

DIVERSITY OF ALGAE SPECIES IN XUANHUONG LAKE, DALAT

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Abstract

*Xuanhuong Lake is considered the heart of Dalat. In this study, algal abundance and diversity in Xuanhuong Lake were studied. Water samples were collected from four different sampling sites from September 2012 to January 2013. The identified species were 75 species belonging to 13 orders, 8 classes, 5 phyla (Cyanophyta, Chlorophyta, Bacillariophyta, Euglenophyta, Pyrrophyta). Chlorophyta has the most species with 33 species (44%), the next was Bacillariophyta with 18 species (24%), Cyanophyta with 12 species (16%), Euglenophyta with 11 species (15%), and the least was Pyrrophyta: 1 species (1%). There has also been bioindicator species including *Euglena viridis*, *Euglena acus*, and *Synedra ulna*. Therefore, Xuanhuong Lake is considered mesosaprobic*

Keywords: Bioindicator; Chlorophyta; Diversity; Xuanhuong Lake.

1. INTRODUCTION

Xuanhuong Lake is an artificial lake located in the center of Dalat city, which is closely connected to the history of Dalat city.

Xuanhuong Lake has an area of 32 ha and an average depth of 1.5m – 3.5m. It is located on an altitude of 1,478 m above sea level with a capacity of approximately 7.2 million m³. Xuanhuong Lake's perimeter is around 5 km; it has a crescent shape with many beautiful scenes alongside, such as Cu Hill, Yersin Park, and City Flower Garden. The water quality in the lake depends on the upper reach and watershed. Most of the waste water from tourism, business and agricultural activities is accumulated here.

In recent years, there have been several algal blooms in Xuanhuong Lake which have caused harmful influences on local people's life and tourism. The government and scientists have already organized various conferences to discuss the issue of water

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pollution regarding renovation of sedimentation tank, building bar screens to prevent large objects like cans, rags, sticks, plastic packets etc. to enter the sewage system, growing water hyacinth in the sedimentation tanks, etc. However, most studies have just focused on finding out the cause of the bloom or the algae species. There has been no research on the algae overview of Xuanhuong Lake to help people understand the relationships among species, biotic and abiotic factors as well as the energy and material cycle in lakes, especially the use of the local algae species to treat water pollution and limit algae bloom to help build an efficient and sustainable solution.

2. MATERIALS AND METHODS

2.1. Locations and time of sampling

- Time: from September 2012 to January 2013; 1 time/month.
- Locations: at the 4 positions located by GPS with the following coordinates:

Table 1. Coordinates and locations of sampling

Locations	Symbol of sampling locations	Coordinates	
		North latitude	East longitude
Near Causat	XHS1	11°56'52"	108°27'6"
Bichcau Lake	XHS2	11°56'21"	108°26'21"
Thanhthuy	XHS3	11°56'21"	108°26'16"
Middle lake	XHS4	11°56'22"	108°27'7"



Figure 1. Locations of sampling in Xuanhuong Lake

2.2. Collection and handling of samples

Samples of floating algae were collected with plankton nets N0. 64, N0. 70, N0. 75. Algae growing on surfaces were collected by hand.

The samples were fixed in 4% formaldehyde. The method of Nguyễn (2003) was used in the whole process.

2.3. Analysis sample and identification

Samples were analyzed at the laboratory of the Faculty of Biology, Dalat University with Cole Parmer, National Digital DC5-163 microscope.

Identification of samples is based on the morphology and classification criteria by Phạm (1972), Dương (1996), Dương and Võ (1997), Nguyễn (2003), Prescott (1962), Cole and Sheath (1990), Smith (1950) and Yamagishi (1992).

3. RESULTS AND DISCUSSION

75 species / subspecies of 13 orders, 8 Classes, 5 Phyla: *Cyanophyta*, *Chlorophyta*, *Bacillariophyta*, *Euglenophyta*, *Pyrrhophyta* (Table 2) have been identified.

