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Distribution and Abundance of *Pteroptyx* Fireflies in Rembau-Linggi Estuary, Peninsular Malaysia

Wan Faridah Akmal Wan Jusoh, Nor Rasidah Hashim and Zelina Zaiton Ibrahim

Faculty of Environmental Studies, Universiti Putra Malaysia 43400 UPM, Serdang, Selangor, Malaysia

Abstract

Prior to this study, no scientific documentation of firefly distribution and abundance in the Rembau-Linggi estuary, Peninsular Malaysia had been made. Therefore, this study provides important baseline information for the conservation of *Pteroptyx* spp. and their habitats. Our study was conducted over six months (2008 and 2009) during which we surveyed the distribution and abundance (percentage cover) of congregating fireflies, *Pteroptyx* spp., in the estuary. We also recorded the plant species on which adult fireflies congregate to mate along the rivers. Our main findings were: 1 *Pteroptyx* spp. populations occupied the lengths of 0.7 - 9 km of the main rivers in the study area. 2. The percentage of *Pteroptyx* population size fluctuated over time. 3. The *Pteroptyx* colonies congregated mainly on four plant species: *Sonneratia caseolaris, Rhizophora apiculata, Hibiscus tiliaceus* and *Ficus* sp.

Keywords: istribution; abundance; *Pteroptyx* fireflies; mangrove forest

1. Introduction

Fireflies are charismatic fauna and are sometimes highly revered, e.g. in Japan (Ohba and Wong, 2004; Osamu, 2006; Takeda *et al.,* 2006). Worldwide, fireflies are a very diverse taxon, i.e. more than 2000 species and it is believed that more than four genera can be found in Malaysia (Ballantyne and McLean, 1970; Wong, 2001; Nallakumar 2002; Wong, 2007). The genus *Pteroptyx* is primarily restricted to mangroves and each stage of a species' lifecycle depends on different parts of the mangrove ecosystem (Nallakumar, 2002; Nada *et al.,* 2008). The adults congregate on mangrove trees, especially at night, for mating purposes. 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 snails, can be found typically five to 30 m from the display trees in the area where **nipah** and sago palms grow (Nada *et al.,* 2008).

So far in Malaysia, there is a serious lack of detailed and reliable information on the distribution and abundance of fireflies as most reports are based on opportunistic observations (see Nallakumar, 2002; Zaidi *et al.,* 2005; Wan Jusoh, 2007; Nada *et al.*, 2008). This situation needs quick rectification as the fireflies and their mangrove habitats are fast becoming endangered by anthropogenic activities (Nallakumar, 2002; Nada and Kirton, 2004; Ohba and Wong, 2004; Wong, 2008) whilst information on their population ecology is required to ensure their survival and conservation (Takeda *et al.,* 2006). As such the aim of our study is to add baseline information of the *Pteroptyx* populations in Peninsular Malaysian mangrove forests. The objectives of this study were: 1) To map the distribution of *Pteroptyx* spp. in the Rembau-Linggi estuary 2) To identify the main display trees for *Pteroptyx* spp. 3) To assess the abundance of *Pteroptyx* spp. on selected display trees.

2. Materials and Methods

2.1. Study site

This study was conducted in the Rembau-Linggi estuary located in the southwestern coast of Peninsular Malaysia (Figure 1). Prior to this study, no scientific documentation of *Pteroptyx* fireflies has been made in this area. The Rembau-Linggi estuary consists of two main rivers i.e. Rembau and Linggi. Other tributaries are Ramuan China Besar, Ramuan China Kechil, Dua Ulu and Dua Ilir. The main vegetation consists of mangrove trees (such as *Rhizophora apiculata* Bl., *Sonneratia alba* J. Smith, *Sonneratia caseolaris* Engl.), **nipah** palms, *Oncosperma* spp. and ferns.

2.2. Field observation

Field observations were carried out from November 2008 until April 2009. The distribution of *Pteroptyx* fireflies was recorded along 15.7 km of the main rivers. The location of each colony was identified by recording the location of the trees that the fireflies congregated on at night using GPS. The main display trees along 9 km of Rembau River were tagged and each tree was then identified to the species level.

2.3. Visual estimates

Visual estimates of abundance percentage of *Pteroptyx* fireflies were made using a modified comparison chart (Terry and Chilingar, 1955). Estimates were made at twenty display trees along Rembau River by two observers who were trained to apply the technique.

