LIFE CYCLES AND ECOLOGY OF SOME SPECIES OF EPHEMEROPTERA FROM SPAIN

J. Alba-Tercedor

Departmento de Biologia Animal, Ecologia y Genética, Faculdad de Ciencias, Universidad de Granada, Spain

ABSTRACT

The life cycles, distribution and autecology of the mayflies *Oligoneuriella marichuae* Alba-Tercedor, *Ephemerella ikonomovi nevadensis* Alba-Tercedor and *Torleya cf. belgica* Lestage were determined from a years sampling in six streams of the Sierra Nevada mountains in southern Spain.

INTRODUCTION

This study forms part of a broader study of the autecology and life cycles of the mayflies of the Sierra Nevada mountains in southern Spain (Alba-Tercedor 1981, 1983, 1986). In this paper results are presented for the two endemic species *Oligoneuriella marichuae* Alba-Tercedor 1983 and *Ephemerella (Chitonophora) ikonomovi nevadensis* Alba-Tercedor 1983 and for a third taxon close to *Torleya major* (Klapalek 1905) which was provisionally identified as *Torleya cf. belgica* Lestage 1917 by Alba-Tercedor and Sanchez-Ortega (1984).

MATERIALS AND METHODS

Eight sampling sites were distributed amongst six streams from both the northern and southern slopes of the Sierra Nevada (Rio Aguas Blancas, 1300 m 1140 m, 800 m; Rio Dúrcal, 760 m; Rio Torrente, 840 m; Rio Lanjarón, 640 m; Rio Chico, 800 m and Rio Poqueira, 1600 m; numbered I to VIII respectively) (Fig. 1).

Every month from April 1979 to March 1980 samples were collected from the stream edge and midstream using a surber sampler with a mesh size of 0.36 mm and an area of 0.07 m^2. The type of bed was noted and current velocities measured

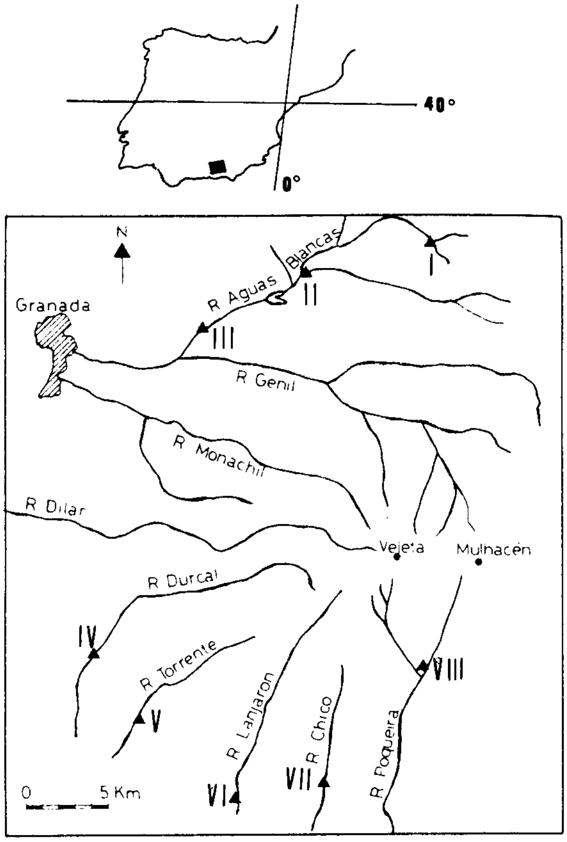

Fig. 1. Sampling sites in the Sierra Nevada (Spain).

I.C. Campbell (ed.) Mayflies and Stoneflies, 13–16.

using an instrument similar to that described by Dowdeswell (1967). Chemical characteristics and water temperature were also determined (Alba-Tercedor 1983). Total length (not including cerci) was measured on nymphs collected using an ocular scale with 0.1 mm accuracy, and this data was used to construct monthly size frequency histograms (Figs 2–4).

RESULTS AND DISCUSSION

Oligoneuriella marichuae

Nymphs of this species were collected at all sites except I, VII and VIII, and were most numerous at site IV. The species occurs at between 2 to 30 cm depth, with currents both slow (0.1 cm.sec^{-1}) and fast (130 $\pm$ 13 cm.sec^{-1}), with the smaller nymphs normally occurring in the slower waters of the stream edge. It was most numerous at current velocities between 52 $\pm$ 6 and 97 $\pm$ 6 cm.sec^{-1}.

