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THE STONEFLIES (PLECOPTERA) OF THE NETHERLANDS

E.E.C.M. Claessens

Rijksmuseum van Natuurlijke Historie, Leiden *

Introduction

Recently I have made a survey of the Dutch species of stoneflies (Plecoptera). This study was started because we had the impression that the number of species of this insect order had declined severely in the course of this century, while some of the remaining species had become much restricted in their distributions. The important changes in abundance and distribution were expected to be related with the severe deterioration of the environment, especially during the more recent decades. The aim of the present study was to describe the present situation for all Dutch species against the background of documented historical data and show the near-extinction of a whole insect order in our country (Claessens in prep.).

Some general information on Plecoptera

The Plecoptera comprise ca. 1500 recent species, 387 of which occur in Europe (Illies 1978). The larvae usually inhabit running waters, such as

springs, brooks and rivers, but some live on the shores of lakes. The order occurs world-wide, but is excluded from the tropics. The species diversity is greatest in the temperate regions.

The most important factors influencing distribution are stream velocity, altitude, substratum, chemical composition of the water, temporal drying out of the habitat and the ability to colonize (e.g. Hynes 1941). The water movement influences the oxygen content and substratum; altitude the temperature of the water.

The imagines of most species emerge early in spring, but some emerge only in autumn. They are poor flyers and usually hardly migrate, and re-establishing after local extinction is very slow. Disturbance of the habitat therefore has a long-time effect in this group of insects. Because of their inconspicuous colour and low flight activity Plecoptera are not collected as much as the more showy and busy beetles and butterflies. Earlier records are scarce, but during the last twenty years more data have become available through hydrobiologists sampling larvae.

The Dutch list

The Netherlands are relatively poor in species. Until now only 28 species have been recorded

* Present address: Minister Loudonlaan 71,
7521 BB Enschede

Table 1

Check list of Dutch Plecoptera

Species	Records
1. <i>Brachyptera risi</i> (Morton, 1896)	Before 1900 only
2. <i>Brachyptera trifasciata</i> (Pictet, 1832)	Before 1900 only
3. <i>Taeniopteryx nebulosa</i> (Linnaeus, 1758)	18.. - 1954
4. <i>Oemopteryx loewii</i> (Albarda, 1889)	Before 1900 only
5. <i>Amphinemura standfussi</i> (Ris, 1902)	1925 - present
6. <i>Nemoura avicularis</i> Morton, 1894	18.. - present
7. <i>Nemoura cambrica</i> Stephens, 1835	1903 - present
8. <i>Nemoura cinerea</i> (Retzius, 1783)	18.. - present
9. <i>Nemoura dubitans</i> Morton, 1894	18.. - present
10. <i>Nemoura marginata</i> Pictet, 1836	1931 - present
11. <i>Nemurella pictetii</i> Klapálek, 1900	18.. - present
12. <i>Protonemura meyeri</i> (Pictet, 1841)	18.. - 1937 ?
13. <i>Protonemura nitida</i> (Pictet, 1835)	1953
14. <i>Euleuctra geniculata</i> (Stephens, 1835)	18.. - 1955
15. <i>Leuctra nigra</i> (Olivier, 1811)	1954 - present
16. <i>Leuctra fusca</i> (Linnaeus, 1758)	18.. - 1955
17. <i>Isogenus nubecula</i> Newman, 1833	18.. - 1936
18. <i>Isoperla grammatica</i> (Poda, 1761)	18.. - 1954
19. <i>Isoperla obscura</i> (Zetterstedt, 1840)	Before 1900 only
20. <i>Perlodes microcephala</i> (Pictet, 1833)	18.. - present
21. <i>Dinocras cephalotes</i> (Curtis, 1827)	Before 1900 only
22. <i>Marthamea selysii</i> (Pictet, 1841)	18.. - 1918
23. <i>Perla burmeisteriana</i> Claassen, 1936	Before 1900 only
24. <i>Isoptena serricornis</i> (Pictet, 1841)	18.. - 1925
25. <i>Chloroperla tripunctata</i> (Scopoli, 1763)	Before 1900 only
26. <i>Siphonoperla torrentium</i> (Pictet, 1841)	Before 1900 only
27. <i>Siphonoperla burmeisteri</i> (Pictet, 1841)	Before 1900 only
28. <i>Xanthoperla apicalis</i> (Newman, 1836)	18.. - 1916
-- <i>Protonemura</i> spec. (larva)	1954 - present

(Table 1), as compared with 54 for Belgium (Aubert 1956, 1957) and about 108 for Western Germany (Illies 1955, Joost 1963, 1965). Of these 28 species three are to be considered doubtful, viz. *Dinocras cephalotes*, *Perla burmeisteriana* and *Siphonoperla burmeisteri*, no material being preserved. These species were recorded earlier in species lists by Albarda (1889) and Geijskes (1940). Especially the occurrence of *S. burmeisteri* seems highly unlikely, because it is restricted to North and Eastern Europe and Mauretania. Geijskes (1940), too,

mentioned 28 species of Dutch stoneflies, but two species have to be removed from his list, while two others must be added: *Perlodes mortoni* is now considered as a short-winged form of *P. microcephala*; the single recorded specimen of *Protonemura lateralis*, from near Arnhem, appears to belong to *P. meyeri*. The two new additions are *Leuctra nigra*, for the first time collected in 1954 (Smissaert 1956) and *Protonemura nitida*, for which we have a single record from South Limburg (1953).

