UDC 911.2
DOI: 10.31652/2786-5665-2022-1-17-26

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THEORETICAL PROVISIONS SET OF MODERN LANDSCAPE SCIENCE

The goal of the givan article is to reveal the main theoretical provisions set on the landscape systems organisation. These provisions reveal the essence of such organization, its relationship with the environment, patterns of variability, integrity and purposefulness in development, a clear programmability to achieve the goal of development, i.e. ensuring their own landscape environment to maintain a harmonious state.

The analyzed theoretical positions show that landscape systems are in the field of general organizational dependencies of any natural systems and at the same time are characterized by a certain individuality. It is shown that a certain set of theoretical propositions is clearly distinguished, which plays a peculiar theoretical and invariant role in studies of the landscape systems organization. Such an invariant set of theories not only consolidates the relevant theoretical positions around itself, but also reveals signs of a kind of theoretical integrity. Such theoretical construction of the landscape systems organisation is inherent in both natural and anthropogenic variants, which naturally creates a chain of theoretical justification of the organization of systems from their origin to qualitative development. At the same time, these theories substantiate the natural need for the stable development of landscape systems properties of a certain freedom of action, uncertainty and even chaos. This unity of the theoretical foundations of the landscape systems organisation represents the general patterns of their existence in space and time.

Keywords: theories of organization of landscape systems, regular and evolutionary chain of theories, invariant set of organizational theories.

Петлін В.М. НАБІР ТЕОРЕТИЧНИХ ПОЛОЖЕНЬ СУЧАСНОГО ЛАНДШАФТОЗНАВСТВА

Розвиток сучасного ландшафтознавства потребує удосконалення наявних та розробки нових теоретичних положень, що дозволить краще вирішувати й низку практичних завдань. Метою статті є розкриття сукупності головних теоретичних положень щодо організованості ландшафтних систем. Показано, що чітко виокремлюється певна сукупність теоретичних положень, яка виконує своєрідну теоретично-інваріантну роль у дослідженнях організованості ландшафтних систем. Така інваріантна сукупність теорій не лише консолідує навколо себе дотичні теоретичні положення, а й виявляє ознаки своєрідної теоретичної цілісності. Така теоретична конструкція організованості ландшафтних систем притаманна як натуральним, так і антропогенним їх варіантам, яка закономірно створює ланцюг теоретичного обґрунтування організованості систем від їх виникнення й до якісного розвитку.

Ключові слова: теорії організованості ландшафтних систем, закономірно-еволюційний ланцюг теорій, інваріантна сукупність організаційних теорій.

Despite of the fact that landscape science as a scientific field has been developing for hundreds of years and it is believed that it is well developed mainly field research methods and, as a result, received a significant amount of empirical material, in the theoretical field there are still significant problems. First of all, they are that landscape science, as a generalizing natural direction, does not keep up with modern theoretical trends in natural science in general, and therefore its inherent set of theoretical positions often remains unconnected and considered separately.

The aim of this work is to single out the invariant part of such provisions in the form of certain integral theories and to find organizational connections between them.

The existing theoretical positions of modern landscape science in Ukraine were developed by P.H. Shyshchenko, M.D. Hrodzynskyy, H.I. Denysyk and others. In general, the theoretical provisions of landscape science belong to the general theory of geography, which reveals the links between independent theories of spatial structures and derivative theories of temporal processes [21]. It is a historically formed set of scientific knowledge (concepts, terms, ideas, hypotheses, concepts, theories, doctrines) about the geographical world and its components. The main blocks of the theory of geography are the doctrine of the geographical envelope (epigeosphere); doctrine of territorial differentiation; the doctrine of the geosystem, as well as a set of theoretical issues relating to the geographical aspects of nature and society [8].

