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Seasonal biodiversity of adult insects in relation to environmental factors at the irrigation system based on light trap collection

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Abstract

The aim of this study was to determine the biodiversity of adult insects collected by black light traps. The effects of environmental factors on its biodiversity were also evaluated for monitoring of environmental change in the future. The samples were collected monthly near an irrigation pond outlet at Kasetsart University, Kamphang Saen Campus from January to December 2014. A total of 319,160 individuals representing 13 orders were identified. Trichoptera (80.66%) was the highest number of individuals, followed by Diptera (6.94%), Ephemeroptera (4.67%), Hymenoptera (4.06%), and Coleoptera (2.13%). The eight least abundant orders (i.e., Lepidoptera, Orthoptera, Hemiptera, Isopters, Embiidina, Blattodea, Mantodea, Dermaptera) represented only 1.42%. Canonical Correspondence Analysis (CCA) indicated that the air temperature, precipitation, wind speed and relative humidity were factors that affected the biodiversity of adult insects. The study provides baseline information about phonological patterns of insect abundance and permits evaluation of this group as a resource for various food chains and different trophic levels.

Key words: Adult insects, Air temperature, Wind speed, Precipitation, Relative humidity

1. Introduction

Insects are the dominant group of animals on Earth. They are predominantly terrestrial, but there are some insects that live in freshwater and marine systems. Insects are dominant components of numerous food webs. In the recent years, insects widely have been used as indicators of ecological conditions and environmental quality [1-2]. Insects play various roles in different ecosystems such as pollinators, herbivores, and prey for bats and birds [3]. The climate change, including rising temperature was affected the distribution, abundance, physiology, behavior and ecology of all insects [4]. The light traps are widely used to attract a wide variety of all orders of volant, nocturnal flying insects [5]. Most insects are commonly attracted to lights, especially ultraviolet or black light [6]. Weather conditions, such as rainfall, and temperature, also influence catch size [7]. This study was to examine the biodiversity and seasonal occurrence of adult insects using black light traps in an irrigation pond in Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom Province, Thailand. The effects of four weather parameters (i.e., air temperature, wind speed, relative humidity, and precipitation) on the insect richness and numbers of insects trapped per night in each month were also determined.

2. Material and methods

The sampling was carried out in an irrigation pond outlet located at N 14°02. 215´, E 099°57. 818´ in Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom Province, Thailand. At each sampling date, adult insects were collected by using portable black-light traps (10-W fluorescent tube, 12-Volt DC battery) (Figure 1) suspended across a white pan containing a detergent solution. Adult insects were collected monthly from January to December 2014. In the laboratory, specimens were sorted and examined under a dissecting stereomicroscope. Specimens were identified at the order level using [8]. The climate data (Table 1) was obtained by the Meteorological station at the Kasetsart University, Kamphaeng Saen Campus. Numbers of specimen from collections at each sampling month were summed. Canonical correspondence analysis (CCA) of PC-ORD Version 4.0 [9] was investigated the contribution of the environmental stressors on the abundance of adult insects. The Monte-Carlo test was applied to test the significance of the produced canonical axes with 998 permutations at $P < 0.05$.

3. Results

A total of 319,160 insects representing 13 orders were collected (Table 2). The eight least abundant orders (i.e., Lepidoptera, Orthoptera, Hemiptera, Isopters, Embiidina,

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Table 1 The average clamate data at the collecting site obtained from the meteorological station at the Kasetsart University, Kamphaeng Saen Campus

Month/factors	Air temperature (°C)	Precipitation (mm)	Wind speed (m/s)	Relative humidity (%)
January	25.85	0.00	1.90	69.50
February	28.45	0.50	2.60	73.00
March	29.70	0.00	4.30	69.50
April	30.25	0.90	3.90	70.00
May	30.20	2.20	3.30	73.50
June	28.65	6.60	2.50	74.00
July	28.25	1.90	3.90	76.00
August	29.00	2.40	4.40	78.50
September	27.90	7.00	3.00	79.50
October	27.05	6.50	2.90	78.50
November	26.70	3.50	3.20	79.00
December	22.15	0.00	3.10	76.50

