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## Trubizh water management paradynamic landscape-technical system

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### ABSTRACT

**Formulation of the problem.** The incorporation of any reclamation system into the existing landscape complexes leads to increased contrast of environments and activation of material-energy-information flows. The construction of the reclamation system in the basin of the Trubizh River radically changed the landscape structure of the riverbed and floodplain, which led to a significant impact on the adjacent landscape complexes. Trubizh water management landscape-technical system goes beyond one river valley, so ill-considered economic activity can lead to deterioration of the ecological condition of adjacent landscape complexes. The study of anthropogenic paradynamic connections between different landscape structures will provide a better understanding of the functioning of the Trubizh water management landscape-technical system and the peculiarities of interaction with adjacent landscapes, which, in turn, will predict its further development and develop ways of rational use.

**Purpose.** The purpose of the article is to study the Trubizh water management landscape-technical system as an anthropogenic paradynamic system.

**Methods.** The process of transformation of natural paradynamic connections into anthropogenic and formation of anthropogenic paradynamic landscape complexes with the help of databases of GIS packages SAS.Planet.Release and GoogleEarthPro is analyzed. The research was conducted using the following methods: system analysis, generalization, comparative-geographical, final results, cartographic, GIS-method. To analyze anthropogenic paradynamic landscape complexes and anthropogenic paradynamic connections between them, GIS packages were used, with the help of databases the process of restructuring of natural paradynamic connections into anthropogenic and formation of anthropogenic paradynamic landscape complexes was analyzed.

**Results.** Because the Trubizh water management landscape-technical system extends beyond one river valley (covering floodplain, floodplain terrace and slope types of areas), it unites the entire river basin into a single whole with the help of anthropogenic paradynamic connections. This poses a threat to the environment, as ill-considered economic activities can lead to the deterioration of the ecological condition of landscape complexes both within one basin and have a negative impact on adjacent basins.

Factors in the functioning of paradynamic connections are due to the presence of external and internal links, contrast and spatial dependence between the interacting landscapes complexes. External anthropogenic paradynamic connections include: *thermal* – the effect of solar radiation on the landscape; *mechanical* – gravitational influence of watersheds on the low-lying channel-floodplain complex; *aquatic* – the influence of surface and groundwater on the supply of rivers and the chemical composition of water; *social* – the impact of economic activity. The internal anthropogenic paradynamic connections include: *biocosmic* (interaction between living and nonliving matter) and *biotic* (biocenosis interaction between components).

**Scientific novelty.** The study of paradynamic connections in this complex natural economic structure will provide a better understanding of the features of its functioning and decline, to develop ways of rational use and predict its further development.

**Keywords:** *Trubizh water management landscape-technical system, paradynamic system, paradynamic connections, spatial dependence, contrast, external and internal connections, rational nature management.*

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**Formulation of the problem.** Landscape dynamics is not a new problem. Geographers and landscape scientists have been working on it for almost a century. Already at the beginning of the 20<sup>th</sup>, the landscape was often considered a dynamic formation [10, 24, 30, 33]. L. S. Berg noted: «Due to the fact that landscapes are not something immutable over time, the geographer must keep in mind not only the statics, but also the dynamics of landscapes, that is, to study

their change» [7]. However, for a long time the interest in understanding the dynamics of landscapes was low, and only from the early 70s of the 20<sup>th</sup>, the problem of the dynamics of landscape complexes became almost central in landscape research. The VII All-Union Conference on Landscape Studies, held in Perm (Russia) in 1974, was entirely devoted to theoretical, methodological and practical aspects of landscape dynamics. At the same time, despite the significant

number of publications on landscape dynamics, a number of problems have not been solved, including an unambiguous understanding of the concept of «landscape dynamics». This can be verified by analyzing the concept of landscape dynamics in the most authoritative geographical sources of the late 20<sup>th</sup> – dictionaries and encyclopedias [35, С. 117; 28, С. 69]. In the Geographical Encyclopedia of Ukraine [9] the dynamics of the landscape is not mentioned at all. At the end of the 20<sup>th</sup> O. M. Marynych, defining the main tasks and prospects for the development of physical geography, noted that «the study of theoretical problems, methodological and practical issues of landscape dynamics requires accelerated development» [22, С. 47].

However, even at the beginning of the 21<sup>st</sup>, this problem was not properly reflected in the research of landscape scientists in Ukraine. There are especially few researches devoted to the dynamics of anthropogenic landscapes, although they have intensified over the past decade [12, 14, 15, 20, 21, 36, 37]. Experience shows that the dynamics of anthropogenic landscapes should be studied in three closely interrelated aspects: retrodynamic analysis, the internal dynamics of the landscape complex and its paradyamic connections with the environment [12]. Each of them needs separate consideration. This study focuses on the paradyamic connections between different types of anthropogenic landscape complexes as the least studied in modern landscape science. Model structure «Trubizh water management landscape-technical system – adjacent Forest-Field». The study of paradyamic connections in this complex natural economic structure will provide a better understanding of the features of its functioning and decline, to develop ways of rational use and predict its further development.

