Title: SYSTEM OF PLANKTON DATABASE OPENING TO THE PUBLIC IN LAKE BIWA

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Abstract

In Lake Biwa, we have been performing a long term monitoring survey which contain the identification and counting of zooplankton and phytoplankton, aiming the evaluation of the water quality of the lake from multiple standards and to figure out the occurrences of ″ freshwater red tide″ and ″Water-bloom″.

We provide here the information on continuous watch for the lake and it's method as well on the instance of the foundation of ″Plankton data opening system″ which open the accumulated data to public with the help of GIS.

Introduction

At the Lake Biwa Environmental Research Institute, bi-monthly monitoring of water quality and plankton status has been carried out for more than 30 years, aiming to evaluate the water quality of Lake Biwa, Japan's largest lake.

In July 2007, on our homepage we started a program

entitled “The Plankton Observation Room of Lake Biwa” and we are providing the public with various information concerning plankton outbreak, freshwater red tide outbreak, algae outbreak and so on.

In particular, the plankton map information system for which GIS is used is very effective. By using this system, the user can see on a map what kinds of plankton were monitored in any year and in any month. Also the user can see how they were distributed in any spot of Lake Biwa.

In addition, we made the images of searched planktons ready to display on this homepage.

In this report, we will show the methods of long-term monitoring, retrieval of data and practical usage of it.

We will also show concrete examples deduced from the accumulated data on planktons in the center of the northern part of Lake Biwa.

Processes

1. The open day of “The Plankton Observation Room of Lake Biwa”: July 1st, 2007

2. Official site: Lake Biwa Environmental Research Institute http://www.lberi.jp/

: “The Plankton Observation Room of Lake Biwa” http://www.lbei.jp/root/jp/06db/bkjh_plankton.htm

3. List of data provided (updated)

3.1 Phytoplankton data (14 years from 1994)

3.2 Zooplankton data (11 years from 1994 to 2004)

3.3 Weekly news flash of Seta River’s plankton (9 years from 1999)

3.4 Freshwater red tide data (13 years from 1995)

3.5 Water bloom data (13 years from 1995)

3.6 Plankton image data

- 60 kinds of representative planktons with commentary
- 150 kinds of phytoplankton and 50 kinds of zooplanktons, of which about 60 kinds are able to be searched in this homepage.

4. Method of investigating the planktons

4.1 Phytoplankton (Figure 1)

1 ml of lake water was taken in a plankton counting chamber (manufactured by Rigosya Co. ltd) on which floor the grids are engraved for the guidance of sight. Each species of phytoplankton were counted using a light microscope without fixation.

4.2 Zooplankton:

1 liter of lake water were added Plankton fixation liquid (2% v./v.) and were concentrated 100 times. Plankton fixation liquid were mixed solution of 500ml of glutaraldehyde (25%) and 5ml of formarine and 12.5g of calcium carbonate dissolved in it. After the concentration, I took 1ml of sample, corresponding 100ml of lake water, in a plankton counting chamber and each species of zooplankton were counted using a microscope.

Results:

1. The example of public data in “The Plankton Observation Room of Lake Biwa”

(1) Plankton in Lake Biwa (Figure 2)

With the change of the water environment of Lake

Biwa, the kinds of plankton inhabiting the lake and the circumstances of their increase are changing year by year.
In this page, we explain about water bloom, i.e. freshwater red tide, algae, and so on, and about micro algae called "pico phytoplankton."
Endemic species of Lake Biwa are also explained.

(2) Plankton Map Information (Figure 3-5)

By using the plankton information disclosure system with GIS (Geographic Information System), we can retrieve plankton information such as the kind, the date, the spot and its distribution, and collect raw data of every kind of the plankton and its image.

(3) Findings of this survey

(3)-1 Plankton in Lake Biwa (Figure 6-8)

By inputting the conditions such as the spot, the depth and the year, we can retrieve the details of findings of both phytoplankton and zooplankton.
The findings will be displayed in a graph or list and can be examined in detail.
Especially with phytoplankton, classified 600

kinds of cell capacities have been registered in a database and therefore it is possible to retrieve the data and download files of quantity of total cell capacity (quantity of existence).

(3)-2　Weekly Flash News of Seta River’s plankton (Figure 9)

Although more than 400 rivers are flowing into Lake Biwa, the only river flowing out from Lake Biwa is Seta River.

We collect water in the center part of the flow of this river, which contains plankton produced in Lake Biwa.

As for the main phytoplankton and zooplanktons, which are made in the lake and flow out, numbers and kinds are measured each week and then we update the report in a PDF file.　Because this lake is a source of public city water, this report is highly evaluated by business entities and local inhabitants of Kyoto, Osaka, Kobe and so on.

(4) Freshwater red tide research (Figure 10-12)

From April to July of each year, freshwater red tide is caused in Lake Biwa by heterology of *Urogrena*

americana Calkins.

We carry out freshwater red tide patrol twice a week during this period. By inputting the year and date in freshwater red tide database, we can retrieve detailed results on the map or figures. With the "a freshwater red tide outbreak information" system, by designating the monitoring year, it can be displayed on a map (Figure 11 & 12).

(5) Algae Research (Figure 13)

With the algae database, we can research the outbreak status of algae and the algae formation class of algae in Lake Biwa in detail year by year, and for every outbreak a detailed calculation result is displayed.

And in the algae news flash of Lake Biwa, calculation results of the algae formation class and the image of each kind can be displayed by clicking the scientific names or places (Figure 14).

