

The Water Bugs (Hemiptera; Heteroptera) from the Western Thong Pha Phum Research Project Area, Kanchanaburi Province, Thailand

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Abstracts: Water bugs belong to the order Hemiptera, suborder Heteroptera which contains two kinds of members; semiaquatic (Gerromorpha), and true water bugs (Nepomorpha). They play a major role as biological control agents, and ecologically as food for higher trophic levels (birds and fish). This study is aimed at ascertaining the basic biodiversity and distribution, as well as biological and ecological based data, of water bugs in Thailand and to this aim this part the research was conducted at 4 locations of lotic habitats during May 2002 to April 2003 and at 4 wetland locations during May 2005 to June 2006, in the western Thong Pha Phum research project area. Data on the physical factors of each location were recorded at the time of collection of water bugs. Fifty-six species, from 49 genera and 14 families, were identified but this is an underestimate of the true biodiversity with and more than 16 different morphospecies likely to represent but true different species still in the process of identification. *Timasius chesadai* Chen, Nieser and Lekprayoon, 2006 (Hebridae) was found and described as a new species and the first record from Thailand. To aid future researchers, a key to families of Heteroptera within the Thong Pha Phum area of Thailand was prepared and is presented along with summary biological and ecological information at the family level. This report on species diversity of water bugs suggests that at least 72 species are expected to have been found from the west Thong Pha Phum area, a small part of Thailand. As well as representing the first species diversity study of these insects in this region including their distribution, biological and ecological information, it serves to illustrate the potential high species diversity within Thailand and the need for further evaluation.

Key words: Heteroptera, Thong Pha Phum, lotic habitat, wetland

Introduction

Water bugs are insects in the order Hemiptera, suborder Heteroptera, and are classified into two infraorders: (1) Nepomorpha (the true water bugs) which stay alive beneath the water surface and, (2) Gerromorpha (the semiaquatic bugs) which spend most of their lives on the surface of water and not in the water. Most of these water bugs are predators which feed on captured prey by piercing and sucking body fluid from them. Their mouthparts are correspondingly beak or rostrum in form and they display various forms of raptorial forelegs for grasping prey. The forewings which are hemelytra and membranous, reveal different forms across the infraorders; entire wing (Helotrephidae and Pleidae), macroptera, brachyptera and aptera. The scutellum (a small triangular plate behind the posterior end of pronotum and at the junction of forewings) is found in most of these bugs. The life cycle development is an incomplete metamorphosis or hemimetabolous consisting of egg, larvae or nymph and adult stages. In gross appearance, adult water bugs

vary in morphology and can superficially resemble very small beetles, stick insects, cockroaches, scorpions and dipterans. Likewise considerable adult size polymorphism exists between water bug species, ranging from 0.2 to 60 millimeters. In total there are about 4,000 species of water bugs across both infraorders. Andersen et al. (2002), Nieser (1996, 1997, 1998), Polhemus (1990), Dudgeon (1999), Papacek and Zettel (2000), Sites and Polhemus (2000, 2001), Zettel (1996, 1998), Zettel and Chen (1996) reported and revised the taxonomy in many groups of aquatic and semiaquatic bugs including the data from Thailand.

Water bugs serve both an important ecological role as biological control agents and also as food for higher trophic levels (birds and fish) in water resources. Additionally, they may be used as indicators of the biological quality of aquatic habitats. Indeed, Chen (1996) has reported the use of water bug species diversity and abundance as biogeographic indicators. Because of their diverse lifestyles and habitats, they are excellent model organisms in evolutionary biology, ecology, and

conservation biology (Andersen and Weir, 2004). However, little is known about aquatic and semiaquatic bugs in Thailand despite its potential as a biodiversity hotspot. Although some preliminary surveys have reported on the water bugs from some provinces in Northern, Northeast and Southern parts of Thailand, data for the Central and Western parts of Thailand, especially in Thong Pha Phum area is lacking. This area is near relatively undisturbed ecosystems (natural forests with small people communities) and the western part is bordered to Myanmar country. Therefore the species diversity of the water bugs from this area, along with taxonomy and ecology were studied to expand the database for water bugs in Thailand.

Methodology

The taxonomy and ecology of water bugs were conducted at lotic and at wetland locations during May 2002 to April 2003 and May 2005 to June 2006, respectively. The geographical data for the study sites comprised of 4 lotic and 4 wetland locations (Table 1 and Figure 1) with typical habitat illustrated for each site in Figure 2.

The specimens were collected from the different microhabitats (on the surface and in the water; stream pool; at the benthic; at the rim of water; intertidal area and littoral area), for one hour at each site to standardise sampling effort per site. All collected samples were preserved in 70% (v/v) ethanol. In lotic habitats, 4 sampling sites were selected and sampling was repeated 6 times: May, July and October 2002 (wet season), and December 2002, February, and April 2003 (dry season) except for TPP04 site where was inaccessible during wet season. Therefore, a total of 21 samples were collected: 4 sampling sites × 3 times (wet season) plus 3 sampling sites × 3 times (dry season). The important physical factors for each sample site were recorded at the

time of insect collection, as well as the coordinates and altitudes of the collecting sites (GPS). Specimens collected during the sampling visits and identified as far as species level form the basis of this report, with the Diversity index of the water bugs analysed by Shannon Weinner index (Krebs, 1999). Those samples identified only to morphospecies level and some samples collected during May 2005-October 2005 and December 2005 - June 2006 are awaiting completion of species level identification, but of course will be included in the final analysis and data set.

The specimens from other lentic locations in Thong Pha Phum area were collected and identified for more information of species diversity from this area.

Results

1) From both sampling periods, 56 species from 48 genera and 14 families of water bugs were found with additional specimens, currently identified only as far as family and morphospecies, likely to represent at least a further 16 different species from the indicated habitats and microhabitats (Table 2). It also remains plausible, if not likely, that extra species will be detected when the taxonomic analysis of the specimens from the second sampling period is completed.

