Ephemera, 2001, Vol. **3** (2) : 109-116.

An annotated check-list of Swedish mayflies [Ephemeroptera]

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Keywords : Ephemeroptera, check-list, new records, Sweden.

A mayfly check-list for each Swedish province is provided, with notes on the difficulties in counting the number of species.

Catalogue annoté des éphémères de Suède [Ephemeroptera]

Mots-clés : Ephemeroptera, catalogue, citations nouvelles, Suède.

Un catalogue des Ephémères est présenté pour chacune des provinces suédoises. Il est assorti de commentaires relatifs à la difficulté de dresser une liste exhaustive des espèces.

1. Introduction

How many mayfly species are there in Sweden ? At present there is no definite answer to this question. This is largely due to the ice sheet that has covered Scandinavia on a number of occasions and caused taxonomic problems. Another reason is that the identification and reintroduction of the former doubted species described by Simon Bengtsson has not yet been completed ; a few aspects still require clarification. When it comes to creating check-lists for each province, it is mainly a question of being in the right place at the right time.

When THOMSON (1862) made the first identification key for Swedish adult mayflies, he had nine species to consider, described by Linné and De Geer. Fifty years later the list of Swedish mayflies was twice as long but in some disarray. Bengtsson never made a check-list, but between 1904 and 1936 he wrote a number of papers, most of them about the new species he had found. A few mayflies, like *Rhithrogena* and *Prosopistoma*, he never mentioned, although he doubtless knew of them. These included, Bengtsson probably considered there to be 51 mayfly species in Sweden.

2. Sources and material

The check-list presented here is based on mayflies collected over the last 25 years.

Most of the records are of larvae found in some 10,000 bottom fauna samples, mainly collected by P-E. Lingdell and E. Engblom (LIMNODATA HB). Contributing collectors are too numerous to mention here; their names should be found in the Swedish Environmental Protection Agency database. Additional, non-computerised, adult material from hundreds of locations has also been collected by a number of individuals. Contributors of a few unique findings important to Table 1 are mentioned in the table legend.

The author has identified all the province records, except for the literature additions e.g. *Parameletus minor* (SÖDERSTRÖM & NILSSON 1986) and *Electrogena affinis* (BELFIORE & al. 1999). The check-list in ENGBLOM (1996) gives 57 species : three names have been removed from that list and other names added to create an up-to-date check-list of 58 species and 7 variations.

3. Notes on the provinces

Table 1 suggests that the north of Sweden is richer in mayfly species than central or southern Sweden. This was very likely not true a hundred years or so ago, but nowadays the north is less affected by acidification and pollution than the rest of the country.

The divergent figures for the southern provinces require comment. The two calcareous islands of Öland (ÖL) and Gotland (GO) are poorest in species. Most running water on Öland dries out in summer. Gotland has a number of fine rivers, but its position in the Baltic Sea is perhaps too isolated for many mayfly species. In addition not polluted waters on this island are in general small sized source-streams cold even in the summer.

DS and BO on the West Coast have suffered severely from acidification. The single record of *Cloeon dipterum* in BO is from a small lake accidentally over-limed with soda, resulting in a pH of over 10. Over the last 20 years strenuous efforts have been made in HA to restore waters to original pH. A large number of species as for example *Baetis liebenauae* are able to survive there solely thanks to liming. The main problem in the small province of BL is pollution.

To some extent, the number of species and their abundance in each province mirrors the intensity of the collecting efforts made ÖG being the least studied. Despite the low number of species, VS, in the centre of the country, is the most intensively searched province for mayflies.

4. Inward migration

For a number of Swedish mayflies there are two of a kind, presumably an effect of divergent postglacial immigrant histories. In my opinion *Heptagenia sulphurea* and *H. dalecarlica* are definitely two different species, and so are *Serratella ignita* and *S. lactata*. In contrast, *Ameletus alpinus-inopinatus* and *Baetis rhodani-wallengreni* are so intimately related that they are perhaps impossible to distinguish.

