Biogeographic status of the steppe plains and foothills of the northern and western Caspian lowland

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Abstract. The discussion focuses on the zonal nature of the Caspian steppe and the status of the local biota, which in its spatial-temporal organization and regional succession system has preserved the pool of biodiversity of dry-steppe and desert complexes. Each of them represents a set of ancient systematic groups of organisms that migrated here along both the Eastern (Turan) and Western (Caucasus, Mediterranean) coasts of the Caspian Sea, forming "young" lowland ecosystems. There is a weak significance in the Genesis of the biota of the xerophilic foothills of the Eastern Caucasus (Daghhestan) and the southern Urals, which, apparently, only at the early stages of formation during periods of major sea transgressions served as refugia. The phylocenogenetically determined polyclimax and the predominance of pasqual and climatogenic subclimates in the region are manifested due to constant impact of cyclical short-term (hundreds of years) destabilizing factors.

1. Introduction
The zonal-provincial character of the biogeographic zoning of the European part of Russia is to some extent violated by the allocation of the Caspian region, which has well-defined boundaries, but not quite a definite biogeographic status [1, 2]. On one side, it is the prolongation of the Russian plain by geomorphological and geological features. So one would expect that there should be formed the “East-European” zonality in the biota distribution along the climatic gradient. So one would expect that there should be the “East-European” type of zonality in the biota distribution along the climatic gradient. But, on the other side, fluctuations of the Caspian Sea’s level, climate and depth of the saline waters’ occurrence in the Later Pleistocene and Holocene led to the development of the massive of original arid ecosystems, biogeographical status of which needs, to our opinion, clarification. In addition, dominance of the anthropogenic modifications of arid ecosystems in this area in the last millennia and the relatively recent inclusion of their biota in the phylocenogenetic (evolutionary) and successional (modern digressive-demutational) system operating in the region are also an important distinctive feature of the local ecosystems.

2. Factors of evolitional and successional dynamic of biome of the Caspian lowland
Before the start of these phylocenogenetic transformations among external factors of biota dynamic were only climate, fire and selective hunting for the big animals of the ancient people. As a rule, all these was accompanying with the self-restoration of biota. With the including of the Caspian lowland to the single “Eurasian steppe pastoral system” cyclic climatic and hydrologic changes in synergism of the grazing began influence reversible or irreversible on the regional biota status. By the Early
Holocene the Caspian ecosystem lost the major of the components of the “Mammoth’s fauna” and with the development of the cattle breeding it lost big herbivorous animals (Onager, Steppe tarpan, Persian gazelle) and then predators (Guepard, Manulcat, etc.). As a pastoral one, a dry-steppe, replaced the entire zonal steppe natural complex and desert digressive-demutational complex was formed here, which demonstrated and continues demonstrate cyclical biogeographic rearrangements in accordance with climate changes, fluctuations in the Caspian Sea level and grazing loads.

3. Contemporary biogeographic trends as reflection of biom’s “youth”
As we see it, contemporary biogeographic trends in the region are tied with the beginning of the Anthropogen. They should be looked for not only and not so much in comparing the compositions of regional floras and faunas, but in phyloceneogenesis in the whole biota and in those displays that are determined by the anthropogenic transformation of the regional succession systems. During very rapid and deep climate changes, the ecosystem first changes its position on the relief. Then it whether migrates following the movement of climatic regions (geographic changes), or, if migration is impossible, it died, making space for new ecosystems, which develops as a result of phyloceneogenes. Both used to appear in the different periods of biome’s developing, following the catastrophic (rapid) impacts of sea transgressions and regressions, humidization and aridation, cyclicality of grazing loads.

Caspian region, which in comparing with neighboring plain and low mountain areas (steppes of Volga and Transvolga region, steppes of Terek-Sulak lowland, seashore foothills of the Eastern Caucasus, Stavropol highland, Ust-Yurt plateau, Mugodzhary), exists for a relatively short period of time in conditions close to modern conditions. Therefore, we can speak about the “youth” of the natural complex that has developed here. The last large transgressions and regressions of Caspian Sea had significant biogeographic effect not only for the maritime biota, but also for the land biota of the Caspian region. Sea level fluctuations, in fact, were an important factor in the spread of animals and plants, the development of microevolutionary processes in them in connection with periodically occurring geographical isolation of organisms and, conversely, due to biotic translational and transmeridional flora and fauna exchange with areas featuring more ancient biota, and also in connection with processes of new reclamation of surfaces freed from flooding.