Table 2 Total number of adult insects collected over the period from January to December 2014

Order/month	Jan-14	Feb-14*	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Total
Trichoptera	25,344	2,637	30,760	51,813	21,042	18,333	31,311	17,370	12,672	19,179	10,125	16,875	257,461
Hymenoptera	423	133	552	882	1,575	1,053	1,944	612	4,311	333	486	675	12,979
Lepidoptera	117	32	296	243	432	126	576	27	36	108	126	117	2,236
Coleoptera	234	60	352	1,107	81	702	342	720	369	594	1,116	1,134	6,811
Ephemeroptera	1,449	83	984	1,656	387	2,889	2,403	1,341	558	585	1,215	1,665	15,215
Diptera	477	57	2,032	639	2,664	2,376	1,647	2,547	927	3,105	1,980	3,708	22,159
Hemiptera	108	8	120	135	171	315	99	99	126	135	261	324	1,901
Orthoptera	18	2	24	0	0	0	0	0	45	9	27	27	152
Isoptera	0	20	56	0	0	0	9	0	0	0	0	0	85
Embiidina	0	0	8	0	27	0	0	0		0	9	0	44
Blattodea	0	0	0	0	36	0	0	0	9	18	0	9	72
Mantodea	0	0	0	0	0	0	0	9	9	0	9	9	36
Dermaptera	0	0	9	0	0	0	0	0		0	0	0	9
Total	28170	3032	35193	56475	26415	25794	38331	22725	19062	24066	15354	24543	319160

*rain falling during the trap was operated.

Figure 1 Sampling site (left) with light traps (right)

Blattodea, Mantodea, Dermaptera) represented only 1.42% (3,698 individuals) of the total. The most abundant orders were Trichoptera (80.66%), Diptera (6.94%), Ephemeroptera (4.67%), Hymenoptera (4.06%), and Coleoptera (2.13%).

In general, there was an increase in the number of insects captured from March to July, with the peak in April (56475, 17.69%). Subsequently, there was a distinct reduction in the number of insects with a low occurrence from August to December.

The Eigenvalues of CCA applied for insect assemblages and environmental variables in canonical axis 1 and 2 were high and explaining 39.8% and 15.05% of constrained inertia, respectively (Table 3). According to CCA, the number of individual of insect was negatively associated with precipitation and relative humidity in the month with the rainfall. In addition, insect abundance was positively related with wind speed and air temperature (Table 4).

4. Discussion

The occurrence of adult insect abundance and the differences among orders are still not completely understood. There are probably the biotic and abiotic responsible for the phenomenon [10]. The swarming distribution of adult insect is influenced by more factors such as the favourable or

Table 3 Summary of CCA results for the abundance of adult insect order and environmental variables. Axes 1 and 2 were significant following Monte-Carlo permutation procedures (P<0.05)

	Axis 1	**Axis 2**
Eigenvalue	0.398	0.150
% of variance explained	26.1	9.9
Cumulative % explained	26.1	36.0
Pearson Correlation, Spp-Envt*	0.856	0.758

Table 4 Intraset correlation coefficients between environmental variables and axes derived from CCA for sampling period

Variable	**Correlation**	
	Axis 1	**Axis 2**
PRE	**-0.657***	-0.033
Wind	**0.674***	-0.156
AT	0.538	**0.560***
RH	**-0.914***	-0.184

Values in bold were considered important in structuring the adult insect community. *Significant P<0.05

