Species diversity of Fireflies (Coleoptera: Lampyridae) in selected natural and agricultural habitats in Southern Sri Lanka

Bogahawatta, C.N.L.[1], Wegiriya, H.C.E.[2] and Rajapaksha, R.S.P.K.M.[3]

Department of Zoology, Faculty of Science, University of Ruhuna, Matara

1. E-Mail: cnlb@zoo.ruh.ac.lk
2. E-Mail: hemantha@zoo.ruh.ac.lk

Abstract

Sampling of fireflies in five selected habitats representing in Hambantota, Matara and Galle Districts of Southern Province was conducted during October 2006 to February 2008. Samplings were carried out in two natural habitats; a mangrove forest and a natural forest and three agricultural habitats *i.e.* vegetable/ paddy cultivation, coconut and tea plantations in each district. Transect sampling was done using sweep nets. Collections of fireflies were carried out on three sampling occasions from 6.30 p.m. to 9.30 p.m. within the study period. Data on eight species of fireflies were analyzed by Shannon's Diversity index.

Eight firefly species namely, *Luciola chinensis, L. melaspis, L. humeralis, L.cingulata, Dioptoma greeni, D. ademsi, Diopenus latesence* and *Honasca necrobiodes* were identified. The present study revealed that *L. chinensis* was the dominant lampyrid species in all habitats of three districts in Southern Province. Four species, *L. cingulata, D. ademsi, D. latesence* and *H. necrobiodes* were the least abundant. *L. chinensis* showed higher abundance compared to the other firefly species, it was well marked in all three agro ecosystems; Matara (65%), Galle (58%) and Hambantota (53%). However in natural ecosystems in all the three districts their percentage abundance was less than 40%. In contrast, *L. melaspis* was mainly restricted to tea plantations of three districts. Mean values of Shannon's Diversity index showed the highest species diversity in natural habitats of Galle District. Results also indicated that natural habitats had higher species diversity than the agro ecosystems in all three districts. Three unidentified Luciolinae species indicated that the possibility of new species in Sri Lankan firefly fauna.

Keywords: *Fireflies, Diversity, Natural habitats, Agro-ecosystems, Sri Lanka*

Introduction

Members of family Lampyridae, includes fireflies or lightning bugs well known for their conspicuous nocturnal use of bioluminescence. About 2000 species belonging to 100 genera and seven subfamilies have been recorded from the world. The subfamily Luciolinae is restricted to the warmer parts of the Old World, while Lampyrinae occur throughout the New World and in Eurasia and Africa (Lawrence, 1995). Two hundred and eighty species of fireflies have been recorded from Asia. Although tropical climate with high rainfall and humidity often favours a diverse firefly fauna, thirty species have been recorded from Sri Lanka (Wijesekera and Wijesinghe, 2003).

Taxonomic studies on Sri Lankan firefly fauna conducted by European and North American scientists dates back to the eighteenth century. Documentation of the Sri Lankan firefly fauna began during the British rule. Early work on the fireflies of Sri Lanka is contained in the 'Fauna of British India' series (Arrow, 1910 - 49). Thirty species of fireflies have been recorded by Green (1912), Baker (1937) and Bertrand (1973). Of them, sixteen species have been recorded from Central and North East Provinces of Sri Lanka belonging to subfamily Luciolinae. From Southern Province, three species belonging to subfamily Luciolinae, namely *Luciola chinensis*, *L. melaspis* and *L. cingulata* have been recorded (Mc Dermott, 1966). The endemic species, *Harmataliua ototretinae* is restricted to the Central Province of Sri Lanka.

A study on the diversity of fireflies is important from the point of biodiversity as well as Agriculture in Sri Lanka. In agricultural habitats, fireflies are important as general predators, feeding on invertebrate pests in cultivated lands. The larvae of fireflies are predatory, feeding on snails, slugs and invertebrate pests.

