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A NOTE ON THE PLECOPTERA OF ISRAEL

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ABSTRACT

Five species of Plecoptera are recorded in Israel, two of them for the first time. Three species *(Marthamea beraudi, Protonemura zernyi, Leuctra kopetdaghi*) were found in the headwaters of the River Jordan, while two species (*Brachyptera galeata, Leuctra hlppopus)* were found in the streams of the Golan Heights. Relationships between sympatric species at these two sites is discussed. A key to the identification of Plecoptera nymphs is given.
KEY WORDS: Plecoptera, distribution, Israel.

INTRODUCTION

The Plecoptera are a relatively rare insect order in Israel, both in abundance and in species diversity, only five species, representing four families, being known. While some species are locally abundant, the general scarcity of this order reflects the fact that Israel represents the southernmost area of their distribution in the Middle East. The first published record of Plecoptera in Israel was by Zwick (1972), and more recently, they have been recorded by Zwick (1984) and Por *et al.* (1986).

The material on which this paper is based is presently in the Inland Water Ecological Service (IES) collection at the Hebrew University of Jerusalem, and the National Entomological Collection at Tel Aviv University (TAU).

METHODS

Sampling methods varied since a number of collectors were involved. Nymphs were generally collected using hand nets, or occasionally trapped in colonization cages (see Por *et al.*, 1986). Samples of mixed invertebrates were preserved in the field in 4% formaldehyde, and the Plecoptera were later sorted, identified, measured and preserved in 70% ethyl alcohol in the laboratory. Adults were collected using entomological hand nets. All body measurements were taken from the anterior tip of the head to the posterior tip of the abdomen.

TABLE 1. PLECOPTERA OF ISRAEL: DISTRIBUTION, HABITAT AND SEASONALITY

Species	Distribution in Israel	Months of Capture		Habitat Notes	Distribution outside Israel
		Nymphs	Adults		
Marthamea beraudi	Tel Dan, N. Dan, N. Banyas, N. Hazbani	Jan, May July	May, June July	Limited to cold stenothermic permanent water in R. Jordan headwaters	Headwaters of R. Litani, Lebanon (Zwick, 1984)
Protonemura zernyi	Tel Dan, N. Dan, N. Tal, N. Govta, N. Hazbani	Nov, Dec, Jan, Feb, May, Aug.	Jan, Feb, April	As above	Lebanon (Berthelemy & Dia, 1982)
Brachyptera galeata	Qusbiya, N. Nuchile, N. Meshushim, N. Gamla	Dec, Jan, Feb, Mar.	Jan, Feb.	Permanent and temporary waters on Golan Heights	Lebanon (Zwick, 1971; Berthelemy & Dia, 1982)
Leuctra kopetdaghi	N. Iyon, N. Tal	Jan, Feb, June July (N. Tal)	Feb.	Permanent and semi-permanent waters in R. Jordan headwaters	Lebanon, Anatolia, Central Asia (Berthelemy & Dia, 1982; Zhiltzova, 1972; Theischinger, 1976)
Leuctra hippopus	N. Gamla, N. Meshushim, N. Samakh Qusbiya (adults only)	Aug, Sep, Oct, Dec, Jan, Feb, Mar.	Jan.	Mainly permanent water sites on Golan Heights	Wide distribution in Europe; Lebanon; Iran; Siberia (Consiglio, 1980; Zwick, 1971; Berthelemy & Dia, 1982)

Data on the distribution of the species and in which seasons they were captured are summarized in Table 1. Fig. 1 shows the sites where the five species were collected. Fig. 2 records the sizes of nymphs captured throughout the year.

1. *Marthamea beraudi* (Navás), 1909

Fig. 3

This species has already been recorded from Banyas Springs, Nahal Hazbani, N. Dan and Tel Dan Springs (Zwick, 1984). A single additional record is from N. Dan Station 6, near to its confluence with N. Hazbani (see Fig. 1). According to Alouf (1984) who studied this species in Lebanon, *M. beraudi* is a semi-voltine species with adult emergence from May to July, and it prefers water temperatures not exceeding 15°C. The water temperatures of the known habitats of *M. beraudi* in Israel, do not in general exceed 16°C, and these are the coolest of Israel's permanent streams during summer, with an annual temperature variation of about 2°C.

