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Distribution, habitat, and conservation status of threatened Odonata in Norway

HANS OLSVIK & DAG DOLMEN

Olsvik, H. & Dolmen, D. 1992. Distribution, habitat, and conservation status of threatened Odonata in Norway. *Fauna norv. Ser. B 39:* 1—21.

The article gives a survey of records of endangered and vulnerable dragonfly species. New records of *Calopteryx splendens, Lestes dryas, Platycnemis pennipes, Coenagrion armatum, C. lunulatum, Gomphus vulgatissimus, Onychogomphus forcipatus, Brachytron pratense, Somatochlora sahlbergi, S. flavomaculata, Libellula depressa, Orthetrum coerulescens, Sympetrum vulgatum, S. sanguineum, Leucorrhinia caudalis, L. albifrons,* and *L. pectoralis* are presented. One species, *Orthetrum cancellatum,* is reckoned as extinct. The habitats and status of each species are briefly commented, and distribution maps (10 x 10 km squares) are given, as well as a distribution table for all 44 Norwegian species.

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Dag Dolmen, Univ. Trondheim, The Museum, N-7013 Trondheim.

INTRODUCTION

European dragonflies have experienced a serious decline during the last few decades. In Britain 3 species have disappeared since World War II, and 9 of a total of 41 reproducing species are reckoned as threatened (Merrit 1987). In The Netherlands, 9 species have not been observed since 1950 (Geijskes & Tol 1983). In (the former) Western Germany, 6 species have been eradicated and more than 60% of the Odonata species are reckoned to be more or less threatened (Clausnitzer, Pretscher & Schmidt 1983). Likewise in Switzerland 5 species/subspecies have disappeared and 66% are regarded as more or less threatened (Maibach & Meier 1987).

The classic studies on the distribution of Norwegian dragonflies are by Sømme (1937a) and Tjønneland (1953), both including bibliographies of previous Norwegian publications. More recent investigations, regionally or nationally, were made by e.g. Aagaard & Dolmen (1971, 1977). Later, Aagaard & Hågvar's (1987) survey of rare insects in Norway was a status overview, and a basis for future work with respect to endangered and vulnerable species.

In order to check the occurrence of southern and «rare» species at previously known sites (cf. Aagaard & Hågvar 1987), and to find new localities for these species, the dragonfly fauna in southern parts of Norway was then thoroughly investigated. Especially important was the area around the Oslofjord and the coast from Kristiansand to Oslo. This investigation was made in order to obtain a picture of possible changes in the Norwegian dragonfly fauna during the last half a century.

A first draft of a red list was also given by Aagaard & Hågvar (1987). Olsvik, Kvifte & Dolmen (1990), however, suggest a more detailed list, which regards one species as extinct, eight as endangered, seven as vulnerable and nine as rare (cf. Olsvik 1990d). The results from the new investigations were hoped to provide the basis for a more realistic red list of Norwegian dragonflies and for the protection of important localities.

This article presents all known records, mainly made by the authors, during the latest decades, except for some of the species regarded as «rare», but which are distributed in larger parts of Norway. Some new records presented here have earlier been published/-reported by Aagaard & Hågvar (1987), Olsvik (1990c), Olsvik et al. (1990, which again includes some old unpublished records by G. Kvifte), Dolmen & Strand (1991), and Pedersen (1992). In order to give a picture of the total Norwegian Odonata fauna as well, for comparison, the distributions of the more common species have also been included. Apart from that mentioned earlier, distri-

butional information on these dragonflies has been given by Tjønneland (1955a, b), J. Økland (1964), Midttun (1977), Bruserud (1987), Olsvik (1989, 1990c, d, 1991), and Dolmen (1990, 1992). Although not very accurate for Norway, the European main distribution is given by Askew (1988).

In addition to own records, we have obtained permission to publish records made by a number of collectors. Their names are listed in the Acknowledgements and abbreviated in the text.

MATERIAL AND METHODS

In this investigation, mainly imagines, but also some larvae (all stages that may be called nymph are here named larva) and exuviae, have been collected. The localities have, as far as possible, been visited two or three times during the flight season of the dragonflies, from May to September/October. This is necessary because many species have only a restricted flying season. The terms «a few» and «several» have been used when 1—5 or 6—10 specimens have been observed/collected, «numerous» when more than 10.

The material and also the exact location (UTM coordinates) of the localities are kept by the authors and in the collection of the University of Trondheim, The Museum.

EIS square numbers (J. Økland 1977) are referred to behind the locality names in the text.

The distribution of the species is shown in maps based on 10 x 10 km UTM squares and,

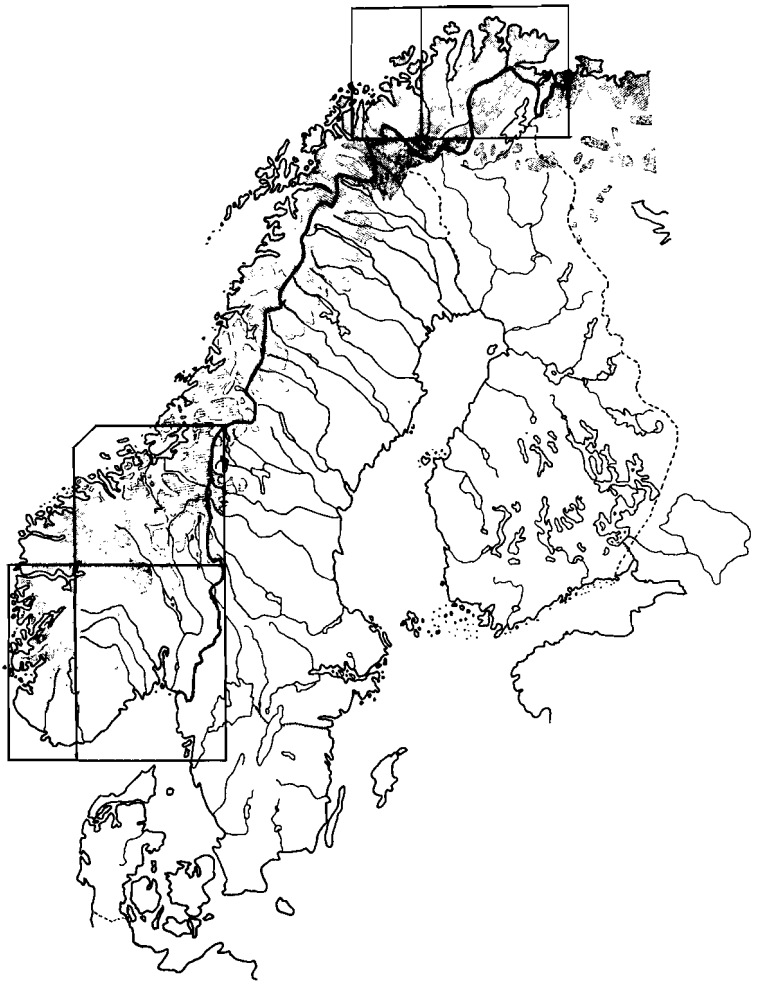


Fig. 1. Map of Norway, showing the different sections presented in detail in Fig. 2. (Arctic-alpine areas are shaded.)

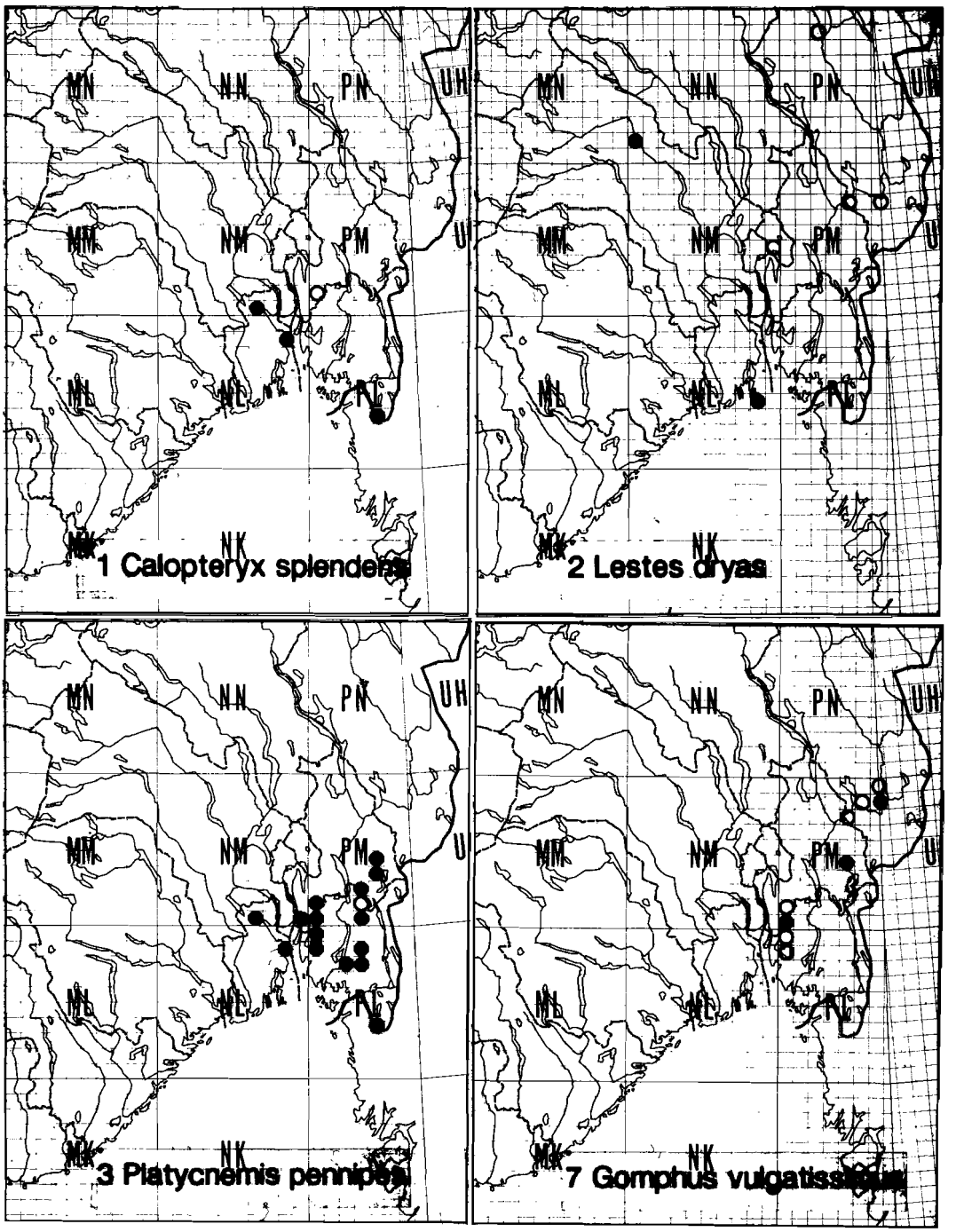
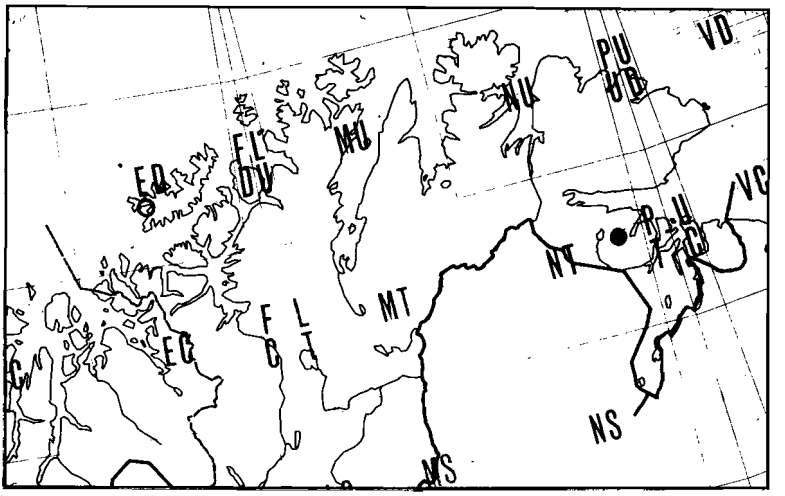
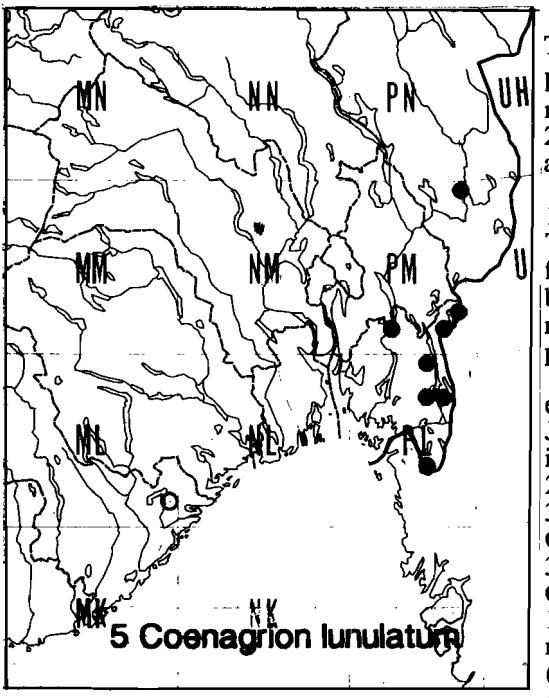


Fig. 2, 1—18. The distribution of threatened Norwegian Odonata according to 10 x 10 km UTM squares. Open circles show records before 1960, dots show records from 1960 and onwards.





including the more common species, in a distribution table, similar to that of e.g. Lindroth (1962) and K. A. Økland (1981). Old records are sometimes not precise with respect to locality description; some circles may therefore have been placed in a neighbouring square to the correct one.

THE THREATENED SPECIES

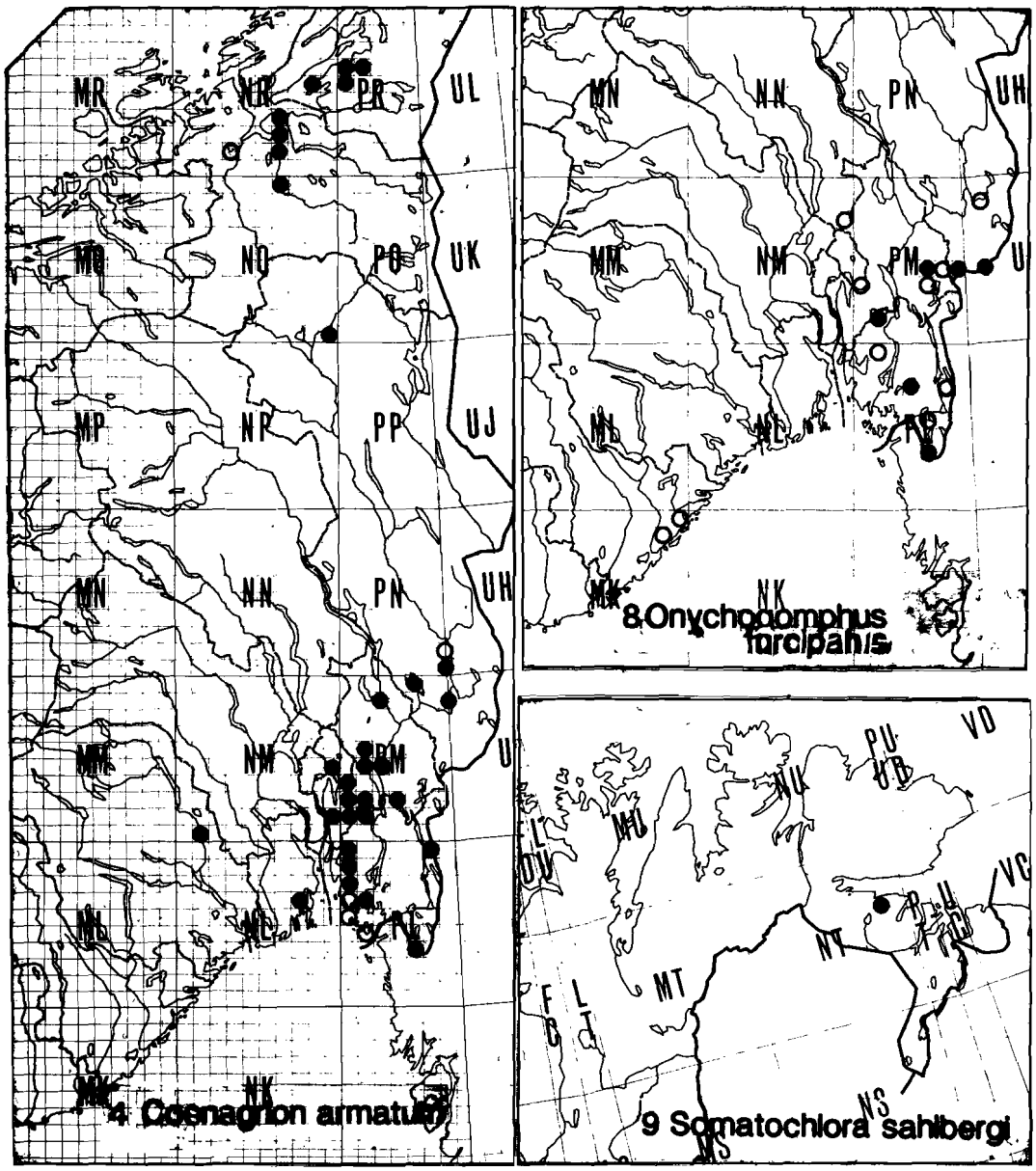
Fig. 1 shows the position of different detailed map sections of Norway, as presented in Fig. 2. The distributions of the threatened species are shown in Fig. 2, 1—18.

1. *Calopteryx splendens* (Harris, 1782)
The species is previously reported from Østfold: Halden; Akershus: Ås; Vestfold: Jarlsberg (Sømme 1937a, Solem 1969). Solem's record from 1968 has so far been the only one published of this species from our century.

New records: Østfold (Ø): Halden: Berbyelva (= Enningdalselva) at Berby (EIS:12) 15 July 1986 >50 ind.; 23 June 1989 15—20 ind.; 8 July 1989 numerous; 12 Aug. 1989 2—3 ♂♂, 1 ♀; 27 May 1990 several larvae; 31 May 1990 numerous larvae + 1 exuvia. Outlet Rødsvatn (Enningdalselva (EIS:12) 31 May 1990 1 ♂, 1 ♀. Vestfold (VE): Borre: Outlet river Borrevatn (EIS:19) 19 June 1990 1 ♂; 8 Aug. 1990 1 ♂, 1 ♀. Hof: The river between Vikevatn and Bergsvatn (EIS:28) 25-, 27-, 28 July 1988 10—16 ind. observed each date (PT); 20 July 1990 4 ♂♂ (PT).

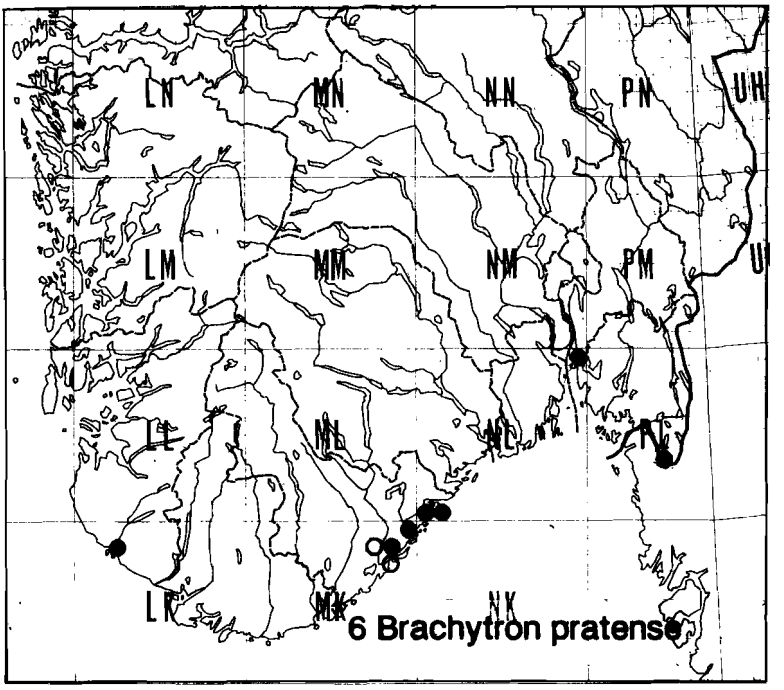
The present-day number of localities are the same as that of the previous half century. It is possible that the new record at the outlet of Borrevatn is the same site as referred to by Sømme (1937a) as Jarlsberg.

C. splendens thus occurs in three streams/-rivers in Norway today, but only two of these (Berbyelva and the river Vikevatn-Bergsvatn) appear to be sites with reasonably large populations. The population of Berbyelva,



first reported by Solem (1969), seems to be even larger than previously thought, and the species is probably fairly common in all suitable parts of the river downstream from Lake Kirkevatnet. However, a future lesser regulation of this river for hydroelectrical power as planned, poses a serious threat to this beautiful damselfly.

