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Proceedings of the International Forum on Climate Change and Sustainable Development: New Challenges of the Century



September 9–11, 2021

in terms of the Visegrad Project #22110149

Petro Mohyla Black Sea National University,
Mykolaiv, Ukraine



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Proceedings of the International Forum on Climate Change and Sustainable Development: New Challenges of the Century present abstracts of the reports of the forum, which had place on September, 9–11, 2021 at Petro Mohyla Black Sea National University, Mykolaiv, Ukraine in terms of the Visegrad project #22110149.

The proceedings cover such questions as: strategy of sustainable development as a road map of civilization; sustainable development of territories; sustainable use and protection of flora and fauna; environmental biochemistry, physiology and medicine; food technology in the context of sustainable development; monitoring of the atmosphere, hydrosphere and climate management; circular economy; rational use of water resources and wastewater treatment; rational use of land resources and reclamation of disturbed lands; environmental education for sustainable development.



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Software for Rapid Assessment of the Reservoir Radionuclide Contamination According to Environmental Safety Principles

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The use of water reactors at NPPs requires their cooling by surface water and the creation of technological reservoirs (cooling-ponds, bio-treatment rates), which causes changes in the ecosystem of freshwater reservoirs in the NPP area. It requires the development of environmental standards of allowable pollution levels for human safety and biota operational solutions and recommend effective preventive countermeasures to protect them. Based on the use of basic radionuclide and basic radiation characteristics the theory, the method of operative assessment of the reservoir near the NPP area radionuclide contamination was developed. This method allows rapid assessment of the value of characteristics for which limitations of radiation-hygienic (effective dose of human exposure) and environmental (radionuclide content in the biota of bottom sediments) safety principles are known. This will allow making rapid decisions and recommendations of preventive countermeasures to protect biota and the population that uses the ecosystems of such freshwater bodies for living, production and recreation.

A calculation program for the assessment of radionuclide contamination of freshwater reservoirs according to radiation-hygienic and ecological safety principles was developed. The software is developed using technologies HTML5, CSS3, Java Script, jQuery, Bootstrap4.

The developed program allows to assess the dose load on the population from the inflow of radionuclides to humans and to assess the ecological and radiation status of the reservoir on the ecological principle.

The State and Ways of Preserving the Population of *Marmota Bobak* in the Mykolaiv Region

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The problem of conservation of steppe marmot (*Marmota bobak*) for the fauna of Ukraine at the beginning of the XXI century is very acute and deserves special attention [1]. Possibilities of natural settlement of this species are extremely limited. The main reason is the destruction of habitats: plowing and afforestation. Due to the fact that the level of agricultural land in the Mykolayiv region reaches 85%, it is important to preserve the last pieces of steppe in order to maintain the ecological balance of the steppe ecosystem. In recent years, climate change has become an extremely important factor, affecting the survival of a number of steppe species, including *Marmota bobak*. At the state level, the Ministry of Environment in January 2021 updated the list of animal species listed in the Red Book of Ukraine. Among them are *Marmota bobak*. The state of the population of this exclusively steppe species in the Mykolaiv region should be defined as critical. Previous attempts to restore the marmot in the area during 1980-2000 ended in a series of failures. Only one colonial population is known in the north of the region near the village Syrove, which is divided into 15 family plots and can number up to 50-70 individuals. On the slope of the valley with an area of about 20 hectares there are 240 residential burrows of all types. Adults, often with babies, are observed near some burrows. The colony is characterized by stability for at least 15 years. The creation of a zoological reserve will allow preserving the valuable population of *Marmota bobak*, as well as steppe typical plant species, habitats of steppe fauna. This colony under effective protection can become a center for further reintroduction of *Marmota bobak* to other steppe areas of the region.

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Proper Management of Invasive Canadian goldenrod

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Solidago canadensis L, originating in North America, is nowadays found to be one of the most widespread invasive neophyte in Central and Eastern Europe. Although the impact of Canadian goldenrod invasion on the local ecosystems is still not absolutely clear neither it is unequivocal. Doubtless, there is a need of its regulation, since the regular mowing is found to be one of the best control methods. On the other hand, as the Canadian goldenrod dispose with several biologically valuable features: contents of proteins, lipids, saccharides, vitamin C, total carotenoid and amino acid represent valuable products for bioeconomy; major compounds of essential oil extracted from Canadian goldenrod are used as a constituent of phytoterapeutic drugs for chronic diseases treatment and account antioxidant, antimicrobial and antifungal activity; essential oil contains constituents generally found to be responsible for essential oil repellency, equally, EO was confirmed to account phytotoxic potential; leaf extract contains secondary metabolites that can act both as reducing and as stabilizing agents in the green synthesis of triangular and hexagonal gold nanoparticles (AuNPs). In our study, morphometric parameters were determined on the material of *S. canadensis* collected from twelve sampling stands at five sampling terms, and our results indicate the term within the growing season, when the highest amount of the usable biomass could be obtained simultaneously with aim to keep the population of invasive neophyte under control. A combination of the regular harvesting with consecutive utilization of Goldenrod biomass seems to be the best management purpose of the invaded plots.

Modern Technologies in Solving Environmental Problems of the Milk-producing Industry

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According to the views of European scientists, milk production – a pyramid whose base are the volumes of whey processing, the upper layers of technology at various levels, from the traditional to the membrane, the peak of the pyramid – specific extraction and fractionation. There is growing interest in the processing of whey in the first place it refers to the deep processing of whey by membrane technology [1, 2], which generates products such as therapeutic drugs.

In recent years, milk production trend towards the use of membrane technology [3–5], which will expand the range of dairy products and lead to fundamental changes in approach to the processing of whey.

The use of electrodialysis allows solving the important problem of whey demineralization by 70-80%, as a result of which curd whey can be successfully used in the production of baby food, ice cream, drinks etc.

Despite the fact that daily large volumes of whey are generated at the enterprises, until the issue of their complete recovery is resolved, it is poured down the drain, which, on the one hand, complicates the ecological situation in the region, and on the other hand, the profitability of dairy production decreases.

Every year 80000 tons of cheese, cottage cheese and other dairy products are produced in Georgia. 1 ton of spilled milk whey equals 100 m³ of household wastewater contamination. The research was carried out on cottage cheese and cheese whey. The serum was purified by ultrafiltration in a circulation mode on polyamide hollow fibers, demineralization was carried out by the method of classical electrodialysis on ion-exchange MK-40 and MA-40 membranes.

The optimal parameters of the process have been determined: the dependence of the process productivity (W) on concentration, time and pressure.

A complete chemical analysis of whey concentrates was carried out for the content of fat, protein, water, lactose, and also its density and electrical conductivity were determined (fig. 1). The possibility of concentrating serum by membrane methods has been established.

It turned out that in the first 20 minutes the productivity of the ultrafiltration process drops sharply, then it grows, reaching a maximum at $P = 1.4$ atm and remains constant (fig. 2).

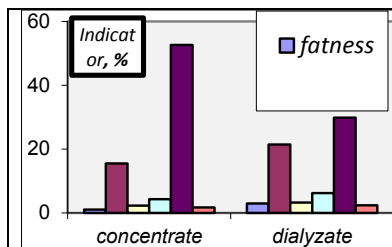


Fig 1. Demineralization of cheese whey by electro dialyses

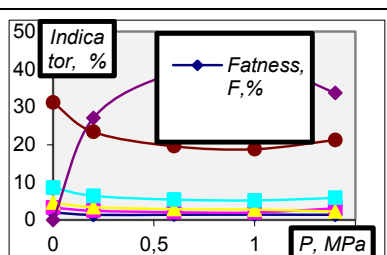


Fig 2. The dependence composition and indicator of cheese whey on the applied pressure

It was found that the degree of purification and concentration of cheese whey is higher than that of curd.

Based on the analysis, it was found that the composition of the concentrated cheese whey depends on the pressure: when the pressure rises to the maximum, the concentration of lactose and protein in the concentrate increases by 29 and 30%, respectively, conductivity by 29.8% and density by 22.5%; the water content is reduced by 58%.

When concentrating cheese whey, all indicators of the concentrate are lower than that of curd, in particular, when concentrating, the content of lactose (20.2%), protein (12.4%), electrical conductivity (16.5%) and density (18.7%) increases; the water content is reduced by 26.6%.

It was found that all indicators in the dialysate, except for the water content, are higher than in the concentrate.

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Prospects for Assessing the State of the Aquatic Ecosystem by the Number of Kairomones of Predatory Fish

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An important and poorly studied component of aquatic ecosystems is their chemical landscape. The peculiarities of its formation by aquatic organisms and "reading" of this environment are only beginning discovering [1].

It is known that most of the kairomones released by fish can be characterized as non-volatile compounds of non-protein nature and low molecular weight. In particular, the kairomones of *Leucaspis delineatus*, *Carassius carassius* and *Rutilus rutilus* are non-alkeinic anions of low molecular weight and medium lyophilicity. Accordingly, the concentration of non-alkein anions in water can be judged on the biomass of aquatic predators and interpret these data when calculating the total biomass in the ecosystem [2]. And the obtained data, in turn, allow to characterize the state of the aquatic ecosystem and the sustainability of the flow of ecosystem services, in particular by calculating the energy niche of the species.

Thus, the concentration of low molecular weight non-alkein anions in river water is measured by chemoreception or mass-spectrometry simultaneously with pH fixation and compared with the results of a field experiment by measuring this concentration for control representatives of the main genera inherent in the reservoir at different pH levels. After that, based on the calculation of the energy balance in the food chain of the ecosystem, it is possible to determine the energy niches of producers and consumers. Since humans are among the latter, this approach allows to justify the limits of biological resources from freshwater terrestrial ecosystems.

Thus, it is possible to abandon the monitoring of aquatic ecosystems by the method of control catches of aquatic organisms, and to develop ecosystem approach to nature management by developing methods of identification of kairomons inherent in different species.

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Optimization of the Structure of Atmospheric Air Monitoring System

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The automatic station AirFreshMax installed on the central case of NULES determines in real time concentrations of fine dust (PM_{2.5} and PM₁₀), CO, NO₂, SO₂, NH₃, O₃ and RAD, and also indicators of temperature, pressure and humidity. The conducted researches allowed to develop the automated system of monitoring of atmospheric air which consists of subsystems of administration and visualization. The administration subsystem manages the work of the database of the results of monitoring researches of a condition of atmospheric air. It was possible to automate the processes of collection, storage and analysis of the whole set of indicators of various stations from the public monitoring network (Eco City, SaveDnipro, luftdaten, AirVisual, etc.). The visualization subsystem provides visualization of the obtained data and provides an opportunity to view them, compare indicators from different stations, generate reports for a certain period in terms of different air monitoring stations. The architecture of the data processing system is shown in figure 1.

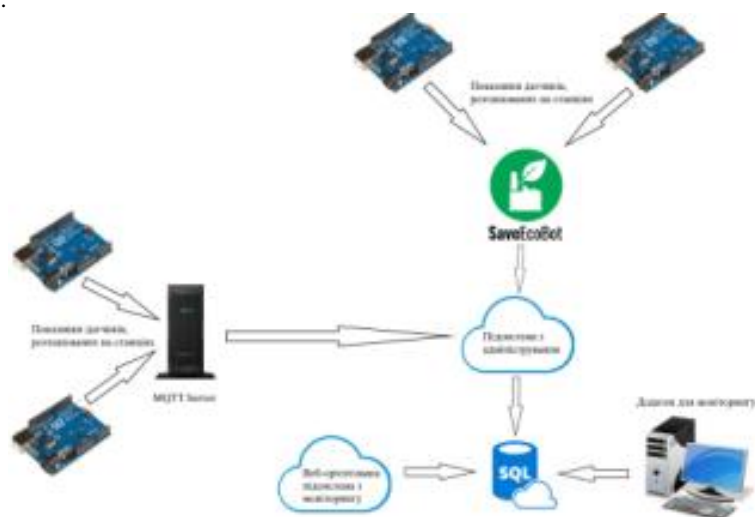


Fig. 1. General architecture of the data processing system.

The Role of Automation in Ensuring the Involvement of Local Communities in Sustainable Development

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Discussions on sustainable development often focus mainly on the environmental and economic dimensions. The role of social and cultural factors is not always well recognized. It is important that “sustainable” actions are carried out not only by eco-activists and formal representatives of the authorities for accountability, but by local communities in general. In our opinion, regional sustainable development should be organized in such a way that it increases the involvement of citizens in the processes of improving society.

- Global climate change leads to such risks for life and health of the population in the south of Ukraine as heat waves and unexpected frosts, and also causes the need for reliable information to the public about unfavorable days for picnics in the forest. This requires continuous improvement of meteorological monitoring networks.
- Global measurement systems as well as local measurements conducted by citizens help to create a more accurate temperature field, which is necessary to determine the climate characteristics at points where professional actinometrical observations are not carried out [1, 2]. In the future, this will allow the creation of more accurate models for predicting emergencies and climate change.
- The popularization of portable electronic devices and systems for monitoring environmental parameters among the population will allow people to feel involved in the processes of monitoring and managing condition of environment and climate change. In addition, it will speed up the response to disasters, as people will be more quickly aware of sudden releases of hazardous substances, and car owners will be able to evacuate themselves. However, this requires further research and development of a response methodology, when implemented, in order to prevent panic among the population.

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Local History Series of Popular Science Publications «Green Pages of Mykolaiv Region History»

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“Green Pages of Mykolaiv Region History” series was founded in 2014 by the Center for Ecological Information and Culture together with an initiative group of historians, ethnographers, librarians, and ecologists with the support of the Department of Environmental Protection and Improvement of the Mykolaiv City Council Housing Department in order to raise public awareness about the history of the region.

The series is dedicated to outstanding scientists who have made a significant contribution to the development of nature science of Ukraine, preservation and promotion of natural resources of the region; historical figures who contributed to the increase of green heritage and beautification of our land; beauty and healing power of native nature, which is praised in the poetry of local poets. To date, four collections have already been published.

From the pages of the books in the series, readers will learn about the intense activity of our compatriot, prominent scientist and conservationist O.A. Yanata. Furthermore, in the second book of the series, they will find out about the great deed of the remarkably talented people of that time, G.O. Potiomkin, M.L. Falieiev, and other outstanding people of that period - the creation of a green oasis of our city in the middle of the steppe, dried by extreme heat and strong winds. The reprint of the book by J. Ettinger "Gardening of Mykolaiv, Kherson province and its outskirts" (1897) on the pages of the series became a scientific accomplishment of our city. A real gift for lovers of poetry was the anthology "Green Book rustle", which presents selected poems of poets, whose fates are somehow connected with Mykolaiv region, with its unique nature.

The creative group of a series of editions “Green Pages of Mykolaiv Region History” is currently doing research into the subject of activity of Mykolaiv nature lovers society - a scientific circle which was founded and worked in our city in the beginning of the 20th century (1908-1917) and played a significant role in the development of education, science and culture of southern Ukraine in particular and in the history of Ukrainian science in general. The research is aimed at the composing a new 5th collection of materials.

Assessment of the Thermal Comfort of People for the Equivalent-Effective Temperature in Mykolaiv

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One of the main components of the normal functioning of the body is thermal comfort. A known indicator that allows you to assess the thermal state of man, taking into account the simultaneous effects of air temperature, relative humidity and wind speed is the equivalent-effective temperature (*EET*) [1].

$$EET = 37 - (37 - T)/(0.68 - 0.0014\varphi + 1/(1.76 + 1.4v^{0.75})) - -0.29(1 - \varphi/100)$$

mean T – air temperature, °C;

φ – relative humidity, %;

v – wind speed, m/s.