Two provinces (TO and JÄ) have mountain passages towards the west. After the last ice age these were used by mayflies recolonising from relict Norwegian populations, one likely example is *Ameletus inopinatus*. No further species are expected from that direction.

A number of species appears to have migrated to NB from the east via Finland. A possible recent addition to the mayfly fauna is *Heptagenia orbiticola*, first collected in 1961. Moor mayflies can be expected in NB, since species like *Baetis tracheatus* and *B. liebenauae* are found on the other side of the Border River.

SK is the gateway to the south. *B. liebenauae* and *Electrogena affinis* probably came here via Denmark. These are truly recent additions: both of them seem to have arrived as late as the 1970s. Ongoing climate change may be expected to bring hitherto further unrecorded species into the country from the south.

Since both SK and NB are open for inward migration, they ought to be the two best mayfly provinces, but surpassed by Dalarna (DR) where many species with a southerly or northerly distribution overlap. Some 40 or so species is probably the upper limit for a Swedish province.

The provinces of Sweden / Les provinces de Suède

Northern / Région Nord / Norrland

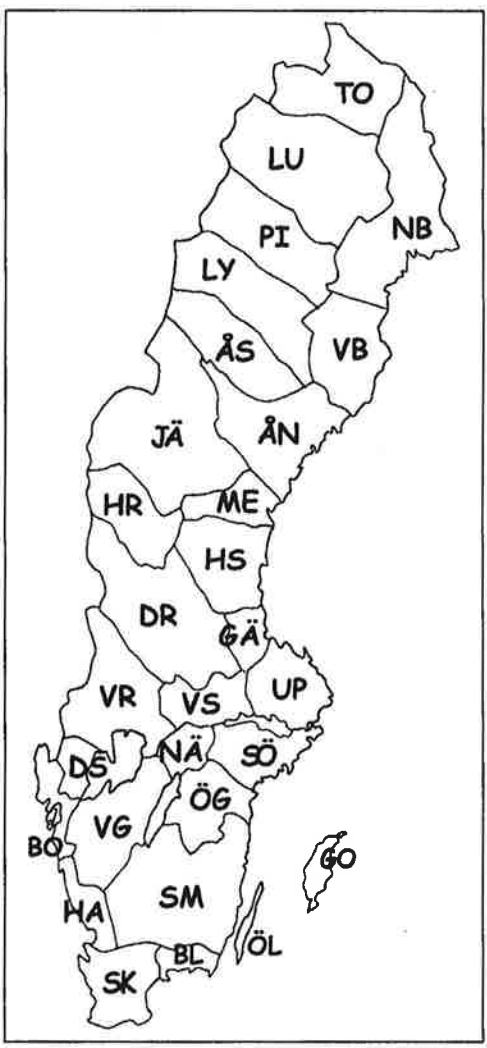
TO	Torne Lappmark
LU	Lule Lappmark
PI	Pite Lappmark
LY	Lycksele Lappmark
ÅS	Åsele Lappmark
NB	Norrbotten
VB	Västerbotten
JÄ	Jämtland
ÅN	Ångemanland
HR	Härjedalen
ME	Medelpad
HÄ	Hälsingland
GÄ	Gästrikland

Central / Région centrale / Götaland

DR	Dalarna
VR	Värmland
VS	Västmanland
UP	Uppland
NÄ	Närke
SÖ	Södermanland

Southern / Région Sud / Svealand

DS	Dalsland
VG	Västergötland
ÖG	Östergötland
BO	Bohuslän
HA	Halland
SM	Småland
ÖL	Öland
GO	Gotland
SK	Skåne
BL	Blekinge



The provinces of Sweden / Les provinces de Suède.