However, the rain forests, undisturbed forest reserves and mangroves as well as agricultural habitats such as paddy and vegetable cultivations, tea and coconut plantations provide suitable habitats for colonies of fireflies. In addition, low-lying vegetation especially the grass species are known resting places of fireflies during daytime.

In the present study, fireflies in selected natural habitats and agro ecosystems in Southern Province were identified. Therefore the comparative studies of firefly fauna between selected natural habitats and agro ecosystems in Southern Province are necessary to assess the diversity of fireflies in natural habitats versus agricultural habitats.

Materials and methods

For this study on fireflies, five habitats in three districts of the Southern Province, Sri Lanka, were selected. Two of them were undisturbed natural habitats, i.e., forest reserves and mangrove vegetation with *Sonaratia* sp and *Avicinia* sp. The other three habitats were vegetable and paddy cultivations, coconut and tea plantations (Table 1). This study was conducted during October 2006 to February 2008. Sampling was carried out along the line transects. Collections were done in three occasions, in each habitat of three districts in Southern Province from 6.30 pm to 9.00 pm for a period of sixteen months.

Sweep nets were used for collecting fireflies on flight. Number of species of fireflies in each sampling occasion at each sampling site was recorded. Collected adult fireflies were identified using taxonomic keys. Identification was confirmed with the help of National Museum, Colombo, and the Department of Agriculture, Gannoruwa, Sri Lanka. Data on collected species of fireflies in two selected natural habitats and three selected agro ecosystems in three districts in Southern Province were analyzed by Shannon's Diversity Index.

Results

A total of eight species of fireflies, namely *Luciola chinensis, L. melaspis, L. humeralis, L. cingulata, Dioptoma greeni, D. ademsi, Diapenus latesence* and *Honasca necrobiodes* composed over 5180 were recorded from the five sampling sites in Southern Province during the three sampling occasions (Table 1).

Table 1: Vegetation type in selected habitats and study locations in Matara, Galle and Hambantota Districts

Sampling locations	*Nature of vegetation*	*Habitat type*
Matara District		
Nawimana	Mangroves	Natural
Kekanadura	Forest	Natural
Kamburugamuwa	Coconut	Agricultural
Denipitiya	Vegetable/ Paddy	Agricultural
Kamburupitiya	Tea	Agricultural
Galle District		
Unawatuna	Mangrove	Natural
Hiyare	Forest	Natural
Habaraduwa	Coconut	Agricultural
Imaduwa	Vegetable/Paddy	Agricultural
Wawulagala	Tea	Agricultural

Hambantota District

Rekawa	Mangroves	Natural
Bundala	Forest	Natural
Ambalantota	Mangroves	Natural
Tangalle	Coconut	Agricultural
Angunakolapelessa	Vegetable/Paddy	Agricultural
Kekiriobada	Tea	Agricultural

Table 2: Fireflies species recorded from five sampling sites in Southern Province

Matara District

Firefly species	*Nawimana*	*Kekanadura*	*Kamburugamuwa*	*Denipitiya*	*Kamburupitiya*
L. chinensis	+	+	+	+	+
L. melaspis	+		+	+	+
L. humeralis	+	+	+	+	+
Diaptoma greeni		+	+		
D. ademsi	+	+			
Diopenus latesence	+	+		+	
Unknown	+		+		

Galle District

Firefly species	*Unawatuna*	*Hiyare*	*Habaraduwa*	*Imaduwa*	*Wawulugala*
L.chinensis	+	+	+	+	+
L. melaspis	+	+		+	+
L. humeralis	+	+	+	+	+
Diaptoma greeni		+		+	+
D. ademsi		+	+		
Diopenus latesence					
Unknown	+	+	+		

Hambantota District

Firefly species	*Rekawa*	*Ambalantota*	*Tangalle*	*Angunakola*	*Kekiriobada*
L.chinensis	+	+	+	+	+
L. melaspis	+	+	+	+	+
L. humeralis	+	+	+	+	+
Diaptoma greeni		+			
D. ademsi		+		+	
Diopenus latesence					+
Unknown	+	+	+		

