

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

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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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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 (Meritt 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 (Clau-snitzer, 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 dra-

gonfly 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, Kvitte & 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. Kvitte), 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,

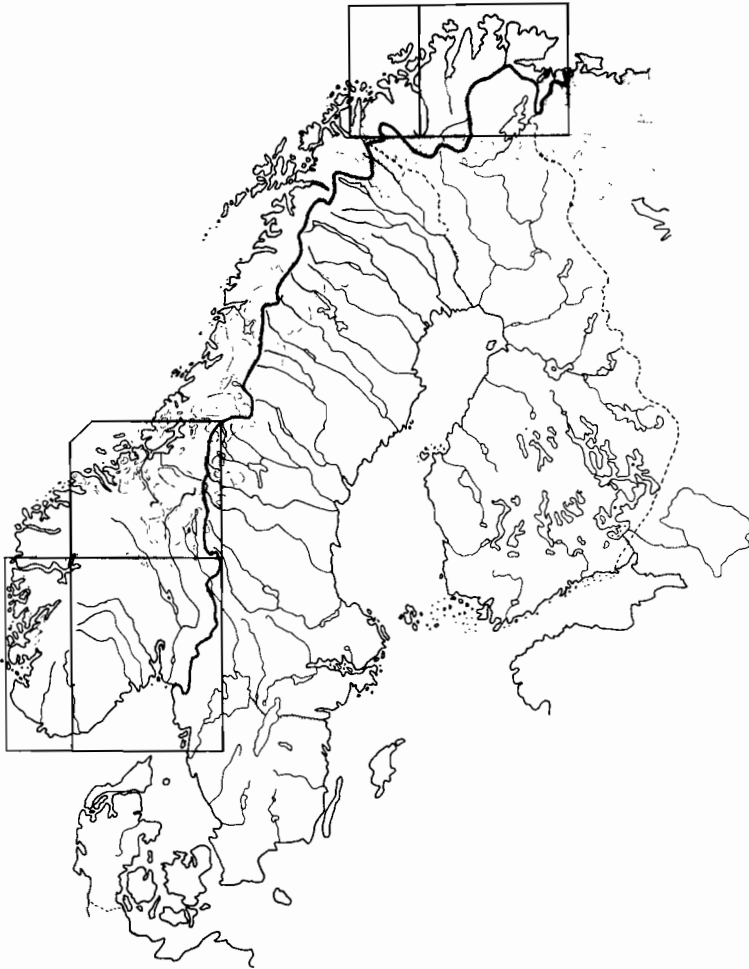


Fig. 1. Map of Norway, showing the different sections presented in detail in Fig. 2. (Arctic-alpine areas are shaded.)

