitalia. 3. Right valva and part of tegumen. 4. Aedeagus. 5. Uncus and upper part of tegumen.

hair-scales reaching from base to two thirds. Hind wing with anal fold in which the scale tuft of the hind tibia fits; vein  $M_3$  and  $CuA_1$  on common stalk. Costal strigulae in forewing are lacking.

Male genitalia. Uncus (Figure 5) basally with long setae, otherwise naked, narrowing in distal third, apex bifurcate; socii absent; lower edge of valva (Figure 3) excavated before cucullus, with tuft of strong setae below basal excavation; lower edge of basal excavation medially with small triangular thorn; cucullus basally with group of strong spines, lower edge slightly concave, this edge with short spines; aedeagus (Figure 4) broad, distally pointed, with two nail-shaped cornuti of different size.

***Sambara sinuana* sp. n.**

*Type material:* Holotype male, Tanzania: Tanga Region, Lushoto Distr. 1400 m. Mazumbai Forest Reserve, 30.xi-7.xii.1995, S. McKamey et al., genital slide Aarvik 23025, coll. ZMUC.

Paratype 1♂ as holotype (not dissected), coll. ZMUC.

***Description***

Male (Figure 1). Wingspan 18 mm. Forewing basally light reddish brown, along costa becoming almost white in distal half; a large brownish red area extends towards tornus from the upper portion of the central part of wing; a patch of this colour is also present in apical area; a sinuous whitish band goes from base of dorsum to 2/3 of wing length; the whitish band is edged with dark brown above; a dark brown patch is also present in the middle of the wing; a whitish band extends from just above tornus towards the tip of the sinuous band; a whitish band from costa to termen isolates the apical spot from the rest of the pattern. Hindwing brownish grey.

Male genitalia. See genus description.

***Etymology***

The genus name is derived from “Usambara”, the name of the mountains where the moths were collected. The species name refers to the sinuous line in the forewing.



## SYSTEMATIC POSITION OF SAMBARA GEN. NOV.

The very characteristic forewing pattern of *Sambara sinuana* sp. n. is unique among members of the subfamily Olethreutinae, in particular the lack of costal strigulae is peculiar. The presence of costal strigulae is a ground plan character of the subfamily (Horak 1999). Tribal assignment of *Sambara* gen. nov. is difficult. The hind wing with veins  $M_3$  and  $CuA_1$  stalked, as well as the male genitalia with their bifurcate, unspined uncus and the shape of valva speak for the inclusion in Eucosmini. The presence of a tibial scale tuft, on the other hand, is a character typical for the tribe Olethreutini. The forewing pattern indicates placement in Olethreutini rather than Eucosmini. As in *Rhodotoxotis* Diakonoff, 1992 the male genitalia lack socii. *Rhodotoxotis*, distributed in tropical Africa and Madagascar, could be the sister genus of *Sambara* gen. nov. *Rhodotoxotis* has a wing pattern resembling *Sycacantha* Diakonoff, 1959 (in Olethreutini) (Diakonoff 1992). Diakonoff (1992), however, placed *Rhodotoxotis* in Eucosmini. In the male genitalia *Sambara* gen. nov. differs from *Rhodotoxotis* by its long uncus and short and truncate aedeagus. The discovery of the female of *Sambara sinuana* sp. n. would probably shed some light on its taxonomic position.

**Acknowledgements.** I thank Ole Karsholt, Copenhagen, for lending me the African Tortricidae kept in the Zoological Museum, Copenhagen (ZMUC). My wife, Nini Cecilie Aarvik, is thanked for executing the beautiful water-painting of the new species. Lars Ove Hansen, Oslo, is thanked for technical assistance. I thank an anonymous referee for constructive comments to the manuscript.

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## Revision of the subtribe Neopotamiae (Lepidoptera: Tortricidae) in Africa

Leif Aarvik

Aarvik, L. 2004. Revision of the subtribe Neopotamiae (Lepidoptera: Tortricidae) in Africa. *Norw. J. Entomol.* 51, 71–122.

The Afrotropical species of Neopotamiae are revised. The following six new genera are proposed: *Afrocostosa* gen. nov. with *A. flaviapicella* sp. n. as type species, *Neorrhyncha* gen. nov. with *N. congolana* sp. n. as type species, *Geita* gen. nov. with *G. bjoernstadi* sp. n. as type species, *Paraeccopsis* gen. nov. with *Argyroploce insellata* Meyrick, 1920 as type species, *Afrothreutes* gen. nov. with *A. madoffei* sp. n. as type species and *Afroploce* gen. nov. with *A. karsholti* sp. n. as type species. The following additional species are described as new: *Eccopsis agassizi* sp. n., *E. morogoro* sp. n., *E. deprinsi* sp. n., *E. ochrana* sp. n., *E. tucki* sp. n., *E. niniceilie* sp. n., *Cosmorrhyncha microcosma* sp. n., *Neorrhyncha camerunica* sp. n., *Megalota namibiana* sp. n., *M. purpurana* sp. n., *M. archana* sp. n., *Afroploce turiana* sp. n. and *A. ealana* sp. n. *Cosmorrhyncha acrocosma* (Meyrick, 1908), stat. nov. is removed from synonymy with *Cosmorrhyncha ocellata* (Mabille, 1900) and reinstated as a valid species. The following synonymizations are made: *Eccopsis chromatica* Diakonoff, 1983 is synonymized with *E. praecedens* Walsingham, 1897, syn. nov., *Eccopsis undosa* Diakonoff, 1981 is synonymized with *E. incultana* (Walker, 1863), syn. nov., and *Polychrosis inflicta* Meyrick, 1920 and *Argyroploce atricapsis* Meyrick, 1930 are both new synonyms of *Argyroploce insellata* Meyrick, 1920 syn. nov. *Argyroploce anaclina* Meyrick, 1921 is synonymized with *Argyroploce balanacma* Meyrick, 1914 syn. nov., and *balanacma* is transferred to the genus *Metendothenia* Diakonoff, 1973, comb. nov. *Argyroploce rhopalitis* Meyrick, 1920 is transferred to *Megalota* Diakonoff, 1966, comb. nov.

Key words: Lepidoptera, Tortricidae, Olethreutini, Neopotamiae, *Eccopsis*, *Cosmorrhyncha*, *Metendothenia*, *Megalota*, *Proschistis*, *Basigonia*, new genera, new species, new synonyms, Africa.

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### INTRODUCTION

The Tortricidae fauna of tropical Africa has been little studied. Since the time of Edward Meyrick (1854–1938) only few lepidopterists have worked on the Microlepidoptera fauna of this continent. In contrast, the knowledge of the faunas of Tortricidae of Asia and Madagascar is fairly good due to the studies made by Alexey Diakonoff whose greatest contribution was his monograph on the South Asiatic Olethreutini (Diakonoff 1973). In this he not only described the South Asian taxa, but also included data from the rest of the world's fauna and established a classification

for the tribe Olethreutini relevant everywhere. In a series of papers he revised the Madagascan fauna of Tortricidae, e.g. Diakonoff (1959, 1963, 1981, 1983b, 1992), and this is of particular importance when studying the fauna of the African mainland.

Because of the plasticity of the male genitalia, Diakonoff (1973) relied heavily on the structure of the signa in the female genitalia to define suprageneric groupings within the tribe. Diakonoff (1973) allocated the genera of Olethreutini to 12 subtribes, and this classification is still used, with the modification that some of the subtribes now have been raised to tribal rank. Most African

members of Olethreutini cluster around the genus *Eccopsis* Zeller, 1852. The type of signum met with in *Eccopsis* and allies is not common among the Asian species. Species of the genus *Megalota* Diakonoff, 1966, placed by Diakonoff (1973) in subtribe Neopotamiae, possess this type of signum. *Megalota*, previously reported from Madagascar (Diakonoff 1981), is also present in Africa, thus linking the Asian and African faunas of Olethreutini. In the present paper *Eccopsis* is grouped with *Megalota* in the subtribe Neopotamiae. The signum characteristic of this group consists of a single plate with 1-3 anteriorly directed projections. Diakonoff (1973) also placed in Neopotamiae a small group of genera where the female possesses double signum of diverse shape. In *Neopotamia* Diakonoff, 1973 and *Costosa* Diakonoff, 1968 there are species with large banana-shaped signa resembling those in *Afrocostosa* gen. nov. described below.

Males of many species have modifications of the hind wing combined with hair tufts of the hind leg. These modifications that serve as scent organs, are more or less developed, and may be present in one – and completely absent – in another closely related genus. Scent organs of this type occur throughout the tribe Olethreutini, but are not of much aid in classification (Diakonoff 1981). Nearly all species treated here have tufts of hair-scales on the male hind tibia. The modifications of the male hind wing are lacking in the genera *Afrocostosa* gen. nov., *Megalota* Diakonoff and *Paraeccopsis* gen. nov.

## MATERIAL AND METHODS

The present treatment deals with the species of Neopotamiae occurring in Africa south of Sahara. A few species of the group present in Madagascar and the islands of the western part of the Indian Ocean were dealt with by Diakonoff. Some of these species occur also in tropical Africa and are included here. The genus *Hopliteccopsis* Diakonoff, 1963 – with three species, *H. amemorpha* Diakonoff, 1963, *H. maura* Diakonoff, 1983 and *H. crocostoma* Diakonoff, 1992 – belongs to this group and is closely related to *Eccopsis* Zeller,

1852 and *Cosmorrhyncha* Meyrick, 1913. *H. amemorpha* and *H. crocostoma* occur in Madagascar (Diakonoff 1963, 1992) and *H. maura* in Comoro Islands (Diakonoff 1983a). So far no representative of this genus has been recorded from mainland Africa, and consequently *Hopliteccopsis* is not included in the present study.

The types that were dissected and figured by Diakonoff (1981, 1983a,b) have not been checked. Diakonoff's figures are clear, and leave no doubt about the identity of the species in question. A cladistic analysis is beyond the scope of this paper. The sequence of taxa is based in part on Diakonoff (1973) and partly on my own experience with the group, starting with the presumably most generalized taxa. A key is not given, as identification of species can in most cases be made directly by comparison with the coloured figures of wings. In a few cases dissection of the genitalia is necessary for safe identification.

Material from the following museums have been studied: The Natural History Museum, London (BMNH), Musée Royal de l'Afrique Centrale, Tervuren (MRAC), Museum für Naturkunde, Berlin (MNHB), Transvaal Museum, Pretoria (TM) and Zoological Museum, University of Copenhagen (ZMUC). Relevant type specimens from Muséum National d'Histoire Naturelle, Paris (NHMN), have also been checked. Part of the material was collected in Tanzania by Anders Bjørnstad (ABJ) from 1989 till 1991, and by myself (LAA) in 1991-1993. Recently, 1998-2000, David Agassiz (DA) collected a large material of Tortricidae in Kenya, in 2001 also in Tanzania and in 2002 in Malawi, and this was made available for the present study. I recently had the opportunity to check the private collection of Anthony Kingston (AK), and have included part of his material. Types of some of the species described in the present paper are preserved in the Zoological Museum, University of Oslo (ZMUO).

To avoid confusion The Democratic Republic of the Congo (formerly Zaire) is referred to as Congo (Zaire).

Labels on specimens sometimes lack information about locality or collector (leg.). This is the reason why this information sometimes is omitted from the lists below. The depository of examined specimens is indicated by the abbreviated name of the collection/collector in parenthesis. The terminology of male and female genitalia is the one used in standard taxonomic works on Tortricidae, e.g. Bentinck & Diakonoff (1968).

After maceration male and female genitalia were dissected under a stereoscopic microscope and embedded in euparal on glass slides. Photos of the genitalia were taken using a Leica DC 200 digital camera. The digital images were manipulated with Adobe Photoshop 6.0. The colour figures of imagines were obtained by projecting a dias photo on paper, and then the contours of

the moth, including wing pattern, were painted on the paper. Subsequently all details were painted by comparing with the specimen under a stereoscopic microscope.

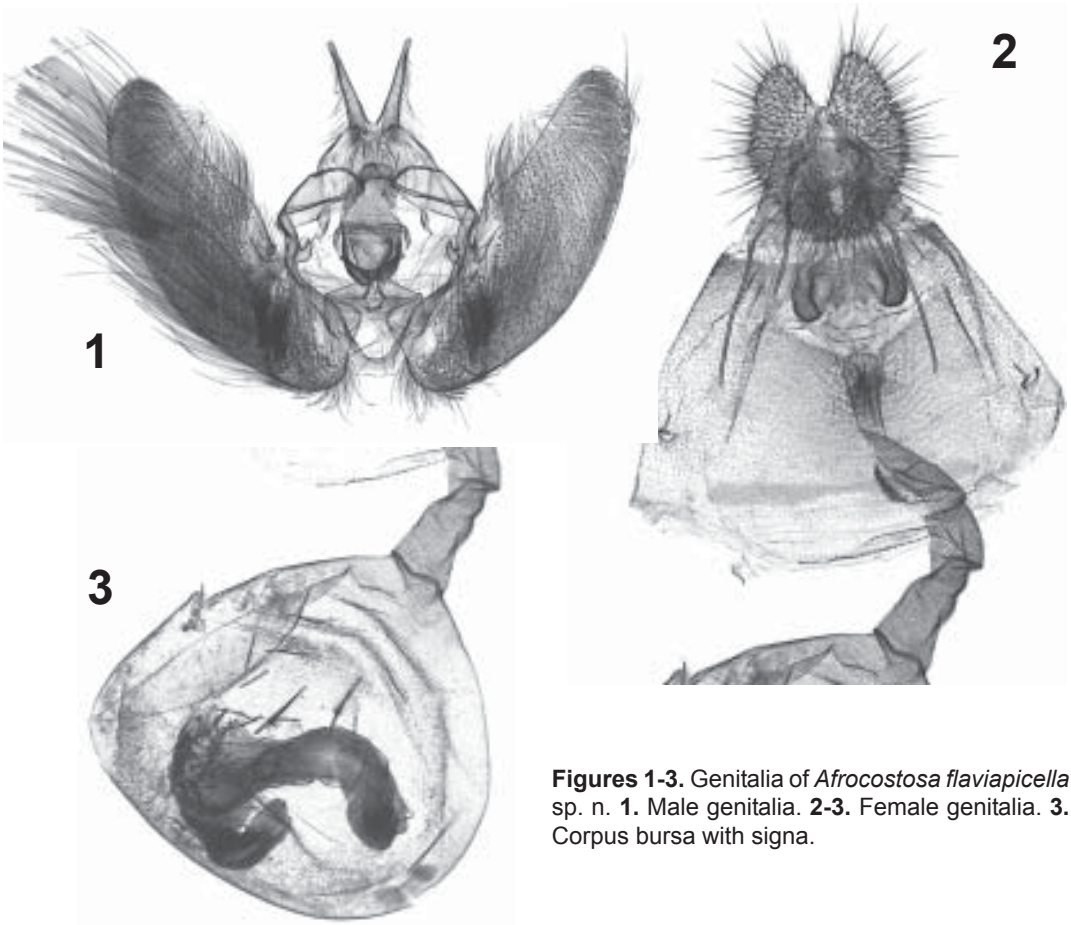
## SYSTEMATICS

### *Afrocostosa* gen. nov.

Type species: *Afrocostosa flaviapicella* sp. n.

#### Description

Labial palp short, slightly exceeding diameter of eye, second segment roughly scaled, of even width, third segment very short. Head roughly scaled. Thorax with double posterior crest. Hind-wing with cubital pecten. Male hind tibia proximally with dense brush of long hair-scales.



**Figures 1-3.** Genitalia of *Afrocostosa flaviapicella* sp. n. **1.** Male genitalia. **2-3.** Female genitalia. **3.** Corpus bursae with signa.

Abdominal segment 8 in male with lateral pockets anchoring long pencils of hair-scales.

Male genitalia (Figure 1). Uncus consisting of two straight horns forming a “V”; socii absent; valva “sole”-shaped, external disc with dense cover of thick, long setae, internal disc with shorter and weaker setae, cucullus not differentiated, basal excavation reduced, hardly discernible; aedeagus short and straight.

Female genitalia (Figures 2,3). Papillae anales broad; sterigma prominent, strongly sclerotized laterally; colliculum tubular, split medially; corpus bursa with two large banana-shaped signa.

#### Remarks

*Afrocostosa* gen. nov. is the African vicariant of the Oriental *Costosa* Diakonoff, 1968. It differs from *Costosa* by the absence of socii and produced basal process of valva (labis) in the male genitalia. The female of *Afrocostosa* gen. nov. has two similar, large, banana-shaped signa. In *Costosa* the two signa are dissimilar, one small spindle-shaped and another large banana-shaped. For comparison see Diakonoff 1973, Figures 466-473. Only a single African species can at present be placed in the new genus.

#### *Afrocostosa flaviapicella* sp. n.

*Type material*: Holotype male, TANZANIA: Tanga Reg., Muheza Distr.: Tongwe Forest Reserve 3-4.ii.1992 Frontier leg., genital slide LAA 20108 (ZMUC).

Paratypes, TANZANIA: Pwani Reg., Rufiji Distr.: Namakutwa Forest Res. 1♂ 27.viii.1992 Frontier leg. (ZMUC); Morogoro Distr. & Town: Kigurunyembe 700-900 m 1♂ 10.i.1992, 1♂1♀ 29.iii.1992, 1♂ 14.iv.1992, 1♀ 2.vi.1992 L.Aarvik leg. (LAA); Morogoro Distr.: Kimboza For. Res. 300 m 1♂ 30.x.1992 L. Aarvik leg. (LAA); Morogoro Distr.: Kitulungalo For. Res. 420-540 m 2♂♂1♀ 6.xii.1992, 1♂ 1.i.1993, 1♂ 28.ii.1993 L. Aarvik leg. (LAA); Geita Distr.: Rubondo Island 1140 m 2♀♀ 26.i.1991 A. Bjørnstad leg. (ABJ). 1 male paratype and 1 female paratype with genital slides LAA 2309 and LAA 2310 respectively.

#### Description

Figure 84. Male. Wingspan 18-20 mm. Forewing ground colour cream, often almost completely concealed by dark scaling; pattern complicated and variable. Usually a sub-basal fascia indicated as dark spot on costa and a dark preapical spot can be traced; a distinct light apical spot, bordered below by a dark streak, is always present. Colour of pattern varying from ochreous and reddish brown to almost black. In blackish specimens there are patches of bluish, especially near tornus and along dorsum. Hindwing fuscous; fringes proximally white. Hind tibia proximally with dense brush of long, white hair-scales. Abdomen light fuscous.

Female. As male except that the hind tibia is lacking the scale brush and the hindwing proximal fringes are fuscous.

Male genitalia. See genus description.

Female genitalia. See genus description.

#### Distribution

Northern and eastern Tanzania.

#### Ecology

Collected in forest from 300 to 1100 m.

#### Remarks

The species is easily recognisable externally by the light apical spot and the white hair scales on the male hind tibia.

#### *Eccopsis* Zeller, 1852

*Eccopsis* Zeller, 1852, *Lepid. Microptera, quae J.A. Wahlberg in Caffrorum terra collegit*: 79.

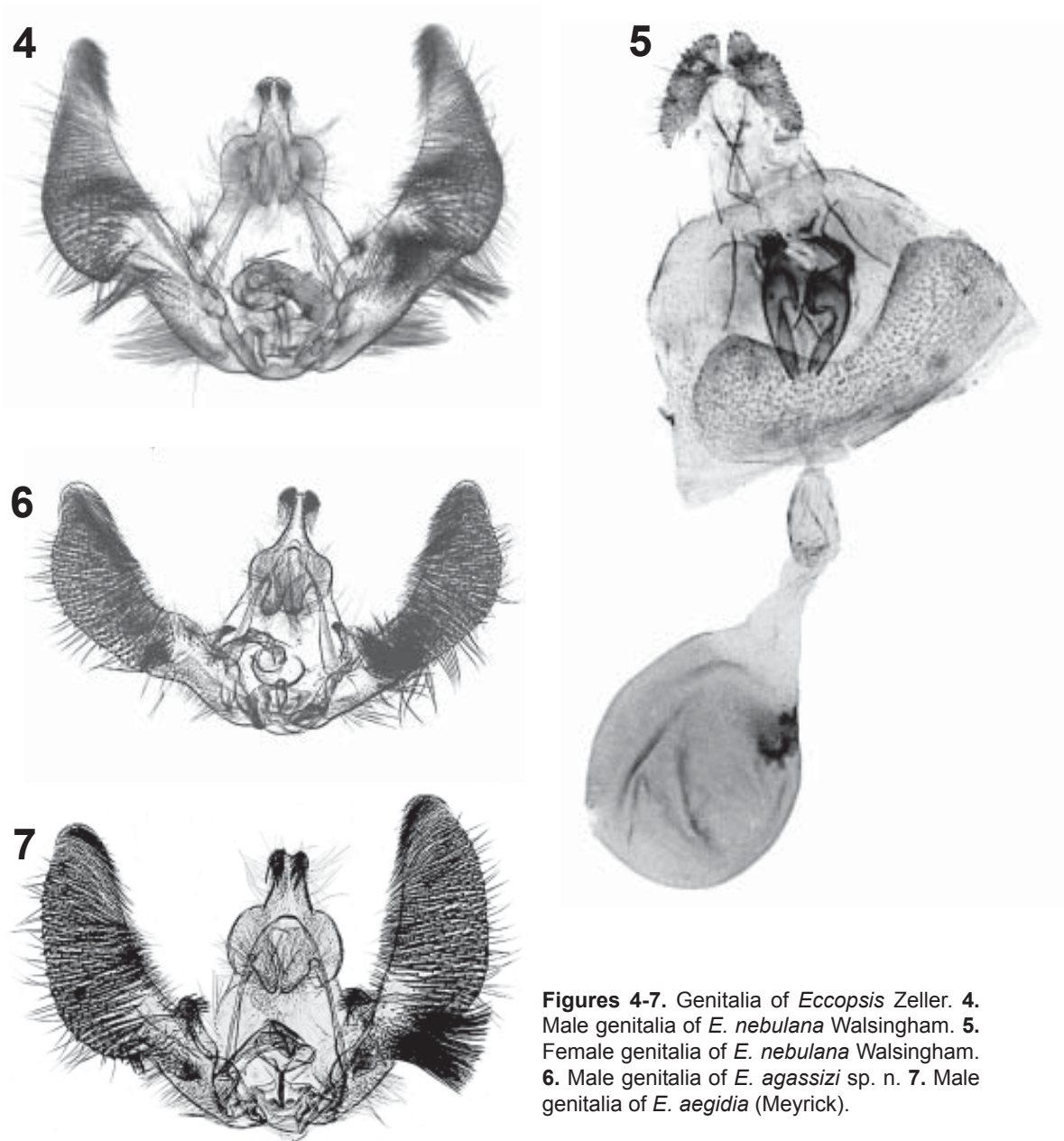
*Eccopsis* Razowski, 1977, *Acta zool. cracov.* 22: 236. Misspelling.

Type species: *Eccopsis wahlbergiana* Zeller, 1852

#### Description

Labial palp of moderate length. Thorax with posterior crest. Forewing costa in male of some species straight with characteristic bend at 2/3, often with dark triangle. Hindwing with cubital pecten; in males of most species with anal part





**Figures 4-7.** Genitalia of *Eccopsis* Zeller. **4.** Male genitalia of *E. nebulana* Walsingham. **5.** Female genitalia of *E. nebulana* Walsingham. **6.** Male genitalia of *E. agassizi* sp. n. **7.** Male genitalia of *E. aegidia* (Meyrick).

shortened; proximal edge rolled into a rigid tube. Male hind tibia and femur with long hair scales.

Male genitalia. Uncus slightly bilobate, with strong bristles; socii strong, in some species

heavily sclerotized; dorsal edge of valva with well developed (weak in *wahlbergiana*) basal process, bristled at the top; right valva with large tuft of setae below cucullus (this tuft is often termed

Spc<sub>2</sub>); in the left valva this tuft is absent or weak, thus making the valvae slightly asymmetrical.

Female genitalia. Sternite 7 with rounded excavation medially; ostium and colliculum forming a sclerotized tube; signum a small plate with 2-3 anteriorly directed projections.

#### Remarks

At present 13 species are known, all of them restricted to the Afrotropical region. The two species from the Comoro Islands, *E. heterodon* Diakonoff, 1981 and *E. encardia* Diakonoff, 1983 have not been studied by the author. The latter is known from a single female, and its generic placement should be confirmed. Diakonoff (1981) gave a detailed redescription of the genus.

#### ***Eccopsis nebulana* Walsingham, 1891**

*Eccopsis ? nebulana* Walsingham, 1891: 71, pl. 3, Figure 7.

*Material examined.* Holotype female, GAMBIA: Bathurst 1885 Carter leg., genital slide BM 2099 (BMNH).

CONGO (ZAIRE): Upper Uele Distr.: Dungu 1♂ (BMNH); KENYA: Mt. Kenya: Nyeri Sagana 6000 ft. 1♀ 31.viii.1949 J.A. Riley leg., genital slide BM 3000 (BMNH); Arabuko Sokoke, Mixed forest 50 m. 1♂ 4.iv.2001 J. & W. De Prins leg. (MRAC); SOUTH AFRICA: Kwazulu Natal Prov.: Phinda Forest Reserve 1♀ 9.ii.2002 A. Kingston leg. (AK); SEYCHELLES: Cascade Ratale, Mahé 1♂ 1908 H. Scott leg. (BMNH); TANZANIA: Muheza Distr.: Kilulu Hill Forest 200-267 m 1♂ 15-16.ii.1992 Frontier leg. (LAA); Morogoro Distr.: Kitulangalo For. Res. 420-540 m 1♂ 1.i.1993 L. Aarvik leg., genital slide LAA 2198 (LAA).

