

DISTRIBUTION, ABUNDANCE AND HABITAT CHARACTERISTICS OF CONGREGATING FIREFLIES (LUCIOLINAE: LAMPYRIDAE) IN REMBAU-LINGGI ESTUARY, PENINSULAR MALAYSIA

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Introduction

Pteroptyx fireflies are one of the charismatic fauna in mangrove ecosystems because they are able to elicit public interest due to their ability to flash synchronously. These beetles have been found congregating on trees or shrubs along tidal rivers in several areas in Malaysian mangrove forests (see Ballantyne & McLean, 1970; Wong, 2001; Zaidi *et al.*, 2005).

The unique lifecycle of the fireflies consisting eggs, larvae, pupae and adults, depends totally on the mangrove ecosystem. Adult fireflies make use of the vegetation, particularly mangrove trees near the river edge and produce synchronous flashing for mating purpose at night. After mating, the successful females fly to the muddy banks behind the vegetation and lay their eggs on the moist soil. The larvae which feed on river snail can be found typically five to 30 m from the display trees in the area where **nipah** and sago palms grow (Nada & Kirton, 2004).

Media reports based on local village experience suggest that some decline has already occurred over the years (Kirton *et al.* 2006a). The habitat of fireflies is threatened by human activities although the local people in firefly sites do acknowledge that the fireflies have tourism attraction, e.g. in Kuala Selangor (Kirton *et al.* 2006b).

During and after the process of habitats destruction and degradation, mangrove trees are felled to be used in industrial, aquaculture and plantation activities. The changes of river water quality resulting from river pollution, the use of diesel by-products and development around firefly habitat may cause the decline of firefly population. Hence, the conservation of these interesting beetles can be very challenging.

It was recommended that accurate understanding of the distribution, abundance and habitat requirements of fireflies is essential towards the effective conservation of firefly population (Takeda, 2006). Surprisingly, the number of scientific data on the habitat requirements of the *Pteroptyx* fireflies, particularly in Peninsular Malaysia is minimal. Furthermore, most studies have only been carried out in Kuala Selangor.

This study therefore aims to investigate the population ecology of *Pteroptyx* fireflies in Rembau-Linggi estuary, Peninsular Malaysia. Specifically, I seek to address the following questions:

- i. What are the distribution and abundance of *Pteroptyx* fireflies in study area?
- ii. What are the habitat characteristics of *Pteroptyx* fireflies in study area?

Materials and methods

Study site

This study was conducted in the Rembau-Linggi estuary (Figure 1). The Rembau-Linggi estuary is situated within the state boundary of Negeri Sembilan and Melaka. The vegetation in this study area was dominated by mangrove trees such as nipa palms and *Sonneratia caseolaris* (L.) Engl. trees, and in the background, other trees such as **nibong** (*Oncosperma* spp.) palms and ferns grow. Further downstream, the riverbanks were lined by dense stands of mangrove species such as *Rhizophora apiculata* Bl. and *Sonneratia alba* J. Smith.