2. From the first period of study, 47 species from 41 genera and 11 families were found from the 4 lotic study sites, with *Ptilomera trigrina* showing the highest relative abundance at 16.5% and 17.3 % in the wet and dry seasons, respectively, while *Rhagovelia femorata* and *Rhagovelia* sp. were the next most abundant in the wet and dry seasons at 12.9 % and 8.54 %, respectively. Gerridae, Veliidae and Naucoridae were the dominant family groups in lotic habitats. The average number of water bugs recorded in each two month period at lotic habitats decreased in the

Table 1. Coordinates (UTM) and altitudes (Alt.) of collecting sites at Thong Pha Phum

Site No.	Locations	Habitat Types	UTM	Alt. (m.)
TPP 01	Huai Kayeng	Lotic	N 1614660/ E 47 454880	222
TPP 02	Lam Pilok	Lotic	N 1617466/ E 47 453874	193
TPP 03	Huai Pak Khok	Lotic	N 1618918/ E 47 448938	180
TPP 04	Patsaduklang	Lotic	N 1608972/ E 47 454048	317
TPP 05	Pong Phu Ron	Wetland	N 1619279/ E 47 449008	178
TPP 06	Tha Maduea	Wetland	N 1618102/ E 47 455733	185
TPP 07	The Forest Industry Organization	Wetland	N 1621480/ E 47 456721	184
TPP 08	Phu Nong Pling	Wetland	N 1616634/ E 47 457793	218

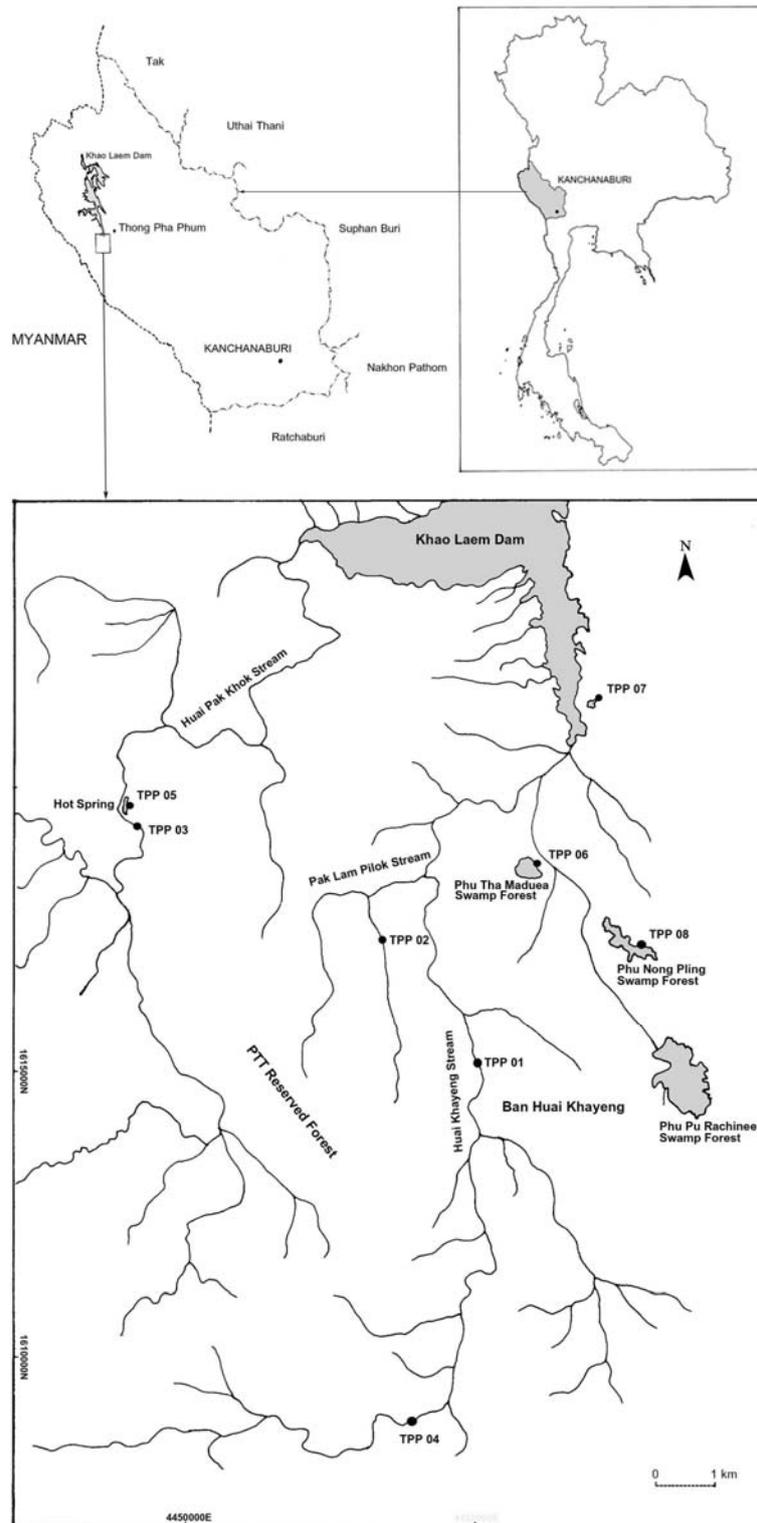


Figure 1. Collecting sites (TPP01-TPP08) at Thong Pha Phum area (see detail in Table 1)

wet season (May 2002 - October 2002) and increased in the dry season (December 2002 - April 2003) as summarised in Figure 3. The mean abundance of water bugs in the dry season (82.9 ± 37.9) was significantly higher than in the wet season (53.2 ± 31.0) (Table 3).

3. Diversity index (H') of water bugs in both dry and wet seasons at lotic habitats were not significantly different (Table 3). A summary of the diversity index data in each two month period for one year is shown in Figure 4.