As for purely landscape science, among its inherent theoretical positions is primarily the theory of natural territorial systems, which consists of extremely complex internal organization and also contains a close unity of biogenic and abiogenic components; the presence of extensive possibilities of combining elementary territorial systems into hierarchically more complex formations; the presence of spontaneous external and internal conditioned direction of development; presence of approximate and distant external spontaneous and natural control; the presence of different variants and different intensity of anthropogenic impact, which leads to a wide range of anthropogenic modifications; presence of unstable in time and space anthropogenic territorial formations; periodic occurrence of various fluctuation phenomena; periodic occurrence of local centers of instability and destructiveness. These and a significant number of unlisted secondary and derivative features contribute to the separation of the theory of natural territorial systems to a special section of the general theory of systems [17].

This core theory is characterized by a set of other clarifying theories, as well as its relationship to more general theories. These include, for example, the General Theory of Systems (GTS) (a comprehensive program for building GTS in the twentieth century in the late 40's – early 50's was put forward by biologist and theorist Ludwig von Bertalanffy). This is an interdisciplinary field of research, which aims to identify and theoretically describe the patterns of structure, behavior, functioning and development of systems. In reality, GTS is a general theory of systems theories [18].

The main tasks of general systems theory are: 1) the formation of general principles and laws of behavior of systems, regardless of their special form, the nature of the elements that make them up and the relationship between them; 2) establishment as a result of the analysis of biological, social and behavioral objects as systems of exact and strict laws in non-physical fields of knowledge; 3) creating a basis for the synthesis of modern scientific knowledge based on the detection of isomorphism of the laws of various fields of activity [26].

As for the place in this theory of theoretical provisions inherent in natural territorial systems, they are characterized by a central place, because it is the organizational basis of natural formations, which in any case controls their origin, functioning in time and space and development. First of all, this is reflected in the theory of functional systems, which paves the way mainly from the works of 30-60's writeen by P.K. Anokhin. Sometimes it is even considered to be the most complete system theory, because it not only clearly defines the concept of the system, but also develops the internal operational architecture of the system and outlines the basic principles of its operation. The basic concept of the theory of functional systems is the behavior of the system. In line with the systems approach, it is considered as a holistic, in some way organized process, aimed, firstly, at adapting the system to the environment and, secondly, at its active transformation. The adaptive behavioral act associated with changes in intrasystem processes (including structural) always has a purposeful character, which provides the system with a balanced existence [1].

Such a variety of theoretical positions is reflected in the theory of landscape systems, which are often perceived in the form of geosystemic organizations. This theory is divided into special and general. A special theory of geosystems can be considered as a theory that describes their functional, dynamic and evolutionary features, laws, patterns, principles, etc., which conceptually provide an explanation of the spatial nad temporal organization of geosystems, its purpose and individuality. The general theory of geosystems is a generalization of the provisions of the special theory of geosystems for various physical fields within geosystem structures, as the transition to the analysis of geosystem organization at the level of physical fields has significant features [17].

Directly landscape and geophysical field is a set of fields of quantitative indicators of physical properties of landscape systems as integral territorial formations, which contain information about the nature of geophysical processes both in the landscape systems and within their immediate environment [16]. Such a field not only characterizes the functional and dynamic properties of landscape systems, but also controls their main organizational properties. Due to the presence of synergetic effects, new qualities and properties appear. The direct synergetic effect, or according to H. Khacken, synergy, is very close to the effect of emergence, but not identical to it. Here relatively simple elements interact, which form a functional coherent unity. The question even arises: is such unity a system? Conditions for the emergence of a synergistic effect: the presence of a set of elements; their spatial proximity; functional connection; functional proximity in intensity, specialization, purpose, etc.; consistency in functioning; the expediency of the phenomenon is manifested in the fact that the reaction of the landscape to the action of one process is greater when this process interacts with another [6].