**Analysis of recent research and publications. Selection of previously unsolved parts of the overall problem.** An analytical review of the publications of foreign scientists shows that most of them are devoted to the study of hydrological objects as dynamic systems [1, 5]. Almo Farina [3] considers the landscape as a powerful model for studying the dynamics of landforms, organisms and human activities (land use) and notes that «landscape dynamics» refers to every change that occurs in the physical, biological and cognitive assets of the landscape. Jacques Baudry [2] points out that the landscape does not remain static in space and time and its scales change from a month to millennia and emphasized the importance of the acquired knowledge about changes in the landscape, which, first of all, is necessary for understanding and managing the environment. The issue of the perspective of river management in the Anthropocene era is studied by J. Horacio García, Alfredo Ollero, Askoa Ibisate, Ian C. Fuller, Russell G. Death, Hervé

Piégayf [4]. Scientists consider rivers as natural and dynamic systems and emphasize an integrated approach to the creation of a new river landscape, which they propose for the Anthropocene era. An integrated approach should be based on the use of discussions between an interconnected network of actors, regulators, scientists and natural and cultural values. The collective research of Polish scientists [6] deserves attention, where in separate (5, 6 and 7) chapters the current state and paradyamic connections of the Polish and Opil landscape complexes of the western part of Poland, which are similar to the landscape complexes of the Forest-Steppe Poles in a number of features, are considered of Ukraine. However, anthropogenic factors in the formation of paradyamic interconnected have been considered only partially.

The idea of the existence of integral paradyamic landscape complexes in nature at the same time as the development of the concept of «catena» by A. Koneicher was developed in the works of F. M. Milkov [23, 25]. According to his definition, a paradyamic landscape complex is a system of spatially contiguous regional or typological structures characterized by the presence of an exchange of matter and energy between them [24]. Later, F. M. Milkov and his students substantiated that paradyamic landscape systems are formed as a result of the joint manifestation of the main directions of the physical-geographical process – zonal, azonal, vertical and economic activity of people [13]. At the end of the 20<sup>th</sup> anthropogenic paradyamic landscape complexes in Ukraine began to be investigated by G. I. Denisyk, A. V. Gudzevich – between mining and adjacent landscapes [11, 16, 18], water management paradyamic landscape systems of the Right Bank of Ukraine – G. I. Shwebs [34], G. I. Denisyk [14], Yu. V. Yacentyuk [36]; on the example of an individual paradyamic landscape system «Dniester Reservoir – Adjacent Landscapes» – M. V. Dudchak [19]. Valley-river paradyamic systems of the Southern Bug, and then of the rivers of the Right Bank of Ukraine, were studied by O. D. Lavryk [14, 20, 21]. The original searches of the Azov anthropogenic paradyamic system within Ukraine were carried out by V. P. Vorovka [8]. There are still few studies of paradyamic connections between the reclamation systems of the Forest Steppe (Lysopol) and the adjacent landscapes [33].

**The purpose of the article** is to investigate the Trubizh water management landscape-technical system as an anthropogenic paradyamic system.

**Materials and methods of research.** In the process of research of the Trubizh paradyamic water management landscape-technical system, the following methods were used: system analysis (establishment of paradyamic anthropogenic connections between paradyamic anthropogenic landscape comp-

lexes); generalization (based on the received data on paradyamic anthropogenic landscape complexes the conclusion on paradyamic anthropogenic landscape system in general is made); comparative-geographical (analysis of spatial and temporal differences between natural and anthropogenic paradyamic connections in the study area); final results (establishment of features of formation of paradyamic anthropogenic landscape system and paradyamic anthropogenic connections between its paradyamic anthropogenic landscape complexes on the basis of available results only); cartographic (information processing and map construction) and GIS-method (analysis of changes in natural landscape complexes and their transformation into anthropogenic and, accordingly, transformations of paradyamic connections).

