

# Plant Formations in the Turanian BioProvince

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## Turanian Gypsophilic (gypsum-loving) Sagebrush

Gypsum, which is composed of calcium sulphate, occurs in abundance in the weathered products of local mountains. Altogether it is estimated that there are some 400 gypsophilic species in the area and including many of the endemic genera. Most are dwarf shrubs of various species of sagebrush such as the endemic *Artemisia terrae-albae* and *A. turanica* (Asteraceae), and usually bloom and fruit in autumn after summer dormancy. The former is the dominant over much of central Kazakhstan. There are also many thorny or spiny species like *Acanthophyllum pungens*, *Atraphaxis spinosa*, *Noaea spinosissima* and *Sisymbrium subspinescens*, and an unusual large number of tall Apiaceae often growing to heights of over 2 m. Most are perennial species and include *Ferula assa-foetida*, *F. ferulaeoides*, *Hyalolena turcomanica*, *Munetia oeroilanica* and endemic or near endemic *Oedibasis apiculata* (Apiaceae). Other significant species include *Caragana grandiflora*, *Convolvulus frutescens*, *Ephedra distachya* and *Sophora griffithii*. Another type of gypsophilic sagebrush is characterized by *Artemisia kemrudica* (kemrud). This occupies large parts of northwest Turkmenistan on the Beltau, Krasnovodsk and Ustyurt plateaus and also occurs in the delta of the Amudarya River. It is fairly uniform with an upper layer reaching heights of 100 cm. These larger shrubs include various *Calligonum* species, such as the endemic *Calligonum alatum* (Polygonaceae) and *Haloxylon aphyllum* (Chenopodiaceae). However, most of the species occur in the second tier with heights of between 20-40 cm. Here the dominant shrubs is *Artemisia kemrudica*, while other common species include *Salsola arbuscula*, *S. gemmascens* and the endemic *Astragalus turcomanicus* (Fabaceae). The lower (third) layer mainly consists of herbaceous elements such as *Ceratocarpus utriculosus*, *Climacoptera lanata*, *Goldbachia laevigata*, *Tetracme quadricorus* and various endemic or near endemic species like *Gagea reticulata* (Liliaceae), *Iris longiscapa* (Iridaceae), *Nonea caspica* (Boraginaceae) and *Tulipa sogdiana* (Liliaceae).

## Turanian Halophilic (salt-loving) Shrubland

This is mainly restricted to depressions where the groundwater is close to the surface and in zones around salt lakes where salt-rich soils known as solochaks occur. Chenopods are the predominant group with *Salicornia herbacea*, *Halocnemum strobilaceum* and the endemic *Halostachys caspica* and *Seidlitzia rosmarinus* (Chenopodiaceae) being some of the more characteristic species. Most are succulents but there are also woody plants such as *Haloxylon* and *Kalidium*. *Haloxylon ammodendron* is a tree reaching heights of 14 m. The halophilic grasses present include *Alopecurus ventricosus*, *Puccinellia fomini* and *P. scleroides*. Formations dominated by *Salsola gemmascens* (tetyr formations) represent one of the more typical of the desert halophyte communities and occurs in the Uzboi dry beds, on the southern Ustyurt and Krasnovodsk plateaus near Karabogazgol Bay in the Caspian and in the Trans-Unguz area. Patches are also found in the Karakum Desert. The dominant shrub, *Salsola gemmascens*, can live for up to 25 years and reach heights of 40 cm, but is usually much more stunted especially in gypsum-bearing soils. Other common shrubs include *Salsola arbuscula* and *S. orientalis*. Floristically, however, this formation is relatively poor with no more than about 35 species and certain shrubs such as *Hypoxylon aphyllum* and the endemic *Calligonum setosum* (Polygonaceae) are so depressed in that they rarely reach heights of more than about 50 cm. The vertical structure is also poorly developed with just two tiers. Lower level species reach about 20 cm in height and are mainly composed of ephemeral or annual species. The desert sedge *Carex pachystylis* often dominates while other common low-level species include *Ceratocephala falcata*,

*Eremopyrum orientale* and *Leptaleum filifolium*. In summer a significant number of annuals make their appearance such as *Salsola sclerantra* and the endemic or near endemic *Halimocnemus karelinii* (family?).