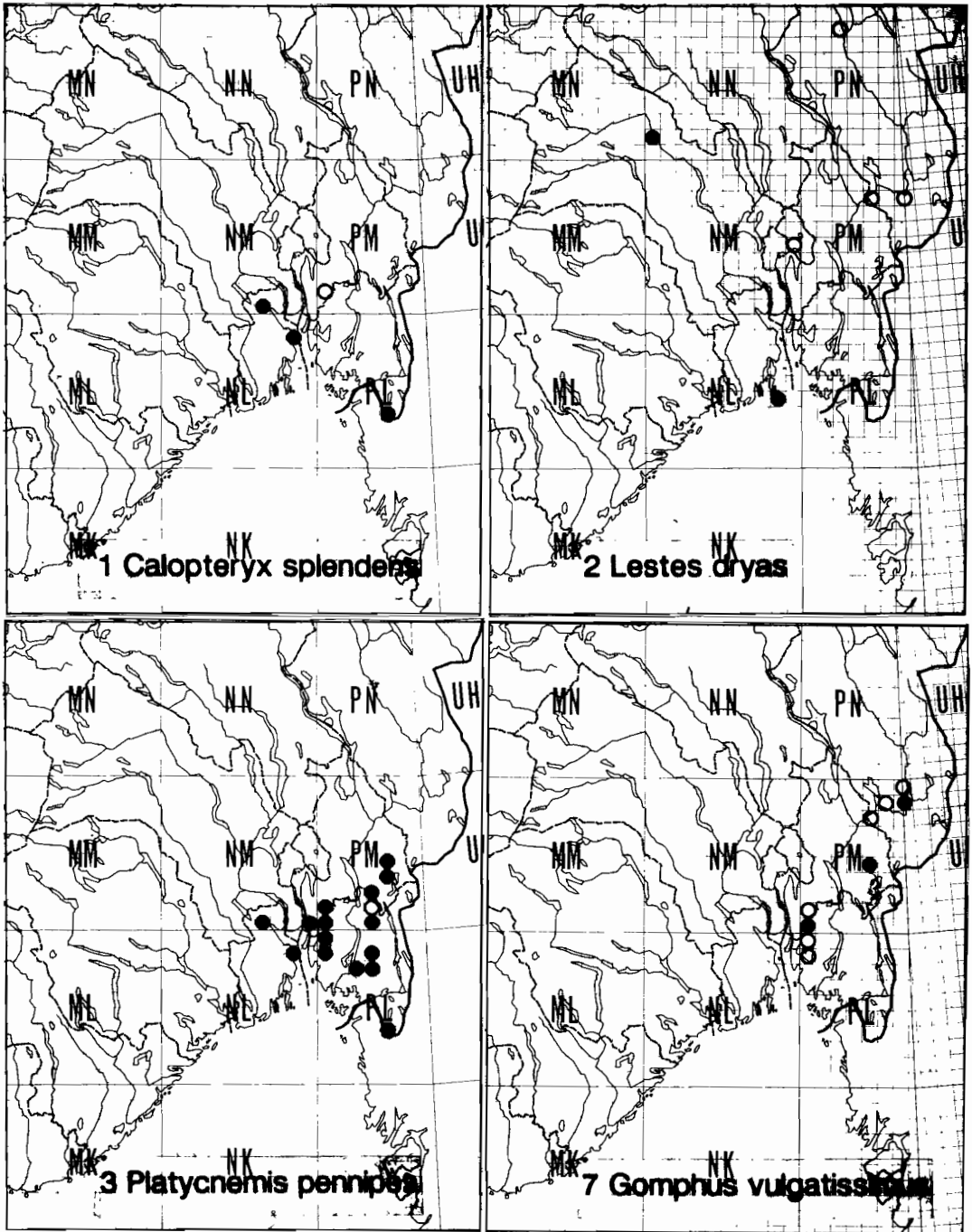
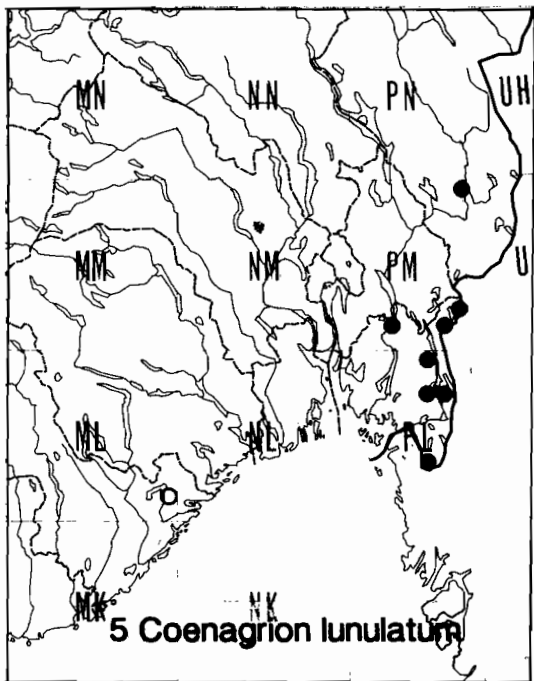
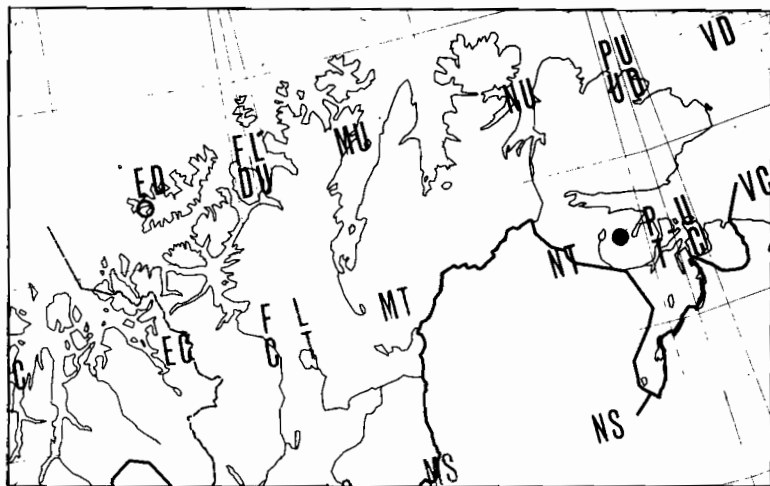


