

# ✓ COMPOSITION AND BIODIVERSITY OF BENTHIC MACRO-INVERTEBRATES COMMUNITIES IN THE MEKONG RIVER

NGO XUAN QUANG<sup>\*</sup>, NGO THI LAN<sup>\*\*</sup>

## ABSTRACT

*Benthic macrofauna communities in the Mekong river were investigated on species composition, densities and biodiversity in 8 sampling stations. Results showed 109 species of aquatic invertebrates belonging to 3 great phylum: Mollusca, Arthropoda and Annelida. They are characterized by high densities with number from 202 to 3353 inds/m<sup>2</sup> and high biodiversity (the Shannon – Wiener index H' range from 1.3 – 3.2). Results of this study indicated variety of important biological resources of benthic macro – invertebrate in the Mekong river. Hence, there should have suitable policy and exploration to conserve valuable species for economic development and scientific purpose.*

**Keywords:** biodiversity, benthic macro – invertebrate, Mekong river.

## TÓM TẮT

**Thành phần loài và đa dạng quần xã động vật đáy không xương sống cỡ lớn sông Mekong**

*Thành phần loài, mật độ phân bố và đa dạng sinh học của quần xã động vật đáy không xương sống cỡ lớn đã được nghiên cứu tại 8 khu vực trên sông Mekong. Kết quả nghiên cứu ghi nhận được 109 loài thuộc 3 ngành lớn là Mollusca, Arthropoda và Annelida. Quần xã động vật đáy không xương sống cỡ lớn ở đây không những có mật độ phân bố khá cao (dao động từ 202 tới 3353 cá thể/m<sup>2</sup>) mà còn rất đa dạng (Chỉ số Shannon – Wiener H' dao động trong khoảng từ 1.3 – 3.2). Kết quả nghiên cứu cho thấy động vật đáy không xương sống cỡ lớn là nguồn tài nguyên sinh học quan trọng của vùng sông Mekong. Do đó, cần có những biện pháp quản lý và khai thác phù hợp để có thể bảo tồn các loài có giá trị kinh tế và khoa học.*

**Từ khóa:** đa dạng, động vật đáy không xương sống cỡ lớn, sông Mekong.

## 1. Introduction

Benthic macro – invertebrates are considered as all invertebrate with size more than 1 mm living on the bottom of the rivers, on or inside the substratum. They play an important and diverse role in the aquatic food web, breaking down organic detritus, grazing on periphyton, algae and heterotrophic microbes attached to submerged substrata in almost aquatic ecosystems, removing organic matter from the water column and in turn serving as prey for larger animals and people. They are also

<sup>\*</sup> PhD., Institute of Tropical Biology, Vietnam Academy of Science and Technology

<sup>\*\*</sup> MSc., Ho Chi Minh City Education of University

considered as the link of an important chain to make transport material and help to balance ecological system.

They are further known being useful indicators of habitat and water quality because they are affected by multiple and synergistic effects of different pollutants, are sensitive to both chemical and physical impacts on their habitat (Nguyen Xuan Quynh et al. 2000, 2001; Ngo Xuan Quang, 2001, 2007). However, there is still little known about these benthic invertebrate in the great Mekong river in Vietnam.

Hence, investigation on their biodiversity is not only necessary for aquaculture, local food sources but also for bioconservation. Indeed, many of them such as mollusk, shrimp are over explored for local food every day. Moreover, some species face to problem of distinction or become rarely due to environmental contamination, climate change.

