

## DATA ON AQUATIC INSECTS IN THE SEO MY TY AND NAM CANG STREAMS, HOANG LIEN NATIONAL PARK, LAO CAI PROVINCE, VIET NAM

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### ABSTRACT

The aims of this study are to show the data on faunas and communities of aquatic insects in the Seo My Ty Stream in Ta Van Commune and the Nam Cang Stream in Nam Cang Commune in the Hoang Lien National Park, Lao Cai Province. Ta Van Commune belonging to the core area of the National Park, while Nam Cang Commune is located in the buffer area of the National Park. In this study, we collected aquatic insects at 6 sampling sites in January 2018 and August 2018. Specimens were collected both quantitatively by a Surber net (mesh size 250  $\mu\text{m}$ , with acreage 0.1  $\text{m}^2$ ) and qualitatively using hand nets and pond nets. As a result, a total of 141 aquatic insect species belonging to 108 genera, 50 families and 9 orders were recognized. Among these, the order Ephemeroptera had the highest species number with 64 species, followed by Trichoptera with 32 species, Diptera with 13 species, Coleoptera with 10 species, Plecoptera with 8 species, Odonata with 7 species, Hemiptera with 4 species. Lepidoptera with 2 species and Megaloptera had the lowest of species number, only 1 species. Besides, the results from quantitative analysis and the functional feeding groups were provided.

**Keywords:** aquatic insects; Hoang Lien National Park; qualitative analysis; quantitative analysis

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## DẪN LIỆU VỀ CÔN TRÙNG NƯỚC Ở SUỐI SÉO MÝ TỶ VÀ SUỐI NẠM CANG THUỘC VƯỜN QUỐC GIA HOÀNG LIÊN, TỈNH LÀO CAI, VIỆT NAM

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### TÓM TẮT

Kết quả phân tích mẫu vật côn trùng nước thu được tại 6 điểm nghiên cứu khác nhau bằng lưới Surber (kích thước mắt lưới 250  $\mu\text{m}$ , diện tích thu mẫu 0,1  $\text{m}^2$ ) với mẫu định lượng và vợt tay, vợt ao với mẫu định tính ở suối Séo Mỹ Tỷ và suối Nậm Cang thuộc Vườn quốc gia Hoàng Liên, tỉnh Lào Cai trong đợt thu mẫu tháng 01/2018 và tháng 8/2018 đã xác định được 141 loài thuộc 108 giống và 50 họ của 9 bộ côn trùng nước. Trong đó bộ Phù du có số lượng loài lớn nhất với 64 loài, tiếp theo là bộ Cánh lông với 32 loài, bộ Hai cánh có 13 loài, bộ Cánh cứng có 10 loài, bộ Cánh úp có 8 loài, bộ Chuồn chuồn có 7 loài, bộ Cánh nửa có 4 loài. Hai bộ Cánh vẩy và Cánh rộng có số lượng loài ít nhất, mỗi bộ lần lượt là 1 và 2 loài. Các kết quả phân tích định lượng cũng như các nhóm dinh dưỡng chức năng cũng được trình bày trong nghiên cứu này.

**Từ khóa:** côn trùng nước; Vườn Quốc gia Hoàng Liên; phân tích định tính; phân tích định lượng

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## 1. Introduction

Aquatic insects, the most diverse group of organisms in freshwater bodies, are integral part of the aquatic ecosystem, having both ecological and economical value. They may be considered as model organisms in analyzing the structure and function of the freshwater ecosystem because of their high abundance, high birth rate with short generation time, large biomass and rapid colonization in freshwater habitats.

The Hoang Lien National Park located in the Northwest of Viet Nam has 28,477 ha of the core area and 38,724 ha of the buffer area. The Park is covered mainly by a primary forest which has mountainous tropical vegetation and diversified stream system. There are favorable conditions for the survival and growth of aquatic organisms, especially of the aquatic insects. However, the actual make up of the fauna inhabiting these regions has not been fully investigated. Sang Woo Jung et al. (2008) studied aquatic insects faunas and communities in the Muong Hoa Stream, a mountain stream in Sa Pa highland, flows through San Sa Ho, Ta Van and Ban Ho Communes [1]. Nguyen Van Hieu and Nguyen Van Vinh (2015) [2] studied the population of Mayflies (Ephemeroptera) in the buffer area of the Hoang Lien National Park. Their samples were collected from the Nam Cang Stream, Nam Sai Commune and Ngoi Bo Stream, Sa Pa Commune. However, aquatic insects communities in the Seo My Ty Stream in Ta Van Commune and Nam Cang Stream in Nam Cang Commune have not yet been studied. Therefore, we investigated aquatic insect communities in these two streams.

