

## SOME OBSERVATIONS ON THE DISTRIBUTION AND LIFE HISTORY OF CAENIS ROBUSTA EATON (EPHEMEROPTERA) IN CHESHIRE AND NORTH SHROPSHIRE, ENGLAND

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### Abstract

*Caenis robusta* Etn. was found in only 8 of 107 water bodies sampled. All the habitats from which it was recorded contained plant debris; the waters were still or slow-flowing and had conductivities ranging from 120-687  $\mu\text{mhos cm}^{-1}$  at 25°C.

In North Shropshire, England, *C. robusta* had one generation per year. Newly hatched nymphs were abundant in August and growth occurred rapidly until September. No growth took place from October until March but was again rapid from April until June. Emergence took place at dusk in late June and July.

### Introduction

There is little published information on the distribution and life history of *Caenis robusta* Etn. in the British Isles. The present authors have succeeded in tracing records from only Norfolk, Berkshire, Hampshire, Shropshire (Macan, 1970) and Lincolnshire (Langford & Bray, 1969). The only published data on life history are based on the period of emergence (Mackey, 1978). Macan (in litt.) has kindly told us of three as yet unpublished records from the south of England.

This article gives an account of the life history of a population of *C. robusta* in a North Shropshire pool based primarily on the growth patterns of the nymphs and includes a survey of the distribution of this species in over 100 meres, ponds and rivers during the period 1971-1978.

### Methods

The life history was studied in pool 1 at Brown Moss (Table 1) where *C. robusta* was abundant and where no other species of *Caenis* was recorded. Monthly samples were taken at two stations, one in a bed of *Typha latifolia* L. with a water depth of a few centimetres and the other at the outer margin of the reed bed in deeper water. In preliminary investigations the nymphs were rarely observed swimming; they were usually found clinging to plants or plant remains from which they were not easily dislodged. Accordingly, for each sample, the bottom debris together with rooted and floating vegetation from an area of 400 cm<sup>2</sup> were removed with the aid of a hand net having a mesh of 15 strands cm<sup>-1</sup>.

Each sample was placed in water, a small amount at a time, in a white enamel dish and stirred vigorously at frequent intervals and the nymphs removed. Finally, to ensure that any very small nymphs had not been overlooked, the plant material and debris was removed piece by piece and carefully examined. The body length, anterior margin of head to the base of the cerci, and head width of each live specimen was measured.

The period of emergence was studied by field observations and also by the emergence of sub-imagines from nymphs in the samples.

The distribution data are based on samples taken from a variety of aquatic habitats in the area. The records for the majority of the sites were based on only a few visits over the period 1971-78, but for some sites samples were taken at monthly intervals. At each site the aquatic macrophytes were noted and the pH and conductivity of surface water samples were measured.

TABLE 1. The numbers of nymphs of Caenis robusta at the sites where they were recorded in Cheshire and Shropshire.

