

Diversity of Adult Caddisfly (Trichoptera) in Two Intermittent Streams During Dry Season in Phayao Province, Thailand

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Abstract

The effect of anthropogenic activities on natural intermittent stream and diversity of adult caddisfly were studied at the University of Phayao, Thailand. The caddisfly adults were collected monthly from 2 intermittent streams (the Huai Thub Chang and Huai Luang streams) from February to May 2015 (cool-dry to hot-dry season) using a black-light trap. Huai Thub Chang stream received wastewater from the oxidation pond, while Huai Luang stream was affected by an agricultural field of the university. Both streams are located in a deciduous forest. The 14 species of 7 families were collected and identified. *Cheumatopsyche lucida* (Hydropsychidae) and *Leptocerus dirghachuka* (Leptoceridae) were found in both streams. *C. lucida* was the most abundant species. *Micrasema turbo*, *Amphipsyche meridiana*, *C. globosa*, *Diplectrona lavinia*, *Macrostemum dohrni*, *Marilia sumatrana*, and *Wormaldia relict*a were found only in Huai Thub Chang stream, whereas *C. dhanikari*, *Lepidostoma doligum* and *Chimarra toga* were found only in Huai Luang stream. A high number of *C. lucida* in both streams from February to April reflected a drought effect on the emergence of the caddisflies. Huai Thub Chang stream had a higher diversity of Trichoptera species than Huai Luang stream because of the variety of substrate types which were suited for the larval stage, especially hydropsychids.

Keywords: Caddisfly, Intermittent streams, Dry season, Trichoptera species, Hydropsychids, Phayao

Introduction

Caddisflies are the main group of aquatic insects; their larval stage inhabits many types of aquatic ecosystems, and their adults form to live in the terrestrial ecosystem. Their larva morphology is similar to butterfly larva. Their adults are also similar to the micro moth. The 14,548 described species are distributed over the globe [1,2], while some families are worldwide in occurrence; others are restricted to either the northern or the southern hemisphere [3]. In Thailand, studies of trichoptera have been conducted since 1978, where it was performed by Malicky and Chantaramongkol [4]. These insects have been continuously studied, mainly in northern Thailand, until now, and there have been 1,004 species reported [5]. In Northern Thailand, investigations on caddisflies were done in 2007 by Nuntakwang *et al.* [6] and also in some specific areas such as Doi Suthep-Pui (Chiang Mai Province) [7-9], Champathong Waterfall (Phayao Province) [10], and Mae Keong Waterfall (Phare Province) [11].

Intermittent streams are common inland freshwater habitats around the world, but these habitats are poorly studied compared to permanent streams [12]. These streams flow seasonally when the groundwater tables are elevated over the streambed by the influence of precipitation and rain. In dry seasons, the streams will be dry because the groundwater tables are reduced under the stream bed level [13]. There are a few studies on caddisfly in intermittent stream around the worlds.

The University of Phayao is located in Phayao province, Thailand. The campus is surrounded by a deciduous forest and natural intermittent streams. There are 2 intermittent streams, which are outlets from the reservoir of the university (**Figure 1**). Huai Thab Chang stream is located to the north of the university. It receives domestic water from the university and flows to the second reservoir, which is used for local agriculture outside the university. Huai Luang stream is located to the east of the university. It was modified to be an irrigation canal that receives water from the reservoir of the university. The expansion of the university during the past 5 years caused deterioration on land and water. Some natural intermittent streams were used to receive untreated wastewater from domestic and agricultural areas, which affected aquatic fauna. To study the impact of the dry season and stream reach type on the stream and fauna, the adult of the caddisfly was chosen to study, due to them being very common in these streams, especially hydropsychid larva.



Figure 1 Sampling sites (A: Huai Thab Chang stream, B: Huai Luang) in 2 intermittent streams of the University of Phayao, Thailand.

Materials and methods

Study area

Two intermittent streams, Huai Thab Chang and Huai Luang, were selected for setting a black-light trap to collect Trichoptera (adult) overnight. Each stream was divided into 2 sampling points, Huai Tab Chang 1 (HTC1), Huai Tab Chang 2 (HTC2), Huai Luang 1 (HL1), and Huai Luang 2 (HL2), respectively (**Figure 2**). The materials were collected once a month from February to May 2015 during a seasonal transition (late cool dry season to hot dry season).