On the basis of the processed meteorological indicators for the period of June of 2021 in the city of Mykolaiv, calculations for definition of zones of comfort are carried out (Figure).

The presented table delimits the zones of thermal comfort. In summer the temperature from 17.3 to 21.7 is considered comfortable. Below 17.3 – cooling zone. Above 21.7 – overheating zone.

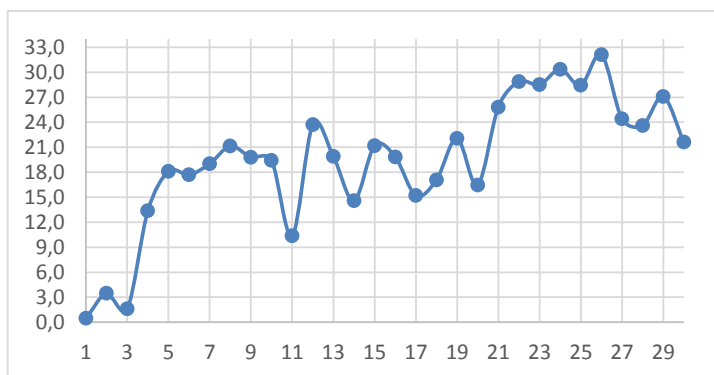


Fig. 1. Equivalent-effective temperature for June

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The Role of Forests in Regulating the Water Regime of the Territory

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The rapidly growing shortage of fresh water on earth makes the search for ways and means of a more complete and rational use of water resources as a priority task. One of the most important functions of the forest is water regulation. The forest regulates the intra-annual distribution of runoff, reducing the peak of floods, increasing the water content of rivers during the low-water period, and reducing the slope runoff [1].

The hydroecological role of the forest is manifested, first of all, in the regulation of the hydrological regime of water bodies. The water regulating function of the forest is ambiguous in space and time and depends on many factors, such as the area and nature of the location of the forest on the catchment, the structure of plantations, climatic features of the area, the degree of anthropogenic transformation of the catchment, and others [1, 2].

In general, forest ecosystems are one of the most important links in water circulation in watersheds and factors of its regulation. In a targeted impact on this link lies a real way to solve important water management problems, including increasing the flow, including the most valuable underground, improving its qualitative composition. It is required to sharply increase attention to this problem.

Tentative economic calculations show that through a targeted influence on the hydrological functions of forests, it is possible to obtain a tangible economic effect and solve large-scale water management tasks, comparable in importance to the effect of large hydraulic structures. Solving these problems requires combining the efforts of various departments, primarily forestry and water management, and a sharp increase in attention to the problem on the part of scientific, design and production organizations.

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Prospects for the Development of Solar Energy in Ukraine

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Solar electricity could cover a quarter of the world's electricity needs by the middle of the century, becoming the second largest source after wind. Global capacity could exceed 18 times the current capacity by more than 8,000 gigawatts by 2050 [1].

According to official IRENA data from April 4, 2021, the total capacity of solar power plants in the world in 2020 increased by 21.6% - up to 714 GW. In particular, all European countries (including non-EU countries) in 2020 increased the capacity of solar power plants by 14.5% - up to 163.5 GW. In terms of total capacity (7.33 GW), Ukraine ranks 6th in Europe, second only to such industry leaders as Germany (53.8 GW), Italy (21.6 GW), Spain (14 GW), and France (11.7 GW) and the Netherlands (10.2 GW). According to the growth rate of the solar energy sector in 2020, Ukraine is in 4th place with a rate of + 23.5%. According to the IB Center, in 2021 the total investment in solar energy projects may exceed \$ 80 billion globally.

The European Union has set itself the goal of obtaining 32% of energy from renewable sources by 2030. As of 2020, the share of renewable energy in the EU is about 20% [2, 3].

In 2017, Ukraine adopted the Energy Strategy of Ukraine, according to which by 2035 Ukraine plans to increase the share of renewable energy in its energy balance to 25%.

As of the end of November 30, 2020, there are more than 27,000 families in Ukraine who have installed home solar power plants.

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Environmental Monitoring as the Main Sustainable Development Achievement Tool of the Area of Influence of Mining and Chemical Enterprises

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Studying the current state of achievement of sustainable development goals and effective ways of transition to sustainable development is important for both research and practical needs, as it allows to live in a stable ecosystem. Research on the ecological part of development needs special attention in this issue.

The purpose of the work is to substantiate a systematic approach to analyzing the state and ensuring the goals of sustainable development in the area of influence of mining and chemical enterprises.

As the problem of non-implementation of projects of reclamation and remediation of the territories disturbed by mining and chemical activity still remains acute in Ukraine, it is no less important to ensure sustainable development of the territories of influence of mining and chemical enterprises.

It is researched and established that ecological monitoring is an important tool for improving the state of ecological safety of the territories of influence of mining and chemical enterprises [1]. But still, the system of environmental monitoring as an important component of the system of public administration in the field of nature management, ecological safety, formation of the state policy of sustainable development, fulfillment of international obligations of Ukraine in the field of nature protection needs fundamental improvement.

The main reasons for the problems of the environmental monitoring system are the imperfect legal framework, low level of coordination of environmental monitoring entities, low level of informational and educational activities, insufficient funding, including from extrabudgetary sources, outdated instrumentation, and technical base of entities of ecological monitoring, etc [2].

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Phytochemical Study of the Invasive Plant Species *Fallopia japonica* Populations from Different Climatic Regions of Slovakia

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Climate change is accompanied by changing temperatures, moisture regimes and extreme climatic events. They operate universally, but thanks to several specific genetic mechanisms, invasive plants are generally better equipped than native plants to adapt well and relatively quickly to them [1]. *Fallopia japonica* (Houtt.) Ronse Decr. is a perennial dioecious herb with an extensive and richly branched rhizomes, which produce allelopathic substances. It naturally occurs in East Asia, where it has long been used as a medicinal plant [2]. The population in Central Europe belongs to a single female genotype. In Slovakia it inhabits human-made, semi natural as well as natural habitats [3]. The invaded stands are mainly riparian shrubs and grasslands, preferably in humid habitats. Due to rapid growth and large biomass production, it eliminates native vegetation. In addition, it affects the chemistry of the soil, which can have an impact on soil organisms. The aim of this work was to examine in detail the phytochemical profile of *Fallopia japonica* both in terms of intraspecific diversity and in relation to habitat conditions. A total of 27 samples from 9 localities within the three climatic regions of Slovakia were evaluated. As shown by HPLC-DAD-ESI-MS/MS analysis, the dominant components of the shoot extracts are polyphenolic compounds such as phenolic acids and flavonoids (glycosides of quercetin, apigenin and luteolin), to a lesser extent procyanidin and catechin derivatives are present. The results of preliminary *in vitro* tests using a model organism, the *Tubifex tubifex* worm, indicated strong anthelmintic effects of the extracts.

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Environmental Differences in Endometriosis

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Retrograde menstruation of endometrial cells into the peritoneum is the most widely accepted theory, that explain the origin of endometriosis. However, this phenomenon occurs in approximately 90% of women while the prevalence of endometriosis is much lower. Other factors are thought to contribute to the development of the disease, including environmental factors. Endometriosis is a common, benign, estrogen-dependent gynecological disease that represents one of the main causes of hospitalization in industrialized countries. Humans are daily exposed to a large amount of natural and man-made chemicals that could adversely influence physiological processes and potentially cause diseases, including endometriosis. Geographical, regional, and environmental factors may influence the manifestation of the disease but may also play an important role in the chosen method of diagnosis and treatment of endometriosis. In our study, we found significant differences between Košice and Prešov region in stages of endometriosis ($p = 0.0000$), in clinical symptoms associated with endometriosis ($p = 0.0044$), as well as in methods for disease diagnosis ($p = 0.0000$). We need to better understand the mechanism of action of environmental pollutants, not only on reproductive health, but also on overall health of individuals.

Quality of Surface Water and Fish Resources in Climate Change Context (The Ustya River Basin Example)

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Freshwater ecosystems of almost all rivers in Ukraine have undergone significant anthropogenic impact, which reflecting some global changes in inland waters – pollution, habitat degradation (including fragmentation), over-exploitation of fish, introduction of non-native species etc; the impacts of climate change will interact with many of these factors [1]. It is established that average increase in the surface water temperature of the Ustya river basin (a tributary of the Horyn River, Pripyat basin) is 1 °C during 2013-2020. Assessment of surface water quality according to I_e index showed that the waterbodies belong to the III-IV quality classes and characterized as “slightly polluted” – “moderately polluted” – “dirty”, by data 2009-2018. There was a significant excess of standards for the content of nutrients, in particular phosphates and ammonium nitrogen – up to category 7, the water very dirty. During 2011-2019 annually there were fish kills due to a sharp decrease in dissolved oxygen in conditions of organic pollution and water temperature increase – the loss of fish resources amounted to more than 400,000. Pathogens of protozoan, helminthic, mycoses and crustacean diseases in fish have been registered on the most common species – *Rutilus rutilus* and *Carassius gibelio* in the river basin. There was also an increase in low-quality fish – from 18 to 21% by the state standard of organoleptic quality [2]. If measures are not taken to reduce anthropogenic pressure on the aquatic ecosystems, we will lose fresh water supplies as well as sources of fish resources, the quality of this fish will continue to deteriorate, up to a direct threat to health.

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Bottom Sediments of Reservoirs as a Source of Greenhouse Gases

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Greenhouse gases can be emitted to the atmosphere by many complex processes of physical, chemical, or biochemical nature [1], as shown in Figure 1. This paper describes results of a study of greenhouse gas emissions from selected five reservoirs in southeastern Poland [1, 2, 3, 4, 5, 6]. For this purpose, fluxes of methane (CH_4) and carbon dioxide (CO_2) at the sediment-water interface were analysed for the years 2009-2012. Fluxes of CO_2 and CH_4 at the water-air interface were measured using the "static chamber" method. The results indicate that not only water bodies in the tropical zone, but also objects located in the temperate zone can be a source of significant amounts of greenhouse gases.

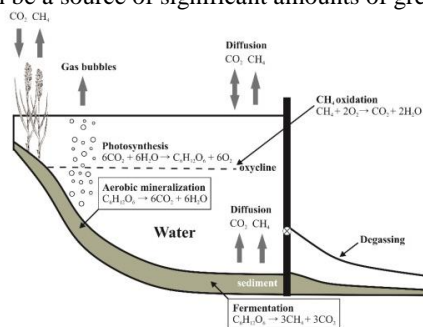


Fig. 1. Production and transportation pathways of CH_4 and CO_2 in a reservoir [1]

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Plant Invasions Affecting by Climate Change and Study of Alien Species Biological Activities

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The increase of the number of invasive taxa and the increased rate of their spread have been recorded especially in the last three decades. These plant species have previously come from Asia and America as ornamental or honeybee plants. Invasive plant species are often very aggressive to original species resulting in considerable economic damage, biodiversity loss, and influence on human health. Global climate change results in species invasions which cause two of the greatest threats to biodiversity and ecosystem functioning. The mechanism underlying the interaction between climate change and biological invasions, however, remains unclear. In November 2014, the European Union published a new Regulation on Invasive Alien Species as foreseen under target 5 of the EU's Biodiversity Strategy to 2020. A priority under the EU Biodiversity Strategy to 2020: Target 5: „Combat Invasive Alien Species.“ The aims of our study were: (1) monitoring of non-native plant species occurrence in Slovakia; (2) study their secondary metabolism and (3) to test different phytochemicals for their potential biological activities as eco-friendly herbicides. *Solidago canadensis*, *Solidago gigantea* and *Heracleum sosnowski* were investigated as a dominant non-native plant species. There were found specific concentrations of essential oils, which affected seed germination and plant growing of both types of plants – monocots and dicots. Experimental findings may uncover one of the possible mechanisms of their successful spreading in new areas.

Climate Change and Human Exposure in Modern Conditions

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In everyday life, a person is exposed to ionizing radiation from natural and man-made natural sources, as well as from artificially created sources of ionizing radiation. According to modern information in the structure of human exposure, the vast majority falls on natural sources of radiation, which form a natural radiation background. This background is formed due to cosmic radiation, cosmogenic radionuclides, radioactive elements of the earth's crust, building materials, water, air, food, as well as radioactive elements that are part of living organisms. The predominant amount of natural radioactive substances (^7Be , ^{10}Be , ^{35}S , ^{32}P , ^{33}P , ^{21}Na , ^{22}Na , ^{14}C , ^3H), which occur during the interaction of cosmic radiation with atoms of chemical elements of air, is formed in the stratosphere, with the main cosmogenic factors of human external radiation - ^7Be , ^{10}Be , ^{21}Na , ^{22}Na , and cosmogenic factors of human internal irradiation - ^3H and ^{14}C . From natural sources of radiation a person receives an effective radiation dose of an average of 3.5 mSv/year.

Climate change and increased solar activity, which we have seen significantly in recent decades, may affect the level of human exposure to cosmogenic natural radionuclides.

The relationship between climate change, solar activity and the intensity of cosmogenic factors in human exposure needs to be studied. The southern region of Ukraine is marked by the emergence of granite layers to the surface, as well as numerous enterprises for the extraction and processing of granite for both construction and uranium production, which leads to man-made changes in the natural background and, as a consequence, creates an additional burden on humans from man-made sources of natural origin. Therefore, changes in the levels of human exposure to cosmogenic radionuclides can affect the level of total human exposure to natural sources.

Accumulation of Copper by Lawn Grass

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Contamination of natural ecosystems and agrobiocenoses by toxic metals, including copper, is a widespread environmental problem. Bioremediation is one of the promising methods of copper removal from contaminated sites [1]. Herein, the ability of lawn grass to remove copper was investigated. The aqueous solutions of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ were added into the soil with grown grass to the total Cu(II) concentration - 50 mg/kg. The fluorescence spectroscopy method [2] showed that the grass accumulated copper compounds in high concentrations (Fig.1).

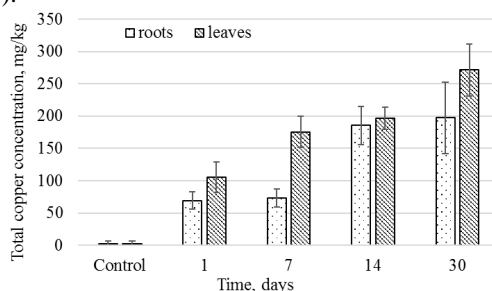


Fig. 1. Accumulation of Copper by lawn grass at the initial concentration 50 mg/kg of soil

Thus, the grass began to accumulate copper on the first day after the insertion of the copper solution. The concentration of copper in the roots and leaves (above-ground part) was 69.1 ± 13.2 and 105.2 ± 23.8 mg/kg, respectively. The concentration of copper in grass increased 2.9 times in the roots (197.2 ± 55 mg/kg) and 2.6 times in the leaves (271.4 mg/kg) after 30 days of growth in copper-contaminated soil. It was shown that lawn grass is able to accumulate toxic copper. The obtained patterns of copper removal can be used to develop technologies for bioremediation of contaminated sites.

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Ragweed and the Prevalence of Allergopathologies

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There are three types of ragweed in Ukraine: ragweed - *Ambrosia ambrosioides* L., ragweed - *Ambrosia trifida* L., ragweed - *Ambrosia aptera* DC. Most often sensitization is caused by ragweed [1]. It is known that the flowering season of ragweed is associated with a period of high risk of exacerbation of allergies, including asthma. *Ambrosia* blooms in Ukraine from the second half of July to mid-autumn. A preventive approach to asthma management is very important during the COVID-19 pandemic [2]. The major allergen of ragweed is Amb a 1, which is also capable of cross-reactivity. In particular, 40% of children in the Mykolaiv region with allergopathology are sensitized to weed pollen. Ragweed occupies a leading place among all pollen allergens [3].

