VNU Journal of Science: Natural Sciences and Technology, Vol. 33, No. 4 (2017) 35-42

Preliminary Results on Aquatic Insects in the Me Linh Station for Biodiversity, Vinh Phuc Province

Nguyen Van Hieu[1,*], Nguyen Van Vinh[2]

[1]*Faculty of Biology - Agricultural Technology, Hanoi Pedagogical University 2, 32 Nguyen Van Linh, Vinh Phuc, Vietnam*

[2]*Faculty of Biology, VNU University of Science, 334 Nguyen Trai, Hanoi, Vietnam*

Received 13 October 2017
Revised 22 October 2017; Accepted 30 October 2017

Abstract: An intensive field survey on aquatic insects of Me Linh Station for Biodiversity in Vinh Phuc province was conducted in December 2015. Specimens were collected at 8 different sites and aquatic insects were collected both quantitatively by Surber net and qualitatively by hand net, pond net. As a result, a total of 110 aquatic insect species belonging to 98 genera, 49 families and 9 orders were recognized. Among these, the order Ephemeroptera had the highest species number with 26 species, followed by Odonata with 25 species, Trichoptera with 18 species, Coleoptera with 15 species, Hemiptera with 11 species, Diptera with 9 species. Lepidoptera, Plecoptera and Megaloptera had the lowest of species number, represented by 3 species of Lepidoptera, 2 species of Plecoptera and 1 species of Megaloptera. Besides, the quantitative analysis results and the functional feeding groups were provided.

Keywords: Aquatic insects, Me Linh Station for Biodiversity, qualitative, quantitative analysis, Vinh Phuc province.

1. Introduction

Me Linh Station for Biodiversity was established in August, 1999 with area of 175ha and belonging to buffer zone of the Tam Dao National Park, Vinh Phuc province. Me Linh Station for Biodiversity has quite rich and diverse stream systems, these are favorable conditions for the survival and growth of aquatic organisms, especially the aquatic insects.

In general, Me Linh Station for Biodiversity has diverse flora and fauna. However, only certain groups of plants and animals have been investigated in this area, e.g. vascular plants and mammals. The fauna of aquatic insects has not been sufficiently studied.

Based on the analysis of the samples was collected in Me Linh Station for Biodiversity, the present paper provides preliminary data of aquatic insects in the studied area.

2. Materials and methods

Materials: the species belonging to aquatic insects was collected at 8 sampling sites in

*Corresponding author. Tel.: 84-987508243.
Email: nguyenvanhieusp2@gmail.com
https://doi.org/10.25073/2588-1140/vnunst.4696

December 2015 in Me Linh Station for Biodiversity, Vinh Phuc province.

Methods: The samples were collected according to methods illustrated by Edmunds (1982) [1], McCafferty (1983) [2], Nguyen 2003 [3]. The qualitative samples of aquatic insects were collected by using pond net and hand net, while quantitative samples were taken by using Surber net (sized 50cm x 50cm, mesh size 0.2mm), two surber samples were obtained at riffle and pool habitats. During field collection, some environmental parameters were also recorded, including stream width and depth, coverage, DO (dissolved oxygen), pH, conductivity, temperature of water (portable water checker: WQC-24, TOA, Japan).

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 Nguyen (2003) [3], Cao (2002) [4], Chen *et al.* (2005) [5], Dudgeon (1999) [6], Hoang (2005) [7], Morse *et al.* (1996) [8].

McNaughton's dominance index (DI), Margalef's richness index (d) and Shannon-Weiver species diversity index (H') were calculated according to Smith and Smith (2001) [9]. Functional feeding groups (FFGs) were classified mainly according to Morse *et al.* (1994) [8].

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

3. Results

3.1. Environmental conditions in sampling site

Most of sampling site were located in forested area and a few next to the roads. The environmental parameters of sampling sites such as DO (Dissolved oxygen), pH, conductivity, water temperature and other conditions are presented in Table 1.

