

**XXV INTERNATIONAL
ECO-CONFERENCE® 2021
22th–24th SEPTEMBER**

**XIV ENVIRONMENTAL PROTECTION
OF URBAN AND SUBURBAN
SETTLEMENTS**



PROCEEDINGS

NOVI SAD, SERBIA

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AND SUBURBAN SETTLEMENTS**

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2021

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THE ECOLOGICAL MOVEMENT OF THE CITY OF NOVI SAD: AN IMPORTANT DECISION OF ITS PROGRAMME COUNCIL

Since 1995, the Ecological Movement of the City of Novi Sad organizes "EcoConference® on Environmental Protection of Urban and Suburban Areas", with international participation. Seven biennial conferences have been held so far (in 1995, 1997, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013 and 2015.). Their programs included the following environmental topics:

Session 1: Environmental spheres: a) air, b) water, c) soil, d) biosphere

Session 2: Technical and technological aspects of environmental protection

Session 3: Sociological, health, cultural, educational and recreational aspects of environmental protection

Session 4: Economic aspects of environmental protection

Session 5: Legal aspects of environmental protection

Session 6: Ecological system projecting (informatics and computer applications in the field of integrated protection)

Session 7: Sustainable development of urban and suburban settlements-ecological aspects.

Conference participants have commended the scientific and organizational levels of the conferences. Conference evaluations have indicated that some aspects are missing in the conference program. In addition, since a team of conference organizers was completed, each even year between the conferences started to be viewed as an unnecessary lag in activity.

Eco-Conference® on Safe Food

With the above deliberations in mind, a decision was made that the Ecological Movement of the City of Novi Sad should embark on another project – the organization of Eco-Conferences® on Safe Food. These Conferences were planned to take place in each even year. Preparations for the first Eco-Conferences® on safe food started after the successful completion of the Eco-Conference® '99.

So far four Eco-Conferences® have been held (in 2000, 2002, 2004, 2006, 2008, 2010, 2012 and 2014.) focusing this general theme.

Theme of the Eco-Conference®

By organizing the Eco-Conference® on Safe Food, the organizer wishes to cover all factors that affect the quality of human living. Exchange of opinions and practical experiences should help in identifying and resolving the various problems associated with the production of safe food.

Since 2007 Eco-Conference gained patronship from UNESCO and became purely scientific Conference.

Objectives of the Eco-Conference®

- To acquaint participants with current problems in the production of safe food.
- To make realistic assessments of the causes of ecological imbalance in the conventional agricultural production and the impact of various pollution sources on the current agricultural production.
- Based on an exchange of opinions and available research data, to make long-term strategic programs of developing an industrialized, controlled, integral, alternative and sustainable agriculture capable of supplying sufficient quantities of quality food, free of negative side effects on human health and the environment.

Basic Topics of the Eco-Conference®

Basic topics should cover all relevant aspects of the production of safe food.

When defining the basic topics, the intention was itemize the segments of the production of safe food as well as the related factors that may affect or that already have already been identified as detrimental for food safety and quality. The topics include ecological factors of safe food production, correct choice of seed (genetic) material, status and preparation of soil as the basic substrate for the production of food and feed, use of fertilizers and pesticides in integrated plant protection, use of biologicals, food processing technology, economic aspects, marketing and packaging of safe food.

To paraphrase, the envisaged topics cover the production of safe food on the whole, individual aspects of the production and their mutual relations, and impact on food quality and safety.

Sessions of the Eco-Conference®

1. Climate and production of safe food.
2. Soil and water as the basis of agricultural production.
3. Genetics, genetic resources, breeding and genetic engineering in the function of producing safe food.
4. Fertilizers and fertilization practice in the function of producing safe food.
5. Integrated pest management and use of biologicals.

6. Agricultural production in view of sustainable development
7. Production of field and vegetable crops.
8. Production of fruits and grapes.
9. Livestock husbandry from the aspect of safe food production.
10. Processing of agricultural products in the framework of safe food production.
11. Economic aspects and marketing as segments of the production of safe food.
12. Food storage, transportation and packaging.
13. Nutritional food value and quality nutrition.
14. Legal aspects of protecting brand names of safe food.
15. Ecological models and software in production of safe food.