Increasing the concentration of carbon dioxide in the air, global climate change contribute to the prevalence of ragweed and increase the volume of it's pollination. According to studies conducted by Peter Wayne, Susannah Foster and others [4]: "A doubling of atmospheric CO₂ concentration stimulated ragweed-pollen production by 61% (P = 0.005)". Over the years, there has been a steady trend to increase the prevalence of ragweed in Ukraine, in particular due to climatic and environmental and administrative factors. Climate change contributes to the prevalence of ragweed. Accordingly, the number of patients with allergy pathology associated with ragweed sensitization is increasing. The problem of ragweed allergy is growing every year.

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Environmental Safety of Wastewater Disposal - Factor of Sustainable Development of Cities

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The environmental safety of wastewater disposal systems – one of the life support systems for a population, is a condition for sustainable urban development [1]. Gaseous emissions from such systems contain a number of highly hazardous substances [2-4]. The concentrations of hydrogen sulphide and formaldehyde – a hazard category 2 substances – in sewer network emissions and in the underroof space of sewer collectors by direct measurement and a calculation were experimentally investigated. It has been proved that the concentrations of hydrogen sulphide and formaldehyde in emissions from explored sewer shafts are many times greater than the maximum permissible concentration daily average for this compound: 663 times for formaldehyde and 188 times for H_2S .

The calculation of hydrogen sulfide dispersion, released from the sewerage pipelines, showed, that at some sections of the sewer net the environmentally safe area is at a distance of 225-260 m from the shafts.

Two technical solutions that have proven to be effective in the removal of hydrogen sulphide and formaldehyde were deemed promising for the effective extraction of this compound from emissions from sewer shafts: cooling of wastewater transported by water disposal networks and installation of degasifiers on sewer networks. Such technical solutions could significantly reduce the level of danger that such gaseous emissions from sewage networks pose for the urban atmosphere.

The interface of the page is designed with the monitoring parameters of the ecological safety and operating reliability at separate sections of the sewerage pipelines for the geoinformational system of the urban sewer nets

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Field Practice as a Tool for Sustainable Environmental Education. A Case Study in Alsó-hegy

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The aim of environmental engineering B.Sc. study is to give high level theoretical knowledges, practical skills, and ecological attitudes to the students. The field practices are crucial to gain appropriate skills among real conditions. Such a field practice helps also to develop teamwork abilities and problem solving attitudes. There are several karstic landscapes in Hungary, therefore it is important to show to environmental engineering students a karstic region during their summer practice.

The National Parks are excellent to study a closely natural landscape. The Aggteleki National Park shows several karstic phenomena including vertical caves, mostly in Alsó-hegy. The Alsó-hegy was chosen, for a one-day trip, because it has a well design observation path: vertical caves observation loop trail (Zsombolyos tanösvény).

This observation path presents well the surface karstic formations (karren fields, limestone quarries, dolines, sinkholes, springs). The subsurface formations were also studied during the field practice: vertical as well as horizontal caves, dripstone formations (stalagmites, stalactites, helictites and popcorns). Different strata and their characteristic features were recognized along the trip. During the field practice the vegetations were also studied, water chemistry and water flow volumetric measurements were also done. The anthropogenic effects were evaluated on the Alsó-hegy emphasizing the sustainability.

Aquatic Invertebrates of Phytotelmata on Plants of the Genus *Dipsacus*

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This post focuses on the small ecosystems of common teasel plant (*Dipsacus sylvestris*), which are often unnoticed and do not receive enough attention. Phytotelmata represent simple habitats with a number of taxa species, even though the common teasel is the only plant in Slovak territory, creating a true phytotelmata in leaves. This research did not discover the presence of the specific species of organisms dependent on this environment. Dominant invertebrates species from teasel were included in order Diptera: *Dasyhelea* and *Metriocnemus eurynotus*. From the samples, we have identified 1429 individuals of flies (Diptera). Because of their different life conditions, they did not compete in a common environment. Due to the significant influence of the abiotic conditions on life in the periodic waters, it is necessary to continue with the research and generalizing obtained results.

Acknowledgements

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Aquatic Invertebrates of Dendrotelmata in the Locality of Demjata (Slovakia)

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This post deals with insufficiently explored group of extreme habitats - dendrotelmata or water-filled tree-holes, defined as aquatic biotope emerging in trees' hollows. Dendrotelmata are habitats of various more or less specialized organisms, which are quite widespread but often overlooked. During our research (vegetation period 2018), we identified 1168 invertebrates individuals out of 44 litres of substrate (63 dendrotelmata). The most frequent was the beetle *Prionocyphon serricornis* with the number of 452 larvae. Abundant ones were also taxa of different Diptera families such as non-biting midges (*Metriocnemus cavicola*), biting midges (Ceratopogonidae), mosquitoes (*Aedes geniculatus* and *Anopheles plumbeus*), hoverflies (*Myathropa florea*) and others taxa. Summarized results from all samplings revealed that the largest diversity of taxonomic groups was recorded in locality C (median 4, minimum 2). Following localities were A, B, and D with the same median (3 taxa). The highest number of organisms has been found in dendrotelmata from small to medium-sized. By analysis of results and relationships between aquatic invertebrates of dendrotelmata and environmental factors we investigated that the area of the forest is the most significant from all analysed factors (forest area, volume and hole size of dendrotelma). Forest area influenced the taxonomic fauna composition of aquatic invertebrates in this environment during whole research. During whole research, the taxonomic fauna composition of aquatic invertebrates in this environment was the most influenced by above-mentioned factor of forest area. However, the dendrotelmata are very variable ecosystems, and it is necessary to give them increased attention.

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The Relative Risk of Thyroid Cancer Incidence: Overview and Statistics in Ukraine

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The primary purpose of this study was to present detailed information on the thyroid cancer incidence (TCI) among the males and females in Ukraine and to calculate the relative risk of this thyroid pathology during 2000-2016. According to the National Cancer Register of Ukraine, the increase in the TCI (per 100,000 population) among the population of Ukraine, male and female as well, within 2000-2016 was noted. The peak of TCI among the total population of Ukraine was in 2015 (8.7 per 100,000 population). The relative risk of TCI in each subsequent year, relative to the previous one, was higher from 2001 to 2008, from 2010 to 2013, and in 2015. Thus, the tendency to an annual increase of TCI in the total Ukrainian population was confirmed. The relative risk of TCI in 2016 compared to 2000 was noted. The highest incidence rate among the male population was detected in 2014 (3.6 per 100,000 population). In general, from 2000 to 2016, the TCI among the male population was increased by 2-fold (from 1.5 to 3.0 per 100,000 population). The relative risk of thyroid cancer among the male population of Ukraine in 2016 compared to 2000 was 1.69 ($p < 0.001$). There was a tendency to increased TCI among the females. The peak incidence rate was 13.4 per 100,000 population in 2015. An increase in the thyroid cancer incidence from 2001 to 2006, in 2008, from 2010 to 2013, and in 2015 compared to previous years was observed. The highest relative risk was recorded in 2011 compared to 2010 ($RR = 1.18$, $p < 0.001$).

In conclusion, these results suggest the need for primary prevention of cancer, taking into account regional peculiarities incidence and prevalence of cancer pathology, providing programs to environmental protection against carcinogens-induced pollution, the implementation of measures and training of the population to healthy lifestyle issues (rationale and optimal nutrition, rest, personal hygiene, smoking cessation, alcohol abuse, etc.).

Regional Characteristics of the Thyroid Pathology Among the Children Population in the Endemic Regions of Western Ukraine

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Lviv region in Ukraine, along with Volyn, Rivne, Ternopil, Ivano-Frankivsk, Zakarpattia, Chernivtsi regions, is one of the regions with a high degree of endemic iodine deficiency. In Ukraine, areas with partially expressed iodine deficiency, with moderate and mild iodine deficiency, as well as regions with sufficient iodine availability have been identified. The unequal degree of iodine deficiency within the Lviv endemic region based on the iodine content in the drinking water of settlements was also revealed. Regional peculiarities of prevalence, morbidity and relative risk in the incidence of thyroid pathology among children of 20 regions and 8 large industrial towns of the Lviv region through 2010-2016 were revealed. Reduction in the rates of prevalence and morbidity of thyroid pathology among children (781.9 in 2016 versus 985.5 per 10,000 population in 2010 and 80.4 versus 104.8 per 10,000 population, respectively) in 14 districts and 6 towns were established. The risk rates were higher in 2016 than in 2010 in five districts ($RR = 1.15$, $p < 0.001$, $RR = 1.06$, $p = 0.102$, $RR = 1.95$, $p < 0.001$, $RR = 1.05$, $p = 0.161$ and $RR = 1.06$, $p = 0.211$) and two industrial towns in the region ($RR = 1.12$, $p = 0.06$, and $RR = 1.04$, $p = 0.411$). Based on the quantitative assessment of iodine concentration in the water of districts and cities in the region, regions with different degrees of iodine deficiency have been determined. The relative risk in the incidence of thyroid pathology among the children of the Lviv region was higher in regions with high and moderate degrees of iodine deficiency compared to the average rate in the region and lower in regions with mild iodine deficiency. To reduce the risk of diseases caused by iodine deficiency in the endemic region, a differentiated approach to iodine prophylaxis has been suggested, taking into account the regional degree of iodine level and individual iodine intake.

The Introduction of a Closed Cycle of Household Waste Recycling Can Solve the Problem of Waste Disposal

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Today in Ukraine the problem of landfills is one of the most important and the most pressing among other problems of environmental pollution. This problem is so urgent not only in Ukraine, but all over the world, that there is even a saying "waste takes us by the throat" or "we are drowning in garbage". As the number of city dwellers and industrial enterprises grows, so does the amount of waste. Industrial and household waste creates many problems, such as transportation, storage and disposal. More than three thousand overcrowded landfills and tens of thousands of illegal landfills in Ukraine pose a danger to nature and people. Only the introduction of a closed cycle of household waste recycling will solve this problem. Actively and effectively using the creative developments of Zhytomyr (TOV SION), for the widespread implementation of their latest developments – universal boilers of the new generation "GRAND" with high efficiency and very low emissions $CO = 0-150 \text{ mg/m}^3$, etc. harmful substances. The fuel for these boilers is household waste, almost all, without exception. Importantly, the absence of smoke and odors, fuel humidity up to 65% without reducing the efficiency of the boiler. The use of new generation boilers "GRAND" allows: first, to dispose of burning waste; secondly, to receive additional thermal energy; third, to minimize the negative impact on the environment by destroying garbage, etc. economic, sanitary, hygienic, safety and social advantages. Instead of making a profit for an already poor country, millions of tons of waste poison the land, water and air. While Ukraine does not know what to do with billions of tons of garbage, Europe makes extensive use of waste in a variety of industries, earning a lot of money. After all, you can have a very good business in waste recycling. In developed countries, recycled waste has long been a full-fledged product of international trade. Thermal and electric energy are obtained from secondary raw materials. Sorting of household waste in Ukraine is still the prerogative of ordinary citizens and activists. Analysis of the problem of waste disposal shows the need for state support for the widespread implementation of the latest developments of Zhytomyr – universal boilers of the new generation "GRAND" with high efficiency and very low emissions of harmful substances.

Contaminated Bottom Sediments - Methods of Reducing the Environmental Impact

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Accumulation of excessive amounts of bottom sediment in rivers and water reservoirs reduces their capacity and depth and adversely affects the usability of the reservoirs. Accumulated sediments cause turbidity of water, are a place of deposition of pollutants and have a negative impact on water quality. Therefore, it is necessary to periodically remove sediments, i.e. dredging. The bottom sediments obtained after this treatment must be properly managed or neutralized so that they do not pose a threat to the environment and living organisms. Among the techniques of bottom sediment treatment, there are in-situ and ex-situ methods, both physical, chemical, thermal, biological and combined (Fig. 1). The paper presents the characteristics of bottom sediments in terms of the presence of pollutants and methods of their removal from excavated bottom sediments, as well as discusses the methods of management of excavated bottom sediments.

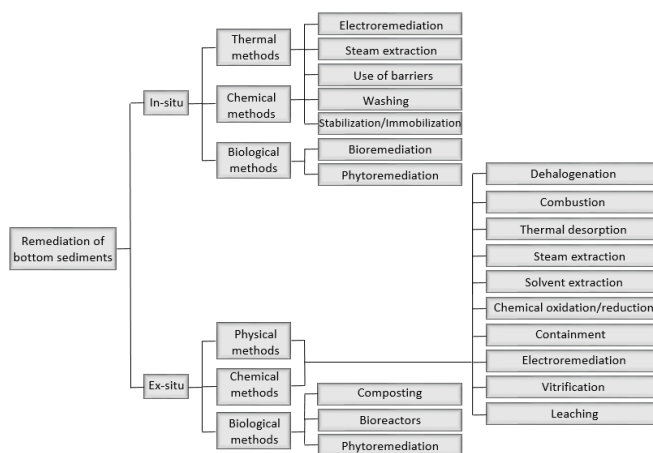


Fig. 1. Methods of remediation of bottom sediments [1], [2].

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Monitoring of Snow Cover at the Territory of Academic Vernadsky Polar Research Base

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During the 24-year (1997-2020) observation period, there is a clear tendency to shift the timing of beginning of the permanent snow cover formation to later, and its complete destruction – to earlier dates. If at the beginning of the studied period the formation of snow cover was observed in March, today it is stable in April. The average dates for the destruction of snow cover also shifted, although somewhat less – from the third decade of February to mid-February. As a result, we have a stable tendency to decrease of snow cover occurrence period in the study area.

The dates of the beginning of formation of the snow cover shifted most significantly. With a linear trend of 12.7 days over 10 years, a shift of 1 month occurred over a 24-year observation period. An analysis of dates of the maximum snow cover for the period under study also showed their shift to later dates. However, the dates of maximum snow depth as well as the dates snow thawing have shifted less significantly.

With the help of mathematical and statistical methods, we obtained the amplitudes and phases of harmonics of the intra-annual component of the snow depth, among which the next three were statistically significant – 57, 103 and 240 days. The first two harmonics are characterize the initial period of formation of the snow cover, and the third – the period of maximum increments of the snow mass (late July – early August). Analysis of the snow accumulation showed, that during the period from April to August are formed 6-8 stable layers (although in some unstable winters their number may be greater), the total height of which is about 250-260 cm. Because the layers are built by certain atmospheric processes, the dates of their formation from year to year are quite close. During the period of maximum snow growth (July-August) an avalanche-hazardous layer of insignificant vertical thickness is formed. The snow thawing time is characterized by 3-4 stable periods. All of the above mentioned us to make an assumption about the presence of significant changes in the very process of formation of the snow mass at area of Academic Vernadsky polar research base, which is manifested in changes in the height of the snow during 1997-2020.

The obtained results give a broad understanding of the properties of snow and the very process of snow accumulation in the study area.

Green Innovations in the Mining Industry

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Nowadays leading companies consider innovations and startups as the main driver of sustainable socio-economic development of our society. Startups have penetrated to all business spheres, including mining industry enterprises, which are very promising in terms of innovations because they have both environmental and economic issues.

So, we have proposed our own 'green' startup-project based on both the economic component – resource-conservation measures & technologies and on ecological components, in particular, on air quality.

The concept of the startup is to use mixed biofuels with biodiesel (BD) additives as a motor fuel for special vehicles of the mining enterprises and heavy trucks. Biodiesel component was obtained by an improved method [1] from production waste or from pure oil products.