Eight identified fireflies were belong to three sub families namely Luciolinae, Rhagophthalminae and Lampyrinae. Figure 1 has indicated four sub families of fireflies in all three districts in Southern Province which is in agreement with the previously recorded information in Sri Lanka. Five species belonging to the sub family Luciolinae and two species in sub family Rhagophthalminae, one species in sub family Lampyrinae were recorded in during sampling in Matara District. Of the sub families, four Luciolinae species, one Rhagophthalminae species and one Lampyrinae species were recorded in Galle District. In Hambantota District, sub family Luciolinae with four species of *Luciola* and one Rhagophthalminae species were recoded during the study period. Results also revealed that identified fireflies in five selected sampling sites of all three districts had close relationship with the diversity of vegetation (Table 2).

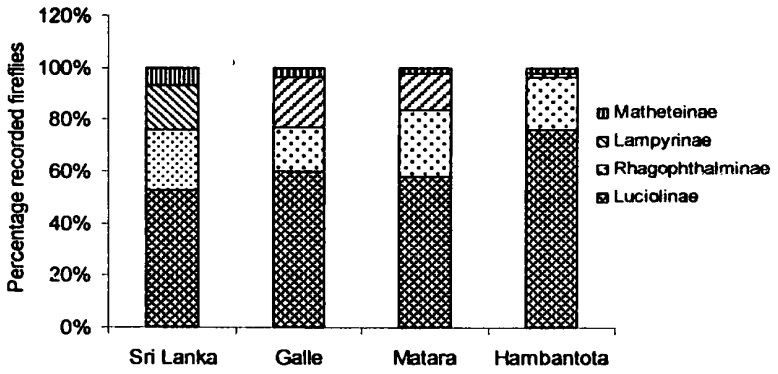

Figure 1: Percentage fireflies belonging to four different sub families recorded during sampling period in Southern Province with reference to recorded species from Sri Lanka

The percentage number of fireflies in each species collected at three sampling occasions of Matara District, Galle District and Hambantota District are given in Figures 2a, 2b and 2c respectively.

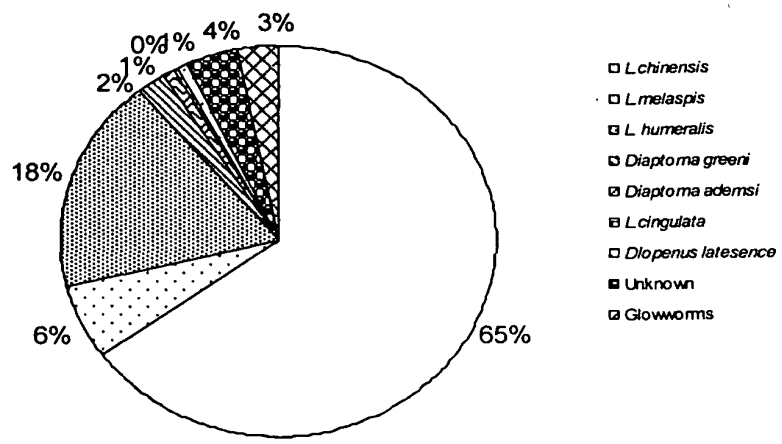

Figure 2a: Percent firefly species collected from five sampling sites in Matara District

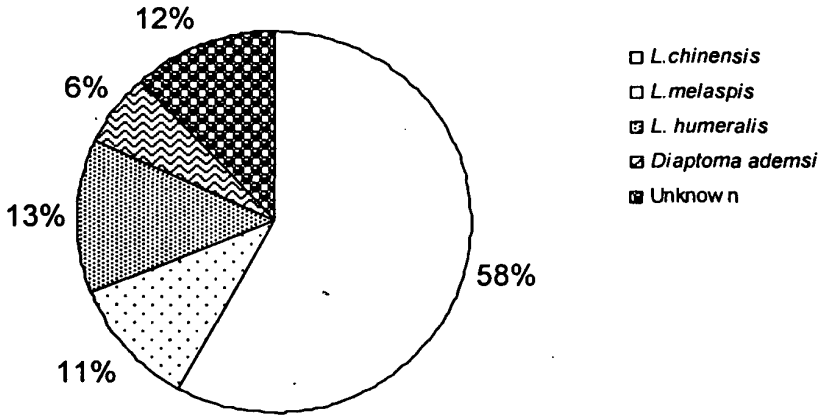

Figure 2b: Percent firefly species collected from five sampling sites in Galle District

