

ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN – POLONIA

VOL. LXXVIII

SECTIO B

2023

LYUBOMIR TSARYK

<https://orcid.org/0000-0003-0944-1905>

Ternopil V. Hnatiuk National Pedagogical University

Faculty of Geography

Department of Geoecology and Methods of Teaching

Environmental Disciplines

2 M. Kryvonosa St., Ternopil, 46027, Ukraine

tsaryk155@gmail.com

PETRO TSARYK

<https://orcid.org/0000-0002-4503-4437>

Ternopil V. Hnatiuk National Pedagogical University

Faculty of Geography

Department of Geography of Ukraine and Tourism

2 M. Kryvonosa St., Ternopil, 46027, Ukraine

pitertsaryk@gmail.com

LIUBOV YANKOVSKA

<https://orcid.org/0000-0001-7939-7423>

Ternopil V. Hnatiuk National Pedagogical University

Faculty of Geography

Department of Geoecology and Methods of Teaching

Environmental Disciplines

2 M. Kryvonosa St., Ternopil, 46027, Ukraine

lubayank@gmail.com

SVITLANA NOVYTSKA

<https://orcid.org/0000-0001-7354-4787>

Ternopil V. Hnatiuk National Pedagogical University

Faculty of Geography

Department of Geoecology and Methods of Teaching

Environmental Disciplines

2 M. Kryvonosa St., Ternopil, 46027, Ukraine

ekosvit76@ukr.net

VOLODYMYR TSARYK

Ternopil V. Hnatiuk National Pedagogical University

Faculty of Geography

Department of Geoecology and Methods of Teaching

Environmental Disciplines

2 M. Kryvonosa St., Ternopil, 46027, Ukraine

carikvldimir5@gmail.com

Functional and Spatial Optimization of the Protected and Ecological Networks of Ternopil Region in Ukraine

Funkcjonalno-przestrzenna optymalizacja sieci stref chronionych
i regionów ekologicznych Tarnopola na Ukrainie

Abstract: The article examines the essence of the European Strategy for the Conservation of Landscape and Biotic Diversity, the principles of formation, conservation and use of eco-networks in Ukraine, the existing problems of national and regional networks, taking into account the new administrative-territorial structure at the administrative-district level and the level of territorial communities. The purpose of the article is to assess the functional and territorial structure of the protected and ecological networks of Ternopil region and to substantiate the ways of their optimization in modern conditions. The paper is based on the information obtained in the course of field expeditionary research in 2019–2022, as well as on statistical data, cartographic materials, and materials from the open network of aerospace satellite images Google Earth. The collected

materials were processed using a system of methods (analysis, synthesis, comparison, decoding, cartographic, computer modeling, etc.). The data obtained showed that in 36.5% of the territorial communities, protected areas cover less than 1%. In order to improve the situation, the authors propose the creation of 53 new protected areas in 25 communities of Ternopil region with a total area of 39,358 hectares and substantiate the new core and connecting territories of the local rank of the regional eco-network.

Keywords: ecological network (eco-network); functional and spatial structure; regime of nature conservation; proposed protected areas; Ternopil region

Streszczenie: Artykuł analizuje istotę Europejskiej Strategii Ochrony Krajobrazu i Różnorodności Biotycznej, zasady tworzenia, ochrony i wykorzystania sieci ekologicznej na Ukrainie, istniejące problemy sieci krajowych i regionalnych, biorąc pod uwagę nową strukturę administracyjno-terytorialnego ustroju na poziomie jednostek administracyjno-rejonowych, a także wspólnot terytorialnych. Celem artykułu jest ocena funkcjonalno-terytorialnej struktury sieci stref chronionych i regionów ekologicznych Tarnopola oraz uzasadnienie sposobów ich optymalizacji w nowych warunkach. Materiały do artykułu opierają się na informacjach uzyskanych w badaniach terenowych przeprowadzonych w latach 2019–2022, a także na zebranych i przetworzonych danych statystycznych, materiałach kartograficznych i materiałach z otwartej sieci lotniczych zdjęć satelitarnych Google Earth. Zebrane materiały zostały przetworzone przy użyciu systemu metod (analiza, synteza, porównanie, dekodowanie, mapowanie, modelowanie komputerowe itp.). Uzyskane dane wykazały, że w 36,5% jednostek terytorialnych obszary chronione zajmują mniej niż 1%. W celu poprawy sytuacji autorzy proponują utworzenie 53 nowych obszarów chronionych w 25 gminach obwodu tarnopolskiego o łącznej powierzchni 39 358 ha oraz uzasadnienie nowych rdzeni i terytoriów łączących lokalne elementy regionalnej sieci ekologicznej.

Słowa kluczowe: sieć ekologiczna; struktura funkcjonalna i przestrzenna; reżim ochrony przyrody; planowane obszary chronione; obwód tarnopolski

INTRODUCTION

The Pan-European Strategy for the Conservation of Biotic and Landscape Diversity is a rational approach of the European Union countries to preserve their natural heritage for present and future generations. The economically developed Europe seeks to halt the degradation of natural ecosystems not only to preserve biodiversity but also to maintain proper natural conditions for human habitat. Thus, the Pan-European Strategy is another consistent step towards the implementation of the strategic provisions of sustainable environmental, social and economic development. The declared goals include strengthening the ecological integrity of Europe; significant reduction of threats to biotic and landscape diversity; creation of opportunities for restoring biodiversity and ecosystem resilience; and involvement of the public. Ukraine joined the Strategy by adopting the Law “On the State Programme for Development of National Ecological Network of Ukraine for 2000–2015” (Pro Zahalnodierzhavnu... 2000). In addition

to the specially adopted law, Ukraine has an appropriate system of environmental legislation with the basic law “On Environmental Protection” of 1991, which formulated the principles of environmental protection in Ukraine based on European experience and serves as a reliable legal basis for developing approaches to the development of an ecological network.

In order to understand the essence of the ecological network strategy, it is important to pay attention to the principles of formation, preservation and use of the ecological network declared in the Law of Ukraine “On Ecological Networks” (Pro ekolohichnu... 2004):

a) ensuring the integrity of the ecosystem functions of the components of the ecological network,

b) conservation and ecologically balanced use of natural resources on the territory of the ecological network,

c) stopping the loss of natural and semi-natural areas (occupied by plant communities of natural origin and complexes altered by human activity), expanding the area of the ecological network,

d) providing state support and incentives for business entities to create territories and objects of the nature reserve fund and other areas subject to special protection on their lands, and to develop the ecological network,

e) ensuring the participation of citizens and their associations in the development of proposals and decision-making on the formation, preservation and use of the ecological network,

f) ensuring the connection of the national ecological network with the ecological networks of neighboring countries that are part of the pan-European ecological network, and the comprehensive development of international cooperation in this area,

g) improving the structure of the land fund of Ukraine by ensuring a scientifically sound correlation between different categories of land,

h) systematic consideration of environmental, social and economic interests of the society.

The ecological network of Ukraine is considered as an integral part of the ecological network of Eastern Europe (Fig. 1), in which the country has significant biodiversity that requires effective forms of conservation and restoration.

At the same time, there are many unresolved tasks and problematic issues in this area, including the search for ways to improve the strategy for the development of regional elements of the eco-network, especially at the levels of newly created administrative districts and territorial communities, improve its structure and functioning, and reduce the risk of degradation processes caused by increasing anthropogenic pressure or global and regional climate change.

