# APPLY BMWP[1] SCORE SYSTEM TO ASSESS WATER QUALITY OF SOME RUNNING WATER

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A considerable amount is known in Europe and North America and to a lesser extent Australia, of the macroinvertebrate fauna of rivers and lakes. Research has been extensive because of the importance of macroinvertebrates in aquatic ecological processes and by extension to water-quality assessment, environmental management and conservation (C.F. Mason, 1981; Metcalfe, 1989).

Using macroinvertebrates to assess water quality is a rapid biologicalmonitoring method [5, 8, 9]. The BMWP score has been applied successfully, with some adaptations to suit local conditions, in Thailand and India for example. From 1998 to 2000 the project cooperation between Biology Faculty (Hanoi University of Sciences) and Field Studies Council, Institute of Freshwater Ecology (UK) sponsored by the UK government's Darwin Initiative has been carried out. Protocols for sampling, data analysis and BMWP score system for Vietnam are presented [7].

The present study has 2 primary objectives:

- To adapt the BMWP methodology to assess water quality of some running water
- Determination of macroinvertebrate composition in the sampling sites

## Methods

■ Samples were taken in September (hot season) and December (cold season), 1999, from three currents: Ao Vua stream (affected by tourist activities), Ca Lo river (affected by sewage from agriculture and erode) and Nhue river (affected by sewage from industries and larger towns). Along each running waters 5 sites were taken sampling

■ Macroinvertebrate sampling:

- Smaller sites were sampled using a combination of pond netting (sweep and kick sampling) for 3 minutes and hand searching for 1 minute - all habitats being sampled for a period of the total time in proportion to the area occupied.

- Larger sites were sampled by a combination of pond-netting of marginal habitats and dredge sampling in deeper water.

- Samples were transferred to white trays and sorted on the river bank before preservation in alcohol and identification to family level in the laboratory

■ Identification of Macroinvertebrates: All specimens were identified to family level, using some keys follows: Dang Ngoc Thanh et all, [4]; Nguyen Xuan Quynh et al, [7]; R.W. Meritt and K.W. Cummins, [10]; W. Patrick McCafferty, [12].

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[1] Biological Monitoring Working Party (Nhóm hoạt động giám sát sinh học)

■ Data analysis:

- Using BMWP score system of UK and BMWWP score system of Vietnam to mark each index family.

- ASPT$^2$ = Total BMWP score: total index families

- Use the Water Quality Index (table 1) to assess the water quality of each sampling sites

**Table 1:** The Water Quality Index

| ASPT | Water quality |
|---|---|
| 10 — 8 | Very clean water |
| 7,9 — 6 | Rather clean — clean water |
| 5,9 — 5 | Average |
| 4,9 — 3 | Dirty water |
| 2,9 — 1 | Very dirty water |
| 0 | Extremely dirty water (nolife at all) |

Sourse: - Richard Orton, Anne Bebbington and John Bebbington, 1995

- Stephen Eric Mustow, 1997

**Results**

***1. Composition of Macroinvertebrates in AoVua stream, CaLo river and Nhue river***

Results of macroinvertebrate surveys, using only the criteria of presence or absence are shown in table 2. Sites have been arranged in order of their field sampling sites. Fifty-seven taxa were recorded. They belong to Arthropoda, Molussca and Oligochaeta.

Discussion:

- Fourty two macroinvertebrate families were recorded in AoVua stream. They are 2 families of *Diptera*, 6 families of *Coleoptera*, 9 families of *Ephemeroptera*, 5 families of *Hemiptera*, 7 families of *Odonata*, 1 family of *Plecoptera*, 6 families of *Trichoptera*, 3 families of *Decapoda*, 2 families of *Gastropoda* and 1 family of *Hirudinea*. The number of Insect families make up 85%, and most of them are like clean water.

- In CaLo river has been found 18 families macroinvertebrate. They are 2 families of *Diptera*, 2 families of *Hemiptera*, 2 families of *Odonata*, 3 families of *Decapoda*, 5 families of *Gastropoda*, 4 families of *Bivalvia* and some specimen of *Oligochaeta*. So that the Molluscs families make up 50% total families which have been found in CaLo river. Most of them are like living in organic water as *Thiaridae, Chironomidae*, ...