	Swedish Ephemeroptera	RD	SK	BL	HA	SM	ÖL	GO	ÖG	VG	BO	DS	NÄ	SÖ	UP	VS	VR	DR	GÄ	HS	ME	HR	JÄ	ÄN	VB	NB	ÅS	LY	PI	LU	TO	Total
1	*Parameletus chelifer* Bengtsson, 1908																	2		1	1	2	2	1	1	2	2	2	1	2	2	13
2	*Parameletus minor* (Bengtsson, 1909)																				1				L	2	L	1	L	L	1	8
3	*Siphlonurus aestivalis* (Eaton, 1903)		2	2	1	2		2	1	2	2	1	1	1		1	2	2	2	2	2	2	2	2	1	2	3	2	1	2	2	27
4	*Siphlonurus armatus* (Eaton, 1870)	NT												2	1																	2
5	*Siphlonurus lacustris* (Eaton, 1870)														1	1	1	3	1	3	2	3	3	2	1	2	3	3	2	2	2	17
6	*Siphlonurus alternatus* (Say, 1824)		1	2	1	2		1	1	2			2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	26
7	*Ameletus alpinus* Bengtsson, 1913		1		1	1				1								3		2	2	3	3	2	1	2	3	3	2	3	2	17
7b	*Ameletus inopinatus* Eaton, 1887																														2	1
8	*Metretopus alter* Bengtsson, 1930																	1			1	2	2	1	1	2	2	2	2	2	2	12
9	*Metretopus borealis* (Eaton, 1871)					1			1							1	1	2	2	3	2	2	2	1	2	2	2	2	2	2	2	18
10	*Acentrella lapponica* Bengtsson, 1912																	1				2	3			1	2	3	2	2	2	9
11	*Alainites muticus* (Linné, 1758)		2	2	1	2			1	2		1		1	1	2	1	3	1	2	2	3	3	2	1	2	3	3	2	2	2	25
12	*Baetis buceratus* Eaton, 1870		1			1			1	2			1		1	1			1					1								9
13	*Baetis bundyae* Lehmkuhl, 1973																	2			1	2	2	1	1	1	1	2	2	2	2	12
14	*Baetis fuscatus* (Linné, 1761)		1	2	2	2			1	2	1		2	2	2	2	2	3	2	3	2	3	3	2	2	2	3	2	2	2	2	26
15	*Baetis liebenauae* Keffermüller, 1974		1	2	1	1				1																						5
16	*Baetis macani* Kimmins, 1957		1							1			1	2	2				1	1					1	1	1			1	1	12
17	*Baetis rhodani* (Pictet, 1845)		3	3	2	3			2	3	2	2	2	3	2	3	2	3	2	3	3	3	3	3	2	2	3	3	3	3	3	27
18	*Baetis gemellus*-form		2		1																											2
19	*Baetis subalpinus* Bengtsson, 1917					1									1	2	2	3	2	3	2	3	3	3	2	3	3	3	2	3	3	18
20	*Baetis tracheatus* Keffermüller & Machel, 1967	CR												1																		1
21	*Baetis vernus* Curtis, 1834		1	1	1	2			1	2	1	1	1	2	2	2	1	1	1	2	1				1		1	1			1	21
21b	*Baetis vernus*-group													1	1		1															3
22	*Nigrobaetis digitatus* (Bengtsson, 1912)		1	2	2	2			1	2	1	1	2	1	1	1	1	2	2	2	2	1	2	2	1	1	2	1			1	25
23	*Nigrobaetis niger* (Linné, 1761)		2	2	2	3			2	3	2	2	2	3	2	3	2	3	2	3	3	3	3	3	2	2	3	2	2	2	2	27
24	*Centroptilum luteolum* (Müller, 1776)		2	3	2	3		2	2	2	2	2	2	3	2	3	2	3	2	3	3	3	3	3	2	2	3	2	2	2	1	28
24a	*Centroptilum luteolum*-group		1	1	1	1	1	2	1	1	1	1	1	1	1	2	1	1		1							1					18
24b	*Centroptilum luteolum*-group																											1		1		2
25	*Cloeon dipterum* (Linné, 1761)		1		1						1			2	2																	5
26	*Cloeon inscriptum* Bengtsson, 1914		2	2	2	3	1	2	2	2	2	2	2	3	3	3	2	2	2	2	2		1	3	1		1	1				24
27	*Cloeon praetextum* Bengtsson, 1914		1		1	1				1	1		1	1	1	1	2	1		2			1	1	1	1	1	1	2	1		20
27b	*Cloeon praetextum*-group													1																		1
28	*Cloeon schoenemundi* Bengtsson, 1936	VU					1	1																								2
29	*Cloeon simile* Eaton, 1870					1	1	2																								3
30	*Procloeon bifidum* (Bengtsson, 1912)		1	2	2	2				1	1	1	1	1	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	1	26
31	*Arthroplea congener* Bengtsson, 1909					2			1	2	1	1	1	2	1	2	2	2	2	2	3	2	2	3	1	2	3	2	2	2	2	24
32	*Electrogena affinis* (Eaton, 1885)		L							1																						2
33	*Heptagenia dalecarlica* Bengtsson, 1912																	3	2	2	2	3	3	3	2	2	3	3	3	2	2	14