Figure 2. Study sites (TPP01-TPP08) at Thong Pha Phum area:

- | | |
|--|--------------------------|
| 1. TPP 01 Huai Kayeng | 2. TPP 02 Lam Pilok |
| 3. TPP 03 Huai Pak Khok | 4. TPP 04 Patsaduklang |
| 5. TPP 05 Pong Phu Ron | 6. TPP 06 Tha Maduea |
| 7. TPP 07 The Forest Industry Organization | 8. TPP 08 Phu Nong Pling |

Table 2. The species list with habitats and microhabitats of water bugs from Thong Pha Phum area during May 2002 - April 2003 and May 2005 - February 2006.

No.	Infraorder/family/subfamily	Habitats			Microhabitats			
	Scientific name	Lotic	Lentic	Wetland	surface	in water	margin	benthic
	GERRMORPHA							
	Gerridae							
	Cylindrostethinae							
1	<i>Cylindrostethus costalis</i> Schmidt, 1915	X		X	X			
2	<i>Cylindrostethus scrutator</i> (Kirkaldy, 1899)	X	X		X			
	Eotrechinae							
3	<i>Amemboa cristata</i> Polhemus & Andersen, 1984	X		X	X			
4	<i>Amemboa riparia</i> Polhemus & Andersen, 1984	X	X	X	X			
5	<i>Onychotrechus esakii</i> Andersen, 1980	X					X	
	Gerrinae							
6	<i>Limnogonus fossarum</i> (Fabricius, 1775)	X	X	X	X			
7	<i>Limnogonus nitidus</i> (Mayr, 1865)	X	X	X	X			
8	<i>Limnometra ciliata</i> (Mayr, 1865)	X			X			
9	<i>Limnometra femorata</i> Mayr, 1865	X		X	X			
10	<i>Limnometra matsudai</i> (Miyamoto, 1967)	X		X	X			
11	<i>Neogerris parvulus</i> (Stal, 1860)		X		X			
	Halobatinae							
12	<i>Metrocoris acutus</i> Chen & Nieser, 1993	X	X		X			
13	<i>Metrocoris nigrofascioides</i> Chen & Nieser, 1993	X	X		X			
14	<i>Metrocoris tenuicornis</i> Esaki, 1926	X	X		X			
15	<i>Ventidius hungerfordi</i> Cheng, 1965	X			X			
16	<i>Ventidius malayensis</i> Hungerford & Matsuda, 1960	X		X	X			
17	<i>Ventidius modulatus</i> Lundblad, 1933	X			X			
18	<i>Ventidius pulai</i> Cheng, 1965	X			X			

Table 2. (continued)

No.	Infraorder/family/subfamily	Habitats			Microhabitats			
	Scientific name	Lotic	Lentic	Wetland	surface	in water	margin	benthic
	Ptilomerinae							
19	<i>Pleciobates</i> sp.	X			X			
20	<i>Pleciogonus wongsirii</i> Chen, Nieser and Wattanachaiyingcharoen, 2002	X			X			
21	<i>Ptilomera tigrina</i> Uhler, 1860	X			X			
22	<i>Rheumatogonus intermedius</i> Hungerford, 1933	X			X			
	Rhagadotarsinae							
23	<i>Rhagadotarsus kraepelini</i> Breddin, 1905		X		X			
	Trepobatinae							
24	<i>Cryptobates johorensis</i> J. & D. Polhemus, 1995			X	X			
25	<i>Gnomobates kuiteri</i> (Hungerford & Matsuda, 1958)	X			X			
26	<i>Naboandelus signatus</i> Distant, 1910	X			X			
	Hebridae							
	Hebrinae							
27	<i>Hebrus</i> sp.	X			X			
28	<i>Timasius chesadai</i> Chen, Nieser and Lekprayoon, 2006	X			X		X	
	Hydrometridae							
	Hydrometrinae							
29	<i>Hydrometra greeni</i> Kirkaldy, 1898	X	X	X	X			
30	<i>Hydrometra longicapitis</i> Torre-Bueno, 1927	X	X	X	X			
31	<i>Hydrometra orientalis</i> Lundblad, 1933	X	X		X			
	Mesoveliidae							
32	<i>Mesovelia</i> sp.	X	X	X	X		X	
	Veliidae							
	Haloveliinae							
33	<i>Strongylovelia</i> sp.	X			X			
	Microveliinae							
34	<i>Lathriovelia</i> sp.			X	X			
35	<i>Microvelia</i> sp.	X	X	X	X		X	
36	<i>Pseudovelia</i> sp.	X	X		X		X	
37	<i>Xiphovelia</i> sp.	X			X		X	
	Perittopinae							
38	<i>Perittopus asiaticus</i> Fieber, 1861		X		X			
	Rhagoveliinae							
39	<i>Rhagovelia femorata</i> Dover, 1928	X			X			
40	<i>Rhagovelia rudischiui</i> Zettel, 1993		X		X			
41	<i>Rhagovelia singaporensis</i> Yang & Polhemus, 1990	X			X			
42	<i>Rhagovelia sondaica</i> Polhemus & Polhemus, 1988	X			X			
43	<i>Rhagovelia sumatrensis</i> Lundblad, 1922	X			X			
	Veliinae							
44	<i>Angilia</i> sp.	X	X		X		X	
	NEPOMORPHA							
	Aphelocheiridae							
45	<i>Aphelocheirus femoratus</i> Polhemus & Polhemus, 1988	X						X

Table 2. (continued)