Table 1. Environmental parameters of the sampling sites in Me Linh Station for Biodiversity

Site	Location	Altitude	Wid	Dep	Cov	DO	pH	Con	Tem
S1	N: 21^0 23,657' E: 105^0 42,871'	110	3-4	10-20	50-60	8.58	6.98	87	20.3
S2	N: 21^0 23,601' E: 105^0 42,871'	90	3-5	15-30	85-95	8.89	6.71	86	20.5
S3	N: 21^0 23,471' E: 105^0 42,785'	87	2-3	10-20	80-90	7.93	7.23	87	20.6
S4	N: 21^0 23,438' E: 105^0 42,778'	85	2-4	10-30	35-55	8.33	6.80	84	20.4
S5	N: 21^0 23,377' E: 105^0 42,767'	83	1-1.5	5-10	0-5	9.46	6.77	89	20.7
S6	N: 21^0 23,318' E: 105^0 42,756'	82	2-4	10-15	30-50	8.68	6.79	85	20.5
S7	N: 21^0 23,242' E: 105^0 42,772'	77	2-3	15-20	0-5	9.78	6.94	93	20.4
S8	N: 21^0 23,176' E: 105^0 42,755'	59	2-3	10-12	5-10	8.95	6.81	77	20.1

Explication: Loc - Location, Alt - Altitude (m), Wid - Width of stream (m), Dep - Depth of stream (cm), Cov - Coverage (%), Con - Conductivity (µS/cm), Tem - Temperature of water (^{0}C).

3.2. Aquatic insect fauna

On the basis of analysis of quantitative and quanlitative sampls, a total number of 110 species belonging to 98 genera, 49 families and 9 orders of aquatic insect was recorded in Me Linh Station for Biodiversity. The result is shown in Table 2.

Table 2. Number of aquatic insect taxa in Me Linh Station for Biodiversity

Orders	Families		Genera		Species	
	Number	%	Number	%	Number	%
Ephemeroptera	9	18.5	18	18.5	26	23.7
Odonata	8	16.4	25	25.5	25	22.7
Plecoptera	2	4.1	2	2.0	2	1.8
Hemiptera	5	10.2	11	11.2	11	10.0
Coleoptera	6	12.2	14	14.3	15	13.6
Megaloptera	1	2.0	1	1.0	1	0.9
Diptera	6	12.2	7	7.1	9	8.2
Lepidoptera	1	2.0	2	2.0	3	2.7
Trichoptera	11	22.4	18	18.4	18	16.4
Total	49	100	98	100	110	100

Among the found orders in the studied area, Ephemeroptera had the hightest species number with 26 species (23.7% of the total species number), followed by Odonata with 25 species (22.7%), Trichoptera with 18 species (16.4%), Coleoptera with 15 species (13.6%), Hemiptera with 11 species (10.0%), Diptera with 9 species (8.2%). Lepidoptera, Plecoptera and Megaloptera had the lowest of species number (3 species (2.7%), 2 species (1.8%) and 1 species (0.9%) respectively). Compared with the aquatic insect fauna of Tam Dao National Park (Nguyen *et al.*, 2001) [10], Hoang Lien National Park (Jung *et al.*, 2008) [11], Ba Vi National Park (Nguyen *et al.*, 2012) [12], the number of aquatic insect species in Me Linh Station for Biodiversity was lower. However, the order Ephemeroptera, Odonata, Trichoptera, Coleoptera and Hemiptera which usually domminated in stream ecosystem still had the highest species numbers in the studied area.

Ephemeroptera (Mayflies): Ephemeroptera is one of the most species-rich and abundant aquatic insect groups. Most mayfly nymphs are collector or scrapers and feed on a macrophytes and animal materials. In the studied area, this order had 26 species, 18 genera and 9 families. Among its families found from the studied area, the family Baetidae is the most species rich family with 10 species, but the identification to scientific names of species is still impossible. Three families, Polymitarcyidae, Teloganellidae and Teloganodidae were represented only one species each, corresponding *Polyplocia orientalis, Teloganella umbrata* and *Teloganodes tristis*. Comparing with Nguyen *et al.* (2001) [10], Nguyen (2004) [13]; in this study, three species such as *Polyplocia orientalis* (Polymitarcyidae), *Teloganella umbrata* (Teloganellidae), and *Teloganodes tristis* (Teloganodidae) were new records for Tam Dao National Park, Vinhphuc province.