Fig. 2, 1—18. The distribution of threatened Norwegian Odonata according to 10 x 10 km UTM squares. Open circles show records before 1960, dots show records from 1960 and onwards.



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)

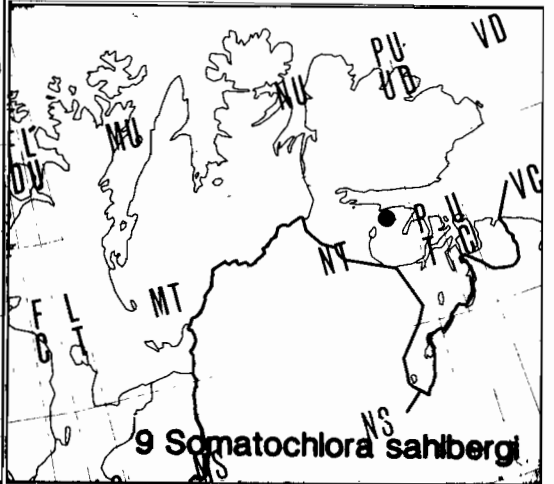
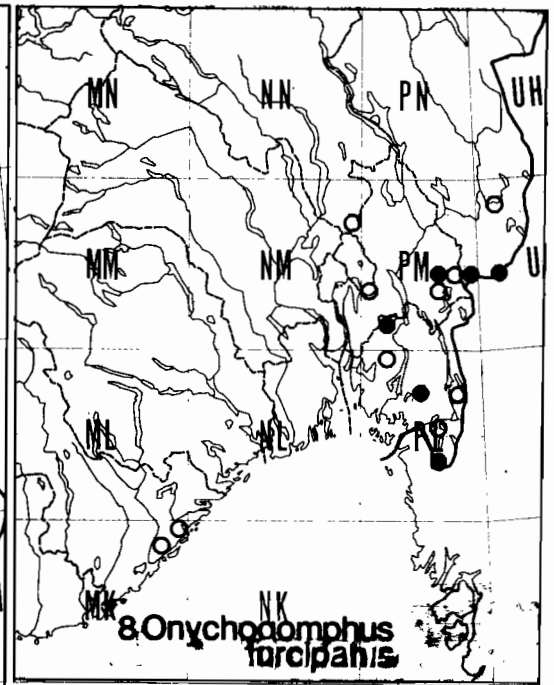
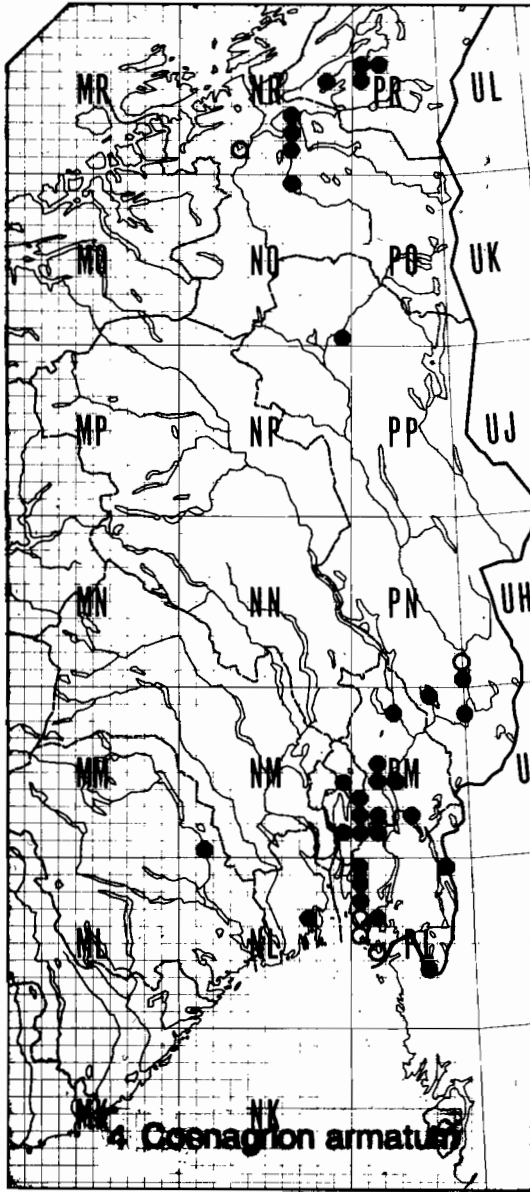
The species is previously reported from Østfold: Halden; Akershus: Ås; Vestfold: Jarlsberg (Sømme 1937a, Solem 1969). Solem's record from 1968 has so far been the only one published of this species from our century.