No.	Infraorder/family/subfamily	Habitats			Microhabitats			
	Scientific name	Lotic	Lentic	Wetland	surface	in water	margin	benthic
46	<i>Aphelocheirus grik</i> Polhemus & Polhemus, 1988	X						X
	Belostomatidae							
	Belostomatinae							
47	<i>Diplonychus rusticus</i> (Lepeletier & Serville, 1825)	X		X		X	X	
48	<i>Lethocerus indicus</i> (Fabricius, 1781)	X				X	X	
	Helotrephidae							
	Helotrephinae							
49	<i>Distotrephes shepardi</i> Zettel & Polhemus, 1998	X				X		
50	<i>Fischerotrephes</i> sp.	X				X		
51	<i>Helotrephes australis</i> Zettel & Polhemus, 1998	X				X		
52	<i>Hydrotrephes septentrionalis</i> Zettel, 1998	X				X		
53	<i>Idiotrephes asiaticus</i> Zettel & Polhemus, 1998			X		X		
54	<i>Idiotrephes polhemusi</i> Papacek & Zettel, 2000			X		X		
55	<i>Tiphotrephes indicus</i> Distant, 1910	X				X	X	
	Micronectidae							
56	<i>Micronecta</i> sp.	X	X			X		
	Naucoridae							
	Cheirochelinae							
57	<i>Ctenipocoris asiaticus</i> Montandon, 1897	X		X				X
58	<i>Gestroiella limnocoroides</i> Montandon, 1897	X						X
	Laccocorinae							
59	<i>Heleocoris</i> sp.	X		X				X
	Naucorinae							
60	<i>Naucoris scutellaris</i> Stal, 1858	X	X	X				X
	Nepidae							
	Ranatrinae							
61	<i>Cercotmetus asiaticus</i> Amyot & Serville, 1843	X					X	
62	<i>Cercotmetus brevipes</i> Montandon, 1909	X					X	
63	<i>Cercotmetus compositus</i> Montandon, 1909	X					X	
64	<i>Cercotmetus</i> sp.			X				
65	<i>Ranatra parmata</i> Mayr, 1865	X					X	
66	<i>Ranatra gracilis</i> Dallas, 1850	X					X	
67	<i>Ranatra longipes</i> Lansbury, 1972	X					X	
	Nepinae							
68	<i>Laccotrephes</i> sp.		X				X	
	Notonectidae							
	Notonectinae							
69	<i>Anisops nigrolineatus</i> Lundblad, 1933		X			X		
70	<i>Enithares</i> sp.	X	X	X		X		
	Ochteridae							
71	<i>Ochterus marginatus</i> (Latreille, 1804)	X		X			X	
	Pleidae							
72	<i>Paraplea</i> sp.	X		X		X		

Table 3. Mean abundance (number of individuals per sample) and diversity index (H') of water bugs at lotic habitats in dry and wet seasons, N = number samples.

Seasons	Mean (S.D)*	
	Abundance	H'
Dry (N=12)	82.9 (37.9) ^a	2.997 (0.557) ^c
Wet (N=9)	53.2 (31.0) ^b	2.770 (0.478) ^c

* Means with the same letter are not different significantly (Mann-Whitney U Test; $P < 0.05$)

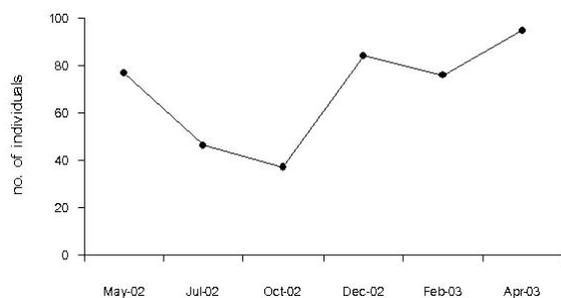


Figure 3. Mean abundance of water bugs at lotic habitats during May 2002 – April 2003

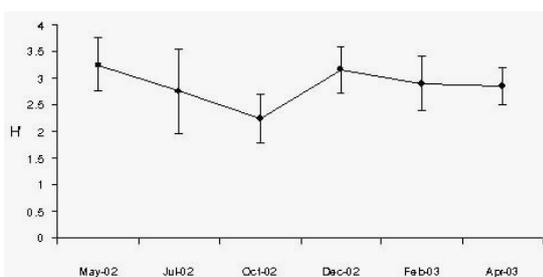


Figure 4. The diversity index (H') of water bugs at lotic habitats during May 2002 - April 2003

4. The description of water bugs in family level was modified from Andersen and Weir (2004) and Chen et al. (2005). Some general biological information and known distribution ranges are provided below.

Aphelocheiridae **Benthic Water Bugs**

Diagnosis: Small to medium-sized (3.5-11.5 mm), oval, strong flattened; head produced anteriorly, and posteriorly embraced by anterolateral angles of pronotum; antennae elongate, slender, filiform; rostrum very long, reaching onto the metasternum; metathoracic scent glands lacking; first abdominal segment strongly reduced, the second segment is the first segment; fore femur only slightly thickened, tarsal formula 3-3-3.

Biology: Tropical Asian *Aphelocheirus* are mostly found in well aerated streams, although they may occur in slow flowing

streams and occasionally in stagnant waters. They may be useful in controlling Simuliidae (Diptera, black flies) larvae which share the same habitat (Chen et al., 2005). During daytime, they hide under pebbles or sand of the stream bed; at night they are active and crawl over the substrate. Biological studies have been performed only on *Aphelocheirus aestivalis* (Fabricius).

Aphelocheirus femoratus Polhemus & Polhemus, 1988 and *Aphelocheirus grik* Polhemus & Polhemus, 1988 were found in the lotic habitats.

Distribution: This family is distributed worldwide.

Family Belostomatidae **Giant Water Bugs**

Diagnosis: Flattened and oval in shape; fore legs are robust and raptorial; two short appendages at the end of the abdomen which each consists a spiracle opening at the base; < 25-70 mm in body length.