Odonata (Dragonflies and Damselflies): Odonata is mainly distributed in tropical and subtropical. Odonate nymphs are aggressive predators. Odonata was the second diverse aquatic insect order with 25 species in 8

families recognized from this study. Among these families, the family Gomphidae had the highest species number with 7 species, followed by Libellulidae with 6 species, while other families had relative low species number.

Plecoptera (Stoneflies): Nymphs of Plecoptera usually require habitat with specific water temperature. Some species are shredders or predators throughout their nymphal stage. Two species in two families were found in the studied area. The family Perlidae had one species (*Togoperla noncoloris*), this species was more commonly found, occurring in all most sampling sites. The family Leuctridae had one species (*Rhopalopsole* sp.) with 2 individuals found only at site S2.

Hemiptera (True bugs): Hemiptera have representatives that live either both underwater (true aquatic bugs) and on the surface (semi-aquatic bugs). Most species are predators. In the studied area, a total of 11 hemipteran species of 5 families were recognized. Among them, two families: Gerridae and Naucoridae were the most rich with 4 species each, the other families had only one species each.

Coleoptera (Beetles): The species of Coleoptera is either only larval stage or both larval and adult stages living in aquatic habitats. Feeding habits of aquatic Coleoptera are extremely variable. 15 species belonging to 6 families of Coleoptera were found in the studied area. Family Elmididae was the most species-rich taxon of Coleoptera in Me Linh Station for Biodiversity with 7 species. Among these, larvae of Psephenidae were found at riffles.

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

Diptera (True flies): Diptera is one of the largest and the most diverse orders of the insects. In our survey, 9 species in 6 families belonging to Diptera were collected. This order was found common in all sampling sites, especially Chironomidae, Simulidae and Tipulidae.

Lepidoptera (Moths): Larvae of most Lepidoptera eat plant materials. In the studied area, we collected 3 species (*Parapoynx* sp., *Eoophyla* sp.1, *Eoophyla* sp. 2) belonging to Pyralidae of Lepidoptera.

Trichoptera (Caddisflies): Trichopteran larvae show a wide range of adaptations to various types of habitats. Larvae of most Caddisflies eat plant materials, some species are mainly predaceous. In Me Linh Station for Biodiversity, larvae of 18 Caddisfly species were found. Among which, two families Hydropsychidae and Leptoceridae were the most diverse with 4 species each, the other families had only 1-2 species each.

3.3. Community

The quantitative sampling resulted in a total of 1056 individuals. Three major aquatic insect groups were dominated Ephemeroptera with 405 individuals, equivalent to 38.4% of the total of collected individuals in the studied area; Diptera with 216 individuals (20.5%) and Trichoptera with 220 individuals (20.8%), followed by Odonata with 89 individuals (8.4%), Coleoptera with 53 individuals (5.0%), Hemiptera with 49 individuals (4.6%), Plecoptera with 13 individuals (1.2%), Lepidoptera with 6 individuals (0.6%) and Megaloptera with 5 individuals (0.5%) (Fig. 1).

In the riffle habitats, the average numbers of species (17.3 ± 4.9 species per 2500cm^2) and of individuals (129.9 ± 71.2 individuals per 2500cm^2) were higher than those in pool habitats (11.1 ± 4.7 species per 2500cm^2) and (67.6 ± 36.8 individuals per 2500cm^2). The number of species and individuals at each sampling site were significantly different (α = 0.05 respectively) between the habitat types (Table 3).