Table 1.

Swedish Ephemeroptera (continued)		RD	SK	BL	HA	SM	ÖL	GO	ÖG	VG	BO	DS	NÄ	SÖ	UP	VS	VR	DR	GÄ	HS	ME	HR	JÄ	AN	VB	NB	AS	LY	PI	LU	TO	Total
34	*Heptagenia sulphurea* (Müller, 1776)		2	2	2	3			2	3	1	1	2	2	1	2	2	3	2	3	2	3	3	2	1	2	3	2	2	2	2	27
35	*Heptagenia fuscogrisea* (Retzius, 1783)		2	3	2	3		1	2	3	2	2	2	3	2	3	3	3	2	2	3	2	2	3	2	2	3	2	2	2	1	28
36	*Heptagenia orbiticola* Kluge, 1986	DD																					1		1	1		1	1	1		6
37	*Paracinygmula joernensis* (Bengtsson, 1909)																1	2		2	2	3	3	2	1	2	2	2	2	2	2	14
38	*Rhithrogena germanica* Eaton, 1885	NT	1		1	1				2																						4
39	*Leptophlebia marginata* (Linné, 1767)		2	2	3	3			2	3	2	2	2	3	2	3	3	3	2	3	3	3	3	3	2	2	3	2	2	2	2	27
40	*Leptophlebia vespertina* (Linné, 1758)		2	2	3	3	1	2	2	3	2	2	2	3	2	3	3	3	2	3	3	3	3	3	2	2	3	2	2	2	2	29
41	*Paraleptophlebia cincta* (Retzius, 1783)			2	1	1				2				1		1	1	2	1	2	2	1	1	2	1	1	2	1	1	1	1	21
42	*Paraleptophlebia strandii* (Eaton, 1901)																	2		2	1	1	2	2	2	2	2	2	2	2	2	13
43	*P. submarginata* (Stephens, 1835)																														1	1
44	*Paraleptophlebia werneri* Ulmer, 1919	DD																										1	1		1	3
45	*Ephemera danica* Müller, 1764		2		2	2			2	2	1	1	2			1	1	2	2	2	2	2	3	2	1	2	2	1	1	1		23
46	*Ephemera glaucops* Pictet, 1845	NT								1					A		1															3
47	*Ephemera vulgata* Linné, 1758		2	2	2	2			2	2	1	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2	2	1	1	2	1	27
48	*Ephemerella aurivillii* (Bengtsson, 1907)									1						1	1	3	1	2	2	3	3	2	2	2	3	3	3	3	2	17
49	*Ephemerella mucronata* (Bengtsson, 1909)																2	2		2	2	2	2	2	1	2	2	2	2	2	1	14
50	*Serratella ignita* (Poda, 1761)		2	2	1	2			1	2		1	1		2	1	1	2	2	2	1	2	1	2	1	2	1	1	1	1	1	25
51	*Serratella lactata* (Bengtsson, 1909)												1		1	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	1	18
52	*Brachycercus harrisellus* Curtis, 1834	NT	1			1														1	1			1								5
53	*Caenis horaria* (Linné, 1758)		2	2	2	3	1	2	2	2	2	2	2	3	2	3	2	2	2	2	2	1	1	3	2	1	2	1	1	1	1	29
53b	*Caenis horaria*-group																							1								1
54	*Caenis lactea* (Burmeister, 1839)		1	1		1							1	1	1	1	1	1			1			A	A	1						13
55	*Caenis luctuosa* (Burmeister, 1839)		2	2	2	3	1	2	2	2	1	1	2	3	2	2	1		1	1	1											19
56	*Caenis macrura* Stephens, 1835	DD						1					A																			2
57	*Caenis rivulorum* Eaton, 1884		2	1	2	2				2	1		1	1				1		1	1	2	2	2			1	1	1	1	1	19
57b	*Caenis rivulorum*-group					1			1	1			1																			4
58	*Caenis robusta* Eaton, 1884								1	1			1	2	2	1	1	1	1													9
0	*Prosopistoma pennigerum* (Müller, 1785)	RE																														0
Number of Species & Variations			33	24	29	35	7	12	25	35	22	20	30	31	32	32	35	41	31	38	39	34	37	39	39	39	40	40	38	37	39	