Our subspecies (*C. s. splendens)* is said to have declined drastically in abundance during the last two or three decades in Europe (Askew 1988, cf. Tol & Verdonk 1988). It inhabits small or fairly large rivers of mesotrophic, good water quality and muddy bottom, with some overhanging vegetation, but also open areas.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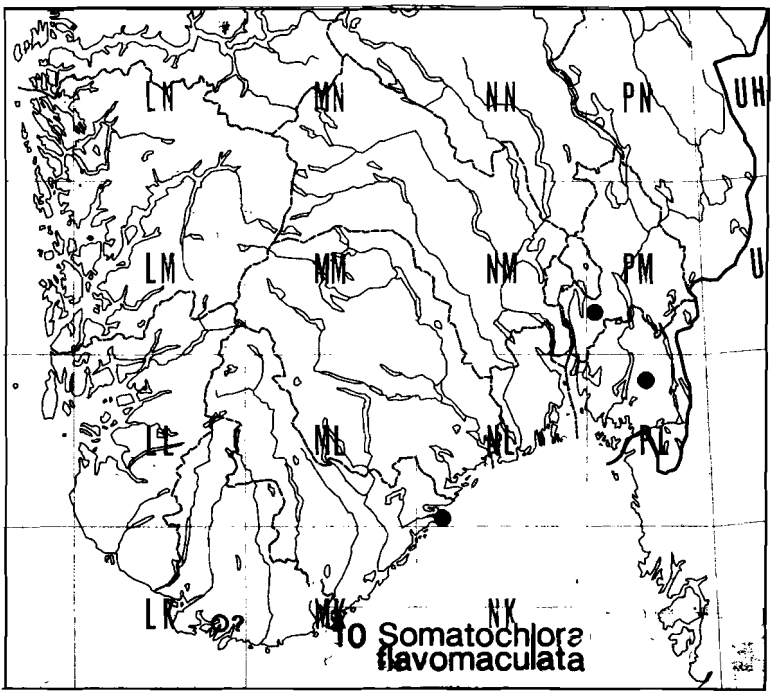
6 Brachytron pratense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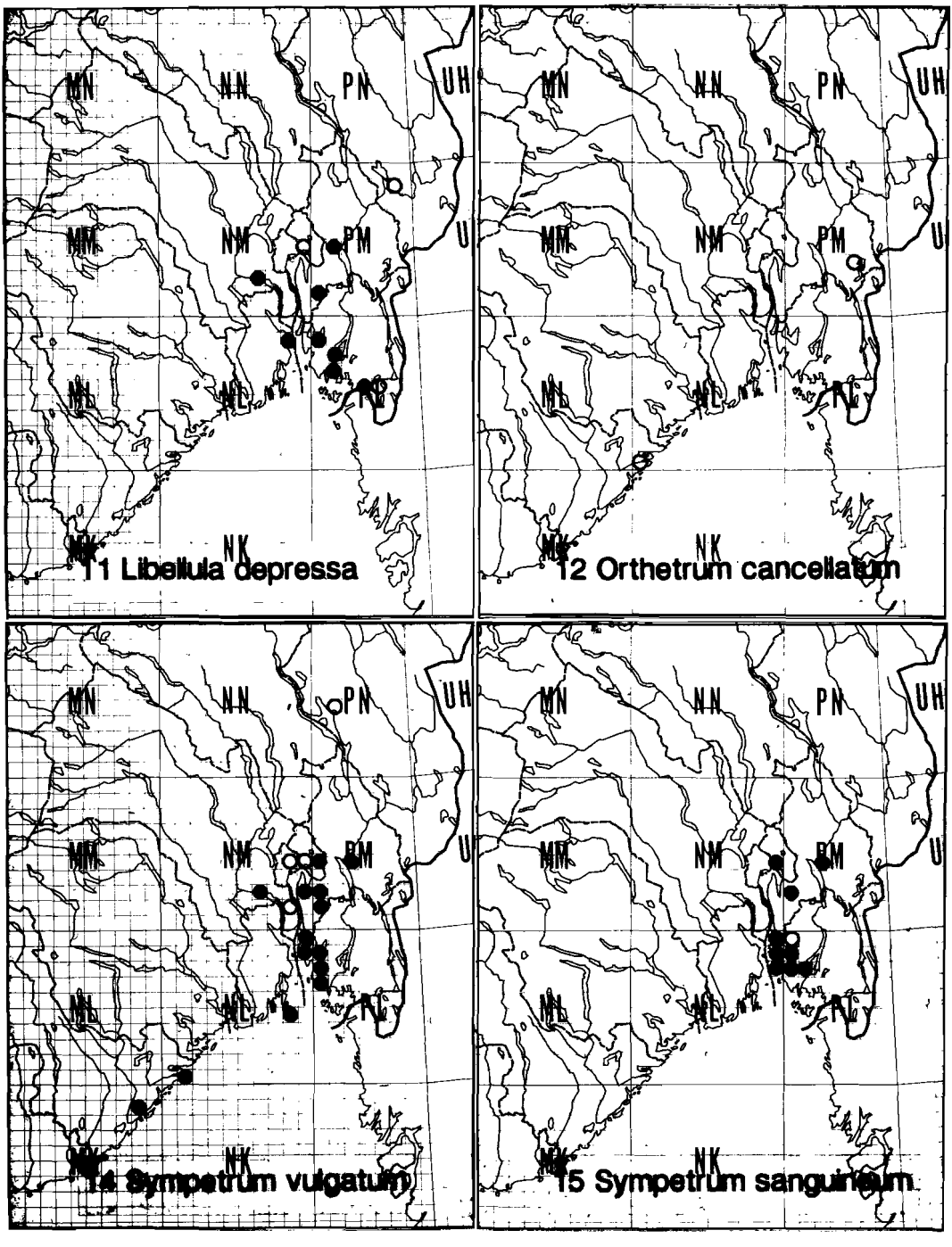
10 Somatochlora flavomaculata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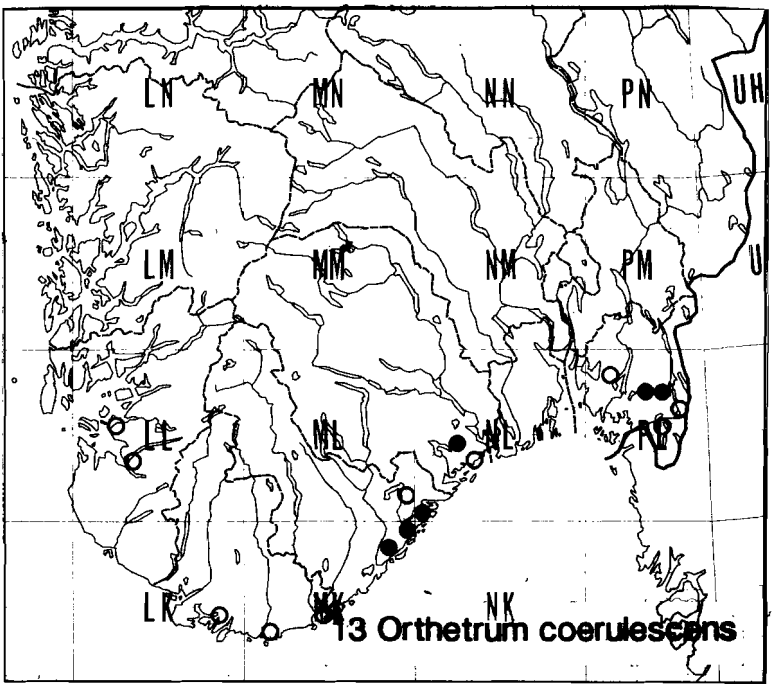
11 Libellula depressa
12 Orthetrum cancellatum
14 Sympetrum vulgatum
15 Sympetrum sanguineum



The status endangered (IUCN:E; see Wells, Pyle & Collins 1983) in Norway is quite obvious, and all three present-day localities should be protected.

2. *Lestes dryas* Kirby, 1890
Previously reported from Akershus: Nes and Oslo; Hedmark: Kongsvinger and Åmot; Buskerud: Nes (Sømme 1937a, Bruserud 1987).

Between ca. 1930 and 1983 this species was not recorded in Norway, and after 1983 it has been found only at two localities.

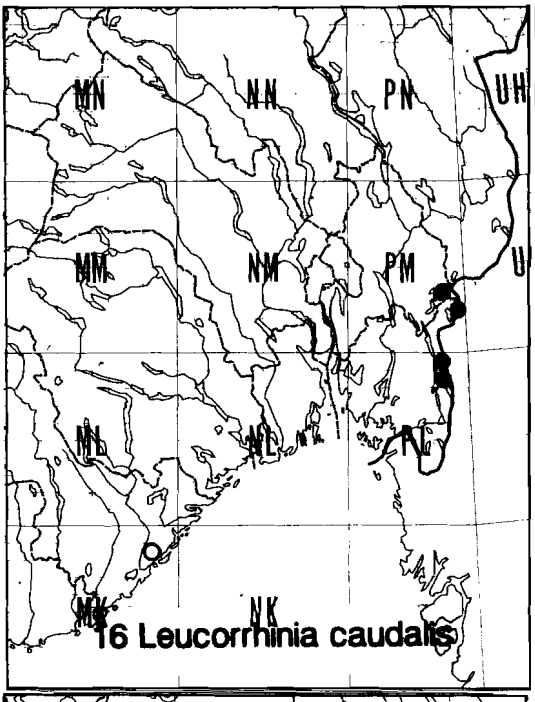
New records: Vestfold (VE): Tjøme: Ponds at Moutmarka (EIS:19) 12 July 1990 40—50 ind.; 8 Aug. 1990 >3 ind.; 16 June 1991 4 ♂♂, 2 ♀♀ (OB). *L. dryas* is new to Vestfold (VE) and EIS:19.

It is declining and threatened in parts of northern Europe where heavy applications of nitrogenous fertilizers are causing eutrophication of standing water on arable land (Askew 1988, Tol & Verdonk 1988). The habitat is usually mesotrophic moorland, shallow ponds or puddles with dense telmatophytic vegetation.

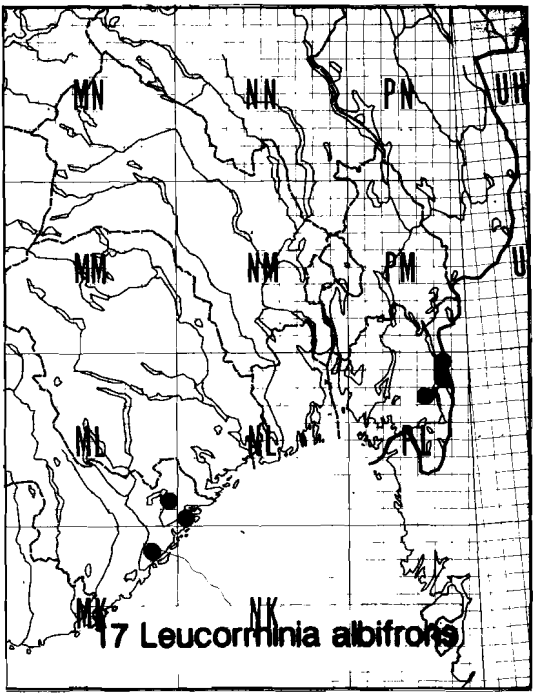
The status endangered (IUCN:E) in Norway is quite clear. The locality at Tjøme is protected as a landscape area. Although *L. dryas* prefers habitats with a dense water vegetation, these ponds must probably be managed to avoid any denser occurrences of *Phragmites australis,* which in the future may otherwise cover all areas of open water surface.

3. *Platycnemis pennipes* (Pallas, 1771)
This species has been found in Østfold: Eidsberg, Rakkestad, Skjeberg, Trøgstad, and Våler; Akershus: Aurskog-Høland (Sømme 1937a, Åbro 1966, Bjånes 1973).

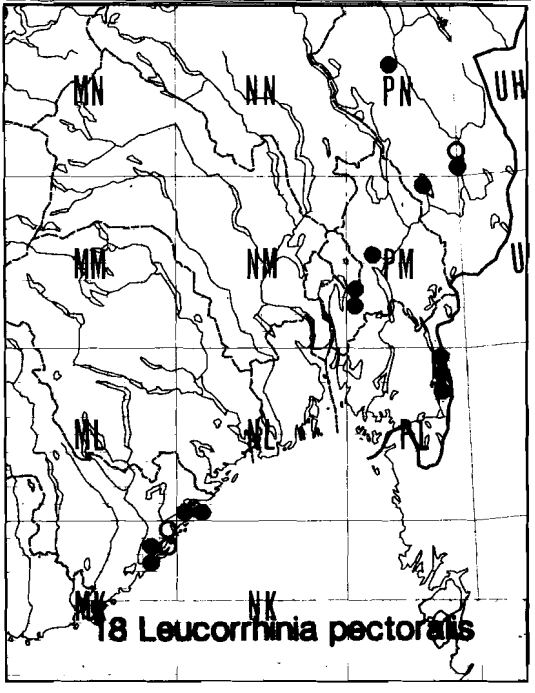
New records: Østfold (Ø): Eidsberg: Lekumelva (EIS:20) 10 June 1990 1 ind. Halden: Berbyelva (EIS:12) 15 June 1986 >50 ind.; 23 June 1989 numerous; 8 July 1989 numerous; 13 Aug. 1989 3—4 ind., 6 May 1990 several larvae; 27 May 1990 several larvae; 31 May 1990 2 ind. Outlet of Rødsvatn (Enningdalselva) (EIS:12) 31 May 1990 several. Hobøl: Hobølelva near Hobøl church (EIS:28) 22 June 1984 numerous; 3 June 1986 several larvae; 17 June 1986 ca. 15 larvae; 24 June 1986 >20 ind.; 30 July 1986 ca. 10 ind.; 23 July 1987 ca. 30 ind.; 5 July 1989 several; 31 May 1990 3 larvae. Kråkstadelva (EIS:28) 3 June 1986 1 larva. Hobølelva near Holstad (EIS:28) 30 June 1987 1 larva. Rakkestad: Rakkestadelva (EIS:20) 15



16 Leucorrhinia caudalis



17 Leucorrhinia albifrons



18 Leucorrhinia pectoralis

July 1986 2 ind. Pond in the river Dørja (EIS:20) 15 July 1986 1 ind. Skjeberg: Isoa (EIS:20) 23 June 1989 >40 ind. Buerbekken (= Børtelv) (EIS:20) 23 June 1989 4—5 ind.; 27 June 1990 4 ind.; 13 July 1990 1 ind. (var. *lactea).* Våler: Hobølelva near the outlet into Vannsjø (near Bjørnerødvatn) (EIS:20) 19 June 1983 1 ind.; 24 June 1986 >100 ind. Akershus (AK): Vestby: Hølenelva (EIS:28) 24 June 1986 >10 ind. Aurskog-Høland: Inlet Bjørkelangen (EIS:29) 22 July 1987 >20 ind.; 30 June 1989 15—20 ind.; July 1991 several (JRG). Hellesjøvann (EIS:29) 30 June 1989 1 ♀. The stream at Hemnes (EIS:29) 30 June 1989 >2 ♂♂. The outlet stream at the north end of Øgderen (EIS:29) 30 June 1989 >6—8 ind. Vestfold (VE): Borre: The outlet river from Borrevatn (EIS:19) 11 July 1985: 19 June 1990 >3 ♂♂; 8 Aug. 1990 >1 ♂. Hof: The river between Vikevatn and Bergsvatn (EIS:28) 27 July 1988 >10 ind. (PT); 20 July 1990 >10 (PT). *P. pennipes* is new to Vestfold (VE), EIS:12, EIS:19, and EIS:28.

The typical habitat of *P. pennipes* is small or fairly large rivers of mesotrophic water quality. Our (nominal) subspecies is probably not threatened in Europe (Tool & Verdonk 1988).

In Norway the species is found, sometimes in fairly large numbers, at several streams and rivers in its distribution area, but this area is rather restricted around the Oslofjord, south of 60°N. The localities are all situated within the most strongly exploited agricultural areas, a fact which supports the status as vulnerable (IUCN:V).

4. *Coenagrion armatum* (Charp., 1840)
Reported from Østfold: Hvaler, Onsøy, Råde, and Våler; Akershus: Aurskog—Høland, Enebakk, Fet, Oslo, Ski, and Ås; Hedmark: Hof; Sør-Trøndelag: Melhus, Orkdal, and Trondheim; Nord-Trøndelag: Levanger (Sømme 1937a, Tjønneland 1953, Åbro 1965, Dolmen, Sæther & Aagaard 1975, Olsvik 1983, Dolmen & Refsaas 1987, Dolmen 1992).

New records: Østfold (Ø): Fredrikstad: moat-ponds Gamlebyen (EIS:20) 6 May 1990 12—14 ind. Halden: Endetjern (EIS:12) 28 May 1990 several. Marker: Nordre Brutjern (EIS:21) 25 June 1986 >10 ind.; 6 May 1990 30—40 ind. Gjølsjø (EIS:21) 24 May 1989 >50 ind.; 22 June 1989 >5 ind. Råde: Channel into Skinnerflo (EIS:20) 9 June 1988 >1 ♂. Spydeberg: Lyseren (EIS:29) 25 June 1986 >10 ind. Våler: Bjørnerødvatn (EIS:20) 24 June 1986 ca. 3 ind. Vannsjø near Sperbund (EIS:20) 14 June 1985 several. Lødengfjorden in Vannsjø (EIS:20) 24 June 1986 >5 ind. Akershus (AK): Aurskog-Høland: Hemnessjøen (Øgderen) (N end) (EIS:29) 6 July 1987 1 ♀. Fet: Monsrudvika, Nordre Øyeren (EIS:29) 28 May 1986 7—8 ind. (recently emerged). Enebakk: Vågvatn (EIS:29) 17 June 1984 1 ♂; 22 June 1984 >10 ind.; 20 June 1986 >50 ind.; 29 June 1987 >15 ind. Mjær (N part) (EIS:29) 29 June 1987 1 ♂. Oslo: Østensjøvannet (EIS:28) 15 June 1986 >20 ind. Skedsmo: Ringstilla (EIS:37) 23 June 1991 10 ♂♂ 2 ♀♀ (OB). Ski: Midtsjøvatn (EIS:28) 28 June 1987 >30 ind.; 31 May 1988 ca. 40 ind.; 24 May 1989 10—15 ind. Nærevatn (EIS:28) 22 May 1990 1 ♂. Svartkulp (EIS:28) 29 June 1987 1 ♂. Rullestadtjern (EIS:28) 21 June 1988 1 ♂. Ullensaker: Risa near Risebru (EIS:37) 11 June 1989 1 ♂. Ås Østensjøvatn (EIS:28) 22 June 1984 1 ♂; 21 May 1985 5 larvae; 20 June 1986 >30 ind. Årungen (EIS:28) 24 June 1986 >10 ind. Hedmark (HES): Grue: Pond near Øygarden, Kirkenær (EIS:47) 12 June 1989 2 ♂♂. Sør-Odal: Pond near Berger (EIS:37) 14 June 1989 6—8 ind. Kongsvinger: Prestegårdstjernet (EIS:38) 12 June 1989 >2—3 ♂♂. (HEN): Tynset: Bjørnsmotjørna/Stasjonstjørna (EIS:80) 14 June 1988. Buskerud (BØ): Notodden: Pond W of the airport (EIS:27) 25 June 1991 3 ♂♂, 1 ♀ (OB). Vestfold (VE): Stokke: Gjennestadvatn (EIS:19) 4 June 1991 numerous. *C. armatum* is new to eastern Buskerud (BØ): northern Hedmark (HEN); Vestfold (VE), EIS: 19, 21, 27, 38, 47, and 80.

This is a boreal or boreonemoral species, with an eastern distribution. It is extinct in the UK and in the northern parts of the Continent, and suffers due to over-eutrophication of ponds and lakes and lowering of the water table (Askew 1988). The habitat in Europe is usually mesotrophic peatmoors (Tool & Verdonk 1988). In Norway, however, it is found in more or less eutrophic ponds or lakes, with dense littoral telmatophytic vegetation. The species may also be found in bog localities.

Agricultural eutrophication seems at present to be an advantage for the species in Norway, both with respect to the number of local populations and to local population size. But if this eutrophic influence increases, the localities may become too polluted in the future. On this background the status as vulnerable (IUCN:V) seems defendable.

5. *Coenagrion lunulatum* (Charp., 1840)
This species has been reported from Aust-Agder: Vegårdshei; Finnmark: Hasvik and Sør-Varanger (Sømme 1937a, 1937b, Kvifte 1942a, Hämäläinen 1983, Aagaard & Hågvar 1987).