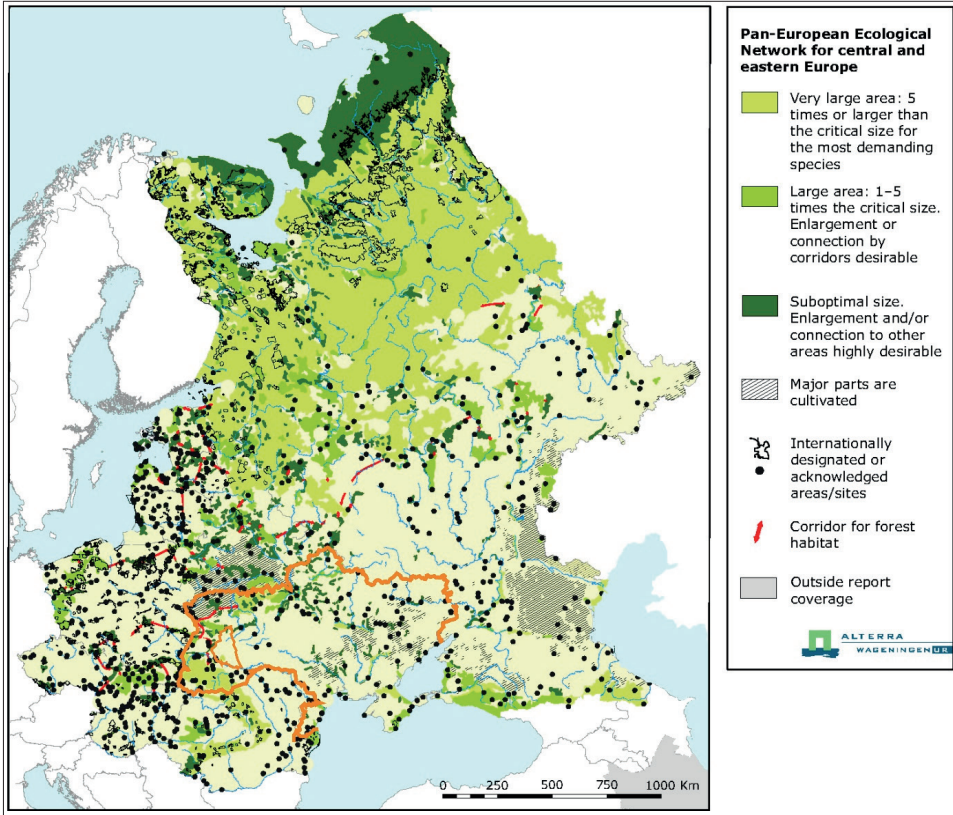


Fig. 1. Ecological network of Ukraine and Ternopil region in the system of the Eastern European Ecological Network
Source: (EEA 2009).

The first scientific provisions of the ecological network idea were developed in the works of Robert MacArthur and Edward Wilson on the theory of island biogeography, and the second source of the concept was the metapopulation strategy for wildlife conservation. As a result of creative comprehension of these ideas in the early 1980s, the concept of ecological structure of landscapes in Czechoslovakia and the model of “ecological spots and corridors” in the United States were developed (Shelyag-Sosonko et al. 2004). Later, other European countries worked out similar concepts in terms of ideology, the provisions of which were included in the Pan-European concept of ecological networks of the 1990s (Vseyevropejska strategiya... 1998).

This kind of research was conducted by scientists from European countries: Czech Republic (Buček and Lacina 1983 on the conceptual and applied principles of territorial systems of ecological stability of landscapes); Poland (Liro 1995), who developed an eco-network scheme based on the natural valorisation

of the country and assessment of the distribution of endangered species and ecosystems as well as the strategy for the implementation of the national ecological network ECONET-POLAND (Liro 1998); a map of ecological corridors in Poland (Jędrzejewski et al. 2011); Slovakia (Koren et al. 1996; Izakovičová, Świąder 2017). Izakovičová and Świąder (2017) analysed various initiatives and approaches, as well as their positive and negative aspects, presented methodological approaches to the creation of territorial systems of ecological stability, as well as legal provision of ecological networks in Slovakia and Poland.

The first major scientific work in the area of substantiating the strategy for the formation of an ecological network in Ukraine was the collective monograph *Formation of the Ecological Network of Ukraine* edited by Shelyag-Sosonko, which provides a detailed description of the nature features and proposes methodological approaches to the creation of the eco-network of Ukraine (Shelyag-Sosonko 1999). In the period 1999–2004, a number of articles and dissertations were published on the problems of forming the ecological network of Ukraine and regional ecological networks. In particular, the concept of trans-European nature protection strips and eco-network development in Ukraine was presented by Zinko, Kravchuk, Brusak, Kazakov (2000), the conceptual foundations of the formation of the national ecological network of Ukraine were presented in the publication by Tkachov, Ivanenko (2000). The issues of theory and methodology of research of landscape prerequisites and factors of development of the ecological network of Ukraine are considered by Hrynevetsky (2002). Andriienko (2004) discusses the role of interstate protected areas in the ecological network system, Farion and Chexnij (2004) published a study on the landscape aspects of building an eco-network of Ukraine. The problems of landscape conservation diversity of Western Podillia in the context of formation of the regional eco-network are highlighted in the publication of Tsaryk (2009). Kagalo (2009) published a study of building an eco-network of Ukraine. Baydikov and Paschenko (2014) consider the landscape framework as a spatial and structural basis of the ecological network. Ecological and geographical approaches to the organization of the ecological network of Zaporizhzhia region are substantiated in the publication of Vorovka (2004). Domaranskyi (2004) carried out the analysis of the concept of landscape diversity in the context of the formation of the national ecological network. Korzhyk (2004) published a discussion paper entitled *Ecological Network or Ecolandscape Network*, whereas Prychodko wrote the monograph *Regional Ecological Network as a Factor of Landscape Optimisation in Ivano-Frankivsk Region* (2004). Theoretical and practical aspects of ecological network formation on the example of Mykolaiv region of Ukraine are considered in the publications of Derkach et al. (2004). In 2004, a team of authors published one

of the basic monographs that developed a methodology, general strategy and methods for designing the Dnipro basin ecological network. Based on the basin approach, theoretical, methodological and applied aspects of the implementation of interdisciplinary research of ecological networks were developed (Shelyag-Sonko et al. 2004).

An important scientific and methodological work is the methodological recommendations for the development of regional ecological network schemes published by Andriienko et al. (2004), which made it possible to unify methodological approaches to the formation of regional ecological network schemes in Ukraine. In the period 2005–2015, one of the first PhD theses in the speciality 11.00.11 “Constructive Geography and Rational Use of Natural Resources” on the geographical principles of the formation of the eco-network of Ternopil region was prepared by Tsaryk (2005). In 2006, the research work *Geoinformation Modelling of the Ecological Network* by Samoilenko and Kohoda was published, which reveals the principles of geoinformation mathematical and cartographic modeling of the regional ecological network, provides typological classifications of its elements (Samoilenko, Kohoda 2006).

