Phytoplankton Indicators in the Ban Thai Reservoir, Phuket province, Thailand

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Abstract

The composition and abundance of phytoplankton community are indicators of ecological conditions in a water body. This study examined genera composition, abundance and seasonal variation of phytoplankton in the Ban Thai reservoir in Phuket province, the South of Thailand. Samples were collected every two months during the period of June 2011- January 2012. As a result, a total of 29 genera belonging to six groups of phytoplankton were identified from the reservoir. More than 80% of the genera were Cyanophyceae (41.91%) and Chlorophyceae (40.04%), and 20 % were Euglenophyceae (11.23%) and Dinophyceae (6.19%). Two groups represented by a small number of genera with low abundance were Bacillariophyceae and Chrysophyceae. Total abundance of phytoplankton in the rainy season was higher than the dry season, with an average of $65.08x10^6$ cells/L and $37.20x10^6$cells/L, respectively. *Oscillatoria* sp. was the dominant genus with an average of $8.64x10^6$cells/L and was accounted for 35.72% of total phytoplankton abundance. A bloom of the *Oscillatoria* sp. was found in June along to September. This genus can be used as an indicator of the amount of nutrients level in the reservoir. In addition, patterns of seasonal phytoplankton community and genera composition can reveal the degree of organic pollution in the reservoir.

Keywords: Phytoplankton, Bioindicator, Organic pollution, Phuket reservoir,

1. Introduction

Phytoplankton abundance and diversity are widely used as biological indicators of water quality in reservoirs (Khuantrairong and Traichaiyaporn, 2008). The density and species composition of phytoplankton in tropical reservoirs demonstrate particular annual biological characteristics (Pongswat et al., 2004). Phytoplankton succession in open reservoirs depends on the availability of nutrients, temperature, light intensity and transparency. Light limitation by high turbidity is another factor that frequently controls phytoplankton growth either during the whole year or seasonally (Ariyadej et al., 2005).

Biological monitoring is valuable method used in conservation studies to protect and preserve the biological integrity of natural ecosystem, which includes preventive measures. Bioindicators of pollutants are useful in predicting the level and degree of pollutants before the effects of the pollutants starts (Kumari et al., 2008). *Oscillatoria* is the most dominant genus during high temperatures and constituted the bulk of population during rainy season. The genus-specific blooms are also found in summer season when oxygen contents are very low. These genera of Cyanobacteria tolerant to organic pollution can be used as indicator of water pollution (Suresh et al., 2011).

Diversity indices are applied in water pollution research to evaluate the effects of pollution on species composition. The objective of this study was to investigate the diversity, genera composition and seasonal variation of phytoplankton indicators and community in Ban Thai reservoir, in order to establish primary data that may be useful as the basis knowledge for conservation planning that maintains sustainable ecosystems.

2. Method

2.1 Study area

Ban Thai reservoir is an open reservoir located in the Muang district of Phuket province, southern Thailand (Figure 1). The reservoir is a major source of water for a lot of people in community of the district and used for irrigation, agriculture, fishing and recreation, and household purpose. However, despite the local importance of this reservoir, few researches have been done on limnology and biodiversity. The geographic coordinates of this site was determined by GPS using UTM (Universal Transverse Mercator) system. The location of the sampling site was 838237N and 412199 E.

