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ACCUMULATION OF HEAVY METALS IN BIOTA OF VYRLYTSA LAKE

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Abstract. *The main task was to investigate the pollution by heavy metals of biota of Vyrlytsa Lake. The contents of movable forms of heavy metals in aquatic plants, fish and snails was determined by atomic absorbtion method and were made the conclusions about general state of the water object.*

Keywords*:* heavy metals, accumulation, biota, pollution, atomic absorption spectroscopy.

Introduction

Pollution of natural waters causes the process of changing the composition and properties of water. Anthropogenic pollutants caused by human activities lead to deterioration of water quality [1].

Water pollution by heavy metals, including cadmium compounds, mercury, and other heavy metals intoxicate the population. Thus, in 1956 an epidemic disease called Minamata incurred the population of Minamata Bay coast (Japan). The reason was polluted by methyl mercury fishes and crustaceans (staple food of local people) that in high concentrations discharged from chemical plant [2].

Accumulation of heavy metals causes several toxicological effects on human health and the aquatic ecosystem and it can be poisonous. The problem can be actual in the case of the lake pollution by industrial plants and usage of the lake for fishing.

The Vyrlytsa Lake is located in the middle of inhabited area where a highway, industrial enterprises, incineration plant, city sewage treatment plant are situated. All these objects are polluting sources for the lake.

Novelty

Bioaccumulation by heavy metals in biota of ecosystems is a consequence of big pollution. At the same time it is important for an ecosystem state determination of the lake and for the human health protection because they are using this water object. There is no sufficient information on the impact of heavy metals on biocenosis components for aquatic ecosystems in urban areas including the Vyrlytsa Lake.

Characteristics of biota

The Vyrlytsa Lake is bordered by the air strip of aquatic vegetation width 3 - 5 m. It composed mainly common reed (Phragmites australis (Cav.) Trin. ex Steud.) with a small stake of narrow-leaved cattail (Typha angustifólia L.) and manna large (Glyceria maxima (C.Hartm.) Holmb.). Numerous bays in varying degrees are overgrown with air - water (common reed, sedge Carex sp.)) and submerged (pondweed) plant species. In the south - western part of the shallow lake occupied by thickets of pondweed comb (Potamogeton pectinatus L.).

Zoobenthos of the lake is rich enough: there are more than 60 species, of which 15 species are mollusks, 15 - chironomid larvae, 14 - oligochaetes, 2 species of bryozoans, leeches, caddis fly larvae, dragonflies, beetles**.**

The lake contains 30 species of fish, some of them are not found in other reservoirs of the capital of Ukraine. In addition to catfish (Siluriformes), walleye (Sander vitreus), pike (Sander vitreus glaucus), bream (Abramis brama), perch (Perca flavescens), crucian carp (Carassius carassius), carp (Cyprinus carpio), minnows (Pimephales promelas), burbot (Lota lota) (many of these fish come in several varieties), as well as other popular breeds, “scaled’.

There are two kinds of needles and endangered gobies (Microgobius gulosus) (listed in Red Book of Ukraine) in the lake. The most dominant species are Scardinius erythropthalmus and Carassius gibelio was taken for investigation.

Materials and methods

Acid-soluble forms of heavy metals was researched after special samples preparation by atomic absorbtion analysis [3].

The determination of the content of heavy metals began from the samples gathering. Using of special equipments it was selected such aquatic plants as: Clasping-leaved pondweed (Potamogeton perfoliatus), Ceratophyllum demersum (Rigid Hornwort or coontail), Phrágmites austrális or Phragmites commúnis and fish as Scardinius erythropthalmus, Carassius gibelio, and also snails Pomacea insularum.

The mass of each sample was 2 g. Than it was placed in automated sample preparation "Temos - Express" TE – 1, after it was burned to ashes. To the dry weight of samples was added of 20 ml 0.1 HCl N for extraction of heavy metals to movable forms. The samples were filtered with special type of the filtrates “white ribbon” [4; 5; 6].

Results and discussions

Aquatic plants and organisms were sampled in 16.09.10 – 21.09.10.

Accumulation process in biota showed that Mn and Cu are accumulated in such aquatic plant as Ceratophyllum demersum.

This fact can be characterized by the specificity of the plant (fig. 1.).

Ceratophyllum demersum is floating on the surface, the plant has no roots at all, and does not tolerate drought. This plant floats in great numbers just under the water surface. It excellent protect the fish-spawn and snails. Potamogeton perfoliatus also has high accumulation properties of heavy metals.

The less accumulated heavy metals are Pb and Zn. But Co and Cd almost did not identify by the method of atomic absorption spectrometry (fig. 1).

