

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 saltworks essentially dominate, and to less extent-wormwood communities of hemipsammophytic *Artemisia terrae-albae* and psammophytic *Artemisia arenaria* and *A. lerchiana*. Deserts of Mangyshlak are much diverse. Dwarf semishrubs are presented by species of perennial saltworks (*Anabasis salsa*, *Nanophyton erinaceum*, *Arthrophytum lehmanianum*, *Salsola orientalis*) and wormwoods (*Artemisia terrae-albae*, *A. gurganica*, *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.

MATERIAL

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 biormorph is dwarf semishrub (Larin *et al.*, 1954; Nikitin, 1954; Nikolskaya, 1985; Ladygina, Rachkovskaya & Safronova, 1995a, b; Safronova, 1996, 1998, 2000).

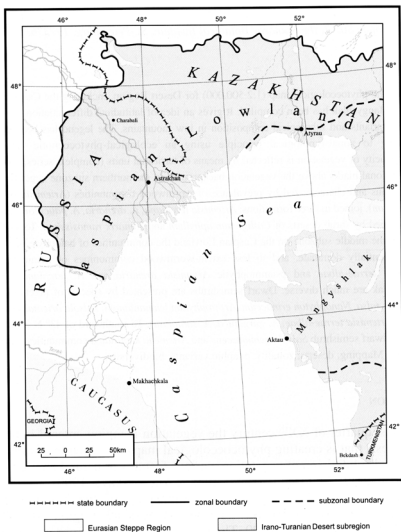


FIGURE 1 - Map of the studied Area.

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-phytoecoenotic 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.

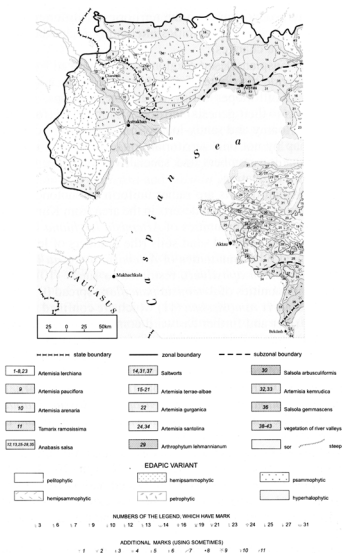


FIGURE 2 - The Phytoecological Map of the Caspian Desert Region.

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: pelitophytic (on loamy soils), hemipsammophytic (on sandy-loamy soils), psammophytic (on sandy soils and sands), hemipterophytic (on debris soils), petrophytic (on stony-debris soils) and hyperhalophytic (on solonchak).

The low mapping unit corresponds to typological unit in rank of association (in the meaning of Russian geobotanists using dominant-determinant classification), group of associations 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 phytocoenomes 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 *Halocnemum strobilaceum*, though occurring 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 suffruticosum*, *L. gmelinii*, 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-

21) 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. ischernieviana* (24), are restricted to sands. Large areas are occupied by hyperhalophytic deserts on solonchaks, these are communities of *Halocnemum strobilaceum*, *Anabasis salsa*, *Aeluropus litoralis*, 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. ischernieviana* (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. pauciflora*, *A. santolina*, *Arthrophytum lehmannianum*, *Salsola arbusculiformis*). Communities of the latter group (*Artemisia arenaria*, *A. pauciflora*, *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 "steppified 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 sub-zones (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 "steppified desert" and "semidesert" and replaced them by term "northern deserts".

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RIASSUNTO

Si presenta uno studio fitoecologico della Regione del mar Caspio Settentrionale, inclusi il Bassopiano del Caspio e la Regione di Mangyshlak (46-54° Ed e 48°30' -42° N) all'interno della sotto-regione Irano-Turaniana della zona desertica Saharo-Gobi. Dal punto di vista strutturale la forma dominante è rappresentata da cespugli bassi. Nella mappa fitoecologica in scala 1:2 500 000 sono evidenti variazioni latitudinali della vegetazione in base a differenti condizioni climatiche e litologiche. Si usa una classificazione di tipo ecologico-fitocenologico strutturata in modo gerarchico: le unità di rilevamento corrispondono ad associazioni, gruppi di associazioni e unità territoriali (complesso, serie, combinazione, serie ecologica). La mappa della vegetazione mostra chiaramente la differenza tra la coste settentrionali ed orientali del mar Caspio. Ad ovest del fiume Ural solamente una sottozona latitudinale del deserto settentrionale è distinguibile mentre ad est sono presenti tutte (settentrionale, centrale e meridionale). Nell'area tra il fiume Kuma e l'Ural solamente due varianti edafiche sono notate: emipsammofitica e psammofitica; mentre in Mangyshlak sei tipi occupano aree significative. La fisionomia della Regione studiata è costituita da molte formazioni. Alcune formazioni (ad *Anabasis salsa*, *Artemisia gurganica*, *A. kemrudica*, *A. lerchiana*, *A. terrae-albae*, *Salsola gemmascens*) hanno una larga ampiezza ecologica, altre (ad *Artemisia arenaria*, *A. pauciflora*, *A. santolina*, *Arthrophytum lehmannianum* e *Salsola arbusculiformis*) sono caratterizzate da un'ecologia più ristretta, mentre alcuni gruppi (ad *Artemisia arenaria*, *A. pauciflora*, *A. santolina*) sono largamente distribuiti, mostrando condizioni fisiografiche particolari nella regione studiata. La vegetazione sulla costa occidentale del mar Caspio è influenzata dalle montagne di Caucaso.

