

Aquatic Biodiversity of the 6 main lakes of Hanoi city and the necessity of its conservation

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Abstract

1. Hanoi city was built up on the wetland landscape of the Red River delta therefore it has a network of many lakes and rivers.
2. The aquatic biodiversity (Macrophytes, Invertebrates, Fishes, Vertebrates) of the 6 main lakes (Ho Tay, Hoan Kiem, Bay Mau, Giang Vo, Dong Da, Thanh Nhan) are rich and diverse. It represents the patterns of Red River delta one's. Many rare and endangered species are found in these lakes particularly a giant freshwater turtle species in Hoan Kiem lake.
3. All of these lakes are more or less polluted. Their environments are seriously degrading both in water quality and aquatic biodiversity.
4. Based on socio-economical and cultural role of these lakes of Hanoi city, it is very necessary to preserve and to restore their environments and aquatic biodiversity: water pollution control, landscape planning, making roads around the lakes and erosion control for their banks, legislation measures, rational exploitation of aquatic biodiversity, restoration the artificial wetlands with macrophytes.

Introduction

Since the year '61, I have opportunity to carry out some surveys on the aquatic biodiversity and water qualities of the 6 main lakes of Hanoi city (Ho Tay, Bay Mau, Hoan Kiem, Dong Da, Giang Vo, Thanh Nhan). Many papers have been reported (1) (2) (3) (4) (5).

Hanoi city was built up on a riverine wetland landscape since the year 1010 under the Ly dynasty. The first map of Hanoi city (= Thang Long city) (Hong Duc maps 1470) showed that there are high percentage of surface water at that time. The urbanisation of Hanoi city is rapidly since the time of French colonisation (1884), particularly since the years' 90 by the policy "open the door" of the Vietnamese government. Many lakes have been converted into the human settlements. Nevertheless, now, with too many lakes (~20) in the centre of Hanoi city (more 500 ha), Hanoi is considered as (even) a city of lakes!

Methods

For surveys on the aquatic biodiversity, I used the classical textbook of Limnology. For identification the freshwater organisms of Vietnam, I used the book as (6) (7) (8). For water quality analysis I used the book of APHA (9).

Results

1. Natural conditions of the 6 main lakes

The water drainage system of Hanoi city centre composes a network of many lakes and rivers (excluding Red River) (Map 1). The total surface area of all lakes are more than 500 ha. Among them, 6 main lakes are Ho Tay, Bay Mau, Hoan Kiem, Dong Da, Giang Vo, Thanh Nhan. Ho Tay lake is the most important with 413 ha and has origin of portion of Red River (15000 years ago). The depth of all these lakes is shallow with average 2 m. There are two seasons for these lakes: rainy season (VI - VIII) and dry season (XI - IV). The precipitation of Hanoi city is 1700 mm/year. In case of all these lakes are located in the centre of human settlements therefore these lakes have received both rainy water and waste water of their watershed. These lakes are working as water reservoir and waste water purification for the city.

2. Aquatic biodiversity of the 6 main lakes and its values in socio-economical and cultural development of Hanoi city

Aquatic biodiversity of the 6 main lakes of Hanoi city is very rich and diverse. There are 18 species of aquatic macrophyte, 82 species (or genus) of aquatic invertebrate, 39 species of fish, 21 species of aquatic or aquatic-related vertebrate. The aquatic flora and fauna here represented the flora and fauna of Red River delta lakes (Tables 1, 2, 3, 4). The aquatic biodiversity of Ho Tay lake is the most interesting. It contents some rare and endangered species which were unregistered in the Red data Book of Vietnam (10). There are 3 new described species of Invertebrates and Fishes. The common carp species living here has many races. The Hoan Kiem lake has a giant freshwater turtle which was unregistered in the Red data Book of Vietnam. The values of socio-economical and cultural of aquatic biodiversity of these lakes are very important. Annually, these lakes have produced more than 500 tons of fishes. For the city these lakes are working now as: water reservoir of drainage system, waste water purification for human settlements, recreative, leisure, sporting areas for the people, water supply for domestic uses and irrigation, environmental education for schoolchildren and mass-media

3. Aquatic Biodiversity degradation and its causes

The degradation of Aquatic biodiversity of the 6 main lakes is very seriously. The species

composition of the different taxonomical groups is more and more poor. The aquatic macrophytes are remained some species and with small areas of distribution. The migratory bird population were not occurring in the Ho Tay lake since 10 years ago. The White heron population in the Bay Mau lake was disappeared. The benthic mollusc populations of the Ho Tay lake were decreased quickly. The aquatic bioindicators for pollution are increased. The wild species of fished are decreased. Some lakes are heavily polluted therefore they do not used in aquaculture. It is very particularly that the giant freshwater turtle in Hoan Kiem lake is absolutely in protection. I have collected one silver carp which was in mutation very particularly (with long fins).

