THE CHARACTERISTIC OF WATER QUALITY AT BATUR LAKE, KINTAMANI DISTRIC, BALI PROVINCE

I Wayan Arthana
Faculty of Agriculture, Udayana University. Bali-Indonesia.
iwarthana60@yahoo.co.id

Abstract

Batur Lake located at Kintamani district, Bangli regency is the biggest lake in Bali that is very important as water stocking for Bali area. Collecting samples at 50 substations was done from June up to October 2009. Temperature value at Batur Lake varied of 23.00 ^{o}C - 25 ^{o}C with average of 23.88 ^{o}C. The water clarity was around 1.58 - 2.90 meter with the average of 2.32 meter. The average value of water quality of BOD_5 and COD were 3.817 ppm and 6.333 ppm respectively. The average content of ammonia was 0.4545 ppm and for Sulfide was 0.0009 ppm. The nutrient content in Batur Lake is that nitrate value varied of 0.0174 - 3.6070 ppm with average of 1.1498 ppm. Phosphate content was from no detection up to 0.3610 ppm with the average of 0.1242 ppm. Heavy metals, the average content of Cd, Pb, Cu and Fe were 0.0038 ppm, 0.0023 ppm, 0.0055 ppm and 0.0428 ppm respectively. There is a strong positive correlation between COD and BOD_5 that the higher content of the COD the higher BOD_5 content as well with correlation value of R^2 = 0.927. The ratio value between COD and BOD_5 (COD/ BOD_5) varies of 1.061 – 12.163 with the average value of 2.492 ± 1.909.

Key words*: lakes, heavy metals, water quality, phosphate, nitrate*

1. Introduction

Batur Lake located at Kintamani district, Bangli regency is the biggest lake in Bali that is very important as water stocking for Bali area. Besides as a water stock for Bali, Batur Lake has strategic meaning and very vital to support human live at villages surrounding Batur Lake. Various human activities base on lake resources has been developed intensively e.g. fishing, fish culture, horticulture, tourism, transportation and recreation.

Part of Batur Lake areas that has specific activity and a bit different between them is Kedisan Village which has been used as a boat harbor crossing the lake to the Trunyan Village and also as an agriculture area. A lot of boats floating and at the agriculture sites grow red onion. Other part is Abang Village with the topography more flat, there is an intensive agriculture activity with grows various plants. Some of the plants are red onion, chili and tomatoes. Trunyan village is a dense population that various activities mixing in there like boat, fish culture using floating net, agriculture with red onion and big chili etc. At Toya Bungkah Village is a tourism area that a lot of hotels. There are also fish culture activities and agriculture with tomatoes as the most plant growing. Then, Bumbung Klambu Village is the area for central fish culture activity using floating net system. In the flat coastal area of Bumbung Klambu, local people grow vegetable plants like cabbage.

With that condition, it look that surrounding of Batur Lake has various activities and a lots of land use changing recently. In some areas have been used as a settlement, agriculture and other exploitation activities. Uncontrolled land use changing especially at close to the lake's beach has caused high volume of pollutant enter to the Batur Lake. Some of them are kind of nutrient especially nitrogen and phosphate. High intensity of using organic and inorganic fertilizer has caused the nutrient content in Batur Lake getting higher. Base on phosphate content, from the recent research result showed that Batur Lake has been categories as eutrophic lake. Whatever the category, the eutrophycation threaten at Batur Lake is getting worried.

The other side, Batur Lake is a lake that no inlet and outlet. The water sources only depend on the catchment area surrounding Batur Mount that has

the form of big bowl. This will be different with other lakes that have rivers to flow water to the lakes. With the condition that has no outlet, the implication is that all things will be trapped in Batur Lake and can not move out from the water body so it will be accumulated in Batur Lake include nutrient, waste, pollutant and sedimentation.

Research about characteristic of water quality in Batur Lake is the only one among others approaches to find the key parameters in order to predict the level of eutrophycation in Batur Lake. This is because the threaten of eutrophycation in other lakes in Indonesia, for example, some of them haven't been maintained because of high speed of sedimentation so the function of the lakes to patch water and to support the natural aquatic ecosystem will be destroyed.

The aim of this research is to find out the water quality parameters that the level has been passed over the requirement and to find the correlation between parameters measured.

2. Materials and methods

Collecting samples have been done from June up to October 2009 in Batur Lake, Kintamani Distric, Bangli Regency, Bali Province (Figure 1).

Choosing of research stations in Batur Lake was based on the differences of activities characteristic at each location. There are 5 (five) stations selected for collecting the samples namely:

a. Station I : the location is at Kedisan Village. This area is a place/harbour to cross the lake with a lot of boats and also a place for agriculture.
b. Station II : the location is at Abang Village. This area is a place for intensive agriculture.
c. Station III : the location is at Trunyan Village. This area is a place for settlement.
d. Station IV : the location is at Toya Bungkah Village. This area is a place for tourism and there is built a lot of hotels.
e. Station V : the location is at Bumbung Klambu Village. This area is a place for fish culture using floating net system.