The materials used in the article were obtained in the process of analyzing archival and cartographic materials and own field research. This made it possible to draw up a preliminary, overview version of the maps for further detailed field research. With the help of the GIS packages SAS.Planet.Release and GoogleEarthPro, the existing cartographic material was clarified and the routes of field investigations and field research areas of paradyamic connections between different types of landscape complexes, both within the Trubizh water management landscape and technical system, and its adjacent ones were determined forest field landscape complexes. In the future, the materials of the 2016, 2018, 2020 field studies on the development of paradyamic connections were monitored monthly at a specified time using the specified GIS packages. Recorded changes, both in the landscape complexes of natural areas, and in the relationships between them, were verified in the process of field landscape studies. More often and more clearly, such paradyamic relationships were manifested as a result of changes in microclimatic indicators, the state and nature of the use of soil and vegetation cover, as well as the functioning of reclamation hydrotechnical structures.

#### **Presentation of the main research material.**

Any reclamation systems are not built in an isolated space, but fit into a complex mosaic of existing landscapes. At the same time, they are not only neighbors with fields, pastures or oak groves on the slope, but are in close cooperation with them. The very appearance of the reclamation system in the relatively balanced structure of the existing landscapes is accompanied by an increase in the contrast of the environment and the intensification of the exchange of matter and energy between them. Active and complex paradyamic systems are formed, the peculiarities of development and dynamics of which are determined both by the dynamics of the reclamation systems themselves and by the peculiarities of the dynamics

of previous and adjacent landscapes. The paradyamic connections of the reclamation systems of swampy river headwaters differ significantly from those in the lower reaches of rivers formed within wide wetlands and swamps or on terraces. The Trubizh water management drainage-humidification landscape-technical system is no exception.

Trubizh water management system (TVMS) is a reclamation system of bilateral action within Kyiv and Chernihiv regions (Fig. 1). It was built during 1954–1966. The area of reclaimed lands is 37,6 thousand hectares (one of the largest in the Forest-Field zone of Ukraine), in particular in the floodplain of Trubizh – 28,3 thousand hectares, Nedra – 4,2 thousand hectares, Karan – 5,1 thousand hectares. Drainage and humidification is carried out by means of open canals with a total length of 1238 km and closed drainage with an area of 12,5 thousand hectares. It is raining on an area of 732 hectares. The system has 1125 different hydraulic structures, including 827 control locks, of which 19 are on the main canal (length 216 km) [26].

At the beginning of the third decade of the 21<sup>st</sup>, the Trubizh water management drainage-humidification landscape-technical system was desolate. Only some of its components are supported in the «working condition» – small (0,5–1,5 km) sections of canals and underground drainage systems (up to 300–420 ha), which prevent waterlogging of reclaimed areas, dams and pumping stations. Landscape research conducted during 2018–2021 allow us to conclude that the paradyamic connections between the Trubizh reclamation landscape-technical system and the adjacent landscape complexes (natural, natural-anthropogenic and anthropogenic) will continue in one way or another.

#### **The factors of functioning of paradyamic interrelations are caused by natural features of development of interacting landscape complexes.**

*Spatial dependence.* Trubizh water management drainage-humidification landscape-technical system is built within Trubizh Polissya. This Polissya is a component of the Forest-Steppe (Forest-Field) Polissya strip, which forms a trinity (Opille-Polissya Ribbon, Main Landscape Frontier, Forest-Steppe Polissya Ribbon) structure of the Middle Landscape Belt of the Eastern European Plain [17]. The presence of mixed-forest landscape complexes in the structure of forest-steppe ones, already at the stage of their natural development, led to the intensification of paradyamic connections between them. Each of these landscape complexes differs in a unique and complex structure and a variety of geocomponents forming them [13]. Gradually, longitudinal and transverse paradyamic connections developed between them, most clearly expressed in the systems «river valley – adjacent territories», in particular between the Polis-