Biology: They are found in both standing water and slow flowing water and stick to the plants at the bank of water. They spend much time hanging from the water surface by the air straps and frequently fly to light. They are voracious predators and can inflict a painful bite. The male parental investment of the type seen in this family (the female plays no part in parental care) is an extremely rare trait among animals (Dudgeon, 1999). They are economically important insects for local people.

Lethocerus indicus (Fabricius, 1781) was found as a single specimen from the bank of slow flowing small stream at KP. 13.5. This genus is large, elongate oval water bug, reaching 115 mm in body length.

Diplonychus rusticus (Lepelletier & Serville, 1825) was found. This water bug is small, looks like small cockroach, at less than 25 mm in body length. After mating, the female lays her eggs on the back of male and the eggs are carried around until hatching.

Distribution: Found in tropical Asia to

New Guinea and Australia, and common in Thailand.

Family Corixidae **Water Boatmen**

Diagnosis: Small to medium-sized (3-15 mm), dorsoventrally flattened, usually elongate and parallel-sided flat; mostly dorsally medium brown with yellowish markings; short antennae 4 segmented; short beak with wide at base and truncate at tip; fore tarsi with fringe hairs and scoop-like at the end of tarsi.

Biology: Found at standing and slow flowing waters, some colonized in big groups. They swim by using their legs with fringe hairs. Their feeding habits are predators and some are herbivores. Most of them feed as collector gathers by using scoop-like tibia. This group can make a noise. No specimens were found in this study.

Distribution: This family is worldwide.

Family Micronectidae **Small Water Boatmen**

Diagnosis: Flattened body, with 0.8- 5 mm in body length, lateral side of body parallel; dorsally brownish, usually with darker, sometimes indistinct longitudinal stripe; antennae 3 segmented; short beak; front tarsi scoop like with fringed hairs.

Biology: They are found in shallow still water covered with dense water plants. In this study *Micronecta* sp. was found as the sole representative. Although the genus *Micronecta* was originally classified in subfamily Micronectinae, family Corixidae, the subfamily was reclassified to Micronectidae subsequently (Andersen and Weir, 2004).

Distribution: This genus is common but little known in Thailand.

Family Naucoridae **Creeping Water Bugs**

Diagnosis: Dorso-ventral flattened body with 15-25 mm in body length; extended fore femora with curved slender distal end; mid and hind legs with swimming hairs; small cockroach like.

Biology: They are found in slow flowing streams and ponds of good quality water. They creep into sand or gravel of benthic habitat, and indeed are as good and fast at

creeping as they are at swimming (Dudgeon, 1999).

Ctenipocoris asiaticus Montandon, 1897, *Gestroiella limnocoroides* Montandon, 1987, *Heliocoris* sp. (Figure 5-7) were mostly found in lotic habitats.

Naucoris scutellaris Stål, 1858 was found in lotic, lentic and wetland locations. This species is the smallest creeping water bug, from 6.5 to 7.5 mm in body length, with various speckles on the under side of body, especially on fore femora. They are common and found in ponds or at the bank of streams which are covered with water plants.

Distribution: This family is found in Java, India and Thailand (Sites et al., 1997).

Family Nepidae **Water Scorpions**

Diagnosis: Fore legs raptorial, femora widened with ventral groove to receive tibia and tarsus; two respiratory siphon non-retractile, usually long and filiform, sometime relatively short, either dorso-ventrally flattened, suboval or subcylindrical water bugs; medium size to very large, body length from 12 to 60 mm excluding the respiratory siphon; brownish colour body.

Biology: Nepids are predacious bugs and hide in the mud or perch in the submerged vegetation, waiting for prey to come within reach of their raptorial fore legs. Nepids may 'play dead', when they are handled roughly.

Cercotmetus asiaticus Amyot & Serville, 1843; *Cercotmetus brevipes* Montandon, 1909; *Cercotmetus compositus* Montandon, 1909; *Ranatra parmata* Mayr, 1865; *Ranatra gracilis* Dalas, 1850; and *Ranatra longipes* Lansbury, 1972 were found. The *Cercotmetus* and *Ranatra* have distinctly different morphological characters; fore femora shorter than pronotum in *Cercotmetus*, but longer than that in *Ranatra*. *Laccotrephes* sp. was found. This genus is comprised of large, broad and rather flattened water bugs, with respiratory siphon usually as long as or longer than body length.

Distribution: Nepids are worldwide, these 6 species have been reported from Thailand before (Nieser and Polhemus, 1998).

Family Ochteridae **Velvety Shore Bugs**

Diagnosis: Small (4.5-9 mm), broadly

oval, moderately dorso-ventrally flattened body with soft velvety hemelytra. Predominantly blackish with yellowish to light brown markings; in addition, notably scutellum and hemelytra variably marked with bluish-grey spots; antennae four-segmented, not concealed beneath head; ocelli present; rostrum very long; membrane of hemelytra with either 7 or over 20 cells.

Biology: They usually live at the edge of running water, found at sandy or stony places with little vegetation in shaded places. Adults fly away immediately when movement is observed.

Ochterus marginatus (Latreille, 1804) (Figure 5-8) was found as both nymphs and adults in wetland locations but only as nymphs in lotic habitats at the stream banks.

Distribution: *Ochterus marginatus* were reported from Thailand; Chiangmai, Choburi, and Trang (Kormilev, 1971).

Family Notonectidae Back Swimmers

Diagnosis: Elongate, wedge-shaped species, usually > 4 mm in body length; eyes large, vertex narrow; fore and mid legs modified for grasping; oar-like hind legs long, with fringes of long hairs on their tibia and tarsi; rostrum short and stout.

Biology: They are excellent swimmers, typically swimming on their backs, and occur in quiet waters of pools, ponds and lakes. They are predacious water bugs, feeding on small aquatic arthropods and also on small fish and other aquatic vertebrates.

