

ECO-NETWORK DEVELOPMENT IN UKRAINE: EUROPEAN, NATIONAL AND REGIONAL ASPECTS

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Abstract. Development of ecological network of different taxonomic ranks is a weighty contribution to regional sustainable development. It proved to be among the most efficient ways to help preserve biological and landscape diversity. National eco-network in Ukraine is being formed alongside with European network. However, its development in this country is connected with certain problems existing on both national and local levels. Our analysis of national eco-network's present-day state showed that Ukraine is rather successful in the concept's realization. The network's territory dynamically increases; legal and regulatory framework and methodical/applied approaches are being developed; and neighboring states are closely and intensely cooperated with in questions of formation of eco-network elements within boundary territories. However, the major goal – formation of eco-network as an integral system with its maximally possible continuity and inter-linkage of component elements – has not yet been achieved. The situation is explained by a number of problems occurring in juridical, economic and organizational spaces.

Introduction

It was at the turn of the 21st century that the extension of the area of interplay between society and the environment, its transition from local to global level, excess of degrees of ecologically allowable anthropogenic impacts, distortion of mechanisms of self-regulation/restoration of environmental balance and geo-ecosystems' ecological functions became major trends in

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nature/society relationship. Having neglected the loss of biosphere entirety, the changes in global land use and biochemical cycles, impacts effected on planetary and regional climate, the mankind encountered the necessity of reinterpretation of its attitude towards the environment. When aware of the danger of living by a code of “take the maximum despite the resources capacity and exhaustibility”, the world has come to a new paradigm which was a balanced development of economic, ecological and social components, and whose numerous tasks were connected with the necessity of solving problems of biological and landscape diversity preservation. Acceptance of the Rio Declaration at the 1992 UN Conference on Environment and Development was a logical end to such reinterpretation of nature-protecting ideas of biodiversity as a basis for evolution of biosphere, ecosystems and sustainable provision of the Earth’s population demands. Development of an international strategy of nature protection (preservation of major levels of nature’s biota organization (from populations to eco-systems) instead of preservation of its single chains (species and groups)) has prompted substantiation of new approaches to realization of nature-protecting practices.

Development of ecological network of different taxonomic ranks is among the most efficient ways to preserve biological and landscape diversity, the balance of natural and changed landscapes and their variability, and conditions for provision of safe environment of populations existence. Its importance is proved by the facts that, in conditions of civilization’s systems crisis, biosphere becomes a basis for biological existence of mankind and a barrier on the way of ecological crisis; living organisms are not only the material-energetic basis for the existence of eco-systems but represent the most sensitive informational indicators of environmental changes; preserving the most valuable and the least distorted areas of nature, it provides for physical conditions required for populations survival within landscapes that are actively used in economic activity.

The idea of development of ecological network as nature-protecting technology appeared as far back as the 1980s. And it was in 1993 during the Protection of European Natural Heritage through Development of Pan-European Ecological Network, an International Conference held in Maastricht, Netherlands, that experts suggested establishment of the European Ecological Network, or EECONET. The question of European Ecological Network formation was included into Pan-European Biological and Landscape Diversity Strategy, or PEBLDS, adopted on the Environment for Europe: Third Ministerial Conference (Sofia, 23-25 October 1995).

Historic details of eco-network formation were thoroughly described in Forman, 1995 and Grodzyinsky, 2005. It is worth mentioning that the concept

in the first turn bases on pioneer developments by R. McArthur & Wilson (1967), known as Theory of Island Biogeography. It was practically upon articulation of the theory principles that there appeared a number of publications where potentials of its application within the frame of terrestrial landscapes were disclosed. The most complete analysis of such potentials was presented by Diamond & May (1981). A theory of metapopulation and subsequent metapopulation strategy for wildlife protection was another theoretical source of eco-network concept (Levins 1970). Simultaneous creative interpretation of these ideas in Europe and the US in early 1980s resulted in elaboration of two concepts of the so-called *landscape ecological structure* that were closely similar with respect to their essence and initial premises. The US concept has become known as *model of ecological patch and corridors* (Forman&Gordon 1986 and Forman 1995), and European – as *territorial systems of landscape ecological sustainability* (Bucek, Lacina, 1983 and Low, 1985). Later, there appeared strategically close concepts developed in other European countries, and those have become the basis for development of regional and national schemes for ecosystem and landscape protection.

