

## Comparison of Water Quality According to Seasonal Variation in Mokpo and Wando Costal Areas

Woo-Hang Kim and Young Sik Lee\*

*Faculty of Ocean System Engineering, Mokpo National Maritime University, Jeonnam 530-729, Korea*  
*Aquaculture Environment Institute, NFRDI, Gyeongnam 650-943, Korea*  
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### Abstract

The objective of this study was to evaluate the relationship between nutrients and phytoplankton. This study was done by the comparison to two costal areas Mokpo, which inflow fresh water, and Wando. In August, salinity of the sea water decreased by 3.5-4.5‰ in Mokpo coastal area, but was not nearly decreased in Wando coastal area. This suggests a lot of fresh water inflow in Mokpo coastal area. DIN and DIP were decreased by water temperature increasing in Wando. However, in Mokpo, DIN and DIP were increased greatly during the summer season. Nitrogen was limited to a 10 N/P ratio especially during the summer season in Wando coastal area while phosphorus in Mokpo coastal area was limited with over 28 N/P ratio in all the seasons. Coefficient of determination( $r^2$ ) between DIP and Chl.-a was 0.91 in Mokpo coastal area. On the other hand, Coefficient of determination( $r^2$ ) between Chl.-a and DIN, DIP were 0.93 and 0.89, respectively, in Wando coastal area. These results suggest DIP in Mokpo and DIN and DIP in Wando might be limited at the increase of phytoplankton.

**Key Words :** Nutrients, Limitation nutrient, Nitrogen, Phosphorous, Phytoplankton

### 1. Introduction

Nutrients in aquatic systems are biologically important elements, which are mainly used by plants for growth and reproduction. On the global scale, most marine geochemists believe that the input of P to the oceans determines the level of net marine production. This conclusion is based on the fundamental difference between the N and P cycles, which depend on the redox and oxygenation state of the environment. N has a large atmospheric reservoir. Because of this atmospheric reservoir, any N deficit can theoretically be compensated by the fixation of atmospheric N. In con-

trast, P, as the by-product of chemical weathering, is transported to the oceans almost exclusively by rivers. In many estuaries, harbours and bays, P, concentrations are very high due to anthropogenic inputs. P enrichment can heavily contribute to eutrophication<sup>1-3)</sup>. Biogenic N input to the ocean is in the reduced form, mainly as ammonium and amino N. Almost all of ionic N is in the thermodynamically stable form of nitrate. In addition, the bacterial degradation of organic matter in water and sediments leads to the release of inorganic N and P<sup>4-6)</sup>. This will then become available for new phytoplankton production.

Aquatic systems have started to become adversely affected due to man's activities over the past several decades. Anthropogenic loading with nutrients may enhance biological productivity in costal waters and bays that already tend to higher productivity. However, high

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Corresponding Author : Woo-Hang Kim, Faculty of Ocean System Engineering, Mokpo National Maritime University, Jeonnam 530-729, Korea  
Phone: +82-61-240-7310  
E-mail: whkim@mmu.ac.kr

amounts of nutrients alone cannot be regarded as eutrophication. Nutrient enrichment must be followed by an accelerated growth of algae, which create an undesirable disturbance of the life cycle of organisms resulting in water quality changes. Rather and Dunstan pointed out that phosphate can be used as a tracer of pollution originating from anthropogenic sources and is the main causative agent of excessive algal growth, eutrophication and other adverse effects associated with organic pollution<sup>7</sup>. Additionally, the same authors concluded that N also can limit and control algal growth and eutrophication, especially in anoxic environments.

Therefore, the objective of this study was to evaluate the relationship between nutrients and phytoplankton. This study was compared two costal areas of Mokpo, which inflow fresh water, and Wando.