| Site + Grid reference                          | Vegetation at sampling station   | pH  | Conductivity micromhos cm <sup>-1</sup> | Surface area ha. | Years in which samples taken | Years in which nymphs found | Mean no. of nymphs per sample |
|--|--|-----|---|------------------|------------------------------|-----------------------------|-------------------------------|
| Inflow Quoisley Little Mere Cheshire SJ 549456 | <u>Phragmites communis</u> Trin<br><u>Lemna trisulca</u> L.                      | 7.5 | 687                                     | -                | 1971-78                      | 1973                        | < 1                           |
| Tributary of R. Weaver Cheshire SJ 647497      | <u>Ranunculus aquatilis</u> L.   | 7.1 | 502                                     | -                | 1973                         | 1973                        | 1                             |
| Ilse Pool Cheshire SJ 727607                   | <u>Myriophyllum spicatum</u> L.<br><u>Lemna minor</u> L.                         | 7.6 | 668                                     | 0.7              | 1971-78                      | 1978                        | < 0.1                         |
| Moston Flash Cheshire SJ 719620                | <u>Lemna minor</u> L.<br><u>Lemna trisulca</u> L.                                | 7.6 | 564                                     | 4.4              | 1971-78                      | 1973                        | < 1                           |
| Doddington Mere Cheshire SJ 714465             | <u>Lemna minor</u> L.  | 8.0 | 550                                     | 23.4             | 1973-75 + 1978               | 1973-75 + 1978              | > 10                          |
| Brown Moss Pool 1 Shropshire SJ 650396         | <u>Ilypha latifolia</u> L.<br><u>Riccia fluitans</u> L.<br><u>Lemna minor</u> L. | 6.4 | 120                                     | 1.3              | 1971-78 + 1978               | 1971-76                     | > 10                          |
| Brown Moss Pool 2 SJ 561398                    | <u>Menyanthes trifoliata</u> L.  | 7.3 | 210                                     | 1.9              | 1971-76                      | 1973-74                     | < 1                           |
| Brown Moss Pool 3 Shropshire SJ 563394         | <u>Ilypha latifolia</u> L.<br><u>Lemna minor</u> L.                              | 7.3 | 212                                     | 10.2             | 1971-76 + 1978               | 1973                        | < 1                           |

## Distribution

One hundred and seven water bodies were examined, all of which were found to be rich in salts and may be described as eutrophic. *C. robusta* was found at eight (7.5%) of these sites, two of which were slow-flowing streams. It was abundant at two sites, one of the larger meres and a pond (Table 1). It was not found in any of the very small field ponds which are so common in the North West Midlands, nor in the larger streams or rivers. Although all the sites where *C. robusta* was recorded had abundant vegetation and a substratum of decaying vegetation, many of those sites in which it was not found showed similar conditions.

## Life History

The data on head widths and body lengths (Fig. 1) indicate that *C. robusta* had one generation per year. Newly hatched nymphs appeared in late July (there is also a possibility of some delayed hatching in 1974) and grew rapidly until September; there then followed a period lasting until March when virtually no growth took place; further growth began in April and continued rapidly in May and June. Careful comparison of the confidence limits of the means during the winter months shows that

there was a significant decrease in body lengths between December 1973 and February 1974 ( $p \approx 0.001$ ), but no significant change in the head widths which remained constant from September until March ( $p \approx 0.1$ ). Between November and December 1974 there was a significant decrease in both head widths and body lengths ( $p < 0.001$ ). The absence of any small nymphs at these times indicates that delayed hatching of eggs was not the cause of the decreases.

The observed period of emergence in 1974 was from 27th June to 20th July. The sub-imagines of 27th June developed from nymphs collected on 23rd June which were then kept in the laboratory. It is unlikely that any occurred in the field before that date. However, it is possible that emergence occurred for a few days after 20th July. Fully grown nymphs were present on 20th July but when the pond was visited on 25th July neither fully grown nymphs nor imagines were seen. By 28th July very small newly hatched nymphs were common. Imagines were seen swarming in large numbers on the 18th and 20th of July. They began to rise at 19:30 G.M.T. and were observed until 20:15 when light conditions rendered further observations impossible.

