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PRELIMINARY RESULTS ON SPECIES COMPOSITION OF AQUATIC INSECTS IN DAI DINH TOWN, TAM DAO DISTRICT, VINH PHUC PROVINCE

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Abstract. In this study, specimens were collected at 5 different sites. The aquatic insects were collected both quantitatively by Surber net (size 50 cm × 50 cm, mesh size 0.2 mm) and qualitatively by hand net and pond net. A field survey was conducted in December 2019 (dry season) and in June 2020 (rainy season). The study aims to show the preliminary data on faunas and communities of aquatic insects in Dai Dinh town, Tam Dao district, Vinh Phuc province. As a result, a total of 91 aquatic insect species belonging to 76 genera, 44 families, and 9 orders were recognized. Among these, the order Ephemeroptera had the highest species number with 32 species; followed by order Trichoptera with 18 species; order Odonata with 16 species; order Coleoptera with 8 species; order Hemiptera and Diptera with 6 species, each; order Plecoptera with 3 species. Order Lepidoptera and Megaloptera had the lowest of species number, represented by 1 species for each order. Besides, the quantitative analysis results and the functional feeding groups were provided in this study.

Keywords: composition species, aquatic insects, Dai Dinh town, qualitative, quantitative analysis.

1. Introduction

Aquatic insects spend at least part of their lives in water. They are derived from various terrestrial ancestors that have secondarily invaded aquatic environments and therefore do not represent a distinct taxonomical unit within the class Insecta. Some insect orders contain only species that are aquatic in some life stages (e.g., mayflies, stoneflies, dragonflies, caddisflies, megalopterans), whereas other orders contain both aquatic and terrestrial species (e.g., beetles, bugs, butterflies, neuropterans, orthopterans, and dipterans). 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 a short generation time, large biomass, and rapid colonization in freshwater habitats [1]. In the past, the aquatic insect faunas in Tam Dao district, Vinh Phuc province were virtually unknown and only limited insect taxa have been reported in scattered literature [1-5]

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and Nguyen (2004) [6] studied aquatic insect fauna and composition Mayflies in Thac Bac stream. The specimens in these studies were collected inTam Dao town and Ho Son commune. On the other hand, Dai Dinh town is located in the north of Tam Dao district with an area of 34,56 km^2. The climate here can be divided into two distinct seasons: cold, dry winter and hot, rainy summer. There are quite rich and diverse stream systems in Dai Dinh town, these are favorable conditions for the survival and growth of aquatic organisms, especially the aquatic insects. However, the actual composition of the fauna inhabiting these regions has not been fully investigated. Only certain groups of aquatic insects have been investigated in this area by Nguyen Van Hieu (2017) [7] with composition Mayflies (Ephemeroptera) in Tay Thien stream.

Based on the analysis of the samples was collected in Dai Dinh town, the present paper provides preliminary data of aquatic insects in the studied area.

2. Content

2.1. Materials and methods

**** Materials***

The species belonging to aquatic insects were collected at 5 sampling sites in December 2019 and June 2020 in Tay Thien stream and its branches.

**** Methods***

The samples were collected according to methods illustrated by Edmunds (1982) [8], McCafferty (1983) [9], Nguyen (2003) [10]. The qualitative samples of aquatic insects were collected by using pond net and hand net, while quantitative samples were taken by using Surber net (size 50 cm × 50 cm, mesh size 0.2 mm), two Surber samples were obtained at riffle and pool habitats. During field collection, some environmental parameters were also recorded at each site, including location, altitude; stream width, stream depth, and coverage.

The samples were preserved in 80% ethanol and deposited in the Lab of Zoology, Faculty of Biology - Agricultural Technology, Hanoi Pedagogical University 2.

The aquatic insects were identified to the species level or lowest taxonomic categories, based on published identification keys, e. g. by Dudgeon (1999) [1], Nguyen (2003) [10], Morse *et al.* (1994) [11], Hwang and Bae (2008) [12].

McNaughton's dominance index (DI) and Shannon-Weaver species diversity index (H') were calculated according to Smith and Smith (2001) [13].