Attempts will be made to make the above conference program permanent. In this way will the conference become recognizable in form, topics and quality, which should help it find its place among similar conferences organized elsewhere in the world.

By alternately organizing conferences on environmental protection of urban and suburban areas in odd years and conferences on safe food in even years, the Ecological Movement of the City of Novi Sad is completing its contribution to a higher quality of living of the population. Already in the 19th century, Novi Sad was a regional center of social progress and broad-mindedness. Today, owing first of all to its being a university center, Novi Sad is in the vanguard of ecological thought in this part of Europe.

It is our duty to work on the furtherance of the ecological programs of action and, by doing so, to make our contribution to the protection of the natural environment and spiritual heritage with the ultimate goal of helping the population attain a higher level of consciousness and a higher quality of living.

Director of the Ecological
Movement of Novi Sad
Nikola Aleksic

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Original Scientific paper

ENDANGERMENT OF THE BIOLOGICAL MINIMUM AND EUTROPHICATION – FACTORS OF DISTURBANCE OF ECOLOGICAL BALANCE AND SUSTAINABILITY OF THE UKRINA RIVER ECOSYSTEM

Abstract

The Ukrina River (Bosnia and Herzegovina) is a smaller right tributary of the Sava River, whose basin lies between the lower reaches of the Vrbas and Bosna rivers. In addition to being a relatively small basin area, the Ukrina River is characterized by exceptional biological diversity. The appearance of the mayflies (Ephemeroptera) in the summer period of the year also contributes to the biological diversity of the Ukrina River, which makes it the site of this natural rarity. In this study, the threat to the biological minimum and the increased eutrophication of water are considered, as the main factors of disturbing the ecological balance and sustainability of the Ukrina River ecosystem.

Ključne riječi: *Ukrina river, pollutants, eutrophication, biological minimum*

INTRODUCTION

The Ukrina River (Bosnia and Herzegovina) is a smaller right tributary of the Sava River, whose basin lies between the lower reaches of the Vrbas and Bosna rivers. In addition to being a relatively small basin area (1500 km²), the Ukrina River is characterized by exceptional biological diversity. In addition to the rich fish fund, the presence of the Ephemeroptera taxon significantly contributes to the species diversity of the Ukrina River. Ephemeroptera belong to an ancient order of the class Insecta within the subclass Pterygota. They got their scientific name

because of the short (ephemeral) life of the adults, which lasts from a few hours to a few days. After swarming and laying eggs, adult individuals fall to the water surface, where they float like flowers. The appearance of the mayflies (Ephemeroptera) in the summer period of the year is characteristic of the Ukrina River (Republika Srpska), which makes it the site of this natural rarity. Numerous activities are being carried out in order to protect this natural rarity under the auspices of the Municipality of Derвента, the Government of Republika Srpska and UNESCO. In addition, Ephemeroptera larvae have great importance in food chains in river ecosystems (Šarčević-Todosijević and Popović, 2019). The main activities for the protection of the Ukrina River ecosystem are aimed at preventing the possible occurrence of two phenomena: endangerment of biological minimum and increased eutrophication of water.

In this study, the mentioned factors of disturbing the ecological balance and sustainability of the Ukrina River ecosystem are considered.

FACTORS OF DISTURBANCE OF ECOLOGICAL BALANCE AND SUSTAINABILITY OF THE UKRINA RIVER ECOSYSTEM

The main drainage "artery" of the area between the lower reaches of the Vrbas and Bosna rivers is the Ukrina River. The length of the Ukrina watercourse is 119.3 km.

The left tributaries of the Ukrina are Vijaka with Lišnja and Planuša, then Jadovica,



Figure 1. Geographical position of the Ukrina River basin
(Sofilj et al., 1985)

Velika Kremnica, and a series of smaller watercourses. The right tributaries of the Ukrina River are the Radnja River, the Ilova River and the Lupljanica River with numerous streams. The Povelić River in the northwestern part of the area and the Turjanica in the western part gravitate their waters into the Vrbas River. The Usora River in the southeastern part of the border area belongs to the Bosna River basin (Sofilj, 1980; Sofilj et al., 1985; Šarčević-Todosijević and Popović, 2019).

