The landscape – analog approach to optimization of steppe nature management

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Abstract. The attempt to analyze morphological, genetic, and typological landscape-analogs in Steppe Eurasia enveloping the vast transcontinental space of Inner Eurasia from the Danube basin to the Amur River basin has been made for the first time in the paper. Despite considerable provincial differences of a latitudinal row of steppe and forest-steppe regions connected with a degree of climate continentality, geological-geomorphological peculiarities, high altitude of low-laying, elevated and upland plateau-like plains within the all steppe Eurasian space, thanks to the comparative-geographical method, we can define landscape-analogs of a different type that are distant from each other at thousands kilometers. Steppe landscapes of Eurasia have a long and rich history of economic development, having the standard features of zonal nature management, anisochronous in time for hundreds, sometimes thousands, years. Steppe nature management experience in different longitudinal sectors can be used to solve zonal ecological problems of which countries and regions of Steppe Eurasia have met.

1. Introduction
Concepts about landscape-analogs began to work out thanks to developing a comparative method of geographical studies promoting nature scientists to fix similar features of natural regions that were remote from each other. Observations for nature caused it during long-time scientific expeditions. In works of Academician expeditions in 1768-1774 (P.S. Pallas, I.I. Lepyokhin, J.P. Falk, and others), in new regions, researchers noticed landscape peculiarities that had been already known during the previous travels. In the 20 century, A.I. Voeykov [1], V.P. Semyonov-Tyan-Shansky [2], A.A. Grigoriev [3] used a notion of geographical analogs. For the first time, F.N. Milkov [4] generalized the concept about landscape-analogs; he defined inter-zonal landscape-analogs of the genetic type, morphological, and typological landscape-analogs.

2. Problem setting
Steppe and forest-steppe zones are noticed as strips of unequal width within Steppe Eurasia extended from west to east more than 8500 km. Simultaneously, we should note that landscapes zones are divided into three principal sectors: western – East-European (from the Pannonian basin to Trans-Volga and South Ural), middle – West-Siberian and Kazakhstan (from South Ural to Altai), and eastern – East-Siberian and Mongolian (From Altai to Manchuria). Each of these sectors of Steppe Eurasia is characterized by the independent structure of intra-zonal landscape-analogs.

Their palette is traced along the whole Steppe Belt within all three sectors and in different altitudinal levels regarding morphological landscapes-analogs. The example can be psammitic
landscapes, natural formations connected with granite and granitoid exposure, landscapes of lake-saline depressions, karst landscapes caused by spreading of carbonate (limestone, chalk) and sulfate (gypsum) rocks.

Typological landscape-analogs have all-round distribution within Steppe Eurasia. In our opinion, it is dominant or typical kinds of the country: flats on loess basis, valley-river landscapes formed by flood plains and terraces above the flood plain, hilly sands, ravine-gullies, residual-watershed outcrops of solid sediment or crystalline rocks, variants of interfluvial-non-drained types of the country.

In designing the problem concerning steppe nature management and strategy of nature diversity conservation in regions, a record of the united system of landscape-analogs allows using a positive and negative experience of economic development in the geographical space of Steppe Eurasia for the historic period.

Despite uplands and lowlands and large transit rivers within Steppe Eurasia space, open, accessible land transport communications’ landscapes have promoted developing trade-economic and cultural relations between the areas of settled farming culture during about six thousand years. Waves of nations’ resettlement along a vast steppe corridor played a significant role in the ethnogenesis of a considerable part of North Eurasia’s population. The use of horses and camels in the transcontinental caravan routes and wheel transport adoption made the opportunity tribes and nations move at a considerable distance. They met landscapes similar to those where they had lived before migration. Settling in a landscape similar to the last living place, the Turkic and Mongolian people transferred their toponymy to new homes. It was toponymy that became the first evidence of landscape-analogs that we met along the Steppe Belt from Inner Mongolia to the Danube basin. It is enough to address to "Dictionary of folk geographical terms" by E.M. Murzaev [5], or "Physical Geography Dictionary" by F.N. Milkov [6] to reveal the whole series of landscape-analogs in North Eurasia imprinted in "the Earth’s language" – toponyms and names of specific holes and countries: rovnyad (flat drained watershed-flats), dunes (hilly sand steppes), riparian forest, urman (flood plain forest), bor, karagay (pine forest), sor (saline lake hollow), syrt (watershed upland, steeply-sloping plain), etc.

Local geographical terms and names served as reference points for steppe people and defined practical meaning in countries and geographical objects. For many centuries, generations of peoples exchanged each other have passed the economic meaning one or another similar country, which remained by the present. Therefore, geographers studying landscapes widely use local geographical terms to mark holes and countries [6].

A practical experience of landscape-analogs development was accumulated for a many-centuries history of steppe nature management in Inner Eurasia regions; it was conveyed along with all transcontinental zonal-latitudinal space as the cultural exchanges so together with people-settlers. It happened as in the ancient times and the Middle Ages so in the early modern and modern periods (settlement of border Cossak’s lines, the resettlement campaigns at the end of 19 – the beginning of 20 centuries, virgin land reclamation since 1954, and others).