Table 1. (continued). Provincial records and abundance of Swedish mayflies.

1 = low abundance (< 5 sampling sites), 2 = moderate abundance (5-50 sites), 3 = high abundance (> 50 sites), L = literature (2VB-2PI-2LU & 32SK), A = adults. RD : red list : RE : regionally extinct; CR : critically endangered ; VU : vulnerable ; NT : near threatened. Collectors : A = 46UP (Håkan Elmqvist), 54ÅN & 54VB (Karl Müller), 56NÅ (Anders N. Nilsson).

Tableau 1. (suite). Répartition et abondance des éphémères de Suède.

1 = peu abondant (< 5 stations d'échantillonnage), 2 = abondant (5-50 stations), 3 = très abondant (> 50 stations), L = littérature (2VB-2PI-2LU & 32SK), A = adultes. RD : liste rouge ; RE : disparu de la région ; CR : situation critique ; VU : vulnérable ; NT : near threatened. Récolteurs : A = 46UP (Håkan Elmqvist), 54ÅN & 54VB (Karl Müller), 56NÅ (Anders N. Nilsson).

5. Omitted records

Various kinds of human influence have rendered many older locations unsuitable for mayflies. For instance, efforts to rediscover *Ephemera glaucops* in a lake in SÖ were in vain.

Sadly, two species have been removed from the current list. *Prosopistoma pennigerum* (Müller, 1785) has not been found since 1916, when it was recorded in HA and BL (ALM 1918). The record of *Ephemera lineata* Eaton, 1870 from SK (WALLENGREN 1882) might be doubtful (BENGTSSON 1912b). However, single larvae by the author not acceptable as *E. danica* have been sampled in different rivers in central Sweden. Efforts to collect these larvae for rearing purposes have so far been unsuccessful.

6. New records

Baetis tracheatus is new to Sweden, collected on 11 September 1996 by R. Huononen in lake Turingen (SÖ) 59°12'N, 17°27'E (LINGDELL & al. 1996, taxa list in appendix 4).

Electrogena affinis, known from SK since 1975 but recently identified (BELFIORE & al. 1999), was found much further north on 30 September 1997, collected by P. Holmberg in the river Knipån (VG) 57°56'N, 14°02'E (LINGDELL & ENGBLOM 1997, taxa list on page 34).

