LIFE HISTORIES OF SOME EPHEMEROPTERA FROM VICTORIA, AUSTRALIA

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ABSTRACT

Three species of Australian mayflies, *Austrophlebioides* sp., *Nousia* sp. and *Baetis* sp. are shown to have univoltine life histories in a subalpine stream, while detailed studies of the life history of *Austrophlebioides pusillus* (Harker) in a lower altitude stream failed to demonstrate a clear summer generation. The three species from the cooler site had more synchronous life histories, but the stream discharge at that site was probably less variable, so that neither temperature nor discharge can be singled out as the causal factor for synchrony.

INTRODUCTION

There are only five previously published studies of the life histories of Australian mayflies, encompassing 19 species (see Campbell 1985 for review). This paper presents data on a further 3 species: *Austrophlebioides* sp., *Nousia* sp. and *Baetis* sp., and additional data on a species, *Austrophlebioides pusillus*, for which some data has already been published (Marchant *et al.* 1983). The data presented here were collected from two sites: Chalet Creek a small stony stream at an altitude of 1120 m on Mt Buller (Fig. 1) and the Wellington River, a larger, lower altitude (300 m) stream, full descriptions of both sites are provided by Campbell (1985). Terminology referring to life history patterns is that proposed by Lake *et al.* (1985).

METHODS

The species from Chalet Creek were collected monthly between July 1971 and June 1972 using the kick sampling technique and a square-framed net with 430 μm mesh. The insects were separated from the debris by flotation with saturated calcium chloride solution, and counted and measured. The measurement used as an indicator of size was body length (excluding cerci length) in the case of *Baetis* sp. and headwidth in the case of *Austrophlebioides*. Each nymph was also assigned

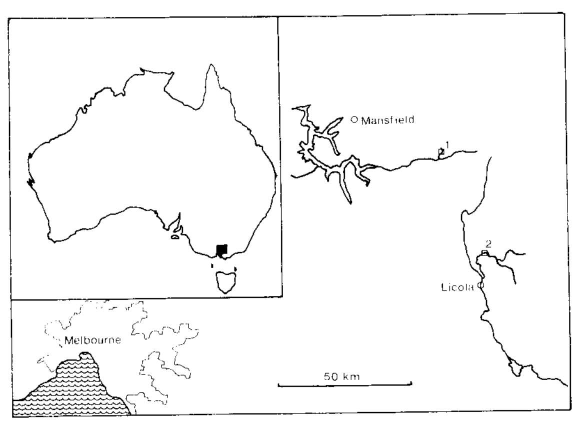

Fig. 1. Map showing the locations of the Chalet Creek (1) and Wellington River (2) sites.

I.C. Campbell (ed.) Mayflies and Stoneflies, 81–84.