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Legend of the phytocological map of the Caspian desert region, scale 1:2.500.000

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

NORTHERN DESERTS ON BROWN SOILS

Artemisia lerchiana vegetation types

Pelitophytic vegetation types on loam substrates

1. Communities of *Artemisia lerchiana* in complex with communities of *Artemisia pauciflora* on solonetz
2. Communities of *Artemisia lerchiana* in complex with communities of *Anabasis salsa* on solonetz

Hemipsammophytic vegetation types on sandy-loam substrates

3. Communities of *Artemisia lerchiana-Poa bulbosa*, locally communities of *Artemisia lerchiana-Stipa sareptana*, *S. lessingiana*
4. Communities of *Artemisia lerchiana-Poa bulbosa* in complex with communities of *Artemisia lerchiana* on salt substrates
5. Communities of *Artemisia lerchiana-Poa bulbosa* in complex with communities of *Artemisia pauciflora-Poa bulbosa* and communities of *Artemisia pauciflora* on solonetz

Psamphytic vegetation types on stabilized hummocky sands

6. Communities of *Artemisia lerchiana-Poa bulbosa* with *Agropyron fragile*, *Stipa sareptana*, *S. lessingiana*
7. Communities of *Artemisia lerchiana* with *Krascheninnikovia ceratoides* and *Calligonum aphyllum* on salt sands

Petrophytic vegetation types on stony-debris substrates

8. Series of communities of *Artemisia lerchiana+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 lerchiana*

Artemisia arenaria vegetation types

Psamphytic vegetation types on weak stabilized sands

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

Tamarix spp. vegetation types

Psamphytic 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

Pelytophytic vegetation types on salt loam substrates

12. Communities of *Anabasis salsa* in complex with communities of *Artemisia lerchiana*
13. Communities of *Anabasis salsa* in complex with communities of *Artemisia lerchiana*, communities of *Artemisia pauciflora*, communities of *Atriplex cana*, and communities of annual saltworts (*Salsola foliosa*, *Climacoptera brachiata*)

Annual saltwort and perennial saltwort vegetation types

Hyperhalophytic vegetation types on solonchaks

14. Ecological range of communities: communities of annual saltworts (*Petrosimonia triandra*, *Suaeda acuminata*, *Salicornia perennans*, *Bassia sedoides*), communities of *Artemisia pauciflora-Leymus ramosus*, communities of *Atriplex verrucifera*, and communities of *Halocnemum strobilaceum*

MIDDLE DESERTS ON GREY-BROWN SOILS

Artemisia terrae-albae vegetation types

Pelitophytic 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 *Stipa caspia* in complex with communities of *Anabasis salsa*+*Salsola orientalis*

Hemipetrophytic vegetation types on debris substrates

17. Communities of *Artemisia terrae-albae*, *A. gurganica*-*Catabrosella 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 erinaceum* on salt clays

19. Combination of series of communities: of *Artemisia terrae-albae* on limestone, of *Artemisia lerchiana* on sandstone, and of *Nanophyton erinaceum* on chalk

20. Combination of series of communities: of *Artemisia terrae-albae* on limestone, and of *Nanophyton erinaceum* 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 leucocladum*, *C. caput-medusae*, *Astragalus karakugensis*)

Anabasis salsa vegetation types

Pelytophytic 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 erinaceum* and communities of *Anabasis brachiata*

Arthrophytum lehmannianum vegetation types

Petrophytic vegetation types on stony-debris substrates

29. Series of communities of *Arthrophytum 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 polysenii*, *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*-*Atraphaxis repli-cata*
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**Psamrophytic vegetation types on weak stabilized barkhan sands**

34. Communities of *Artemisia santolina*-*Calligonum leucocladum*, *Astragalus karakugensis*, *Haloxylon 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 communities: of annual saltworts (*Climacoptera lanata*, *Suaeda arcuata*, *Salicornia europaea*, *Haloplepis 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 austriaca* 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 litoralis*, 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 acuminata*; *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 procera*
4. Halophytic communities of *Leymus ramosus*, of *Artemisia santonica*-*Limonium gmelinii*, of *Aeluropus pungens*, of *Salicornia perennans*
5. Communities of *Artemisia terrae-albae*, *A. gurganica* - *Atraphaxis replicata*, *Caragana grandiflora*, *Convolvulus fruticosus*, *Salsola arbuscula* on limestone
6. Communities of *Artemisia kemrudica* - *Atraphaxis replicata*, *Convolvulus fruticosus*, *Salsola arbuscula*, *Rhamnus sintensisii* on limestone
7. Petrophytic shrub communities on different kind of rocks: sandstone, limestone, chalk and salt clayer
8. Communities of *Anabasis brachiata*, of *Nanophyton erinaceum*, of *Xanthoparmelia camtschadalis*-*Ephedra aurantiaca* on strong hypsum soils
9. Communities of *Artemisia gurganica*, of *Anabasis brachiata*, of *Nanophyton erinaceum* on takyrs
10. *Artemisia taurica*
11. *Stipa sareptana*