ON PHYTOCOENOTICAL MAPPING OF
THE CASPIAN DESERT REGION

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ABSTRACT - The phytocoecological map (1:2.500,000) for Desert Region, including the Caspian Lowland and the Mangyshlak has been compiled. It gives an idea of latitudinal differentiation of vegetation, edaphic variants and lithological composition in low mountains. The legend has been constructed according to zonal-typological principle using an ecological-phytocoenotic classification. Heterogeneity of vegetation is reflected by means of territorial units (complex, series, combination) and additional marks above the vegetation background. In the northern subzone vegetation is fairly monotonous and characterized by prevalence of wormwood communities (Artemisia of subgenus Seriphidium), joined in three formations: Artemisia lerchiana, A. arenaria, A. pauciflora. Small areas are occupied by shrub deserts of Calligonum aphyllum and Tamarix ramosissima. To southward of 47° N in the middle subzone on the Caspian Lowland the communities of halophyte perennial saltworts essentially dominate, and to less extent-wormwood communities of hemipammophytic Artemisia terrae-albae and psammophytic Artemisia arenaria and A. lerchiana. Deserts of Mangyshlak are much diverse. Dwarf semishrubs are presented by species of perennial saltworts (Anabasis salsa, Nanophyton erinaceum, Arthrophyton lehmanianum, Salsola orientalis) and wormwoods (Artemisia terrae-albae, A. gurgunica, A. santolina). To southward of 43° N in the southern subzone dwarf semishrub Salsola gemmascens and Artemisia kemrudica communities prevail.

KEY WORDS - Mapping, deserts, zonality, edaphic variants, biodiversity.

INTRODUCTION

In the last quarter of XXth century the vegetation mapping entered in new stage of its progress, that is creating phytocoecological maps on which by means of multidimensional subdivision of vegetation, various features of natural environment are shown (Sochava, 1979; Ozenda, 1997; Iljina & Yurkovskaya, 1999).

We have accomplished phytocoecological mapping of the Northern Caspian Region, including the Caspian Lowland and Mangyshlak Region (46-54° E and 48°30' -42° N) in scale 1:2.500,000. The given scale permits to observe the general regularities of vegetation and at the same time to show in detail its diversity depending on some or another physiographic conditions.
Mapping region (Figure 1) lies within the limits of the Irano-Turanian subregion of the Saharo-Gobian Desert Region (zone) (Lavrenko, 1965). On the plains of the Caspian Region and Turan the desert type of vegetation is characterized by distribution of communities of xerophilous and hyperxerophilous micro-and mesothermic plants of different growth forms, mainly dwarf semishrubs, semishrubs and shrubs. Dominating biomorph is dwarf semishrub (Larin et al., 1954; Nikitin, 1954; Nikolskaya, 1985; Ladygina, Rachkovskaya & Safronova, 1995a, b; Safronova, 1996, 1998, 2000).

**Figure 1** - Map of the studied Area.
Phytoecological map (Figure 2) gives an idea of latitudinal changes of vegetation in the Northern Caspian Region, depending on climate, and reflects its relation to soil conditions on plains and to lithological composition of rocks on low mountains.

The legend of the map was constructed according to zonal-typological principle using an ecological-phytocoenotic classification. The structure of the legend is hierarchic. Its highest subdivisions are “Vegetation of deserts” (1-37) and “Vegetation of river valleys” (38-43). The subdivisions of next rank reflect latitudinal differentiation into three subzonal types: northern deserts on brown soils, middle and southern deserts on grey-brown soils.

Figure 2 - The Phytoecological Map of the Caspian Desert Region.
Subtitles of next rank show diversity of formations in every subzone. Formations in their turn are subdivided into edaphic variants, determined by mechanical soil texture: pelitrophic (on loamy soils), hemipsammophytic (on sandy-loamy soils), psammophytic (on sandy soils and sands), hemipetric (on debris soils), petrophytic (on stony-debris soils) and hyperhalophytic (on solonchak).

The low mapping unit corresponds to typological unit in rank of assotiation (in the meaning of Russian geobotanists using dominant-determinant classification), group of assotiations or to territorial unit: complex, series, combination, ecological range (complex consists of plant communities which alternate regularly according to microrelief and soil varieties; series include group of communities representing stages of vegetation succession; combination consists of regularly alternating phytocoenomeres or phytocoenochoras on the territories of different genesis; ecological range represents series of communities alternating each other as the degree of salinity and soil moisture changes).