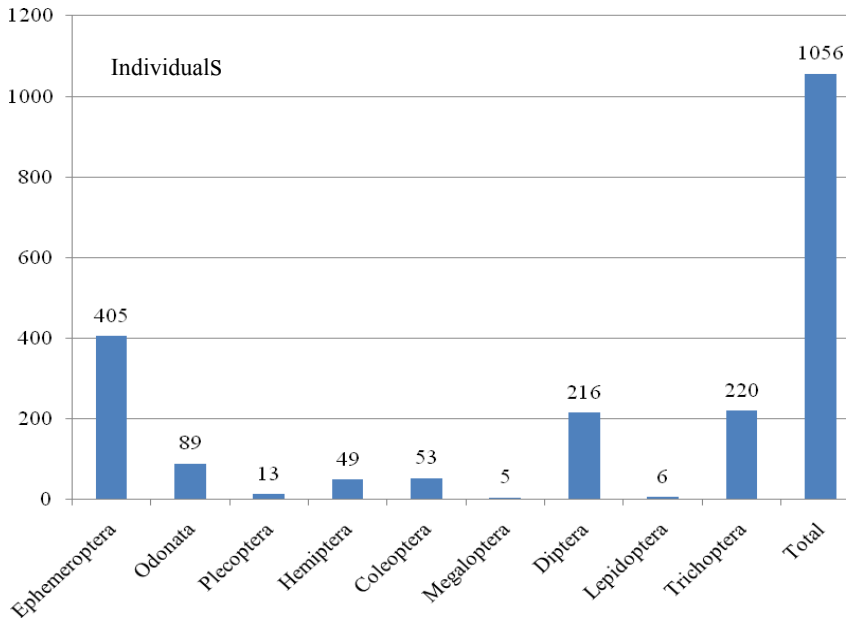

Fig. 1. Number of collected individuals of aquatic insect orders in the studied area.

Table 3. Comparison of species and individual numbers of aquatic insects per surber sample (2500cm^2) between the riffle and pool habitats in the studied area

Sites	No. of species		No. of individuals	
	Riffle	Pool	Riffle	Pool
S1	22	9	73	53
S2	18	15	64	61
S3	19	14	141	83
S4	21	17	153	83
S5	16	12	273	40
S6	9	2	108	146
S7	22	12	60	36
S8	11	8	167	39
Mean ± SD	17.3 ± 4.9	11.1 ± 4.7	129.9 ± 71.2	67.6 ± 36.8
α (n = 8)	0.05		0.05	

Explication: SD: Standard deviation

McNaughton's dominance index (DI), Margalef's richness index (d) and Shannon-Weiver species diversity index (H') fell within the following ranges [mean ± SD: 0.32-0.85 (0.40 ± 0.11); 5.32-12.64 (9.09 ± 2.13) and 2.90-3.56 (3.32 ± 0.25)] respectively (Table 4).

Table 4. Average numbers of species and individual and biodiversity indice of aquatic insects per surber sample (2500cm^2) in Me Linh Station for Biodiversity

Sites	No. of species	No. of individuals	DI	d	H'
S1	26	430	0.85	9.49	2.9
S2	25	270	0.45	9.87	3.31
S3	25	224	0.51	10.21	3.34
S4	31	236	0.55	12.64	3.21
S5	22	313	0.37	8.41	3.5
S6	10	254	0.95	7.53	3.01
S7	14	278	0.47	5.32	2.96
S8	20	115	0.32	9.22	3.56
Mean ± SD	21.6 ± 6.8	265.0 ± 88.5	0.40 ± 0.11	9.09 ± 2.13	3.22 ± 0.25

Morse *et al.* (1994) classified feeding of aquatic insects into 5 FFGs, such as collector-gatheres, collector-filterers, predators, shredders and scrapers [8]. In order to reconstructing the feeding structure of the aquatic insect communities in Me Linh Station for Biodiversity, the data obtained from quantitative sampling were analyzed. The results showed that the collector-gatheres represented the largest portion at the value of 43.9%, followed by shredders with 30.4%, scrapers with 12.6%, collector-filterers with 6.9% and predators with 6.2% (Fig. 2).

