

THE AFFILIATION ON ZONAL TYPE VEGETATION OF THE NORTH-WESTERN CASPIAN PLAIN

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Abstract. It is generally accepted the vegetation of the North-Western Caspian Plain include to the desert zone. The purpose of the article is to justify the belonging of the vegetation of this area to the steppe zone. The descriptions of vegetation on ecological-topological profiles on three key sites carried out in 1961 and 2008 are compared. Comparative analysis of plant communities revealed changes that occurred in almost half a century. It is established that the composition of the vegetation remains the presence the steppe turf grasses on light chestnut and brown-steppe soils and extra zonal of xero-halophytes on solonetz soils. The constant participation of turf grasses in the addition of communities gives grounds to refer the vegetation cover of the North-Western Caspian Plain to the subzone of the southern desert steppes of the steppe zone.

Keywords: turf grasses, steppe zone, extra zonal of xero-halophytes, desert, North-Western Caspian Plain.

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1. Introduction

The North-Western Caspian Plain is the Western edge of the belt of great Asian deserts (Fig. 1). The identification of zonal type vegetation of this region causes certain difficulties due to the variety of dynamic and ecological series of vegetation that are formed under the influence of natural and anthropogenic factors. The purpose of the study is to determine the elements of indigenous vegetation that persist in a variety of series of plant communities in the Sarpa lowlands, the North-Western Caspian Plain.

2. Objects and methods

The object of the study was dynamic series of communities, which form successional series directed either towards the increasing digression or the restoration of indigenous communities, as well as ecological alignments illustrating the relation between vegetation, relief forms and soils. The fieldwork was conducted on the site of the Sarpa lowlands, located on the right bank of the Volga river, south of Volgograd, in 2008 (Li, 2009). The description of observation points on the key areas was carried out along profiles laid down by technical leveling and tied to large-scale topographic maps and satellite images. To identify the trends of vegetation dynamics, the profiles 2008 were laid on the site of the profiles described in 1961 (Mozhaeva, 1964).

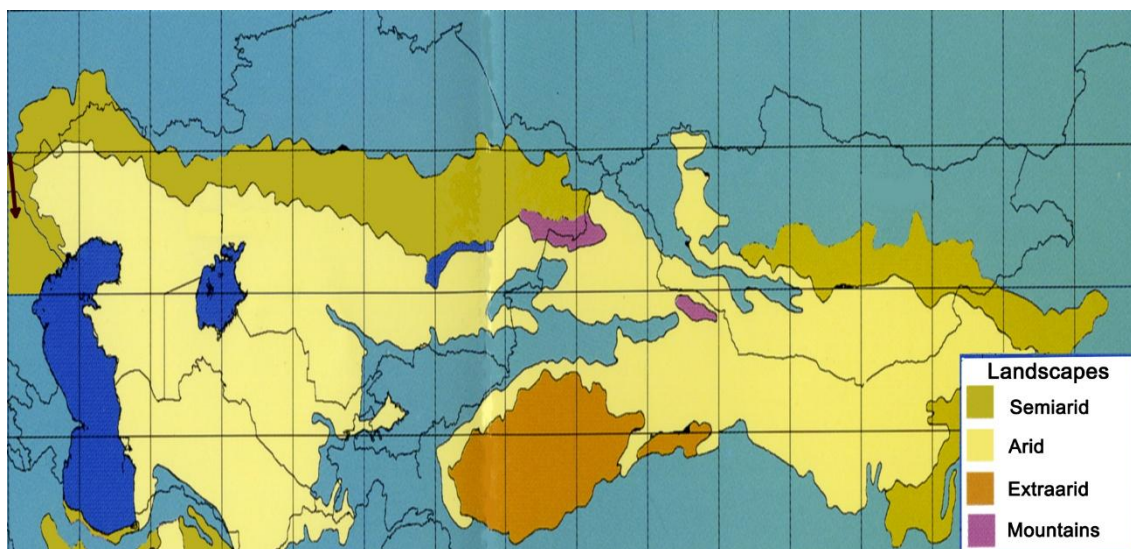


Fig. 1. The arid landscapes belt of Eurasia (Kharin, 1999)
The arrow points to the North-Western Caspian Plane

