

***Eulichas incisicollis* (Coleoptera: Eulichadidae), an important decomposer of leaf litter in Asian tropical stream communities**

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INTRODUCTION

Coleoptera is the largest order of insects, and its approximately 5000 aquatic members make up one of the major groups of freshwater arthropods [1]. However, inhabitants in the swifter portions of streams and rivers are rare and, in general, small in body size [1]. However, there are exceptions. A North American ptilodactylid, *Stenocolus* sp. is an extremely large coleopteran (14-22 mm in adult body length) living in stream riffles during its larval stages [1]. In Southeast Asia, *Eulichas*, the only genus of Eulichadidae, are large coleopterans with aquatic larval stages [2]. However, no information is available on their larval morphology or life cycles. In this paper, some bionomical data of *E. incisicollis* Pic, 1933 are presented.

METHODS

The study site (200 m long) was located at a tributary (stony stream, altitude 200 m) of the Gombak River near the Field Study Center, University of Malaya, located in Ulu Gombak, Selangor Darul Ehsan, Malaysia, and was visited five times: 5-11 September 1992, 9-11 February 1993, 6 June 1993, 27 September-10 October 1993, and 19 March 1994. The larvae were collected with a hand net (2.0 mm mesh) throughout the study site and, after the prothorax length (Fig. 1) was measured with a slide caliper to the nearest 0.05 mm, they were released at each collecting point. Stream temperatures were taken at noon one to three times at each visit.

Six large larvae were reared in a laboratory aquarium (20 X 30 cm², 7 cm in water depth). The water was continuously aerated and kept at 23-25°C (14 h light: 10 h dark). Small pieces of carrot were given as larval food. A glass box (7 cm in diameter) containing wet peat moss was placed in the aquarium for the larvae to pupate. Emerged adults were reared in a plastic cage (20 X 30 cm², 20 cm high) the bottom of which was covered with wet fallen twigs and leaves. They were also given a roughly 10 % sugar solution containing a little fermented milk.

On 8 October 1993, nine larvae were fixed in 70 % ethanol immediately after collection and later dissected. The whole gut (foregut to hindgut) and the body were separately dried at 80°C for 12 h to estimate the dry weight ratio of gut contents to the gutted body. All gut contents were identified under a binocular microscope (X20) after dissection.

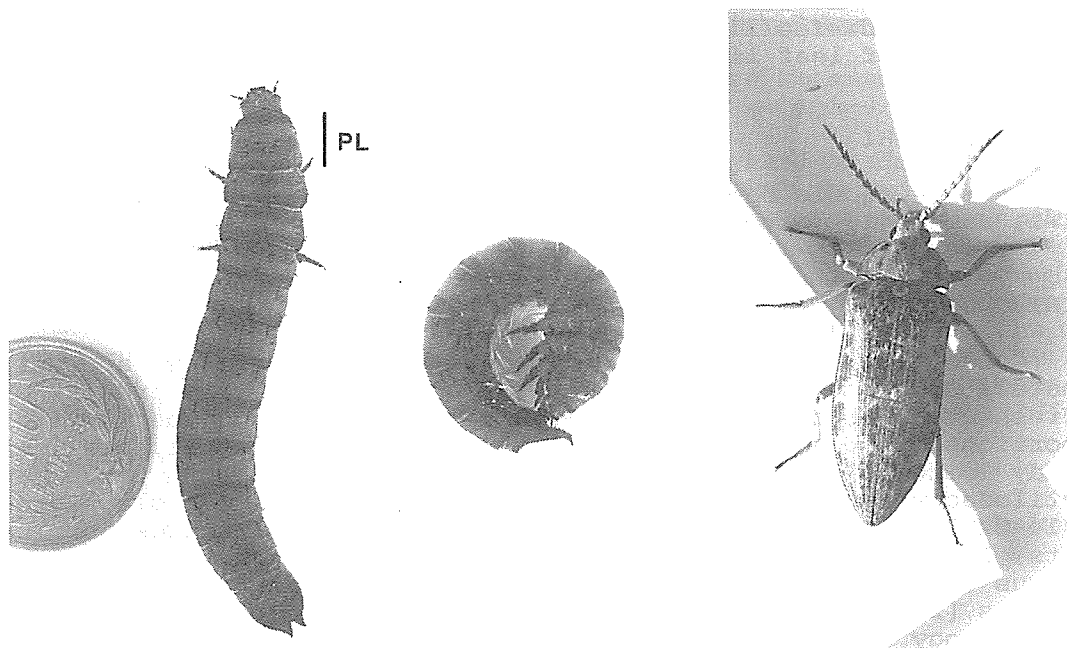


Fig. 1. Larvae (left, dorsal; center, lateral view) and adult females (right, dorsal) of *Eulichas incisicollis*. The coin is 23.5 mm in diameter. PL: prothorax length.

The density of *Eulichas* larvae in the study site was estimated on 30 September 1993. In the riffles, stones were sampled individually by washing them in a net (0.20 mm mesh) held immediately downstream. Stones were weighed to the nearest 0.01 kg using a spring balance, and their surface areas were later estimated by the following equation [3]:

$$S = (4320.1 W + 559.4)^{0.667},$$

where S (cm^2) is the surface area of the stone and W (kg) its weight. The larval density per unit of stone surface was then calculated.

RESULTS

Of nine laboratory-reared larvae, only one female adult (Fig. 1 right) emerged after the 17-day pupal period. This female left the pupating space in the peat moss after another 11 days, and lived for 112 days in the cage. The body was brown coloured, and 34 mm in total length and 12 mm in width at the widest point. Eggs removed from this unmated female were white and ellipsoidal, 0.70 mm ($N=5$, $SE=0.01$) long and 0.58 mm ($N=5$, $SE=0.02$) wide.