New records: Østfold (Ø): Aremark: Tarn W of Sjulitjern (EIS:20) 23 May 1989 1 ♂, 2 ♀♀ collected + several observed; 6 July 1989 1 ind. Samedalstjern (EIS:20) 23 May 1989 several. Breidmosetjern (EIS:21) 21 May 1989 several. Tarn NNW of Breidmosetjern (EIS:21) 21 May 1989 numerous. Brynhildstjern (EIS:21) 21 May 1989 1 ♀. Tarn near the road SE of Breidmosetjern (EIS:21) 21 May 1989 3 ind.; 27 May 1990 >2 ♂♂. Halden: Endetjern (EIS:12) 28 May 1990 numerous. Marker: Bjørnetjern (EIS:20) 24 May 1989 >10 ind. Gresstjern (EIS:20) 24 May 1989 20—30 ind. (some recently emerged). Rakkestad: Bog tarn W of Aremarksjøen (EIS:20) 23 May 1989 6—10 ind. Midtre Nordslettetjern (EIS:20) 23 May 1989 1 ♂, 2 ♀♀. Nordre Nordslettetjern (EIS:20) 23 May

1989 a few ind. Rømskog: Oselva (EIS:29) 10 June 1990 1 ♂. Pond NW of Gåsemosan (EIS:29) 10 June 1990 12—15 ind. (♂♂, ♀♀). Akershus (AK): Enebakk: Vestre Tretjern Hauglandsfjellet (EIS:29) 30 May 1990 >3 ♂♂ + 1 pair. Hedmark (HES): Grue: Nesmyra (EIS:38) 12 June 1989 numerous. Finnmark (FØ): Sør-Varanger: Lake in open landscape at Haukberget, Valen (Neiden) (EIS:168) 19—22 July 1983 1 ♀ (P. Valtonen pers. com.). *C. lunulatum* is new to Østfold (Ø), Akershus (AK), southern Hedmark (HES), eastern Finnmark (FØ), EIS: 12, 20, 21, 29, 38, and 168.

This is mainly an eastern species, which is vulnerable in Europe and rare in Asia. It is a species of mesotrophic and oligotrophic conditions, usually in localities with floating vegetation; in the Atlantic zone it is also found in peatbogs (Tol & Verdonk 1988). It is very common in the Inari district in Finnish Lapland (Hämäläinen 1984). In Norway, in accordance with this, it inhabits acid tarns and larger ponds edged with *Sphagnum* mosses on ombrogenous bogs; it is rare in more eutrophic lakes.

Several new localities have been discovered in eastern parts of south-eastern Norway during the last two years. At the previously known locality at Vegårdshei, near the southern coast of South Norway, however, *C. lunulatum* seems to have disappeared. Therefore the species was judged as endangered by Olsvik et al. (1990), also because the only recent record until 1988 was in Finnmark. It is an early flier (May—June) with a short flying season, however, and in its special habitat it may therefore have been overlooked. The new records from 1989 and 1990 show that the species is much more common than previously thought, but its area is threatened by acid precipitation and other air-borne pollutants. The Norwegian status as endangered (IUCN:E) is therefore maintained.

6. *Brachytron pratense* (Müller, 1764)
The species is known from Østfold: Moss; Aust-Agder: Moland, Tromøy and Øyestad (Sømme 1937a, Åbro 1965).

New records: Østfold (Ø): Halden: Endetjern (EIS:12) 28 May 1990 2 imagines. Øvre Elgvatn (EIS:12) 29 May 1990 several imagines. Nedre Elgvatn (EIS:12) 30 May 1990 1 exuvia, several imagines. Lille Lyse(vatnet) (EIS:12) 30 May 1990 1 exuvia. Godatjern (EIS:12) 30 May 1990 several imagines. Near Ormetjern (EIS:12) 29 May 1990 1 ♂. Varpetjern (EIS:12) 29 May 1990 1—2 imagines. Creek/ditch near Amundrød (EIS:12) 29 May 1990 1—3 ind. River near Saga (EIS:12) 30 May 1990 1 ♂. Moss: Patterødtjern (EIS:19) 6 June 1990 3—4 ♂♂; 30 June 1991 2 ♂♂ (OB). Aust-Agder (AAY): Froland: Mårvatn (EIS:6) 5 June 1990 2 ind. Moland: Kvitetjern (EIS:6) 15 July 1987 1 ♀. Longumvatn (EIS:6) 9 June 1990 1 ♀. Molandsvatn (EIS:6) 9 June 1990 1 ♂. Risør: Fidjevatn (EIS:11) 6 June 1991 3—4. Kvernvatn (EIS:11) 8 June 1990 1 ♂. Åkvågvatn (EIS:11) 9 June 1990 2—4 ind. and 1 exuvia. Tvedestrand: Litjern (EIS:11) 7 June 1991 1 exuvia. Råbergtjern (EIS:11) 9 June 1990 1 ♂. Stordalsvatn (EIS:11) 9 June 1990 1 ♀. Åltjern (EIS:6) 9 June 1990 1 ♂. Øyestad (= Arendal): Assævatn (EIS:6) 5 June 1990 >3 ind. Bråstadtjern (EIS:6) 1930—50 (GK); 5 June 1990 a few imagines. Sagvatn, including the outlet stream (EIS:6) 5 June 1990 >4—5 ind. Seljåstjern (EIS:6) 6 June 1990 4—5 ind. Skoletjern (= Haugåsdalstjern) (EIS:6) 27 June 1984 1 ♂; 6 June 1990 4—5 ind. Solevatn (EIS:6) 5 June 1990 2—3 ind. Stoatjern (EIS:6) 6 June 1990 2—3 ind. Sørsvatn (EIS:6) 6 June 1990 2—3 ind. Daletjern (EIS:6) 1930—50 (GK); 8 June 1991 1 exuvia. Bergtjern (EIS:6) 1930—50 (GK). Rogaland (RY): Eigersund: Fotlandsvatn near Tengs (EIS:3) 29 May 1973 >1 ind. (AF). *B. pratense* is new to coastal Rogaland (RY), EIS:3, and 12.

In Norway it is usually observed along lowland bog- and forest tarns, often fairly eutrophic, with floating *Sphagnum* mats and *Myrica gale* bushes. It is an early flier (May—June) and may therefore be overlooked.

Although uncommon and declining in several countries, this marshland species is widespread and not reckoned as threatened in Europe (Tol & Verdonk 1988). *B. pratense* was regarded as endangered in Norway by Olsvik et al. (1990), but recent records indicate that although not numerous at each locality, it is fairly widespread within its distribution area. It is a southern coastal species in Norway, and the status should probably by vulnerable (IUCN:V).

7. *Gomphus vulgatissimus* (L., 1758)
Records are known in Østfold: Hobøl and Våler; Akershus: Nes and Ås; Hedmark: Grue and Odalen (Sømme 1937a, Åbro 1965).

New records: Østfold (Ø): Hobøl: Hobølelva near Hobøl church (EIS:28) 19 June 1983 2 ind. seen, 1 ♀ collected; 9 June 1988 1 ♂, 1 ♀; 31 May 1990 2 exuviae + 5 larvae. Akershus (AK): Aurskog-Høland: The river into Bjørkelangen near Halvorsrud (EIS:29) 16 June 1988 2 ind. observed in their maiden flight (most likely this species); 26 June >1 ♂ observed. Hedmark (HES): Kongsvinger: Skasåa near Årbogan (EIS:38) 12 June 1 exuvia.

G. vulgatissimus is vulnerable in Europe, due to a serious decline in many places (Tol & Verdonk 1988).

In Norway its habitat is slowly-flowing small or large rivers in lowland clay districts, i.e. usually in areas of agriculture. Sømme (1937a) reported a mass occurrence of this species in the Hobøl river in south-eastern Norway in 1930, estimating an emergence of 10 000 specimens per km river. Sømme's locality and several others have been investigated during the latest decade, but just a few specimens, including larvae and exuviae, have been found. Its status should be endangered in Norway (IUCN:E), in view of the restricted distribution area, the obvious decline (see map), and the few recent records, together with the fact that its habitat undergoes a general destruction from agricultural eutrophication.

8. *Onychogomphus forcipatus* (L., 1758)

The species is known from Østfold: Aremark, Halden, Skjeberg, and Våler; Akershus: Aurskog-Høland and Oslo; Hedmark: Eidskog and Grue; Oppland: Gran; Aust-Agder: Øyestad (Sømme 1937a, Åbro 1965, Bjånes 1973).

New records: Østfold (Ø): Hobøl: Hobølelva near Nordre Hov (EIS:29) 23 July 1987 1 ♂. Skjeberg: Buerbekken (= Børtelv) (EIS:20) 23 June 1989 >15—20 ♂♂; 5 July 1989 several (OB); 6 July 1989 several, 1 exuvia. Halden: Berbyelva (EIS:12) 8 July 1989 several. Rømskog: Oselva (EIS:29) 10 June 1990 30—40 larvae + 1 imm. Våler: Unemselva/Bjørkedalselva (EIS:20) 6 June 1990 1 larva. Akershus (AK): Aurskog-Høland: Setta (EIS:29) 25 July 1989 2—3 ind. Hedmark (HES): Eidskog: Buvikelva (EIS:29) 26 June 1990 20—30 exuviae. Outlet stream Leirsjøen (EIS:38) 6 July 1985 1 ♂ collected, >20 observed (HH). Aust-Agder (AAY): Tvedestrand: Sprengselva at Holt Agricultural School (EIS:6) 1930—50 (GK).

The habitat is usually more swiftly-flowing rivers than preferred by the previous species, and a good, mesotrophic water quality, with stony shores and bottom.

O. forcipatus is rather abundant in most rivers in southern Europe, but declining or even locally extinct in industrialized countries, therefore vulnerable (Tol & Verdonk 1988).

The species has not been rediscovered along the southern coast of Norway, despite many investigations. Although a few streams and rivers on the eastern side of the Oslofjord still seem to have fairly good populations in some years, the apparent absence in other years, together with a restricted distribution area and an obvious decline (see map), indicate that the species should be regarded as endangered (IUCN:E).

9. *Somatochlora sahlbergi* Trybom, 1887

New records: Finnmark (FØ): Sør-Varanger: Bugøynes (EIS:177) 7 July 1990 1—3 ind. (observation) (HP) (Pedersen 1992). New to Norway. No specimen has so far been caught, however.

This species, the latest addition to the list of Norwegian dragonflies, was expected to be found in eastern Finnmark, cf. Sømme (1937a) and Olsvik (1990d). The species is more common than previously known in northern Finland (M. Hämäläinen pers. comm.).

It is probably not a threatened species in its Siberian range, but rare in Europe (Tol & Verdonk 1988).

Its habitat is, according to Askew (1988), northern moorlands at the edge of the tundra, with cold, quite deep, standing water in ponds and bog pools in which aquatic mosses are dominant.

With respect to pollution, particularly acidification, eastern Finnmark is one of the most exposed areas in Norway because of the airborne pollution from Russian industry on the Kola Peninsula. *S. sahlbergi,* despite a supposed tolerance to low pH values, may be endangered if the acid precipitation continues and makes its larval environment unsuitable. *S. sahlbergi* should be regarded as endangered (IUCN:E) in Norway. The one observation was made in a geological reserve, a protected area.

10. *Somatochlora flavomaculata* (Vander Linden, 1825)

An old somewhat uncertain record of this species is based on a specimen in the collections of the University of Trondheim, The Museum, labelled «? Lyngdal C. D.» As pointed out by Tjønneland (1953), no journal has been found that could explain the exact meaning of the question-mark. We now know that C. D. (Carl Dons) collected beetles in the Lyngdal district around 1916—20. Because this was the only indication that the species was found in Norway, it has not been reckoned as a «Norwegian» species until Olsviks (1990b) records, referred to below.

The species is known from Akershus: Ski; Østfold: Rakkestad (Olsvik 1990b).

New records: Aust-Agder (AAY): Risør: Kvernvatn (EIS:11) 3 July 1990 4—5 ♂♂; 12 Aug. 1991 1—2 ind. ? Fidjevatn (EIS:11) 3 July 1990 >2 ♂♂; 12 Aug. 1991 1—2 ind. *S. flavomaculata* is new to coastal Aust-Agder (AAY) and EIS:11.

Its European distribution is widespread, especially in mesotrophic and oligotrophic peatmoors in woodland, but it is uncommon and locally declining. According to Tol & Verdonk (1988) more information is needed on this vulnerable species.

The localities in which the species has been found in Norway, are mesotrophic or eutrophic tarns in the lowland, with reed-beds of tall telmatophytic vegetation (e.g. *Phragmites australis)* nearby. Several specimens may usually be seen over these «meadows» (Askew 1988, Olsvik 1990b).

The records during two successive years from certain localities in Aust-Agder indicate that a local population is really present. The species seems to be one of the least common dragonflies in Norway, and should be regarded as endangered (IUCN:E) here, in view of present knowledge.

11. *Libellula depressa* L., 1758

The species is known from Østfold: Halden (Tistedal) and Rygge; Akershus: Oslo; Hedmark: Sør-Odal (Sømme 1937a, Dolmen 1989, 1992).

This species, which had not been recorded in Norway since 1897, was rediscovered by Dolmen (1989). After that, many new records have been reported by different people looking for the species in its typical habitat, cf. Olsvik (1990c) (see below).

New records: Østfold (Ø): Borge: Pond near Leca (EIS:20) 26 July 1990 1 ♂ (RO, MP). Halden: Pond at Hov near Idd (EIS:20) 4 June 1984 >1 ♂ observed (RN/JBO) (GH pers comm.). Rygge: Eskelund pond (EIS:20) 3 July 1987 1 ♀; 29 April 1990 1 larva; 3 May 1990 >20 larvae (2 ♂♂ + 4 ♀♀ hatched in lab. 17—18 May); 13 May 1990 11 larvae; 27 June 1990 1 ♂. Tune: Tunevann, Råkil (EIS:20) 5 July 1989 1 ♂ (TJO, HO contr.). Akershus (AK): Fet: Pond near Tuen (EIS:29) 18 June 1989 1 ♂, 1 ♀ (TB). Ski: Farm pond at Østre Rustad (EIS:28) 9 June 1990 1 ♂ (TB, HO contr.); 11 June 1990 1 ♂ (AB). Buskerud (BØ): Lier: ponds in gravel pit near Grinda/Undersrud (EIS:28). Imagines and larvae found through many years, from before 1973, but the ponds were drained and destroyed in 1989 (PH/KE). Vestfold (VE): Borre: Three ponds in Damgata, Åsgårdsstrand (EIS:19) 22—24 June 1973 2 ♂♂ caught, several observed (SJO). (These ponds were filled-in a few years later.) *L. depressa* is new to eastern Buskerud (BØ) and Vestfold (VE), EIS:19, and 29.

It is not a threatened species in Europe, but rather widespread and common in many biotopes (Tol & Verdonk 1988).

In Norway the species seems to prefer newly-dug ponds with bare shores (without vegetation) on clayey ground.

It should be noted that most new records from still-existing ponds are of single individuals, which is no proof of breeding. Only one good breeding site is known so far (in Rygge). Small populations at farm ponds, ponds in gravel pits and other «shortlived» man-made localities in a restricted distribution area around the Oslofjord strongly underlines its status as endangered (IUCN:E) in Norway.

12. *Orthetrum cancellatum* L., 1758

This species is known from Akershus: Aurskog-Høland (N. Høland); Aust-Agder: Tvedestrand (Holt) (Olstad 1922, Sømme 1937a).

There are no new records of *O. cancellatum,* and it is reckoned as extinct (IUCN:EX) in Norway (Olsvik et al. 1990).

The old localities known in Norway are both fairly eutrophic lakes in agricultural areas, 124 and 51 m above sea level, respectively: Bjørkelangen in Aurskog-Høland (N. Høland) (where two specimens were found) and Litjern near Laget, Tvedestrand (cf. Olsvik et al. 1990). It is a strong migrant, how-

ever, and there is a possibility that the two records in Norway, both from the period before 1930, were immigrants. The distribution in Sweden is in the south-east up to Uppland, especially along the coast, in lakes or brackish water. However, a few records have been made in Dalsland, not far from the Norwegian border in south-western Sweden (Sahlén 1985).

O. cancellatum is a widespread and very common species in Europe, in a number of biotopes (Tol & Verdonk 1988).

In Central Europe its habitat is often ponds in former sand or stone quarries etc., where the species has found suitable conditions (Buchwald 1985). This is probably also the biotope in which one should look for it in Norway.

13. *Orthetrum coerulescens* (Fabricius, 1798)
This species is known from Østfold: Halden (Tistedal) and Våler; Telemark: Bamble; Aust-Agder: Moland, Vegårdshei and Øyestad; Vest-Agder: Holum and Randesund; Rogaland: Forsand and Strand (Sømme 1937a, Kvifte 1942b, Tjønneland 1953, Åbro 1965).

New records: Østfold (Ø): Rakkestad: Søndre Nordslettetjern (EIS:20) 6 July 1989 2 ♂♂. Skjeberg: Buerbekken (= Børtelv) (EIS:20) 6 July 1989 >1 ♂. Telemark (TEY): Skien: Åslandstjern, Kilebygda (EIS:11) July 1983 (GON leg., DD det.). Aust-Agder (AAY): Froland: Mårvatn (EIS:6) 7 July 1990 1 ♂. Moland: Molandvatn outlet 19 Aug. 1991 1—2 ♂♂. Tvedestrand: Igletjern (EIS:10) 1930—50 (GK); 4 July 1990 1 ♂. Størdalsvatn (EIS:10) 10 aug. 1 ♂. Svinebutjern (EIS:10) 10 Aug. 1991 4 ♂♂. Litjern (EIS:11) 1930—50 (GK); 12 Aug. 1991 2—3 ♂♂. Sprengselva (Dalen og Kleiva) (EIS:6) 18 July 1991 numerous. Øyestad (= Arendal): Solbergvatn (EIS:6) 1930—50 (GK); 24 July 1986 several ♂♂. Sørsvatn (EIS:6) 1930—50 (GK); 24 July 1986 several ♂♂; 6 July 1988 1 pair. Skoletjern (EIS:6) 7 July 1988 1 ♂. Assævatn (EIS:6) 1930—50 (GK); 5 June 1990 2 immature; 7 July 1990 1 ♂ + 1 imm.; 13 Aug. 1990 3 ♂♂. Solevatn (EIS:6) 1930—50 (GK); 6 July 1990 1 ♂ imm.; 7 July 1990 1 imm.; 20 July 1991 1 ♂, 1 ♀. Lilleå (EIS:6) 12 Aug. 1990 1 ♂; 13 Aug. 1990 3 ♂♂ + 1 ♂ and 1 ♀; 20 July 1991 several. Bråstadtjern (EIS:6) 1930—50 (GK); (inlet) 20 July 1991 several. Daletjern (EIS:6) 1930—50 (GK). Sagvatnet (EIS:6) 1930—50 (GK); (lake and outlet) 20 July 1991 several. Stoatjern (EIS:6) 1930—50 (GK).

O. coerulescens is widespread in Europe, but mainly a south European species (Askew 1988, Tol & Verdonk 1988). In Norway it is often found in bog tarns, but usually in fairly eutrophicated ones, sometimes along running water.

Recent investigations indicate that the species is a regular inhabitant of suitable localities along the southern coast. The status vulnerable (IUCN:V) seems to be reasonable in view of the restricted distribution and the preference for coastal lowland localities, where industrial development, sewage from human settlements and agricultural activities may have a negative influence on the habitat.

14. *Sympetrum vulgatum* L., 1758)
This species is known from Østfold: Fredrikstad, Moss, Onsøy, Rygge, and Våler; Akershus: Oslo; Hedmark: Hamar; Buskerud: Hurum; Vestfold: Borre (Sømme 1937a, Tjønneland 1953, J. Økland 1964, Åbro 1965, Bjånes 1973, Dolmen 1992).

New records: Østfold (Ø): Fredrikstad: Seutelva (EIS:20) 20 Sept. 1988 several ca. 10 ♂♂, 1 ♀. Moss: Ponds at Grønli/Reier, Jeløya (EIS:19) 12 Aug. 1989. Patterødtjern (EIS:19) 1 Aug. 1990 >1 ♂. Noretjern (EIS:19) 1 Aug. 1990 >6—8 ♂♂. Mosseelva at Storebaug (EIS:19) 1 Aug. 1990 2—3 ♂♂ + 1 ♀ imm.; 30 aug. 1991 numerous (OB). Våler: Vannsjø near Mosseros (EIS:20) July 1984 1 ♀ imm. (SL leg., HO det.). Akershus (AK): Oslo: Østensjøvatn (EIS:28) 31 July 1982 2 ind. (recently emerged); 15 Aug. 1982 2 ♂♂. Ski: Bergsengkulpen (EIS:28) 3 Aug. 1990 1 ♂ (recently emerged). Midtsjøvatn (EIS:28) 27 Aug. 1982 several; 28 Aug. 1983 10—20 ind.; 16 Aug. 1985 >20 ind.; 28 Aug. 1988 1 ♂; 25 Aug. 1991 numerous (OB). Nærevatn (EIS:28) 8 Aug. 1988 2—3 ♂♂, 1 ♀; 28 Aug. 1988 1 ♂; July—Aug. 1990 regularly observed (MB); 26 aug. 1990 4—5 ♂♂, 1 ♀. Åråsbekken (EIS:28) 26 Aug. 1990 3—4 ♂♂; 25 aug. 1991 several (OB). Ås: Pollen (EIS:28) 6 Aug. 1989 1 ♂, 3 ♀♀. Pond E of Student Society Building (EIS:28) 30 July 1990 3—4 ♂♂, 1 ♀. Fet: Monsrudvika, Nordre Øyeren (EIS:29) 1 Sept. 1983 1 ♂. Buskerud (BØ): Nedre Eiker: Pond near Drammenselva, Killingrud (EIS:28) 29 Aug. 1989 1 ♂ (PT); 22 Aug. 1991 1 ♂ (PT). Near Solbergelva (EIS:28) 27 Sept. 1991 1 ♂ (PT,

HO contr.). Vestfold (VE): Tjøme: Moutmarka (EIS:19) 8 Aug. 1990 4—5 ♂♂. Aust-Agder (AAY): Arendal: Bergtjern (EIS:6) 16 Aug. 1991 1—2 ind. Moland: Jovatn (EIS:6) 18 Aug. 1991 ca. 6 ind. Risør: Åkvågvatn (EIS:11) 1930—50 (GK); 12 Aug. 1991 ca. 5 ind. *S. vulgatum* is new to coastal Aust-Agder (AAY), EIS:6, 11, and 29.

