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Seasonal flight activity of Adult Amphipsyche meridiana Ulmer 1902 (Trichoptera: Hydropsychidae) in an Irrigation Pond Outlet

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A b s t r a c t

Seasonal flight activity of adult *Amphipsyche* meridiana Ulmer 1902 (Trichoptera: Hydropsychidae) in an irrigation pond outlet at Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom Province were investigated, with the influence of air temperature, wind speed, precipitation and relative humidity on its population density being evaluated. Samples were collected monthly from January to December 2016 by light trapping. Monthly sample records for adults collected were 3054, 6396, 576, 6654, 9228, 3222, 3402, 7974, 1950, 3483, 5016 and 5178, respectively. An increase in the number of adults collected was observed from April to May with peaks of 9,228 (16.48%) in May. A remarkable decrease in the number of insects collected was observed in the month after September. There was an increase in the number of adults with an increase in wind speed. Changes in the temperature, relative humidity and precipitation had less influence on seasonal flight activity of adult *A. meridiana.*

Introduction

Trichoptera, or caddisflies, one of the largest groups of aquatic insects, are holometabolous insects with aquatic larvae and pupae and terrestrial adults (Wiggins & Currie, 2007). Trichoptera are potentially useful indicators of river and stream health (Chantaramongkol, 1983; Resh, 1992; Stanić-Koštroman et al., 2014). They are relatively easy to identify to species level in the adult stage and show a diverse range of ecological, behavioral and functional feeding modes as larvae. Furthermore, they are good indicators of environmental perturbation. Because they are distributed along the stream continuum, they constitute one of the most interesting groups for studying the ecology of organisms in running water (de Moor, 1999). Their seasonal activity is therefore essential to understanding the ecological impacts (Nowinszky et al, 2014).

Adult Trichoptera that emerge from streams live in the nearby riparian zone where they may select streamside trees as preferred sites to rest while awaiting proper swarming time, to feed in order to increase egg production, or to mate (Jackson & Resh, 1991). Provision of suitable habitat for adult aquatic insects, both in terms

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of its quality and quantity, is an important consideration as the adult stage can be critical in regulating population numbers of aquatic larvae, and adults can play an important role in terrestrial food webs (Ormerod & Tyler, 1991).

Documentation for the use of adult caddisflies as bioindicators of water quality in Thailand has been given in the papers of Prommi & Permkam (2010), Prommi & Thamsenanupap (2012), Seetapan & Prommi (2012), Prommi & Thani (2014), Prommi et al. (2014), Prommi (2015), and Prommi et al. (2016). Caddisflies were chosen for this study because they are usually more diverse than other aquatic insect orders (Wiggins, 1996). Adults have been studied widely because they are easily collected by light traps and can be used as a useful tool for bioassessment (Greenwood et al., 2001; de Moor, 1999). Chantaramongkol (1983) recommended light trapping for assessing water quality in large rivers. Knowledge of the taxonomy and ecology of the species has proven valuable in biomonitoring programs because of differences in susceptibilities of the various species to pollutants and other types of environmental disturbances. Genus- or species-level identifications of adult caddisflies are possible and clearly produce more accurate results than family-level identification, thereby giving better ability to assess changes of water quality.

The caddisfly, *Amphipsyche meridiana* Ulmer 1902 (Trichoptera: Hydropsychidae), is an aquatic species that inhabits lake outlets. The main objective of this study was to monitor the occurrence and number of *A. meridiana* in an irrigation pond outlet. This pond received water from the Mae Klong Dam. Water from an irrigation pond is an important water resource for the University, and it serves mainly as a source of drinking water supply and agricultural activities.

Materials and methods

1. Sampling and laboratory analyses

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, central part of Thailand (Fig. 1). At each sampling date, adult caddisflies were collected using one unit of 10-watt portable black lights placed over 24 × 30 cm white plastic pans filled with detergent solution. The device was placed ~1 m from the stream edge. Specimens were collected one night in a month for 12 months from January to December 2016. In the laboratory, specimens were sorted and examined under a dissecting stereomicroscope. Specimen identifications were accomplished at the species level using Malicky (2010). Specimen counts from collections at each sampling month were summed. Abiotic factors (air temperature, precipitation, relative humidity, and wind speed) in this study were obtained from Nakhon Pathom Meteorological Station year 2016, which is located nearby the sampling site.

Fig. 1 Photographs of the sampling site (A), light traps (B) and specimens contains in the white tray (C).

2. Data analyses

To evaluate the relationship between abiotic factors and adult *Amphipsyche meridian,* a Pearson correlation coefficient was used. Statistical analyses were performed using SPSS software (version 16.0) (http://www.spss.com/).