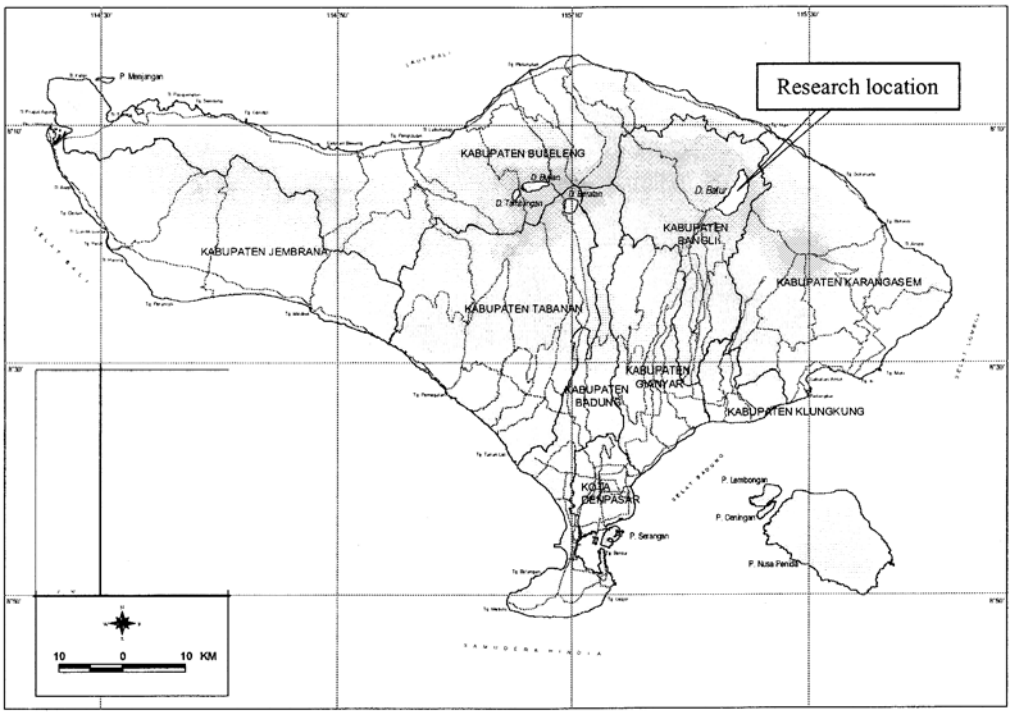

Figure 1. Map of Research Location in Batur Lake, Kintamani Distric, Bangli Regency, Bali Province

In each station, it was selected 10 substations for collecting water samples so in total there are 50 substations. Samples were collected and were brought to Analytic Laboratory of Udayana University for further analysis.

There are 14 parameters measured namely temperature, water clarity, pH, oxygen content, BOD_5, COD, nitrate, ammonia, phosphate, sulphide, cadmium, lead, copper and iron.

3. Result and Discussion

3.1 Result

The locations of 50 points collecting samples were recorded for their coordinate as shown in appendix 1. The average temperature value at Batur Lake was 23.88 °C. The minimum temperature was 23.00 °C and the maximum was 25 °C (Table 1). Figure 2a shows that water temperature condition at station I and V were significantly lower than that in other stations. The highest temperature tends to be at station IV, although in fact there are no significant different with that in station II.

Table 1. The Resume of water quality value from 50 sampling sites at Batur Lake

No.	Parameter	Maximum	Minimum	Average
1	Temperature (°C)	25.00	23.00	23.88
2	Water clarity (m)	2.90	1.58	2.32
3	pH	8.46	8.00	8.21
4	Oxygen (ppm)	7.400	5.000	5.884
5	BOD_5 (ppm)	8.720	0.245	3.817
6	COD (ppm)	10.051	2.120	6.333
7	NO_3-N (ppm)	3.6070	0.0174	1.1498
8	NH_3-N (ppm)	0.8620	0.0850	0.4545
9	PO4-P (ppm)	0.3610	ndt	0.1242
10	H_2S (ppm)	0.0016	ndt	0.0001
11	Cd (ppm)	0.0060	0.0010	0.0038
12	Pb (ppm)	0.0040	ndt	0.0023
13	Cu (ppm)	0.0090	0.0010	0.0055
14	Fe (ppm)	0.1080	0.0150	0.0428

