Distribution of Element Concentration in an Aquatic Macrophtyes Community in a River

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Abstract

Aquatic macrophyte communities in rivers have function of controlling water flow as well as chemical modification of river water. However, distribution of aquatic macrophytes community is heterogeneous in natural river ecosystems, and then evaluation of physical and chemical interaction of plants' community and river water is quite difficult. Because of the heterogeneity of aquatic macrophytes, the flow rate of water and distribution of element concentration in an aquatic community also become heterogenious[1)]. In this research, we tried to investigate a relationship between aquatic macrophytes coverage and distribution of physical and chemical parameters in a natural river community with reference to the heterogeneity of environment. We chose a 20 m long and 10 m wide area in the Iwatakegawa River and determined hydrophyte coverage, flow rate, electric conductivity (EC), pH, and element concentration (Na^+, Ca^{2+}, Mg^{2+}, K^+, Cl^-, NO_3^-, SO_4^{2-}). The flow rate measured within a hydrophyte community was less than the flow rate measured in non-vegetated area. And we also found that distribution of element concentration was heterogeneous within and outside aquatic macrophytes community. Among elements, $NO_3^-$and Na^+ showed highly heterogeneous distribution; concentration of NO_3^- increased from the upper to the lower stream of the river, whereas concentration of Na^+ was higher within the vegetated area compared as the non-vegetated area .

Keywords: coverage, flow rate, distribution of element concentration

Introduction

By the function of natural purification of river, concentration of water pollutant decreases as water flow down in the river[2)]. Aquatic macrophytes community as well as microorganisms community in water column have purifying function in the river. However, the evaluation of the water purifying function in natural steam was quite difficult. Water chemistry of river water is a result of not only water purifying function by organisms in river but also the loading of chemicals by natural and artificial processes, and then the determined water chemistry is an integration of these two processes. Another reason is the highly heterogeneity of the river

environment. Especially the aquatic macrophytes community in natural river system is quite heterogeneous and then the chemical and physical parameters of river water are strongly affected by the distribution of plants in the river. In this research, we focus on distribution of flow rate and element concentration by heterogeneously distributed aquatic macrophytes community, and we tried to analyze the function of aquatic macrophytes on the formation of water chemistry including the heterogeneity within a fine scale of river.

Study site

This study was conducted in Iwatakegawa River. Iwatakegawa River is originated from Inugatake in Yabahitahikosan Park and flowing through urbanized area of Buzen city into Suou-nada Japan (33°34'N 131°07'E). The river has the basin of 36.9km^2. The total length of the river is about 20km. (Fig.1)

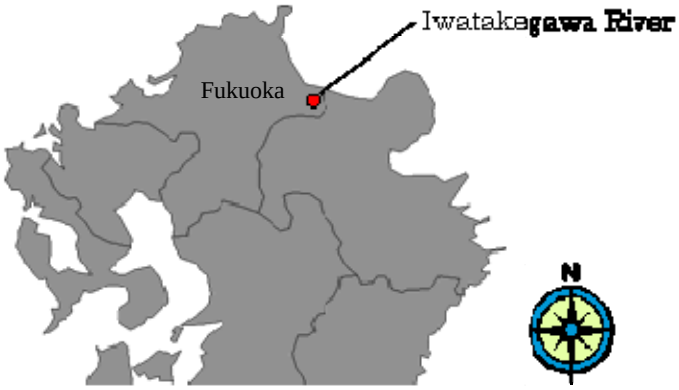

Fig.1 Map showing the study site Iwatakegawa River in Southeast Fukuoka Japan

Materials and Methods

This study had conducted three times (spring 27 May., summer 11 Aug., autumn 6 Nov. 2008). We have located the permanent 20 m long and 10 m wide plot in the middle-watershed at Iwatakegawa River with crowded vegetation of *Phragmites japonica* Stend., dominated community (Fig.2). Then, we examined coverage, column diameter of *P. japonica*, column height of *P. japonica*, flow rate, water table depth, EC, pH and ionic concentration of water at every 1 m x 1 m quadrat in this area. Samples were brought into the laboratory, and chemically analyzed by Ion chromatography (IC) and Inductiovely-coupled plasma atomic emission spectrometry (ICP-AES) to determine concentrations of major cations (Na^+, K^+, Mg^{2+}, Ca^{2+}), anions (Cl^-,SO_4^{2-}, NO_3^-) Data were analyzed with 3-D graphics of cover degree, flow rate, each element concentration by G-sharp in order to clarify the relationship between vegetation and physical and chemical parameters of river water at 1m resolution.

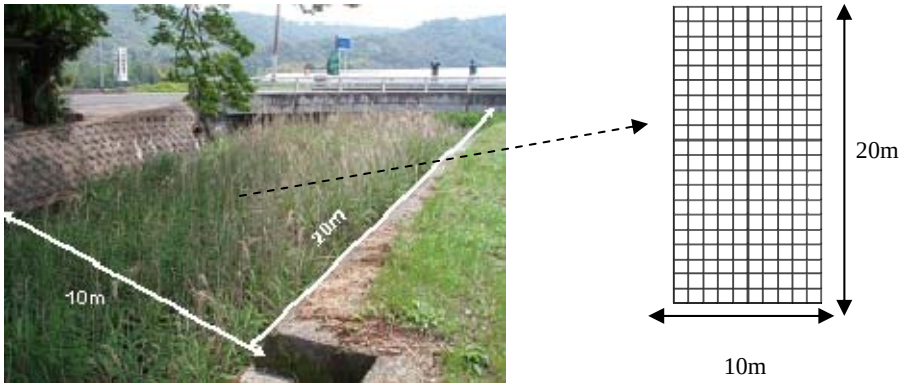

Fig.2 The image of the investigation design in the Iwatakegawa River

Results and Discussion

Flow rate distribution

The distribution of coverage and flow rate was shown in Fig.3 and Fig.4 which were measured at 27 May 2008. The mean flow rate in the crowded *P. japonica* community was 0.2 - 0.3 m s^{-1}, whereas the mean flow rate in the non-vegetated area was 0.6 - 0.8 m s^{-1}. Thus the contact time of water to vegetation was 3 times higher than the non-vegetated area, and the aquatic macrophyte community could be the pool for chemical modification in river water.