It is rather eurytopic, widespread and not threatened in Europe (Tol & Verdonk 1988).

In Norway this species seems to prefer eutrophicated ponds, tarns and lakes in the lowland around the Oslofjord. It is regarded as vulnerable (IUCN:V) although it is fairly common at some localities. A restricted distribution in areas where agricultural and other activities influence its habitat, is the main reason behind this evaluation.

15. *Sympetrum sanguineum* (Müller, 1764)
The species is known from Østfold: Fredrikstad, Moss, Våler (Sømme 1937a, Åbro 1965, Bjånes 1973).

New records: Østfold (Ø): Fredrikstad: Seutelva (EIS:20) 20 Sept. 1988 4—5 ind. Moss: Mosseelva at Storebaug (EIS:19) 1 aug. 1990 >1 ♂; 30 Aug. 1991 6 ♂♂, 2 ♀♀ (OB). Patterødtjern (EIS:19) 30 Aug. 1991 3 ♂♂ (OB). Noretjern (EIS:19) 1 Aug. 1990 >1 ♂. Rygge: Eldøya (EIS:19) 10 July 1987 >20 ind. Råde: Vannsjø near Langøya (EIS:20) 13 July 1985; 7—8 Aug. 1985 numerous. Våler: Vannsjø near Mosseros (EIS:20) July 1984 1 ♀ imm. (SL leg., HO det.). Akershus (AK): Oslo: Bogstadvatn (EIS:28) 11 Aug. 1982 4—5 ♂♂. Ski: Nærevatn (EIS:28) 28 Aug. 1983 >10 ind. Midtsjøvatn (EIS:28) 28 Aug. 1983 >20 ind. Langen near Bru (EIS:28) 6 Aug. 1983 1 ♂; 28 Aug. 1983 >1 ♂; 18 Aug. 1984 >5 ind.; 19 Aug. 1984 1 ♂. Bergsengkulpen (EIS:28) 28 Aug. 1983 >2 ♂♂. Fet: Monsrudvika, Nordre Øyeren (EIS:29) 1 Sept. 1983 several; 8 Sept. 1991 1 ♂, 1 ♀ (OB). *S. sanguineum* is new to Akershus (AK), EIS:28, and 29.

The species is widespread and common in Europe (Tol & Verdonk 1988).

The habitat is eutrophic ponds, tarns and lakes with dense vegetation, often where the water level varies throughout the season, with dry shores in late summer.

This species is so far only recorded on the east side of the Oslofjord, north to about 60°N. Although some localities near the coast in Østfold seem to have good populations, the species is regarded as vulnerable (IUCN:V) in Norway. Only in years with a hot and sunny late summer (July—August) does the species seem to disperse to Akershus and the Oslo area.

16. *Leucorrhiniia caudalis* (Charp., 1840)
The species is known from Aust-Agder: Øyestad (Kvifte 1943).

New records: Østfold (Ø): Marker: Nordre Brutjern (EIS:21) 25 June 1986 10—15 ♂♂; 6 July 1987 >5 ♂♂ + 2 pairs; 11 July 1987 >10 ♂♂; 23 June 1988 ca. 15 ind.; 22 June 1989 >15—20 ind. Søndre Brutjern (EIS:21) 6 July 1987 >4 ♂♂; 11 July 1987 >4 ♂♂; 5 Aug. 1988 1 ♂. Steintjern (EIS:21) 11 July 1987 >2 ♂♂. Abbortjern (EIS:21) 1 July 1987 several. Tarn east of Søndre Brutjern (EIS:21) 11 July 1987 a few ind.; 5 Aug. 1988 2—3 ♂♂. Stikletjern (EIS:21) 22 June 1989 >3—4 ♂♂. Solerudtjern (EIS:21) 22 June 1989 >1 ♂. Skinnarbutjern (EIS:21) 22 June 1989 >1 ♂. Rømskog: Nordre Veneåstjern (EIS:29) 10 June 1990 >1 ♂. Akershus (AK); Aurskog-Høland: Langebruslora (EIS:29) 16 June 1988 >10 ♂♂. *L. caudalis* is new to Akershus (AK), Østfold (Ø), EIS:21, and 29.

This is mainly an eastern species with only small Central European local populations left (Askew 1988). It is endangered (Tol & Verdonk 1988), and one of the three Norwegian dragonflies on the Berne Convention, appendix II.

In Norway the species has been found in forest- and bog tarns with floating leaf vegetation (*Nymphaea, Nuphar*), and often with bare rocks close to the water.

The species seems to have disappeared at the only previous locality on the southern coast of Norway. A new distribution area along the Swedish border in Østfold and Akershus was discovered in 1986. This area is among the most restricted known for dragonflies in Norway, although the species seems to be quite abundant at some of the localities within the area. Because of the small distribution area, this species, which by Olsvik et al. (1990) was classified as vulnerable, should be regarded as endangered (IUCN:E) in Norway.

17. *Leucorrhinia albifrons* (Burmeister, 1839)
The species is known from Aust-Agder: Tvedestrand and Vegårshei (Sømme 1937a, Kvifte 1943).

New records: Østfold (Ø): Marker: Nordre Brutjern (EIS:21) 22 June 1989 >15—20 ind. Tarn NE of Bergtjern (EIS:20) 7 July 1989 several. [2—3 ♂♂ were observed at Stikletjern (EIS:21) 22 June 1989, but no specimen was collected and identified in hand.] Aust-Agder (AAY): Tvedestrand: Gulspett-/Råberg-/Igletjørna (EIS:10) 1930—50 (GK). Størdalsvatn (EIS:10) 4 July 1990 ≥2 ♂♂; 10 Aug. 1991 1—2 ind. Svinebutjern (EIS:10) 9 June 1990 5—6 ind.; 4 July 1990 numerous; 11 Aug. 1990 2 ♂♂. Vegårshei: Kviftekilen, Vegår (EIS:10) 26 June 1984 >25 ind. + 2 pairs; 15 July 1987 >15 ♂♂; 9 July 1990 parts of one dead specimen. Romundstadtjern (EIS:10) 26 June 1984 1 ♂. Åletjern (EIS:10) 9 Aug. 1990 1 ♂. Solbergvatn (EIS:10) 1930—50 (GK). Øyestad (= Arendal): Solevatn (= Lindåstjern) (EIS:6) 7 July 1988 2 ♂♂; 7 July 1990 2—3 ♂♂. *L. albifrons* is new to Østfold (Ø), EIS:20, and 21.

This is mainly an eastern species with only small Central European local populations left (Askew 1988). It is endangered (Tol & Verdonk 1988) and also on the Berne Convention, appendix II.

Its habitat in Norway is forest- and bog tarns, often close to rocky hills, or bays of larger lakes, with floating leaf vegetation (*Nymphaea, Nuphar*).

The species is distributed in two small areas in Norway, most abundant in Aust-Agder on the southern Norwegian coast. A few new localities were discovered in 1989 in eastern Østfold, near the Swedish border. At least in Aust-Agder there seem to be a few good populations, but the species should still be regarded as endangered (IUCN:E) in Norway.

18. *Leucorrhinia pectoralis* (Charp., 1825)

The species is known from Hedmark: Vang; Aust-Agder: Øyestad (Sømme, 1937a, Kvifte 1942a, 1943, Jödicke 1986).

New records: Østfold (Ø): Aremark: Breidmosetjernet (EIS:21) 7 July 1989 several. Bog tarn NNW of Breidmosetjernet (EIS:21) 7 July 1989 a few ind. Marker: Nordre Brutjern (EIS:21) 6 July 1987 1 ♂. Gjølsjø (EIS:21) 23 June 1988 >25 ind.; 22 June 1989 4—5 ind. Stikletjern (EIS:21) 22 June 1989 >10 ind. Akershus (AK): Aurskog-Høland: Setten near Hverven (EIS:29) 16 June 1988 >1 ♂. Skedsmo: Kongsrudtjern (EIS:37) 3 July 1989 >30 ind. Ski: Svartkulp (EIS:28) 30 June 1986 >10 ind.; 29 June 1987 >1 ♂ (imm.); 12 June 1988 3—4 ♂♂. Bergsengtjørna (EIS:28) 21 June 1988 ca. 10 ♂♂; 18 June 1989 >1 ♂. Rullestadtjern (EIS:28) 21 June 1988 >2 ♂♂ (+ 1 ♀?). Hedmark (HES): Grue: Pond near Øgarden, Kirkenær (EIS:47) 12 June 1989 3—4 ♂♂. Sør-Odal: Tarn/pond near Berger (EIS:37) 14 June 1989 >1 ♂. Aust-Agder (AAY): Øyestad (= Arendal): Solevatn (= Lindåstjern) (EIS:6) 27 June 1984 >25 ind.; 7 July 1988 3—4 ♂♂ + 1 pair; 5 June 1990 a few ind.; 7 July 1990 numerous. Skoletjern (= Haugåsdalstjern) (EIS:6) 27 June 1984 5—10 ind.; 6 June 1990 a few ind. Seljåstjern (EIS:6) 6 June 1990 several. Bog tarn SSW of Sagvatn (EIS:6) 5 June 1990 several. Bergtjern (EIS:6) 1930—50 (GK). Tvedestrand: Størdalsvatn (EIS:10) 9 June 1990 a few. Fidjevatn (EIS:11) 3 June 1990 1 ♂. *L. pectoralis* is new to Akershus (AK), Østfold (Ø), EIS:6, 21, 28, 29, 37, and 47.

This is mainly an eastern species with only small Central European local populations left (Askew 1988). Its European status is vulnerable (Tol & Verdonk 1988), and it is the third (all *Leucorrhinia's*) Norwegian species on the Berne Convention, appendix II. The species seems to prefer fairly eutrophic or also dystrophic ponds and tarns with dense cover of e.g. *Potamogeton natans.*

This species was previously only recorded at a few localities in a small area on the southern coast of Norway. Recent investigations have shown that it has a wider distribution, but usually not abundant, in southeastern Norway. The generally small populations are the main reason why this species should be regarded as vulnerable (IUCN:V).

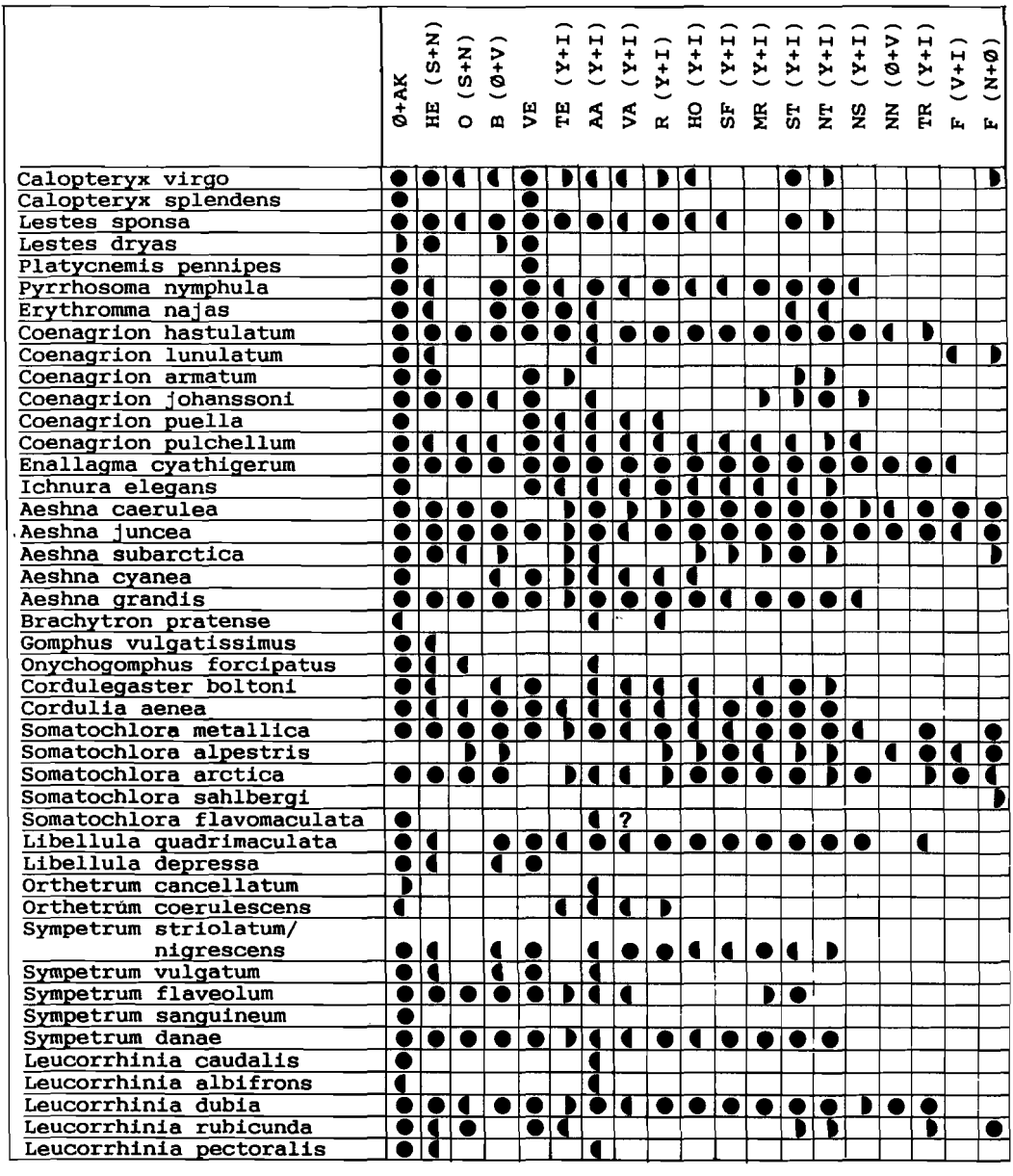
THE ODONATA FAUNA OF NORWAY

Table 1 shows the known distribution of all Norwegian Odonata, according to regions (see also Fig. 3). Also unpublished records of more common species, made by several collectors, are included.

THREATS TO NORWEGIAN DRAGONFLIES

Dragonflies are to a great extent large insects, beautifully coloured, and relatively easy to identify. They have therefore for many years been the subject of faunistical and ecological

Table 1. The distribution of Norwegian Odonata, according to regions (cf. Fig. 3; cf. K. A. Økland 1981).



studies. Since the many species have very often different habitat preferences, and tolerances, the occurrence of different dragonflies may act as «habitat indicators» (cf. Carle 1979, Watson et al. 1982, New 1984). There has been a serious decline in the Odonata fauna of Europe during the last decades, however, mainly due to habitat loss/destruction (Tol & Verdonk 1988).

Some species dealt with here are not «rare» in Europe, and some, like *Libellula depressa* and *Orthetrum cancellatum,* are even wide-

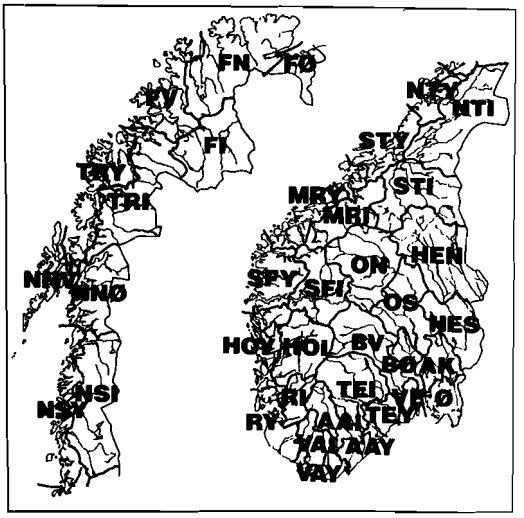


Fig. 3. The position of the different Norwegian regions in Table 1 (cf. K. A. Økland 1991).

spread and eurytopic. Within our country, however, all species mentioned here have at least one of the criteria of Rabinowitz' «seven forms of rarity» (see e.g. Rabinowitz, Cairns & Dillon 1986): i.e. a narrow geographic distribution. It is the authors' opinion that they, because they are endangered or vulnerable in Norway, should be considered for protection on a national level. Every species has a value in itself, and so has the biological diversity of any area. Besides, northern populations may differ genetically from more southern ones, and therefore be especially interesting. Most of the species, however, are also threatened on the Continent, first of all the three *Leucorrhinia* species which are on the Berne convention. With respect to these we have a clear international responsibility to protect them.

The kind of biotope which is probably most rapidly being destroyed in Norway, is small, more or less eutrophic, water bodies, like cattle-ponds etc. in the culture landscape (Dolmen 1992), but also ponds and tarns in forest- and bog areas. Also lowering of the water-table along meandering streams, by channelling, has dried-out many valuable oxbow-lakes, which are usually excellent Odonata sites (Dolmen & Strand 1991).

The legislation concerning small water bodies in both suburban areas and in the country-side (i.e. «Brønnloven av 1957») dictates that all ponds should be fenced-in or filled-in. The latter alternative has usually been chosen, especially when most farms were connected to the municipal water network. This degrading of «the pond» as a valuable biotope for animal life and as an aesthetic landscape element etc. has probably caused a marked decline in Norway of e.g. the pond-favouring dragonfly *Libellula depressea* in this century. The species is still present in the Oslofjord district, however, as seen from this study. It is of great importance, not only for *L. depressa,* but for other dragonfly species and freshwater fauna as well, that ponds in the countryside should now be taken care of/managed, and that new ones should be made. Since dragonflies are very rapid colonists, the creation of new ponds may prove to be successful for the conservation of some species. Many examples of such management in Britain are referred to by Usher & Jefferson (1991).

Also «modern» forestry practices with draining of bog ponds and tarns has often destroyed the habitats of rare or threatened dragonflies. This threat first of all may apply to the forest- and bog tarn species like *Coenagrion lunulatum, Leucorrhinia caudalis,* and *L. albifrons,* probably also *L. pectoralis* and *Orthetrum coerulescens.* Dolmen (1990b) has given advice on how to avoid destroying valuable biotopes for herptiles in connection with forestry; this may also serve as guide-lines in dragonfly management. A more scientific and general approach for dragonfly or insect conservation, especially with respect to the importance of habitat managements, has been given by e.g. New (1984), Soulé (1986), Tol & Verdonk (1988), and Collins & Thomas (1991).

Another threat in Norway is heavy eutrophication/saprobiation, which may concern most of the species. Some, like *Coenagrion armatum,* may profit for a while on the enrichment of lowland lakes, since it usually prefers fairly eutrophic localities, but in the long run the living conditions of even this species may be damaged. The effect of eutrophication, acid precipitation, and liming of acid waters on the dragonfly fauna is now being studied.

The greatest hazard, however, is probably experienced by those species living in running water in the south-eastern lowland, like *Calopteryx splendens, Platycnemis pennipes, Gomphus vulgatissimus* and *Onychogomphus forcipatus.* This is also the area where most

people live, and such rivers, acting as resipients, are therefore very easily eutrophicated by agricultural fertilizers and sewage, and polluted by pesticides and industry effluents. It is probably no coincidence that it is the running water species *G. vulgatissimus* that shows the most serious decline of the Norwegian species. More effective means of keeping pollutants from being drained or washed into the river, together with less use of fertilizers and pesticides in agriculture and less intensive use of the river-neighbouring land areas, may probably reverse this growing problem.