The theory of synergetics includes new priorities of the modern picture of the world: the concept of unstable, unbalanced world, uncertainty and many alternatives of development, the idea of the birth of order out of chaos [15], it aims to explain the formation and self-organization of open stationary systems from antientropic exchange [13]. Yet these theories do not explain why landscape systems are extremely stable in development. They are so stable that it is almost impossible to move them without destroying them. The factor that gives landscape systems strong stability in development is its purpose. Thus, teleological theory shows that the existence of any system of different levels is determined primarily by the plan or ultimate goal, to achieve which is the development [10].

Thus, a more or less generalized picture emerges, which reveals the main organizational properties of landscape systems. Collectively, they are reflected in the theory of organization as a system of knowledge about the patterns of functioning and development of a set of relations in natural systems. In general, the theory of organization is a branch of scientific knowledge that studies the general patterns of formation, formation, functioning and development of organizations as complex dynamic systems that have a purpose. It is designed to give the key to mastering the laws and principles of organizational systems, should make them clear in terms of internal structure and mechanism of operation [27]. The object of the theory of landscape systems organization are regulated and self-regulating processes that occur in natural organizational systems, as well as a set of organizational relations in horizontal and vertical structural components: organization and disorganization, subordination and coordination, ordering and coordination, ie interaction of structural components and the systems themselves as integral formations in order to organize joint life within their organizational field to ensure that a certain part of the landscape is in a harmonized state. The subject of the theory of organization is the organizational relations between landscape systems and their structural components in all spatial and temporal complexity. That is, the theory of organization of landscape systems can be considered a theory of organizational relations. They are represented by connections and interactions between various integral formations and their structural components, as well as processes and actions of organizing and disorganizing orientation.

The presence of organizationally oriented dependencies (today there are several hundred of them) raises the question of the need to select the most effective of them. This is aided by the theory of the potential efficiency of complex systems, which occupies an intermediate position between the conceptual part of systemology [20] and more specific and therefore less general computational methods of systems analysis (Quaid, 1969) – a modern version of operations research. The aim of this theory is to formulate general restrictive laws that limit the effectiveness of complex systems of any nature. In the absence of restrictions, even at the level of organizational dependencies, there will be significant chaotic phenomena in the processes of landscape systems organization. Therefore, the natural limitation of such dependencies is a constructive property of nature in general.

Another powerful organizational component of landscape systems is the presence of information influences, connections and interactions. First of all, this is manifested in such a property as reflection. Thus, information reflection is characterized by reaction of structural elements of landscape system and the most functionally integral system to the corresponding information signals and codes. When the system is at the stage of self-organization, information reflection plays a significant organizational role. Such a phenomenon is reflected in the theory of reflection, which is based on informational reflection itself [24].

Another essential element of the multifunctional organization of landscape systems is that all its processes and phenomena are characterized by probability. Probability is perceived here as the degree (relative measure, quantification) of the possibility of a certain event. When the possibilities for a certain event to actually take place outweigh the opposite possibilities, such an event is called probable. In probability theory and mathematical statistics, the concept of probability is formalized as a numerical characteristic of an event – a measure of probability (or its value) – a measure of a set of events (subsets of a set of elementary events), which takes values from 0 to 1. A value of 1 corresponds to a probable event. An impossible event has a probability of 0 (the reverse is generally not always correct). If the probability of occurrence of the event is equal to p, then the probability of its occurrence is equal to 1 – p. In particular, the probability of ½ means an equal probability of occurrence and non-occurrence of the event. Empirical determination of probability is related to the frequency of occurrence of an event, since in a sufficiently large number of studies, the frequency should strive for an objective degree of possibility of this event. In the modern interpretation of probability theory, probability is defined axiomatically as a partial case of abstract set theory. At the same time, the link between the abstract measure and the probability that characterizes the degree of possibility of the event is the frequency of its observation [3]. Therefore, it should always be borne in mind that organizational processes, phenomena, relationships in landscape systems are always characterized by probability, which, if necessary, must be quantified.