Note : ndt = no detection

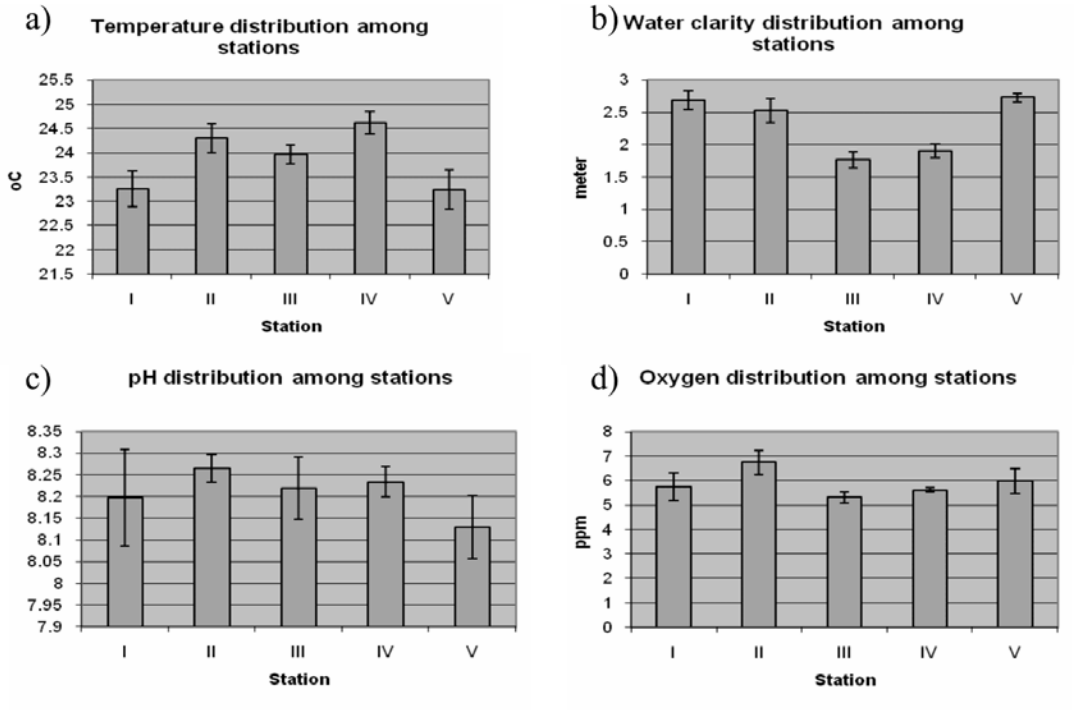

Figure 2. Water quality characteristic at station I and V: (a) temperature, (b) water clarity, (c) pH, and (d) oxygen.

The average water clarity value at Batur Lake was 2.32 meter. The minimum water clarity was 1.58 meter and the maximum was 2.90 meter (Table 1). Figure 2b shows that the water clarity condition at station III tends to be the lowest among others although no significant different with that at station IV. But if it was compared to that in station I, II and V, the water clarity condition at station III was significantly different. Then, the average value of pH was 8.21. The minimum pH was 8.00 and the maximum was 8.46 (Table 1). Figure 2c shows that only pH value at station II (Abang) was significant higher than that in station V (Bumbung Klambu).

For oxygen, the average value was 5.884 ppm. The minimum oxygen value was 5.00 ppm and the maximum was 7.400 ppm (Table 1). Figure 2d shows that the lowest oxygen value tends to be at station III but no significant different than that in station I. Oxygen value at IV shows that the oxygen value variation among replicates (five times) has low differences so the standard deviation is low too.

Biological oxygen demand (BOD_5), however, the average was 3.817 ppm. The minimum BOD_5 value was 0.245 ppm and the maximum was 8.720 ppm (Table 1). Figure 3a shows that there is no significant different of BOD_5 value among stations. The average COD value at Batur Lake was 6.333 ppm. The minimum COD was 2.120 ppm and the maximum was 10.051 ppm (Table 1). Figure 3b shows that COD value among stations has no significant different.

For the nutrient content like nitrate, the average value was 1.1498 ppm. The minimum nitrate content was 0.0174 ppm and the maximum was 3.6070 ppm (Table 1). Figure 3c shows that nitrate value among stations has no significant different. The average ammonia content at Batur Lake was 0.4545 ppm. The minimum ammonia value was 0.0850 ppm and the maximum was 0.8620 ppm (Table 1). Figure 3d shows that there is no different of ammonia content among stations significantly although tends the highest value at station V (Bumbung Klambu) where a lot of floating nets for fish culture available.