Vegetation of the Caspian Desert Region is characterized by considerable heterogeneity owing to wide distribute of salt substrates fit for arising of complexes. On sand massifs and hill slopes series vegetation develops. Besides, the often change of different (as to their genesis) territories is observed (for instance an alternation of plains with loamy and sandy-loamy soils, etc.). Heterogeneity of vegetation is shown on map by not only territorial units but also by using of additional marks (both accompanying numbers and special, out of scale, ones) at the background of dominating vegetation.

The Northern Caspian deserts are rather uniform (monotonous) and characterized by the prevalence of wormwood deserts in the area from Kuma River up to Ural River. They dominated by communities of Artemisia lerchiana in various environments-on loamy, sandy-loamy and sand soils (the numbers of legend are 1-8). The vast areas are occupied by communities of Artemisia arenaria (using with participation of shrub Calligonum aphyllum), restricted to sands (10). On solonetz and strongly salt soils communities of Artemisia pauciflora spread (9). Very peculiar are shrub coenoses of Tamarix ramosissima (11) which are confined to salt dunes. From right bank of Ural river and further eastward communities of Anabasis salsa (12-13) begin play the leading role in vegetation (Safronova, 2002).

Communities of Halocnenum strobilaceum, though occuring on sands in all subzones of the Desert Zone, only in subzone of northern deserts form complexes and ecological ranges with communities of Artemisia pauciflora, Petrosimonia triandra, Suaeda acuminata, Salicornia europaea, Bassia sedoides; those of Artemisia pauciflora, Leymus ramosus, of Limonium sufruticosum, L. gmelini, of Atriplex cana, of Atriplex verrucifera (14).

Subzones of the middle and the southern deserts are pronounced only in the east part of the Region. The first spread between 47° N in the North and 43° N in the South. In the Caspian Lowland they are represented mainly by halophytic communities at solonchak and solonetz (45) and to less extent by wormwood deserts-hemipsammophytic of Artemisia terrae-albae (30) and psammophytic of Artemisia lerchiana (37).

The middle deserts of Mangyshlak Region are more diverse. Thus, the plains with loam and sandy-loam soils and the slope of low mountains with various lithological composition are dominated by communities of Artemisia terrae-albae (15-
and of *Anabasis salsa* (25-28) - the species with wide ecological range. The regional feature is wide distribution of communities formed by *A. gurganica*-endemic species of Mangyshlak Region and Usturt Plateau (22). In the Eastern Mangyshlak communities of *A. lerchiana* achieve the southern limit of their phyto-coenotic range (23). However, in the stripe of middle deserts in Mangyshlak they are confined only to sandy soils, sands and sandstone whereas in the northern deserts of the Caspian Lowland they occur in variety of environments. At western limit of their range are communities of *Salsola arbusculiformis* (30) and *Arthrophytum lehmannianum* (29) formations. The deserts of *Artemisia santolina*, often with participation of *A. tschernieviana* (24), are restricted to sands. Large areas are occupied by hyperhalophytic deserts on solonchaks, these are communities of *Halocnemum strobilaceum, Anabasis salsa, Aeluropus littoralis*, etc. The peculiarity of the above subzone reveals itself in participating of the *Artemisia halophila* coenoses (31).

Southward of 43° N in the southern deserts subzone vegetation is dominated by coenoses of *Artemisia kemrudica* (32, 33) and those of *Salsola gemmascens* (36), locally also by coenoses of *Anabasis salsa* together with *Salsola gemmascens* (35). On sands, as in the middle deserts, communities of *Artemisia santolina* are distributed but without *A. tschernieviana* (34). On solonchak soils and solonchak, as in the middle deserts, coenoses of *Halocnemum strobilaceum* and of *Kalidium caspicum* spread together with specific coenoses of the given subzone formed by *Halostachys belangeriana, Reaumurea fruticosa* and *Salsola gemmascens* (37).

