Y. J. Bae (Ed.). 2001. The 21st Century and Aquatic Entomology in East Asia. Proc. 1st Symp. AESEA. Korean Soc. Aquatic Entomol., Korea. pp. 123-133.

Altitudinal Distribution of Aquatic Insects from Tam Dao National Park in Northern Vietnam

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Abstract. Altitudinal distribution of aquatic insects was investigated from the Thac Bac Creek of Tam Dao National Park in northern Vietnam. Nine sites (St. A-I) from upper to lower reaches of the stream were sampled in 1998, 2000, and 2001. As results, a total of 145 species (Ephemeroptera 39 spp., Odonata 26 spp., Plecoptera 12 spp., Hemiptera 12 spp., Megaloptera 2 spp., Trichoptera 23 spp., Lepidoptera 2 spp., Coleoptera 17 spp., and Diptera 12 spp.) occurred with highest species richness in the mid-stream reaches (St. E-G: 750-450 m in altitude). Ephemeroptera and Diptera (Chironomidae) were the most abundant aquatic insect groups. More discussions on the altitudinal distributions of major aquatic insect taxa are provided.
Key words. Aquatic insects, Fauna, Altitudinal distribution, Stream, Vietnam

Introduction

Tam Dao National Park is located in northern Vietnam, about 90 km Northwest from Hanoi (21°21'-21°42' N, 105°23'-105°24' E) (Fig.1). The area was designated as a protected forest reserve in 1977 and later it was raised to the status of national park in 1996 (Cao, 1998). The national park comprises the Tam Dao Mountain (1592 m) and its surrounding buffer zone areas stretching to Thai Nguyen, Vinh Phuc, and Tuyen Quang provinces. It is endowed with moderate climate all the year round with average annual temperature between 21-23 °C; and it is one of the largest precipitation centers in northern Vietnam amouting to 2630 mm per year. Tam Dao National Park contains highly valuable biological resources of the tropical rain forest where many endemic and rare species are inhabited. This high level of biodiversity could be partly attributed to the location of the Tam Dao Mountains: an ecological frontier zone between the tropical forest of southern China and the alpine forest of eastern Himalaya.

Dispite this faunistic and ecological importances of this area, aquatic insect faunas of this area have been virtually unknown and only limited aquatic insect taxa have been reported in scattered literatures (e.g., Braasch and Soldán, 1984a, 1984b, 1986, 1988; Malicky, 1995; Stark and Sivec, 1999). We herein present altitudinal distributions of aquatic insects from the Thac Bac Creek of Tam Dao National Park based on field investigations in 1998, 2000, and 2001. This is the first comprehensive faunistic study of aquatic insects from Vietnam and may provide basic data for further taxonomic and ecological studies of aquatic insects in tropical Southeast Asia.

Matrials and Methods

Aquatic insect materials used for this study were collected during the field investigations of October 10-11 in 1998, October 14-16 in 2000, and February 14-15 in 2001 from Tom Dao National Park. Aquatic insects were qualitatively collected by hand nets but same sampling techniques in terms of collectors (experienced), time duration (ca. 30 minutes per site), and

microhabitats (typical riffle, run, and pool areas and other particular microhabitats such as stream margins, macrophytes, waterfalls, etc.) were used to judge the relative abundance of each aquatic insect species between the study sites. Aquatic insects were determined up to the lowest taxonomic level using various reference sources (Kawai, 1985; Morse *et al.*, 1994; Yoon, 1995; Merritt and Cummins, 1996; Nguyen *et al.*, 2000) and additional available taxonomic literatures dealt with Vietnamese or Southeast Asian aquatic insects. Materials were preserved in 80% ethanol and deposited in Seoul Women's University Aquatic Insects Collection (SWU-AIC).

Study Sites

Nine sampling sites (Fig. 1) were chosen as follows in consideration of altitude and stream size. (Sites A, B, and I were investigated only in 1998.)

Site A (1000 m): width 1-3 m, depth 5 cm; boulder (60%), cobble (20%), pebble (15%), gravel and sand (5%); steep headwater stream, completely canopied.

Site B (900 m): width 8-10 m, depth 15 cm; boulder (10%), cobble (40%), pebble (40%), gravel and sand (10%); below small village, water somewhat polluted with organic matter.

