

CHEMICAL PROPERTIES IN THE CONSERVATION AREAS OF GILIMANUK BAY, WEST COAST OF BALI

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ABSTRACT

The study on chemical properties in the conservation areas of Gilimanuk Bay, west coast of Bali was carried out in March 2006. The dissolved oxygen and degree of acidity (pH) in surface water were analyzed. The nutrients, consisting of phosphate, nitrate and ammonia concentrations in water were analyzed as well. In general all the chemical parameters were normal for coastal waters. Dissolved oxygen in this area was lower than those in Jakarta Bay and Panimbang waters, while the nutrient concentrations were lower compared to those of Cisadane Estuary, but higher compared to those of Mamberamo Waters. The fluctuations of pH, dissolved oxygen and other nutrients were influenced by the condition of surrounding area.

Keywords: Chemical properties, Conservation areas, Gilimanuk Bay, Bali

INTRODUCTION

The present study was made under a joint research program, involving biological oceanography, plankton, sea-grass, mangrove and benthos researchers in the conservation areas of Gilimanuk Bay, West coast of Bali during March 2006.

Nutrients are the material currency of energy flow and structural form in biological systems. Inorganic phosphate and nitrate are the first micronutrients in sea water used by phytoplankton for growth. Phytoplankters generally utilize both nitrate and phosphate in the same concentrations (Lund, 1950; Jorgensen, 1953; and Presscot, 1969). However, some scientists believe that nitrogen uptake is greater. In the sea, nitrate and phosphate concentrations differ in different coastal waters (Nakahara, 1978; Wallentinus, 1988)

The concentrations of nutrient: phosphate, nitrogen nitrate, ammonia and dissolved oxygen in the water column are highly variable but tend to increase towards the coast. This may be due to the nutrient inputs by fresh water. In Gilimanuk Bay these nutrients are mostly derived from land, small rivers and mangrove forests.

At the moment, much it is not known regarding the nutrients and the acidity of the water column of Gilimanuk Bay and adjacent waters.

The aim of this study is to investigate the distributions and variations of the degree of acidity, dissolved oxygen, inorganic phosphate, nitrate and ammonium concentrations of Gilimanuk Bay as a conservation area and to compare the result with those of other areas, such as of the Jakarta Bay, Cisadane Estuary, Mamberamo Estuary and Panimbang waters. The two former areas are known as polluted areas while the two latter ones are not.

The conservation area of Gilimanuk Bay is located in Bali Strait, west of Bali Province. This area is is protected by the Forestry Department and is called Taman Nasional. Adjacent to this study area are a harbor and diving resort which offers to enthusiasts the opportunity for diving. Huge diversity of macro subjects, ranging from seahorses, variety of ghost pipefish, dragonet, nudibranchs, mantis shrimp and more are found in the bay. All of these activities have potential impact on the environmental conditions, including chemical, physical and biological conditions of these areas.

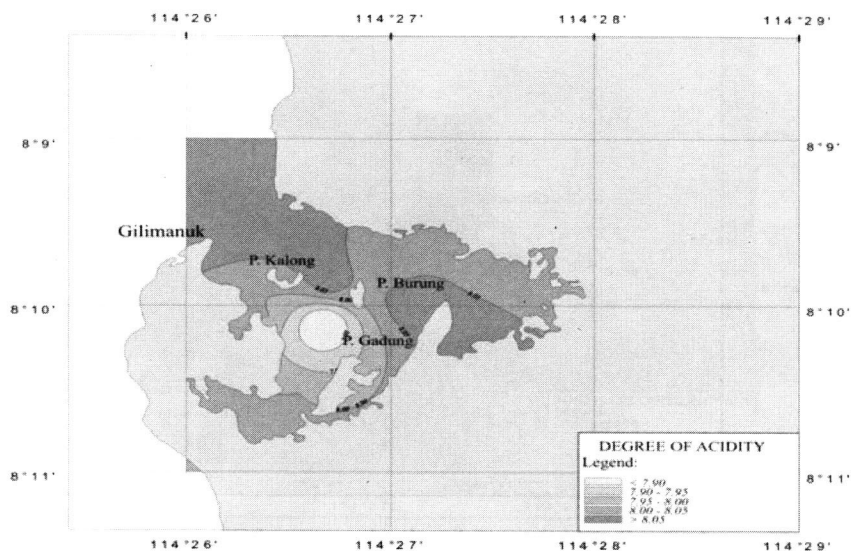


Figure 2. Acidity (pH) in the conservation area of Gilimanuk Bay, March 2006

2, 3, 4 and St 6) were lower compared to those in the other areas. This might be due to the organic input from mangrove trees surrounding those areas and the effect of water mass from the land.