**RESULTS**

Phytoecological mapping of the Northern Caspian Desert Region revealed its specific features. It is well seen on the map that vegetation of the western and the northern coasts of the Caspian Sea differs strongly from that of the eastern coast. This is connected with differences in physiography. In the last vegetation is more diverse; that is resulted in spectrum of latitudinal subzones: to the west of Ural river only one the northern desert subzone is distinguished, to the east-all three subzones (northern, middle and southern) are presented. In the area from Kuma river up to Ural river only two edaphic variants are noted: hemipsammophytic and psammophytic deserts, whereas in Mangyshlak six variants occupy significant areas. A physiognomy of the mapping Region is created by several formations, their communities dominate complexes, series, combinations or form homogenous vegetation. Some formations have wide ecological amplitude (*Anabasis salsa, Artemisia gurganica, A. kemrudica, A. lerchiana, A. terrae-albae, Salsola gemmascens*), the other are characterized by narrow ecological range (*Artemisia arenaria, A. pauci-flora, A. santolina, Arthrophytum lehmannianum, Salsola arbusculiformis*). Communities of the latter group (*Artemisia arenaria, A. pauci-flora, A. santolina*) occupy the large areas owing to peculiar physiographic conditions in given Region.

At the western coast of the Caspian Sea vegetation is influenced by the Caucasus mountains. The boundary between Steppe and Desert Areas coincides here with 44° N whereas at the eastern coast the same latitude corresponds to the middle deserts.
DISCUSSION

Untill the beginning of 80th of the last century it was believed that in Desert Turan grasses are abundant only in the North-in so called "steppefied desert" or "semidesert". According to data obtained for creation of vegetation map of Kazakhstan and Middle Asia with in the limits of Desert Region (Ladygina et al., 1995a, b). The bunchgrasses are appeared to be characteristic of not only the northern subzone but of the whole territory of the Desert Turan, of all its latitudinal subzones (northern, middle and southern ones). They always participate in plant communities on loam, sand and stony-debris soils, i. e. they are characteristic species in hemipsammophytic, psammophytic and petrophytic variants. Some of them (Stipa sareptana, Agropyron fragile, Poa bulbosa, etc.) occur both in the Desert and the Steppe Zones, whereas the some others (Stipa caspia, S. richteriana, etc.) are distributed only in the Desert Zone (Korovin, 1961; Rachkovskaya et al., 1989, 1990; Safronova, 1996). This is why we have refused them from the terms "steppefied desert" and "semidesert" and replaced them by term "northern deserts".

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RIASSUNTO

REFERENCES


OZENDA P., 1997 - Vegetation cartography and phytoecological mapping in Laboratory of vegetation biology of the Alps in the Grenoble university, France. Geobotanical mapping (St.-Petersburg) 1996: 31-38.


SAFRINGOVA I. N., 1996 - Deserts of Mangyshlak Region (Vegetation). St.-Petersburg.


DWARF SEMI-SHRUB, SEMI-SHRUB, SHRUB AND ANNUAL VEGETATION TYPES

NORTHERN DESERTS ON BROWN SOILS
Artemisia lechiana vegetation types

Pelitophytic vegetation types on loam substrates
1. Communities of Artemisia lechiana in complex with communities of Artemisia pauciflora on solonetz

2. Communities of Artemisia lechiana in complex with communities of Anabasis salsa on solonetz

Hemipsammophytic vegetation types on sandy-loam substrates
3. Communities of Artemisia lechiana-Poa bulbosa, locally communities of Artemisia lechiana-Stipa sareptana, S. lessingiana

4. Communities of Artemisia lechiana-Poa bulbosa in complex with communities of Artemisia lechiana on salt substrates

5. Communities of Artemisia lechiana-Poa bulbosa in complex with communities of Artemisia pauciflora-Poa bulbosa and communities of Artemisia pauciflora on solonetz

Psammophytic vegetation types on stabilized hummocky sands
6. Communities of Artemisia lechiana-Poa bulbosa with Agropyron fragile, Stipa sareptana, S. lessingiana

7. Communities of Artemisia lechiana with Krascheninnikovia ceratoides and Calligonum aphyllum on salt sands

Petrophytic vegetation types on stony-debris substrates

8. Series of communities of Artemisia lechiana+Anabasis salsa on limestone

Artemisia pauciflora vegetation types

Pelitophytic vegetation types on salt loam substrates

9. Communities of Artemisia pauciflora in complex with communities of Artemisia lechiana

Artemisia arenaria vegetation types

Psammophytic vegetation types on weak stabilized sands

10. Series of communities of Artemisia arenaria-Calligonum aphyllum+Tamarix ramosissima, T. laxa

Tamarix spp. vegetation types

Psammophytic vegetation types on weak stabilizes sands

11. Communities of Tamarix ramosissima, T. laxa on salt barkhan sands in combination with communities of Artemisia arenaria-Calligonum aphyllum+Tamarix ramosissima, T. laxa