Preferred habitat had stony or pebbly substrata with filamentous algae or the roots of marginal vegetation which provided a physical support. This was important for the smaller nymphs without a fully developed filtering apparatus as the vegetation (roots, filamentous algae, moss etc.) filters and retains particles transported by the stream thus providing shelter and a source of food for the small nymphs. As the nymphs grow and their filtering systems become more developed their resistance to the current is greater so that they can live in midstream with high current velocities. Groups of nymphs have been observed on the tops of stones, facing into the current and bearing the full force of the water.

Due to the small numbers of animals caught at most sites (1,4,1,14 at II,III,V and VI respectively) a histogram was drawn only for site IV (Fig. 2) where 680 specimens were collected.

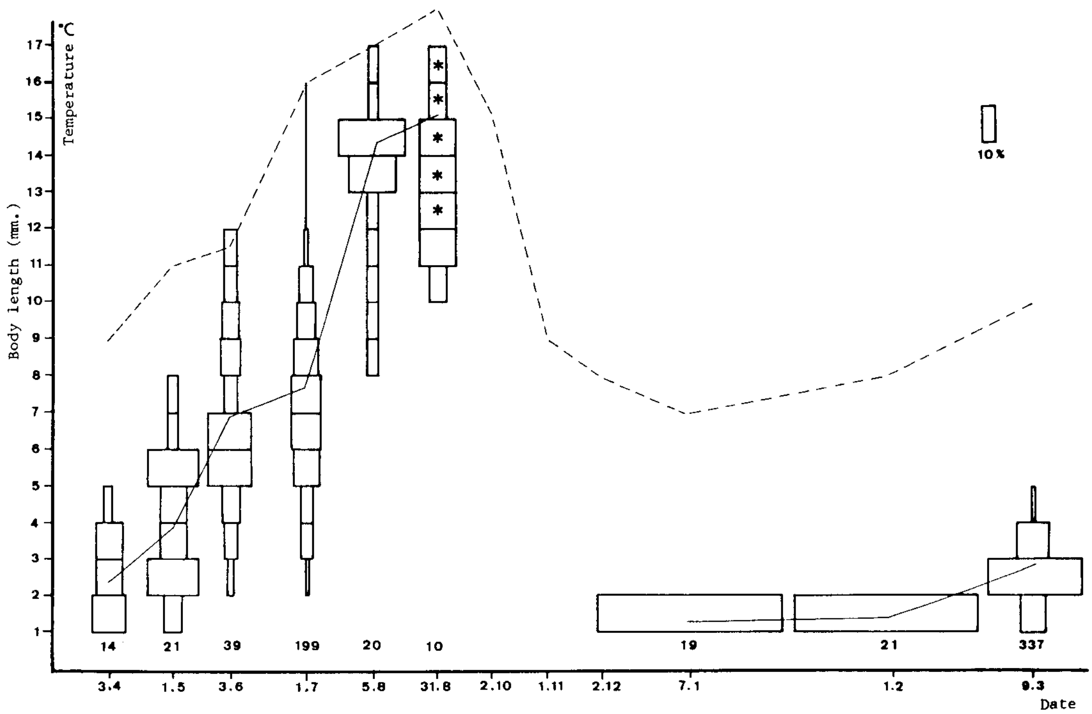

Fig. 2. Life cycle data for *Oligoneuriella marichuae* over a year. Change in average body length is indicated by the solid line and temperature by the dashed line. Asterisks indicate the presence of nymphs with black wing pads, and the number of nymphs caught each month is indicated.

The species appears univoltine with a very short emergence period. Mature nymphs with black wing pads are present at the end of August, and they emerge, the subimagines moult, and the imagines lay the eggs in the water all within a period of 3–4 hours. Numerous recently hatched nymphs appear in the first week of January, and these barely grow until early March. Once temperature begins to increase growth is steady until July and then accelerates with almost fully grown nymphs appearing in the first days of August. Thus the nymphal growth takes eight months, and hatching begins four months after oviposition, indicating an egg diapause such as has been found for some other species of *Oligoneuriella* (Degrange 1960, Sowa 1975).

