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EROSHENKOVA VICTORIA

ENVIRONMENTAL RISKS OF ANTHROPOGENIC IMPACT ON THE LOWER DNIESTER ECOSYSTEM. ASSESSMENT AND MANAGEMENT MEASURES

166.01. ECOLOGY

Summary of the doctoral thesis in environmental sciences

CHIȘINĂU, 2025

The thesis was developed on the basis of the Laboratory of Ecourbanistics of the Institute of Ecology and Geography of Moldova State University The doctoral studies were completed at the Doctoral School of Natural Sciences of Moldova State University.

Doctoral supervisor:
BULIMAGA Constantin, doctor habilitate of biological sciences, associate professor, Institute of Ecology and Geography, Moldova State University

Composition of the Doctorate Commission:

UNGUREANU Laurentia	doctor habilitate of biological sciences, research professor, ASM corresponding member, Institute of Zoology, Moldova State University – ***president***
BULIMAGA Constantin	doctor habilitate of biological sciences, associate professor, Institute of Ecology and Geography, Moldova State University – ***doctoral supervisor***
LIOGCHII Nina	doctor of biological sciences, associate professor, Institute of Ecology and Geography, Moldova State University – ***reviewer***
COZARI Tudor	doctor habilitate of biological sciences, professor, ASM corresponding member, State Pedagogical University «I. Creanga» – ***reviewer***
FILIPENCO Serghei	doctor habilitate of biological sciences, associate professor, T.G. Shevchenko State University, Tiraspol – ***reviewer***

The defense will take place on **September 5**, 2025 at **14:00** at the meeting of the specialized council in the premises of the Main Directorate - Doctoral School of Natural Sciences (DSNS), Moldova State University (http://www.usm.md/), 65, M. Kogalniceanu St., Building 3, Room 332, MD-2009, Chișinău, Moldova.

The dissertation and the abstract can be found in the National Library of the Republic of Moldova, "Andrei Lupan" Central Library (Institute), the Central Library of Moldova State University, the Library (60, A. Mateevich St., Chișinău, MD 2009), on the USM website (http://usm.md) and on the ANACEC website (http://www.cnaa.md).

The summary was sent on 23.07.2025.

The President of the Doctorate Commission
doctor habilitate of biological sciences, research professor, ASM corresponding member **UNGUREANU Laurentia**

Doctoral supervisor:
doctor habilitate of biological sciences, assistant professor **BULIMAGA Constantin**

Author: **EROSHENKOVA Victoria**

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CONCEPTUAL FRAMEWORK OF THE RESEARCH

The actuality of the subject. The main source of water resources for the Republic of Moldova is the Dniester River and its tributaries from the right bank that have a permanent water regime; these include: Reut, Ikel, Byk, Botna. The Dniester River with its tributaries is not only the main drinking resource for the significant part of Moldova, but also provides a solution to such important socio-economic problems as industrial water supply, hydropower, irrigation, recreation and other things [21].

Today, the tributaries of the Lower Dniester are experiencing strong anthropogenic impact, primarily associated with various types of human activity. Thus, the main anthropogenic factors that have a negative impact on the rivers of our region are: discharge of insufficiently treated or untreated wastewater of various origins; collection and use of water from river basins necessary for various activities of the population; discharge of some pollutants with wastewater into surface water objects, etc. [17, 18]. All the above factors lead to the development of such negative ecological consequences as a decrease in quality of river water; intensive development of blue-green algae that leads to eutrophication of the reservoir; a decrease in dissolved oxygen in the water that adversely affects the vital activity of fish communities; a decrease in species floristic diversity and the replacement of valuable plant species by invasive ones, etc. [20].

In the comparative characteristics of the ecological state of the Dniester River with its tributaries: Reut, Ikel, Byk, Botna the highest level of anthropogenic pressure is experienced by its tributaries, in which the fifth class of water quality, i.e. "very polluted" was more often recorded and more often detected. The most unfavorable tributary of the Lower Dniester is the Byk River, for which the most serious and ecologically catastrophic situation has been identified, associated with the discharge of large volumes of insufficiently treated or untreated wastewater of various origins, which has an excessive negative impact on the ecological state of the river [6].

As a consequence, heavily polluted tributaries flowing into the Dniester River have an adverse effect on it that leads to the development of environmental consequences along its entire course: the level of biogenic pollution increases, resulting in a decrease in water quality, dissolved oxygen decreases due to which the numerical and species diversity of fish living in the Dniester decreases.

In this regard, the question arose about the need to improve the water quality of the right tributaries, which are the main sources of water pollution in the lower part of the Dniester.

In this context, it is advisable to study ways to improve the water quality of the right tributaries, which are the main sources of pollution of the Lower Dniester**.**

The purpose of the research is to assess the environmental risks of anthropogenic impact associated with chemical, microbiological pollution, violation of phyto cenoses of the Lower Dniester ecosystem and develop measures to reduce these risks.

To achieve this purpose, the following tasks were set:

1. To study the hydro-chemical and microbiological state of the right tributaries of the Lower Dniester.
2. To study the intra-annual dynamics of the degree of biogenic and microbiological pollution with the identification of the most unfavorable tributaries.
3. To establish the dynamics and process of pollution of the tributaries of the Lower Dniester (the Byk River as an example).
4. To determine the floristic diversity in the studied ecosystem of the Lower Dniester.
5. To determine the environmental risks of anthropogenic impact on the ecosystem of the Lower Dniester.
6. To develop recommendations for reducing environmental risks and minimizing anthropogenic impact.

The methodological basis of the conducted research was the fundamental works by I. Dediu [19], Yu. Odum [22], K. Brashe [2], J. Allan [1]; research and scientific work conducted by Moldovan scientists on the hydro chemical state of the tributaries Reut, Byk, Botna, Ikel; the introduction of their biogenic pollution into the Dniester River by G. Duca [8-10], M. Sandu [11-13], E. Zubkova [15], V. Gladkiy, N. Goryacheva [17, 18]; results of research held by C. Bulimaga in the Laboratory of Ecourbanistics of the Institute of Ecology and Geography [4,5].

Scientific novelty. A comprehensive study of the environmental condition of the mouth of the Lower Dniester tributaries was conducted. An assessment of the water quality of the right tributaries of the Lower Dniester was made based on chemical (ammonium, nitrites and nitrates) and microbiological (total coliform bacteria, thermotolerant coliform bacteria and coliphages) indicators and recommendations were developed to reduce the degree of pollution. The probability of environmental risk development in river ecosystems was shown based on the frequency of biogenic and microbiological water pollution .

The scientific task solved consists in establishing the causes and dynamics of pollution of the right tributaries of the Lower Dniester (using the Byk River as an example) and substantiating measures and proposals to reduce and minimize anthropogenic impact on river ecosystems, ensuring a reduction in the environmental risk for this ecosystem. Monitoring data on chemical and bacteriological indicators, reflecting the actual state of the aquatic ecosystem, serve as a basis for developing measures aimed at reducing environmental risks in the ecosystem of the Lower Dniester

Fundamentally new results for science and practice based on modern ecological methods and approaches were obtained about the microbiological and biogenic state of the Lower Dniester tributaries, which showed their intra-annual and seasonal variability under the influence of anthropogenic factors.

Theoretical significance lies in the fact that the obtained results make a significant contribution to the analysis and understanding of the sanitary and ecological state of the Lower Dniester aquatic ecosystem exposed to chemical and bacteriological pollution of anthropogenic origin.

The applied significance lies in the implementation of the developed recommendations that allow adjusting the processes of wastewater discharge by industrial enterprises to the Chisinau treatment facilities that will ensure the normal operation of the Chisinau Treatment Plant, which will lead to the restoration of the aquatic ecosystem and decrease in environmental risks in the ecosystem of the Lower Dniester.

Main provisions submitted for defense

1. Violation of environmental and sanitary and epidemiological standards of management has led to a catastrophic state of the right-bank tributaries of the Lower Dniester, increased the risks of deterioration in water quality, suppression of aquatic and coastal biocenoses, epidemiological risks of intestinal infections and risks of deterioration in the quality of life for the population.
2. The water quality class in the tributaries of the Reut, Ikel, Byk, Botna, according to biogenic and microbiological indicators, is classified as "very polluted" (class 5), while seasonal indicators for these pollutants vary from "normal", associated with a warm period of time, to "very polluted" class, associated with a cold period of time.
3. The risks of deterioration in water quality in the tributaries of the Reut, Ikel, Byk, Botna, according to biogenic pollutants, have reached a critical value - 100% probability; according to microbiological pollutants, they increase in a row of tributaries: Botna (33%) < Reut (50%) < Ikel (75%) < Byk (83%).
4. Invasive plant species *Ailanthus altissima* (Mill) Swingle, *Acernegundo* L., *Amorpha fruticosa* L., *Ambrosia artemisiifolia* L., *Grindeli asquarrosa* Willd of the coastal water strip of the lower section of the Dniester River and its tributaries indicate deep disturbances in the ecosystem of the Lower Dniester.

Implementation of scientific results. The research results are used at «APÂ-CANAL-CHISINĂU» Biological Treatment Plant (BTP), Chisinau to reduce the degree of wastewater pollution by industrial enterprises; Bender Centre of Hygiene and Epidemiology in organizing measures aimed at preserving, restoring and rational use of water resources of the Lower Dniester; T.G. Shevchenko State University in the process of training specialists in the area of education and environmental protection.

Testing of the work. The dissertation materials were presented at the following international conferences and symposia: Integrated Management of the Transboundary Dniester Basin: Cooperation Platform and Current Challenges (Tiraspol, 2017), Impact of Hydropower on the River Ecosystem (Tiraspol, 2019), European Integration and Dniester Basin Management (Chisinau, 2020), Current Trends in Scientific Development: Young Researchers' Views (Chisinau, 2020), Developing Personal Potential as a Value of Modern Education (Tiraspol, 2022), Transboundary Dniester Basin Management and European Integration - Step by Step (Chisinau, 2022), Science in the North of the Republic of Moldova: Achievements, Problems, Prospects (Balti, 2024); regional conferences, including those with international participation: Scientific Conference "Science in the North of the Republic of Moldova: Achievements, Problems, Prospects" (Balti, 2022), Scientific and Practical Conference "Research-based Education for a Prosperous Society" (Chisinau, 2023), Scientific and Practical Conference "Natural Sciences in the Dialogue of Generations" (Chisinau, 2023).

Personal contribution of the author. The dissertation is based on the research materials of the hydro chemical and microbiological state of the estuary part of the Lower Dniester tributaries, carried out by the author for the period 2019-2022. The author formulated the problem, set the objectives, analyzed the research results and formulated generalizations, conclusions and recommendations. The share of the author's personal participation in joint publications is proportional to the number of authors.

Publications on the topic of the dissertation. 25 scientific papers have been published on the topic of the dissertation (including 3 without co-authors): articles in journals included in the National Register of Specialized Scientific Journals – 3, publications in international conference materials – 8, in national collections – 14.

Volume and structure of the work. The dissertation is presented on 134 pages of the main text that includes: an introduction, 5 chapters, general conclusions and recommendations. The work contains 24 tables, 35 figures and a list of references, including 203 titles.