Several monographs have been prepared on the problems of substantiating eco-network schemes, its place and role in the natural and economic systems of the national and regional levels. In particular, in 2007, Boyko published *Spatial and Temporal Structure of Biocenoses of the Lower Dnipro Ecocorridor*, and in 2009, Tsaryk published a monograph *Constructive and Geographical Principles of Formation and Development of Regional Nature Protection Systems: Conceptual Approaches, Practical Implementation* based on the materials of the Podillia region (2009). Zarubina wrote the monograph *Geographical Bases of Formation and Development of the Regional Ecological Network in Kirovograd Region* (2010).

In 2012, Prof. Bayrak prepared a report on the status of implementation of the National Program for the Formation of the Ecological Network of Ukraine for 2006–2010, which resulted in the publication of a national report by the Ministry of Ecology. These materials indicate the preparation of eco-network schemes and the formation of their elements at the national and regional levels within the natural zones of Ukraine, major regions, administrative districts, and the city of Kyiv (Bayrak 2012)

In 2014–2019, Karpiuk presented PhD thesis *The Internal Functional Structure of the Volyn Polissia Ecological Network (within Volyn Region)* (2014); Koniakina – *Regional Ecological Network of Cherkasy Region: Geographical Principles of Formation and Development* (2015); Omelchuk – *Floodplain Phytosystems in the Structure of River-Valley Corridors of Trans-Carpathians* (2016),

Kondratiuk – *Legal Regime of the Lands of the National Ecological Network of Ukraine* (2019). From the above topics of dissertations, it can be concluded that during this period, emphasis was placed on detailing the spatial aspect of the structure of ecological networks and river-valley systems, raising and partially resolving legal issues of formation and functioning of the basic elements of ecological networks. In the period 2011–2020, local eco-network schemes were created for the cities of Kyiv, Sevastopol, Ternopil, Khmelnytskyi, Vinnytsia, Kremenchuk, Mohyliv-Podilskyi and the administrative districts of Chernihiv (Zaporizhzhia region), Murovano-Kurylovets and Mohyliv-Podilskyi (Vinnytsia region), etc.

Such a significant number of scientific papers on the ecological network of Ukraine and regional networks made it possible not only to successfully fulfil the tasks assigned to scientific institutions within the timeframe established by law, but also to expand the methodological foundations and methodological applied approaches of scientific interdisciplinary research

The aim of the article is to analyze the current state of the protected and ecological networks of Ternopil region and to substantiate proposals for optimizing their functional and spatial models. The problem of nature conservation in Ukraine has become particularly relevant after the decentralization reform, as in some administrative districts and territorial communities, protected areas cover only 0.5–5% of the territory. This necessitates a scientific study of such areas in order to create new protected sites. Therefore, the study of the current state of the nature reserve fund of the territorial communities in Ternopil region (and other regions) is a relevant and important scientific and practical task. Such studies will help to actualise the solution to this problem in other regions of Ukraine, especially those affected by military operations caused by Russian aggression.

MATERIALS AND METHODS

The methodological basis of the research is the concepts of geoecology and sozology. In particular, the concept of eco-networks, which envisages the formation of an integral environmental protection system of interconnected basic components: core areas (protected areas of nature reserve status, national natural and regional landscape parks, nature reserves of 500–1,000 ha), which are connected by a network of connecting areas (eco-corridors) that connect two or more core areas and create conditions for effective migration of biodiversity. River valleys (Seret, Zbruch, Strypa, Zolota Lypa, etc.), hilly ridges (Tovtrovyi Ridge), and forest, meadow, rocky-steppe, and wetland vegetation areas in Ternopil region perform such functions. In addition to the above, the eco-network includes

protective (buffer) areas – partially anthropogenised landscapes located around the core and along connecting areas (a one-kilometre protective zone around the Medobory Nature Reserve, a zone of protected areas, meadows, pastures, and hayfields adjacent to river valleys). The fourth component of the eco-network is restoration areas (areas of land that require renaturalisation measures to restore natural vegetation and reduce the intensity of anthropogenic impact in core and connecting areas).

Initially, the authors of the ecological network scheme identified the distribution areas of rare flora, fauna and biota based on the Red Data Book of Ukraine (Fig. 2).

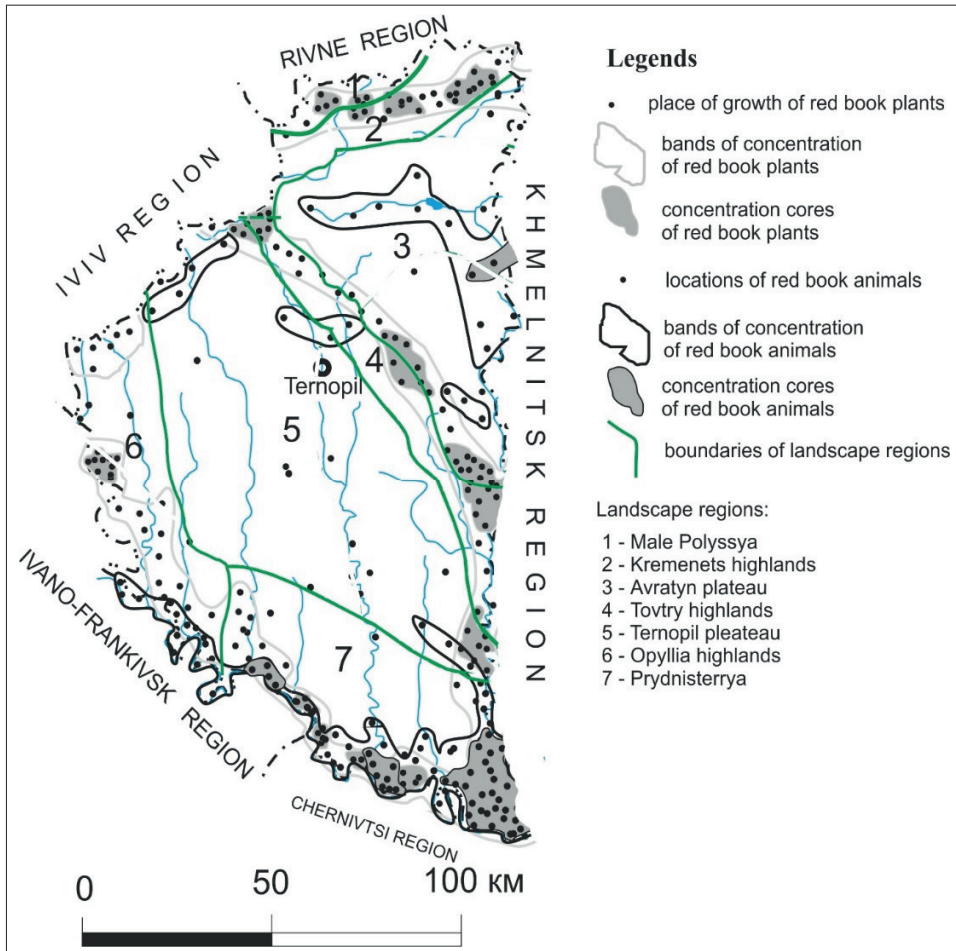


Fig. 2. Areas of concentration of rare plants and animals and their natural habitats
Source: Authors' own study.