Material collection

Trichoptera (adult) were collected using a portable black-light trap set (10-W fluorescent tube, 12-Volt DC battery) suspended on a plastic tray containing a detergent solution. Light traps were placed near the stream margin before sunset and left overnight (**Figure 3**). On the morning of the next day, the insect material was transferred into 80 % ethyl alcohol and transported to the laboratory.

Material identification

The caddisflies (male) were sorted and examined under a dissecting stereomicroscope. The last 2 abdominal segments of adult male genitalia were separated and cleared by heating in 10 % NaOH at 70 °C for 30 - 45 min. Species level identification was done by using the Atlas of Southeast Asian Trichoptera [5].

Data analyses

The individual number of each species was counted and summarized. The total number of individuals was transformed into a log number of each species. A Sorensen's similarity index was used to compare the trichopteran species in each sampling point [14].

$$\text{Percentage of Sørensen index (Sørensen's similarity coefficient)} C_s = [2j/(a + b)] \times 100 \quad (1)$$

where j = Number of species found in both sites
 a = Number of species in site A
 b = Number of species in site B



Figure 2 The sampling points of Huai Thub Chang stream and Huai Luang stream.



Figure 3 The black-light traps were placed to collect the adult caddisflies overnight.

Results and discussion

Species abundance

14 species of adult caddisflies were collected, listed in **Table 1**. *Cheumatopsyche lucida* (Hydropsychidae) and *Leptocerus dirghachuka* (Leptoceridae) (**Figure 4**) were found in both Huai Thab Chang and Huai Luang streams. *C. lucida* had the highest species abundance. *Micrasema turbo*, *Amphipsyche meridiana*, *Cheumatopsyche globosa*, *Diplectrona lavinia*, *Macrostemum dohrni*, *Marilia sumatrana*, and *Wormaldia relict*a were found only in Huai Thab Chang stream, whereas *Cheumatopsyche dhanikari*, *Lepidostoma doligung*, and *Chimarra toga* were found only in Huai Luang stream. The location of the stream and the dispersal ability of the species can be used to explain a difference of species abundance in these 2 streams. Some species fly very well, but others can fly only a few kilometers. The continuity of habitat is also important and could benefit or adversely affect caddisfly communities. These 2 streams were separated by road and the University campus. This can be a barrier to limit the distribution of some species that cannot be found in other streams.

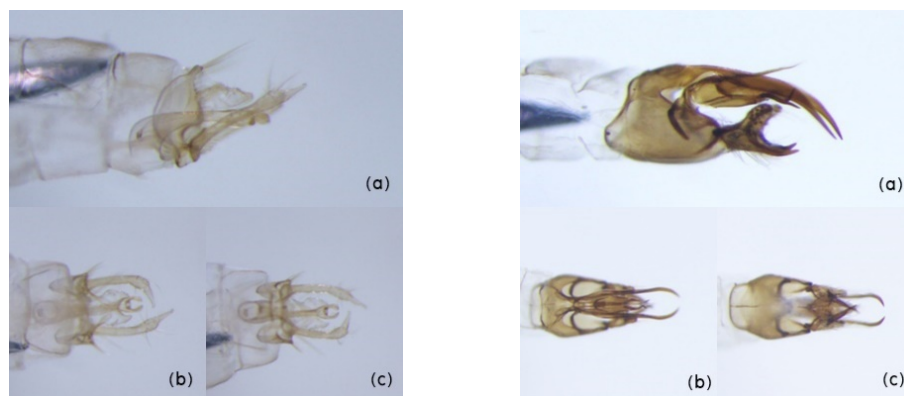


Figure 4 Left: Male genitalia of *Cheumatopsyche lucida* (a) lateral (b) dorsal (c) ventral. Right: Male genitalia of *Leptocerus dirghachuka* (a) lateral (b) dorsal (c) ventral.