Fig.3 shows that the pH in this water were higher compared to those of Cisadane Estuary and Mamberamo Waters with the mean of 7.86 (Anonim, 2004) and 7.79 (Muchtar, 2000) respectively but not significantly different to Jakarta Bay with the mean of 8.02 (Ilahude and Liasaputra, 1980) and Panimbang Waters with the mean 8.1 (Anonim, 2004). This due to

high dissolved organic material (DOM) contribution in Cisadane Estuary and Mamberamo Waters than in the Gilimanuk Bay and Jakarta Bay.

Dissolved oxygen

The dissolved oxygen (DO) of Gilimanuk Bay ranged from 3.21 to 4.31 ml/l (the mean 3.80 ml/l Table 1). Figure 4 shows the DO concentrations is lower at stations 3, 4, 5, 6 and St 7. These stations are in the area surrounded by mangrove forest. It is thought the relatively low DO may be due to high bacterial utilization of organic material coming from

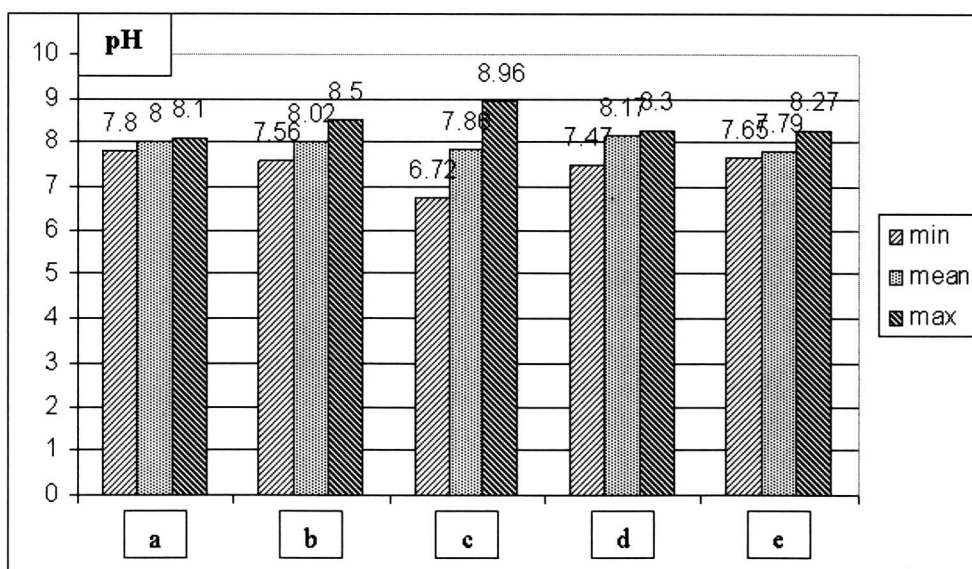


Figure 3. Acidity (pH) in the conservation area of Gilimanuk Bay (a), Jakarta Bay (b), Cisadane Estuary (c), Panimbang Waters (d) and Mamberamo Waters (e)