Anabasis salsa vegetation types

Pelitophytic vegetation types on salt loam substrates

12. Communities of Anabasis salsa in complex with communities of Artemisia lechiana

13. Communities of Anabasis salsa in complex with communities of Artemisia lechiana, communities of Artemisia pauciflora, communities of Atriplex cana, and communities of annual saltworts (Salsola foliosa, Chimaecoptera brachiatu)

Annual saltwort and perennial saltwort vegetation types

Hyperhalophytic vegetation types on solonchaks

MIDDLE DESERTS ON GREY-BROWN SOILS

Artemisia terrae-albae vegetation types

Pelitrophic vegetation types on loam substrates
15. Communities of Artemisia terrae-albae in complex with communities of Anabasis salsa

Hemipsammophytic vegetation types on sandy-loam substrates
16. Communities of Artemisia terrae-albae with Sipha caspia in complex with communities of Anabasis salsa+Salsola orientalis

Hemipetrophytic vegetation types on debris substrates
17. Communities of Artemisia terrae-albae, A. gurganica-Cactobrosella humilis, Poa bulbosa in complex with communities of Artemisia terrae-albae, A. gurganica-Anabasis aphylla

Petrophytic vegetation types on stony-debris substrates
18. Combination of series of communities: of Artemisia terrae-albae on sandstone, of Salsola arbusculiformis on salt sandstone, of Artemisia gurganica on limestone, of Nanophyton erniceum on salt clays
19. Combination of series of communities: of Artemisia terrae-albae on limestone, of Artemisia lerchiana on sandstone, and of Nanophyton erniceum on chalk
20. Combination of series of communities: of Artemisia terrae-albae on limestone, and of Nanophyton erniceum on chalk
21. Series of communities of Artemisia terrae-albae on chalk

Artemisia gurganica vegetation types

Petrophytic vegetation types on stony-debris substrates
22. Series of communities of Artemisia gurganica on salt sandstone

Artemisia lerchiana vegetation types

Psammophytic vegetation types on stabilized hummocky sands
23. Communities of Artemisia lerchiana-Agropyron fragile, Stipa caspia-Carex physodes with shrubs (Atraphaxis replicata, Salsola arbuscula, Convolvulus fruticosus)

Artemisia santolina vegetation types

Psammophytic vegetation types on weak stabilized barkhan sands
24. Series of communities of Artemisia santolina with shrubs (Calligonum leucocladium, C. caput-medusae, Astragalus karakugensis)

Anabasis salsa vegetation types

Pelitrophic vegetation types on salt loam substrates
25. Communities of Anabasis salsa in complex with communities of Anabasis salsa+Anabasis aphylla and communities of Anabasis salsa+Salsola orientalis
26. Communities of Anabasis salsa in complex with communities of Artemisia terrae-albae

A. 2. 5. 2. Hemipsammophytic vegetation types on salt sandy-loam substrates
27. Communities of Anabasis salsa in complex with communities of Salsola orientalis+Anabasis salsa and communities of Artemisia terrae-albae+Salsola orientalis

Hemipetrophytic vegetation types on debris-loam substrates
28. Communities of Anabasis salsa in complex with communities of Artemisia terrae-albae, communities of Nanophyton erniceum and communities of Anabasis brachiata

Arthrophytom lehmannianum vegetation types

Petrophytic vegetation types on stony-debris substrates
29. Series of communities of Arthrophytom lehmannianum on salt sandstone

Salsola arbusculiformis vegetation types

Petrophytic vegetation types on stony-debris substrates
30. Combination of series of communities: of Salsola arbusculiformis on limestone and of Artemisia terrae-albae on chalk
Annual saltwort and perennial saltwort vegetation types

Hyperhalophytic vegetation types on solonchaks

31. Ecological range: communities of annual saltworts (Climacoptera crassa, Suaeda salsa, Salsola paulsenii, Atriplex tatarica), communities of Puccinellia dolicholepis, and communities of Halocnemum strobilaceum