Key words: Lower Dniester ecosystem, hydro chemical indicators, bacteriological indicators, floristic diversity, anthropogenic impact, sanitary and ecological state, environmental risks, management measures.

THESIS CONTENT

INTRODUCTION highlights relevance, scientific and practical significance of studying the hydro chemical and microbiological state of the right tributaries of the Lower Dniester, indicates the purpose and objectives of the study, the methodological and scientific-theoretical basis of the work and its scientific novelty.

1. GENERAL CHARACTERISTICS OF ENVIRONMENTAL PROBLEMS OF THE LOWER DNIESTER TRIBUTARIES

The chapter examines hydro chemical and microbiological changes in the river ecosystems of the Lower Dniester in the course of time, both, according to past studies in the 1990s and 2000-2019 before conducting our own studies, as well as according to modern data on the ecological state of these tributaries. According to reported data and previously conducted studies on the state of the Lower Dniester tributaries: Reut, Ikel, Byk, Botna, environmental problems in the river ecosystem, associated with anthropogenic impact, are described. This

chapter also provides a general analysis and assessment of unfavorable environmental situations (environmental risks) for the Dniester tributaries: Reut, Ikel, Byk, Botna.

2. MATERIAL AND RESEARCH METHODS

The research material was water samples that were collected quarterly in the period 2019-2022 directly from the mouth of the tributaries: Reut, Ikel, Byk, Botna for hydro chemical and bacteriological analyses. Water samples for microbiology were collected in accordance with the requirements for sampling in special sterile glass containers of 0.4 liters, which were delivered to the bacteriological laboratory of the Republican Centre for Hygiene and Epidemiology in Bender.

Chemical analysis of river water samples was carried out by the photometric method with the determination of the mass concentration of ammonium ions, nitrites and nitrates [25]. Water quality in the rivers was assessed using the standard [23, 24].

Assessment and analysis of water quality as well as the classification of rivers by microbiological indicators were carried out in accordance with the requirements [26].

The obtained laboratory data served as the material for analysis and assessment of the sanitary and ecological state of the river ecosystem. Based on their results, environmental risks of anthropogenic impact on the Lower Dniester ecosystem were identified.

For a comparative analysis of the environmental state of the Dniester River and its tributaries as well as their impact on the quality of water in the river samples were additionally collected at two stations: Station 1 – the Dniester River upstream from the tributary, Station 2 – the Dniester River downstream from the tributary [14].

Field floristic studies were carried out using the linear route method [7]. The identification of the discovered plant species was carried out in laboratory conditions using a higher plant identification guide; the author is T.S. Geideman [16].

To establish the reliability of the data, methods of mathematical and statistical analysis were used with the help of MO Excel 2007 software package.

3. ASSESSMENT OF THE SANITARY AND ECOLOGICAL STATE OF THE LOWER DNIESTER TRIBUTARIES

Our studies have established that environmental risks associated with microbiological and biogenic pollution have been identified in the studied tributaries of the Lower Dniester. In terms of microbial pollution, a general seasonal trend is observed in determining the most unfavorable period of time, which was the winter period. However, in terms of biogenic pollution, such a general seasonal trend was not observed due to the fact that for each river biogenic pollution differed in the concentrations of their excesses and cases of their detection in the water.

In the comparative excess characteristics of permissible standards between microbial and biogenic pollution, the microbiological indicators of GCB (general coliform bacteria) and TCB (thermotolerant coliform bacteria) dominated, which had an excesses of 240 times (TCB) and 48 times (GCB), but biogenic excesses were observed more frequently. Such an ecologically unfavorable situation was observed in all tributaries.

The dynamics of seasonal variability of biogenic and microbiological indicators of water quality of tributaries was characterized by a wide range; the river water was classified from "normal" to "very polluted". The most polluted section of the river was the Byk, where the water was often assessed as "very polluted" and here excesses in coliphages were detected indicating the epidemiological unfavorability of this reservoir.

According to the results of water analysis, dominant indicators are observed in the tributaries of Reut, Ikel, Byk, Botna, i.e. biogenic indicators – nitrites and microbiological indicators – TCB (thermotolerant coliform bacteria), which indicate the entry of pollutants of recent origin into the rivers.

Sanitary-ecological condition of the Reut tributary

For this tributary unfavorable sanitary and ecological situations are associated with biogenic and microbiological pollution, the concentrations of which had different intra-annual dynamics, both in terms of the degree of exceedances as well as in cases of their detection. The results of laboratory data (Fig. 3.1) demonstrate that ammonium pollution is observed constantly and is characterized by a wide range of variability from 0.28 to 2.8 mg N/l.

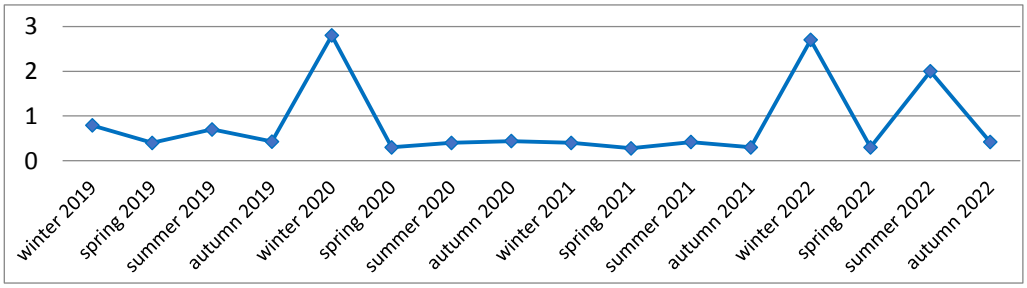

Fig. 3.1. Dynamics of ammonium content in water of the Reut River for the period 2019-2022 (mg N/l)

Ammonium pollution had a pronounced maximum in the winter period in 2020 and 2022, in other years the same period also dominated, but not so pronounced.

In 2020 there was a pronounced peak in the ammonium content in the winter period – 2.8 mg N/l that was 7 times higher than the norm, and in 2022 there were two pronounced peaks of ammonium pollution – in the winter and summer periods. For the winter period the values were 2.7 mg N/l, and for the summer – 2 mg N/l, which exceeded the norm, respectively, 6 times in winter and 5 times in summer. This is explained by the fact that during the winter period there is an intensive decomposition of organic matter and a decrease in the self-purification processes of the river during this period of time.

The intra-annual dynamics of nitrites, according to laboratory data (Fig. 3.2), had a wide range of variability from 0.07 to 0.8 mg N/l, especially in the winter period of 2021.

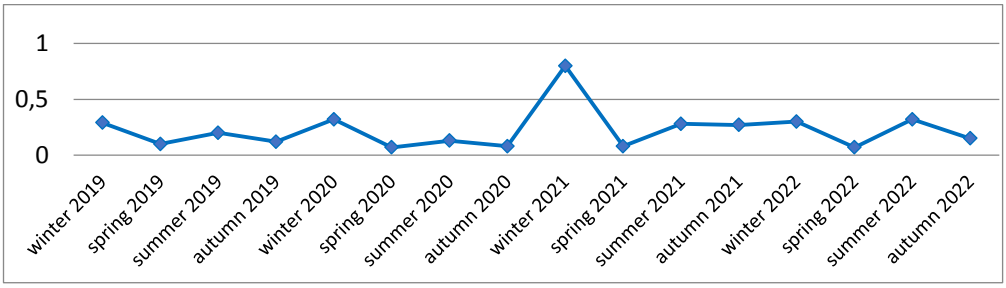

Fig. 3.2. Dynamics of nitrites content in water of the Reut River for the period 2019-2022 (mg N/l)

We can observe that the Reut river water had a relatively stable level of nitrite pollution, which mainly had maximum peaks in the winter period and minimum peaks in the spring and autumn periods. The highest nitrite values were detected in the winter period of 2021that corresponded to a value of 0.8 mg N/l, which exceeded the norm by 13 times. Such variation depending on the seasons can be explained by the vegetation processes inside the reservoir that occur throughout the year. In the fall, the initial stage of decomposition of organic matter occurs, which reaches its maximum in the winter period, due to which the maximum peak of nitrites in the reservoir occurs in winter.

A stable level of this pollution was observed for nitrates without pronounced jumps, which varied within the range from 3.0 to 6.5 mg N/l. In the autumn period the highest values of

nitrates were most often observed, that is why the autumn period is the most unfavorable (Fig. 3.3).

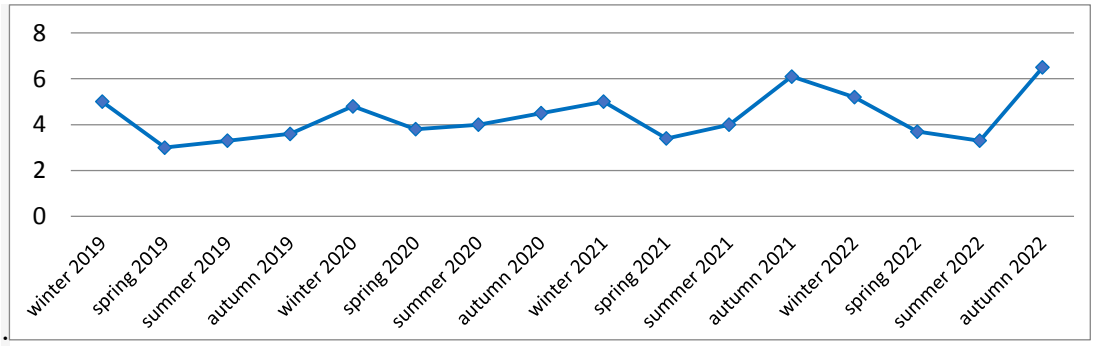

Fig. 3.3. Dynamics of nitrates content in water of the Reut River for the period 2019-2022 (mg N/l)

In the last year of our study (2022), the highest level of pollution was observed not only by nitrates, but also by ammonium. At the same time there was a seasonal similarity with nitrites associated with the fact that in 2021 the maximum peak for nitrites coincided with the maximum peak for nitrates in winter. Such seasonal variation, depending on the season, is associated with several significant factors: intra-reservoir processes by season of the year, discharges of pollutants into the tributary and weather conditions (water temperature, precipitation), summer cottage season with intensive water intake, etc.).

Unfavorable sanitary and environmental situations in the Reut were also identified by microbiological indicators: GCB (general coliform bacteria) and TCB (thermotolerant coliform bacteria). No excesses in coliphages were detected. Over the entire period of our study, the intra-annual seasonal dynamics of microbiological indicators had pronounced peaks of maximum and minimum concentrations. The variability characteristics of general coliform bacteria and thermotolerant coliform bacteria had a fairly wide range of variability from 0 to 24,000 CFU/ml.

The results of studies for 2019-2022 have shown a certain seasonal similarity in the maximum peak of bacterial pollution in the winter period over four years, which coincides with the peak of biogenic pollution in the same period of time.

According to the data (Fig. 3.4), the GCB (general coliform bacteria) were characterized by maximum values in the winter period – 24,000 CFU/ml, which was 48 times higher than the permissible norm. Significantly lower values of this indicator were noted in the summer period – 2,400 CFU/ml, which was 4.8 times higher. Minimum values were observed in the spring period – 620 CFU/ml, which was slightly higher. No GCB was detected in the autumn period.