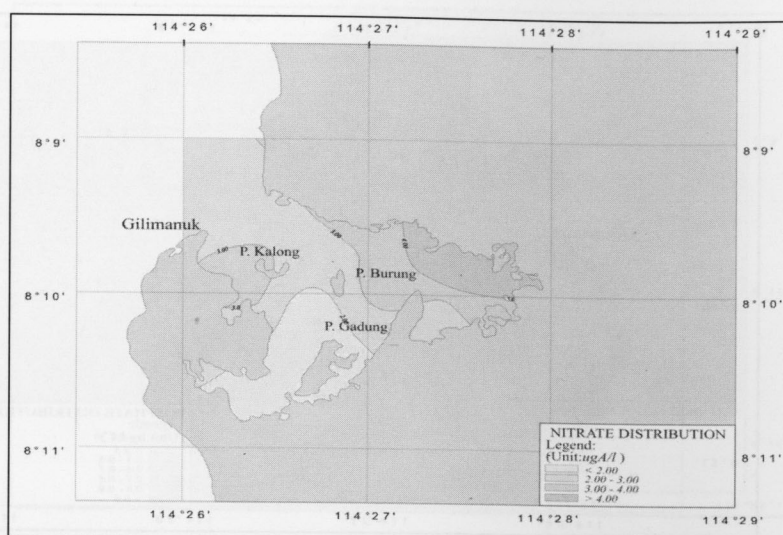


Figure 8. Distributions of nitrate concentrations of Gilimanuk Bay, March 2006

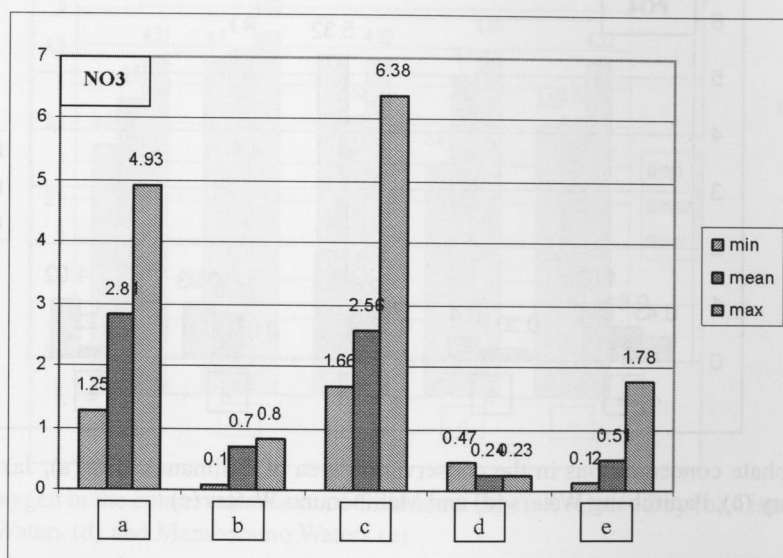


Figure 9. Nitrate concentrations in the conservation area of Gilimanuk Bay (a), Jakarta Bay (b), Cisadane Estuary (c), Panimbang Waters (d) and Mamberamo Waters (e)

1.78 $\mu\text{g-A/l}$ (mean 0.51 $\mu\text{g-A/l}$) (Muchtar, 2000) and Panimbang Waters which 0.47 to 0.23 $\mu\text{g-A/l}$ (mean 0.24 $\mu\text{g-A/l}$) (Anonim, 2004). This was due to the supply of inorganic material from the land and mangrove areas surrounded Gilimanuk Bay and Cisadane Estuary which were much higher than that in Jakarta Bay, Panimbang and Mamberamo Waters.

Ammonia

The concentrations of ammonia in Gilimanuk Bay are summarized in Table 1. The ammonia

concentration ranged from 1.05 to 3.66 $\mu\text{g-A/l}$, (mean 2.21 $\mu\text{g-A/l}$). Figure 10 shows that the ammonia concentrations inside of Gilimanuk Bay (St. 2, 3, 4, 6 and 10) were higher compared to other areas. This was due to oxidation of supply of inorganic material from the land.

Figure 11 shows in general the concentration of ammonia in the area of Gilimanuk Bay were higher compared with Bayur and Bungus Bays which have ammonia concentrations were ranged from 0.26 to 3.84 $\mu\text{g-A/l}$ and from 0.34 to 1.83 $\mu\text{g-A/l}$ with mean 2.19 and 1.11 $\mu\text{g-A/l}$ respectively (Muchtar, 1999) but were lower compared with