Huai Thub Chang stream

There were 3 emergence periods of caddisflies. The 1st period was in February, in which *Cheumatopsyche globosa* and *Chimarra akkaorum* were found. The 2nd period was in April, where many species were presented- *Amphipsyche meridiana*, *Cheumatopsyche lucida*, *Diplectrona lavinia* *Hydroptila thuna*, *Leptocerus dirghachuka*, *Marilia sumatrana*, and *Wormaldia relict*. The 3rd period was in May, in which *Micrasema turbo* and *Macrostemum dohrni* were found. The increasing caddisfly apparently reflected a drought effect on the emergence of the adult caddisflies, which started from February to April, especially on *C. lucida*, which was high in abundance in this stream (**Table 1**). Their number decreased from April to May, during which the stream water became too dry (**Figure 5**).

Table 1 Species list and population of male caddisflies which were collected from February to May 2015 in Huai Tab Chang stream and Huai Luang stream.

Family	Trichoptera species	HTC1	HTC2	HL1	HL2
Hydroptilidae	<i>Hydroptila thuna</i> OLAH 1989	14	0	262	8
Philopotamidae	<i>Chimarra akkaorum</i> C&M 1986	1	1	0	1
	<i>Chimarra toga</i> M&C 1993	0	0	0	7
	<i>Wormaldia relict</i> MARTYNOV 1935	1	0	0	0
Hydropsychidae	<i>Amphipsyche meridiana</i> ULMER 1909	1,024	43	0	0
	<i>Cheumatopsyche dhanikari</i> MALICKY 1979	0	0	0	14
	<i>Cheumatopsyche globosa</i> ULMER 1901	1	0	0	0
	<i>Cheumatopsyche lucida</i> ULMER 1907	13,980	1,949	777	704
	<i>Diplectrona lavinia</i> MALICKY	2	0	0	0
	<i>Macrostemum dohrni</i> ULMER 1905	1	0	0	0
Odontoceridae	<i>Marilia sumatrana</i> ULMER 1951	1	0	0	0
Lepidostomatidae	<i>Lepidostoma doligung</i> MALICKY 1979	0	0	1	0
Brachycentridae	<i>Micrasema turbo</i> M&C 1992	1	0	0	0
Leptoceridae	<i>Leptocerus dirghachuka</i> GORDON & SCHMID 1987	11	15	19	8
Total families (7)	Individual number	15,037	2,008	1,059	742
Total species (14)	Species number	11	5	4	6