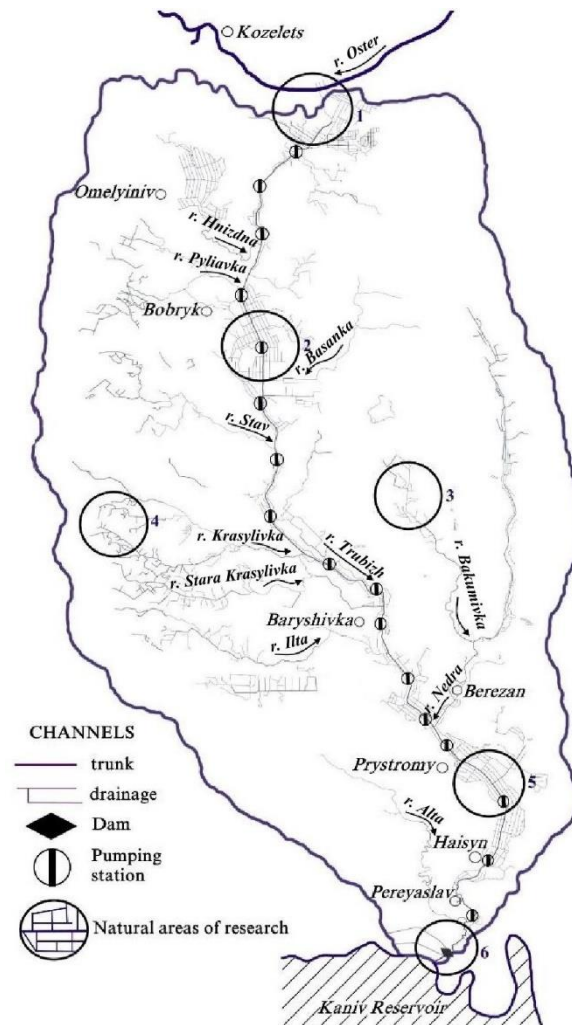


Fig. 1. Scheme of Trubizh drainage-humidification landscape-technical system

sya landscape of the lower part of the Trubizh river valley and the adjacent Forest-Steppe.

*Contrast.* The natural contrast between Trubizh Polissya and the adjacent Forest-Steppe is primarily due to the affiliation of the contacting landscape complexes to different orographic structures. Heights (Poltava Upland) and plain (Dnieper Lowland) landscape complexes, rising above the lowland forests of the Dnieper, including Trubizh, together form a single landscape paradynamic system of orographic type [27]. The difference in the height levels of the paradynamic system «Trubizh Polissya – adjacent Forest-Steppe» is due to neotectonic and modern vertical movements of the earth's crust with the simultaneous deepening of river valleys. The undulating watersheds of the plains and heights of the Left Bank Dnieper are located in areas where the intensity of modern tectonic movements is up to  $\pm 3\text{--}5$  mm/year, most often  $\pm 1\text{--}2$  mm/year [31].

The active process of continental denudation also contributed to the contrast and, accordingly, to the formation of the paradynamic system «Trubizh Polissya – adjacent Forest-Steppe». Eluvium was formed on the heights, in the adjacent river and ancient valleys of glacial runoff (Middle Dnieper) – the

accumulation of deluvial-alluvial deposits. That is, the different altitude level of Trubizh Polissya and the adjacent heights (30–80 m), due to which the paradynamic system was formed, is a consequence of the newest and modern tectonic-geomorphological processes (Fig. 2).

In this system, at insignificant (5–7 km) distances, there is also a change in high-altitude watershed landscape complexes with fertile dark-colored soils of the Forest-Steppe, lowland swampy landscapes of Trubizh Polissya with relatively poor humus light gray, sod-podzolic and peat-swamp soils. In the paradynamic landscape system «Trubizh Polissya – adjacent Forest-Steppe» contrasting (1–2°C) were microclimatic conditions, water regime, flora and fauna [29].

*External and internal connections.* The interaction of the lowland landscape of Trubizh Polissya with the adjacent landscape of the Forest-Steppe is carried out through internal and external connections. It is caused by influence of various natural factors (fig. 3). In particular, the impact of solar energy on the landscape of Trubizh Polissya and adjacent areas of the Forest-Steppe is mostly manifested in their temperature regime. Analysis of climatic directories