Site C (880 m): width 6-10 m, depth 20-30 m; boulder (60%), cobble (20%), pebble (10%), gravel and sand (10%), fallen leaves present; 60% canopied, preserved.

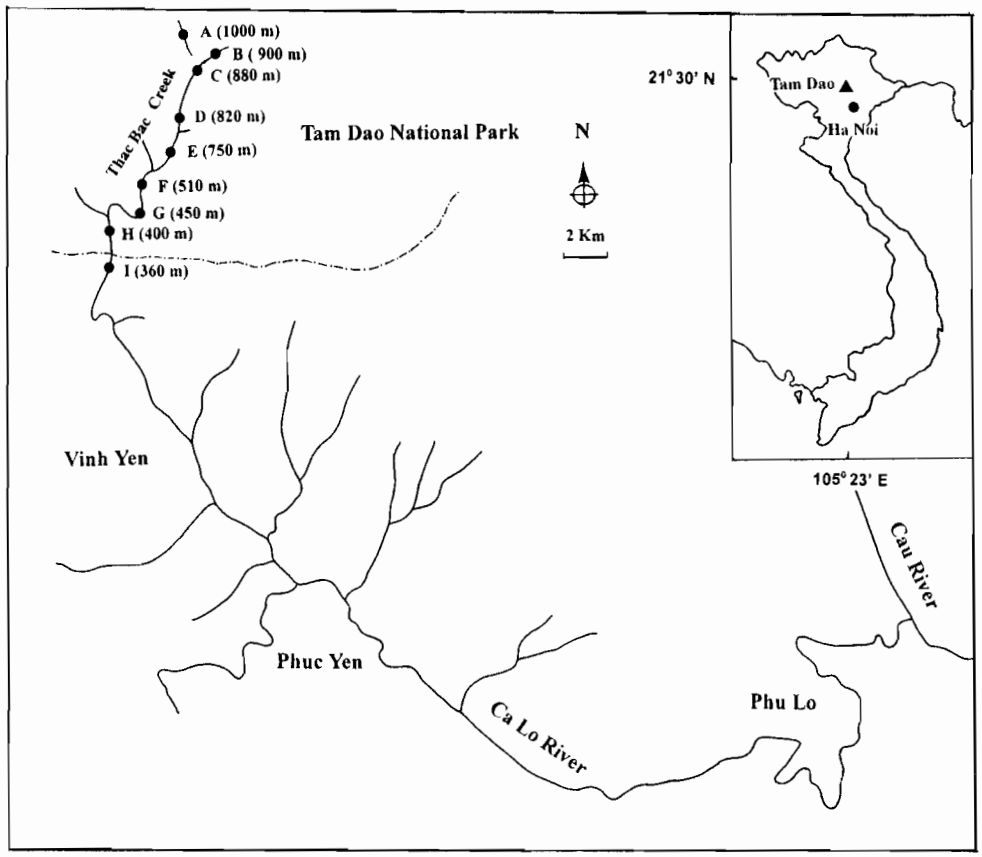

Fig. 1. Study sites from the Thac Bac Creek of Tam Dao National Park in northern Vietnam.

Site D (820 m): width 8-9 m, depth 30-50 cm; boulder (55%), cobble (25%), pebble (10%), gravel and sand (10%), fallen leaves abundant; completely canopied, preserved.
Site E (750 m): width 8-10 m, depth 20-50 cm; boulder (40%), cobble (30%), pebble (15%), gravel and coarse sand (15%), fallen leaves abundant; 80% canopied, preserved.
Site F (510 m): width 7-10 m, depth 20-50 cm; boulder (40%), cobble (25%), pebble (20%), gravel and coarse sand (15%), green-colored algae present, fallen leaves abundant; 90% canopied, preserved.
Site G (450 m): with 8-9 m, depth 25-30 cm; boulder (25%), cobble (30%), pebble (30%), gravel and coarse sand (15%), green-colored algae and fallen leaves present; 30% canopied.
Site H (400 m): width 8-10 m, depth 25-30 cm; boulder (25%), cobble (40%), pebble (20%), gravel and coarse sand (15%), gereen-colored algae present; 0% canopied, beside traffic road.
Site I (360 m): width 8-10 m, depth 15-20 cm; bolder (40%), fine gravel (10%), very coarse sand (10%), coarse sand (40%); 0% canopied.