## 2. Materials and Methods

This study was conducted with comparison of Mokpo and Wando costal area. Fresh water from Youngsan lake inflow to Mokpo costal area but only a little fresh water inflow to Wando costal area. Fig. 1 shows the point of sampling for two costal area. The sampling points of Mokpo were an estuary of Youngsan lake(1), inside of Mokpo harbor(2), north-east of Koha island(3), east of Dalri island(4), north east of Jangjoa island(5) and east of Abhae island(6). The sampling points of Wando were south-east of Wandoup(1), east of Wandoup(2), north of Shinji island(3), south of Wando(4) and east of Choyak island(5). Seasonal data were collected from February, May, August and November and data were calculated with average for 5 or 6 points during 10 years. Items of water quality were determined using water temperature, salinity, pH, dissolved oxygen(DO), chemical oxygen demand (COD), dissolved inorganic nitrogen(DIN), dissolved inorganic phosphorus(DIP) and Chlorophyll-a(Chl.-a). All the data were used gathered from a 10 year data (from 1996 to 2005) from environmental measurement system in National Fisheries Research and Development Institute(NFRDI)<sup>8</sup>. But data of DIP and Chl.-a data in Wando and Mokpo were gathered from 5 and 7

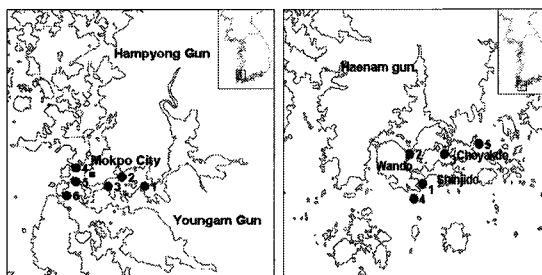


Fig. 1. Sampling stations in the Mokpo and Wando costal areas.

year-records.

## 3. Results and Discussion

Fig. 2 shows seasonal variation of salinity, water temperature, pH and DO. Salinity in Mokpo was decreased by 3.5~4.5‰ with 26.5‰ during the summer. This is caused by a lot of fresh water inflow. But salinity of Wando almost was not decreased in summer. It was known that fresh water almost were not influent in Wando costal area. Salinity of Mokpo was lower than that of Wando through the year and this proves that fresh water flow more in Mokpo than in Wando. Water temperature was almost the same from 8.6°C in winter to 23.5°C in summer. There were little differences between the pH and DO of two areas.

Fig. 3 shows seasonal variation of nutrients and N/P ratio. In Wando costal area, DIN was decreased from winter to summer and then it was increased from summer to winter. It might happen that DIN was decreased according to phytoplankton growth with the increase in water temperature. However, in Mokpo costal area, DIN was increased from spring to summer because influent DIN was higher than using DIN by phytoplankton growth. DIN is higher in Mokpo than in Wando all through the seasons. It is known that salinity of the Mokpo was lower than that of Wando all the season as fresh water flow in Mokpo than in Wando. DIP has the same variation with DIN. In Wando costal area, DIP was decreased from winter to summer and then it was increased from summer to winter while there was a considerable increase in the parameter in Mokpo costal area from spring to