Beside the Pan-European eco-network, there exist a number of other important national and international initiatives of territory-protecting networks called to rehabilitate environment, in particular, the Natura-2000, and Emerald Network. The former is realized within the EU countries, while the latter, being the analogue of the Natura-2000, was designed for the countries that did not member the European Union. The Permanent Committee of the Bern Convention in its Resolution No 4 of 1996 declared to initiate formation of territories of conservation of European wildlife and natural habitats, especially with respect to rare and endangered species (Lozo, 2014).

By 2015, the Emerald Network covered nearly 3500 potential emerald objects in 16 countries with the area totaling to 600 000 km², or 11-12% on the average of national territories of this eco-network's member countries.

As a party to many international nature-protecting conventions and agreements, Ukraine undertook to integrate its national eco-network to European and actively participate in expansion of the latter. It was in 1996 that our country joined the project of the Areas of Special Conservation Interest within the Emerald Network. Being formed in parallel with the Emerald Network, the Ukrainian eco-network encountered a number of national-scale and regional problems which have become the focus of this study to help find constructive ways of their solution.

Results and discussion

Formation of national eco-network is a complex process that stumbles over a number of barriers and limits even in the EU countries where ecological policy and awareness are rather advanced. Problems of formation, present-day state of, and methodological bases for Ukrainian eco-network were in sufficiently full detail disclosed and analyzed in Pashchenko, 2004, 2011; Sheliag-Sosonko, 2004; Sheliag-Sosonko et al, 2004; Samoilenko & Korogoda, 2013 etc.

Active implementation of the eco-network concept in Ukraine is witnessed by the extension of the network territory, in the first turn, due to expansion of existing territories and creation of objects of nature reserve fund (NRF). In particular, the nature reserve fund of Ukraine as of 01.01.2016 had 8184 territories and objects with total area of 4083 thousand ha (actual area - 3803 thousand ha), and 403 thousand ha within the water area of the Black Sea. The “conservation” index hence amounted to 6,3% (National Environmental reports, 2014, 2015).

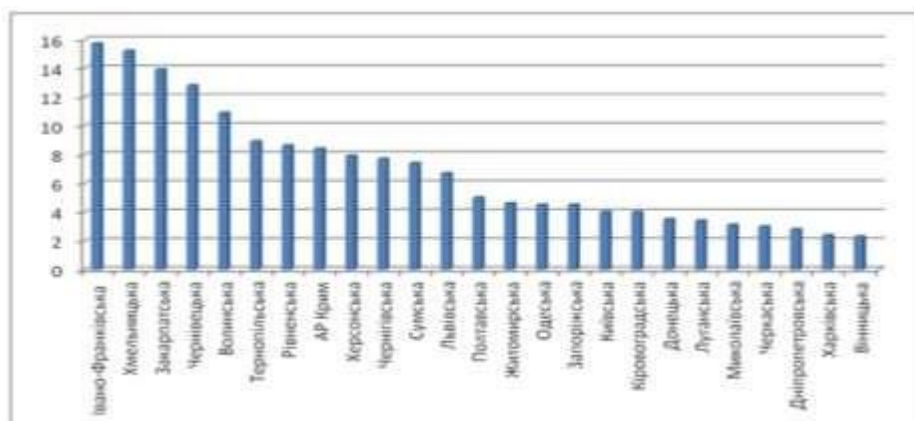


Fig.1. Share of nature reserve fund areas in the total areas of administrative units of Ukraine (%)

It was in 2015 that the number of objects and territories of nature reserve fund was added by 32 units of 89,9 thousand ha. In particular, the NRF area grew by 80,2 thousand ha in Kherson Oblast, 6,2 thousand ha in Chernigiv Oblast, 2,1 thousand ha in Kyiv Oblast, 0,9 thousand ha in Dnipropetrovsk Oblast, 0,8 thousand ha in Zakarpattia Oblast, and 0,4 thousand ha in Zaporizhzhia Oblast (National Eco-Network Development Report, 2015).

The share of NRF area in the total area of an administrative unit (“index of conservation”) varies from 2,24 to 15,7%. The least share – 2,24-2,36% – was observed in Vinnytsia and Kharkiv oblasts, the biggest – 12,8-15,7% – in Ivano-Frankivsk, Zakarpattia, Khmelnytsky and Chernivtsi oblasts. The same in the City of Kyiv amounted to 21%, and to 30,3% in the City of Sevastopol. Conservation territories in Dnipropetrovsk, Donetsk, Zhytomyr, Zaporizhzhia, Kyiv, Kirovograd, Lugansk, Mykolaiv, Odessa, Poltava and Cherkassy oblasts showed 3-5%, while it was 7,4-11,1% in Volyn, Lviv, Rivne, Sumy, Ternopil, Kherson, Chernigiv oblasts and the Autonomic Republic of Crimea (Fig. 1).