#### Description

Figure 85. Wingspan 16-17 mm. Labial palp 1.5 times diameter of eye, cream, with three fuscous spots on outer surface of second segment. Forewing with large, black dorsal patch and small triangular spot on costa. Male hindwing modified, with proximal edge rolled, forming a tube. Male hind tibia with groove containing long, black hair-

pencil, this groove surrounded by shorter cream-coloured hair-scales.

Male genitalia (Figure 4). Socii normal, not heavily sclerotized as in most other members of *Eccopsis*; cucullus narrow in distal half; wall of aedeagus with two short thorns.

Female genitalia (Figure 5). Sternite 7 short, with wide posterior concavity; colliculum funnel-shaped, widening towards ostium; signum with three short prominences.

#### Distribution

Congo (Zaire), Gambia, Kenya, Rep. South Africa, Tanzania and Seychelle Island.

#### Ecology

The Tanzanian specimens were collected in forest.

#### Remarks

The large black forewing spot makes the species unmistakable.

#### ***Eccopsis agassizi* sp. n.**

*Type material:* Holotype male, KENYA: Kenya Central, Naro Moru 6500 ft. 27.xii.1999 D. Agassiz leg., genital slide LAA 21027, in coll. D. Agassiz (to be deposited in BMNH).

Paratype male, KENYA: Rift Valley, Rumburuti 1800 m. 29.iv.2003 D. Agassiz leg., genital slide LAA 23026 (DA).

#### Etymology

Named in honour of the collector, my friend David Agassiz.

#### Description based on holotype

Figure 86. Wingspan 20 mm. Labial palp 1.5 times diameter of eye, brownish black except base and lower edge of second segment which are white, third segment with whitish tip. Antenna fuscous, scape white posteriorly, fuscous anteriorly. Head and thorax fuscous. Forewing costa arched at 2/3, straight in apical third; basal 2/3 blackish fuscous, apical third dirty white, sprinkled with fuscous scales; costal strigulae present, but indistinct; fringes partly damaged, basally white,

at tornus dark grey. Hindwing, grey, modified, with proximal edge rolled, forming a tube. Male hind tibia with groove surrounded by short cream-coloured hair-scales. The groove contains black scales. It is difficult to observe in the two specimens, but the black scales probably form, as in relatives, a long hair-pencil.

The paratype (Figure 87) differs strongly from the holotype in the forewing pattern. The ground colour is a mosaic of light grey and brownish ochreous, in distal half suffused with rufous; dorsum with two blackish maculae reaching to middle of wing; costal strigulae more evident than in holotype.

Male genitalia (Figure 6). Uncus constricted before end, distally cleft; socii rather broad, rounded, not strongly sclerotized; basal process of valva triangular, distally spined; valvae asymmetrical, with edge straight in right sacculus, concave in left sacculus; lower edge of right cucullus with one strong spike and several long spines; lower edge of left sacculus with shorter spines on curved ridge; aedeagus medially with two humps, without cornuti or carinae.

Female. Not known.

#### Distribution

Only known from central Kenya.

#### Remarks

As only two specimens are known, the extent of variation in forewing colour and pattern is impossible to determine. Probably this is a highly variable species. The bicoloured forewing of the holotype is reminiscent of European species of *Hedya* and *Apotomis*. The genitalia indicate closer relationship with *Eccopsis aegidia* and *E. maschalista*, but in these two species forewing pattern is very different from *agassizi* n.sp., and they have the hind wing modifications much less pronounced.

#### *Eccopsis aegidia* (Meyrick, 1932)

*Argyroploce aegidia* Meyrick, 1932: 112;

*Olethreutes aegidia*, Clarke, 1958: 480, pl. 239, Figures 2, 2a;

*Eccopsis aegidia*, Diakonoff, 1981: 11.

*Material examined*: Holotype male, ETHIOPIA: Djem-Djem Forest, ca. 9000 ft. 4.x.1926 H. Scott leg., genital slide JFGC 7308 (BMNH).

KENYA: Escarpment Kikuyu, Ibea 7500–8500 ft. 2♂♂2♀♀ ix-x.1900 Doherty leg., one male genital slide BM 28971, and a female with slide BM 28972 (BMNH); Rift Valley: Prov. Turi 8000 ft. 1♂ 9.iii.1999, 1♀ 21.vi.1999 D. Agassiz leg. (DA); Kenya Central: Timau 8000 ft. 1♂ 6.iv.2000, genital slide LAA 21011, D. Agassiz leg. (DA).

#### Description

Figure 88. Wingspan 19 mm. Labial palp twice diameter of eye, outer surface grey, second and third segment with distal edge white. Forewing more rectangularly shaped than typical *Eccopsis* species; grey, with blackish marks. Fresh specimens have a greenish tinge. Male hindwing with short anal roll.

Male genitalia (Figure 7). Top of tegumen broad, globular; socii rectangular, long, moderately sclerotized; right valva with tuft of setae below cucullus, basal process of valva formed as a hump; aedeagus apically very narrow, with carinae.

Female genitalia (Figures 8,9). Colliculum bent, posteriorly spindle-shaped; lamella antevaginalis, setose, widened posteriorly, with deep medial concavity; signum with single long projection.

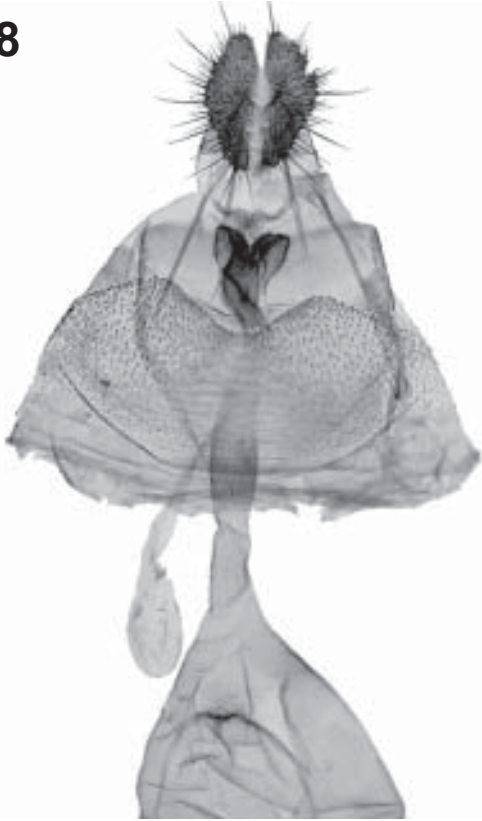
#### Distribution

Ethiopia and Kenya.

#### Remarks

*E. aegidia* and *E. maschalista* (Meyrick, 1932) (next species) are similar externally. The male genitalia differ mainly in the shape of the basal process of valva. In *aegidia* (Figure 7) it is short and broad, whereas in *maschalista* (Figure 10) it is long and slender.

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***Eccopsis maschalista* (Meyrick, 1932)**

*Argyroploce maschalista* Meyrick, 1932: 112;

*Olethreutes maschalista*, Clarke, 1958: 527, pl. 262, Figures 2, 2a;

*Eccopsis maschalista*, Diakonoff, 1981: 11.

*Material examined*: Lectotype male, ETHIOPIA: Djem-Djem Forest, ca. 9000 ft. 1.x.1926 H. Scott leg., genital slide JFGC 7320 (BMNH), Paralectotypes, 2♂♂2♀♀, with same data as holotype.

***Diagnosis***

Externally similar to previous species, *aegidia*.

Male genitalia (Figure 10). Resembling those of *aegidia*, but with broader valva, armed with long basal prominence; socii narrowed distally.

Female. Not known.

***Distribution***

Ethiopia.

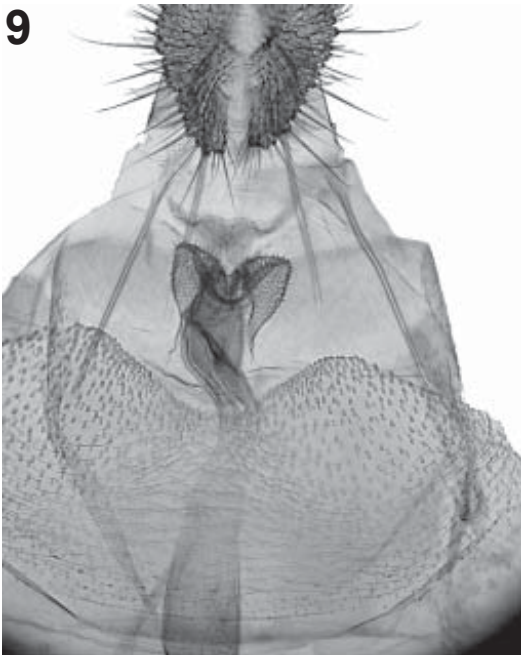
***Eccopsis praecedens* Walsingham, 1897**

*Eccopsis praecedens* Walsingham, 1897: 56, pl. 3, Figure 21; Diakonoff, 1981: 12, Figures 4, 7, 8.

*Eccopsis chromatica* Diakonoff, 1983a: 67, Figures 19-20. Syn. nov.

*Material examined*. ANGOLA: 7 mls W Gabela 1♀ 16-18.iii.1972 (BMNH); CONGO (ZAIRE): Eala 1♀ xi. 1936 Mme. J. Ghesquière leg. (MRAC); KENYA: Escarpment Kikuyu, Ibea 7500-8500 ft. 2♂♂4♀♀ ix-x.1900 Doherty leg., one male with genital slide BM 26666 (BMNH); Kenya Eastern: Embu 5000 ft. 1♂ 28.v.2000 D. Agassiz leg. (DA); NIGERIA: Oyo State: Gambari Forest 1♂ 1978 M.A. Cornes leg. (BMNH); RÉUNION: Bassin Martin 3♂♂ 10.vi.1985 on “Quilici letchi”, genital slide BM 25242 (BMNH); Grand Bois 1♂ 23.xi.1982 on “Quilici letchi” (BMNH); SOUTH AFRICA: Natal: Pinetown 1♂ [arva] 1909 (BMNH); Cape Prov.: Wilderness 1♂ 18.xii.1995 O. Karsholt leg. (ZMUC); TANZANIA: Tanga Reg.: Muheza Distr.: Kwamgumi For. Res. 170-220 m 1♂ 21.vii.1995 S.H. McKamey et al. leg. (ZMUC);

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**Figures 8-9.** Female genitalia of *Eccopsis aegidia* (Meyrick).



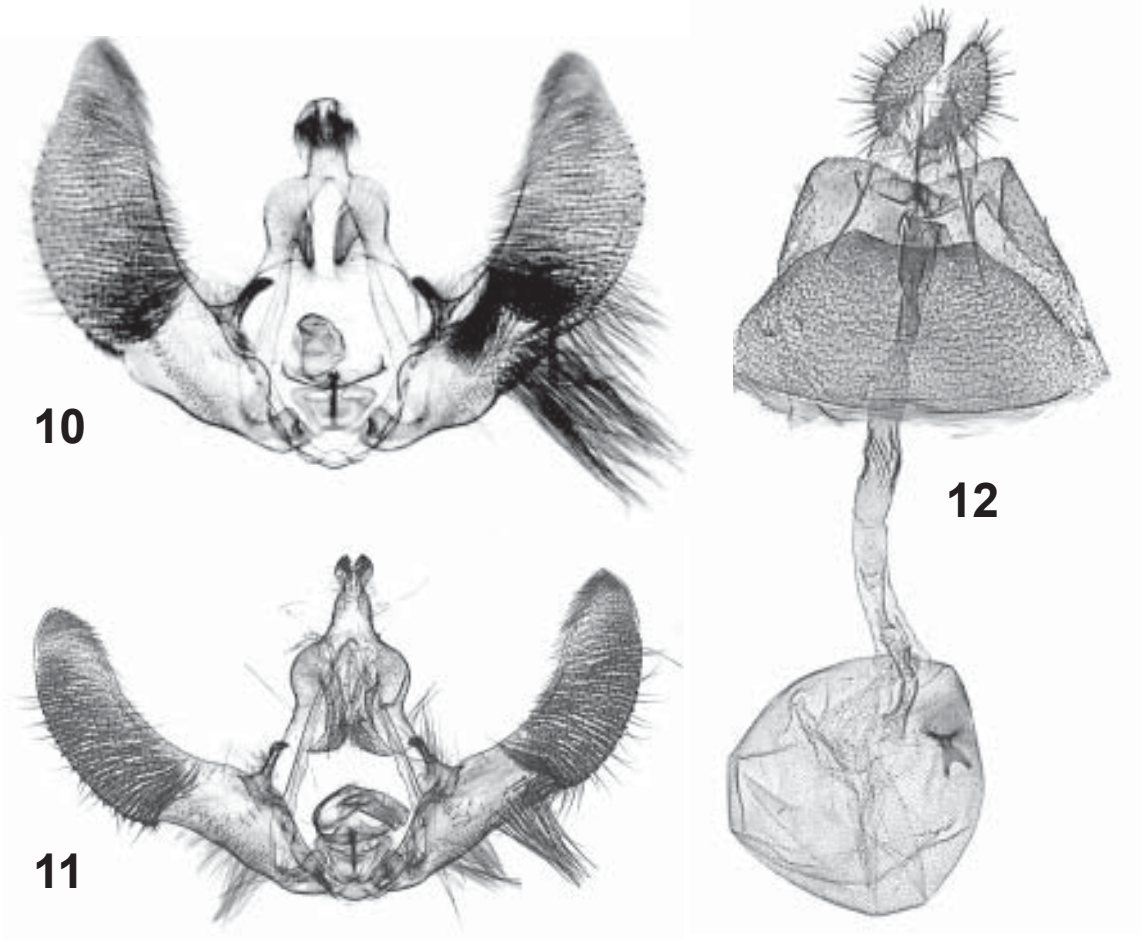
Arumeru Distr.: Usa River 1170 m 1♂ 11.viii.1991 L. Aarvik leg., genitalia on slide LAA 2199 (LAA); Morogoro Distr. & Town 550-600 m 1♂ 29.xi.1991, 1♀ 11.iv.1992, 1♂ 8.vi.1992 (LAA); Morogoro Distr.: Kitulangalo For. Res. 420-540 m 1♂ 1.i.1993 (LAA); Geita Distr.: Rubondo Island 3♂♂ 1♀ 26.i.1991 A. Bjørnstad leg., genital slides LAA 2199, 2200, 2201, 2123 (LAA, ABJ).

**Description**

Figure 89. Wingspan 15-20 mm. Labial palp 1.5 times diameter of eye, second segment basally brown, otherwise pale ochreous. Forewing costa “bent” at two thirds, ground colour pale ochreous,

often suffused with purple and fuscous in dorsal half; pattern fuscous, complicated, consisting of short dots and lines, distinct triangle and smaller dots on costa. Hindwing fuscous, becoming reddish apically; in male modified, with anal roll. Male hind tibia with groove concealing ochreous hair-pencil.

Male genitalia (Figure 11). Socii strongly sclerotized, curved; basal process of valva well developed; aedeagus robust, curved, with one cornutus. The proportions of the male genitalia vary; the width of the socii, valva and the basal process of the valva show individual variation.



**Figure 10-12.** Genitalia of *Eccopsis* Zeller. **10.** Male genitalia of *E. maschalista* (Meyrick). **11.** Male genitalia of *E. praecedens* Walsingham. **12.** Female genitalia of *E. praecedens* Walsingham.



Female genitalia (Figure 12). Ductus bursa widening posteriorly into a sclerotized, punctulate tube, the colliculum; lamella postvaginalis present as a sclerotized plate, with medial ridge; signum with two projections.

#### *Distribution*

Angola, Cabo Verde Islands (Diakonoff 1983a), Congo (Zaire), Congo Rep. (Walsingham 1897, Diakonoff 1981), Kenya, Madagascar (Diakonoff 1981), Nigeria, Réunion, South Africa and Tanzania.

#### *Biology*

Bred from cocoa, *Theobroma cacao*. Diakonoff (1977: 110) recorded a specimen bred from inflorescence of mango, *Mangifera indica*.

#### *Remarks*

I have not examined the type of this species, but base the identity on the original description and the paper by Diakonoff (1981). The male genitalia of *Eccopsis chromatica* figured by Diakonoff (1983a: 66) fall within the variation of *praececedens*. The female genitalia figured on the same page agree closely with those of specimens of *praececedens* from Tanzania. Consequently *chromatica* is synonymized with *praececedens*. The female genitalia figured by Diakonoff (1981: 13, Figure 7) probably represent another species. Externally this species is distinguished by the combination of the forewing costal triangle and the reddish apex of the hindwing.

#### ***Eccopsis morogoro* sp. n.**

*Type material*: Holotype male, TANZANIA: Morogoro Distr. & Town 550-600 m 5.iv.1992 L. Aarvik leg., genital slide LAA 2530 (ZMUO).

#### *Description*

Figure 92. Male. Wingspan 15.5 mm. Labial palp 1.5 times diameter of eye; second segment ochreous except fuscous brown base, distal edge and small spot near upper edge; third segment fuscous brown. Forewing costa medially straight, very slightly curved basally and apically; termen slightly convex. Ground colour golden ochreous, with scattered silvery scales; pattern consisting

of short fuscous streaks and dots, costal triangle and discal spot indistinct, fringes ochreous, except some greyish ones at tornus. Hindwing fuscous, outline in anal area not modified, anal roll very narrow, indistinct. Hind tibia dilate, with groove concealing greyish and cream-coloured hair-pencil, the cream hair-scales overlying the greyish ones.

Male genitalia (Figure 13). Uncus of even width, distally cleft; socii broad, ventral part strongly setose; basal process of valva well developed, distally spined, valva slender, cucullus gradually tapering in distal half, right valva with tuft of setae below cucullus; aedeagus tapering towards nearly pointed apex, no cornuti or carinae.

Female. Not known.

#### *Distribution*

Only known from eastern Tanzania.

#### *Remarks*

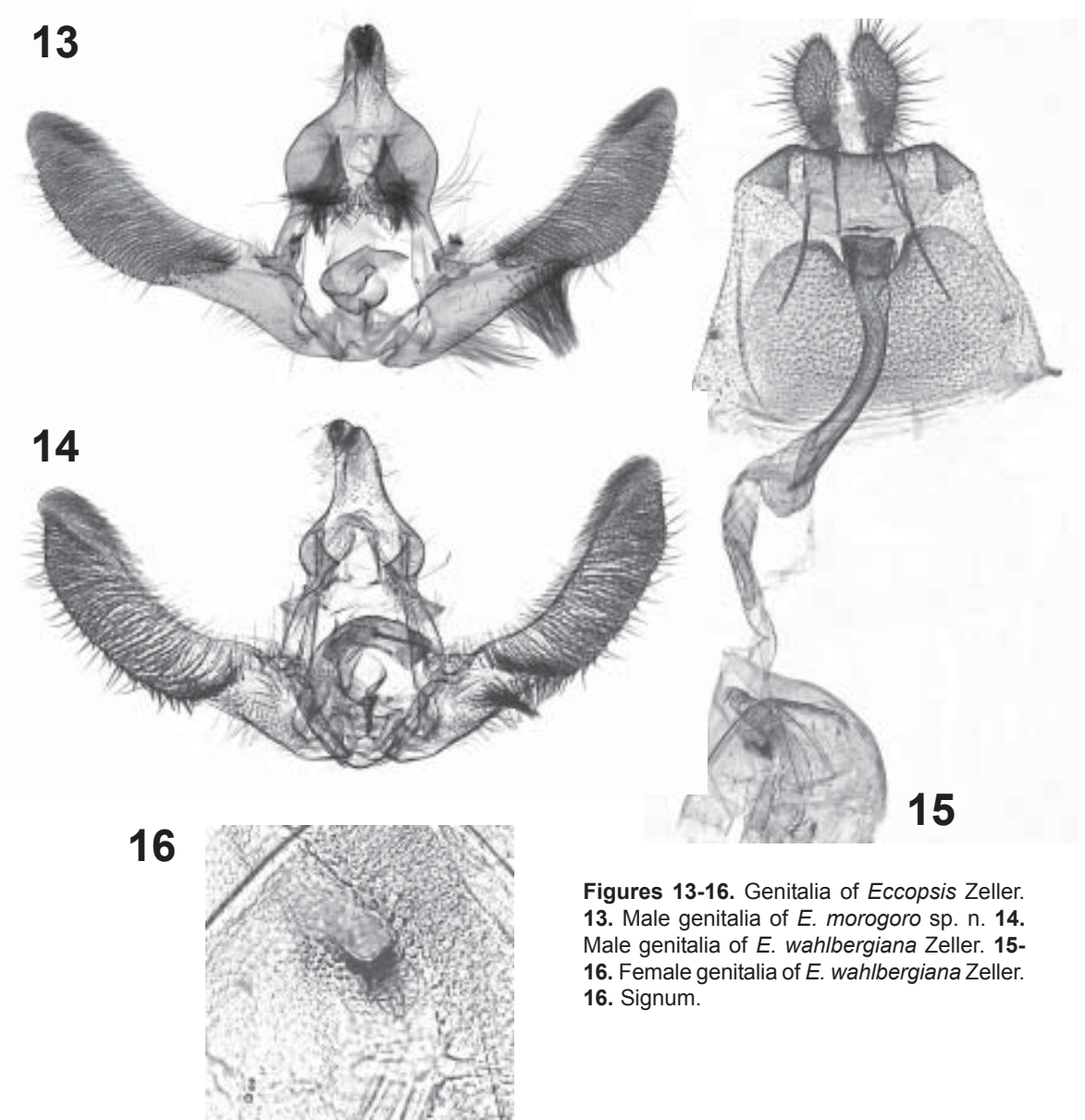
Externally resembling *praececedens*, previous species, differing by shape of hindwing, which also lacks the reddish apical coloration present in *praececedens*. The genitalia differ considerably.

#### ***Eccopsis wahlbergiana* Zeller, 1852**

*Eccopsis wahlbergiana* Zeller, 1852: 79; Diakonoff, 1958: 71, text Figures 1,2, pl. Figures 1,2; Diakonoff, 1981: 12, Figures 3, 5, 6.

*Eccopsis fluctuatana* Walsingham, 1881: 230, pl. 10, Figure 7.

*Material examined*: CAMEROON: Yaounde 1♂ xi.1968 [collector not mentioned] (BMNH); CABO VERDE ISLANDS: 1♂ 16.vi.1983 ex *Ricinus* S. Jorga leg. (BMNH); CONGO (ZAIRE): [Lubumbashi] Elisabethville 1♀ iv.1952 Ch. Seydel leg. (MRAC); Katanga: Bibanga 1♂ 20.xii.1925 Ch. Seydel leg. (MRAC); Km 43 Rt. Lusambo-Batempa 1♂ 19.viii.1949 Dr. Fontaine leg. (MRAC); GABON: Lake Azingo 1♂ xii.1907 Ansoerge leg. (BMNH); GHANA: Brit. Togoland, Kbebe 1♂ ii.1932 la[rva] on Castor oil palm [*Ricinus*]; 1♂, larva on leaves of Castor [*Ricinus*] G.S. Cotterell leg. (BMNH) GAMBIA: Bathurst 1♂ 1♀ 1885. Carter leg. (BMNH); IVORY



**Figures 13-16.** Genitalia of *Eccopsis* Zeller. **13.** Male genitalia of *E. morogoro* sp. n. **14.** Male genitalia of *E. wahlbergiana* Zeller. **15-16.** Female genitalia of *E. wahlbergiana* Zeller. **16.** Signum.

COAST: 1♂ (BMNH); KENYA: Shimba Hills 1♂ 28-31.vii.1982 (BMNH); Kenya 2♂♂1♀ vi.1958 bred *Ricinus communis* J.P. Graham leg. (BMNH); Escarpment Kikuyu, Ibea 7500-8500 ft. 2♂♂ ix-x.1900 Doherty leg. (BMNH); Kenya Central: Naro Moru 6500 ft. 1♀ 29.xii.1999 D. Agassiz leg. (DA); Kenya Eastern: Embu 5000 ft. 1♂ 28.v.2000 D. Agassiz leg. (DA); Rift Valley: Marich Pass

3000 ft. 1♀ 31.v.1999 D. Agassiz leg. (DA); MADAGASCAR: 2♂♂ 1♀ H. Perrot leg. (BMNH); MALAWI: Mlanje 1♂ 5.ii.1914, Mlanje, Lucheniya R. 2♀♀ 26.ii.1914 S.A. Neave leg. (BMNH); Zomba 1♂ [19]20 H.B. leg. (BMNH); Lilongwe 1♂ 13-31.iii.1989 B. Skule leg. (ZMUC); MOZAMBIQUE: Ruo Valley 2000 ft. 1♂ 29.xii.1913 S.A. Neave leg. (BMNH);

NIGER: Anambara Creek 1♀ (BMNH); NIGERIA: Zungeru 1♂ 4.xi.1911 S. Macfie leg. (BMNH); Aiyetoro 1♀ 10.iv.1920 A.W.J. Pomeroy leg. (BMNH); Zaria, Samaru 1♂ 2.xii.1966 ex Castor [*Ricinus*] J.C. Deeming leg. (BMNH); Ile-Ife, West State 1♂ 7.i.1972 J.T. Medler leg. (BMNH); Lagos: Ikoyi 1♂ 15.iii.1995 M.A. Cornes leg. (BMNH); SENEGAL: 1♂ 1944 J. Risbec leg. (BMNH); Bambey 1♂ 12.xii.1939 la[rva] Ricin [*Ricinus*] J. Risbec leg. (MRAC); SIERRA LEONE: 1♂ ix.1925 ex *Ricinus* ex coll. Meyrick (BMNH); Bo 1♀ xii.1967, 1♂ i.1969 D.J. Revell leg. (BMNH); SOUTH AFRICA: Natal: Wenen: Estcourt, Kimbolton 1♀ 1892 Hutchinson leg. (BMNH); Natal: Durban 1♂1♀ 1904 Leigh leg. (BMNH); Cape Prov. Swellendam 1♀ 17.xii.[19]31-18.i.[19]32 (BMNH); TANZANIA: Njombe 6000-6500 ft. 1♀ 26.viii.1952 W. Peters leg. (BMNH); Mpanda Distr.: 33 km S Uvinza on Mpanda Road 1450 m 1♀ 27.v.1990, 57 km S Uvinza on Mpanda Road 1700 m 1♂ 3.viii.1990 A. Bjørnstad leg. (ABJ); Morogoro Distr. & Town 550-600 m, 1♂ 3.iii.1992 (genital slide LAA 2196), 1♂ 30.viii.1992, 1♂ 27.x.1992, 1♂ 13.i.1993, 1♂ 4.ii.1993, 1♂ 17.iii.1993, 1♂ 23.iii.1993; Arumeru Distr.: Usa River 1170 m, 1♀ 4.viii.1991 (genital slide LAA 2197), 1♂ 11.viii.1991 L. Aarvik leg. (LAA); UGANDA: Kampala 1♂ ix.1929 bred H. H[argreaves] leg. (BMNH); Kampala 1♀ 22.viii.1929, 1♂ 24.viii.1929 H. Hargreaves leg. (BMNH).