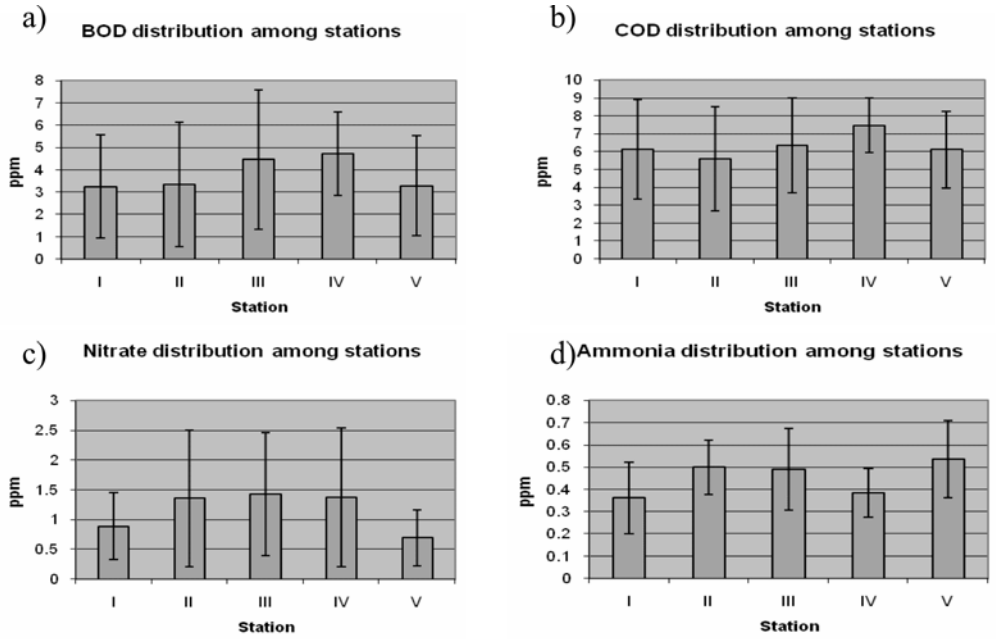

Figure 3. Water quality characteristic at station I and V: (a) BOD, (b) COD, (c) nitrate, and (d) ammonia.

The average content of phosphate at Batur Lake that was 0.1242 ppm is much lower than nitrate content. The minimum phosphate content was no detection and the maximum was 0.3610 ppm (Table 1). Figure 4a shows that there is no different of phosphate content among stations significantly although tend the lowest content at station I which all no detection. The average sulphide content at Batur Lake was 0.0009 ppm. The minimum sulphide value was no detection and the maximum was 0.0016 ppm (Table 1). Figure 4b shows that there is no so different the value among stations.

For the heavy metals like cadmium, the average content at Batur Lake was 0.0038 ppm. The minimum cadmium was 0.0010 ppm and the maximum was 0.0060 ppm (Table 1). Figure 4c shows that the value among station has no significantly different. The average of lead content at Batur Lake was 0.0023 ppm. The minimum lead content was no detection and the maximum was 0.0040 ppm (Table 1). Figure 4d shows that lead content among stations has no significantly different.

The average copper content at Batur Lake was 0.0055 ppm. The minimum copper content was 0.0010 ppm and the maximum was 0.0090 ppm (Table 1). Figure 4e shows that copper content among stations has no significantly different also. Then the average of iron content at Batur Lake was 0.0428 ppm. The minimum iron content was 0.0150 ppm and the maximum was 0.1080 ppm (Table 1). Figure 4f shows that the lowest iron content tends to be at station III.