If compared to 2000, the area of the Ukrainian nature reserve fund increased by 1683,8 thousand ha, though the rates of growth of the same significantly decreased (Table 1).

It is worth mentioning that the NRF expanse in Ukraine is somewhat behind the schedule. In particular, according to 2020 Strategic Ecological Policy Act, Ukraine, the system of nature-protecting measures and preservation of bio and landscape diversity was to be implemented by 2015; the NRF fund was to be expanded to 10 % by the same year (6,3% as of 01.01.2016), and to 15% out of the country’s total area by 2020. The figures stated in the Act were designed in by the Convention on Biological Diversity adopted by 193 world countries inclusive of Ukraine. It was supposed that a system of nature-protecting territories is developed on 17% of lands and 10% of sea areas by 2020.

Table 1. Territories and objects of nature reserve fund of Ukraine (National Eco-Network Development Report, 2015).

NRF territories and objects category	Land areas, thousand ha				
	As of 1.09.2000	As of 1.01.2010	As of 1.01.2015	As of 1.01.2016	Planned for 2015
National nature parks	600.0	1001.8	1231.0	1311.6	2329.0
Natural reserves	160.0	198.7	205.3	205.3	422.0
Biosphere reserves	212.0	246.4	252.1	252.1	301.0
Other categories	1427.0	1821.1	304.1	2313.8	3223.0
Total area	2399.0	3268.0	3992.5	4082.8	6275.0
National significance reserve (Black Sea)			402.5	402.5	

Ukraine is represented by 645 national-level NRF territories and objects that include 19 natural and 4 biosphere reserves, 48 national natural parks, 309 wildlife sanctuaries, 132 natural landmarks, 18 botanic gardens, 7 zoo parks, 19

dendrological parks, 89 parks/monuments of garden art. Their total area amounts to 2144,49 thousand ha (within the territory of Ukraine), or 54,7% of actual NRF area, and 3,55% of the territory of Ukraine. The number of local-level NRF territories and objects amounts to 7456 units of 1,8 million ha.

The Ukrainian NRF structure includes 11 categories of territories and objects of national and local significance. The biggest – nearly 90% – share of these is represented by natural landmarks, wildlife sanctuaries and natural boundaries. Wildlife sanctuaries, national natural and regional landscape parks occupy 85,5% of total NRF area.

Despite the rank and category and due to essential anthropogenic changes and segmentation of natural vegetation cover, almost every plot containing natural plants is valuable and important in the sense of preserving bio-landscape diversity, and can be regarded as an element of eco-network. Such plots may have value for a certain small territory, and for the part of the world, in particular, Europe, that is, fit eco-networks of different territorial levels, thus being specific with respect to their outlining and modeling. Our national network is therefore suggested to have three territorial levels - *national, regional and local*. Eco-network's structural elements are clearly defined in *National Ecological Network Act, Ukraine*, and represented by the *key, connective, buffer and renewable territories* (Art 3).

Key territories provide for preservation of the most valuable and region-typical components of landscape and biological diversity. According to the Act's provisions, the network's key territories include NRF territories and objects, water-and-marsh lands of international significance, and other territories where the most valuable natural complexes have been preserved. The territories possessing NRF objects whose percentage is higher than the average national share, as well as territories containing habitats of rare and endangered flora and fauna species are combined into natural regions – huge natural-territorial formations whose entirety is defined by specific phyto-landscape, physic-geographical, administrative and other attributes that play regional eco-stabilizing role *National Ecological Network Development Act, Ukraine* (1989). Natural regions as elements of Ukrainian national eco-network include as follows: Carpathian, Crimean Mountainous, Polissia (West-Polissia, Central-Polissia, and East-Polissia), Mid-Dnieper, Near-Donetsk, Donetsk-Near-Azov, Tavriia, Down-Dniester, Down-Danube, Azov, and the Black Sea. It is with respect to the Carpathian natural region that the measures to be taken to form the eco-network as part of Pan-European Eco-Network have already received the most complete scientific substantiation.