A survey of the disappeared species

Even before 1940 the aquatic environment in our country was so severely polluted that 14 species had already disappeared before that year, all species from our larger rivers, Rhine and Meuse. Of these 14, nine had only been collected before 1900 (Table 1). *Oemopteryx loewii* and *Marthamea selysii* probably are completely extinct now. *O. loewii* inhabited the Rhine and has not been collected after 1900; *M. selysii* was typical for the river Meuse and was last recorded from the Netherlands in 1918.

Between 1940 and 1960 five species seem to have disappeared: *Taeniopteryx nebulosa*, *Isoperla grammatica*, *Leuctra fusca*, *Protonemura nitida* (?) and *Euleuctra geniculata*, all living in our smaller rivers and larger brooks. Next to the increased pollution, which following the larger rivers also affected our smaller streams, the regulation of our brooks and rivulets may have contributed to this local extinction.

The distribution of our present species

The remaining ten species live more or less successfully in the Netherlands, although some have now a very limited distribution and are very close to local extinction. This particularly holds for *Perlodes microcephala*, our last representative of the Perlodidae. According to Smis-saert (1959) this species was common in the river Geul (South Limburg), but in recent times it appears to be very difficult to find and should be classified as very rare.

Nemoura marginata is only known from South Limburg, living in small brooklets near the river Geul.

Leuctra nigra has been recorded from Middle-Limburg and from the surroundings of Nijmegen. From the latter locality also *Nemoura cambrica* is known.

The most abundant Dutch species, *Nemoura cinerea*, lives all over the Pleistocene parts of the Netherlands. It is comparatively highly resistant against water pollution. The other species (*Amphinemura standfussi*, *Nemoura avicularis*, *N.*

dubitans and *Nemurella pictetii*) have a more scattered distribution, with the exception of the *Protonemura* larva (probably conspecific with *P. nitida*), which only lives in the southernmost part of the province of Limburg.

Distribution and ecology of three species

Isogenus nubecula

I. nubecula is a 14-20 mm large species of the Perlodidae. It occurs from Middle Europe to Siberia. It seems to be rather scarce in recent times. It was last recorded in Austria in 1868 (Kühntreiber 1934), in Belgium in 1888 (Aubert 1956) and in Switzerland in 1910 (Aubert 1959).

The oldest Dutch records are reported by Albar-da (1889), the last specimen was collected in 1936. Dutch collections comprise 18 specimens collected before 1900 and 23 between 1900 and 1936. It was chiefly collected along the river Rhine between Rotterdam and Arnhem (Fig. 1).

The ecology of this species remains largely unknown; it inhabited the larger rivers and probably has never been abundant (Illies 1955). It was rediscovered in Great Britain in 1959 in a fast running river, which recovered from a light pollution (Hynes 1963). Dutch rivers are too much polluted now to expect new records.

Nemoura dubitans

A species of 6 to 9 mm, belonging to the Nemouridae. It is distributed over Middle and Northern Europe. It is also known from Belgium, Western - Germany, Denmark and Great-Britain.

Dutch records come from c. ten localities scattered over the southern and eastern provinces. (Fig. 2). Geijskes (1940), in his survey, only mentioned Venlo, Hatert and Oisterwijk.

Its habitat are little shallow spring brooks (Hynes 1941). Wojtas (1963) found it in a small brooklet grown with plants, draining a peat moor. In the Netherlands *N. dubitans* is found in trickles where seeping water is present. Vegetation is usually abundant. Imagines have been found in May and June.