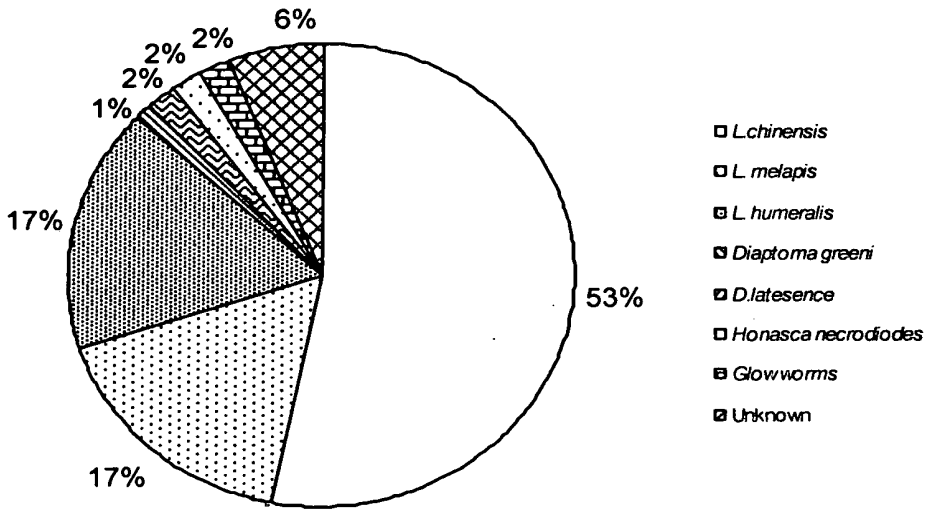

Figure 2c: Percent firefly species collected from five sampling sites in Hambantota District

The total number of fireflies in each species collected in five sampling sites at three sampling occasions of Matara District, Galle District and Hambantota District are given in Figures 3a, 3b and 3c respectively.