- Twenty two macroinvertebrate families were recorded in Nhue river. They are 2 families of *Diptera*, 1 family of *Coleoptera*, 1 family of *Ephemeroptera*, 4 families of *Hemiptera*, 4 families of *Odonata*, 3 families of *Decapoda*, 4 families of *Gastropoda*, 2 families of *Bivalvia*, 1 family of *Hirudinea* and some specimen of *Oligochaeta*. But only tubificid worms (*Oligochaeta*) and chironomid larva (*Chironomidae*) occurred with large number.

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Average Score Per Taxon (Điểm trung bình trên đơn vị phân loại)

## Table 2: Macroinvertebrate Data
### Occurrence (presence/absence) of macroinvertebrates taxa in the sampling sites

| No | Phylum, Class | Sub-Class, Order, Family | Ao Vua stream 1 | 2 | 3 | 4 | 5 | Ca Lo river 1 | 2 | 3 | 4 | 5 | Nhue river 1 | 2 | 3 | 4 | 5 | BMWP Score UK | V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **ARTHROPODA** | | | | | | | | | | | | | | | | | | |
| | **Insecta** | **Diptera** | | | | | | | | | | | | | | | | | |
| 1 | | Tipulidae | | | | - | + - | | | - | | | - | | | | | 5 | 5 |
| 2 | | Chironomidae | + - | | | | + - | - | + - | + - | | | - | - | + - | + - | + | 2 | 2 |
| | | **Coleoptera** | | | | | | | | | | | | | | | | | |
| 3 | | Psephenidae | | - | + - | + - | + | | | | | | | | | | | | 5 |
| 4 | | Elminthidae | | - | | - | + | | | | | | | | | | | 5 | 5 |
| 5 | | Hydrophilidae | | | | | + | | | | | | | | | | | 5 | 5 |
| 6 | | Dytiscidae | | | | | | | | | | | | - | - | | | 5 | 5 |
| 7 | | Gyrinidae | | + | | | | | | | | | | | | | | 5 | 5 |
| 8 | | Dryopidae | | | | | + | | | | | | | | | | | 5 | 5 |
| 9 | | Helodidae | | | | | - | | | | | | | | | | | 5 | 5 |
| | | **Ephemeroptera** | | | | | | | | | | | | | | | | | |
| 10 | | Heptagenidae | + - | + - | + - | + - | + - | | | | | | | | | | | 10 | 10 |
| 11 | | Ephemeridae | + | | | + - | | | | | | | | | | | | 10 | 10 |
| 12 | | Baetiidae | + - | | - | - | + - | | | | | | - | | - | | | 4 | 4 |
| 13 | | Leptophlebiidae | + - | | - | + - | + - | | | | | | - | | | | | 10 | 10 |
| 14 | | Ephemerellidae | - | | | + - | | | | | | | | | | | | 10 | 10 |
| 15 | | Oligoneuriidae | | | | - | | | | | | | | | | | | | 10 |
| 16 | | Potamanthidae | | | | - | | | | | | | | | | | | 10 | 10 |
| 17 | | Siphlorunidae | | | | - | + | | | | | | | | | | | 10 | 4 |
| 18 | | Caenidae | | | | - | | | | | | | | | | | | 7 | 7 |
| | | **Hemiptera** | | | | | | | | | | | | | | | | | |
| 19 | | Naucoridae | | | | + | | | | | | | | | | | - | 5 | 5 |
| 20 | | Belostomatidae | | | | | | | | | | | | | | | - | | 5 |
| 21 | | Pleidae | + - | + - | - | + - | + | | | | | | | | | | | 5 | 5 |
| 22 | | Corixidae | | | | | | - | - | + - | | | - | | + - | + - | + - | 5 | 5 |
| 23 | | Mesoveliidae | | | | | + | | | | | | | | | | | 5 | 5 |
| 24 | | Aphelocheridae | - | | | | + - | | | | | | | | | | | 10 | 10 |
| 25 | | Notonectidae | - | | | | | | | | | - | | - | | - | | 5 | 5 |
| | | **Odonata** | | | | | | | | | | | | | | | | | |
| 26 | | Gomphidae | - | - | | | - | | | + | | | + - | + | | | + | 8 | 6 |
| 27 | | Amphipterygidae | + | | | | - | | | | | | | | | | | | 10 |
| 28 | | Cordulegastridae | | + | | | - | | | | | | | | | | | 8 | 6 |
| 29 | | Coenagrionidae | | | - | | + | | | + | | | | | - | - | | | 4 |
| 30 | | Aeshnidae | | + | | | + - | | | | | | | | | | | 8 | 6 |
| 31 | | Libellulidae | | | | | | | | | | | | | + | | | 8 | 4 |
| 32 | | Protoneuridae | | | | | + | | | | | | | | | - | - | | 3 |
| 33 | | Lestidae | | | + | | | | | | | | | | | | | 8 | 6 |
| | | **Plecoptera** | | | | | | | | | | | | | | | | | |
| 34 | | Perlidae | - | | | | + | | | | | | | | | | | 10 | 10 |