A more widespread formation is characterized by *Anabasis salsa* (biyurgun formation). It extends over wide areas of Middle Asia and Kazakhstan. *Anabasis salsa* can grow to heights of 40 cm and can reach densities of up to 50,000 plants per ha. Other shrubs include *Anabasis eriopoda*, *Atraphaxis spinosa* and *Nanophyton erinaceum*. A lower herbaceous layer may sometimes be present with species like *Arnebia decumbens*, *Lepidium perfoliatum* and endemic or near endemic *Amberboa turanica* (Asteraceae). *Salsola orientalis* can also occasionally occur as a dominant species (kevrek formation) such as on the ancient alluvial plain of the Kunyadarya River and on the Meshed-Messerian Plain. Far more widespread is the succulent-halophytic desert formation dominated by *Halocnemum strobilaceum* (sarsazan). This is typical of solonchak depressions and small salt hills (chukalaks). The largest expanses occur on the ancient delta of the Atrek River, the Kelkor Solonchaks and on the shores of the Karabogazgal Bay. The dominant species, *Halimocnemum strobilaceum*, is a stem succulent, leafless sub shrub and can reach heights of about 40 cm. Structurally these formations are usually simple and rarely have more than one layer, but in areas of reduced salt content a greater variety of species can be found such as *Limonium subfruticosum*, *Tamarix hispida* and the endemic or near endemic *Halimocnemum longifolia* (Chenopodiaceae) and *Halostachys caspica* (Chenopodiaceae).

One final vegetation type covered here is the so-called black sakaul formation named after the dominant *Haloxylon aphyllum*. It is primarily associated with river deltas and desert depressions. In Turkmenistan major stands are associated with the ancient alluvial deposits along the Amudarya River and the Assake-Audan and Sarykamysch depressions. *Haloxylon aphyllum* displays remarkable ecological plasticity. In depressions with shallow water tables it develops in to a tree reaching heights of 9 m, but where the water supply is less reliable it forms small shrubs little more than 1 m high. The species diversity of these formations can be relatively high with up to 140 species recorded in some localities, but their vertical structure is fairly simple. There is usually an upper layer of *H. aphyllum*, which is sometime accompanied by shrubs such as *Reaumuria oxiana*, *Salsola richteri* and the endemic *Smimovia turkestanica* (Fabaceae). The second layer (30-40 cm high) is usually composed of small semi shrubs such as *Artemisia badhysi* and *Salsola gemmascens*, but with low density and abundance. The third layer is largely composed of annual or ephemeral herbaceous species such as *Allium sabulosum*, *Ferula assafoetida* and the endemic *Streptoloma desertorum* (Brassicaceae). Other endemic or near endemic species generally associated with solonchak soils include *Arthrophyton lehmanniana* (Chenopodiaceae), *Euphorbia sororia* (Euphorbiaceae), *Kalidium caspicum* (Amaranthaceae), *Lepidium borsczovi* (Brassicaceae), *Limonium caspium* (Plumbaginaceae), *Alexandra lehmanni*, *Bienertia cycloptera*, *Ofaiston monandrum*, *Petrosimonia squarrosa*, *Piptoptera turkestanica*, *Suaeda microsperma*, *Salsola kasakorum* (Chenopodiaceae) and *Zygophyllum oxianum* (Zygophyllaceae).

### **Turanian Psammophilic (sand-loving) Vegetation**

In total the area supports some 350 psammophilic species, 56% of which are endemic. The shrub communities are particularly interesting being represented by species of *Calligonum* including the endemic *C. arborescens* and *C. eriopodum* (Polygonaceae), which have their centre of distribution in Kazakhstan. Deserts within this zone, such as the Karakum Desert, also support a number of tree species, and some of these such as the endemic *Ammodendron conollyi* and *Eremospermum flaccidum* (Fabaceae) can grow up to