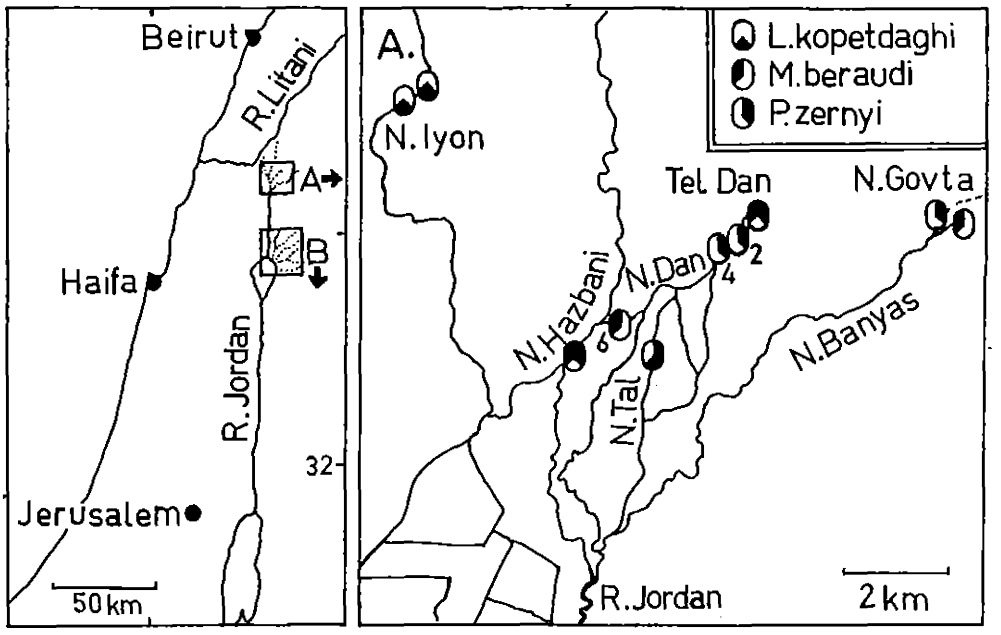
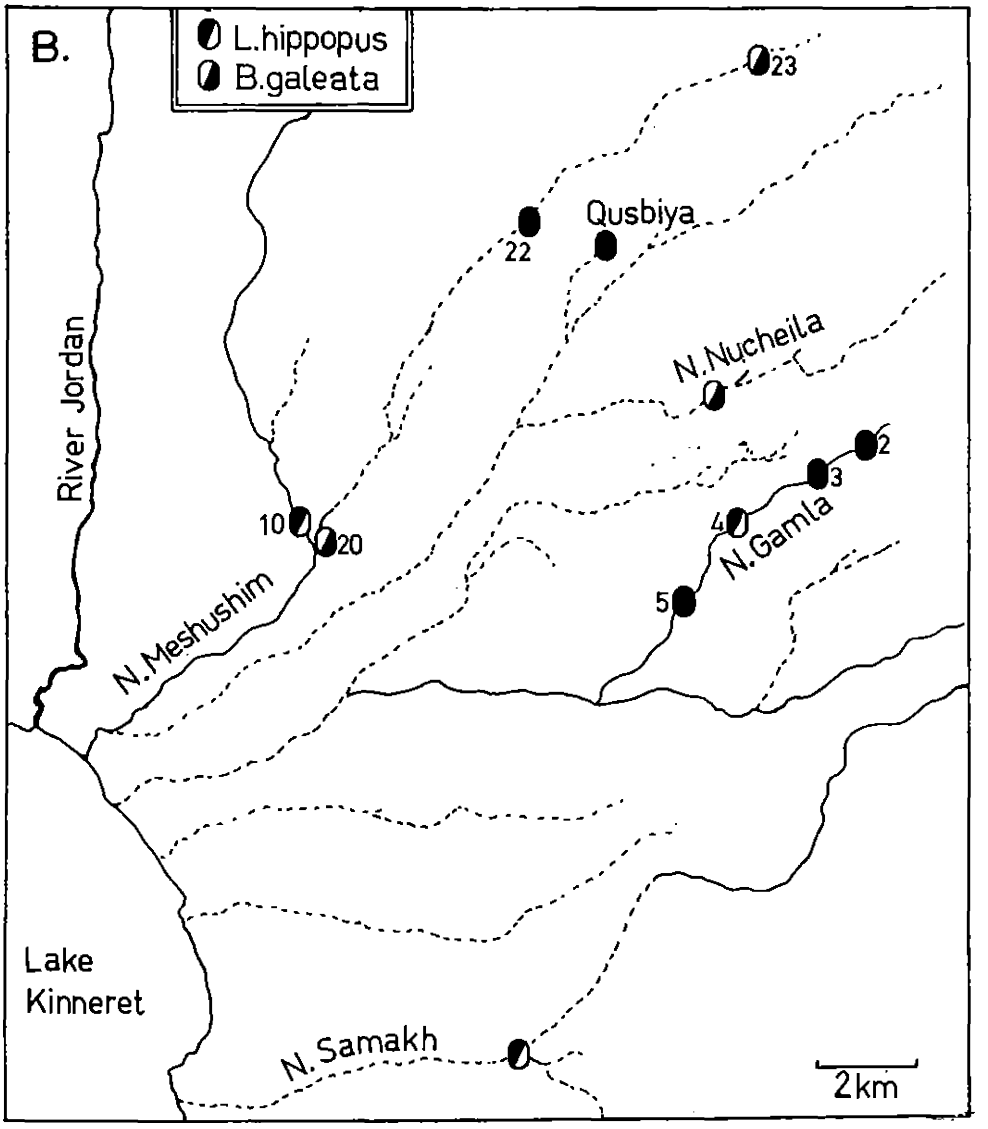


