Distribution and Habitat of the Firefly, *Asymmetricata circumdata* (Motsch.) (Coleoptera: Lampyridae: Luciolinae) in the North of Thailand

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ABSTRACT

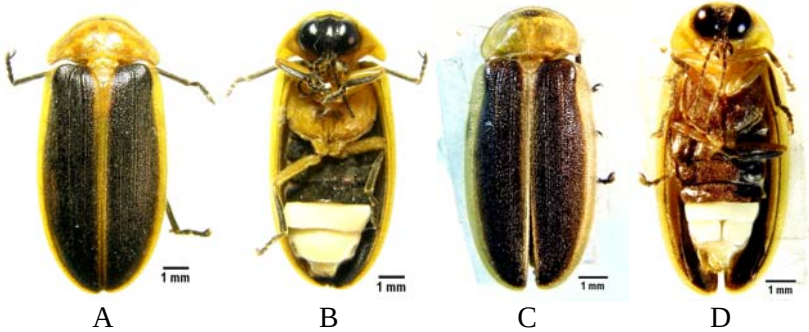
The investigation on distribution and habitat of the firefly, *Asymmetricata circumdata* (Motsch.) in the north of Thailand were conducted from July 2007 to June 2011. *A. circumdata* were found in 30 different geographical habitats. The altitude of the study areas ranged between 38 and 1,226 msl. The insect collections were carried out from 6:00 pm. to 12:00 pm. which adults of *A. circumdata* were collected by an insect sweeping net. The investigations showed that *A. circumdata* had the broadly distribution in the north of Thailand, and mostly found throughout summer and rainy seasons. Their abundant areas were found at the mixed deciduous forests. They were also found in disturbing areas such as urban and cultivating areas. In addition, they were more abundant in the natural habitats which more than 50 individuals/study sites were recorded. In contrast, in the cultivating areas and urban areas, the population was less than 5 individuals/study site. This result showed that even though *A. circumdata* can be found in several different habitats, they rather preferably occupy the natural habitats. This indicated that natural habitats have to be protected for the survival of *A. circumdata*. The distribution map of *A. circumdata* in the north of Thailand is also provided.

Keywords: *Asymmetricata circumdata,* species distribution, habitat, geographical map, Northern Thailand.

INTRODUCTION

Genus *Asymmetricata* is revised by Ballantyne and Lambkin in 2009 which composed only two South-East Asian firefly species name *A. circumdata* (Motsch.) and *A. ovalis* (Hope). Both species were previously classified in the genus *Luciola* but *Asymmetricata* was distinguished from all other Luciolinae by the asymmetrical tergite 8 emarginated on its right side. Despite of *A. circumdata* and *A. ovalis* are similar in coloration and appearance. They are distinguished by the entire light organ in ventrite 7 in which *A. ovalis* is bipartite (figure 1). Theraphat (1969) reported that the general existence of *A. circumdata* in the orchards of Bangkok and Samut Prakarn provinces which was the highest number of their population to find from May to November. However, Lloyd *et al.*, (1989) reported its distribution throughout Thailand and the samples were collected all year round. This species was also

reported widely in Myanmar, Thailand and Cambodia by Bourgeois (Ballantyne and Lambkin, 2009). Thancharoen (2001) surveyed and reported the appearance of *A. circumdata* in the tropical rain forest of Pha Kluai Mai waterfall, Khao Yai National Park, Thailand at about 680 meters above mean sea level (msl). In addition, in highland habitat, the adults of *A. circumdata* occurred in short period of summer to early rainy season (from April to June). However, this species was neither found in the freshwater area (at Salaya campus, Mahidal University, Nakhon Pathom province) nor the brackish water area (Samut Songkram and Samut Prakarn provinces) at the elevation about 1 msl. The disappearance of *A. circumdata* in the lower central riverbank of Thailand may be due to the disturbance from urban electric light and broadly chemical used in agriculture. The research project entitled "A Study of Diversity and Ecology of Firefly in Thailand" under Her Majesty the Queen Sirikit's Initiative (Firefly Project under HM Queen Sirikit's Initiative committee, 2001) has surveyed and reported the species diversity of firefly in Thailand since 1997. However, no data about *A. circumdata* in the north of Thailand has been reported. The latest report by Tittayavan (cited in Napompeth, 2009) confirmed the commonly existing of *A. circumdata* in the Queen Sirikit Botanic Garden in Chaingmai province in the northern Thailand with the briefly description on morphology and flash behavior, but the habitats occupied by this species were not mentioned. We conducted the surveys in order to investigate the species distribution and habitat in the north of Thailand. The information we obtained can be applied for the sustainable conservation of *A. circumdata* both in the north of Thailand and elsewhere.



