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Ecological assessment of water quality of the Songhua River upper reaches by algal communities

松花江水质生态评价上达到由藻类群落

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ABSTRACT

Ecological analysis of 77 phytoplankton species preferences in the Songhua River upper reaches was doing in purpose to assess the river water quality dynamic with using of bio-indication methods implemented in first time for China. Results show that studied part of the river can be divided into two different parts — upper stations between Fullness Dam above Jilin settlement and below Jilin up to Zhenjiang port. Algal community structure and species richness are dramatically change with increasing number of species and productivity of community. The water chemistry show increasing of total suspending solids after the Jilin accompanied input of phosphates and nitrates where agriculture doing impact of the river water quality. Bio-indication characterized the river upper reaches as inhabit by rich phytoplankton community prefer photosynthetic type of nutrition on the upper stations and enriched by facultative heterotrophic taxa in the lower stations, and water as low-alkaline, low-saline, middle oxygenated, with increasing of nutrients and organic pollution down the river, where change from mesotrophic to eutrophic state. The major variables that impacted algal diversity were the nutrient-related such as nitrates and phosphates concentration. The water quality was dramatically changed from low polluted Class III in upper stations to polluted Classes IV and V in lower stations. Indices of the photosynthesis activity (WESI) revealed low-toxicity impact in all studied part of the river but indices of saprobity show high self-purification capacity down the river.

抽象的

在松花江上游77浮游植物种类的喜好生态分析,在做的目的,评估河流水质的动态使用在中国第一次实现生物指示的方法。结果表明,河流的研究的一部分,可以分成两个不同的部分 - 上面吉林结算及以下的吉林丰满大坝的上站至镇江港。藻类群落结构和物种丰富度正在显着的增加种群和群落生产力的数量变化。该水化学节目吉林后,总悬浮固体的增加伴随着磷酸盐和硝酸盐的投入,其中农业做的河流水质的影响。生物指示表征河上游的栖息通过丰富的浮游植物群落喜欢光合型营养在上站和兼性异养类群在较低的车站充实,水作为低碱性,低盐水,中含氧,随营养物质和有机污染顺流而下,这里的变化,从营养型向富营养状态。该影响藻类多样性的主要变量是营养素相关如硝酸盐和磷酸盐的浓度。水质量显着低污染III级在上站污染的IV类和V改变降低了站。光合作用活性(WESI)的指数表明在河但saprobity显示高自净能力顺流而下指数的所有研究的一部分,低毒性的影响。

1. Introduction

Pollution in the freshwater aquatic objects is a complicated system of problems and methods for dissolution of which needs more understanding for ecosystem structure and relevancy of methods for its state assessment. The methods and indices that can be used for assessment of pollution impact on the natural water bodies are based on the ecological point of view to the water and biota relationships. The production of proteins is involved level of primary producers, that assume that algae can be used as bio-indicators of pollution impact. Our database of species-specific ecological preferences [1,2] where the freshwater algae are grouped with respect to the major variables: pH, salinity, temperature, streaming and oxygenation, saprobity, nutrition type, and trophic level helps us to assess the water quality and ecosystem state with the systemic approach.

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Water supply and sanitation in the People's Republic of China is undergoing a massive transition, while facing numerous challenges — such as rapid urbanization and a widening economic gap between urban and rural areas [3].

The quality of groundwater or surface water is a major problem in China, be it because of man-made water pollution or natural contamination [4,5].

In this purpose we try to implement some new bio-indication methods for the water quality assessment that important for the large rivers [6,7] in the example of the upper reaches of the Songhua River that take our attention because few years ago have an ecological incidents influenced of the Amur River [8,9]. Some parts of the Songhua river basin has been assess by different methods with algae using [10,11], but biological assessment of the upper part of the river was doing in first time.

The aim of present study is to assess the Songhua River upper reaches water quality with using of bio-indication methods on the base of ecological preferences of phytoplankton algae.

2. Description of study site

The Songhua River is the right tributary of the Amur River and followed from the Changbai Mountains in the Northern China across the Nenjiang which drains the North Manchurian Plain and the Nenjiang River grassland ecoregion. The total length of the Sungari is 1925 km. Its drainage area is about 550,000 km^2. Major settlements in the river catchment basin are: Jilin, Harbin, and Jiamusi. Studied upper part of the river takes about 350 km and placed between the Songhua Lake Fullness Dam and Yitong Yinma and Songhua River downstream of the confluence (Fig. 1). We choose five stations for algal and chemical stations that were shown in Table 1.