Results and Discussion

Altitudinal Distribution

Total number of aquatic insect species occurred from each site of the study area is showed in Fig. 2 and their detailed altitudinal distributions are listed in Appendix 1. In the whole study area, 145 species of aquatic insects in 63 families and nine orders occurred. In most cases, species identifications are not available.

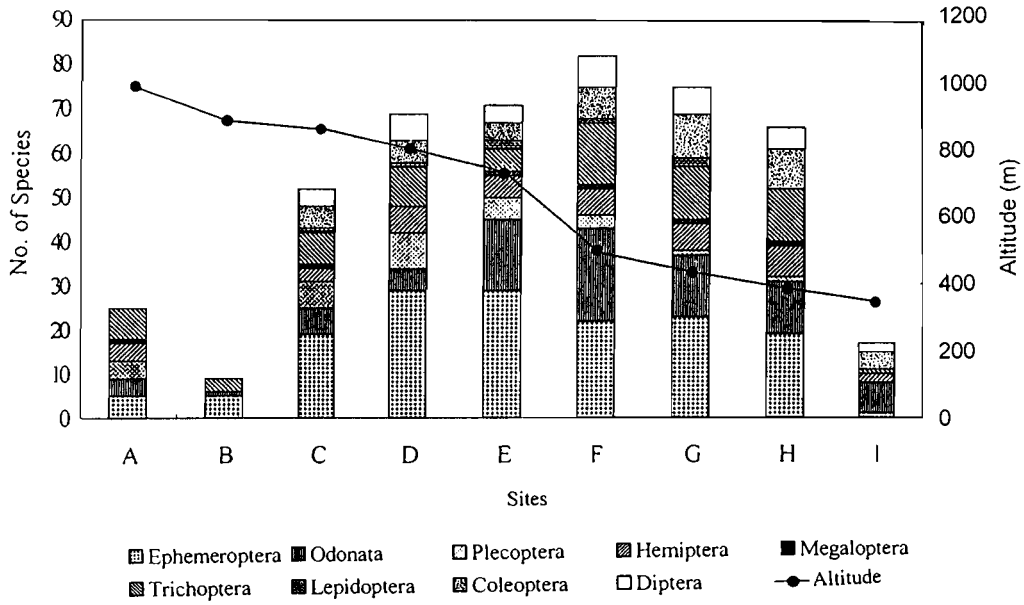

Fig. 2. Species number and ordinal composition of aquatic insects from the study sites.

In general, aquatic insects from the study area were more diverse in the mid-stream reaches with a peak in the species abundance (82 spp.) at St. F (510 m). Ephemeroptera (39 spp.) was the most abundant aquatic insect order followed by Odonata (26 spp.), Trichoptera (23 spp.), Coleoptera (17 spp.), Plecoptera (12 spp.), Hemiptera (12 spp.), Diptera (12 spp.), Megaloptera (2 spp.), and Lepidoptera (2 spp.). Comparing with aquatic insect faunas in typical temperate streams in Northeast Asia (e.g., Bae *et al.*, 1998), Odonata, Coleoptera, and Hemiptera are relatively more diverse in the study stream.

Ephemeroptera

Thirty-nine species of Ephemeroptera in seven families occurred from the whole study area. Species compositions of aquatic insects were somewhat different among the sites, but Ephemeroptera was the major aquatic insect group throughout the stream reaches except for the lowest site (St. I). The families Baetidae, Heptegeniidae, and Leptophlebidae were relatively abundant. Some baetid and heptageniid species such as *Baetis* sp. 2 and *Thalerosphyrus vietnamensis* were relatively abundant throughout the stream reaches. Caenids and *Vietnamella thani* occurred mainly in the lower stream reaches. Isonychiid species were relatively rare.

Odonata

Odonata became the second diverse aquatic insect order as 26 species in 12 families occurred from the whole study area. As mentioned above, this is different from the typical distribution pattern in temperate Northeast Asian streams. Majority number of Odonata species of this stream occurred in the stream reaches of lower than 820 m in altitude with a peak in species abundance at St. F (510 m). The family Gomphidae was relatively abundant, while other families contained relatively small number of species.