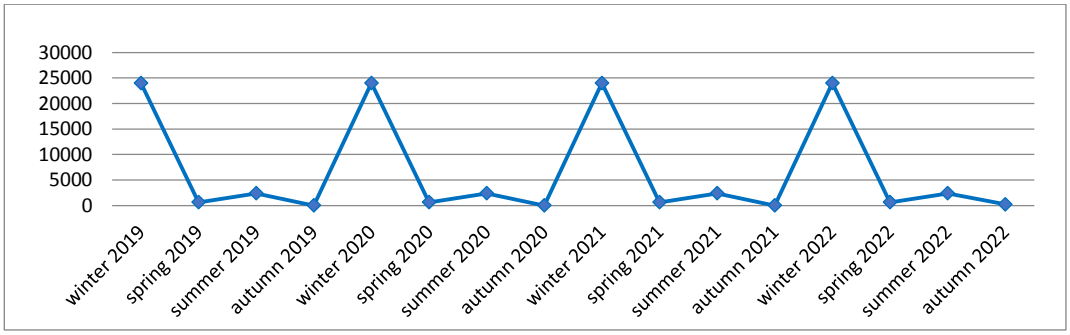

Fig. 3.4. Dynamics of general coliform bacteria content in water of the Reut River for the period 2019-2022 (CFU/ml)

According to the results of the data analyses (Fig. 3.5), thermotolerant coliform bacteria had a maximum peak in the winter period - 24000 CFU/ml, which was a very large excess – 240 times. Significantly lower values were noted in the summer period - 2400 CFU/ml, which

was 24 times higher. Minimum values were noted in the spring period - 620 CFU/ml, which was 6 times higher than the norm. This indicator was not detected in the autumn.

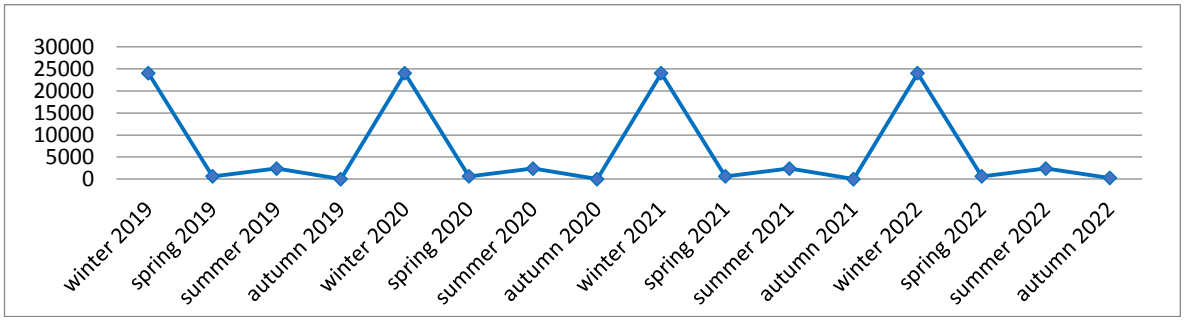

Fig. 3.5. Dynamics of thermotolerant coliform bacteria content in water of the Reut River for 2019-2022 (CFU/ml)

In the comparative characteristics between biogenic and microbial pollution, microbial pollution dominates in terms of the excess degree and biogenic pollution prevails in terms of detection cases.

For this tributory a seasonal trend and similarity are observed in identifying the most unfavorable period as in biogens, as in microbiology, which is the winter period. This situation can be explained by the fact that the richer the river water is in organic matter, the more microbes it contains, and in our case the peak of biogenic pollution coincides with the peak of microbial pollution. This fact can be used to explain the current unfavorable situation.

Sanitary-ecological condition of the Ikel tributary

For this river unfavorable sanitary-ecological situations are associated with biogenic and microbiological pollution. These indicators had a wide range of seasonal variability.

According to the data results (Fig. 3.6), ammonium was recorded constantly and had a pronounced variability, the range varied within the limits from the minimum of 0.43 mg N/l to the maximum of 7.8 mg N/l.

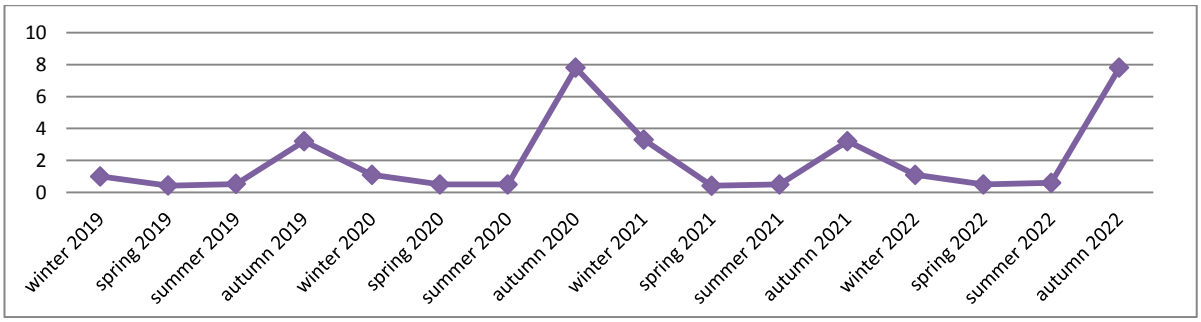

Fig. 3.6. Dynamics of ammonium content in water of the Ikel River for the period 2019-2022 (mg N/l)

Ammonium with the highest concentrations was regularly observed in the autumn period, especially in 2020 and 2022 when the excess of the norm was 19.5 times. Minimum values of ammonium were observed more often in the spring period, which were recorded at almost the same level 0.42-0.5 mg N/l, which slightly exceeded the permissible norm.

Such seasonal variability of ammonium during the year is possibly due to the fact that in the summer phytoplankton and macrophytes develop intensively that use nitrogenous elements for their development, thereby reducing their concentrations. In the autumn phytoplankton activity decreases significantly and the processes of decomposition of organic matter to mineral forms prevail in the reservoir.

The dynamics of nitrite content in water was characterized by pronounced intra-annual seasonal variability that was expressed in maximum values mainly in the summer period and minimum values in the spring period (Fig. 3.7).

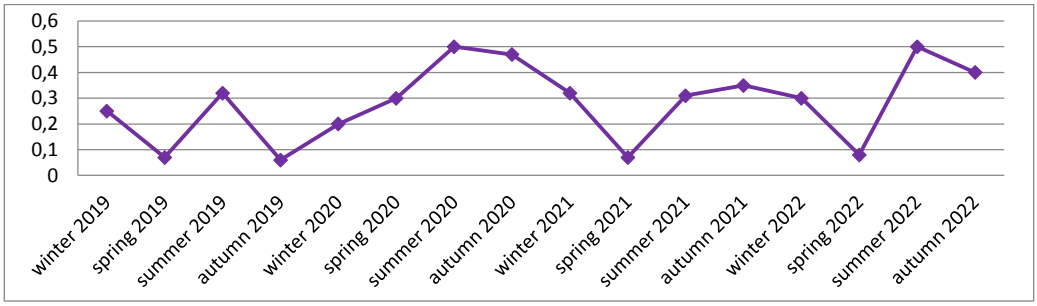

Fig. 3.7. Dynamics of nitrites content in water of the Ikel River for the period 2019-2022 (mg N/l)

The seasonal dynamics of nitrites had a wide range of fluctuations from 0.06 to 0.5 mg N/l and was characterized by their highest values in 2020 and 2022.

In 2020, there was an increase in nitrites in all seasons and a more pronounced peak of the maximum, compared to the previous year. The maximum peak was noted in the summer period - 0.5 mg N/l, which was 8.3 times higher than the norm, and in the autumn period – 0.47 mg N/l there was an excess of 7.8 times, for the spring time – an excess of 5 times, which had the value of 0.3 mg N/l. The smallest amount of nitrites was detected in the winter period – 0.2 mg N/l, which was several times higher than the normal limits.

In 2022 a slight increase in nitrites was observed, compared to the previous years studied. The summer period was characterized by the highest values of nitrites – 0.5 mg N/l, exceeding the norm by 8.3 times; lower values were found for the autumn period – 0.4 mg N/l, which exceeded the norm by 6.6 times; less nitrites were noted in the winter period – 0.3 mg N/l, exceeding the norm by 5 times. The minimum peak of nitrites was observed in the spring – 0.08 mg N/l, which exceeded the norm, but insignificantly. Nitrates were observed constantly and had a stable level of their excess. The dynamics of nitrates had variability within the range from 3.4 to 13.8 mg N/l (Fig. 3.8).

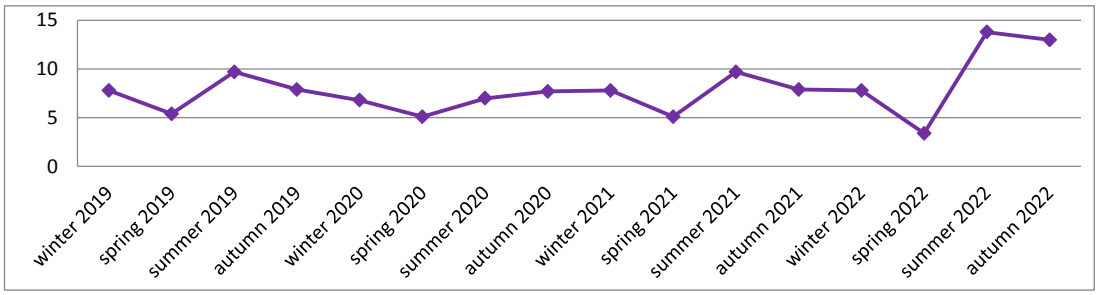

Fig. 3.8. Dynamics of nitrates content in water of the Ikel River for the period 2019-2022 (mg N/l)

The highest values were noted in 2022 in the summer period – 13.8 mg N/l, having an excess of 4.6 times; slightly lower values of nitrates were found in the autumn period – 13 mg N/l, which were 4 times higher than the norm; and significantly lower nitrates were observed in the winter period – 7.8 mg N/l, which was several times higher than the norm and in the spring – 3.4 mg N/l, having insignificant excesses.

Such a variation between the winter and summer periods is probably due to the fact that summer is the season of water intake from the tributary due to which the water level decreases, which contributes to an increase in the concentration of biogens in water.

According to the results of laboratory studies, excesses were found in microbiological indicators: GCB (general coliform bacteria) and TCB (thermotolerant coliform bacteria), but coliphages had insignificant excesses. Seasonal dynamics of microbes had a well-defined range of their fluctuations, which varied from 630 to 24000 CFU/ml. According to the analysis, a general seasonal trend is observed in maximum values in the winter period.

According to the results of the analysis (Fig. 3.9), GCB (general coliform bacteria) had a fairly wide range of variability from a minimum of 630 CFU/ml to a maximum of 24,000 CFU/ml.