ACKNOWLEDGEMENTS

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SAMMENDRAG

Utbredelse, habitat og vernestatus for truete øyenstikkerarter i Norge

Artikkelen beskriver utbredelse og habitat for de 18 øyenstikkerartene som enten reknes som truete, sårbare eller utdødde i Norge. Med utgangspunkt i gamle funn av sjeldne arter ble det i perioden 1973—91 foretatt spesielle undersøkelser for å kontrollere artenes fortsatte eksistens på stedene, og også om mulig å finne nye lokaliteter for dem. Nye funn er angitt for *Calopteryx splendens, Lestes dryas, Platycnemis pennipes, Coenagrion armatum, C. lunulatum, Gomphus vulgatissimus, Onychogomphus forcipatus, Brachytron pratense, Somatochlora sahlbergi, S. flavomaculata, Libellula depressa, Orthetrum coerulescens, Sympetrum vulgatum, S. sanguineum, Leucorrhinia caudalis, L. albifrons,* and *L. pectoralis.* Én art, *Orthetrum cancelletum,* reknes som utdødd i Norge. Utbredelsen av samtlige 44 norske arter er dessuten presentert i tabellform. Undersøkelsen har resultert i en langt bedre forståelse for artenes utbredelse og reelle vernestatus her i landet. For noen arter er det påvist en betydelig nedgang, f.eks. for *Gomphus vulgatissimus.* Truslene for de sjeldne øyenstikkerartene i Norge er habitatødeleggelser, f.eks. gjenfylling/drenering av dammer og myrområder og, kanskje viktigst: forurensning av rennende vann.

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Received 3 Febr. 1992.

Short communications

GRAPHODERUS BILINEATUS (DEGEER, 1774) (COL., DYTISCIDAE), NEW TO NORWAY

HANS OLSVIK

Graphoderus bilineatus (DeGeer, 1774) is reported new to Norway. A female was found in the oligotrophic lake Frysjøen, Grue in Hedmark, southeastern Norway, on June 12th 1989.

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A female of *Graphoderus bilineatus* (DeGeer, 1774) was found in the north end of Frysjøen in Grue, Hedmark (HES, EIS: 47, UTM 33V UH 443 052, 205 m altitude), on June 12 1989. Frysjøen is situated ca. 20 km from the border to Sweden, and its size is about 5 x 1.6 km (at the broadest). It is an oligotrophic lake with a rather poor beach vegetation, which at the finding locality mainly consists of *Carex rostrata* and some water lilies (Nymphaea). The bottom slopes gradually, and the substrate consists of sand, gravel and stones, covered with some mud in less exposed places. The surrounding forest is dominated by spruce (*Picea abies),* pine (*Pinus sylvestris)* and birch (*Betula* spp.).

G. bilineatus is easily recognized by the broad and flattened shape of the body. Its shape is therefore more similar to *Acilius* than to other Norwegian *Graphoderus* species.

In Sweden *G. bilineatus* is distributed in southern and central parts of the country, north to Dalarne and Hälsingland (Lindroth 1960, Lundberg 1986), and thus a record in the eastern parts of southeastern Norway was to be expected.

Exonomic support to the investigation in Hedmark in 1989 was given by the County Governor's Environmental Protection Department, Fylkesmannen i Hedmark.

SAMMENDRAG

Graphoderus bilineatus (DeGeer, 1774) er funnet ny for Norge i Frysjøen, Grue i Hedmark. En hunn ble fanget 12. juni 1989.

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SOMATOCHLORA SAHLBERGI TRYBOM, 1889 (ODONATA: CORDULIIDAE) — A NEW SPECIES TO NORWAY

HENNING PEDERSEN

Males of *Somatochlora sahlbergi* Trybom, 1889 was observed near Bugøynes, Sør-Varanger on 7 July 1990. This is the first record of *S. sahlbergi* in Norway.

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Received 12 Dec. 1991.

Coleoptera from six small islands in the middle Oslofjord, SE Norway

LARS OVE HANSEN & SINDRE LIGAARD

Hansen, L. O. & Ligaard, S. 1992. Coleoptera from six small islands in the middle Oslofjord, SE Norway. *Fauna norv. Ser. B. 39:* 23—31.

A list of 119 species of Coleoptera, mainly found in pit fall traps on six islands in the middle Oslofjord, is presented. 22 species are previously not recorded from eastern Buskerud, while 30 species are «new» to Vestfold. Two species, *Aphthona pallida* Bach, 1856 and *Atheta aquatica* L. (Thomson, 1852), are not previously recorded from Norway.

Tofteholmen, Ramvikholmen and Mølen are situated in eastern Buskerud, while Langøya, Killingholmen and Kommersøya are situated in Vestfold. All islands, except Mølen, are of Silurian origin. The fauna on these islands is from a national point of view particular, and includes a comparatively high number of rare and possibly threatened Coleoptera species. Several European species have their northwestern limits of distribution in this south-eastern area of Norway. The unique habitats on the islands are vulnerable and easily destroyed, and the need for conservation is urgent, even though nature reserves are established in the area.

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INTRODUCTION

Earlier studies have demonstrated that the Oslofjord region has probably the highest concentration of insect species in Norway, including a high number of rare and possibly threatened species (see Andersen & Fjeldså 1984, Aagaard & Hågvar 1987, Andersen & Søli 1989). Several habitats, which are becoming rare on the mainland, are still present on islands in the Oslofjord and many rare and vulnerable species are in Norway only found here (Aarvik & Midtgaard 1986, Andersen & Hansen 1990).

Until recently several of these islands have been spared from severe human impact, but during the last two decades the pressure on these unique island habitats has increased considerably. Large areas are now used for shore residences, camping-grounds etc., resulting in changes in, and destruction of the natural vegetation.

This study focuses on the Coleoptera fauna on the six small Oslofjord-islands: Tofteholmen, Ramvikholmen and Mølen in eastern Buskerud (BØ), and Langøya, Killingholmen and Kommersøya in Vestfold (VE), Tofteholmen was probably known among entomologists as a good locality for collecting Coleoptera already during the last century, and records done by J. F. Berg are known from that period (Kvamme & Hågvar 1985). Later the island has been frequently visited by T. Münster, H. K. Hansen and others in the beginning of this century. Earlier records of Coleoptera from Tofteholmen and Langøya are given by Born (1926), Münster (1921, 1922, 1923, 1927—28, 1932, 1933) and Strand (1935, 1937, 1954, 1955). However, no records from the other islands seems to have been published.

STUDY AREA

All the islands are situated in the middle Oslofjord (59° 30'N) (figure 1). The EIS-grid numbers and faunistical regions are in accordance to J. Økland (1977) and K. A. Økland (1981), and botanical names are according to Lid (1985).

Tofteholmen	BØ	Hurum:	EIS 19	UTM 32VNL8898
Ramvikholmen	BØ	Hurum:	EIS 19	UTM 32VNL8799
Mølen	BØ	Hurum:	EIS 19	UTM 32VNL8595
Langøya	VE	Våle	EIS 19	UTM 32VNL7896
Killingholmen	VE	Sande:	EIS 19	UTM 32VNL7599
Kommersøya	VE	Sande:	EIS 19,28	UTM 32VNL7499

The northern part of Kommersøya lies within EIS-grid no. 28, but this study includes only EIS-grid no. 19.

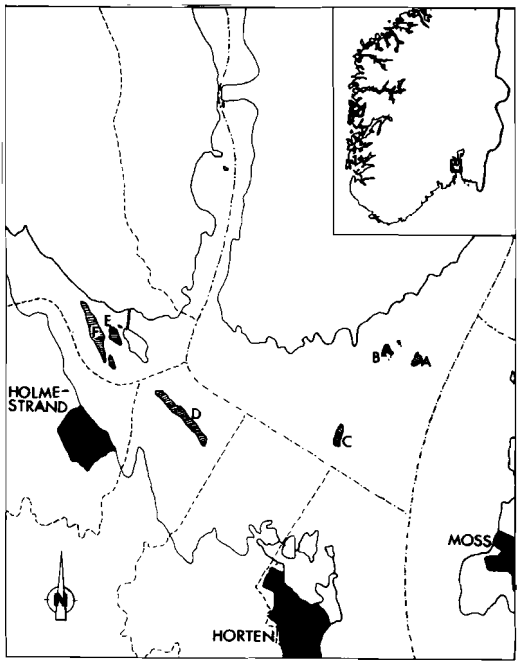

Figure 1. The Oslofjord area, SE Norway, with the six islands: A: Tofteholmen, B: Ramvikholmen, C: Mølen, D:Langøya, E: Killingholmen and F: Kommersøya. Scale 1: 150 000.

Tofteholmen covers an area of 0.11 km². The distance to the mainland is approximately 2 km, and it is about 1 km to the nearest island. The rocks are Cambro-Silurian sediments and Permian eruptives (Brøgger 1929). The flora is very rich (Dyring 1921, Lid 1929). In the dry calcareous meadows along the shores, herbs like *Geranium sanguineum, Galium* spp., *Sedum* spp. and *Origanum vulgare* are abundant. The scrub-vegetation is dominated by *Juniperus communis, Rosa* spp., *Rubus* spp., *Prunus* spp., *Cotoneaster* spp. and *Crataegus* spp. The interior of the island is covered with old spruce forest (*Picea abies)* mixed with deciduous trees, particularly lime (*Tilia cordata*).

Because of the rocky ground, sometimes combined with high wind exposure, taller spruces may die in dry summers. This gives the island a remarkable character, with many standing and fallen dead trees. The island has been protected as nature reserve since 1919 (for details see Hansen 1989).

Ramvikholmen covers about 0.10 km² and the distance to the mainland is about 1.25 km. The geological origin and the vegetation are rather similar to Tofteholmen, but Ramvikholmen is more disturbed by human activity. Mistletoe (*Viscum album)* is found on both of the islands, but seems to be more abundant on Ramvikholmen. For details concerning the flora, see Dyring (1921). The island is protected as nature reserve, but the regulation dates back to 1936 and needs revision (Hansen 1989).

Mølen covers about 0.25 km², and the distance to the mainland is approximately 3.5 km. The rocks are of Pre-Cambrian origin (Gleditsch 1948), but the rich sea-shell mixed substrata give rise to a very interesting flora, with a rich scrub and herb vegetation (Dyring 1921, Hagen 1950). Many of the same plant species occuring on Tofteholmen and Ramvikholmen are represented here. The interior of the island is covered with an old and dense lime forest mixed with elm (*Ulmus glabra).* Most of the older limes are heavily attacked by mistletoe. *Prunus spinosa* and *Rhamnus cathartica* form several meter tall trees with well developed trunks. The island has been protected as nature reserve since 1977 (Hansen 1989).

Langøya is situated about 2 km from the mainland. The island is about 3.2 km long and covers about 1 km². The origin is Silurian limestone with a high fossil content. Limestone has been quarried on the island for more than 90 years, resulting in two big quarries covering about 60% of the total area of the island. Very little of the original forest is left. The northern part of the island is covered with birch (*Betula verrucosa),* mixed with other deciduous trees. Here is also small basiphilous pine forests, where orchids (e.g. *Ophrys insectifers* and *Epipactis atrorubens)* are common.

Most of the western shore is covered with heaps of crushed limestone from the quarries. Calcareous meadows with larger populations of herbs (e.g. *Artemisia campestris, A. absinthium, Inula salisina, Melilotus* spp., *Centaureae* spp., *Carlina vulgaris, Origanum vulgare* and *Geranium sanguineum)* have been established here. The scrub-vegetation is rather similar to that of Tofteholmen.

The northern part of the island, a small part in the south and the east shore are now pro-

tected as nature reserve (Miljøverndepartementet 1985, Fylkesmannen i Vestfold, Miljøvernavd. 1989).

Killingholmen and **Kommersøya** are both of Silurian origin and consist of limestone with slate layers; parts of Kommersøya consist of marble. Kommersøya covers about 0.7 km^2, and the highest point about 60 m.a.s.l. Killingholmen covers about 0.1 km^2, and has a large number of cabins. Both islands have dry calcareous meadows with remnants of basiphilous pine forest. Kommersøya has some old and dense deciduous and coniferous forest, many places with decaying tree trunks. Even though marble has been quarried and logging has occured at Kommersøya, most of the island is still quite undisturbed by man. Two small areas on each island are now protected as nature reserves (Miljøverndepartementet 1985, Hansen 1989).

METHODS

Collecting was done during the years 1984 to 1990, with the most intensive sampling period in 1987. This year fifteen pit-fall traps were placed on each island from primo June to medio November. Five traps on each island were supplied with bait (meat, fish etc.). The traps were placed in a gradient from forest, through meadow into the littoral zone; a few traps were placed in fallen decayed treetrunks.

In addition, some specimens were collected by sweep net, random hand picking or in light-traps. On Langøya a light trap fitted with a 700 W mercury vapour bulb (HQL) was run continuously for approximately 150 nights, from early June to mid November 1987. On the other islands light traps were used during shorter periods.

SYSTEMATIC LIST WITH DISTRIBUTIONAL NOTES

The list below comprises records done by Hansen (1989), together with several additional records. However, records of species considered common are not included in the list. Unless nothing else is stated, the specimens are collected in pit-fall traps in 1987. Those marked with an asterisk (*) indicate new regional records. The nomenclature is in accordance to Lundberg (1986), while distributional notes are according to Lindroth (1960) unless otherwise is stated.

Carabidae

Trechus micros (Herbst, 1787); 1 ex. June Langøya.

**Stomis pumicatus* (Panzer, 1796); 1 ex. June and 1 ex. Sept.—Oct. Langøya. Considered rare; in Norway only recorded from AK.

Amara convexior Stephens, 1828; 2 ex. July Mølen, random picking.

**A. praetermissa* (Sahlberg, 1827); a few ex. Kommersøya, Killingholmen and Langøya.

**A. equestris* (Duftschmid, 1812); 5 ex. Aug.—Sept. Langøya. Considered rare; several southern Norwegian records exist. An unpublished record exist from VE (S.O. Hansen pers. com.).

**Harpalus rubripes* (Duftschmid, 1812); a few ex. Langøya, random picking. Not rare.

Stenolophus mixtus (Herbst, 1784); 1 ex. June Langøya. An expanding species in Norway (Kvamme 1978); not rare in the Oslofjord area.

Acupalpus flavicollis (Sturm, 1825); 1 ex. June Langøya.

A. parvulus (Sturm, 1825); 1 ex. Killingholmen.

Georissidae

**Georyssus crenulatus* (Rossi, 1794); 3 ex. Aug. Killingholmen and Langøya. Previously recorded from Ø, AK and AAY.

Ptilidae

**Acrotrichis cognata* (Matthews, 1877); 3 ex. Aug. Killingholmen. Not rare.

A. atomaria (Degeer, 1774); 1 ex. Langøya.

Leiodidae

**Leiodes oblonga* (Erichson, 1845); 3 ex. Aug.—Oct. Langøya. Previously recorded from BØ, RI, SFY.

L. polita (Marsham, 1802) [syn.: *L. calcarata* Erichson, 1845]; 1 ex. Ramvikholmen.

**L. badia* (Sturm, 1807); 5 ex. Aug.—Oct. Langøya and Kommersøya. Previously only recorded from AK and BØ.

Agathidium nigrinum Sturm, 1807; 3 ex. Tofteholmen and Mølen.

Silphidae

Nicrophorus humator (Gledisch, 1776); 1 ex. Sept.—Oct. Mølen.
Necrodes litoralis L., 1758); 1 ex. Langøya.

Catopidae

Catops nigriclavis Gerhardt, 1900; 1 ex. Langøya.
C. westi (Krogerus, 1931); 5 ex. Killingholmen.

Colonidae

**Colon latum* Kraatz, 1850; 3 ex. Sept.—Oct. Tofteholmen and Killingholmen. Not rare.
**C. brunneum* (Latreille, 1807); 2 ex. Aug. Killingholmen. Previously recorded from AK, HEN, ON, OS and BØ.

Scaphididae

**Scaphisoma boleti* (Panzer, 1793); 1 ex. Aug. Tofteholmen. Previously recorded from AK, HES, VE and northern Norway.

Staphylinidae

Philonthus rectangulus Sharp, 1874; 2 ex. Killingholmen.
**Ocypus ater* (Gravenhorst, 1802); a few ex. June Langøya. Previously recorded from BØ, TEY, AAY and RY.
**Quedius cruentus* (Olivier, 1795); 1 ex. July Langøya. Previously recorded from Ø, AK and OS.
Q. scitus (Gravenhorst, 1806); 1 ex. Tofteholmen, 1 ex. Ramvikholmen and 1 ex. Mølen, Sept.—Oct.
Xantholinus laevigatus Jacobsen, 1847 [syn: *clairei* Coiffait, 1956]; 2 ex. Kommersøya.
**Rugilus similis* (Erichson, 1839); 1 ex. June Langøya. Previously recorded from Ø, AK, HES, BØ and TEY.
**Lathrobium pallidum* Nordmann, 1837; 2 ex. June Langøya. Considered very rare; previously only recorded from AK.
Omalium rugatum Mulsant & Rey, 1880; 5 ex. Tofteholmen, Mølen, Langøya and Killingholmen.
**Anthobium unicolor* (Marsham, 1802); several ex. Mølen, Langøya, Killingholmen and Kommersøya. New to VE; not rare in Norway.
Acidota cruentata (Mannerheim, 1830); a few ex. Tofteholmen, Ramvikholmen, Mølen, Langøya and Killingholmen.
Syntomium aeneum (Müller, 1821); 1 ex. Langøya.
Mycetoporus clavicornis (Stephens, 1832); 1 ex. Aug. Killingholmen.
**M. longicornis* Mäklin, 1847; 5 ex. Aug.—Oct. Kommersøya. Not rare in Norway.
Tachinus pallipes Gravenhorst, 1806; 2 ex. Mølen.
Aleochara sanguinea (L., 1758); 1 ex. Langøya.
**A. spadicea* (Erichson, 1837); 2 ex. Sept.—Oct. Mølen. Previously recorded from AK, VE and TEY.
Oxypoda longipes Mulsant & Rey, 1861; 3 ex. Tofteholmen and Langøya.
**O. spectabilis* Märkel, 1842; A few ex. Sept.—Oct. Tofteholmen and Killingholmen.
**Parocyusa rubicunda* (Erichson, 1837); 1 ex. Aug. Langøya. Considered quite rare.
Ocalea picata (Stephens, 1832); 1 ex. Killingholmen.
Ilyobates subopacus Palm, 1935; 2 ex. Langøya.
**Liogluta pagana* (Erichson, 1839); 1 ex. Aug.—Oct. Mølen, 2 ex. Aug.—Oct. Killingholmen. Considered very rare in Norway; previously only recorded from HOY.
**L. granigera* (Kiesenwetter, 1850); 5 ex. Mølen, Killingholmen and Kommersøya. Not rare.
**Dimetrota hansseni* (Strand, 1943); 1 ex. June Mølen. Very rare; previously only recorded from AK.
**Atheta parapicipennis* Brundin, 1954; 2 ex. Sept.—Oct. Ramvikholmen.
**A. ebenina* (Mulsant & Rey, 1874); 1 ex. July—Aug. Kommersøya. Very rare, previously recorded from AK, HOI and northern Norway.
**A. aquatica* (Thomson, 1852); 1 ex. Sept.—Oct. Killingholmen. Not previously recorded from Norway.
A. fungicola (Thomson, 1852); a few ex. Tofteholmen.
**A. brunnea* (Fabricius, 1798); 1 ex. June Langøya. Considered rare; previously recorded from Ø, AK, BØ and TEI.
Lomechusa emarginata (Paykull, 1789); 2 ex. Langøya.
**Gyrophaena joyi* Wendeler, 1924; 1 ex. Sept.—Oct. Mølen, random picking. Previously recorded from AK, HES, ON, VE and northern Norway.

Helodidae

**Cyphon ochraceus* Stephens, 1830; A few ex. Ramvikholmen and Mølen, random picking and sweep net. Not rare.

Lucanidae

Sinodendron cylindricum (L., 1758); 1 ex. Langøya, sweep neet May 1988.

Lampyridae

Lampyris noctiluca (L., 1758); 1 ex. Tofteholmen and 2 ex. Langøya.

Drilidae

**Drilus concolor* Ahrens, 1812; 1 ex. June Langøya, sweep net. Very rare; in Norway only recorded from AK.

Elateridae

Ectinus aterrimus (L., 1761); 2 ex. Mølen.

Eucnemidae

Xylophilus corticalis (Paykull, 1800); 4 ex. July Kommersøya Several records from southern Norway.

Throscidae

Trixagus carinifrons (Bonvoluloir, 1859); 3 ex. Langøya.

Buprestidae

Anthaxia similis Saunders, 1871 [syn.: *morio* auct. nec. Fabricius, 1792]; 3 ex. Mølen.

Trachys geranii Silfverberg, 1977; 4 ex. July Tofteholmen, sweep net.

Dermestidae

Anthrenus scrophulariae (L., 1758); 5 ex. Killingholmen.

Anobiidae

**Hedobia imperialis* (L., 1767); 1 ex. June Mølen, at light.

**Grynobius planus* (Fabricius, 1787); 1 ex. June Langøya, at light. First record from the Oslofjord area. Several coastal records from TEY to MRY and one unpublished recorded from VE (S. O. Hansen pers. com.).

Anobium nitidum Fabricius, 1792; 1 ex. Mølen.

Xyletinus ater (Creutzer, 1796); 1 ex. June Langøya.

Dorcatoma dresdensis Herbst, 1792; 1 ex. Langøya.

Ptinidae

Ptinus rufipes Olivier, 1790; 2 ex. Tofteholmen.

Melyridae

Dolichosoma lineare (Rossi, 1790); 10 ex. July Langøya.