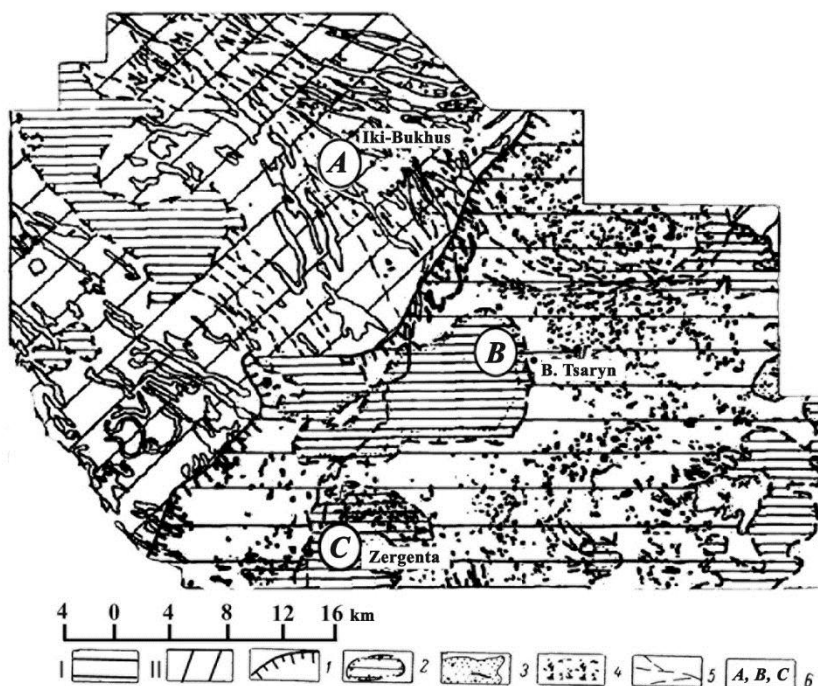


Fig. 2. The landscape-geomorphological map of the Sarpa lowlands by Mozhaeva (1964).
Legend: I – the landscape of the flat marine accumulative middlekhvalynskiy plain; II – the landscape of the undulating plain on the site of the ancient delta of the Volga's Sarpa branch; 1 – the coastal zone of Khvalynian basin, 2 – ancient marine limans, 3 – ancient beach ridges with further aeolian treatment, 4 – depressions of suffusion origin, 5 – riverbeds of modern periodic watercourses, 6 – key areas, the site of landscape-geobotanical profiles in 1961 and 2008.

The features of the geomorphological structure of the Sarpa lowlands are determined by flat surfaces of late- and earlykhvalynskiy marine terraces, in some areas covered with fluvial sandy deposits of the Paleo-Volga. The surface of terraces is complicated by numerous suffusion depressions, 10–100 m in diameter (Fig. 2). The climate is sharply continental. Summers are hot and dry, winters are cold. The average annual rainfall is 326 mm, evaporation capacity is 850 mm. The dry season lasts from July to October.

3. Results

A comparative analysis of vegetation descriptions of three key areas in the Sarpa lowlands on the profiles laid in 1961 and 2008 is given below (see Fig. 2).

The key area A is situated on the undulating plain on the site of the ancient delta of the Sarpa branch of the Volga, near the village of Iki-Bukhus. In 1961, the features of vegetation along the profile (Fig. 3) were determined by a combination of *Artemisia pauciflora*+*A. santonica* community involving *Camphorosma monspeliaca* on solonetz soils with *Beckmannia eruciformis*+*Artemisia lerchiana* community involving *Agropyron desertorum*, *A. pectinatum*, *A. fragile* on light chestnut soils.