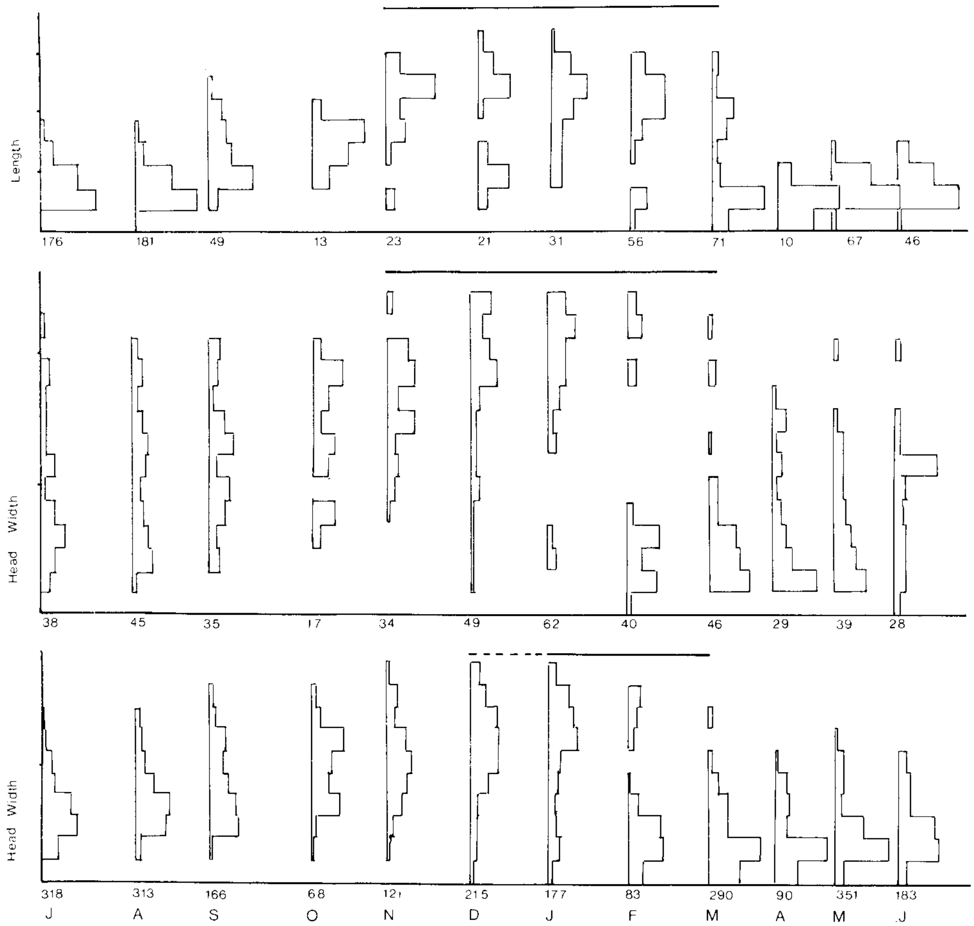

Fig. 2. Histograms showing the change in size frequency (as a percentage of the sample) with time for *Baetis* sp. (top) *Nousia* sp. (middle) and *Austrophlebioides* sp. (bottom) from Chalet Creek. The distance between the baselines is proportional to time elapsed between samples, the numbers at the bottom of the histograms indicate the number of animals in the sample. The line above each set of histograms indicates the known (solid line) or inferred (dashed line) presence of adults.

to one of the four developmental stages designated by Clifford (1970).

Austrophlebioides pusillus was collected from the Wellington River between 1978 to 1980 together with the material discussed by Campbell (1985), collecting and measuring techniques are described in detail in that paper. The measurement used was combined pro and mesonotum length.

RESULTS AND DISCUSSION

Results are presented in the form of size frequency histograms (Figs 2, 3), with the distances between the baselines of the individual histograms proportional to the time elapsed between the sample dates.

All three species from Chalet Creek exhibited univoltine life histories. *Baetis* sp. (Fig. 2) has a synchronous life history with a 5 month emergence period from November to March. The smallest nymphs are present from February to August indicating some delay before egg hatching. Nymphal growth is slow from March to August but increases in spring and summer as the stream becomes warmer.

Nousia sp. (Fig. 2) had a less synchronous life history although the emergence period was more precisely timed, occurring over only four months.