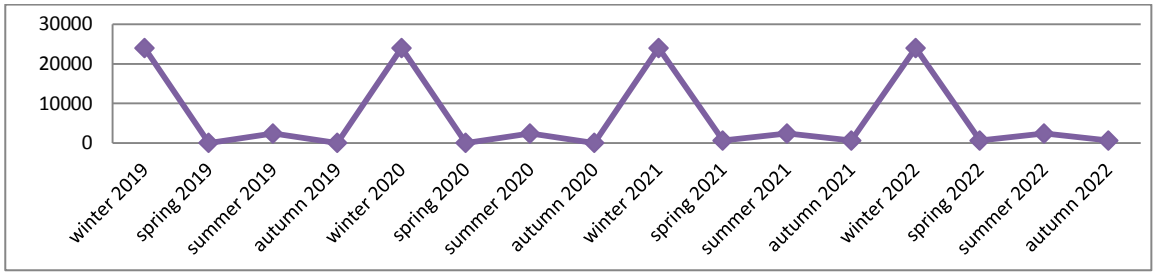

Fig. 3.9. Dynamics of general coliform bacteria content in water of the Ikel River for the period 2019-2022 (CFU/ml)

This indicator had a clearly defined peak of maximum values in the winter period – 24000 CFU/ml, which was 48 times higher than the permissible norm. This indicator was significantly lower in the summer period – 2400 CFU/ml, which was almost 5 times higher. No excess was observed in the spring and autumn.

TCB (thermotolerant coliform bacteria) had high values in the winter period. The range of seasonal variability varied widely from 0 to 24000 CFU/ml.

According to the data (Fig. 3.10), two distinct peaks are observed: the maximum values were detected in the winter period and the minimum – in the summer.

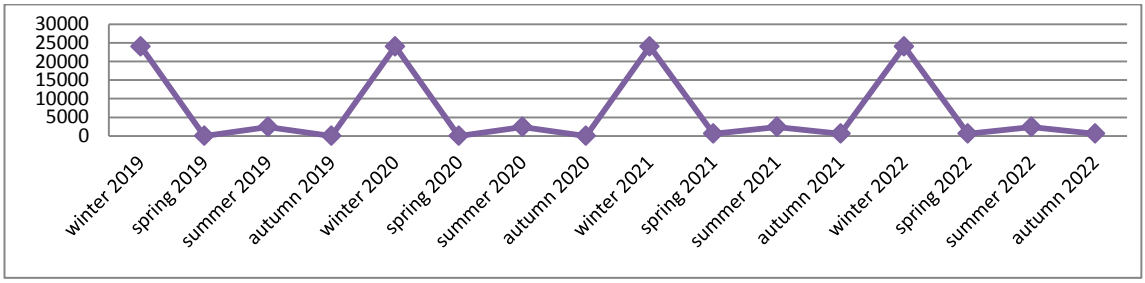

Fig. 3.10. Dynamics of thermotolerant coliform bacteria content in water of the Ikel River for the period 2019-2022 (CFU/ml)

In winter the values were the highest – 24000 CFU/ml, which were 240 times higher. Much lower values were found in the summer – 2400 CFU/ml, which were 24 times higher. The lowest concentrations were observed in two periods at once: spring and autumn – 630 CFU/ml, which exceeded the permissible norms, but insignificantly.

In winter the high content of thermotolerant coliform bacteria and general coliform bacteria is due to the fact that in our region winter is relatively warm and short-lived, and that the maximum precipitation occurs at the end of the autumn period with rainwater there is a washout from agricultural lands and private sectors flowing directly into the tributary without preliminary treatment. These meteorological factors: warm winters and rains in combination with reduced phytoplankton activity in the autumn-winter period are favorable for the development of bacteria.

Sanitary-ecological condition of the Byk tributary

This tributary is the most unfavorable in sanitary-ecological and epidemiological terms due to the fact that an "extremely high" level of pollution is observed most often.

According to the data, ammonium pollution has been quite high throughout the entire period of time and maintains a tendency for a stable level of its high concentrations.

The range of seasonal variability of ammonium varied widely from 3.8 to 20 mg N/l, which exceeded the norm by a maximum of 48 times. This high excess of ammonium was found only in the Byk River, while in other tributaries: Reut, Ikel and Botna ammonium pollution was significantly lower. Maximum peaks of ammonium were most often recorded in the autumn period and minimum ones in the spring (Fig. 3.12).

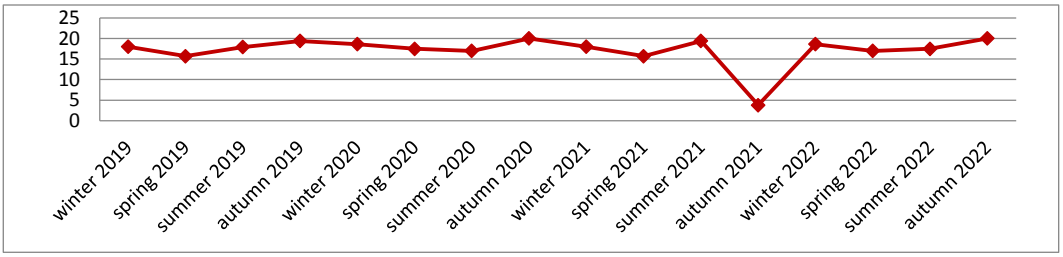

Fig. 3.12. Dynamics of ammonium content in water of the Byk River for the period 2019-2022 (mg N/l)

The constant presence of high concentrations of ammonium in the Byk River water indicates the influx of large volumes of pollutants of recent origin, which reduce the quality of water.

According to the results of data analysis (Fig. 3.13), nitrites were characterized by pronounced jumps in maximum and minimum, but nitrite concentrations were significantly lower than ammonium in the Byk River. This situation showed that the processes of decomposition of organic matter prevailed over the processes of self-purification of the river.

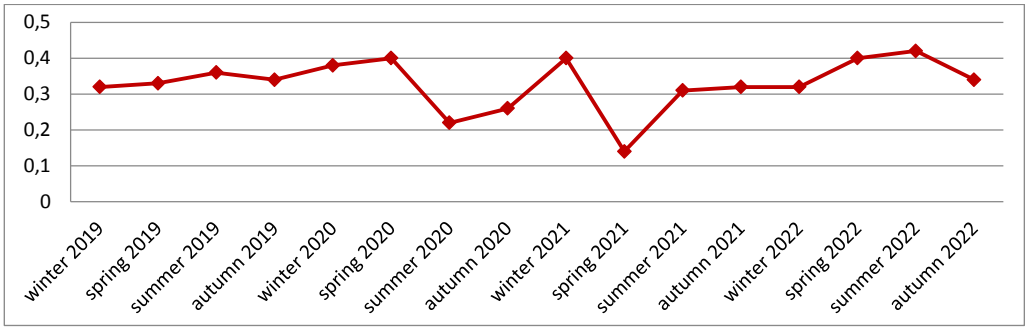

Fig. 3.13. Dynamics of nitrites content in water of the Byk Kiver for the period 2019-2022 (mg N/l)

Nitrite pollution tended to increase in concentration over time.

Intra-annual seasonal variability of nitrites was within the range of 0.18- 0.42 mg N/l.

There was no general seasonal trend in identifying the most unfavorable period of time due to the fact that in 2019 the maximum nitrite values were observed in two periods: summer and autumn. In 2020 this period was winter and spring, and in 2021 – the winter period, in 2022 – the summer period. Nitrates were observed constantly and had a wide range of variability from 4 to 18.4 mg N/l (Fig. 3. 14). However, nitrates and nitrites had significantly lower excess of permissible norms, compared to ammonium.

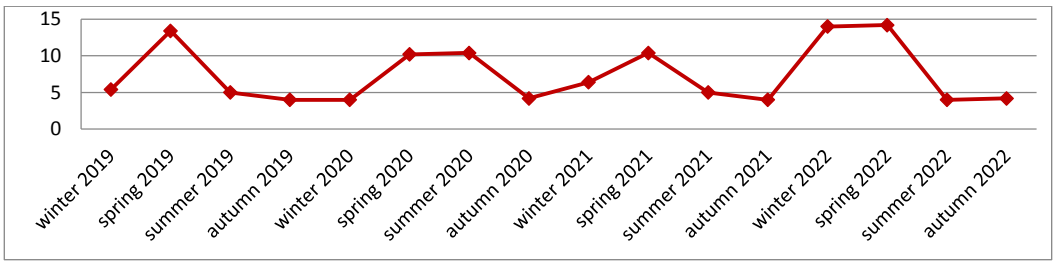

Fig. 3.14. Dynamics of nitrates content in water of the Byk River for the period 2019-2022 (mgN/l)

The highest concentrations of nitrates were more often recorded in spring, exceeding the norm by a maximum of 4.6 times. Minimum nitrate values were mainly noted in autumn.

The current situation is explained by the fact that along the entire course of the Byk River there are a lot of industrial and food enterprises that discharge wastewater directly into the river, thereby increasing the degree of biogenic and microbial pollution, which leads to the development of environmentally unfavorable situations.

Microbiological indicators of pollution had a wide range of variability and well-defined maximum and minimum peaks. The indicators of GCB (general coliform bacteria) and TCB (thermotolerant coliform bacteria) pronounced seasonal peaks in maximum and minimum from 630 to 24,000 CFU/ml.

The concentrations of the GCB value were recorded continuously and had a stable level of its concentrations in the periods of winter, spring and summer (Fig. 3.15).

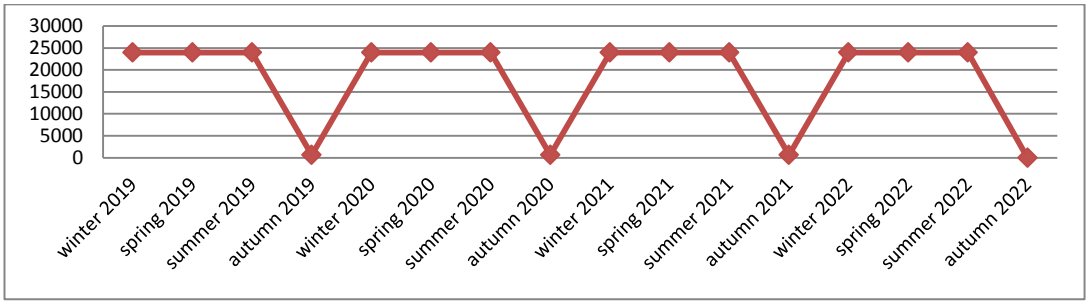

Fig. 3.15. Dynamics of general coliform bacteria content in water of the Byk River for the period 2019-2022 (CFU/ml)

The dynamics of seasonal variability of GCB is characterized by maximum values in three periods: winter, spring and summer in which the concentrations were 24000 CFU/ml, which is 48 times higher than the permissible norm. In the summer period this indicator had its minimum values – 630 CFU/ml, which is 38 times less than in previous periods of time (Fig. 3.15).

TCB (thermotolerant coliform bacteria) were recorded constantly and their maximum was observed in three periods: winter, spring and summer with the determination of the value - 24,000 CFU/ml, which exceeded the permissible norm by 240 times. In the fall, significantly lower concentrations of this value were observed – 630 CFU/ml, which exceeded the norm by 6.3 times (Fig. 3.16).