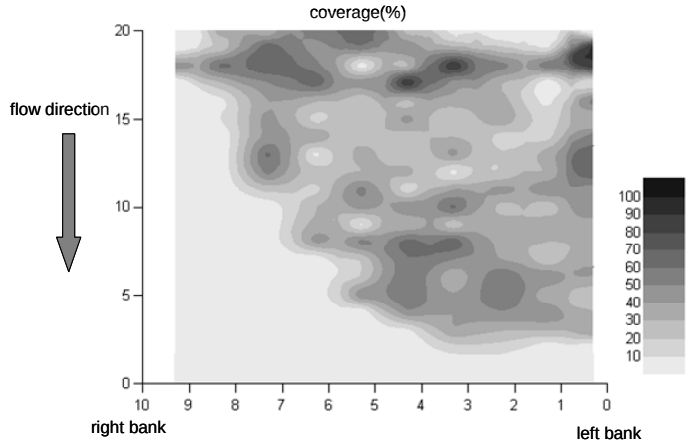

Fig.3 The coverage of *P. japonica* community

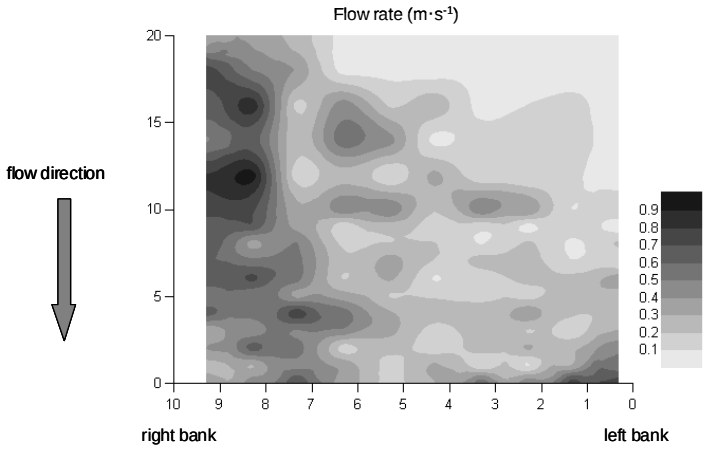

Fig.4 The distribution of flow rate in p.*japonica* community

Distribution of element concentration

Concentration of each element showed heterogeneous distribution within and outside the plants' community. Element concentration showed a increasing trend from the upper to the lower stream of the river. Among chemical parameters, NO^{3-} and Na^{+} showed characteristic distribution. Concentration of NO^{3-} increased from the upper to the lower stream of the river. Na^{+} showed higher concentration within the aquatic marcophytes. These results showed that function of aquatic macrophytes community on chemical modification of river water depends on elements.

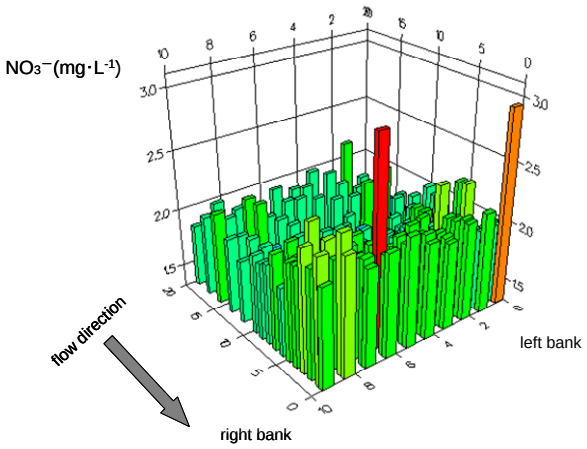

Fig.5-1 Distribution of NO^{3-}

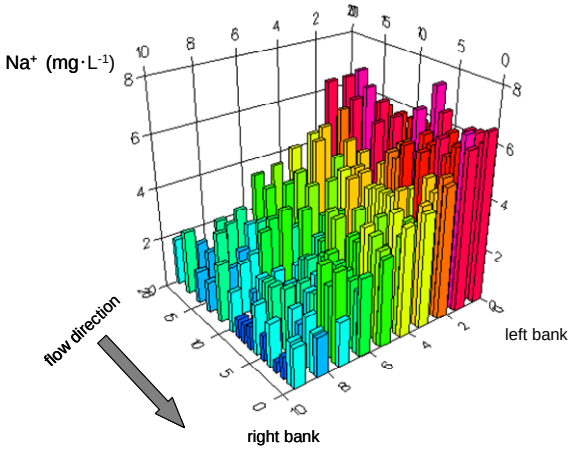

Fig.5-2 Distribution of Na^{+}

In this study, we found that the distribution of element concentration and flow rate were heterogeneous due to heterogeneous distribution of coverage in the same stream. By the accumulation of data with different water table and different season, we will get the more exact function of aquatic macrophytes community on physical and chemical environments of river water.

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