A MASS CULTURE TECHNIQUE ENSURING SYNCHRONOUS EMERGENCE FOR *LEUCORRHINIA INTACTA* (HAGEN) (ANISOPTERA: *LIBELLULIDAE*)

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An efficient technique for the mass culture of *Leucorrhinia intacta* (Hagen) that results in relatively synchronous emergence of adults at a predetermined date was developed. The timing and degree of synchrony of the mass emergence were investigated for experimental batches run at two different dates in the winter.

INTRODUCTION

Dragonflies are, in many respects, ideal insects for laboratory study. Their large size facilitates delicate neurophysiological and morphological examination (WHEDON, 1942) while their remarkable evolutionary stability and complex life history make this order of particular interest to the ecologist and evolutionary biologist. Laboratory studies of life history, energetics, and behaviour of dragonflies could be especially rewarding. However, such investigations have been rare, probably due to the difficulty involved in rearing a sufficient number of specimens for satisfactory quantitative analysis of the results. To date, only techniques for the culture of small numbers of larvae have been described (CALVERT, 1929; KRULL, 1929; LAMB, 1924; PROCTER, 1973; WHEDON, 1942). Consequently, this simple method of culturing a large number of synchronously emerged adults could be very useful.

MATERIAL AND METHODS

The technique was developed and tested on a series of last instar *Leucorrhinia intacta* (Hagen) larvae. The larvae had been collected from ponds in southern Ontario in late October, 1972, and were stored in vials at 4°C, under a 12:12 hour photoperiod. When rearing was begun, the possibility of death due to temperature shock was reduced by placing the vials of larvae in a tray of water at approximately 10°C, which was then allowed to assume room temperature (about 20°C) over a period of one or two hours. The larvae were then transferred to individual cages to prevent cannibalism. The cages were constructed of light nylon screening (Nitex monofilament nylon fabric number 947) in the form of a cylinder 35.6 cm x 15.2 cm (Fig. 1), and were plugged at each end with stoppers – one of rubber at the bottom, and one of nylon foam at the top. This "open ended" design facilitated the cleaning of the cage, as well as the feeding and transfer of the dragonfly larvae. The cages were hung in rows from wires strung across the top of an aquarium, and the aquarium was placed in a controlled environment room. Air was bubbled through the water, and the water was kept at a constant depth of approximately two thirds of the height of the cages. The ambient air temperature was maintained at 25°C, and the photoperiod was set at a summer cycle of 16 light : 8 dark hours. This particular

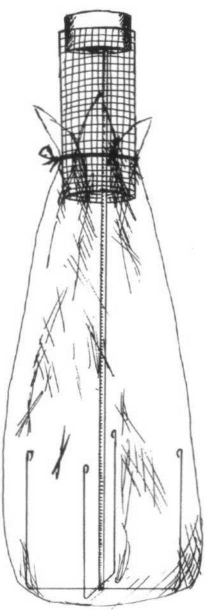

Fig. 1. A dragonfly larvae rearing cage and emergence net.

treatment of temperature and photoperiod was selected because similar treatments have been found to produce the most rapid maturation of the larvae of a variety of temperate species (MONTGOMERY & MACKLIN, 1962; PROCTER, 1973).

Despite the added labour, the culture of a prey species as food was considered the best method of feeding the larvae. WHEDON (1942) fed them on dead tissue, and PROCTER (1973) fed them on white worms (*Enchytraeidae*), but these methods necessitated the hand feeding of individuals, which is more time consuming than rearing prey. Mosquito larvae (*Aedes aegypti* L.) were used because they were easily reared and readily accepted by other libellulid larvae (LAMB, 1924; WRIGHT, 1946). Filter paper on which mosquito eggs had been laid was placed in a tray of dechlorinated water. Grated dog food (Purina chow) was sprinkled on the surface, and within a week or two (depending on the ambient temperature) late instar larvae and pupae were abundant in the tray. About three times a week, approximately twenty late instar mosquito larvae were removed and added to each cage by eyedropper. The presence of uneaten mosquitoes and faeces in the cage permitted the monitoring of the ingestion and egestion of each dragonfly. From these data, the total number of mosquito larvae eaten by each dragonfly larva before emergence was calculated.

When signs of the imminent transformation of a particular larva (i.e. puffed wing buds, appearance of the adult eyes beneath the cuticle around the larval eyes) were noticed. the foam stopper was removed and an emergence net was placed over the cage. This consisted of a 45.7 cm length of 0.64 cm wooden doweling, to which four thick 'L'-shaped metal wires were attached. A bag made of mosquito netting, measuring about 40.6 cm x 22.9 cm, was draped over this structure and was tied around the upper mouth of the cage (Fig. 1). The larva was now able to emerge in an open space wider than the cage, but still enclosed to retain the adult if it tried to fly. The wood doweling and the netting provided an excellent substrate for ecdysis. After transformation was complete, the net could be removed from the cage with the adult still inside, and transported to the storage or research area. Two batches of larvae were run, thirty larvae starting on February 2, 1973, and nine larvae starting on April 9, 1973. The date of death of emergence was recorded for each larva.

RESULTS

Since neither an F-test comparing the variances, nor a t-test comparing the means revealed any significant difference between the two experimental batches, the data were pooled. The mean number of days to emergence (from initiation of the culture) was 21.1 ± 0.88. The mortality based on the pooled data was 23.1%. The data on the total amount of food consumed by each larva were examined, and correlation coefficients for these data for each batch and for the pooled data were calculated. However, no linear correlation or non-linear relation between the amount of food consumed and the number of days to emergence was apparent.

DISCUSSION

The results from the two batches show that *Leucorrhinia intacta* can be reared readily under the described conditions. The experimental mortality was acceptably low, and the metamorphosis to the adult form was highly synchronous and independent of feeding history. Therefore, it can be concluded from this study that large numbers of adult *L. intacta* can now be successfully reared for various uses at a specified future date.

CORBET (1954) defines a spring species of dragonfly as one which "possesses a diapause in the final larval instar" which ensures that "larvae embark upon metamorphosis simultaneously as soon as conditions become favourable in the spring". Thus, *L. intacta* appears to fit into Corbet's category of a spring species, and it is likely that other spring species could be raised with comparable success using this technique.

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