Fig. 1. Sampling sites in northern Israel where the five species of Plecoptera were collected: A. River Jordan headwaters; B. Golan Heights.



2. *Protonemura zernyi* Aubert, 1964
Fig. 4

Adults and nymphs of this species were first recorded in Israel from the springs of Tel Dan (Zwick, 1972). Additional collections of this species are now recorded from Tel Dan Springs, N. Dan (Stn. 2 & 4), N. Govta (Banyas Road Bridge), N. Tal and N. Hazbani. It appears that *P. zernyi* like *M. beraudi*, is limited to the cold-stenothermic permanent headwaters of the River Jordan. In Lebanon, larvae of *P. zernyi* were collected all year round and adults emered in winter and spring (Berthélemy and Dia, 1982).

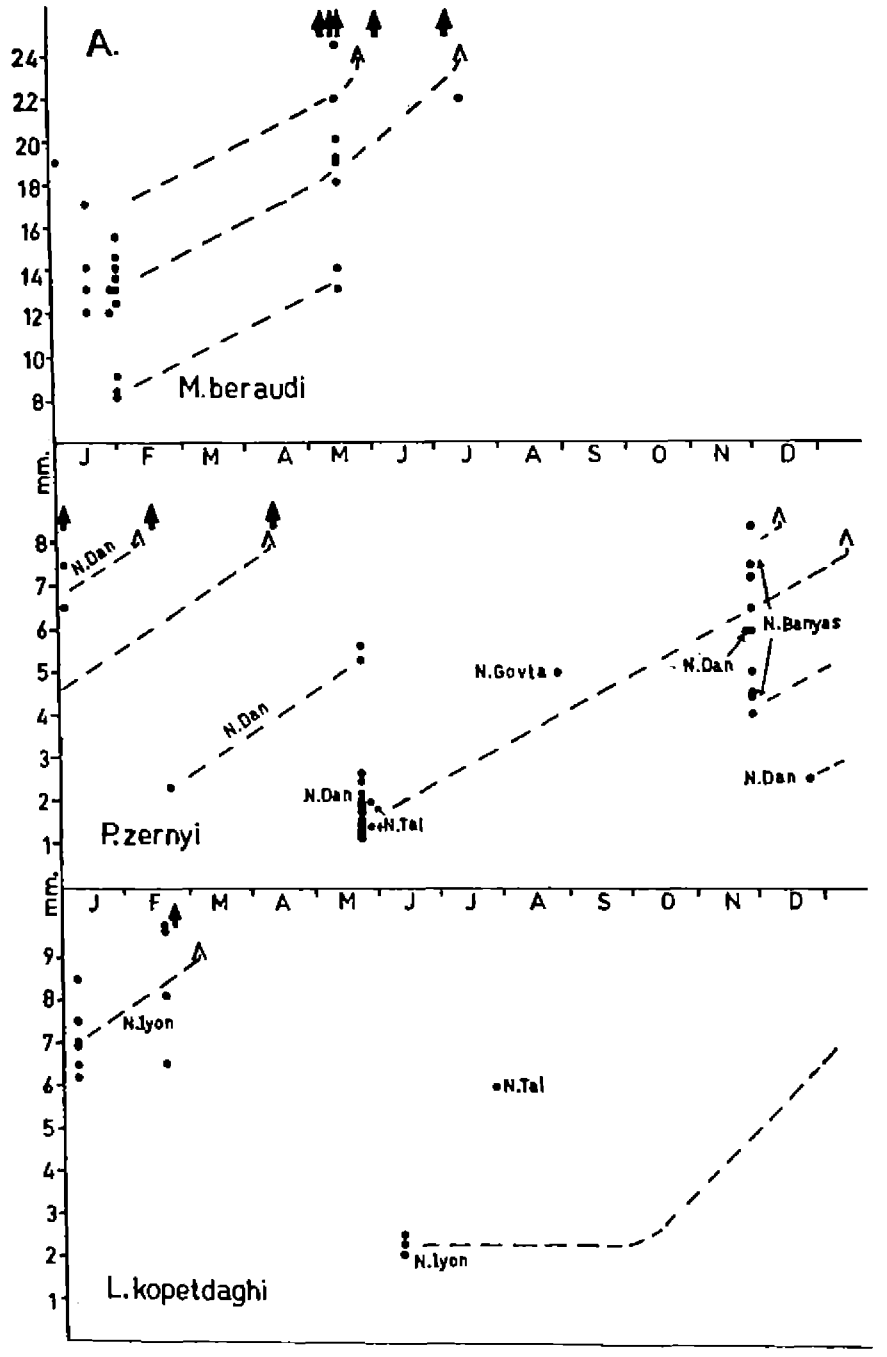
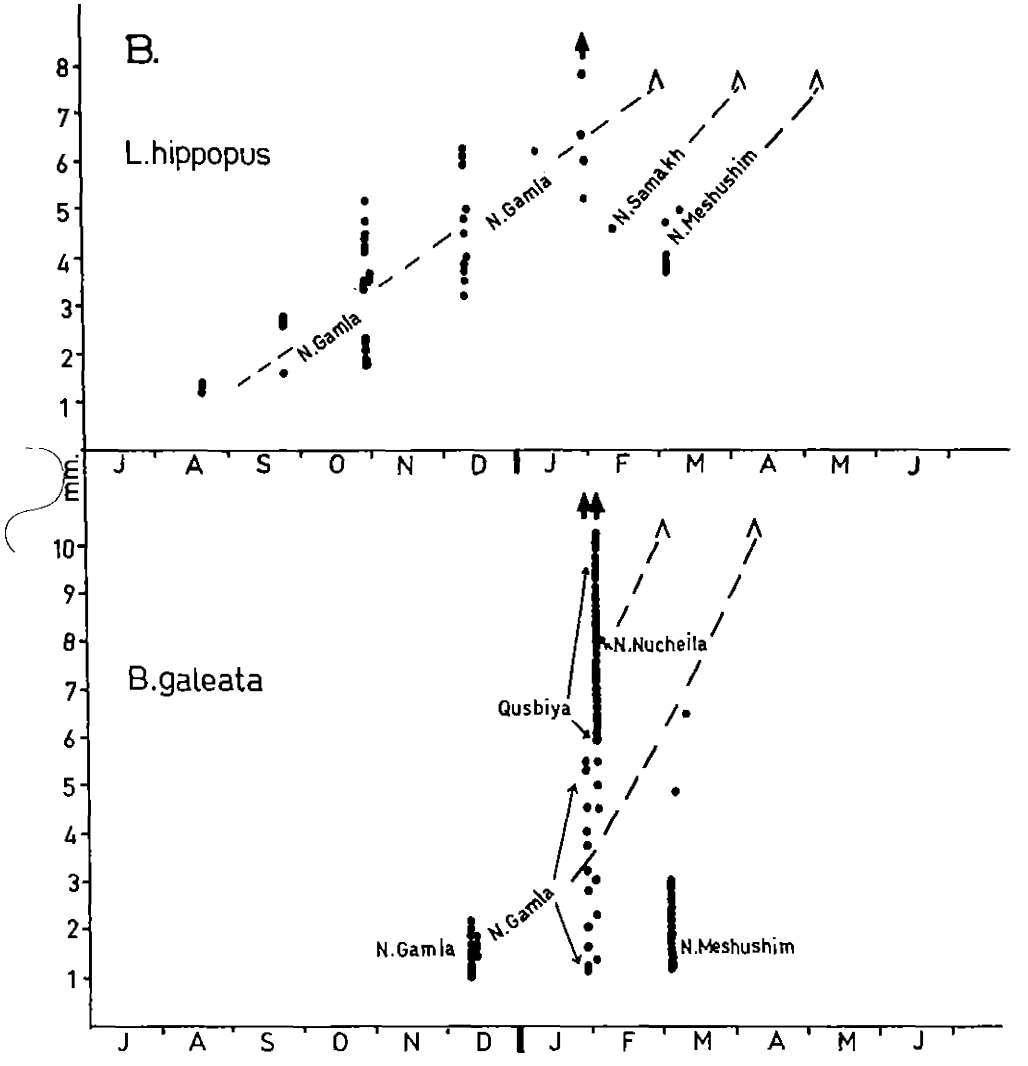


Fig. 2. Sizes of Plecoptera nymphs captured throughout the year: A. Species from R. Jordan headwaters; B. Species from Golan Heights. Heavy arrow indicates capture of adults; Broken line and open arrow indicate probable rate of growth and emergence.