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.

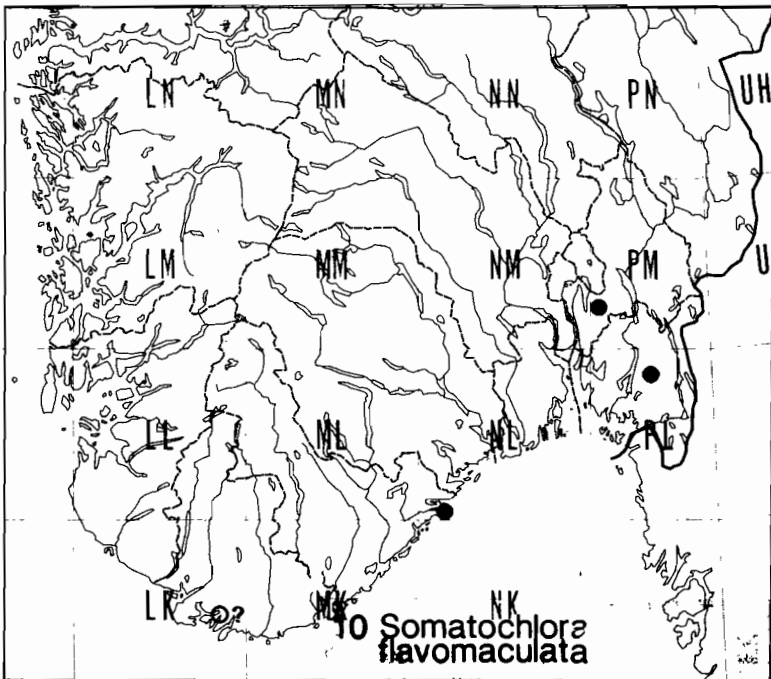
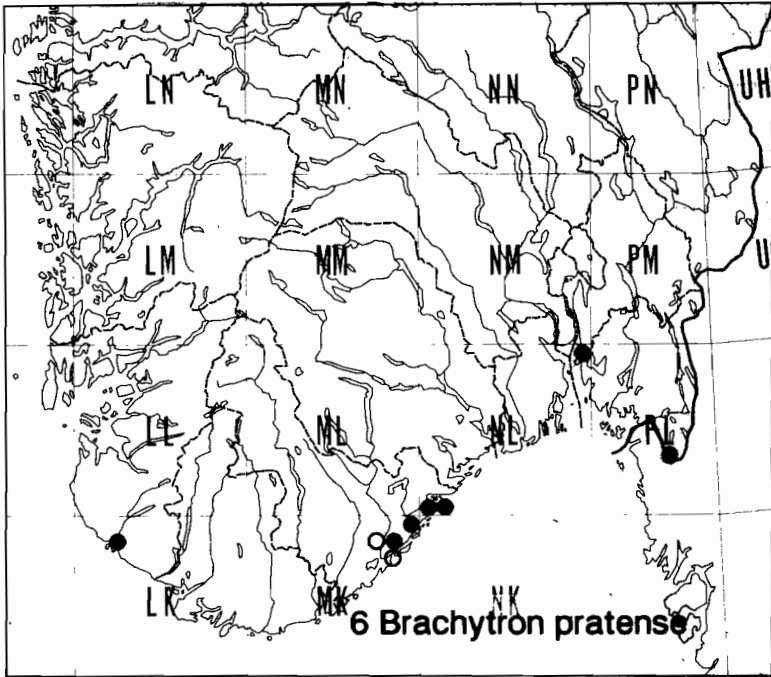
C. splendens thus occurs in three streams/rivers in Norway today, but only two of these (Berbyelva and the river Vikevatn-Bergsvatn) appear to be sites with reasonably large populations. The population of Berbyelva,