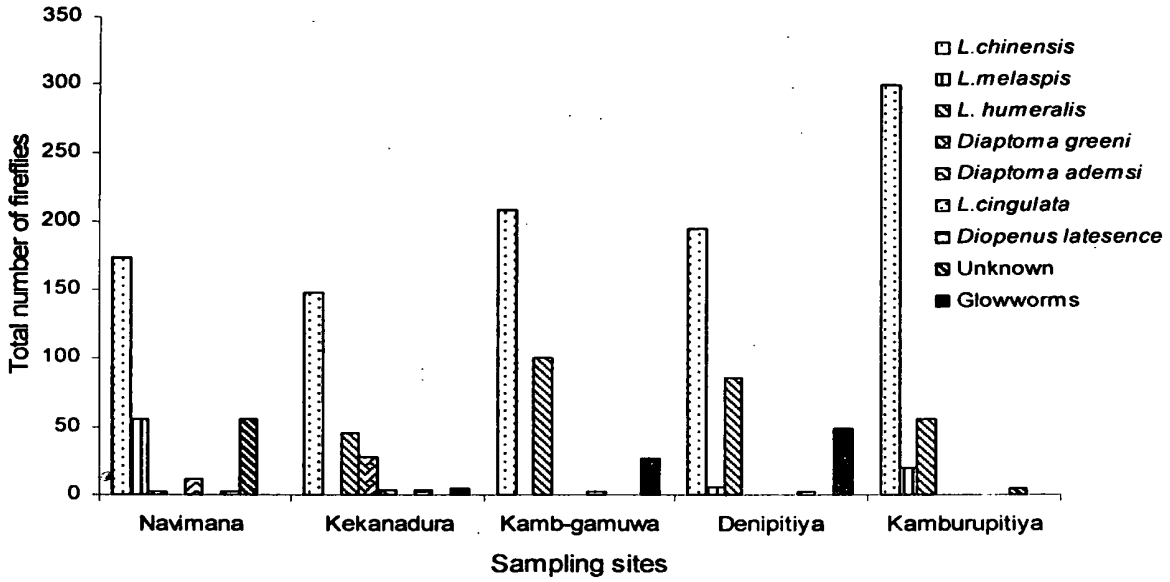

Figure 3a: Number of fireflies in each species collected from five sampling sites in Matara District

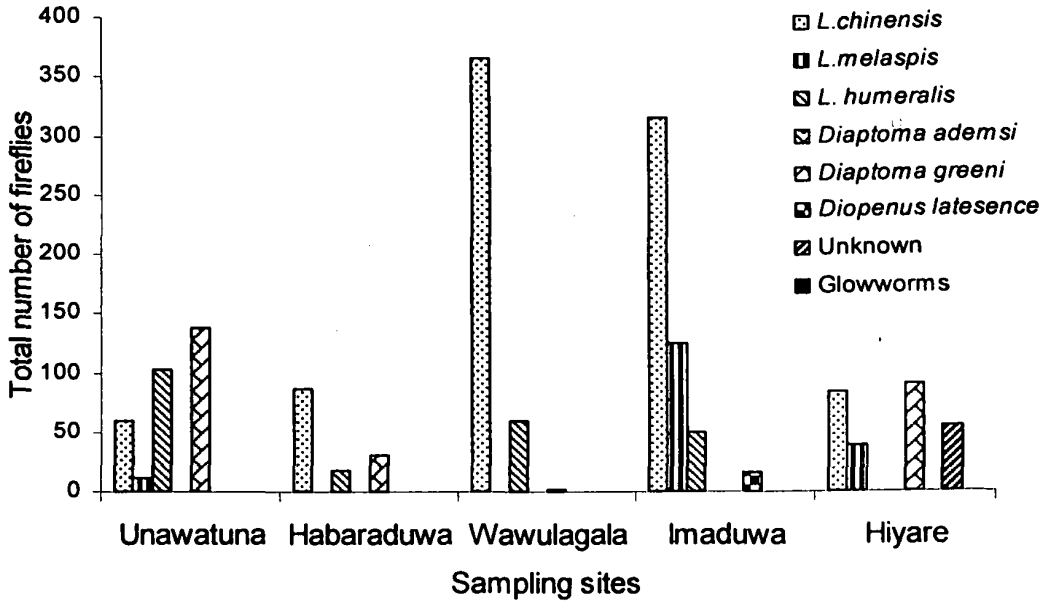

Figure 3b: Number of fireflies in each species collected from five sampling sites in Galle District