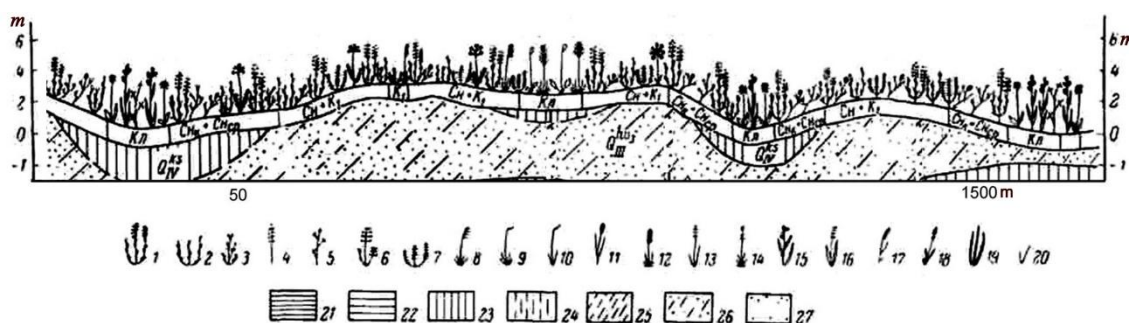


Fig. 3. The landscape-geobotanical profile across the undulating plain near the village of Iki-Bukhus. Based on the data (Mozhaeva, 1964).

Legend.

V e g e t a t i o n : 1 – *Artemisia pauciflora*, 2 – *Artemisia lerchiana*, 3 – *Artemisia santonica*, 4 – *Artemisia procera*, 5 – *Artemisia arenaria*, 6 – *Kochia prostrata*, 7 – *Camphorosma monspeliaca*, 8 – *Tanacetum achilleifolium*, 9 – *Festuca valesiaca*, 10 – *Stipa sareptana*, 11 – *Agropyron desertorum*, 12 – *Agropyron pectinatum*, 13 – *Agropyron fragile*, 14 – *Elytrigia repens*, 15 – *Beckmannia eruciformis*, 16 – *Carex stenophylla*, 17 – *Inula Britannica*, 18 – *Glycyrrhiza glabra*, 19 – xerophilous herbage, 20 – weedy herbage. **S o i l s :** КЛ^{сн} – meadow-chestnut sandy loam; КЛ – meadow-chestnut; К^н₁ – light-chestnut sandy; К^{сн}₁ – light-chestnut solonetz-like; СН₂ – deep solonetz; СН_{ср} – medium solonetz; СН_к – crust solonetz; СН_л – meadow solonetz; СН^{сн}_л – meadow solonchak-like solonetz; Л^{сн}_л – meadow liman solodized; Л^{сн}_л – meadow liman solonchak-like; Л_б – meadow marshy. **L i t h o l o g y :** 21 – gray thin-bedded clay with loam and sand lenses; 22 – chocolate-colored thin-bedded clay with sand lenses; 23 – heavy gray-brown loam; 24 – medium brown loam; 25 – light yellow-brown loam; 26 – yellow-brown sandy loam; 27 – yellow and yellow-brown granular sand.

In 2008, the features of vegetation along the profile associated with the 1961 profile were determined by *Elytrigia repens* community with the participation of *Artemisia lerchiana* and *A. austriaca* on meadow-chestnut soils, as well as *Agropyron pectinatum* community with the participation of *Artemisia lerchiana*, *A. austriaca* and *A. procera* on light chestnut soils.

The data of species occurrence on the profiles 1961 and 2008 are given on the histograms (Fig. 4). The coefficient of floristic community of vegetation on the profiles in 1961 and 2008 is 0.26. Common species are the representatives of zonal steppe flora *Agropyron pectinatum*, *Tanacetum achilleifolium* and *Artemisia lerchiana*, as well as the intrazonal species of xero-halophyte *Artemisia pauciflora*.