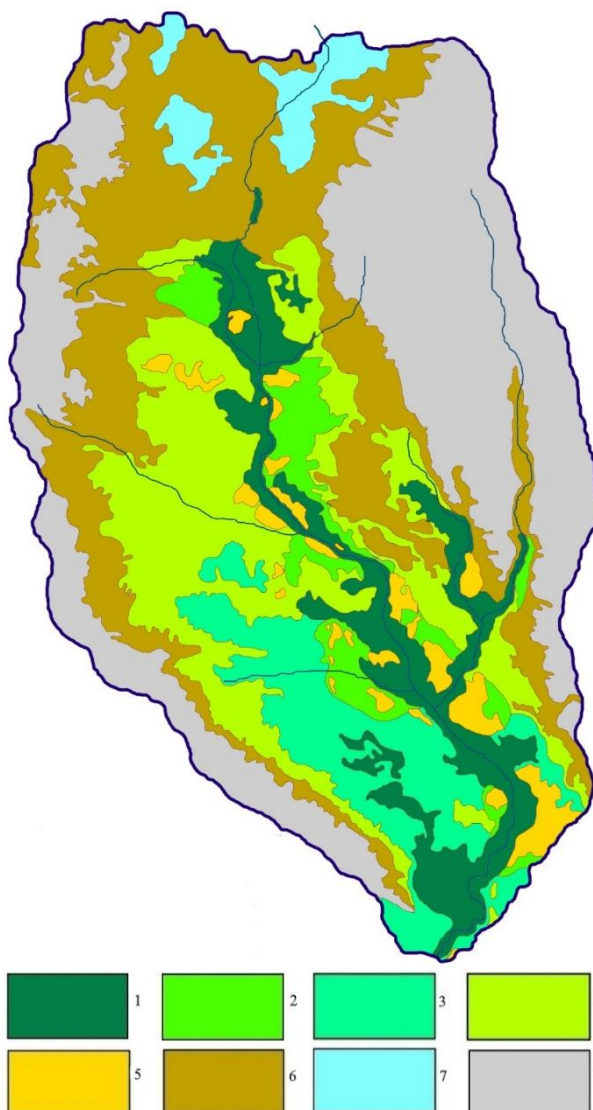


Fig. 2. Geomorphological structure of the territory of the Trubizh river basin:  
 1 – floodplain (90–100 m); 2 – high floodplain (95–105 m); 3 – low floodplain terrace (buried) (100–105 m);  
 4 – high floodplain terrace (buried) (100–110 m); 5 – pine terrace (110–115 m);  
 6 – slopes; 7 – passage valley; 8 – plakor

and materials of regional (meteorological station of the Central Geophysical Observatory in Boryspil and United Hydrometeorological Station in Baryshivka) meteorological stations shows that the adjacent plains and heights receive more heat than lowland fields. During the warm period, the difference in the sum of temperatures of these areas reaches 35–50°C. Within Trubizh Polissya, frosts are more frequent (12–14%) and their duration is longer in spring and autumn. Compared to the adjacent Forest-Steppe, the humidity is higher here (more by 10–20 days with a relative humidity of 80%) and fogs are formed more often.

**Anthropogenic factors in the functioning of paradyamic landscape connections.** Since the 1960s, the exchange of matter, energy, and information in the paradyamic system «Trubizh Polissya – adjacent Forest-Steppe» has been under the ever-increasing influence of anthropogenic factors. Based

on Trubizh Polissya, the Trubizh drainage-humidification system was gradually built up, the main parameters of which were mentioned earlier. Between it and the adjacent Forest-Field, new and previously acquired connections are being formed. The informativeness of natural geocomponents and landscape complexes decreases significantly. These losses are offset by the growth of information due to technogenesis. In general, the state of the landscape of the adjacent Forest-Steppe and the landscape of Trubizh Polissya is changing. A new anthropogenic paradyamic mesosystem «Trubizh water management landscape-technical system – adjacent Forest-Field» is being formed. External mechanical connections are most active in this system.

*Mechanical* anthropogenic paradyamic connections are manifested due to changes in the landscape structure of watersheds, terraces, floodplains