Landscape organization is always accompanied by landscape organization. The main phenomenon that accompanies such patterns is dissipation. It is a process that avoids disordered connections in unbalanced systems by transforming some of the energy from the environment into a new type of ordered behavior. At the same time, dissipative structures are spatial or spatiotemporal structures that can occur at a distance from equilibrium in nonlinear conditions when the system parameters exceed the critical values. The theory of dissipative structures was proposed directly by the Belgian school under the direction of Nobel Prize winner I. Prigozhin. In this theory, self-organization and the formation of structures is described in terms of a thermodynamic approach. Here the concept of self-organization of landscape systems is perceived as a process of organizing elements of one level of organization in the system due to internal factors, without controlling external influences (at the same time changing external conditions can also be a stimulating effect). As a result, the emergence of a unit of the next qualitative organizational level. That is, the phenomenon of self-organization occurs in landscape systems at the stage of their externally controlled qualitative development. This process is explained by the theory of self-organized criticality, which considers the natural environment of landscape formations as a system that is in a state away from equilibrium, interrupted by avalanche-like dynamics on different spatial and temporal scales. The system reaches the critical value of the control parameter independently without external control.

During the billion-year existence of the Earth's landscape sphere, its components have acquired significant organizational harmony. Here the concept of «harmony» is perceived as the main property of being, which is reflected in the relative balance and interdependence of negatively opposite forces of nature, unity of diversity, structural proportions of integrity, co-creation of natural systems, to achieve a common goal of preserving the same harmony [16]. The theory of harmony in the organization of natural territorial systems shows that this is an important generalization of the natural sciences based on the doctrine of the informational essence of the harmonious component of systems, informational connection with the properties of the studied system and its environment. by the processes of organizational development of the system and timely corrective actions aimed at inhibiting fluctuation deviations in it [17]. A set of patterns that are aimed at revealing the harmonious organization of landscape systems (as natural and anthropogenic) is the basis of the theory of harmony in relation to landscape formations.

Organizational development of landscape systems through functional and dynamic dependencies purposefully provides evolutionary transformations. Theoretically, such a process is revealed by the ergodynamic theory of evolution, which consists in the following provisions: 1) evolution has the purpose to maintain the balance of systems in the variability of the environment; 2) evolution is predicted because its purpose is known; 3) the cause of evolution is a change (regular or «accidental») of the environment; 4) evolution is a means of maintaining the internal equilibrium of the system in a changing environment [4].

In this case, any evolutionary processes in landscape systems are always subject to different conflict situations. The situation is complicated by the fact that landscape formations in a state of conflict are always characterized by a certain uncertainty, i.e. the degree of probability of the possibility of transition into reality. There is an inverse relationship between uncertainty and probability. From a theoretical point of view, this situation is solved with the help of game theory, which aims to find optimal solutions in conflict situations, based on the mathematical apparatus. The scope of its application is the choice of solution in conditions of uncertainty. The logical basis is the formalization of the concepts of conflict, decision-making in it and the optimality of such a decision. This theory is based on a wide variety of mathematical methods and is closely related to mathematical programming [17].

In general, the patterns of organization of landscape systems within the landscape are closely related to their hierarchy. The theory of hierarchical systems (developed by M. Mesarovych and his collaborators) is a section of general systems theory, which reveals the essential characteristics of any hierarchy that is a consistent vertical arrangement of subsystems that make up a particular system under study (vertical decomposition); priority of actions or the right of intervention of upper-level subsystems on lower-level subsystems; dependence of actions of subsystems of the top level on actual performance by the lower levels of the functions [14]. The main thing is that this theory is aimed at identifying patterns of space-time functioning, dynamics, evolution, development of complex natural and anthropogenic systems. The patterns it combines are in fact limiting dependencies that will keep the systems within the corresponding functionally invariant corridors.