The scheme of the regional ecological network of the region was developed by the specialists of the Institute of Ecology of the Carpathians of the Academy of Sciences of Ukraine in cooperation with the research laboratory “Modelling of Ecological and Geographical Systems” of the Department of Geoecology of Ternopil Volodymyr Hnatiuk National Pedagogical University, in which all the authors of this publication are involved. P. Tsaryk prepared and defended his PhD thesis (Tsaryk 2005) and L. Tsaryk published his doctoral thesis (Tsaryk 2009), respectively for the territory of Ternopil region and Podillia.

This publication focuses on the functioning of regional and local elements of the ecological network. In order to collect information, we used the methods of field expeditionary research in 2019–2022, statistical, cartographic, and analysis of the open network of aerospace satellite images Google Earth. Computer visualization methods (Corel DRAW graphic editor software) were used to present the results obtained. As a result of the research, for the first time, the objects that are promising for conservation were identified and substantiated on the territory of the communities of Ternopil region. In determining the category, type of object and its protection regime, the environmental, scientific, recreational, cognitive, aesthetic values of complexes and objects, their typicality and uniqueness were assessed. The resilience of natural complexes to anthropogenic stress, the economic value of the territory and economic losses because of its withdrawal from economic use were taken into account. When determining the areas and boundaries of prospective protected areas, it was considered that the area of the protected territory should ensure the self-renewal of the natural complex and its environmental stability.

RESULTS AND DISCUSSION

The EU Biodiversity Strategy 2030 (2022) requires that at least 30% of the land and 30% of the marine areas be protected. In addition, at least one third of these protected areas (10%) should be under strict protection (biosphere reserves). In Ukraine, at the national level, the average protected area rate is about 7%, in Ternopil region, it is about 10%, in Ternopil administrative district it is 4.44%, and in one third of the territorial communities (TCs) of Ternopil region, it is less than 1%. Such a discrepancy between the indicators of protected areas and their inconsistency with international and European standards puts on the agenda the need for scientific research on the prospects of conservation in order to optimize regional schemes of protected areas and ecological networks.

Fig. 4 shows a map of the network of protected areas in Ternopil region, which consists of 645 territories and objects (as of 1 January 2022), as well

as the eco-network with cores and connecting areas. It should be noted that the protected areas of the region are represented by 10 out of 11 categories of nature reserve fund available in Ukraine, except for the category of biosphere reserves. Forty-one protected areas have the status of national significance, and 604 have local significance. Nature reserves (45.77%), regional landscape parks (31.74%), national nature parks (13.78%) and reserves (7.07%) occupy the largest areas in the nature reserve network. Those protected sites with an area of more than 1,000 ha are nationally designated core areas. It is important that such core areas represent every type of landscape in the region to preserve not only biotic but also landscape diversity. The situation with the protection of the Malopolis and Berezhany landscapes is problematic. Therefore, nature conservation experts proposed to create the Malopolissia Regional Landscape Park and the Berezhanskyi (Opillia) National Nature Park, and dozens of reserves and natural monuments. The large protected areas will be the subject to a strict protection regime. In most of the smaller areas, local administrations and territorial communities will be responsible for ensuring compliance with the environmental protection regime.

At the level of the administrative districts, the ecological network is fragmented, with local core areas of 500–990 ha and local eco-corridors connecting these core areas. The situation with local fragments of ecological networks and basic protected areas is the most problematic. In 72.7% of the territorial communities (analogous to Polish *gminas*), the regime and share of protected area does not meet the established environmental standards (more than 10% of the total area). In the materials of Tab. 1, this corresponds to the territorial communities included in the first and second typological groups with a reserve rate of less than 10% (Tab. 1).

Tab. 1. Typological groups of the territorial communities by the share of protected areas

No.	Typological groups of the territorial communities by the share of protected areas (%)	Number of the territorial communities, units	Share of the total number of the communities (%)
1	Less than 1	20	36.35
2	1–10	20	36.35
3	11–20	9	16.30
4	21–30	2	3.65
5	31–40	2	3.65
6	41–50	1	1.85
7	More than 50	1	1.85

Source: Authors' own study.

Only 15 communities out of 55 have protected areas that meet European standards (Tab. 2, Fig. 3). These are the communities within the region's national nature parks (Dniester Canyon, Kremenets Mountains), the Medobory Nature Reserve, some regional landscape parks, and large reserves (Surazhsky, etc.).

Tab. 2. Protected areas within the territorial communities of Ternopil region

No. in Fig. 3	No. in Fig. 4	Territorial community	Number of protected areas	Area of protected sites (ha)	Share of conservation in territorial community (%)
1	55	Melnysia-Podilska	25	13,816.74	56.51
2	38	Koropets	10	3,996.76	46.10
3	47	Zolotopototska	17	6,226.5	38.89
4	53	Zalishchyky	40	12,703.15	36.25
5	42	Kopychyntsi	9	4,504.92	26.33
6	44	Gusiatyn	7	6,133.74	24.85
7	35	Hrymailiv	7	5,862.61	17.72
8	2	Shumsk	36	11,065.21	17.49
9	49	Tovste	20	5,582.12	16.49
10	1	Kremenets	30	9,136.28	16.25
11	9	Zaloztsi	10	3,759.48	15.03
12	19	Kupchyntsi	6	1,437.86	14.73
13	27	Skalat	11	2,894.28	12.91
14	51	Borshchiv	46	5,262.13	12.78
15	16	Berezhany	21	2,716.10	11.38
16	21	Ternopil	16	1,618.30	9.67
17	36	Monastyryska	19	4,282.13	9.08
18	32	Terebovlya	22	3,464.39	7.86
19	13	Zbarazh	28	4,486.17	7.59
20	45	Zavodske	9	662.90	7.31
21	38	Buchach	26	3,133.71	5.99
22	8	Lanivtsi	17	2,844.16	5.93
23	12	Bila	8	672.67	4.91
24	48	Nagiryansk	11	821.93	4.55
25	15	Naraiivka	21	966.34	4.43
26	43	Khorostkiv	4	747.52	4.05
27	41	Chortkiv	15	603.46	3.99
28	50	Bilche-Zolote	14	395.67	3.80
29	29	Pidhaitsi	17	1,320.55	2.71
30	3	Pochaiv	6	534.22	2.46
31	54	Ivanovo-Puste	6	194.64	2.43
32	43	Vasylkivets	3	398.73	2.34

33	26	Pidvolochysk	11	495.03	1.41
34	30	Zolotniky	2	398.00	1.40
35	20	Pidhorodnie	5	135.62	1.10
36	7	Borsuky	6	144.38	0.95
37	5	Lopushnyany	5	91.18	0.63
38	14	Skoryky	4	163.20	0.62
39	22	Baikivtsi	11	93.93	0.54
40	40	Bilobozhnytsia	8	14.23	0.5
41	10	Zboriv	12	208.71	0.45
42	52	Skala-Podilska	14	81.77	0.44
43	25	Velykobirky	4	27.62	0.42
44	28	Saranchuky	11	92.10	0.41
45	24	Velykohai	9	59.31	0.40
46	6	Vyshnivtsi	7	99.50	0.31
47	31	Mykulintsy	7	62.43	0.26
48	48	Kolindyany	3	18.85	0.12
49	17	Kozova	12	20.73	0.05
50	4	Velikoderkaly	1	7.11	0.04
51	23	Velykoberezovytsia	8	3.19	0.02
52	11	Ozerniany	2	0.11	0.00066
53	33	Ivanivka	1	0.02	0.0002
54	30	Trybukhivka	1	0.02	00002
55	18	Kozliv	0	0	0

Source: (Tsaryk et al. 2023).

