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STUDYING AND USING MACRO-INVERTEBRATES FOR ASSESSING THE QUALITY OF WATER ENVIRONMENT IN NHUE RIVER

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Abstract

In order to have a scientific basis for proposing measures to protect and improve the water resource in Nhue river, macroinvertebrates had been used as bioindicators for assessing water quality of the river. Based on analysing macroinvertebrate samples of 3 field surveys on 9 - 10 May and 28 - 29 October, 2001 and 6 -7 April, 2002 at 11 sampling sites that were chosen as representatives for different habitats along 74 km of the whole of Nhue river, the obtained results showed that:

1. The composition of macro-invertebrate in Nhue river was rather diverse, consisting of 43 families and representatives of the class Oligochaeta. The family number of macro-invertebrate was variably by sampling sites and by time in which it was more diverse and abundant in rainy season than in dry one. 2. Based on biological indices ASPT that were calculated by the score system BMWPVIETNAM showed that the level of pollution at 11 studying sites in Nhue river during three survey periods were belonging to the medium level of pollution α (α - Mesosaprobe) but all ASPT scores mainly were in a low interval, from 3,2 to 4,0 and near to the level of very pollution (Polysaprobe). Therefore, it is clear that the water quality of Nhue river has been polluted critically and needs solutions to prevent and minimize the pollution of water environment in the river effectively.

Keywords: Biological indices, bioindicator, macroinvertebrate, pollution, score system, water quality

Introduction

Nhue river runs through the Hanoi city, Ha Tay and Ha Nam provinces but its main part belongs to Ha Tay province. Nhue river is an important and natural branch of Red river but it has been dredged and reformed many times for serving aims of agriculture and living of people of the area.

In the basin of Nhue river and adjacent regions, many new industrial and urban areas have been built. Recently, in the up-stream of Nhue river, the industry of Hanoi city has been developing and increasing considerably. Therefore, at present, Nhue river has a role to receive and circulate a large amount of different wastes. It has been resulting in pollution of Nhue river and the decline of its water quality.

In the face with the situation, in order to have a scientific basis for proposing measures of sustainable protection and surveillance of water resource, it is necessary to study on the relationship between the biodiversity of macroinvertebrate and water quality and using the bioindicator group for assessing water quality in Nhue river.

Methods

The obtained studying results based on 3 periods of field sampling, from May, 2001 to April, 2002:

- Period 1: 9 - 10 May, 2001
- Period 2: 28 - 29 October, 2001
- Period 3: 6 and 7 April, 2002

11 sampling sites that are representatives for different habitats along 74 km of the whole of Nhue river were chosen, from the first one at the beginning of Nhue river linking to Red river through Lien Mac sewer in the North to at the end one where Nhue river runs into Day river through Phu Ly sewer in the South and Ung Hoa sewer in the West (Figure 1).