### Description

Male (Figure 90). Wingspan 16-18 mm. Labial palp 1.5 times diameter of eye, ochreous, second segment more or less suffused with purple, third segment and tip of second bluish grey. Forewing costa straight, bent at two thirds; ground colour cream, with patches of pearl; costal triangle and strigulae olive-brown, dorsal half suffused with olive-brown, often intermixed with purple, bluish black sub-basal fascia distinct in costal half, prominent discal spot black. In some specimens the median part of dorsum is suffused dark brown or blackish up to 1/2 or 1/3. Hindwing distinctly modified in anal area, varying from ochreous to grey, often with reddish suffusion apically, anal

roll well developed. Hind tibia with groove concealing pencil of fuscous hair-scales, overlaid by cream hair-scales.

Female (Figure 91). Similar to male, but labial palpi twice diameter of eye, and hindwing usually fuscous; the form with ochreous hindwing is rare in females.

Male genitalia (Figure 14). Uncus curved, cleft; socii strongly sclerotized, broad apically; valva slender, with fine bristles, distinct edge below cucullus, basal process weakly developed, right valva with tuft of setae below cucullus; aedeagus broad, curved, with single slender, long cornutus.

Female genitalia (Figures 15, 16). Sternite 7 with deep rounded excavation, giving room for the cup-shaped ostium; colliculum a long, slightly curved, sclerotized tube; signum (Figure 16) a plate of indefinite shape, with 1-2 projections.

### Distribution

The whole Afrotropical Region, including Madagascar, Cabo Verde Island and Comoro Islands. Diakonoff (1983c: 274) reported it from Saudi Arabia: Asir Mountains.

### Biology

It has been bred from leaves of castor, *Ricinus*.

### Remarks

A male lectotype was designated and published together with a redescription of the species by Diakonoff (1958). *Eccopsis fluctuatana* Walsingham, 1881 was synonymized with *wahlbergiana* by Diakonoff (1981).

### *Eccopsis deprinsi* sp. n.

*Type material*: Holotype male, KENYA: Aberdare Nat. Park, Camp Site M3 1600 m, 12.iv.2001 J. & W. De Prins leg., genital slide LAA 23008 (MRAC).

### Etymology

Named in honour of the collectors, Jurate and Willy De Prins, Musée Royal de l'Afrique Centrale, Tervuren, Belgium.

**Description**

Figure 93. Male. Wingspan 16.5 mm. Labial palp 1.5 times diameter of eye; second segment reddish brown, third segment grey. Head rough scaled, frons grey, vertex brown-grey. Thorax with reddish anterior rim, otherwise pale fuscous, crest grey. Forewing with produced apex; ground colour light ochreous, sub-basally and medially with heavy blackish suffusion; a triangular field of dark suffusion reaches from apex to two thirds of termen, along termen forming band of bluish iridescent scales; fringes basally black, distally grey, at tornus mixed ochreous and greyish. Hindwing light grey, becoming ochreous towards costa and apex; apex with rufous edge; cilia grey, in anal area pale yellowish; anal roll well developed, pale yellowish. Hind tibia with groove concealing pencil of grey hair-scales, overlaid by cream hair-scales.

Male genitalia (Figures 17, 18). Top of tegumen triangular, gradually narrowing into uncus; uncus spinose, cleft; socii well sclerotized, large, falci-form; valva slender, with fine bristles, basal process weakly developed, right valva with tuft of bristles at base of cucullus; aedeagus (Figure 18) broad, lateral wall on right side with carinae, one slender cornutus. Male genitalia resembling those of *E. wahlbergiana*, differing e.g. by larger socii and lack of distinct edge below cucullus.

Female. Not known.

**Distribution**

Only known from Aberdare Mountains in Kenya.

**Remarks**

Easily recognisable species by the characteristic contrasting forewing pattern. The male genitalia show that it is closely related to the widespread *E. wahlbergiana* Zeller, 1852.

***Eccopsis ochrana* sp. n.**

*Type material*: Holotype female, TANZANIA: Morogoro Distr. & Town 550-600 m, 16.viii.1992 L. Aarvik leg., genital slide LAA 2618 (ZMUO).

**Description**

Figure 94. Female. Wingspan 18 mm. Labial palp 1.5 times diameter of eye; second segment buff, end of second segment and third segment dark brown except a few light scales at the very tip of third segment. Head buff except brown tuft between base of antennae. Thorax and antennae buff. Legs buff, tarsi with brown spots. Abdomen yellow. Forewing ground colour buff, pattern brown, consisting of numerous transverse strigulations, a costal triangle in middle, a narrow oblique patch from middle of termen towards costa and a small blackish brown discal spot; fringes buff. Hindwing yellow, with brown scales along proximal edge and rufous scales near apex.

Female genitalia (Figures 19, 20). Sternite 7 with deep rounded medial excavation, lateral sides extended posteriorly; lamella postvaginalis strongly denticulate, consisting of a rectangular basal part and two posterior denticulate lobes; ostium cup-shaped; colliculum a long and bent sclerotized tube; ductus bursa with sclerite below inception of ductus seminalis; signum (Figure 20) an irregular oval plate without projections.

Male. Not known.

**Distribution and ecology**

Only known from eastern Tanzania. The specimen was attracted to light in a garden within the built-up area of Morogoro town. The vegetation in the area is mixture of native plants and ornamental trees and shrubs as well as patches of cultivated fields.

**Remarks**

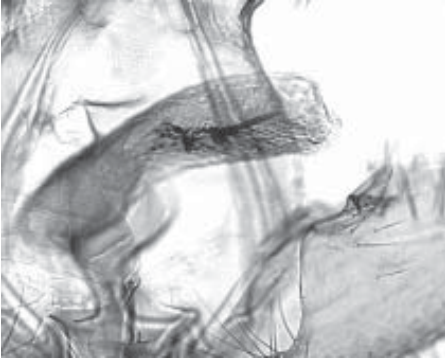
The forewing pattern with the presence of a costal triangle shows affinity with *wahlbergiana* and *praecedens*. The genitalia display further development of characters present in *wahlbergiana*, viz. reduced signum, shape of colliculum and sternite 7. However, signum lacks the projection otherwise typical for *Eccopsis*. This is interpreted as a secondary reduction. When the male becomes available, this will allow reconsideration of the generic position. The combination of the buff/brown forewing and the yellow hindwing is unique among African Neopotamiae species.



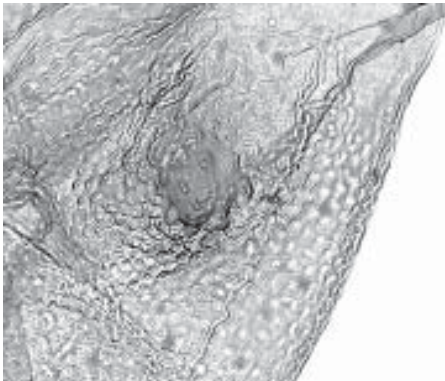
17



18



20



19

**Figures 17-20.** Genitalia of *Eccopsis* Zeller. **17-18.** Male genitalia of *E. deprinsi* sp. n. **18.** Aedeagus. **19-20.** Female genitalia of *Eccopsis ochrana* sp. n. **20.** Signum.

***Eccopsis tucki* sp. n.**

*Type material:* Holotype, male, KENYA: Escarpment Kikuyu, Ibea 7500-8500 ft. ix-x.1900 Doherty leg., genital slide BM 26662 (BMNH).

Paratypes. 18 males labelled as holotype (BMNH).



### *Etymology*

Named in honour of my friend Kevin Tuck, The Natural History Museum, London, who recognised the species as an undescribed member of *Eccopsis*.

### *Description*

Figure 95. Male. Wingspan 19 mm. Labial palp 1.5 times diameter of eye; second segment reddish brown, third segment black. Forewing costa straight, bent at two thirds, termen slightly concave; ground colour light ochreous brown; rows of silvery scales in area near tornus and beyond black discal spot – this area forming an indistinct “mirror”; patches of darker brown scales present at costa near apex and from 1/3 to 2/3 where other *Eccopsis* species have a costal triangle, similarly there is a large brown triangle below discal spot and a patch sub-basally below fold; fuscous costal strigulae present in basal third and, indistinctly, in apical third. Hindwing without modifications of outline in anal area, but with rolled edge; fuscous, becoming ochreous along edge and in apical area. Hind tibia with grey hair-pencil, overlaid by cream-coloured hair-scales.

Male genitalia (Figure 21). Uncus cleft, constricted before apex; socii strongly sclerotized, setose, with broad base, distal part long and narrow; valva slender, cucullus narrow before tip, basal process not developed, right valva with tuft of setae below cucullus; aedeagus truncate, with two rows of carinae of dissimilar size.

Female. Not known.

### *Distribution*

Kenya.

### *Remarks*

Externally resembling *ochrana* sp. n., differing by its fuscous hindwing. In the male genitalia distinguished from the related *wahlbergiana* Zeller, 1852 and *deprinsi* sp. n. by the shape of uncus, socii and aedeagus.

### *Eccopsis ninicecilie* sp. n.

*Type material*: Holotype male, TANZANIA Tanga Region, Lushoto Distr., 1400 m, Mazumbai Forest Reserve 30.xi.-7.xii.1995 S. McKamey et al. leg., genital slide LAA 20106 (ZMUC).

Paratypes. 1♂2♀♀, labelled as holotype; one female with genital slide LAA 20107 (ZMUC).

### *Etymology*

The species is named after the author’s wife, Nini Cecilie Aarvik, who executed the water paintings for this work.

### *Description*

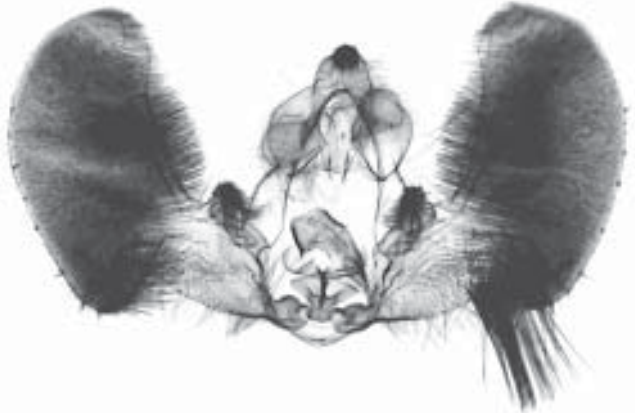
Figure 96. Male. Wingspan 18 mm. Labial palp 1.5 times diameter of eye, cream-coloured, outer surface of second segment with two dark grey spots, third segment buff, lower part grey. Forewing costa almost straight in basal two thirds, then with slight bend, and apical third straight. Ground colour cream. Basal, sub-basal and medial fasciae fuscous, not reaching dorsum. Distinct white discal spot penetrates outer edge of medial fascia. Large brownish fuscous patch in apical area and along termen. A smaller, but similarly coloured patch situated at dorsum just before tornus. External half of wing interspersed with purplish scales. Hindwing dark brownish grey; anal part shortened, with pencil of grey hair-scales and proximal edge rolled into a rigid tube. Hind tibia with groove concealing tuft of fuscous hair-scales overlaid by beige-coloured ones. Rear end of abdomen with scale tuft.

Female. Differing from male by presence of large fuscous patch on outer surface of labial palp segment two. Differing also by lack of modifications of hind wing, abdomen and hind tibia.

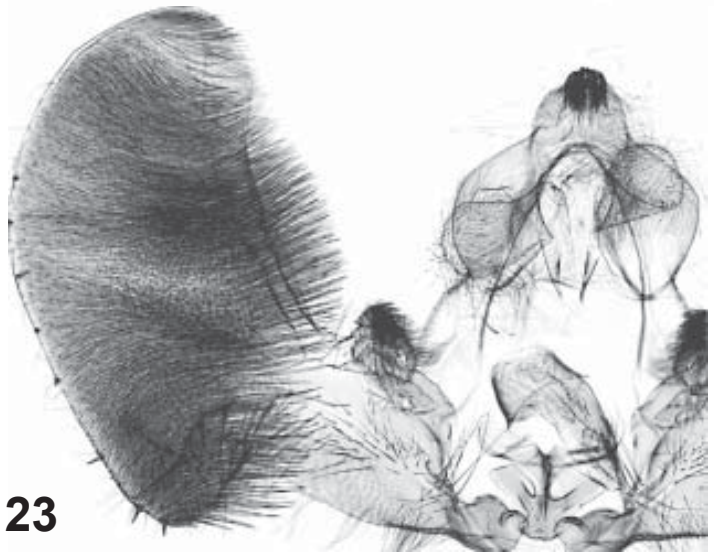
Male genitalia (Figures 22, 23). Uncus basally broad, terminally narrowed, armed with numerous spines; tegumen medially constricted; socii broad, rounded, setose; basal process of valva developed, basally with spines; cucullus broad, dorsal edge with few short spines, right valva with tuft of long setae; aedeagus terminally with two dentate ridges and one cornutus.



22

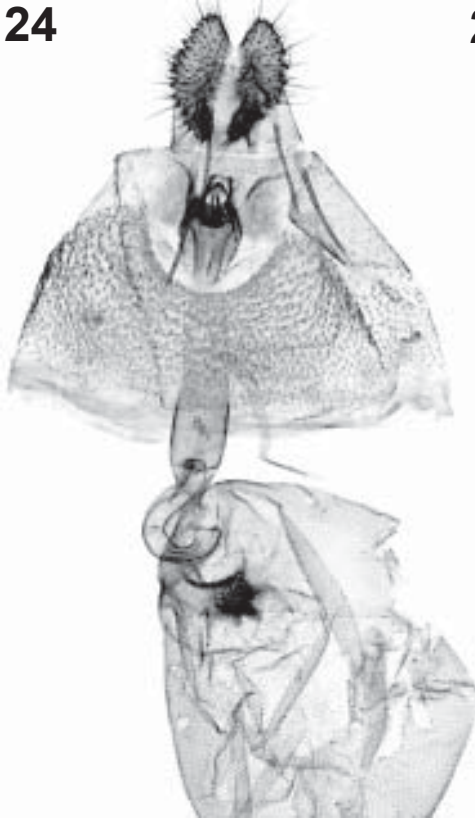


23



**Figure 21-23.** Genitalia of *Eccopsis* Zeller. **21.** Male genitalia of *E. tucki* sp. n. **22-23.** Male genitalia of *E. ninicecillie* sp. n.

24



25



Figures 24-25. Female genitalia of *Eccopsis ninicecilie* sp. n. 25. Signum.

Female genitalia (Figures 24, 25). Sternite 7 with deep semicircular excavation; sterigma with lateral round sclerites; colliculum widening posteriorly, with lateral folds; ostium and colliculum covered by diamond-shaped scobinate sclerite; ductus bursa entirely membranous; signum (Figure 25) scobinate, with two anteriorly directed projections.

**Distribution**

Eastern Tanzania.

**Remarks**

The material was collected with light trap in the mountain rainforest at Mazumbai, West Usambara mountains.

*E. ninicecilie* n.sp. does not closely resemble other known species of *Eccopsis*. The male genitalia show affinity with *incultana* (Walker), differing e.g. by narrower cucullus and uncus, and by short-

er and broader aedeagus. *E. incultana* lacks the strong modifications of the male hind wing which is present in the new species.

***Eccopsis incultana* (Walker, 1863)**

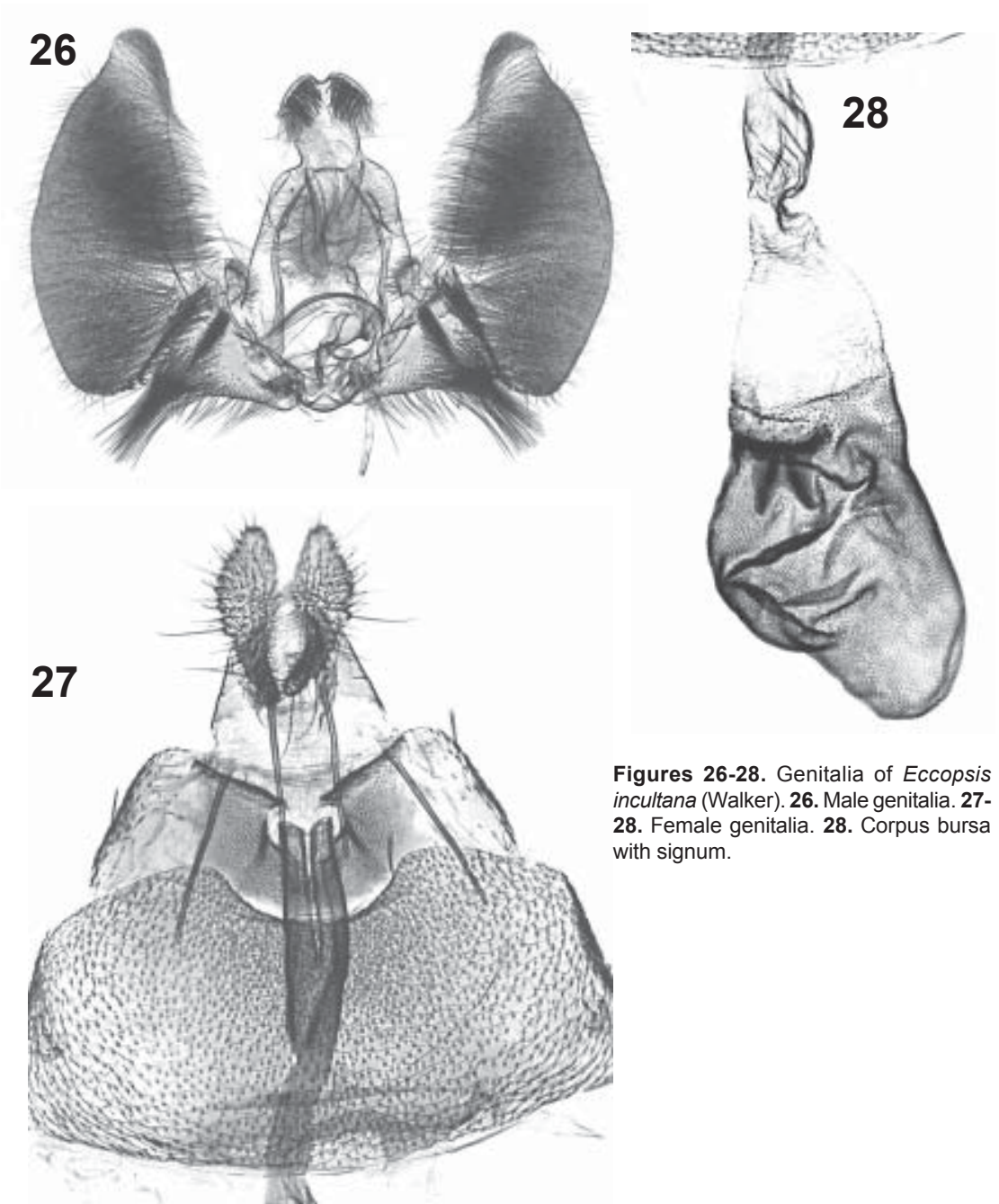
*Batodes incultana* Walker, 1863: 316;

*Eccopsis incultana*, Diakonoff, 1981: 15, Figures 10-12.

*Argyroploce trixiphias* Meyrick, 1939: 51.

*Eccopsis undosa* Diakonoff, 1981: 17, Figure 15. Syn. nov.

*Material examined.* ANGOLA: Marimba 1♂ 30.ix.1903 Ansoerge leg. (BMNH); CONGO (ZAIRE): Eala 2♀♀ ix.1936 J. Ghesquière leg. (MRAC); [Lubumbashi] Elisabethville 2♂♂ iv-v.1952 Ch. Seydel leg., genital slide LAA 98035 (MRAC); GAMBIA: Bathurst 1♀ viii.1885 Carter leg. (BMNH); GHANA: Accra 1♀ 188? Carter leg. (BMNH); KENYA: Mombasa 1♂ 1906 A.J.



**Figures 26-28.** Genitalia of *Eccopsis incultana* (Walker). **26.** Male genitalia. **27-28.** Female genitalia. **28.** Corpus bursae with signum.

Cholmley (BMNH); Kenya Central: Naivasha 6000 ft. 1♂ 29.xii.1998 D. Agassiz leg (DA); Kenya Coast: Kilifi 1♀ 10.iv.1999 D. Agassiz leg. (DA); MALAWI: Amboize 1♀ 29.ix.1875 A.V. Homeyer leg. (BMNH); Mlanje: Luchenya R. 1♂

12.ii.1914 S.A. Neave (BMNH); MAURITIUS: Port Louis 1♀ 2.v.1904, 1♀ 10.viii.1905 TBF leg. (BMNH); NIGERIA: Lagos 1♂ 6.x.1974 M.A. Cornes leg. (BMNH); NAMIBIA: East Caprivi, Mudumu N.P., Nakatwa 1♀ 8-13.iii.1992 W. Mey



leg. (genital slide LAA 23009) (MNHB); RÉUNION: St. Denis 1♀ 30.iv.1884 ex coll. Meyrick (BMNH); SÃO TOMÉ AND PRÍNCIPE: Príncipe Isl. 1ex 19.xii.1952 W.H. Tams leg. (BMNH); SOUTH AFRICA: Natal: Umroti 1♂ iv.1892 Hutchinson leg. (BMNH); TANZANIA Arumeru Distr.: Usa River 1170 m 2♂♂ 1♀ 4-10.viii.1991 L. Aarvik leg. (LAA); Morogoro Distr. & Town 550-600 m 1♂ 20.v.1992, 1♀ 23.iii.1993, 1♀ 9.iv.1993 L. Aarvik leg. (LAA); Morogoro Distr. & Town: Kigurunyembe 700-900 m 1♂ 3.v.1992, 1♂ 30.v.1992 L. Aarvik leg. (LAA); Morogoro Distr. & Town: Kihonda 500 m 1♂ 20.iii.1992, 1♀ 5.iv.1992 L. Aarvik leg. (LAA); Biharamulo Distr.: Nyakanazi quarry 1300 m 1♂ 17.iii.1990 A. Bjørnstad leg. (LAA); Kasulu Distr.: Kasulu Town 1300 m 1♂ 11.viii.1989 A. Bjørnstad leg. (LAA); Mpanda Distr.: 31 km S Uvinza on Mpanda Road 1520 m 2♂♂ 20.vii.1990 A. Bjørnstad leg. (LAA); 57 km S Uvinza on Mpanda Road 1700 m 1♀ 3.viii.1990 A. Bjørnstad leg. (LAA); ZAMBIA: Mbala 1♀ 23-26.i.1975 "Locust Ctr. Center" leg. (BMNH); ZIMBABWE: [Harare] Salisbury 1♂ 1894 Marshall leg., genital slide BM 26667 (BMNH). 2 males and 2 females from Tanzania were dissected by the author (slides LAA 2192, 2193, 2531, 2533).

#### Diagnostic description

Male (Figure 97). Wingspan 13-18 mm. Labial palp 2 times diameter of eye; cream-coloured, outer surface more or less suffused with fuscous, third segment usually with faint basal ring. Forewing costa without bend at two thirds. Ground colour cream; a distinct fuscous brown patch from base of dorsum extending towards centre of wing, above this a similarly coloured streak parallel with costa; a broad fuscous brown fascia covers almost two thirds of wing surface, outer border of fascia interrupted by two tongue-shaped incisions almost dividing it; apex fuscous, and a fuscous oblique patch present below apex; fringes brownish purple, lighter at tornus. Hindwing of unmodified shape, anal edge forming short roll. Hind tibia with groove concealing tuft of fuscous hair-scales overlaid by cream-coloured ones.

Female. As male, but lacking modifications of hindwing and hind tibia.

Variation. Some specimens from western Tanzania have the forewing ground colour ochreous with reddish brown marks. The female illustrated (Figure 99) represents this form. A small aberrative male specimen (Figure 98) is also figured.

Male genitalia (Figure 26). Uncus broad, cleft; socii long, apically rounded; basal process of valva developed, terminally broad, cucullus large, basally very broad, narrow at apex, lower edge with row of spines; aedeagus slender, curved, dorsally sclerotized and with apical dent.

Female genitalia (Figures 27, 28). Sterigma a large plate with circular excavation around ostium; colliculum long and tubular; signum a scobinate plate with one broad projection which is triangularly incised.

#### Distribution

The Afrotropical region including Mauritius, Seychelles Islands and Madagascar.