The idea of this project was to find out the optimal content of BD in the mixed fuel composition in order to achieve the best ecological results and decrease the consumption of fossil fuels. So, the priority task of our 'green' startup was to obtain the best ecological results. It was found experimentally that BD content need to be ≤ 25 % vol. Positive changes in ecological parameters of tested diesel engine have been determined – the contents of CO and smoke in exhaust gases have decreased. The content of nitrogen oxides (in terms of NO₂) was quite ambiguous. If BD is added in a concentration of up to ~16 % vol. this indicator decreases by (5.5–11.3) %, but with a further increasing of the BD content it increased by an average of ~5.3 %.

In order to make our 'green' startup more competitive and successful we proposed a new approach to its marketing that is based on a conceptual combination of the theory of innovation marketing, industrial marketing, small businesses marketing and venture projects marketing and also integrating E. Ries's lean-methodology of startup realization. For making substantiated decisions on the expediency of startup realization two methods were developed such as T. Saaty's analytic hierarchy methodology and probabilistic-graphical modeling with Bayesian networks. So, we found that the expediency of our startup-project further realization is ~81.6 %.

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Adventive Plants of National Nature Park Buzkiy Gard During Climate Change

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National Nature Park Buzkiy Gard (NPP), 6138 hectares, is located in the north part of Mykolaiv region and in the north-west part of the Steppe Zone of Ukraine. It is very interesting botanical territory, there are 34 species of Ukrainian Red Book (2009) including some local endemics grow here. Two of them - *Moehringia hypanica* and *Dianthus hypanicus* - listed in Resolution 6 of Bern Convention.

There are about 900 species of vascular plants listed for the NPP [1], adventive plants – 190 species (21 %). The most of them are located in ruderal habitats. The main ways of expansion of adventive species are roads, recreation places, unnatural forests and the Southern Bug River (S. Bug). It flows through 4 regions of Ukraine for 600 km then flows through the NPP for 50 km. S. Bug brings plant seeds, so adventive species such as *Acer negundo*, *Amorpha fruticose*, *Echinocystis lobata* are very common on its banks.

During 1950-2015 the temperature in Pervomaisk and Vosnesensk increased [2] and the evaporation of water from the Bug increased as well. NPP is located mainly in the S. Bug canyon, so the local climate has become more humid. Then *Acer negundo*, *Robinia pseudoacacia*, *Armeniaca vulgaris*, *Ailanthus altissima*, *Grindelia squarrosa* occupy new territories. We plan to remove them each year for the conservation of the NPP natural habitats.

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Smoking and Male Infertility

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Semen quality in men is decreasing. Numerous chemicals act as endocrine-disrupting agents. In addition, cigarette smoke and their detrimental effect on fertility and spermatogenesis has been shown. Many studies have reported that the contents of cigarette smoke negatively affect sperm parameters, seminal plasma, and various other fertility factors. The effect of smoking on semen parameters is based on the well-established biological finding that smoking increases the presence of reactive oxygen species, thereby resulting in oxidative stress. Oxidative stress devastating effects on sperm parameters, such as viability and morphology, and impairs sperm function, hence reducing male fertility. Ours study deals with the arguable association between smoking and male fertility and also assesses the impact of smoking routes on male infertility. This study aimed to estimate sperm parameters (sperm count, motility and morphology) in infertile male smokers and infertile non-smokers in a selected population of Prešov and Košice region, (Eastern Slovakia). The subjects were categorized into infertile based on cut off values of sperm parameters as recommended by the WHO i.e., sperm count/ejaculate of $39 \times 106/\text{ml}$, sperm motility 40 % and normal morphology 4 %. Seventy infertile non-smokers and 75 infertile male smokers subjects were included in the study. Sperm concentration, motility, and morphology were significantly affected in smokers (**p<0.001).

Rational Land Use In The Land Management System

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The purpose of the article is to substantiate the role of rational land use in the land management system. The paper defines that the effectiveness of managerial influence on land use should be assessed through the prism of land use rationalization. It was found that the main condition for the rational use and protection of land is the organization of land management on a landscape basis. It is determined that the content of rational land use is to apply a set of investment and non-investment factors aimed at increasing soil fertility, their protection, increasing the number of products needed by society, improving its quality, increasing productivity. It was found that the rational use of land is to achieve the maximum effect in the implementation of strategic goals of land use, taking into account its full interaction with other natural and environmental factors. It is believed that an important role in achieving the condition of rationalization of land use belongs to land management, through which the condition of rational organization of the territory and location of production is achieved. It is noted that the development of land use development strategy should be based on such successive steps as establishing the types, species and number of crop rotations; placement of crop rotations; placement of crop rotation fields and working areas; placement of field protection strips; placement of field roads; location of field camps and water sources; placement of irrigation network. The goals and objectives of rational land use are defined. The main components that will affect the rational use of land are indicated.

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Environmental Education at the Faculty of Natural Sciences of Comenius University in Bratislava

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The study of Environmental sciences at the Faculty of Natural Sciences of Comenius University in Bratislava has the longest tradition in Slovakia. This research field can be studied in Bachelor's, Master's and Doctoral studies for more than 35 years, since academic year 2015/2016 also in English (Bachelor's studies). Sustainable development, biodiversity and landscape diversity are a key component in nature-oriented curricula. The presence or absence of sustainable development themes in the different subjects of two master's study programmes 1. Environmental Planning and Management, and 2. Landscape Protection and Land Use (currently Environmental Ecology) was evaluated [1]. The structure of their thematic focus was assessed based on the 14 themes defined by the UN Commission [2] – 1. Poverty, 2. Governance, 3. Health, 4. Education, 5. Demographics, 6. Natural hazards, 7. Atmosphere, 8. Land, 9. Oceans, seas, and coasts, 10. Freshwater, 11. Biodiversity, 12. Economic development, 13. Global economic partnership, 14. Consumption and production patterns, insofar as they are a synoptic representation of the pivotal themes of sustainable development. The analysis results showed that 20 out of the total of 41 subjects cover 7-14 (more than 50%) of the sustainable development themes. Environmental education is focused not only on local and regional issues, but also to a large extent on global issues. Students, together with their teachers, are involved in several international research and educational projects with the possibility of traveling and working at foreign universities. Graduates can participate in the solution of environmental problems, work in interdisciplinary teams, have the professional prerequisites for work in the field of environment. They can use not only the theoretical knowledge, but also the practical knowledge from working in the field, in laboratories, with databases and in creating maps. They apply the acquired knowledge in state administration, self-government, non-governmental organizations, or the private sector.

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Role of Fungi in Soil Carbon Sequestration

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Earth climate is the equilibrium between the amount and distribution of incoming radiation absorbed from the sun and the outgoing longwave radiation emitted at the top of the atmosphere. Atmospheric trace gases such as water vapour, carbon dioxide, methane, and nitrous oxide are greenhouse gases. Those gases absorb far more efficiently longwave radiation than solar radiation. The greenhouse gases increase the amount of energy available to the earth and keep it warmer than otherwise [1]. The radiative energy trapped by greenhouse gases is absorbed into the climate system, warming the lower atmosphere, and therefore the earth's average surface temperature in recent times is increasing. Carbon dioxide is considered a major anthropogenic greenhouse gas; its concentration is increasing as the result of both human activities and natural phenomena. [2].

Fossil fuels have drastically increased emissions of CO₂ during the 20th century. One of the primary sources of increase in the atmospheric concentration of CO₂ is also considered land-use change, e.g., deforestation and biomass burning, and conversion of natural to agricultural ecosystems [3]. One method for reducing the CO₂ concentration is carbon sequestration. Carbon sequestration implies transferring atmospheric CO₂ into long-lived pools and storing it securely. Soil fungi can enhance the rate of soil carbon sequestration through carbon assimilation from the atmosphere. These microorganisms assimilate carbon in their hyphae.

Clemmensen showed that a common group of fungi, the mycorrhizal fungi, can sequester carbon in the soil. In turn, carbon can be stored in the soil for a quite long time and therefore help to offset the release of greenhouse gases to the atmosphere. CO₂ are removed from the atmosphere by plants during photosynthesis, and then CO₂ is partly background to the roots and therefore transferred to mycorrhizal fungi [4]. These fungi consist of hypha and use carbon as a building block. When hypha dies, it is easily decomposed, and its carbon is stored as soil organic matter for a long time. The long-term storage of carbon in the soil so that the buildup of CO₂ in the atmosphere will be slowed down is known as carbon sequestration (Figure 1) [5].

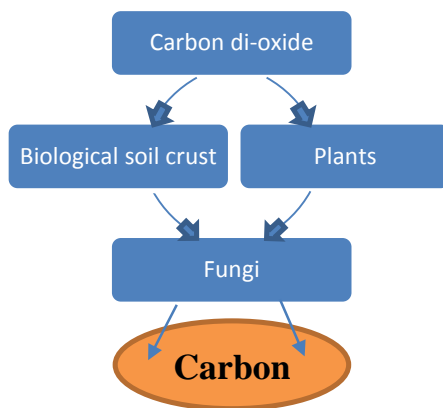


Fig. 1. Simplified method of carbon sequestration in soil organic matter by fungi

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Reclamation of Man-made Massifs with the Use of Bottom Sediments of the River, which Receives Domestic and Industrial Sewage

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Bottom sediments are one of the most objective and reliable indicators of the state of pollution of the aquatic environment and the overall level of man-made load on it. On the other hand, bottom sediments are an important component of the river ecosystem in which ecological pollutants accumulate and are retained. In the lower reaches of the Southern Bug River and in the Bug Estuary, bottom sediments are represented by highly organic silt, which can be used as an organic layer in the reclamation of man-made massifs, such as tailings of industrial enterprises [1]. The accumulation of ecological pollutants and radionuclides by bottom sediments of the Bug Estuary [2] and their contribution to the ecological and radiation capacity of the aquatic ecosystem have been studied. The bottom silt of the Bug Estuary in the area of the city sewage discharge in Mykolaiv, (in the village of Halytsynivka) is characterized by a high content of organic matter. It is proposed to use these bottom sediments to cover the aggressive surface of man-made massifs. For example, it will be useful to create an organic layer (Fig. 1) in the reclamation of the surface storages of red sludge, which is characterized by high alkalinity and cannot be reclaimed in the usual way.

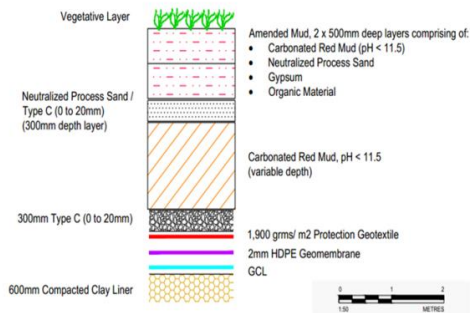


Fig. 1. Vegetation restoration technology

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Sustainable Use of Plants of the Lamiaceae Lindl Family in the Southern Steppe Zone of Ukraine under Climate Change Conditions

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Family Lamiaceae Lindl., or Labiatae Juss., includes 250 genera and about 7.9 thousand species, of which a significant number of species are grown as essential oil plants, in particular, narrow-leaved lavender, peppermint, clary sage, medicinal sage, rosemary, savory, lemon balm, nereta, Monarda, hyssop and others. Vegetable raw materials and essential oil are used in perfume, cosmetics, pharmaceutical, food and other industries [1]. In the context of sustainable development, one of the essential principles of an ecological lifestyle is the use of natural vegetable raw materials and essential oils for aromatherapy, hygiene, and treatment. Such areas as eco-tourism, photo shoots in the fields of essential-oil-bearing plants, ecological apiaries are gaining significant popularity. Along with this, essential oil crops have an important agroecological significance. In particular, two - or perennial essential plants can be grown on unproductive stony lands, they protect the soil from wind and water erosion, and they also can be used for phytomelioration and phytoremediation on anthropogenically altered soils [2-4]. Cultivation of essential oil crops provides an increase in biodiversity in agroecosystems, air purification from pathogenic bacteria by releasing essential oil with antiseptic properties, aesthetic beauty during the flowering phase, are valuable honeybees.

Analysis of biological features and adaptive potential of *Lavandula angustifolia* Mill., *Mentha x piperita* L., *Melissa officinalis* L., *Nepeta transcaucasica* Grossch. as well as the demand for vegetable raw materials and essential oil on the world market indicates the prospects for their cultivation in the southern steppe zone of Ukraine in the context of climate change.

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Eco-friendly Synthesis of Gold Nanoparticles for Biomedical Applications

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Nanomaterials have become the object of extensive studies in recent decades due to their unique chemical, physical and physico-chemical properties. Unusual electronic, magnetic, thermal, and optical properties can find the application in various areas.

Optical properties of gold nanoparticles are size- and shape-dependent, whereby they exhibit the light absorbance in a wide range of optical spectrum spanning the visible and near infrared-spectral regions. The response in the range of 650-1350 nm, also known as the biological transparency window or therapeutic window, open new possibilities to diagnostics, therapeutics, and drug delivery systems.

Recent studies have developed the various physical, chemical, and biological methods for the synthesis of gold nanoparticles. The group of methods that involves the application of non-toxic natural reactants received the name of “green chemistry methods”. These methods are based on the use of actinomycetes, bacteria, fungi, plants, viruses, and yeasts.

In this report, we present the recent results in the field of the development of green synthesis protocols for synthesis of gold nanoparticles with response in the near-infrared region using extracts of selected plants. It was observed that the utilization of *Syzygium aromaticum* L. [1], and *Sambucus nigra* [2] plant extracts lead to the formation of almost perfectly spherical biocompatible silver and gold nanoparticles. However, the application of the different ratios of the other aqueous and aqueous-ethanol extracts of *Juniperus communis* [3], *Solidago canadensis* [4], *Mentha × piperita* [5] plant extracts can be successfully used for the preparation of the prismatic-shaped gold nanoparticles with absorbance in near-infrared region.

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Modern Problems of Climate Change

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Climate and its change play an important role in formation the environment, natural resources, infrastructure, economy and other aspects of life in all countries of the world. At the OSCE Summit in Astana in December 2010 The Secretary-General of the UN Ban Ki-moon appealed for a combine effort by all countries to struggling with climate change on earth [1].

The principled and agreed position of the World health Organization, the United Nations and the World Meteorological Organization, formulated at world conferences on climate change, is based on the results of a number of scientific studies. It reflects the prevailing view on the negative impact of global climate change on population health [2].

Analysis of world literature shows the emergence in recent years of a number of scientific publications on the medical and environmental consequences of global climate change. Most articles note the extremely high degree of relevance of this problem.

To avoid invading ecosystems, which are already heavily burdened, countries will need to almost double the current rate of agricultural productivity growth, while minimizing the associated damage to the environment [3].

Thus, the variability of weather and meteorological factors makes a significant negative contribution to the level of air pollution, which leads to the development of adverse effects on population health, which is expressed in increasing mortality, morbidity, deterioration of physical development.

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Sustainable Development of Territories. Urban Adaptation in Mykolaiv: the Ways of Adaptation to Climate Change

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Despite the increasing awareness of climate change impacts and the need to adapt, many of Ukraine's cities and towns as Mykolaiv city are struggling to handle the impacts of heatwaves, severe droughts and destructive torrential rains, especially in summertime. Today, we have the urgent need for action for development, implementation adaptation and resilience at local and national government levels.

