Bull. Annls Soc. r. belge Ent. 131 (1995): *47-51*

The spatial distribution of *Caenis horaria* (L., 1758) (Caenidae, Ephemeroptera) in a pond in Niel (Belgium)*

by L. INT PANIS[1/2], L. BERVOETS[1], R.F. VERHEYEN[1]

[1] Universitaire Instelling Antwerpen, Departement Biologie, Universiteitsplein 1, B-2610 Wilrijk/Antwerpen.
[2] Research assistant of the Belgian National, Fund for Scientific Research (N.F.W.O.).

Abstract

In 1991 and 1992 the larvae of Caenis horaria *(LINNAEUS, 1758) were sampled in a pond in Niel (Belgium). We have estimated densities in two different habitats. The relation between organic material and the spatial distribution is discussed.*

Key words : *Caenis horaria*, Ephemeroptera, Spatial distribution, Detritus.

Samenvatting

In 1991 en 1992 werden de larven van Caenis horaria *(LINNAEUS, 1758) bemonsterd in een vijver in Niel (België). We maakten densiteitsschattingen voor twee verschillende habitats. Het belang van organisch materiaal voor de horizontale verspreiding op de bodem wordt besproken.*

Introduction

Larvae of *Caenis horaria* (LINNAEUS, 1758) can be found in running and in standing waters. In both habitats their presence is restricted to muddy and silty places. They crawl over the bottom where they collect fine particulate detritus. This decomposing organic material is thought to be their main food source. *C. horaria* is usually univoltine and has an overwintering larval stage. The lowest larval densities are found in June, July and August. Adults were caught from May to September in the British Isles. A good review of the general ecology of *C. horaria* and other Ephemeroptera is given by ELLIOTT *et al.* (1988) and BRITTAIN (1982).

* Received 14.III.1994.

The objective of the study described in this paper was to test if a patchy distribution of organic detritus in a pond in Niel affects the density and distribution of a population of *C. horaria*. Such relationships have already been described for many taxa in rivers (e.g. EGGLISHAW, 1964; TOLKAMP, 1980). Reports in literature on the densities of Caenidae in lentic habitats are very rare. CLIFFORD (1980) has made a detailed study of the literature on holarctic mayfly densities. He found that only 5% of all reported densities pertained to mayflies from lentic habitats. Only 12% of these references mentioned *Caenis*. This is remarkable because *Caenis* seems to be the third most abundant mayfly genus in the entire holarctic region. In only about one third of these articles, the animals were identified up to species level. Accurate density estimates of *Caenis* species in ponds and correlations between densities and environmental factors are very scarce. Data collected by GHOSH & INT PANIS (unpublished, Table 1) suggest that the presence of organic detritus influences the density of larvae of *Caenis*. Several species of *Caenis* were present in their samples but *Caenis luctuosa* (BURMEISTER, 1839) seems to be the most abundant species. These samples were taken with a Petite Ponar in a shallow area of the main pond of the Fort VI in Wilrijk (Antwerp, Belgium). They found high densities in a zone that was completely covered with decaying leaves. The area with a bare sandy bottom had much lower densities.

Table 1. Densities and 95% confidence intervals of *Caenis* spp. in Wilrijk (Fort VI) (data from GHOSH & INT PANIS).

Date	Station	Device	Number of samples	Density (N/m²)
January 1990	Leafs	Ponar	4	1300 (1000 - 1700)
March 1990	Leafs	Ponar	5	900 (700 - 1200)
March 1990	Sandy	Ponar	5	50 (20 - 330)

Methods

The pond that we have sampled is situated in the nature reserve "Waelenhoek" in Niel (Antwerp, Belgium). It has an area of about 1.5 ha and is 4 metres deep in its centre. The water is eutrophic. During summer, the water is stratified and has an oxycline at 2.5 metres. The water mass below this depth is almost completely anoxic during the summer. Previous studies have shown that, in this pond, *C. horaria* does not occur deeper than 2.5 metres due to the oxygen depletion at these depths. Therefore, we have only studied samples that were taken in the littoral zone. The littoral zone of this pond consists of two narrow areas near the two longest, opposite, shores. In December 1991 we have taken eight grab samples with a "Petite Ponar" (Wildco, Cat. No. 1728). This small grab samples an area of approximately 240 cm². Three samples were taken along the North Western shore and another five were taken along the South Eastern shore. In February 1992 a total of 20 samples was taken to improve the precision of the density estimates. Ten samples were taken along the NW shore and ten samples were taken along the SE shore.

The organic carbon content of the sediment in a grab sample was measured by oxidizing the organic material with $K_2Cr_2O_7$ according to the method of WALKLEY & BLACK (1934).