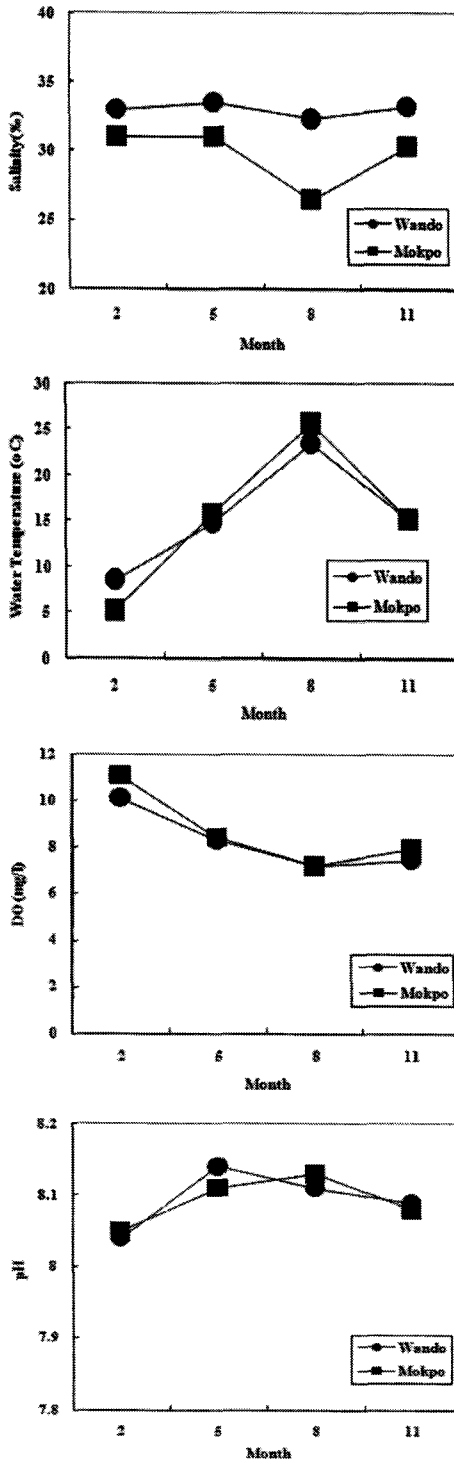


Fig. 2. Seasonal variation of water parameter in two coastal areas.

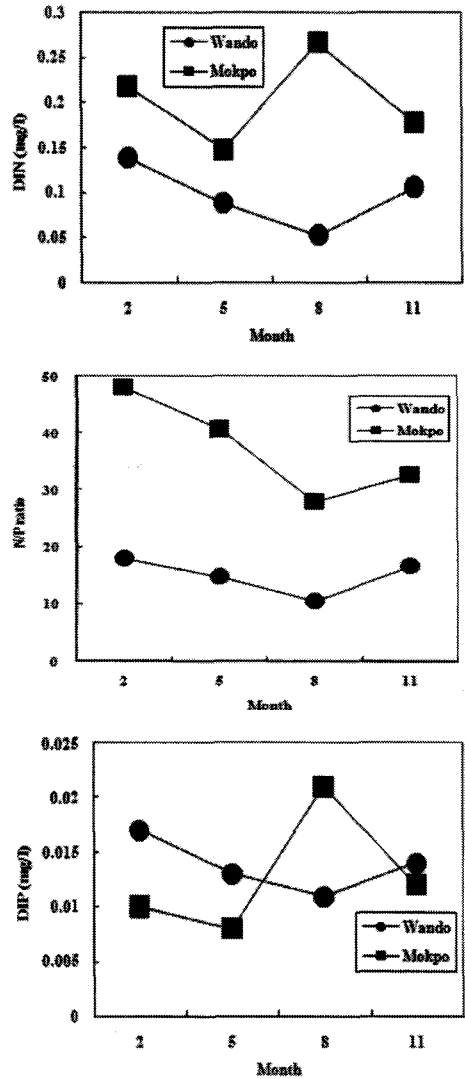


Fig. 3. Seasonal variation of nutrients concentration and DIN/DIP ratio in two coastal areas.

summer. DIN was higher in Mokpo than in Wando but the opposite resulted with DIP except for summer. Limitation nutrient is evaluated with Redfield ratio(N:P=16:1). In Mokpo coastal area, Phosphorus was limited as N/P ratio was 48.0 in the highest winter and was 28.0 in the lowest summer. Meanwhile, Nitrogen was limited in Wando coastal area as N/P ratio was 10.5 in the lowest summer. This result showed that Mokpo coastal area could become comparable to lake with fresh water influent.

Fig. 4 shows chl.-a and COD to know phytoplankton and organic matter variation. Chl.-a was increased from winter to summer in Wando. This result explains that phytoplankton growth was directly proportional to water temperature and has a reverse correlation with nutrients. In Mokpo, Chl.-a remained nearly unchanged from winter to spring but highly increased from spring to summer. It can be observed that phytoplankton was not increased by limitation phosphorus during winter and spring but was increased by nutrient influent in summer. COD revealed the same inclination with Chl.-a as COD increased from winter to summer in Wando. In Mokpo, COD increased without phytoplankton increasing in spring and was not increased highly in summer compare to the increase in phytoplankton. Comparing the two coastal areas, Mokpo has higher phytoplankton growth and organic matter production than Wando because much nutrients flow in Mokpo coastal area from Youngsan lake.