The theory of hierarchical systems is closely related to the constructive theory, which is based on the idea that the morphological structure of the resulting systems is formed under the influence of the laws of matter motion optimization and energy consumption. In this case, there is an emergence in the optimization of individual components of the elementary level, from which then, if there are appropriate conditions, larger-scale systems are formed. There are no statistics here, and there is a deterministic calculation of the optimal structure. This is a real construction that takes place in nature. In constructive theory, a new arrow of time is introduced: in the direction from elementary (small, incomplete) to larger (complete), from simplified to complex [25].

Hierarchy and constructive organization of the landscape sphere is characterized by the property of stratification. Thus, according to the theory of stratification, the landscape is considered as a polysystem formation, which consists of many monosystems that do not intersect. The processes and phenomena that form these relatively independent structures have different characteristic times and spatial scales, so they cannot interact, but overlap or are in a relationship of subordination [23]. At the same time, it is believed that the idea of interdependent structures violates the principle of the general relationship of natural components and is not consistent with the concept of emergent properties of the landscape [11].

Modern theoretical studies of the landscape systems organization are largely in the field of information dependencies. In this case, the informativeness of landscape formations is considered at the level of information fields as an invariant amount of information within the functional field of the system, i.e. the interconnected set of internal and external information of landscape systems. Today it is believed that this is the first intangible field that contains the attributes of the physical, material field. The information field is the boundary field between the material dynamic world in all its manifestations and the field of immaterial peace, which is presented as the guiding principle for the information field and even the whole material world [17]. According to I.F. Trofimov, within the theory of the information field it is possible to prove the following axioms: the field, each element of which contains information about itself and all its surrounding elements – information; the information field is a dynamic, controlled, pulsating, open system.

Despite the fact that the appeal to information dependencies makes it possible to determine the evolutionary path of landscape systems, such a definition cannot be completely predictable. This is convincingly evidenced by the theory of «non-strict determinism» (put forward by W. Hofkirkhner), which characterizes the dialectical path between the extremes of unambiguous determinism and indeterminism: events related to self-organizing systems cannot be fully predetermined due to the system itself introduces into the determination an unreduced degree of freedom. As a result, cause is not equal to consequence to loose determinism divides the roles of cause and effect into such an ambiguous means that allows causes to have different consequences, or consequences – different causes (Hofkirchner, 2003).

It is the degree of freedom in the landscape systems organization that often leads to inconsistencies between them and their environment (tangent landscape systems). As a result, there are situations of intersystem interaction, which can be even catastrophic. If such situations are inherent in systems at the stage of self-organization (qualitative development), then they are quite natural, and if at other evolutionary stages are not natural. To a large extent, such phenomena are described by catastrophe theory as a philosophical and mathematical concept that describes the patterns of sudden transition of complex systems from one stable state to another. It is believed that the theory of catastrophes can be applied to the analysis of any extreme phenomena in animate and inanimate nature, technology, social life [12]. It contains an analysis of the factors that affect the mode of the system operation and its behavior when changing parameters. The objectives of this theory are to identify the causes that can destroy the system, taking into account random phenomena and processes in order to build a stable system capable of resisting threats and dangers [7]. Cuvier's best-known theory of catastrophes contains not only Darwinian gradual improvement of species, which determined the process of development, but also rapid restructuring. At the same time, catastrophic conditions in the landscape sphere, which gave rise to bifurcations, were as natural elements of the evolutionary process as adaptation and intraspecific struggle.

An extremely important phenomenon in the landscape systems organization is that any organizational functions, processes, connections, etc. are characterized by limitations. Justification of such limitations is the prerogative of theoretical research. The importance of this is convincingly demonstrated by the theory of constraints as a completely independent theoretical generalization, which, however, has some common ground with the economic theory of constraints. According to this theory, any organization of territorial systems at any time is characterized by at least one limitation that prevents the system to achieve the development of full functional equilibrium. All these limitations can be classified as internal resource limitations, as well as intensities and interactions [17]. The theory of limitations of landscape systems is based on the statement that organizational efficiency depends on limitations. They prevent both the system from achieving anomalous amplitudes of variability and the exit in the direction of near-equilibrium states. That is, the constraint theory approach is based largely on identifying active constraints and the mechanisms that govern them.