Data processing: data were processed through the tables and graphs in Microsoft Office Excel 2007 software from Microsoft Corporation.

2.2. Results and discussion

2.2.1. Environmental conditions in sampling site

In the studied area, 04 sampling sites were located in a forested area (St2, St3, St4, St5) and 01 sampling site was next to roads (St1). The environmental parameters of sampling sites are presented in Table 1.

Table 1. Environmental parameters of the sampling sites in the studied area

Site	Location	Altitude (m)	Width of the stream (m)	Coverage (%)
St1	N: 21^0 23,403’ E: 105^0 15,922’	178	16 - 20	05 - 10
St2	N: 21^0 28,437’ E: 105^0 36,525’	190	2 - 3	70 - 80
St3	N: 21^0 28,522’ E: 105^0 36,236’	215	10 - 14	40 - 60
St4	N: 21^0 28,510’ E: 105^0 36,212’	257	13 - 15	05 - 10
St5	N: 21^0 28,595’ E: 105^0 36,483’	351	10 - 12	70 - 80

2.2.2. Species biodiversity of aquatic insect fauna in the studied area

Based on the analysis of quantitative and qualitative samples, a total number of 91 species belonging to 76 genera, 44 families, and 9 orders of aquatic insect were recorded in the studied areas. The results are shown in Table 2.

Table 2. Number of aquatic insect taxa in the studied area

Orders	Families		Genera		Species	
	Number	***%***	***Number***	***%***	***Number***	***%***
Ephemeroptera	6	13.6%	19	25.0%	32	35.2%
Odonata	10	22.7%	16	21.1%	16	17.6%
Plecoptera	1	2.3%	3	3.9%	3	3.3%
Hemiptera	5	11.4%	6	7.9%	6	6.6%
Coleoptera	5	11.4%	8	10.5%	8	8.8%
Megaloptera	1	2.3%	1	1.3%	1	1.1%
Diptera	4	9.1%	6	7.9%	6	6.6%
Trichoptera	11	25.0%	16	21.1%	18	19.7%
Lepidoptera	1	2.2%	1	1.3%	1	1.1%
Total	**44**	**100%**	**76**	**100%**	**91**	**100%**

Among the found orders in the studied area, Ephemeroptera had the highest species number with 32 species (35.2% of the total species number); followed by Trichoptera with 18 species (19.7%); Odonata with 16 species (17.6%); Coleoptera with 8 species (8.8%); Hemiptera and Diptera with 6 species (6.6%), each; Plecoptera with 3 species (3.3%). Lepidoptera and Megaloptera had the lowest species number with 1 species (1,1%) each. Our finding showed that the number of aquatic insect species recorded in the studied area was smaller than those from other areas in Vietnam, such as Thac Bac

stream (Tam Dao, Vinh Phuc) [5] and Muong Hoa Stream (Sa Pa, Lao Cai) [14]. However, the order Ephemeroptera, Trichoptera, Odonata which usually dominated in stream ecosystem still had the highest species numbers in the studied area. The dominance of the order Ephemeroptera and Trichoptera suggested that the two studied streams are overall in good stream health.

Ephemeroptera (Mayflies): In this study, there are 32 species, 19 genera, and 6 families belonging to the order Ephemeroptera. Among its families found from the studied area, the family Baetidae is the most species-rich family with 11 species, but the identification of scientific names of species is still impossible. Most mayfly nymphs are collectors or scrapers and feed on macrophytes and animal materials. Comparing with Nguyen Van Hieu *et al.* (2017) [7]; the species *Procloeon spinosum, Paegniodes dao, Rhithrogena parva, Teloganodes tristis* and *Eatonigenia* sp. were not found in this study

Odonata (Dragonflies and Damselflies): Odonate nymphs are aggressive predators. Odonata was the third diverse aquatic insect order with 16 species in 10 families recognized from this study. Among these families, the family Gomphidae had the highest species number with 5 species, other families had a relative low species number, from 1 to 2 species.