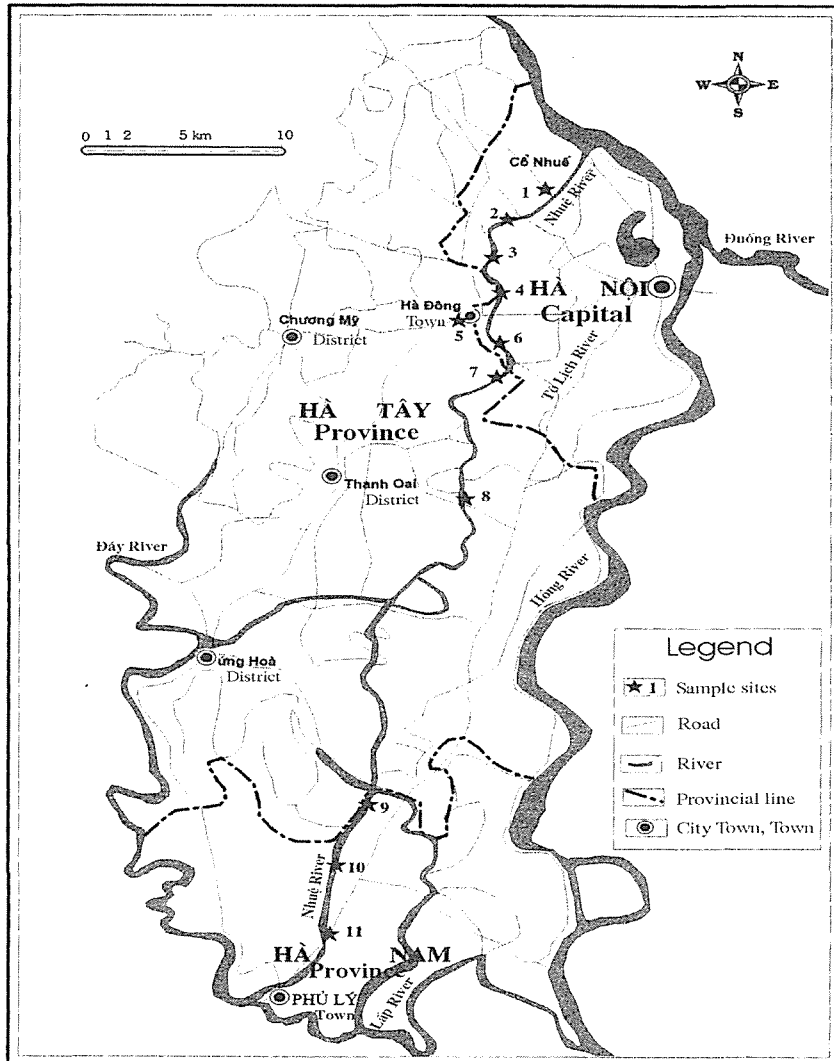


Figure 1: The map of sampling sites

Macro-invertebrate specimens were sampled by a pond net with the area of mesh size 1mm^2 (Figure 2) and a standard naturalist's dredge with the dredging area $0,02\text{m}^2$ (Figure 3). In shallow positions, samples were obtained by kicking method with the pond net during 3 minutes. In places where are covered with aquatic plant, the pond net was used to dig into them from 3 to 5 times to get specimens. In deeper positions the dredge was used. Samples were maintained in alcohol 90%.

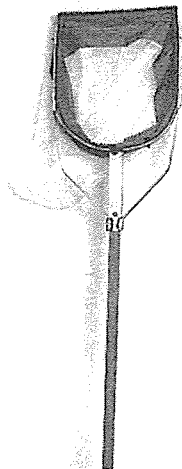


Figure 2: Pond net

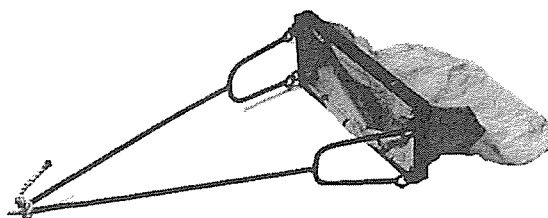


Figure 3: A standard naturalist's dredge

In order to serve the main aim of using macro-invertebrate as bioindicator for assessing water quality, samples were identified only until the family taxon based on published classification keys (Hawking and Smith, 1997; Idris, 1983; Patrick, 1981; Quynh et al, 2000; Quynh et al, 2001; Thanh, 1980; Thanh et al, 1980) and counted individual number of each family for determining their abundance.

Score calculation of BMWP was based on score system of England (Mustow, 1997) and modified one for Vietnam (Quynh et al, 2000; Quynh, 2001). Average score per taxon (ASPT) was computed by dividing the total of score to the number of families that were scored.

From the obtained results by computing BMWP and ASPT scores, pollution levels of studying sites of Nhue river were determined based on Table 1.

Table 1. Relationship between biological index ASPT and levels of pollution (Nguyen Xuan Quynh, 2001)

| ASPT score | Levels of pollution |
|------------|---|
| 0 | Over pollution (invertebrate is absent) |
| 1 - 2.9 | Very pollution (<i>Polysaprobe</i>) |
| 3 - 4.9 | Medium pollution α (α - <i>Mesosaprobe</i>) or rather pollution |
| 5 - 5.9 | Medium pollution β (β - <i>Mesosaprobe</i>) |
| 6 - 7.9 | Little pollution (<i>Oligosaprobe</i>) or rather clean |
| 8 - 10 | Clean water |

Results and Discussion

The results of analysing samples in 11 studying sites through 3 field sampling periods showed that the composition of macro-invertebrate was variably by time and sampling points.

The biodiversity of macro-invertebrate in Nhue river had a tendency to decrease gradually through 3 sampling periods that is resulted from a difference of diversity by season. In rainy season, the composition of macro-invertebrate was more diverse and abundant than in dry one: the first survey at beginning of rainy season (May, 2001) obtained 43 families, the second survey at the end of the same season (October, 2001)

did 39 families and the third survey at the end of dry season (April, 2002) had the lowest number of family (33 families).

