

Using Macro-Invertebrates as Bio-indicators to Assess Water Quality in Selected Water Bodies of Xuan Son National Park, Phu Tho Province

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Abstract: The present study aims to assess environmental condition of selected water bodies in Xuan Son National Park, Phú Thọ province. Field surveys in 2015 have yielded 60 macro-invertebrate families that were included in the BMWP^{Viet} scoring system, which were collected from 19 sampling sites. The ASPT scores showed that the water quality in 13 of those sampling sites were fairly clean (Oligosaprobe) with values ranging from 6.0 - 6.5. The remaining six sampling sites had ASPT scores ranging from 5.5 - 5.9, corresponding to quite polluted level (β -Mesosaprobe). In general, the water quality of water bodies in Xuan Son NP is still safe for aquatic organisms' lives.

Keywords: Macro-invertebrates, bio-indicators, BMWP, ASPT, Xuan Son National park.

1. Introduction

Xuan Son National Park (NP), which is located in Tan Son district, Phú Thọ province, is considered an area contains high biodiversity. This NP has spectacular natural landscapes, making it an ideal destination for eco-tourism. Over the last few years, the NP has been trying to boost eco-tourism activities, to receive more visitors. The NP is also home of thousands local people. The livelihoods of the local people are mainly traditional agriculture. All the daily activities of local people, as well as the activities of tourists certainly have some

impacts on the quality of water bodies within the area.

Therefore, this study is aim to assess the environmental conditions of selected water bodies in Xuan Son NP, using freshwater macro-invertebrates as biological indicators (bio-indicators).

2. Materials and methods

Field surveys were conducted in May and August 2015, with 19 sampling sites, as listed below and in Figure 1.

TS1: Xuan Son, Xoan stream, Lung Mang area.

TS2: Xuan Son, A stream by the road, Lung Mang area.

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TS3: Kim Thuong, Tan Ong stream, at Chin Tang waterfall.

TS4: Kim Thuong, Tan Ong stream, ca. 2km from Chin Tang waterfall.

TS5: Kim Thuong, Tân Ong stream, ca. 4km from Chin Tang waterfall.

TS6: Kim Thuong, Ha Bang stream, near the confluence with Xoan stream.

TS7: Kim Thuong, Xoan stream, near the confluence with Ha Bang stream.

TS8: Kim Thuong, Chieng stream, near ranger station.

TS9: Kim Thuong, Xoan stream.

TS10: Kim Thuong, Ha Bang stream.

TS11: Lap stream, at Ngoc waterfall.

TS12: Lap stream, 1st concrete bridge from Ngoc waterfall.

TS13: Lap stream, 2nd concrete bridge from Ngoc waterfall.

TS14: Đông Sơn, Than stream.

TS15: Đông Sơn, Than stream.

TS16: Đông Sơn, Than stream.

TS17: Ban Coi, Coi stream, by the road to Tan Son.

TS18: Ban Coi, Coi stream, near bridge.

TS19, Ban Coi, Coi stream, water from underground.

Aquatic macro-invertebrates were collected by using pond nets and hand nets, according to the methods illustrated by Nguyen Xuan Quynh *et al.* (2004) [1]. Specimens were then preserved in 70% ethanol.