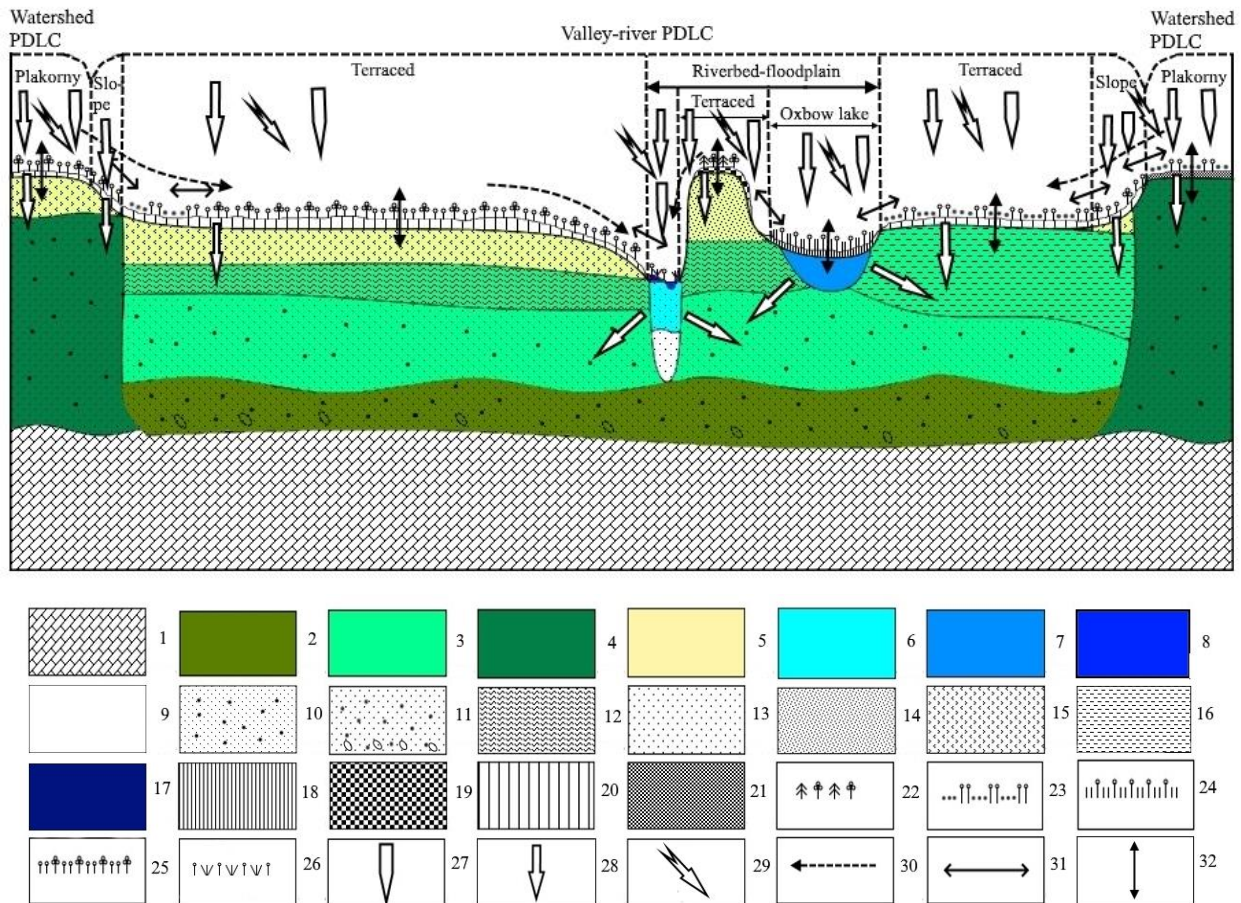


Fig. 3. Paradynamic anthropogenic landscape system

«Trubizh water management landscape-technical system – adjacent Forest-Field».

**Landscape profile:** 1 – pre-Quaternary formations (siltstones, clays, sands); 2 – modern alluvial deposits (Trubizh degree); 3 – modern alluvial deposits (Vilshan degree); 4 – modern alluvial deposits (Cherkasy degree); 5 – eluvial and aeolian-deluvial deposits; 6 – alluvial-swamp sediments of floodplains; 7 – lake-swamp deposits; 8 – surface waters (riverbed); 9 – alluvial deposits of floodplains; 10 – multi-grained sands; 11 – multi-grained sands with pebbles; 12 – clay sands; 13 – fine-grained sands; 14 – sands, sandy loams; 15 – light loess woody; 16 – loam; 17 – peat-swamp soils and peatlands; 18 – meadow-chnozem surface-saline light loam soils in combination with meadow-swamp and meadow-saline; 19 – sod-slightly podzolic sandy and clay-sandy soils; 20 – light gray, gray and dark gray podzolic light loam and sandy soils; 21 – chernozems typical low-humus and low-humus light loam; 22 – oak-pine (eagle, herbaceous) and pine forests; 23 – meadow steppes and steppe meadows and agrocenoses in their place; 24 – saline and brackish meadows in combination with agrocenoses in their place; 25 – agrocenoses mainly in place of beech, oak, oak-hornbeam forests; 26 – agrocenoses on the site of drained grass bogs and swampy meadows.

**Paradynamic connections.** *External:* 27 – social; 28 – aquatic; 29 – thermal; 30 – mechanical.

*Internal:* 31 – biotic; 32 – biocosmic

and riverbed. Increase of anthropogenically caused erosion processes is observed everywhere, despite insignificant relative heights within the river valley of Trubizh (watershed PDLC – 140–120 m asl and channel-floodplain PDLC – 110–90 m asl). In the Trubizh basin, the intensity of planar runoff on plowed slopes averages 17,5 t/ha per year. The development of linear erosion processes is due to the nature, mainly, of agricultural and reclamation activities. In the coastal strip of the river Trubizh it is widespread stormwater erosion, due to the destruction of soils due to erosion of shores and coastal slopes by wastewater flows,

which did not have time to seep into the soil due to lack of grassy vegetation (plowing, trampling by cattle, recreational regression, etc.). All these erosion processes contribute to siltation and lowering of the water level in the Trubizh riverbed.

*Aquatic* anthropogenic paradynamic connections are formed in the conditions of over-regulation of the riverbed, its transformation into a main canal and the construction of a reclamation network that extends beyond the floodplain and terrace types of terrain. Due to the stabilization of the water regime in the canals and the lowering of the groundwater level,

there is a decrease in the substance-energy exchange between the floodplain and adjacent landscape complexes. Aquatic anthropogenic paradynamic connections are also manifested during the transfer of water from the Oster basin paradynamic landscape complex to Trubizh, which is caused by the latter's water deficit.