Table 2. Species of microalgae at Xuanhuong Lake

STT	Taxon	Order	Class	Phylum
1	<i>Staurastrum paradoxum</i> Meyen	Desmidiales	Conjugatophyceae	Chlorophyta
2	<i>Closterium porrectum</i> Nordst.	-	-	-
3	<i>Pleurotaenium</i> sp.	-	-	-
4	<i>Staurastrum gracile</i> Ralfs.,	-	-	-
5	<i>Cosmarium</i> sp	-	-	-
6	<i>Closterium tumidum</i> Johns	-	-	-
7	<i>Spirogyra crassa</i> Kuetz.	Zygnematales	-	-
8	<i>Actinastrum</i> sp.	Chlorococcales	Chlorophyceae	-
9	<i>Dictyosphaerium Ehrenbergii</i> Naeg	-	-	-
10	<i>Pediastrum duplex</i> Meyen	-	-	-
11	<i>Pediastrum obtusum</i> Lucks	-	-	-
12	<i>Pediastrum simplex</i> var. <i>duodenarium</i> (Bailey) Rabenhorst	-	-	-
13	<i>Coelastrum microporum</i> Naeg.	-	-	-
14	<i>Coelastrum</i> sp.	-	-	-

Table 2. Species of microalgae at Xuanhuong Lake (cont.)

STT	Taxon	Order	Class	Phylum
15	<i>Actinastrum Hantzshii</i> Lagerh.	-	-	-
16	<i>Tetrastrum glabrum</i> Alstr.et Tiffany	-	-	-
17	<i>Tetrastrum multisetum</i> Chod.	-	-	-
18	<i>Scenedesmus bijugatus</i> Kuetz.	-	-	-
19	<i>Scenedesmus denticulatus</i> Lagerh.	-	-	-
20	<i>Scenedesmus acuminatus</i> Chodat	-	-	-
21	<i>Scenedesmus dimorphus</i> (Turp.) Kuetz.	-	-	-
22	<i>Scenedesmus quadricauda</i> var. <i>armatus</i> (Chodat.) Dedus.,	-	-	-
23	<i>Scenedesmus pseudoarmatus</i> var. <i>bicaudatus</i> Hortob.	-	-	-
24	<i>Crucigenia quadrata</i> Morren.	-	-	-
25	<i>Tetraedron lobatum</i> var <i>subtetraedricum</i> Reinsch.	-	-	-
26	<i>Ankistrodesmus</i> sp.	-	-	-
27	<i>Ankistrodesmus fusiformis</i> corda sensu Kors.	-	-	-
28	<i>Ankistrodesmus falcatus</i> var <i>spirilliformis</i> (W.et G.S.West) G.S. West	-	-	-
29	<i>Chlorella luteoviridis</i> Chod.	-	-	-
30	<i>Chlorella</i> sp.	-	-	-
31	<i>Ulothrix</i> sp.	Ulotrichales	-	-
32	<i>Pandorina morum</i> Bory.	Volvocales	-	-
33	<i>Gonium pectorale</i> Mull	-	-	-
34	<i>Melosira granulate</i> sp	Discinales	Centricae	Bacillariophyta
35	<i>Cyclotella</i> sp.	-	-	-
36	<i>Stephanodiscus</i> sp.	-	-	-
37	<i>Synedra acus</i> Kuetz.	Araphinales	Pennatae	-
38	<i>Achnanthes exigua</i> Grun.	Raphinales	-	-
39	<i>Achnanthes</i> sp.	-	-	-
40	<i>Cymbella</i> sp.	-	-	-
41	<i>Gomphonema longiceps</i> Ehr.	-	-	-
42	<i>Gomphonema parvulum</i> sp	-	-	-
43	<i>Gomphonema brasiliense</i> var. <i>demararae</i> Grun.	-	-	-

Table 2. Species of microalgae at Xuanhuong Lake (cont.)