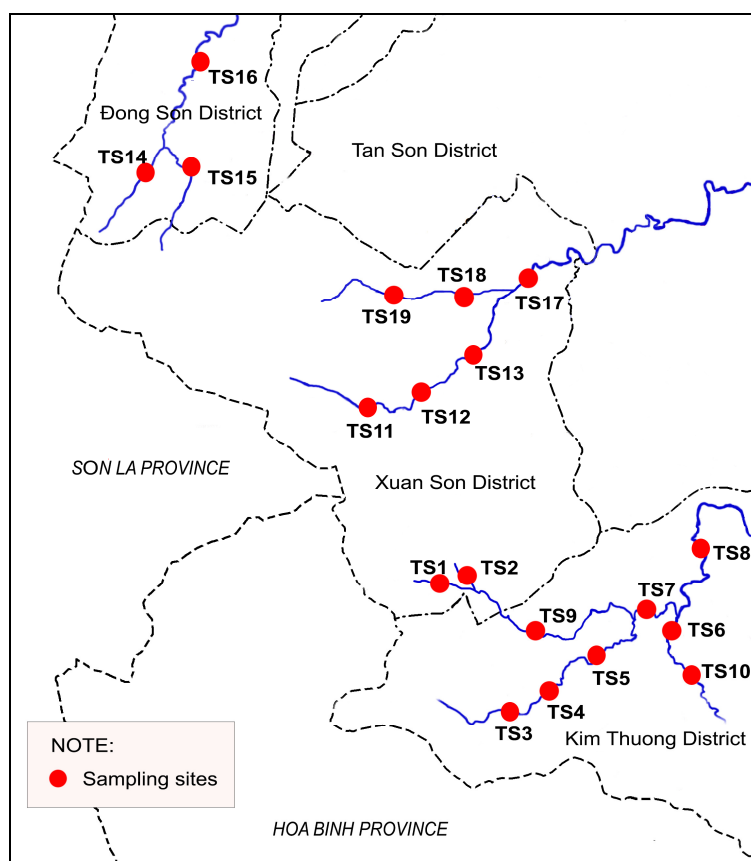


Figure 1. Location of sampling sites in Xuan Son NP.

The protocol of water quality assessment using macro-invertebrates as bio-indicators was implemented according to [1-3]. This protocol has been adopted and applied in many countries [1-3].

Macro-invertebrates were identified to family level, based on published identification keys in [1, 4-6]. BMWP scores (Biological Monitoring Working Party) were calculated according to the BMWP^{VIET} scoring system [1]. The total BMWP score of each sampling site was the total sum of BMWP score for each family encountered in the sample. The ASPT score (Average Score Per Taxon) was the total BMWP score of a sampling site divided by the number of families counted for BMWP score in that site.

The water quality and pollution levels of each sampling site was assessed by matching the BMWP and ASPT scores with the scale presented in Table 1.

Table 1. Classification of pollution level based on the ASPT score [7]

ASPT score	Pollution level
0	Extremely polluted (no macro-invertebrates found)
1.0 - 2.9	Polysaprobe (very polluted)
3.0 - 4.9	α -Mesosaprobe (quite polluted)
5.0 - 5.9	B-Mesosaprobe (quite polluted)
6.0 - 7.9	Oligosaprobe (fairly clean)
8.0 - 10	Clean water

3. Results and discussion

Field collection and identification of specimens have resulted in 83 macro-invertebrate families (Table 2). Among them, 60 families were included in the BMWP^{VIET} scoring system, most of them were aquatic insects.

Table 2. Number of macro-invertebrate families collected from the Xuan Son NP

Taxon	Number of families collected	Number of families included in BMWP ^{VIET} scoring system
ARTHROPODA:		
INSECTA		
Odonata	12	10
Ephemeroptera	12	7
Trichoptera	13	10
Diptera	10	4
Plecoptera	4	3
Coleoptera	8	7
Hemiptera	12	8
Megaloptera	1	1
ARTHROPODA:		
CRUSTACEA		
Decapoda	3	3
MOLLUSCA		
Gastropoda	7	1
Bivalvia	1	1
Total	83	60

The BMWP and ASPT scores for each sampling site are presented in Table 3. Among 19 sampling sites, no site was classified as clean water. Six sites (TS1, TS7, TS8, TS10, TS17 and TS18) were classified at the β -Mesosaprobe level, with ASPT scores ranging from 5.5 to 5.9. The remaining 13 sampling sites (two thirds of the total sampling sites) were classified at the Oligosaprobe level, or fairly clean water quality, with ASPT scores ranging from 6.0 to 6.5. All the sites of the Oligosaprobe level were located far from village, or near headwaters, less disturbed by human, while the sites of the β -Mesosaprobe level were located near villages, more or less being polluted by domestic wastewater, cattle waste and fertilizer, etc.