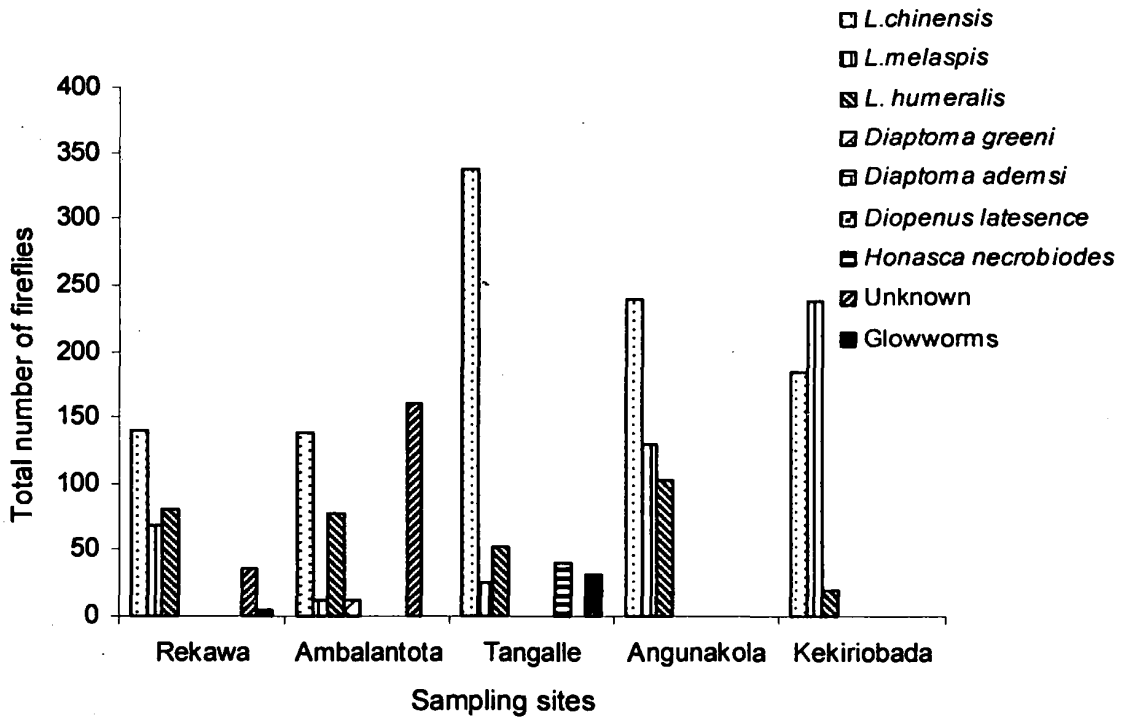

Figure 3c: Number of fireflies in each species collected from five sampling sites in Hambantota District

Both *L. chinensis* and *L. humaralis* were collected from selected two natural habitats and all agro-ecosystems in Southern Province, and *L. melaspis* was found

to be very common in Tea plantations in all three districts. Although, *L. cingulata* was restricted to coconut plantation in Southern Province, a very few numbers of them was recorded in coconut plantation in Matara District. In contrast, agro-ecosystems with one major crop type, coconut or tea, had the lower number of firefly species compared to the agro-ecosystems with more than one crop type.

This study indicated that eight species of fireflies namely, *L. chinensis, L. melaspis, L. humeralis, L.cingulata, Dioptoma greeni, D. ademsi, Diapenus latesence* and *Honasca necrobiodes* in Southern Province representing four sub families *i.e.* Luciolinae, Rhagophthalminae, Lampyrinae and Matheteinae. Of the three major sub families, Luciolinae, Rhagophthalminae and Lampyrinae with four genera of fireflies were recorded in Southern Province. The result also indicates that four species of Luciolinae are dominated in southern Province. Among them, *L. chnensis* was the dominant Luciolinae species throughout the sampling period. Both *L. chinensis* and *L. humeralis* become more abundant in all three districts in Southern Province.