The causes of the degradation of aquatic biodiversity are numerous: it could be enumerated here:

- pollution of water for these lakes. Most of main water chemistry parameters are over the standards (11) (Table 5)
- high sedimentation. The speed of sedimentation of the 5 main lakes (excluding Ho Tay lake) is average 10 cm/year. The mud layer of Ho Tay lake is more than 1 m.
- urbanisation rapidly. The total surface area of these lakes is reduced by invasion of human settlements (Ho Tay, Thanh Nhan, Dong Da, Giang Vo).
- Habitat deterioration such as water qualities are polluted, disappearing the aquatic macrophytes, high sedimentation...
- Unrational exploitations: overexploitations of molluscs, shrimps,...shooting the birds.
- Lack of awareness for Environmental Protection in general and for aquatic biodiversity in particular.

4. Measures must be implemented for conservation / restoration of aquatic biodiversity of the 6 main lakes

Based on the values of aquatic biodiversity in socio-economical and cultural development of Hanoi city. It is very necessary to implement a system of measures for conservation / restoration of aquatic biodiversity such as:

- water pollution control. The waste water of the city does not discharge into the lakes.
- Making roads around the lakes for stopping the invasion of human settlements.
- Landscape planning and erosion control for the banks
- Rational exploitation of aquatic biodiversity
- Mass-media education in Environmental Protection
- Legislation measures for good management. It could be better planned to consider Ho Tay lake and Hoan Kiem lake as "Regional" Parks
- Restoration the wetlands around the lake shores.

References

- (1) *Mai Dinh Yen and others, 1961*. Preliminary investigation on Hydrobiological and Aquatic Resources of lake Ho Tay (Hanoi). West-Pacific Fisheries Congress, Ulan Bator, Mongolia.
- (2) *Mai Dinh Yen, 1991*. Hoan Kiem lake ecosystem (in Vietnamese) (unpublished)
- (3) *Mai Dinh Yen, 1993*. West lake (= Ho Tay lake) in "Survey of the State of World lakes", Volume V., Publication of ILEC and UNEP.
- (4) *Mai Dinh Yen and others, 1995*. Analysis and Assessment of the water quality of some lakes of Hanoi (in Vietnamese). Journal of Biology 17(1) (CD): 14-18
- (5) *Mai Dinh Yen and others, 1998*. Biological studies for drainage project for Environmental Improvement in Hanoi first stage. Hanoi Drainage Project (unpublished)
- (6) *Dang Ngoc Thanh and others, 1980*. Identification of freshwater invertebrate animals of North Vietnam (in Vietnamese). Science and Technic Publishing House, Hanoi.
- (7) *Mai Dinh Yen, 1978*. Identification of freshwater fish species of North Vietnam (in Vietnamese). Science and Technic Publishing House, Hanoi.
- (8) *Vo Qui, 1975*. Bird species of Vietnam Tome 1 2 (in Vietnamese). Science and Technic Publishing House, Hanoi.
- (9) *APHA, 1982*. Standard methods for the examination of water and waste water. Publication office American Public Health Association 15th ed.

Table 1

List of Aquatic Macrophytes occurring in 6 main lakes of Hanoi city

N° (1)	Name of macrophyte (2)	Ho Tay lake (3)	Bay Mau lake (4)	Hoan Kiem lake (5)	Dong Da lake (6)	Giang Vo lake (7)	Thanh Nhan lake (8)
	<u>Salviniaceae</u>						
1	<i>Salvinia cucullata</i>	+					
2	<i>S. natans</i>	+					
	<u>Potamogetonae</u>						
3	<i>Potamogeton polygonifolius</i>	+					
4	<i>P. crispus</i>	+					
	<u>Convolvulaceae</u>						
5	<i>Ipomea aquatica</i>	+			+	+	+
	<u>Araceae</u>						
6	<i>Pistia stratiotes</i>	+			+		
	<u>Azollaceae</u>						
7	<i>Azolla pinnata</i>	+					
	<u>Lemnaceae</u>						
8	<i>Lemna minor</i>	+	+		+	+	+
	<u>Nelumbonaceae</u>						
9	<i>Nelumbium nucifera</i>	+					
	<u>Nymphaeaceae</u>						
10	<i>Nymphaea stellata</i>	+		+			
	<u>Menyanthaceae</u>						
11	<i>Limnanthemum indicum</i>	+					
	<u>Pontederiaceae</u>						
12	<i>Eichhornia crassipes</i>	+	+		+	+	+
	<u>Ceratophyllaceae</u>						
13	<i>Ceratophyllum demersum</i>	+					
	<u>Hydrocharitaceae</u>						
14	<i>Hydrilla verticillata</i>	+					
15	<i>Vallisneria spiralis</i>	+					
	<u>Haloragaceae</u>						
16	<i>Myriophyllum spicatum</i>	+					
	<u>Lentibulariaceae</u>						
17	<i>Utricularia aurea</i>	+					
	<u>Hydrocaryiaceae</u>						
18	<i>Trapa bicornis</i>	+					

