

# Strategy of Forming the Geoecological Framework of the Territory: on the Example of the Chechen Republic

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**Abstract** – The article analyzes the scientific and practical prerequisites for the formation (design) of the geoecological framework of the territory, the specific terminology in this area in the works of domestic and foreign researchers. The article studies the dynamics of the development of the concept of ecological networks (framework) in European countries and in Russia over the past decades. Using the example of the Chechen Republic, an interconnected system of nature conservation areas of various functional purposes has been developed, including existing specially protected natural territories, designed to maintain geoecological balance in the region. The cartographic method of research allowed visualizing the main structural elements of the proposed framework of a given territory. The article claims the relationship and the value of the basic, local and linear elements of the frame in the preservation of biological diversity and natural landscapes. The article also gives assessment of the current state and prospects of development of specially protected natural territories.

**Keywords** – *geoecological framework of the territory; emerald network; sustainable development; specially protected natural territories; biological diversity.*

## I. INTRODUCTION

Questions to develop a scientifically based system for the use of nature, the preservation of landscape and biological diversity are becoming increasingly important both in regions with highly developed industry, tourist and recreation sector and in agrarian-oriented regions. These refer to the Chechen Republic [15, 16].

The term “frame” in French “carcasse” means the skeleton. It is used in various fields of science and technology. The concept of a geoecological framework of a territory does not have an unambiguous and generally accepted definition. There is no unity of researchers in the choice of the concept itself. Thus, in modern geographic literature, different terms are used – “natural frame” [14], “natural-ecological frame” [3], “ecological frame” [7-11], “ecological network” [4], “landscape-ecological skeleton” [13], “natural reserve skeleton” [1], “ecological-cultural framework” [12], etc.

With all the differences in approaches to the concept of ecological framework and originality of interpretations, they all include the system basis in the concept under consideration, pointing to a network of interconnected objects acting as a single whole or supporting framework [1, 3, 4, 10-16, 22, 31, etc.].

There are also specific approaches to the definition of the ecological framework. In [11, p. 131] the authors interpret it as a set of “undeveloped areas with landscaping” that provide ecosystem services, including the possibilities of the population for recreation. Frame approaches and frame models are also used to form a “sustainable urbanized frame” in combination with the natural-ecological one [2, p. 148].

The article uses the term “geo-ecological framework of the territory” defining it as a system of spatially and functionally interrelated specially protected natural territories and objects, which allows maintaining geo-ecological balance in the region [16].

In foreign scientific literature the authors use several different approaches to study of geoecological framework which correspond to the concepts of “ecological nets /networks” [17, 22, 24, 28, 30, 31], green infrastructure [19, 20].

## II. METHODS AND MATERIALS

The authors use the following methods: comparative geographical, historical, statistical, cartographic, as well as field route studies.

The factual basis of the work consists of stock and statistical data on specially protected natural territories and objects, biodiversity, data of the Ministry of Natural Resources and Environmental Protection of the Chechen Republic. The map of the geoecological framework of the territory of the Chechen Republic was created using the Corel DRAW program.

### III. GEOECOLOGICAL FRAMEWORK OF THE TERRITORY AS A BASIS FOR SUSTAINABLE DEVELOPMENT STRATEGY

Conceptual approaches to the planning of spatial development with the aim of improving environmental strategies have been most actively developed since the 1990s. XX century. This process was historically preceded by the period of formation of the concept of sustainable development. The term “sustainable development” was first used at the Stockholm Conference in 1972, and the concept itself in its modern interpretation was first formulated in 1987 in the report of the International Commission on Environment and Development under the guidance of G.Kh. Brundtland.

The key point in the pan-European strategy for the conservation of biological and landscape diversity was the development of the Pan-European Ecological Network [29]. The Council of Europe actually founded it in 1989, and officially established it in 1995 [27]. This concept has received significant political support over the past two decades [26]. Regional and national approaches to the formation of ecological networks in European countries are at different stages of development, but all of them are based on modern landscape-ecological principles [30].

The pan-European ecological network consists of three subprojects completed in 2002 and 2006s, they differ in a detailed approach taking into account regional specifics [29]. Work on it continues at the present time. The project is based on national, regional and interregional ecological networks that are formed throughout Europe. Their further development should include the creation of trans-European ecological corridors that ensure international coherence.