| No | Class | Taxon | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | UK | V |
|----|-------|-------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|
| | | **Trichoptera** | | | | | | | | | | | | | | | | | |
| 35 | | Hydropsychidae | | | | + | + - | | | | | | | | | | | 5 | 5 |
| 36 | | Philopotamidae | | | | | - | | | | | | | | | | | 8 | 8 |
| 37 | | Leptoceridae | | + | | - | + - | | | | | | | | | | | 10 | 10 |
| 38 | | Phryganeidae | + | | | | | | | | | | | | | | | 10 | 10 |
| 39 | | Odontoceridae | | | | - | + | | | | | | | | | | | 10 | 10 |
| 40 | | Psychomuiidae | | | | | - | | | | | | | | | | | 8 | 8 |
| 41 | **Crustacea** | **Deapoda** Atyiidae | + - | + - | + - | + - | - | + - | + | + | | + | | | | | | | 3 |
| 42 | | Palaemonidae | + - | + - | | | | + - | + - | + - | + - | + - | + - | + - | + - | + - | + - | | 3 |
| 43 | | Parathelphusidae | | | | | | | + | + | | | | | - | + | + - | | 3 |
| 44 | | Potamidae | + | | | + - | | | | | | | | | | | | | 8 |
| | **MOLLUSCA** | | | | | | | | | | | | | | | | | | |
| 45 | **Gastropoda** | **Pulmonata** Planorbiidae | | + - | | | | | | | | | | | | | | 3 | 3 |
| | | **Prosobranchia** | | | | | | | | | | | | | | | | | |
| 46 | | Thiaridae | + | + | + | + | - | + | + - | + - | + - | + - | + - | + - | + - | + - | + - | | 3 |
| 47 | | Viviparidae | | | | | | + - | + - | + - | + - | - | + - | + - | | | | | 4 |
| 48 | | Littorinidae | | | | | | + - | + - | + | + - | + - | - | | - | - | - | | 3 |
| 49 | | Bithyniidae | | | | | | | | | | | + | + | + | + | + | | 3 |
| 50 | | Pachychilidae | | | | | | | | | + | - | | | | | | | |
| 51 | | Stenothyridae | | | | | | | + - | - | - | - | | | | | | | |
| 52 | **Bivalvia** | **Eulamellibranchia** **Heterodonta** Corbiculidae | | | | | | + - | + - | + | + - | - | | | + - | + - | | | 3 |
| | | **Schizodonta** | | | | | | | | | | | | | | | | | |
| 53 | | Mytilidae | | | | | | | | | - | | | | | | | | 5 |
| 54 | | Amblemidae | | | | | | | | | + | - | | | | | | | 4 |
| 55 | | Unionidae | | | | | - | + - | + | + | - | | - | | + - | + - | | 6 | 4 |
| | **ANNELIDA** | | | | | | | | | | | | | | | | | | |
| 56 | **Hirudinea** | Hirudinidae | | | | - | | | | | | | | | | - | | 3 | 3 |
| 57 | **Oligochaeta** | | | | | | - | + - | + | | - | | + - | + - | + - | + - | + - | 1 | 1 |
| | | No Taxa (+) | 12 | 9 | 6 | 10 | 20 | 6 | 10 | 13 | 9 | 4 | 6 | 6 | 7 | 9 | 10 | | |
| | | No Taxa (-) | 15 | 7 | 8 | 16 | 21 | 9 | 10 | 8 | 9 | 9 | 13 | 8 | 11 | 10 | 11 | | |