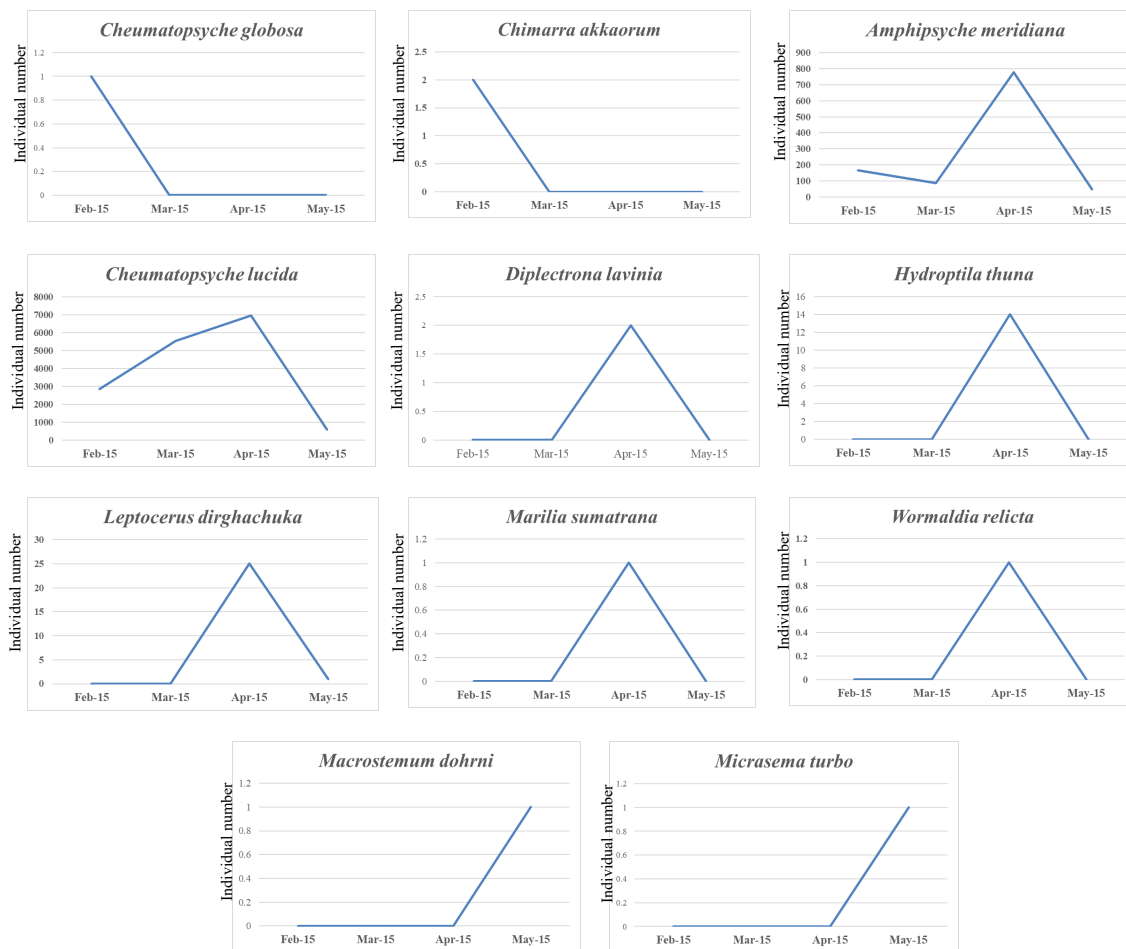


Figure 5 Individual number of caddisfly species and their emergence periods in Huai Thub Chang stream during February 2015 to May 2015.

Huai Luang Stream

There were 4 emergence periods of caddisfly. The 1st period was in February, in which *Hydroptila thuna* and *Chimarra akkaorum* were found. The 2nd period was in March, in which *Cheumatopsyche dhanikari*, *Cheumatopsyche lucida*, and *Chimarra toga* were found. The 3rd period and 4th period were in April and May, in which only *Leptocerus dirghachuka* and *Lepidostoma doligum* were collected, respectively (**Figure 6**).

According to Prommi *et al.* [15], *C. lucida* was collected from Mae Tao and Mae Ku watersheds in Tak province. This species is found only in some areas in Northern Thailand. Its distribution is quietly specific to stream reach, in which the stream bed consists mainly of bedrock, gravel, sand, small stones, and some large boulders, which is similar to Huai Thub Chang stream and Huai Luang stream in this research. Due to the feeding habits of the larval stage, as a filter feeder, the species requires a stable substrate to build an attached case over a substrate to collect fine particulate organic matter in a stream flow [16,17].

A Sorensen's similarity index shows that the highest similarity was 63 % (HTC1-HTC2) and the lowest similarity was 40 % (HTC1-HL1) (**Figure 7**). These results show that the species of caddisfly among these 2 streams were located in the same forest were different.