The analysis of Tab. 2 shows that it is necessary not only to coordinate the solution of environmental problems of the territorial communities, but also to involve scientists and eco-activists in the implementation of environmental and ecological network tasks.

The materials of the map (Fig. 3) demonstrate the spatial differentiation of the territorial communities by the indicators of conservation. The largest share of protected areas is observed in the Chortkiv district (south of the region), which has the highest rate of protected areas in the region – 15.01%. The most problematic in terms of the level of conservation are Bilobozhnytsia (40), Kolydianka (42), Skala-Podilska (48) and Trybukhivska (54) communities.

In the Ternopil administrative district (central part of the region), protected areas cover only 4.4% of the territory and 24 communities have a low level of nature conservation. In 12 territorial communities with less than 1% of protected areas, the situation with nature protection is the most critical.

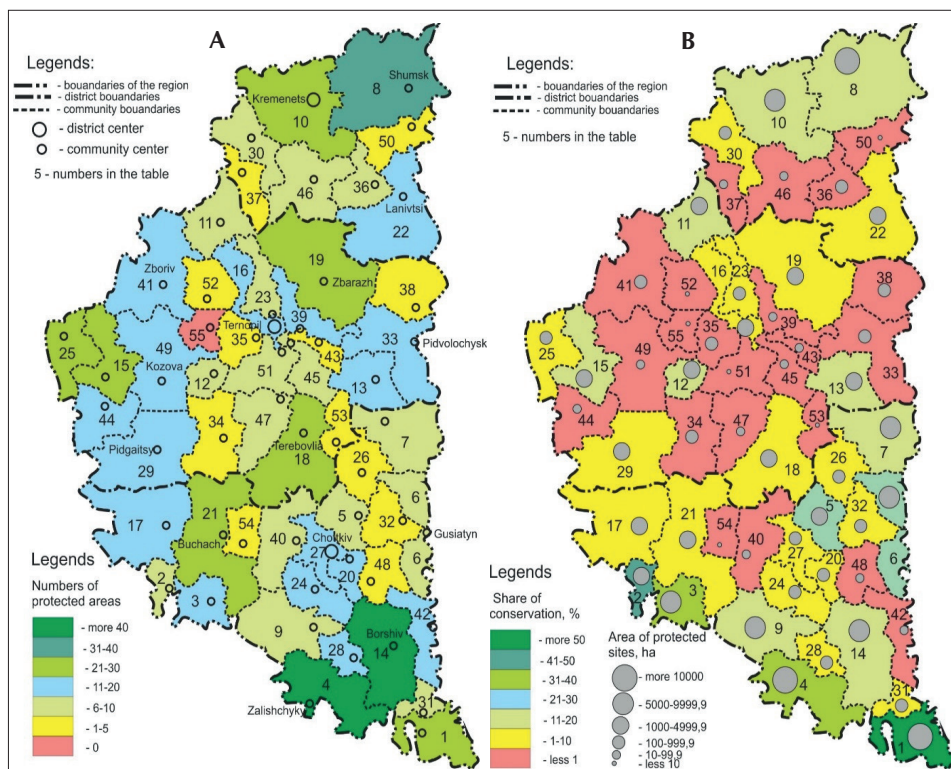


Fig. 3. Number of protected areas (A), degree and area of protection (B)
Source: Authors' own study.

The Kremenets administrative district (northern part of the region) has an average degree of conservation (8.8%). Only four territorial communities in this district have less than 1% of protected areas, and two communities have 2.4–5.9% of their total area protected.

In this regard, together with experts from the nature reserve, national nature parks, and the Kremenets Botanical Garden, a network of promising sites for conservation was proposed, the creation of which will change the situation in the problematic communities for the better.

Based on the results of a set of studies of the geo-ecological condition of the proposed sites, the suitability of landscapes and natural components for their use as protected areas, proposals were agreed on the prospects for the creation of 53 new protected areas in 25 communities with a total area of 39,358 ha (Tab. 3).

The regional landscape parks are the most promising for creation, as their large area will contribute to the growth of the protected status of the individual territorial communities and administrative districts, and will be used for tourism,

Tab. 3. Promising nature protection areas in the territorial communities of Ternopil region

No.	Community	Name of the object	Area (ha)	Total area (ha)
1	Kremenets	Regional landscape park "Malopolisskyi"	2,500.0	6,001.0
		Regional landscape park "Bilokrynytsia"	3,500.0	
		Hydrological natural monument "Source of the Vilia River"	1.0	
2	Lanivtsi	Regional landscape park "Horynskyi"	1,500.0	1,500.0
3	Lopushentsi	Hydrological natural monument "Krynka Spring"	0.2	0.7
		Botanical natural monument "Staroaleksynska Linden Alley"	0.5	
		Regional landscape park "Zbarazhski Tovtry"	1,500.0	
4	Zbarazh	Landscape reserve "Novikivske Tract"	10.0	1,513.8
		Hydrological natural monument "Chernykhivitsi Springs"	0.2	
		Hydrological natural monument "Stryivets Spring"	0.2	
		Hydrological natural monument "Kobylske Spring"	0.2	
		Hydrological natural landmark "Paradove Spring"	0.2	
		Hydrological natural monument "Shymkivski Springs"	3.0	
		Regional landscape park "Pidhaitsyi"	4,500.0	
5	Pidhaitsi	Regional landscape park "Princely Forest"	4,000.0	4,500.0
6	Terebovlya	Hydrological natural monument "Ostaletska Valley of Springs"	1.0	4,002.0
		Park-monument of landscape art "Remains of an ancient park in the village of Suschyn"	1.0	
7	Berezhany	Regional landscape park "Urmansky"	4,000.0	4,000.0
8	Ternopil	Regional landscape park "Zalitzivsko-Vertelkivskyi"	3,500.0	3,680.0
		Park-monument of landscape art "Park of the National Revival"	55.0	
		Park-monument of landscape art "Sopilche Park"	98.0	
		Park-monument of landscape art "Taras Shevchenko Park"	22.0	
		Park-monument of landscape art "Biblical Garden of V. Hnatiuk TNPU"	5.0	
9	Pidvolochysk	Hydrological natural monument "Supranivsky spring"	0.2	0.2
10	Mykulynets	Park-monument of landscape art "Mykulynetskyi Park"	10.0	10.0