Notes: 1, 2, 3, 4, 5: the order of sampling sites in each running water
(+) Occurred in September; (-) occurred in December
(UK) The BMWP Score System as used in the UK (National Water Council, 1981)
(V) BMWP score system of Vietnam (Nguyen Xuan Quynh, Clive Pinder et al, 2000)

## 2. Water quality of the sampling sites

Values for BMWP total and for the ASPT were calculated using BMWP score system of UK and BMWP score system of Vietnam and results are shown in table 3

**Table 3:** ASPT of the sampling sites in AoVua stream, CaLo river and Nhue river

| | | | | Ao Vua stream | | | | | CaLo river | | | | | Nhue river | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| BMWP score system of UK | Total BMWP | + | 51 | 46 | 21 | 55 | 109 | 0 | 9 | 22 | 6 | 0 | 9 | 9 | 16 | 14 | 22 |
| | | - | 84 | 28 | 52 | 82 | 118 | 14 | 14 | 12 | 6 | 6 | 36 | 13 | 19 | 22 | 17 |
| | No taxa index | + | 7 | 6 | 3 | 7 | 16 | 0 | 3 | 5 | 1 | 0 | 2 | 2 | 4 | 4 | 5 |
| | | - | 11 | 4 | 7 | 11 | 16 | 4 | 4 | 4 | 2 | 1 | 8 | 4 | 5 | 6 | 4 |
| | ASPT | + | 7,3 | 7,7 | 7,0 | 7,9 | 6,8 | - | 3,0 | 4,4 | 6,0 | - | 4,5 | 4,5 | 4,0 | 3,5 | 4,4 |
| | | - | 7,6 | 7,0 | 7,4 | 7,5 | 7,2 | 3,5 | 3,2 | 3,0 | 3,0 | 6,0 | 4,5 | 3,3 | 3,8 | 3,7 | 4,3 |
| BMWP score system of VN | Total BMWP | + | 78 | 51 | 30 | 66 | 111 | 19 | 26 | 44 | 23 | 12 | 20 | 20 | 21 | 27 | 33 |
| | | - | 93 | 37 | 64 | 91 | 141 | 28 | 28 | 22 | 27 | 29 | 49 | 27 | 36 | 32 | 38 |
| | No taxa index | + | 12 | 9 | 6 | 10 | 18 | 6 | 9 | 13 | 7 | 4 | 6 | 6 | 7 | 9 | 10 |
| | | - | 14 | 7 | 10 | 13 | 20 | 9 | 9 | 6 | 8 | 8 | 13 | 8 | 11 | 10 | 11 |
| | ASPT | + | 6,3 | 5,7 | 5,0 | 6,6 | 6,2 | 3,2 | 3,0 | 3,4 | 3,3 | 3,0 | 3,3 | 3,3 | 3,0 | 3,0 | 3,3 |
| | | - | 6,6 | 5,3 | 6,4 | 7,0 | 7,0 | 3,1 | 3,1 | 3,7 | 3,4 | 3,6 | 3,8 | 3,4 | 3,3 | 3,2 | 3,5 |

Notes:

- 1, 2, 3, 4, 5: the order of sampling sites in each running water
- (+) occurred in September; (-) occurred in December

The results of sampling sites water quality assess, using Water Quality Index are shown in table 4

