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CHEMICO-ECOLOGICAL EVALUATION OF THE QUALITY OF LAKE ARPI WATERS ACCORDING TO NUTRIENT ELEMENTS

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Nowadays, natural reservoirs and all water resources are evaluated insufficient in the Republic of Armenia. This status of water resources leads to the ecological disbalance between nature and society. The unsparing and intensive use of water resources, incomplete mechanisms of their management, monitoring and quality evaluation have been accompanied with the increase of the technogenic load and the deterioration of reservoirs and surface waters and their depletion in some cases. All of this is observed in Lake Arpi watershed basin. Lake Arpi is situated in the north-west of the Republic of Armenia. Being alpine specific ecosystem with its rare flora and fauna it ensures ecological balance of the adjacent extensive area. In practice, each sphere of human economic activity has its impact on the environment. Industrial pollution is not observed in this region and human activity impact on the environment is expressed by the inflow of nutrient elements, especially nitrogen and phosphorus, from watershed basin to Lake Arpi by rivers and ground waters. In addition, it is important to mention that sewage network is absent in this region and sewage of human economic activity is not accumulated and cleaned. Discussed in this article are the results of the content researches of nutrient elements in Lake Arpi. Seasonal variation regularities of nutrient elements was observed in Lake Arpi. According to ammonium ion concentration, water quality of Lake Arpi ranged between very clean and polluted. Four-year researches revealed that chemico-ecological evaluation of the quality of Lake Arpi waters, according to nutrient elements, was satisfactory, and this could not prevent the normal growth of the lake ecosystem.

Keywords: Nutrient elements, Watershed basin, Agricultural and domestic wastewaters, Water quality.

Introduction

The unsparing and intensive use of water resources, incomplete mechanisms of their management, monitoring and quality evaluation have been accompanied with the increase of the technogenic load and the deterioration of reservoirs and surface waters and their depletion in some cases. All of this is observed in Lake Arpi watershed basin. Lake Arpi is situated in the north-west of the Republic of Armenia. Being alpine specific ecosystem with its rare flora and fauna it ensures ecological balance of adjacent extensive area. In practice, each sphere of human economic activity has its impact on the environment. Industrial pollution is not observed in this region and human activity impact on the environment is expressed by the

inflow of nutrient elements, especially nitrogen and phosphorus, from watershed basin to Lake Arpi by rivers and ground waters. In addition, it is important to mention that sewage network is absent in this region and sewage of human economic activity is not accumulated and cleaned. The increase of nutrient concentration in the environment affect all levels of ecological pyramid. The reduction of upper levels leads to the changes of lower levels, community succession, dominant species, reconstruction of food webs, etc [1, 2]. The microplankton community is merged in the condition of the high concentration of nutrient elements in the experimental environment, and its trophic structure becomes simple, or food web includes only autotrophic hydrobionts, primary consuments, and secondary consuments go out from web [3, 4, 5].

Material and Method

The object of this study was Lake Arpi. Water samples were collected during 2006–2009. Researches were done by chromatographic, spectrophotometric and mass spectrometric methods.

Results and Discussion

Mineral nitrogen exists in the form of ammonium, nitrite and nitrate ions in waters. The increase of concentration of ammonium and nitrate ions indicates the fresh pollution of the environment, and the increase of concentration of nitrite ion indicates previous pollution of the environment.

Ammonium ion. Ammonium ion is produced in natural waters by the degradation of organic matters containing nitrogen. Its concentration ranges between 10–200 mkg/l (according to nitrogen mass) in natural waters. Ammonium ion existence in the unpolluted waters is basically related to the biochemical degradation of protein, amino acid and carbamide. Main sources of ammonium ion entering the lake from watershed basin are wastewaters of agricultural and domestic activities. The increase of the absolute content of ammonium ion and its section in the total nitrogen content is observed during the changing of the oligotrophic lakes to the mesotrophic and eutrophic lakes. The increase of ammonium ion content is used as indicator of the environmental pollution with agricultural and domestic wastewaters (Table 1).

Table 1. Ammonium ion content as indicator of reservoir pollution level.

Pollution level	*Ammonium ion concentration, mg/l*
Very pure	0.05
Pure	0.1
Moderate polluted	0.2 – 0.3
Polluted	0.4 – 1.0
Dirty	1.1 – 3.0
Very dirty	> 3.0

Researches shown that water quality of Lake Arpi ranged from very pure to polluted classes of waters according to ammonium ion concentreation (Tables 1, 2) [6]. The high level of pollution was observed in April 2009 which was due to entrance of the high concentrations of organic matters into Lake Arpi during spring overflow (Table 2).