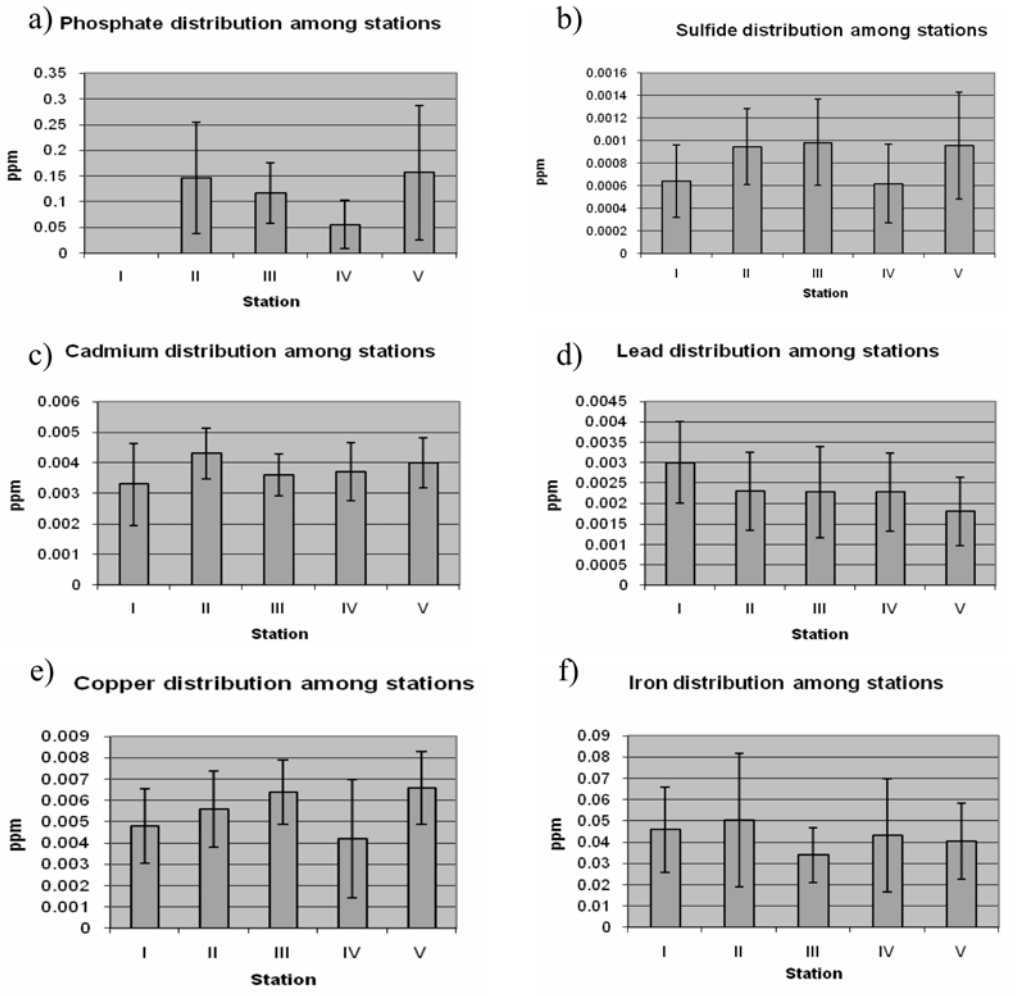

Figure 4. Water quality characteristic at station I and V: (a) phosphate, (b) sulphide, (c) cadmium, (d) lead, (e) copper, and (f) iron.

There is a strong correlation between COD and BOD_5 at five station of Batur Lake. The correlation is positive that the higher COD content the bigger BOD_5 value with the correlation value of $R^2 = 0.927$ (Figure 5). The ratio value between COD and BOD_5 (COD/BOD_5) varied of 1.061 – 12.163 with the average of 2.492 ± 1.909.

3.2 Discussion

Water quality condition at Batur Lake is depends on diluted components in the water such as living organisms, matters, energy or other components. Furthermore the living organisms at Batur Lake for their growth and development mostly depends on the water quality it self. Beside, the way of live for living organisms in the lake will be influenced by water quality dynamic as a result of organism's activities and changing dynamic of oxygen content, pH and diluted organic substances.

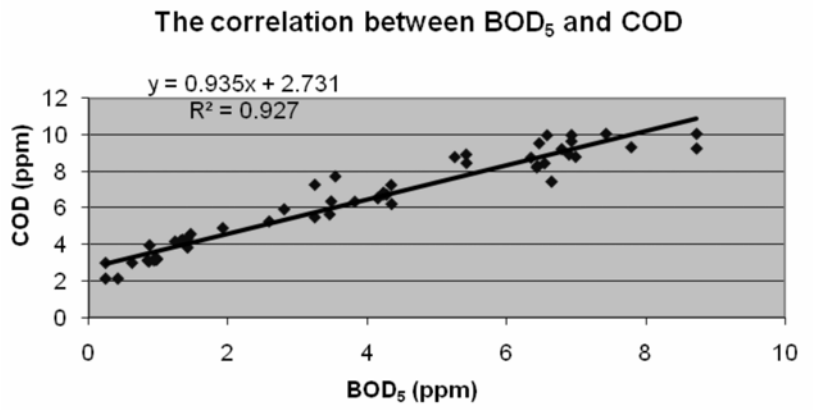

Figure 5. The correlation between BOD_5 and COD at five stations of Batur Lake

The temperature at Batur Lake varied of 23.00 - 25 °C with the average of 23.88 °C (Table 1). Water temperature in the lake will depend on some factors like latitude, altitude, season, time in a day, air circulation and cloud cover. At low latitude and low altitude, water temperature tends to warmer compared to at higher latitude and higher altitude. Batur Lake area is situated at mountainous area of 1000 m above sea level so it has cold weather. The water temperature will be no different with the air temperature.

Water temperature condition will influence metabolism pattern of the aquatic life. At the higher temperature, the metabolism process on the organism also increases and vice versa. If metabolism process go faster at aquatic life so the growth will be also quicker. Water temperature will also influence the microorganism activities in term of decompose organic substances which is the higher of temperature the microorganism activities which cause of diluting oxygen consumption will be higher.

Aquatic organisms like phytoplankton from diatom will grow optimum at the temperature of 20 – 30 °C while phytoplankton from phylum of Chlorophyte prefer higher temperature at about 30 – 35 °C. Generally, optimum temperature variation for the growth of phytoplankton in waters is about 20 – 30 °C (Haslam, 1995). Whereas for tropical fishes, the optimal temperature for their live is at the temperature over 25 °C (Stickney, 1979).

The average water clarity at Batur Lake was 2.32 meter. The minimum water clarity was 1.58 meter and the maximum was 2.90 meter (Table 1). When this research was done, water condition in the lake look greenish that indicates of water clarity was more impacted by the availability of phytoplankton rather than by suspended matters and diluted substances.