For the study of the horizontal distribution we have calculated the Index of Dispersion I_d according to the formula given by ELLIOTT (1977) (Formula (1)). We have tested if the distribution of numbers could represent a Poisson distribution, indicating a random distribution pattern. Therefore, the departure from unity of the variance to mean ratio was assessed by comparing I_d with a table of χ^2 with n-1 degrees of freedom.

$$I_d = \frac{S^2}{\bar{x}}(n-1) \qquad (1)$$

Because the mean and variance were not always equal, the counts were log transformed before 95% confidence intervals for the (geometric) mean densities were calculated. Some zero counts were present in our datasets, therefore we have always used the log(x+1) transformation (ELLIOTT, 1977). It is clear that these densities are underestimates of the true density in the field because the geometric mean is always lower than the arithmetic mean. Moreover, animals can be lost during the processing of the sample. Small animals for example may be lost when the sample is sieved (SUTER & BISHOP, 1980).

Results & Discussion

Densities

The results from the samples taken in December 1991 (Table 2) indicate that there is a major difference between the densities of both littoral areas. However, due to the low number of samples, the 95% confidence interval is very wide and the difference is not significant (t-test, $p = 0.07$).

The results of the February sampling program confirm that there is a difference between the two zones. The densities along the NW shore were much higher than the densities along the SE shore (t-test, $p < 0.05$). Using the logarithmic transformation we obtained 95% confidence intervals for the (geometric) mean densities of 70 (30 - 120) animals/m² for the SE samples and 500 (200 - 1000) animals/m² for the NW samples. This means that *Caenis horaria* is one of the dominant insect species of the littoral zone together with *Polypedilum nubeculosum* MEIGEN, 1804 (800 (600 - 1200)) and *Stictochironomus* KIEFFER, 1919 (200 (100 - 400)) (Diptera, Chironomidae).

Table 2. Densities and 95% confidence intervals of *Caenis horaria* in Niel (Waelenhoek).

Date	Zone	Device	Number of samples	Density (N/m²)
December 1991	NW	Ponar	3	600 (20 - 6400)
December 1991	SE	Ponar	5	40 (4 - 110)
February 1992	NW	Ponar	10	500 (200 - 1000)
February 1992	SE	Ponar	10	70 (30 - 120)

Spatial pattern

The distribution of numbers is significantly different from a Poisson distribution for the samples taken in February. The I_d equals 516, which is much higher than the critical value of 35.2. We have tested the hypothesis that this aggregation is the result of a patchy distribution of suitable places with a lot of detritus. A correlation coefficient between the numbers of *C. horaria* and the percentage of organic carbon found in the sample was calculated to demonstrate that density may be influenced by the amount of detritus. This correlation coefficient ($r = 0.78$) is highly significant ($p << 0.001$). It is mainly caused by the different sediment carbon content of both shores. Along the SE shore there are almost no patches with a high content of organic carbon (mean %C = 0.95). Most sampling units from the NW shore have a higher organic carbon content (mean %C = 2.3). This difference between the sampling units along both shores is significant (t-test; $p < 0.01$).

Conclusions

The densities reported in this article fall well within the range given by Clifford (1980).

The clumped spatial distribution is most probably caused by an aggregation in places that are rich in organic detritus. The higher densities of *C. horaria* along the north western shore suggest that the spatial pattern in this pond is not patchy. It can best be described as two different zones. It cannot be excluded that other important factors also differ between both zones. Therefore, the conclusion that organic detritus is the ultimate cause of the spatial pattern should be tested experimentally and verified in other ponds.

Acknowledgements

The authors wish to thank the N.F.W.O. for their support of L.I.P.. Rita Ghosh, Johan Coeck, Rudi Ysebоodt, Hilde Sluyts and Bert Int Panis are thanked for their help during the sampling programs. Lieve

Clement is thanked for her help with the analysis of the organic carbon content of the samples. We would also like to thank Dr. Boudewijn Goddeeris for his comment on an earlier version of the manuscript.

Bibliography

Brittain, J.E., 1982. - Biology of mayflies. *A. Rev. Ent.*, 27: 119-147.

Clifford, H.F., 1980. - Numerical abundance values of mayfly nymphs from the holarctic region. In : Flannagan, J.F., Marshall, K.E., (ed.), *Adv. Ephemeroptera Biol., Proc. Int. Conf. Ephemeroptera, 3rd, Winnipeg, Can.*: 552 pp.

Egglishaw, H.J., 1964. - The distributional relationship between the bottom fauna and plant detritus in streams. *J. anim. Ecol.*, 33: 463-476.

Elliott, J.M., 1977. - Some methods for the statistical analysis of samples of benthic invertebrates. *Scient. Publs Freshwat. biol. Ass.* 25: 160 pp.

Elliott, J.M., Humpesch, U.H., Macan, T.T., 1988. - Larvae of the British Ephemeroptera - A key with ecological notes. *Scient. Publs Freshwat. biol. Ass.* 49: 145 pp.

Suter, P.J., Bishop, J.E., 1980. - The effect of mesh size on the interpretation of the life history of two mayflies from south Australia. In : Flannagan, J.F., Marshall, K.E., (ed.), *Adv. Ephemeroptera Biol., Proc. Int. Conf. Ephemeroptera, 3rd, Winnipeg, Can.*: 552 pp.

Tolkamp, H.H., 1980. - Organism-substrate relationships in lowland streams. PHD-thesis Wageningen. 211 pp.

Walkley, A., Black, I.A., 1934. - An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. *Soil Sci.*, 37: 29-38.