論文内容の要旨

論文題目　Effects of physical field on nutrient dynamics in a shallow eutrophic lake - Nutrient dynamics and lake restoration using aquatic macrophytes -　（富栄養化した浅い湖沼における栄養塩動態に対する物理場の影響―栄養塩の動態と水草を用いた保全対策の検討―）

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Phosphorus (P) is the essential element for all the living organisms. The increase of P induces eutrophication, which has been observed since 1960s. Such issues, excessive P loading – especially due to anthropogenic, from the agricultural, industrial, and urbanized areas – still remain for many countries. In spite of the decrease of P loading by sewage treatment in Japan, internal loading induces eutrophication via P release from sediment and resuspension. This thesis highlighted the importance of sediment resuspension for a shallow eutrophic lake and the restoration by using aquatic macrophytes.

In this study, I focused on Lake Teganuma which is one of the most eutrophicated lakes in Japan. In terms of wind resuspension event on the Kanto Plain, wind speed increases in the day and it decreases in the night. This wind pattern implies the hypothesis that wind resuspension can change daily and this pattern can induce the regime shift which is the shift from the state of well- turbid and high phytoplankton biomass to calm and less turbid state.

For a long term P dynamics, I collected the water samples from June to September and analyzed suspended solids (SS) by P fractionation scheme. As a result, in cases of high phytoplankton biomass and high concentration in SS, Fe and Al sorbed P is released to water, which supported the further growth of phytoplankton.

In terms of daily change pattern of wind-induced sediment resuspension and phytoplankton response, sediment resuspension increases in the day and it decreases in the night in spite of large fluctuation of SS in the night. Phytoplankton also grows in the day and increases pH, which releases PIP from resuspended sediment.

These sediments can be supplied by inflow from the tributaries named Otsu and Ohori. Normally in the Otsu River, sediment is accumulated on the bottom in the downstream region where the broad river width and flat river slope are observed. From the Otsu River, sediment is supplied due to rain and replenishment. The abrupt increase of SS concentration

in the downstream region is attributable to the resuspension of bottom sediments. In terms of P, SRP supplied from the upstream end of the Otsu River. It is always sorbed upon sediment or SS throughout the river and resuspended sediment during the rain event is processed adsorption and supplied to the downstream Lake Teganuma.

To preclude resuspension from bottom, macrophytes use can be considered. Although *Nelumbo nucifera* is the dominant species in Lake Teganuma, its colony is the large pool of easily degradable inorganic P. The easily degradable inorganic P accounted for more than 50% of TP, which is approximately 480 kgP, which is relatively the same quantity of P supplied from the Ohori River for one month. If the colony decayed in a short time, less than 1 month, *N. nucifera* colony is the critical P source for eutrophication.

The above mentioned eutrophication mechanisms within Lake Teganuma show that restoration of submerged macrophytes can be the most effective way to combat eutrophication. Submerged macrophytes especially preclude resuspension and some species accelerate calcification and precipitation of SRP from surface water. However, our study suggests that groundwater with high free CO_2 can be a key role for the habitat of submerged macrophytes. As the concluding remarks, for the restoration of submerged macrophytes, I suggest that to keep the quantity of groundwater and reduce P from the upstream end of the tributaries are the most effective restoration measures.