## 2. Materials and methods

**2.1. Materials:** The species belonging to aquatic insects were collected at 6 sampling sites in January 2018 and August 2018. Six samples were taken from the Seo My Ty Stream and Nam Cang Stream, Hoang Lien National

Park, Lao Cai Province. Three sites (St1-St3) were at the Nam Cang Stream, and three sites (St4-St6) were at the Seo My Ty Stream.

**2.2. Methods:** Samples were collected following to the methods of McCafferty (1983) [3], Merritt & Cummins (1996) [4] and Nguyen (2003) [5]. Qualitative samples were collected using pond nets and hand nets, while quantitative samples were collected using a Surber net (mesh size 250  $\mu\text{m}$ , 0.1  $\text{m}^2$  area), with five replicated at each site.

Samples were preserved in 80% ethanol and analyzed in the Laboratory of Zoology, Faculty of Biology - Agricultural Technology, Hanoi Pedagogical University 2.

Aquatic insects were identified to the species level or lowest taxonomic categories, based on the published identification keys, e. g. Nguyen (2003) [5], Morse et al. (1994) [6], Dudgeon (1999) [7], Narumon & Boonsoong (2004) [8], Chen et al. (2005) [9], Hoang (2005) [10], Jacobus & McCafferty (2008) [11], Cao (2008) [12] and Webb & McCafferty (2008) [13].

**2.3. Data analysis:** Data from qualitative and quantitative samples were used to calculate three diversity indices: McNaughton's dominance index (DI), Margalef's richness index (d) and Shannon-Weaver species diversity index ( $H'$ ). Data from quantitative samples were used to perform the cluster algorithm (Bray-Curtis similarity index group average clustering algorithm) of six studied sites. Functional feeding groups (FFGs) were classified mainly according to Merritt & Cummins (1996) [4]. The number of individuals in each FFG was then used to study the composition of FFGs in the two streams studied.

Data analysis were processed in Microsoft Office Excel<sup>®</sup> 2007 software from Microsoft Corporation<sup>®</sup> and Primer V.6 from Primer<sup>®</sup>-E<sup>™</sup> Ltd, UK.

### 3. Results and discussion

#### 3.1. Species biodiversity of aquatic insects in the studied area

There were 141 recored species belonging to 108 genera, 50 families and 9 orders of aquatic insects (Table 1).

**Table 1.** Number of aquatic insect taxa in the studied area

Orders	Families		Genera		Species	
	Number	%	Number	%	Number	%
Ephemeroptera	8	16.00	32	29.63	64	45.39
Odonata	6	12.00	7	6.48	7	4.96
Plecoptera	2	4.00	8	7.42	8	5.67
Hemiptera	2	4.00	4	3.71	4	2.84
Coleoptera	5	10.00	10	9.26	10	7.09
Megaloptera	1	2.00	1	0.92	1	0.72
Diptera	9	18.00	13	12.03	13	9.22
Lepidoptera	2	4.00	2	1.85	2	1.42
Trichoptera	15	30.00	31	28.70	32	22.69
<b>Total</b>	<b>50</b>	<b>100</b>	<b>108</b>	<b>100</b>	<b>141</b>	<b>100</b>

**Table 2.** The average numbers of species, density and biodiversity indices of aquatic insects per 0.5m<sup>2</sup> in the studied area

Sites	No. of species	No. of individuals	DI	d	H'
St1	70	560	0.14	10.90	5.34
St2	60	787	0.28	8.55	4.53
St3	55	526	0.16	8.62	4.94
St4	37	355	0.37	6.13	3.99
St5	45	650	0.39	6.79	4.14
St6	35	179	0.32	6.55	4.27
<b>Mean ± SD</b>	<b>50.33 ± 13.74</b>	<b>509.50 ± 215.72</b>	<b>0.28 ± 0.11</b>	<b>7.92 ± 1.80</b>	<b>4.54 ± 0.52</b>