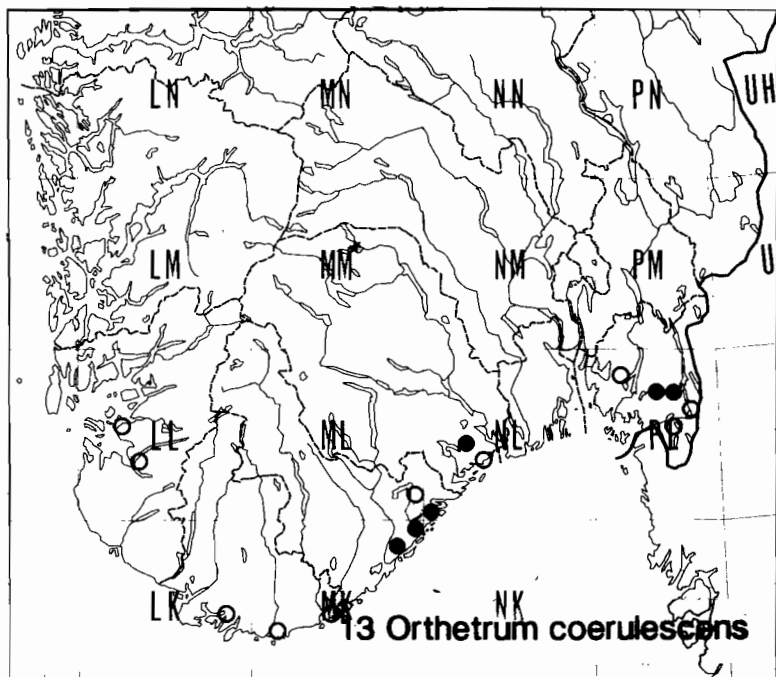
including the more common species, in a distribution table, similar to that of e.g. Lindroth (1962) and K. A. Økland (1981). Old records are sometimes not precise with respect to locality description; some circles may therefore have been placed in a neighbouring square to the correct one.



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.





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.

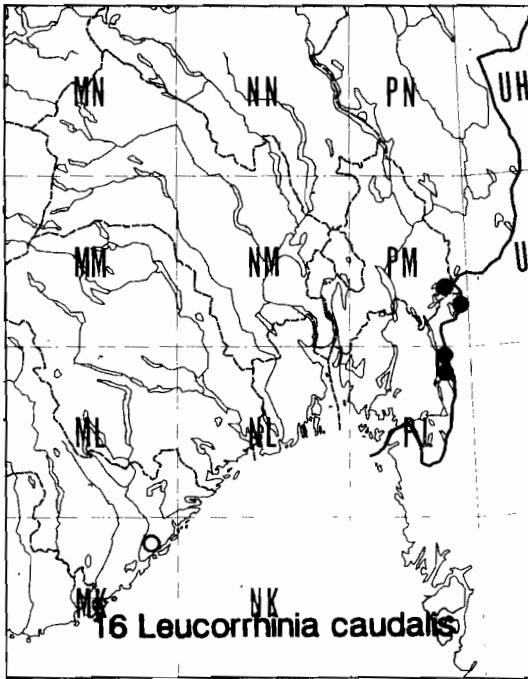
The status endangered (IUCN:E) in Norway is quite clear. The locality at Tjøme is protected as a landscape area. Although *L.*

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.