To date, nature conservation in Russia is not among the priority areas of state policy. However, in a number of subjects the development programs for the formation of the ecological framework of the territory within the framework of the pan-European biological and landscape diversity strategy get support [7]. The problem of creating transboundary ecological corridors is among the priority ones, the solution of which will help to ensure habitat protection [24]. Attempts are being made to create a methodological base [21], which allow integrating the pan-European ecological network with the Natura 2000 network. The latter covers over 18% of the territory of the European Union and almost 6% of its water area.

In Russia, by the decision of the Executive Committee of the European convention on the conservation of wildlife and natural habitat (Strasbourg) of November 30, 2012, 740 objects got the status of promising areas of the Emerald network [16]. Emerald network – an ecological network of “Special Conservation Areas”. There are 9 specially protected natural areas and objects of the Chechen Republic [15]. They are classified as regulated types of protected areas: A – for the protection of flora, fauna, habitats and landscapes; B – endowed with special status by sectoral legislation, or administrative acts, for tasks other than direct nature conservation, but also contributing to its protection (protective forests, water protection zones, etc.); C – with a regime established by private order, but ensuring long-term preservation of fauna, flora and habitats (biological stations and hospitals, private conservation areas, etc.).

Green infrastructure, in addition to the important contribution to the overall strategy for the sustainable functioning of the global ecosystem, is of very important medical and biological importance and contributes to the formation of comfortable living conditions and human activities [19]. Under urban ecosystems, urban forests and areas with woody vegetation make the largest contribution to the implementation of ecosystem services [32]. In managing them, spatial planning of green infrastructure, consideration of ecosystem services is important [10, 20]. This long and laborious process should ensure that the urban ecosystems are filled with natural-ecological objects, allowing meeting the needs of citizens in recreation.

In the development of the concept of ecological networks (framework) in European countries over the past decade, there has been a tendency to shift the focus from environmental protection to the sustainable development of the region as a whole. In forming the geoecological framework of the territory, it is important to take into account the interests of key stakeholders, the support of the local community [31].

The article pays special attention to the study of the features of the formation and evolution of ecosystems. Analysis of the spatial and temporal characteristics of ecosystems involves research in the field of molecular, genetic and global ecology [18]. A review of current publications suggests the dominance of studies devoted to the study of plant communities; taxonomic groups such as reptiles, amphibians, lichens, and fungi remain less studied [22]. It is necessary to take into account (for example, in the process of ecosystem management) interspecific antagonistic and mutualistic ties [23]. The study [28] substantiated the need to enhance the flow of knowledge and information among practitioners in this field, the synthesis of spatial planning and the formation of ecological networks in a transboundary context.

### IV. TYPES – INDICATORS OF THE GEOECOLOGICAL FRAMEWORK OF THE TERRITORY

Along with priority species for protection of pan-European significance, species listed in the Red Books of the Russian Federation and the Chechen Republic were taken into account as indicator species whose habitat indicates a good condition of the territory. There are 8 potential reserves of regional significance: (Argunsky, Bragunsky, Vedensky, Parabochevsky, Stepnoy, Urus-Martanovsky, Shali, Green zone of Grozny) and one (Sovetsky) – federal.

In the Chechen Republic, despite the insignificant area, there is a high concentration of biological diversity at both species, and at the ecosystem and landscape levels [24]. Here, from the north to the south, semi-desert, steppe, forest-steppe, mountain-forest, mountain-meadow and nival zones replace each other. Each of them is peculiar – a specific environment, a variety of species (including endemics), with the exception of nival, which is practically devoid of vegetation, and the lichens of Lekanora and Rhizokarpa are developed only on outcrops of rocks here.

In relation to the fauna of the former USSR, in the Chechen Republic live out of amphibians 21.8% (8 species), reptiles – 20% (up to 280 species). Of the mammals (about 91 species),

43% of the species are wild ungulates, 44% are predators, up to 25% of the species composition of rodents [24]. At the same time, the area of the republic is only about 0.06% of the territory of the USSR. The ichthyofauna of the Chechen Republic is the second only to the coastal republic of Dagestan in its diversity of species composition. There are three orders of reptiles: lizards, snakes, and turtles. At least 17-18 species penetrate into the mountains right up to the alpine belt. The Red Book of the Chechen Republic contains 74 species of invertebrates (including 1 species of crustaceans and 73 insects) and 115 species of vertebrates (1 of them are cyclostomes, 13 are fish, 4 are amphibians, 16 are reptiles, 55 are birds and 26 mammals) [6]. In the flora of the republic 2200 species of plants are noted. The number of registered endemic species is 15, but in fact not less than 60 [5].