Plecoptera (Stoneflies): Nymphs of Plecoptera usually require a habitat with specific water temperature. Some species are shredders or predators throughout their nymphal stage. Three species in the family Perlidae were found in the studied area.

Hemiptera (True bugs): Hemiptera have representatives that live either underwater (true aquatic bugs) and on the surface (semi-aquatic bugs). Most species are predators. In this study, a total of 6 hemipteran species of 5 families were recognized. The families had from 1 to 2 species.

Coleoptera (Beetles): The species of Coleoptera are either only larval stage or both larval and adult stages living in aquatic habitats. The feeding habits of aquatic Coleoptera are extremely variable. 8 species belonging to 5 families of Coleoptera were found in the studied area. The families Dytiscidae, Elmididae, and Psephenidae with 2 species each. Two families Helodidae, Ptilodactiliidae had only 1 species each.

Megaloptera (Dobsonflies and fishflies)**:** Megaloptera has only a small number of species. The larvae of Megaloptera are well known for their large size, centipede-like body and highly active, rather ferocious nature. In this study, only one species was found, the species *Corydalus* sp. belonging to Corydalidae.

Diptera (True Flies): Diptera is one of the largest and the most diverse orders of insects. In our survey, 6 species in 4 families belonging to Diptera were collected. This order was found common in all sampling sites, especially Chironomidae, Simulidae and Tipulidae.

Trichoptera (Caddisflies): The larvae of most Caddisflies eat plant materials, some species are mainly predaceous. Trichopteran larvae show a wide range of adaptations to various types of habitats. In this study, larvae of 18 Caddisfly species and 11 families were found. Among which, two families Hydropsychidae and Branchycentridae were the most diverse with 3 species each, the other families had only 1-2 species each.

Lepidoptera (Moths): The larvae of most Lepidoptera eat plant materials. In the studied area, we collected 1 species *Eoophyla* sp. belonging to Pyralidae of Lepidoptera.

2.2.3. Community

The quantitative sampling resulted in a total of 465 individuals. Two major aquatic insect groups were dominated Ephemeroptera with 304 individuals, equivalent to 65.4% of the total of collected individuals in the studied area; followed by Trichoptera with 120 individuals (25.8%); Coleoptera with 14 individuals (3.0%), Odonata with 13 individuals (2.8%), Diptera with 6 individuals (1.3%), Hemiptera with 4 individuals (0.9%), Plecoptera with 2 individuals (0.4%), Lepidoptera and Megaloptera with 1 individual (0.2%) each (Figure 1).

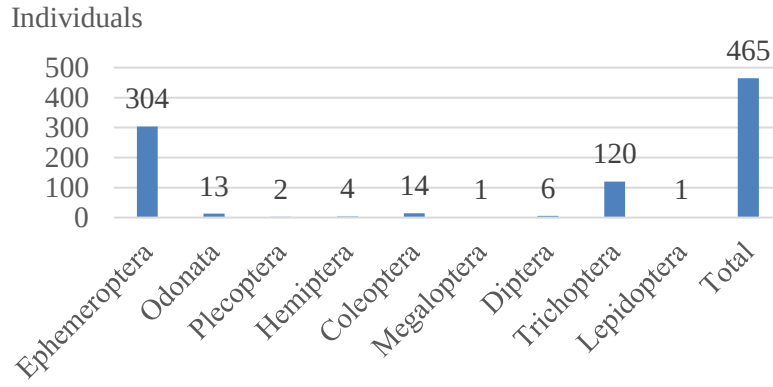

Figure 1. Number of collected individuals of aquatic insect orders in the studied area (per 4 m^2)

Table 3. Average numbers of species and individual and biodiversity indices of aquatic insects per Surber sample (2500 cm^2) in the studied area

Season	Sites	No. of species	No. of individuals	DI	H'
Rainy	St1	19	63	0.49	3.23
	St2	16	38	0.37	3.55
	St3	8	9	0.33	2.95
	St4	7	8	0.38	2.75
	St5	-	-	-	-
Dry	St1	8	19	0.58	2.60
	St2	13	38	0.50	3.04
	St3	17	85	0.49	3.15
	St4	10	44	0.55	2.68
	St5	8	161	0.51	2.61
Mean ± SD (n = 9)		**11.8 ± 4.6**	**51.7 ± 48.0**	**0.5 ± 0,1**	**3.0 ± 0.3**

Explication: SD: Standard deviation; -: don't collect quantitatively.