Because of the construction of the Trubizh water management landscape-technical system around the drainage canals, a hydrogeological field was formed, which manifests itself as a drainage zone. The larger the area of the landscape-technical system, the more blurred the boundaries of the paradynamic anthropogenic landscape system. The manifestation of the hydrogeological field is traced in the direction from the «central place» to the peripheral landscape complexes and gradually at a distance of 1–3 km reaches zero, which is the limit of Trubizh paradynamic water management landscape-technical system [37].

The formation of *thermal* anthropogenic paradynamic connections is due to the difference in average air temperature between plowed watersheds and reclaimed floodplains. The average temperature in July on the watersheds is 20°C, and on the floodplain – 18°C. The pattern of distribution of the average January temperature is followed in the same direction and is -5°C and -7°C, respectively. Peat-swamp soils, even plowed, need more heat to warm up, so the number of days with frost on these soils is 2–2,5 times more than on mineral watersheds. The duration of the frost-free period near the riverbed and floodplain is much shorter (156–160 days) than on the slopes (170–175 days).

The functioning of the landscape paradynamic mesosystem «Trubizh water management landscape-technical system – adjacent Forest-Field» is not only under the influence of external natural and social connections. Internal connections are no less important here. Biocosmic connections in the landscapes of the «Trubizh water management landscape-technical system – adjacent Forest-Field» mesosystem are manifested through the biological cycle of substances, which covers the soil and various tiers of vegetation with the animals living in them. Photosynthesis, respiration of animals, plants and microorganisms are involved in the cycle, and due to the decomposition of plants and animals, biogenic accumulation of humus and microelements in the soil horizon is carried out. As a result of mineralization, humification, deciduous, and grass litter enriches the soil with mineral nutrients. In the landscapes of the Forest-Field, due to a more intensive washing regime and the presence of an active aerobic environment, the process of decomposition of plant remains is rapid. Humification of deciduous forests in Forest-Field Polissya, in particular in Trubizh, is slowed down by the presence of an acidic environment and significant wetlands. This is manifested in various

enrichment of soils with humus: from 3–4% in dark gray and podzolic chernozems of the Forest-Steppe to 1–1,5% in sod-podzolic soils of the Forest-Field Polissya.

Biocosmic connections in the landscapes of the paradynamic mesosystem «Trubizh water management landscape-technical system – adjacent Forest-Field» can be traced in the flow of substances from the underground tier to the terrestrial in the form of carbon dioxide released from the soil. Equally important is the role of animals in the biocosmic connections, which function in the soil and actively move various substances vertically. The flow of substances up the soil profile is much larger than the flow directed downwards [15]. Earthworms and burrowing animals do a particularly significant job in this direction. The soil raised to the surface is enriched with mineral compounds (carbon, nitrogen, flint, iron, aluminum, calcium, magnesium), which are dispersed in other landscape complexes due to exogenous processes. Thus, biocosmic connections in different landscapes, in particular Forest-Field and their Polissya, are interconnected and act as unifying for the whole paradynamic mesosystem «Trubizh water management landscape-technical system – adjacent Forest-Field».

Biotic connections in the landscape paradynamic mesosystem «Trubizh water management landscape-technical system – adjacent Forest-Field» are most manifested between plants and animals, as well as different species of animals. This is observed not only in their trophic connections, but also in the migratory features of plants and animals. The eroded and mosaic relief of Forest-Field with variegated soil cover facilitates the latter. Biotic connections are also influenced by the quantitative and species composition of organisms. Drained and plowed areas of heights with small areas, often dissected by fields, areas of oak and hornbeam forests are less favorable for wild ungulates than Forest-Field Polissya. Within Trubizh Polissya, on an area of 100 km<sup>2</sup>, there are on average 16 to 30 European roe deer, more than 5 European moose, 6–15 wild pigs, etc. Beavers, muskrats are actively breeding. In the territories of the Forest-Steppe adjacent to Trubizh Polissya, these indicators are lower: European roe deer – 11–15; European moose – 1–5; wild pigs – 4–5 [27].

**Conclusions.** The formation and functioning of natural (natural, natural-anthropogenic and anthropogenic) paradynamic systems is a complex, long and still poorly studied process. Modern water management paradynamic landscape-technical systems were built not only on various landscape complexes, but also on already existing paradynamic landscape systems. As an example, the development of the paradynamic mesosystem «Trubizh water management landscape-technical system – adjacent Forest-Field»,

which is formed based on the paradyamic system «Trubizh Polissya – adjacent Forest-Steppe» is considered. In the process of cognition of these systems, special attention should be paid to the use of the principle of natural-anthropogenic combination and the comparative method of natural analogues.