Addressing climate change adaptation in Mykolaiv city is increasingly urgent as nearly 68,4% of people in Mykolaiv region live in urban areas. This number is expected to grow in coming years. Moreover, the way we plan and construct our city remains unsustainable. Specifically, continued construction on floodplains, the increased covering of soil surfaces by concrete or asphalt, and urban sprawl encroaching on wildfire are making city much more vulnerable. Poor air quality continues to damage people's health, especially in urban areas. Road transport, power plants, industry, agriculture and households are the main sources of air pollutants. These sources are closely linked to Mykolaiv's core systems of production and consumption, and are also key drivers of greenhouse gas emissions and biodiversity loss.

All these factors demand the appropriate solutions in development and implementation of measures in adaptation climate change in Mykolaiv city, such as expanding district heating, promoting cycling, the renewable projects, lowering speed limits and issuing congestion charges that tend to improve local air quality. Other common initiatives include relocating industrial facilities, modernising household stoves and boilers, using cleaner fuels for heating, switching to cleaner buses or trams and introducing low-emission transport zones. One of the ways to reduce the air pollution, including greenhouse gases, that put considerable contribution to climate change, is switching to renewable energy sources. For the past several years in Mykolaiv region has been noticeable progress in the deployment of renewable energy sources, especially solar power plants. The share of renewables in the Mykolaiv region final energy use increased from 1,4 % in 2018 to 5,8 % in 2020, and to an expected rise in 2021, according to the Mykolaiv Regional General Statistic Office (MRGSO) report.

The Idea of a Modern University is a Conceptual Force and Hub For the Transition to Sustainable Development of Life

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The ideas of the creators of the most common concept of "zero post-industrial growth", as a consequence of the strategy of sustainable development, are reflected in the implementation of certain policies: 1. Birth control. 2. Decrease in education. 3. Destruction of agro-industrial foundations of modern society. Thus, the intentions and actions are based on the preservation of the existing privileged state of the ruling clans of the world, while neglecting the basic right to life, a dignified life, for all, not just the elect.

But the opposite attitude to sustainable development is also known, the one consistently implemented by a group of Soviet scientists led by Pobisk Kuznetsova, consolidated at the Russian Space Society.

The ideas of the creators of an alternative view of sustainable development are reflected in the policy: 1. The best way to save the Earth for future generations is to mould people who can creatively solve the problems of transition to sustainable development. 2. Synthesis of theories of natural, technical and human sciences as the basis of scientific support of sustainable development. 3. Education modernization. The concern of modern generations for the generations to come is the education of people who are capable and realize their ability to be creative. 4. Formation of scientific support and of a new generation of young people focused on the transition to sustainable development of life. 5. To direct our lives to creating everything to save our descendants from destruction.

Herman Daly formulates the principle in the form of the Eleventh Commandment: "Do not allow unlimited inequality in the distribution of private property." Society will not be able to move from the strategy of growth to a stable state without establishing the very principle of limiting inequality, formulating ethical principles, fundamental principles of activity in the world. And, as Daniel Bell put it: "Efficiency is the rationality of choosing between two alternatives. This is the basis of basic education."

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Environmental Education Directions for Sustainable Development

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The starting point for the evolution of environmental education was the report "Growth Limits" in the early 70's of last century. Since then, there have been several waves of ups and downs.

The first "wave" (1972) is associated with the realization of anthropogenic pollution and the first intuitive reaction – to protect it from the barbaric influence of human.

The second "wave" (1986) entered the international experience called "Environmental education for sustainable development", which meant not only nature protection, but also, along with it, the rational use of technology.

The third "wave" (1997) was called "Education for the Sustainable Future of People", which arose with the awareness of the need to introduce new principles of ethics, culture and justice in the context of humane sustainable development. Under this name is hidden, in fact, a new philosophy that requires other approaches to the whole set of conditions of human existence. The title outlines the goal - a sustainable future, for which it is necessary to prepare not only specialists but also all citizens.

The fourth "wave" (2005) was named by the UN General Assembly "Education for Sustainable (Balanced) Development". This name indicates the subordination of the educational process to the phenomenon of sustainable (balanced) development, by which we mean something in general in relation to a set of environmental, economic and social processes.

The current stage of environmental education content development is characterized by a new status through the following leading areas, characteristics: adaptation of educational ideas for sustainable development to the mentality, way of life; search for analogues in the national culture; pedagogical research should be carried out not in the direction of greening at the expense of additional educational material, when there is no single semantic field, but at the expense of conceptual greening (worldview, categorical integration); conceptual greening is provided not by increasing the amount of educational material, violating its traditional logic and structure, but by giving existing educational material a new meaning, a vector of direction.

Environmental Risk and State of Surface Water Resources

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Almost all over the world there is a growing negative impact on the quantitative and qualitative state of water resources such factors as land use, population growth, water pollution and climate change.

Objective is to carry out a qualitative and quantitative assessment of the ecological status and to determine the level of environmental risk of surface water resources in the Mykolaiv region on the basis of the appropriate methods. Ecological quality classification of surface waters and estuaries of Ukraine is built on ecosystem principle. The necessary completeness and objectivity of the characteristics of surface water quality are achieved a fairly wide set of indicators that reflect the characteristics of abiotic and biotic components of aquatic ecosystems.

The base of the study is selected organoleptic and sanitary-toxicological indices of water quality, because its most fully reflect the ecological condition of water resources. Assessment of ecological status according to the organoleptic properties of water provides for evaluation in terms of color, pH index and suspended solids. Based on sanitary-toxicology data includes the assessment of COD and, nitrates (NO₃-), total hardness, chlorides, sulphates, phosphates, total ferrum and manganese.

The assessment of the status of water in terms of ecological risk coincides with the assessment of environmental quality. Individual points are class II quality "good". Quite often water is "unsatisfactory", class 4 quality. 5 class of water quality is "bad", separately found almost for each item of observations, due to excessive concentrations as a result of an anthropogenic impact on water objects. This situation indicates that water bodies in the study area have somewhat disturbed the ecological parameters of their ecological status is estimated as "ecological regression". The research presented that water objects of the area are unsuitable for drinking water supply. The ecological condition is characterized by ecological imbalance due to excess concentrations of pH, suspended solids, color, COD, BOD₅, total hardness, sulfates, chlorides, total iron and manganese.

Strategic Aspects of Biodiversity Conservation

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In accordance with the provisions of the Carpathian Convention on Sustainable Transport (TRANSGREEN Policy. 2019), it is proposed to define an overall development strategy, including aspects of biodiversity. Transport networks divide wildlife habitats into small areas and create barriers between them. This can reduce the size of habitats so that they cannot support viable populations; or the fragments will be so isolated from each other that it is impossible to move between them. This, in turn, increases the vulnerability of species and leads to species loss. That is why the fragmentation of the landscape and its consequences is recognized as one of the greatest threats to the conservation of biological diversity. A holistic approach that integrates social and environmental factors is needed to produce environmentally sustainable transport infrastructure and mitigate the negative effects on wildlife (Fig. 1). The latest challenge for environmentalists, infrastructure planners and engineers to develop adequate tools to assess, prevent and mitigate the effects of transport infrastructure.

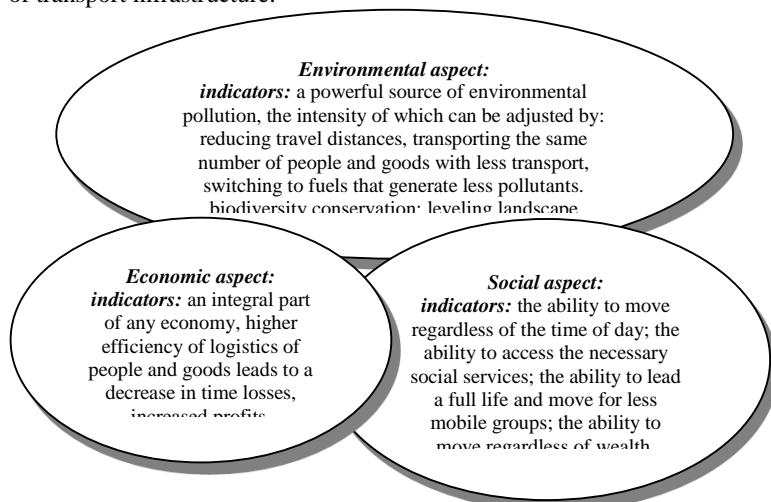


Fig. 1. Visualization of the principle of "sustainable development" in the transport sector

Climate Change and Fluctuations at the Global and Regional Level: Scenarios and Their Consequences

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Climate is a long-term weather regime caused by solar radiation, its transformation in the active layer of the earth's surface. [3]. It consists of two parts: constant (physical peculiarities of the Earth), and variable (activity of the Sun, Ocean, volcanoes, human influence).

A fundamental question arises: do changes occurs within normal natural processes, or under the influence of the global greenhouse effect?

Obviously, there is an increase in average air temperature at a rate of 0,5-0,7° per 100 years [1]. For the Mykolaiv region increase makes 1-1,5° in comparison with the previous period [2, Fig. 1].

However, the physical nature of temperature fluctuations (against the background of its linear trend) is still not clear. [2]. Spatial and temporal climate change is still under question due to a number of "uncertainties"[1].

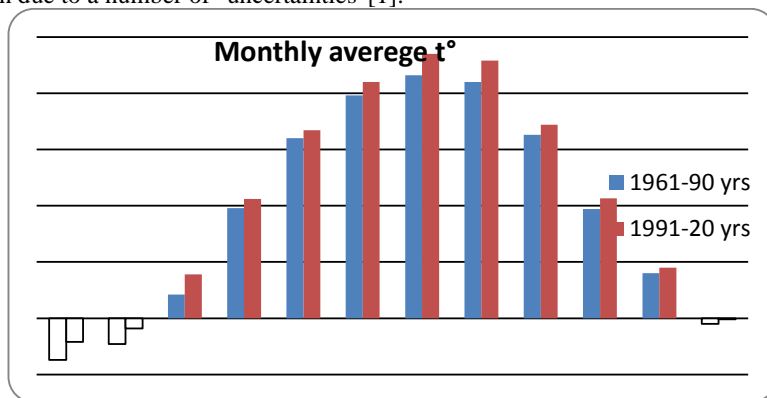


Fig. 1. Changes in monthly average temperature in compare of 2 periods, Mykolaiv region.

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Changes in the Breeding Program of Poppy (*Papaver Somniferum* L.) in Response to Global Climate Change

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Changing climate conditions cause serious problems in the agricultural sector. This requires more measures in plant cultivation. One of the possibilities is the focusing of the breeding programs on the creation of varieties adapted to these changes. Most Central European countries are struggling with drought, especially during the spring and early summer. This causes significant problems for spring crops, including oilseeds poppy. Therefore, there is a general growing interest of growers in the winter forms of poppy, which are able to overcome the drought, especially in the initial stages of growth due to good rooting. Winter forms of poppy are able to overcome the spring dry season compared to spring forms. The previous poppy breeding in Slovakia was mainly focused on the creation of spring food type varieties. The Research Station in Malý Šariš has started the breeding of a winter poppy variety for food purposes. The main aim for the new variety is the achievement of good wintering and adaptation to Central European environmental conditions, which are often accompanied with strong frosts in winter. With this objective, the winter variety Zeno 2002 (of Austrian provenance) began to be studied in the year 2018. In the year 2020, the collection expedition to the north-eastern part of Slovakia was carried out (Lúčka village, Svidník district, 190 m above sea level, 49°06'08"N, 21°28'34"E). As result, the regional winter genotype was selected and subsequently evaluated in a small-plot experiment. The initial evaluations have shown the excellent ability of the plants to overwinter due to the good developed and rooted ground leaf rosette. In the spring, the plants quickly formed a massive leaf area and the leaves were covered with a relatively thick wax layer. The obtained plants will form the basis for further evaluation, selection, and possible hybridization. The best materials will be the starting point for the registration of the first Slovak winter food variety of poppy.

Phytoremediation of Heavy Metals Contaminated Waters Using Green Microalgae as Biosorbent

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Environmental contamination due to heavy metals is a serious threat towards all ecosystems including aquatics. Chemical and physical ways are employed to treat this metal contamination [1]. Recently, the use of algal species as a cost-effective, rapid, environmentally safe, and recyclable method has gained popularity and is termed as phytoremediation [2]. Green microalgae show high photosynthetic activity and turnover rate making them a good candidate for bioremediation [3]. It is essential to choose the right algal species possessing not only high phytoremediation ability but also producing high biomass with industrial beneficial products so that multiple benefits can be gained by the phytoremediation treatment systems [4]. Removal of Pb, Cr, Cu, Cd, As, Zn and Ni has been investigated using green microalgae such as *C. vulgaris*, *C. ellipsoidea*, *C. sorokiniana*, *C. pyrenoidosa*, *S. dimorphus*, *S. obliquus*, *C. glomerata* and *M. amoena* [5,6,7]. Industrially important compounds such as antioxidants, antiviral, anti-inflammatory, antitumor products, biofuels, pigments, fatty acids, amino acids, fibers and allelochemicals can be derived from green algae during phytoremediation process at different extends which can be used for human benefits [8]. It can be stated that using algal species for economic and eco-friendly metal removal in aquatics is a much advantageous method and the potential of green algal strains for phytoremediation makes them a good biosorbent with the added advantage to generate important biproducts.

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Weather's Comfort of Mykolaiv and Adaptation to Climate Change

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The transition from anthropocentrism to neoanthropocentrism, from a consumerist way of life to sustainable development, from greedy expansion to rational use of nature is the only sure way to salvation [1,2].

The zone of tolerance (comfort) for living organisms is narrowing, so environmental factors force them to adapt to survival [2].

The most favorable weather conditions for inhabitants of Mykolaiv are indicators of a summer season. To assess it, two main factors were used - the average daily temperature (t) and the average relative humidity (w).

Figure 1 shows the allocation of the tolerance zone - the range (2.5 - 3.5), under the conditions of simultaneous action on the object.

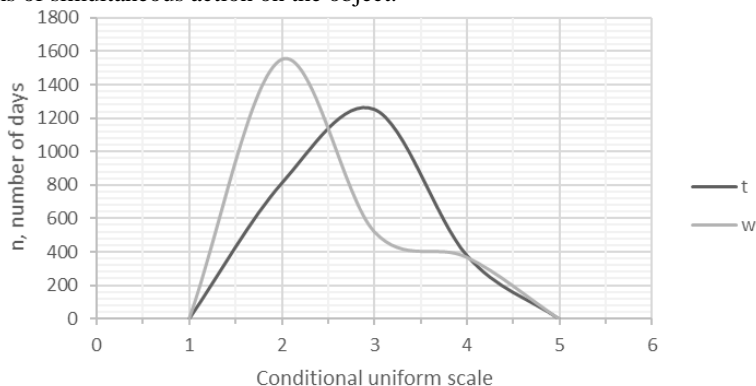


Fig. 1. The nature of the factors

Comfort of weather conditions in Mykolaiv is low as makes only 36% of their maximum possible quantity. The dynamics of the first and last frosts confirms the phenomenon of global warming.

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Searching for Sustainable Development

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Civilizations, just like individual people and whole species, emerge, grow, age, and disintegrate. The failure of creative power often follows after a period of major accomplishments. Because our Western civilization has enjoyed enormous technological progress and accumulation of wealth in the past two centuries, we should take care to keep our eyes open at this point.

The article consists of three development scenarios:

- sustainable development;
- sustainable retreat;
- collapse of society.

Sustainable development was formulated in 1987 by the United Nations. It is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

In 2006, British physicist James Lovelock came with the idea that it is too late for sustainable development, we should strive for sustainable retreat instead. For Lovelock, the deadliest issue is the ongoing climate change, as it is irreversible and can only be mitigated. Why some societies perish while others survive? Whether a society collapses or not depends largely on its environment. The absolute key is nevertheless the society's response to its problems and its capacity to solve them.