In the context of development of national eco-network, the National Academy of Sciences substantiated allotment of 52 national-level key territories

of 633902,0 ha and 78 regional-level key territories (529900 ha) for Ukrainian Forest-Steppe. The territories differ in their areas, contour shapes, types of territorial integrity, and belong to biotic, hydro-biological nature-landscape types.

Their vegetation cover is diverse and representatively discloses regional types of plants. The territories are distinctive for the diversity of ecosystems with high-level preservation of natural complexes. The majority of key territories have 540 nature-reserve objects of different categories and ranks that often occupy the greater part within their total area. The allotted key territories present rare plant groupings of 156 associations of 32 formations (19,5% of Ukrainian rarity phytocoenofund), included into *Green Book of Ukraine*.

Connective territories (eco-corridors) join the key territories, provide for animal migration and exchange of genetic material. The list of eco-network's connective territories includes those that provide for linkage between key territories and eco-network entirety, namely: lands of water fund, forestry lands, and, partially, agricultural lands. At the same time, national ecological law applies the term of "natural corridors" to denote natural (or brought to natural) lands or water surfaces, which, on different levels of eco-network's spatial organization, provide for continuity, systemic integrity and bio-communication of natural environment. Natural corridors are formed by the parts of natural landscapes of elongated configuration, different width, length, and shape, and connect natural regions. Such corridors should provide for respective conditions of wildlife fauna and flora species preservation. Basic territories and objects that comprise eco-network corridors include forests, water objects, meadows, pastures, hayfields, brushwood, etc.

The majority of eco-corridors as structural components of Ukrainian eco-network are at the stage of their substantiation and formation. The most important present-day national projects to form future eco-corridors are as follows:

- landscape-science and bio-geographic substantiation of spatial localization of the Halytsko-Slobozhansky inter-regional trans-border eco-corridor, and its respective map-scheme substantiation;
- development of concept of regional scheme for eco-network of the *Dniester* river meridian eco-corridor;
- development of concept of regional scheme for eco-network of the *Polissia* eco-corridor;
- conceptual substantiation of the structure and the components of the *Azov-Black Sea* eco-corridor of international significance;
- preparation of concept of the *Dnieper* ecological corridor;
- processing the elements of the *Desna* natural corridor;

- preparation of indicative map of the *South Bug* meridian eco-corridor;
 - development and approval, on different administrative levels, of the *Turkiv* eco-corridor scheme (for the migration of bison, brown bear, lynx, wild boar and other wild fauna between nature-protected territories of Poland and “Skolivski Beskydy”, Research and Production Enterprise, Ukraine);
 - development of the scheme of the *Bukovyna* eco-corridor (between the “Vyzhnytskyy” National Nature Park, Ukraine, and the Vânători-Neamț National Park (Romania) for the purpose of renewal of natural ecosystem links (eco-corridors) in populations of bison, bear and lynx in Ukraine and Romania).
- Buffer territories* as eco-network’s structural elements provide for protection of key and connective territories from external influence. As a rule, it is a “locality with natural or partially changed landscape that surrounds the most valuable portions of ecological network and protects them from the effects of external negative factors of natural origin and caused by human activity”. Eco-network’s buffer zones are the areas surrounding key territories to prevent impacts of human economic activity performed on adjacent territories. These include water-protected zones, waterside shelter belts, field-protecting wind-breakers, and recreational lands.

Renewable territories provide for eco-network’s spatial entirety. They represent the areas soon intended for restoration of original natural state. According to Art 16, Ecological Network Act, Ukraine, the list of eco-network’s territories includes distorted, degraded and rough lands; lands affected by negative processes or natural phenomena; other territories important from the point of view of formation of eco-network’s entirety. Among the scope of renewable territories, high value is placed to radio-contaminated non-used lands that are subject to enhanced protection as natural regions having special status.

As seen from Table 2, lands that form the buffer and renewable territories comprise nearly 3570,7 ha within the national eco-network.

As to region - level elements of national ecological network, they are substantiated within regional programs and schemes of eco-network formation. As of this day, 8 regional schemes of eco-network formation are already approved for the Autonomous Republic of Crimea, Vinnytsia, Zhytomyr, Zakarpattia, Kyiv, Odessa, Ternopil oblasts, and the city of Kyiv, as well as 47 local schemes for the Zakarpattia (13), Zaporizhzhia (2), Lugansk (4), Lviv (1), Poltava (1), Ternopil (1), Kharkiv (24), and Chernivtsi (1) oblasts.