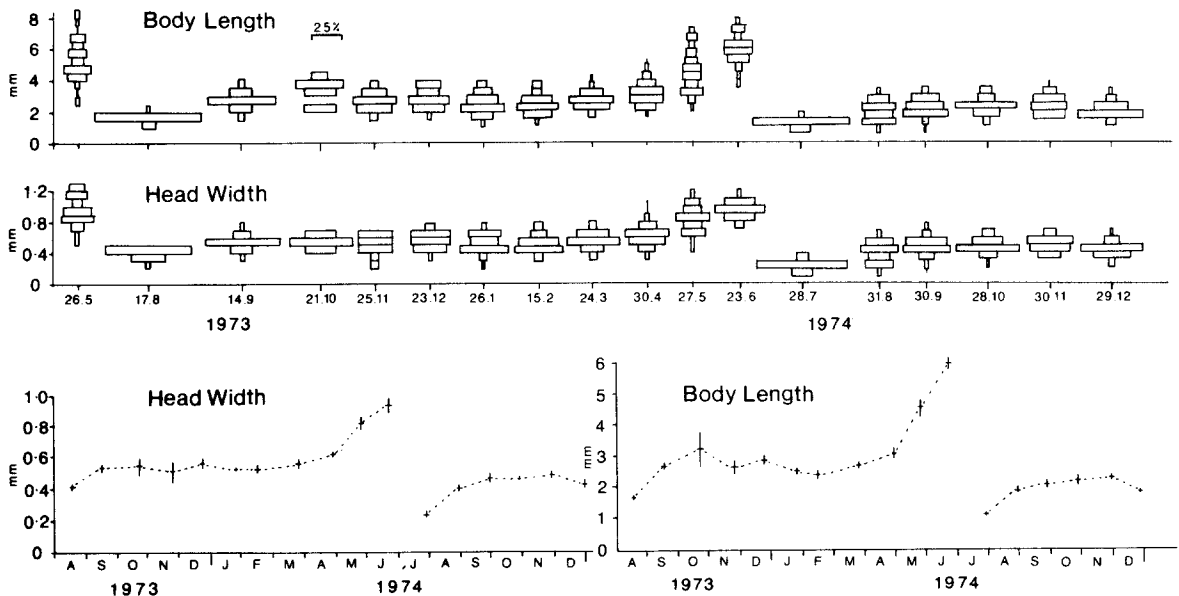


Fig. 1. Population size-structure histograms and population mean sizes  $\pm$  95% confidence limits. The data are based on body lengths and head widths as indicated.

## Discussion

*C. robusta* is found in Cheshire and Shropshire in still or slow-flowing waters of high conductivity which contain considerable amounts of vegetation. These waters, like most in the area, contain high proportions of calcium and bicarbonate ions (Gorham, 1957a, 1957b; Savage & Pratt, 1976). Similar chemical conditions were reported for the waters in which *C. robusta* was found in Lincolnshire (Langford & Bray, 1969). The few remaining records of its occurrence are also from lowland regions but chemical data for these sites are not available, although Macan (in Kimmins, 1954) suggests that one of these habitats is calcareous.

There is one isolated reference for *C. robusta* from a temporarily saline habitat (Langford & Bray, 1969). However, it was not found in any of the saline flashes (lakes) in Cheshire but it was recorded in 1978 at Ilse Pool which was saline until 1973 and temporarily saline in 1975 (Savage, 1977).

Thus *C. robusta* appears to be confined to still or slow-flowing eutrophic waters in the southern half of the British Isles. The relatively few records for it in the literature indicate that it is a rare species. However, the nymphs' habit of clinging to vegetation and the crepuscular emergence of imagines suggest that it is likely to have escaped attention.

The results show that *C. robusta* had one generation per year with emergence occurring in late June and July. These emergence dates are supported by the observations of Mackey (1978). Observations on *Caenis horaria* (L.) (Moon, 1939), which probably also included *Caenis moesta* (Bengtss.) (Macan, 1970), and *Caenis rivulorum* Etn. (Armitage, 1976) indicate that all the species of this genus so far studied in the British Isles have similar life histories viz. hatching followed by a period of growth during the late summer; a period with virtually no growth during winter; a period of rapid growth in the late spring followed by emergence. In contrast, Landa (1968) has stated that Central European populations of *C. robusta*, *C. horaria* and *C. moesta* have two generations per year.

The slight decrease in length in the population of nymphs of *C. robusta* recorded during the winter is similar to that reported by Moon (1939) for *C. horaria*. It seems probable that winter conditions exerted some form of environmental stress and that there was differential survival in favour of the smaller nymphs. The precise nature and effect of this stress is not known.

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