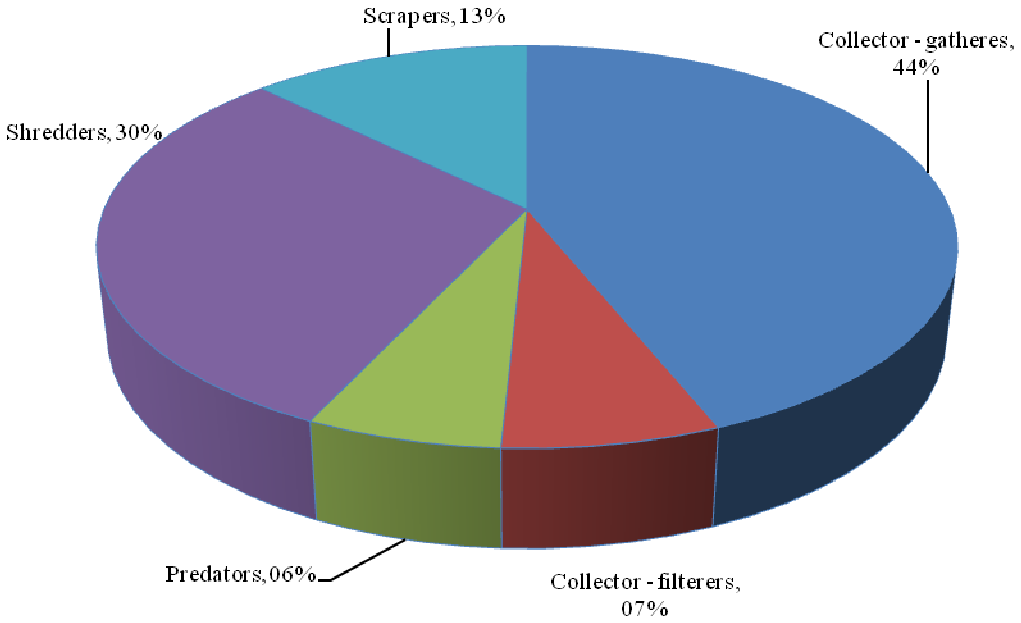

Fig. 2. Percentages of species number (%) of functional feeding groups in the studied area.

4. Conclusion

This study has obtained a total number of 110 species belonging to 98 genera, 49 families and 9 orders of aquatic insect in Me Linh Station for Biodiversity, including 26 species of Ephemeroptera, 25 species of Odonata, 18 species of Trichoptera, 15 species of Coleoptera, 11 species of Hemiptera, 9 species of Diptera, 3 species of Lepidoptera, 2 species of Plecoptera and 1 species of Megaloptera.

The quantitative sampling resulted in a total 1056 indiciduals of aquatic insects: Ephemeroptera had the most individual number with 405 individuals, Diptera with 216 individuals, and Trichoptera with 220 individuals, followed by Odonata with 89 individuals, Coleoptera with 53 individuals, Hemiptera with 49 individuals, Plecoptera with 13 individuals, Lepidoptera with 6 individuals and Megaloptera with 5 individuals.

The riffle habitats generally yielded larger species and individual numbers (numeber of species 17.3 ± 4.9 per 2500cm^2, individual number 129.9 ± 71.2 per 2500cm^2) than in pool habitats (numeber of species 11.1 ± 4.7 per 2500cm^2, individual number 67.6 ± 36.8 per 2500cm^2). McNaughton's dominance index (DI) with 0.40 ± 0.11, Margalef's richness index (d) with 9.09 ± 2.13 and Shannon-Weiver species diversity index (H') with 3.32 ± 0.25.

The FFGs: the collector-gatheres dominanted with 43.9% of total number of individual, followed by shredders with 30.4%, scrapers with 12.6%, collector-filterers with 6.9% and finally predators with 6.2%.