Fig. 5 shows relationship between DIN and Chl.-a,

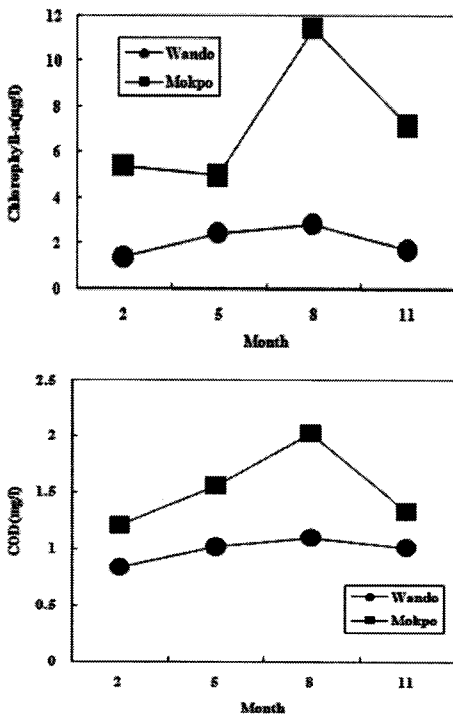


Fig. 4. Seasonal variation of Chlorophyll-a, COD and DO in two coastal areas.

DIP and Chl.-a. Coefficient of determinations ( $r^2$ ) between DIN and Chl.-a were 0.93 and 0.40 in Mokpo and Wando coastal area respectively. These results show that phytoplankton growth was affected by DIN in Wando but was not affected by DIN in Mokpo. Coefficient of determinations( $r^2$ ) between DIP and Chl.-a were 0.91 and 0.89 in Mokpo and Wando coastal area respectively. These results suggest that phytoplankton growth was affected by DIP in two locations. These results revealed that phytoplankton growth was highly affected with DIP in Mokpo and with DIN, DIP in Wando respectively. The relationship was positive in Mokpo and negative in Wando. It is known that phytoplankton was grown with nutrient influent in Mokpo and nutrient was decreased by phytoplankton growth in Wando.

#### 4. Conclusion

1. In August, salinity of the sea water was decreased

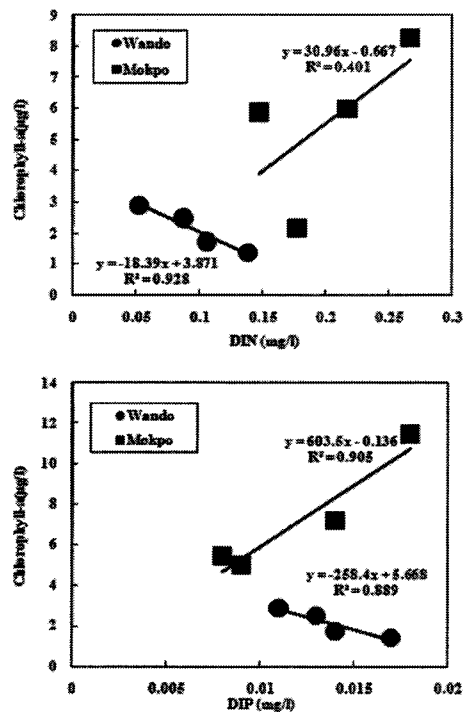


Fig. 5. Results of linear regression analyses of chlorophyll-a vs. DIN and DIP.

by 3.5-4.5‰ in Mokpo coastal area, but was not nearly decreased in Wando coastal area.

2. DIN and DIP were decreased by water temperature increase in Wando. But they were increased greatly during the summer season in Mokpo.

3. Nitrogen was limited with 10 of N/P ratio especially during the summer season in Wando coastal area. On the other hand, phosphorous was limited with over 28 of N/P ratio in all the seasons in Mokpo coastal area.

4. Coefficient of determination( $r^2$ ) between DIP and Chl.-a was 0.91 in Mokpo coastal area while in Wando coastal area, the coefficient of determination( $r^2$ ) between Chl.-a and DIN, DIP were 0.93 and 0.89, respectively. These results suggest that DIP in Mokpo and DIN and DIP in Wando might be limited at the increase of phytoplankton.

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