A B C D

Figure 1 Adult males of *A. circumdata* A) Dorsal view; B) Ventral view and *A. ovalis* C) Dorsal view; D) Ventral view.

METHODS

The survey of distribution and habitat of *A. circumdata* were carried out in different geographic areas in the north of Thailand (the latitude range between 15° N and 21 ° N and the longitude range between 97 ° E and 102° E) by the systematic random sampling technique (Krebs, 1999). Adult fireflies were collected by an insect sweeping net and were preserved in 70 % ethyl alcohol. The populations were estimate counted. The field activity began at 6.00 pm. to 12.00 pm. Our field surveys took place during July 2007 through June 2011. *A. circumdata* samples were confirmed the actual species by dissection of male genitalia, and confirmed with the dichotomous key of Ballantyne and Lambkin (2009). The habitats of *A. circumdata* samples were recorded. The altitudes and localities were located by a GPS receiver (Garmin); the data were then used to determine the distribution of this species.

RESULTS AND DISCUSSION

The surveying data, we found that in the north of Thailand, *A. circumdata* occurred in a long period, between late April and early August, in several habitat types. The highest abundance usually found from late April to mid May which are early rainy period. There are several other factors which could promote to the abundance of these insects and availability of food could be one of the very important factors. Most firefly larvae are predators of snails and slugs (Lloyd, 1991) which have most activities in the rainy season. Therefore, this high abundance may be due to the synchronization of reproduction with the food availability of predatory firefly larvae. One hundred and forty six *A. circumdata* specimens were collected from 30 study sites in 12 provinces (table 1) with various geographical areas (figure 2). The altitude of the study areas ranged between 38 and 1,226 msl. and the habitats occupied by this species were classifieds into 6 types; such as, evergreen forest, mixed deciduous forest, pine forest with grassland, secondary forest, cultivating area and urban area. Common appearances of this species were observed in late summer season of mixed deciduous forests and evergreen forests at altitude range between 103 and 956 msl. In mixed deciduous forests, where the altitude ranges between 103 and 526 msl, the firefly populations were more than 50 individuals/site. These forests compose of brook, stream, marsh or pond, which are suitable habitats for land snails, earthworms and soft body insects. Also are good food sources for firefly larvae (Lloyd, 1991). Moreover, the most abundance of this species were recorded with the population record that was more than 1,000 individuals/site in the mixed deciduous forest of Mae Wong NP (289 msl). The average of firefly population with 100 individuals/site were recorded in the evergreen forests with the altitude are 950 msl. In addition, the larvae of this firefly species have been reported throughout the year in evergreen forests. This may be due to an appropriate temperature throughout the year. Therefore, the food sources are available for firefly larvae. Moreover, in those forests where less polluted pesticides accumulation and also less electric light, *A. circumdata* are able to reproduce naturally, therefore, they commonly appear. In those lowland areas and disturbing areas; such as, urban areas and cultivating areas, less than 5 individuals/study site were recorded. These may be due to the generally applying of agricultural chemicals which is harmful for fireflies (Thancharoen, 2001). Moreover, the electric lights in urban areas interfere with the sexual communication of firefly (Thancharoen, 2007). Reduction of sexual communication leads to unsuccessful copulation and depopulation or absolute disappearing of *A. circumdata* in those habitats. In addition, none of individuals was recorded in the mountainous areas with the altitude higher than 1,300 msl. In higher latitude areas, lower temperature and immoderate humiditycauses unsuitable conditions for the survival of this firefly species. Yuma (1984) and Yuma and Hori (1981) reported that temperature is one of the factors affecting the survival of eggs and pupation of *Luciola cruciata* in Japan.