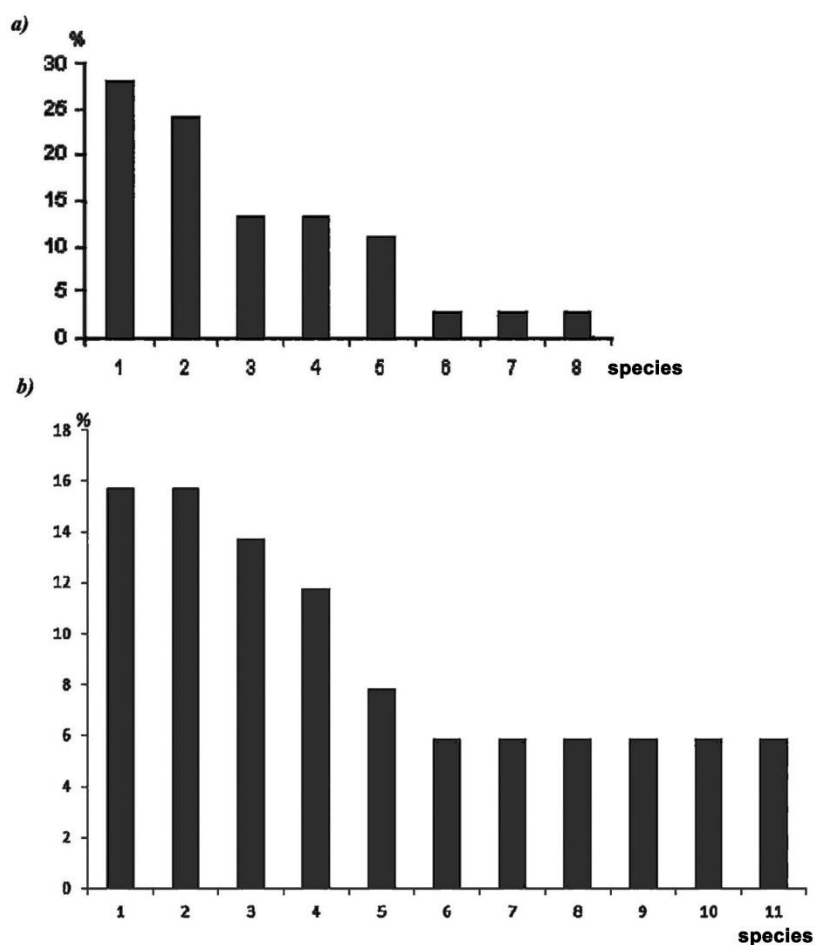


Fig. 4. Species participation in the composition of plant communities: a) the profile 1961: 1 – *Artemisia pauciflora*, 2 – *Artemisia santonica*, 3 – *Artemisia lerchiana*, 4 – *Camphorosma monspeliaca*, 5 – *Beckmannia eruciformis*, 6 – *Artemisia arenaria*, 7 – *Tanacetum achilleifolium*, 8 – *Agropyron fragile*; b) the profile 2008: 1 – *Artemisia lerchiana*, 2 – *Elytrigia repens*, 3 – *Artemisia austriaca*, 4 – *Artemisia procera*, 5 – *Agropyron pectinatum*, 6 – *Artemisia pauciflora*, 7 – *Festuca valesiaca*, 8 – *Limonium platyphyllum*, 9 – *Poa bulbosa*, 10 – *Taraxacum serotinum*, 11 – *Tanacetum achilleifolium*.

The comparison of geobotanical descriptions in 1961 and 2008 shows a significant change in the vegetation cover. In 1961, extra zonal xerophyte-halophytical communities on solonetz soils dominated, while steppe elements on light-chestnut soils occupied a secondary place. The study area was converted into irrigated cropland in the 1980s, which was abandoned in the early 1990s. The overgrowing of cultivated land was affected by soil desalinization. As a result *Elytrigia repens* community on meadow-chestnut soils in depressions and *Agropyron pectinatum* community on light chestnut soils of flat drainage divides occupied a dominant position on the profile in 2008.

