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Ecology-types determine physicochemical properties and microbial communities of sediments obtained along the Songhua River

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ABSTRACT

Sediments and their associated microbial communities are a vital part of riverine ecosystems. In order to understand the effects of ecology-types on microbial communities in the riverine sediments, the sediments and water samples were collected from several ecology-types along the Songhua River, and characterized in several ways. We analyzed the microbial communities in the sediments using denaturing gradient gel electrophoresis (DGGE). Furthermore, we determined environmental parameters, such as organic matter, nutrients (total N and P) and particle size distribution. The results revealed that the sediments are grouped by ecology-types along the river, but not by their geographical location. Longitude, latitude and elevation were also partially correlated with microbial community composition. This study suggests that sites of similar ecology-types affect the microbial communities in a similar manner, and result in increased heterogeneity in ecological landscapes.

1. Introduction

River sediments are an essential part of riverine ecosystems as they recycle nutrients and clean the aquatic body (Gerbersdorf et al., 2011). Often, contaminants are discharged into rivers, where sediments governed them. Sediments serve as a platform for several key biogeochemical processes, such as nutrient transformation, solute transportation and bacterial metabolism (Findlay et al., 2003). Therefore, the characteristics of sediments not only reflect water quality, but also the trophic status and function of the river (Varol and Şen, 2012). The cause of this functionality lies in thousands of microorganisms contained in sediments, which interact with organic matter in the marine environments and directly affect ecosystems (Maron et al., 2011). However, studies aimed at understanding the effects of ecology-types on the physicochemical properties of sediments and microbial communities are rare.

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The objective of this study was to clarify the variations of the microbial community structure and diversity within different ecotypes. We hypothesize that the physicochemical properties should vary with the different ecology-types, and that the associated microbial community should vary along with them. To test this hypothesis, we collected the sediment samples from 12 different sites belonging to five ecology-types along the Songhua River in China. We then investigated the characteristics of the sediments and the patterns of the microbial community associated with the five ecology-types.

2. Materials and methods

2.1. Sampling sites

We collected the sediment samples from national water monitoring locations along the Songhua River in China (Fig. 1). We selected a total of twelve sampling sites, including three agricultural (S1, S2 and S3), three urbanized (S4, S5 and S6), four estuarine (S7, S8, S9 and S10) and two mountain farming (S11 and S12) sites. We collected all sediment and water samples in July 2010 (Table 1).

2.2. Sample collection and measurements of physicochemical properties

We collected each sediment sample at a river sediment depth of 0.2 m using a bottom sampler (Ekman-Birge, Germany), and subsequently homogenized the samples. We used wet sieving and an elutriation system to analyze the particle size distribution. Additional sediment samples for the analysis of the bacterial communities were homogenized and stored at −80 °C. We dried all sediment samples with a freeze dryer (Labconco, Cole-Parmer Instrument Co., USA) and measured total nitrogen (TN), NH_4^+, total phosphorus (TP) and organic matter (OM) following the methods described by Jin and Tu (1990). We collected water samples into sterile glass bottles, and measured pH and redox potential (E_h) *in situ* with suitable electrodes (PHB-5, REX, China). For the water samples, we measured the levels of total nitrogen, total phosphorus, ammonium nitrogen of water (W-TN, W-TP, W-AM), suspended substance (W-SS) and chemical oxygen demand (W-COD). We furthermore determined the total nitrogen (S-TN), total phosphorus (S-TP), redox potential of sediment (S-Eh) and organic matter (S-OM) in all sediment samples taking the latitude (N-L), longitude (E-L) and elevation (El) of our 12 sampling points into account. We collected and analyzed all samples in triplicates.

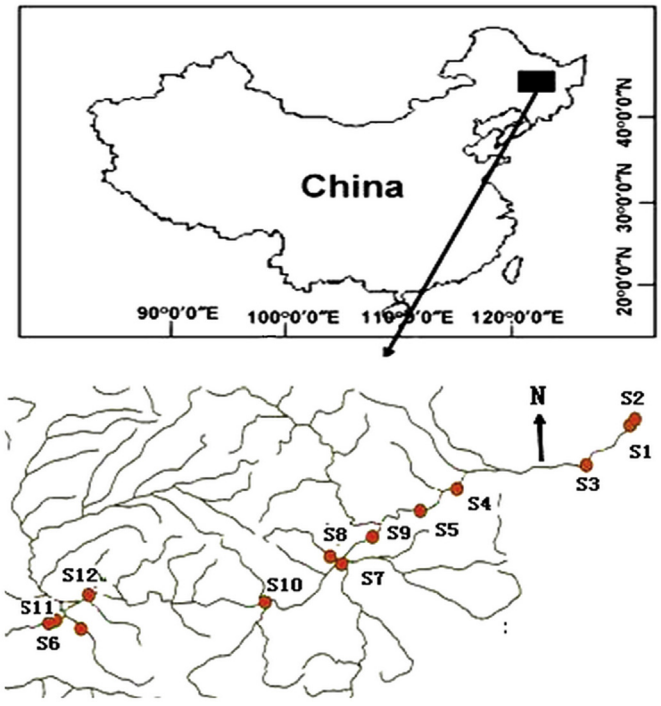

Fig. 1. Figure 1 shows a location map for our twelve sampling sites (S1 to S12) along the Songhua River in China.