McNaughton's dominance index (DI) and Shannon-Weiver species diversity index (H') fell within the following ranges [mean ± SD, DI: 0.33 - 0.58 (0.5 ± 0.1); H': 2,60 - 3,55 (3,0 ± 0.3)]. The level of biodiversity of aquatic insects in the studied area was quite good.

Morse *et al.* (1994) classified feeding of aquatic insects into 5 FFGs, such as collector-gatherers, collector-filterers, predators, shredders, and scrapers [[11]]. In order to reconstruct the feeding 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 at the value of 42.3%, followed by shredders with 32.4%, scrapers with 13.0%, collector-filterers with 7.2%, and predators with 5.1% (Figure 2).

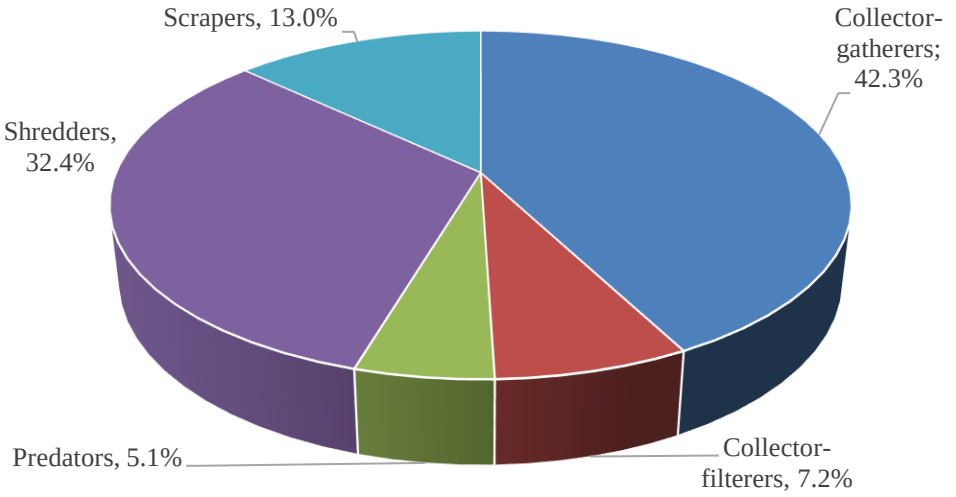

Figure 2. Percentages of species number (%) of functional feeding groups in the studied area

3. Conclusions

This study has obtained a total number of 91 species belonging to 76 genera, 44 families and 9 orders of aquatic insect were recorded in the studied area, including the order Ephemeroptera with 32 species, the order Trichoptera with 18 species, the order Odonata with 16 species, the order Coleoptera with 8 species, the order Hemiptera and Diptera with 6 species, each; the order Plecoptera with 3 species. The order Lepidoptera and the Megaloptera had the lowest species number, represented by 1 species each.

The quantitative sampling resulted in a total of 465 individuals of aquatic insects: Ephemeroptera with 304 individuals, Trichoptera with 120 individuals; Coleoptera with 14 individuals, Odonata with 13 individuals, Diptera with 6 individuals, Hemiptera with 4 individuals, Plecoptera with 2 individuals, Lepidoptera and Megaloptera with 1 individual each.

The McNaughton's dominance index (DI) with 0.5 ± 0.1 and the Shannon-Weaver species diversity index (H') with 3.0 ± 0.3. The level of biodiversity of aquatic insects in the studied area was quite good.

The FFGs: the collector-gatherers dominated with 42.3% of the total number of individuals, followed by shredders with 32.4%, scrapers with 13.0%, collector-filterers with 7.2%, and finally predators with 5.1%.

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