The level of water clarity constitute of water transparency level which visually measured by secchi disk. Water clarity is important because it will show the level of productive water column (eutrophic zone) in the lake. Water clarity value is recorded in meter unit, which the value depend upon of weather

condition, time of measurement, turbidity, suspended solid content in waters. Water with high water clarity mean that it was low content of suspended solid. Decreasing of water clarity can be caused by high productivity of phytoplankton. At Batur Lake, the water clarity value was mostly related on the availability of plankton in the water.

The average oxygen content was 5.884 ppm. The minimum oxygen was 5.00 ppm and the maximum was 7.400 ppm (Table 1). Water condition at Batur Lake, particularly at station III (Trunyan) has oxygen content relatively lower than that at other stations. According to Effendi (2003), a lake with average water temperature of 25 ^{o}C, generally has diluting oxygen content of 8 mg/l. Moreover for optimum fishes live, the minimum oxygen content is 5 mg/l. In the condition when oxygen content is very low (below 3 mg/l) it is very dangerous for living organisms to live in waters. Then the differences of diluting oxygen content in waters, mostly is influenced by photosynthetic process intensity of phytoplankton rather than by turbulence factors. Especially at Batur Lake, because the measuring was done in the day time so the oxygen content was depend on the availability of phytoplankton.

The level of oxygen content in a lake is depending on the balancing between the supply and demand. Dissolved oxygen in water comes from atmosphere oxygen, diffusion process and from photosynthesis result of aquatic plants. Some of the demand are for respiration of aquatic animals and plants, for decomposition process of organic compound by micro organisms biologically. Then demand of oxygen is for inorganic chemical reaction processes. Another thing to influence the dissolved oxygen in water is local temperature and altitude. The higher on temperature the lower dissolved oxygen content. Moreover the higher local altitude the lower also dissolved oxygen content.

The average of BOD_5 value was 3.817 ppm with the minimum one was 0.245 ppm and the maximum was 8.720 ppm (Table 1). The BOD condition among stations shows no significant different. This may be because when the water samples were collected, it was monitored that the lake water flow strong enough because of wind so the water column become homogenous.

BOD value is reflection of the organic level content that can be decomposed biologically (biodegradable). This organic matter can be fat, protein, carbohydrate, glucose, aldehide, ester etc. However, decomposition process on organic matter of cellulose becomes relatively slower.

According to Jeffries and Mills (1996), natural waters will have BOD content around 0.5 – 7.0 mg/l. Waters with BOD content above 10 mg/l will be assumed that it has been polluted. Base on that value, the BOD content at Batur Lake is still below level of polluted condition.

The average pH at Batur Lake was 8.21. The pH minimum value was 8.00 and the maximum was 8.46 (Table 1). As a comparison, water pH at station II was significantly higher than that at station V. Station II it self is situated at Abang Village where a lot of agriculture activities occur, meanwhile at station V it is a lot of floating net for fish culture done by local people.

The pH value will reflect the amount of hydrogen ion concentration in waters. The fluctuation of pH value in waters is mostly influenced by the availability of carbonate buffer system in those waters. The higher carbonate ion (CO_3^{2-}) and bicarbonate ion (HCO_3^{-}) content so the buffer system become stronger to keep pH value stable in waters. Waters which have low pH value will increase the toxicity of same gases compoud in waters. According to Novotny and Olem (1994), mostly aquatic biota in waters are sensitive to the changing of pH value and they prefer at pH value of 7 – 8.5.

The average nitrate at Batur Lake was 1.1498 ppm. The minimum nitrate content was 0.0174 ppm and the maximum was 3.6070 ppm (Table 1). Nitrate (NO_3) is a main form of nitrogen in natural waters and as a main nutrient needed by aquatic plants and phytoplankton. Nitrate is easy to dissolve in waters and it is very stable. Nitrate is an organic nitrogen compound that can come from nitrogen gases and organic nitrogen (protein and metabolism product). Organic nitrogen waste that enters to waters will be transformed into ammonia and then through nitrification process it is transformed into nitrate.

The among others of main nitrate sources in lake waters is from domestic waste and agriculture waste. Nitrate compound in waters generally uses for key parameter to measure the level of waters productivity and to analyze the level of eutrophycation. Oligotrophic waters (less productive) have nitrate content of 0 – 1 mg/l, mesotrophyc waters (medium productive) have nitrate content of 1 – 5 mg/l, and eutrophyc waters

(productive) have nitrate content of 5 – 50 mg/l (Volenweider, 1969 *in* Wetzel, 1975). However, in this research, there were no significant different of nitrate content among stations observed in Batur Lake.

The average ammonia content at Batur Lake was 0.4545 ppm. The minimum ammonia value was 0.0850 ppm and the maximum was 0.8620 ppm (Table 1). The highest of ammonia content tends to be at station V where a lot of floating net for fish culture (Figure 5.16). The more of organic compound in waters the higher of micro organism's activities that mean the consumption of oxygen for organic decomposition becomes higher and ammonia content as a result of that process will increase.