Plecoptera

Twelve species of Plecoptera in three families occurred from the whole study area. As usual, most Plecoptera species occurred from the upper reaches of the stream. *Amphinemura* sp. showed a relatively wider altitudinal distribution, while other species were limited in centain distributional ranges.

Hemiptera

Twelve species of Hemiptera in eight families occurred from the whole study area. Gerrids such as *Rhyacobates* sp. and *Neogerris* sp. occurred in a wider range in altitudunal distribution, whereas others were limited in certain habitats.

Megaloptera

Two species of Megaloptera in the family Corydalidae occurred from the study stream. The first species, *Protohermes* sp.1, occurred in the upper stream reaches (St. A and C: 1000-880 m), whereas the second species, *Protohermes* sp. 2, occurred in the mid-stream reaches (St. E-H: 750-400 m).

Trichoptera

Twenty-three species of Trichoptera in 16 families occurred from the whole study area. In general, most Trichoptera species were found from mid to lower stream reaches (St. C-H: 880-

Table 1. First and second dominant species of aquatic insects from the study sites

Sites	1st dominant species	2nd dominant species
C (880 m)	*Thalerosphyrus vietnamensis*	*Habrophlebia promines*
D (820 m)	*Thalerosphyrus vietnamensis*	*Choroterpes trifurcata*
E (750 m)	*Ephemera* sp. 1	*Choroterpes trifurcata*
F (510 m)	*Baetis* sp. 2	*Vietnamella thani*
G (450 m)	Chironominae sp. 3	*Vietnamella thani*
H (400 m)	Chironominae sp. 4	Chironominae sp. 3

400 m). The net-spinning hydropsychids, *Ceratopsychy* sp., *Cheumatopsyche* sp., and *Hydropsyche* sp., occurred in the uppermost stream reaches around village.

Lepidoptera

Two species of Lepidoptera in the family Pyralidae occurred from the study stream, both of which were distributed in the mid-stream reaches (St. C-G: 880- 450 m).

Coleoptera

Seventeen species of Coleoptera in nine families occurred from the whole study area. They were the most abundant in the mid-stream reaches (St. F-H: 510-400 m). The psephenids showed a wide range in altitudinal distribution, but they were more abundant in the mid-stream reaches. The dytiscids, girinids, and scirtids were found in the mid to lower stream reaches (St. F-I: 510-360 m).

Diptera

Twelve species of Diptera in six families occurred from the whole study area. They were more abundant in the lower stream reaches below St. F (510 m). Chironomids were the most abundant throughout the stream reaches.

Dominant Species

Dominant aquatic insect species from the six sites of the Thac Bac Creek are listed in Table 2. In general, the Ephemeroptera and Chironomidae were the first and second dominant species throughout the sites. In the upper stream reaches, Ephemeroptera species, in particular *Thalerosphyrus vietnamensis*, were domonant, while chironomids were dominant in the lower stream reaches.

Acknowledgements. We thank Mr. N.T. Nguyen, Director of Tam Dao National Park, for his kind permission in the field investigations in Tom Dao National Park. This study was supported by the Korea Science and Engineering Foundation (R01-2001-000-00086-0) and VVN, DHH, and TKTC were supported by the BK 21 Fellowships.

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Appendix 1. List of aquatic insects and their relative abundance from the Thac Bac Creek of Tam Dao National Park in Northern Vietnam. [o: present, +++: >10 inds/sample, ++: 5-10 inds/sample, +: <5 inds/sample]