Transmitting of experience of steppe nature management in time and space has happened intuitively for a long time. Based on their knowledge and skills, settlers used traditional agricultural practices to increase farmlands' productivity and improve the habitat. As a convergent branch of applied natural science, modern steppe science can successfully solve tasks of adaptive agriculture, taking into account the practical experience in climate and anthropogenic changes.

3. Results and Discussion
Numerous typological landscape-analogs are noticed within a huge transcontinental belt of North Eurasia. They are represented along the entire length of the zonal-latitudinal space. In this paper, we consider some of them, the most typical and reflecting peculiarities of the megaregion’s landscape structure.
3.1. Steppe flats (plakory)

Dominant types of the country of Steppe Eurasia’s plains are flats formed on loess and loess-like loams. Such a country is characterized by the complete absence of forests due to the calcareous lithological composition of soil-forming materials. Flats with zonal full-profiled soils of a Chernozem kind—from chestnut to typical Chernozem are the most valuable lands that suffered plowing more than two thousand years ago in the east Steppe Eurasia in the Hwang Ho basin and during 18-20 centuries in Central and East Europe. Zonal types of vegetation and zonal types of steppe zone vegetation corresponding subzones of southern, typical, and northern steppes were formed on flats before agricultural time [7].

Within the Pannonian plain, in Romania, Serbia, and Hungary areas, unplowed flats remained only fragmentary either on residuals in river valleys (the Körös River) within the southern border of Hungary or in gentle slopes of the northern Transylvania, where the meadow-steppe preserve with a high diversity of species is placed under protection—an analog of meadow forbs-grasses steppes in Ukraine and the Black soil region of Russia [8]. Also, in the level of tracts, plots of the fescue-feather grass-forbs steppe are protected in Moldova—reserves Vrănești, Budjak-1, Budjak-2 [9].

On the level of countries (flats and high terraces above flood plain), zonal forbs-fescue-feather grass steppes on loess are conserved in Ukraine—the landscape preserves "Tarutinskaya steppe" in Odessa oblast [10], natural reserve "Elanetskaya steppe." The original variants of zonal steppes in Ukraine are the reserve plot "Askania-Nova" and "Khomutovskaya steppe" on the Azov Upland. Fragments of forbs-grass and feather grass steppes on loess were included in the planned regional landscape park "Forest-steppe Chernozem" [11] in Poltavskaya oblast.

Special Protected Natural Areas (SPNA) remained at the same scales in the Russian Federation; they have different categories and are represented in southern and south-east Russia’s regions. Their review is described in the author’s monograph [12]. Analogs of the flat steppe on loess are conserved in Ukraine—the landscape preserves "Tarutinskaya steppe" in Odessa oblast [10], natural reserve "Elanetskaya steppe." The original variants of zonal steppes in Ukraine are the reserve plot "Askania-Nova" and "Khomutovskaya steppe" on the Azov Upland. Fragments of forbs-grass and feather grass steppes on loess were included in the planned regional landscape park "Forest-steppe Chernozem" [11] in Poltavskaya oblast.

3.2. Steppe pine forests

Along with steppe flats covered by zonal forbs-grasses vegetation on Chernozem and chestnut soils, insular pine forests have transcontinental distribution along the whole latitudinal belt of Steppe Eurasia. According to the ecotope, pine forests in the steppe zone can be conditionally connected either with sands and Chernozem sandy clay or outcrops of hard-rocks, such as granite granitoid and products of their weathering. In 1927, G.A. Tanfiliev pointed out vast spreading of coniferous species in the steppe zone: "...if in the south, no loess and different loess-like loams were developed but sands, then, forests with the dominance, probably, coniferous species would have reached to the Black and Azov Seas. And now, sands along river valleys penetrating to the south somewhere is covered by pine" [16, p. 480].

V.V. Alyokhin wrote that pine could not be considered a zonal forest tree. He asserted that "it is a sort of an inter-zonal character connected, mainly, with sandy substrate." Alyokhin wrote: "Pine with its separate islands deeply penetrates the steppe zone there, where sandy soils were developed. It is believed that if our steppe south had been covered not Chernozem but sandy soils, pine would have occupied vast territories reaching the Black Sea." We can add these thoughts by V.V. Alyokhin. Firstly, pine occupied vast areas with sandy soils in the steppe and forest-steppe zones in Central and
East Europe, but it was cut down. Secondary, suppose we accept sands and chernozem sandy clays as a zonal etalon of steppe soils instead of loess and loess-like loams. In that case, Punis sylvestris could be considered no intra-zonal but zonal "steppe" forest species (!).