The key area B is situated on the flat surface of the ancient liman Bolshoy Tsaryn (see Fig. 2). In 1961, the features of vegetation along the profile (Fig. 5) were determined by ass. *Artemisia lerchiana*+*Tanacetum achilleifolium* involving turf grasses (*Beckmannia eruciformis*, *Agropyron desertorum*, *A. pectinatum*, *A. fragile*, *Festuca valesiaca*, *Stipa lessingiana*, *S. sareptana*, *S. capillata*) on light chestnut soils with a combination of ass. *Artemisia pauciflora*+*A. santonica* on solonetz soils. In the 80s of the XX century the studied area was occupied by rice checks, at the beginning of the XXI century irrigation stopped, and rice checks were transformed into a fallow.

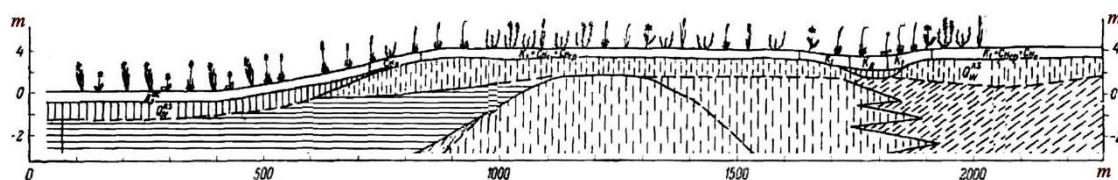


Fig. 5. The landscape-geobotanical profile across the flat surface of the liman Bolshoy Tsaryn. Based on the data (Mozhaeva, 1964). For the legend, see Fig. 3.

In 2008, the features of vegetation along the profile associated with the profile 1961 were determined by ass. *Eremopyrum triticeum* +*Bassia sedoides* with the participation of *Artemisia austriaca* and *A. lerchiana* and partially *Agropyron fragile* on slightly salted light chestnut soils.

The data of species occurrence on the profiles 1961 and 2008 are given on the histograms (Fig. 6). The coefficient of floristic community of vegetation on the profiles in 1961 and 2008 is 1.66. Common species are representatives of zonal steppe flora *Agropyron fragile* and *Artemisia lerchiana*.

The key area C is confined to a flat marine plain, partially cultivated for agriculture, and hillock sands formed on the site of ancient beach ridges. In 1961, the vegetation cover on the flat marine plain at the beginning and at the end of the profile (Fig. 7) was determined by a combination of *Beckmannia eruciformis*+*Tanacetum achilleifolium* community involving *Artemisia lerchiana* on abandoned cultivated light chestnut soils and *Artemisia pauciflora*+*A. santonica* community involving *Glycyrrhiza glabra* on solonetz soils. The vegetation of the hillock sands was represented by turf grass ass. *Beckmannia eruciformis*+*Agropyron fragile*+*Festuca valesiaca* with the participation of *Kochia prostrata* and *Artemisia lerchiana* on brown-steppe sandy soils.

The profile 2008 was associated with the profile of 1961. The features of vegetation at the beginning of the profile were determined by ass. *Elytrigia repens*+*Tanacetum achilleifolium* with the participation of *Festuca valesiaca* and *Stipa sareptana*; those at the end of the profile were represented by the composition of ass. *Elytrigia*

repens+Anisantha tectorum+Cardaria draba and ass. Anisantha tectorum+Chenopodium album+Euphorbium seguieriana. The vegetation of the central part of the profile that crossed the hillock sands was represented by turf grass ass. Agropyron desertorum+Stipa capillata+Anisantha tectorum with the participation of *Tanacetum achilleifolium* and *Artemisia austriaca*, *A. lerchiana*.