The level of biodiversity, as a rule, is largely determined by the presence and actual state of specially protected natural territories. Specially protected natural territories are extremely important for maintaining the ecological balance of the territory, preserving the environment-forming and environment-forming functions of the natural landscape. The conservation business in Russia began earlier than in many other countries and one of the first in 1924 was the Caucasian Reserve.

The system of specially protected natural territories in the Chechen Republic began to take shape in 1963, when hunting reserves were established—Sovetsky, Vedensky and Parabochevsky. In accordance with the law of the Chechen Republic “On Specially Protected Natural Territories” (2007), taking into account the peculiarities of the regime of specially protected natural territories and the status of environmental objects located on them, the following categories of protected areas are: natural parks; state natural reserves; monuments of nature; dendrological parks and botanical gardens. There are no state nature reserves in the region.

In 2006, the certification and cadastre of protected areas began. However, to some of them (mainly in the mountainous and foothill areas) to date there is no access due to mining of the territory, and military units. So, on the territory of the federal reserve “Sovetsky” there are frontier posts and their infrastructure facilities. Due to the complex geopolitical situation in the border areas, there is no proper state control and protection of this territory.

The share of specially protected natural territories of all categories defined by the current federal and regional legislation in the Chechen Republic is 19.5%. The ratio of these areas according to the state report “On the state and environmental protection of the Russian Federation in 2017” with other North Caucasian regions (Table 1) revealed their slight dominance in Karachay-Cherkessia (29.5%), Kabardino-Balkaria (27%) and North Ossetia-Alania (24%). However, they significantly exceed the same indicator in Dagestan, where it is comparable to the average Russian (11.8%). We believe that taking into account the specifics of mountain regions (a higher level of biodiversity, the presence of reference areas of untouched nature, exposure to dangerous natural phenomena and processes, etc.), the highest percentage of areas of specially protected natural territories is justified here [16].

TABLE 1. RATIO PROTECTED AREAS IN THE NORTH CAUCASUS REGION (ON 01.01.2018)

No.№ number	Region	Total area, ha	In % of the total area of the region
1	Chechnya	316890	19,6
2	Dagestan	628630	12,5
3	Ingushetia	70012	19,3
4	Kabardino-Balkaria	366100	29,4
5	Karachay-Cherkessia	602400	42,1
6	North Ossetia-Alania	192000	24,0

#### V. PROPOSED STRUCTURE OF THE GEOECOLOGICAL FRAMEWORK OF THE TERRITORY OF THE CHECHEN REPUBLIC

As already noted, individual protected areas are able to perform their “ecosystem, social, scientific” and other functions only if they form a geoeological framework. To maintain biological equilibrium, these disparate areas must be connected by corridors that ensure the unimpeded migration of animals and their free settlement. That is, all specially protected natural areas should be combined into a holistic planned, effectively functioning structure in the form of a spatially connected network (framework) of natural and semi-natural territories.

The system of spatially and functionally interconnected specially protected natural territories and objects, which allows maintaining geo-ecological balance in the region, should include basic elements (cores or framework nodes), local and linear elements [3, 7]. Biological reserves can act as basic elements and hydrological and botanical monuments of nature can act as local ones. Narrow valleys of permanent (or temporary) watercourses, green areas along highways, field, forest roads can perform the role of linear elements or transit areas. They provide communication between the cores of the framework (Fig. 1).

In the Chechen Republic about half of the total area of specially protected natural areas (144200 hectares or 45%) falls on Sovetsky and Vedensky reserves with a common border that runs along the Sharoargun River, which are confined to the mountainous and high-mountainous zones. On the territory of these reserves there are botanical (Radde birch grove, Makazhevsky pine forest) and hydrological (Kurosky carbon dioxide source, lake Kezenoy-am, etc.)

On the territory of the Vedensky reserve, lake Kezenoy-am – the largest high-mountain reservoir (at an altitude of 1,870 meters above sea level) in the North Caucasus, deserves special attention because it is the pearl of the entire Russian Caucasus. Only here there is the Eisenam trout listed in the Red Books of the Chechen Republic and the Russian Federation. The lake is one of the five objects on the territory of the republic included in the inventory of wetlands that meet the criteria of the Ramsar Convention: “Lake Kezenoy-am”, “Lake Galanchozh”, “Lake Budary”, “Lake Kapustino, Mayorskoe”, “Urochishche Kissyk” [5]. It is of international key importance for such species as the vulture, bearded vulture, griffon vulture, etc. In addition, there are 25 endemic, rare and endangered plant species, including 3 species of psefelus, ground crane and Caucasian dryad. This lake, together with the adjacent territory,

is recommended by the Union for the Protection of Birds of Russia to get the status of a national park [14].