People's activity in the studied part is concentrated mostly in the agriculture, the car production, and petrochemical industry.

Table 1
Description of the sampling stations on the Songhua River studied part.

Station no.	Site	Longitude, E	Latitude, N
0	Fullness Dam downstream 5 km	126°66′20″	43°77′70″
00	Fullness Dam water	126°69′30″	43°73′70″
3	Dehui City hole (Yitong River and Songhua River upstream of the confluence Yinma) after	125°92′40″	44°77′70″
4	Redstone Village (Yitong River and Songhua River confluence Yinma)	125°76′50″	44°89′30″
5	Zhenjiang port (Yitong Yinma and Songhua River downstream of the confluence)	125°29′10″	44°85′50″

3. Material and methods

Material for work come from 10 phytoplankton samples collected in July 2015 from five sampling sites of the Songhua River upper reaches between the Fullness Dam Reservoir to EPA referenced sites near the Yitong and Songhua rivers confluence (Table 1). Phytoplankton samples were collected near the river bed with the Apstein phytoplankton net, gas 20 mesh. Samples were placed to the 50 ml sampling tubes, partly fixed in the 3% neutral formaldehyde solution and transported to the laboratory in the ice box. In parallel with the phytoplankton samples in each site were taken samples of water about 1 l for total analysis and 0.5 l for the BOD analysis with fixation, and transported to the laboratory in ice box. Algae were studied in live and fixed state using SWIFT-M4000-D and an OLYMPUS BX-40 dissecting microscope under magnifications 740×–1850× from three repetitions of each sample and were photographed with a DC (OMAX A35100U). For the study of diatoms, permanent slides [12] modified for glass slides were made [13] and were fixed in Naphrax® resin from two repetitions of each sample. Determination of algal species

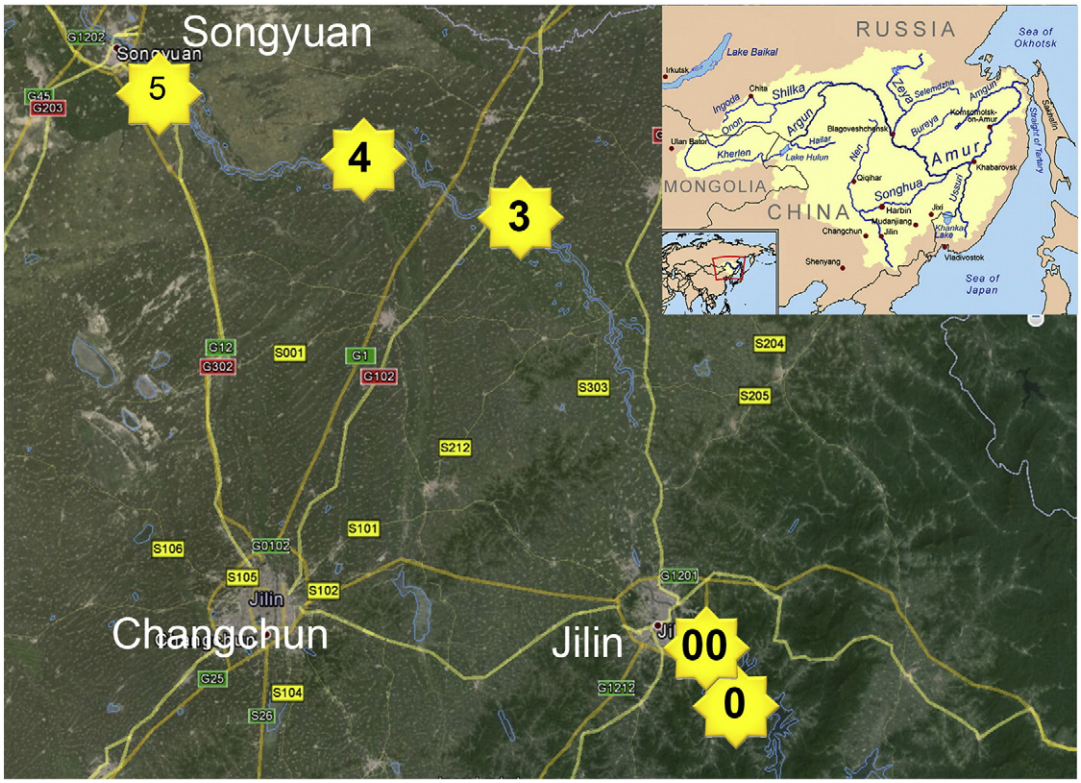

Fig. 1. The Songhua River sampling sites, yellow stars. Station numbers as in Table 1.