3. *Brachyptera galeata* Koponen, 1949

Fig. 5

The many records of nymphs of this species are all from three Golan stream systems, from both temporary and permanent water sites (Fig. 1): Qusbiya Springs, N. Nuchile, N. Meshushim (all temporary water sites) and N. Gamla (permanent water). Imagos are recorded only from Qusbiya. In Lebanon, Berthélemy and Dia (1982) record adult *B. galeata* from December to April and nymphs in December, January and March.

Since collections of fauna from the Golan streams were carried out from February 1984 till March 1985, and no nymphs of *B. galeata* were captured between April and November, it is probable that this species spends the summer in diapause in the egg stage, even in the permanent N. Gamla. High summer temperatures of up to 24°C in N. Gamla may be an influencing factor in the seasonality of *B. galeata*. (Winter temperatures are as low as 5°C.) From the data presented in Fig. 2, it is likely that the emergence of *B. galeata* in N. Gamla occurs slightly later than in the temporary waters of Qusbiya and N. Nuchile.

4. *Leuctra kopetdaghi* Zhiltzova, 1972

Fig. 6

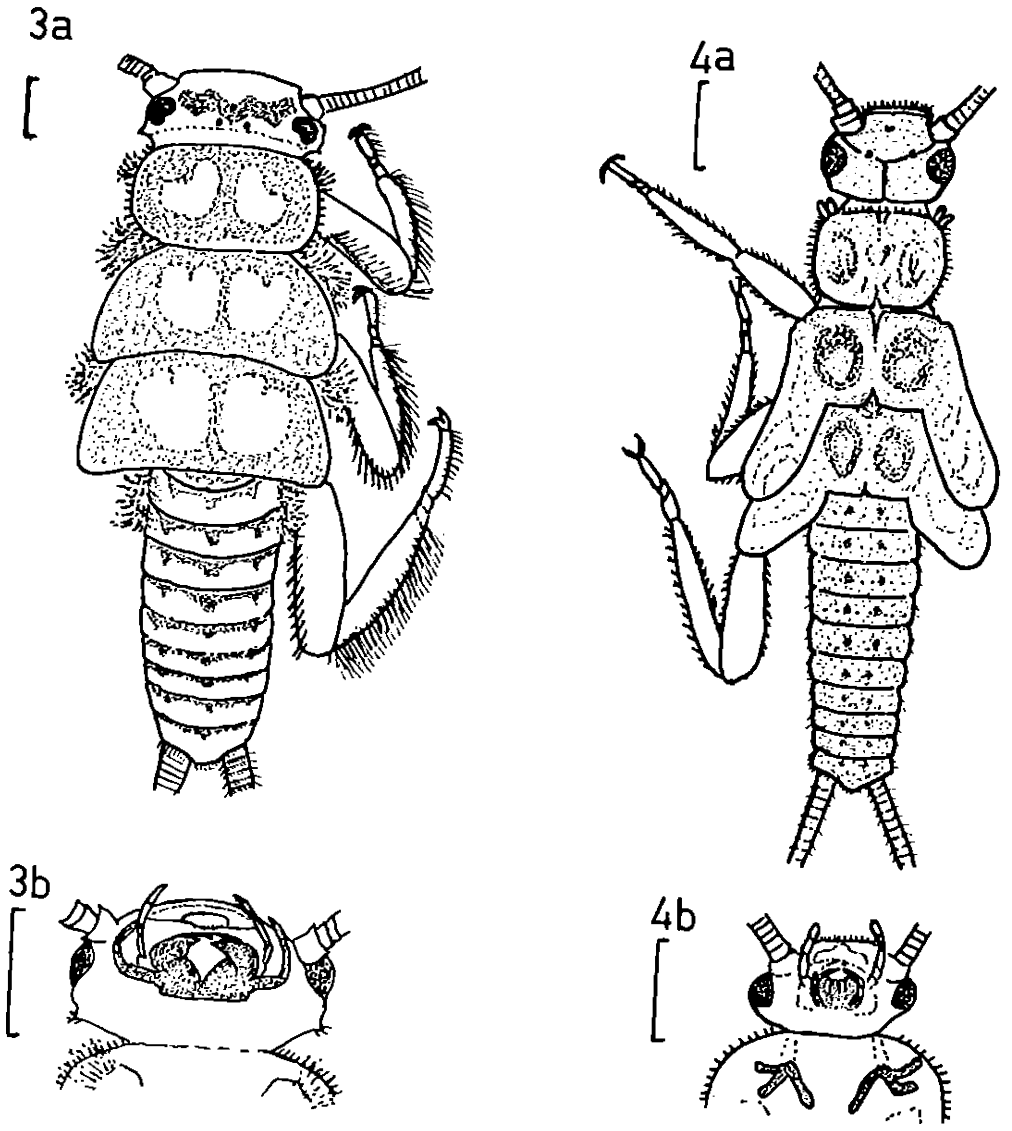
This species has been identified from two sites in Israel: N. Iyon, a semi-permanent tributary of N. Hazbani, with greatly reduced flow in summer; and N. Tal, a permanent tributary of N. Dan. Large nymphs from N. Iyon were collected in January and February (see Fig. 2) and two adults were also caught in February. In contrast, 3 small nymphs of *Leuctra* sp., measuring less than 2.5 mm, collected from N. Iyon in June are presumed to be *L. kopetdaghi* on the basis of the collection site only, and could have been in diapause stage. A single nymph captured in N. Tal in July measured 6 mm, and emergence may be at a different time for this population. In Lebanon, nymphs of *L. kopetdaghi* were captured in October and November, while adults were caught from November to April (Berthélemy and Dia, 1982).