The Ukrina River is a smaller right tributary of the Sava River and its basin (1500 km²) represents a relatively small basin area. Recent research has shown that the river water on the territory of the Municipality of Derвента belongs to the second (II) class of quality. Second class of water quality is the most favorable for the life of fish from the family Cyprinidae, which are also the most common in the Ukrina River (Korene et al., 2005; Šarčević-Todosijević and Popović, 2019).

Table 1. Fish species in the Ukrina River
(Šarčević-Todosijević and Popović, 2019)

Ordinal number	Species
1.	<i>Acipenser ruthenus</i>
2.	<i>Ctenopharyngodon idella</i>
3.	<i>Acerina cernua</i>
4.	<i>Acerina schraetser</i>
5.	<i>Rutilus rutilus</i>
6.	<i>Noemacheilus barbatulus</i>
7.	<i>Chalcalburnus chalcoides</i>
8.	<i>Misgurnus fossilis</i>
9.	<i>Leuciscus cephalus</i>
10.	<i>Abramis brama</i>
11.	<i>Tinca tinca</i>
12.	<i>Cottus gobio</i>
13.	<i>Barbus meridionalis</i>

In such waters, the reduction processes are almost complete, the aerobic state is established, H₂S and ammonia are absent, CO₂ is present in significant amounts, as well as amino acids, which occur as the final components of protein decomposition. The amount of oxygen is stable. The water sometimes has a greenish color from the developed phytoplankton (Cvijan, 2000; Đuković et al., 2000, Šarčević-Todosijević et al., 2018; Šarčević-Todosijević and Popović, 2019). In addition to the rich fish fund, the presence of the Ephemeroptera taxon significantly contributes to the species diversity of the Ukrina River. Ephemeroptera belong to an ancient order of

the class Insecta within the subclass Pterygota. Encompasses tens of thousands of species of medium size, elongated soft body of yellowish or gray-brown color and delicate membranous wings with dense nervation, of which the anterior pair is larger and triangular, and the posterior much smaller or non-existent. They got their scientific name because of the short (ephemeral) life of the adults, which lasts from a few hours to a few days. After swarming and laying eggs, adult individuals fall to the water surface, where they float like flowers. The appearance of the mayflies (Ephemeroptera) in the summer period of the year is characteristic of the Ukrina River (Republika Srpska), which makes it the site of this natural rarity. Numerous activities are being carried out in order to protect this natural rarity under the auspices of the Municipality of Derventa, the Government of Republika Srpska and UNESCO. In food chains, in river ecosystems, Ephemeroptera larvae are of great importance because they represent food for cenobionts (especially fish). On land, many animals feed on developed adult mayflies (Brittain and Sartori, 2003; Šarčević-Todosijević and Popović, 2019).

In the area of the Ukrina River basin, artificial hydrography consists of two fish ponds, AD "Ribnjak" Prnjavor, in which fish is farmed on an area of 638.5 ha and the fish pond "Sijekovac" in Bosanski Brod, which occupies over 2400 ha, and consists of feed and drainage canals on the Ukrina River and a pool system with a water mirror of 700 ha.



Figure 2. Fish pond "Sijekovac", Bosanski Brod

(source: <https://ba.ekapija.com/news/2471320/brod-zeli-ozivjeti-ribnjak>)

In AD "Ribnjak" Prnjavor, only carp are raised, while in the fishpond "Sijekovac", about 800 tons of carp, silver carp, catfish and juvenile fish are produced annually. Due to the fact that fish ponds are supplied with water from Ukrina during the fish farming season, while, after autumn and winter fishing, a significant amount of water from the fish pond is discharged back into the river, strict care must be taken

to prevent the possible occurrence of two phenomena: endangerment of biological minimum, as well as increased eutrophication of water.