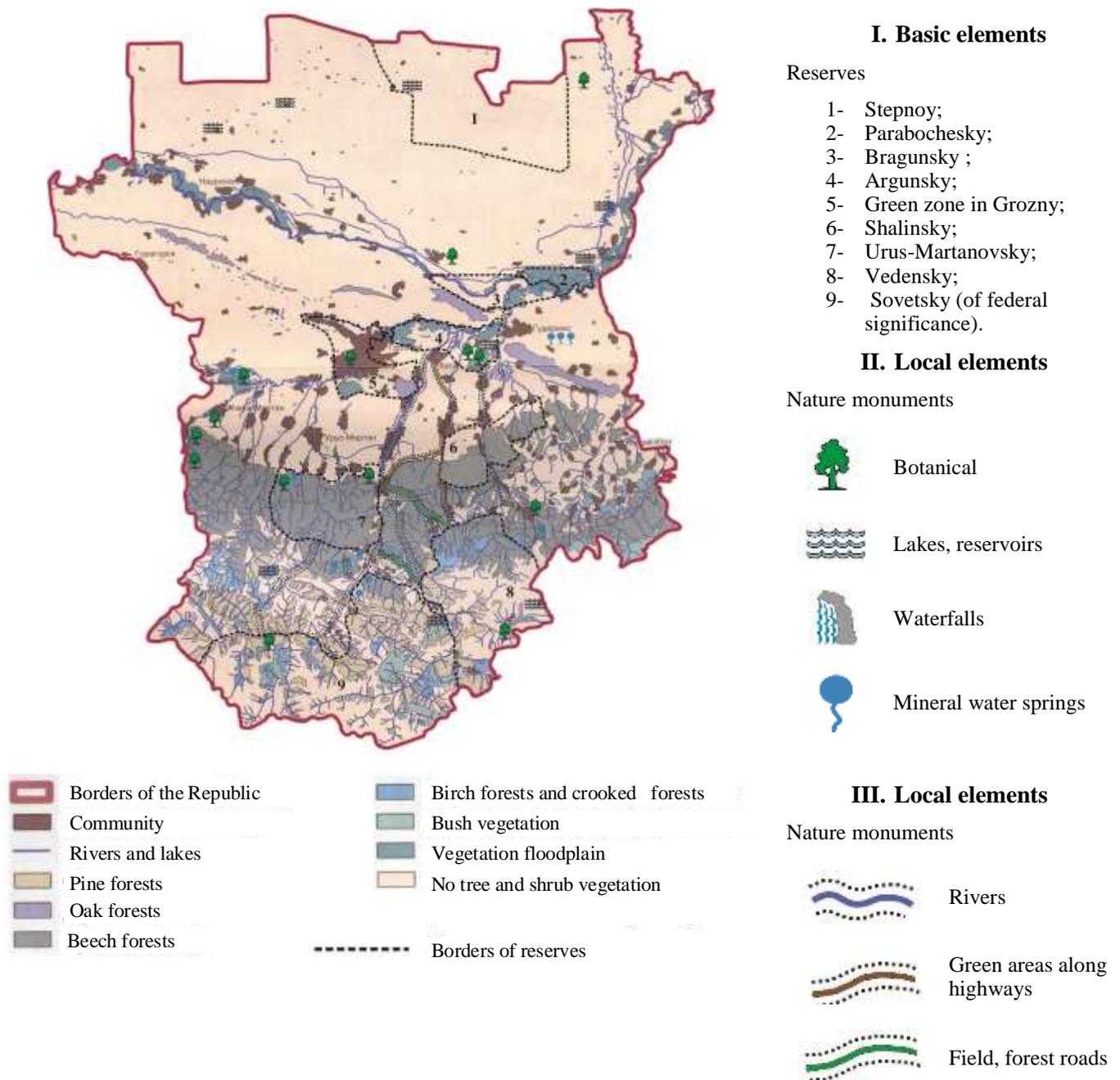


Fig. 1. The proposed scheme for the ecological framework of the territory of the Chechen Republic (compiled by Kh.Sh. Zaburaeva)

The Sovetsky and Vedensky reserves have a different status, borders, dimensions, but the same environmental conditions (area of mountain forests and meadows) resulted here the presence of substantial similarity of species of fauna and flora, and of course, their boundaries do not coincide with the natural boundaries that determine the way of animal migration, including species of European importance. Against the background of the whole territory of the region, it is noted the maximum biological and ecosystem diversity. Here are more common species of plants and animals listed in the All-Russian and regional Red Books. The mountain and highland zones are poorly populated and, accordingly, are less involved in economic activities. As confirmed by modern publications [5, 6, 15, 24, etc.], Mountainous area in the Caucasus –one of the foci floral and faunal endemic.