Table 2

List of Aquatic Invertebrates living in 6 main lakes of Hanoi city

N ^o (1)	Name of Taxa (2)	Ho Tay lake (3)	Bay Mau lake (4)	Hoan Kiem lake (5)	Dong Da lake (6)	Giang Vo lake (7)	Thanh Nhan lake (8)
	<u>Rotatoria</u>						
1	<i>Brachionus caudatus</i>	+	+	+			
2	<i>B. diversicornis</i>	+	+	+	+	+	+
3	<i>B. calyciflorus</i>	+	+	+		+	
4	<i>B. forficula</i>	+	+	+	+	+	+
5	<i>B. urceus</i>	+	+	+	+	+	+
6	<i>B. angularis</i>	+	+	+	+	+	+
7	<i>B. budapestinensis</i>	+	+	+		+	+
8	<i>B. falcatus</i>	+	+	+	+	+	+
9	<i>B. quadridentatus</i>		+	+	+	+	
10	<i>Keratella tropica</i>	+		+	+	+	+
11	<i>K. cochlearis</i>	+		+			
12	<i>Anuraeopsis fissa</i>	+					
13	<i>Platyias quadricornis</i>		+	+		+	
14	<i>P. patulus</i>	+	+	+			
15	<i>Asplanchna sieboldi</i>		+	+	+	+	+
16	<i>Asplanchnopus multiceps</i>	+					
17	<i>Rotaria rotaria</i>	+	+	+			
18	<i>R. neptunia</i>	+	+	+			
19	<i>Philodina roseola</i>	+	+	+			
20	<i>Trichocerca (Duirella) tigri</i>	+	+				
21	<i>T. (Trichocerca) capucina</i>	+	+	+			
22	<i>T. (Trichocerca) pusilla</i>	+					
23	<i>T. (Trichocerca) longiseta</i>	+	+	+			+
24	<i>T. (Trichocerca) cylindrica</i>	+	+	+	+	+	+
25	<i>T. (Trichocerca) ucina</i>				+	+	+
26	<i>Ploesoma truncatum</i>	+	+		+	+	
27	<i>Polyathra vulgaris</i>	+	+	+	+	+	+
28	<i>Lecane (Monostyla) bulla</i>	+	+		+	+	
29	<i>L. (Lecane) luna</i>	+	+	+	+	+	+
30	<i>L. (Lecane) leontina</i>	+	+	+			+
31	<i>Filinia longiseta</i>	+	+	+			
32	<i>F. brachia</i>		+				
33	<i>Pompholyx complanata</i>	+	+	+	+	+	+
34	<i>Hexathra mira</i>	+	+				
35	<i>Metadiaschiza trigona</i>	+					
	<u>Cladocera</u>						
36	<i>Bosmina longirostris</i>					+	