Species	Site A 1000m	Site B 900 m	Site C 880 m	Site D 820 m	Site E 750 m	Site F 510 m	Site G 450 m	Site H 400 m	Site I 360 m
Ephemeroptera									
Baetidae									
Acentrella sp.			+		+	+	++	++	
Baetis sp. 1	o			+					
Baetis sp. 2		o	+++	++	+	+++	++	++	
Baetis sp. 3					+	+	+		
Baetis sp. 4		o	+++	++	+	+	+	+	o
Baetiella sp.			++	+	+		++	++	
Centroptilum sp.		o	++	+	+		+	++	
Latiobaetis sp.			++	+	++	++	++	+	
Nigrobaetis sp.			++		++	++	++	+	
Platybaetis sp.			++	+		+	+	+	
Procloeon sp.			+++	++	++	+++	++		
Pseudocloeon sp.	o	o	+	+	+	+			
Caenidae									
Caenis sp. 1			+					+	
Caenis sp. 2							+	+	
Ephemerellidae									
Ephemerella sp.			+		+				
Serratella sp. 1			++	+			++	+	
Serratella sp. 2					+		+		
Vietnamella thani						+++	+++	++	
Ephemeridae									
Ephemera sp.			++	++	+++	+			
Heptageniidae									
Asionurus primus	o			++	+++		+		
Cinygma sp.				+	+	+			
Cinygmina cervina				+	++	+	+	+	
C. landai				+	+++	++			
Cinygmina sp.	o			+	+	+			
Ecdyonurus sp.			+	+	+	+		+	
Epeorus tiberius		o	+	+	+	+	+		
Iron martinus			++						
Iron sp.				+		+			
Thalerosphyrus vietnamensis	o		+++	+++	++	++	++	+	
Th. sinuosus				+	+		+		
Th. torridus							+	+	
Thalerosphyrus sp.				+	+				
Trichogenia maxillaries				+	+		+		
Isonychiidae									
Isonychia sp. 1						+			

(Appendix 1, continued)

Species	Site A 1000m	Site B 900 m	Site C 880 m	Site D 820 m	Site E 750 m	Site F 510 m	Site G 450 m	Site H 400 m	Site I 360 m
Isonychia sp. 2				+	+				
Leptophlebiidae									
Choroterpes trifurcata				+++	+++	++	++	+	
Choroterpes sp.				+	+	+			
Habrophlebiodes prominens			+++	+++	+	+	+	+	
Isca janiceae				+	+				
Odonata									
Amphipterygidae									
Philoganga sp.						+	+	+	o
Calopterygidae									
Calopteryx sp.				+	+	++			
Mnais sp.					+	+	+	+	
Coenagrionidae									
Agriocnemis sp.					+	+	++	++	o
Cercion sp.				+	+	++			
Euphaeidae									
Anisopleura sp.					+	+	+	++	o
Bayadera sp.		o	+	++	+++		+		
Lestidae									
Indolestes sp.					+	+			
Platycnemididae									
Platycnemis sp.						+	+	+	o
Protoneuridae									
Prodasineura sp.						+	++	++	
Aeshnidae									
Aeschnoplebia sp.	o		+		+	+	+		
Cephalaeschna sp.					+	+			
Planaeschna sp.						+	+	+	
Cordulegastridae									
Anotogaster sp.			+		+	+			
Chlorogomphus sp.			+	+	++	+			
Gomphidae									
Davidius sp.	o				+	+			
Gomophidia sp.						+		+	
Labrogomphus sp.	o				+		+		
Lamelligomphus sp.					+				
Leptogomphus sp.			+				+	+	o
Meligomphus sp.						+			
Orientogomphus sp.						+	+	+	o
Phaenandrogomphus sp.	o		+				+		
Libellulidae									
Pseudothermis sp						+	++	+	
Macromiidae									
Macromia sp.				++	+	+			
Macromidia sp.					+	+		+	o
Plecoptera									

(Appendix 1, continued)

Species	Site A 1000m	Site B 900 m	Site C 880 m	Site D 820 m	Site E 750 m	Site F 510 m	Site G 450 m	Site H 400 m	Site I 360 m
Nemouridae									
Amphinemura sp.			+	++	+	+	+	+	
Nemoura sp.			+	+					
Peltoperlidae									
Cryptoperla sp.	o		+	+					
Perlidae									
Etrocorema sp.					+	+			
Kamimura sp.				+	+				
Kiotina sp.				+	+	+			
Neoperla inexspectata			+						
N. lushana									
Neoperla sp.				+	+				
Phanoperla sp.	o		+						
Tetropina sp.	o		+						
Togoperla sp.	o								
Hemiptera									
Gerridae									
Rhyacobates sp.				+	+	++	++	++	
Neogerris sp.			+	+	+		++	++	
Helotrephidae									
Trephotomas sp.						+	+	+	
Mesovellidae									
Mesovellia sp.						+		+	
Naucoridae									
Cheirochela sp.	o			+		+	+		
Gestroiella sp.					+	+	+	+	
Heleocoris sp.							+	+	o
Noctonectidae									
Enithares sp.	o								
Noctonecta sp.	o		+	+	++	++			
Pleidae									
Paraplea sp.	o		+	+	+				
Saldidae									
Saldula sp.				+					
Veliidae									
Rhagovelia sp.								+	o
Megaloptera									
Corydalidae									
Protohermes sp. 1	o		++						
Protohermes sp. 2					+	+	+	+	
Trichoptera									
Brachycentridae									
Micrasema sp.	o		+						
Calamoceratidae									
Anisocentropus sp.						+	+	+	
Heteroplectron sp.						+	+	+	