11	Velykobirky	Botanical natural monument "Sredne Bog"	7.5	7.5
12	Saranchuki	Hydrological natural monument of local importance "Source of the Bybelka River"	0.2	0.2
13	Ivanivka	Protected tract "Dubyna Lozivetska"	1.5	18.5
		Protected tracts "Stadnytsia Selo", "Hleshchava Selo"	12.0	
		Hydrological natural monument "Kopanka" source of the Taina River in Ivanivka village	5.0	
14	Buchach	Regional landscape park "Baryshskiy"	2,000.0	2,001.0
15	Monastyryska	Hydrological natural monument "Osivetsky springs"	1.0	1.0
		Hydrological natural monument "Vesnivski waterfalls"	1.0	
16	Borshchiv	Regional landscape park "Forest Song"	300.0	300.0
17	Kopychintsy	Kopychynetskyi Landscape Reserve wetlands in Kopychynets	22.0	22.5
		Protected tract "Perebendykha" in the village of Kotivka	0.5	
18	Chortkiv	Regional landscape park "Serednosertskiy"	4,000.0	4,000.0
19	Tovste	Hydrological natural monument "Dzherelo and Stream"	0.2	1,164.2
		Botanical natural monument "Chahor Tract"	210.0	
		Landscape reserve "Over Dzhuryn"	954.0	
20	Melnytsia-Podiliska	Botanical natural monument "Dniester Pearls"	15.0	15.0
21	Skala-Podiliska	Regional landscape park "Nadbruchanske Podillya"	2,500.0	2,500.0
22	Zolotopotok	Hydrological natural monument "Vozyliv waterfalls"	1.0	1.0
23	Koropets	Lemkivske Selo Regional Landscape Park	4,000.0	4,000.0
		Hydrological natural monument "Semeniv Stream"	0.9	
		Hydrological natural monument "Pond in the village of Dzhurynska Slobidka"	52.0	
24	Bilobozhnytsia	Hydrological natural monument "Pond in the village of Polivtsi"	4.0	68.3
		Hydrological natural monument "Pond in the valley of the Bila River"	11.0	
		Hydrological natural monument "Two Springs"	0.2	
25	Kolindiany	Hydrological natural monument "St. Anne's Spring"	0.2	51.0
		Landscape reserve in the village of Kolindiany	51.0	

Source: Authors' own study.

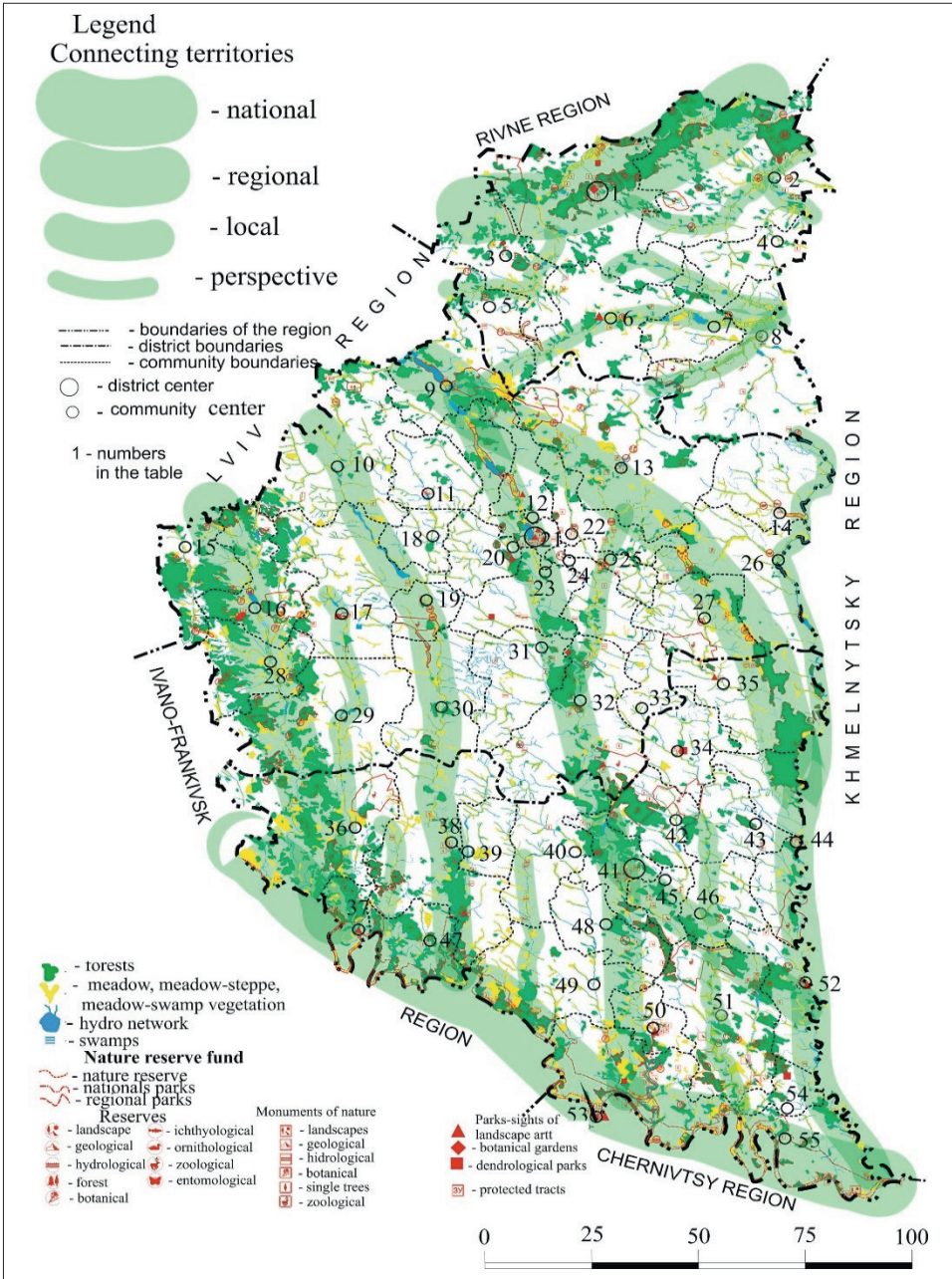


Fig. 4. Protected areas and ecological networks of Ternopil region
Source: (Tsaryk, 2023).

recreation and environmental education. The proposed 13 regional landscape parks (RLPs) will increase the area of the region's nature reserve fund by 37,800 ha and serve as the core areas of the regional ecological network. In addition to the RLPs, the need to create 23 hydrological natural monuments of local significance (83 ha), six parks-monuments of landscape art (191 ha), four landscape reserves (1,037 ha), four botanical natural monuments of local significance (233 ha) and three protected tracts (14 ha) has been substantiated. The creation of these protected areas will help increase the protected area of the Kremenets district from 8.8 to 12.5%, the Ternopil district from 4 to 7%, and the Chortkiv district from 15 to 17%. Overall, the protected area of Ternopil region will increase to 13–14%.

In some territorial communities, the implementation of the proposed measures will increase the protected area by 46%. For example, the creation of the Lemkivske Selo RLP in the Koropets territorial community will ensure that the level of nature conservation in this administrative unit is 96% of the required level. In the Ternopil territorial community, the prospective Zaliztsivsko-Vertelivskyi RLP and four parks-monuments of landscape art will increase the reserve area from 9.7 to 39.5%. In the Kremenets territorial community, the creation of two RLPs, Malopoliska and Bilokrynytsia, will ensure a 30% reserve level (Fig. 5).

The designation of protected areas will help to improve the conservation status of the communities with low indicators. For example, due to the creation of the Pidhaitsi RLP with an area of 4,500 ha, the level of conservation in the Pidhaitsi territorial community will increase from 2.5 to 12.5%. In the Skala-Podilska community, the formation of the Nadzbruchanske Podillia RLP will increase the level of conservation from 0.5 to 14%.