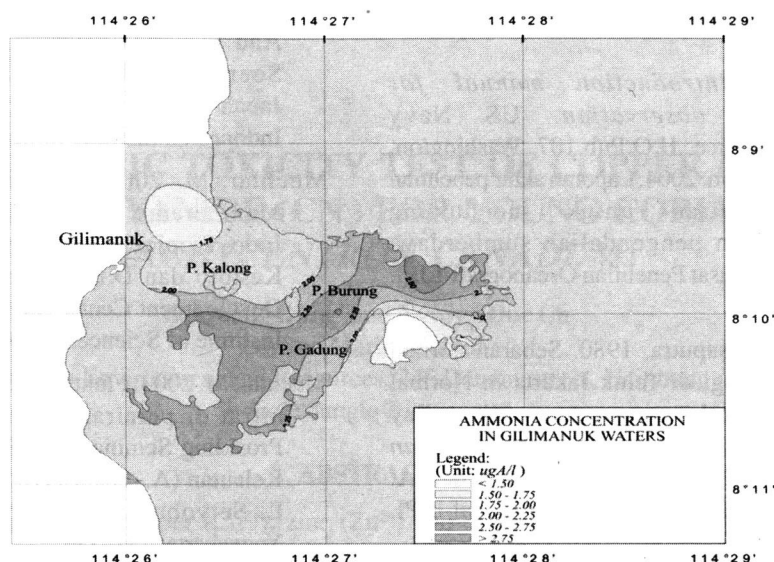


Figure 10. Ammonia concentrations of Gilimanuk Bay

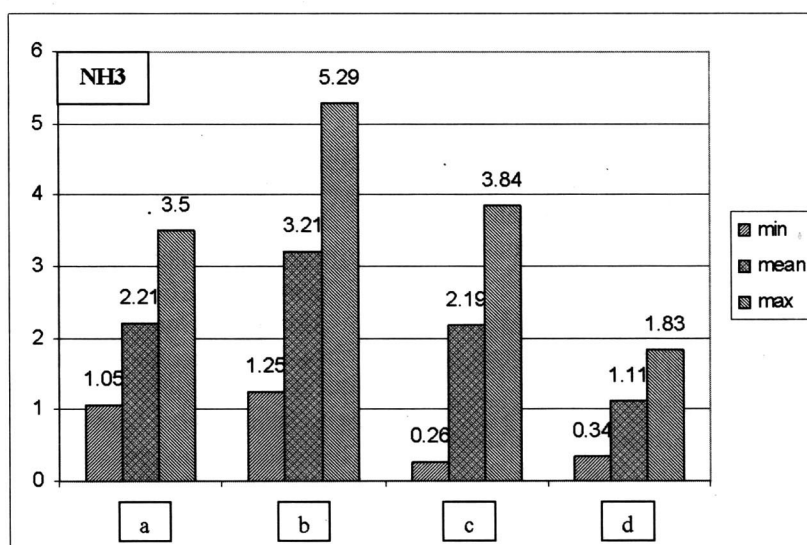


Figure 11. Ammonia concentrations in the conservation area of Gilimanuk Bay (a), Cisadane Estuary (b), Bayur Bay (c) and Bungus Bay (d)

those in Cisadane Estuary which have ammonia concentrations were ranged from 1.25 to 5.29 with mean 3.21 $\mu\text{g-A/l}$ (Muchtart, 2003). This was due to the supply of organic material from the land in this area much lower compare to Cisadane Estuary

CONCLUDING REMAKS

The concentrations of nutrient in the Gilimanuk Bay e.g. phosphate, nitrate, ammonia, dissolved oxygen and pH are normal for coastal waters. The distribution patterns of phosphate and nitrate indicate that phosphate and nitrate concentrations

near mangrove area were higher compared to those of the offshore area.

Fluctuation of nutrient, dissolved oxygen and pH in the Gilimanuk Bay were due to influenced by the condition of surrounding area and the effect of water masses from the land.