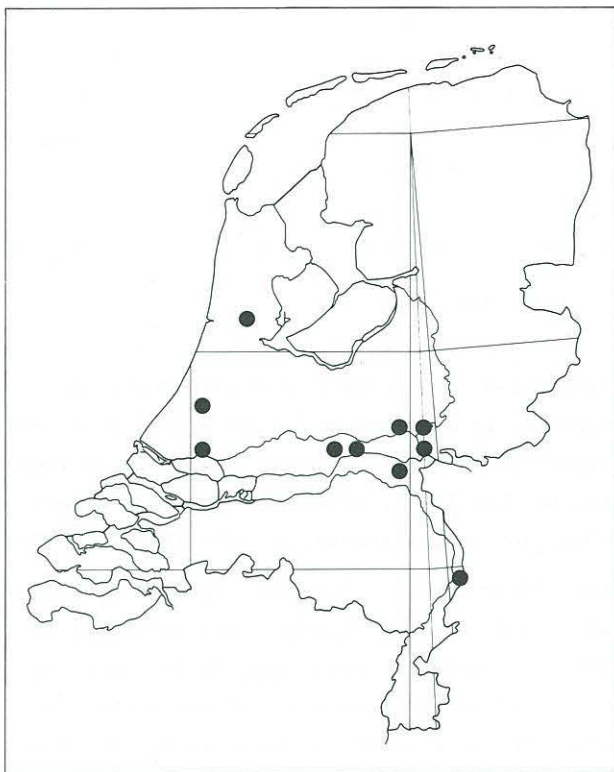


Fig. 1. *Isogenus nubecula*

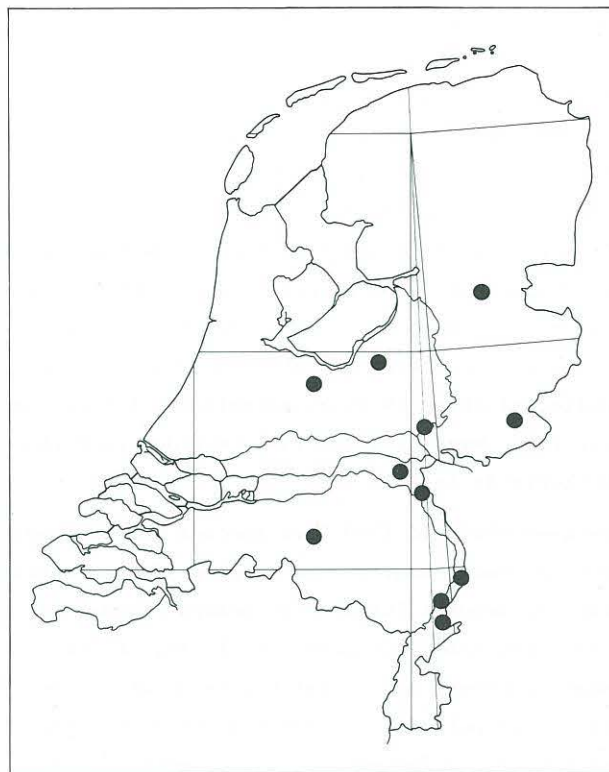
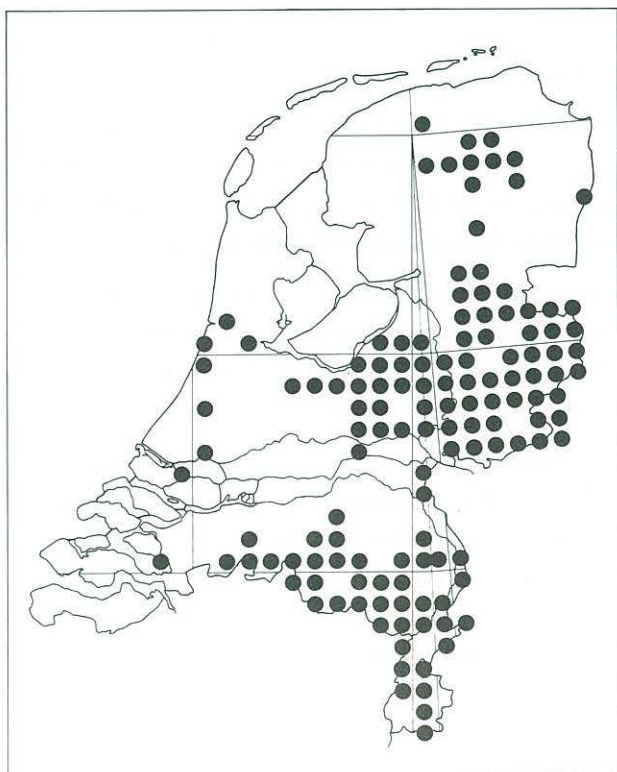


Fig. 2. *Nemoura dubitans*

Fig. 3. *Nemoura cinerea*



Nemoura cinerea

A species of 6-9 mm of the family Nemouridae. It is the most widespread stonefly, living all over Europe and Middle Asia. Also in the Netherlands it is the most common and most abundant species (Fig. 3).

The Albarda collection (before 1889, in Rijksmuseum van Natuurlijke Historie, Leiden) comprises only 15 specimens. Up to the present *N. cinerea* can be found in very large numbers in slow running waters with half-decayed leaf-packets. As noted before it requires a relatively low oxygen content (40%), and is also hardly influenced by temperature. In the Netherlands it locally inhabits even stagnant waters.

It has a one-year life cycle. The eggs go in diapause for up to seven months, when the biotope dries up in summer. After a drought-period the further development can be completed in three to eight months (Beyer 1980). A population of stoneflies is most sensitive to drying up of the water when the imagines are ready to emerge. In Holland this time lasts from March till May for *Nemoura cinerea* (Beyer 1980).

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