A major societies, empires, and civilizations, in a similar way to humans, go through the stages of youth, adulthood, and old age. The duration of the stages varies. Unlike in humans, they need not "die" but can instead transform into a new form.

A crisis is usually followed by hope, rebirth, and flourishing. Regardless how big a crisis is, it always presents an opportunity for catharsis and hope for a new beginning. However, there is no physical law stating that a crisis must be followed by restoration and prosperity.

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Search of Pattern in Presence of Epiphytic Lichens on Trees Growing in an Urban Environment - Case Study Prešov Town (Slovakia)

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In Prešov town, 3 lichen species most often grow on the trees: *Xanthoria parietina*, *Phaeophyscia orbicularis*, and *Physcia adscendens*. The most common lichen was the *Ph. orbicularis* accounted for up to 86 % of all records. We found that in presence of *Ph. orbicularis* was influenced by the density of traffic and by the orientation towards the road. The highest presence was confirmed in localities with the highest traffic densities and in the northern and western areas of the trunk. *Ph. orbicularis* grew most frequently on the side of the tree facing perpendicular to the road, and the lowest cover of this species was recorded on the side of the tree facing away from the road.

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Influence of Climatic Factors on the Covid-19 Incidence

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Today, Covid-19 is a global pandemic caused by the SARS-CoV-2 virus. The coronavirus crisis has led to reduced greenhouse gas emissions, reduced air pollution in industrial cities and even encouraged the emergence of new climate-friendly habits (work at home, virtual work meetings, etc.) [1].

The aim is to investigate the relationship between climatic factors and the incidence of Covid-19.

It is known that weather changes affect the human body. High temperatures lead to death from cardiovascular and respiratory diseases; these include the elderly and patients with chronic diseases. In poor countries, people are more sensitive and less resilient to crises: economic crisis, climate change or pandemic. Failure to comply with sanitary requirements, such as hand washing and social distance, could trigger a new epidemic of Covid-19 [2]. An example is the outbreak of a new, more aggressive coronavirus mutation in India. From March to July, more than 19.7 million new cases were recorded.

The body of a healthy and sick person is affected by all climatic factors. The population health depends on the ability of the organism to adapt to the conditions of the surrounding socio-ecological and technical environment [3]. Poverty and poor sanitation contribute to the spread of Covid-19. Therefore, the role of social factors is no less important than the role of biological and climatic.

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Recommended Action Plan for the Problem of Storm Sewers in Mykolaiv

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The main problem of urban storm sewers is many factors, among which in the first place, in addition to flooding, is the ingress of pollutants into the municipal storm sewer system during heavy rains. The primary reason for this is the mass unauthorized connection of households to the municipal sewerage system, as well as the ingress of pollutants as a result of flushing during the rains. Today, the problem for the city is, as you know, heavy vehicles that transit through the city's highways. As a result, in addition to the ingress of hazardous substances into the air with vehicle exhausts, we also have the deposition of the latter on the surface of roads and adjacent areas, which during rainfall can fall into the city storm sewer system.

An action plan has been developed to study and solve the problem of storm sewers in Mykolaiv. Including:

- to identify each of 16 storm drains of the city sewerage of Mykolaiv;
- comprehensively analyze the technical network of the storm sewer system with connection to the collectors and places of storm sewers of the city sewer;
- carry out a systematic analysis to identify the source of storm sewer pollution;
- provide recommendations for calculating the limit values of pollutants discharge into the aquatic ecosystem of the lower reaches of the Southern Bug River (near of the Mykolaiv city);
- to identify possible bioindicators of aquatic ecosystem pollution by detected pollutants;
- to offer aquatic plants-absorbers of pollutants for biological reclamation (purification) of the ecosystem of the lower reaches of the Southern Bug River (near of Mykolaiv city).

The City Microclimate as a Factor in the Comfort of Residents' Life

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The relationship between weather changes and exacerbations of chronic and mental illness, heart attacks, strokes and asthma attacks has been proven. Therefore, it is important today to study the characteristics of microclimate directly in the place where people spend most of their time continuously for a long period. Since the vast majority of the population are citizens, attention should be paid to weather conditions in cities.

The main factors in formation of climatic conditions in the urban ecosystem are anthropogenic factors. Among them: urban development, street coverage, distribution of greenery, air dust, etc. The walls of houses, cobblestones, etc., absorbing radiation, heat up more during the day than the soil and therefore give off more heat to the air, especially in the evening. Therefore, the air temperature in cities in 70–80 % of cases is higher than in rural areas. In large cities average annual temperatures are 1 °C or higher. Various coatings – roofs, roads, sidewalks, the total area of which reaches 50 % of the city, are virtually impermeable to moisture and poorly reflect sunlight (10–27 %) and heat (11 %) and have a high heat capacity. Thus, they transform almost 90% of radiant energy of the Sun into heat. Cities are characterized by increased air dust. As a result, transparency of air decreases by 15–25 %.

Temperature differences are more pronounced in clear weather. During the day the temperature differences between urban and suburban areas decrease and at noon become minimal. Temperature differences between the city and its surroundings increase after sunset. During the day in the city center and near the stations the air warms up the most. The park area remains the coldest in the city. In cloudy weather, temperature differences between areas of the city are small.

Thus, we can say that the state of the microclimate in a certain area is an important indicator of comfort of the residents in the city. The degree of influence of green plantations on the microclimatic conditions of the territory is significant: with their help it is possible to significantly reduce direct solar radiation, air and surface temperature, wind speed and in some cases increase the humidity. Reducing the air temperature, and hence improving the comfort of life in the city, can be done by planting trees and shrubs, painting houses in light colors, reducing the area of asphalt surfaces, use as a coating materials with better sanitation.

Antibacterial Functionality of Leaf Extracts of *Ficus benjamina* L. (Moraceae) and Its Cultivars against *Aeromonas* Strains as an Alternative Approach for Sustainable Aquaculture

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The present study is an *in vitro* study to evaluate the antimicrobial activity of the ethanolic extracts derived from leaves of *Ficus benjamina* and its cultivars, i.e. *F. benjamina* 'Safari', 'Baroque', 'Amstel Gold', 'Reginald' against three *Aeromonas* strains, i.e. *Aeromonas sobria* (K825) and *Aeromonas hydrophila* (K886), as well as *Aeromonas salmonicida* subsp. *salmonicida* (St30) to assess the possible use of this plant in preventing infections caused by these fish pathogens in aquaculture. Our results revealed, that *F. benjamina* and its cultivars possessed antibacterial properties against *Aeromonas sobria* strains. The ethanolic extract obtained from leaves of *F. benjamina* 'Safari' exhibited the maximum antimicrobial activity against *Aeromonas sobria*. The ethanolic extract obtained from leaves of *F. benjamina* 'Safari' exhibited the maximum antimicrobial activity against *Aeromonas hydrophila*. The ethanolic extract obtained from leaves of *F. benjamina* 'Reginald' exhibited the maximum antimicrobial activity against *Aeromonas salmonicida* subsp. *salmonicida*. This strain was susceptible to the *F. benjamina* 'Safari' and 'Baroque'. The results of this study provide a new perspective for the use of various *Ficus* species as medicinal plants to improve the antibacterial responses in aquaculture. Further studies including the use of other medicinal plants as food additives in aquaculture, the assessment of their antioxidant effects on various tissues of salmonids are in progress.

This study was carried out by The International Visegrad Fund in the Institute of Biology and Earth Sciences, Pomeranian University in Słupsk (Poland). We thank The International Visegrad Fund for supporting our study.

Ecological state of the Dniester River in the Climate Change Conditions

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The Dniester basin belongs to the regions with a high degree of economic development of natural resources, their long-term intensive development. Intense anthropogenic pressure on the environment has disturbed the natural balance in this basin system. Maintaining the water level of the Dniester in the conditions of climate change and maintaining its quality are important tasks today. The aim of the study is the impact of climate change on the ecological status of the Dniester River.

The value of hydrochemical parameters along the river, from the town of Sambir, Lviv region, to the Kuchurgany village, Odesa region. Exceedances in the content of nitrite ions, sulfate ions, chloride ions, ammonium ions, and the indicator of biochemical oxygen consumption at individual observation posts were established. The change of ammonium content and the value of biochemical oxygen consumption (BOD) according to the results of surface water monitoring from observation posts in the period from 2014 to 2020 in the Dniester river basin was studied. The pollution index and water quality class in the districts of the village of Rozvadiv, Lviv region and and Mayaki Odessa region. A comparative characterization of water quality according to the calculated WPI of these water bodies in 2016, 2018, and 2020. The upper reaches of the Dniester River (the village of Rozvadiv, Lviv region) are characterized by significantly higher values of the water pollution index compared to the Dniester valley (the village of Mayaki, Odesa region). According to certain values of the water pollution index, it can be assumed that the water of the Dniester River has not yet reached the critical level of pollution and has the potential for self-purification.

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Ecological and Economic Substantiation of the Process of Copper Removal from Wastewater

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Plating is considered to be one of the most dangerous industries. Since the enterprises are characterized by a wide range of technological processes, composition of solutions and electrolytes [1–3].

The purpose of the work is environmental and economic justification for the removal of copper from wastewater and its further use for metallization and for remelting as secondary raw materials.

The main factors of the negative impact of waste of boards and galvanics` production on the environment are revealed. In order to avoid the accumulation of sludge on the territory of the enterprises it is proposed to use the regeneration technology of waste digestion solutions, in which the recovered metal is used as secondary raw material for copper production, and the recovered solution is reused for etching of printed circuit boards.

The scientific novelty of the work lies in the fact that the proposed approach and the mechanism of obtaining additional raw materials from the sewage of PCB production have been discovered.

The practical significance is that the obtained results can be applied in the production of printed circuit boards to reduce the environmental impact of production wastes, as well as to obtain cheap raw materials from industrial wastewater. It is also important to reduce the environmental impact of production waste. The total sludge hazard index for the existing state of sludge storage in the territory of enterprises (0.045) and after the implementation of wastewater recovery (100) is determined. The economic indicators of the equipment created on the basis of this research are estimated. Implementation of new wastewater treatment technology with only one plant can bring more than 2.8 million UAH of economic effect.

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Study of Changes in the Ecological Condition of the Psel River

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Ukraine is one of the countries with insufficient water resources. To obtain a holistic picture of the current environmental situation, large enough administrative-territorial units of the industrialized countries of the world, in particular Ukraine, even with the gradual reduction of industrial potential, use environmental monitoring. In Ukraine, the main thing is the monitoring of surface water bodies within the river basin [1].

The State Agency of Water Resources has launched an interactive map «Monitoring and environmental assessment of water resources of Ukraine» [2]. On the map it is possible to track the data of monitoring of surface water bodies for a certain period of time on indicators such as: nitrates, nitrites, phosphates, ammonium ions, sulfates.

Based on the monitoring data of the State Agency of Water Resources, an analysis of changes in the ecological status was carried out, according to the main indicators of the Psel river for 2010-2020. The analysis was carried out on the basis of data from 6 water sampling posts in the Psel river [2]: 1) Psel river, 528 km, Krasnopol district; 2) Psel river, 480 km, the village of Velyka Chernetchyna; 3) Psel river, 444 km, Chervone village, below Sumy; 4) Psel river, 405 km, Bishkin village; 5) Psel river, 350 km, Kaminne village; 6) Psel river, 172 km, Velyka Bagachka urban-type settlement.

Based on the data obtained, the following conclusions can be drawn. In the Psel river there is a significant increase in the content of pollutants at post 3. The reason for such a point increase may be the location of the fence post in the village (village of Chervone), where there are no treatment facilities. The population can discharge domestic wastewater, which contains harmful pollutants, into surface water bodies.

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Aspects of the Mechanism of Implementation of the Sustainable Development Strategy of Rural Areas of Ukraine

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The goal of sustainable development is to improve the quality of life in accordance with the capabilities of ecological systems and the availability of natural resources. At the same time, high standards of quality of life of the population must be combined with its responsible attitude to the environment as a direct environment of their own existence. The framework documents on sustainable development emphasize the need to ensure the availability of quality drinking water, sanitation, safe food, which is relevant for all countries without exception [1]. In recent years, the problems of transition to sustainable development have been quite actively studied in Ukraine, but the problems of sustainable development of rural areas remain out of consideration. Thus, the problem of sustainable development of rural areas is extremely relevant and requires immediate solution. Issues of sustainable development of territories are gaining priority due to the implementation of the "Municipal Governance and Sustainable Development Program" (2004-2013) and others. [2]. The assessment of the territory of the region should be carried out on the basis of the analysis of the dynamics of changes in indicators that most broadly characterize the environmental, economic and social components of rural development. Important tasks of studying the processes of transition to sustainable development of rural areas are the collection, systematization, formation of databases on the availability and condition of production and resource and labor potential, as well as the nature and intensity of its use. Thematic structuring of the obtained data, their analysis and visualization of the research results are considered expedient for the successful development of organizational and economic mechanisms for the implementation of the strategy of sustainable development of rural areas in modern conditions.

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Survival of Tropical Species *Pistia stratiotes* and *Eichhornia crassipes* in Temperate Climates in SW Slovakia

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Invasive species from tropical areas are gradually beginning to spread in Europe. These include *Pistia stratiotes* and *Eichhornia crassipes*, which the EPPO Council added to the EPPO A2 List of pests recommended for regulation as quarantine pests [1]. The mass occurrence of these invasive species is known to cause significant natural and economic damage. In reservoirs and rivers completely covered by *P. stratiotes* and *E. crassipes*, biodiversity is significantly reduced. The first findings of *P. stratiotes* in SW Slovakia were recorded on the Danube lowland in 2007. Since then, *P. stratiotes* has been found to a greater or lesser extent in the Čierna voda and Malý Dunaj rivers every year (during res. Seed production was also recorded. Very frequent accompanying plant is *E. crassipes*, which also occurred [2]. The research In Europe, *P. stratiotes* and *E. crassipes* manifested itself as an invasive species e.g., in Italy [3]. *P. stratiotes* was spreading massively in Germany in the river Erft, heated by discharge locations of thermally heated water from the nearby opencast mining [4] and in Ukraine in the Siverskyi Donetsk river, where the main source of phytoviasion was the cooling channel of Eskhar heating station [5]. In the monitored area of SW Slovakia, the species continuous overgrowth occurred only along the riverbanks, the first solitary individuals were observed in July/August and the last ones in December were destroyed by frost. If warmer winter temperatures allowed the species to overwinter, management would therefore have to be targeted and sustained. In connection with climate change an increased risk of endangering natural aquatic communities can be expected. It is therefore necessary to constantly monitor these species and to take appropriate measures in the event of their occurrence in natural communities. The research was supported by VEGA grants No. 1/0658/19 and 1/0155/19.

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Solving Environment Problem of the Large Cities of Ukraine Related to Climate Change through the Implementation of the Green Buildings Principles

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Scientists around the world have agreed that over the past 100-150 years, the planet has undergone climate change, the root cause of which is human activity. The operation of large cities, which consume 75% of natural resources and at the same time have a high negative impact on the environment (in particular due to greenhouse gas emissions), leads to environmental problems in the cities themselves. It is possible to reduce the negative impact of global climate change and solve the main environmental problems of large cities by introducing the principles of green building at the legislative level. The leading countries of the world widely introduce norms of green building. Ukraine is still on the path of implementing EU environmental norms into the legal framework of Ukraine. Climate change directly or indirectly affects each of the urban development sectors. Scientific, methodological and organizational support must be provided to take into account the adaptation of cities to climate change. Strategic planning for the development of Ukraine's cities should take into account the best practices of adaptation of the world's cities to climate change. Cities are centers of innovative development, which strengthens responsibility and opens up opportunities to take the processes of adaptation and increasing resilience to climate change to a qualitatively new level [1; 2].