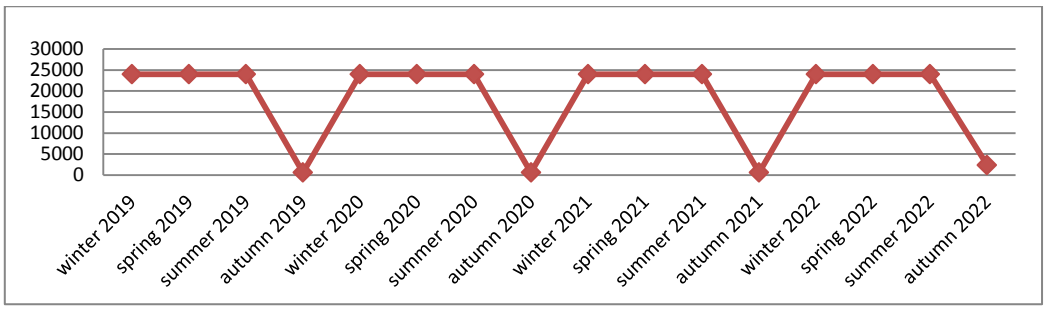

Fig. 3.16. Dynamics of thermotolerant coliform bacteria content in water of the Byk River for the period 2019-2022 (CFU/ml)

According to the results of the data analysis (Fig. 3.17), coliphages were observed only in the spring-summer period, the limits of excess varied from 18 to 32 PFU/ml, which had excesses of 1.8-3.2 times.

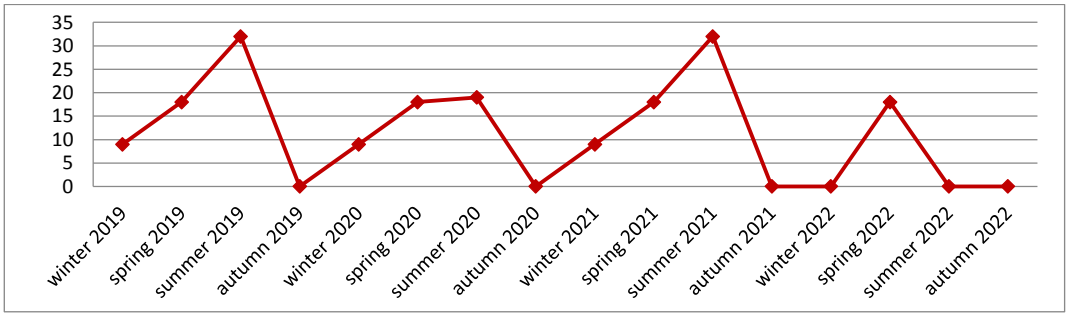

Fig. 3.17. Dynamics of coliphages content in water of the Byk River for the period 2019-2022 (CFU/ml)

Based on the results of the assessment and analysis of biogenic and microbiological pollution, it can be concluded that there is a high level of pollution which is caused by the entry of large volumes of pollutants of anthropogenic origin into the river.

Sanitary-ecological condition of the Botna tributary

For this tributory, as well as for the previous rivers Reut, Ikel and Byk, unfavorable sanitary and ecological situations are associated with biogenic and microbiological pollution.

Ammonium was characterized by a relatively stable level of its exceedances throughout the entire study period. The range of variability varied from a minimum of 0.4 to a maximum of 0.98 mg N/l (Fig. 3.18).

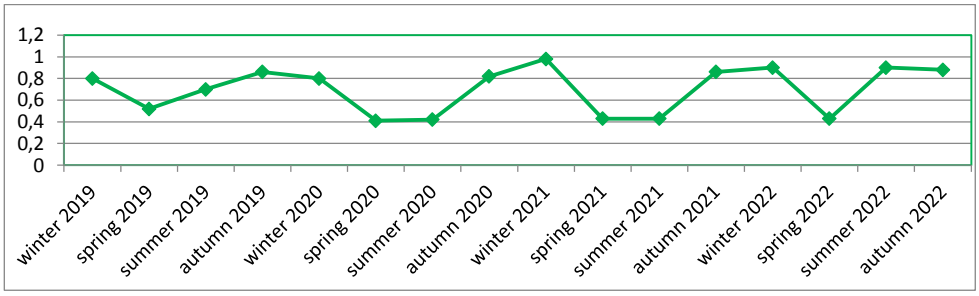

Fig. 3.18. Dynamics of ammonium content in water of the Botna River for the period 2019-2022 (mg N/l)

According to the data (Fig. 3.18), there are clearly defined peaks of maximum and minimum ammonium concentrations. This indicator most often had a maximum peak of its values in the winter period, and minimum values were always recorded in the spring period. The

highest ammonium values were recorded in 2021 in winter – 0.98 mg N/l, which was 2.4 times higher than the norm.

This situation is possibly due to the fact that in the autumn-winter period there is an intensive decomposition of organic matter that reaches the maximum in the winter period and with the fact that in these periods the activity of phytoplankton is reduced, which are necessary for the development of nitrogen elements.

Nitrites generally had a stable level of its excess and a well-defined maximum peak in 2020, where their values were 0.9 mg N/l, which was 15 times higher than the permissible norm. The range of nitrite variability fluctuated within very wide limits from 0.07 to 0.9 mg N/l (Fig. 3.19).

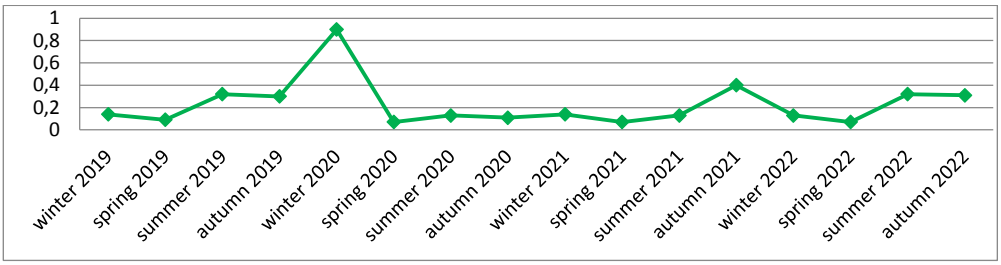

Fig. 3.19. Dynamics of nitrites content in water of the Botna River for the period 2019-2022 (mg N/l)

Seasonal dynamics of nitrites shows that most often the highest values were recorded in the autumn period and the lowest were always recorded in the spring period. The variability of nitrites had a seasonal similarity with ammonium in revealing minimum concentrations in the spring period. However, the degree of pollution is higher for nitrites, compared to ammonium due to the fact that for ammonium the excess of permissible standards was lower mainly by 2-2.4 times; and nitrites had excess of permissible standards by 5-15 times. Nitrates were constantly observed in the river water of Botna and had pronounced jumps in maximum and minimum peaks of their values. The range of seasonal variability had the following limits from 4.2 to 18 mg N/l (Fig. 3.20).

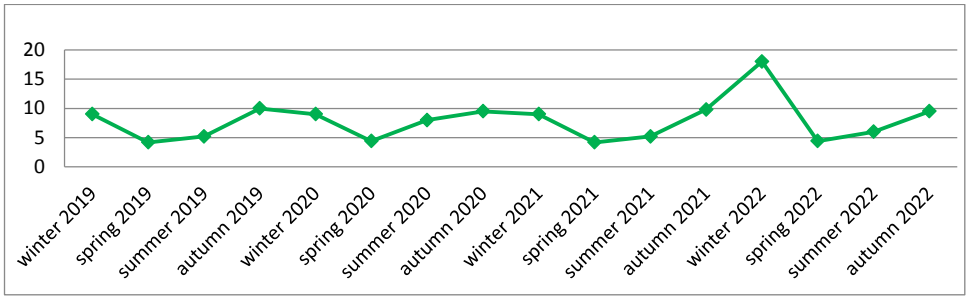

Fig. 3.20. Dynamics of nitrates content in water of the Botna River for the period 2019-2022 (mg N/l)

The seasonal dynamics of nitrates in terms of maximum and minimum values is similar to that of ammonium in the same period, for which the highest values were also recorded in the winter period and the lowest in the spring period. But the excess of permissible norms was higher for nitrates than for ammonium. In the spring minimum values were recorded for both ammonium and nitrites which indicates a general seasonal trend. This may be associated with the spring flood, as a result of which the water level in the river rises and thereby the concentration of biogenic components decreases.

In the Botna tributary unfavorable sanitary and environmental situations were identified by microbiological indicators: GCB (general coliform bacteria) and TCB (thermotolerant coliform bacteria), and coliphages were not characterized by high excesses of permissible norms.

General coliform bacteria had a wide range of variability, ranging from 0 to 24000 CFU/ml. This indicator had a seasonal focus in identifying the most unfavorable periods: winter and spring throughout the entire study period (Fig. 3.21).

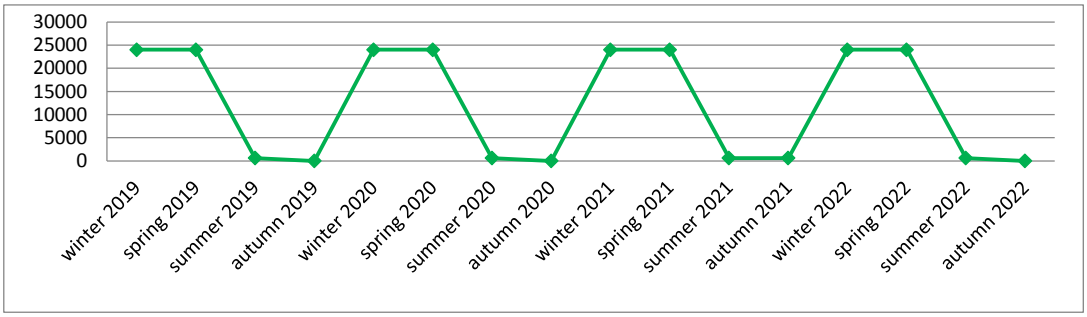

Fig. 3.21. Dynamics of general coliform bacteria content in water of the Botna River for the period 2019-2022 (CFU/ml)

According to the data (Fig. 3.21), the dynamics were characterized by two pronounced maximum peaks in winter and spring, the values of which corresponded to 24000 CFU/ml, which exceeded the permissible norm by 48 times. Significantly lower values of this indicator were detected in the summer – 630 CFU/ml, which slightly exceeded the norm. In the autumn the indicator was not detected.

Thermotolerant coliform bacteria had a wide range of variability from the maximum in winter and spring to the minimum in the summer (Fig. 3.22).

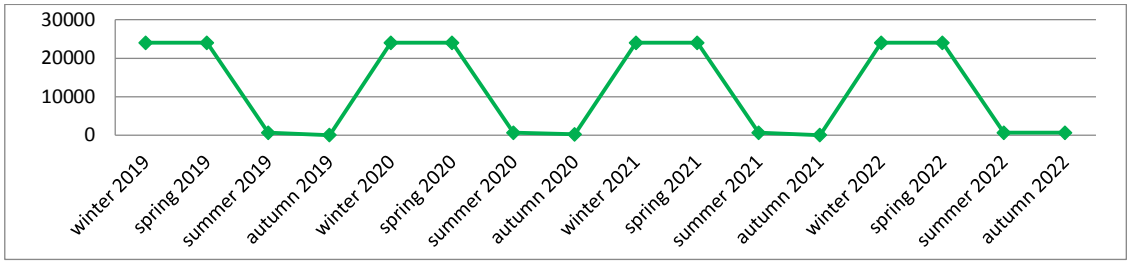

Fig. 3.22. Dynamics of thermotolerant coliform bacteria content in water of the Botna River for the period 2019-2022 (CFU/ml)

In the autumn period this indicator was practically not observed. The variability varied within the limits from 0 to 24000 CFU/ml (Fig. 3.23).