Table 1 The study sites and abundance level of *A. circumdata*. Abbreviations; Habitat types: CA = cultivation area; UB = urban area; MDF = mixed deciduous forest; P+GL = pine forest with grassland; EG = evergreen forest; 2^{nd} = secondary forest. +, ++ and +++ are abundance level of rare, common and abundance number of fireflies, respectively. Altitude is valued in meters above mean sea level.

Altitude	Study site	Date	Habitat	Abundance
40	1. Muang district, Phitsanulok	May 23, 2008	CA	+
		Aug 4, 2008	CA	+
100	2. Khirimat district, Sukhothai	May 5, 2011	MDF	++
100	3. Muang district, Phetchaboon	Aug 1, 2008	UB	+
170	4. Mae Wong district, Nakorn Sawan	Apr 24, 2008	MDF	++
170	5. Srisut Chanarai district, Sukhothai	Aug 9, 2008	MDF	++
200	6. Lan Sak district, Uthai Thani	Jun 6, 2008	MDF	++
200	7. Wang Chin district, Phrae	May 9, 2011	MDF	++
200	8. Chat Trakan district, Phitsanulok	May 23, 2011	MDF	++
250	9. Khlong Lan district, Kamphaengphet	Apr 25, 2008	MDF	++
250	10. Song district, Phrae	May 12, 2011	MDF	++
280	11. Chiang Muan district, Phayao	May 12, 2011	MDF	++
290	12. Khlong Lan district, Kamphaengphet	Apr 22, 2008	MDF	+++
290	13. Mae Sariang district, Mae Hongson	Jun 1, 2011	MDF	++
320	14. Khlong Lan district, Kamphaengphet	May 7, 2008	MDF	++
350	15. Ngao district, Lampang	Aug 10, 2009	MDF	++
380	16. Muang district, Phetchaboon	May 15, 2010	MDF	++
400	17. Phobphra district, Tak	Jul 6, 2007	CA	+
450	18. Muang district, Phayao	May 11, 2011	MDF	++
460	19. Nam Pat district, Uttaradit	May 8, 2009	MDF	++
470	20. Lan Sak distric, Uthai Thani	May 12, 2008	MDF	++
480	21. Muang Pan district, Lampang	May 10, 2011	MDF	+++

Table 1 Continue.

Altitude	Study site	Date	Habitat	Abundance
490	22. Ban Khok district, Uttaradit	May 9, 2009	MDF	++
520	23. Wang Thong district, Phitsanulok	May 1, 2008	MDF	++
750	24. Khao Kho district, Phetchaboon	May 2, 2008	P+GL	++
900	25. Muang district, Phayao	May 11, 2011	EG	++
950	26. Nam nao district, Phetchaboon	May 20, 2008	EG	+++
		Aug 2, 2008	EG	+
950	27. Um Phang district, Tak	Apr 18, 2008	EG	+++
1070	28. Chat Trakan district, Phitsanulok	May 30, 2009	2nd	+
1200	29. Pai district, Mae Hongson	Jun 3, 2011	EG	++
1220	30. Khun Yuam district, Mae Hongson	Jun 2, 2011	EG	++

CONCLUSIONS

A. circumdata were widely distributed in the north of Thailand. They are able to occupy several habitat types, from plain areas up to mountainous area. The most abundance of firefly occurred in the mixed deciduous forests in the early rainy period, which provide adequate food sources for firefly larvae. This species also appear with less population in disturbing areas; such as, urban area and cultivation area. However, the altitude higher 1,300 msl. areas they were not found in any study sites. Urbanization development and the application of agricultural chemicals, which leads to the lost of suitable fireflies habitats and food sources, cause the reduction of firefly population in low land areas of the lower northern plain. In order to conserve this firefly species and others urbanization development and agriculture expanding should be managed into an appropriate level.