The life cycle belongs in Hynes' (1970) "F-fast seasonal cycle", type "F3" but does not correspond to any particular subgroup in the classifications of either Landa (1968) or Sowa (1975).

Ephemerella ikonomovi nevadensis

This species was collected only in soft waters (55–340 μS.cm^{-1}) where it occurred both at the margins and midstream where there was some vegetation (roots, moss, algae etc.) and detritus on stony or sandy beds with a thin layer of mud. Current velocities were variable from slow (below the range of the instrument) to moderately high (108 $\pm$ 9 cm.sec^{-1}).

The life cycle was similar at all sites where the animal was collected, and Fig. 3 represents the data from a total of 189 nymphs pooled from all sites. The species appears to be univoltine, with emergence from mid-June to mid-August (one subimago was caught in mid-June and mature nymphs at the beginning of August). There is a six month egg diapause with the first small nymphs appearing in February probably resulting from the eggs laid by the adults in June, and the layer nymphs from the eggs laid in August. Nymphal growth was slow in winter accelerating in spring and summer as the temperature increased. The cycle belongs in Hynes' (1970) "fast seasonal" type "F2" category but does not fit well in any of the categories of Landa (1968) or Sowa (1975).

Torleya cf. *belgica*

This species was found in low densities only in the upper part of the Rio Aguas Blancas (sites I and II) where the waters were harder than at other sites (145–470 μS.cm^{-1}). The nymphs prefer stream edges (5–17 cm depth) on sandy and muddy beds with dense vegetation and a thin layer if detritus (which is the habitat recorded by Lestage (1917) and Sander (1981) for *T. belgica*), and none were found in areas without current or where current was strong. They were most abundant at velocities between 0.8 and 59.3 cm.sec^{-1}

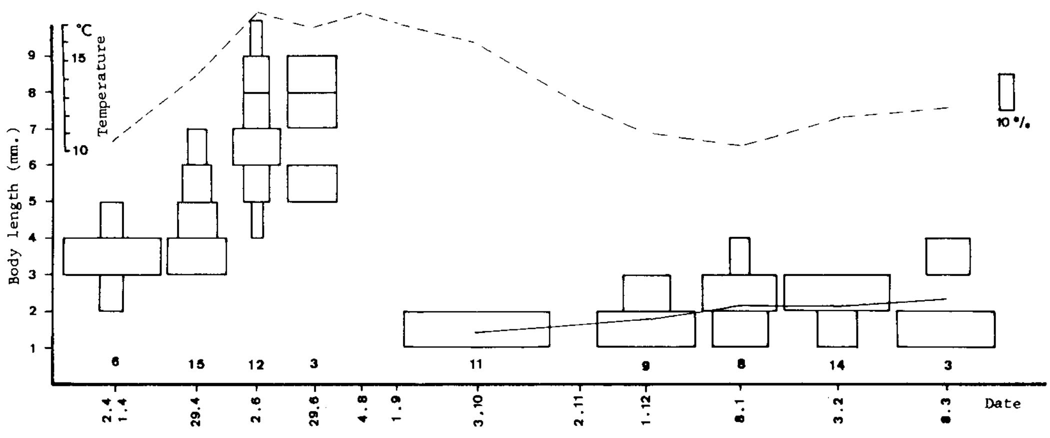

Fig. 3. Life cycle data for *Ephemerella (Chitonophora) ikonomovi nevadensis*. Labelling as for Fig. 2.