5. *Leuctra hippopus* Kempny, 1899

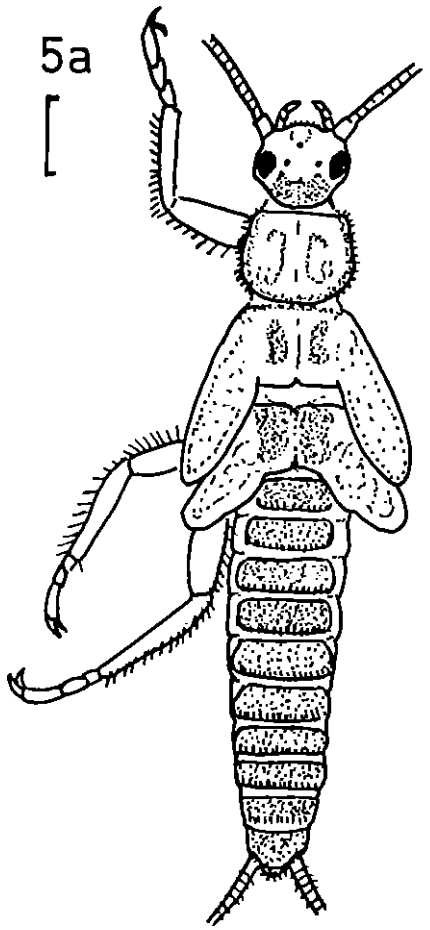
Fig. 7

L. hippopus nymphs were collected from three Golan stream systems: N. Gamla, N. Meshushim and N. Samakh. All sites except N. Meshushim St. 22 (see Fig. 1) are permanent water sites. According to Consiglio (1980), adults of *L. hippopus* emerge in Europe from February to June. While no nymphs of *L. hippopus* were collected from the temporary site of Qusbiya, 5 imagos were collected there on 31.1.1978 by D. Furth, together with a single imago of *B. galeata*, and identified by P. Zwick. It can be assumed from the size of nymphs in N. Gamla in January, that emergence of *L. hippopus* in this stream takes place in February/March, while emergence from other Golan streams (N. Meshushim, N. Samakh) is probably later (see Fig. 2). As with *Leuctra* from N. Iyon, some very small specimens of *Leuctra* from these Golan sites are presumed to be *L. hippopus* on the basis of colection site only and in the absence of other conflicting data. Larger specimens could be identified according to the characters given in the key (see below).

It should be noted that *L. hippopus* nymphs from Israel are not identical with those from Central Europe with respect to long prominent setae on the pronotum and abdomen (Zwick, pers. comm.) which are absent in the Israeli material, and it is probable that *L. hippopus* is actually a species complex.