The main ammonia source in waters is from organic nitrogen and inorganic nitrogen waste that available in the soil and water that come from decomposition of organic compound. Apart from incoming waste volume, the availability of ammonia in waters also depends on the water condition particularly the oxygen content. If the oxygen content high enough so the ammonia will be converted into nitrate.

Ammonia is a toxic substance for aquatic organisms but for some fishes, they have relatively high sensitivity on ammonia content and some others are very sensitive event at low level content of ammonia. Fishes group of *Tilapia*, according to Redner (1978) relatively sensitive on ammonia in which at the ammonia content of 0.12 mg/l their growth rate have been impacted.

The average content of phosphate at Batur Lake was 0.1242 ppm. The minimum phosphate content was no detection and the maximum was 0.3610 ppm (Table 1). At all substations, especially at station I Kedisan the content was no detection. This maybe all phosphate has been used by plankton for development and growth so its content in Batur Lake was very low. Even though as an average the phosphate content at station V was the highest, but looking from standard deviation of each stations, there are no significant different among stations (Figure 5.18).

Some sources of phosphate in waters are from decomposition of dead plants and animals, aquatic organism's excretion, weathering of mineral stones and from incoming waste content of detergent. Surface run off from agriculture area also give big contribution for the phosphate content in waters.

Similar with nitrate, the concentration of phosphate in waters is an indication of productivity level and to monitor eutrophycation. According to Boyd (1988), phosphate (PO_4) content that be allowed in drinking water is 0.2 mg/l. Phosphate content in natural waters generally at about 0.005 – 0.02 mg/l. If phosphate content is over 0.1 mg/l, the waters are categorized as eutrophyc one. Base on phosphate content, some parts of Batur Lake have been categorized of high productivity.

The average sulphide content at Batur Lake was 0.0009 ppm. The minimum sulphide value was no detection and the maximum was 0.0016 ppm (Table 1). Figure 5.19 clear shows that the sulphide content was much higher at station V compared to others. At station V, there are floating nets for fish culture. Maybe the high source of sulphide comes from the activities of those floating nets.

In waters, sulphur belts with hydrogen and oxygen ions and one of them in form of sulphide hydrogen (H_2S). Sulphide hydrogen is formed from organic decomposition at anaerobic condition that often occurs at organic decomposition in mud substrate.

If there is no oxygen, sulphate have a role as a source of oxygen for oxidation process done by anaerobe bacteria. In this condition, sulphate ion will be changed into sulphite ion that forms a balance with hydrogen ion to create sulphide hydrogen.

In natural waters that enough aeration, commonly H_2S cannot be found because it has been oxidized into sulphate. In bottom waters that content a lot of mud deposit, the sulphide hydrogen content can be up to 0.7 mg/l, however at column water, generally the content is only about 0.02 – 0.1 mg/l (Effendi, 2003).

4. Conclusion

1) Temperature value at Batur Lake waters varied of 23.00 ^oC - 25 ^oC with average of 23.88 ^oC. The water clarity was around 1.58 - 2.90 meter with the average of 2.32 meter. The value of pH varied of 8.00 - 8.46 with the average of 8.21. The value of BOD_5 was at range of 0.245 - 8.720 ppm with the average of 3.817 ppm. COD value varied of 2.120 - 10.051 ppm with the average of 6.333 ppm. The content of ammonia was at around 0.0850 - 0.8620 with the average of 0.4545 ppm. Sulfide content varied from no detection up to 0.0016 ppm with the average of 0.0009 ppm.

2) The nutrient content in Batur Lake is that nitrate value varied of 0.0174 - 3.6070 ppm with average of 1.1498 ppm. Phosphate content was from no detection up to 0.3610 ppm with the average of 0.1242 ppm.
3) Heavy metals content in Batur Lake was that the average of cadmium was 0.0038 ppm with the minimum content of 0.0010 ppm and the maximum was 0.0060 ppm. Lead content on average was 0.0023 ppm. Lead minimum content was no detection and the maximum was 0.0040 ppm. The average of copper was 0.0055 ppm with the minimum content of 0.0010 ppm and the maximum was 0.0090 ppm. Iron content on average was 0.0428 ppm with the minimum value of 0.0150 ppm and the maximum was 0.1080 ppm.
4) There is a strong positive correlation between COD and BOD_5 that the highest content of the COD the highest BOD_5 content as well with correlation value of $R^2 = 0.927$. The ratio value between COD and BOD_5 (COD/ BOD_5) varies of 1.061 – 12.163 with the average value of 2.492 ± 1.909.

References

Arthana, I.W. 2006. "Studi Kualitas Air Danau Beratan, Buyan dan Tamblingan di Bedugul, Bali". *Ecotrophic*, 1 (2): 34-38.