STT	Taxon	Order	Class	Phylum
44	<i>Navicula palaisiensis</i> var. <i>lanceolata</i> Grun.	-	-	-
45	<i>Pinnularia major</i> (Kutz.) Cl.	-	-	-
46	<i>Pinnularia nobilis</i> Ehr.	-	-	-
47	<i>Pinnularia microstauron</i> (Ehr.) Cl.	-	-	-
48	<i>Pinnularia</i> sp.	-	-	-
49	<i>Hantzschia amphiosys</i> (Ehr.) Grun.	-	-	-
50	<i>Nitzschia sublinearis</i> Hust	-	-	-
51	<i>Nitzschia</i> sp.	-	-	-
52	<i>Merismopedia tenuissima</i> Lemm.	Chroococcales	Chroococceae	Cyanophyta
53	<i>Tetrapedia</i> sp.	-	-	-
54	<i>Microcystic aeruginosa</i> Kutz	-	-	-
55	<i>Microcystic aeruginosa</i> f. <i>flosaquae</i> Elenk.	-	-	-
56	<i>Annabaena</i> sp.	Nostocales	-	-
57	<i>Calothrix</i> sp	-	-	-
58	<i>Oscillatoria simplicissima</i> Gom.	Oscillatoriales	Hormogoneae	-
59	<i>Oscillatoria</i> sp ₁	-	-	-
60	<i>Oscillatoria</i> sp ₂	-	-	-
61	<i>Lyngbya</i> sp ₁	-	-	-
62	<i>Lyngbya</i> sp ₂	-	-	-
63	<i>Phormidium fragile</i> (Menegh.) Gom.	-	-	-
64	<i>Euglena acus</i> Ehr.	Euglenales	Euglenophyceae	Euglenophyta
65	<i>Euglena limnophila</i> var. <i>swirencoi</i> (Arn.) Popova	-	-	-
66	<i>Euglena oxyuris</i> sp.	-	-	-
67	<i>Euglena spirogyra</i> sp.	-	-	-
68	<i>Euglena viridis</i> Ehr.	-	-	-
69	<i>Phacus caudatus</i> Hubner	-	-	-
70	<i>Phacus longicauda</i> sp.	-	-	-
71	<i>Phacus pleuronectes</i> (Ehr.) Duj.	-	-	-
72	<i>Trachelomonas hispida</i> sp.	-	-	-
73	<i>Trachelomonas planctonica</i> sp.	-	-	-
74	<i>Trachelomonas volvocina</i> sp.	-	-	-
75	<i>Ceratium hidrundinella</i> (O.F.Muell.) Dujardin	Peridinales	Dinophyceae	Pyrrhophyta

Among 5 phyla, Chlorophyta includes 33 species/ subspecies accounting for 44%, Bacillariophyta 18 species/ subspecies representing 24%, Cyanophyta 12 species/ subspecies accounting for 16 %, Euglenophyta 11 species / subspecies accounting for 15%, and the least is Pyrrophyta with 1 species accounting for 1%.

The wide distribution in the Xuanhuong Lake is not heterogeneous (Table 3). The composition of algae in the middle of the Lake and along the Lake is a discrepancy. Some algae species are present near the shore but not in the middle of the lake such as *Coelastrum microporum* and some species in the *Scenedesmus* genus and vice versa such as some species of the *Chlorella* genus...