Figs. 3-7.Plecopteran nymphs. *Marthamea beraudi:* 3a, dorsal view; 3b, ventral view of head. *Protonemura zernyi:* 4a, dorsal view; 4b, ventral view of head. *Brachyptera galeata:* 5a, dorsal view; 5b, lateral view of posterior abdominal segments; 5c & 5d, ventral view of tip of abdomen, ♀ & ♂. *Leuctra kopetdaghi:* 6a, dorsal view; 6b, integument of abdomen. *Leuctra hippopus:* 7a, dorsal view; 7b, integument of abdomen. Scale bar = 1mm except where otherwise indicated.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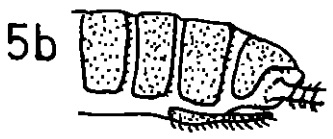
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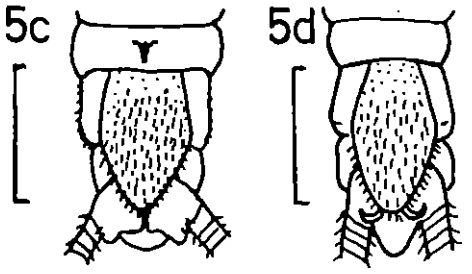
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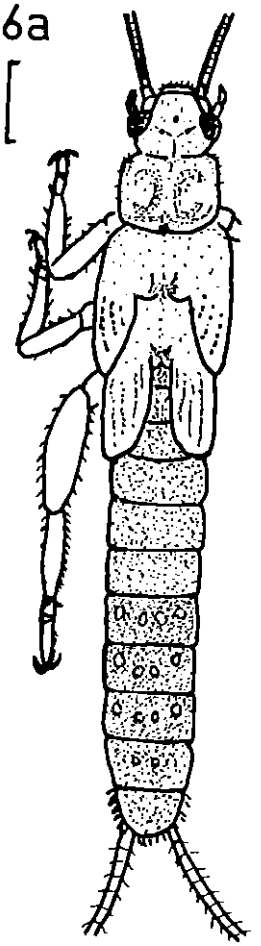
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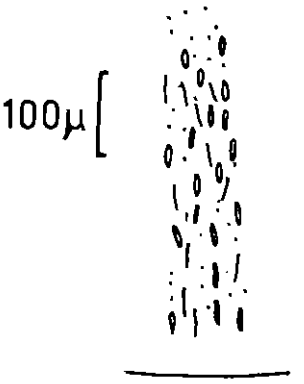
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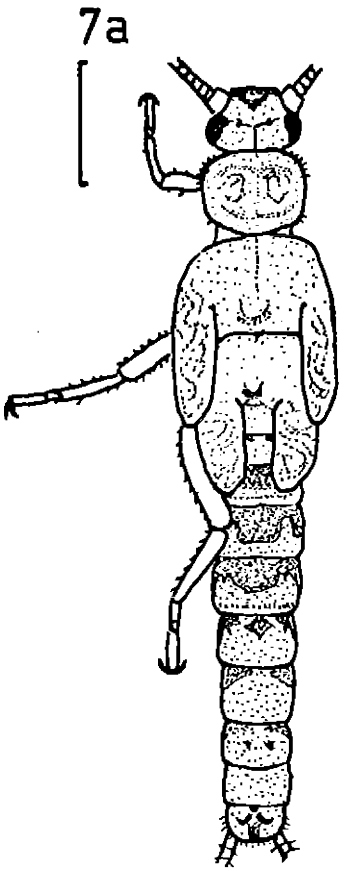

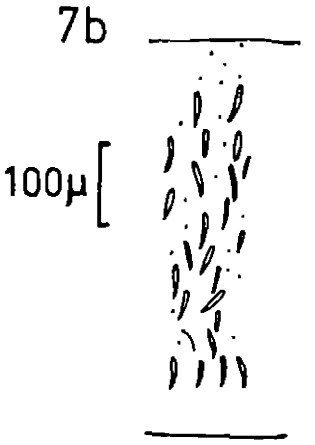

DISCUSSION

The five Plecoptera species are distributed in two distinct areas of northern Israel: the permanent, stenothermic headwaters of the River Jordan and the permanent and temporary streams of the Golan Heights.

Relationships between sympatric species in the Jordan headwaters

The carnivorous *M. beraudi* and the detritivorous *P. zernyi* have both been collected in small numbers (10 or less) from Tel Dan, N. Dan, N. Banyas and N. Hazbani. *M. beraudi* is a much larger animal than *P. zernyi* and apart from their dietary differences, the emergence periods of the two species do not overlap, *P. zernyi* emerging between January and April and *M. beraudi* emerging between May and July. In addition, *M. beraudi* nymphs appear to be

more common in N. Hazbani and N. Banyas while *P. zernyi* nymphs have been collected more frequently from N. Dan.