4. Effects of “island biogeography” and biota’s isolation in the Caspian lowland
These processes were influenced also by effects of “island’s biogeography” for the region’s territories with various elevation above the sea level both on the plain and in the foothills of the Eastern Caucasus. In addition, the processes of “narrowing” and “expansion” of the space of development of biota, associated with transgressions and regressions of the Caspian sea, were influenced by the quite contrasting conditions of the regional climate, fluctuations in the level of salty groundwater and the thermal regime of the sea itself - from cold-water in the final period of the Valdai glaciation to warm-water in Holocene (contemporary). It is known [3], that on the end of the Atlantic time (nearly 5,000 ago) in the period of the Makhachkalinian sea regression the transition from arid warm conditions to the modern one (more humid and colder) was carried out. The regression, which lasted for about 2,000 years, formed “land bridges” both in the west and east of the Caspian region, which, against the background of the advancing transgression, directed streams of “steppe” biota onto arid (in fact, desert) complexes of the lowland.

Earlier, as can be understood when analyzing the Holocene chronology of the region, biogeographic status on the plain and low mountain parts of the northern Caspian region was changing considerably. The reason was in the oscillations of the sea level, which were not be synchronized with dynamic of zonal vegetation (ecosystems) of the adjacent land. It “disjuncted” during the period of the Khvalynskaya transgression’s maximum, when the natural biotic exchange between the eastern (“Turanian”) and western (“Pontic”) elements of the terrestrial biota was disrupted, then it created wide corridors of transmeridian exchange of flora and fauna, when the Caspian lowland, in fact, united into a single whole with the Tersko-Kumskaya lowland. At the same time, the eastern regions of the Caucasus - foothills and mountains - were periodically separated from the plain by water barriers. On
the one hand, it stimulated evolutionary processes, and on the other, did not allow the mountains to be traditional refugia for zonal vegetation and fauna of the steppes (and moreover, deserts) during periods warming and/or aridization of the climate in the Caspian region. Rather, on the contrary, in the foothill part of the Western Caspian Sea, according to S.V. Kirikov [4], herds of kulans, tarpan, saigas against the background of a relatively high pasture use by nomads and sedentary populations up to the 19th century were common. L.G. Dinesman [5] writes about the same, however, paying attention to the dry steppe complex of the fauna of small mammals and birds, which is quite dynamic in relation to anthropogenic impact, which, with an increase of grazing and aridity, changes more intensively towards desertification. Truth to be told, the weakening and disappearance of grazing in the region unambiguously led to the emergence of both early spring and autumn burns, which in turn stimulated the development of degradation processes here up to the formation of deserts.

5. Biogeographic status of Caspian region

There appear to be no definite discussion on the nature zonality of the Caspian region for more than 100 years [6-10]. This fact has not allow to solve the main question about the status of the local biota, which saved in its spatial-temporal organization and, above all, in the regional successional system the pool of the biodiversity, providing development and coexistent of the biotic systems of the dry steppes and deserts. Each of them represent the group of sufficiently ancient organisms [11-12], which migrated here along both the eastern (Turan) and western (Caucasus, Mediterranean) seashore of the Caspian Sea and formed the “youth” ecosystems. During the last millennia, the huge sea transgressions was not being here and exponion of the surface of the lowland allows finishing the primary succession with development of light chestnut and brown desert soils, sands, solonetzs and solonchaks. In addition, it is safe to conclude that the main result of evolution of the Caspian ecosystems under the cyclic short-terms (hundreds of years) destabilizing factors, that is phylocoenogenetic policlimaxs and anthropogenic modifications domination (pastures and climatogenic subclimax).

From a biogeographic point of view, one can confirm, that two biotic areas – Eurasian steppe area and African-Asian one – give floristic and faunistic pool for formation development of the ecosystems’ terminal stages in the Caspian Region. According species richness of the leading families and biggest genera the flora of the concerned region closer to the deserts of Turan, but not to the Black Sea (Pontic) steppes. So, representatives of Rubiaceae occupy the leading positions here, and genera of Artemisia (12), Atriplex (11), Salsola (10), Suaeda (9), Petrosimonia (7), Astragalus (6), Allium (6), Lepidium (5), Chenopodium (5), Climacoptera (5), Leymus (5), Limonium (5) dominate by the number of species.

Endemism of Caspian region’s flora is near to that in the northern deserts of Turan (2-3%). For example, there are practically no endemics in the plain steppes of Daghestan, contrary to the mountains areas of the region, where endemism reach 15-20% (similar value of the endemism of the Caucasus at whole) [13].