The dynamics of this indicator was characterized by two peaks: winter and spring, in which the values were 24000 CFU/ml, which was 240 times higher than the permissible norm. Much lower values were observed in the summer period – 630 CFU/ml, which were 6 times higher. In the autumn period this indicator was not detected.

The variation between winter and summer can be explained by the fact that these microorganisms are resistant to low temperatures and that biogenic pollution is often observed in this period which contributes to the growth of these bacteria.

Sources and dynamics of the pollution process of the Lower Dniester tributaries (the Byk River as an example). The main objective of the study of the Byk River pollution process was to determine the pollutants and the environmental assessment of wastewater (WW) from

enterprises, as well as pollution sources in the Chisinau municipality, which discharge wastewater to the Chisinau Wastewater Treatment Plant (WTP).

The object of the study was 140 food enterprises of the Chisinau municipality that produce and discharge wastewater to the WTP of the Chisinau municipality. The impact of WW discharges from enterprises on the water quality of the Byk River was studied. For the analysis there were used data on the quality of WW discharged by food enterprises of the Chisinau municipality [6].

There was an environmental assessment [4, 5] and an analysis of the data carried out provided by "Apâ-Canal-Chisinau" JSC as a result of unannounced inspections of the quality of wastewater, discharged from food enterprises of the Chisinau municipality; and the specifics of each pollutant and an assessment of their excess of permissible standards were identified. Some companies were identified whose discharges have the most negative impact on the Chisinau WTP and, as a result, worsen the quality of the Byk River water. Based on the results of the assessment of wastewater from enterprises, carried out in the "Ecourbanistics" laboratory of the Institute of Ecology and Geography, recommendations have been developed to reduce the degree of pollution of wastewater by enterprises that are discharged into the Chisinau WWTP.

4. GENERAL FLORISTIC CHARACTERISTICS OF THE LOWER SECTOR OF THE DNISTER RIVER AND THE MOUTHS OF ITS TRIBUTORS

In the stations under study we have identified: 113 species from 103 genera belonging to 55 families of higher plants (*Magnoliophyta*). The families with the greatest diversity are *Asteraceae* (21 species) and *Poaceae* (8 species), mostly growing in the coastal zone. The remaining families are mostly represented by 1-3 plant species.

In the aquatic environment near the bank, we found free-swimming species: *Lemna minor* L., *Ceratophyllum demersum* L., *C. submersum* L. and fixed to the bottom: *Vallisneria spiralis* L., *Alisma plantago-aquatica* L., *Sparganium erectum* L., *Phragmites australis* (Cav.) Trin. ex Steud, *Butomus umbelatus* L. and others.

Biological elements are represented by the following groups: *spontaneous* element, *ruderal* element, *segetal, adventitious, subspontaneous* and *naturalized ones.* The *spontaneous* element of the flora predominates and makes up 48%. The *ruderal* element of the flora is represented by 36 species and makes up 31% (Fig. 4.1).

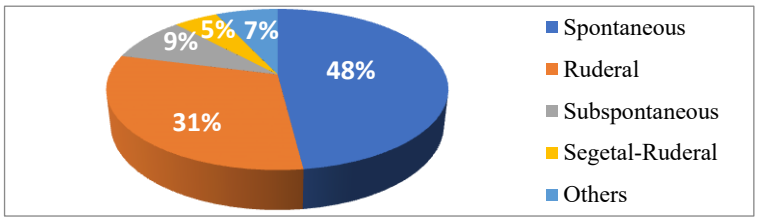

Fig. 4.1. Percentage ratio of biological indices of the flora of the lower section of the Dniester River and its tributaries

Basically, these are species characterized by a wide ecological amplitude, their presence indicates their invasive nature. This group includes species: *Sonchus arvensis* L., *Cyrsium setosum* Wimm.Grab, *Ambrosia artemisiifolia* L., *Galium aparine* L. and others. A significantly lower percentage of detection was determined for *subspontaneous* species – 9%, an even lower percentage was determined for *segetal-ruderal* elements – 5%. The remaining biological elements (Se, RSe, RSp, RAdv, AdvR, etc.) occupy almost the last place, which amounted to – 7%.

This situation with the predominance of *spontaneous* species indicates some disturbances in this ecosystem associated with human activity. Plants that serve as indicators of trophic status

have been identified in this area, such as *Eutrophic* species*: Atriplex tatarica* L.*, Stellaria media* (L.) Vill, *Cardaria draba* (L.) Desv., *Artemisia vulgaris.* L., m*esotrophic type Potentilla reptans* L. The predominance of species of the trophic category was revealed for *etrophic* species – 68%, a significantly lower percentage of their detection was determined for *mesotrophic* species – 13%, followed by *oligotrophic* species – 13%, and the last place is occupied by *eutrophic-mesotrophic* species – 6% (Fig. 4.2).

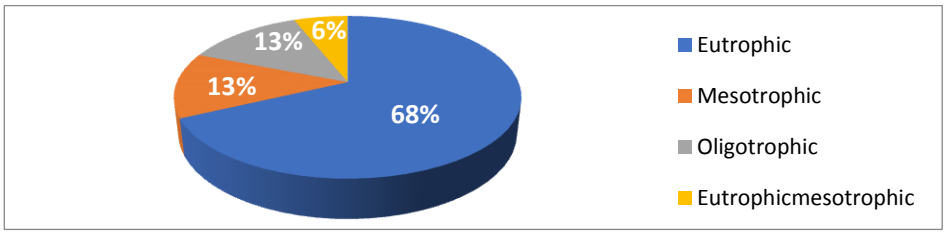

Fig. 4.2. Percentage ratio of plant species-indicators of trophicity of the lower section of the Dniester River and the mouth of its tributaries

This distribution of plants in the ecosystem indicates the process of eutrophication and excess of biogenic substances, which may show the pathways of entry of these substances into the ecosystem.

5. ECOLOGICAL RISKS OF ANTHROPOGENIC IMPACT ON THE LOWER DNIESTER ECOSYSTEM

Ecological risks in the Lower Dniester and its tributaries are associated with a high degree of biogenic and microbiological pollution that negatively affects the functioning of the river ecosystem and the health of people living in the river basin.

Based on the results of the analysis of previously conducted studies of the river ecosystem, the authors [8-13, 15] found that the rivers of Moldova are experiencing anthropogenic impact, as a result the level of pollution of the rivers and their depletion increase.

The most serious consequences (ecological risks) were identified in the Byk River where eutrophication processes are developing negatively, affecting life forms, the vital activity of flora and fauna. The unfavorable ecological situation on the Byk affects that of the Dniester River, since this tributary brings a high degree of biogenic and microbiological pollution into it. This ecological situation in the Byk River may have the development of serious irreversible consequences associated with the impossibility of restoring the functioning of the river ecosystem.

Environmental risks in the Reut River are caused by biogenic and microbiological pollution that reduces the quality of river water and the self-purification potential of the reservoir.

According to the results of the analysis (Fig. 5.1), a high percentage of discrepancies in the Reut water samples were recorded for biogenic and microbiological parameters. The frequency of cases of water pollution dominates in biogenic parameters.

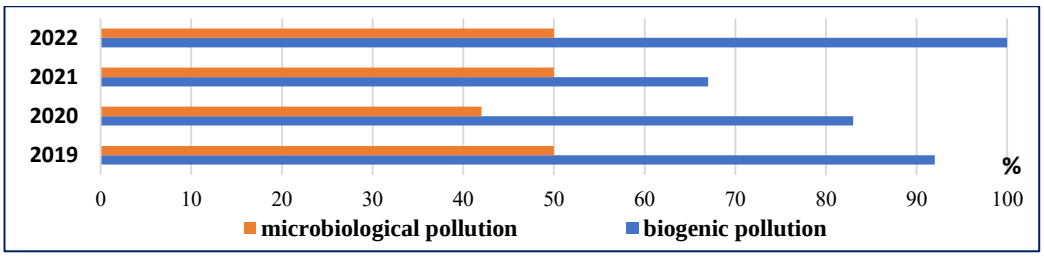

Fig. 5.1. Frequency of water pollution incidents in the Reut River for the period 2019-2022

In terms of the exceeding degree of the permissible standards, microbiological pollution dominates: 240 times in terms of TCB (thermotolerant coliform bacteria) and 48 times GCB (general coliform bacteria) in terms of TCB in winter.

The presence of high concentrations of microbiological pollution in river water creates an increased risk to human health (water is a route for the transmission of infectious diseases) and an environmental risk to biocenoses: a decrease in biodiversity, accumulation of harmful substances and transmission through food chains “plant-animal-human”.

The probability of developing environmental risks in the Reut river section is proven by the frequency of adverse situations in terms of biogenic pollution: in 2019 – 92%, 2020 – 83%, 2021 – 67%, and in 2022 the highest frequency of "polluted" water cases was revealed – 100%. In terms of microbiological pollution, the frequency of "polluted" water cases was 50% in 2019, 2021, 2022, and in 2019 the frequency of "polluted" water cases was 42%.

Environmental risks in the Ikel River are associated with microbiological and biogenic pollution, which affects the ecological state of the river ecosystem. It causes intensive development of blue-green algae, reduces the concentration of oxygen dissolved in water and develops putrefactive processes, degrades populations of higher aquatic organisms. High concentrations of bacterial contamination increase the risk of developing an epidemiological situation associated with an increase in intestinal infections among the population using this water resource.

According to the results of the analysis (Fig. 5.2), the highest percentage of non-compliance of river water samples was determined by biogenic parameters, but in terms of the degree of exceeding permissible standards, microbiological contamination dominates, which is 240 times higher in terms of TCB (thermotolerant coliform bacteria) and 48 times – higher in terms of GCB (general coliform bacteria).

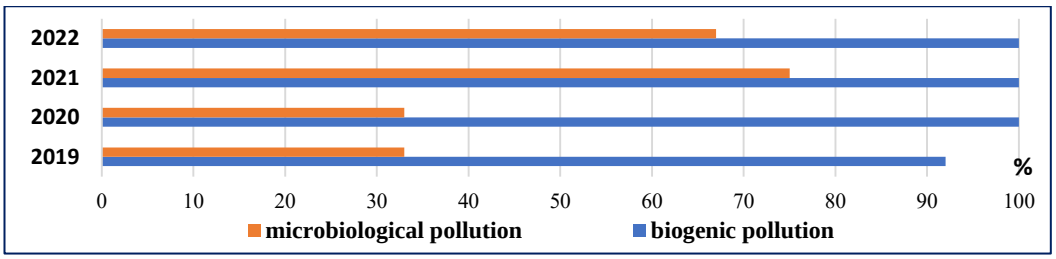

Fig. 5.2. Frequency of water pollution incidents in the Ikel River for the period 2019-2022

The environmental risks in the Ikel River are proven by the frequency of cases of "polluted" water for biogenic pollution, which was 100% in 2020 – 2022 and 92% in 2019. The frequency of cases of microbiological pollution of water tends to increase in the degree of pollution over time, which is proven by growth, namely: in 2019 and 2020 it was 50%, and in 2021 – 75% and in 2022 – 67%.