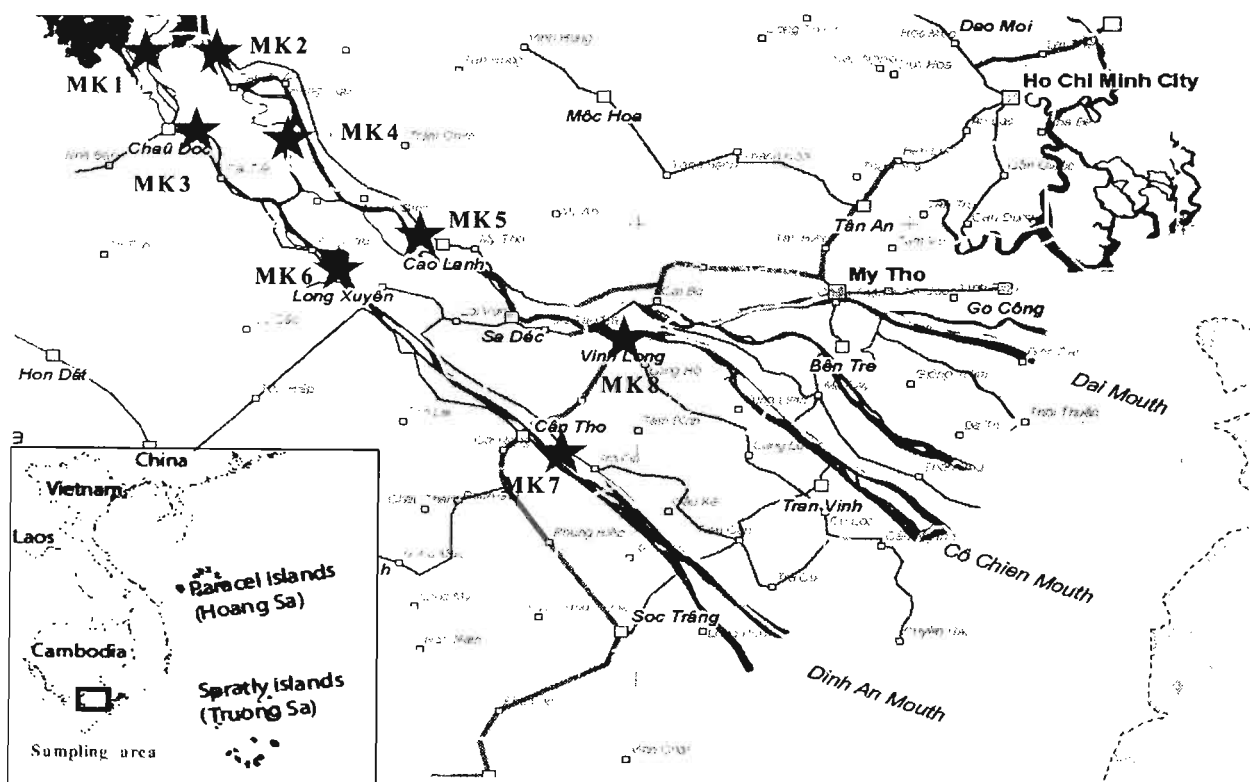
This research focuses to identify species composition, densities and biodiversity of benthic macro – invertebrate communities. It also aims to provide a baseline data of benthic macro – invertebrate's sources for further study on biological conservation, environmental contamination and climate change in the Mekong river delta.

## **2. Methodology**

### **2.1. Sampling stations**

Samples of benthic macro – invertebrates were collected at the 8 stations in two branches of Mekong river: Hau river and Tien river in April 2008. These sampling stations locate from the Cambodian border toward the sea. They were coded by MK with coordination such as: MK1 (10°55'7.40"N, 105° 5'49.52"E), MK2 (10°53'48.10"N, 105°11'39.33"E), MK3 (10°43'14.44"N, 105° 6'56.25"E), MK4(10°43'23.05"N, 105°21'48.27"E), MK5 (10°26'10.59"N, 105°35'18.30"E), MK6(10°23'10.87"N, 105°27'10.40"E), MK7(10°1'7.25"N, 105°48'54.93"E), MK8(10°16'42.02"N, 105°55'24.72"E) (Figure 1).

At each station, five samples were collected from the right, middle, and left parts of the river, respectively. Four samples per location were taken by the Ekma grab with area of 0.025 m<sup>2</sup> and 15 cm deep, covering a total area of 0.1 m<sup>2</sup>. All benthic macro – invertebrate samples were washed through a sieve (0.5 mm mesh) and fixed with formaldehyde 10% before transferring to laboratory for identification.