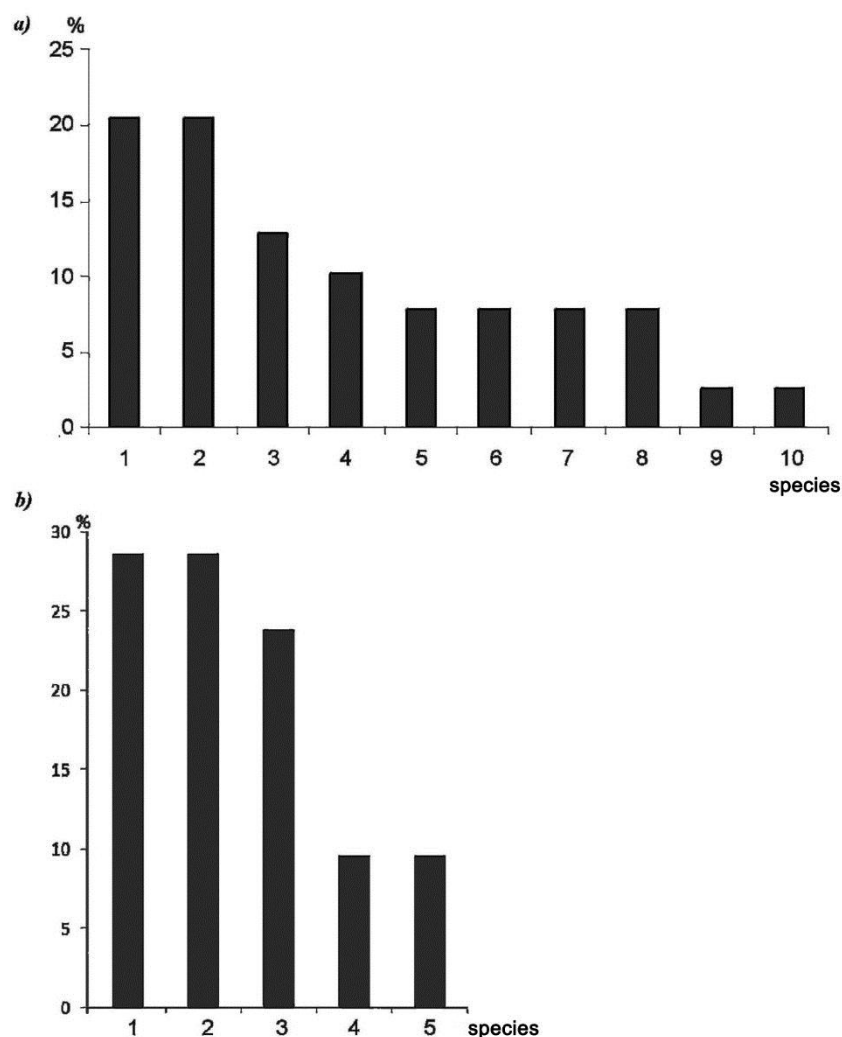


Fig. 6. Species participation in the composition of plant communities: *a)* the profile 1961: 1 – *Artemisia lerchiana*, 2 – *Tanacetum achilleifolium*, 3 – *Beckmannia eruciformis*, 4 – *Agropyron pectinatum*, 5 – *Festuca valesiaca*, 6 – *Artemisia pauciflora*, 7 – *Agropyron fragile*, 8 – motley grass, 9 – *Stipa sareptana*, 10 – *Agropyron desertorum*; *b)* the profile 2008: 1 – *Eremopyrum orientale*, 2 – *Bassia sedoides*, 3 – *Artemisia austriaca*, 4 – *Agropyron fragile*, 5 – *Artemisia lerchiana*.

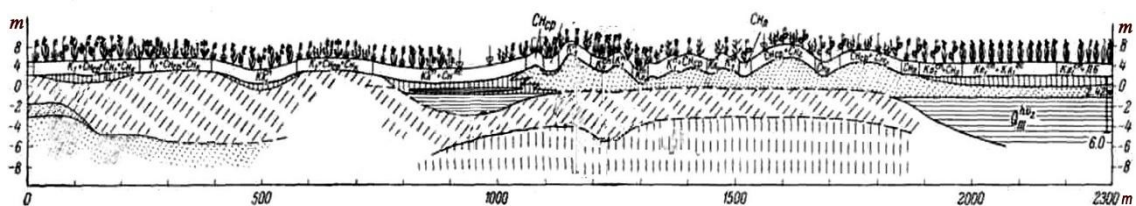


Fig. 7. The landscape-geobotanical profile across the ancient marine plain and hillock sands on the site of ancient beach ridges with further aeolian treatment, near the settlement of Zergenta. Based on the data (Mozhaeva, 1964). For the legend, see Fig. 3.

