

Pteroptyx valida (Coleoptera: Lampyridae) firefly culture at Night Safari, Singapore

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シンガポール動物園・ナイトサファリにおける プテロプティックス・バリダ (甲虫目ホタル科) の飼育

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This article lists down the first attempt in the culturing of the tropical fireflies *Pteroptyx valida*. There are 21 species of fireflies belonging to the genus *Pteroptyx* in South-east Asia. The culturing of fireflies is one of mixed success over an eight-year period and is still ongoing. Presently the problem facing the culture is one of females fireflies not producing enough viable eggs.

熱帯のマングローブ地域に生息する陸生のホタル *P. valida* の累代飼育を目的としてシンガポール動物園ナイトサファリの施設の室内で飼育繁殖を実施した。シンガポール克蘭ジ地区から採集した成虫を透明プラスチック容器内に入れて産卵させた。採卵は雄成虫と雌成虫を丸い透明な飼育容器に入れて行った。卵は直径 0.6 mm, 産卵数は最高 83 個であった。孵化にはほぼ摂氏 28°C の飼育温度で 12 日から 14 日までを必要とした。1 齢幼虫の餌は巻貝を与え、小型の餌はそのまま、成貝は砕いて与えた。1 齢幼虫は、水苔 50% および砂 50% からなる飼基盤上で飼育した。飼育容器 1 個に入れた幼虫に対して 5 日ごとに 5 匹のカタツムリの幼貝 *Subulina octona* を与えた。3 齢幼虫からは、幼虫は個々に飼育し、餌はすべての 5 日ごとに与えた。幼虫の飼育には、2 種の巻貝、*Lymnae* sp と *S. octona* を餌としたが、後者が餌として適していた。幼虫は 30.4% から 54.6% の生存率であった。幼虫は 120 日間で終齢である 5 齢に達した。飼育幼虫は、一様に成長せず、様々な齢段階が見られた。蛹は地中で 6 日後に羽化した。蛹部屋で羽化した成虫は 3 日間、土部屋内にいて地表に現れた。現在、1 年間にわたってホタルの生活史を維持することが可能ではあるが、継続累代飼育を実現するためには、多数の 1 齢幼虫および雄と雌の同時羽化の実現と、飼育による産卵数の減少を解決する必要性がある。

Introduction

There are eight species of fireflies in Singapore known to the authors. Of these the *Pteroptyx*, a genus consisting of 21 species are distributed throughout South-

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east Asia. The species *Pteroptyx valida* occurs in Singapore, Malaya, Thailand, Indo-china and Sarawak, sometimes away from the mangrove swamps. A search for information on the natural history of this species almost drew a blank, only a few scanty articles on the flash communication and mating behaviour were available. Nothing on the breeding aspect was known. At that time, Tama Zoo, Tokyo in Japan was kind to show the senior author their firefly culture system but unfortunately the species cultured *Luciola cruciata* has an aquatic larval stage. The *Pteroptyx valida* available for culture are terrestrial by nature. *Pteropyx valida* was chosen because it is a hardier, bigger and has interesting flashing pattern. Our experiments with local species of fireflies (mainly *Colophotia* sp. and *Pteroptyx valida*) have been ongoing for the past eight years with mixed success. The culture for *Pteroptyx valida* listed below is still ongoing and we hope to improve on it.

Material and Method

The original successful culture began with four males and four females *Pteroptyx valida* collected from the wild in Kranji, Singapore in 1998. This culture was carried out in a laboratory set up in the Night Safari (culture procedure described below). From the four females, 330 larvae were reared and 153 became adults. From 153 adults (sex ratio: 1:1), 4680 larvae were produced. It was at the third to fourth instars stages that the feeding of aquatic snails (*Lymnaea* sp.) resulted in nematodes infestation and many larvae were killed. Only 700 larvae survived and 213 became adults. These adults were displayed in the Night Safari over a five-month period. During the display period, the paired female adults did not produce much eggs. This was attributed to insufficient egg laying area in the form of moist cloth in display tubs. Some fireflies were kept indoor strictly for breeding and we were then able to increase the egg produc-

tion. The new malpractice of frequent sieving of substrates in search of larvae killed many larvae. This malpractice was immediately stopped. We had to introduce new batches of larvae (collected from the wild) to build up the basal larval stock but the present adult fireflies are not as prolific as earlier batches even though the methodology of culture remain the same.