#### Remarks

The identity of the present species is in accordance with Diakonoff (1981). Diakonoff (1981), after studying the type, also synonymized *Argyroplote trixiphias* Meyrick, 1939 with *E. incultana*. *Eccopsis undosa* Diakonoff, 1981 was described from a single male from Madagascar (Diakonoff 1981). Comparison of Diakonoff's figure of the male genitalia of *E. undosa* with additional slides, has shown that it is conspecific with *E. incultana*.

There is a specimen without abdomen in BMNH from Chile: Rodriguez Isl., H.P. Thomasset & H.J. Snell leg., identified as *incultana*. More material is needed to clarify whether this otherwise African species really is resident in South America.



### ***Cosmorrhyncha* Meyrick, 1913**

*Cosmorrhyncha* Meyrick, 1913, *Ann. Transv. Mus.* 3: 276.

Type species: *Tortrix ocellata* Mabille, 1900

#### **Diagnosis**

Male antenna fasciculate, antenna in female with short cilia. Labial palp very long, more than twice the diameter of eye, with pointed apical segment. Thoracic crest small. Forewing with pointed apex and characteristic network pattern formed by numerous narrow lines; with distinct black-edged silvery discal spot. Male hindwing with short anal roll. Male hind leg with tufts of hair-scales. Morphology of genitalia of both sexes resembling *Eccopsis*.

#### **Remarks**

In addition to the two species treated below, only the type species *Cosmorrhyncha ocellata* (Mabille, 1900), can at present be assigned to this genus.

### ***Cosmorrhyncha acrocosma* (Meyrick, 1908) stat. nov.**

*Eccopsis acrocosma* Meyrick, 1908: 717.

*Material examined.* Holotype male, MALAWI: Lake Nyassa, Songwe (BMNH), genital slide BM 30762.

CONGO (ZAIRE): Dungu, Upper Uelle Distr. 1♂ viii. [no year or collector], genital slide BM 28983 (BMNH); KENYA: Rift Valley: Prov. Turi 8000 ft. 1♂ 5.xi.1998, 1♂ 13.i.1999, 1♂ 21.i.1999, 1♂ 5.ii.1999, 1♀ 4.iii.1999 D. Agassiz leg. (DA); MALI: Yanfolila 11°11'N, 08°09'W 1♂ 31.vii. 1986 Marcus Matthews leg., genital slide BM 28982 (BMNH); SIERRA LEONE: Bo 1♀ xii.1967 R.J. Revell leg., genital slide BM 28981 (BMNH); TANZANIA: Morogoro Distr. & Town 550-600 m 1♀ 11.iv.1992 (genital slide LAA 2312), 1♂ 12.v.1992, 1♂ 27.v.1992, 1♂ 1.ii.1993 (genital slide LAA 2311) L. Aarvik leg. (LAA); Arumeru Distr.: Usa River 1170 m, 1♀ 11.vii.1991, 1♂ 11.viii.1991 L. Aarvik (LAA); Lushoto Distr.: Mazumbai For. Reserve 1500 m, 1♂ 11.xii.1991 L. Aarvik leg. (LAA); Tanga Reg., Muheza Distr.: Kwangumi For. Res. 170-220 m, 1♀ 24.vii.1995 S.H. McKamey et al. leg., genitalia slide LAA 20111 (ZMUC).

#### **Description**

Figure 100. Male. Wingspan 14-16 mm. Labial palp twice diameter of eye; second segment basally dirty white, with two black bands and two yellow spots, lower edge cream to light brown; third segment black, pointed; upper edge of segment two and three plumbeous. Scape of antenna basally white, with sub-basal black patch in front. Head and thorax with white-tipped purplish brown scales. Forewing pattern a mosaic formed by cream-coloured scales and indistinct transverse lines of purplish brown. Apex with short white line edged on both sides with black; the white line continues as two silvery lines, edged with black and rufous. There are additional silvery spots along costa and termen. Discal spot silvery, edged black. Hindwing fuscous, anal part shortened and proximal edge rolled into a rigid tube, pencil of greyish brown hair-scales present distad to anal roll. Hind femur with longitudinal split concealing one tuft of blackish brown hair-scales and another tuft of ochreous hair-scales. Tibia likewise with split and pencil of long, purplish brown hair-scales, overlying pencil of long, yellow hair-scales.

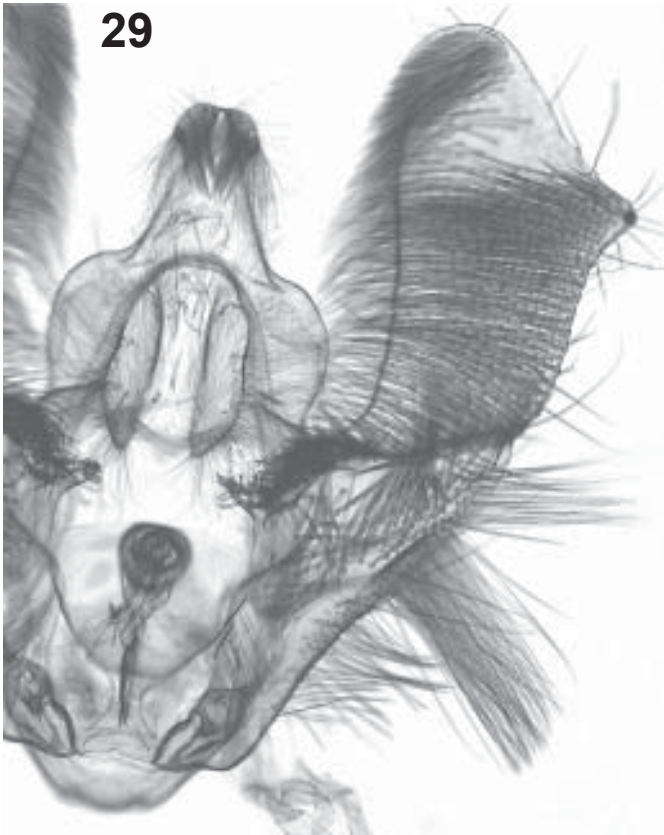
Female similar to male, but lacking modifications of hindwing and hindleg.

Male genitalia (Figure 29). Uncus spinose; tegumen broad, with convex sides; socii broad, rounded; valva broadened in distal part, divided by spinose medial ridge, and with narrow basal process, cucullus with lateral projection which is armed with one thorn; aedeagus very short, with single short cornutus.

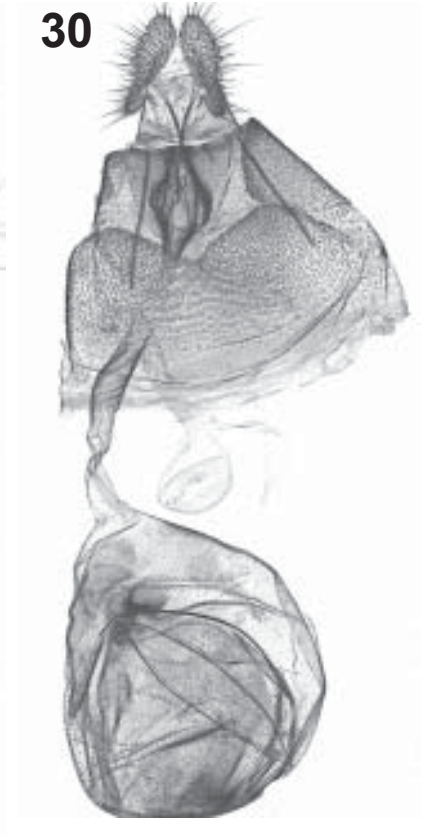
Female genitalia (Figures 30, 31). Sternite 7 with broad v-shaped excavation medially; ostium and colliculum spindle-shaped; sterigma triangular; medial part of ductus bursa weakly sclerotized, with wrinkles; signum (Figure 31) a small plate with one broad anteriorly directed projection.

#### **Distribution**

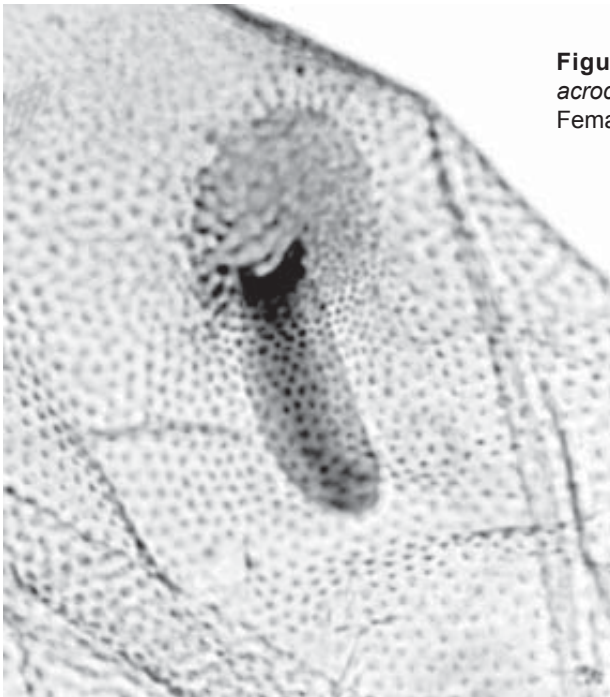
Congo (Zaire), Kenya, Malawi, Mali, Sierra Leone and Tanzania.



29



30



31

**Figures 29-31.** Genitalia of *Cosmorrhyncha acrocosma* (Meyrick). **29.** Male genitalia. **30-31.** Female genitalia. **31.** Signum.

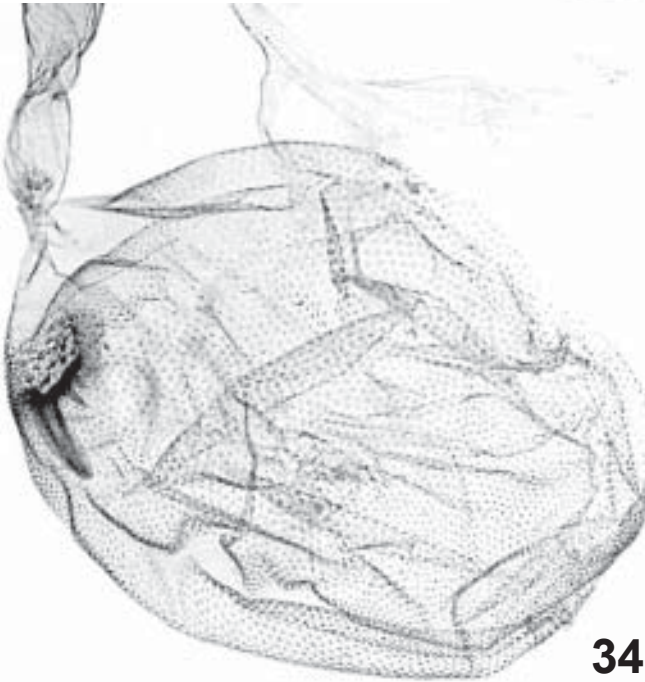
32



33



**Figures 32-34.** Genitalia of *Cosmorrhyncha microcosma* sp. n. **32.** Male genitalia. **33-34.** Female genitalia. **34.** Corpus bursa with signum.



34



**Remarks**

The holotype was dissected by Kevin Tuck, who found it to agree with the concept of *acrocosma* used here. *C. acrocosma* has a distally widened valva. In the closely related *C. microcosma* sp. n. (described below), the valva is narrower and is not widened distally.

*C. acrocosma* was synonymized with *Cosmorrhyncha ocellata* (Mabille, 1900) by Meyrick (1913). The male genitalia of the holotype of *ocellata* figured by Diakonoff (1959) shows that *acrocosma* and *ocellata* are different species. The female genitalia of *C. ocellata* were figured by Diakonoff (1981). *C. ocellata* is known from Madagascar and Grande Comore Island (Diakonoff 1981).

***Cosmorrhyncha microcosma* sp. n.**

*Type material*: Holotype male, CONGO (ZAIRE): Eala viii.1936 J. Ghesquière leg., genital slide LAA 21003 (MRAC)

Paratypes. CONGO (ZAIRE): Eala 1♀ viii.1936 J. Ghesquière leg., genital slide LAA 21004 (MRAC); KENYA: Gazi Mangrove & coastal veg'n, 1♂ 1♀ vii-viii.1982 R.J. Barnett leg., genitalia on slide BM 28979 and 28980 respectively (BMNH); SÃO TOMÉ and PRÍNCIPE: Principe I. 1♂ 31.xii.1932 W.H.T. Tams leg., genital slide BM 28990 (BMNH); UGANDA: Ruwenzori Range; Semliki Forest 2800 ft. 1♂ 22.viii-3.ix.1952 D.S. Fletcher leg., genital slide BM 7191 (BMNH).

**Description**

Wingspan 11-14 mm. Coloration of wings and body as in *acrocosma*. Male hind tibia with split and blackish brown pencil of long hair-scales.

Male genitalia (Figure 32). Similar to those of *C. acrocosma* (previous species), but differing by narrower and straighter valva which is not widened in distal half; lateral projection of valva small.

Female genitalia (Figures 33, 34). Similar to previous species, but ostium/colliculum part shorter, less extended posteriorly.

**Distribution**

Congo (Zaire), Kenya, São Tomé and Príncipe, and Uganda.

**Remarks**

Externally similar to *C. acrocosma* (previous species), but smaller. There are differences in the genitalia (see above).

***Neorrhyncha* gen. nov.**

*Type species*: *Neorrhyncha congolana* sp. n.

**Description**

Male antenna fasciculate, female antenna with short cilia. Labial palp as in *Cosmorrhyncha*: length more than twice the eye diameter and with pointed apical segment. Male hind femur with internal brush of ochreous scales, hind tibia with internal brush of long ochreous and brownish hair-scales. Male hindwing with short anal roll.

Shape and markings of forewing as in *Cosmorrhyncha*. Male abdominal wall laterally widened at basal segments (Figure 35).

Male genitalia (Figures 36, 37). Uncus broad, with long spines; socii strong, with dense tuft of narrow cilia; valvae asymmetrical, cucullus with groups of strong spines and tuft of setae; aedeagus long, curved.

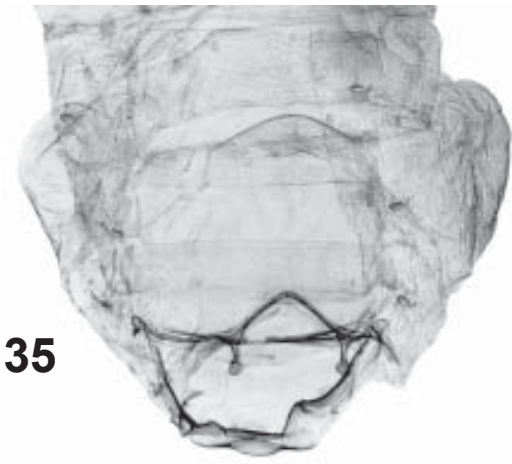
Female genitalia. Colliculum tubular, sclerotized; signum a sclerite with broad anteriorly directed projection.

**Remarks**

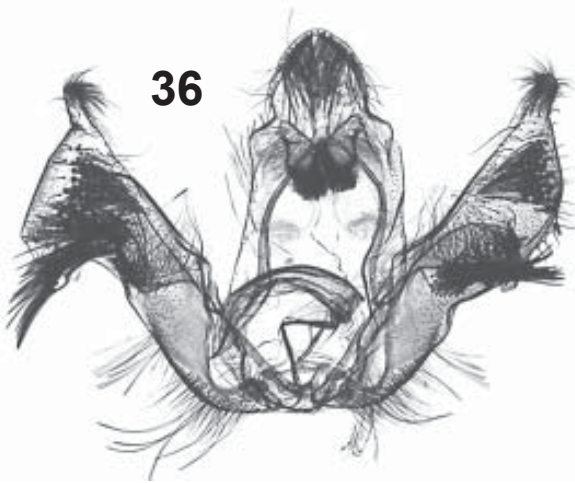
Externally the two species at present assigned to *Neorrhyncha* n. gen. agree closely with *Cosmorrhyncha*. However, the strongly derived male genitalia indicate its distinctness from *Cosmorrhyncha*, and a new genus is necessary for the species. The male of *camerunica* n. sp. is unknown.

***Neorrhyncha congolana* sp. n.**

*Type material*: Holotype male, CONGO (ZAIRE): Eala ii.1936 J. Ghesquière leg., genital slide LAA 20110 (MRAC).



**Figures 35-37.** Male *Neorrhyncha congolana* sp. n. **35.** Base of abdomen showing widening of anterior segments. **36-37.** Genitalia. **37.** Uncus and socii.



Paratypes. 1♂ as holotype, but with date ix.1935, genital slide LAA 20109 (MRAC); 1♀ as holotype, but with date iii.1936, genital slide BM 28992 (BMNH).

**Description**

Figure 101. Wingspan 18-24 mm. Labial palp 2.5 times diameter of eye, black, with plumbeous sheen, basally cream, yellow spot present at lower edge of second segment, upper edge with brush of white-tipped scales. Wing shape and pattern as in species of *Cosmorrhyncha* except that the silvery spots in the forewing are more numerous. Male genitalia. See genus description.

Female genitalia (Figures 38, 39). Anterior rim of sternite 7 shallowly concave; colliculum tubular, smooth, tapering anteriorly; sterigma with deep u-shaped excavation, and with distinct lateral and anterior edges that form a crate-shaped structure round ostium.

**Distribution**

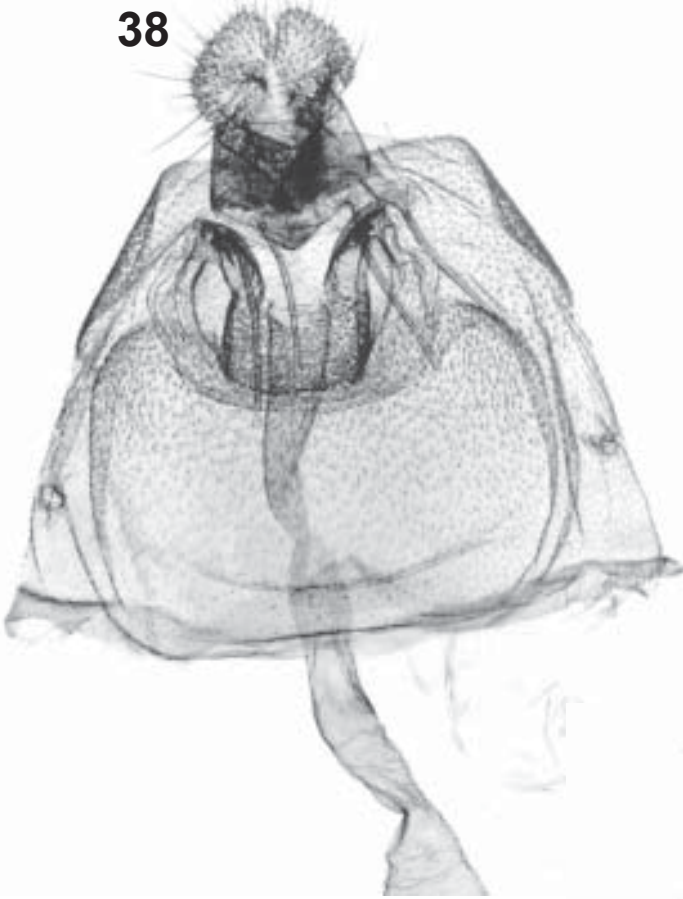
Congo (Zaire).

**Remarks**

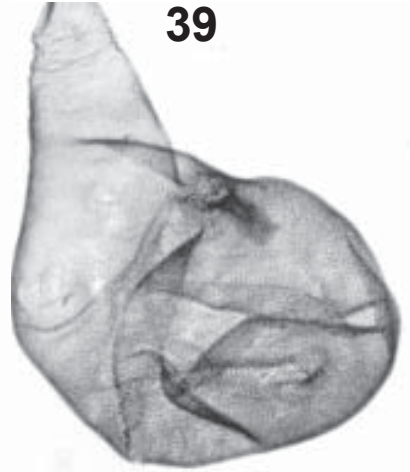
Similar to next species, *N. camerunica* sp. n.; in the female genitalia differing particularly by the presence of the crate-shaped structure round ostium.



38



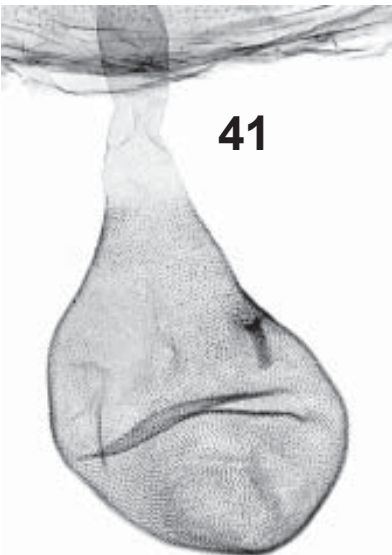
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40



41



**Figures 38-41.** Female genitalia of *Neorrhyncha* gen. nov. **38-39.** *N. congolana* sp. n. **40-41.** *N. camerunica* sp. n. **39, 41.** Corpus bursa with signum.

**Neorrhyncha camerunica sp. n.**

*Type material:* Holotype female, Afriq. Occid. [CAMEROON]: Johann-Albrechts Höhe, Station-Kamerun, L. Conradt leg., 1896, genital slide BM 28984 (BMNH).

**Description**

Wingspan 19 mm. Labial palp 2.5 times diameter of eye; lower part basally cream, followed by brown band and a yellow band reaching to third segment; upper part of segment two and whole segment three black with plumbeous sheen; upper edge of segment two with brush of white-tipped scales; upper edge of segment three with narrow white line. Coloration and pattern of forewing as in *congolana* n. sp. except that it appears to be lighter.

Female genitalia (Figures 40, 41). Anterior rim of sternite 7 shaped as a shallow V; colliculum tubular, smooth, longer than in *congolana*, tapering anteriorly; sterigma with broad v-shaped excavation.

*Male.* Not known.

**Distribution**

Cameroon.

**Remarks**

Similar to previous species, *N. congolana* sp. n.; in the female genitalia differing particularly by the lack of the crate-shaped structure round ostium which is found in *congolana* sp. n.

**Metendothenia Diakonoff, 1973**

*Metendothenia* Diakonoff, 1973, *Zool. Monogr. Rijksmus. nat. Hist.* 1: 445.

*Type species:* *Metendothenia emmitla* Diakonoff, 1973

**Remarks**

A detailed diagnosis of the genus can be found in Diakonoff's (1973) work. Of particular importance is the presence in the male genitalia of a basal process of the valva and long and slender uncus in most species. The female of the type species is not known, and consequently its type

of signum is unknown too. It is possible that *Metendothenia* is heterogeneous, and when more females become known, some of its members will be transferred to other genera. The generic placement of the single African species treated here is provisional. The signum of *Metendothenia rhodambon* Diakonoff, 1973 is of the same type as the one in *M. balanacma* (Meyrick) (compare Diakonoff 1973, Figure 663). Diakonoff (1973) considered *Metendothenia* to be closely allied to *Eccopsis* Zeller.

**Metendothenia balanacma (Meyrick, 1914) comb. nov.**

*Argyroploce balanacma* Meyrick, 1914 : 275; Clarke, 1958: 487, pl. 242, Figure 4 (*Olethreutes*).

*Argyroploce anaclina* Meyrick, 1921: 58. syn. nov.

*Material examined:* Holotype female of *balanacma*, Portuguese East Africa [MOZAMBIQUE]: E. of Mt. Mlanje, Ruo Valley 2000 ft. 4.iii.1913 S.A. Neave leg. (BMNH) (examined by Kevin Tuck).

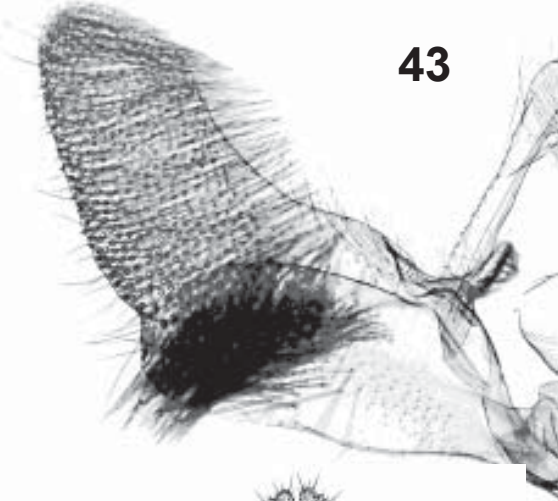
Holotype male of *anaclina*, [ZIMBABWE]: Umtali, Rhod[esia]. 5.i.[19]18, A.J.T. Janse leg., genital slide 3798 (TM) (examined by Józef Razowski).