The territories of the Sovetsky and Vedensky reserves are also distinguished by a high level of flora diversity, which is represented by such rare European-Caucasian species as the three-toothed orchid, the globular traushsteiner. European vulnerable species also grow here (perennial daisy, rowan Glogovina and others), as well as the endemics of the Caucasus (mountain violet, kladoheta whitish, the long-coniferous rhododendron, birch Radde and many others).

The fauna is often represented by endemics, which are listed both in the regional and in the Red Book of Russia and also have European significance. Among the insects there are : ground beetle Maurus, ground beetle Cumanus, alpine barbel, cyrus. Among the vertebrates there are : the common triton Lanza, Caucasian lizard, transcaucasian snake, viper Lotiyev, viper Dinnik, bearded vulture, black grouse, caucasian black grouse, Caucasian snowcocks, common shrew Radde, near eastern leopard , forest cat, brown bear, European lynx and others. In the alpine zone, there are turs and snowcocks and and on the border of the forest in the area of subalpine forests – caucasian chamois, bezoar goat and others.

Between the Sovetsky and Urus-Martanovsky reserves, along the corridor, there is a wetland–Galanchozh Lake, declared a natural monument. It is of international importance in the conservation of valuable species of birds: the peregrine falcon, bearded vulture, golden eagle, etc. The region’s bird complex contains 19 endemics of the Caucasus. Over 20 endemic species in the flora have been recorded in the land area.

The flora and fauna of the Urus-Martanovsky and Shalinsky reserves are quite diverse. They are located in similar landscape zones (mountain forests and forest-steppe) and occupy an area of about 57,300 hectares. These reserves are habitats for rare insect species (stag beetle, Transcaucasian stag beetle, big oak barbel, oak barbel rhesus, crimson ribbon, small night peacock eye), birds (bearded, peregrine falcons), mammals (common shrew Radde , forest cat , common lynx, etc.). For the free movement of animals, these reserves should be connected by ecological corridors that can pass both along river valleys and green areas along highways and field roads and forest roads. In need of special protection are rare European (European daisy), the Euro-Caucasian (hordelimus European, dayberry) and endemic Caucasian (kladoheta whitish, Kuznetsov carnation) species.

In the vast steppe zone of the Chechen Republic on the area of about 51,000 hectares are located reserves: Argunsky, Bragunsky and Green zone of Grozny. Taking into account the greatest occupancy and susceptibility to anthropogenic impact (compared to other landscape zones), this area is not so significant. According to various estimates, the optimal area of specially protected natural areas to ensure a favorable environmental situation should be at least 20% [15]. At the same time, this share should be increased in proportion to the increase in anthropogenic load and environmental degradation. The area of the steppe zone in the region is at least 460 thousand hectares. Consequently, the share of specially protected natural territories here accounts for only about 10% of the territory.

Many reserves in the conditions of the considered region are located at insignificant distances from each other. Some of them have common borders. In particular, the border between the Green zone of Grozny and the Argunsky reserves lies along the Sunzha river bed and between Bragunsky and Parabochevsky–along the Terek River. They can be connected mainly along river beds (Argun, Dzhalka). Since northern parts of Shalinsky and Urus-Martanovsky reserves are located in this zone, for the free migration of steppe animals viewed reserves may also be combined for forest stands along the major highways.

The diversity of flora and fauna of the Green zone of Grozny, Argunsky and Bragunsky reserves, including rare and endangered species, varies widely. There are not less than 10 and 35 species of plants and animals of European significance, respectively, listed in the Red Books of the Russian Federation –15 and 53, and the Chechen Republic–32 and 125 [6]. Rare Euro-Caucasian (birthwort Dutchman's-pipe ,beautiful feather-grass), Euro-Asian (dead man's finger), European-Mediterranean (saw grass ) and other plant species, as well as many endemics of the Caucasus (arched bird, primula daryal ).

Among the animals, there are rare species of reptiles (Mediterranean tortoise, patterned snake, four-strip snake), birds (steppe harrier, European chickpea, burial ground, North Caucasian pheasant) and mammals (European Caucasian mink, steppe polecat, Caucasian otter, Caucasian reed cat, Red deer ).