"Eastern relation" also demonstrates phytocenotic diversity: the desert wormwood-fescue-feather grass steppes are represented mainly by the Trans-Volga-Kazakhstanian variants and are common on the northern and western outskirts of the Caspian Sea (Ergeni), in the Southern Ural-Ilek Syrt and the Obshchyi Syrt. Gramineous Festuca valesiaca, Stipa sareptana, S. lessingiana, S. capillata, Agropyron desertorum, Koeleria macrantha and Leymus ramosus dominate here. Desert dwarf shrubs Artemisia lerceana, Tanacetum achilleifolium, Artemisia austriaca, Bassia prostrata, Salsola laricina, Artemisia taurica (in the Ergeni), Artemisia pauciflora, Bassia prostrata, Camphorosma monspeliaca ssp. monspeliaca (on the solonetzs) are sodominants. The border between steppe and desert zones corresponds approximately to that between areas of light chestnut and brown soils. The deserts of the Caspian Sea region are also North Turanian in terms of their botanical and geographical relation, area and diversity. The question on the existence of the “eastern deserts of the Black Sea region” in the Kuma-Manych depression and the South-West of the Volga-Ural watershed as nature phenomena could be discussed, but in whole it demonstrates the anthropogenic modification of the dry
and desert steppes. In vegetation cover of the desert ecosystems grasses give way to xerophilous suffrutesces Artemisia lercheana, A. pauciflora, A. taurica, A. terrae-albae, etc., shrubs and dwarf shrubs of Tamarix, Salsola, Ephedra, Calligonum, Nitraria, etc. and species of Anabasis, Salsola, Kalidium genera.

Doubtless, the comparison of the representativeness and systematic diversity of the different groups of fauna can give additional arguments to clarify the biogeographic status of the Northern Caspian region. So, quite contrasting differences are observed when comparing the representativeness of different groups of flora and fauna of dry steppes and deserts of the Northern Caspian region and steppes, xerophytic communities and forests of the foothills and mountains of Dagestan (table 1). The difference is just emphasized by the generally "desert" and "Turanian" image of the plain biome with an impoverished fauna of mammals, amphibians, vascular plants, and an exceedingly high diversity of reptiles.

**Table 1.** Representativeness (number of species) of flora and fauna groups in the dry steppes and deserts of the Northern Caspian region and Daghestanian foothills and mountains.

| Biome                                           | Mammals | Birds | Reptiles | Amphibians | Vascular plants | Bryophytes | Lichens |
|-------------------------------------------------|---------|-------|----------|------------|----------------|------------|---------|
| Steppes and xerophytic communities of the Dagestan foothills | 70      | 180   | 15       | 12         | 3000          | 200        | 350     |
| Dry steppes, deserts and flood lands of the Caspian region | 40      | 150   | 25       | 5          | 1200          | 130        | 120     |

**6. Conclusions**

Caspian steppe is one of the youngest biomes in European part of Russia, which is experiencing in the last millennia, the cyclic action of sea oscillations, deflation-denudation processes, high pasture load (at first wild, and then mixed - both wild and domestic, and at the present stage - home ungulates).

The formation of its biota proceeded mainly due to the migration of species along the coasts of the Caspian Sea in the regression period, which went almost evenly over the east and west coasts, but at the present stage more due to "Turanian" way. To some extent, this is also confirmed by the predominance of Central Asian species in the "adventive" part of the flora, rather than European ones.

The xerophilic foothills and low mountains of the Eastern Caucasus (Dagestan) and the Southern Urals, as well as xero-mesophilic steppes along the northern border of the biome, which, apparently, only at early stages, during periods of large transgressions, played the role of refugia, are of relatively low importance in the genesis of the biota.

Under the conditions of constant action of cyclical short-term (hundreds of years) destabilizing factors (natural and anthropogenic) in the region and due to phylocenogenesis, polyclimaxity of plant communities and the dominance of their anthropogenic modifications (pasqual) and climatogenic subclimaxes, included in the modern successional system of the region, are become obvious in the region.

With this paper, we mark directions of the future researches in the region, which will allow not only clarify the biogeographic status of the Caspian region but also reveal here the key biogeographic landmarks, coincide or not coincide with the zonal or climatic borders. The whole block of researches is planned to devote to evaluating of the role of biota of xerophilic foothills and low-mountains of the
Eastern Caucasus and of the Southern Ural and northern deserts of Turan in formation of the Caspian biome’s original composition. All this will help to solve important fundamental problems – genesis, successional dynamic, originality of the floristic and faunistic complexes of the region, and various applied problems of the territorial nature conservation and biota’s renewal.

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