**Table 4:** Water quality of sampling sites

| Sites | | Using BMWP score system of UK | | | | Using BMWP score system of Vietnam | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 9/99 | | 12/99 | | 9/99 | | 12/99 | |
| | | ASPT | Water quality | ASPT | Water quality | ASPT | Water quality | ASPT | Water quality |
| AoVua stream | 1 | 7.3 | Rather clean | 7.6 | Rather clean | 6.3 | Rather clean | 6.6 | Rather clean |
| | 2 | 7.7 | Rather clean | 7.0 | Rather clean | 5.7 | Average | 5.3 | Average |
| | 3 | 7.0 | Rather clean | 7.4 | Rather clean | 5.0 | Average | 6.4 | Rather clean |
| | 4 | 7.9 | Rather clean | 7.5 | Rather clean | 6.6 | Rather clean | 7.0 | Rather clean |
| | 5 | 6.8 | Rather clean | 7.2 | Rather clean | 6.2 | Rather clean | 7.0 | Rather clean |
| CaLo river | 1 | - | | 3.5 | Dirty water | 3.2 | Dirty water | 3.1 | Dirty water |
| | 2 | 3.0 | Dirty water | 3.2 | Dirty water | 3.0 | Dirty water | 3.1 | Dirty water |
| | 3 | 4.4 | Dirty water | 3.0 | Dirty water | 3.4 | Dirty water | 3.7 | Dirty water |
| | 4 | 6.0 | Rather clean | 3.0 | Dirty water | 3.3 | Dirty water | 3.4 | Dirty water |
| | 5 | - | | 6.0 | Rather clean | 3.0 | Dirty water | 3.6 | Dirty water |
| Nhue river | 1 | 4.5 | Dirty water | 4.5 | Dirty water | 3.3 | Dirty water | 3.8 | Dirty water |
| | 2 | 4.5 | Dirty water | 3.3 | Dirty water | 3.3 | Dirty water | 3.4 | Dirty water |
| | 3 | 4.0 | Dirty water | 3.8 | Dirty water | 3.0 | Dirty water | 3.3 | Dirty water |
| | 4 | 3.5 | Dirty water | 3.7 | Dirty water | 3.0 | Dirty water | 3.2 | Dirty water |
| | 5 | 4.4 | Dirty water | 4.3 | Dirty water | 3.3 | Dirty water | 3.5 | Dirty water |

Discussion

- The water quality of AoVua stream is rather clean. But only the water quality of second sampling site is average, because this site is received wastewater from Huong Rung Hotel.

- The water quality of CaLo and Nhue rivers is polluted. All sampling sites in theirs have ASPT index between 3.0 to 4.0.

- When using UK BMWP score system were not calculated ASPT index for some sampling sites in CaLo river as first site and fifth site. It shown that UK BMWP not suitable to assess water quality of running water in Vietnam

Vietnam BMWP score system include the families of crustaceans and molluscs. These families are occurred many in the sampling sites. So using Vietnam BMWP to assess water quality of these sites are better.

## *Conclusions*

- There are the specimens of 42 macroinvertebrates families in Ao Vua stream (Ba Vi). The aquatic insect families make up 85%. and most of them are like clean water. In Ca Lo river there are 18 macroinvertebrates families and some specimens belong to *Oligochaeta* Class. The number of mollusc's families makes up 50%. In Nhue river 22 macroinvertebrates families and some specimens of *Oligochaeta* Class have been found. Most of specimens belong to *Chironomidae* and *Oligochaeta.*

- The water quality of AoVua stream is rather clean. The water quality of Ca Lo and Nhue rives are average dirty.

- Using macroinvertebrates as bioindex to assess water quality is not expensive and useful method.

- The BMWP Vietnam score system is more suitable for the sampling sites than BMWP UK score system.

## Reference

1. Lê Thu Hà, Nguyễn Xuân Quýnh. Góp phần nghiên cứu mức độ đa dạng sinh vật động vật không xương sống cỡ lớn theo dòng suối Tam Đảo (Vĩnh Phúc), *Tạp chí Sinh học*, tập 23 **3A**(2001), trang 62-68.

2. Hoàng Thị Hoà. Nghiên cứu sử dụng động vật không xương sống cỡ lớn đánh giá chất lượng nước khu vực thành phố Đà Lạt. Suối Dac Ta Dun và sông Đa Nhim, *Luận án Thạc sĩ Khoa học*, 2000.