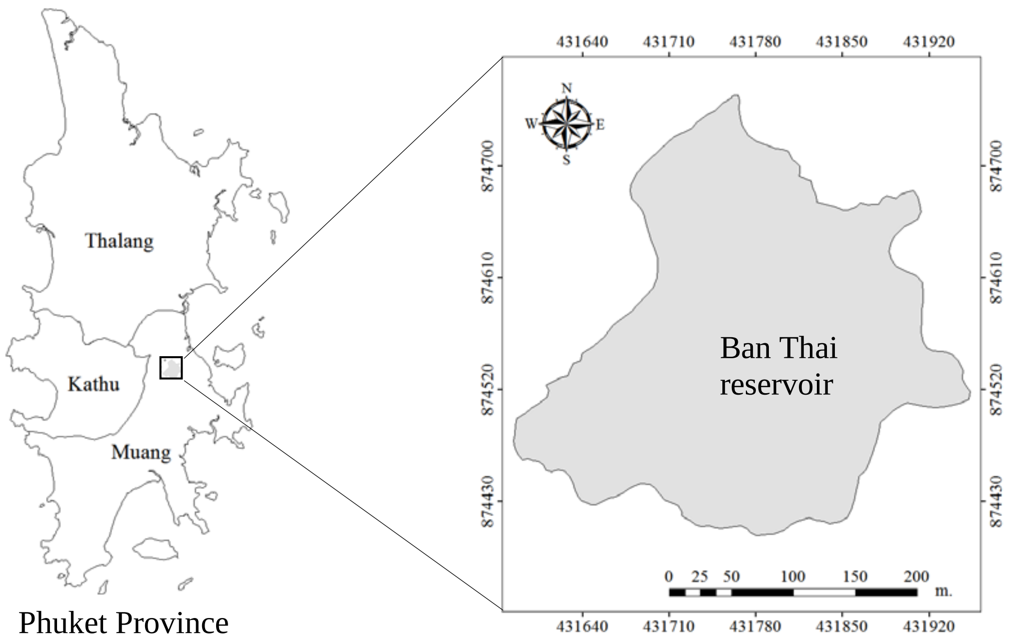

Figure 1: Study area

2.2 Phytoplankton sampling

Phytoplankton samples were collected four times during June 2011 to January 2012; two samples for rainy seasons (November 2011 and January 2012) and the other two for dry season (June and September 2011). Samples were collected by dragging and filtering water through 20 μm mesh size plankton net far from the bank about 50 meters. The samples were fixed with 5% formalin solution before transportation. In the laboratory, abundance of phytoplankton genera was determined by enumeration of cells in a Sedgwick-Rafter counting chamber using an inverted light microscope. The genera were identified using keys by Wongrat (1999).

3. Results

The phytoplankton communities in Ban Thai reservoir during June 2011-January 2012 were composed of 29 genera from six classes: Chlorophyceae (14 genera), Cyanophyceae (6), Euglenophyceae (3), Bacillariophyceae (3), Dinophyceae (2) and Chrysophyceae (1). The main genera of phytoplankton were *Oscillatoria* (Table 1). The total number of phytoplankton ranged from a lowest density in January 2012 with 16.68x10^6cell/L and the highest density in September 2011 with 44.36x10^6cell/L.

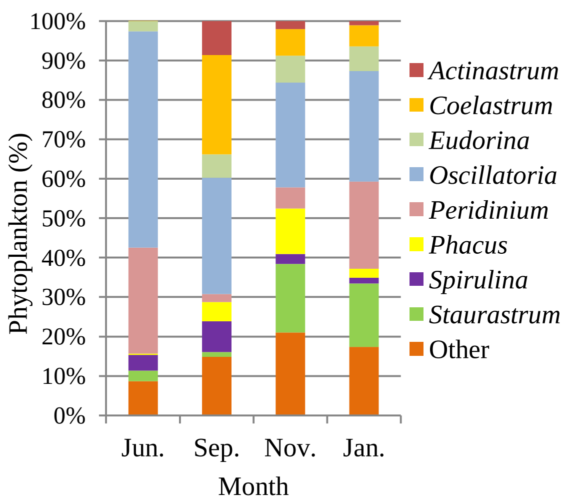

Figure 2: Percent abundance of dominant phytoplankton found in Ban Thai reservoir during study period.

Table 1: List of phytoplankton genera and averaged cell density found along the sampling site during the study period. The density (cells/mL) is presented in - = not found; + = 1-100; ++ = 101-1000; +++ = 1001-10,000; ++++ = 10,001-15,000.