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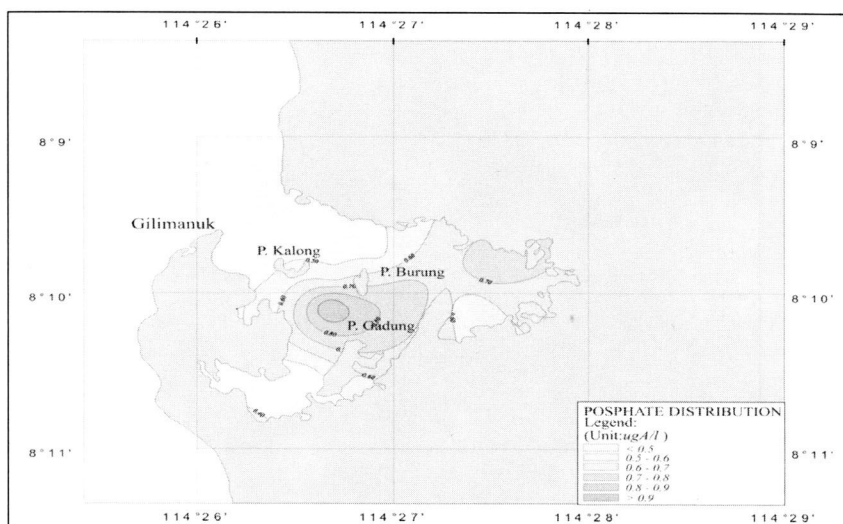


Figure 6. Distribution of phosphate of Gilimanuk Bay, March 2006

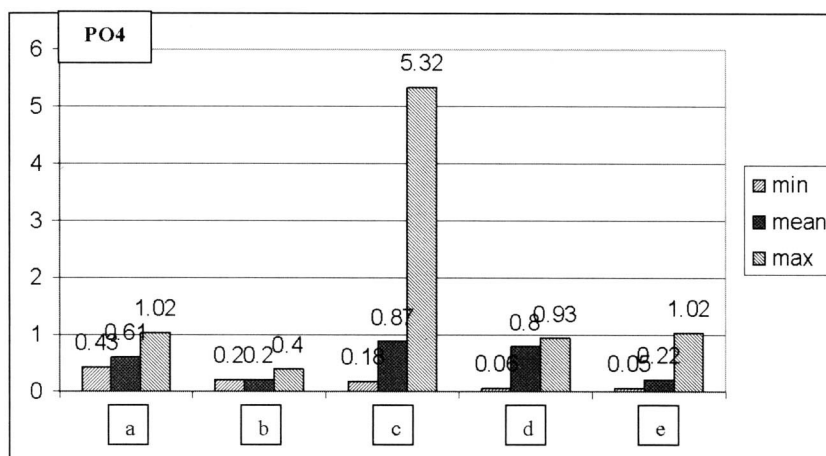


Figure 7. Phosphate concentrations in the conservation area of Gilimanuk Bay (a), Jakarta Bay (b), Cisadane Estuary (c), Panimbang Waters (d) and Mamberamo Waters (e)

$\mu\text{g A/l}$ with mean $0.80 \mu\text{g A/l}$. This due to beside input of the organic material from mangrove areas also the from rivers (Cisadane and Ciseuket rivers), the same as Nakahara, 1978 and Wallentinus, 1988 who found that the coastal water with more runoff from land can hold more nitrogen and phosphorus. Those data also shows that the phosphate concentrations in this area were higher compared to those of Mamberamo waters which ranged from 0.05 to $1.02 \mu\text{g A/l}$ with the mean of $0.22 \mu\text{g A/l}$ (Muchtar, 2000) and Jakarta Bay which ranged from 0.20 to $0.40 \mu\text{g A/l}$ with the mean of $0.20 \mu\text{g A/l}$ (Ilahude and Liasaputra, 1980). This might be due to the organic input from mangrove trees surrounding Gilimanuk Bay which had wider forest.

Nitrate

Concentration of Nitrate in Gilimanuk Bay ranged from 1.25 to $4.93 \mu\text{g-A/l}$, (mean $2.81 \mu\text{g-A/l}$). The distribution of nitrate concentration (Fig. 8) looks almost similar to the distribution of phosphate concentrations. The higher concentrations of nitrate were found at the stations near mangrove and sea-grass areas.