37	<i>Macrothrix spinosa</i>	+		+	+			
38	<i>M. triserialis</i>			+	+			
39	<i>Scapholeberis Kingi</i>			+				+
40	<i>Moina dubia</i>	+		+			+	
41	<i>Moinodaphnia macleayii</i>	+		+	+			
42	<i>Ceriodaphnia rigaudi</i>	+						
43	<i>Diaphanosoma</i>					+	+	
44	<i>leuchtenbergianum</i>	+						
45	<i>Chydorus sphaericus</i>			+	+			
46	<i>Alona rectangula</i>				+			
47	<i>Camptocercus vietnamensis</i>	+						
48	<i>Biapertura pseudoverrucosa</i>				+			
	<i>Kurzia longirostris</i>							
	<u>Ostracoda</u>							
49	<i>Heterocypris anomala</i>	+				+		
	<u>Conchostraca</u>							
50	<i>Cyclestheria hislopi</i>	+						
	<u>Copepoda</u>							
51	<i>Mesocyclops leuckarti</i>	+		+	+	+	+	+
52	<i>Thermocyclops taihokuensis</i>	+				+	+	
53	<i>T. hyalinus</i>	+						
54	<i>Microcyclops varicans</i>			+	+		+	+
55	<i>Paracyclops fimbriatus</i>						+	+
	<u>Decapoda</u>							
56	<i>Macrobrachium nipponense</i>	+						
57	<i>Palaemonetes tonkinensis</i>						+	
58	<i>Somanniathelphusa sinensis</i>					+	+	
	<u>Amphipoda</u>							
59	<i>Grandidierella vietnamica n.sp.</i>	+						
	<u>Oligochaeta</u>							
60	<i>Branchiodrilus semperi</i>	+		+	+	+	+	+
61	<i>Branchiura sowerbyi</i>	+		+	+			+
62	<i>Limnodrilus hoffmeisteri</i>	+		+	+		+	+
	<u>Chironomidae</u>							
63	<i>Chironomus</i>	+		+	+	+	+	+
64	<i>Tanytus</i>	+		+	+	+	+	+
65	<i>Culex</i>					+	+	+
	<u>Gastropoda</u>							
66	<i>Sinotaia aeruginosa</i>	+			+			
67	<i>Angulyagra polyzonata</i>	+						
68	<i>A. boettgeri</i>					+		
69	<i>Allocinma longicornis</i>	+						
70	<i>Lymnea swinhoi</i>	+			+	+	+	+

71	<i>L. viridis</i>				+	+	+
72	<i>Melanoides tuberculatus</i>	+		+		+	
73	<i>Gyraulus convexiusculus</i>				+	+	+
74	<i>Hippeutis umbilicalis</i>					+	+
	<u>Hemiptera</u>						
75	<i>Sphoerodema</i>				+	+	
76	<i>Micronecta</i>				+	+	+
77	<i>Anisops varius</i>					+	+
78	<i>Laccotrephes</i>				+		
	<u>Coleoptera</u>						
79	<i>Cybister</i>				+		
80	<i>Canthydrus</i>				+		
81	<i>Hydrophilidae larvae</i>				+		
	<u>Odonata</u>						
82	<i>Ichtiogomphus decoratus</i>				+		

Table 3

List of fishes living in 6 main lakes of Hanoi city

N° (1)	Name of fish species (2)	Ho Tay lake (3)	Bay Mau lake (4)	Hoan Kiem lake (5)	Dong Da lake (6)	Giang Vo lake (7)	Thanh Nhan lake (8)
	<u>Cyprinidae</u>						
1	<i>Cyprinus carpio</i>	+	+	+	+	+	+
2	<i>Carassius auratus</i>	+	+	+	+	+	+
3	<i>Hypophthalmichthys molitrix</i>	+	+	+	+	+	+
4	<i>Aristichthys nobilis</i>	+	+	+	+	+	+
5	<i>Cirrhina molitorella</i>	+	+	+	+	+	+
6	<i>Labeo rohita</i>	+	+	+	+	+	+
7	<i>Carassioides cantonensis</i>	+					
8	<i>Cirrhina mrigala</i>	+	+		+	+	+
9	<i>Squaliobarbus curriculus</i>	+					
10	<i>Ctenopharyngodon idella</i>	+			+	+	+
11	<i>Megalobrama terminalis</i>	+					
12	<i>Erythroculter pseudobrevicauda</i>	+					
13	<i>Culter brevicauda</i>	+	+	+	+	+	+
14	<i>Mylopharyngodon piceus</i>	+					
15	<i>Elopichthys bambusa</i>	+					
16	<i>Luciobrama typus</i>	+					
17	<i>Toxabramis Houdmeri</i>	+	+	+	+	+	+
18	<i>T. hotayensis n. sp.</i>	+					
19	<i>Puntius semifasciolatus</i>	+			+	+	+
20	<i>Rasborinus lineatus</i>	+	+				
21	<i>Osteochilus salsburyi</i>	+					
22	<i>Hemiculter lencisculus</i>	+					
23	<i>Xenocypris argentea</i>	+					
	<u>Siluridae</u>						
24	<i>Parasilurus asotus</i>	+					
	<u>Clariidae</u>						
25	<i>Clarias fuscus</i>	+	+		+	+	+
	<u>Bagridae</u>						
26	<i>Pseudobagrus fulvidraco</i>	+					
	<u>Anabantidae</u>						
27	<i>Anabas testudineus</i>	+	+		+	+	+
28	<i>Macropodus opercularis</i>	+			+	+	+
	<u>Cichlidae</u>						
29	<i>Tilapia mossambica</i>	+	+	+	+	+	+
30	<i>T. nilotica</i>	+	+		+	+	+
	<u>Ophiocephalidae</u>						
31	<i>Ophiocephalus striatus</i>	+	+		+	+	+

