

## Study on the congregation behaviour of fireflies (Insecta: Coleoptera: Lampyridae) in selected sites of Thrissur district, Kerala

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### Abstract

The congregation behaviour of fireflies was studied from 5 different sites of Thrissur district, Kerala. Study revealed that firefly congregation peaks by 7 pm and starts declining before it reaches its lower count by 11 pm. This is because of the increase in the value of abiotic factors such as humidity, wind speed and atmospheric pressure, and decrease in temperature. Two genera of fireflies belonging to the Family Lampyridae were identified; *Abcondita* Ballantyne, Lambkin & Fu 2013 was the dominant firefly during the entire study followed by *Asymmetricata* Ballantyne, 2019. More firefly count was observed in Palappilly and less count was observed from Karikulam. Mainly 3 display trees were observed; *Havea brasiliensis*, *Bombax ceiba* and *Terminalia catappa* in five different sites.

**Keywords:** Congregation, Fireflies, Humidity, Temperature, Wind speed

### Introduction

Fireflies are fascinating nocturnal insects and they are commonly known as lightning bugs. They belong to the family Lampyridae of Order Coleoptera. Worldwide, there exist over 2,200 species of fireflies (Martin *et al.*, 2019) [10] and one of the distinctive features of these beetles is the capability of emitting light from the specialized luminous organs positioned at the end of their abdomen (Buck and Buck, 1968) [5]. Firefly congregations are the phenomena where fireflies gather and synchronize their flashing lights for courtship ritual. The male species has its own specific flashing pattern, which serves as a “light language” to attract females. The rhythmic and synchronized nature of these light helps male fireflies stand out and seize the attention of females and in response, female produce their own specific light patterns, which serve as a signal of their receptiveness and availability for mating (Buck and Buck, 1966) [4].

It is crucial to recognize the challenges faced by firefly populations. Habitat loss, caused by urbanization, agriculture, and deforestation, poses a significant threat to fireflies. Destruction of their natural habitats can disrupt their life cycle and weaken suitable breeding grounds. Water and air pollution also destructively impacts firefly populations. In addition, light pollution poses a significant threat for fireflies. Artificial lights; particularly those that emit bright and constant illumination during the night, can interfere with their normal behaviours. Fireflies rely on darkness and light signals to communicate and locate potential mates. Excessive artificial lighting can confuse them, making it difficult for them to find suitable mates. To conserve firefly populations, it is crucial to raise consciousness about the threats they face and take necessary steps to protect their habitats. Efforts such as preserving natural areas, creating firefly-friendly environments, and implementing regulations to reduce light pollution can help improve the negative impacts on them. By understanding and addressing the challenges faced by fireflies, we can work towards ensuring their continued presence and

preserving the magic they bring to our summer nights. (Fallon *et al.*, 2019) [7]

### Material and methods

#### Study area

In this study, the congregation behaviour of fireflies was investigated at five different sites in Thrissur district, Kerala (Fig 1): Munippara (10°18'25.93" N, 76° 24' 0.284" E), Kerala Forest Research Institute (KFRI) campus (10°31' 59.236" N 76°20'34.411" E), Paripillichira (10° 23' 46.684" N, 76° 23' 3.328" E), Palappilly (10° 25' 49.958" N, 76° 22' 49.421" E) and Karikulam (10° 25' 0.106" N, 76° 23' 24.162" E). In each site, display trees were monitored on three consecutive days between 19:00 and 23:00 (three data sets; 19:00, 21:00 and 23:00) during the month of May and June. Data sheets were created for each observation from five sites. From each site, two male and female specimens were collected for the taxonomic identification. Sampling was done using a sweeping net. Number of individuals, environmental parameters such as temperature, humidity, wind speed and pressure are noted. For habitat study, other parameters such as display trees, vegetation, larvae etc. are also referred.

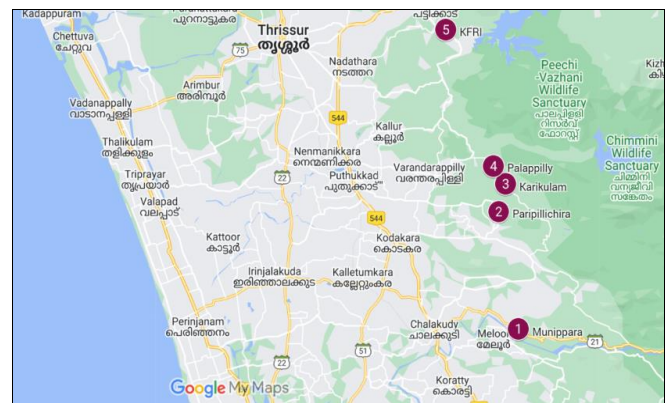


Fig 1: Study areas plotted in map

**Sampling**

**Visual count**

During the visits, we observed the timing of the arrival of fireflies in the study sites and we could easily predict the congregation’s arrival time. We watched them and took a visual count of the fireflies near to display trees.