Nitidulidae

**Laria dulcamarae* Scopoli, 1763; 2 ex. July Tofteholmen, sweep net. Previously recorded from Ø, AK, VE and TEY.

Meligethes subaeneus Sturm, 1845; 1 ex. Ramvikholmen.

**M. bidens* B. de Barneville, 1863; 1 ex. May 1988 Langøya, sweep net. Considered rare; in Norway only recorded from AK.

M. ochropus Sturm, 1845; 1 ex. May 1990 Kommersøya, sweep net.

Epuraea melanocephala (Marsham, 1802); 2 ex. Mølen.

Sphindidae

Sphindus dubius (Gyllenhal, 1813); 1 ex. Langøya.

Rhizophagidae

**Rhizophagus cribratus* Gyllenhal, 1827; 2 ex. Aug.—Oct. Mølen. Rare; recorded from AK, OS, TEI, MRI and northern Norway.

Cryptophagidae

**Telmatophilus typhae* (Fallen, 1802); A few ex. July Langøya. Previously recorded from Ø, AK and AAY.

Cryptophagus fallax Balfour-Browne, 1953; 1 ex. Mølen.

C. dentatus Herbst, 1793); 2 ex. Tofteholmen.

Atomaria turgida Erichson, 1846; 2 ex. Killingholmen.

**A. diluta* Erichson, 1846; 2 ex. Sept.—Oct. Mølen. Rare; previously recorded from AK, TEY and HOY.

**A. nigriventris* Stephens, 1830; 2 ex. Langøya, sweep net. Previously recorded from Ø, AK, HES, ON, BØ and AAY.

A. bella Reitter, 1875; 1 ex. Tofteholmen.

Latridiidae

Dienerella elongata (Curtis, 1830); 2 ex. Killingholmen.
**D. separanda* (Reitter, 1887); 1 ex. June Mølen. Rare; previously recorded from AK and TEY.

Oedemeridae

**Nacerdes melanura* (L., 1758); 1 ex. July Mølen. Not rare.
Oedemera flavipes (Fabricius, 1792); 3 ex. Langøya.

Aderidae

**Euglenes pygmaeus* (Degeer, 1774); 1 ex. July Langøya, at light. Previously recorded from AK, BØ and AAY.

Tenebrionidae

Prionychus ater (Fabricius, 1775); 1 ex. July Mølen.
Pseudocistela ceramboides (L., 1758); 2 ex. Mølen.
Isomira murina L., 1758); several ex. July Tofteholmen and Killingholmen.

Mordellidae

**Curtimorda maculosa* (Naezen, 1794); 1 ex. June Langøya, random picking.
Mordellochroa abdominalis (Fabricius, 1774); 2 ex. July Langøya.

Melandryidae

Hallomenus binotatus (Quensel, 1790); 2 ex. Langøya and Kommersøya.
Serropalpus barbatus (Schaller, 1783); 1 ex. Ramvikholmen.

Cerambycidae

**Oplosia fennica* (Paykull, 1800); 8 ex. July Mølen, at light. Considered very rare; previously recorded from Ø, AK, VE and AAY.
**Exocentrus lusitanus* (L., 1767); 1 ex. July 1989 Mølen, sweep net.
Tetrops praeusta (L. 1758); 1 ex. Langøya.

Chrysomelidae

Cryptocephalus fulvus Goeze, 1877; a few ex. Tofteholmen, Mølen and Langøya.
Phyllotreta atra (Fabricius, 1775); 5 ex. May 1990 Langøya.
**Aphthona pallida* Bach, 1856; 5 ex. July Langøya, sweep net. Previously not recorded from Norway.
**Longitarsus exoletus* (L., 1758); 2 ex. July Langøya, sweep net. Previously only recorded from AK, BØ and VE.

Anthribidae

Dissoleucas niveirostris (Fabricius, 1798); 1 ex. Langøya.
**Platystomos albinus* (L., 1758); 1 ex. Langøya, random picking.
Anthribus nebulosus Forster, 1771; 1 ex. May 1990 Langøya.
Choragus horni Wolfrum, 1930; 1 ex. Sept.—Oct. Mølen. Very rare. Previously only recorded from MRY Sunndalen: Considered very rare.

Apionidae

**Apion onopordi* Kirby, 1808; 2 ex. June Langøya, sweep net. Previously only recorded from Ø, AK and TEY.

Curculionidae

Trachyphloeus aristatus (Gyllenhal, 1827); 2 ex. Langøya.
**Limnobius borealis* (Paykull, 1792); several ex. July Mølen and Langøya, sweep net. Previously recorded from Ø, AK, AAY and northern Norway.
Dorytomus taeniatus (Fabricius, 1781); 1 ex. Langøya.
Cionus hortulanus (Fourcroy, 1785); 10 ex. Mølen.
Cleopus pulchellus (Herbst, 1795); 5 ex. Tofteholmen, Mølen, Langøya and Killingholmen.
Brachonyx pineti (Paykull, 1792); 2 ex. Mølen.
**Rhyncolus elongatus* (Gyllenhal, 1827); 1 ex. June Tofteholmen and 1 ex. June Mølen, sweep net. Rare, but perhaps overlooked. Previously recorded from Ø, TEY and SFI.
Trachodes hispidus (L., 1758); Ramvikholmen and Mølen.
Pissodes validirostris (Sahlberg, 1834); 3 ex. July Mølen.
Trichosiroculus troglodytes (Fabricius, 1787); Mølen.

DISCUSSION

The present list includes 119 species, where a majority are considered rare. Two of the species are new to Norway, and 52 represents new regional reocrds: 22 from eastern Buskerud (BØ) and 30 from Vestfold (VE). Three species are recorded new to both regions.

When accounting for this apparently unique Coleoptera fauna, three factors have to be stressed:

— they are situated in a climatically favourable area
— five of the islands have calcareous ground
— the islands are still quite undisturbed by human activities.

Dead or decaying wood is abundant and several of the rare species are either directly or indirectly dependent on this habitat (e.g. *Scaphisoma boleti, Quedius cruentus, Q. scitus, Gyrophaena joyi, Xylophilus corticalis, Hedobia imperialis, Grynobius planus, Rhizophagus cribratus, Euglenes pygmaeus, Oplosia fennica, Exocentrus lusitanus, Choragus horni* and *Rhyncolus elongatus* (Palm 1959)). *Biphyllus lunatus* (Biphyllidae), recorded by J. F. Berg in last century (Kvamme & Hågvar 1985), may also be included in this category.

The dry and herb-rich meadows, in particular the calcareous ones, are also an important habitat type (Dyring 1921, Hagen 1950), and species like *Amara equestris, Harpalus rubripes, Oxypus ater, Trachys geranii, Dolichosoma lineare, Meligethes bidens, Mordellochroa abdominalis, Aphthona pallida, Longitarsus exoletus, Apion onopordi, Limnobius borealis* and *Cionus hortulans* were found here.

Several of the recorded species have a southerly or southeasterly distribution and may have their northernmost limits in the Oslofjord area (e.g. *Acupalpus flavicollis, Leiodes badia, Rugilus similis, Lathrobium pallidum, Aleochara spadicea, Dimetrota hansseni, Atheta aquatica, A. brunnea, Drilus concolor, Anthaxia similis, Hedobia imperialis, Laria dulcamarae, Meligethes bidens, Atomaria diluta, Dienerella elongata, Oplosia fennica, Aphtona pallida, Longitarsus exoletus, Apion onopordi* and *Cleopus pulchellus* (Lindroth 1960, Lundberg 1986)).

Even some of the recorded species have a restricted distribution in northern Europe. *Lathrobium pallidum* is considered very rare in northern Europe (Ottesen, 1982) and has only been found a few times in Denmark and southern Sweden, but no records exist from Finland nor the Baltics (Lundberg, 1986). The species seems to inhabit subterranean galleries of some rodents like *Agricola terrestris* (L.). *Dimetrota hansseni* is another very rare staphylinid beetle. It is previously only recorded from the type locality in Norway, together with some records from southern Sweden, Germany and the Alps (Lundberg 1986, Benick & Lohse 1974). *Atheta aquatica* is not previously recorded from Norway. It is considered very rare in Sweden, Denmark and Finland (Lundberg 1986), but more widespread further south (Benick & Lohse 1974).

The snail predator *Drilus conculor* is considered very rare and has a very restricted distribution with few records from northern Europe. *Aphthona pallida* is previously not recorded from Norway; it is found in the Baltics (Lundberg 1986), Polen and Germany (Freude et al. 1966). The norwegian population is perhaps relict because the species is not encountered elsewhere in the nordic countries (Hansen & Ligaard 1991). *Choragus horni* is previously only recorded once in Norway (Hanssen in press). It is considered very rare in northern Europe and recorded sparsely from Sweden and Denmark; but not Finland (Lundberg 1986).

Even though parts of the islands are protected as nature reserves, uniqe habitats are obviously still threatened. The increasing human impact is a severe threat. It is uncertain whether these unique habitats will survive in the future, so the need for further conservation is urgent.

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SAMMENDRAG

Biller fra seks små øyer i midtre Oslofjord

Totalt 119 billearter, vesentlig fra fallfeller, omtales. 22 arter er tidligere ikke registrert fra Buskerud, mens 30 arter er «nye» for Vestfold. To arter, *Aphthona pallida* Bach, 1856 og *Atheta aquatica* (Thomson, 1852) er nye for Norge. Tofteholmen, Ramvikholmen og Mølen ligger i Buskerud, mens Langøya, Killingholmen og Kommersøya tilhører Vestfold. Faunaen på disse øyene er fra et nasjonalt synspunkt interessant, og inneholder forholdsvis mange sjeldne og sannsynligvis truete billearter. Mange europeiske arter har deres nordvestre utbredelsesgrense i dette sydøstre området av Norge. De unike habitater som disse øyene har er sårbare og lett å ødelegge, derfor haster det med ytterligere vern, selv om naturreservater er opprettet i området.

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New records of Carabidae and Staphylinidae (Col.) from several districts in southern and central Norway

ARILD ANDERSEN, SINDRE LIGAARD, FRODE ØDEGAARD AND ODDVAR HANSSEN

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One-hundred-twenty (120) new records of seven (7) carabid and eighty (80) staphylinid species are given. The material was collected in pitfall traps in agricultural fields, mainly in the counties of Aust-Agder, Sogn og Fjordane and Møre og Romsdal. Several of the finds indicate that the staphylinid fauna of these districts is especially poorly known.

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INTRODUCTION

Research projects on the role of polyphagous predators in agricultural fields gave some new records of carabids and many few records of staphylinids. The material was collected iin pitfall traps, filled with water or formalin, in agricultural fields in 1985—1989. Most of the fieldwork was done by supervisors of local agricultural expermental groups. The species are arranged alphabetically within the two families, and the nomenclature follows Silfverberg (1979) with later corrections by Biström and Silfverberg (1983, 1985, 1988). Unless otherwise indicated, the catch from each locality is one specimen. Most of the material is stored at the Norwegian Plant Protection Institute, N-1432 Ås-NLH, Norway. The investigations were partially funded by the Agricultural Research Council of Norway.

RESULTS

Carabidae

Agonum assimile (Paykull). MRI, Sunndal: Hoel (EIS:78) 4 July 1988.
Amara ovata (Fabricius). AAY, Øyestad; Løddesøl (EIS:6) 6 June 1988, MRY, Molde: Årø (EIS:84) 25 July 1986, SFI, Lærdal: Ljøsne (EIS:51) 4 specimens June—July 1985—1989, and SFI, Lærdal: Hauge (EIS:51) 4 specimens June—Sept. 1985—1989.
Asaphidion flavipes (L.). TEI, Bø: Gvarv (EIS:18) 24 June 1988.
Bembidion tetracolum Say. MRY, Molde: Årø (EIS:84) 4 specimens Oct. 1986—87, and MRY, Molde: Fuglset (EIS: 84) 24 July 1986.
Trechus discus (Fabricius). TEI, Bø: Gvarv (EIS:18) 13 July 1989, AAY, Øyestad: Løddesøl (EIS:6) 11 July 1988, and AAY, Grimstad: Lia (EIS:6) 12 July 1989.
Trechus micros (Herbst). AAY, Øyestad: Løddesøl (EIS:6) 10 specimens May—June 1988, and NTI, Frosta: Logstein (EIS:92) 4 specimens June-Aug. 1985 and 1988.

Staphylinidae

Acrotona muscorum (Brisout de Barneville). SFI, Lærdal: Ljøsne (EIS:51) 28 May 1987, and SFI, Lærdal: Eri (EIS:51) 5 June 1989.
Aleochara bilineata Gyllenhal. AAI, Bygland: Nese (EIS:9) 4 July 1988.
A. bipustulata (L.). AAI, Bygland: Nese (EIS:)) 6 specimens June 1988, AAI, Bygland: Jordalsbø (EIS:9) Very common (77 specimens) June—July 1989, MRY, Molde: Årø (EIS:84) 9 June 1985, MRY, Molde: Fuglset (EIS:84) 3 specimens July—Aug.

1987, and MRI, Sunndal: Hoel (EIS: 78) 4 specimens 14 May 1989.
A. brevipennis Gravenhorst. ON, Nord-Fron: Vinstra (EIS:62) 15 specimens June—July 1988—89, AAI, Bygland: Jordalsbø (EIS:9) 12 specimens June—July 1989, SFI, Lærdal: Eri (EIS:51) June 1988, and MRY, Molde: Årø (EIS:84) 26 June 1985, 6 July 1986.
A. inconspicua Aube. AAI, Bygland: Nese (EIS:9) 6 June 1988.
A. villosa Mannerheim. SFI, Lærdal: Ljøsne (EIS:51) 6 June 1985.
Amischa analis (Gravenhorst). MRY: Molde: Årø (EIS:84) 26 June 1985, 6 July 1986, 10 Oct. 1987, and MRY, Molde: Fuglset (EIS:84) 6 Aug. 1985, 27 Aug. 1987.
Anotylus rugosus (Fabricius). AAI, bygland: Jordalsbø (EIS:9) 5 specimens June—July 1989, SFI, Lærdal: Hauge (EIS:51) Common (49 specimens) in May—Sept. 1985—89, SFI, Lærdal: Ljøsne (EIS:51) Common (93 specimens) May—Oct. 1985—89, SFI, Lærdal: Eri (EIS:51) Common (48 specimens) June—July 1988—89, MRI, Sunndal: Hoel (EIS:78) Very common (129 specimens) May—July 1988, and MRI, Surnadal: Vindøla (EIS:85) 9 specimens May—July 1989.
Arpedium quadrum (Gravenhorst). MRI, Surnadal: Vindøla (EIS:85) 3 specimens May 1989.
Atheta debilis (Erichson). SFI, Lærdal: Hauge (EIS:51) 26 July 1985.
A. elongatula (Gravenhorst). AAI, Bygland: Jordalsbø (EIS:9) 5 June 1989.
A. graminicola (Gravenhorst).MRI, Sunndal: Hoel (EIS:78) 9 specimens May—July 1988.
A. incognita (Sharp). RY, Stangeland: Stavanger (EIS:7) 3 specimens July—Sept. 1988.
A. palustris (Kiesewetter). AAI, Bygland: Nese (EIS:9) June 1988, AAI, Bygland: Jordalsbø (EIS:9) 3 specimens 5 June 1989, and NTI, Frosta: Logstein (EIS:92) 15 specimens May—Aug. 1985—88.
A. pertyi (Heer). MRY, Molde: Årø (EIS:84) 26 June 1985, 3 specimens July—Oct. 1987, MRY, Molde: Fuglset (EIS:84) 27 Aug. 1987, and NTI, Frosta: Logstein (EIS:92) Common (26 specimens) Aug.—Sept. 1985, 3 specimens Aug.—Sept. 1986, 1 specimen 11 Aug. 1987.
A. spatuloides G. Benick. MRI, Sunndal: Hoel (EIS:78) 28 May 1988.
A. xanthopus (Thomson). MRY, Molde: Fuglset (EIS:84) 6 Aug. 1985.
Autalia puncticollis Sharp. MRY, Molde: Fuglset (EIS:84) 22 Aug. 1986.
Bryoporus cernuus (Gravenhorst). AK, Ås: NLH (EIS:28) 24 May 1988.
Deliphrum tectum (Paykull). MRY, Molde: Fuglset (EIS:84) 27 Aug. 1987.
Dinaraea angustula (Gyllenhal). MRY, Molde: Årø (EIS:84) 7 Aug. 1985, 4 specimens 25 July 1987, and NTI, Frosta: Logstein (EIS:92) Common (51 specimens) May—Sept. 1985-89.
Gabrius pennatus Sharp. TEI: Bø: Gvarv (EIS:18) 6 specimens May—June 1988.
G. subnigritulus (Reitter). AAI: Bygland: Jordalsbø (EIS:9) 12 July 1989.
Ilyobates subopacus Palm. RY, Årsvoll: Sandnes (EIS:7) 21 Aug. 1988.
Geostiba circellaris (Gravenhorst). MRY, Molde: Fuglset (EIS:84) 26 June 1985.
Gyrohypnus fracticornis (Müller). STI, Orkdal: Fannrem (EIS:91) 2 specimens June 1989.
G. scoticus (Joy). AAI, Bygland: Jordalsbø (EIS:9) 5 June 1989, SFI, Lærdal: Hauge (EIS:51) Common (40 specimens) May—Sept. 1985—88, SFI, Lærdal: Ljøsne (EIS:51) Very common (85 specimens) May—Oct. 1985—89, MRY, Molde: Årø (EIS:84) 8 specimens May—Oct. 1985—87, and MRY, Molde: Fuglset (EIS:84) 4 specimens June—Aug. 1985—87.
Hapalarea puberula (Bernhauer). SFI, Lærdal: Ljøsne (EIS:51) 6 specimens May 1985.
Lathrobium elongatum (L.). MRI, Surnadal: Vindøla (EIS:85) 4 specimens May—June 1989, and NTI, Steinkjer: Sparbu (EIS:98) 2 specimens June 1989.
L. punctatum Zetterstedt. ON, Nord-Fron: Vinstra (EIS:62) 17 July 1989.
Lesteva longoelytrata (Goeze). AK, Ås: NLH (EIS:28) 5 June 1989, MRY, Molde: Årø (EIS:84) 6 July 1986, 2 specimens 15 Oct. 1987, and MRY, Molde: Fuglset (EIS:84) 24 July 1986, 2 speciemens 27 Aug. 1987.
L. pubescens Mannerheim. MRY, Molde: Fuglset (EIS:84) 2 sspecimens 26 June 1985.
Megarthrus denticollis (Beck). RY, Årsvoll: Sandnes (EIS:7) 4 specimens Aug.—Sept. 1985—88, and RY, Stangeland: Stavanger (EIS:7) 14 Sept. 1986.
M. sinuatocollis (Lacordaire): AAI, Bygland: Jordalsbø (EIS:9) 12 July 1989, and SFI, Lærdal: Ljøsne (EIS:51) 9 Sept. 1985.
Mycetoporus lepidus (Gravenhorst). SFI, Lærdal: Ljøsne (EIS:51) May 1988.
Ocypus aenocephalus (Degeer). MRY,