Acknowledgements

This study was financially supported by Foundation of Science activities and Technology of Hanoi Pedagogical University 2, code: C.2015.17. We thank the staff of Me Linh Station for Biodiversity for providing help during our fieldtrip.

References

[1] G. F. Edmunds, Ephemeroptera, Synopsis and Classification of Living Organisms, McGraw - Hill, New York (1982) 330.

[2] W. P. McCafferty, Aquatic Entomology, Jones and Bartteth publishers, Boston - London, 1983.

[3] V. V. Nguyen, 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.

[4] T. K. T. Cao, Systematics of the Plecoptera (Insecta) in Vietnam, Thesis for the Master's degree, Department of Biology, The Graduate School of Seoul Women's University, Korea, 2002.

[5] 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, 2008.

[6] D. Dudgeon, Tropical Asian Streams - Zoobenthos, Ecology and Conservation, Hong Kong University Press, Hong Kong, 1999.

[7] D. H. Hoang, Systematics of the Trichoptera of Vietnam, Ph.D Thesis. Seoul Women's University, Korea, 2005.

[8] J. C. Morse, L. Yang and L. Tian, Aquatic Insects of the China useful for monitoring water quantily, Hobai University Press, Nanjing, China, 1994.

[9] R. L. Smith and T. M. Smith, Ecology and field biology, 6th edn, Benjamin Cumming, San Fransisco, 2001.

[10] V. V. Nguyen, D. H. Hoang, T. K. T. Cao, X. Q. Nguyen and Y. J. Bae, Altitudinal distribution of aquatic insects from Thac Bac creek Tam Dao, Korean Soc. Aquatic Entomol., Korea 1 (2001) 123.

[11] 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 (2008) 219.

[12] V. V. Nguyen, T. A. N. Nguyen, A. D. Tran, X. Q. Nguyen, The diversity of aquatic insects in Ba Vi national park, Hanoi, VNU Journal of Science: Natural Sciences and Technology 28(2) (2012) 55.

[13] V. V. Nguyen, Data of Ephemeroptera from Thac Bac creek of Tam Dao National Park, Vinh Phuc province, VNU Journal of Science: Natural Sciences and Technology 20(2) (2004) 55, (in Vietnamese).

Kết quả nghiên cứu bước đầu về côn trùng nước ở Trạm đa dạng sinh học Mê Linh, tỉnh Vĩnh Phúc

Nguyễn Văn Hiếu[1], Nguyễn Văn Vịnh[2]

[1]*Khoa Sinh - Kỹ thuật nông nghiệp, Trường Đại học Sư phạm Hà Nội 2, 32 Nguyễn Văn Linh, Vĩnh Phúc, Việt Nam*

[2]*Khoa Sinh học, Trường Đại học Khoa học Tự nhiên, ĐHQGHN, 334 Nguyễn Trãi, Hà Nội, Việt Nam*

Tóm tắt: Kết quả điều tra côn trùng nước thu được tại 8 điểm nghiên cứu khác nhau bằng lưới Surber với mẫu định lượng và vợt tay, vợt ao với mẫu định tính ở Trạm Đa dạng sinh học Mê Linh thuộc tỉnh Vĩnh Phúc trong đợt thu mẫu tháng 12/2015 đã xác định được 110 loài thuộc 98 giống và 49 họ của 9 bộ côn trùng nước. Trong đó bộ Phù du có số lượng loài lớn nhất với 26 loài, tiếp theo là bộ Chuồn chuồn với 25 loài, bộ Cánh lông có 18 loài, bộ Cánh cứng có 15 loài, bộ Cánh nửa có 11 loài, bộ Hai cánh có 9 loài. Ba bộ Cánh vảy, Cánh úp và Cánh rộng có số lượng loài ít nhất, tương ứng là 3 loài với bộ Cánh vảy, 2 loài với bộ Cánh úp và 1 loài với bộ Cánh rộng. 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, Trạm Đa dạng sinh học Mê Linh, phân tích định tính, phân tích định lượng, Vĩnh Phúc.