(Appendix 1, continued)

Species	Site A 1000m	Site B 900 m	Site C 880 m	Site D 820 m	Site E 750 m	Site F 510 m	Site G 450 m	Site H 400 m	Site I 360 m
Ecnomidae									
Ecnomus sp.				+					
Glossosomatidae									
Agapetus sp.						+	+	+	
Goeridae									
Goera sp.						+	+	+	o
Helicopsychidae									
Helicopsyche sp.					+	+		+	
Hydropsychidae									
Ceratopsyche sp.	o	o	+			+			
Cheumatopsyche sp.	o		+						
Hydropsyche sp.	o	o	+						
Hydroptilidae									
Hydroptilia sp.		o				+	+	+	
Lepidostomatidae									
Dinarthrum sp.	o		+	+	+	+			
Goerodes sp.						+	+	+	
Leptoceridae									
Leptocerus sp.				+	+			+	
Mystacides sp							+	+	
Setodes sp.				+		+	+		
Trichosetodes sp.							+		
Limnephilidae									
Apatania sp.	o			+	+				
Philopotamidae									
Chimarra sp.	o		++	+		+	+	+	
Polycentropidae									
Polycentropus sp.				+		+	+	+	
Psychomyidae									
Psychomyia sp.								+	
Rhyacophilidae.									
Rhyacophila sp.			+	+	+	+			
Stenopsychidae									
Stenopsyche sp.				+		+	+		
Lepidoptera									
Pyralidae									
Eoophyla sp.				+	+	+	+		
Parapoynx sp.			+		+		+		
Coleoptera									
Dytiscidae									
Hyphydrus sp.						+	++	++	
Neonectes sp.						+	+	+	
Placynectes sp.								+++	o
Elmidae									
Ordobrevia sp.			+						

(Appendix 1, continued)

Species	Site A 1000m	Site B 900 m	Site C 880 m	Site D 820 m	Site E 750 m	Site F 510 m	Site G 450 m	Site H 400 m	Site I 360 m
Girinidae									
Dineutus sp.						+	+	+	o
Hydrobiidae									
Hydrobia sp.							+	+	
Hydrophilidae									
Hydrobius sp.				+					
Hydrophylus sp.				+			+	+	
Psephenidae									
Dicranopselaphus sp.			+						
Eubrianax sp.					+	+			
Ectopria sp.					+	+	+		
Metaeopsephus sp.			+	+	+	+	+		
Psephenus sp.			+	+					
Ptilodactylidae									
Stenocolus sp.						+	+	+	
Scirtidae									
Cyphon sp.							+	+	o
Elodes sp.							+	+	o
Staphylinidae									
Stenus sp.			+	+	+				
Diptera									
Athericidae									
Atherix sp.			+						
Atrichops sp.			+	+					
Chironomidae									
Chironominae sp. 1			++	+	+				
Chironominae sp. 2				++	+	+	+		
Chironuminae sp. 3					++	++	+++	+++	
Chironominae sp. 4					+	+	+++	+++	o
Dixidae									
Dixa sp.						+	+	+	o
Simulidae									
Prosimulium sp.				+					
Simulium sp.						+			
Tabanidae									
Tabanus sp.				+		+	+	+	
Tipulidae									
Hexatoma sp.			+	+					
Tipula sp.						+	+	+	
Total species number	25	9	52	67	71	82	74	66	17
Grand total species number	145								