Results and discussion

The seasonal flight activity of *A. meridiana* was recorded all year round as with many tropical aquatic invertebrates, seems to have a multivoltine life cycle, the year- round favorable environmental conditions resulting in continuous growth and development (Humantinco & Nessimian, 2000). A total of 55,653 adult *A. meridiana* were captured during the sampling period (Table 1, Fig 2). The number of *A. meridiana* specimens collected was 3054, 6396, 576, 6654, 9228, 3222, 3402, 7974, 1950, 3483, 5016 and 5178, respectively. Peak abundance of flying insects was recorded at the hot-dry season (April to May), which coincided with both high temperature and wind speed. The abundant flying insect population probably was favoured by increased availability of microhabitats to provide cover and food (plants growing leaves and flowers) (Hill & Hill, 1994). Insect abundance declined to the lowest flying insects (Table 1) in the cold-dry season (September to December) coinciding with low temperature in the same period (Table 1). It has been noted that many tropical insect species become inactive at temperatures below 18°C, as there appears to be a preferred temperature for species, within which the insect thrives (Hill & Hill, 1994). Therefore, in the lowland habitat, seasonality in flying insect abundance could fairly be influenced by weather condition. The temperature, moisture (rainfall) and food supplies vary with season and are important factors for reproduction for insects (Miller & Harley, 1992).

Table 1 Total number of adult Amphipsyche meridiana collected over the period from January to December 2016. AT=Air temperature; PT=Precipitation; RH=Relative humidity; WS=Wind speed. All abiotic factors were obtained by Nakhon Pathom Meteorological station.

Month	Total	%abundance	AT (°C)	PT (mm)	RH (%)	WS (m/s)
January	3,054	5.38	26.10	0.00	72.50	4.10
February	6,396	11.39	26.60	0.00	68.00	4.70
March*	576	1.03	30.10	0.20	69.50	5.50
April	6,654	11.85	32.70	0.00	66.00	7.40
May	9,228	16.48	32.00	0.70	68.50	6.70
June	3,222	5.78	30.30	1.70	74.50	5.40
July	3,402	6.01	29.80	4.00	77.00	4.30
August	7,974	14.22	30.10	2.70	75.00	6.20
September	1,950	3.45	29.35	7.00	79.00	4.00
October	3,483	6.25	28.70	7.50	81.50	4.10
November	5,016	9.01	27.80	1.50	79.00	3.60
December	5,178	9.15	25.65	0.00	72.50	5.80
Total	55,653	100				

Remark: * raining during light traps operated.