Table 3. Quantity of algae in the Xuanhuong Lake sampling

No.	Location	Quantity of algae
01	XHS1	32
02	XHS2	28
03	XHS3	30
04	XHS4	27

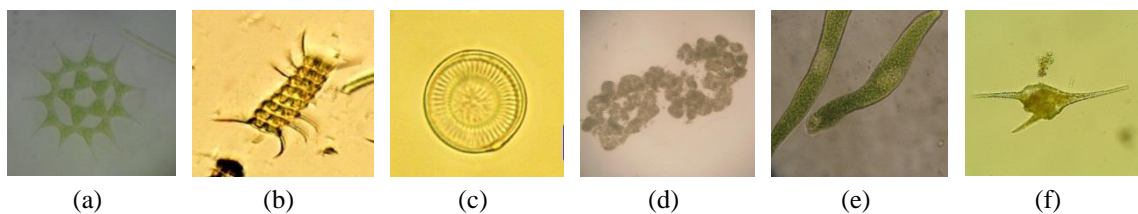


Figure 2. Photos of microalgae from Xuanhuong Lake

Note: (a) *Pediatrum simplex* var. *duodenarium* (Bailey) Rabenhorst; (b) *Scenedesmus quadricauda* var. *armatus* (Chodat.) Dedus; (c). *Cyclotella* sp; (d) *Microcystic aeruginosa*; (e) *Euglena oxyuris* sp; (f) *Ceratium hidrundinella*.

During the survey process, it was recognized that a bloom of *Mycrosistic* repeatedly occurred especially in the location XHS3. This may be due to the penetration of XHS3 wastewater from lakeside restaurants and the influence of the wind blowing from the south to north as *Mycrosistic* densely concentrated at this location.

Among 75 identified species / subspecies there is only one representative of the Pyrrophyta algae, a typical phylum of mountainous clean water. These algae's samples are collected at XH1 which is the main water supply to the lake. Also in the water also

appeared dirty indicator species of *Euglena viridis*, *Euglena acus*, *Synedra ulna*, which indicates that Xuanhuong Lake's water is mesosaprobic (medium dirty).

4. CONCLUSION

75 species / subspecies of 13 sets, 8 layers, 5 phyla: Cyanophyta, Chlorophyta, Bacillatoriophyta, Euglenophyta, Pyrrophyta were identified. Chlorophyta is the most abundant with 33 species / subspecies (44%); the second is bacillatoriophyta with 18 species / subspecies, the third cyanophyta with 12 species / subspecies (16%), the fourth euglenophyta 11 species / subspecies (15%), and the least pyrrophyta (1%).

Although cyanophyta is not the most abundant, it is the major cause of Xuanhuong Lake algae bloom during the survey time.

A number of dirty indicator species as *Euglena viridis*, *Euglena acus*, *Synedra ulna*, etc. were discovered, indicating that Xuanhuong Lake water is at the level of mesosaprobic (medium dirty).

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ĐA DẠNG VỀ THÀNH PHẦN LOÀI KHU HỆ TẢO Ở HỒ XUÂN HƯƠNG, ĐÀ LẠT

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Lịch sử bài báo

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Tóm tắt

Hồ Xuân Hương được xem như trái tim của thành phố Đà Lạt. Qua khảo sát điều tra, định danh thành phần vi tảo ở hồ Xuân Hương – Đà Lạt cho thấy hệ thực vật nổi ở đây khá đa dạng và phong phú. Mẫu được thu tại 4 địa điểm khác nhau ở hồ trong thời gian từ tháng 9 năm 2012 đến tháng 1 năm 2013. Kết quả điều tra đã xác định được 75 loài/ dưới loài thuộc 13 bộ, 8 lớp thuộc 5 ngành: Cyanophyta (tảo lam), Chlorophyta (tảo lục), Bacillariophyta (tảo silic), Euglenophyta (tảo mắt), Pyrrhophyta (tảo giáp). Ngành có nhiều loài nhất là tảo lục (33 loài/dưới loài) chiếm 44%, kế đến là tảo silic (18 loài/dưới loài) chiếm 24%, tảo lam (12 loài/dưới loài) chiếm 16%, tảo mắt (11 loài/dưới loài) chiếm 15%, và ít nhất là tảo giáp (1 loài) chiếm 1%. Đáng lưu ý với sự xuất hiện một số loài chỉ thị độ bẩn như *Euglena viridis*, *Euglena acus*, *synedra ulna* báo động mức nước hồ Xuân Hương thuộc mức mesosaprobe.

Từ khóa: Chỉ thị sinh học; Đa dạng sinh học; Hồ Xuân Hương; Tảo học.