3. Results and Discussion

3.1. Firefly distribution

Pteroptyx colonies were found in the middle estuary, i.e. about 10 km from the mouth of the estuary (Fig. 1; Table 1). The colonies were found along four out of six rivers, and they seemed to prefer certain rivers in the estuary (Table 1). In total, we recorded 122 *Pteroptyx* colonies on their display trees, with the most abundant colonies being recorded along the Rembau River. Here, a total of 87 *Pteroptyx* colonies were distributed along 9 km of the river compared to 0.7-3 km or 10-20 *Pteroptyx* colonies for the other rivers, such as Linggi, Ramuan China Besar and Ramuan China Kechil (Table 1).

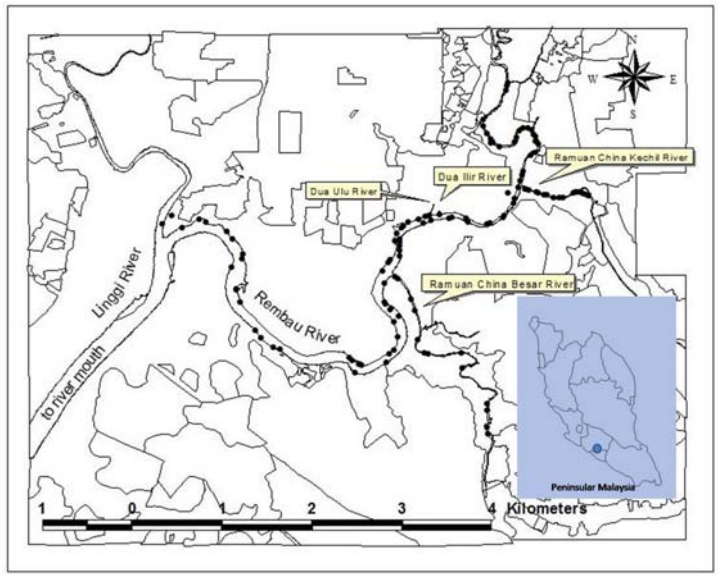

Figure 1. The Rembau-Linggi mangrove forests, consisting of two major rivers i.e. Linggi River and Rembau River. Other tributaries are Ramuan China Besar River, Ramuan China Kechil River, Dua Ulu River and Dua Ilir River. Black dots indicate location where *Pteroptyx* colonies were found.

Table 1. Information about *Pteroptyx* firefly distribution and its display tree.

Location	Firefly species	Distribution of fireflies along the river	Display tree	Local name	No. of firefly colonies on the display trees	Total firefly colonies
Rembau	*P. tener*	9 km	a) *S. caseolaris* b) *H. tiliaceus* c) *R. apiculata* d) *Ficus* sp.	a) Berembang b) Bebaru c) Bakau d) Jejawi	658104	87
Linggi	*Pteroptyx* sp.	3 km	a) *S. caseolaris*	a) Berembang	2	2
Ramuan China Besar	*P. tener*	3 km	a) *S. caseolaris* b) *R. apiculata*	a) Berembang b) Bakau	103	13
Ramuan China Kechil	*P. tener*	0.7 km	a) *S. caseolaris* b) *R. apiculata*	a) Berembang b) Bakau	182	20
Dua Ulu	-	-	-	-	-	-
Dua Ilir	-	-	-	-	-	-
	TOTAL	**15.7 km**				**122**

3.2. Firefly display trees

There were four plant species that the fireflies used as display trees along Rembau River: 1. *Sonneratia caseolaris*, 2. *Rhizophora apiculata*, 3. *Hibiscus tiliaceus*, 4. *Ficus* sp. Among the 87 *Pteroptyx* colonies, 65 (75%) of them were found on *S. caseolaris* trees compared to 4-10 colonies on other types of trees (Table 1). A total of 645 *S. caseolaris* trees were counted along the 9 km of firefly area along Rembau River but only 65 (or 10%) of these trees were occupied by fireflies (Fig. 2).

3.3. Firefly abundance

In terms of abundance, we found that the percentage of *Pteroptyx* population size fluctuated over the six month study period. On average, the highest abundance percentage (6%) of *Pteroptyx* was recorded in November and December, while the lowest abundance percentage (2%) was recorded in January and March (Table 2). Interestingly, the firefly colonies for two display trees (nos. 7 and 10) were absent for two months (January and March). Moreover, one display tree died and the colony that had occupied it moved to an adjacent tree as we found some 3% cover percentage of firefly occupying a tree located 50 m from the dead tree.

The results of our study indicated that the 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 **nipah** palms were the main vegetation species.