At the end of 2016, there were 17 projects of regional schemes of eco-network formation that required different adjustments and approvals (Volyn, Dnipropetrovsk, Donetsk, Zaporizhzhia, Ivano-Frankivsk, Kirovograd,

Lugansk, Lviv, Mykolayiv, Poltava, Rivne, Sumy, Kharkiv, Kherson, Khmelnytsky, Cherkasy, Chernigiv, and Chernivtsi oblasts). The final stage of

Table 2. Composition of lands referred to components of National Eco-Network of Ukraine (<https://menr.gov.ua/news/31220.html>)

Lands – eco-network components	Total area (thousand ha) as of 01.09.2000	Total area (thousand ha) as of 01.01.2015	Total area (thousand ha) as of 01.01.2016
Hayfields and grasslands	7772.9	7848.3	7840.5
Forests and forested areas	10380.2	10630.3	10633.1
Open moss lands	940.4	982.6	982.3
Contaminated lands not used in agriculture	136.0	123.8	123.7
Open lands with no insignificant vegetation cover	1180.8	1015.8	1020.6
Waters	2415.0	2426.4	2426.4
Total area (thousand ha), % of total area of Ukraine	22825.3 37.8 %	23027.2 38.16%	23026.6 38.16%

preparation and approval is observed with such schemes developed for the Cherkasy, Khmelnytsky, Rivne and Zaporizhzhia oblasts. Besides, 11 projects of local schemes to form the eco-network in the Vinnytsia (4), Donetsk (2), Zaporizhzhia (1), Kharkiv (2) and Chernigiv (2) oblasts have already been developed (*National Environmental Report, 2014; National Eco-Network Development Report, 2015*).

Development of national eco-network is performed with consideration of basic requirements for functioning of Pan-European Eco-Network, which, in conditions of Ukraine, is realized within the formation of the aforesaid Emerald Network. The latter came in Ukraine in 2001 having started as pilot project to help test the procedure and define fifteen “emerald” Ukrainian objects under the EC aegis and financial support. In 2013-2014, databases for 169 Ukrainian potential Emerald Network’s objects were prepared. The Permanent Committee of the Bern Convention (34th Sitting, December 2014) supported Ukrainian project and appropriated the European Emerald Network’s candidate status to 159 objects (*National Environmental Report, 2014*).

In the above-stated context, there takes place the formation of the trans-border eco-network’s elements such as trans-border biosphere reserves (TBR) of Ukraine and neighboring countries, these being represented as follows:

- *“Western Carpathians”*, a Ukrainian-Polish-Slovakian TBR where the Ukrainian party is represented by the Uzhany National Natural Park and the “Nadsiansky” Regional Landscape Park;
- *“Danube Estuary”*, a Ukrainian-Romanian TBR where the Ukrainian party is represented by the Danube Biosphere Reserve;
- *“West Polissia”*, a Ukrainian-Belarusian-Polish TBR where the Ukrainian party is represented by the Shatsky National Natural Park;
- *“Carpathian Primary Beech Forests and German Ancient Beech Forests”*, a trans-border Ukrainian-Slovakian-German serial object of the UNESCO World Natural Heritage where the Ukrainian party is represented by the parts of the Carpathian Biosphere Reserve and the Uzhany National Natural Park;
- *“Prypita-Stokhid-Prostyr”*, a Ukrainian-Belarusian trans-border water-and-marsh acreage where the Ukrainian party is represented by the “Prypiat River Flood Plain” and the “Stokhid River Flood Plain”, water-and-marsh acreages of international significance.

The project of the Ukrainian-Romanian trans-border biosphere sanctuary in the Maramures Mountains is now at the stage of its development, etc.

Summing up the present-day state of eco-network concept realization in Ukraine, we would outline its positive aspects to be as follows:

1. Regulatory and legal framework for Ukrainian eco-network formation has been developed. Major legal instruments that regulate the process of National Eco-Network’s formation are the Ecological Network of Ukraine Act of 24 June 2004 and the 2000-2015 National Ecological Network Development Act of 21 September 2000. Legal bases for eco-network’s regulation are also found in Environmental Protection Act (1991), Nature Reserve Fund of Ukraine Act (1993), Vegetation World Act (1999), Moratorium on Clean Felling in Mountain Slopes of the Carpathian Region with Fir and Beech Forests (2002), Town-Planning Principles Act (1992); Land Protection Act (2003); Land Survey Act (2003); Self-Governing in Ukraine Act; Water (1995), Forest (1994) and Land (2001) codes of Ukraine; Framework Convention on the Carpathians Environment Protection and Sustainable Development (2003); and other legal Ukrainian.