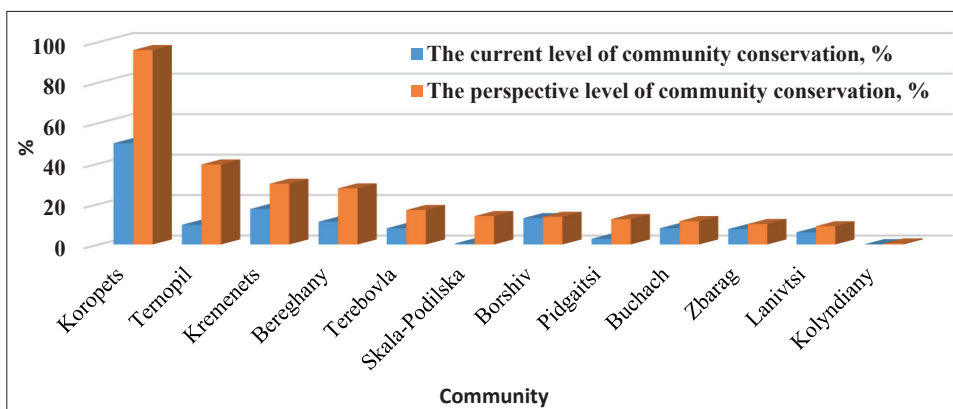


Fig. 5. Current state and prospects of the reserve status of the chosen territorial communities in Ternopil region

Source: Authors' own study.

CONCLUSIONS

Based on the results of the research on optimization of protected and ecological networks, the article notes a low level of protection at the regional and local levels, which is manifested in a significant discrepancy with European and world standards. The article analyses and compares the protected areas and ecological networks at the regional and local levels in the context of the new administrative-territorial structure of Ternopil region. The data obtained showed that 36.5% of territorial communities in the region have a level of protection of less than 1%. The situation with a low level of conservation is unsatisfactory in 16 communities of the Ternopil district and 4 communities of the Kremenets and Chortkiv districts. In order to improve the situation, it is proposed to create 53 new protected areas in 25 communities of Ternopil region with a total area of 39,358 ha. The authors substantiate new core and connecting territories of the local rank of the regional ecological network. This will significantly increase the level of protected areas in the communities, the level of protected areas in the administrative districts will be more than 10%, and the protected area in Ternopil region will reach 13–14%. The study proposes to expand the scheme of the regional ecological network by adding promising core areas (Baryska, Skala-Podilska, Borshchivska, Koropetska, Serednoselyska) and local rank territories (Nad Dzhuryn, Chahor, Moklekiv, Mordovian Forest) and local connecting territories (Baryska, Dzhurynska, Nychlavska, Seretska-Zbruchanska).

REFERENCES

Literature

- Andriienko T. 2004. Mizhderzhavni pryrodno-zapovidni terytoriyi – vazhlyva skladova ekologichnoyi merezhi [Interstate protected areas as an important component of the ecological network]. *Ecological Bulletin* 7–8, 2–5 (in Ukrainian).
- Andriienko T., Malyuk A., Vakarenko L., Grebenyuk Y. 2004. *Formuvashchpnyya regional'ny`ch schem ekomerezhi. Metody`chni rekomendaciyi* [Formation of regional ecological network schemes. Methodological recommendations]. Kyiv (in Ukrainian).
- Baydikov I.A., Paschenko V.M. 2014. Landshaftnyj karkas yak prostorova j strukturna osnova ekomerezhi [The landscape framework as a spatial and structural basis of the ecological network]. *Ukrainian Geographical Journal* 3, 44–50 (in Ukrainian).
- Bayrak O.M. 2012. *Regional`na ekomerezha Poltavshhy`ny* [Regional ecological network of Poltava region]. Poltava: Verstka (in Ukrainian).
- Boyko P.M. 2007. *Prostorovo-chasova struktura bioheotsenoziv Nyzhnodniprovskoho ekokorydoru* [Spatial and Temporal Structure of Biocenoses of the Lower Dnipro Ecocorridor]: dys... kand. biol. nauk: 03.00.16 / UAA; Nikitskyi botanichnyi sad – Natsionalnyi naukovyi tsentr. Yalta. 325 ark. Bibliohr.: ark. 172–213 (in Ukrainian).
- Buček F., Lacina J. 1983. *Vytvareni uzemnich systemu ekologicke stability jako predpoklad zachovani genofondu. Aktualni problemy ochrany fauny* [Creation of territorial systems of ecological

- stability as a prerequisite for the preservation of the gene pool. Current problems of fauna protection]. Brno: UVO CSAV a KSPPOP.
- Derkach O., Kolomiyez G., Kostyshyn V. 2004. Teorety`chni ta prakty`chni aspekty` formuvannya ekomerezhi na pry`klad My`kolayivs`koyi oblasti Ukrainy` [Theoretical and Practical Aspects of Ecological Network Formation on the Example of Mykolaiv Region of Ukraine]. *Scientific Notes Ternopil Volodymyr Hnatiuk National Pedagogical University. Series: Geography* 2(1), 211–215 (in Ukrainian).
- Domaranskyi A. 2004. Koncepciya landshaftnogo riznomanityta v konteksti formuvannya nacional`noyi ekomerezhi [The concept of landscape diversity in the context of national ecological network formation]. *Ukraine: Geographical Problems of Sustainable Development* (vol. 2, pp. 82–84) (in Ukrainian).
- Farion Y.M., Chexnij V.M. 2004. Landshaftoznavchi aspekty` stvorennya ekomerezhi Ukrainy [Landscape aspects of creating an ecological network of Ukraine]. *Ukrainian Geographical Journal* 3, 36–43 (in Ukrainian).
- Hrynevetskyi V.T. 2002. Ponyattya ekomerezhi ta osnovni napryamy yiyi landshaftoznavchogo obgruntuvannya v Ukraini [The concept of an ecological network and the main directions of its landscape substantiation in Ukraine]. *Ukrainian Geographical Journal* 4, 62–67 (in Ukrainian).
- Izakovičová Z., Šwiąder M. 2017. Building ecological networks in Slovakia and Poland. *Ekológia* 36(4), 303–322.
- Jędrzejewski W., Nowak S., Stachura K., Skierczyński M., Mysłajek R. W., Niedziałkowski K., ... Ślusarczyk R. 2011. *Projekt korytarzy ekologicznych łączących Europejską Sieć Natura 2000 w Polsce*. Białowieża: Zakład Badania Ssaków PAN.
- Kagalo O.O. 2009. Rozbudova ekologichnoyi merezhi v Ukraini: pryncypy, problemy, perspektyvy [Creating an Ecological Network in Ukraine: Principles, Problems, and Prospects]. In *Proc. of the 9th scientific conference of young scientists "Scientific basis for the conservation of biotic diversity"* (pp. 10–13). Lviv: Institute of Ecology of the Carpathians of the National Academy of Sciences of Ukraine (in Ukrainian).
- Karpiuk Z.K. 2014. *Vnutrishnia funktsionalna struktura ekolohichnoi merezhi Volynskoho Polissia (u mezhakh Volynskoi oblasti)* [The Internal Functional Structure of the Volyn Polissia Ecological Network (within Volyn Region)]; avtoref. dys.... kand. heohr. nauk: 11.00.11 / Lviv nats. un-t im. Ivana Franka (in Ukrainian).
- Kondratiuk T.M. 2019. *Pravovyi rezhyim zemel natsionalnoi ekolohichnoi merezhi Ukrainy* [Legal Regime of the Lands of the National Ecological Network of Ukraine]. Kyiv (in Ukrainian).
- Koniakina S.M. 2014. Rehionalna ekomerezha Cherkaskoi oblasti: heohrafichni aspekty formuvannya i rozvytku. [Regional eco-commerce of the Cherkasy region: Geographical aspects of formation and development]. *Physical Geography and Geomorphology* 3, 89–100 (in Ukrainian).
- Koren M., Steffek J., Sabo P. 1996. *Návrh národnej ekologickej siete Slovenska – NECONET*. Bratislava: Nadácia IUCN.
- Korzyk V. 2004. Ekologichna merezha chy` ekolandshaftna merezha [Ecological network or ecological landscape network]. In *Ukraine: Geographical Problems of Sustainable Development* (vol. 2, pp. 58–60) (in Ukrainian).
- Liro A. 1995. *Koncepcja krajowej sieci ekologicznej ECONET-Polska*. Warszawa: IUCN Polska.
- Liro A. (Ed.). 1998. *Strategia wdrażania krajowej sieci ekologicznej ECONET-Polska*. Warszawa: IUCN Polska.
- Omelchuk O.S. 2016. *Zaplavni fitosystemy u strukturi richkovo-dolynnykh korydoriv ekomerezhi Zakarpattia* [Floodplain Phytosystems in the Structure of River-Valley Corridors of Trans-Carpathians]; avtoref. dys.... kand. biol. nauk: 03.00.16. Derzh. akad. pisliadyplom. osvity ta upr. Kyiv.