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Vegetation Cover Affects the Heat Balance of the Cities

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We live in a time of global warming and climate change, which is reflected in more frequent and devastating floods, extreme heat surges, more frequent droughts and increased risks of wildfire fires. Significant potential for reducing the impacts of these global processes lies primarily in vegetation cover, its plant species and functional diversity. In particular, residents of urban spaces such as cities and towns are suffering the consequences of these processes. It is known that the city works as a heat island. Larger amounts of green structures can significantly affect the temperature balance and the final microclimate [1; 2]. The green structure is understood to be mainly forested and grassy places with free soil cover. These are urban forests, parks, trees along river, sports and children's playgrounds, but also less spatially demanding elements such as street tree lines, a fountain with accompanying greenery, a front garden by the house, etc. [3]. All these elements, especially if they contain tree greenery, improve the microclimate and air quality [4]. The recreational function of urban forests is also irreplaceable, the importance of which has been constantly reminded in recent years [5]. Climate change can be mitigated by measures that preserve or strengthen green structures in cities. Planning and maintenance of urban units should focus more on the functionality of green structures. Related to this is the use of environmental practices to improve water retention in green structures and in the planting of tree species that are more resistant to pests and tolerate the urban environment well. Only healthy greenery can fulfill all the required functions in the long run [6].

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The Effects of Recent Climate Change on Trends in Pollen Season Characteristics of Allergenic Plant Taxa

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Increased surface air temperature in the last few decades is a well-known global phenomenon, with consequences for biota. The recent climate change may influence the timing, duration, and intensity of the pollen seasons of phytoallergens and thus contribute to a heightened risk of allergic respiratory diseases. This study aimed to analyse the changes in the intensity, timing, and duration of pollen seasons of two allergological important plant taxa (*Alnus* of trees and *Artemisia* of herbs) in Bratislava over 17 years (2004–2020). The pollen sampling was performed using a Hirst-type sampler. Mann–Kendall tau test was used to determine trends in pollen season characteristics, while Spearman's correlation analysis was used to identify the relationships between the characteristics of pollen seasons and both air temperature and precipitation trends. The notable changes in the pollen-season-related features were observed for both analysed taxa. The *Alnus* pollen season now reaches the peak earlier and its intensity is rising in line with the summer-autumn temperature increasing trend (Fig. 1), while unexpectedly intensity and duration of the *Artemisia* pollen season are declining in line with the increased precipitation and/or temperature trends (Fig. 1).

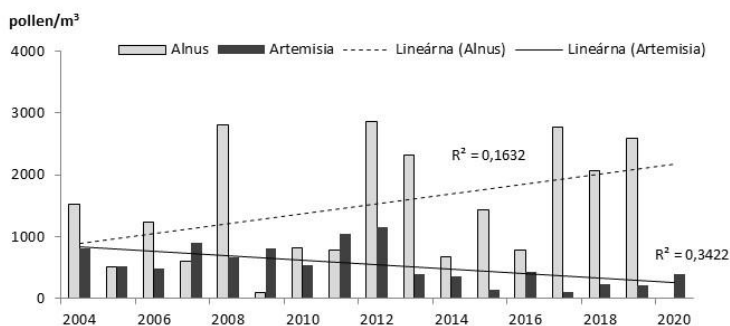


Fig. 1. *Alnus* and *Artemisia* annual total pollen concentrations in Bratislava and their trends over a long-term period

The Optimal Solution for Sustainable Environmental Development

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In general, the Optimal Solution for modelling the state of the environment implements the program of sustainable development, through balanced combination of green economy, techno-ecology, and responsible society. Integration into each other with the trio as economy-ecology-society will form the optimal system of the environment for a comfortable life of staffs moreover, nature. Sustainable Development is directly proportional to the sum of development of both the Green Economy, and Techno-Ecology, and a Responsible Society. This is the ideal formula for the formation of any state in the World. Word, that seeks harmonious development. The Green Economy in the Sustainable Development is a new direction of the economy, which can replace the Capital Economy. Techno-Ecology in the Sustainable Development acts as a catalyst between old and new equipment, equipment of enterprises, big business, and agriculture. A responsible society in Sustainable Development will bring global development to future generations in an innovative World; a World dominated by Nature is in cooperation, not competition with the Man of the Future.

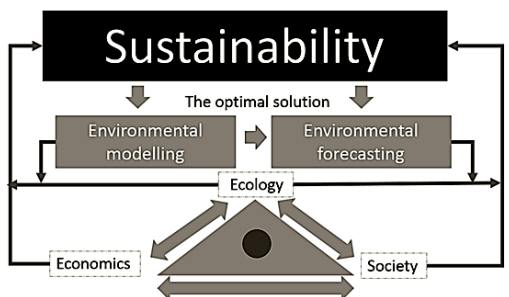


Fig.1. Optimal Solution for Sustainable Development

In general, the Sustainable Development of the World is the Optimal Solution to global economic and environmental problems of civilization. Consider Figure 1. Modelling the state of the environment is becoming an increasingly normal process of manual control of anthropogenic pressure on Nature. Then, forecasting the state of the environment allows us to anticipate the human factor of influence on Nature and make constructive and optimal decisions of balancing and integration between the Economies, Ecology, and Society to achieve a common goal: Sustainable Development of the World.

Environmental Safety in the Field of Medical Waste Management

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About 1 million tons of medical waste are generated in Ukraine every year. 90 percent of medical waste ends up in garbage cans and is disposed of in landfills without sorting, pre-treatment and disinfection. Such wastes can cause outbreaks of infections and epidemics, the spread of tuberculosis, and damage to the skin and mucous membranes [1; 2]. Improper treatment of medical waste causes cases of hepatitis B virus infection, hepatitis C infection, and HIV infection.

Residues of pharmaceuticals in drinking water pose a great threat to the health of the population of Ukraine. Constant consumption of such water causes the human body to become accustomed to certain drugs and their accumulation, which complicates the treatment process in case of disease and contributes to the exacerbation of chronic diseases, allergic reactions and more.

In response to this growing problem, three main strategies are recommended that can be applied simultaneously. The first strategy should be based on the concerted efforts of the medical sector itself, not limited to clinics and hospitals, in order to effectively minimize their medical waste. Waste minimization means that less waste needs to be disposed of properly and the environmental and economic problems associated with improper disposal are reduced. Second, health professionals, policymakers and other relevant stakeholders should work together to raise awareness of appropriate methods of disposing of medical waste and the risk of improper disposal. They should also work to implement and promote effective alternative waste management methods that do not simply incinerate or dump waste.

Adequate funding for treatment and disposal systems can reduce the cost of medical services, financial losses for quarantine, and addressing the spread of infectious diseases.

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Bee Products as a Possible Bioindicator of Environmental Contamination by Heavy Metals

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Heavy metals and the chronic nature of their toxicity are a constant factor of concern for their anthropogenic pollution of environment. With the persistence of heavy metals in the environment and high exposures grows also the potential of their bioaccumulation and biomagnification in organisms in their natural habitat, including honey bees. This post point out the differences in the content of heavy metals, especially mercury in the bodies of bees and their products in selected localities with various damage caused by anthropogenic activity throughout Slovakia. The highest measured mercury concentration in the pollen came from the village Radošovce, 0.089954 mg/kg. The maximum permitted concentration of mercury of 0.5 mg/kg did not exceeded by any of the studied honey samples, the highest measured concentration came from the village of Terchová, 0.004170 mg/kg. The highest level of mercury was measured in a lichen bag from Jelenec, its value reached up to 0.832543 mg/kg. In moss bags, mercury values ranged from 0.146429 mg/kg (Podhradie) to 0.243507 mg/kg (Nová Vieska). We statistically confirmed the relationship between secondary landscape structures, which were dominated by continuous and incoherent urban structure, urban greenery, railway networks and roads, watercourses and mercury content in bee products. In addition, many bee hives in the country usually means a higher concentration of mercury in bee products.

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Scientific Principles of Recultivation of Industrial Zones

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In recent years, land recultivation is part of the "Man and Nature" program and raises quite complex issues of medical and biological nature, which are associated with the development and prevention of various diseases that lead to disability and premature death. The choice of direction of recultivation is determined by natural and economic conditions and in most cases is dictated by which lands were disturbed in the process of mineral development and how they were previously used. Thus, the soil characteristics themselves largely suggest what decisions need to be made. Indicators such as the degree and type of salinization, the level of groundwater and groundwater, the method of field development, etc. can provide similar assistance in choosing the type and direction of recultivation. Development of recultivation projects should be carried out taking into account [1]: natural conditions of the district (climatic, geological, hydrological conditions, vegetation); location of the disturbed area; prospects for the development of the development area; actual and forecasted condition of disturbed and disturbed lands up to the moment of recultivation (area, forms of technogenic relief, degree of natural overgrowth, modern and perspective use of disturbed lands, forecast of groundwater level, flooding, drainage, erosion processes, soil pollution level); indicators of chemical and granulometric composition, agrochemical and agrophysical properties, engineering and geological characteristics of overburden and dump soils; economic, socio-economic and sanitary-hygienic conditions of the area of placement of disturbed lands; the term of use of disturbed lands (taking into account the possibility of repeated violations); protection of the environment from its pollution by dust, gas emissions and sewage in accordance with established norms; protection of flora and fauna. The effectiveness of recultivation largely depends on the timing and quality of its implementation. The responsibility for technical recultivation rests with the head of the enterprise.

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Using of Products of Organic Substrates Anaerobic Fermentation as Fertiliser

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The wastewater treatment process produces large amounts of sludge that must be utilized or treated to reduce biosphere pollution. Anaerobic stabilization of sewage sludge is carried out to destroy (ferment) the organic part of substance, which is biodegraded to carbon dioxide, methane and water with help of microorganisms. Biogas and digestate, which are formed as a result, have great prospects for utilization. Biogas is one of the most efficient sources of bioenergy because it is a product of an environmentally friendly method of organic waste disposal.

As a result of fermentation, a product (digestate) is formed from organic matter, which is an extremely valuable fertiliser due to the fact that it contains a large amount of ammonia, potassium compounds and phosphorus. In addition, heat treatment kills pathogenic bacteria and pest larvae. Simultaneously with a bacteria neutralizes seeds of plants that may be in a substrate.

It should be noted that as raw materials for biogas and digestate production and utilization can be used as organic agro-industrial, household waste, wastewater and vegetable raw materials – corn silage, grass silage, grain and cereal silage. The most suitable types of waste for processing are pig manure and cattle, poultry manure; tops of vegetable crops; substandard harvest of cereals and vegetables, sugar beets; pulp and molasses; bard alcohol; beer pellets, malt sprouts, protein sludge; starch and molasses production waste; fruit and vegetable pomace; whey and buttermilk.

The introduction of coenzyme technologies for processing of organic substrates mixtures at wastewater treatment complexes with production and use of complex fertilisers is perspective.

Digestate should be divided into components – liquid and solid phases. The liquid phase can be watered, and the solid – granulated, dried and applied as fertiliser.

It should be emphasized that organo-mineral fertilisers obtained after an anaerobic digestion reactor are more easily absorbed by plants than artificial ones, such as urea, ammonium nitrate, etc., because after fermentation nutrients turn into a form accessible to plants, dissolve well and this is very important moment in development of new technologies.

Antibacterial Properties of Root and Stalk Extracts of *Chelidonium majus* L. (*Papaveraceae*) against *Enterococcus Faecalis* Strain

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Over the past decade, much attention has been placed on the study of plant-derived compounds for their antibacterial activity, especially against multidrug-resistant Gram-negative and Gram-positive bacteria. *Chelidonium majus* L. (*Papaveraceae*), or greater celandine, is a plant highly praised for its therapeutic potential in western phytotherapy and traditional Chinese medicine exhibiting antimicrobial properties, so we attempted to investigate this activity. The present study is an *in vitro* study evaluating the antimicrobial activity of the ethanolic extracts derived from roots and stalks of *C. majus* against *Enterococcus faecalis* (Andrewes and Horder) Schleifer and Kilpper-Balz (ATCC® 51299™) strain to assess the possible use of this plant in preventing infections caused by this pathogen. Antimicrobial susceptibility of the tested *E. faecalis* strain was performed by the Kirby-Bauer disc diffusion method. Our results of the antimicrobial screening revealed, that *C. majus* possessed mild antibacterial properties against *E. faecalis* strain. The ethanolic root extracts of *C. majus* collected from rural agglomerations exhibited the maximum antimicrobial activity against *E. faecalis* (the mean of inhibition zone diameters was 8.77 ± 1.21 mm) compared to the control samples (7.48 ± 0.99 mm). There was a 17% increase in the zone of inhibition compared to the control samples. Stalk extracts of *C. majus* collected from urban areas also exhibited antibacterial ability against *E. faecalis* strain (7.9 ± 1.08 mm). There was a non-significant increase in the zone of inhibition by 5,6% compared to the control samples. Stalk extracts also showed antibacterial properties against the *E. faecalis* strain, but a larger diameter of the zone of inhibition was observed in stalk extracts of *C. majus* collected from rural areas (7.97 ± 0.85 mm). *E. faecalis* strain was also susceptible to the stalk extracts of *C. majus* collected from urban agglomerations (7.9 ± 1.08 mm). Based on these results, investigated plant extracts can be recommended for further investigations of antibacterial and antioxidant activity.

Effects of Therapeutic Formalin-Induced Treatment on Oxidative Stress Biomarkers in the Gills of Rainbow Trout (*Oncorhynchus mykiss* Walbaum)

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Formaldehyde is used in aquaculture to control bacterial diseases, fungal and parasitic diseases, demonstrating efficacy in short-term baths. However, formaldehyde is a mutagen and carcinogen even at low concentrations and presented toxicity in a variety of organisms. It causes oxidative DNA damage in cells by increasing the production of reactive oxygen species (ROS). The present study aims to explore the potential contributions of formalin-induced disinfection to the development of oxidative stress and antioxidant defenses in the gills of rainbow trout (*Oncorhynchus mykiss* Walbaum). In this study, we sought to determine whether the profile of 2-thiobarbituric-acid-reacting substances (TBARS), aldehydic and ketonic derivatives of oxidatively modified proteins, as well as activities of superoxide dismutase (SOD), catalase (CAT), glutathione reductase (GR), glutathione peroxidase (GPx), and total antioxidant capacity (TAC) in gills of juvenile rainbow trout, changed following exposure to formalin. Assays for oxidative stress and antioxidant defenses were used to identify potential biomarkers in the assessment of formalin disinfection of rainbow trout. The test group was exposed to formalin in a final concentration of 200 mL per m³. Fish were bathed for 20 min, three times, every 3 days. Two days after the last bathing fish were sampled. TBARS and carbonyl derivatives of protein oxidative destruction, as well as antioxidant defense biomarkers, were determined. The formaldehyde-exposed animals showed a decrease in lipid peroxidation biomarker (TBARS), aldehydic and ketonic derivatives of oxidatively modified proteins, and decreased glutathione peroxidase activity. Recognizing the role of biochemical changes in the tissues of formalin-exposed trout has important implications for understanding the complexity of the physiological changes that occur during disinfection but also for improving aquaculture practices to maximize tissues growth and health of treated trout. For the present study, the prophylactic treatments in rainbow trout should be performed at the abovementioned and lower concentrations of formalin.