**Figure 1.** *Sampling stations of benthic macro-invertebrate communities in the Mekong river, Vietnam*

**2.2. Data collection and analysis**

All specimens were counted and identified under stereo - microscope according to Dang Ngoc Thanh and Ho Thanh Hai (2001) [1], Dang Ngoc Thanh et al (1980) [2], Edmondson (1998) [3], Nguyen Xuan Quynh et al. (2001) [4], Nguyen Xuan Quynh et al (2000) [5], Rolf and Brandt (1974) [6], Patrick et al. (1981) [7].

Data of benthic macro – invertebrate was processed in Microsoft Excel 2007 to analyze the composition of communities, species richness and densities. The software Primer v.6.0 was used to measure the Shannon-Wiener biodiversity index (H'). This index is calculated from the proportional abundances  $p_i$  of each species (abundance of the species ( $N_i$ ) per total abundances ( $N_t$ )):  $H' = -\sum (p_i * \log (p_i))$  (in which  $p_i = N_i/N_t =$  relative abundance of each species or genera the  $i$ ).

**3. Results and discussion**

**3.1. Composition of benthic macro - invertebrate communities**

Total of 12.914 specimens of benthic macro - invertebrate in the Mekong River were identified to 109 species belonging to 3 phylum: Mollusca (44% total species), Arthropoda (including Crustacea and Aquatic Insecta with 40.4% total species), and Annelida (15.6% total species) (table 1).

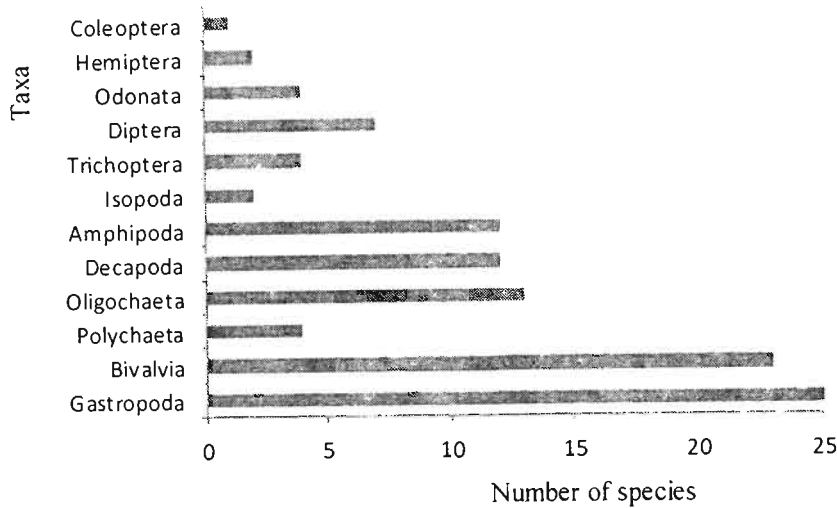
Phylum Mollusca was great variety in all sampling stations with 48 species. In which, class Bivalvia were recorded in the Mekong River with 12 species of family

Corbiculidae, 3 species of family Unionidae, 4 species of Amblemidae. These species were considered as valuable food sources for local people such as: *Ensidens ingallsianus ingallsianus*; *Pilsbryoconcha exilis exilis*; *Uniandra contradens tumidula*; *Pilsbryoconcha exilis compressa*, *Hyriopsis bialatus*; *Trapezoideus exolescens comptus*, *Corbicula leviuscula*, *Corbicula lamarckiana*, *Corbicula tenuis*, vv. Species *Limnoperna siamensis* of family Mytilidae was found contribution in almost sampling stations in the Mekong river.

In addition, class Gastropoda was recorded up 25 species. Three family Thiariidae, Stenothyridae and Viviparidae presented highest number of species. Some typical species found in this river such as: *Angulyagra polyzonata*, *Sinotaia aeruginosa*, *Mekongia swainsoni swainsoni*, *Melanoides tuberculatus*, *Stenothyra glabrata*, *Stenothyra moussoni*.