3. Đặng Ngọc Thanh. *Khu hệ động vật không xương sống nước ngọt Bắc Việt Nam.* Nhà xuất bản KHKT Hà Nội, 1980.

4. Đặng Ngọc Thanh, Thái Trần Bái, Phạm Văn Miên. *Định loại Động vật không xương sống nước ngọt Bắc Việt Nam.* Nhà xuất bản KHKT, Hà Nội, 1980.

5. C.F. Mason. *Biology of Freshwater pollution.* Produced by Longman Singapore Publishers Ltd., third edition, 1996.

6. *National Water Council.* River quality: the 1980 survey and future outlook. National Water Council. London. 1981.

7. Nguyen Xuan Quynh. Mai Dinh Yen. Clive Pinder and Steve Tilling. Biological Surveillance of Freshwater. Using Macroinvertebrate. *A Practical Manual and Identification Key for use in Vietnam. Darwin Initiative.* Field Studies Council. UK. 2000.

8. P. S. Croft. A key to the Major Group of British Freshwater Invertebrates. *Field Studies Council AIDGAP Project.* Printed in Great Britain. 1986.

9. R. Fitter and R. Manuel. *Lakes. Rivers. Streams and Ponds of Britain and north-west Europe.* Collin photo guide. Harper Collins Publishers. 1995.

10. R. W. Merritt and K. W. Cummins. *An Introduction to the Aquatic Insects of North America.* Kendall/Hunt Publishing Company. 1996.

11. Richard Orton. Anne Bebbington and John Bebbington. *Freshwater Invertebrates. Field Studies Council Published,* 1995. Stephen eric Mustow. Quatic macroin-vertebrates and environmental quality of rivers in Northern Thailand, *PhD thesis* 1997.

12. W. Patrick McCafferty. *Aquatic Entomology.* Jones and Bartlett Publishers. Boston. London. 1981.

# ÁP DỤNG HỆ THỐNG ĐIỂM BMWP ĐÁNH GIÁ CHẤT LƯỢNG MÔI TRƯỜNG NƯỚC MỘT SỐ DÒNG CHẢY

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Sử dụng động vật không xương sống (ĐVKXS) cỡ lớn để đánh giá chất lượng nước các dòng chảy là một phương pháp rẻ tiền, có thể áp dụng trên một diện rộng với nhiều điểm quan trắc khác nhau. Nghiên cứu được thực hiện trên 3 dòng chảy: suối Ao Vua (chịu tác động của các hoạt động du lịch), sông Cà Lồ (chịu tác động của nước thi nông nghiệp và nạn xói mòn) và sông Nhuệ (chịu tác động của nước thải sinh hoạt, công nghiệp). Mỗi một dòng chảy có 5 điểm nghiên cứu, mẫu được thu vào 2 đợt: tháng 9 (mùa nóng) và tháng 12 (mùa lạnh) năm 1999.

- Tại suối Ao Vua đã xác định được các đại diện của 42 họ ĐVKXS cỡ lớn, trong đó các họ thuộc côn trùng và ấu trùng côn trùng ở nước chiếm đến 85%, phần lớn các họ này là các họ ưa sạch. Trên sông Cà Lồ đã thu được 18 họ ĐVKXS cỡ lớn và một số đại diện của Giun ít tơ (*Oligochaeta*), trong số đó chủ yếu là bọn Thân mềm (*Mollusca*) chiếm 50%. ở sông Nhuệ đã gặp 22 họ ĐVKXS cỡ lớn và một số đại diện của Giun ít tơ (*Oligochaeta*). Lượng mẫu thuộc họ *Chironomidae* và lớp *Oligochaeta* chiếm đa số.

- Chất lượng môi trường nước suối Ao Vua là tương đối sạch. Sông Cà Lồ và sông Nhuệ có mức ô nhiễm trung bình.

- Phương pháp sử dụng ĐVKXS làm sinh vật chỉ thị để đánh giá chất lượng nước là một phương pháp khả thi, mang lại kết quả tốt, lại ít tốn kém.

- Hệ thống điểm BMWP của Việt Nam sát thực hơn so với hệ thống điểm BMWP của Anh.