The dominance of the order Ephemeroptera and Trichoptera suggested that the two studied streams are overall in good stream health. However, our finding showed that the number of aquatic insect species recorded in the Seo My Ty Stream and Nam Cang Stream belonging to Hoang Lien National Park was smaller than those from othernational parks in Vietnam. Aquatic insect fauna in the Thac Bac Stream of the Tam Dao National Park in northern Vietnam has 145 species, 127 genera and 63 families (Nguyen et al., 2001) [14], the DakPri Stream in southern Vietnam has 268 species, 230 genera and 91 families (Hoang & Bae, 2006) [15]. Additionally, the number of aquatic insect species in the Nam Cang Stream and the Seo My Stream was also smaller than that in the Muong Hoa Stream (216 species, 139 genera and 61 families) even though these three streams are both

located in the Hoang Lien National Park (Jung et al., 2008) [1]. The reason for this might be due to either differences in local stream habitats between our studied streams and their stream or the potential negative effects of the local economic development during the past nine years. Further studies are needed to confirm our proposed reasons.

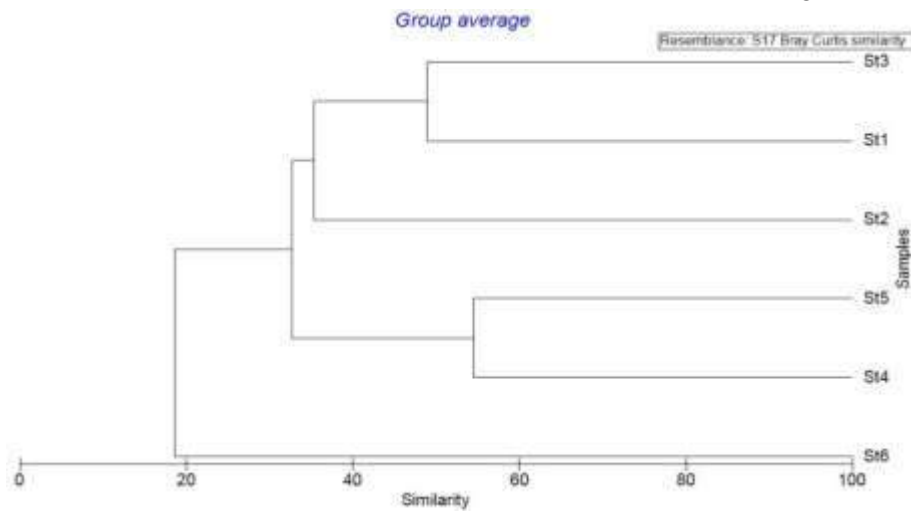
The range (mean ± standard deviation) of McNaughton's dominance index (DI), Margalef's richness index (d) and Shannon-Weiver species diversity index (H') were 0.14-0.39 (0.28 ± 0.11); 6.13-10.90 (7.92 ± 1.80) and 3.99-5.34 (4.54 ± 0.52), respectively (Table 2).

#### 3.2. Community structure of aquatic insects in the studied area

The quantitative sampling resulted in a total of 3.057 individuals. Three major aquatic insect groups were dominated Ephemeroptera

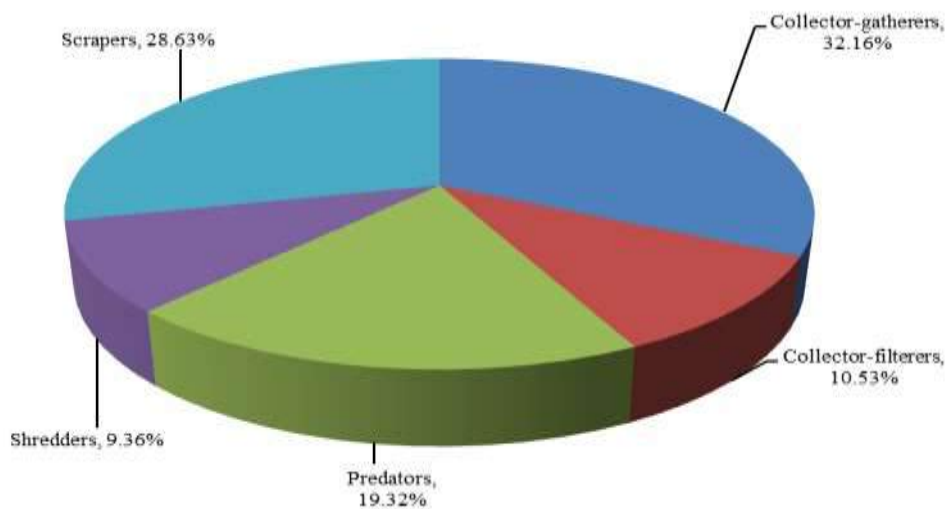
with 1.281 individuals (41.90%). Trichoptera with 792 individuals (25.91%), Diptera with 517 individuals (16.91%), Coleoptera with 270 individuals (8.83%), Plecoptera with 81 individuals (2.65%), Odonata with 67 individuals (2.2%), Hemiptera with 41 individuals (1.34%), Megaloptera with 7 individuals (0.23%) and Lepidoptera with 1 individual (0.03%).