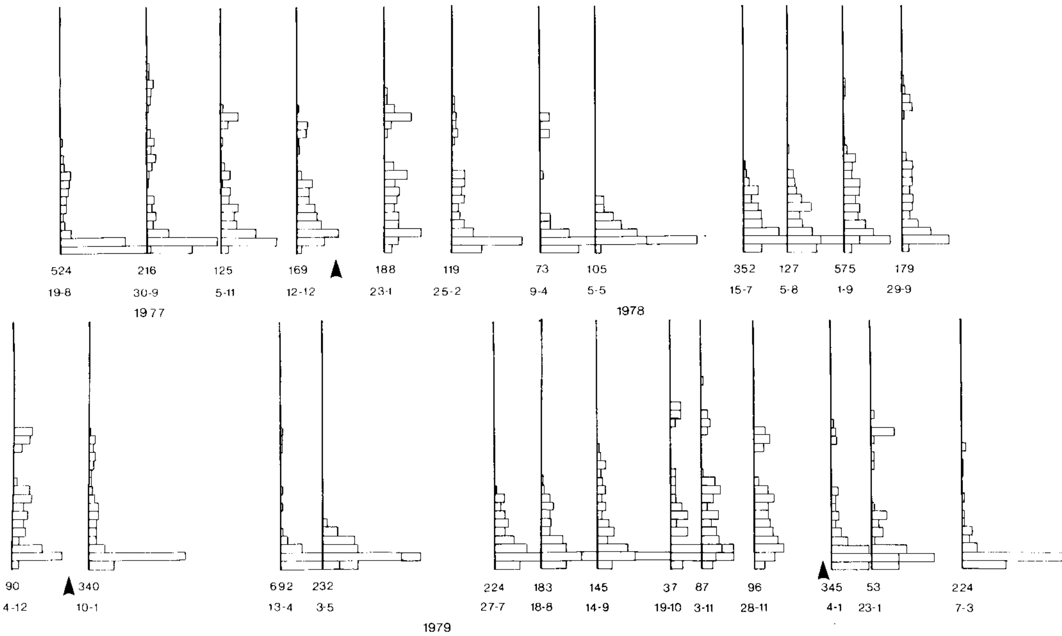

Fig. 3. Histograms showing the change in size frequency with time for *Austrophlebioides pusillus* in the Wellington River. Numbers below each histogram indicate the number of animals in the sample and the day/month of sampling. Arrows indicate January 1st.

Very small nymphs were not recorded for this species, possibly because they were not collected or possibly because they could not be distinguished from small nymphs of *Austrophlebioides*. The presence of small nymphs from December to August suggests that eggs hatch over a long period. There appears to be rapid growth until May for nymphs arising from eggs hatched in December. From May to August little growth occurs, to be followed by increased growth from September onwards. The rapid growth from September is accompanied by the enlargement of the wing pads as nymphs develop through to stage IV. In contrast no nymphs develop beyond stage II in the period April to August, even though they may equal or exceed the size of stage III and IV nymphs of the summer months.

Austrophlebioides sp. (Fig. 2) also has a fairly synchronous life history with a 5 month emergence period from November to March. The presence of newly hatched nymphs from December to July indicates delayed hatching of at least some eggs. Growth of nymphs appears to be relatively steady throughout the year, increasing a little in spring and early summer.

In the Wellington River, *Austrophlebioides pusillus* had a less synchronous life history (Fig. 3). Mature nymphs were present from October to April indicating a 7 month emergence period. Small nymphs were present and abundant throughout the year with the exception of November and December and sometimes January when their abundance decreased. Their abundances seemed to peak in August/September and February/March. The August/September recruitment seems to precede the appearance of mature nymphs in all three years indicating that there is not a simple bivoltine life history as suggested by Marchant *et al.* (1983). The simplest explanation is a univoltine life history with delayed egg hatching, so that adults emerging in October/November produce the nymphs which recruit in February/March and the later emerging adults produce the later nymphal recruitment. A strict bivoltine life history with a summer generation, would expose that generation to the risk of decimation if the river flows dropped very low in January/February as is often the case. Delayed hatching of nymphs from adults emerging in spring means that large nymphs are not exposed to low flows and that the population includes abundant small nymphs, capable of entering the hyporheic, at the time when flows are most likely to be low. Further studies on egg development times and nymphal growth rates are required to establish if this is indeed the case.

The lower degree of synchrony in the Wellington River species could be attributed to the higher temperatures encountered (4700 degree days per year compared with 2520 degree days per year at Chalet Creek), as has generally been suggested for mayfly life histories. However, Marchant *et al.* (1983) have suggested that the lower degree of synchrony may be due to the greater variability of discharge in larger Australian streams. Neither of the study sites is gauged, so we are unable to evaluate the differences in discharge variability between the sites, and determine which hypothesis is more plausible.

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