Rhithrogena germanica seems to be the only species of *Rhithrogena* in Sweden, a conclusion drawn having reared and compared larvae from different locations. In 1983 *R. germanica* was known from SK only, but this species has now also been recorded much further north. It was collected on 30 September 1997 by P. Holmberg in the river Hornån (VG) 57°58'N, 14°04'E.

Paraleptophlebia submarginata has finally been preserved in alcohol. Older records have either turned out to be wrong determinations or the material is absent. The specimens identified by JENSEN (1974) cannot be found in the Kaltisjokk material (TO). Perhaps Jensen took them back to Denmark. However larvae of *P. submarginata* were collected by D. Evander on 15 September 1999 in the small brook Soulojoki, SW of Kiruna (TO) 67° 48'N, 20° 04'E.

7. Notes on some of the mayflies

It is clear from Table 1 that much remains to be clarified.

7b. The status of *Ameletus* has not been fully determined. Material collected recently from Lake Baïkal confirms the view of *A. alpinus* as an eastern intruder and *A. inopinatus* as the original Scandinavian species. Bengtsson found *Ameletus* only in the mountains. Nowadays *Ameletus* has a scattered distribution throughout the country. The mountain regions (Norway included) seem to be a hybrid zone with intermediate forms resulting from interbreeding.

14. The *Baetis fuscatus*-group requires more collecting and rearing to ascertain their number.

17-18. *Baetis rhodani*-group includes at least three different varieties. The small *B. gemellus*-form (ENGBLOM 1996, fig. 32) is probably *B. pusillus* Bengtsson, 1912. The medium-sized variety, which might be a genuine *B. rhodani*, is very difficult to distinguish from the larger *B. wallengreni* Bengtsson, 1912.

21b. *Baetis vernus* has a particular tendency to exhibit local variations but «*B. vernus* with long gills» (ENGBLOM 1996, fig. 211b), easily recognised in its larval form, seems to be one and the same within a given distribution area.

24a. *Centroptilum* sp. (ENGBLOM 1996, fig. 17) must be regarded as a species different from the ordinary *C. luteolum*. Progress on this issue has been thwarted, or at least severely delayed, as a result of artificial impact of the water flow. Understanding 24b will require more material.

27b. *Cloeon praetextum*-group is an endemic creature, known from a single lake. It is probably a new species, but larvae have so far avoided the sampling tray.

34. BENGTSSON (1917) mentions a *Heptagenia sulphurea* var. *citrina*. These yellow larvae are to be found in fairly large rivers in southern Sweden. Their gill-tufts are larger and more branched than for ordinary *sulphurea*. This may be the sole distinction.

35. BENGTSSON (1917) gives two imago variations for *Heptagenia fuscogrisea* : the yellow-green *ictericus* and the greenish black *nigrovirens*. *H. fuscogrisea* is one of the most variable mayfly species, especially when it comes to gill shape. Larvae from a number of waters have been reared, always with the same result, which is probably *ictericus*.

53b. *Caenis horaria* from brackish water (ENGBLOM 1996, fig. 147) has not yet been reared.

57b. Last but not least there is the endemic speciality *Caenis rivulorum*-group, in ENGBLOM (1996) wrongly identified as *C. beskidensis*. More rearing will take place next spring.

8. Overlooked mayfly species

Siphlonurus armatus, first recorded in SK (BENGTSSON 1917), might be the most overlooked species. It is present for four to five weeks in early spring and may prefer small coastal ditches, an aquatic habitat not usually included in environmental monitoring. There ought to be a number of suitable sites for this species, especially on Öland (ÖL).

Brachycercus harrisellus, another species only collectable for a few weeks each year and in a very specific type of biotope, is probably more common in rivers along the East Coast.

Two lake species there is good reason to suspect are more frequent are *Caenis macrura* and *Ephemera glaucops*, which lurk in deep water.

Knowledge of the distribution of most Swedish mayflies is passable, at least in the north of the country. Southern distribution areas are fragmented and there may still be undiscovered refuges holding further province records, or even relict populations of mayflies not yet described.

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(paru en juin 2003)