KENYA: Taita Hills 1600 m Ngangao, *Ocimum suave* 1♀ 9.IV.2001 J. & W. De Prins leg. (MRAC); [MALAWI]: Nyasaland Mlanje, Lucheny R. 1♀ 26.vi.1914 S.A. Neave leg., genital slide BM 28987; Mt. Mlanje 1♀ 19.vi.1913 S.A. Neave leg., genital slide BM 28988 (BMNH); Dzalanyama 1250 m 1♂ 13.xii.2002 D. Agassiz leg. (DA); NAMIBIA: Kavango: Popa Falls 1♂1♀ 26.ii-3.iii.1992 W. Mey leg. (MNHB); Grootfontein: Otavi 1♀ 16-19.ii.1992 W. Mey leg. (MNHB); E. Caprivi: Mulilo 1♀ 1-8.iii.1992 W. Mey leg. (MNHB); Bushmanland: Klein Dobe 1♂1♀ 19-21.ii.1992 W. Mey leg. genital slides LAA 23017 and 23018 respectively (MNHB); Kavango: Kaudom Camp 1♀ 22-25.ii.1992 W. Mey leg., genital slide LAA 23019 (MNHB); TANZANIA: East Usambara Mts., Amani 900 m 1♂ 1.ix.1981 M. Stoltze & N. Scharff leg., genital slide LAA 97008 (ZMUC); Morogoro 1200ft. 1♀

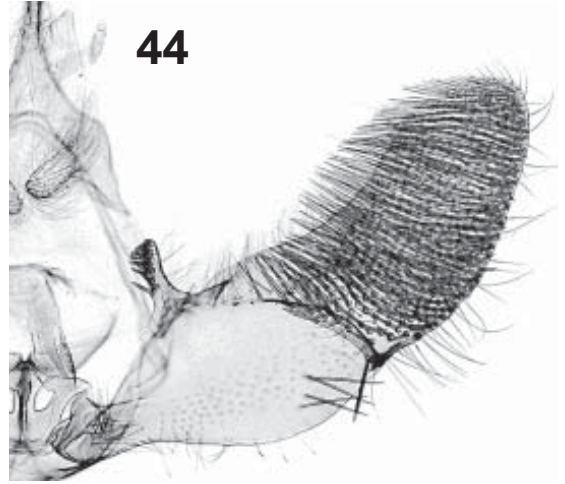
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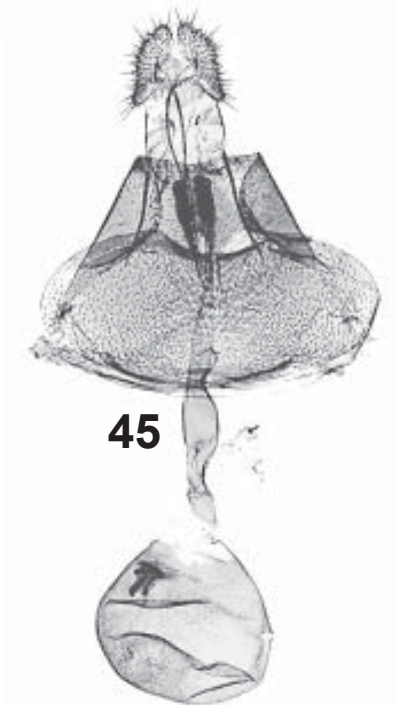
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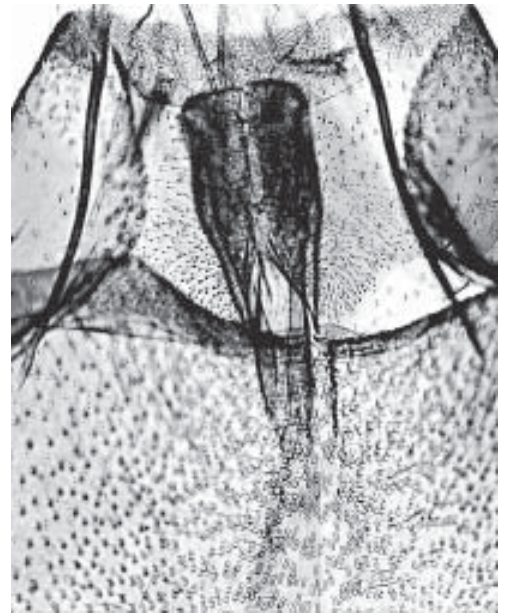
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45



46



**Figures 42-46.** Genitalia of *Metendothenia balanacma* (Meyrick). **42-44.** Male genitalia. **43.** Left valva. **44.** Right valva. **45-46.** Female genitalia. **46.** Colliculum and lamella postvaginalis.



24.iv.2001 D. Agassiz leg. (DA); [ZIMBABWE]: Salisbury, Mashonaland 1♂1♀ 1895 Marshall leg., genitalia of male on slide BM 28989 (BMNH).

### Description

Figure 102. Wingspan 15-16 mm. Head and thorax light brown. Head with erect scales. Labial palp 1.5 times diameter of eye, pale beige; external surface with three black dots, the most basal one often obsolete. Thorax with posterior double crest. Male hind tibia with beige hair-scales concealing groove with fuscous hair-scales. Forewing ground colour light olive brown. The darker pattern elements vary in colour from brown or fuscous brown to almost black. They consist of a discal dot, short costal strigulae, an apical spot, a broad oblique band towards costa from above middle of termen, a straight band directed towards middle of costa from 1/5 on dorsum, a dominant roundish patch on mid-dorsum, and a patch on mid-costa. Hindwing dark brownish grey; anal part shortened, and proximal edge rolled into a rigid tube. Rear end of male abdomen with scale tuft.

Male genitalia (Figures 42-44). Uncus long and narrow, distally with short spines and long hairs; socii “normal”, i.e. formed as oval setose lobes; valva broadest before middle, with basal process proximally armed with row of short spines, cucullus strongly spinose; valvae asymmetrical, left valva (Figure 43) medially with sclerotized fold, large tuft of setae, a few spines and a dent; right valva (Figure 44) medially with crack and a single dent; anellus wide; aedeagus short and very narrow.

Female genitalia (Figures 45, 46). Colliculum formed by two parallel folds in posterior end of ductus bursae; lamella postvaginalis a large tube (Figure 46), hinged at its anterior base, with inner wall densely denticulate; posterior edge of sternite 7 shallowly concave; signum an ill-defined sclerite with three fused projections.

### Distribution

Kenya, Malawi, Mozambique, Namibia, Tanzania and Zimbabwe.

### Biology

In Kenya bred from *Ocimum suave* Willd. (Lamiaceae).

### Remarks

The holotype of *balanacma*, figured by Clarke (1958, pl. 242, Figure 4), has lost its abdomen. However, Kevin Tuck carefully compared the type with other specimens in BM identified as *balanacma*, and found them to agree externally. We have found no other African tortricid that could be confused with *balanacma* externally or in the genitalia.

The holotype of *Argyroploce anaclina* Meyrick, currently on loan to Institute of Systematics and Evolution of Animals, Krakow, was examined by Dr. Józef Razowski and compared with figures of *balanacma*. He found them to agree. In the description of *anaclina* Meyrick mentioned two females from French Congo, Ubangi. The whereabouts of these specimens are unknown to me.

The long and slender uncus and the “normal” socii in the male genitalia, as well as the characteristic lamella postvaginalis of the female, speak against inclusion in the otherwise close genus *Eccopsis*.

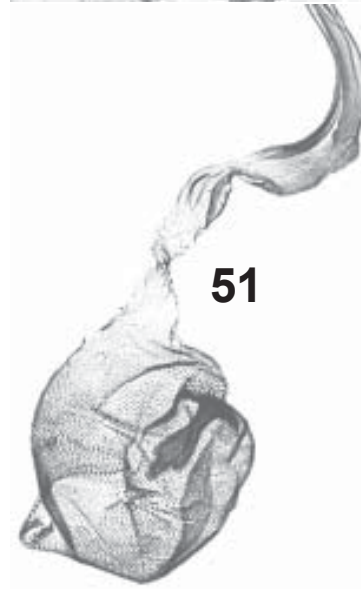
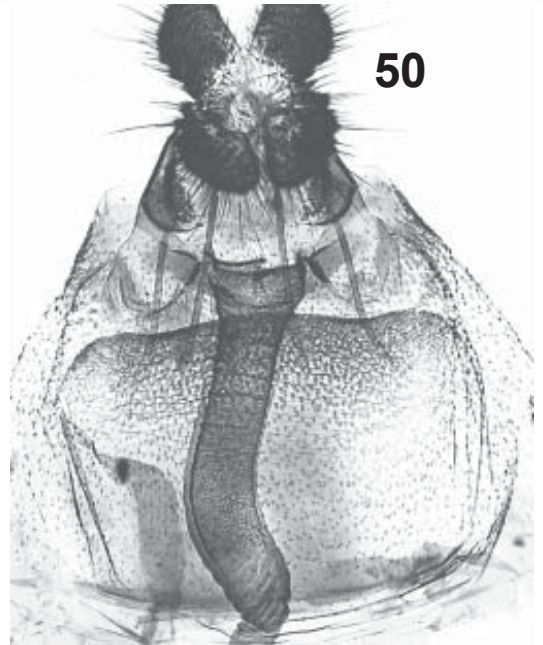
### *Geita* gen. nov.

Type species: *Geita bjoernstadi* sp. n.

### Description

Male antenna fasciculate. Labial palp 1.5 times diameter of eye. Thoracic crest not present. Tergum 2 in both sexes with pair of semicircular openings. Wall of abdominal segments 3-6 in male with lateral invaginations set with hair-scales (Figure 47). Shape of male hindwing unmodified, but with anal pencil of hair-scales. Male hind tibia not modified.

Male genitalia (Figures 48, 49). Uncus long and slender, lacking spines; socii strongly sclerotized, with dentate processes; valva slender, medial part with process of dissimilar shape in left and right valva, dorsal edge of cucullus with row of short spines, basal cluster of setae present on dorsal edge of right valva only; aedeagus long and slender, arched, with single cornutus.



**Figures 47-51.** *Geita bjoernstadi* sp. n. **47.** Base of male abdomen showing openings of tergum 2 and lateral invaginations with hair-scales. **48-49.** Male genitalia. **50-51.** Female genitalia. **51.** Anterior part of ductus bursa and corpus bursa with signum.



Female genitalia (Figures 50, 51). Papillae anales constricted in middle; colliculum a long sclerotized tube, bent; lamella postvaginalis absent; sterigma formed as band, with lateral fold; posterior rim of sternite 7 straight, without excavation; ductus bursa very long, inception of ductus seminalis about one fifth from corpus bursa; signum a small scobinate plate with single large projection.

#### Remarks

Lateral invaginations set with hair-scales are also present in the Javanese species *Ophiorrhabda favillosa* Diakonoff, 1973 (Diakonoff 1973, Figure 678). The genus *Ophiorrhabda* Diakonoff, 1966 belongs to a different section of the subfamily Olethreutini, viz. the subtribe Olethreutae (Diakonoff 1973). Externally the single female from Congo exactly matches the two Tanzanian males. Their conspecificity is confirmed by the presence of the semicircular openings in tergum 2 in both sexes.

*Geita* gen. nov. differs from other genera in Neopotamiae by the presence of specialisations in the abdomen, by the lack of modifications in the male hindwing and hind tibia, by the unique shape of the male socii, and by the constricted papillae anales in the female.

#### *Geita bjoernstadi* sp. n.

*Type material*: Holotype male, TANZANIA: Geita Distr.: Rubondo Island 1140 m 26.i.1991 A. Bjørnstad leg., genital slide LAA 2532 (ZMUO).

Paratype. Male. Same data as holotype (LAA); CONGO (ZAIRE): Eala 1♀ viii.1936 J. Ghesquière leg., genital slide LAA 21036 (MRAC).

#### Etymology

The species is named after my friend Anders Bjørnstad who collected the present species and lots of other interesting moths in Tanzania. The genus name refers to the district in Tanzania where Bjørnstad collected the species.

#### Description

Figure 103. Wingspan 15 mm. Labial palp whitish ochreous, lower and upper edge greyish. Scape above blackish, whitish below. Tuft on vertex ochreous and purplish grey; thorax purplish grey, scales white-tipped; abdomen grey. Forewing ground colour ochreous white, strigulate with grey; basal third suffused with grey and rufous; discal spot plumbeous; costa with blackish brown spots; costa and termen with yellow tinge; fringes rufous, at tornus ochreous. Hindwing grey; male anal pencil of hair-scales brown.

Male genitalia. See genus description.

Female genitalia. See genus description.

#### Distribution

Tanzania and Congo (Zaire).

#### *Megalota* Diakonoff, 1966

*Megalota* Diakonoff, 1966, *Zool. Verh. Leiden* 85: 52.

Type species: *Polychrosis fallax* Meyrick, 1909

#### Description

Labial palp of moderate length. Thorax with small posterior crest. Forewing subrectangular; in males without bend at 2/3 of costa. Forewing with characteristic pattern: Median fascia a dark, oblique band reaching middle of wing; a dark semicircular mark below apex reaches or approaches median fascia. Hindwing with cubital pecten; not modified in male. Male hind tibia with hair-pencil from base above.

Male genitalia. Uncus consisting of two large lobes densely covered with spines and setae; gnathos absent; socii present in African species, apparently absent in Asian ones (Diakonoff 1973); valva narrow, with prominent spined basal process; in basal half with one or two spine clusters.

Female genitalia. Colliculum cylindrical or funnel-shaped with frontal crack and reinforced lateral edges; signum consisting of a basal plate and two or more anteriorly directed teeth.

**Remarks**

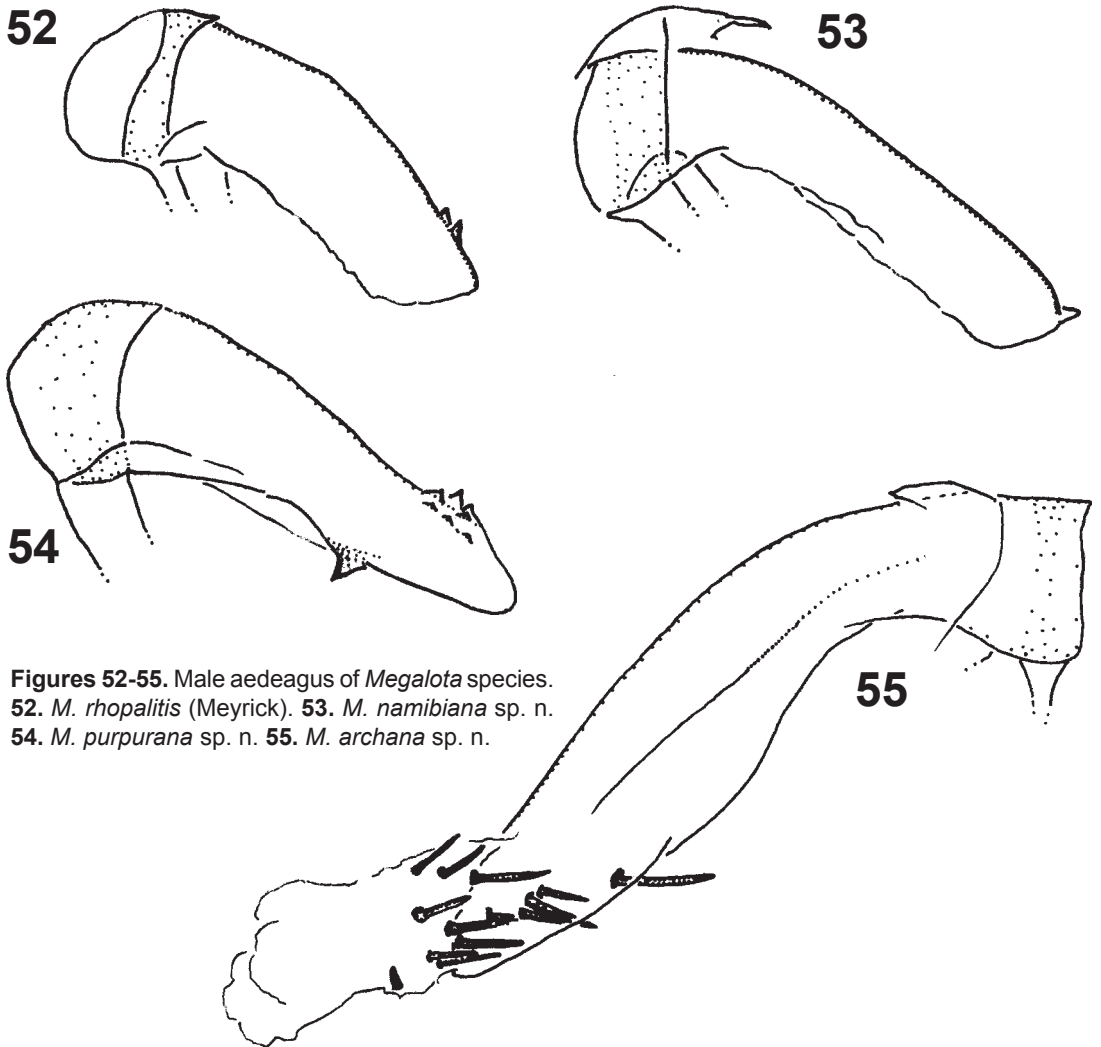
*Megalota* is easily recognised due to the typical forewing pattern and the male genitalia, where in particular the shape of the uncus, is characteristic. The shape of the signum in *M. anceps* (Meyrick) and *M. fallax* (Meyrick) (cf. Diakonoff 1973, Figures 486 and 490 respectively) and the species described below, resemble the shape found in *Eccopsis* Zeller. Thus this genus forms a link between Asian species of Neopotamiaie and the African fauna centred round the genus *Eccopsis*. Diakonoff (1981) described *M. antefracta*, a typical member of the genus, from Madagascar.

The four *Megalota* species treated here are very similar externally. In general, dissection of the genitalia is necessary for safe identification. In the males the aedeagus (Figures 52–55) gives the best diagnostic characters, in the females the shape of the colliculum (Figures 59, 62, 66, 70) is specifically distinct.

***Megalota rhopalitis* (Meyrick, 1920)  
comb. nov.**

*Argyroploce rhopalitis* Meyrick, 1920: 64.

*Material examined*: Holotype female, Afrique orient. anglaise [KENYA]: Forêt de Nairobi 1700



**Figures 52–55.** Male aedeagus of *Megalota* species.  
**52.** *M. rhopalitis* (Meyrick). **53.** *M. namibiana* sp. n.  
**54.** *M. purpurana* sp. n. **55.** *M. archana* sp. n.

m. ii.1912 Alluaud & Jeannel leg., genital slide LAA 99020 (MNHN).

TANZANIA Kigoma Distr.: Tubira Forest 1100 m 2♂♂ 26.viii.1989, 1♀ 27.vii.1990 A. Bjørnstad leg., female and one male dissected, genital slides LAA 2568 and 2526 respectively (LAA).

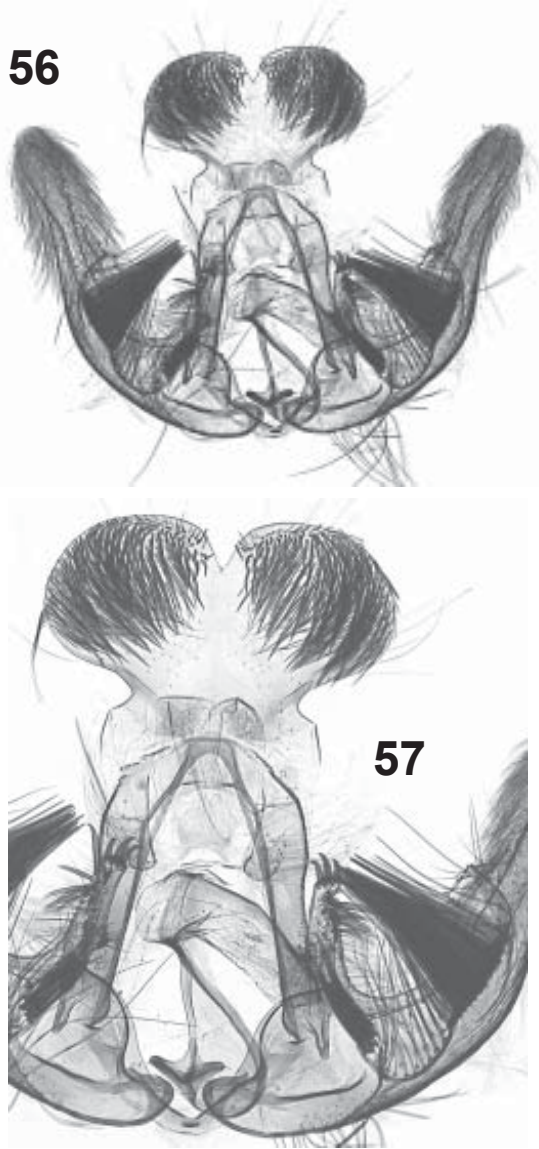
**Description**

Figure 104. Male. Wingspan 18-22 mm. Labial palp 1.5 times diameter of eye, basally light ochreous, the rest greyish brown. Head and thorax greyish brown, with light-tipped scales. Forewing ground colour light brown-grey, more or less strigulate with bluish grey, particularly in apical half; costa with brown striae; median fascia blackish brown, reaching from costa to middle of wing; a similarly coloured mark, extending from middle of termen towards costa, forms an arch almost reaching lower edge of median fascia; apical spot also blackish brown. Hindwing brownish grey. Cilia of both wings grey, distally light brown. Hind tibia above with long pencil of light ochreous hair-scales.

Female. As male, but hind tibia without hair-pencil.

Male genitalia (Figures 52, 56, 57). Uncus lobes terminally with a few short spines, otherwise densely covered with long spines; socii rather weak, setose; valva arched in basal half, basal process with three terminal and approximately five lateral spines; valva with medial excavation, the outer edge of which has a large cluster of long setae, a cluster of approximately ten long setae is situated near the proximal edge; aedeagus (Figure 52) rather short, truncate, above with two apical carinae. *M. archana* sp. n. differs by longer and straighter cucullus and longer aedeagus with numerous cornuti. *M. purpurana* sp. n. is very close, differing mainly by the presence of additional carinae in distal part of aedeagus. In *namibiana* sp. n. there is only a single apical dent in the aedeagus.

Female genitalia (Figures 58, 59). Sternite 7 medially with shallow semicircular concavity; lamella postvaginalis with two dorsal humps, laterally pointed; ostium almost circular; colli-



**Figures 56-57.** Male genitalia of *Megalota rhopalitis* (Meyrick).

culum tube-shaped, with internal longitudinal folds; signum a scobinate plate with two teeth of different size. *M. archana* sp. n. (Figure 70) has much deeper excavation of sternite 7, and the rim of ostium is anterior to edge of sternite 7. *M. purpurana* sp. n. (Figure 66) has colliculum shorter and ostium does not form a circular opening.

58



**Biology**

Apparently a forest species.

**Distribution**

Kenya and Tanzania.

**Remarks**

Externally *M. rhopalitis* is inseparable from *M. archana* sp. n. Dissection of the genitalia is necessary for identification.

***Megalota namibiana* sp. n.**

*Type material:* Holotype male, NAMIBIA: Bushmanland, Klein Dobe 19-22.ii.1992 W. Mey leg., genital slide LAA 24001 (MNHB).

Paratypes. 2♂♂1♀ same data as holotype, genital slides (♂) LAA 23015 and (♀) LAA 24002; NAMIBIA Kavango, Kaudom-Camp 1♂ 22-25.ii.1992 W. Mey leg., genital slide LAA 23016; NAMIBIA East Caprivi, Mudumu N.P., Nakatwa 1♂1♀ 8-13.iii.1992 W.Mey leg. All paratypes in MNHB except the male from East Caprivi which is in coll. LAA.

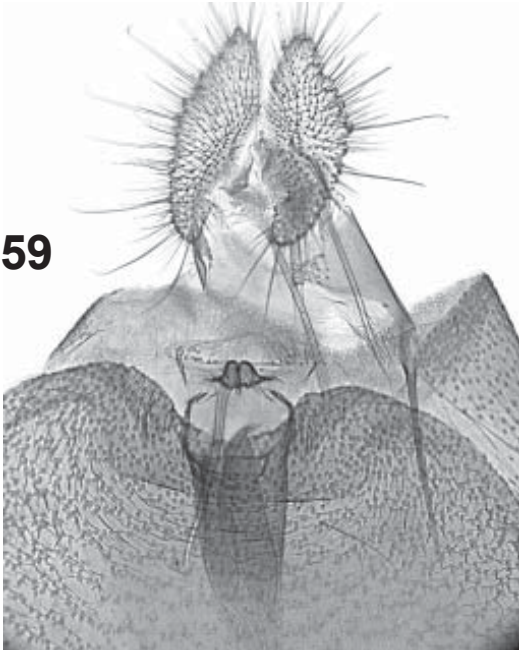
**Description**

Male. Wingspan 17-18 mm. Labial palp 1.5 times diameter of eye, pale beige, second segment with well-developed scale-brush and two lateral greyish spots, terminal segment greyish; head and thorax light greyish brown, thorax with two darker transverse zigzag-lines; abdomen light greyish ochreous. Forewing ground colour light greyish brown, transversely strigulate with darker greyish brown. Median fascia blackish brown, reaching from costa to middle of wing; a similarly coloured mark, extending from middle of termen towards costa, forms an arch almost reaching lower edge of median fascia; apical spot also blackish brown; cilia light greyish brown, darker near apex. Hindwing brownish grey. Hind tibia above with long pencil of beige hair-scales.

Female. As male, but hind tibia without hair-pencil.

Variation. The intensity of the forewing pattern and strigulations vary.

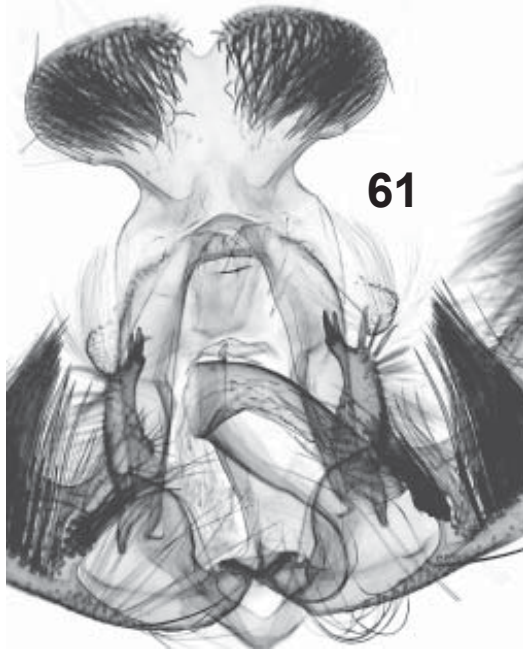
59



Figures 58-59. Female genitalia of *Megalota rhopalitis* (Meyrick).