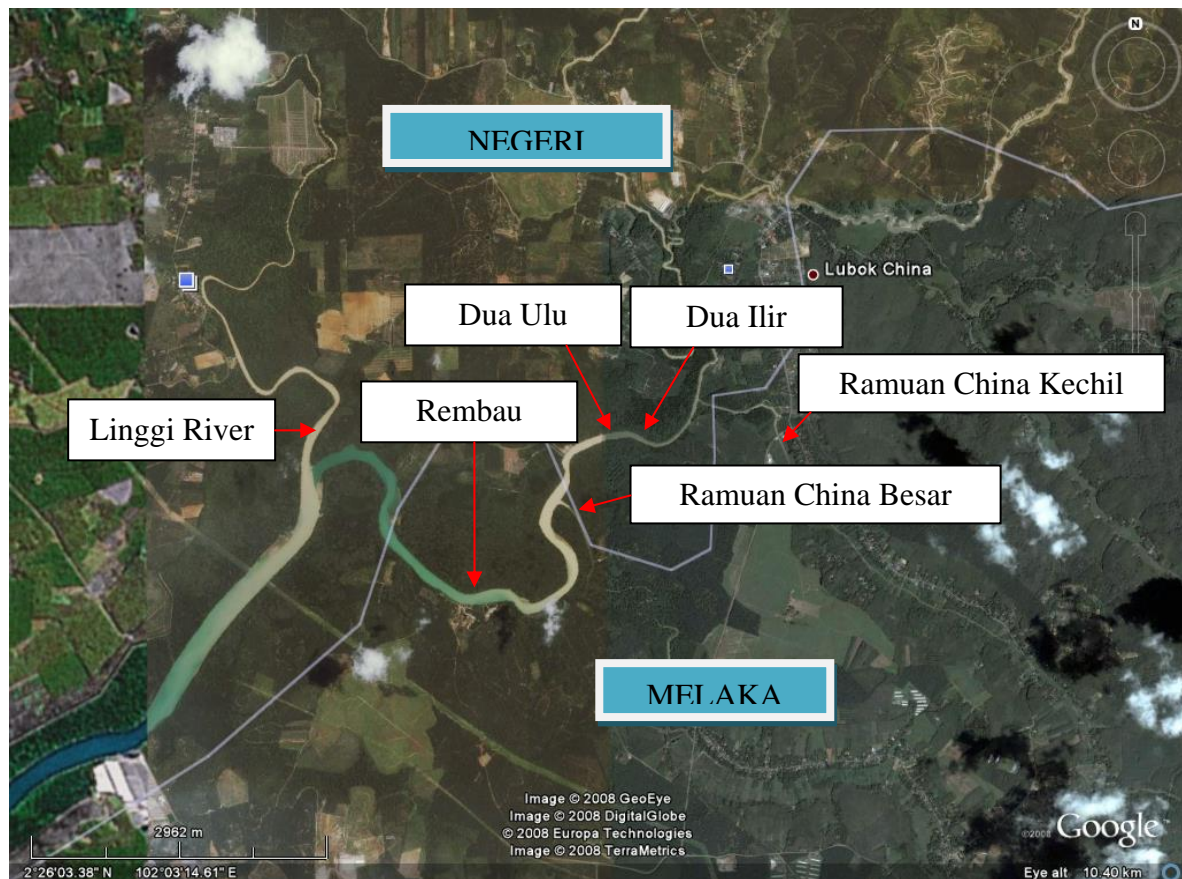


Figure 1: Study site

The Rembau-Linggi estuary consists of two major rivers i.e. Linggi River and Rembau River. Other tributaries are Ramuan China Besar River, Ramuan China Kechil River, Dua Ulu River and Dua Ilir River.

Spatial study scale

This study was divided into three study scales; 1. Large scale, 2. Medium scale, and 3. Small scale (see Figure 2). In a large scale study, the distribution of firefly colony was identified by recording the location of the trees that the fireflies congregated on at night using Global Positioning System (GPS). The main display trees along the rivers were tagged and each tree was then identified to the species level.

In the medium scale study, habitat characteristics of congregating fireflies along Rembau River were identified based on land use spatial analysis, selected water quality measurement and display tree censuses. In the small scale study, percentage cover of fireflies on ten display trees were estimated using percentage chart and the population was monitored over six months. In addition, the tree health characteristics of the display trees and non display trees were compared to determine the factors that influence the selection of a display tree by fireflies.