The biological minimum is the minimum amount of water flow, which ensures the preservation of the natural balance of ecosystems and ensures the survival and development of aquatic flora and fauna that live in the watercourse in natural conditions. Fish ponds are irrigated with water from Ukrina, but during the summer droughts, the need for water is particularly pronounced, so the amount of water taken from the river is higher than expected. Korene et al. (2005) state that such a situation occurred in 2003, but the biological minimum was not endangered and fish and other cenobionts did not die only because the deepening of the riverbed due to gravel extraction favorably affected the survival of cenobionts in dry conditions. Mišetić (1995) defines the biological minimum as the flow of water that must be discharged downstream from the water abstraction on the watercourse to avoid disturbing the ecosystem. Considering the observed impact of possible endangerment of the biological minimum, using larger amounts of river water for the needs of fish ponds during the dry period of the year, it is necessary to determine the biological minimum on the Ukrina River, especially during this period because it is not the same in certain months or seasons. Determining the biological minimum is generally a very complex problem, and the approach to solving it must not be administrative, but, based on a complex multidisciplinary study, must take into account the size and distribution of water flow, habitat characteristics, annual dynamics of physicochemical and biological properties of water, quantity and quality of water in tributaries, cadastre of of polluters, and assessment of the impact of anthropogenic intervention, in this case fish ponds, on physico-chemical and biological parameters in the watercourse. The basic premise is that the quality of water in the period of minimum flows must not be worsened compared to the previous state, and its quantity must provide all the conditions for the development of the overall biocenosis. The size of the biological minimum is often proposed on the basis of hydrological processing of available data, obtained by observation and measurement. Ecologically acceptable flow is a time-dependent size, which changes during the season depending on the specific needs of biocenoses, which have different water needs in different periods. According to the Water Management Strategy of Bosnia and Herzegovina, it is necessary to determine the preliminary values of the biological minimum of the river ecosystem, adopt an acceptable methodology for determining the biological minimum upstream from the water abstraction on the watercourse, with significant consideration of water needs of downstream users. This is especially important in the summer when temperatures are highest or in periods important for the survival of cenobionates within the river ecosystem (Water Management Strategy of the Federation of Bosnia and Herzegovina, 2010-2022). Therefore, one of the most important components in the field of water resources management is the determination of the biological minimum. It is necessary to seasonally define this parameter on the Ukrina River, with the aim of preserving the entire ecosystem and diversity of the river, including Ephemeroptera.

In addition to the possible impact on the endangerment of biological minimum, fish ponds AD "Ribnjak" Prnjavor and "Sijekovac" in Bosanski Brod, as emphasized, can potentially cause the phenomenon of water eutrophication. Due to fish feeding, a large amount of organic matter is introduced into fish ponds, which is not fully

used, but it mineralizes. Dead organisms, which previously developed in the pond, are subject to the same process. During the discharge of water from the fish ponds, an increased amount of mineral substances is introduced into the ecosystem of the Ukrina River, as well as organic matter, which is subject to further mineralization. In conditions of increased content of mineral substances, primarily phosphates and nitrates, eutrophication occurs, that is, primary production increases. Biological and biochemical processes are suddenly intensified and take place along the entire depth of the water layer. By increasing the primary production, phytoplankton and macrophytic vegetation develop profusely. This causes an increase in the population of cenobionates in food chain links until the moment when the increased amount of organic matter does not begin to significantly affect the oxygen regime. The amount of dissolved oxygen in the river ecosystem depends on the relationship between the process of photosynthesis and oxidation of organic matter, which mainly takes place in the river bottom. In conditions of increased decomposition of organic matter, the amount of O₂ decreases sharply, especially with the depth of the water, and at the very bottom it can even completely disappear. In contrast, in the deeper layers, the amount of CO₂ increases sharply. The water takes on a yellow-green to brown color. At this stage, increased primary production adversely affects all cenobionts within the river ecosystem and causes imbalance in the circulation of matter. It is necessary to work on preventing of the mentioned processes, with the aim of preserving the entire diversity, as well as the ecosystem of the Ukrina River.