There was also a difference in family number of macro-invertebrate in different studying sites along Nhue river. Total of family number were the highest in sites 4, 5, 9 and 11 and the lowest in sites 1, 3, 7 and 8.

Biodiversity and abundance of families belonging to different classes of macro-invertebrate in Nhue river closely related to the level of pollution. In the sites where the amount of sewage were discharged into the river too large as sites 7 and 3, there were only families that have an ability to tolerate well a bad quality of water such as family Unionidae belonging to the class Bivalvia or resist with high abundance such as Viviparidae and Thiaridae belonging to the class Gastropoda, while families belonging to the order Decapoda and the class Insecta are poorer than the others.

Based on the score system BMWP^{ENGLAND} (Mustow, 1997) and BMWP^{VIETNAM} (Quynh et al, 2000; Quynh, 2001), biological indices ASTP of every sampling site in each survey period were computed. Comparing the scores of ASTP to Table 1, levels of pollution in studying points of three sampling periods were obtained (Table 2).

Table 2. Levels of pollution according to biological indices ASPT in studying sites

| Studying points | May, 2001 | | October, 2001 | | April, 2002 | |
|--|-----------|-----------------------|---------------|-----------------------|-----------------------|-----------------------|
| | ASTP | Level of pollution | ASTP | Level of pollution | ASTP | Level of pollution |
| <i>According to BMWP^{ENGLAND}</i> | | | | | | |
| 1 | 4,7 | α -Mesosaprobe | 4,5 | α -Mesosaprobe | 6,0 | Oligosaprobe |
| 2 | 5,2 | β -Mesosaprobe | 5,4 | β -Mesosaprobe | 3,8 | α -Mesosaprobe |
| 3 | 5,5 | β -Mesosaprobe | 4,8 | α -Mesosaprobe | Could not do sampling | |
| 4 | 5,4 | β -Mesosaprobe | 4,8 | α -Mesosaprobe | 3,9 | α -Mesosaprobe |
| 5 | 4,8 | α -Mesosaprobe | 5,0 | β -Mesosaprobe | 4,5 | α -Mesosaprobe |
| 6 | 4,1 | α -Mesosaprobe | 4,4 | α -Mesosaprobe | 4,1 | α -Mesosaprobe |
| 7 | 3,7 | α -Mesosaprobe | 3,8 | α -Mesosaprobe | 3,6 | α -Mesosaprobe |
| 8 | 3,5 | α -Mesosaprobe | 4,3 | α -Mesosaprobe | 3,8 | α -Mesosaprobe |
| 9 | 4,7 | α -Mesosaprobe | 5,2 | β -Mesosaprobe | 4,4 | α -Mesosaprobe |
| 10 | 4,4 | α -Mesosaprobe | 4,4 | α -Mesosaprobe | 4,2 | α -Mesosaprobe |
| 11 | 4,5 | α -Mesosaprobe | 5,7 | β -Mesosaprobe | 4,5 | α -Mesosaprobe |
| <i>According to BMWP^{VIETNAM}</i> | | | | | | |
| 1 | 3,4 | α -Mesosaprobe | 3,3 | α -Mesosaprobe | 3,5 | α -Mesosaprobe |
| 2 | 3,9 | α -Mesosaprobe | 4,1 | α -Mesosaprobe | 3,2 | α -Mesosaprobe |
| 3 | 3,6 | α -Mesosaprobe | 3,6 | α -Mesosaprobe | Could not do sampling | |
| 4 | 4,4 | α -Mesosaprobe | 3,7 | α -Mesosaprobe | 3,2 | α -Mesosaprobe |
| 5 | 3,9 | α -Mesosaprobe | 4,0 | α -Mesosaprobe | 3,9 | α -Mesosaprobe |
| 6 | 3,4 | α -Mesosaprobe | 3,6 | α -Mesosaprobe | 3,9 | α -Mesosaprobe |
| 7 | 3,2 | α -Mesosaprobe | 3,5 | α -Mesosaprobe | 3,5 | α -Mesosaprobe |
| 8 | 3,5 | α -Mesosaprobe | 3,9 | α -Mesosaprobe | 4,0 | α -Mesosaprobe |
| 9 | 3,8 | α -Mesosaprobe | 3,8 | α -Mesosaprobe | 3,9 | α -Mesosaprobe |
| 10 | 3,7 | α -Mesosaprobe | 3,8 | α -Mesosaprobe | 3,7 | α -Mesosaprobe |
| 11 | 3,8 | α -Mesosaprobe | 4,2 | α -Mesosaprobe | 4,2 | α -Mesosaprobe |