heights of 5 m or more. Spring geophytes are also well represented. Some of the more notable are *Eminium lehmannii*, *Eremurus inderiensis*, *Iris songarica* and the endemic *Rhinopetalum arianum* (Liliaceae) and *Schummania karelinii* (family?). The most extensive formation of the Karakum Desert is characterized by *Haloxylon persicum* (white sakaul formation). It has a complex structure and can be broadly divided into three layers. The upper layer, 1.5-2 m high, consists of *Haloxylon persicum* together with various other shrubs such as *Ephedra strobilacea*, *Salsola richteri* and various species of *Calligonum* such as the endemic *C. eriopodum* and *C. setosum* (Polygonaceae). Below this is another shrub layer up to 1 m high with species like *Artemisia kelleri* and the endemic *Convolvulus divaricatus* (Convolvulaceae). The third layer is largely herbaceous with perennials and biennials such as *Astragalus chivensis*, *Cousinia oxiana*, *Stipagrostis pennata*, *Tournefortia sibirica* and the endemic or near endemic *Heliotropium argusioides* (Boraginaceae) and *Rheum turkestanicum* (Polygonaceae). However, most species of the lower layer are annuals such as *Anisantha tectorum*, *Cutandia memphitica*, *Erodium oxyrrhynchum*, *Roemeria hybrida*, *Strigosella circinnata* and the endemic *Streptoloma desertorum* (Brassicaceae). Other taxa that dominate sand dune formations include *Ephedra strobilacea*, *Salsola richteri* (cherkez) species of *Calligonum* and the endemic *Ammodendron conollyi* (Fabaceae). *Ephedra strobilacea* (bordzhok formations) represent the characteristic vegetation of barkhan dunes in the northern part of central Karakum. It can also be found at Chilmamedkum, Khanbaagykum and on the Dardzha Peninsula. *Ephedra* is unusual in being a gymnosperm shrub. It can grow to a height of 2 m and is one of the longest living of desert shrubs and can reach an age of up to 100 years. The formation in general is floristically poor with just a few associated shrubs such as *Artemisia santoline* and *Convolvulus erinaceus* and the grasses *Hordeum leporinum* and *Stipagrostis karelinii*. Formations dominated by *Calligonum* species (dzhuzgun formations) occur on both mobile and stabilized sand. Over ten species of *Calligonum* may be involved including *Calligonum caput-medusae*, *C. rubens*, and the endemic *C. arborescens*, *C. eriopodum*, *C. leucocladum*, *C. microcarpum* and *C. setosum* (Polygonaceae). Some of these develop into tree-like forms reaching heights of up to 6 m, but most are shrubs up to 3 m high, and some species can acquire different growth forms depending on conditions. Other shrubs include *Halothamnus subaphyllus*, *Salsola richteri* and the endemic *Smirnovia turkestanica* (Fabaceae), while common herbaceous species are *Heliotropium dasycarpum*, *Senecio subdentatus* and the endemic *Ferula litwinowiana* (Apiaceae). Also widespread on all types of sand, such as along the Amudarya and in the Karakum, are formations dominated by *Salsola richteri* (cherkez formation). The species can grow to a height of 2 m and live for up to 30 years. Most of the associated shrubs are mobile sand specialist such as the *Acanthophyllum elatus*, *Artemisia dimcana* and the endemic *Eremosparton flaccidum* (Fabaceae). Only a few herbaceous elements are present. Perennials include *Cistanche flava*, *Stipagrostis pennata* and the endemic *Heliotropium argusioides* (Boraginaceae), while common ephemeroidees are *Carex physodes* and *Prangos diduma*. Also of considerable interest are formation dominated by the endemic tree *Ammodendron conollyi* (Fabaceae). These 'desert forests' (syuzen formation) are restricted to unstable sands in the Karakum Desert. *Ammodendron* trees can grow to heights of 10 m and live for 60 years or more. Floristically, however, the formation is generally poor but scattered shrubs such as the endemic species *Calligonum microcarpum* (Polygonaceae), *Convolvulus divaricatus* (Convolvulaceae) and *Smirnovia turkestanica* (Fabaceae) may be present, while common annual or ephemeral species include *Chrozophora gracilis*, *Cithareloma verum*, *Horaninovia ulcina* and the endemic *Agriophyllum latifolium* (Chenopodiaceae), *Chartoloma platycarpum* (Brassicaceae) and *Corispermum papillosum* (Chenopodiaceae). Finally on rare occasions grasses such as *Peganum harmala*, *Stipagrostis karelinii*, *S. pennata* or the endemic *Agropyron fragilis* (Poaceae) may dominate communities. *Stipagrostis karelinii* is a perennial that can reach

1 m in height and is often a pioneer of barkan dunes in the Karakum Desert. *Stipagrostis pennata* forms denser communities in more stable areas. Associated taxa usually include small shrubs such as *Artemisia santolina* and the endemic or near endemic *Astragalus ammodendron* and *A. transcaspica* (Fabaceae), while the herbaceous species may include *Ceratocarpus utriculosus*, *Ferula assafoetida* and *Kochia odontoptera*.

Further information required.

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