Class	Genus	Density	
		Rainy	Dry
Cyanophyceae	*Anabaena*	++	-
	Chroococcus	-	+
	Cylindrospermopsis	+	-
	Merismopedia	++	++
	Oscillatoria	++++	++++
	Spirulina	+++	++
Chlorophyceae	*Actinastrum*	+++	++
	Closterium	++	-
	Coelastrum	+++	+++
	Desmidium	+	-
	Eudorina	+++	+++
	Kirchneriella	+	++
	Micractinium	-	+
	Micrasterias	+	++
	Monoraphidium	+	+
	Pediastrum	++	++
	Scenedesmus	+++	+++
	Spirogyra	++	-
	Staurastrum	++	+++
	Tetraedron	++	++
Euglenophyceae	*Euglena*	++	+
	Phacus	+++	+++
	Trachelomonas	+++	+++
Bacillariophyceae	*Navicula*	+	-
	Nitzchia	++	+
	Synedra	-	+
Chrysophyceae	*Dinobryon*	+	-
Dinophyceae	*Ceratium*	+	++
	Peridinium	+++	+++

Based on data collected in the rainy cruise, principal phytoplankton genera were *Oscillatoria, Coelastrum, Peridinium, Spirulina* and *Actinastrum*. *Oscillatoria* dominated every cruise of rainy season, especially in September 2011. *Oscillatoria* became the key genera with 37.54% of the total phytoplankton abundance (Figure 2). In dry season, *Oscillatoria* was still the key genera with 27.17% of the total phytoplankton abundance. *Staurastrum* became important, along with *Peridinium, Phacus* and *Eudorina*.

4. Discussions

In the present study, high total abundance of phytoplankton was observed in rainy season similar to the observation of Arreghini et al. (2005), pointing out the strong impact of nutrient discharge related to rainfall phenomenon.

Cyanophyceae was the most abundant phytoplankton group in the reservoir. This is similar to the studies of Suresh et al., (2011); Khuantrairong and Traichaiyaporn (2008); Rishi and Awasthi (2012). Many previous studies by Rijn and Shilo (1986); Kumari et al. (2008); Paerl (2008); Kumar and Oommen (2011) have reported a direct relation between nutrients and the abundances of blue-green algae. It implies that the blue-green algae can be an indicator of eutrophication in water bodies.

Oscillatoria was the dominance genus of this studied reservoir similar to the observation of Jafari and Gunale (2006) on urban freshwater river in India and Wesanontawech et al. (2003) studied in the Mahasawat Canal, Thailand. *Oscillatoria* was limited in growth by nitrogen availability (Rijn and Shilo, 1986). The genus can thus be used as an organic pollution indicator of water quality (Kumari et al., 2008). Many studies reported the relationship between water quality and land use (Basima et al., 2006; Tu, 2011; Moschini-Carlos and Pompêo, (2008). In this study, land use adjacent to the Ban Thai reservoir was covered by large urban area and abandoned mining pits, causing many nutrients discharge into the reservoir where the condition is suitable for the growth of *Oscillatoria* (Ren et al., 2003; Ferrareze, 2012). Remarkable growth of the genus *Oscillatoria* affected dissolved oxygen in water bodies (Steinberg and Hartmann, 1988) and declined in water quality and thus causing deaths of aquatic animals.

5. Conclusions

Our study provides basis knowledge of variation in the abundance of the major phytoplankton groups and a consideration of pollution indicator of the reservoir. The abundance of phytoplankton can be influenced by the impact of environmental factors. Thus phytoplankton has been used as indicator of water quality. Some genera grow well in eutrophic water bodies. The increasing of urbanization in this area is an important factor that creates an increasing quantity of organic pollution water discharges being added to the reservoir.

Understanding such variation in the phytoplankton abundance and bioindicator of water quality provides a basis for further study of water resources management.

6. References

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