Anisops nigrolineatus Lundblad, 1933 and *Enithares* sp. were found. The *Anisops* and *Enithares* are classified by the morphological characters. The claval commissure of hemelytra with a prominent hair-lined pit anteriorly, close to apex of the scutellum and rostrum of male with prong on the third labial segment are present in the genus *Anisops*. In the genus *Enithares*, mid femora with a pointed protuberance on ventral margin before apex and eyes dorsally widely separated are present.

Distribution: The genus *Anisops* is distributed throughout the subtropical part and tropical part of the old world. The genus *Enithares* is widely distributed in tropical Asia, New Guinea, Australia and Thailand. The notonectids are found world-wide (Andersen and Weir, 2004).

Family Helotrephidae Humpback Bugs

Diagnosis: Minute bugs, < 4 mm in body length; head and pronotum fused; entered wing; anterior end and dorsal convex; two segmented antennae; hind legs with fringed hairs for swimming.

Biology: They are found in standing water and flowing streams along algae, water plants and detritus in the water. Habitats probably vary among genera. Their biology is obscure and nothing has been published on their life history and habits but from consideration of the mouthpart morphology they are suggested to be predatory (Dudgeon, 1999).

Distrotrephes shepardi Zettel and Polhemus, 1998 (Figure 5-4), *Fischerotrephes* sp., *Helotrephes australis* Zettel and Polhemus, 1998, *Hydrotrephes septentrionalis* Zettel, 1998, *Tiphotrephes indicus* Distant, 1910 were found in lotic habitats. *Fischerotrephes* sp., found in lotic habitat is characterized by being a very tiny (1.2-1.6 mm in length) species without the typical extreme convexity of helotrephids.

Idiotrephes asiaticus Zettel & Polhemus, 1998, and *Idiotrephes polhemusi* Papacek & Zettel, 2000, were found in wetlands, especially at Pong Phu Ron.

A few specimens of *Tiphotrephes indicus* (Distant, 1910) were found in some lotic habitats. They inhabit various types of standing or still waters. They are reported widely distributed and abundant in Thailand. There is only one species in the genus (Zettel, 1998).

Distribution: This family is found in India, Malaysia, Burma, Thailand (Bangkok, Khon Kaen, mountain of Petchaboon and Phupan (Sites and Polhemus, 2001) and Nan.

Family Pleidae Pygmy Back Swimmers

Diagnosis: Dorsum of head not fused with prothorax, head-pronotum suture distinct and straight; 3 segmented antennae, short and hidden in groove beneath the eyes; small size from 1.5 to 3.3 mm in body length.

Biology: They are good swimmers and look like smaller notonectids. They are generalized predators, taking small invertebrate prey.

Paraplea (Figure 5-5) was found in lotic and wetland locations. The species of the genus *Paraplea* Esaki & China, 1928 live in

stagnant waters within vegetation (Nieser, 1996).

Distribution: This genus is the single Oriental genus.

Family Mesoveliidae Minute Water Striders

Diagnosis: Tarsus three segmented with apical claws; distinctly spine at hind legs; wing and wingless forms; with <1.2-4.4 mm in body length; light green, pale yellow or brown colour.

Biology: They are found along the water margin or on the surface of standing water and on the floating plants. They feed on detritus.

Mesovelia sp. was found in lotic, lentic and wetland locations.

Distribution: This family and the genus *Mesovelia* are worldwide.

Family Hebridae Velvet Water Bugs

Diagnosis: Small (1.3-3.7 mm), stout body with dull coloured, densely covered with a velvety hydrofuge hair pile; head elongate with bucculae plate-like expanded; rostrum long and slender, resting in a groove or under side of head and thorax notum; a transverse plate meso-scutellum exposed behind pronotum, with the elevation of metanotum (subtriangular lobe) behind; fore wing venation apically reduced; legs of moderately length, not modified for rowing, tarsi two segmented with claws inserted apically.

Biology: This family is primary terrestrial, inhabiting banks of waters, and represent the ancestral type of Gerromorph (Chen et al., 2005). Especially, *Timasius* and *Hebrus* live on land. The genus *Timasius* typically inhabits steep surface of shaded rocks along stream and rivers, especially under overhanging rocks and under the stones along streams. All species are agile runners and quickly fly away when disturbed. Locomotion on ground is done by walking and running not rolling and jumping. Biology is poorly known.

Timasius chesadai Chen, Nieser & Lekprayoon, 2006 (Figure 5-9), is the first record and new species from Thailand.

Hebrus sp. was found.

Distribution: This family is distributed in all zoogeographical regions and from temperate to tropical zones. Because of their small size and generally cryptic habits in the

land –water zone, tropical Hebridae are still very poorly known.

Family Hydrometridae Water Measurers, Marsh Treaders

Diagnosis: Head prolonged anteriorly with eyes set half-way along and antennae near the tip; legs bearing apical claws; no tube at the end of abdomen; winged and wingless forms.

Biology: They subsist on dead prey which are approached carefully and inspected with antennae for signs of life. They resemble tiny twigs and hide among emergent vegetation at the edge of streams and marshes. They are often seen to raise and lower their body rhythmically (Dudgeon, 1999).

Hydrometra greeni Kirkaldy, 1898 and *Hydrometra longicapitis* Torre-Bueno, 1927 were found in lotic and lentic habitats. *Hydrometra orientalis* Lundblad, 1933 was found in wetland location.

Distribution: This genus is common in Thailand, Malaysia, Phillipines and Japan (Zettel, 1996) and worldwide.

Family Veliidae Small Water Striders or Small Water Skaters

Diagnosis: Head with the distinct longitudinal median impressed line on dorsal surface; fore tibia of male usually with a distal grasping comb of short spines along inner margin; hind femora usually stouter than middle femora; coxal cavity of metathorax with scent evaporatorium; small water bugs with short thorax and robust legs.

Biology: The veliids are common inhabitants of freshwater bodies, both stagnant and flowing waters. A few groups have extended their habitats into marine environments. They are predators or scavengers, feeding on emerging aquatic insects, and terrestrial insects accidentally caught on the surface film.