The most accumulated elements are Pb and Mn fig. 2). These heavy metals accumulate in both types of fish, but the most of Pb concentrates in Scardinius erythropthalmus. Scardinius erythropthalmus prefer clear waters rich in plants. They also feed on aquatic vegetation. They hunt for living prey in the upper levels. Consentration of Mn appears in Carassius gibelio (fig. 2).

Limited permissible concentrations of heavy metals for fish (mg/kg): Cd (0.03), Cu (5), Pb (0,5), Zn (10).

According to LPC dates of heavy metals concentrations in fish Pb is exceed norm in Scardinius erythropthalmus.

From researches Pomacea insularum has an accumulation property of heavy metals too, especially of Mn and Pb. These properties depend from snails` shell that can absorb and save for a long period of time heavy metals.

So, to summarize general state of the lake it can be use trophic classifications of lakes.

The Vyrlytsa Lake can be characterized as eutrophic, as it extended a large number of plant species. For availability, certain species of higher aquatic plants (Ceratophyllum demersum, Phrágmites austrális, Potamogeton perfoliatus) and their number can be said that the lake has mesotrophic areas (see table).

Ecosystem of Vyrlytsa Lake located in urban areas suffer significant contamination from anthropogenic emissions of vehicles, not receiving treatment not cleaning enterprises or untreated surface water, and their debris.

Conclusions

According to researches was determined bioavailability of heavy metals for aquatic plants, results show most accumulated heavy metals are Mn and Cu in such aquatic plants as Ceratophyllum demersum and Potamogeton perfoliatus. It depends from aquatic plants accumulation of heavy metals from the lake water and sediments, and from specificity of these type of aquatic plants. Less accumulated heavy metals are Pb, Zn. But Co and Cd almost did not identify by atomic absorption spectrometry.

Studying of accumulation process shows most accumulated elements: Pb and Mn. These heavy metals accumulates in both type of fishes but most of Pb concentrates in Scardinius erythropthalmus and consentration of Mn appears in Carassius gibelio. According to MPC dates of heavy metals concentrations in fish Pb is exceed norm in Scardinius erythropthalmus.

It is does not exist any MPC of heavy metals concentrations in snails for our country. But from researches Pomacea insularum [7, 8] has accumulation properties of heavy metals too especially of Mn and Pb. These properties depends from snails` shell that can absorb and save for a long period of time heavy metals.