Figure 9 shows the mean of nitrate concentrations of Gilimanuk Bay were not so much different compared to Cisadane Estuary which ranged 1.66 to $6.38 \mu\text{g-A/l}$ (mean $2.56 \mu\text{g-A/l}$) (Muchtar, 2003) but higher compared to Jakarta Bay which ranged from 0.10 to $0.80 \mu\text{g-A/l}$ (mean $0.70 \mu\text{g-A/l}$) (Ilahude and Liasaputra, 1980) and Mamberamo Waters which ranged from 0.12 to

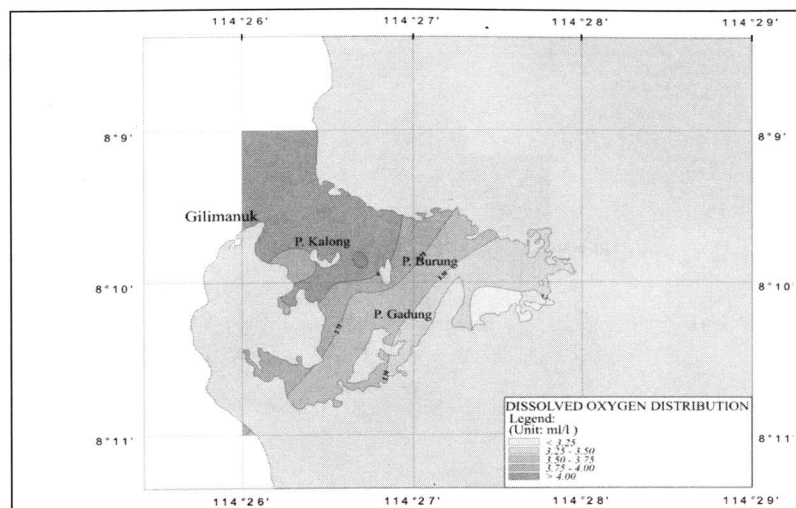


Figure 4. The distributions of dissolved oxygen of Gilimanuk Bay, March 2006

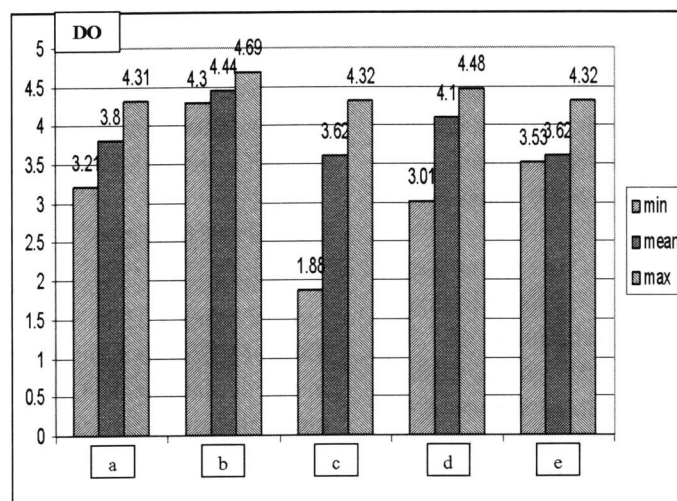


Figure 5. Dissolved Oxygen in the conservation area of Gilimanuk Bay (a), Jakarta Bay (b), Cisadane Estuary (c), Panimbang Waters (d) and Mamberamo Waters (e)

the forest. Higher concentrations were found at stations near Bali Strait. This fact may be attributed to the influence of open sea water of Bali Strait. In general the DO concentrations in this Bay are still normal for coastal waters

Generally, the mean of DO concentrations of Gilimanuk Bay were not so much different with those of Cisadane Estuary (3.62 ml/l; Anonim, 2004) and Mamberamo Waters (3.62 ml/l ; Muchtar 2000)(Fig. 5) but were lower compared to those of Jakarta Bay with the mean of 4.44 ml/l (Ilahude and Liasaputra, 1980) and Panimbang waters (4.10 ml/l; Muchtar, 1997) This was mainly due to no turbulence occurred in this area and supply of organic material from surrounding land and mangrove forest (bacterial utilization oxygen

to degradation of organic material from mangrove forest and land).

Phosphate

Phosphate concentrations of Gilimanuk Bay ranged from 0.43–1.02 $\mu\text{g-A/l}$ (mean 0.61 $\mu\text{g-A/l}$). In general the phosphate in this area were normal for coastal waters. Figure 6 shows the aspect of supply of inorganic material from the land, mangrove and sea-grass to surrounding areas.