The data of species occurrence on the profiles of 1961 and 2008 are given on the histograms (Fig. 8). The coefficient of floristic community of vegetation on the profiles in 1961 and 2008 is 0.23. Common species are the zonal steppe flora *Agropyron fragile*, *Tanacetum achilleifolium* and *Artemisia lerchiana*.

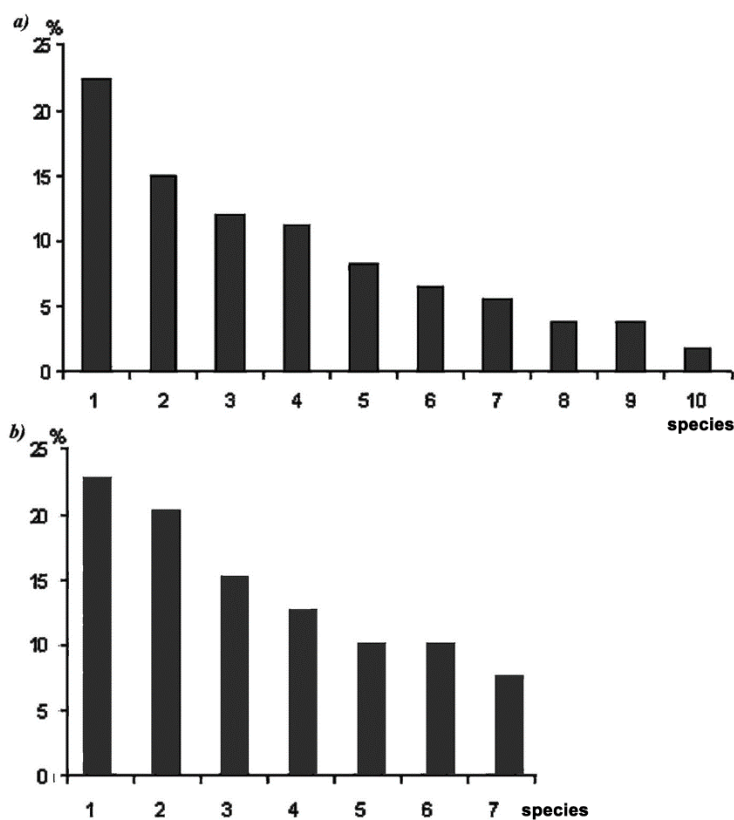


Fig. 8. Species participation in the composition of plant communities: a) the profile 1961: 1 – *Beckmannia eruciformis*, 2 – *Tanacetum achilleifolium*, 3 – *Artemisia lerchiana*, 4 – weed herbs, 5 – *Glycyrrhiza glabra*, 6 – *Agropyron fragile*, 7 – *Artemisia santonica*, 8 – *Artemisia pauciflora*, 9 – *Festuca valesiaca*, 10 – *Kochia prostrate*, b) the profile 2008: 1 – *Agropyron fragile*, 2 – *Anisantha tectorum*, 3 – *Tanacetum achilleifolium*, 4 – *Artemisia austriaca*, 5 – *Stipa lessingiana*, 6 – *Chenopodium album*, 7 – *Artemisia lerchiana*.

4. Discussion

The vegetation cover of the North-Western Caspian Plain is shown as desert on the all vegetation maps of the USSR and Russia, starting with the "Geobotanical map of the USSR" in 1956 to the vegetation map in "The national Atlas of Russia" in 2004. According to the scheme of botanical-geographical zoning of deserts by Lavrenko (1962), the Northern Caspian lowlands belong to the Central Asian subregion of the Sahara-Gobi desert region. Walter and Breckle (2012) include the North-Western Caspian Plain to Kazakho-Dsungarian biome group of Eurasian deserts (Fig. 9).