Strongylovalia sp., *Xiphovelia* sp., *Rhagovelia femorata* Dover, 1928, *Rhagovelia singaporensis* Yang & Polhemus, 1990, *Rhagovelia sondaica* Polhemus & Polhemus 1988, and *Rhagovelia sumatrensis* Lundblad, 1922 (Figure 5-6) were found in lotic habitats.

Microvelia sp. was found in lotic, lentic, and wetland habitats.

Pseudovelia sp. and *Angilia* sp. were found in lotic and lentic habitats.

Perittopus asiaticus Fieber, 1861 and *Rhagovelia rudischiuhi* Zettel, 1993 were found in lentic habitats.

Lathriovelgia sp. was found in wetland habitats.

Distribution: The veliids are found worldwide.

Family Gerridae

Water Striders, Pond Skaters

Diagnosis: Short fore legs and raptorial, mid and hind legs very long and close together, claws of tarsi inserted before the apex and retractability; mesothorax more elongate than others; body covered with waxy fine hairs.

Biology: They make ripple communication for mating signals and can also detect other surface water vibrations to capture their prey or avoid their predators. They are biological control agents of mosquito larvae or other pests which accidentally fall to the surface of water.

Cylindrostethus costalis Schmidt, 1915,

Amemboa cristata Polhemus & Andersen, 1984, *Limnometra femorata* (Mayr, 1865), *Limnometra matsudai* (Miyamoto, 1967) and *Ventidius malayensis* Hungerford & Matsuda, 1960 (Figure 5-1) were all found in lotic and wetland habitats.

Amemboa riparia Polhemus & Andersen, 1984, *Limnogonus fossarum* (Fabricius, 1775) and *Limnogonus nitidus* (Mayr, 1865) were found in lotic, lentic and wetland habitats.

Ptilomera tigrina Uhler, 1860 (Figure 5-3) and *Limnometra ciliata* (Mayr, 1865) were found in lotic habitats.

Neogerris parvulus (Stål, 1860), which is the species in the stagnant water, was found in lentic habitat.

Cylindrostethus scrutator (Kirkaldy, 1899), *Metrocoris acutus* Chen & Nieser 1993, *Metrocoris nigrofascioides* Chen & Nieser, 1993, and *Metrocoris tenuicornis* Esaki, 1926 were found in lotic and lentic habitats.

Ventidius modulatus Lundblad, 1933, *Ventidius pulai* Cheng, 1965, *Ventidius*

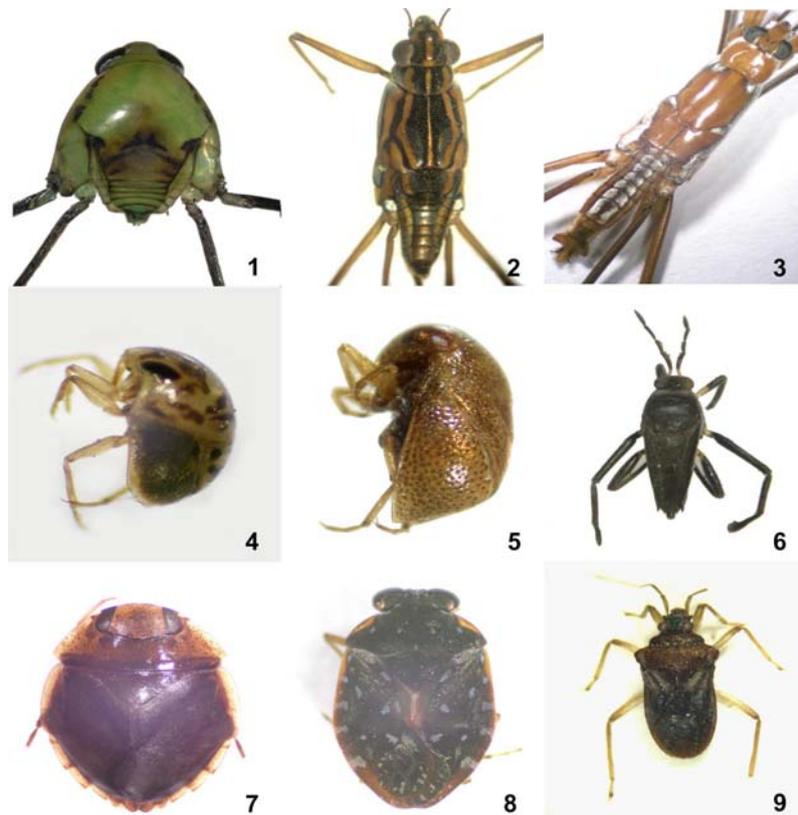


Figure 5. Some adult water bugs (1-9) found in this study:

- | | | |
|---------------------------------|--------------------------------|----------------------------------|
| 1. <i>Ventidius malayensis</i> | 2. <i>Onychotrechus esakii</i> | 3. <i>Ptilomera tigrina</i> |
| 4. <i>Distotrepes shepardii</i> | 5. <i>Paraplea</i> sp. | 6. <i>Rhagovelia sumatrensis</i> |
| 7. <i>Heleocoris</i> sp. | 8. <i>Ochterus marginatus</i> | 9. <i>Timasius chesadai</i> |

hungerfordi Cheng, 1965, *Pleciogonus wongsirii* Chen, Nieser & Wattanachaiyingcharoen, 2002, *Ptilomera tigrina* Uhler, 1860, *Rheumatogonus intermedius* Hungerford, 1933, *Cryptobates johorensis* J. & D. Polhemus, 1995, and *Gnomobates kuiteri* (Hungerford & Matsuda, 1958) were found in lotic habitats.

Onychotrechus esakii Andersen, 1980 (Figure 5-2) was found at a single location, on the hygropetric area on the vertical side of the rock near Jedmitre waterfall.