Based on Figure 7, it could be concluded that in general the phosphate concentrations were lower in this area compared to those of Cisadane Estuary which ranged from 0.18 to 5.32 $\mu\text{g A/l}$ with mean 0.87 $\mu\text{g A/l}$ (Muchtar, 2000) and Panimbang Waters which ranged from 0.06 to 0.93

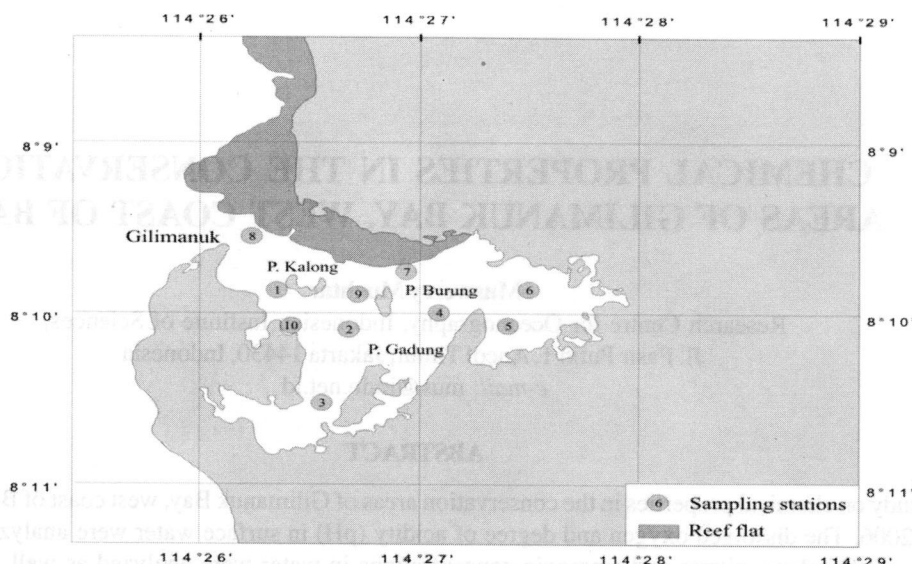


Figure 1. The sampling site in the conservation areas of Gilimanuk Bay, March 2006

Some natural resources in Gilimanuk Bay are mangrove forest, sea-grasses and coral reef. Gilimanuk Bay is a semi enclosed bay, far from the influence of the open sea, while Cisadane Estuary, Panimbang waters, Mamberamo estuary and Jakarta Bay are directly influenced by the open sea

MATERIALS AND METHODS

The study area is shown in Fig. 1. The sampling work was carried out in March 2006. Water samples were collected by using Nansen bottles and kept in the polyethylene bottles for nutrient: phosphate, nitrate and ammonium, and DO glass bottles for dissolved oxygen, while pH was measured by using pH meter.

The water samples were filtered through a Millipore (0.45 μ m). Inorganic phosphate, nitrate

and ammonium were analyzed using spectrometry in the same day according to the methods described by Strickland and Parsons (1972). Dissolved oxygen was analyzed, using Winkler method (Anonim, 1959).

RESULTS AND DISCUSSION

The acidity (pH), concentrations of dissolved oxygen, inorganic phosphate, nitrate and ammonium of Gilimanuk Bay is summarized in Table 1 and Figure 2 to 9.

Degree of acidity (pH)

The pH at the surface layer ranged from 7.8 to 8.1 (mean 8.0). In general the pH in this area is in the normal condition for the coastal waters. Fig. 2 shows that the pH near the mangrove area (St.

Table 1. The concentrations of chemical parameters in the Gilimanuk Bay, March 2006

No	Parameters	Surface layer	
		Range	Mean
1	Phosphate (μ g-A /l)	0.43 – 1.02	0.61
2	Nitrate (μ g-A /l)	1.25 – 4.95	2.81
3	Ammonia (μ g-A /l)	1.06 – 3.66	2.21
4	Dissolved oxygen (ml/l)	3.21 -4.31	3.80
5	pH	7.80 - 8.10	8.00

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