Environmental risks in the Byk River ecosystem associated with a very high degree of pollution are due to the threat of ecosystem degradation and resource depletion. The high level of microbiological pollution of the Byk River (240 times according to the TCB and 48 times according to the GCB) increases the risks of developing epidemiological problems for the population living in the basin of this river. These consequences are associated with the growth of intestinal infections and their rapid spread over a short period of time. The ecological situation in the Byk River is deteriorating due to the detection of coliphages– they have a negative impact on human health, increasing the risk of illness in summer.

Ecological risks in the Byk River are associated with changes directly in the aquatic ecosystem: disruption of trophic and other relationships; disruption of self-purification processes; and a deficiency of dissolved oxygen, which reduces the resistance of aquatic organisms to external factors.

In the Byk River ammonium pollution dominates which is a toxicological substance in terms of harmfulness and therefore the ecological risk is associated with the potential danger of impact on animal and human organisms, especially in food chains.

According to the data (Fig. 5.3), the highest percentage of discrepancies in river water samples for biogenic and microbiological parameters is observed the Byk River in comparison with other tributaries.

The environmental risks of worsening water quality in the Botna River impact the functioning of the ecosystem and human health. This is confirmed by the high percentage of cases of "polluted" water. According to biogenic indicators it was 100% constantly and according to microbiological indicators – 83% in 2019-2021 and 67% in 2022 (Fig. 5.3).

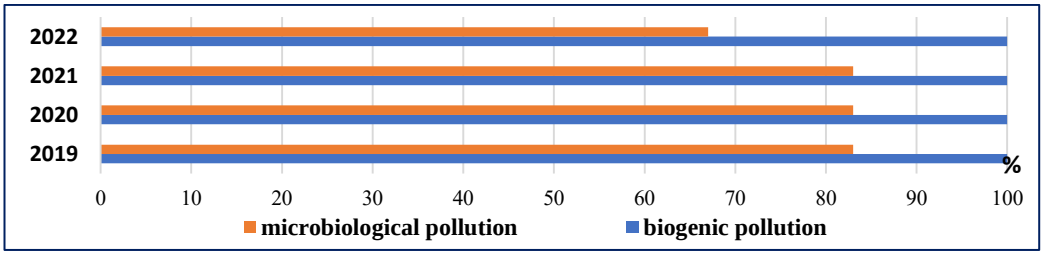

Fig. 5.3. Frequency of water pollution incidents in the Byk River for the period 2019-2022

Environmental risks in the Botna river section are associated with biogenic and microbiological pollution. Pollution with biogens increases the risks of intensive development of eutrophication processes in the reservoir, and this, in turn, reduces the oxygen content, which adversely affects the functioning of the ecosystem.

According to the data analysis (Fig. 5.4), the frequency of cases of "polluted" water in the Botna dominates in biogenic pollution, and concerning the degree of excess – in terms of microbiological pollution.

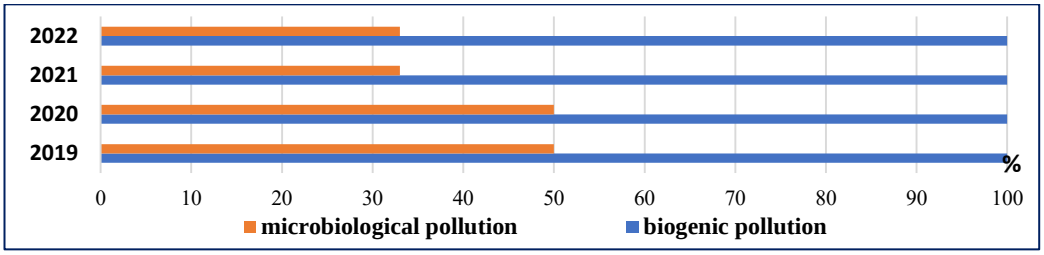

Fig. 5.4. Frequency of water pollution incidents in the Botna River for the period 2019-2022

The probability of developing environmental risks is proven by 100% discrepancy between river water samples for biogenic indicators and microbiological indicators: 50% in 2019, 2020, 33% in 2021 and 2022.

Measures to improve the ecological state of the Lower Dniester ecosystem by reducing environmental risks should be based on modern monitoring data reflecting the actual state of ecosystems, their chemical and bacteriological pollution levels, the state of phyto cenoses and their floristic diversity. An important component in the process of managing environmental risks is the accumulation of sufficient information for decision-making, specific actions, taking into account environmental priorities [1-3].

One of the ways to improve the quality of the river water is regular awareness of the population and its participation in water protection measures [3]. To do this, it is necessary to introduce into practice the preventive principle of natural water protection and make it a mandatory element of modern environmental thinking and the formation of environmental ethics of society [19, 20]. Ecological thinking should become one of the basic moral laws of human behavior and, above all, of those who pollute water bodies and should protect them from pollution.

The fundamental principle of ecological thinking, as applied to the river ecosystem, implies a complete rejection of the very idea of the admissibility of discharge of wastewater into watercourses and the practical application of wastewater treatment rules [27].

Thus, environmental risk management in the area of water use is focused on ecologically balanced development without depleting the water potential of the river ecosystem, which implies increased responsibility for all forms of human economic activity.

GENERAL CONCLUSIONS

1. As a result of anthropogenic impact on the ecosystem of the Lower Dniester and its tributaries Reut, Ikel, Byk and Botna, significant negative changes occurred which manifested themselves in their pollution, decrease in species floristic diversity and development of eutrophication processes.
2. For all tributaries (Reut, Ikel, Byk and Botna), the "fifth quality class" of water was established both for biogenic and microbiological pollution. The intra-annual dynamics of microbiological and biogenic pollution varied in a wide range from a "normal" to a "very polluted" state.
3. A seasonal trend of microbiological pollution was established in all the studied tributaries. Winter is the most unfavorable period. The maximum excess of permissible standards was 240 times for the TCB (thermotolerant coliform bacteria) indicator, 48 times for the TCB (total coliform bacteria) indicator; and these indicators were noted in all rivers. The excesses were significantly lower for biogenic indicators, but cases of their excess were detected more often.
4. An environmental-impact assessment of wastewater from industrial enterprises and the treatment plant of the Chişinău municipality showed a high level of pollution in terms of pH, COC, BOC_5 and suspended solids, which poses a serious threat to the normal functioning of the treatment facilities.
5. Invasive species *Ailanthus altissima* (Mill) Swingle, *Acernegundo* L., *Amorpha fruticosa* L., *Ambrosia artemisiifolia* L., *Grindeli asquarrosa* Willd., identified during the study of the flora of the coastal water strip of the lower section of the Dniester River and its tributaries indicate profound disturbances in the ecosystem of the Lower Dniester.
6. The environmental risksin the Reut River corresponds to a frequency of 42-100% of contaminated water, according to biogenic and microbiological indicators; in the Ikel River it is confirmed by almost 100% frequency of biogenic and 33-75% of microbiological pollution; in the Botna River - by 100% frequency of cases of biogenic and 33-50% of microbiological pollution. The highest environmental risk is determined in the Byk River by 100% frequency of cases of biogenic pollution and 67-83% frequency of cases of microbiological pollution, which increases the risks of development of epidemiological trouble for the population living in the basin of these rivers. These consequences are associated with the growth of intestinal infections and their rapid spread in a short period of time.
7. The Byk River has been found to be dominated by ammonium pollution with concentrations exceeding permissible levels by more than 48 times. Given the high toxicity of ammonium, this pollution poses a significant environmental threat to its potential negative impact on aquatic organisms, animals and humans.

PRACTICAL RECOMMENDATIONS
for the conservation and restoration of the Lower Dniester ecosystem

1. In order to improve the sanitary and ecological situation in the river sections of the Lower Dniester and its tributaries Reut, Ikel, Byk and Botna, it is recommended to apply the basic provisions of the European Water Framework Directive.
2. In order to improve the quality of the Byk river water and thereby improve the quality of the Lower Dniester water, it is recommended to mandatory build and practically implement special stations for preliminary treatment of WS generated at each enterprise with a high pollution potential. Especially for the enterprises: „Cod Mostra" SRL, „Slavena Lux" SRL, „Zernoff" SRL, „Floreni Servicii" Întreprinderea Municipală .
3. In order to prevent environmental risks, it is necessary to continue environmental monitoring of the right tributaries of the Lower Dniester in order to clarify the trends in the change in the ecological state of these rivers.
4. Create a coastal protection strip in order to preserve the natural hydrogeological regime in the "reservoir-bank" system, thereby reducing the anthropogenic load on the coastal zone of the reservoirs.
5. Increase environmental literacy of the population in order to understand the importance of compliance with environmental standards for the protection of the aquatic ecosystem.

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2.2. in collections of republican scientific conferences

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   În: Materialele Conferinței științifico a doctoranzilor. Tendințe contemporane ale dezvoltării științei: viziuni ale tinerilor cercetători, Volumul I, Chișinău, 2020. pp. 171-180.

3. Abstracts/Abstracts in collections

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2. **EROSHENKOVA, V.**, BULIMAGA, C., DOROFTEI, S., DEMCHUKOVA, N. Assessment of the anthropogenic impact on the water quality of the lower Dniester tributies. In: National conference with international participation „Life sciences in the dialogue of generations: connections between universities, academia and business community". Ediția 2, Chişinău, 2022. Moldova State University. p. 172. ISBN 978-9975-159-80-7.
3. **EROSHENKOVA, V.**, BULIMAGA, C., GRABCO, N. Flora of the coastal water stripe of tributaries in the territory of the Republic of Moldova. În: National conference with international participation „Natural sciences in the dialogue of generations", Ed. 7, 2024. Chişinău, Centrul Editorial-Poligrafic al Universităţii de Stat din Moldova. p. 53. ISBN 978-9975-62-756-6.
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ANNOTATION

Eroșenkova Victoria "Ecological risks of anthropogenic impact on the Lower Dniester Ecosystem. Assessment and management measures". PhD thesis in environmental sciences, Chisinau, 2025.

Thesis structure: The dissertation is presented on 134 pages of the main text, consists of an introduction, 5 chapters, general conclusions and recommendations, contains 20 tables, 39 figures, a list of references of 203 titles, 9 appendices. The obtained results were presented in 25 scientific papers.

Key words: Lower Dniester ecosystem, hydro chemical indicators, bacteriological indicators, floristic diversity, anthropogenic impact, sanitary and ecological state, environmental risks, management measures.

Research area: ecology.

The purpose of the work: consists in assessing the environmental risks of anthropogenic impact associated with chemical and microbiological pollution, disruption of phyto cenoses of the Lower Dniester ecosystem and developing measures to reduce these risks.