Table 3. BMWP and ASPT scores and assessment of pollution level in each sampling site

Site	No. of families	Total BMWP score	ASPT score	Pollution level
TS1	23	127	5.5	β -Mesosaprobe
TS2	25	150	6.0	Oligosaprobe
TS3	24	144	6.0	Oligosaprobe
TS4	23	143	6.2	Oligosaprobe
TS5	22	141	6.4	Oligosaprobe
TS6	21	129	6.1	Oligosaprobe
TS7	20	119	5.9	β -Mesosaprobe
TS8	21	120	5.7	β -Mesosaprobe
TS9	22	133	6.0	Oligosaprobe
TS10	16	95	5.9	β -Mesosaprobe
TS11	24	157	6.5	Oligosaprobe
TS12	23	145	6.3	Oligosaprobe
TS13	26	167	6.4	Oligosaprobe
TS14	21	126	6.0	Oligosaprobe
TS15	21	131	6.2	Oligosaprobe
TS16	25	161	6.4	Oligosaprobe
TS17	22	123	5.5	β -Mesosaprobe
TS18	23	137	5.9	β -Mesosaprobe
TS19	24	147	6.1	Oligosaprobe

Overall, the water quality of the selected water bodies in Xuan Son NP were determined from fairly clean to quite polluted, and still considered safe for aquatic organisms. However, for a sustainable development of the area's economy, including eco-tourism, a management plan is needed. The aquatic organisms in particular and the whole natural environment of Xuan Son NP will be badly affected if the water resources are polluted.

4. Conclusion

From field surveys in 19 sampling sites in Xuan Son NP, Phu Tho province, we have identified 60 macro-invertebrate families that were included in the BMWP^{VIET} scoring

system. Based on the calculated ASPT scores, the water quality at these sampling sites were determined as fairly clean (Oligosaprobe level) or quite polluted (β -Mesosaprobe level), with ASPT scores ranging from 5.5 - 6.5. In general, the water quality was considered to be safe for the lives of aquatic organisms. However, there is a need for a management plan that helps to develop the area's economy, including eco-tourism without compromising the natural environment. If the water resources are polluted, the aquatic organisms in particular and the whole natural environment of Xuan Son NP will be badly affected.

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Sử dụng Động vật không xương sống cỡ lớn làm sinh vật chỉ thị quan trắc và đánh giá chất lượng nước các thủy vực ở Vườn Quốc gia Xuân Sơn, tỉnh Phú Thọ

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Tóm tắt: Nghiên cứu này nhằm đánh giá chất lượng nước các thủy vực ở VQG Xuân Sơn, tỉnh Phú Thọ. Năm 2015, với 19 điểm thu mẫu đại diện cho các thủy vực ở VQG đã xác định được 60 họ động vật không xương sống cỡ lớn nằm trong hệ thống tính điểm BMWP^{VIET}. Kết quả tính toán chỉ số ASPT cho thấy có 13 điểm thu mẫu có chất lượng nước ở mức ít bẩn (Oligosaprobe) với ASPT dao động từ 6,0 - 6,5. Sáu điểm thu mẫu còn lại có chất lượng nước ở mức bẩn vừa (β -Mesosaprobe) với ASPT dao động từ 5,5-5,9. Nhìn chung, chất lượng nước các thủy vực ở VQG Xuân Sơn hiện đang ở ngưỡng an toàn, thuận lợi cho đời sống của thủy sinh vật.

Từ khóa: Động vật không xương sống cỡ lớn, sinh vật chỉ thị, BMWP, ASPT, Vườn Quốc gia Xuân Sơn.