Molde: Fuglset (EIS:84) 14 Oct. 1985, 1 specimens 3 Oct. 1986.
Olophrum assimile (Paykull). MRY, Molde: Årø (EIS:84) 5 specimens Aug.—Oct. 1985—87, and MRY, Molde: Fuglset (EIS:84) 0 June 1985.
O. piceum (Gyllenhal). MRY, Molde: Årø (EIS:84) 4 specimens Aug.—Oct. 1986—87, and MRY, Molde: Fuglset (EIS:84) 4 specimens Aug.—Oct. 1987.
Omalium caesum Gravenhorst. SFI, Lærdal: Ljøsne (EIS:51) July 1989.
O. excavatum Stephens. SFI, Lærdal: Ljøsne (EIS:51) 2 specimens Sept. 1985.
Othius angustus Stephens. MRY, Molde: Fuglset (EIS:84) 14 Oct. 1985.
Oxypoda exoleta. Erichson. TEI, Bø: Gvarv (EIS:18) 7 specimens May—July 1989, AAY, Grimstad: Lia (EIS:6) 2 specimens July 1989, AAI, Bygland: Nese (EIS:9) 4 ssspecimens June 1988, AAI, Bygland: Jordalsbl (EIS:9) 13 June 1989, SFI, Lærdal: Hauge (EIS:51) Very common (284) specimens) May—Sept. 1985—Sept. 1985—89, SFI, Lærdal: Ljøsne (EIS:51) 8 specimens May—Oct. 1985—88, SFI, Lærdal: Eri (EIS:51) Common (47 specimens) May—July 1988—89, and MRI, Sunndal: Hoel (EIS:78) 7 specimens May—June 1988.
O. lividipennis Mannerheim. MRY, Molde: Fuglset (EIS:84) 15 Oct. 1987.
O. spectabilis Märkel. RY, Årsvoll: Sandnes (EIS:7) 24 Sept. 1988.
O. umbrata (Gyllenhal). MRI; Sunndal: Hoel ((EIS:78) 2 specimens May and July 1988.
Philonthus addendus Sharp. MRY, Molde: Fuglset (EIS:84) 3 specimens AUG. 1985—86, and MRY, Molde: Årø (EIS:84) 6 July 1986.
P. atratus (Gravenhorst). SFI, Lærdal: Ljøsne (EIS:51) 4 specimens May 1985—87.
P. carbonarius (Gravenhorst). MRY, Molde: Fuglset (EIS:84) 24 July 1986, and MRY, Molde: Årø (EIS:84) 3 Oct. 1986.
P. cognatus Stephens. AAI, Bygland: Nese (EIS:9) 4 specimens July 1988.
P. decorus (Gravenhorst). OS, Østre Toten: Apelsvoll (EIS:45) 14 July 1988, and ON, Nord-Fron: Vinstra (EIS:62) 4 July 1988, 2 specimens June—July 1989.
P. laminatus (Creutzer). AAI, Bygland: Nese (EIS:9) 4 July 1988, AAI, Bygland: Jordalsbø (EIS:9) Common (20 specimens) June—July 1989, MRY, Molde: Årø (EIS:84) Common (41 specimens) May—Oct. 1985—87, MRY, Molde: Fuglset (EIS:84) Common (42 specimens) June—Oct. 1985—87, MRI, Sunndal: Hoel (EIS:78) 12 specimens May—June 1988, and MRI, Surnadal: Vindøla (EIS:85) Common (33 specimens) May—June 1989.
P. marginatus (Ström), AAY, Øyestad: Løddesøl (EIS:6) 13 June 1988.
P. nigriventris Thomson. SFI, Lærdal: Hauge (EIS:51) May 1988.
P. nitidus (Fabricius). MRY, Molde: Fuglset (EIS:84) 14 Oct. 1985.
P. pachycephalus Nordmann. NTI, Frosta: Logstein (EIS:92) 11 June 1987.
P. pseudovarians Strand. STI, Orkdal: Fannrem (EIS:91) 2 specimens June—July 1989.
P. splendens (Fabricius). ON, Nord-Fron: Vinstra (EIS:62) 17 July 1989, and NTI, Steinkjer: Sparbu (EIS:98) 21 June 1989.
P. subvirescens Thomson, SFI, Lærdal: Hauge (EIS:51) 20 specimens May—July 1989.
P. succicola Thomson. AAY, Øystad: Løddesøl (EIS:6) 2 specimens 22 June 1988, and AAY, Grimstad: Lia (EIS:6) Common (17 specimens) June—July 1989.
P. umbratilis (Gravenhorst). SFI, Lærdal: Ljøsne (EIS:51) June 1989.
P. varians (Paykull). AAI, Bygland: Jordalsbø (EIS:9) 12 July 1989, and MRY, Molde: Årø (EIS:84) 3 specimens 15 Oct. 1987.
Proteinus macropterus (Gravenhorst). TEI, Bø: Gvarv (EIS:18) 24 June 1988, SFI, Lærdal: Hauge (EIS:51) 4 Aug. 1988, and NTI, Frosta: Logstein (EIS:92) 30 May 1988.
Quedius fuliginosus (Gravenhorst). SFI, Lærdal: Hauge (EIS:51) May 1987.
Q. molochinus (Gravenhorst). MRY, Molde: Årø (EIS:84) 4 specimens July—Oct. 1986—87.
Sepedophilus testaceus (Fabricius). SFI, Lærdal: Ljøsne (EIS:51) 18 June 1989.
Stenus biguttatus (L.). AAY, Øyestad: Løddesøl (EIS:6) 2 specimens May 1988, and AAI, Bygland: Nese (EIS:9) 20 May 1988.
S. brunnipes Stephens. AAY, Øyestad: Løddesøl (EIS:6) 25 May 1988.
S. canaliculatus Gyllenhal. AAI, Bygland: Nese (EIS:9) 13 June 1988.
Stenus intermedius Rey. SFI, Lærdal: Ljøsne (EIS:51) 20 June 1985, 3 specimens June—Aug. 1989, SFI, Lærdal: Hauge (EIS:51) 16 specimens May—Aug. 1988—89, and SFI, Lærdal: Eri (EIS:51) 5 specimens June—July 1989.
Tachinus corticinus Gravenhorst. MRI,

Sunndal: Hoel (EIS:78) 20 May 1988, and MRI, Surnadal: Vindøla (EIS:85) 6 specimens May—June 1989.
T. marginatus Gyllenhal. AAI, Bygland: Nese (EIS:9) 20 July 1988, and MRI, Surnadal: Vindøla (EIS:85) 14 July 1989.
T. marginellus (Fabricius). MRY, Molde: Årø (EIS:84) 14 Oct. 1985, 27 Aug. 1987, and MRY, Molde: Fuglset (EIS:84) 15 Oct. 1987.
T. proximus Kraatz. MRY, Molde: Fuglset (EIS:84) 3 specimens Oct. 1985, 1 specimen 6 July 1986, and MRY, Molde: Årø (EIS:84) 3 Oct. 1986.
T. signatus (Gravenhorst). AAI, Bygland: Jordalsbø (EIS:9) Very Common (170 specimens) July 1989, MRI, Sunndal: Hoel (EIS:78) Very common (157 specimens) May—July 1988, and MRI, Surnadal: Vindøla (EIS:85) Very common (328 specimens) May—July 1989.
Tachyporus chrysomelinus (L.) AAI, Bygland: Nese (EIS:9) 8 specimens June—July 1988, and AAI, Bygland: Jordalsbø (EIS:9) 2 specimens July 1989.
T. hypnorum (Fabricius). TEI, Bø: Gvarv (EIS:18) 13 June 1988, 26 June 1989, and STI, Orkdal: Fannrem (EIS:91) 26 May 1989.
T. obtusus (L.). AAI, Bygland: Nese (EIS:9) Common (28 specimens) June 1988, MRY, Molde: Årø (EIS:84) 15 Oct. 1987, and MRI, Sunndalen: Hoel (EIS:78) 13 specimens May—June 1988.
T. pusillus Gravenhorst. ON, Nord-Fron: Vinstra (EIS:62) 20 June 1988, and MRY, Molde: Årø (EIS:84) 27 Aug. 1987.
Xantholinus laevigatus Jacobsen. ON, Nord-Fron: Vinstra (EIS:62) 4 specimens June—July 1989, and MRI, Sunndal: Hoel (EIS:78) 2 specimens May—July 1988.
X. tricolor (Fabricius). MRY, Molde: Årø (EIS:84) 2 specimens June and Oct. 1985, 1 specimens 25 July 1987.
Xylodromus concinnus (Marsham). SFI, Lærdal: Hauge (EIS:51) 3 specimens May 1985.

DISCUSSION

Staphyklinids from the little investigated districts of Aust-Agder-inner regions (AAI), Sogn og Fjordane-inner regions (SFI) and Møre og Romsdal (MRY and MRI) make up a large proportion (60%) of the material. In fact, the records add to the district staphylinid faunas as much as 9.7% in SFI, 10.4% in MRI, 28.2% in AAI and 43.8% in MRY, even when agricultural fields were the only investigated habitat.

Staphilinids also must be less investigated than carabids, as new data is reported for only 7 carabid species (2.7% of the regiatrated Norwegian carabid fauna) as compared to 80 staphylinid species (8.8% of the registrated Norwegian fauna). This strongly shows the need for investigations in some districts, as indicated by Refseth (1987), especially concerning staphylinids.

Many of the finds just fill in gaps in the previously known range of the species. Some of the species, however, increase their range (with two or more districts) in a particular part of the country. The carabid *Amara ovata* and the staphylinid *Oxypoda exoleta* increase their range in more than one area, but mainly in western Norway. The staphylinids *Atheta pertyi* and *Dinaraea angustula* increase their range in central Norway, and the staphylinids *Lathrobium elongatum, Philonthus pseudovarians* and *Tachyporus hypnorum* and caught for the first time in central Norway. The carabid *Trechus discus* and the staphylinig *Stenus biguttatus* increase their range towards south-west in eastern Norway.

The staphylinid species *Acrotona muscrorum, Aleochara villosa, Hapalarea puberula, Philonthus subvirescens* and *Sepedophilus testaceus,* previously not found in western Norway, were all caught in Lærdal (SFI). This is probably due to the very dry and warm summer climate in the area, as compared to most of western Norway.

The uncommon carabid *Asaphidion flavipes* and the staphylinids *Atheta pertyi, A. xanthopus* and *Stenus brunnipes* have slightly increased their range. The rare, stenotypic pine forest staphylinid *Atheta incognita* and the highboreal mountain- and pine forest species *A. spatuloides* were caught in a quite unusual habitat. These specimens probably have been trapped in agricultural fields after a swarming.

The present results come from trapping with only one method (pitfall traps) in only one type of habitat (agricultural fields), and clearly shows the need for further investigations of the carabid and staphylinid faunas in Norway, especially in some little investigated districts.

SAMMENDRAG

Nye funn av løpebiller og kortvinger fra flere områder i Sør- og Midt-Norge

Det rapporteres om 120 nye landskapsfunn av 7 løpebille- og 80 kortvingearter. Materialet ble innsamlet i fallfeller i åkre, hovedsakelig i Aust-Agder, indre del (AAI), Sogn og Fjordane, indre del (SFI) og Møre og Romsdal, indre og ytre del (MRI og MRY). De rapporterte funnene øker kortvingefaunaen med 9.7% i SFI, 10,4% i MRI, 28,2% i AAI og hele 43,8% i MRY, noe som klart viser at kortvingefaunaen i disse områdene er særlig dårlig kjent.

Nedenfor beskrives noen av de mest interessante funnene: Løpebillene *Amara ovata* og *Trechus discus* og kortvingene *Oxypoda exoleta* og *Stenus biguttatus* øker sitt utbredelsesområde mot vest. Kortvingene *Atheta pertyi* og *Dinaraea angustula* øker sin utbredelse i Midt-Norge. Kortvingene *Lathrobium elongatum, Philonthus pseudovarians* og *Tachyporus hypnorum* ble fanget i Midt-Norge for første gang. Kortvingene *Acrotona muscorum, Aleochara villosa, Hapalarea puberula, Philonthus subviresens* og *Sepedophilus testaceus* ble fanget i Lærdal. De er ikke kjent fra Vestlandet fra før, og det er sannsynlig at det tørre og varme sommerklimaet i området forklarer funnene.

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A *correction* to Arild Andersen: *Carabidae and Staphylinidae (Col.) frequently found in Norwegian agricultural fields. New data and review* in *Fauna norv. Ser. B 38 No. 2* p. 67. Table 1 should have the following heading: Species Occurrences Scores — The same as in Table 3.

On the Syrphid genera *Brachyopa* Meigen and *Hammerschmidtia* Schummel (Diptera) in Norway

TORE R. NIELSEN

Nielsen, T. R. 1992. On the Syrphid genera *Brachyopa* Meigen and *Hammerschmidtia* Schummel (Diptera) in Norway. *Fauna norv. Ser. B. 39:* 39—43.

Examination of old and new material shows the occurance of seven *Brachyopa* and one *Hammerschmidtia* species in the Norwegian fauna. Four *Brachyopa* species, *bicolor* (Fallén), *cinerea* Wahlberg, *obscura* Thompson and Torp and *pilosa* Collin, are reported new to Norway. Dates are given on distribution, flight periods, habitat and food preference.

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INTRODUCTION

Syrphid flies of the genera *Brachyopa* Meigen and *Hammerschmidtia* Schummel are rusty-red coloured, which is rather unusual for this Diptera family. The species are associated with woodland as their larvae live in wounded or decaying trees.

There has been confusion concerning taxonomy and nomenclature of some of the *Brachyopa* species. Thompsons publication (1980) on this genus clarify these problems, and he also gives a key to Palaearctic species. In 1982 Thompson and Torp describe *obscura* as a new species from the St. Petersburg region.

Siebke (1853, 1877) published *Hammerschmidtia ferruginea* and three *Brachyopa* spp. from Norway: *dorsata, testacea* and *vittata.* Also Bidenkap (1892) reports on *vittata* from eastern Norway, but Bidenkap's specimens are probably lost and have not been available for studies. Examination of Siebke's material, however, verifies most of the species, but his «*vittata*» are either *testacea* or *obscura* and no genuine *vittata.*

The available material (134 *Brachyopa* and 38 *Hammerschmidtia* specimens) illustrates also the flight period of the two genera, fig. 1. *Brachyopa* species start hatching in the beginning of May and the adult population peaks in the period 20 May—20 June. *Hammerschmidtia ferruginea* has its peak about three weeks later.

The present paper is based on material from museum collections and a number of private collections. Where nothing else is mentioned, the material is in the author's collection. The faunal codes used are in agreement with Økland (1981).

Abbreviations used are as follows:

AJN	Alf Jacob Nilsen	ROG	Knut Rognes
BJB	Bjørnar Borgersen	ROS	R. Rosendahl
FMI	Fred Midtgaard	SIE	H. Siebke
HAG	Hagemann	SRY	Tron Soot-Ryen
IME	Inger Meidell	TJO	Terje Jonassen
IN	Ingunn Marie Nielsen	TRM	Tromsø Museum
		TRN	Tore R. Nielsen
JAH	J.A. Husby	ZMB	Zoological Museum, Bergen
LUC	J.A.W. Lucas	ZMO	Zoological Museum, Oslo
MFA	Morten Falck		
OLS	Thor J. Olsen		

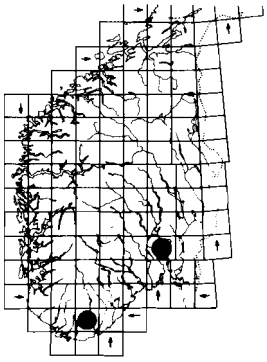
SYSTEMATIC LIST

Genus *Brachyopa* Meigen, 1822.

B. bicolor (Fallén, 1817). Map 1.
New to Norway. Found in two localities, both with rich deciduous forest, AK, Oslo: Kværnerdalen 13 and 26 June 1986 2 ♂♂, leg. and coll. M. Falck. VAY, Kristiansand: Hamresanden, at forest edge 31 May 1983 2 ♂♂, leg. and coll. J. A. W. Lucas.

In Denmark larvae were collected from *Populus alba* attacked by *Cossus cossus,* and adult insects were collected when drinking sap of *Acer pseudoplatanus* (Torp 1986). Stubbs and Falk (1983) reports it taken about beech trees.

B. cinerea Wahlberg, 1844. Map 2.
New to Norway. ON, Skjåk: Aura 6 June 1979 1♂, leg. A. Fjellberg, coll. TRN. TRI, Bardu: Setermoen 26 June 1981, 1♂ sitting on leaf at the edge of *Betula - Salix caprea - Alnus glutinosa* forest,

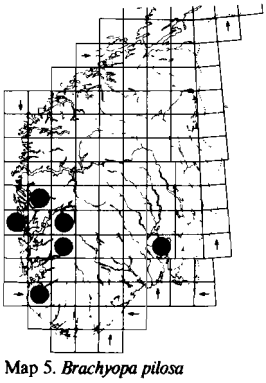


Map 1. *Brachyopa bicolor*

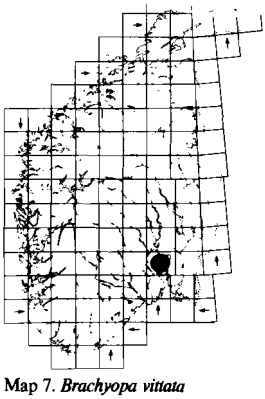
Map 2. *Brachyopa cinerea*

Map 3. *Brachyopa dorsata*

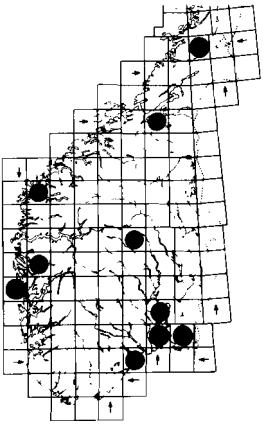
Map 4. *Brachyopa obscura*



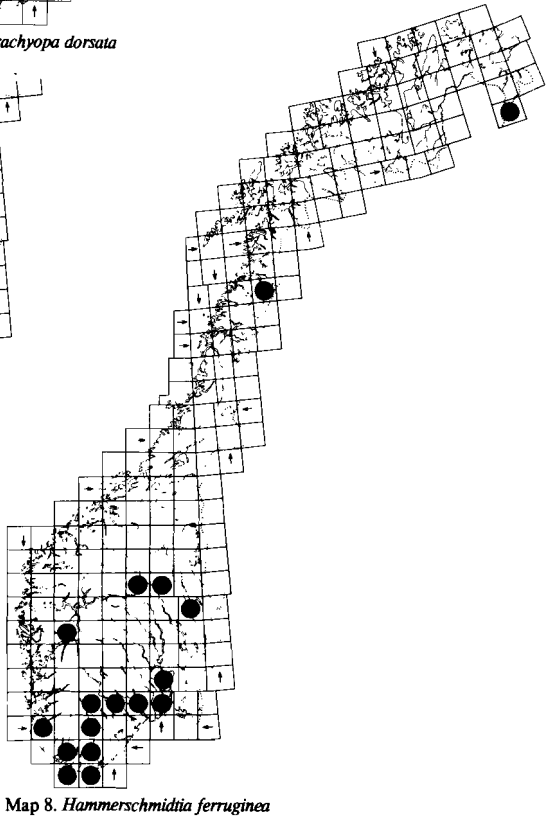
Map 5. *Brachyopa pilosa*



Map 7. *Brachyopa vittata*



Map 6. *Brachyopa testacea*



Map 8. *Hammerschmidtia ferruginea*

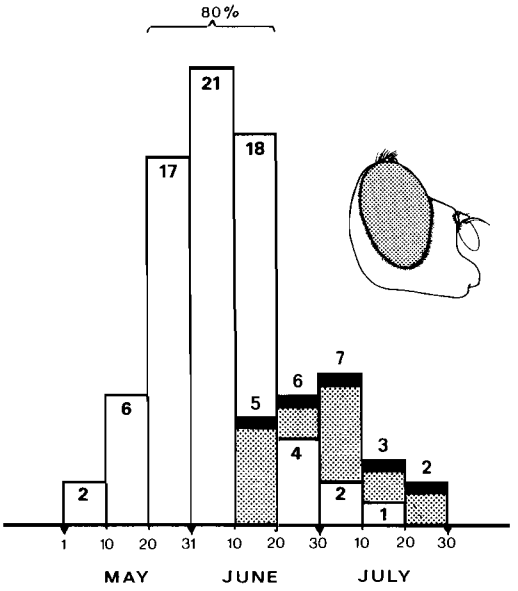


Fig. 1. Flight periods in south Norway (specimens with exact collecting dates are summed up). — White columns: *Brachyopa* specimens (total 70). Black/dotted columns: *Hammerschmidtia ferruginea* (total 23).

leg. TRN; Balsfjord: Skjåvikør 8 July 1941 1♂, leg. SRY, coll. TRM. FØ, Sør-Varanger: Vaggetem 23 June 1990, 1♂ on *Salix* bush catkins in open, humid birch forest, leg. TRN.

This species is easily recognised by the shining blackish-brown abdomen which contrasts sharply with the orange antennae, face, scutellum and male genitalia.

Flight period: 6 June—8 July.

A rare high mountain and arctic/subarctic species. Originally described from northern Sweden, otherwise reported from Finland (Hackman 1980) and the Soviet Union (Violovitsh 1983).

B. dorsata Zetterstedt, 1838. Map 3.
Previous record: Linderud, Oslo (Siebke 1877).

New records: AK, Bærum: Ostøya 2 ♂♂ 2 ♀♀, 1984 in Malaisetrap, leg. FMI, 31 May 1984 1 ♀, leg. TRN; Asker: Heggedal 2 June 1986 1♂, leg. TRN. OS, S. Aurdal: Suluvatn 7 June 1971 1♂, 1 ♀, FJB leg. ON, Lom: Spiterstulen 1 July 1974, 1♀ in subalpine birch forest at 1050 m a.s.l., TRN leg. BØ, Hurum: Filtvedt 15 June 1981 1♀, FMI leg. VE, Tjøme 25 May 1970 2♂♂, FJB leg. HOY, Bergen: Paradis 20 May 1968 1 ♂, 14 May 1971 1 ♀ and 17 May 1973 1 ♀ in rich deciduous forest, FBJ and TRN leg.; Myravatn 3 June 1970 1 ♀, FJB leg. Samnanger: Årland 14—26 May 1982 1 ♂, 1 ♀ in Malaise-trap, AJN leg. Os: Hattvik 14 June 1970 3 ♂♂, FBJ leg.; Ulvik: Hallanger near Bruravik 28 May—16 June 1982 5 ♀♀ in Malaisetrap, AJN leg. STI, Midtre Gauldal: Mosand 11 June 1985 1 ♂, leg. BJB. NTI; Høylandet: Skiftesåa 3 ♂♂ 5 ♀♀ 1986 Malaise-trap, leg. Museet, Trondheim. NSI, Grane: Majavatn 30 June 1983 1♀ in subalpine birch forest, leg. TRN. Rana -29 June 1986 1 ♀ in Malaisetrap, leg. FMI; Dunderland 20 June 1981 5 ♂♂, 3 ♀♀ in open birch — *Geranium silvaticum* forest, leg. TRN. TRI, Balsfjord: Fjellfrøskvatn 8 July 1922 1 ♀, leg. SRY, in coll. TRM. FN, Alta: Grønnåsen, Gargia 30 June 1979 1 ♀ in subalpine birch forest, TRN leg. FØ: Sør-Varanger: Fiskevann 24 June 1966 1 ♂ in pine-birch forest, leg. ZMO Pasvik-eksp., in coll. ZMO; Gjøkåsen 19 June 1990 1 ♂, 1 ♀ in yellow water trap on pine forest bog, IN and TRN leg.; Emanuelbekken 29 June 1977 1 ♀, in birch and *Salix* scrub forest, TRN leg.; Ødevann 14 June 1974 7 ♂♂, 2 ♀♀ FJB leg.; Neiden 7 July 1983 1 ♂, 1 ♀, leg. TRN.