- Prychodko M.M. 2004. Regional`na ekologichna merezha yak factor opty`mizaciyi landshaftiv Ivano-Frankivs`koyi oblasti [Regional Ecological Network as a Factor of Landscape Optimization in Ivano-Frankivsk Region]. *Scientific Notes Ternopil Volodymyr Hnatiuk National Pedagogical University. Series: Geography* 2(1), 215–221 (in Ukrainian).
- Samoilenko V., Kohoda N. 2006. *Geoinformacijne modelyuvannya ekomerezhi* [Geoinformation modeling of the ecological network]. Kyiv: Nika-Centr (in Ukrainian).
- Shelyag-Sosonko Y.R. 1999. *Rozbudova ekomerezhi Ukrayiny* [Development of Ukraine's ecological network] United Nations Development Program. Project "Ecological networks". Kyiv (in Ukrainian).
- Shelyag-Sosonko Y.R., Grodzynskyi M.D., Romanenko V.D. 2004. *Koncepciya, metody i kriterii sozdaniya ekoseti Ukrainy* [The concept, methods and criterions of the Ukraine's ecomerzhi creation]. Kyiv: Fitosotziotzentr (in Ukrainian).
- Tkachov A., Ivanenko I. 2000. *Konceptual`ni osnovy` formuvannya nacional`noyi ekomerezhi Ukrayiny* [Conceptual framework for the formation of the national ecological network of Ukraine]. *Ridna Nature* 2, 50–55 (in Ukrainian).
- Tsaryk L. 2003. Zberezhennya landshaftnogo riznomanittya Zachidnogo Podillya u konteksti formuvannya regional`noyi ekomerezhi [Conservation of the landscape diversity of Western Podillia in the context of the formation of a regional ecological network.]. In *Proc. of scientific conference "The role of protected areas in Western Podillia and the Oitsovka River in the conservation of biological and landscape diversity"* (pp. 107–114). Grymajliv – Ternopil: Lileya (in Ukrainian).
- Tsaryk L. 2009. *Geografichni zasady` formuvannya i rozvy`tku pry`rodochoronny`ch sy`stem Podillya: konceptual`ni pidchody`, prakty`chna realizaciya* [Geographical foundations of the formation and development of nature protection systems of Podillia: conceptual approaches, practical implementation]. Ternopil: Pidruchn. i posibn. (in Ukrainian).
- Tsaryk L., Koval`chuk I., Tsaryk P., Kuzy`k I., Tsaryk V. 2023. Pry`rodoochoronni standarty` YeS – nacional`ni i regional`ni realiyi [EU environmental standards – national and regional realities.]. *Ukrainian Geographical Journal* 4 (in Ukrainian).
- Tsaryk P. 2005. *Regional`na ekomerezha: geografichni aspekty` formuvannya i rozvy`tku (na materialach Ternopil`s`koyi oblasti)* [Regional Ecological Network: Geographical Aspects of Formation and Development (Based on the Materials of the Ternopil Region)]. Ternopil: TNPU (in Ukrainian).
- Vorovka V. 2004. Ekologo-geografichni pidchody do organizaciyi ekomerezhi Zaporizkoyi oblasti [Ecological and geographical approaches to the organization of the ecological network of Zaporizhzhia region]. *Scientific Notes Ternopil Volodymyr Hnatiuk National Pedagogical University. Series: Geography* 2(1), 206–211 (in Ukrainian).
- Zarubina A.V. 2010. *Heohrafichni osnovy formuvannya i rozvytku rehionalnoi ekomerezhi na terytorii Kirovohradskoi oblasti* [Geographical Bases of Formation and Development of the Regional Ecological Network in Kirovograd Region]. Dys... kand. nauk: 11.00.11 (in Ukrainian).
- Zinko Y., Kravchuk Y., Brusak V., Kazakov V. 2000. *Koncepciya transyevropejs`ky pryrodoochoronnyh poyasiv ta rozbudova ekologichnoyi merezhi v Ukrayini* [The concept of trans-European nature protection belts and the development of an ecological network in Ukraine]. *Ukraine and Global Processes: Geographic Dimension* 3, 24–27 (in Ukrainian).

Netography

Biodiversity strategy for 2030. Retrieved from https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en (access: 21.09.2023).

- EEA. 2009. Indicative map of the Pan-European Ecological Network for central and eastern Europe. Retrieved from <https://www.eea.europa.eu/data-and-maps/figures/indicative-map-of-the-pan-european-ecological-network-for-central-and-eastern-europe> (access: 28.12.2023).
- Pro Zahalnodержavnu programu formuvannia natsionalnoi ekolohichnoi merezhi Ukrainy na 2000–2015 roky. 2000. (Vidomosti Verkhovnoi Rady Ukrainy (VVR), 2000, No. 47, st. 405). Verkhovna Rada Ukrainy [Law “On the State Programme for Development of National Ecological Network of Ukraine for 2000–2015”]. Retrieved from <https://xn--80aagahqwyibe8an.com/ukrajiny-zakony/zakon-ukrajini-pro-zagalnodержavnu-programu-2000-16721.html> (in Ukrainian) (access: 23.12.2023).
- Proekolohichnu merezhu Ukrainy. 2004. (Vidomosti Verkhovnoi Rady Ukrainy (VVR), 2004, No. 45, st. 502) [Law of Ukraine “On Ecological Networks”]. Retrieved from <https://zakon.rada.gov.ua/laws/show/1864-15#Text> (in Ukrainian) (access: 14.09.2023).
- Vseyevropejska strategiya zberezheniya biologichnogo ta landshaftnogo riznomanittya [Pan-European Strategy for the Conservation of Biological and Landscape Diversity]. 1998. Retrieved from https://zakon.rada.gov.ua/laws/show/994_711#Text (in Ukrainian) (access: 14.09.2023).