2. General methodical/applied approaches to eco-network formation based on Pan-European Strategy for Biological and Landscape Diversity, as well as on present-day zoological, landscape ecology, population ecology concepts, etc have been elaborated. Regional eco-network formation approaches were highlighted in publications devoted to eco-networks within the limits of administrative oblasts. Cartographic models of regional eco-networks for almost every administrative oblast of Ukraine were developed, and respective

administrative councils have approved programs of said eco-networks' formation.

3. As a party to many nature-protecting conventions and agreements, Ukraine has undertaken to integrate its national eco-network to European, and thus actively participates in its formation. There takes place an intense cooperation with bordering countries to help develop eco-network's common elements.

5. Principles and methods of mathematical/cartographic modeling and major mathematical and geo-information models that proved to be efficient for eco-network formation and future functioning were generalized and realized; certain positive experience was gained with respect to application of GIS technologies for the purpose of eco-network modeling.

At the same time, the eco-network development is connected with a number of problems as follows:

1. Absence of Joint map of Ukrainian eco-network's formation. It was planned to start the project in 2015, but the work did not even begin due to tendering process cancellation.

2. Occurrence of a number of conflict situations in the sphere of land use connected with land user's notary certified consent for alienation of land areas that were given to NRF establishments in continuous use.

3. Land owners' (land users') antagonism against creation of new reserves and reservation of perspective areas (even with no alienation or change of designed purpose) due to their fear of probable problems in the form of strengthening of nature-protective requirements.

4. Inconformity and imperfection of laws – land, forest, nature-protecting and self-government – with respect to natural reserves. Aforesaid laws require amendments and adoption of new legal provisions where the priority of reservation of natural territories over all other designed purposes of lands rendered into ownership or use would be established..

5. Critical decrease in financial support of natural reserves from the State Budget, employees' low salaries on the background of staff total reduction and absence of motivation.

6. Suppression of Ukrainian eco-network's integration into Pan-European network, caused by the fact that the allotment of territories perspective for the inclusion into the EC Natura-2000 ecological network as provided for by the EC Directive 92/43/EEC of 21 May 1992 presupposes allotment of habitats, biotopes, etc, characteristic for availability of respective biotic and abiotic components that predetermine their special role in preservation of conditions for survival and development of population species that require protection [22]. Such approach has limited application in Ukraine.

Eco-network formation in Ukraine is guided by somewhat different criteria which are provided in the Ecological Network Act, Ukraine, No 1864-IV of 24 June 2004 [20]. In particular, the approach does not ground on the criterion of outlining habitats to be the basis to choose eco-network's component elements, but the eco-network is created on the basis of the NRF territories and objects with further involvement of other-status conservation areas (water-protecting, recreational, etc).

Hence, prior to the Directive's implementation, some legal provisions should be respectively amended. It is necessary to change legislation as it pertains to regulation of eco-network's formation and functioning, or adopt new provisions with regard to eco-networks and habitat protection, the one that would meet the Directive requirements, in the first turn, with respect to the criteria of eco-network formation and the demands of habitat protection.

Conclusion

Formation of eco-network in Ukraine was performed in separate and fragmentary directions. On the one hand, it undoubtedly had positive effects, on the other – did not result in essential shifts with respect to major goal of formation of ecological network as and integral system with maximal continuity and interconnected relationship of its components. Achievement of the desired goal centers around solution of a number of strategic tasks such as development of joint map of network formation in Ukraine; creation of new (expansion of existing) NRF objects; provision of best international practice in introduction of efficient NRF territory and object management system and its integration with the other economic sectors; integration with European system of nature protection declared in 92/43 Directive on preservation of natural environment, wild flora and fauna. Development of really functioning eco-network would help unite the lands of nature reserve fund and other natural/semi-natural landscapes, and provide for preservation, reproduction and non-exhaustive use of nature resources, biological and landscape diversity, as well as strengthen landscape resistance to anthropogenic loads, renew the self-regulative and self-reproductive abilities of natural eco-systems, provide for positive changes of environmental state, and form ecologically safe environment for human life activity.

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