Rhagadotarsus kraepelini Breddin, 1905 was found in lentic habitats. This species has

been reported to be found in standing freshwater and brackish water (Cheng et al., 2001).

Naboandelus signatus Distant, 1910 was found. This water strider is found at the bank of still water, ponds and large natural water reservoirs (Chen and Zettel, 1998).

Distribution: This family is worldwide., All 26 species have been reported from Thailand (Chen and Zettel, 1998; Chen et al., 2002).

5. From this study, a simple key for identification of adult water bugs to families in Thong Pha Phum area is presented.

Key to Families of Heteroptera

1. - Short antennae, arised under compound eyes, unseen from dorsal sideNepomorpha.....2
- Long antennae, protruding infront of the eyes, seen from dorsal side.....Gerromorpha.....11
2. - Beak short and wide at base, triangular shape or truncate at tip, not divided into segments.....3
- Rostrum elongate and divided into segments;4
3. - Scutellum covered by pronotum, 5-10 mm body lengthCorixidae
- Scutellum visible ;< 5 mm body lengthMicronectidae
4. - Abdomen with two tubes, > 4 mm length, each tube with groove.....Nepidae
- Abdomen without tube, if present < 4 mm length.....5
5. - Body flat dorso –ventrally; fore legs raptorial.....6
- Body not flat, long or global or oval shaped; fore leg not raptorial.....7
6. - With two short tube appendages at the end of abdomen.....Belostomatidae
- Without tube appendages at the end of abdomen.....8
7. - Body oval or global shaped.....9
- Body elongate and deep at lateral side.....Notonectidae
8. - Beak long to the base of first coxae.....Naucoridae
- Beak longer to the base of mid or hind coxae.....10
9. - Antennae with three segments; cephalothorax with straight light line dividedPleidae
- Antennae with two segments; cephalothorax without straight line divided.....Helotrephidae
10. - Head produced anteriorly, and posteriorly embraced by anterolateral angles of pronotum.....Aphelocheiridae
- Head moderately transverse, frontal plate not produced above rostrum.....Ochteridae
11. - Head conspicuously prolong; compound eyes at the mid length of head and thorax together; elongate and stick like –body.....Hydrometridae
- Head not prolong; compound eyes nearly at the anterior margin of prothorax; not elongate and stick like body12
12. - Tarsi with preapical claws.....13
- Tarsi with apical claws.....14
13. - Hind femora not as long as abdomen; thoracic segments nearly the same length.....Veliidae
- Hind femora longer than abdomen; mesothorax more elongate than others.....Gerridae
14. - Two segmented tarsi, hind legs without spine.....Hebridae
- Three segmented tarsi, hind legs with spines.....Mesoveliidae

Discussion and Conclusion

This report is the overview of the ongoing study on biodiversity of water bugs in the western Thong Pha Phum research project area, which is still being conducted.

Water bugs from the two infraorders were represented in the samples. The infraorder Nepomorpha which are truly aquatic and usually submerged, are represented by the following nine families: Aphelocheiridae, Belostomatidae, Micronectidae, Naucoridae, Nepidae, Ochteridae, Notonectidae, Helotrephidae, and Pleidae. The specimens which belong to the infraorder Gerromorpha, found on the hygropetric area, are represented by the 5 families: Mesoveliidae, Hebridae, Hydrometridae, Veliidae, and Gerridae. In terms of abundance and species diversity from lotic habitats, Gerridae is the commonest and most abundant members in the collection being represented by 16 genera and 26 species. Veliidae is represented by 8 genera comprised of 6 species and 6 morphospecies. Helotrephidae is represented by 6 genera and 6 species plus 1 morphospecies. Six genera (*Trephotomas*, *Fischerotrephes*, *Helotrephes*, *Hydrotrephes*, *Idiotrephes* and *Tiphotrephes*) of Helotrephidae have been reported in Thailand before (Sites and Polhemus, 2001), but 6 genera (*Distotrephes*, *Fischerotrephes*, *Helotrephes*, *Hydrotrephes*, *Idiotrephes* and *Tiphotrephes*) of them were found in Thong Pha Phum area.

Although poorly characterized, the biology of water bugs differs within and between groups. From those that have been studied and reported, they are clearly very interesting and diverse but many groups still awaiting classification and characterisation robbing the chance for a real and full appraisal of the biological importance and significance as well as biological diversity of these insects. The major role of water bugs in aquatic ecosystem is biological control agents in natural habitats and as part of the food chain, as food supplies to higher trophic levels (birds, fish). One example is the members of *Aphelocheirus* (Aphelocheiridae) which are mostly found in well aerated streams. They may occur in slow flowing streams and occasionally in stagnant waters, and so can be used as an indicator of water quality and may also be useful in controlling Simuliidae (black flies) larvae, human pests as well as human and farm animal disease vectors, which share the same habitat (Chen et al., 2005).

The sites of this study form a small area to the west Thong Pha Phum area, in Kanchanaburi Province. At least 72 different species of water bugs are likely to have been recorded from this small region in the first analysis, although further species may still (and probably will) be recorded when all samples have been fully analysed. Indeed, as more surveys are carried out, many more taxa will be added to the list. Indeed it is likely that many species, including new species and their associated biological and ecological data remain to be discovered from the west Thong Pha Phum area.

Because of their diverse lifestyles, microhabitats, habitats, locomotion, and especially in body form which are adapted to inhabit in various kind of habitats, waterbugs can be found in a diverse array of aquatic habitats. Taking advantage of the observation that many are good predators, some may be applicable as biological control agents for human or livestock disease vectors and aquatic pests in the ecosystem.

The study to determine water bug distribution, abundance, and biology in each family and indeed species level should be conducted in detail to acquire the baseline knowledge of water bug status and ecology in Thailand. The knowledge of their biodiversity and ecology can then be applied to aid the agricultural, medical, public health, and environmental management.

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