Fig. 2 shows the nymph sizes of *P. zernyi* according to season. The smallest nymphs are recorded in December, February and May, while the largest were collected in November, January and May. The presence of these larger nymphs in May could possibly indicate a second period of emergence, or it could indicate a period of slow growth of larger nymphs during the summer and autumn months.

Both *P. zernyi* and *L. kopetdaghi* have been caught in N. Tal. Tow small specimens of *P. zernyi* are recorded in May 1984, while a single, larger (6mm) specimen of *L. kopetdaghi* was caught in July 1979.

The only other known habitat in Israel of *L. kopetdaghi* is N. Iyon. While this stream is regarded as a semi-permanent tributary of N. Hazbani, since flow is drastically reduced during summer, it nevertheless supports a wide variety of primary aquatic invertebrates during these months.

Relationship between sympatric species on the Golan Heights

B. galeata and *L. hippopus* nymphs were found at several sampling stations along the permanent N. Gamla as well as at N. Meshushim (St. 22). Neither species was collected from N. Gamla in the spring and early summer months. *B. galeata* was collected from December to March while *L. hippopus* was caught from August to January, thus the two species are almost completely separated temporally, maturation taking place at different times. From Fig. 2, a clear gradation of *L. hippopus* nymph size according to season can be seen. *B. galeata* nymphs collected at the same sites, (N. Gamla), during December and January (the 2 months of overlap) were much smaller than *L. hippopus* nymphs. Thus, *L. hippopus* has a more slowly growing nymph, while *B. galeata* appears to begin development later but growth is faster. This adaptation could be especially important in temporary habitats. In the temporary waters of N. Meshushim, where both species were collected together in March 1985, all specimens of *B. galeata* were ca. 3mm or less in length, while specimens of *L. hippopus* ranged in size between 3.7 and 4.7 mm.

Geographical notes

Plecoptera have not been recorded to date from the streams of the Western Galilee. This could be related to the generally higher water temperatures of these streams in summer compared with the headwaters of R. Jordan, and in winter compared with the Golan Streams.

The Plecoptera species of Israel are clearly an extension of the Eastern Palaearctic fauna and represent their southernmost limit in this area. It is of interest to note that three of the five Israeli species (*M. beraudi, P. zernyi* and *B. galeata*) are known so far only from Israel and Lebanon, while the two *Leuctra* species are more widely distributed.

Plecoptera have not been found in the neighbouring countries of Egypt, Jordan and Arabia (Zwick, pers. comm.) and the nearest records in a southerly direction are from Ethiopia, where the widespread genus *Neoperla* occurs (Consiglio, 1971).

KEY TO THE PLECOPTERAN NYMPHS OF ISRAEL

1. Large nymphs, up to 25 mm; branched lateral filamentous gills at base of legs; labium with paraglossae extending forward much further than the glossae . . . . . Perlidae: *Marthamea beraudi* (Fig. 3)
– Smaller nymphs, up to 10 mm; no fine filamentous thoracic gills (gills, if present, are fingerlike, cervical gills) labium wth paraglossae and glossae extending forward about the same distance 2
2. Second tarsal segment as long, or longer, than the first; wing pads at an angle to body; 9th abdominal sternite prolonged forming a posterior plate; mature nymphs up to 10mm . . . . . Taeniopterygidae: *Brachyptera galeata* (Fig. 5)
– Second tarsal segment shorter than the first; wing pads at an angle or parallel to the body; 9th abdominal sternite normal 3
3. Six fingerlike ventral cervical gills; hind wingpads extending out from body at an angle; hind legs extend well beyond tip of abdomen; mature nymphs up to 9mm . . . . . Nemouridae: *Protonemura zernyi* (Fig. 4)
– Cervical gills absent; hind wing pads approximately parallel to abdomen; hind legs shorter than abdomen . . . . . Leuctridae 4
4. Integument of abdomen sparsely covered with short, stumpy bristles, interspersed with hairs in a ratio of ca. 2:1; mature nymphs up to 10mm in length . . . . . *Leuctra kopetdaghi* (Fig. 6)
– Integument of abdomen more richly covered with longer, pointed bristles, interspersed with few hairs, in a ratio of 5-20:1; mature nymphs up to 8mm long . . . . . *Leuctra hippopus* (Fig. 7)

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