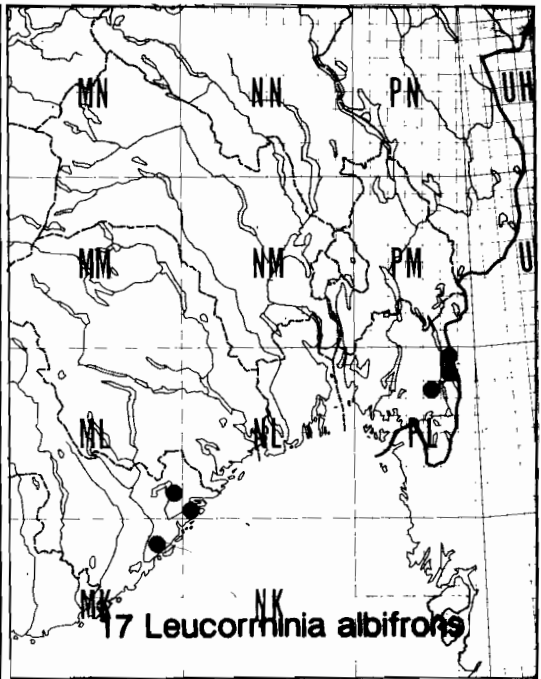
3. *Platycnemis pennipes* (Pallas, 1771)

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

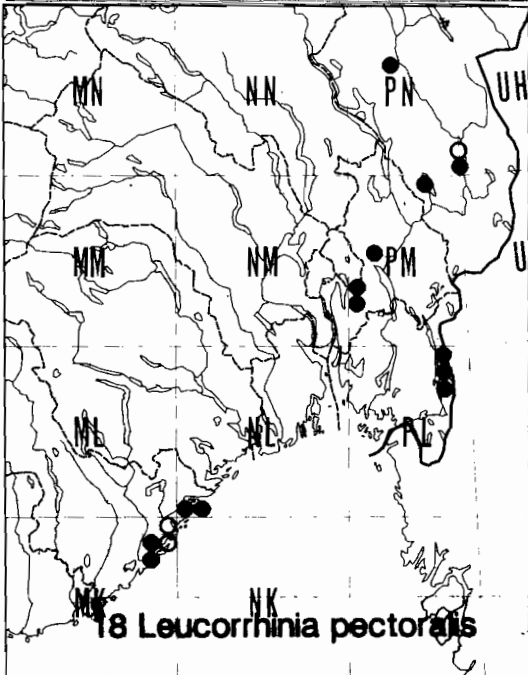
New records: Østfold (Ø): Eidsberg: Lekumelva (EIS:20) 10 June 1990 1 ind. Halden: Berbyelva (EIS:12) 15 June 1986 >50 ind.; 23 June 1989 numerous; 8 July 1989 numerous; 13 Aug. 1989 3–4 ind., 6 May 1990 several larvae; 27 May 1990 several larvae; 31 May 1990 2 ind. Outlet of Rødsvatn (Enningdalselva) (EIS:12) 31 May 1990 several. Hobøl: Hobøelva 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. Hobøelva 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 Hennes (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 Bergvatn (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 Bru-tjern (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: Bjørnerørvatn (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 ♂. Rullestadstjern (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 defensible.

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 Tre-tjern 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: Ende-tjern (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: Patterød-tjern (EIS:19) 6 June 1990 3—4 ♂♂; 30 June 1991 2 ♂♂ (OB). Aust-Agder (AAY): Fro-land: 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: Fidjevatt (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. Råbergstjern (EIS:11) 9 June 1990 1 ♂. Størdalsvatn (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. Støatjern (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. Bergstjern (EIS:6) 1930—50 (GK). Rogaland (RY): Eigersund: Fotlands-vatn 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 low-land 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 be 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: Hobølv elva 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: Hobølv elva near Nordre Hov (EIS:29) 23 July 1987 1 ♂. Skjeberg: Buerbekken (= Børtelva) (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: Bugøyenes (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: Kvernavatn (EIS:11) 3 July 1990 4–5 ♂♂; 12 Aug. 1991 1–2 ind. ? Fidjevatt (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, Vegårdshoi 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 ♂. Stordalsvatn (EIS:10) 10 Aug. 1991 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. Bråstادتjern (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. Stoaetjern (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 eutrophic 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. *Leucorrhinia 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 ♂♂. Aborttjern (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: Tvestrand 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-/Iglejtjørna (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. Romundstادتjern (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 ♂. Gjølshø (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: Svartkul

(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 ♂. Rullestادتjern (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).