The Bray-Curtis similarity matrix indicated that the three sites from Nam Cang Stream can be grouped together, in which St1 and St3 had higher similarity (48.99%) than with St2. The highest similarity was found in between St4 and St5 (54.53%) in the Seo My Ty Stream; whereas the lowest similarity was seen in between St6 in the Seo My Ty Stream and the five other sites (Figure 1).



**Figure 1.** The cluster dendrogram of six studied sites using the Bray-Curtis similarity

In order to reconstruct the functional feeding groups (FFGs) structure of the aquatic insect communities in the studied area, the data obtained from quantitative sampling were analyzed. The results showed that the collector-gatherers represented the largest portion (32.16%); followed by scrapers (28.63%); predators (19.32%); collector-filterers (10.53%) and shredders (9.36%) (Fig. 2).



**Figure 2.** Percentages of species number (%) of FFGs in the studied area

The dominance of collector-gatherers, which feed on FPOM (Fine Particulate Organic Matter) from the stream bottom, suggested the importance of terrestrial inputs of organic matter as the main organic energy source in these forest streams. Interestingly, shredders, which consume leaf litter or other CPOM (Coarse Particulate Organic Matter) including wood and nonwoody material, only contributed a small portion (9.36%); whereas obligate shredders are generally common in small forest Northern Hemisphere streams due to the dominance of litter in the food base of stream communities (Winterbourn et al., 1981 [16]; Winterbourn, 1997 [17]). The inconsistency between our finding and the common pattern in other streams may be due to the classification of FFGs which was based on the study of Merritt & Cummins (1996) from North America streams [4]. Many stream invertebrates are believed to feed on a wide range of foods; therefore, the category of their trophic or functional terms might be partly depended on where they are found. For example, collector-gatherers can consume both detritus and algae, a shift from detritus to algae in their diets normally found at sites where the forest canopy is lost (Winterbourn, 2000) [18]. It is, therefore, necessary to modify the classification of Merritt & Cummins (1996) to reflect more accurate functional feeding groups of aquatic insects in Vietnamese streams [4].

#### 4. Conclusion

In this study, we recorded a total number of 120 species belonging to 96 genera, 46 families and 9 orders of aquatic insect in Seo My Ty and Nam Cang stream, including 48 species of Ephemeroptera, 29 species of Trichoptera, 12 species of Diptera, 10 species of Coleoptera, 8 species of Plecoptera, 7 species of Odonata, 4 species of Hemiptera and 1 species each of Lepidoptera and Megaloptera.

The quantitative sampling resulted in a total 3,057 individuals of aquatic insects: Ephemeroptera is the highest in number with 1,281 individuals (41.90%). Trichoptera with 792 individuals (25.91%), Diptera with 517 individuals (16.91%), Coleoptera with 270 individuals (8.83%), Plecoptera with 81 individuals (2.65%), Odonata with 67 individuals (2.2%), Hemiptera with 41 individuals (1.34%), Megaloptera with 7 individuals (0.23%) and Lepidoptera with 1 individual (0.03%). The median and standard deviation of McNaughton's dominance index (DI) were  $0.28 \pm 0.11$ , Margalef's richness index (d) were  $7.92 \pm 1.80$  and Shannon-Weaver species diversity index ( $H'$ ) were  $4.54 \pm 0.52$ .