This is our most widespread *Brachyopa* species, probably occurring in most parts of the country. It has been found in lowland forests as well as in subalpine forests (1050 m a.s.l.) and on *Pinus-Salix-Betula odorata-Betula nana* bogs in Finnmark.

Flight period: 6 May—8 July.

B. obscura Thompson and Torp, 1982. Map 4.
New to Norway. AK, Oslo: Bekkelaget 8 June 1846 1 ♂, leg. Siebke, in coll. ZMO; Frogn: Håøya 19 May—3 June 1984 2 ♂♂ and 3—16 June 1984 1 ♂ in Malaisetrap, leg. FMI, coll. TRN. VAY, Kristiansand: Hamresanden 31 May 1983 1 ♂, leg. LUC, coll. TRN. HOY, Bergen: Paradis 7 June 1970 1 ♂ in rich deciduous forest, leg. and coll. TRN.

B. pilosa Collin, 1939. Map 5.
New to Norway. AK, Frogn: Håøya 3—16 June 1984 2 ♂♂, 2 ♀♀ in Malaisetrap, leg. FMI. RY, Sandnes: Dale 12 May 1974 1 ♂ on birch foliage, in open birch-*Calluna* forest, leg. TRN; Bjerkreim: Birkeland 24 May 1975 1 ♂, 3 ♀♀ on male catkins of *Salix* bushes, in humid birch-*Salix* forest, leg. TRN. RI, Forsand: Røssdalen 20 May 1982 1 ♀, leg. ROG; Suldal, Kvennaflåto at Bråtveit 22 May 1945 1 ♂, leg. IME, coll. ZMB. HOY, Bergen: Paradis 1 May 1968 1 ♂ and 22 May 1968 1 ♀, both leg. TRN; Myravann 8 June 1969 2 ♂♂ and 11 June 1968 1 ♂, both leg. FJB; Samnanger: Årland 14—26 May 1982 3 ♂♂ in Malaisetrap, leg. AJN. HOI, Ullensvang: Frisvik 19 May 1953 1 ♂, leg. ROS.

In Denmark one larva was found under the bark of a beech stump (Torp 1986), and in Great Britain it is assumed that *pilosa* is associated with dying or recently dead beech trees (Stubbs & Falk 1983). In Norway it has been found in rich deciduous forests as well as in *Betula-Calluna* and *Betula-Salix* communities.

Flight period: 1 May—11 June.

B. testacea (Fallén, 1817). Map 6.
Previous record: AK, Oslo: Linderud 13 June 1846 1 ♂, leg. SIE, in coll. ZMO.

New records: Ø, Tune: Råkil 1988 1 ♂, leg. OLS. AK, Oslo: Lutdalen, Østmarka 30 May 1984 1 ♂, leg. and coll. MFA; Frogn: Håøya 19 May—3 June 1986 1 ♂ in Malaisetrap, leg. FMI; Bærum: Ostøya 12—30 May 1984 1 ♂ in Malaisetrap, leg. FMI and 16 June 1985 1 ♂, leg. TRN; Asker: Heggedal 2 June 1986 1 ♂, leg. TRN. OS, Gausdal: Svatsum (500 m a.s.l.) 16—17 July 1981 1 ♂, leg. TRN. BØ, Hurum: Filtvedt 15 June 1981 1 ♂, leg. FMI. VE, Sandefjord: Ø. Nes 29 June 1969 2 ♂♂, leg. FBJ; Brunlanes: Mørje, Tvedalen 3 June 1984 1 ♂, leg. BJB. HOY, Bergen: Myravann 8 June 1969 7 ♂♂ and 11 June 1969 3 ♂♂, leg. FJB, in coll. ZMB and TRN; Isdalen 16 May 1968 2 ♂♂ and 25 May 1968 1 ♂, hatched from pupae found in dead spruce stump, leg. FJB, 20 May 1972 2 ♂♂, leg. TRN; Paradis 7 June 1970 2 ♂♂, leg. TRN. SFY, Eid: Hjelle 8 July 1975 2 ♂♂, leg. TRN. STI, Trondheim: Trondheim east 7 June 1980 1 ♂, leg. HUS. NTI, Høylandet: Skiftesåa 11 June 1986 2 ♂♂ in Malaisetrap, leg. Museet, Trondheim.

Speight (1988) associates *testacea* with spruce trees (*Picea*). In the presented material are specimens hatched from pupae found under the bark of rottening spruce stumps (leg. Arne Fjellberg). The adult insects, however, have been collected in different types of forests, in mixed coniferous woods, in spruce plantations but also in deciduous forest. The insects have most frequently been collected when sitting on foliage of trees and bushes.

Flight period: 16 May— 8 July.

B. vittata Zetterstedt, 1843. Map 7.
As mentioned above none of the specimens reported by Siebke (1877) are the true *vittata* of Zetterstedt. There is one find, however, from the latest years. A female specimen was collected at the border of the rich deciduous forests at Hengsengen, Bygdøy in Oslo, 15 June 1985 on flowering *Anthriscus silvestris,* leg. TRN.

Genus *Hammerschmidtia* Schummel, 1834
H. ferruginea (Fallén, 1817). Map 8.
Previous records: Oslo, Åmot, Grundset and Elverum (Siebke 1877).

New records: AK, Frogn: Håøya 3—16 June 1984 2 ♂♂, 1 ♀ in Malaisetrap, leg. FMI. OS, Ringebu: at Ringebu stave church 9 July 1978 1 ♂, leg. TRN. ON, Fron: Skåbu 6 July 1978 1 ♀, leg. TRN. VE, Brunlanes: Mørje, Tvedalen 2 July 1984 1 ♂, leg. BJB, Pauler 5 July 1984 1 ♂, leg. BJB. TEI, Sauherad: Nordagutu 19 June 1985 1 ♀, leg. TRN; Tokke: Dalen 28 June 1980 1 ♂ and Lårdal 4 July 1980 1 ♂, both leg. ROG. AAY, Iveland: Grosås 6—15 July 1982 1 ♂, 1 ♀ in Malaisetrap, leg. AJN. AAI, Bygland: Vassenden, Kleivvollen 6—22 July 1982 2 ♀♀ in Malaisetrap, leg. AJN. VAY, Kristiansand: Hamre 16 June 1983 1 ♀, leg. TRN; Flekkefjord: at Gausdal, Gyland 6—15 July 1982 1 ♀ in Malaisetrap, leg. AJN; Lindesnes: Haraldstad 20 July 1976 1 ♀ and 29 July 1987 1 ♀, both on flowering *Angelica silvestris* at the edge of *Betula-Quercus-Populus tremula* forest, leg. TRN. VAI, Hægebostad: Skeie near Eiken 23 June 1975 1 ♂, leg. TRN. RY, Lund: Moi 16 June 1974 2 ♂♂, 1 ♀ in open deciduous forest with *Rubus fruticosus,* leg. TRN; Bjerkreim: Birkeland 25 May 1975 2 ♀♀ in open, humid *Betula-Salix* bush forest, leg. TRN. RI, Forsand: Røssdalen 26 June 1982 1 ♂ and Songesand 23 May 1984 1 ♀, both leg. TJO. HOI, Kinsarvik: Ulsnes 16 July 1967 1 ♀ on flowering *Angelica silvestris,* leg. TRN. NSI, Saltdal, no date, 1 ♂ leg. HAG, in coll. ZMO. FØ, Sør-Varanger: Skogfoss 21 July 1969 1 ♂ in flowering *Ranunculs acris,* and Vaggetem 23 June 1990 1 ♀ on male catkins of *Salix* bushes in open, humid birch forest, both leg. TRN.

Like *Brachyopa dorsata* this species has a wide distribution in Norway, reaching the pine and birch taiga of east Finnmark. It also occupies suitable localities of mountain forests, as at Skåbu (800 m a.s.l.).

As the *Brachyopa* species , *H. ferruginea* seems to have preference to whitish flowers like *Rubus fruticosus* and *Angelica silvestris.*

Flight period: 25 May–29 July.

ACKNOWLEDGEMENTS

I am greatly indebted to the curators Arne Fjellberg, Tromsø Museum, Lita Greve Jensen, Zoological Museum, Bergen and Jan Emil Raastad, Zoological Museum, Oslo for kind loan of material in their care. I also thank the following persons for contributing with valuable specimens or informations on material in their private collections: Bjørnar Borgersen, Østre Halsen, Morten Falck, Oslo, J. A. Husby, Trondheim, Terje Jonassen, Sjernarøy, Jan A. W. Lucas, Rotterdam, Fred Midtgaard, Oslo, Alf Jacob Nilsen, Hidra, Thor J. Olsen, Sarpsborg and Knut Rognes, Hafrsfjord.

Finally I thank our young daughter Ingunn Marie for her devoted interest and participating in collecting specimens.

SAMMENDRAG

Blomsterfluer av slekten *Brachyopa* Meigen og *Hammerschmidtia* Schummel (Diptera) i Norge

En gjennomgang av nytt og eldre blomsterflue-materiale viser at det finnes syv arter av

slekten *Brachyopa* og en *Hammerschmidtia*-art i den norske faunaen. Fire *Brachyopa*-arter rapporteres nye for Norge: *bicolor* (Fallén), *cinerea* Wahlberg, *obscura* Thompson & Torp og *pilosa* Collin. Artikkelen viser utbredelse, flyperiode, habitat og næringsvalg hos de voksne insektene.

Hammerschmidtia- og *Brachyopa*-artene er knyttet til skogsområder hvor larvene lever i skadde eller råtnende trær. De voksne insektene er oftest rustbrune, og både i form og farge minner de mye om *Sciomyzidae* eller gjødselfluer (slekten *Scatophaga).* Fluene sitter gjerne på bladverket av forskjellige løvtrær og er forholdsvis lite sky.

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The life cycle of *Capnopsis schilleri* (Plecoptera: Capniidae) in Sæterbekken near Oslo, Norway

ØYVIND HÅLAND

Håland, Ø. 1992. The life cycle of *Capnopsis schilleri* (Plecoptera: Capeniidae) in Sæterbekken near Oslo, Norway. *Fauna norv. Ser. B 39:* 45—48.

The life cycle of the stonefly *Capnopsis schilleri* was investigated in the stream Sæterbekken in Bærum near Oslo during 1978—1980. The species fullfilled the life cycle in one year. Eggs were laid at the end of May and the first half of June. The first nymphs were found in the samples at the beginning of August. The nymphs grew steadily at low temperatures throughout the winter and were fullgrown in March/April. They emerge in May when the stream temperature rises. A short description and figure of the first instar nymmph is given.

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INTRODUCTION

Many authors have commented on the systematics, morphology, ecology, and distribution of *Capnopsis schilleri* (Rostock, 1892), but few detailed investigations of the life cycle of the species have been made. The studies that have been made indicate a one-year life cycle (Berthèlemy 1973, Lillehammer 1975b), but do not give exact data on the growth of the nymphs under natural conditions.

The incubation time of the eggs has been studied by Berthe lemy (1973), Lillehammer (1975b) and Håland (1987).

Berthèlemy (1973) claims that the nymphs of *C. schilleri* go through a diapause in the summer in the population he studied in Tunisia. Berthèlemy (1979) has also given some informations on the morphology of the first instar nymphs.

C. schilleri is widely distribution, but mainly in small, scattered and isolated population throughout most of Europe (Illies 1978, Zwick 1984), under very different climatic regimes. This study may form a basis for comparison with other populations of the same or other subspecies in other parts of its distribution area.

MATERIAL AND METHODS

The stream Sæterbekken in Bærum has been well described by Lillehammer (1974b, 1975a). He also gives temperature records for two years at different stations. My station corresponds roughly to his station 1. Only a few data shall be given here.

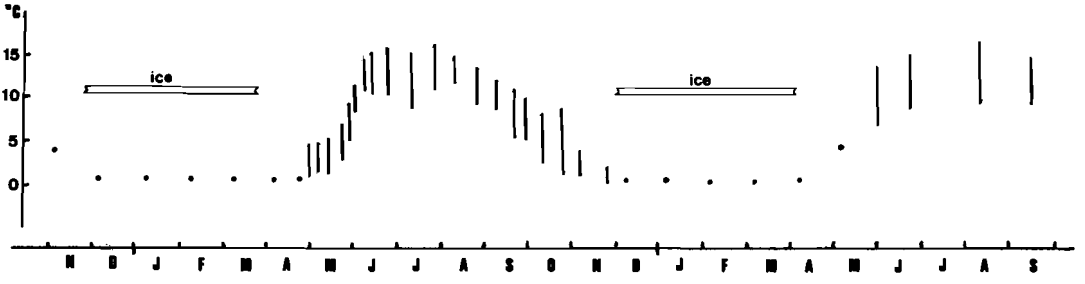

Fig. 1. Temperature in the stream Sæterbekken between Nov. 1978 and Sept. 1980, measured with a max.-min. thermometer. The measurements are indicated in the middle of the period they relate to. Ice-covered periods are also indicated.

Temperature was measured with a max.—min. thermometer during the ice-free season, and on visits during winter and early spring. The stream is ice-covered four months of the year (Fig. 1), from the beginning of December till the end of March or early April. The highest temperature recorded during summer was 17°C. It arises in coniferous forest, but the ripparian vegetation consists mainly of elm, ash and birch, especially in the lower reaches, which is for the most parts well shaded. In the stretches where *C. schilleri* is most abundant, the stream flows over marine clay which seem to supply a good substratum for the nymphs, especially where dead leaves accumulate.

Kick samples of the bottom substratum were taken monthly, sumetimes more often, in the stream between november 1978 and september 1980. The net used had a mesh size of 0.3 mm. Several microhabitats were usually sampled on each sampling occasion, in case nymphs of different size preferred different substrates. In the winter, December until April, the stream was covered by ice, and then holes were made in the ice where the probability of a good catch was high. The samples were taken to the laboratory and the nymphs taken out while they were still alive and easier to find. They were killed and conserved in 70% alcohol and later measured to the nearest 1/12 mm with an ocular micrometer on a binocular microscope. All samples from one date were kept separate, but pooled in the later analysis since size distribution seemed to be the same in all samples.

Adults were collected by beating the low vegetation with a sweep-net and by sifting accumulated debris from the stream-side.

First instar nymphs were hatched from eggs in the laboratory and drawings were made after microphotographs of alcohol-preserved material.

RESULTS

Life cycle

C. schilleri has a univoltine life cycle in Sæterbekken (Fig. 2). The eggs that were deposited in the laboratory, were laid some in the second half of May, but most in the first half of June. The smallest nymphs I could positively identify appeared in the samples from early August. They were in the 2. and 3. instars. No difference in size distribution was evident in the different subsamples. The nymphs grew steadily throughout the autumn and winter, even when the temperature in the stream dropped to 0.2 °C. The nymphs had mostly reached their full body length by February/March, but hatching did not occur until the temperature in the stream had risen significantly, to between 5 ° and 10 °C. A few smaller nymphs were found throughout the winter. The nymphs became scarce in the samples some time before hatching occurred. Adults were mostly found in accumulations of dead leaves and twigs by the border of the stream. Copulation was seen on the leaves of herbs and shrubs by the river.

Description of 1. instar nymph

The newly hatched nymphs were 0.65—0.70 mm long, the head was 0.1 mm broad. The antennae have 9 segments, the cerci 3 segments (Fig. 3). The last six body segments have hairs that are longer than the width of the body. The antennal segments have hairs that are approximately as long as the next segment. The head is a little longer than broad, so that the ratio of width/length is about 0.9.

DISCUSSION

It seems like *C. schilleri* has a univoltine life cycle throughout its distribution area, fitting

Fig. 2. Size distribution of the nymphs of *Capnopsis schilleri* in the stream Sæterbekken. Main hatching period of adults is indicated by arrows.

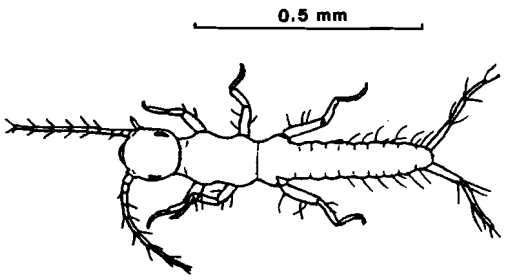

Fig. 3. Drawning of 1.st. instar nymph of *Capnopsis schilleri.*

the Type 1 life cycle of Lillehammer et al. 1989, Fig. 9). The flight period is much earlier in the southern parts. Berlèlemy (1973) gives February—May as the flight period in Tunisia, ending earlier in the lower reaches. Both egg incubation time (Håland 1987) and nymphal growth rate seem to be dependent on temperature. The nymphs grew slower in winter than in early autumn, but growth was significant even at temperatures close to 0 °C. My own laboratory observations indicate that any temperature above 8 °C results in a similar growth rate, while lower temperatures give slower growth. These observations are, however, based on very scant material.

With populations living under so different conditions as those in Tunisia and Norway, there must be a great need of mechanisms to regulate the life cycle. Berthèlemy (1973) claims that in the population in Tunisia that he studied this is done by a diapause in the earlier nymphal stages during the warmest part of the summer. No sign of a diapause was observed in the material from Sæterbekken, but this might be so either because this population does not have the genetic ability to do this or because the temperature regime in Sæterbekken does not induce a diapause. In an attempt to grow nymphs in the laboratory, one nymph survived for a couple of months at 20 °C with no sign of a diapause. Since eggs did not survive at 24 °C (Håland 1987), no higher temperature was tried. The results of Lillehammer (1975b, fig. 9) at 8 °C show the same. This seems to indicate that there are genetic differences regarding ability to diapause in the two populations in Tunisia and Norway.

The egg incubation time of *C. schilleri* has been studied by several authors (Berthèlemy 1973, Lillehammer 1975b, and Håland 1987), but does not show any sign of a regulating mechanism in the form of an egg-diapause or some kind of delayed hatching. Brittain et al. (1986) showed that eggs of *Capnia atra* Morton had greater eggs and greater first instar nymphs in the central parts of its distribution area compared to the peripheral areas in Norway. This might also be the case with *C. schilleri,* where southern Norway is a central area compared to Tunisia, giving the nymphs in the warmer parts of its distribution area a «bad start» compared with those in colder climates. This «bad start» might compensate for the quick growth under high temperature. Food conditions also slow down nymphal growth.

Lillehammer (1974b) list *C. schilleri* in a group of species with a basically north-easterly distribution, since it is so common in northern Europe. Zwick (1984) thinks that *C. schilleri* did not originate in the north, but in the southeast, possibly in Caucasus where the most primitive subspecies, *C. s. archaica* Zwick 1984 is found. Lillehammer (1974b) found *C. schilleri* in the sub-alpine vegetation belt, at 1100 m.a.s. in Central Norway, while Berthèlemy (1973) found the species as low as 450 m.a.s. in Tunisia.

The reason for the drop in average size in the late November sample in 1979 is hard to tell. The best explanation I can think of is a rather heavy spate that occurred a few weeks earlier (Hoff 1980) that might have decimated parts of the population by carrying away the bigger nymphs living among the dead leaves on top of the stream bed, while smaller nymphs that might tend to live deeper in the substratum (own observation) survived the spate to a greater extent. This difference in selection of microhabitat was not evident in the sampling, because all kick-samples disturbed the substratum to a deeper level than even a severe spate probably would do.

Before the numphs hatched, they probably migrated towards the stream banks where they are more difficult to catch, thus becoming more scarce in the samples.

ACKNOWLEDGEMENTS

I want to thank Curator Dr. A. Lillehammer for supervising this work, Zoological Museum in Oslo for facilities and my father-in-law Cand. phil. Knut Pettersen for correcting the English language I use.

SAMMENDRAG

Livssyklus til *Capnosis schilleri*

Livssyklusen til steinfluen *Capnopsis schilleri* er beskrevet fra en populasjon i Sæterbekken i Bærum for årene 1978—1980. Arten er univoltin. Egg ble lagt i slutten av mai — begynnelsen av juni. De første små nymfer ble funnet i august. Nymfene vokste jevnt ved lav temperatur utover vinteren og var utvokst i mars/april. Klekking fant sted i mai da vanntemperaturen stiger. Første nymfestadium er kort beskrevet.

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