60



**Figures 60-61.** Male genitalia of *Megalota namibiana* sp. n.

Male genitalia (Figures 53, 60, 61). Uncus lobes densely covered with long spines; valva shaped as in *rhopalitis*, but the setae forming the cluster in the middle of the valva are set along nearly the whole length of the medial excavation (in *rhopalitis* the dense cluster of setae is positioned more terminally); basal process with 8-10 terminal spines; aedeagus (Figure 53) longer than in *rhopalitis*, with single apical dent.

Female genitalia (Figures 62, 63). Sternite 7 with shallow semicircular concavity; lamella postvaginalis with relatively large medial structure and smaller lateral ones that are laterally pointed; colliculum almost bulbous, narrowing before ostium opening, with two internal longitudinal folds; signum (Figure 63) a scobinate plate with two long and one short tooth. The female genitalia rather resemble those of *M. rhopalitis* (Meyrick), but colliculum is shorter and broader, and ostium does not form a narrow ring.

#### *Distribution*

Namibia.

#### *Remarks*

This species is best characterised in the genitalia. In the male the aedeagus with a single apical dent, and in the female the anteriorly wide colliculum are diagnostic.

#### *Megalota purpurana* sp. n.

*Type material:* Holotype male, KENYA: Nairobi 5400 ft. 15.vii.1949 J.A. Riley leg., genital slide BM 28978 (BMNH).

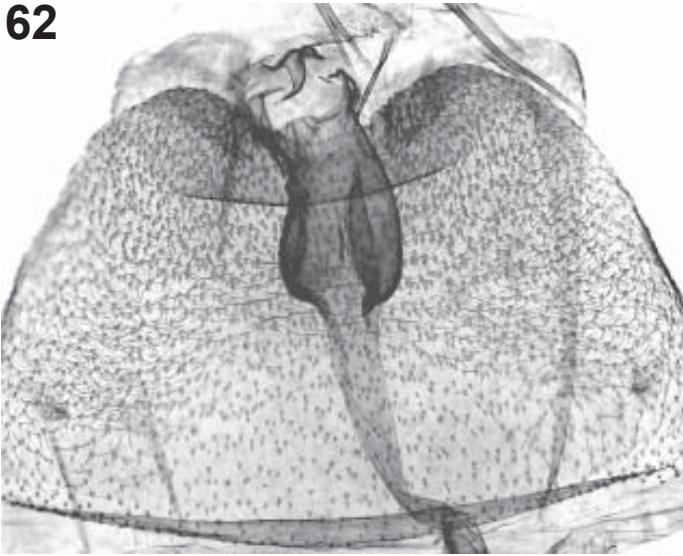
Paratypes. KENYA Mount Kenya, Chorogia 1600 m. 1♂ 13-14.iv.2001 J. & W. De Prins leg., genital slide LAA 23006 (MRAC); Nairobi, Olulua Forest 1600 m. 2♂♂3♀♀ 15.iv.2001 J. & W. De Prins leg., genital slides LAA 23001, 23002, 23003, 23004, 23005 (MRAC, 1♀ coll. LAA);

#### *Description*

Figure 105. Male. Wingspan 16-21 mm. Labial palp 1.5 times diameter of eye, light ochreous to greyish brown, second segment with well-developed scale-brush and two dark spots; head light ochreous-brown. Abdomen light greyish brown; ventral side light greyish yellow, with grey median line. Forewing ground colour light ochreous, heavily irrorate with brown and fuscous; costa with black strigulae; median fascia blackish brown, reaching from costa to middle of wing; a similarly coloured mark, reaching from middle of termen towards costa forms an arch almost reaching lower edge of median fascia; apical spot also blackish brown; plumbeous grey patch present posterior to median fascia; further small



62



63



**Figures 62-63.** Female genitalia of *Megalota namibiana* sp. n. **62.** Sternite 7, Colliculum and lamella postvaginalis. **63.** Signum.

patches of plumbeous grey scattered in apical half of wing. Forewing cilia brown, mixed with grey. Hindwing brownish grey; cilia light grey-brown. Hind tibia above with long pencil of light ochreous hair-scales.

Female. As male, but hind tibia without hair-pencil.

Variation. Some specimens have the forewing rather heavily suffused with plumbeous grey, giving them a very dark appearance. The plumbeous grey suffusion may partly be replaced with rufous brown.

Male genitalia (Figures 54, 64, 65). Uncus lobes densely covered with long spines; valva narrow, basal process with approximately ten spines; medial excavation of valva with one basal and one terminal cluster of long setae; aedeagus (Figure 54) above with row of about 6 apical carinae, in addition there are 1-2 dents below. The medial excavation of valva is longer and narrower than in *M. rhopalitis* and *namibiana* sp. n., and the terminal cluster of setae is longer.

Female genitalia (Figures 66, 67). Sternite 7 with shallow medial excavation; lamella postvaginalis with two dorsal humps, laterally pointed; colli-

culum tube-shaped, rather short and broad, with internal longitudinal folds; signum (Figure 67) a scobinate plate with one large and three small teeth. The female genitalia rather resemble those of *M. rhopalitis* (Meyrick), but colliculum is shorter and broader, and ostium does not form a narrow ring.

#### *Distribution*

Kenya.

#### *Remarks*

Fresh specimens have a violet-purple sheen. Some of the specimens have strong dark suffusion making the dark pattern less obvious. The other *Megalota* species treated here have duller grey-brown ground colour, causing the dark pattern to stand out more conspicuously. In some cases the genitalia should be dissected to achieve safe identification.

#### *Megalota archana* sp. n.

*Type material:* Holotype male, TANZANIA East Usambara Mts. Amani 900 m. 01.ix.1981 M. Stoltze & N. Scharff leg., genital slide LAA 98025 (ZMUC).

64



65



**Figures 64-65.** Male genitalia of *Megalota purpurana* sp. n.

Paratypes. KENYA Arabuko Sokoke, Mixed forest 50 m. 1♂ 4.iv.2001 J. & W. De Prins leg., genital slide LAA 23007 (MRAC); Rift Valley, Rumuruti 1800 m 1♂1♀ 29.iv.2003 D. Agassiz leg., genitalia of male on slide LAA 23023 (DA); TANZANIA Arumeru Distr.: Usa River 1170 m 1♂ 28.vii.1991, genital slide LAA 2527; ditto 1♀ 14.vii.1991, genital slide LAA 2569 L. Aarvik leg.

(LAA); UGANDA western, Budongo Forest 3000 ft. 1♂ 18.vii.2000, genital slide LAA 21047, 1♀ 17.vii.2000 D. Agassiz leg. (DA).

#### *Description*

Wingspan 18-20 mm. Labial palp 1.5 times diameter of eye, dirty white, becoming greyish brown terminally, with two proximal grey spots. Head and thorax greyish brown, with light-tipped scales. Externally inseparable from *M. rhopalitis*.

Male genitalia (Figures 55, 68, 69). Uncus lobes narrower than in the other three *Megalota* species treated here, with short spines in upper part, otherwise with long setae; socii long, weak; valva narrow and straight in distal half (cucullus); inner edge with medial hump which has a dense cluster of short spines; a cluster of weaker, but longer spines is situated below the short cluster; basal process of valva very long, distally with 6-8 curved thorns; aedeagus (Figure 55) long, curved, with numerous cornuti in vesica.

Female genitalia (Figures 70, 71). Sternite 7 with deep rounded medial excavation; lamella postvaginalis with pointed process on each side; ostium boat-shaped, placed anterior to edge of sternite 7; colliculum with wrinkled lateral sclerotizations, curved on left side; signum (Figure 71) a scobinate plate with one broad and one short tooth. The other *Megalota* species treated here differ by their shallower concavity of sternite 7, and the very different shape of colliculum.

#### *Biology*

A forest species.

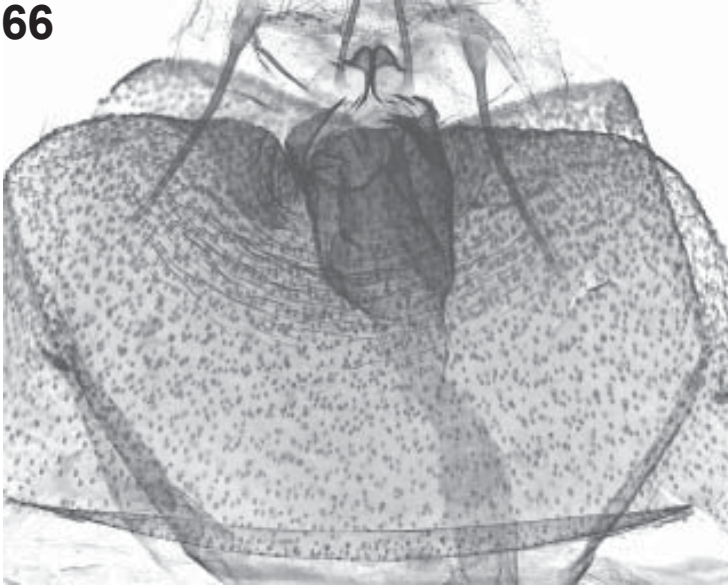
#### *Distribution*

North-eastern Tanzania, eastern Kenya and western Uganda.

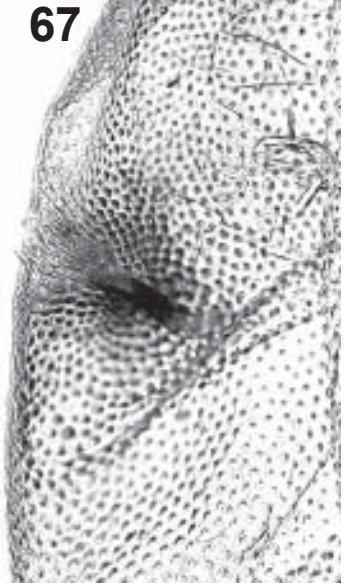
#### *Remarks*

A typical member of the genus, externally similar to *M. rhopalitis*. However, it is readily distinguished by the genitalia.

66



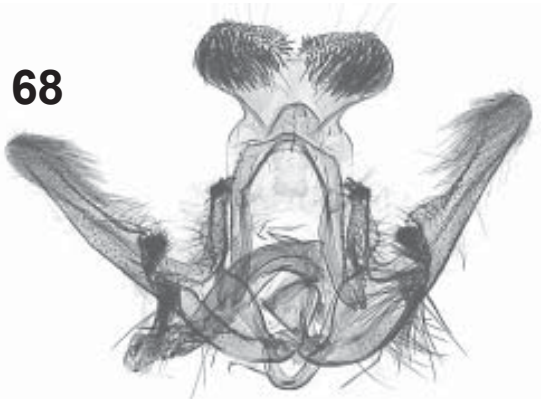
67



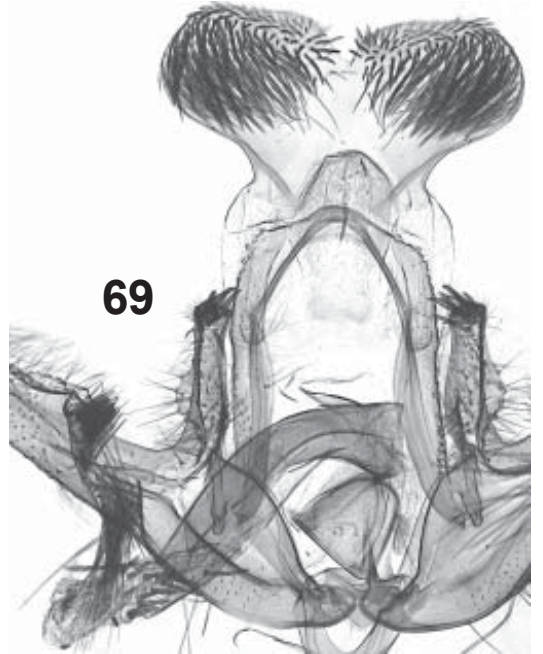
**Figures 66-67.** Female genitalia of *Megalota purpurana* sp. n. **66.** Sternite 7, Colliculum and lamella postvaginalis. **67.** Signum.

**Figures 68-69.** Male genitalia of *Megalota archana* sp. n.

68

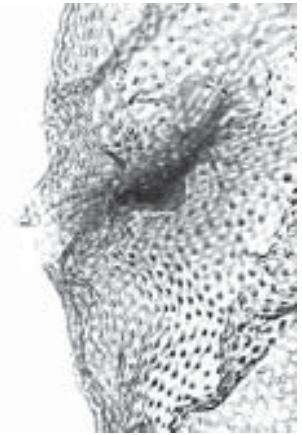
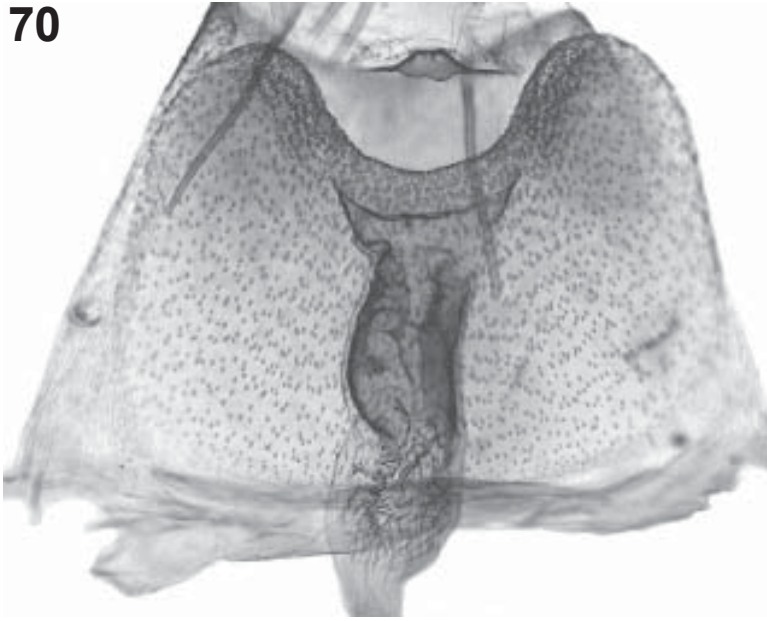


69





70



71

**Figures 70-71.** Female genitalia of *Megalota archana* sp. n. **70.** Sternite 7, Colliculum and lamella postvaginalis. **71.** Signum.

### ***Paraeccopsis* gen. nov.**

Type species: *Argyroploce insellata* Meyrick, 1920

#### **Description**

Labial palp 1.5 times diameter of eye, second segment roughly scaled, third segment very short. Thorax with paired crest. Hindwing with cubital pecten. Male hind tibia proximally with short brush of hair-scales.

Male genitalia (Figure 72). Uncus basally broad, triangular, apically club-shaped, with strong spines; socii shaped as slender lobes; valva with medial semicircular excavation in addition to the normal basal excavation; valvae asymmetrical as the right valva has a cluster of strong setae situated on the upper edge of the medial excavation; this cluster is absent in the left valva; cucullus with cluster of strong spines posterior to medial excavation, otherwise with cover of weaker spines; aedeagus long and sinuous, no carinae or cornuti.

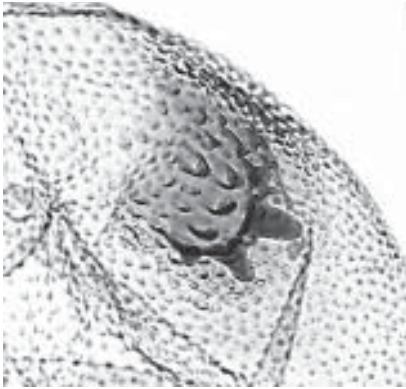
Female genitalia (Figures 73, 74). Sternite 7 with v-shaped excavation; ostium punctulate, asymme-

trical; lamella postvaginalis extended posterolaterally; posterior part of ductus bursa/colliculum a long sclerotized tube; signum (Figure 74) a round sclerite with anteriorly directed projections of dissimilar size.

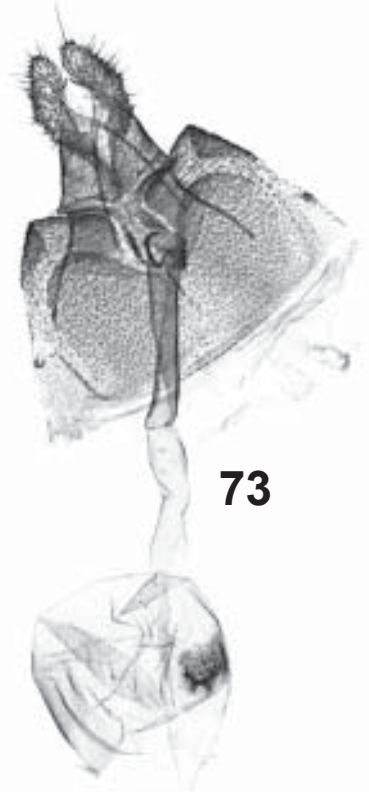
#### **Remarks**

Clarke (1958) transferred two species, in the present paper synonymised with *P. insellata*, viz. *Argyroploce atricapsis* Meyrick and *Polychrosis inflicta* Meyrick, to the genus *Proschistis* Meyrick, 1907. Diakonoff (1982: 75) placed *P. inflicta* in *Eccopsis* Zeller, 1852. In my opinion *P. insellata* fits in neither of these genera. The type species of *Proschistis*, *P. zaleuta* Meyrick, 1907, has a type of signum differing strongly from the species treated here, and *Proschistis* is placed by Diakonoff (1973) in the subtribe Statherotides. The signum in *Paraeccopsis* gen. nov. (Figure 93) is typical for the subtribe Neopotamiae. The male genitalia of *Paraeccopsis* gen. nov. (Figures 89, 90) differ from *Eccopsis* (and other genera of Neopotamiae) by the shape of the valva that also lacks the basal process, and by the shape of the uncus.

72



74



73

**Figures 72-74.** Genitalia of *Paraeccopsis* gen. nov. **72.** Male genitalia. **73-74.** Female genitalia. **74.** Signum.

***Paraeccopsis insellata* (Meyrick, 1920)  
comb. nov.**

*Argyroploce insellata* Meyrick, 1920 (August): 66.

*Polychrosis inflicta* Meyrick, 1920 (October): 347; Clarke, 1958: 579, pl. 288, Figures 2, 2a, 2b (*Proschistis*); Diakonoff, 1982: 75 (*Eccopsis*).  
syn. nov.

*Argyroploce atricapsis* Meyrick, 1930: 602; Clarke 1958: 579, pl. 288, Figures 1, 1a-1c (*Proschistis*).  
syn. nov.

**Material examined:** Holotype female of *insellata*, Afrique Orient. Anglaise [KENYA]: Pori: Mbuyuni 1100 m, iii.1912 Alluaud & Jeannel leg., genital slide LAA 99024 (MNHN).

BOTSWANA: Gaborone 1♀ xii.1977 B. Skule

(ZMUC); GAMBIA: 2♀♀ 18-25.x.1976 H.K. J[ensen] leg., genital slide LAA 98024 & LAA 2524 (ZMUC, LAA); Bakau 1♀ 18-23.xi.1986 G. Grymer & S. Hansen leg. (ZMUC); TANZANIA: Morogoro Distr. & Town 550-600 m 1♂ 23.iii.1993 L. Aarvik leg., genital slide LAA 2525 (LAA).

**Description**

Figure 106. Wingspan 13-14 mm. Labial palp light ochreous, with two lateral brown spots which sometimes are diffuse or missing; terminal segment darker. Head light ochreous; thorax greyish, white-tipped scales. Base of male hind tibia, on internal surface, with pencil of cream-coloured hair-scales. Forewing ground-colour light ochreous, striate with light brown; dark brown median fascia reaching from costa to



middle, with oval plumbeous patch near costa and interspersed with black scales; the dark markings on middle of costa appears as a dark triangle; discal spot cream, on lower edge of dark triangle; darker scales form an oblique patch reaching from base of dorsum half way to costa; apical spot blackish. Fringes basally reddish brown, darker near apex and lighter at tornus, outer fringe line chequered with grey. Hindwing grey, lighter basally.

Male genitalia. See genus description.

Female genitalia. See genus description.

### *Distribution*

Botswana, Gambia, Kenya, Nigeria, Tanzania and India. Probably widespread in Africa.

### *Remarks*

*Argyroploce insellata* Meyrick, 1920 is a senior synonym of *Argyroploce atricapsis* Meyrick, 1930, syn. nov. The holotype of *atricapsis* which came from Nigeria, was figured by Clarke (1958, pl. 288, Figure 1). *A. insellata* is further synonymous with the Indian *Argyroploce inflicta* Meyrick, 1920, syn. nov. The paper with the description of *insellata* was published on 15th August (printed on the front cover). According to the original wrapper in The Natural History Museum, London, the part of Exotic Microlepidoptera containing the description of *inflicta*, was issued in October (K. Tuck pers. comm.). Thus the name *insellata* has priority over *inflicta*. The holotype of *inflicta* was figured by Clarke (1958, pl. 288, Figure 2) on the same page as *atricapsis*. Comparison with additional African material confirms that the three names *insellata*, *inflicta* and *atricapsis* represent one and the same species.

### ***Afrothreutes* gen. nov.**

Type species: *Afrothreutes madoffei* sp. n.

### *Description*

Male. Labial palp 1.5 times diameter of eye. Thorax with posterior crest. Forewing without costal fold, costa rather straight from base to 2/3. Hindwing with cubital pecten, anal part shortened and proximal edge rolled into a tube. Hind tibia

with longitudinal split concealing pencil of fuscous hair-scales.

Male genitalia (Figure 75). Uncus small, rounded, with three strong spines; socii oval, setose; sacculus of valva with group of spines containing one large spike and several narrower spines, right valva with two further spines, one large and one smaller, below cucullus, left valva with one large spine in this position; cucullus with dense cover of slender spines and setae. Aedeagus rather long, without cornuti.

### *Remarks*

Externally resembling *Eccopsis*, but the genitalia differ considerably. The shape and armature of the valva show similarities with that of *Afroploce* gen. nov. (see below), but uncus is very different in the two genera. There are a few additional olethreutine genera with species that possess an uncus similar to that of *Afrothreutes* gen. nov., but other characters of the genitalia do not agree. At present only a single male can be assigned to the new genus.

### ***Afrothreutes madoffei* sp. n.**

*Type material*: Holotype male, TANZANIA: Morogoro Distr. & Town 550-600 m, 26.v.1993 L. Aarvik leg., genital slide LAA 2529 (ZMUO).

### *Etymology*

The species is named after my friend Dr. Seif Madoffe, Morogoro, who assisted me in numerous ways during my stay in Tanzania.

### *Description*

Figure 107. Wingspan 14 mm. Labial palp ochreous, second segment with two brown spots and brown edge apically, terminal segment ochreous. Head and thorax fuscous with ochreous tipped scales; patagia ochreous. Forewing ground colour ochreous; pattern fuscous and with patches of plumbeous scales; cilia with dark line. Hindwing fuscous.

Male genitalia. See genus description.

Female. Not known.

**Distribution**

Only known from eastern Tanzania.

**Remarks**

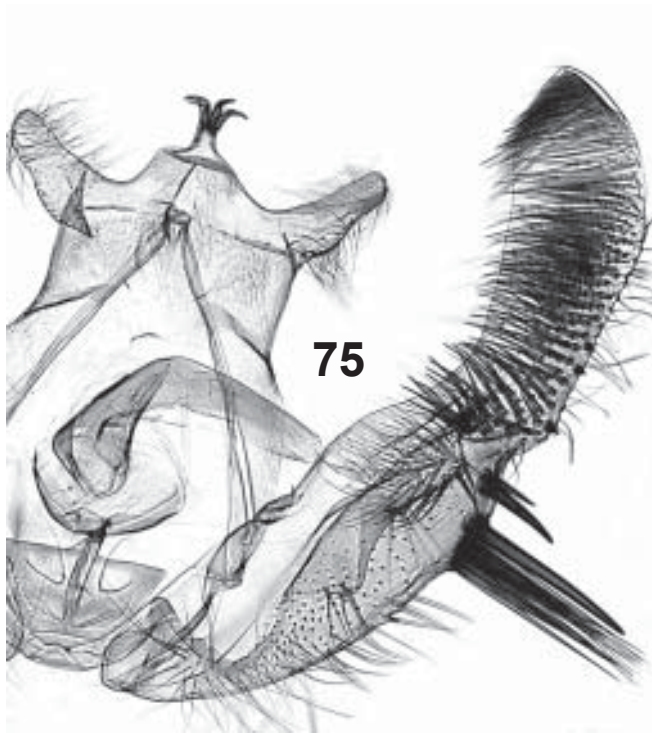
Externally resembling *Eccopsis morogoro* sp. n. from which it can be separated by the shape of the hindwing (in males) and by the genitalia which differ strongly.

***Afroploce* gen. nov.**

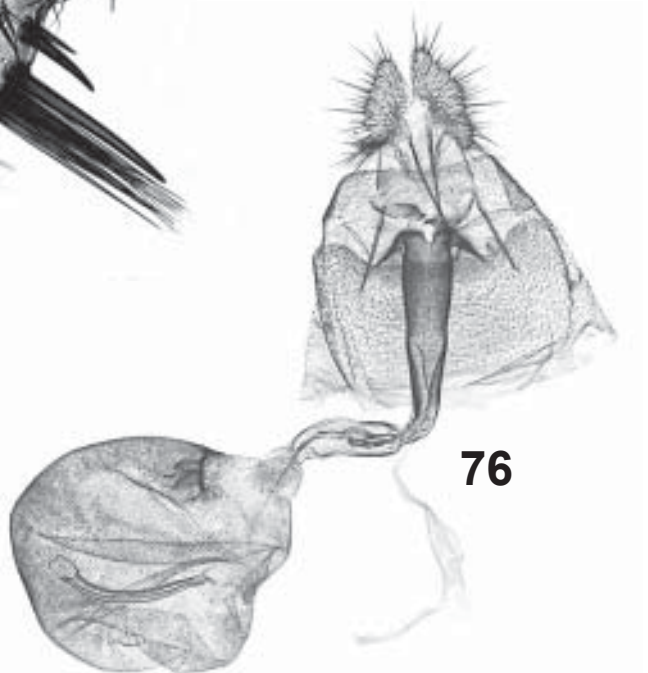
Type species: *Afroploce karsholti* sp. n.