For the FFGs, the collector-gatherers dominated with 32.16% of total number of individual, followed by scrapers with 28.63%, predators with 19.32%, collector-filterers with 10.53% and shredders with 9.36%.

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#### REFERENCES

- [1]. S. W. Jung, V. V. Nguyen, Q. H. Nguyen, Y. J. Bae, "Aquatic insect faunas and communities of a mountain stream in Sapa Highland, northern Vietnam", *The Japanese Society of Limnology*, 9, pp. 219-229, 2008.
- [2]. Nguyen Van Hieu, Nguyen Van Vinh, "The result of study on Ephemeroptera (Ephemeroptera: Insecta) in interzonal Hoang Lien National Park, Lao Cai province", *Proceedings of the 6<sup>th</sup> National Scientific Conference on Ecology and Biological Resources*, pp. 143-148, 2015 (In Vietnamese).
- [3]. W. P. McCafferty, *Aquatic Entomology*, Jones and Bartlett publishers, Boston - London, 1983.
- [4]. R. W. Merritt and K. W. Cummins, *An Introduction to the Aquatic Insects of North America*, Kendall/Hunt Publishing Company, Iowa, 1996.

- [5]. Nguyen Van Vinh, *Systematics of the Ephemeroptera (Insecta) of Vietnam*, Thesis for the degree of Doctor of science, Department of Biology, The Graduate School of Seoul Women's University, 2003.
- [6]. J. C. Morse, L. Yang and L. Tian, *Aquatic Insects of the China useful for monitoring water quantity*, Hobai University Press, Nanjing, China, 1994.
- [7]. D. Dudgeon, *Tropical Asian Streams - Zoobenthos, Ecology and Conservation*, Hong Kong University Press, Hong Kong, 1999.
- [8]. S. Narumon and B. Boonsoong, *Identification of Freshwater Invertebrates of the Mekong river and Tributaries*, Faculty of Science, Applied Taxonomic Research Center Khon Kean University, Khon Kean, Thailand, 2004.
- [9]. P. P. Chen, N. Nieser and H. Zettel, *The aquatic and semi-aquatic bugs (Heteroptera: Nepomorpha & Gerromorpha) of Malesia*, Fauna Malesiana Handbooks 5. Brill, Leiden-Boston, 2005.
- [10]. D. H. Hoang, *Systematics of the Trichoptera of Vietnam*, Ph.D Thesis. Seoul Women's University, Korea, 2005.
- [11]. L. M. Jacobus and W. P. McCafferty, "Revision of Ephemerellidae genera (Ephemeroptera)", *Transactions of a American Entomological Society* 134 (1,2), pp. 185-274, 2008.
- [12]. Cao Thi Kim Thu, *Systematics of the Vietnamese Perlidae (Insecta: Plecoptera)*, Thesis for Degree of Doctor of Philosophy, The Graduate School of Seoul Women's University, Korea, 2008.
- [13]. J. M. Webb and W. P. McCafferty, "Heptageniidae of the World. Part II: Key to the Genera", *Canadian Journal of the Arthropod Identification* 7, pp. 1-55, 2008.
- [14]. Nguyen Van Vinh, Hoang Duc Huy, Cao Thi Kim Thu, Nguyen Xuan Quynh and Bae Yeon Jae, "Altitudinal distribution of aquatic insects from Thac Bac creek Tam Dao", *Korean Soc. Aquatic Entomol.*, Korea 1, pp. 123-133, 2001.
- [15]. D. H. Hoang and Y. J. Bae, "Aquatic insect diversity in a tropical Vietnamese stream in a comparison with that in a temperate Korean stream", *The Japanese Society of Limnology* 7, pp. 45-55, 2006.
- [16]. M. J. Winterbourn, J. S. Rounick and B. Cowie, "Are New Zealand stream ecosystems really different?", *New Zealand Journal of Marine and Freshwater Research* 15, pp. 321-328, 1981.
- [17]. M. J. Winterbourn, "New Zealand mountain stream communities: stable yet disturbed?", *Evolutionary ecology of fresh - water animal*, Birkhauser, pp. 31-54, 1997.
- [18]. M. J. Winterbourn, "Feeding ecology. New Zealand stream invertebrates: Ecology and implications for management", *New Zealand Limnological Society*, pp. 100-124, 2000.