Transformation of the Water and Mass Exchange on the Shatsk National Natural Park Territory under the Influence of Climatic and Anthropogenic Factors

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In thesis the problems of water and mass exchange under influence of climate and technogenic factors on the territory of Shatsk National Natural Park are considered. There are some factors that influence on the hydroecological state of territory, namely: climate, pollution of the water media and Khotislav chalk quarry development on the Belarus territory near border with Ukraine (300.0 m) and on distance 25.0 km from Shatsk Park which to our opinion is the main factor that substantially may to influence in future on the ecological state Shatsk reserve territory. That to prove that exploitation of this quarry not influence on the ecology of Park the Belarus side created the geofiltration model and on the results of numerical modeling of forecasting problems declared that on the end of projected period quarry exploitation (2040 year) the influence on Park territory will be absent. As it is turned out that the created model not covers the territory of possible influence fully and the conclusions of Belarus side are in doubt. On this case the new model was created which includes the Park territory and Khotyslav quarry one too. The results of solution the predictive transient problems on the first stage of investigations showed that at projected value of water drawdown on the quarry contour 45.0m the radius of influence will be more than 29.0 km and the influence will spread almost on the all West Polyssja territory that to changes substantially the hydroecological conditions and the life of population in this region in whole. The quarry development is projected on 30 years and according to obtained forecast calculations inflow to one will be the millions cubic metres of water that is equal the third part of West Polyssja territory water resources. It means that will be unpredictable negative consequences relative ecological state of water system here. That to avoid the forecast catastrophe on the West Polyssja territory most effective and to our opinion only one of kind is carrying over the quarry deep down in Belarus territory on 30-40 km that allows to preserve the stable water-ecological state of all West Volyn region as the measures and recommendations of Belarus side relative ecological protection of Shatsk park are not real and substantiate.

Protective Forest Plantations as a System of Protection Biocenoses and Technocenoses from the Negative External Factors Impacts

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Protective forest plantations (PFP) are a complex with different protective functions. Forest meliorative plantations are one of their type. They're providing an anti-erosion nature protection permanent action with a long payback period and they are multifunctional in their properties. Such complexes, of different plantations types, have certain special constructions and interact with each other [1]. They are creating meliorative and regulatory effects in a certain area to protect bio- and technocenoses from the harmful natural effects. PFP, which are located near highways, provides regulation and reduction of their negative impacts. The main pollutants in this system are engine emissions, noise, vibration, dust (in form of solid emissions and wear products from rain and melt water). All PFP's functions are ensured by forest reclamation and arrangement of sewage disposal facilities from the road surface, according to the rain and melt water volume [2; 3].

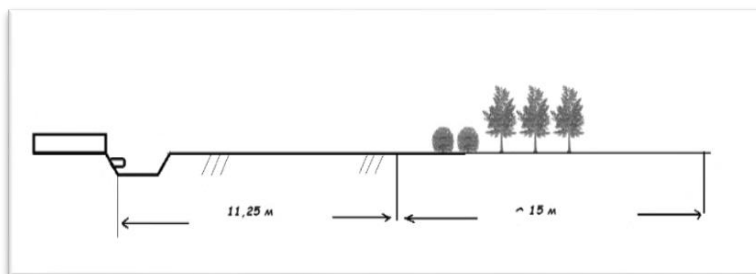


Fig. 1. The scheme of PFP construction in the highway area

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Effectiveness of the Preparation for Animals Based on Oil Solutions of Nanodiamonds

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The aim of the work was to determine the effectiveness of a drug of non-specific resistance of the dairy cattle body based on oil solutions of detonation synthesis nanodiamonds modified with β -carotene. 20 head heifers of paired age were selected and three groups were formed for the introduction of drugs: I – control (saline solution), II experimental (tetravit), III experimental (drug with active substance). Preparations were administered in the form of solutions heated to 30-35°C of 20 ml intramuscularly. Background indicators of beta-carotene content in the blood serum of all groups of heifers were in the range of 0.490-0.493 mg%. The carotene content in the blood of heifers of the control group practically did not change during the experiment. In the blood serum of heifers of the experimental group after administration of tetravit, the level of carotene increased by 20.9%, and in the blood serum of heifers who were administered the experimental drug, the level of carotene increased by 61.2 %. The remaining studied biochemical parameters of blood serum of animals of all groups were within the control values and varied to varying degrees after Drug Administration. From the experimental group, 15 primiparous women from the III experimental group were selected, who were injected with 20 ml/head of the experimental drug within no more than 7 days after calving and given a second injection a month later. It was found that after calving, cows of the experimental group had an increased level of carotene in the blood (1.045 ± 0.031 mg%), 0.252 mg% higher than before calving. Before repeated administration of the drug, carotene levels were lower, which may be associated with the onset of lactation. A month after repeated administration of the preparation and two months after the start of lactation, the level of carotene in the blood still slightly decreased (0.092 mg%). Accordingly, the level of vitamin A decreased, however, the level of carotene in cows during this period was significantly higher than before calving. After the first and repeated administration of the experimental drug, most of the biochemical parameters indicated stabilization of protein and carbohydrate metabolism in primiparous cows. So, the experimental drug is characterized by high bioavailability and significantly increases the level of carotene in the blood serum of cattle, helps to stabilize the body of first-born cows after calving and during the first two months of lactation.

Adaptive Evolution of Domestic Animals in the Context of Climate Change

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Global warming is an indisputable fact of the current stage of the Earth's development. In this regard, animals show adaptive properties: the body area decreases, the frequency of breathing and sweating increases, and food consumption decreases. Metabolic disorders caused by heat stress lead to lameness, acidosis, laminitis, alkalosis, ketosis, and liver lipodosis. Oxidative stress can play a role in some pathological conditions that can affect the productivity and well-being of animals. Heat stress causes an increase in the activity of antioxidant enzymes, which leads to the production of antioxidants and oxidative stress. Thermal stress disrupts the function of the cattle immune system, which also negatively affects reproductive and overall productivity. It is assumed that due to climate changes, infections such as mastitis may become more common. Although some species may experience some evolution due to global climate change, it is unlikely to be sufficient to mitigate the effects of these changes. Thus, the main tasks of the agricultural sector in the future are: development of projects of standard and Modular Farms specially designed to take into account the climatic features of areas; improvement of the animal feeding system and technologies for removing and disposing of manure aimed at reducing greenhouse gas emissions into the atmosphere; breeding strategies for obtaining breeds adapted to climatic stresses; expansion of acreage of more drought – resistant and high – yielding crops, ensuring the intensification and stability of feed production (perennial grasses-not less than 10-15% in the structure of crops); optimization of the ratio of winter and spring crops, as well as changing the timing of sowing spring crops to earlier, and winter crops to later for better use of moisture resources and creating a stable feed base.

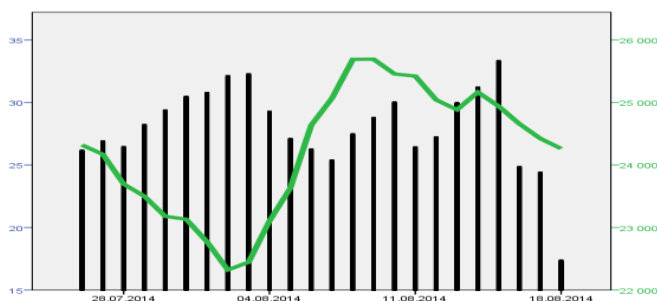


Fig. 1. Dependence of milk yield on air temperature
(green line - daily milk yield; black lines - daytime air temperature)

Analysis of Water Dynamics of the Southern Buh River

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The dynamics of water content of the Southern Buh River is formed under the influence of a complex of physical and geographical factors and primarily depends on climatic, hydrogeological conditions and economic activity [1]. Observation of the hydrological regime in the river basin of the Southern Buh is carried out at 22 hydrological posts [2]. Among them of great importance is the hydrological post Oleksandrivka located in the lower reaches of the river, which is a closing line and has been operating since 1914. The duration of observations is over 106 years. Analyzing the schedule of chronological distribution of average annual water consumption and their trend in the hydrological post Oleksandrivka, the following conclusions were made: the dynamics of water content of the Southern Buh River is characterized by long-term cyclicity of polyhydric and low-aquatic years; the determining factor in the formation of water content is precipitation; the longest low-water phase was observed from 1942 to 1964 (22 years), the high-water phase - from 1965 to 1985 (20 years); currently the water content is in the low-water phase, which began in 2007 and has been going on for 14 years; the current low-water phase is more stable and deeper than the previous ones, which may be due to climate change.

To mitigate the impact of climate change on the water content of the Southern Buh river, adaptation measures should be developed within the framework of the River Basin Management Plan.

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Loss of the Southern Bug River Ichthyofauna as a Result of Small Hydropower Plants Construction

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The Southern Bug has long been considered as the river with the richest fisheries resources. Fishing was the most important trade branch of the Cossacks and provide them with the most common food product. Southern Bug river was considered as one of the best places in Zaporizhzhya region for fishing. Cossacks caught sterlet (*Acipenser ruthenus*), starry sturgeon (*Acipenser stellatus*), Black Sea beluga (*Huso huso ponticus*), Russian sturgeon (*Acipenser gueldenstaedniis*), European catfish (*Silurus glanis*), common bream (*Abramis brama*), roach (transitional form of *Rutilus rutilus*), and river flounder (*Platichthys flesus luscus*) in S. Bug, Ingul, estuaries. But during the twentieth century, Southern Bug river was crossed by several dams, which have damaged the river and changed it into a number of water reservoirs.

Dams not only block the way to the places of spawning for the passing fish. They also affect the spawning places. Sturgeons, for example, deposit roe in places of rapid flow on the rocky or pebble bottom to which it adheres. Large water reservoirs occupy most of these places, silt up and destruct them as spawning places. Transitional sturgeons deposit roe on a pebble or clean sandy bottom of the river. In case of dam, the soil is silted up, and the spawning places lose their significance under such conditions. The way to the spawning places of transitional fishes is often quite long. Spawning places of some species are located in the upper reaches of the river, far from the river mouth. The fishes moving to spawning places from sea to rivers are as follows: beluga, sturgeon, starry sturgeon, Black Sea herring, some coppers, for example, vimba bream, etc. Beluga (*Huso huso*) is the largest freshwater fish (Fig. 1). Along the Southern Bug, beluga moved to Voznesensk (the north of the Mykolaiv region). The construction of small hydropower plants completely stopped beluga migration.



Fig. 1. Beluga – king fish. Completely lost in Southern Bug

The State of the Fauna of Bats in the Ukrainian Azov Region in Modern Environmental Conditions

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The almost complete transformation of the steppe into agrocenoses bordered by forest belts and irrigation canals undoubtedly affected bats against the background of global warming. Using modern ultrasonic detectors (Pettersson D240x, D500x; LunaBat DFR-1 PRO), licensed computer programs and an electronic library of voices, in 2010-2021 15 species of these vulnerable mammals were found in the Ukrainian Pryazovia. Their greatest diversity (11–13 species) is typical of places where intensive migration flows take place. First of all, it is the space between the Dnieper valley and the Crimea peninsula. Probably, in this bottleneck, bats migrating from the northern and northeastern regions cross the land and join those moving along the Azov coast. A significant number of animals move along the floodplain of the Molochna River. A relatively large variety of bats occurs near settlements located directly on the northern shore of the Sea of Azov, along which the migratory movements of bats are particularly powerful. During the winter, with limited research in this period, 8 species were found, during spring and autumn migrations – 13 and in summer – 11 species.

In recent years in the Ukrainian Pryazovia there has been a decrease in the number of *Pipistrellus pygmaeus* and *Eptesicus serotinus*, as well as an increase in groups of *Nyctalus noctula*, *Pipistrellus kuhlii*, *P. nathusii* and *Vespertilio murinus*. In all seasons the least common and not numerous were *Plecotus auritus*, *Myotis daubentonii*, *Nyctalus lasiopterus* and *N. leisleri*, *Hypsugo savii* and *Barbastella barbastellus*.

During migrations in the Ukrainian Pryazovia, bats usually stop in tree hollows in parks, artificial forests and forest belts, various cliffs and buildings, which are used as temporary shelters. In some of them they form small colonies and even overwinter.

The Impact of Climate Change on Workers in the Construction and Road Industries Working Outdoors

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In the context of global climate change, environmental factors pose an additional risk to the health of workers working outdoors. This is primarily workers in the construction and road industries. Factors such as air pollution due to abnormal temperatures and increased noise pollution of urban areas due to the increase in the number of mobile sources of pollution that run on gasoline and diesel fuel have led to increased risks to the health of workers, which requires additional health measures. I and efficiency, starting with personal protective equipment, and there is a need to adjust and bring in line with urban planning norms and recommendations.

The work of many domestic and foreign scientists is devoted to the relationship between global climate change and air pollution in large cities.

The risk of noise pollution on the magnitude of industrial risk and toxicological effects of hazardous substances was also studied separately. The possibilities of these existing solutions allow to obtain relative assessments of the impact of individual factors on the health and safety of workers and have not been considered to date in the context of their interaction against the background of rising temperature trends in the hot months.

The authors present a study on the developed algorithm of the system model for assessing and forecasting the acceptability of industrial risk for workers working outdoors in urban areas. When building the model, a comprehensive approach was used, which takes into account all the influential factors in the context of global climate change. The model consists of two levels of hierarchy. An example of this approach is given for a separate subsystem of the model, which takes into account the subsystem of interaction of temperature and air quality indicators on the health of workers on the example of Darnytska Square in Kyiv based on meteorological data 2013-2020. The results will be useful in developing recommendations for the protection of workers' health in the context of global climate change.

The results will be useful in developing guidelines for protecting the health of workers in the context of global climate change

Climate Change Induced Biological Invasions of Economically Important Insect Pests and Mitigation Action Strategy

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Biological invasions have recently become one of the most serious global environmental challenges. Environmental factors related to climate change can directly influence the spatial patterns of insect pest distribution, including many “southern” and “exotic” elements in mild climate ecosystems [1], especially in the conditions of glasshouses [2]. A lot of species may carry a heavy introduction and invasion potential with well-developed mechanisms for their successful dispersion [3]. According to the facts on the natural and human-induced dispersion mechanisms, a wide variety of new exotic economic species may undisputedly occur in Slovakia over the next couple of years [4]. Facing the economic consequences of climate change and biological commodity trade globalization synergic effects, followed by the dynamic and significant changes in the native biodiversity due to alien pest species introduction and their ability to survive in our conditions, leads us to taking adequate steps towards their potential impact mitigation actions. The crucial point is the prompt and correct determination of allochthonous species. Analysis on phenotypic plasticity impact in economic insect species initial introduction phase, particularly in morphometric variable dimensions, may solve the key problem in optimization of semi-automated online remote identification system modules based on artificial intelligence for prompt and reliable detection of economically important insect species [5]. The early detection and correct determination play the most important role in the mitigation of alien pest invasive potential impact, therefore there is a pushing need for the cooperation between academic and national institutions providing the pest monitoring *ex offio*.

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Proceedings of the International Forum on Climate Change and Sustainable Development: New Challenges of the Century present abstracts of the reports of the forum, which had place on September, 9–11, 2021 at Petro Mohyla Black Sea National University, Mykolaiv, Ukraine in terms of the Visegrad project #22110149.

The proceedings cover such questions as: strategy of sustainable development as a road map of civilization; sustainable development of territories; sustainable use and protection of flora and fauna; environmental biochemistry, physiology and medicine; food technology in the context of sustainable development; monitoring of the atmosphere, hydrosphere and climate management; circular economy; rational use of water resources and wastewater treatment; rational use of land resources and reclamation of disturbed lands; environmental education for sustainable development.



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