Distribution patterns of blackfly (Diptera: Simuliidae) associations in two Irish river systems

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Abstract

Nine blackfly species were found in two river systems in south western Ireland. Their distribution patterns reflected the three main types of running waters: head waters and mountain brooks; meadow streams and river sections at lower altitudes; lake outlets. Cluster analyses showed correlations between the five most dominant blackfly species and stream sites, as well as with some environmental factors. Larval gut analyses demonstrated that in general the supply of suspended algae determined larval gut content, but there were distinct differences in food utilization between associated larvae.

Introduction

Using cluster analysis, Glatthaar (1978) divided blackfly species most frequent in Switzerland into five macro-ecological groups: mountain, silvatic, river, sublacustrine and campestric. These results were essentially confirmed in stream systems of south western Germany (Schröder, 1985a), Niesiolowski (1980) calculated correlations of stream sites and blackfly species in Poland and showed associations between the species and natural habitats.

In August 1980, nine blackfly species were collected in two river systems of south western Ireland (Schröder & Schweder, 1986). In addition, some environmental factors and number and size frequency distribution of suspended algae were measured and Schröder (1987b) analyzed the larval gut contents of the six most abundant blackfly species. The objective of the present paper is to show correlations between distribution patterns of blackfly species, types of inhabited running waters and environmental factors including suspended algae and resource utilization of this food supply.

Methods

The main physiographic conditions were recorded following the categories of Boes & Brändle (1981), Schröder (1982), Schröder & Wolf (1985a, b). 100 ml water samples were taken and fixed with Lugol's solution (Schwoerbel, 1986). The algae were counted in aliquots of 5 ml with an inverted microscope. The lengths of 3 algal categories (suspended diatoms and other algae, periphytic filamentous algae) were measured at 320 × magnification.

The blackfly species were preserved with 70% ethanol and identified using the keys of Davies (1966, 1968), Knoz (1965) and Jensen (1984). The nomenclature followed Zwick (1978). The head capsule width between the eye-spots was measured for each larva. Larvae were identified to instars on the basis of their headwidth frequency distributions (see Schröder, 1987b).

Groups of ten larvae were homogenized by a hand-driven-grinder in 50 ml solution of water fixed in Lugol. Aliquots of 5 ml of these mixtures were transferred into 5 ml counting chambers. After some hours to settle on the bottom of the chamber, the algae were counted and measured at...
320 × magnification with the inverted microscope and following the procedure used for determination of algal food supply (s.a.).

The stream sites were grouped in relation to blackfly associations on the basis of cluster analyses (Kownacki, 1985): Subdominant species were neglected if their proportion did not exceed 10% at one stream site at least. Stream sites were also excluded if a total of less than 5 larvae was collected. Therefore, only 5 species and 19 sites were taken into account. The ‘coefficient distance’ between each pair of sites was calculated as

\[ d_{jk} = \frac{1}{n} \sum_{i=1}^{n} (x_{ij} - x_{ik})^2 \]  

(Sokal, 1961; Kownacki, 1985)

with \( n \) = number of species at paired sites  
\( x_{ij} \) = proportion of species \( i \) at site \( j \)  
\( x_{ik} \) = proportion of species \( i \) at site \( k \)

Subsequently a dendrogram was designed by average linkage clustering of the minimum coefficient distances \( d_{jk} \).

A two-way analysis of the blackfly habitat relationships followed a procedure similar to that of Jenkins et al. (1984): A hierarchical dendrogram of the 5 blackfly species was constructed from average linkage clustering of Spearman rank correlation. Clusters resulted from separation at \( r_s < 0.45 \). In the same way, 7 environmental factors were clustered. Finally, Sperman rank correlations were made between these species and the environmental factors. The resulting \( r_s \) values were illustrated by circles in the figure concerning 5 categories from > −0.6 to > +0.6.

Results

Stream sites and environments

Figure 1 shows the sampling areas in south western Ireland. The Bunnow River system near Derreenauliffe/Sneem included 9 stream sites (Fig. 2),

Fig. 1. The geographic situation of both studied river systems in south western Ireland: OWM/CLG = Owenmore-Cloghane River system on the Dingle Peninsula; BRS = Bunnow River system near Derreenauliffe/Sneem on the Peninsula of Iveragh.