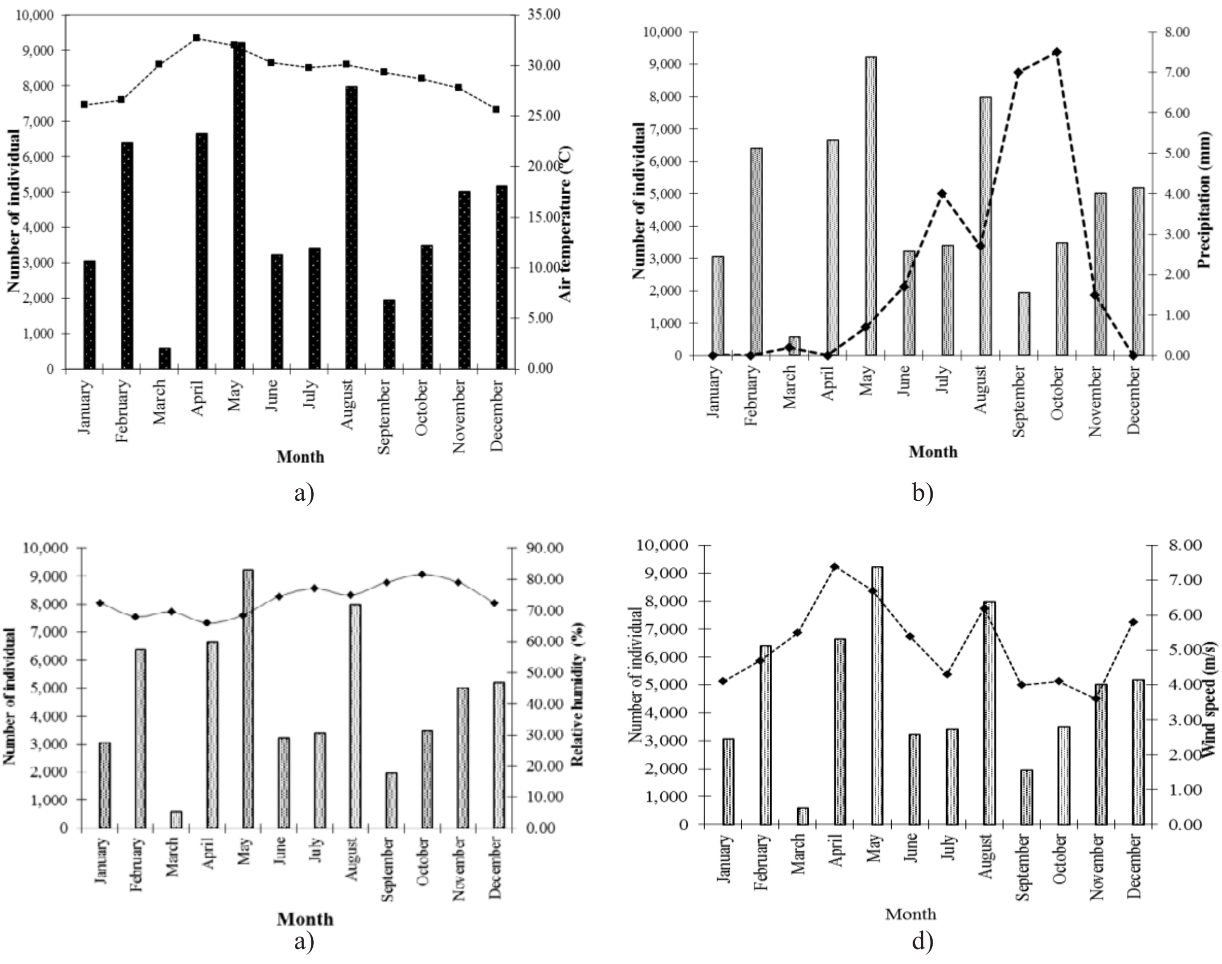

Fig. 2 Seasonal flight patterns of Amphipsyche meridiana adults over the period of January to December 2016 in relation to air temperature (a), precipitation (b), relative humidity (c) and wind speed (d).

The number of collected specimens is influenced by the environmental factors. In general, temperature was the climatic factor which influenced population dynamics of adult insects the most. In contrast to the results obtained in this research, air temperature was not significantly correlated with populations of *A. meridiana* (*r* = 0.470) (Fig. 2a, Table 2). In research by Seetapan & Prommi (2012), 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 Northern Thailand. Because of food available and stable habitat in aquatic environment at that time are appropriate for the larval stage, resulting in adults emerging (Lancaster & Downes, 2018).

An increase in precipitation negatively affected the population of adults, being a factor of importance in the occurrence of these insects among the months (Fig. 2b, Table 2). The correlation coefficient (r = -0.221) obtained by the analysis between this factor and the number of *A. meridiana*, confirmed that the increase in precipitation caused a decrease in the number of adults caught. The results showed the importance of seasonality of precipitation for the populations of Trichoptera species similar to those obtained by Prommi & Permkam (2010), 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 less negative correlation between the number of insects collected (r = -0.358). The driest conditions significantly increased the population density of A. meridiana in the area, enabling the catch of the highest number of specimens (Fig. 2c, Table 2). Likewise, Seetapan & Prommi (2012) verified a negative correlation between relative air humidity and the populations of Trichoptera species in Northern Thailand.

One study pointed out that the wind speed appeared to influence insect flight, with higher wind speeds being associated with lower flight activity (Briers et al, 2003). In this study, wind speed was significantly correlated with populations of A. meridiana (r = 0.592) (Fig. 2d, Table 2). It can be concluded that wind speed had an effect on the population of *A. meridiana*, and this effect is manifested primarily in seasonal fluctuations in this area.

This study was conducted only in the adult stage of *A. meridiana* collected by light traps. The fight period is probably adapted to temperature and the food requirements of the larvae (Byttebier et al, 2012).

Table 2 Pearson's correlation between adult insects and environmental variables in an irrigation pond outlet during January to December 2016.

	AT (°C)	WS (m/s)	PT (mm)	RH (%)	Adult insect
AT (°C)	1				
WS (m/s)	**.586***	1			
PRE (mm)	.549	-.412	1		
RH (%)	-.278	**-.715****	**.836****	1	
Adult insect	.470	**.592***	-.221	-.358	1

Remark: *. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Conclusion

It can be concluded from this study that the seasonal abundance of flying insects in the irrigation pond outlet changes with weather conditions that eventually trigger the emergence of winged and aquatic insects. Altogether, our results suggest that emergence studies are important for obtaining data on the emergence patterns and faunistics of caddisflies from lowland pond habitat, but also to provide information on the ecology of the investigated area.

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