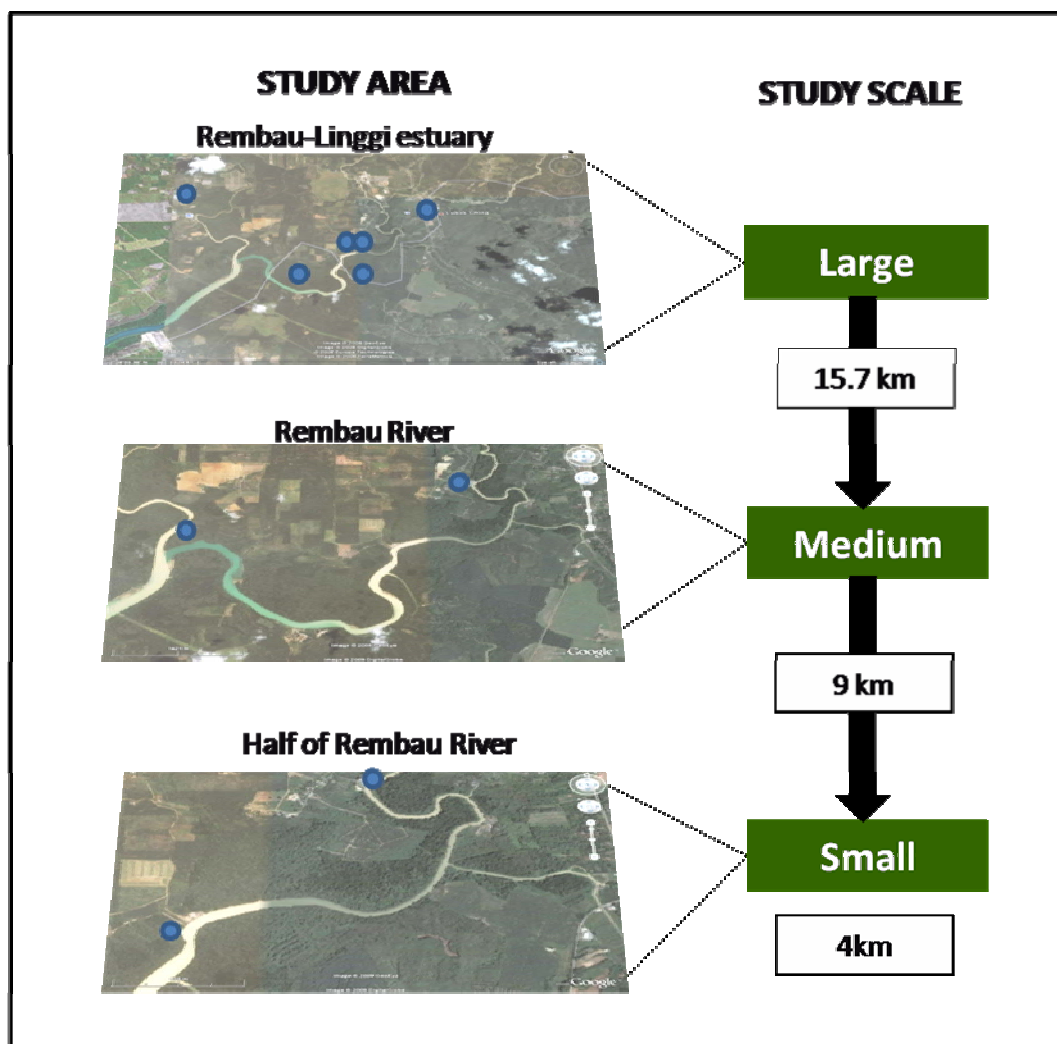


Figure 2: Spatial study scale.

Statistical analyses

In this study, data analysis involving descriptive and inferential statistics was made to summarize and interpret the study data. The recorded data of percentage abundance occupied by firefly population at different sampling points was analyzed using Kruskal-Wallis test. Post-hoc test will further elucidate the differences between the sample means. Further, the relationships between adult firefly percentage cover and daily rainfall were determined using non-parametric correlation analysis.

Results and Discussion

This paper presents the results of large scale study (Chapter 4) and small scale study (Chapter 6). The results are as follows:

There were three firefly species identified in Rembau-Linggi estuary: 1. *Pteroptyx tener* Olivier, 2. *Pteroptyx malacca* Gorham, 3. *Pteroptyx* sp. On the whole, *Pteroptyx* colonies were found in the middle estuary, i.e. about 9 km from the mouth of the estuary. The colonies occupied the lengths of 0.7 – 9 km of the main rivers in the study area and congregated mainly on the four plant species: *Sonneratia caseolaris*, *Hibiscus tiliaceus*, *Rhizophora apiculata* and *Ficus* sp. The colonies were found along four out of six rivers, and they seemed to prefer certain rivers in the estuary. It was found that there were 122 *P. tener* colonies on the display trees, with the most abundant colonies being recorded along the Rembau River. Although 75% of display trees were found to be *S. caseolaris*, only 10% of total *S. caseolaris* trees along the Rembau River were occupied by fireflies. In terms of abundance, the percentage cover of *P. tener* population size fluctuated over the six month study period. On average, the highest percentage cover (6%) of *P. tener* was recorded in November and December 2008, while the lowest percentage cover (2%) was recorded in January and March 2009. It was also found that there was no correlation between firefly percentage cover and daily rainfall (correlation coefficient=1.00, p-value=0.176). Of the measured tree health variables, crown density and dead branches showed the significant difference between *S. caseolaris* display trees and *S. caseolaris* non display trees.

The results of this study showed that firefly colonies were found along four out of six rivers, and they seemed to prefer certain rivers in the estuary. The result also indicated that fireflies preferred *S. caseolaris* as their display tree. This supports earlier observations made by other researchers (Motuyang, 1995; Nallakumar, 2002; Ohba and Wong, 2004). This also explains the absence of firefly colonies in the Dua Ulu River and Dua Ilir River where there was a total absence of the species and nipa palms were the main vegetation species.

The preference for *S. caseolaris* could be due to more than one reason. Firstly, the preference could be due to the presence of sugar (about 20% sucrose) in the sap of *S. caseolaris* which provides food source for the fireflies (Morrison, 1929; Ohba and Sim, 1994; Pandit and Choudry, 2001; Nallakumar, 2002). Secondly, the leaf arrangement of *S. caseolaris* trees is suitable for mating rendezvous compared to other mangrove trees. Finally, another explanation is chance (sensu Buck and Buck, 1966), i.e. *S. caseolaris* happens to be in study area and in high abundance. It remains

to be seen if in other areas that have other dominant species, fireflies would prefer this species or *S. caseolaris*.

It was also found that fireflies would go for *S. caseolaris* trees with high density of leaves or crown so that perfect flashing synchronicity can be performed. In addition, each firefly has its own territory which means one leaf for one individual (Ohba, pers. comm., 2008). The result indicated that fireflies would not go for the tree with dead branches visible over most of the crown. This may due to the fact that adult fireflies prefer shaded area while resting on a tree during daytime as they were often found underside of a leaf or in a rolled leaf (Ohba and Wong, 2004). Moreover, it was also reported that the mortality rate of tree branches would be lower when the whole tree was shaded (Henriksson, 2000).

Significance of findings

Prior to this study, firefly distribution in Rembau-Linggi (Negeri Sembilan and Melaka) estuary had not been scientifically documented. This study has added significantly to the knowledge of the population ecology of *Pteroptyx* fireflies in Peninsular Malaysia. In particular, the results of this study point to the need for protecting the many plant species that the fireflies use; different plants for different stages of its lifecycle. One of the more significant findings to emerge from this study is that an ecosystem approach is seen to be more promising for the conservation of the fireflies.

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