**Table 1.** The composition of benthic macro – invertebrate communities

Stt	Taxa	Number of species	Percentage
	Mollusca ( <i>Thân mềm</i> )		
1	Gastropoda ( <i>Chân bụng</i> )	25	22,94%
2	Bivalvia ( <i>Hai mảnh vỏ</i> )	23	21,10%
	Annelida ( <i>Giun đốt</i> )		
3	Polychaeta ( <i>Giun nhiều tơ</i> )	4	3,67%
4	Oligochaeta ( <i>Giun ít tơ</i> )	13	11,93%
	Arthropoda ( <i>Chân khớp</i> )		
	Crustacea ( <i>Giáp xác</i> )		
5	Decapoda ( <i>Giáp xác mười chân</i> )	12	11,01%
6	Amphipoda ( <i>Chân khác</i> )	12	11,01%
7	Isopoda ( <i>Chân đều</i> )	2	1,83%
	Aquatic Insecta ( <i>Côn trùng nước</i> )		
8	Trichoptera ( <i>Cánh lông</i> )	4	3,67%
9	Diptera ( <i>Hai cánh</i> )	7	6,42%
10	Odonata ( <i>Chuồn chuồn</i> )	4	3,67%
11	Hemiptera ( <i>Cánh nửa</i> )	2	1,83%
12	Coleoptera ( <i>Cánh cứng</i> )	1	0,92%
	<b>Total of taxa</b>	<b>109</b>	<b>100%</b>



**Figure 2.** Number of benthic macro – invertebrate species of per group in the Mekong River

Phylum Arthropoda was second group with high number of species. Class Crustacea was recorded up to 26 species, higher than Aquatic Insecta with 18 species. Many species of order Decapoda in this region such as *Macrobrachium equidens*, *Macrobrachium rosenbergii*, *Macrobrachium pilimanus*, *Palaemon curvirostris*, *Macrobrachium mekongense*, *Macrobrachium lanchesteri* are usually explored as important food sources for local people. They should be considered for conservation.

The class Insecta with aquatic insect larvae in the Mekong River was investigated and found that they were widely distributed. Order Diptera consisted highest number species (7 species). They are mainly belonging to family Chironomidae. Some species such as: *Cricotopus sp.* and *Chironomus sp.* were showed in all stations. Some other aquatic insect species were also widely distributed such as: *Arigomphus sp.*, *Aphylla sp.* (Odonata); *Nectopsyche sp.*, *Glososoma sp.* (Trichoptera); *Sigara sp.*, *Megamelus sp.* (Hemiptera) and *Amphizoa sp.* (Coleoptera).

Phylum Annelida consists only class Polychaeta and Oligochaeta. Polychaeta showed rather poor number of species with range from 1 to 3 species in each sample station. Oligochaeta was impressed by higher number of species (13 species) in which 9 species of genus *Dero*, family Naididae played dominant position. They distributed widely in almost sampling stations.

### 3.2. Densities of benthic macroinvertebrate communities

The density of benthic macro – invertebrate in almost sampling station of the Mekong river showed relative high. They ranged from 202 to 3353 ind/m<sup>2</sup> (table 3). Highest density was recorded at station MK7 (3353 ind/m<sup>2</sup>) and then at station MK1 (2590 ind/m<sup>2</sup>), station MK4 (1490 ind/m<sup>2</sup>), station MK3 (1220 ind/m<sup>2</sup>), respectively.

In contrast, station MK5 was found lowest densities of benthic macro – invertebrate with 202 ind/m<sup>2</sup> Other stations such as MK6, MK8, MK2 were also found

lower with 543 ind/m<sup>2</sup>, MK8 610 ind/m<sup>2</sup> and 692 ind/m<sup>2</sup>, respectively.

Those stations MK7, MK1, MK4 and MK3 were recorded high densities of benthic macro – invertebrate due to high concentration of species belonging to families: Naididae (Oligochaeta), Stenothyridae, Thiaridae, Viviparidae (Gastropoda); Corbiculidae, Amblemidae (Bivalvia), Palaemonidae (Decapoda), Chironomidae (Diptera) and Corophiidae (Amphipoda). They also play as dominant group in the Mekong River.