In the Ukrina River, pollutants come from natural and anthropogenic sources. Natural sources of pollution are caused by various excessive situations, when dangerous pollutants can enter the river ecosystem. Climate change is associated with extreme droughts during which, as emphasized, the flow of water decreases, but also with floods that cause eutrophication (Šarčević-Todosijević et al., 2019). The main anthropogenic sources of sometimes very dangerous pollutants in the Ukrina River basin are municipal wastewater, industrial wastewater and agricultural water. Municipal wastewater, in all municipalities belonging to the Ukrina River basin, is discharged into the river without treatment, and significantly reduces the capability of natural autopurification and poses a threat to cenobionts. These waters often contain dangerous substances; inorganic and biodegradable and other organic substances, as well as microorganisms. The composition and degree of pollution of municipal wastewater is estimated according to the amount of substances in suspension, the amount of dissolved substances and the biological oxygen demand (BOD₅). Wastewater loading, expressed through the value of BOD₅, in the Ukrina River, on the territory of the Derventa municipality, is 18 mg O₂/l, but this value varies because it depends on a number of factors. The percentage of BOD₅ increases in the summer months and at low water levels, which indicates a relatively high level of pollution in that period. The values of this parameter also increase with the increase of the industrial wastewater content in the effluent. The NH₄-N content in municipal wastewater is about 20-30 mg/l, and increasing nitrogen content may indicate presence of industrial wastewater. The pH value of municipal wastewater is 7-7.5, while the presence of toxic substances disables biodegradation processes (Đuković et al., 2000; Cvijan, 2000; Korene et al., 2005; Šarčević-Todosijević and Popović, 2019;

Šarčević-Todosijević et al., 2019). Agriculture and food industry (especially meat) are significantly represented in the municipalities belonging to the Ukrina River basin. Pollutants present in this water, whose BOD5 values are quite high, are mainly biodegradable organic compounds. The chemical industry in the area of the municipalities belonging to the Ukrina River basin mostly includes factories that process leather and textile fibers. Leather industry wastewater is characterized by increased dry matter content, increased hardness, increased salt content, sulfides, chromium, lime deposits, as well as increased BOD5. In the production of textile fibers, wastewater is highly contaminated with fatty substances in the emulsion. Textile dyeing factory emit small amounts of polluted water. However, these waters contain dyes and substances that interfere with biological processes (Đuković et al., 2000).

Although the cadastre of polluters in the Ukrina River basin is still under development, it is necessary, given that these sources of pollution pose a constant threat to the sustainability of the river ecosystem, as well as overall diversity, including Ephemeroptera, to conduct regular assessments of integrated water quality and control pollutant activities.

CONCLUSION

From the aspect of environmental protection, the preservation of rivers is especially important, not only because water is one of the three equally important components of the environment and is involved in basic life processes on Earth, but also because river ecosystems are real treasures of biodiversity. In this sense, the protection of the Ukrina River ecosystem is extremely important due to the rich species diversity and appearance of Ephemeroptera in the summer, which makes this river a locality of extreme natural rarity.

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UGROŽAVANJE BIOLOŠKOG MINIMUMA I EUTROFIKACIJA – FAKTORI REMEĆENJA EKOLOŠKE RAVNOTEŽE I ODRŽIVOSTI EKOSISTEMA RIJEKE UKRINE

Apstrakt

Rijeka Ukrina (Bosna i Hercegovina) je manja desna pritoka Save, čiji sliv leži između donjih tokova rijeka Vrbasa i Bosne. Pored toga što predstavlja relativno malo slivno područje, rijeku Ukrinu karakteriše izuzetna biološka raznovrsnost. Biološkoj raznovrsnosti rijeke Ukline doprinosi i pojava vodenog cvijeta (Ephemeroptera) u ljetnom periodu godine, što je čini lokalitetom odvijanja ove prirodne rijetkosti. U ovoj studiji, razmatraju se ugrožavanje biološkog minimuma i eutrofikacija vode kao glavni faktori remećenja ekološke ravnoteže i održivosti ekosistema rijeke Ukline.

Ključne riječi: *rijeka Ukrina, polutanti, eutrofikacija, biološki minimum*

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