	Ø+AK	HE (S+N)	O (S+N)	B (Ø+V)	VE	TE (Y+I)	AA (Y+I)	VA (Y+I)	R (Y+I)	HO (Y+I)	SF (Y+I)	MR (Y+I)	ST (Y+I)	NT (Y+I)	NS (Y+I)	NN (Ø+V)	TR (Y+I)	F (V+I)	F (N+Ø)
<i>Calopteryx virgo</i>	●	●	●	●	●	●	●	●	●	●			●	●					●
<i>Calopteryx splendens</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Lestes sponsa</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Lestes dryas</i>	●	●	●	●	●	●	●	●	●	●									
<i>Platycnemis pennipes</i>	●	●	●	●	●	●	●	●	●	●									
<i>Pyrhosoma nymphula</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Erythromma najas</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Coenagrion hastulatum</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Coenagrion lunulatum</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Coenagrion armatum</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Coenagrion johanssoni</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Coenagrion puella</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Coenagrion pulchellum</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Enallagma cyathigerum</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Ichnura elegans</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Aeshna caerulea</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Aeshna juncea</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Aeshna subarctica</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Aeshna cyanea</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Aeshna grandis</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Brachytron pratense</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Gomphus vulgatissimus</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Onychogomphus forcipatus</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Cordulegaster boltoni</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Cordulia aenea</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Somatochlora metallica</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Somatochlora alpestris</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Somatochlora arctica</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Somatochlora sahlbergi</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Somatochlora flavomaculata</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Libellula quadrimaculata</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Libellula depressa</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Orthetrum cancellatum</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Orthetrum coerulescens</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Sympetrum striolatum/nigrescens</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Sympetrum vulgatum</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Sympetrum flaveolum</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Sympetrum sanguineum</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Sympetrum danae</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Leucorrhinia caudalis</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Leucorrhinia albifrons</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Leucorrhinia dubia</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Leucorrhinia rubicunda</i>	●	●	●	●	●	●	●	●	●	●			●	●					
<i>Leucorrhinia pectoralis</i>	●	●	●	●	●	●	●	●	●	●			●	●					

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-

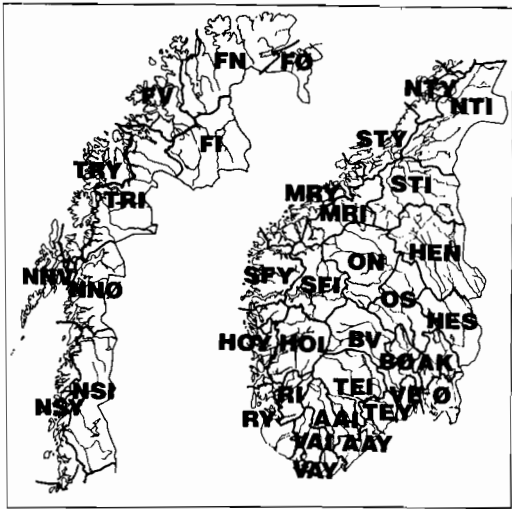


Fig. 3. The position of the different Norwegian regions in Table 1 (cf. K. A. Økland 1991).

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 countryside (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 depressa* 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 recipients, 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.

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SAMMENDRAG

Utbredelse, habitat og vernestatus for truede øyestikkerarter i Norge

Artikkelen beskriver utbredelse og habitat for de 18 øyestikkerartene som enten reknes som truede, 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*, *Letes dryas*, *Platycnemis pennipes*, *Coenagrion armatum*, *C. lunulatum*, *Gomphus vulgatissimus*, *Onychogomphus forcipatus*, *Brachytron pratense*, *Somatochlora sahlbergi*, *S. flavomaculata*, *Libellula depressa*, *Orithetrum coerulescens*, *Sympetrum vulgatum*, *S. sanguineum*, *Leucorrhinia caudalis*, *L. albifrons*, and *L. pectoralis*. En art, *Orithetrum cancellatum*, 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 øyestikkerartene i Norge er habitatødeleggelse, f.eks. gjenfylling/drenering av dammer og myrområder og, kanskje viktigst: forurensning av rennende vann.

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