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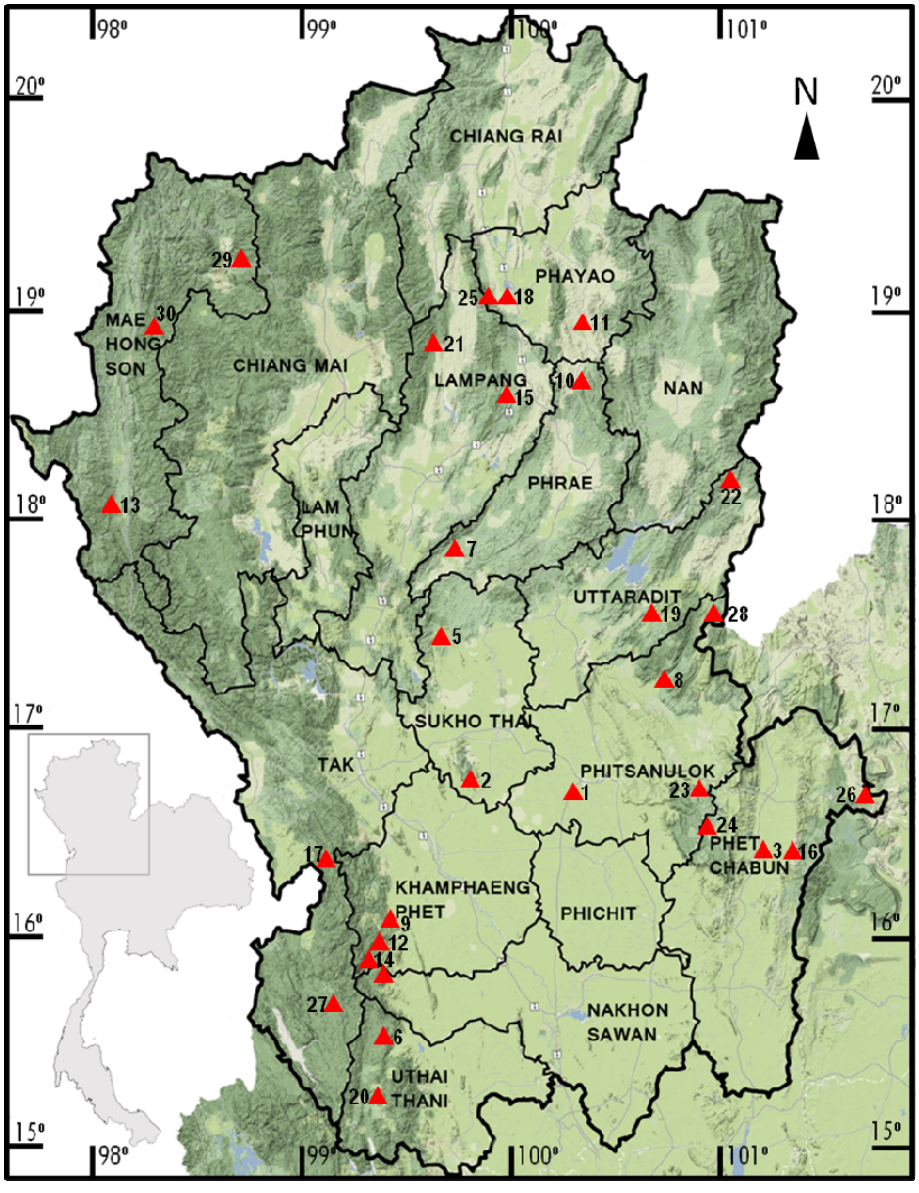

Figure 2 The geographical map of study sites in the north of Thailand with distribution of *A. circumdata* (triangle).

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