SOUTHERN DESERTS ON GRAY-BROWN SOILS

Artemisia kemrudica vegetation types

Hemipetrophytic vegetation types on debris substrates

32. Communities of Artemisia kemrudica + Salsola orientalis in complex with communities of Anabasis salsa+Salsola orientalis and communities of Artemisia kemrudica-Atriplex replicata

33. Communities of Artemisia kemrudica in complex with communities of Artemisia kemrudica+Salsola orientalis, communities of Anabasis salsa+Salsola gemmascens, communities of Nanophyton erinaceum, and communities of Anabasis brachiata

Artemisia santolina vegetation types

Psammophytic vegetation types on weak stabilized barkhan sands

34. Communities of Artemisia santolina-Calligonum leucocladium, Astragalus karakugensis, Haloxyton aphyllum

Anabasis salsa vegetation types

Hemipetrophytic vegetation types on debris substrates

35. Communities of Anabasis salsa in complex with communities of Anabasis salsa+Salsola gemmascens, communities of Anabasis brachiata, and communities of Artemisia kemrudica+Salsola orientalis

Salsola gemmascens vegetation types

Hemipetrophytic vegetation types on debris substrates

36. Communities of Salsola gemmascens in complex with communities of Salsola gemmascens+Anabasis salsa, communities of Artemisia kemrudica+Anabasis brachiata, communities of Anabasis brachiata, and communities of Nanophyton erinaceum

Annual saltwort and perennial saltwort vegetation types

Hyperhalophytic vegetation types on solonchaks

37. Ecological range of: annual saltworts (Climacoptera lanata, Suaeda arcuata, Salicornia europaea, Halopeplis pygmaea), of Salsola gemmascens, of Reaumuria fruticosa, of Kalidium caspicum, of Halostachys belangeriana, and of Halocnemum strobilaceum

VEGETATION OF RIVER VALLEYS

38. Forest communities of Salix alba and of Populus nigra in combination with meadow communities (Elytrigia repens; Bromopsis inermis) and communities of Typha angustifolia; of Scirpus lacustris; of Bolboschoenus maritimus; of Eleocharis palustris, Butomus umbellatus. Sagittaria sagittifolia; of Phragmites australis on wet banks

39. Forest communities of Salix alba and communities of Tamarix ramosissima in combination with meadow communities of Phragmites australis-Glycyrrhiza echinata and of Scirpus lacustris

40. Meadow communities of Elytrigia repens-Glycyrrhiza echinata, G. glabra and of Elytrigia repens-Artemisia australis in combination with communities of Elaeagnus angustifolia, forest communities of Salix alba, communities of Phragmites australis; of Scirpus lacustris; of Butomus umbellatus and desert communities

41. Meadow communities of Bolboschoenus maritimus, of Elytrigia repens, of Aeluropus littoralis, of Phragmites australis in combination with hyperhalophytic communities on solonchak (Halocnemum strobilaceum; Atriplex cana, Salicornia europaea)
42. Meadow communities of Phragmites australis, of Typha latifolia, of Puccinellia gigantea in combination with annual saltwort halophytic (Salicornia europaea; Suaeda acaulis; Petrosimonia spp.) communities and communities of Tamarix ramosissima on solonchak

43. Communities of Phragmites australis, of Scirpus lacustris, of Typha latifolia, and of Bolboschoenus maritimus on wet banks

ADDITIONAL MARKS:
1. Communities of Phragmites australis
2. Meadows of Elytrigia repens-Artemisia austriaca
3. Communities of Artemisia procer a
4. Halophytic communities of Leymus ramosus, of Artemisia santonica-Limonium gmelinii, of Aeluropus longipennatus, of Salicornia perennis
5. Communities of Artemisia terrae-albae, A. gurbanica - Atraphaxis replicata, Caragana grandiflora, Convolvulus fruticosus, Salsola arbuscula on limestone
6. Communities of Artemisia kemrudica - Atraphaxis replicata, Convolvulus fruticosus, Salsola arbuscula, Rhamnus spinosissimii on limestone
7. Petrophytic shrub communities on different kind of rocks: sandstone, limestone, chalk and salt clayer
8. Communities of Anabasis brachyotia, of Nanophyton erinaceum, of Xanthoparmelia cantschadalisa-Ephedra aurantiaca on strong hypersum soils
9. Communities of Artemisia gurbanica, of Anabasis brachiated, of Nanophyton erinaceum on takys
10. Artemisia taurica
11. Stipa tarentana