**УДК 574.5+504.453(477.84)**

# RESEARCH OF THE CONTENT OF PHOSPHORUS AND PHYTOPLANKTON STATE OF IN DIFFERENT AREAS OF RIVER SERET IN CASE OF SUSTAINABLE DEVELOPMENT GOAL 6

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Clean, accessible water for all is an essential part of the world we want to live in and there is sufficient fresh water on the planet to achieve this. Due to Report of the Secretary-General, Special edition: progress towards the Sustainable Development Goals, 2019 session [1], despite progress, billions of people still lack safe water, sanitation and handwashing facilities. Data suggests that achieving universal access to even basic sanitation service by 2030 would require doubling the current annual rate of progress.

One of the key factors in the development and functioning of aquatic ecosystems is the development of autotrophic components of the trophic chain, the basis of which is phytoplankton. It directly affects the formation of water quality, the trophic status of the water body and determines the ecological status of the aquatic ecosystem as a whole [2]. The content of phosphorus is one of the primary determinants of the productivity of ponds and streams. An increase of its content in the water basins contributes to increasing of phytoplankton biomass, and phosphate hypertrophy of reservoirs promote the increasing production of growth factors, resulting in abundant growth of algae [3].

Since the quantity of the phosphorus is associated with the life of planktonic organisms, their influence on the content and dynamics in natural waters is obvious. However, it is not clear enough understandable which of its part is available for biological aquatic organisms intake, which is largely determined by associated environmental factors, the main among which, is often anthropogenic influence [4].

Flowering and unpleasant odor, has been observed on Ternopil pond for more than 8 years. The reason for this phenomenon is that the last time the reservoir was cleaned in 1976-1981, There are several

reasons for flowering. A significant cause of the flowering of water is the flushing and ingress of high phosphorus substances from the upper reaches of the River Seret. These are usually our products of life, synthetic detergents. As a result, of these and several other factors, the number of algae in the reservoir has increased, which causes the flowering process. These algae emit up to 900 toxic substances, 60-70 of which are very aggressive, because they have possibility to cancer.

The aim of this work was to study seasonal changes in the content of phosphorus with the view to the development of phytoplankton in the water of river Seret in areas with different levels of anthropogenic load.

The studies were conducted during the growing season (spring, summer, autumn) in different parts of river Seret, Ternopil region, Ukraine.

To identify the content of phosphate in water of river Seret, the monitoring data were analyzed in such sampling points: "agricultural area" - characterized by active farming and animal husbandry; "urbanized area" - part of the river, which flows within the city limits of Ternopil; "recreation area" - the territory of the reserve. The placement of these areas is the order of the river flow from north to south at a distance of about 60-80 km from one another.

Determination of the phosphate content was performed according to procedure, based on the interaction of the orthophosphate with ammonium molybdate in acidic medium in the presence of antimonate potassium with formation of heteropoly acid, which forms the "molybdenum blue" during reduction. Ascorbic acid was used as the reducing agent. Sampling of phytoplankton, its fixation, concentration, cameral processing, calculation of abundance and biomass was carried out by well-known hydrobiological methods. Analysis of the impact of hydrobionts on fluctuation of the phosphorus level in water was carried out for three types of algae: diatoms, green and blue-green.

*Agricultural area.* In algal flora reservoir within agricultural area, leading position in terms of species and intra-species diversity of algae takes *Bacillariophyta* (51% of the total number of studied species). Representatives of *Chlorophyta* make 40%, which appears subdominant, and *Cyanophyta* form only 9% of the total number of species and intra-specific taxonomic units.

Analysis of the dynamics of phytoplankton throughout the growing season showed that *Bacillariophyta* was determined by the total quantities of biomass (up to 63% of the total algal biomass) in all phytoplankton. In most cases they were dominant or subdominant in association of microalgae in conjunction with other departments (green and blue-green).

Seasonal dynamics of phosphorus in the water depends on hydrometeorological conditions and the level of development of aquatic organisms. In this case, the minimum concentration in the water of the river Seret above the Ternopil reservoir was characterized by the summer, and the maximum – by autumn period (respectively 0.007 and 0.06 mg P/dm$^3$).