**Sweep net**

In order to identify the species, some male and female specimens were collected. Male fireflies come down for mating with females and that is the time when we are able to sweep the net for catching both sexes of fireflies.

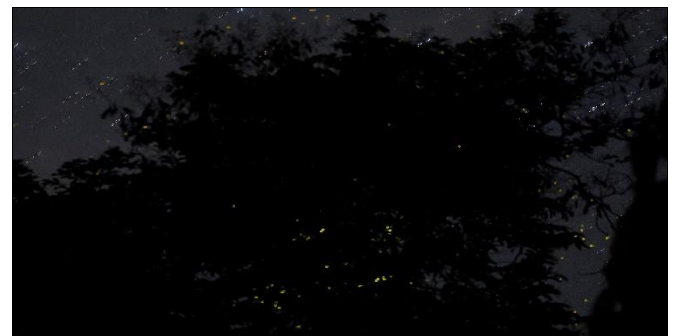
**Preservation**

Fireflies are collected and changed into the container which contain 70% ethyl alcohol for the study. To avoid potential evaporation and subsequent drying of the material, the container lids are sealed. Collected specimens were later studied under Luxeo 6Z stereo zoom microscope with micaps pro-hdmi camera for their morphological characters and genitalia studies also done to confirm the identity of taxon.

**Results**

Two genera of fireflies belonging to the Family Lampyridae were identified; *Abscondita* Ballantyne, Lambkin & Fu 2013 was the dominant firefly during the entire study followed by *Asymmetricata* Ballantyne, 2019. The study revealed that when the time passes from 19:00 to 23:00, the congregation of fireflies (fig 2) shrinks into a minimum and

the main reason behind this decline in numbers may be due to the changes of humidity and the increase in the wind speed. The congregations are sought out near the river banks or any water sources that are very near to the woods. Pollutions like air, water, soil, light and deforestation are the primary factors responsible for the hindrance in the growth of the firefly population. Mainly 3 display trees were observed; *Havea brasiliensis* is the common one, *Bombax ceiba* is another tree which was found at KFRI campus and *Terminalia catappa* at Munippara. Distance from the water source is found to be less in Munippara (2.4 m). Larval stages were observed all sites. More firefly count was observed in Palappilly and less count observed from Karikulam. Palappilly is situated away from the light source and transporting road (190 m) which might be the reason of having larger counts



**Fig 2:** Congregation of fireflies

**Table 1:** Firefly count during various phases of night in different study site

Si no	Sites	DAY 1			DAY 2			DAY 3		
		7.00 pm	9.00 pm	11.00 pm	7.00 pm	9.00 pm	11.00 pm	7.00 pm	9.00 pm	11.00 pm
1	Munippara	105	25	5	80	15	10	90	25	5
2	KFRI campus	105	35	5	75	30	5	85	55	7
3	Paripillichira	105	60	4	95	55	3	0	0	0
4	Palappilly	205	165	115	235	215	105	255	215	150
5	Karikulam	75	50	3	85	55	6	75	45	4

**Table 2:** Measurement of humidity (%)

Si no	Sites	Day 1			Day 2			Day 3		
		7.00 pm	9.00 pm	11.00 pm	7.00 pm	9.00 pm	11.00 pm	7.00 pm	9.00 pm	11.00 pm
1	Munippara	82	86	85	81	82	86	86	88	90
2	KFRI campus	86	86	85	81	81	87	82	82	88
3	Paripillichira	73	79	81	71	77	83	66	72	75
4	Palappilly	88	88	92	86	88	91	83	83	85
5	Karikulam	88	88	92	86	88	91	83	83	85

**Table 3:** Measurement of wind speed (m/s)

Si no	Sites	Day 1			Day 2			Day 3		
		7.00 pm	9.00 pm	11.00 pm	7.00 pm	9.00 pm	11.00 pm	7.00 pm	9.00 pm	11.00 pm
1	Munippara	5.3	5.8	9.3	7	7.5	8.8	6.9	6.8	8.4
2	KFRI campus	6.4	8.1	9.3	6.4	7.4	8.9	9.6	10.9	11.1
3	Paripillichira	14.7	13.1	15.3	11.3	12.4	17.2	16.9	16	15.4
4	Palappilly	7.1	9.2	13.5	8.1	8.3	10.1	10.5	14.1	15.2
5	Karikulam	8.1	10.2	14.4	9.1	12.1	15.1	13.2	15.2	16.1