Within the Pannonian plain, pine forests were cut down in the Middle Ages in sandy terraces of the Danube River (Fülpóháza, Hungary) and Serbia - Deliblato Sands and Suboticka Sands, where natural reserves were established. We should mention that in the border of 18-19 centuries, German-settlers became intensively restore pine forest plantations on the Danube sands but faced the problem of high fire frequency of even-aged clean pine plantations. In connection with it, other species became to be planted on sands, rarely using pine in cultural plantings.

Pine forests on sands were widely spread in the steppe zone of East Europe - the Olesky Sands in Ukraine, Tsimlyanskie Sands in Rostovskaya, and Volgogradskaya oblasts, Diakovskie and Eruslanskie Sands on the border of Saratovskaya and Volgogradskaya oblasts, and finally the largest insular Buzulukskiy pine forest in Trans-Volga. Pine forests on sands in different degrees of safety are traced along the whole steppe zone from the Ural to Altai, and in inter-mountain steppe depressions from Altai to Trans-Baikal [12].

Generalization of conservation and restoration's experience and new pine forests' formation within all latitudinal space of Steppe Eurasia from the Danube basin to Trans-Baikal represents huge scientific-applied interests to optimize steppe forest use and create pine plantings stable to climatic changes and spontaneous fires that would correspond to surrounded steppe landscapes.

3.3. Steppe hilly sands
Landscape-analogs represented in all Steppe Eurasia regions are sand massifs in different degrees transformed by natural processes and economic activity. In periods of increased pasture load on the entire steppe belt, sandy massifs underwent an intensive eolian transformation with the appearance of sandy ridges and dunes unfixed by vegetation – pasturable sands. In the periods of economic activity decrease, steppe sands were again covered by tall grasses and underwent group self-regeneration. Original "northern" deserts in 20 century, and due to threats of sandy storms and worsening of living conditions in the Middle Ages in Central Europe, were the objects of different meliorations promoting sands fixing and creation of productive pastures, hayfields, and forest plantations. Forest reclamation stations, and later, testing grounds and forestries were established on many sandy massifs in the middle part of 20 century. A vast row of hilly (dune) sands are represented by the principal massifs: Deliblato Sands and Suboticka Sands in Serbia, Olesky Sands in Ukraine, Tsimlyanskie, Terskie, Kunskie Sands in the south of European Russia, Eruslanskie Sands in Trans-Volga, many sandy massifs in the Central Caspian Sea region, sands in East Kazakhstan, and along steppe hollows and foothills in Tuva, Buryatia, Trans-Baikal.

3.4. Granite massifs of the steppe zone
It is typical landscape-analogs associated with outcrops of magmatic rock formations enriched with silica. In relief, they are represented as granite fields, separate residuals, and hilly ridges. In Kazakhstan, Altai and Trans-Baikal, they are represented by low-mountain massifs with picturesque rocky sculptures. Granite massifs are spread within the Ukrainian shield - in the middle reaches of the South Bug river - "Buksky Guard" national park, in the Azov Sea's region - "Kamennie Mogily" [Stone Graves], "Kalmiuskaya steppe" – plots of the Ukrainian reserve.

Within the Russian Federation, granite massifs spread and have a status of SPNA of different kinds in South Ural (Karabutaksy, Bayutksky, Sanarsky massifs), in Altai (the Kolyvan mountains), in Tuva – a "Yamaalyg" plot of the "Ubsunurskaya hollow" reserve, in Trans-Baikal – an "Aden-Chalon" field of the "Daursky" reserve.

Granite hilly massifs and low-mountains widely spread in Kazakhstan ("Kokshetau," "Burabay," "Bayanaul," ridges Karkaralinsky and Kent, the Sibinskie Mountains). It is the object of the country's natural heritage – national environmental parks, recreational-touristic zones with pine forests, mountain lakes, and stony steppes.
Granite massifs bring unique steppe nature management elements connected with the extraction of valuable building material, deposits of rare-earth metals, forest resources, for example, pine, hunting resources, development of recreation, and tourism.

Besides described landscape-analogs, many other typological natural complexes are typical for Steppe Eurasia, for example, lake-meadow-forest flood plains of steppe rivers (riparian forests), saline steppe lakes and sors, karst landscapes, diversities of original open woodlands –savannoids on abandoned fallow lands or burnt forests and the others.

4. Conclusion

1. The landscape-analog approach to the development of problems concerning steppe nature management has considerable prospects in connection with possibilities to use the international and inter-regional experience of steppe nature management. This experience helps us to create different types of SPNA, including reserves, preserves, and national parks, opening the unique opportunity for their integration in socio-economic development in the steppe regions.

2. Landscape-analogues of Steppe Eurasia, widely represented by native and secondary pine forests, are not only the objects for the conservation of unique biodiversity but essential strategic resources for forest reclamation, recreation, and tourism.

3. Conservation of zonal steppe etalons on massifs and loess-like loams has an enormous significance for the study and reconstruction of natural mechanisms of forming the most productive and stable agro-biocenoses, designing of nature-similar technologies in the steppe land use.

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