**Table 2.** *Densities (ind./m<sup>2</sup>) of benthic macro – invertebrates of the Mekong River*

Sites	Mekong River			Average
	Right	Middle	Left	
MK1	60-13820	50-820	40-750	2590
MK2	580-1490	0-410	410-1260	692
MK3	590-3180	580-900	230-1840	1220
MK4	1010-3170	640-2640	0-1480	1490
MK5	30-240	70-160	110-600	202
MK6	240-530	130-810	530-1020	543
MK7	380-830	120-560	490-17740	3353
MK8	400-1050	40-410	570-1190	610

**3.3. Biodiversity of benthic macro - invertebrate communities**

Generally, species number of benthic macro – invertebrate in each Mekong river station was quite high (ranging from 34 to 51 species per station). The highest value found in the station MK2 (51 species), MK3 (51 species) and MK8 (48 species). In these stations, families Tubificidae (Oligochaeta), Stenothyriidae and Hydrobiidae (Gastropoda), Corbiculidae and Amblemidae (Bivalvia), Gomphidae (Odonata) and Chironomidae (Diptera) were dominant. In contrast, the lower species number was recorded at stations such as: MK1 (36 species), MK4 (35 species) and MK5 (34 species).

Biodiversity of benthic macro invertebrate communities was measured by the Shannon-Wiener diversity index. Results ranged from 1.3 to 3.2 in 8 sampling stations (table 4). The Shannon-Wiener diversity index was recorded highest at stations: MK8, MK6, MK5 (from 3.2, 3.1 and 3, respectively). The Shannon-Wiener diversity index was recorded lowest in station MK1 (H<sup>'</sup>=1.4), MK4 (H<sup>'</sup>=1.7) and MK7 (H<sup>'</sup>=1.3).

*Table 3. The Shannon-Wiener Diversity Index of Benthic Macroinvertebrate*

Station	MK1	MK2	MK3	MK4	MK5	MK6	MK7	MK8
H'	1.4	2.8	2.7	1.7	3.1	3	1.3	3.2

#### 4. Conclusion

Benthic macro – invertebrate communities in the great Mekong River was characterized high densities and biodiversity. 109 species were recorded belonging to 3 great phylums: Mollusca, Arthropoda and Annelida. In which, many economically valuable species were recorded to distribute in almost sampling stations. They are useful for science, environmental monitoring and local food but facing to problem of decreasing population. There should have a suitable policy for management on these benthic fauna.

#### REFERENCE

1. Dang Ngoc Thanh, Thai Tran Bai & Pham Van Mien (1980), *Classification of freshwater invertebrate zoology in North Vietnam*, Science and Technology Publisher.
2. Dang Ngoc Thanh, Ho Thanh Hai (2001), *Fauna of Vietnam, Freshwater Crustacean (Palaemonidae, Parathelphusidae, Potamidae, Cladocera, Copepoda)*, Science and Technics Publishing House, Ha Noi, Vietnam.
3. Edmondson W. T., (1998), *Fresh water Biology*, University of Washington, Seattle.
4. Ngo Xuan Quang (2001), Use aquatic invertebrate as bioindicator for assessment of water quality in Nhue River, *Bachelor thesis*, Ha Noi National University of Natural Science.
5. Ngo Xuan Quang (2007), Applied the ASPT Index for water quality assessment in main streams of Nui Chua National Park. *Workshop Proceeding of Institute of Tropical Biology*. Science and Technology Publishing House, Ha Noi, Vietnam, pp.625 - 629.
6. Nguyen Xuan Quynh, Mai Dinh Yen, Clive Pinder & Steve Tilling, (2000). *Biological surveillance of freshwater, using macroinvertebrates*. Publishing House University Hanoi.
7. Nguyen Xuan Quynh, Clive Pinder, Steven Tilling (2001), *Classification of Invertebrates group in the freshwater in Vietnam*, Publishing House University Ha Noi.
8. Patrick W., Cafferty Mc., Arwin V. Provonsha (1981), *Aquatic Entomology*, Jones and Bartlett Publishers, Inc.
9. Rolf A. and Brandt M. (1974), *The non-marine aquatic Mollusca of Thai Lan*, Frankfurt am Main.