Tasks: to assess the hydro chemical and microbiological state of the Lower Dniester tributaries; to study the state and intra-annual dynamics of the degree of biogenic and microbiological pollution with the identification of the most unfavorable tributaries; to establish the dynamics and process of pollution of the Lower Dniester tributaries (the Byk River as an example); to determine the floristic diversity of the studied ecosystem; to determine the environmental risks caused by anthropogenic impact on the Lower Dniester ecosystem; to develop recommendations for reducing environmental risks and minimizing anthropogenic impact.

Scientific novelty: A comprehensive study of the environmental condition of the mouth of the Lower Dniester tributaries was conducted. An assessment of the water quality of the right tributaries of the Lower Dniester was made based on chemical (ammonium, nitrites and nitrates) and microbiological (total coliform bacteria, thermotolerant coliform bacteria and coliphages) indicators, and recommendations were developed to reduce the degree of pollution. The probability of environmental risk development in the river ecosystem was shown based on the frequency of biogenic and microbiological water pollution.

The originality of the results: lies in the comprehensive study of the intra-annual dynamics of changes in the water quality of the tributaries associated with anthropogenic impact and their influence on the water quality of the Lower Dniester.

The scientific problem solved: consists in establishing the causes and dynamics of pollution of the right tributaries of the Lower Dniester (the Byk River as an example) and substantiating measures and proposals to reduce and minimize anthropogenic impact on the river ecosystem, ensuring a reduction in the environmental risks for the given ecosystem. The monitoring data of chemical and bacteriological indicators reflecting the actual state of the aquatic ecosystem serve as the basis for developing measures aimed at reducing these environmental risks in the ecosystem of the Lower Dniester.

The theoretical significance: is that the obtained results make a significant contribution to the understanding and analysis of the sanitary and ecological state of the Lower Dniester aquatic ecosystem exposed to chemical (ammonium, nitrites and nitrates) and bacteriological (total coliform bacteria, thermotolerant coliform bacteria and coliphages) pollution of anthropogenic origin.

The practical significance: consists in the implementation of the developed recommendations that allow adjusting the processes of wastewater discharge by industrial enterprises to the Chisinau treatment facilities that will ensure the normal operation of Chisinau Treatment Plant that will lead to the restoration of the aquatic resource and a decrease in the environmental risks in the Lower Dniester ecosystem.

Implementation of scientific results: The research results and recommendations are used by "APÂ-CANAL-CHISINĂU" Biological Treatment Station (BTS, Chisinau) that provide recommendations and measures to reduce the degree of wastewater pollution (WW) by industrial enterprises; "Bendery Center of Hygiene and Epidemiology" State Institution in organizing events aimed at preserving, restoring and rationally using water resources of the Lower Dniester; T.G. Shevchenko State University in the educational process when training specialists in the environmental protection industry and in the field of education.

ADNOTARE

Eroșenkova Victoria "Riscurile ecologice și impactul antropic asupra ecosistemului Nistrului Inferior. Evaluarea și măsuri de gestionare " , teză pentru gradul de doctor ale mediului, Chișinău, 2025.

Structura tezei: lucrarea este prezentată pe 134 de pagini de text principal, constă din introducere, 5 capitole, concluzii generale și recomandări, conține 20 de tabele, 39 de figuri, o listă de referințe din 203 titluri, 9 anexe. Rezultatele obținute au fost prezentate în 25 de lucrări științifice.

Cuvinte-cheie: ecosistemul Nistrului Inferior, indicatori hidrochimici, indicatori bacteriologici, diversitate floristică, impact antropic, stare sanitară și ecologică, riscuri de mediu, măsuri de gestionare.

Domeniul de cercetare: ecologie.

Scopul lucrării este de a evalua riscurile de mediu ale impactului antropic asociat cu poluarea chimică și microbiologică, perturbarea fitocenozelor ecosistemului Nistrului Inferior și de a dezvolta măsuri pentru reducerea acestor riscuri.

Obiective: evaluarea stării hidrochimice și microbiologice a afluenților Nistrului Inferior, studierea stării și dinamicii intraanuale a gradului de poluare biogenică și microbiologică, identificând secțiunile cele mai nefavorabile ale râurilor, stabilirea dinamicii și procesului de poluare a afluenților Nistrului Inferior (de exemplu, râul Bâc), determinarea diversității floristice a ecosistemului studiat, determinarea riscului de mediu cauzat de impactul antropic asupra ecosistemului Nistrului Inferior, elaborarea recomandărilor în vederea reducerii riscurilor de mediu și minimizării impactului antropic.

Noutatea și originalitatea științifică. A fost efectuat un studiu cuprinzător al stării ecologice a gurii de vărsare a afluenților Nistrului Inferior. Evaluare a calității apei afluenților de dreapta ai Nistrului Inferior a fost efectuată pe baza indicatorilor chimici (amoniu, nitriți și nitrați) și microbiologici (bacterii coliforme totale, bacterii coliforme termotolerante și colifagi), fiind elaborate recomandări pentru reducerea nivelului de poluare. Probabilitatea dezvoltării riscului ecologic în ecosistemele râurilor este demonstrată de frecvența cazurilor de poluare biogenică și microbiologică a apei.

Originalitatea rezultatelor constă în studiul cuprinzător al dinamicii intraanuale a schimbărilor calității apei afluenților, asociate cu impactul antropic și influența acestora asupra calității apei Nistrului Inferior.

Problema științifică rezolvată constă în stabilirea cauzelor și dinamicii poluării afluenților de dreapta ai Nistrului Inferior (folosind ca exemplu râul Bâc) și fundamentarea măsurilor și propunerilor pentru reducerea și minimizarea impactului antropic asupra ecosistemelor fluviale, asigurând o reducere a riscului de mediu pentru acest ecosistem. Datele de monitorizare privind indicatorii chimici și bacteriologici, care reflectă starea reală a ecosistemelor acvatice, servesc drept bază pentru elaborarea măsurilor care vizează reducerea riscurilor de mediu în ecosistemele Nistrului Inferior.

Semnificația teoretică constă în faptul că rezultatele obținute aduc o contribuție semnificativă la înțelegerea și analiza stării sanitare și ecologice a ecosistemelor acvatice ale Nistrului Inferior, supuse proceselor de poluare chimică (amoniu, nitriți și nitrați) și bacteriologică (bacterii coliforme totale, bacterii coliforme termotolerante și colifagi) de origine antropică.

Semnificația practică constă în implementarea recomandărilor elaborate care permit corectarea proceselor de deversare a apelor uzate de către întreprinderile industriale către stațiile de epurare din Chișinău, ceea ce va asigura desfășurarea normală a activităților acestora și va duce la restaurarea ecosistemelor acvatice și reducerea riscurilor de mediu în ecosistemele Nistrului Inferior.

Implementarea rezultatelor științifice: rezultatele cercetărilor sunt utilizate la stația de epurare biologică (BTP, Chișinău) «APĂ-CANAL-CHIȘINĂU» pentru reducerea gradului de poluare a apelor reziduale (AR) de către întreprinderile industriale.

Rezultatele cercetării și recomandările sunt utilizate de: Instituția de Stat „Centrul pentru igienă și epidemiologie” din orașul Bender în organizarea de evenimente care vizează conservarea, restaurarea și utilizarea rațională a resurselor de apă ale Nistrului Inferior, cât și de USN T.G. Șevcenco în procesul educațional pentru formarea specialiștilor în industria protecției mediului și în domeniul educației.

АННОТАЦИЯ

Ерошенкова Виктория «Экологические риски антропогенного воздействия на экосистему Нижнего Днестра. Оценка и меры управления», диссертация на соискание ученой степени доктора наук об окружающей среде, Кишинэу, 2025 г.

Структура диссертации: Диссертация представлена на 134 страницах основного текста, состоит из введения, 5 глав, общих выводов и рекомендаций, содержит 20 таблиц, 39 рисунков, список литературы из 203 наименований, 9 приложений. Полученные результаты были представлены в 25 научных работах.

Ключевые слова: экосистема Нижнего Днестра, гидрохимические показатели, бактериологические показатели, флористическое разнообразие, антропогенное воздействие, санитарно-экологическое состояние, экологические риски, меры по управлению.

Область исследования: экология.

Цель работы: состоит в оценке экологических рисков антропогенного воздействия, связанного с химическим и микробиологическим загрязнением, нарушением фитоценозов экосистем Нижнего Днестра и разработке мероприятий по снижению данных рисков.

Задачи: оценить гидрохимическое и микробиологическое состояние притоков Нижнего Днестра; изучить состояние и внутригодовую динамику степени биогенного и микробиологического загрязнения с выделением наиболее неблагополучных притоков; установить динамику и процесс загрязнения притоков Нижнего Днестра (на примере р. Бык); определить флористическое разнообразие изучаемой экосистемы; определить экологический риск, вызванный антропогенным воздействием на экосистему Нижнего Днестра; разработать рекомендации по снижению экологического риска и минимизации антропогенного воздействия.

Научная новизна и оригинальность: Проведено комплексное исследование экологического состояния устьевой части притоков Нижнего Днестра. Выполнена оценка состояния качества воды правых притоков Нижнего Днестра по химическим (аммоний, нитриты и нитраты) и микробиологическим (общие колиформные бактерии, термотолерантные колиформные бактерии и колифаги) показателям, разработаны рекомендации по снижению степени загрязнения. Показана вероятность развития экологического риска в речных экосистемах по частоте случаев биогенного и микробиологического загрязнения воды.

Оригинальность результатов: заключается в комплексном изучении внутригодовой динамики изменений качества воды притоков, связанных с антропогенным воздействием и их влиянием на качество воды Нижнего Днестра.

Решенная научная задача: состоит в установлении причин и динамики загрязнения правых притоков Нижнего Днестра (на примере р. Бык) и обосновании мер и предложений по минимизации антропогенного воздействия на речную экосистему, обеспечивающих снижение экологических рисков для данной экосистемы. Данные мониторинга химических и бактериологических показателей, отражающие реальное состояние водной экосистемы, служат основой в разработке мер, направленных на снижение экологических рисков в экосистеме Нижнего Днестра.

Теоретическая значимость: состоит в том, что полученные результаты вносят значительный вклад в познание и анализ санитарно-экологического состояния водной экосистемы Нижнего Днестра, подверженной процессам химического (аммоний, нитриты и нитраты) и бактериологического (общие колиформные бактерии, термотолерантные колиформные бактерии и колифаги) загрязнения антропогенного происхождения.

Практическая значимость: заключается во внедрении разработанных рекомендаций, позволяющих корректировать сброс сточных вод промышленными предприятиями на очистные сооружения Кишинэу, которые обеспечат деятельность ОС Кишинэу в нормальном режиме, что приведет к восстановлению водных ресурсов и снижению экологического риска на экосистему Нижнего Днестра.

Внедрение научных результатов: Результаты исследований используются: станцией биологической очистки (СБО) «APA-CANAL-CHISINĂU», в которых предусмотрены рекомендации и мероприятия по снижению степени загрязнения сточных вод (СВ) промышленными предприятиями; ГУ «Бендерский Центр Гигиены и Эпидемиологии» в организации мероприятий, направленных на сохранение, восстановление и рациональное использование водных ресурсов Нижнего Днестра; ПГУ им. Т.Г. Шевченко в учебном процессе при подготовке специалистов в природоохранной отрасли и в области образования.

EROSHENKOVA VICTORIA

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