**Description**

Labial palp 1.5 times diameter of eye. Thorax with double posterior crest. Forewing costa straight, bent at 2/3 in *karsholti* sp. n. and *ealana* sp. n. Hindwing with cubital pecten; in males with anal part shortened in *karsholti* sp. n. and *ealana* sp. n.; proximal edge rolled into a rigid tube. Male hind tibia with tuft of cream-coloured hair-scales; in *karsholti* sp. n. and *ealana* sp. n. also with longitudinal split concealing pencil of fuscous hair-scales.



**Figures 75-77.** Genitalia of *Afrothreutes* gen. nov. and *Afroploce* gen. nov. **75.** Male genitalia of *Afrothreutes madoffei* sp. n. **76-77.** Female genitalia of *Afroploce karsholti* sp. n. **77.** Signum.



Male genitalia. Uncus triangular, setose, hardly differentiated from tegumen; socii setose; valva medially with large proximally directed setose lobe; outer edge of valva with one or two medial, large spikes and above this two smaller spines; sacculus with brush of setae; aedeagus long, curved, with 1-3 cornuti.

Female genitalia (Figures 76, 77). Colliculum a long sclerotized tube; rim of ostium with medial notch and with lateral pointed processes; lamella postvaginalis present as a folded structure resembling a plate if the cover-glass is not pressed too hard; signum (Figure 77) a sclerotized ridge with 2-3 more or less fused anteriorly directed projections. The females of *turiana* sp. n. and *ealana* sp. n. are unknown.

#### Remarks

One widespread species and single males of two additional species are known. All are distributed in Africa. It is noteworthy that the forewing patterns of two of the species have parallels in *Eccopsis*. That of *karsholti* sp. n. resembles *E. incultana*, and *ealana* sp. n. resembles *wahlbergiana* and *praecedens*. Secondary sexual characters are reduced in *turiana* sp. n., but the genitalia are very close to the other two species. The male genitalia of *Afroploce* gen. nov. are highly specialized and do not show close affinity with other genera of *Neopotamiae*. The signum of the female genitalia, however, is typical for the group and confirms the position of the genus.

#### *Afroploce karsholti* sp. n.

*Material examined*: Holotype male, TANZANIA: East Usambara Mts. Amani, 900 m, 01.ix.1981 M. Stoltze & N. Scharff leg., genital slide LAA 95007 (ZMUC).

Paratypes. 11 males and 9 females labelled as holotype, one male with genital slide LAA 95006, one female with genital slide LAA 95005 (ZMUC); CONGO (ZAIRE): Yangambi 1♂ 9.iv.1959 Dettart leg., genitalia slide LAA 21037 (MRAC); Gold Coast [GHANA]: Bibianaha 1♂ 1-20.xi.1911 H.G.F. Spurrell, genital slide BM 28974 (BMNH); KENYA: Escarpment Kikuyu, Ibea 7500-8500 ft. 3♂1♀, ix-x.1900 Doherty leg.,

genital slides BM 28975, 28976, 28977 (BMNH); MALAWI: Mt. Mulanje 1000 m, 1♂ 8.xii.2002 D. Agassiz leg., genital slide LAA 23022 (DA); TANZANIA: Arusha N.P. Momela Rd. 5300 ft. 1♀ 9.v.2001 D. Agassiz leg. (DA); Tanga Reg.: Lushoto Distr.: Mazumbai Forest Reserve 1400 m, 2♂♂ 30.xi.-7.xii.1995 S.H. McKamey et al. leg., genital slide LAA 20105 (ZMUC); Morogoro Distr. & Town 550-600 m, 1♂ 11.x.1991, 1♂ 30.i.1992, 1♂ 11.iv.1992, 2♀♀ 19.v.1992, 2♂♂ 20.v.1992, 1♀ 8.vi.1992, 1♂ 3.ix.1992, 1♂ 20.ix.1992, 1♂ 7.x.1992, 1♀ 1.ii.1993 L. Aarvik, one male and one female with genital slide LAA 2202 and LAA 2191 respectively (LAA); Morogoro Distr. & Town: Mafiga 500 m, 1♀ 20.vi.1992 L. Aarvik (LAA); Morogoro 1200 ft. 1♀ 10.v.2001 D. Agassiz leg. (DA); Geita District: Rubondo Island 1140 m 1♂ 26.i.1991, genital slide LAA 95008, 1♂ 3.iv.1991 (ABJ); Kigoma Distr.: Tubira Forest 1100 m 1♂ 19.iii.1989 A. Bjørnstad (ABJ).

#### Etymology

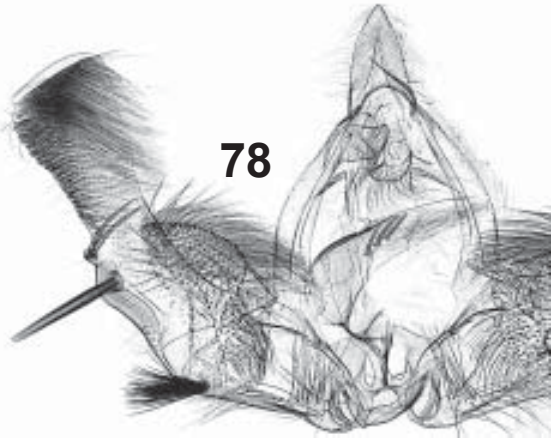
Named after my friend for many years, Ole Karsholt, curator of the Lepidoptera collection at the Zoological Museum in Copenhagen, who has contributed with an important part of the material included in the present study.

#### Description

Figure 108. Wingspan 14-17 mm. Labial palp ochreous, second segment with brown line, in most specimens darkened along lower edge. Forewing ground colour light ochreous, in some specimens with a reddish tinge; a distinct fuscous brown patch from base of dorsum extending towards centre of wing, above this a similarly coloured streak parallel with costa; a broad, medial, fuscous brown fascia covers almost two thirds of wing surface, outer edge of fascia interrupted by three tongue-shaped incisions almost dividing it; apex fuscous, and a fuscous oblique patch present below apex; lighter areas of wing partly covered with plumbeous scales; fringes brownish purple, lighter at tornus. Hind wing fuscous. In male a pair of sex scale tufts are present ventrally on abdominal segment 7.



**Figures 78-80.** Male genitalia of *Afroploce* gen. nov. **78.** *A. karsholti* sp. n. **79.** *A. ealana* sp. n. **80.** *A. turiana* sp. n.



Male genitalia (Figure 78). Differ from those of *Afroploce ealana* sp. n. by longer and more tapering uncus, broader socii and the absence of carinae on the wall of aedeagus. The number of cornuti varies from one to three. There is one strong spine on outer edge of valva; both *ealana* sp. n. and *turiana* sp. n. have two.

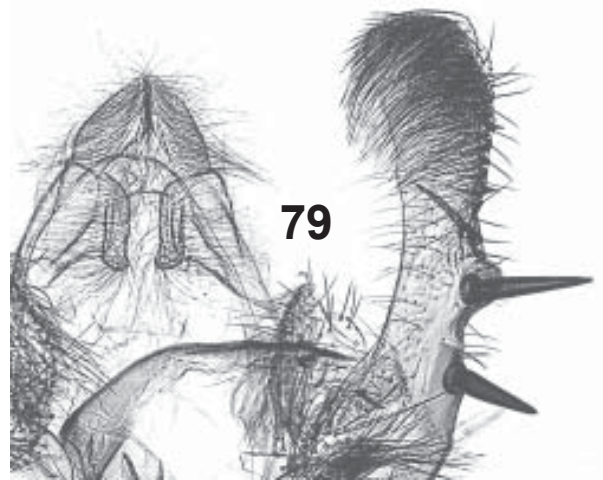
Female genitalia. See genus description.

**Distribution**

Congo (Zaire), Ghana, Kenya, Malawi and Tanzania.

**Remarks**

Two males from Tanzania: Arumeru Distr.: Usa River 1170 m 31.vii.1991 are excluded from the type series. They differ from the rest of the material by the presence of an additional, spine on the sacculus of the valva. This spine, however, is much smaller than the corresponding spine in *ealana* sp. n. and *turiana* sp. n. Externally *Afroploce karsholti* n. sp. resembles *Eccopsis incultana* (Walker, 1863). Males may easily be separated by the hindwing which has the anal part shortened in *A. karsholti* n. sp. It is remarkable that this apparently common species has not previously been named.

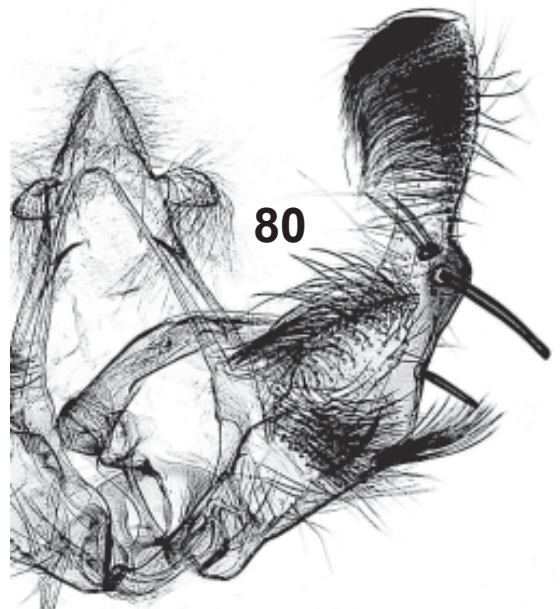


***Afroploce ealana* sp. n.**

*Type material:* Holotype male, CONGO (ZAIRE): Eala vii.1936 J. Ghesquière leg., genital slide LAA 21030 (MRAC).

**Description**

Figure 109. Wingspan 18 mm. Labial palp ochreous, second segment with tuft of narrow scales, dark band and lower edge with fuscous/brown scales. Head and thorax ochreous; thoracic crest with fuscous scales. Forewing broad, costa straight to 2/3; ground colour ochreous, reticulate with brown, brown and grey scales denser along





costa, forming dark patch medially and near apex, dorsum with blackish patch basally; fringes ochreous. Hindwing fuscous, with beige anal roll and fuscous hair-pencil.

Male genitalia (Figure 79). Differ from those of *Afroploce karsholti* sp. n. and *turiana* sp. n. by shorter and less tapering uncus and narrower socii. From *karsholti* sp. n. it differs also by presence of carinae on the wall of aedeagus and two strong spikes on outer edge of valva. Differences from *turiana* sp. n. are given under that species.

Female. Not known.

#### Distribution

Congo (Zaire).

#### Remarks

Externally resembling *Eccopsis praecedens* Walsingham, 1897, which has the apex of the hindwing reddened. The genitalia of the two differ strongly.

#### *Afroploce turiana* sp. n.

*Type material*: Holotype male, KENYA: Rift Valley, Turi 8000 ft. 11.v.2000 D. Agassiz leg., genital slide LAA 23024, in coll. D. Agassiz (to be deposited in BMNH).

#### Description

Figure 110. Wingspan 16.5 mm. Labial palp basally yellowish, second segment darkened at lower edge and medially; head and thorax brownish grey with light tipped scales. Forewing costa rather evenly curved, ground colour dirty white, with slight yellow tinge; basal third, a large blotch in median and costal part, as well as an apical triangular patch are heavily suffused with dark grey and blackish; area between median blotch and basal third with some grey suffusion; terminal margin with short blackish streaks; fringes fuscous, with fringe line, lighter at tornus. Hindwing fuscous, of normal shape in anal area, but with roll. Hind tibia with tuft of cream-coloured hair-scales, but without split and fuscous tuft.

Male genitalia (Figure 80). Close to the other two species in the genus. Differ from *karsholti* by

presence of two strong spikes on outer edge of valva and two dissimilar carinae on the wall of aedeagus; the single large, beak-shaped cornutus is very different from the small cornuti in the other two species. The shape of valvae, socii and uncus resembles *karsholti* sp. n. rather than *ealana* sp. n.

Female. Not known.

#### Distribution

Kenya.

#### Remarks

Externally very distinct from the other two species of the genus. Differences in the male genitalia are small, but significant.

#### *Basigonia* Diakonoff, 1983

*Basigonia* Diakonoff, 1983b, *Annl. Soc. ent. Fr.* (N.S.) 19: 300.

Type species: *Basigonia anisocia* Diakonoff, 1983, by monotypy.

#### Description

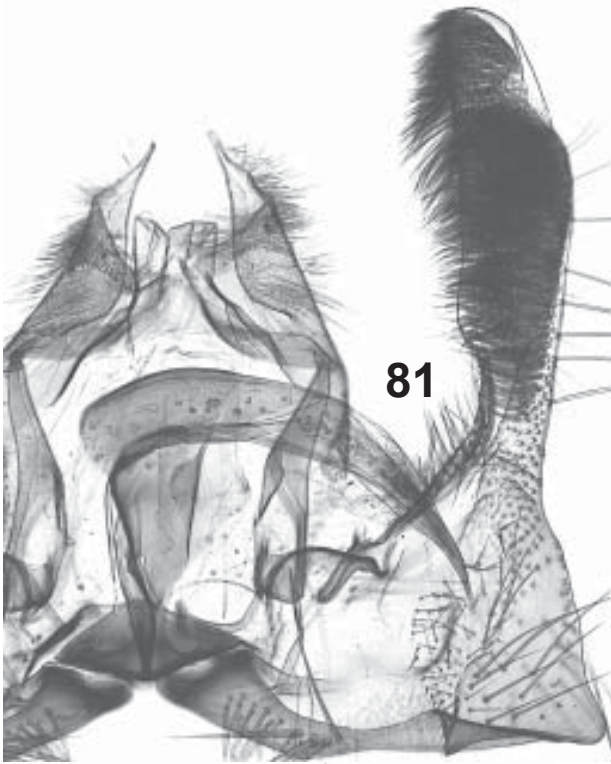
Labial palp 2 times diameter of eye. Antenna short ciliate. Thorax without crest. Hindwing with cubital pecten; in males with anal part shortened; proximal edge rolled into a rigid tube. Male hind tibia with longitudinal split concealing long hair-pencil.

Male genitalia (Figure 81). Uncus absent; socii triangular, with pointed apex, setose; sacculus of valva with strong spines, extended laterally, cucullus setose, slightly constricted before end; aedeagus long and curved, gradually tapering, without cornuti.

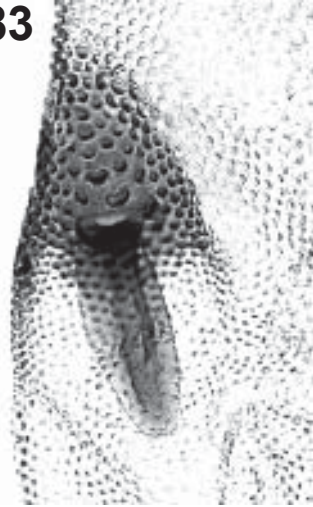
Female genitalia (Figures 82, 83). Colliculum a sclerotized tube, widest in middle; lamella postvaginalis weak; ductus bursa membranous; signum (Figure 83) a sclerotized plate, with one anteriorly directed process.

#### Remarks

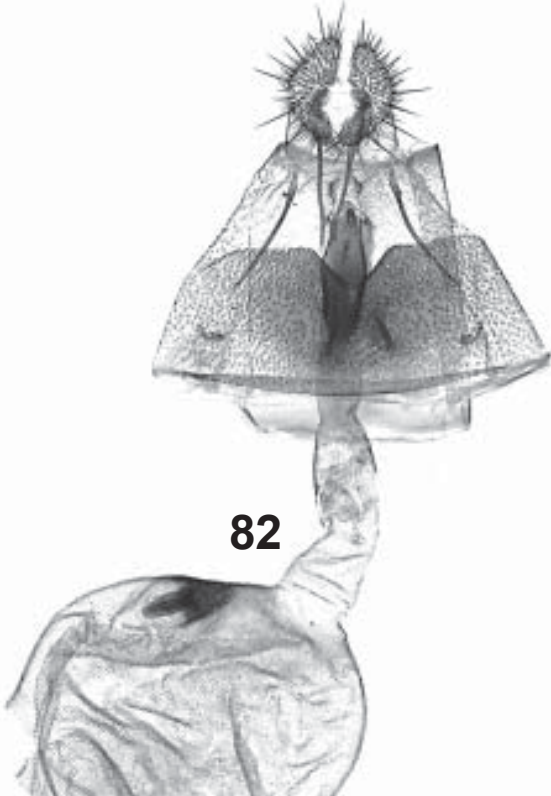
The peculiar male genitalia lacking uncus and with strongly modified socii and valva, justify the genus.



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**Figures 81-83.** Genitalia of *Basigonia anisocia* Diakonoff. **81.** Male genitalia. **82-83.** Female genitalia. **83.** Signum.



***Basigonia anisocia* Diakonoff, 1983**

*Basigonia anisocia* Diakonoff, 1983b: 300.

*Material examined.* TANZANIA: Tanga Region, Muheza Distr. [should be Lushoto Distr.]: Mazumbai For. Res. 1700 m 1♀, 18-24.xi.1995 S.H. McKamey et al. leg. (ZMUC); East Usambara Mts. Amani, 900 m 1♂, 01.ix.1981 M. Stoltze & N. Scharff leg. (ZMUC); Tanga Reg., Muheza Distr.: Kwamgumi For. Res. 170-220 m 3♂♂2♀♀ 20-24.vii.1995 S.H. McKamey et al. leg. (ZMUC) (2♂♂1♀ in coll. LAA); Border area of Cameroon/Nigeria 2♂♂2♀♀, 24.i.1961 J.S.R. Birket-Smith leg. (ZMUC). (Genitalia dissected on slides LAA 98021, 98022, 98023, 2617).

**Description**

Figure 111. Wingspan 16-19 mm. Labial palp light ochreous, second segment with brown patch and two blackish, glossy spots. Head, thorax and forewing ground colour variable from grey to greyish or ferruginous brown, with violet sheen. Pattern in most specimens very indistinct, consisting mostly of transverse fuscous strigulations; costal strigulae short, one fuscous spot in apex; some specimens with fuscous sub-basal fascia, one specimen with fuscous spot representing a median fascia, another specimen with fuscous costal triangle resembling that of certain *Eccopsis* species. Hindwing fuscous, lighter towards base, veins blackish. Male hind tibia with fuscous pencil of hair-scales.

Male genitalia. See genus description.

Female genitalia. See genus description.

**Distribution**

Madagascar, border area of Nigeria/Cameroon and eastern Tanzania.

**Biology**

Tanzanian and Madagascan specimens have been collected in forest.

**Remarks**

Up till now this species was known only from Madagascar. *B. anisocia* is probably widespread

in the Afrotropical region. Externally the species can be recognised by the darkened veins of the hindwing.

**Acknowledgements.** I wish to thank Mr. Kevin Tuck, The Natural History Museum, London, for arranging loan of material, helping with literature and providing essential information. I also thank Dr. Ugo Dall'Asta, Mr. Willy De Prins and Dr. Jurate De Prins, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, for loan of both type specimens and recently collected material. From Dr. Wolfram Mey, Museum für Naturkunde, Berlin, I received tortricids from Namibia and South Africa. I am indebted to Dr. Joël Minet, Muséum National d'Histoire Naturelle, Paris, for arranging the loan of Meyrick's Tortricidae type specimens housed in that museum. I thank Mr. Ole Karsholt, Zoological Museum, University of Copenhagen, for placing at my disposal a large material of tortricids from especially Tanzania and also for giving helpful comments to the manuscript. I thank Mr. David Agassiz, Gravesend, England, and Mr. Anders Bjørnstad, Drangedal, Norway, who both made available all Tortricidae from their private collections. I also thank Mr. Anthony Kingston, Lilongwe, Malawi, for letting me check his collection. Dr. Józef Razowski, Kraków, Poland, is thanked for comparing the type of *Argyroploce anaclina* Meyrick with figures of *A. balanacma* Meyrick. I also thank Mr. Hugo van der Wolf, Nuenen, Netherlands, for tortricid specimens from Namibia and Rep. South Africa. I thank Dr. Martin Krüger, Pretoria, sent information about material preserved in Transvaal Museum. The editor, Prof. Lauritz Sømme, Oslo, is thanked for constructive comments on the manuscript, and Mr. Lars Ove Hansen, Oslo, is thanked for technical help. I am indebted to Mr. Torstein Kvamme, Ås, who gave me permission to use the microscope and digital camera at the Norwegian forest Research Institute. During my stay in Tanzania I received generous support from Prof. Kim Howell, Dar es Salaam, and Dr. Seif Madoffe, Morogoro. I was granted a research permit from Tanzania Commission of Science and Technology, for which I am very grateful. Finally I wish to give special credit to my wife, Nini Cecilie Aarvik, for performing with ever-lasting patience the exquisite water paintings printed in the present article. I also thank the Entomological Department at the Zoological Museum, Oslo, by the curator Jan Emil Raastad, for financing the printing of the color plates.

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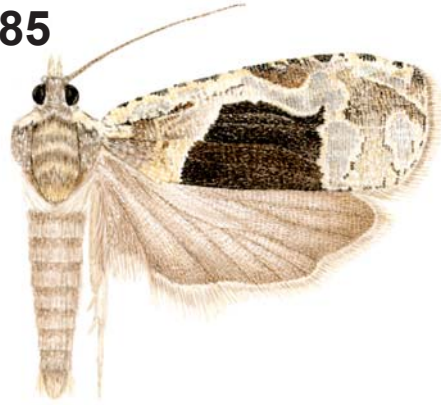
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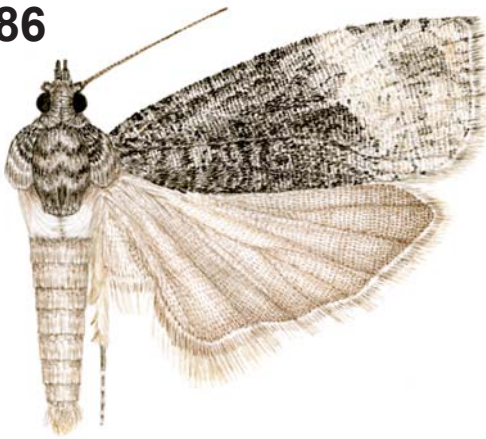
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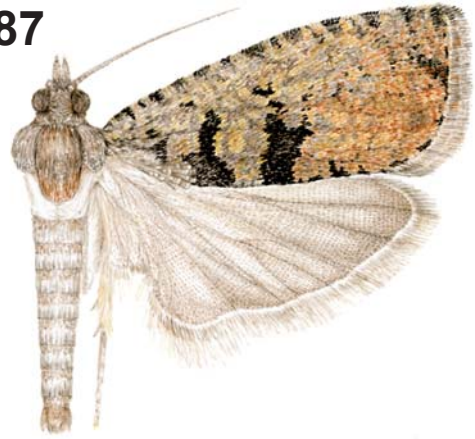
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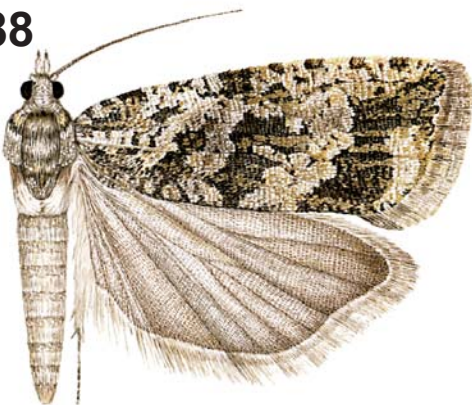
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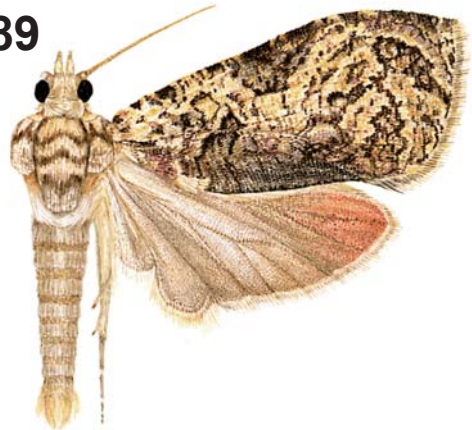
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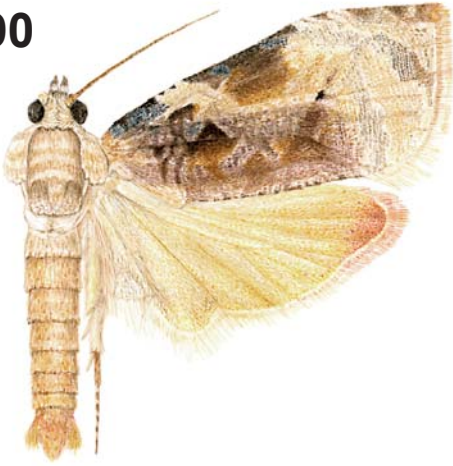


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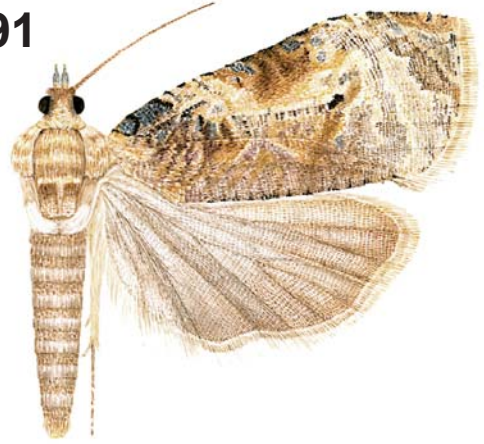


**Figures 84-89.** Adults of *Afrocostosa* gen. nov. and *Eccopsis* Zeller. **84.** *A. flaviapicella* sp. n. ♂. **85.** *E. nebulana* Walsingham ♂. **86.** *E. agassizi* sp. n. Holotype ♂. **87.** Ditto, Paratype ♂. **88.** *E. aegidia* (Meyrick) ♂. **89.** *E. praecedens* Walsingham ♂.