The results in Table 2 showed that according to the score system BMWP^{VIETNAM} all studying sites of 3 sampling periods in Nhue river were belonging to the medium level of pollution α (α -Mesosaprobe) and biological indices ASTP did not vary considerably (only from 3.2 to 4.6) between sites while according to

the score system BMWP^{ENGLAND}, in the sampling site 1 of the third survey, score ASTP was 6.0 and belonging to the little level of pollution (*Oligosaprobe*). Furthermore, the obtained result of pollution level based on the score system BMWP^{VIETNAM} was suitable to the analysed result of physical and chemical indices that were carried in the same time during three surveys at 11 sampling sites. Therefore, it is possible to conclude that the score system BMWP^{VIETNAM} is better than the score system BMWP^{ENGLAND} in the case, because all sampling sites along the Nhue river have been impacted by many factors of pollution such as sewage water, pesticide, chemical fertilizers, waste matters from profession villages along two sides of Nhue river, etc.... without treatment, specially sewage water from To Lich river. That is why the sampling site 7, the site just before discharging sewer of To Lich river, was the highest level of pollution.

The site belonging to the second level of pollution was the site 10 where people usually loaded all waste matters into the river directly or just on the shore of the river. Sites where population is crowded or there are public rubbish grounds on two sides of river were belonging to the highest level of pollution and the level of pollution also had been increasing through 3 surveys such as the sampling the site 3 near Dien bridge and the site 4 near Nhue river bridge.

The sampling site with the highest ASTP score was the site 11 (the last one of Nhue river) but it was also belonging to the medium level of pollution α . It showed that the amount of sewage was discharged into Nhue river over the self-clean capacity of it.

Conclusions

1. The composition of macro-invertebrate in Nhue river was rather diverse, consisting of 43 families and representatives of the class Oligochaeta. The composition of macro-invertebrate in rainy season was more diverse and abundant than in dry one.
2. There was a difference about family number of macro-invertebrate in different studying sites along Nhue river. Total of family number were the highest in sites 4, 5, 9 and 11 and the lowest number of family were in sites 1, 3, 7 and 8.
3. Based on biological indices ASPT that were calculated by the score system BMWP^{VIETNAM} showed that the level of pollution at 11 studying sites in Nhue river during three survey periods were belonging to the medium level of pollution α (α - *Mesosaprobe*) but all ASTP scores mainly were in a low interval, from 3,2 to 4,0 and near to the level of very pollution (*Polysaprobe*). Therefore, it is clear that the water quality of Nhue river has been polluted critically and needs solutions to prevent and minimize the pollution of water environment in the river.

References

1. Hawking J.H. and F.J. Smith. *Colour Guide to Invertebrates of Australian Inland waters*. Co-operative Research Centre for Freshwater Ecology Press, Albury, Identification Guide, (8), p. 213, (1997)
2. Idris B.A.G. *Freshwater Zooplankton of Malaysia (Crustacea: Cladocera)*. Penerbit University Pertanian Malaysia, p. 153, (1983).
3. Mustow S.E.. *Aquatic macroinvertebrates and environmental quality of rivers in northern Thailand*. PhD thesis, University of London. (1997)
4. Patrick Mc Cafferty W.. *Aquatic Entomology, The fishermen' and Ecologist's illustrated Guide to Insects and their Relatives*. Jone and Bartlett Publishers, Boston, London, p. 488 (1981)
5. Quynh Nguyen Xuan, Mai Dinh Yen, Cliver 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, U.K., p. 103 (2000)

6. Quynh Nguyen Xuan, Clive Pinder, Steve Tilling. *Identification of common freshwater invertebrate in Vietnam*. VNU publish house, Hanoi, pp. 66 (in Vietnamese), (2001)
7. Quynh Nguyen Xuan. *Establishing producers for monitoring and assessing freshwater quality by using macro-invertebrate in Vietnam*. Journal of Biology, 23 (3a), Hanoi: 82-88. (in Vietnamese), (2001)
8. Thanh Dang Ngoc. *Fauna of freshwater invertebrate in the North of Vietnam*. Scientific and technical publish house, Hanoi, p. 464 (in Vietnamese), (1980)
9. Thanh Dang Ngoc, Tran Thai Bai, Pham Van Mien. *Identification of freshwater invertebrate in the North of Vietnam*. Scientific and Technical publish house, Hanoi, p.537 (in Vietnamese), (1980)