Arthana, I.W. 1998. *Study of Benthic Organisms as an Indicator of Pollution in the Whiteknights Lakes*. Ph.D Dissertation at School of Animal and Microbial Sciences, The University of Reading, UK

Dinas Perikanan dan Kelautan (DKP) Provinsi Bali. 2005. *Identifikasi Potensi Sumberdaya Perairan Umum di Danau Batur*. Denpasar.

Goldman, C.R and A.J. Horme. 1983. *Limnology*. McGraw-Hill International Book Company. London.

Meybeck, M., E. Kuusisto, A. Makela, and E. Malkki. 1996. "Water Quality". in J. Bartman and R. Balance (Eds). *Water Quality Monitoring, A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes*. E & FN Spon Press, London.

Santoso, S. 2003. *Buku Latihan SPSS Statistik Multivariant*. Elex Media Komputindo, Kelompok Gramedia. Jakarta.

Tamai, K. 1989. *Introduction of Bethology*. Fisheries Research Laboratory, Nansei, Japan. 38 p.

Van Duin, E.H.S. 1992. *Sedimen transport, light and algal growth in the Markemeer*. Ph.D thesis, Agricultural University Wageningen, Department of Natural Conservation. The Netherlands.

Appendix 1. Location of water sampel collection in Batur Lake, Kintamani Bangli

Sub station	Station				
	I (Kedisan)	II (Abang)	III (Trunyan)	IV (Toye Bungkah)	V (Bumbung Klambu)
A1	S: 08° 16' 44,7" E: 115° 23' 15,5"	S: 08° 16' 43,0" E: 115° 24' 33,0 "	S: 08° 15' 0,5" E: 115° 25' 30,1"	S: 08° 15' 04,1" E: 115° 24' 02,4"	S: 08° 16' 28,6" E: 115° 22' 54,6"
A2	S: 08° 16' 45,1" E: 115° 23' 19,3"	S: 08° 16' 46,6" E: 115° 24' 27,4"	S: 08° 15' 0" E: 115° 25' 27,7"	S: 08° 15' 04,7" E: 115° 24' 04,2"	S: 08° 16' 30,9" E: 115° 22' 55,6"
A3	S: 08° 16' 44,2" E: 115° 23' 27,7"	S: 08° 16' 41,7" E: 115° 24' 24,5"	S: 08° 14' 58,7" E: 115° 25' 24,1"	S: 08° 15' 06,2" E: 115° 24' 06,2"	S: 08° 16' 33,6" E: 115° 22' 57,7"
A4	S: 08° 16' 43,2" E: 115° 23' 22,2"	S: 08° 16' 40,0" E: 115° 24' 21,2"	S: 08° 14' 58,1" E: 115° 25' 20,3"	S: 08° 15' 06,9" E: 115° 24' 08,2"	S: 08° 16' 35,6" E: 115° 22' 58,6"
A5	S: 08° 16' 43,3" E: 115° 23' 23,8"	S: 08° 16' 38,5" E: 115° 24' 20,3 "	S: 08° 14' 57,9 " E: 115° 25' 16,1"	S: 08° 15' 07,8" E: 115° 24' 10,9"	S: 08° 16' 39,4" E: 115° 23' 01,7"
B1	S: 08° 16' 43,5" E: 115° 23' 12,3"	S: 08° 16' 31,1" E: 115° 24' 36,1"	S: 08° 15' 13,8" E: 115° 25' 27,2"	S: 08° 14' 58,4" E: 115° 24' 11,7"	S: 08° 16' 20,1" E: 115° 23' 02,1"
B2	S: 08° 16' 43,2" E: 115° 23' 10,5"	S: 08° 16' 29,6" E: 115° 24' 24,2"	S: 08° 15' 13,2" E: 115° 25' 24,6"	S: 08° 14' 59,6" E: 115° 24' 13,3"	S: 08° 16' 22,6" E: 115° 23' 04,2"
B3	S: 08° 16' 40,5" E: 115° 23' 09,1"	S: 08° 16' 28,2" E: 115° 24' 32,2"	S: 08° 15' 12,6" E: 115° 25' 21,6"	S: 08° 15' 0,8" E: 115° 24' 14,2"	S: 08° 16' 27,5" E: 115° 23' 06,0"
B4	S: 08° 16' 41,5" E: 115° 23' 12.5"	S: 08° 16' 26,9" E: 115° 24' 27,9"	S: 08° 15' 11,5" E: 115° 25' 18,9"	S: 08° 15' 2,3" E: 115° 24' 15,5"	S: 08° 16' 29,5" E: 115° 23' 07,6"
B5	S: 08° 16' 39,2" E: 115° 23' 14,5"	S: 08° 16' 25,6" E: 115° 24' 23,7"	S: 08° 15' 13,2" E: 115° 25' 24,6"	S: 08° 15' 3,2" E: 115° 24' 16,9"	S: 08° 16' 34,4" E: 115° 23' 08,8"