**Table 4:** Measurement of pressure (Pa)

Si no	Sites	Day 1			Day 2			Day 3		
		7.00 pm	9.00 pm	11.00 pm	7.00 pm	9.00 pm	11.00 pm	7.00 pm	9.00 pm	11.00 pm
1	Munippara	1010	1010	1010	1008	1009	1010	1007	1008	1008
2	KFRI campus	1008	1009	1010	1006	1006	1009	1007	1007	1010
3	Paripillichira	1008	1009	1010	1008	1010	1010	1007	1009	1010
4	Palappilly	1010	1008	1010	1008	1008	1010	1009	1009	1010
5	Karikulam	1010	1008	1010	1008	1008	1010	1009	1009	1010

**Table 5:** Measurement of temperature (°C)

Si no	Sites	Day 1			Day 2			Day 3		
		7.00 pm	9.00 pm	11.00 pm	7.00 pm	9.00 pm	11.00 pm	7.00 pm	9.00 pm	11.00 pm
1	Munippara	26	24	24	27	26	24	26	24	24
2	KFRI campus	25	25	24	26	26	24	26	26	24
3	Paripillichira	29	28	28	28	28	27	29	28	26
4	Palappilly	24	24	23	25	25	26	24	24	23
5	Karikulam	24	24	25	26	25	25	24	24	26

**Table 6:** Study of different parameters in study sites

Parameters	Munipara	KFRI campus	Paripillichira	Palappilly	Karikulam
Display tree	Terminalia catappa	Bombax ceiba	Havea brasiliensis	Havea brasiliensis	Havea brasiliensis
Water source	2.4 m	32 m	79 m	32 m	41 m
Light source	52.2 m	51 m	48 m	190 m	54 m
Distance from road	33 m	113 m	65 m	190 m	42 m
Light source	street light	led street light	CFL	street light	street light
Water source	canal	stream	Canal	river	pond
Light Pollution	yes	yes	Yes	no	yes
Forest type	moist deciduous	moist deciduous	plantation	plantation	plantation
Height of tree	18 -20 m	30-40 m	20-30 m	20-30 m	20-30 m
Firefly larvae	yes	yes	Yes	yes	yes
Vegetation	herb	herb, shrub	herb, shrub	herb, shrub	herb, shrub

**Discussion**

Fireflies play a crucial role as a pollution indicator and the study revealed that some abiotic factors such as humidity (table 2) and wind speed (table 3) play a major part in the annihilation of the growth in the congregational aspect of the fireflies. In the study, we noted that the change in the humidity (Sulaiman *et al.*, 2017) [11] and wind speed (Asri *et al.*, 2021) [2] affect the behavioural patterns of the fireflies and as the time passes (19:00 to 23:00), the population in the congregation decreases drastically. Nevertheless, the studies conducted in different places shows that the temperature is a major factor which determine firefly population, where 26 -28° C is suitable for the firefly communities (Abdullah *et al.*, 2019) [1]. This study also proved that the temperature (table 5) does have a significance status in the population of fireflies.

Pinpointing the aspect of the habitat preference, we could say that the congregation would be seen generally near the ponds, rivers, streams (table 6) due to several reasons like food, water and mostly to keep their body temperature stable (Ballantyne and Mclean, 1970) [3]. Males do not seek tall trees for their mating, rather they go for trees which are low and it makes the processes of mating simpler. The subsequent aspect is the pollution (table 6); especially light pollution. Light emitted from the electronic devices like street light, vehicle’s head light are the major issues that are in line. Even the sound pollution does no good for the stability of a peaceful inheritance of the congregational habit, firefly tourism is considered as a major recreational activity (Faust, 2017) [9]. However, human interventions like tourism cause damage to the larvae as well as the adult generation of the fireflies. Reflex bleeding has been observed from the posterior end of the abdomen (Fig 3) in *Abcondita* species while handling. It may be the secretion of distasteful chemical lucibufagin, produced when it got threatened (Eisner *et al.* 1997) [6]. This species is been found abandoned in the spider web without been consumed (Fig 4), which also strengthen the presence of *lucibufagin* (Faust *et al.* 2012) [8].



**Fig 3:** Reflex bleeding



**Fig 4:** Abandoned firefly in the spider web

**Conclusion**

The study concludes that the abiotic factors such as humidity, wind speed play a major role in the congregation of fireflies in which the number decreases as time passes from beginning of night to late night. While considering the habitat; it faces a lot of problems as in the mode of pollution such as light, deforestation etc., which affect the population of the fireflies. Conservation is the only solution that could retain the fireflies.

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