Effects of Vegetation types, Temperature and Nutrients on Denitrification Rates in Aquatic Systems

Aquatic Ecology and Water Quality Management Group

ABDUL A. J. MOHAMED

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Name: Abdul A. J. Mohamed

MSc. Environmental Sciences

Supervisors: Annelies Veraart and Jeroen de Klein

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Abstract

The Netherlands is well known for its nitrogen problems, it has the highest reactive nitrogen (Nr) emission densities in the world. It is a small country at the delta of several large European rivers. Ever since the industrial revolution, there have been a growing excess of nutrients and related emission into atmosphere (ammonia, nitrogen oxides, and nitrous oxide) and into groundwater and surface water (nitrate) leading to a large range of cascading environmental impact. The process of denitrification can reduce the nitrogen (nitrate) concentration in the water systems. The aim of this study was to investigate the effects of vegetation types, temperature and nutrient on rate of denitrification. Two different denitrification experiments were conducted in an acclimatized room (Laboratory) using microcosms. The first denitrification experiment aimed at finding out which one between two plant species *Elodea nuttallii* and *Lemna* has highest rate of denitrification in dark and in light environment under the same nutrient level. The second denitrification experiment was conducted to find out at which nutrient level and temperature the denitrification is at highest rate, this denitrification experiment was conducted only in dark. In both two denitrification experiments the ^{15}N addition method using an Isotope Ratio Mass Spectrometer (IRMS) was used to measure the rate of denitrification. In the first denitrification experiment total denitrification rate was found to be higher in the treatment that contained *Lemna* sp as compared to that of *Elodea nuttallii*. In the dark condition the rate of denitrification was found to be 2.18µmolN/m^2/h for *Lemna* and 0.89µmolN/m^2/h for *Elodea nuttallii* at water temperature of 20^{o}C, but mean total denitrification rate of *Elodea nuttallii* at 24^{o}C was 16.30µmolN/m^2/h also at dark condition, while in light condition the mean total denitrification rates were 1.96µmolN/m^2/h and 1.0µmolN/m^2/h for *Lemna* and *Elodea nuttallii* respectively at water temperature of 20^{o}C, whereby mean total denitrification rate of *Elodea nuttallii* at 24^{o}C was 14.81µmolN/m^2/h also at light condition. The second denitrification experiment contained only one type of vegetation (*Elodea nuttallii*) and was conducted in the dark using two different nutrient levels (Low and High) and with two different $^{14}NaNO_3$ concentrations that was 1.5mgN/L and 3.0mgN/L as low and high $^{14}NO_3^-$ concentration respectively spiked respectively in to the microcosms containing low and high Smart and Barko medium. In this experiment four different water temperatures were used that was 10^{o}C, 15^{o}C, 20^{o}C, and 25^{o}C. It has been found that the mean total rate of denitrification was significantly higher at higher nutrient level and temperature with the value of 3550µmolN/m^2/h at high $^{14}NaNO_3$ concentration and at 25^{o}C, while at 10^{o}C and low nutrient level the value was 280µmoN/m^2/h. This concludes that both $^{14}NO_3^-$ level and temperature had a combined effect to the process of denitrification and thus indicating that nutrient and temperature are the controlling factors for the denitrification processes in aquatic systems.

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