Larvae (Fig. 1 left) were found under and among stones at the center of riffles. They were brown in body colour and had many filamentous gills on the ventral side of the abdomen. When stimulated, they bent their bodies (Fig. 1 center). The mean larval density was 1.4 / m^2 stone surface ($N=38$, $SE=0.8$). Gut contents consisted of only small pieces of fallen leaves which were fully

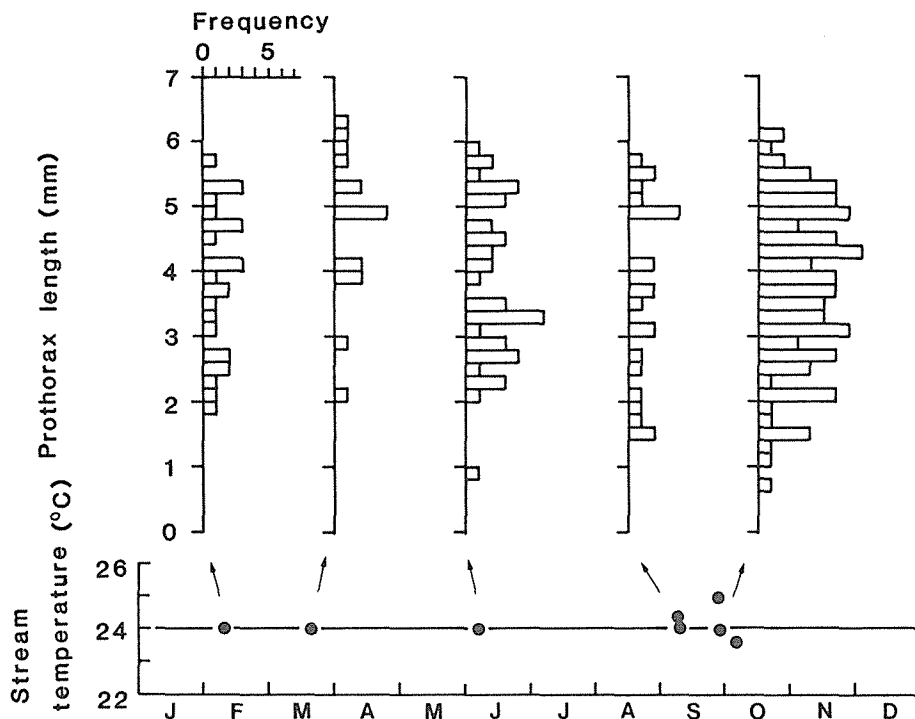


Fig. 2. Seasonal changes in frequency distributions (number of individuals) of prothorax length of larval *Eulichas incisicollis*. Samples were taken on 5-11 September 1992 (N=23), 9-11 February 1993 (N=26), 6 June 1993 (N=44), 27 September-10 October 1993 (N=107), and 19 March 1994 (N=16). Annual stream temperature regime is also shown on the bottom and the line is drawn at 24°C.

packed from foregut to hindgut. The mean prothorax length of nine larvae used for gut content analysis was 4.33 mm (range 2.75-5.60 mm), and the mean gut/body ratio was 29.1% (range 20.5-45.3%).

Annual stream temperature was nearly constant at 24°C, and all sizes of larvae were found throughout the year (Fig. 2). In this study, however, small larvae may have escaped capture due to the coarse mesh size of the collecting net (2.0 mm). The size of the first-instar larvae and the number of instars were unknown.

DISCUSSION

Adult *E. incisicollis* probably appear in all seasons, since the large larvae were collected throughout the year. The larvae inhabited stony riffles at a density of 1.4 /m². They consumed dead leaves which accumulated in the gut, reaching nearly 30% of their body weight. Although there are no comparative data of other species of leaf decomposers inhabiting tropical streams, *E. incisicollis* is considered to be one of most important decomposers.

In East Asia, the relative abundance of Coleoptera in stream riffle benthic communities tends to increase from temperate to tropical regions, and large-sized species such as *Eulichas* spp. are found only in tropical streams [2, 4]. Lotic members of aquatic coleopterans (Psephenidae, Dryopidae, Elmidae, Ptilodactylidae and so on) are generally detritivores [1] as is *E. incisicollis*. Therefore, as fallen leaves decompose on the stream beds, coleopterans probably play a more important role in a tropical riffle community than in a temperate one.

Adults of *E. incisicollis* were much larger than those of the North American *Stenocolus* sp., which is known as one of the largest riffle-dwelling coleopterans [1]. The environment of the studied stream is characterized by (1) constantly high temperature, (2) stable flow regime because of its location in a well preserved hill forest, and (3) no seasonal deficiency in fallen leaf material. In such an environment, in contrast to temperate streams where temperatures decrease in winter and fallen leaves are generally unavailable from spring to summer, growth in tropical streams is uninhibited by falling temperatures or food shortages. This is one possible reason why *E. incisicollis* has a long larval period and subsequently matures to a large body size.

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REFERENCES

1. White, D.S., Brigham, W.U. and Doyen, J.T., 1984: Aquatic Coleoptera. In "An Introduction to the Aquatic Insects of North America" (eds. R.W. Merritt and K.W. Cummins), pp.361-437. Kendall/Hunt Publishing Company, Iowa.
2. Bishop, J.E., 1973: Limnology of a Small Malayan River Sungai Gombak. 485pp. Dr. W. Junk B.V. Publishers, The Hague.
3. Hayashi, F., 1988: Life history variation in a dobsonfly, *Protohermes grandis* (Megaloptera: Corydalidae): effects of prey availability and temperature. *Freshwater Biol.*, 19: 205-216.
4. Hayashi, F., unpublished data.