APPENDIX

List of benthic macro – invertebrate was recorded in the Mekong river, Vietnam

**MOLLUSCA**

**Gastropoda**

***Buccinidae***

- 1 *Clea helena* (Meder in Philippi, 1847)
- 2 *Clea scalarina* (Deshayes in Deshayes & Jullien, 1876)

***Thiaridae***

- 3 *Melanoides tuberculatus* Müller, 1774
- 4 *Neoradina prasongi* Brandt, 1974

***Ellobiidae***

- 5 *Melampus fasciatulus* Horstmann, 1979
- 6 *Melampus nucleolus* Martens, 1865

***Lymnaeidae***

- 7 *Lymnaea viridis* Lee et al., 1995
- 8 *Lymnaea swinhoei* Adams, 1866

***Stenothyridae***

- 9 *Stenothyra glabrata* A.Adams, 1850
- 10 *Stenothyra moussoni* von Martens, 1897
- 11 *Stenothyra annandalei* Brandt, 1968
- 12 *Stenothyra* sp

***Bithyniidae***

- 13 *Bithynia s. siamensis* Leach, 1815

***Neritidae***

- 14 *Neritina violacea* (Gmelin, 1791)
- 15 *Neritina pulligera* (Linnaeus, 1767)

***Viviparidae***

- 16 *Mekongia swainsoni swainsoni* Lea, 1856.
- 17 *Angulyagra polyzonata* (Frauenfeld, 1862)
- 18 *Trochotaia trochoides* (Martens, 1860)
- 19 *Sinotaia aeruginosa* (Reeve, 1863)

***Assimineidae***

- 20 *Cyclotropis bollingi* Brandt, 1974

***Pilidae***

- 21 *Pila polita* (Deshayes, 1830)
- 22 *Pila ampullacea* (Linnaeus, 1758)

***Bulimidae***



- 23 *Cochliopa riograndensis* Pilsbry & Ferriss, 1906  
***Pachychilidae***
- 24 *Adamietta housei* (Lea, 1856)
- 25 Gastropoda larva  
**Bivalvia**  
***Corbiculidae***
- 26 *Corbicula leviuscula* Prime, 1864
- 27 *Corbicula lamarckiana* Prime, 1864
- 28 *Corbicula tenuis* Clessin, 1887
- 29 *Corbicula larva*
- 30 *Corbicula cyreniformis* Prime, 1860
- 31 *Corbicula castanea* (Morelet, 1865)
- 32 *Corbicula bocourti* Morelet, 1865
- 33 *Corbicula baudoni* Morelet, 1886
- 34 *Corbicula gustaviana* von Martens, 1900
- 35 *Corbicula moreletiana* Prime, 1867
- 36 *Corbicula sp*
- 37 *Corbicula fluminea* (Muller, 1774)  
***Mytilidae***
- 38 *Limnoperna siamensis* P. A. Morelet, 1866
- 39 *Limnoperna sp*  
***Amblemidae***
- 40 *Ensidens ingallsianus ingallsianus* (Lea, 1852)
- 41 *Uniandra contradens tumidula* (Lea, 1856)
- 42 *Pilsbryoconcha exilis* (Lea, 1889)
- 43 *Pilsbryoconcha exilis compressa* (Martens, 1860)  
***Unionidae***
- 44 *Hyriopsis bialatus* Simpson, 1900
- 45 *Trapezoideus exolescens comptus* (Deshayes, 1876)
- 46 *Unionidae sp*  
***Arcidae***
- 47 *Scaphula pinna* Benson, 1856  
***Pisididae***
- 48 *Afropisidium clarkeanum* (G. & H. Nevill, 1871)  
**ANNELIDA**  
**POLYCHAETA**  
***Nereidae***
- 49 *Namalycastis longicirris* (Takahashi, 1933)  
***Orbiniidae***