Result of breeding

Eggs

The adult males and females are placed in a cleacircular breeding tub (Fig. 1) measuring 11.5 cm diameter and 8.7 cm height. Three days after the emergence, the adults fireflies are put together with a male

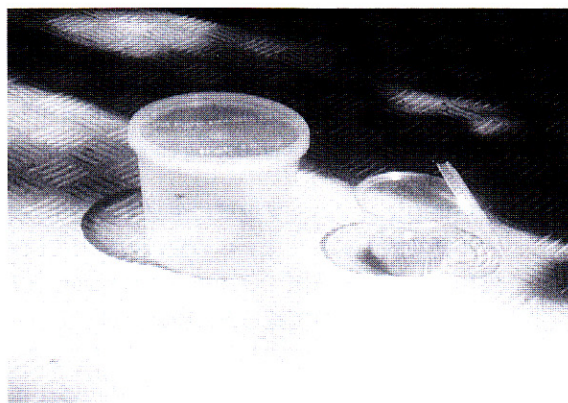


Fig. 1 The adult breeding tub (left) and the rearing tub for larvae (right).

to female ratio of 2:3. They are separated from each other after the third day together. The females are then kept in a circular tub measuring 11.5cm diameter and 8.7 cm height with moist towel lining the tub for oviposition. Eggs laid on the moist cloth are kept moist till they hatch. Eggs may take a month to hatch but normally they take 12 to 14 days to hatch at the ambient temperature of 28 degrees Celsius. These are ovoid and 0.6mm diameter and the maximum average eggs recovered from females are 82 ova.

Larva

From the 1st-instar larvae onwards are transferred onto the larval rearing substrates consisting of moist cloth and filter paper. They are reared on this media till the 4th instar stage. After which they are transferred to a 50 % peat moss and 50 % sand media. This peat moss and sand substrates are sterilized at 80 degree Celsius for four hours and let to cool before use. When used for the rearing of larvae, this mixed sub-



Fig 2. A chest of drawers where larvae are reared and kept.

strates are kept moist. For the 1st-instar larvae, they are kept in groups of five larvae per circular tub (Fig. 1) measuring 7cm diameter and 5cm height. The larvae are fed with baby *Subulina octona* snails; five baby snails per tub every five days. In the absence of baby snails, crushed adult snails are used. These larvae are then kept in a chest of drawers (Fig.2). From the third

instar larvae onwards, larvae are kept individually till emergence and fed every five days. The healthy larvae will normally consume the snails. The growth interval between the 1st instar larvae and 2nd instar larvae is about three weeks. From the 4th instar onwards, larvae are reared on peat moss and sand substrates. The thickness of substrates is 1.5 to 2cm. The substrates used in rearing the larvae are for one generation. The used substrates are then re-used for snail culture. In the rearing of larvae, we have used two types of snails; *Lymnaea* sp and *Subulina octona*. The only disadvantage of using aquatic snails (*L. sp.*) is that it could lead to nematodes infestation that can result in the mortality of the larvae. This problem is not encountered with *Subulina octona*. Sometimes the transferred 4th-instar larvae into the rearing tub individually may result in a few larvae dying (maybe not adapted to the new substrates). The survival rate of larvae to adults were 30.4% to 54.6% and based on the total emergence of adults the sex ratio was 1:1. The larvae undergo five instar stages which will take 120 days. The growth interval from the 3rd instar to the last instar stage is about two months.

Pupae

These pupae remain in the subterranean chambers and metamorphosed into adults by six days. The larval and pupal chambers are mostly built just below the surface of substrates. Rarely are subterranean chambers built partially above the substrates. During the first day of becoming pupae, the pupae did not emit light. On the second day onwards, weak continuous light was emitted from the last abdominal segment.

Adults

The pupae metamorphosed into adults and stayed in the subterranean chambers for three days before emerging. During the three days in the chamber, the adults did not emit light at all.

Snail culture

The culture of *Subulina octona* is quite simple. The snails are reared in number of 50 to 150 per tub (measuring

25 cm diameter and 15 cm height (Fig. 3). The snail will reach breeding age at two months and will produce about four eggs a week and can live up to a year in the culture. They are fed with chopped long bean, carrot, sweet potato and mulberry leaves. Egg shell, shell of mussel or broken coral are given for calcium. The substrates used are 50% peat moss and 50% sand.



Fig. 3. *Subulina octona* snails rearing tub.

Observations

Larvae from the same batch do not grow at the same rate. (OHBA & SIM, 1994, ANITA unpublished 1998) and surprisingly spread over different instar stages. Because of this it is now quite possible to establish fireflies throughout the year with two colonies of fireflies but in order to do this one has to start with a large larval base stock (minimum of 2,000 1st-instar larvae in each culture) and with the adult emergence of males and

females almost at the same time. With a small larval stock it is very difficult to have both sexes emerging at the same time and if single sex emerged it will be difficult to sustain the culture (in such situations, we have tried out lowering the ambient temperature to 22 - 24 degrees Celsius, to prolong the life-span of the fireflies in the hoped for getting pairs). We are presently exploring the prospect of using a special medical refrigerator to synchronize the emergence of the sexes. From our breeding records, we are able to maintain a continuous generation of three successive cultures but run into problem as mention above and have to maintain split colony just to get the present culture going. The present problem is one of adult females not producing enough viable eggs for our culture of fireflies.

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