90



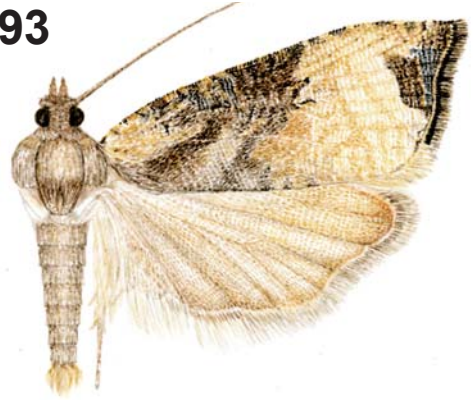
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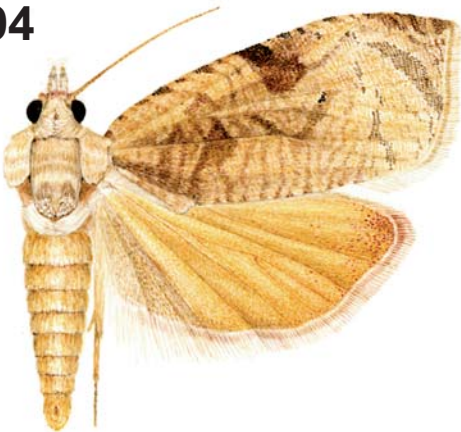
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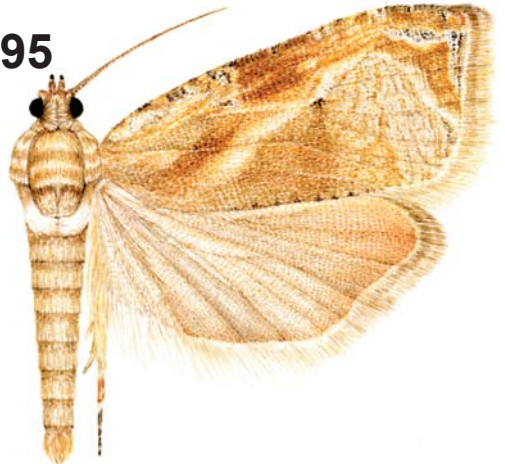
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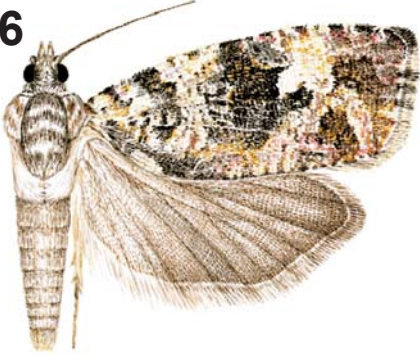
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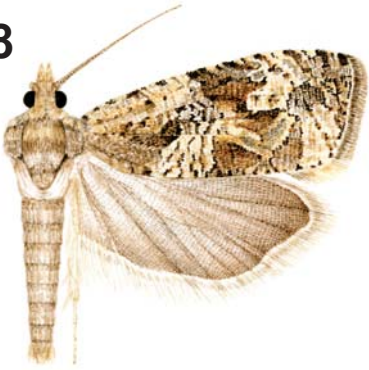
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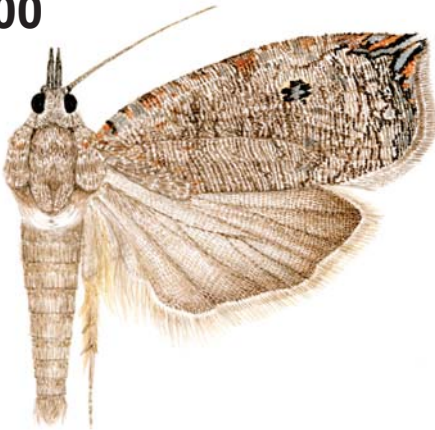
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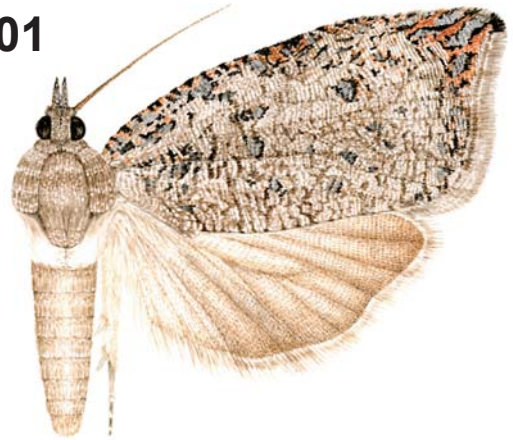
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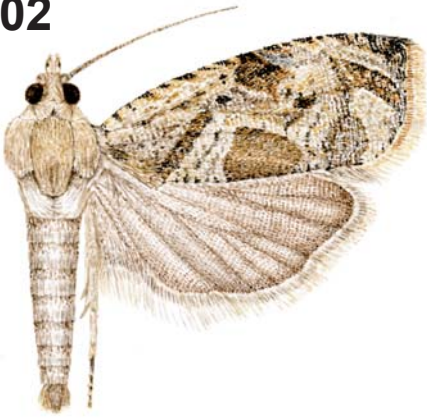


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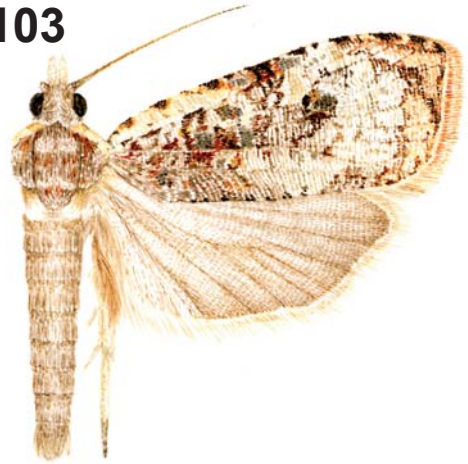


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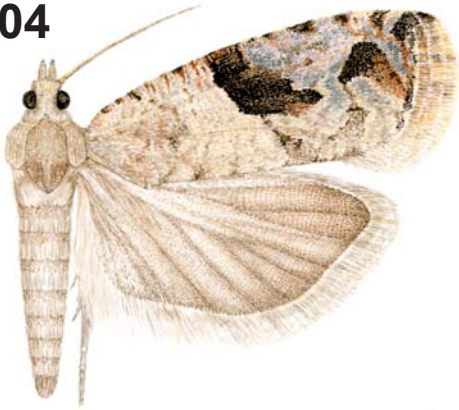
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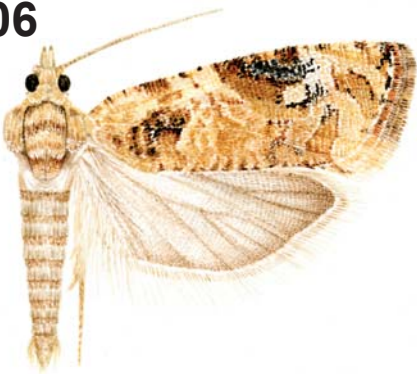
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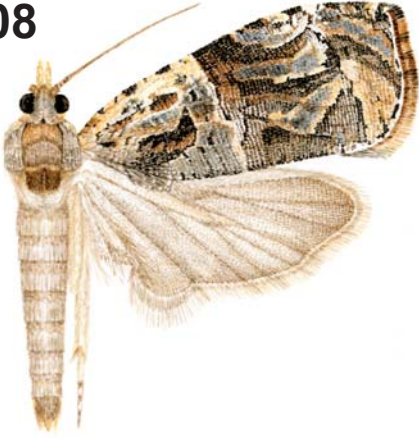
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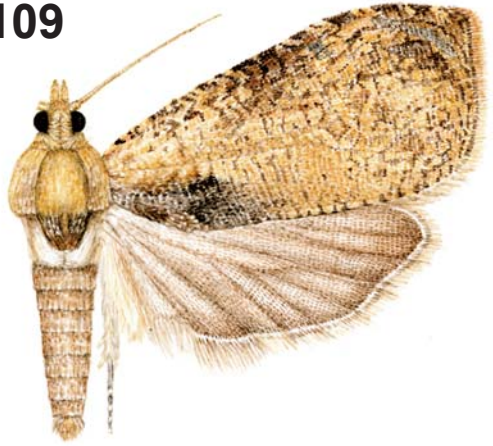
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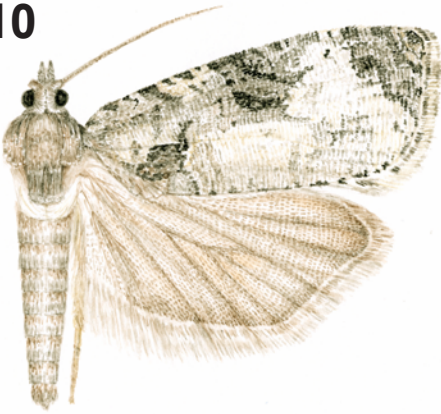
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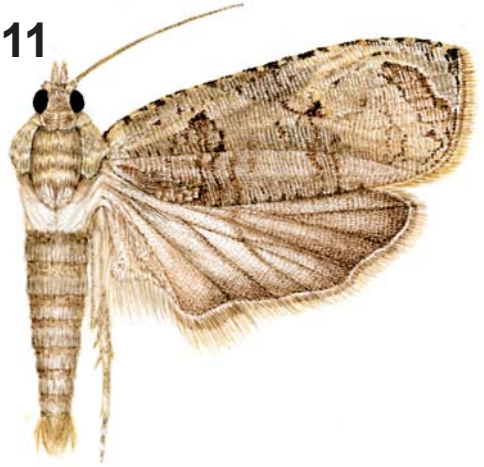
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# On a new *Platycheirus* (Diptera, Syrphidae) from Turkmenistan

Anatolii V. Barkalov & Tore R. Nielsen

Barkalov, A.V. & Nielsen, T.R. 2004. On a new *Platycheirus* (Diptera, Syrphidae) from Turkmenistan. Norw. J. Entomol. 51, 123-126.

*Platycheirus metallicus* spec. nov., a species of the *ambiguus* group, is described from Turkmenistan.

Key words: Diptera, Syrphidae, *Platycheirus*, new species, Turkmenistan.

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## INTRODUCTION

The new species was sampled by the first author on expeditions to Turkmenistan in 1987 and 1988.

## THE SPECIES

### *Platycheirus metallicus* spec. nov.

Holotype: Male dated "Турк. ССР, 15 км з ап. фирюзы, г. Душак 9.v. 1987, сб. А. Баркалов" ("Turkmenistan, 15 km west of Firjuza settlement, Dushak Mountain 9.v.1987, leg. A. Barkalov"). Paratypes: 37 males, 10 females with same locality and collector, 2-9 May 1987 and 16-21 May 1988. Holotype and most paratypes in coll. ZM Novosibirsk; male and female paratype in coll. TRN.

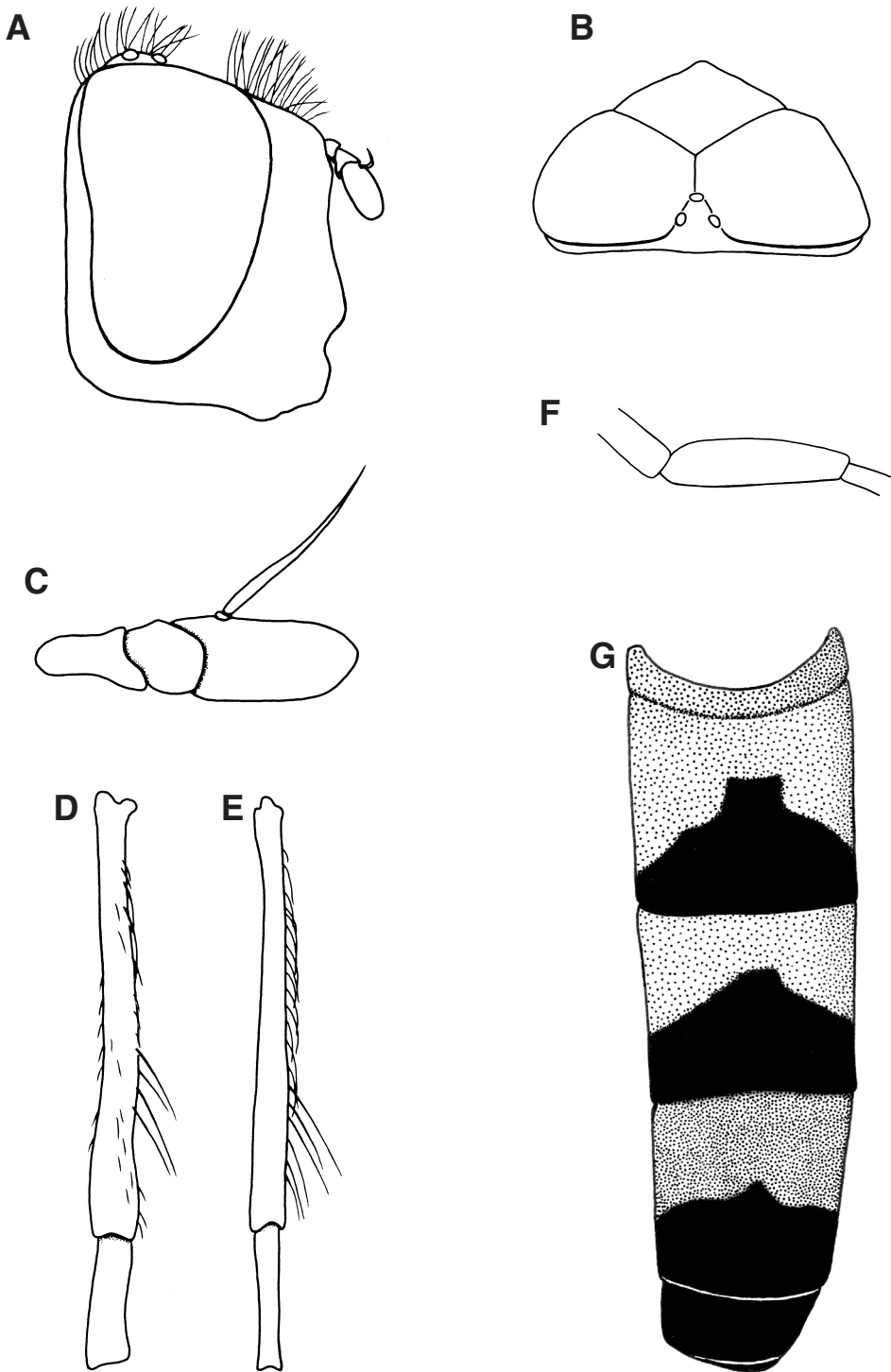
Diagnosis: A rather small and slender species, about the size of *Platycheirus angustatus* (Zetterstedt, 1843). Male: 3<sup>rd</sup> antennal joint extended, 2.1- 2.3 times longer than broad (Figure 1C). Tergite 1, basal half of the tergites 2-4 and all tergite 5 shining metallic bluish grey. Tergites 2-3 each with a couple of whitish pollinose spots upon the metallic parts, not reaching base of the tergites. Female: similar to male, but abdomen shining metallic black with 3 pairs of faint greyish spots.

*Platycheirus metallicus* spec. nov. belongs to the *ambiguus* group. The male is similar to that of *P. asioambiguus* Skufjin (Skufjin 1987) and *P. subambiguus* Nielsen (Nielsen 2004), but differs from both in its smaller size and by presence of a metallic, shining band on basal half of tergite 4 (or 3 and 4), not with separated spots as in *P. asioambiguus* and *P. subambiguus*. The new species differs also from *P. asioambiguus* in the absence of strong yellow bristles on basal 1/3 of mid femur (Figures 3A, B).

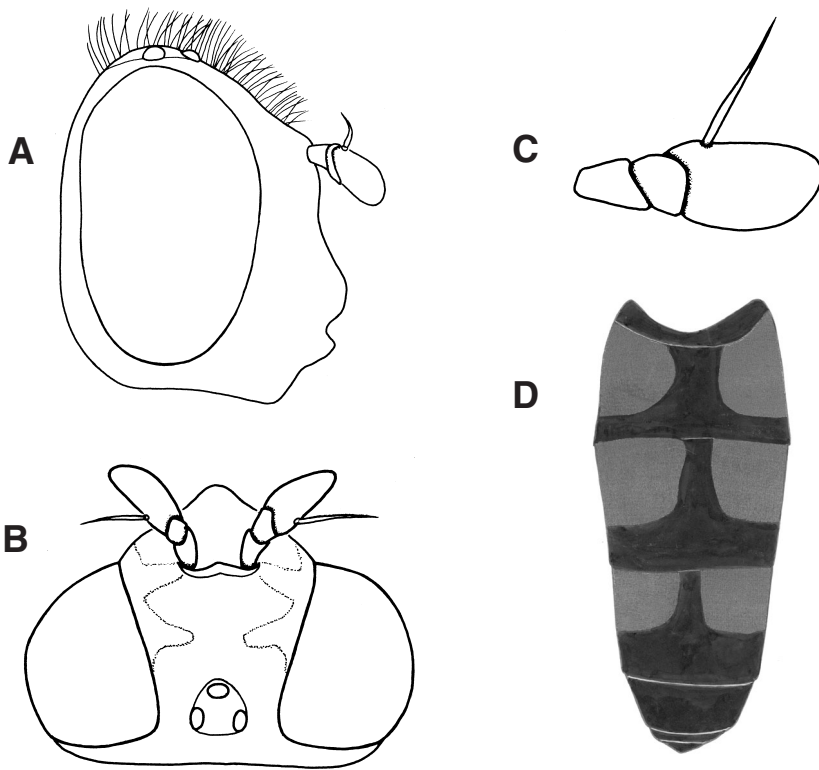
## DESCRIPTION

### Male

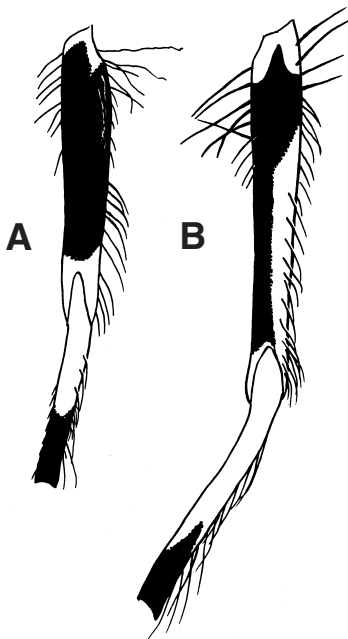
Head: Figures 1A, B, C. Eye angle 115-120°, eyes touching for a distance which is slightly longer than the distance between the ocelli. Frons (except lunulae), face (except facial tubercle and upper mouth-edge), genae and occiput with whitish pollinosity, occiput more heavily dusted. Antennae rather long, 3<sup>rd</sup> joint 2.1-2.3 times longer than broad; 1<sup>st</sup> and 2<sup>nd</sup> joint blackish brown, 3<sup>rd</sup> joint brown, reddish below at base. Arista light brown. Frons and dorsolateral parts of face black haired, lower parts of face, genae and occiput with whitish yellow hairs. Vertical triangle shining black, only very lightly pollinose.



**Figure 1.** *Platycheirus metallicus* spec. nov., male holotype. A: head in lateral view; B: head in dorsal view; C: antenna; D: right fore tibia and basitarsus; E: right mid tibia and basitarsus; F: hind leg: tibia apex and basitarsus; G: abdomen.



**Figure 2.** *Platycheirus metallicus* spec. nov., female paratype. A: head in lateral view; B: head in dorsal view; C: antenna; D: abdomen.



**Figure 3.** Male right femur and tibia (ventral view). A: *Platycheirus metallicus* spec. nov., B: *P. asioambiguus* Skuffin; note the basal third of femur with strong yellow bristles.



Thorax: Scutum, scutellum and pleurae metallic bluish grey, white haired. Scutum and scutellum shining, only very lightly pollinose; humerus and pleurae somewhat dulled by whitish pollinosity. – Legs: Figures 1D, E, F. Fore femur yellow, dark brown behind except for at base and tip. Femur behind with a long black curled bristle at tip (two curled bristles on right femur in the holotype!), followed by eight straight black bristles and a row of black and (at base) white hairs. Mid femur brownish black except for base and apex narrowly yellow, behind with many black (on apical half) and white hairs. The longest hairs are as long as or longer than maximum thickness of femur. Hind femur blackish brown, except for apex narrowly yellow, somewhat dulled by white pollinosity, whitish yellow haired, the longest anteroventral hairs about two times as long as maximum thickness of femur. Fore and mid tibia yellow on basal half to 2/3, greyish brown apically, laterally on apical half with a few soft, obliquely projecting yellowish bristles. Hind tibia brownish black on apical 2/3, the base yellow; tibia laterally with a row of soft, bristly yellow hairs. The tarsi darkened. Hind basitarsus in the middle only slightly thickened, about 1.2 times thicker than tibia at apex. – Wings: Stigma and veins yellow brown, 2<sup>nd</sup> basal cell nearly bare of microtrichia. Halter yellow. Calypter white, the rim yellow.

Abdomen: Figure 1G. tergites 2-4 on basal half each with a couple of metallic bluish grey spots (those on tergites 3 and 4 sometimes connected into bands), greyish white pollinose. Tergites 1 and 5 metallic bluish grey, lightly white pollinose. Tergite 6 glittering black. Sternites shining greyish black with light pollinosity.

Body length: 6.4-7.3 mm, wing length: 5.9-6.2 mm.

### Female

Similar to the male, but differing as follows:

Head: Figures 2A, B, C. Frons shining black with two triangular, greyish dust spots. The hairs black on the upper half, white on the lower half. 3<sup>rd</sup> antennal joint a little shorter than in the male, 1.8 longer than broad. Face a little more protruding than in the male, and post-ocular orbits dorsally

as broad as the distance between the ocelli of the vertical triangle. – Thorax: Hairs on scutum shorter, about as long as thickness of fore femur near apex. Fore and mid femur yellow with faint greyish shadows; hind femur yellow on basal 1/3 and on apical 1/10. – Abdomen: Figure 2D. Tergites shining black with somewhat brassy reflections. Tergites 2-4 with faint greyish spots which are best seen from behind. Tergites 5-6 shining black with brassy lustre.

Body length: 5.7 mm, wing length: 4.9 mm.

### Etymology

The name *metallicus* refers to the shining metallic reflections on thorax and abdomen of this species.

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## ***Aptinothrips rufus* Haliday (Thysanoptera) and *Apamea zeta* (Treitschke) (Lepidoptera) on Svalbard**

Ian D. Hodkinson

Hodkinson, I.D. 2004. *Aptinothrips rufus* Haliday (Thysanoptera) and *Apamea zeta* (Treitschke) (Lepidoptera) on Svalbard. *Norw. J. Entomol.* 51, 127–128.

*Aptinothrips rufus* Haliday, 1836 is recorded from Svalbard for the first time. Evidence is presented for a resident population of *Apamea zeta* (Treitschke, 1825) in Adventdalen, W. Spitsbergen.

Key words: *Aptinothrips rufus*, *Apamea zeta*, Svalbard

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### ***Aptinothrips rufus* Haliday, 1836 (Thysanoptera)**

The insect order Thysanoptera is previously unrecorded for Svalbard. A single adult individual of *A. rufus* was heat extracted from a soil and vegetation core taken from a tundra heath site 1 km east of Ny-Ålesund on 22 June 1992. Within the Arctic, *A. rufus* is known from Ellesmere Island, Canada and Greenland (Chiasson 1986) but is also widely distributed throughout the temperate regions, including mainland Norway (Mound et al. 1976, Kobro 2003). It is found on the leaves or leaf sheaths of grasses. Uncertainty remains as to whether *A. rufus* breeds on Svalbard or whether this is a vagrant wind-dispersed individual.

### ***Apamea zeta* (Treitschke, 1825) (Lepidoptera)**

*Apamea zeta* has been recorded sporadically from Adventdalen under the names *A. exulis* Lefebvre and *A. maillardi* (Geyer) by Kaisila (1973), Alendal et al. (1983) and Coulson & Refseth

(2004) (but see Mikkola & Goater 1988). The first previously unpublished record for Svalbard, however, appears to be 5 August 1924 (The Natural History Museum, London) and not 5 June 1964 as noted by Kaisila (M.R. Honey, personal communication). This species was recently discussed by Coulson et al. (2003), who concluded that its resident status on Svalbard was uncertain.

A few individuals were seen flying on a warm day (4 August 2003) around a cabin in Adventdalen, close to Longyearbyen and one mated female was collected by S. Spjelkavik. This live gravid female produced eggs that hatched within two weeks at room temperature, without the need for prior cold treatment. These observations of flight activity and reproduction, coupled with a long but sporadic record of occurrence in one locality, suggest that a small viable population exists in Adventdalen. Furthermore, the late season activity by adult moths and the apparent absence of a winter egg diapause implies that the moth overwinters probably initially as eggs or, in the case of a warm late season, as early instar larvae.

**Acknowledgements.** I thank Laurence Mound and Martin Honey for confirming the identity of the above species.

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