- 50 *Orbinia johnsoni* (Moore, 1909)  
 51 *Polychaeta* sp  
**Opheliidae**  
 52 *Polyophthalmus pictus* (Dujardin, 1839)  
 OLIGOCHAETA  
**Tubificidae**  
 53 *Aulodrilus prothecatus* Chen, 1940  
 54 *Branchiura sowerbyi* Beddard, 1892  
**Aelosomatidae**  
 55 *Aelosoma bengalense* Stephenson, 1911  
**Naididae**  
 56 *Dero pectinata* Aiyer, 1930  
 57 *Dero denticulata* Treitschke, 1828  
 58 *Chaetogaster langi* Bretscher, 1896  
 59 *Chaetogaster limnaei* Baer, 1827  
 60 *Branchiodrilus semperi* (Bourne, 1890)  
 61 *Dero* sp1  
 62 *Dero* sp2  
 63 *Dero* sp3  
 64 *Dero* sp4  
**Lumbriculidae**  
 65 *Lumbriculidae* sp  
 DECAPODA  
**Palaemonidae**  
 66 *Macrobrachium equidens* (Dana, 1852)  
 67 *Macrobrachium rosenbergii* (de Man 1879)  
 68 *Macrobrachium pilimanus* (de Man, 1879)  
 69 *Palaemon curvirostris* Nguyen Van Xuan, 1992  
 70 *Macrobrachium mekongese* Dang Ngoc Thanh, 1998  
 71 *Macrobrachium lanchesteri* (de Man, 1911)  
 72 Palaemonidae larva  
 73 Decapoda larva  
**Atyidae**  
 74 *Caridina serrata* Stimpson, 1860  
**Potamidae**  
 75 *Ranguna cochinchinensis* (De Haan, 1898)  
**Parathelphusidae**  
 76 *Somaniathelphusa germaini* Rathbun, 1902  
**Diastylidae**

- 77 *Diastylis rathkei* (Krøyer, 1841)  
 AQUATIC INSECTA  
**Diptera**  
*Chironomidae*  
 78 *Cricotopus sp*  
 79 *Chironomus sp*  
 80 *Chironomus attenuatus* Walker, 1848  
 81 *Pseudodiamesa sp*  
 82 *Diamesinae sp*  
*Ceratopogonidae*  
 83 *Bezzia sp*  
*Tabanidae*  
 84 *Chrysops sp*
- Odonata**  
*Gomphidae*  
 85 *Aphylla sp*  
 86 *Arigomphus sp*  
*Petaluridae*  
 87 *Tachopteryx sp*  
*Corduliidae*  
 88 *Epitheca sp*  
**Tricoptera**  
*Glossosomatidae*  
 89 *Glossosoma sp*  
*Leptoceridae*  
 90 *Nectopsyche sp*  
*Limnephilidae*  
 91 *Limnephilus sp*  
 92 *Farula sp*  
**Hemiptera**  
*Corixidae*  
 93 *Sigara sp*  
*Delphacidae*  
 94 *Megamelus sp*  
**Coleoptera**  
*Amphizoidae*  
 95 *Amphizoa sp*  
 AMPHIPODA

***Haustoriidae***

- 96 *Eohaustorius* sp  
 97 *Eohaustorius tandeensis* Dang, 1968

***Hyalidae***

- 98 *Hyale* sp  
 99 *Hyale hawaiiensis* (Joseph, 1972)

***Gammaridae***

- 100 *Melita vietnamica* Dang  
 101 *Gammarus* sp

***Corophiidae***

- 102 *Corophium* sp  
 103 *Corophium minutum* Dang 1965  
 104 *Corophium intermedium* Dang, 1965  
 105 *Grandidierella vietnamica* Dang, 1968  
 106 *Monocorophium* sp  
 107 *Amphipoda larva*

**ISOPODA**

***Anthuridae***

- 108 *Cyathura carinata* (Kroyer, 1847)

***Corallanidae***

- 109 *Tachaea chinensis* Thielemann, 1910

(Received: 02/4/2014; Revised: 21/4/2014; Accepted: 16/5/2014)