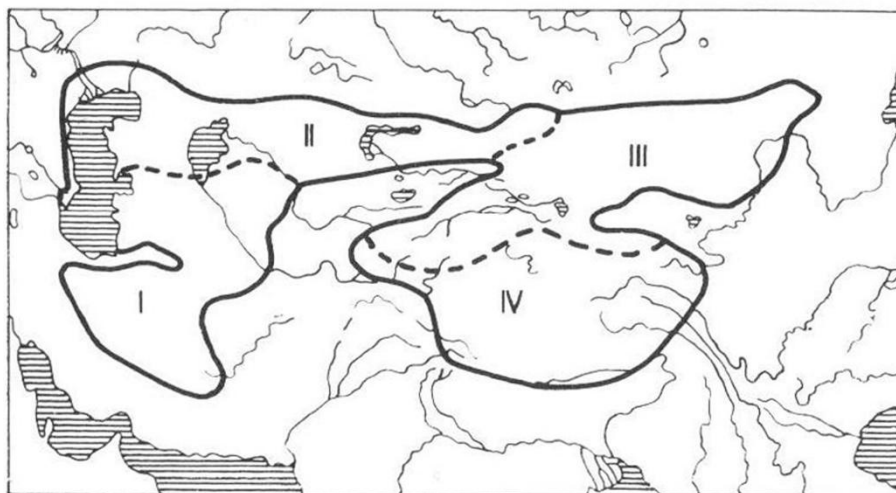


Fig. 9. Biome group of the Eurasian deserts. *I* – Irano-Turanian, *II* – Kazakho-Dsungarian, *III* – Central Asian, *IV* – Pamiro-Tibetan

The basis for the inclusion of the North-Western Caspian region in a desert zone for Lavrenko was Rodin's opinion (Rodin, 1956) about the dominance of *Artemisia lerchiana* in the plant cover. Tsatsenkin (1952) refutes the argument of *Artemisia lerchiana* domination as a desert vegetation indicator. He points that this species prevails in the areas where steppe grasses are displaced by sagebrush as a result of reinforced grazing. *Artemisia lerchiana* is thus an indicator of pastoral digression not that of the zonal type vegetation. Miroschnichenko (1994) notes that steppe ass. *Agropyron+Kochia prostrata* dominated in the North-Western Caspian Plane in the first half of the 20th century. The dominance of *Artemisia lerchiana* in subsequent years was the result of intensification of pastoral digression. It is also worth noting that ass. *Artemisia lerchiana* is formed on light chestnut and brown-steppe soils – not on desert soils, but on those that carry the memory of the steppe vegetation.

In the 21th century Safronova (2005, 2006) identifies vegetation in the North-Western Caspian Plane as the desert (the steppe desert). We believe that the data of our studies allow us to attribute the vegetation of the North-Western Caspian Plane to the steppe (southern deserted steppes of the Euro-Asian steppe zone) (Petrov, Terekhina, 2017).

5. Conclusion

The zonal affiliation of the North-Western Caspian region remains a matter of debate. The solution to this problem is complicated due to the complex spatial-temporal structure of the region's vegetation cover.

The analysis of long-term vegetation changes allows establishing a permanent presence in the vegetation of the North-Western Caspian region two components. The first is the steppe turf grasses (species *Stipa*, *Agropyron*, *Festuca*) with participation *Kochia prostrata* and *Artemisia lerchiana* on light chestnut and brown-steppe soils. The second one is extra zonal of xero-halophytes communities *Artemisia pauciflora*+*A. santonica* on solonetz soils.

The increase in grazing pressure leads to the displacement of turf grasses by sagebrush and ruderal species.

Vegetation of the North-Western Caspian Plane belongs to the steppe zone to the subzone of the southern desert steppes.

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