Our study also showed that not all *S. caseolaris* trees were used by the fireflies. It has been reported that the colonies have preferences for certain mangrove species, although the actual reason for it is still not fully understood (Motuyang, 1995; Chey, 2004; Wong, 2007). This phenomenon could be partly due to an individual tree's traits such as height, crown size, leaf density, and trunk diameter as suggested by Nallakumar (2002) who found that the fireflies only used the young *S. caseolaris* trees in Kuala Selangor. Further investigations will therefore include recording the display trees' characteristics in the Rembau-Linggi estuary.

The fluctuations in population abundance of *Pteroptyx* are related to large-scale environmental phenomena (Yuma, 2007). Excessive water is good for the larvae and it encourages the population growth of the *Pteroptyx* population (Ohba and Sim, 1994; Nallakumar, 2002). However, increased river flows resulting from heavy rainfalls may restrict the foraging activities of small larvae. Heavy rains may also adversely affect populations of *Pteroptyx* larvae's prey species, such as snails (Nallakumar, 2002; Yuma, 2007).

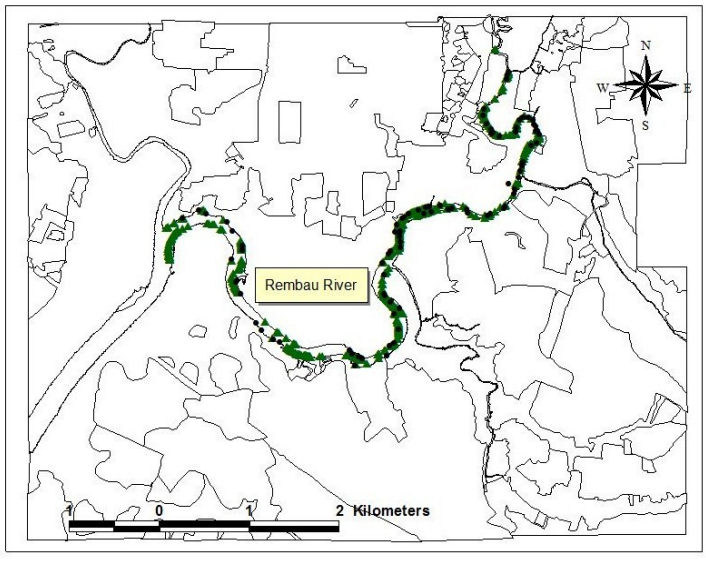

Figure 2. Map showing the distribution of *Pteroptyx* colonies (black dots) and *S. caseolaris* trees (green triangle) along Rembau River

Table 2. Percentage of *Pteroptyx* population abundance on ten focal display trees for six months with daily rainfall data.

			Focal display	1	2	3	4	5	6	7	8	9	10	
Month	**tree no. Observation Date**	**Daily Rainfall (mm)**	**Rainfall time**	**Percentage (firefly abundance)**										**Average %**
November	29/11/2008	0.2	7:00 AM-8:00 AM	7	5	5	5	6	5	8	6	8	8	6
December	28/12/2008	0.8	2:00 PM-3:30 PM	4	7	6	7	7	7	5	4	6	6	6
January	26/1/2009	0	-	2	2	3	3	2	3	7	1	1	0	2
February	28/2/2009	1.6	6:00 PM-Midnight	2	1	2	6	5	1	0	5	3	1	3
March	25/3/2009	0	-	2	Tree died	3	3	3	1	0	3	3	2	2
April	27/4/2009	0	-	3	Tree died	4	5	4	1	3	2	1	3	3

The most interesting finding was that the *Pteroptyx* fireflies switched trees for a certain amount of time. In this case, the findings of the current study do not support the previous findings made by Murray (1984) and Motuyang (1995) who found that *Pteroptyx* colonies used the same display trees over a 5-year period. This behaviour was also observed in the *Phyrophanes* sp. from Indonesia which migrates every week (Ohba and Wong, 2004). Apart from human disturbances, a possible explanation for this might be that the firefly population is dependent on the tree's health. This research question is being further investigated in our on-going research.

4. Conclusions

This study has added significantly to the knowledge of the population ecology of *Pteroptyx* fireflies in Peninsular Malaysia. In particular, the results of our study point to the need for protecting the many plant species that the fireflies use; different plants for different stages of the fireflies' lifecycles. In addition, our study has provided further insight into the possible causes of *Pteroptyx* population fluctuation over a certain period of time. Therefore, the important implication of our study is that an ecosystem approach is more promising for the conservation of the fireflies.

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Correspondence to
Dr. Nor Rasidah Hashim
Department of Environmental Sciences,
Faculty of Environmental Studies
Universiti Putra Malalysia 43400 UPM,
Serdang, Selangor, Malaysia.
Tel: (603)8946 7462
Fax: (603)8946 7463
E-mail: rasidah@env.upm.edu.my