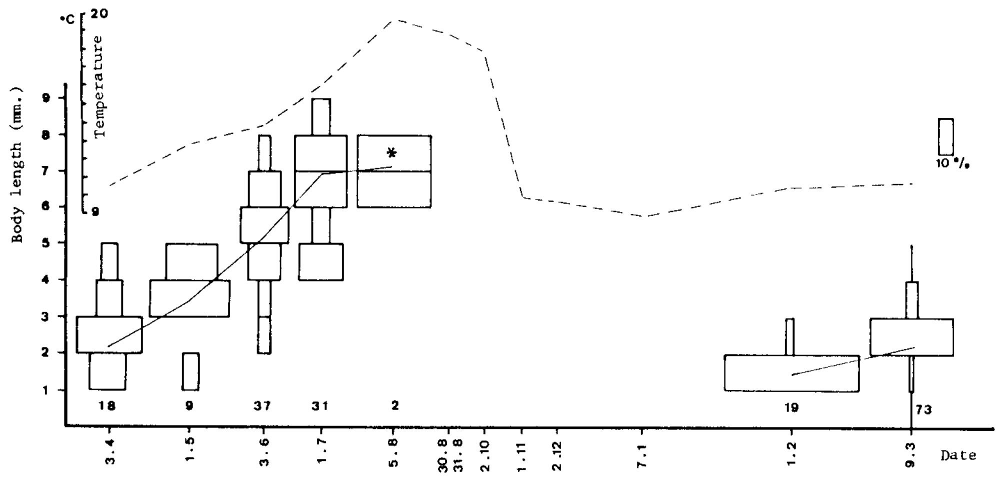

Fig. 4. Life cycle data for *Torleya cf. belgica* with labelling as for Fig. 2.

although they occurred up to a maximum f 72 ± 5 cm.sec-[1].

Figure 4 is based on measurements of 43 and 38 nymphs from sites I and II respectively. The species appears univoltine with a flight period during June. No nymphs were collected until early autumn when the eggs begin to hatch, small nymphs were then collected from October to March during which period growth was slow, increasing strongly during spring. The long time period over which small nymphs were collected could be due to a diapause, as was suggested by Pleskot (1958) for *T. major* Klap. in Austria, or to variable hatching times as suggested by Thibault (1971) for a species "close to *T. belgica* but somewhat different" from Le Lissuraga in the French Pyrenees. The cycle fits group "B3" of Sowa (1975) but not into the classifications of Hynes (1970) or Landa (1968).

ACKNOWLEDGEMENTS

I am most grateful to Prof. F. Jiménez Millán for valuable advice and comments and to Marichu, who assisted considerably with the field work and graphics. This research has been supported by a grant from the Comisión Asesora de Investigación Científica y Técnica (CAICYT No. 3243/83) to the Department of Zoology, Univ. Granada.

REFERENCES

Alba-Tercedor, J. (1981). Efemerópteros de Sierra Nevada: Ciclos de Desarollo, Taxonomía y Ecología de las Ninfas. Doctoral Thesis. 475 pp. Unpublished.

Alba-Tercedor, J. (1983). Ecología, distribución y ciclos de desarrollo de efemerópteros de Sierra Nevada, I: *Baetis maurus* Kimmins, 1938 (Ephemeroptera, Baetidae). *In* Prat, N. (ed.), *Actas del I Congreso Español de Limnológia*, Barcelona.

Alba-Tercedor, J. (1986). Ecología, distribución y ciclos de desarrollo de efemerópteros de Sierra Nevada (Granada, España). II: Baetidae Leach 1815. (Insecta, Ephemeroptera). *Limnetica* 1(1): 234–246.

Alba-Tercedor, J. and Jiménez Millán (1978). Larvas de efemerópteros de las estribaciones de Sierra Nevada. Factores que intervienen en su distribución. *Bol. Asoc. esp. Entomol.* 2: 91–103.

Alba-Tercedor, J. and Sanchez-Ortega A. (1984). Presencia del género *Torleya* Lestage 1917 (Insecta, Ephemeroptera: Ephemerellidae) en la Península Ibérica. *Bol. R. Soc. Española Hist. Nat. (Biol.)* (1982) 80: 81–88.

Degrange, C. (1960). Recherches sur la reproduction des Ephéméroptères. *Trav. Lab. Hydrobiol. Pisc. Univ. Grenoble.* 50/51 (1958/9): 7–193.

Dowdeswell, W.H. (1967). *Practical Animal Ecology.* Menthuen, London.

Hynes, H.B.N. (1970). *The Ecology of Running Waters.* Liverpool Univ. Press.

Landa, V. (1968). Developmental cycles of central European Ephemeroptera and their interrelations. *Acta. ent. bohemoslov.* 65: 276–284.

Pleskot, G. (1958). Die Periodizität einiger Ephemeropteren der Schwechat. *Gewässer und Abwässer.* 1958: 1–32.

Sowa, R. (1975). Ecology and biogeography of mayflies (Ephemeroptera) of running waters in the Polish part of the Carpathians. 2. Life cycles. *Acta. Hydrobiol.* 17(4): 319–353.

Thibault, M. (1971). Le dévelopment des Ephéméroptères d'un ruisseau à truites des Pyrénées atlantiques. Le Lissuraga. *Annls. Limnol.* 7: 52–120.