The modern landscape paradyamic mesosystem «Trubizh water management landscape-technical system – adjacent Forest-Field» functions as a result of the manifestation of weakened internal and somewhat activated by anthropogenic factors, external paradyamic connections. External anthropogenic paradyamic connections include: *thermal* (formed due to the difference in average air temperature between plowed watersheds and anthropogenic floodplains); *mechanical* (manifested due to anthropogenic changes in the landscape structure of terraces, floodplains and streams, accompanied by increased erosion, despite the small relative heights within the river valley); *aquatic* (formed in the conditions of over-regulation of the riverbed, its transformation into a main canal and construction of a reclamation network that goes beyond the floodplain and terrace types of terrain); *social* (formed due to the growing impact of anthropogenic pressure on material-energy-information processes). Internal anthropogenic paradyamic connections include: *biocosmic* (formed by the biological cycle of substances, which causes the accumulation of humus in floodplains due to photosynthesis, decomposition of living organisms and accumulation of alluvial-deluvial deposits); *biotic* (observed in the following processes: cross-pollina-

tion of plants, trophic food chains, animal migration and interspecies competition).

In general, for more than 70 years of not always well-thought-out functioning of the paradyamic mesosystem «Trubizh water management landscape-technical system – adjacent Forest-Field» there has been an almost complete transformation of natural paradyamic connections into anthropogenic ones. This was facilitated by the replacement of the Trubizh riverbed by the main canal and drainage of the floodplain by reclamation canals, which led to a decrease in groundwater levels and the formation of limniophilic conditions. The reduction of the intensity of material-energy-information flows has led to the formation of stagnant areas, intensification of accumulation processes and the formation of paradyamic anthropogenic landscape zones of influence, which have a significant distribution.

One of the largest paradyamic mesosystems of the Forest-Field of Ukraine «Trubizh water management landscape and technical system – adjacent Forest-Field», as well as others in this natural area, especially within the Middle Dnieper, at the beginning of the 21<sup>st</sup> is in disrepair. Their reconstruction requires further joint structural-geographical and landscape studies with hydrologists, soil scientists, reclamation engineers and ecologists. This will give a better understanding of the processes of functioning of the Trubizh water management landscape-technical system, to predict its further development and to develop ways of rational use.

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## Трубізька водогосподарська парадинамічна ландшафтно-технічна система

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Вписування будь-якої меліоративної системи у наявні ландшафтні комплекси призводить до посилення контрастності середовищ і активізації речовинно-енерго-інформаційних потоків. Побудова меліоративної системи у басейні річки Трубіж докорінно змінила ландшафтну структуру річища і заплави, що зумовило значний вплив на суміжні ландшафтні комплекси. Сформована Трубізька водогосподарська ландшафтно-технічна система виходить за межі однієї річкової долини. Не завжди продумана господарська діяльність призвела до погіршення екологічного стану не лише самої системи, але й взаємодіючих з нею ландшафтних комплексів. Суть роботи полягає у дослідженні антропогенних парадинамічних зв'язків у складній природно-господарській структурі «Трубізька водогосподарська ландшафтно-технічна система – прилегле Лісополе». Метою роботи є дослідження Трубізької водогосподарської ландшафтно-технічної системи, як антропогенної парадинамічної системи. На основі системного аналізу, порівняльно-географічного, картографічного і ГІС-методу (бази даних ГІС-пакетів SAS.Planet.Release і GoogleEarthPro) проаналізовано процеси формування, розвитку та функціонування парадинамічних зв'язків у мезосистемі «Трубізька водогосподарська ландшафтно-технічна система – прилегле Лісополе». Чинники функціонування парадинамічних взаємозв'язків зумовлені наявністю зовнішніх (термічних, механічних, водних і суспільних) і внутрішніх (біокосних і біотичних) зв'язків, контрастності (належність *Трубізького Полісся і прилеглого Лісополя до різних орографічних структур*) та просторової залежності (повздовжні й поперечні парадинамічні взаємозв'язки між поліським ландшафтом нижньої частини долини річки Трубіж і прилеглого до неї Лісополя) між взаємодіючими ландшафтними комплексами. Дослідження антропогенних парадинамічних зв'язків між різними ландшафтними структурами дасть можливість краще зрозуміти процеси функціонування Трубізької водогосподарської ландшафтно-технічної системи й особливості взаємодії із суміжними ландшафтами, що, у свою чергу, дозволить спрогнозувати її подальший розвиток і розробити шляхи раціонального використання.

**Ключові слова:** *Трубізька водогосподарська ландшафтно-технічна система, парадинамічна система, парадинамічні зв'язки, просторова залежність, контрастність, зовнішні та внутрішні зв'язки, раціональне природокористування.*

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