(6) Plankton illustrated book (Figure 15 & 16).

About sixty kinds of zooplanktons and phytoplankton,

which are often seen in Lake Biwa, are introduced with images and short commentary.

The plankton search allows searching from illustrations as well as a list of species, so that even a child is able to use this system.
Besides these searches, we can watch images of plankton and their appearance class by clicking them in the search results.
As for the image registration, there are now 150 kinds of phytoplankton and 50 kinds of zooplankton, for a total of 200 kinds.

2. Examples of the long-term change results of the phytoplankton in the center of northern Lake Biwa.
From Figure 17 to Figure 19, concrete examples of phytoplankton data are shown here.

(1)
Figure 17 shows the long-term change in the quantity of phytoplankton.
It is categorized for three periods:

There was a tendency for the quantity of phytoplankton to decrease slowly from 1979 to 1989. In the period from 1989 to 2000, Pico plankton occurred in large quantities, and then the phytoplankton miniaturized. The last period is from 2001 to 2005.
As for more recent tendencies, the range of seasonal increase and decrease has narrowed.

(2)
Figure 18 shows the annual variation of Cyanophyceae. It shows a comparatively little quantity of Cyanophyceae before the massive outbreak of Pico plankton in 1989. After this, a tendency of increasing quantity of Cyanophyecae was recognized. Furthermore, the kind of Cyanophyecae which had a agar envelope around the cell comprised 87% of the total amount of Cyanophyecae.

（3）The numerical change of the kind of plankton in the center of the Northern part of Lake Biwa.
Figure 19 shows the numerical change of kinds observed in collected water of 1 liter.

In the research result from 1978 to 1982, a maximum of 34 kinds and minimum of 7 kinds were observed, with the average being 18 kinds.
When the 1990's began, the number of kinds of plankton began to rapidly decrease.
According to the findings from 2000 to 2005, a maximum of 17 kinds and minimum of 5 kinds were seen, and the average was 10 kinds. This means that the number of plankton has decreased to 56% in these 20 years.
Like the change in the quantity of phytoplankton, the range of numerical seasonal increase and decrease of these kinds also became smaller.

Consideration
As for hardware, this plankton database consists of two server systems. One is the intranet server system which is restricted and used to maintain the database.
Another is a server system to provide data and images on the Internet.
As for software, there are three good points as follows;

The spatial database, which includes chronological order data, map data and plankton calculation results, has improved.
Secondly, concerning information related to this database, the display mode became easier to look at by showing graphs and figures.
The last point is deploying an image of each type of plankton in a database and the ability to search by scientific name and image with a set.

This database system is structured so as to allow for continuous improvements and revisions to the data.

Currently, data concerning phytoplankton, freshwater red tide, and algae from the past 9 to 14 years is able to be searched and viewed.
Furthermore, we are going to provide more information by obtaining and supplying both newly occurring data and data of the past thirty years.
I believe that a plankton database utilizing GIS is the first such action in Japan.
My ultimate purpose is the meteorological

observatory of plankton, which will reveal all trends of the plankton of Lake Biwa.

I want to continue preparing “the plankton observation room of Lake Biwa” so that it is possible to apply this database widely in scientific studies and environmental training.

Figure1: A plankton counting chamber with the grids engraved floor and a fixed frame.
Used in counting phytoplankton and zooplankton.

Figure2: Plankton in Lake Biwa (menu).
Menu view

Figure3: Plankton Map Information.
Click plankton map information to enter.

Figure4: Plankton Map Information.
Select items, date of survey and station you want to obtain data.

Figure5: Plankton Map Information.
The data is shown.

Figure6: Plankton in Lake Biwa.
Click the plankton investigation result to see
The illustration of seasonal trend and rapid report on planktons at Seta river.

Figure7: Plankton in Lake Biwa.
Seasonal variation of phytoplankton biomass in a year.

Figure8: Plankton in Lake Biwa.
Seasonal variation of abundance of zooplankton in a year.

Figure9: Weekly Flash News of Seta River's plankton .
The reports of weekly survey made at Seta river.

Figure10: The Information on occurrences of freshwater red-tide in Lake Biwa.
The entrance to the information on freshwater red-tide of Lake Biwa.

Figure11: The information on freshwater red-tide in Lake Biwa.
The presentation of the results of regular monitoring on freshwater red-tide.

Figure12: The information on freshwater red -tide

in Lake Biwa.

Details of data obtained by regular monitoring, carried out by our institute, on the freshwater red-tide.

Figure13: The information on outbreak's of water bloom in Lake Biwa.

Click water bloom to obtain the information on water-blooms in Lake Biwa.

Figure14: The information on the outbreak of water bloom in Lake Biwa.

Presentations of sites and species composition of water-blooms.

Figure15: The Illustration of plankton of Lake Biwa.

The introduction to dominant planktons in Lake Biwa.

Figure16: Phytoplankton species which amounted to large biomass at the central station of the northern basin of Lake Biwa.

This phytoplankton showed large biomasses in the

seasonal variation in the offshore area of the northern lake.

Figure17: Annual variation of biomass of phytoplankton at the central station of the northern lake (1978～2006).

The amplitude of seasonal fluctuation has been getting smaller.

Figure18: Annual variation of biomass of Cyanophyceae at the central station of the northern lake (1978～2006).

The biomass of Cyanophyceae has gradually been getting larger.

Figure19: The annual variation of number of species observed in 1 ml of lake water.

The number of species has been in a tendency to a declining.