*Urbanized area.* In a sample of water from the reservoir the dominant were representatives of *Chlorophyta* with content of intraspecific taxonomic units - 52% of the total number of the studied taxonomic units.

Total biomass values (up to 67% of the total algae biomass), total phytoplankton as well as on agricultural areas was determined by *Bacillariophyta*.

Seasonal dynamics of phosphorus in the water of Ternopil reservoir has a few differences from the previous area.

*Recreational area.* On the area of river Seret below the Ternopil reservoir, as well as in the reservoir, the basis of phytoplankton was formed by the abundance of *Chlorophyta* with content of intraspecific taxonomic units, 48% of the total studied taxonomic units. Not less indicators showed *Bacillariophyta*, occupying 46% of the species found.

The total value of the biomass (up to 58% of the total algal biomass) in all phytoplankton as well as in previous areas was determined by *Bacillariophyta*.

Seasonal dynamics of phosphorus in the water reservoir of Ternopil is similar to the previous two territories, but since July tends to increase, reaching a maximum concentration in October - 0.31 mg P/dm$^3$.

Thus, phosphorus is associated with the development and functioning of abundance of algae in the river Seret on all areas regardless the level of anthropogenic load. Seasonal changes in water content of the phosphorus depend on the intensity of phytoplankton

growth, as revealed elevated levels of phosphorus in the spring and, mainly, in the autumn, when both the number and biomass algae are characterized by minimum values.

During the study period green algae dominated by the number of species and intraspecific taxonomic units, averaging 46%, and on the biomass – diatoms with a share of presence – 62%.

It was found that in all studied areas the number of algae and phosphorus concentration were in inverse relationship. A direct relationship was established between biomass and phosphorus concentration only in the Ternopil reservoir, and in other cases - inverse.

The main factors that determine the mode of phosphorus compounds in different areas of river Seret are anthropogenic load (farm, municipal and industrial effluents) and meteorological conditions that regulate inter-reservoir biochemical and chemical processes. High background levels of phosphates in the water below the Ternopil reservoir (0.073 - 0.31 mg/dm$^3$) and a sharp increase in the concentration of phosphorus in the end of the growing season reflect the strong anthropogenic pressure from overlying cities (Ternopil, Chortkiv) and increase the scope of recreation on the water object. So, as an area above the Ternopil reservoir does not have antropogenic pressures, and farm runoff is characterized by minimum values, hydroecosystem most effectively regulate the content of phosphorus in the water by phytoplankton, unlike recreational area, where phytoplankton cannot process all the phosphorus.

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**УДК 372.853.006.2**

## ЦИФРОВІ ВИМІРЮВАЛЬНІ КОМПЛЕКСИ ТА ЇХ ЗАСТОСУВАННЯ ПРИ НАВЧАННІ УЧНІВ ПРИРОДНИЧИМ ДИСЦИПЛІНАМ

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Цифрові лабораторії або цифрові вимірювальні комплекси (ЦВК) є інноваційним шкільним технічним засобом, який змінює методологію навчання учнів природничим дисциплінам. Сучасний український ринок шкільного обладнання пропонує ЦВК торгівельних марок Vernier, DISLAB, Einstein та ін. Значна кількість закладів середньої освіти, зокрема Чернігівської області, вже оснащені таким обладнання. Тож майбутній вчитель повинен бути компетентним у виборі та можливостях застосування цифрових лабораторій для організації освітнього процесу в сучасній школі [2].

Цифрові вимірювальні комплекси залежно від виробника та модифікації дещо відрізняються, але складаються з трьох основних компонентів: електронні датчики та сенсори (у компанії Vernier їх налічується понад 50), реєстратор даних, програмне забезпечення. Реєстратор даних залежно від будови може відображати показники датчиків або передавати їх на комп'ютер. Програмне забезпечення дозволяє не лише отримувати значення показників датчиків в реальному часі, а і робити дані максимально інформативними, наприклад будувати графіки і т.д.

Цифрові лабораторії є основою STEM-освіти, міжпредметною зв'язковою ланкою всіх природничих дисциплін [3]. Наприклад, сенсор вологості може бути застосований при поясненні явища вологості повітря. Також з його допомогою