32	<i>O. maculatus</i>	+					
	<u>Engraulidae</u>						
33	<i>Coilia Grayi</i>	+					
	<u>Eleotridae</u>						
34	<i>Eleotris balia</i>	+					
35	<i>Micropercops hotaya n.sp.</i>	+					
	<u>Cyprino dontidae</u>						
36	<i>Oryzias latipes</i>	+	+	+	+	+	+
	<u>Flutidae</u>						
37	<i>Fluta alba</i>	+	+	+	+	+	+
	<u>Cobitidae</u>						
38	<i>Misgurnusfossilis anguillicaudatus</i>	+	+	+	+	+	+
	<u>Mastacembelidae</u>						
39	<i>Mastacembelus armatus</i>	+					

Table 4

List of Aquatic Vertebrates occurring in 6 main lakes of Hanoi city

N ^o (1)	Name of Vertebrate (2)	Ho Tay lake (3)	Bay Mau lake (4)	Hoan Kiem lake (5)	Dong Da lake (6)	Giang Vo lake (7)	Thanh Nhan lake (8)
	<u>Batrachia</u>						
	<u>Ranidae</u>						
1	<i>Rana limnocharis</i>	+	+	+			
2	<i>R. rugulosa</i>	+	+	+			
3	<i>Ooeidozyga lima</i>	+	+		+	+	+
	<u>Microhylidae</u>						
4	<i>Kaloula pulchra</i>	+	+		+		
	<u>Reptilia</u>						
	<u>Colubrinae</u>						
5	<i>Xenochrophis piscator</i>	+	+	+	+	+	+
	<u>Homalopsinae</u>						
6	<i>Enhydryis plumbea</i>	+					
	<u>Emyidae</u>						
7	<i>Chinemys nigricans</i>			+			
8	<i>Pyxidae mouhoti</i>			+			
	<u>Trionychidae</u>						
9	<i>Pelodiscus sinensis</i>	+					
10	(?) <i>Pelochelys bibroni</i>			+			
	<u>Aves</u>						
	<u>Rallidae</u>						
11	<i>Fulica atra</i>	+					
12	<i>Amauromis phoenicurus</i>	+	+		+		+
	<u>Pharacrocoracidae</u>						
13	<i>Pharacrocorax niger</i>	+					
	<u>Anatidae</u>						
14	<i>Anas crecca</i>	+					
15	<i>A. clypeata</i>	+					
16	<i>A. querquedula</i>	+					
17	<i>Aythya baeri</i>	+					
	<u>Ardeidae</u>						
18	<i>Nycticorax nycticorax</i>	+	+				
19	<i>Ardeola bacchus</i>	+	+				
20	<i>Egretta garzetta</i>	+	+				
21	<i>Ardea cinerea</i>	+					

Table 5

Water quality of 6 main lakes of Hanoi city (data of the year' 93-94)

Parameter Lake	Surface area (ha)	Depth (m)	pH	DO (mg/l)	Cl ⁻ (mg/l)	N-NH ₄ ⁺ (mg/l)	P-PO ₄ ³⁻ (mg/l)	BOD ₅	COD (KMnO ₄) (mg/l)	COD (K ₂ Cr ₂ O ₇) (mg/l)	SS (mg/l)
Ho Tay lake	413	1.7	6.8-7.8	5.8	42-63	0.2-0.5	0.5-3	39-48	10-40	48-79	75-225
Bay Mau lake	21.5	2.3	7-7.8	2.2-6.7	71	4	2.7	18-23		100	150-200
Hoan Kiem lake	13	1.2	8.2-10.2	6-9	30	0.07-0.55	0.3-0.7	46-116	5.6-21.6	67-137	23-132
Dong Da lake	16	1.5	7.5	5.7	78	0.27	4	44	22.4	64	40
Giang Vo lake	6.5	3.5	5.5	3.3	53	0.25	12	76	55	82	50
Thanh Nhan lake	8.1	2.5	7.4	3.9	71	0.54	4	114	32	162	43
Vietnam surface water standards											
. A			6-8.5	≥6		0.05	<1	<4	10		20
. B			5.5-9	≥2		1	<4	<25	35		80
A=drinking water											
B=other uses											