In the northern part of the semi-desert zone of the Chechen Republic, the Steppe Reserve is concentrated, and in the south (in the Terek floodplain)–Parabochevsky. Species of European importance (mainly birds (over 20 species), most of which are in the Red Book of Russia, inhabited here. Among them there are various species of birds (European black-throated loon, little bustard, steppe eagle, European subspecies of bustard and large curlew, etc.), mammals (giant mole rat, South Russian ligation, etc.). Many species of birds (sheld duck, ogar, etc.) are listed in the regional Red Book; reptiles (sand stranger, steppe agama, etc.); mammals (corsac fox, Caucasian red cat) and vascular plants (plume grass Ravenna, etc.). Within the limits of the Parabochevsky reserve there is a key ornithological territory of international importance “The Terek River flood plain near Staroshedrinskaya” for globally threatened bird species in the Caucasus ecoregion (red-breasted goose, saker falcon, imperial eagle, sociable plover, etc.) [5].

Within the Terek-Kumskaya lowland, the natural monument “The Steppe Pearl Trail” is of particular importance for the conservation of rare (including European) species of

fauna. This is a natural, anthropogenically-transformed complex of freshwater and brackish old-style reservoirs, which act as the remains of the old river Terek. This monument covers 1,500 hectares, including 1,100 hectares of water surface. The Steppe Pearl is a nesting place and stops on the passage of rare and protected species of waterfowl and near-water and desert-steppe birds listed in the Red Books of Russia and the Chechen Republic. On nesting here are noted: little cormorant, ogar, white-eyed pochard, long-legged buzzard, demoiselle, North Caucasian pheasant, avoset, black-winged pratincole, dikkop, black-winged stilt and etc. The value of reserves for spawning and feeding of valuable commercial fish species is great.

In the proposed geocological framework of the Chechen Republic, the Steppe Reserve, located in the driest part of the region, remains a bit detached. Here are species of flora (yellow everlasting, ephedra two-spiked, etc.) and fauna (toad-headed agama, marble teal, white-eyed diving duck, etc.), inherent only in this territory. Within its borders there is a natural monument "Kissyk Tract", the area of which is about 250 hectares (including 120 hectares of water surface). The tract is a natural complex of permanent and temporary freshwater lakes in the semi-desert natural zone of the North-Western Pre-Caspian Sea [5]. This is a place of nesting and stopping during the period of migrations of rare and protected near-water and desert-steppe birds, including those listed in the Red Books of the International Union for Conservation of Nature and Russia (cormorant, white-tailed eagle, great curlew, little terrick, etc.). It is also classified as a key ornithological area of international importance for globally threatened bird species in the Caucasus ecoregion [16].

Implementations of the proposed framework should be preceded by a full monitoring assessment of the status of protected areas and objects and the creation of their inventories. For Stepnoy and Parabochevsky reserves such work began in 2009, and for Bragunsky and Argunsky - in 2013. According to the Forestry Department, there are about 8 thousand hectares of forest land under landmines. Since a significant portion of the reserve located in the mountainous part make up forests, access is currently limited.

## VI. CONCLUSION

Ecological systems as a whole and processes affecting biological diversity do not become confined within the borders of states or regions, which indicates the insufficiency of environmental measures taken at the local, regional and even national levels. A transition to an international system of coordination and integration is needed to preserve biodiversity and natural landscapes. The fundamental principles of nature conservation, with the realization that "humanity-part of nature" were set out as early as 1982 in the World Charter for Nature. The formation of an ecological network contributes to the preservation of wild species of living organisms, as well as their natural habitats in fragmented natural areas and transformed landscapes.

The territory of the Chechen Republic has the presence of valuable species of flora and fauna, the preservation of which will be an insignificant but important "contribution" to the

overall task of biodiversity conservation and the formation of an ecological network. Most of the specially protected natural territories of Russia, including the Chechen Republic, are represented by scattered, weakly connected objects, so they are not able to perform even environmental functions. To maintain biological equilibrium, they need to be connected by ecological corridors that ensure the unimpeded migration of animals, their free settlement. In the Chechen Republic and contiguous regions of the North Caucasus, it is necessary to form a geocological framework—a system of spatially and functionally interrelated specially protected natural territories and objects, allowing to maintain balance and balanced development of this mountainous country and in the future its connection to the single Pan-European Emerald network.

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