unfavourable change of meteorological elements to the swarming. The populations of insect orders showed sensibility to the precipitation, relative humidity, wind speed and air night temperature variations occurring over the period studied. There was an increase in the number of insects, associated with a decrease in the precipitation and relative humidity. The precipitation was negatively affected the population of adults, being a factor of importance in the occurrence of these insects among the months. The results showed the importance of seasonality of precipitation for the populations of insect orders similar to those obtained by [11] who demonstrated a negative effect of precipitation upon the number of adults of *Ecnomus vinemar* caught in light traps in Ko Hong Hill nature preserve, southern Thailand. The relative humidity was a negative correlation between the numbers of insect collected. The driest conditions significantly decreased the population density of insects in the area, enabling the catch of a lowest number of specimens. Similarly, Seetapan and Prommi [12] verified a negative correlation between relative humidity and the population of Trichoptera species in northern Thailand. In general, temperature was the climatic factor which influenced population dynamics of adult insects the most. The results obtained in this research, air temperature was significantly correlation with populations of insects. In research by [12], it was found that adult Trichoptera species was highest in richness and abundance during February through to April, which was also the end of the dry season in the northern Thailand. Some studies point out that the wind speed appeared to influence insect flight, with higher wind speeds being associated with lower flight activity [13].

In general, the visible light spectrum consists of seven main colors (yellow, orange, indigo, violet, green, blue, and red) with the wavelengths from 400-700 nanometers. A black light at emits ultraviolet light with the wavelength of 380nm. Ashfag et al [14] reported the highest number of insects was observed in container placed under black light, while the lowest in that of red light. The insects are attracted in more number on lights with short wavelengths and high frequencies. The results of this study probably reflect only the diversity and abundance of aquatic insects in the area since the light trap neat the aquatic systems, where the adult aquatic insect occur.

5. Conclusions

It can be concluded that the environmental variable such as precipitation, relative humidity, air temperature and wind speed had an effect on the population of insects, and this effect is manifested primarily in seasonal fluctuations in this area.

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7. References

[1] Gullan PJ, Cranston PS. The Insects: An Outline of Entomology. Chichester: John Wiley & Sons; 2010.
[2] Thomas JA. Monitoring change in the abundance and distribution of insects using butterflies and other indicator groups. Philos T R Soc B – Biol Sci 2005; 360(1451):339-357.
[3] Wickramasinghe LP, Harris S, Jones G, Vaughan Jennings N. Abundance and species richness of nocturnal insects on organic and conventional farms: effects of agricultural intensification on bat foraging. Conserv Biol 2004;18(5):1283-1292.
[4] Cornelissen T. Climate change and its effects on terrestrial insects and herbivory patterns. Neotrop Entomol 2011;42(2):155-163.
[5] Calor AR. Mariano R. UV Light Pan Traps for Collecting Aquatic Insects. Entomo Brasilis 2012;5(2):164-166.
[6] Fayle TM, Sharp RE, Majerus MEN. The effect of moth trap type on catch size and composition in British Lepidoptera. Brit J Entomol Nat Hist 2007;20:221-232.
[7] Butler L, Kondo V, Barrows EM, Townsend EC. Effects of weather conditions and trap types on sampling for richness and abundance of forest macrolepidoptera. Environ Entomol 1999;28(5):795-811.
[8] Triplehorn CA, Johnson NF. Borror and DeLong's Introduction to the Study of Insects. 7th ed. Belmont: Thomson Brooks/Cole; 2005.
[9] McCune B, Mefford MJ. PC-ORD. Multivariate analysis of ecological data. Version 4. Gleneden Beach, OR: MjM Software Design; 1999.
[10] Pinheiro F, Diniz IR, Coelho D, Bandeira MP. Seasonal pattern of insect abundance in the Brazilian cerrado. Austral Ecol 2002;27:132-136.
[11] Prommi T, Permkam S. The caddisfly (Insecta, Trichoptera) of Ko Hong Hill nature preserve, southern Thailand. Denisia 2010;29:295-302.
[12] Seetapan K, Prommi T. Light-trapping of caddisflies (Insecta: Trichoptera) at Champathong waterfall, Northern Thailand with reference to local climate. Entomological Research Bulletin 2012;28:59-63.
[13] Briere RA, Cariss HM, JEE JHR. Flight activity of adult stoneflies in relation to weather. Ecol Entomol 2003;28(1):31-40.
[14] Ashfaq M, Khan RA, Khan MA, Rasheed F, Hafeez S. Insect orientation to various color lights in the agricultural biome of Faisalabad. Pak Entomol 2005;27(1):49-52.