In general, the organizational development of landscape systems over time is subject to a significant number of theoretical dependencies. At the same time, one of the main ones is that such systems do not develop gradually, but in certain cascades. This is evidenced by the theory of rhythmic cascades. The main regularity of this theory is that the development of phenomena occurs in cascades, which are subject to certain rhythms. In this case, these rhythms are due primarily to the five principles of formation: nonlinearity, openness, instability, dynamic hierarchy, observability [2].

The presentation of the theoretical components of the landscape systems organization may cause a misconception that such an organization is completely stationary, i.e. able to maintain homeostasis in a relatively narrow range of parameters of its state without any contradictions and inconsistencies. But this is far from this case. The organization of any landscape system is necessarily characterized by the presence of certain chaotic phenomena and processes. Thus, in the theory of chaos, chaos is represented by an unusual form of behavior of any system in a balanced state. The nature of the system is so sensitive to the initial conditions that long-term prediction of behavior becomes impossible. There are a number of reasons and circumstances that result in a loss of stability and the transition to chaos: 1) noise, external disturbances (chaos and noise are often identified); 2) the presence of a significant number of degrees of freedom that are inherent in systems in the process of functioning. They are able in this case to implement completely random sequences; 3) a rather complex organization of the system (for example, the chaos of the rainforest); 4) «butterfly effect», the essence of which comes down to the fact that nonlinear systems are extremely sensitive to the initial conditions and are characterized by the ability to quickly dilute the initially approximate trajectories. Chaos can manifest itself as a super-complex order, and an environment that seems completely disordered, a random elements set, contains the necessary for the emergence of a large number of ordered structures of different types, as complex and complete as you like [22].

The universality of the considered theoretical provisions of the landscape systems organization is confirmed by the theory of infinite nesting of matter. According to it, it is considered an established fact that any natural systems are self-similar and self-embedded, developing according to the same laws. The set of such systems is represented by an infinite set, starting from systems with objects of infinitesimal mass and size, and ending with systems with objects of infinitely large mass and size. SPF symmetry is established for such systems, where by appropriate changes in the masses, sizes and velocities of processes it is possible to move from one level of organization of matter, which is considered as a system of objects, to another level of matter, and the equations of motion of objects remain unchanged due to symmetry. laws of physics [19]. Landscape systems constitute a special class of the general set of space systems and are therefore subject to all their laws, including hierarchical and isomorphic ones.

An important consequence of the matter infinite nesting theory is the confirmation of the fact that systems in nature are not just separate open or closed, the general properties of which must be studied using systems theory, the essential is as follows: at any level level of organization and including all lower organized levels; the distribution of territorial systems by areas of hierarchy levels is organized close to geometric progression; at all levels of hierarchical (morphological) organization there is a similarity of dependencies that represent the shape, size, speed of processes; the organization of hierarchical territorial systems is maintained by the interaction of both the systems themselves in the form of integral formations, and their component and structural components; organizational approximate copying of natural territorial systems occurs under the influence of approximate system forming factors within the invariant spectrum of their diversity; the generation of energy, matter and information by landscape systems creates the potential to influence functionally connected territorial formations.

Conclusions. The theoretical provisions set that reveal the patterns of landscape systems organiation, against the background of their considerable diversity are characterized by the presence of a kind of invariant basis around which other theoretical provisions are formed. Such an invariant set of theories naturally forms a theoretical chain that accompanies landscape systems from origin to qualitative development. It covers all important aspects of the life of landscape formations in their individual and intersystem functioning, in particular during catastrophic situations. As a result, a kind of theoretical integrity emerges, which contributes to the formation of an interconnected theoretical background on which the knowledge of the organization of landscape systems unfolds.

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