Nitrate ion. The nitrate content existence in natural waters is conditioned by nitrification processes, atmospheric precipitation which ingests nitrogen oxides produced during thunderstorm, inflow of industrial, agricultural and domestic wastewaters.

Main organisms reducing nitrate concentration are phytoplankton and denitrifying bacteria. Denitrifying bacteria use the oxygen of nitrates for the degradation of organic matters in case of oxygen lack. Nitrates exist in dissolved form in surface water.

Concentration of nitrates complied seasonal variation in Lake Arpi. The low concentrations of nitrates in vegetative stage was due to the use of nitrates by phytoplankton and macrophytes, and the concentration of nitrates reached its maximum value after vegetative stage which was due to the slight use of nitrogen and the degradation of nitrogen organic compositions and their changing of nitrates (Table 2). The high content of nitrates in spring was due to spring overflow during which high concentrations of organic matters entered into lake from watershed basin.

Table 2. Content of nutrients in the waters of Lake Arpi (mg/l).

Sampling date	*Nitrate ion, mg/l*	*Nitrate ion, mg N /l*	*Nitrite ion, mg/l*	*Nitrite ion, mg N /l*	*Ammonium ion, mg/l*	*Ammonium ion, mg N /l*	*Total inorganic nitrogen, mg N /l*	*Phosphates, mg/l*	*Phosphates, mg P /l*
05.05.2006	5.102	1.153	0.158	0.048	0.011	0.009	1.210	0.218	0.095
13.06.2006	0.878	0.203	0.032	0.010	0.000	0.000	0.213	0.133	0.058
31.08.2006	0.717	0.198	0.237	0.072	0.219	0.181	0.451	0.117	0.051
26.09.2006	0.368	0.086	0.016	0.005	0.000	0.000	0.090	0.415	0.181
13.06.2007	4.924	1.113	0.126	0.038	0.200	0.155	1.306	0.320	0.140
18.09.2007	2.964	0.669	0.000	0.000	0.006	0.005	0.674	0.080	0.035
05.05.2008	3.788	0.856	0.000	0.000	0.064	0.050	0.906	0.163	0.071
10.06.2008	1.817	0.410	0.126	0.038	0.037	0.029	0.477	0.143	0.062
02.07.2008	1.792	0.405	0.158	0.048	0.037	0.029	0.481	0.143	0.062
26.08.2008	1.071	0.242	0.124	0.038	0.037	0.029	0.309	0.158	0.069
16.10.2008	1.143	0.258	0.000	0.000	0.000	0.000	0.258	0.260	0.113
18.11.2008	1.690	0.382	0.079	0.024	0.037	0.029	0.435	0.320	0.140
20.04.2009	1.436	0.325	0.029	0.009	0.604	0.470	0.803	0.299	0.131
21.05.2009	2.288	0.517	0.003	0.001	0.310	0.241	0.759	0.117	0.051
10.07.2009	0.102	0.023	0.012	0.004	0.326	0.254	0.280	0.019	0.008
17.09.2009	0.311	0.070	0.007	0.002	0.000	0.000	0.072	0.113	0.049
20.10.2009	0.485	0.110	0.004	0.001	0.184	0.143	0.254	0.097	0.043
12.11.2009	0.377	0.085	0.006	0.002	0.239	0.186	0.273	0.213	0.093

Nitrite ion. Nitrites are considered intermediate result of nitrification and denitrification. Nitrites exist in dissolved form in surface water. The increase of nitrite content indicates the intense degradation of organic matters in the lake and the pollution of water area. The maximum concentration of nitrites in Lake Arpi was in the second half of summer which was due to phytoplankton intensity (diatom and green algae convert nitrates to nitrites) (Table 2) [7].

Phosphates. Phosphorus is considered important nutrient element: the productivity of reservoirs is basically limited by phosphorus by which is conditioned the bloom of reservoirs due to domestic and agricultural wastewaters. It exists in the form of ortophosphate, polyphosphate and organic composition in natural waters.

Mineral phosphorus enters the lake due to the weathering and washing of rocks, the using of fertilizer and synthetic wash means in watershed basin, the biological treatment of the remains of animals and plants.

The concentration of phosphates usually ranges between 0.1 - 0.001 mg/l in natural reservoirs, and it can reach few mg/l due to pollution. The concentration of phosphorus composition complied seasonal variation which was conditioned by photosyntesis (decrease of phosphate concentration) and biochemical degradation processes (increase of phosphate concentration) in the lake. The lowest content was observed in summer, and the highest content was observed in Autumn-Spring period (Table 2).

Conclusion

The chemico-ecological evaluation of the quality of Lake Arpi waters, according to nutrient elements, was satisfactory, and this could not prevent the normal growth of the lake ecosystem.

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