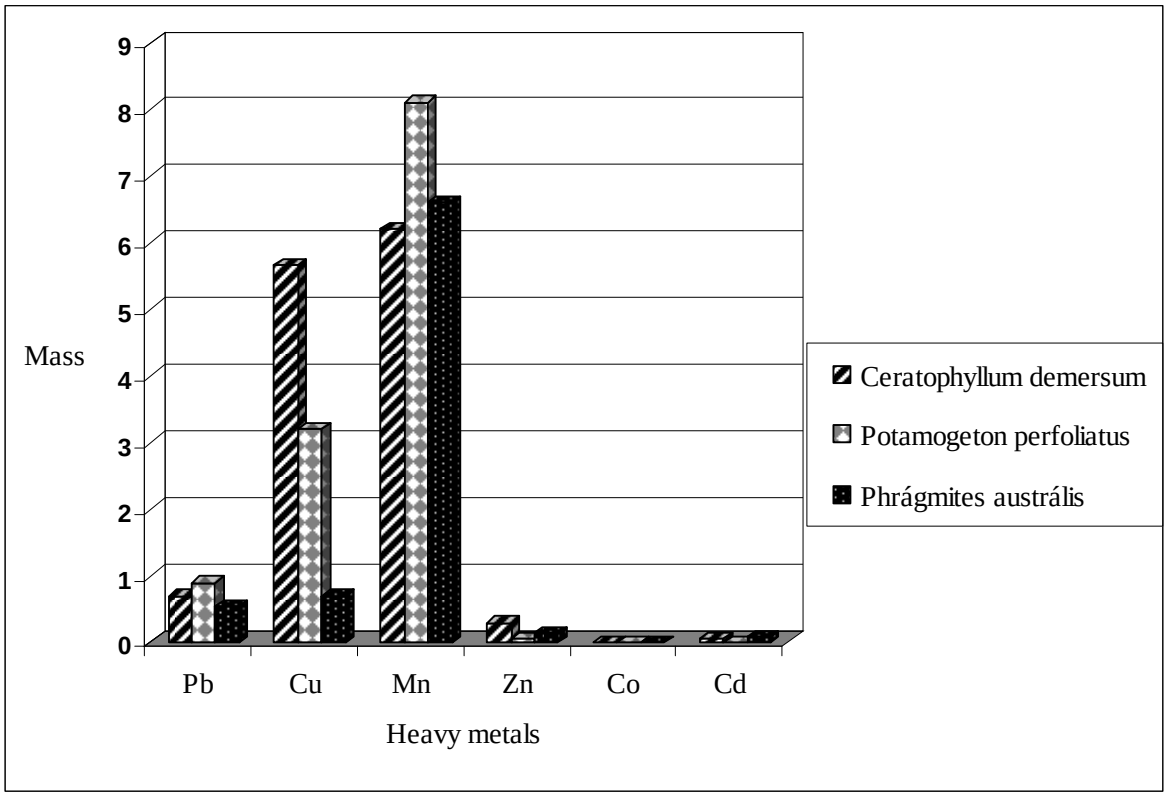

Fig. 1. Content of heavy metals in aquatic plants

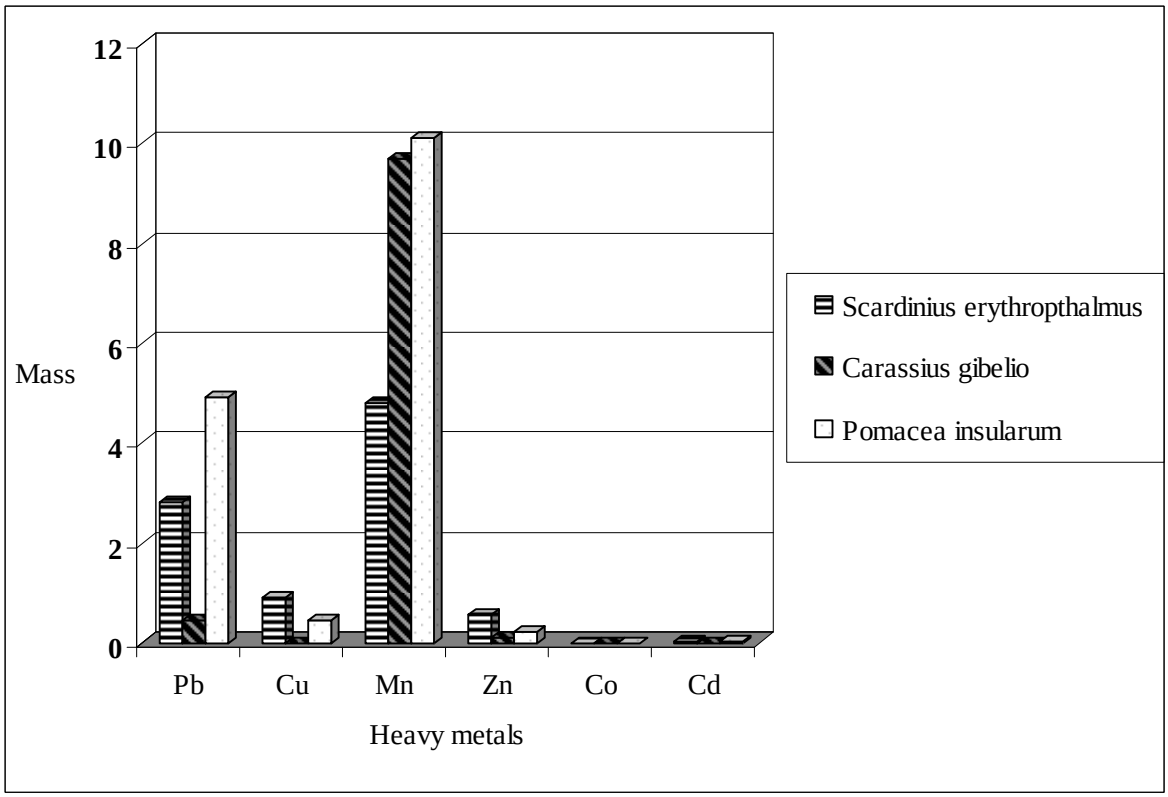

Fig. 2. Content of heavy metals in fish and snails

Classifications of lakes according to biological productivity [1]

Trophic Class	Characteristics
Oligotrophic	Lakes are lakes with low primary productivity. These lakes have low algal production, and consequently, often have very clear waters, with high drinking-water quality
Mesotrophic	Lakes are lakes with an intermediate level of productivity. These lakes are commonly clear water lakes and ponds with beds of submerged aquatic plants and medium levels of nutrients
Eutrophic	Body of water, commonly a lake or pond has high primary productivity. Eutrophic waters commonly lack fish species
Hypereutrophic	Lakes are the most biologically productive lakes, and support large amounts of plants, fish and other animals

According to researches Lake Vyrlytsa can be characterized as eutrophic, as it extended a large number of the plant species. The lake has a high nutritional requirements, because of the presence of the filamentous algae. For availability, certain species of higher aquatic plants (Ceratophyllum demersum, Phrágmites austrális, Potamogeton perfoliatus) and their number can be said that the lake has mesotrophic zones.

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