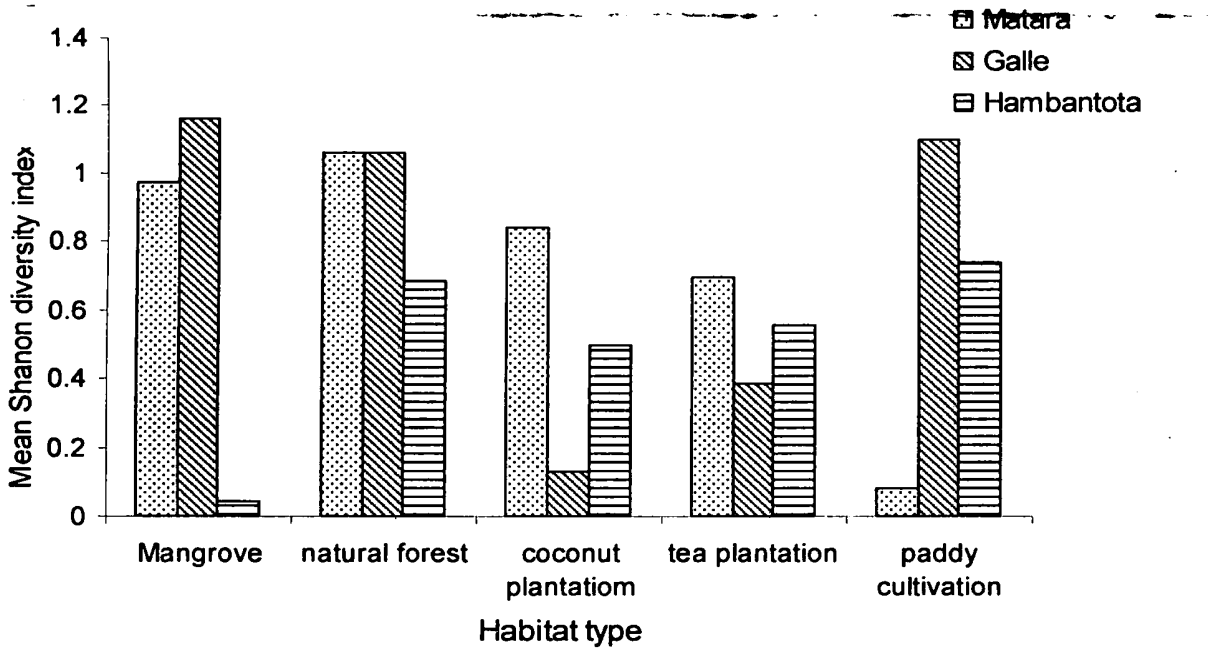

Figure 4: Mean Shannon's diversity index of species of fireflies in five selected habitats in Matara, Galle and Hambantota Districts

The analysis based on combined data suggests that the highest species diversity was in selected natural habitats compared to the selected agro ecosystems.

Discussion

Based on available literature as far back as 1890, a list of thirty species of fireflies including the one endemic species, *Harmataliua ototerinae* belonging to sub family

Ototerinae (Matheteinae) in Central Province was documented in Sri Lanka. Among, thirty species of fireflies recorded in terrestrial and aquatic ecosystems in Sri Lanka (Green, 1912; Baker, 1937 and Bertrand, 1972), only three Luciolinae species, *L. cingulata L. doriae* and *L. melaspis* were recorded in Southern Province (McDermott, 1966). In the present study four Luciolinae species were recorded.

Even with collected fireflies in previous surveys in Sri Lanka, a larger portion still remains to be identified due to lack of taxonomic expertise in this group. Of the identified thirty species of fireflies, only a few genera such as *Luciola* and *Rhagophthalmus* have been documented substantially. There are many recorded species in sub family Luciolinae, however, most of their biology or taxonomy have not been fully studied.

Both adults and larvae of fireflies are general predators, feeding on arthropods and other invertebrates especially slugs and small land snails. Since several species of fireflies were collected from agro-ecosystems, further investigations of the role of fireflies as natural enemies will be very useful for designing suitable Integrated Pest Management programmes for selected major pests of field crops.

Findings of the present study indicated a positive relationship between plant diversity and the diversity of fireflies. Therefore, efforts are needed to study the identified species found in different habitats and their role in the ecosystem.

According to the results there is an indication on the relationship between species diversity of fireflies and the nature of their habitats. Mangrove forests showed high level of species diversity compared to that of the agro-ecosystems. Even within the agro ecosystems mix crop agro-ecosystems favours high species diversity.

Fireflies collected from mangroves in all three districts contained significant proportion of unidentified firefly species which are not available in the reference collection of Sri Lankan firefly fauna. This might be an indication that the possibility of a presence of new species unique to these mangrove forests, which could be a valuable result for Biodiversity in Sri Lanka.

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