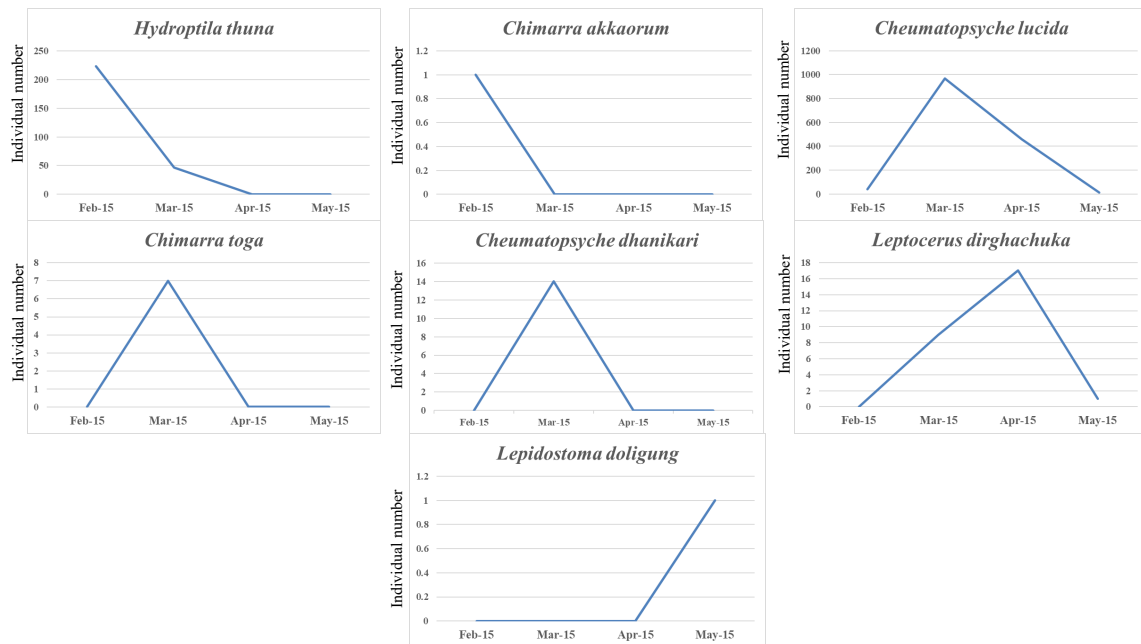


Figure 6 Individual number of caddisfly species and their emergence periods in Huai Luang stream from February 2015 to May 2015.

	HTC1	HTC2	HL1	HL2
HTC1		●		
HTC2	63			●
HL1	40	44		●
HL2	47	55	60	

	> 75 %
●	51 - 75 %
	< 50 %

Figure 7 Sorensen's similarity percentage of caddisfly species, comparing 4 sampling points.

Conclusions

The intermittent streams in the deciduous forest, substratum type, had affected the diversity of trichoptera. The stream reach of Huai Thub Chang stream is pool-riffle and step-pool, and predominant bed materials are gravel cobble and boulder, while the stream reach of Huai Luang stream is pool-riffle, and predominant bed materials are gravel and some debris materials. Both streams had a dominant sediment source of fluvial, bank erosion, inactive channels, and debris flows [16]. According to the species richness of Huai Thub Chang stream, which is located in the natural deciduous forest, and Huai Luang stream, which was transformed into an agricultural field, these 2 streams had a low diversity during the dry season, except for HTC1, which had a higher species number. Decreasing water had affected the hydropsychid species, especially *C. lucida*, which had high abundance in this area. This is clearly similar to Huai Luang stream, in that the number of *C. lucida* decreased from the same time as

Huai Thub Chang stream (**Figure 8**). Some species, such as *Chimarra akkaorum* and *Leptocerus dirghachuka* which were found in both streams, showed the same emergence period in March and April. Environmental factors, such as substratum in each stream, affected the species number of caddisfly due to them providing a different microhabitat and material for caddisfly in the larval stage to live and build their cases. The major substrate of HCT1 was a big boulder that provided a proper habitat for hydropsychid (net-spinning caddisfly) and philopotamid (finger-net caddisfly) species. Larvae of these groups were filtered feeders, which need a high stable substrate to build fixed cases and fast water currents to feed seston [17]. The substrate of HTC2, HL1, and HL2 were cobbles, sand, and clay. The water current was slow. This condition is suited for deposit feeder larva, such as Hydropsychidae, Lepidostomatidae and Leptoceridae.

In Thailand, there are few studies on trichoptera in intermittent streams, especially in dry deciduous forest. *C. lucida* in these 2 streams may be used as a bioindicator for the drought period of the dry season for this area, but the correlation between its larval stage and water discharge is a necessary study to find out its function in ecosystem service [18,19]. Annual study is necessary to find out the seasonal pattern of the emergence, which will lead to understanding of the phenology of caddisfly in intermittent streams.

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