Characterization of areas

I. *Gymnospermae*

Ephedraceae

Ephedra L.

(H.Freitag and M.Maier-Stolte)

Ephedra is a highly isolated relic genus distributed through the arid zones of all continents except Australia. Most species – probably due to their high age – have wide, almost zonal areas of distribution. Ecologically and phytocoenologically, they are nicely differentiated, and any climatic zone from the each the hot Saharo-Sindian deserts to the cold alpine semi-deserts of the Pamir and subhumid woodlands of different mountain systems has its own *Ephedra*-species.

Except the widely differing growth forms, most *Ephedra*-species look much alike. The leaves are usually very small, decussate or whorled and more or less fused to a sheath. Their function is overtaken by the green one-year branches. They are more or less furrowed, have a smooth or scabrous surface and a pith core which by its white, brown or blackish colour is helpful in identification. Most species have a broom-like appearance, caused by the dense branching system. With a few exceptions, the species are strictly dioecious. The male cones differ in shape, number of flowers, number of anthers and their position on a band-shaped columna. The female cones bear the most useful diagnostic characters: position and number of bracts; fusion of bracts, in particular of the innermost ones; bract structure at maturity (in most species the cone turns to a red, orange, yellow or white berry-like structure, in others the mature cones become dry and the bracts develop large hyaline wings); number of seeds which varies from 1–3(4). Without having the male or, better, the female cones, for the non-specialist the species are difficult to identify, and even in reproductive stage errors occur easily.

For some years, the authors have been working on a revision of the Old World species of *Ephedra*. Intensive studies on huge herbarium material and in the field led to reconsideration of several species. Some results are published here for the first time. Because of many confusing records found even in recent floras, the maps are prepared mainly on base of material seen by the authors themselves. They are indicated by full black dots. Only in some species reliable literature records have been incorporated; for convenience, they are given as rings half-way white inside. Also most ecological and phytocoenological notes are based on own field work.

Beside of being important component of desert and semi-desert ecosystems, many species are used. Only a few are important fodder plants for goat, sheep and camel all the year round. In most species, the this-year branchlets are browsed from high summer to winter only, when now other green plants are vailuable. A few species are completely avoided, being not only less palatable (tannins) but even poisenous (alcaloids). Such species are favoured by high grazing pressure. Since ancient times (the first citation in Chinese literature dates back to 2800 B.C.), certain species have a high reputation as medicinal plants against e.g. bronchial catarrh, asthma, pneumonia,

typhoid fever which is attributed to the high content of alcaloids (ephedrine, pseudo-ephedrine). Particularely famous in this respect are *E. distchya*, the closely related *E. sinica*, and the eastern varieties of *E. major* ("*E. equisetina* Bunge"). Locally, the berry-like mature female cones (in particular of *E. distachya*) which are free of alcaloids and tannines are collected for juice and jam. A few more or less psammophilous species are used in landscaping and as means to control erosion due to their sand-binding capacity.

Conspectus of species occuring in the area, and group characters (the groups reflect natural relations but are informal and not identic with the classical concept of sections and tribes):

Group *Alatae*

Female cones turning dry in maturation, all bracts separated from the base, with broad hyaline wings enabling anemochory; male cones with at least some anthers on long stalks (2–4 x length of anthers), pollen grains of the *Fragilis*-type; clump-forming shrubs of arid to hyper-arid desert habitats.

E. alata Decne.

E. strobilacea Bunge

E. przewalskii (Stapf) Andrz.

Group *Sarcocarpae*

Female cones turning fleshy, but all bracts with comparatively wide hyaline margin and inner bracts fused for 1/3–3/5; male cones with most anthers distinctly stalked (1–3 x lenght of anthers), pollen grains of the *Fragilis*-type; clump-forming shrubs of arid habitats.

E. transitoria Riedl

E. sarcocarpa Aitch. & Hemsl.

E. lomatolepis Schrenk & C.A. Mey.

Group *Fragilis*

Female cones turning fleshy, inner bracts almost completely fused, forming a cup- or a tube-like structure; male cones with all anthers sessile, pollen grains of the *Fragilis*-type; single-stemmed erect or overhanging shrubs or climbers of semihumid to arid habitats.

E. fragilis Desf.

E. foeminea Forssk. (see vol.8, p.5)

E. aphylla Forssk.

E. foliata Boiss.

Group *Distachyae*

Female cones turning fleshy, usually 2–seeded, inner bracts fused for 1/3–4/5; male cones with sessile and shortly stalked anthers, pollen grains of the *Distachya*-type; low to medium-sized clump-forming shrubs of semi-arid to arid habitats.

For practical purposes this large group is subdivided on base of seed number in the female cones in 2 subgroups:

Subgroup *Distachyae* s.str.

Usually 2–seeded, only occasionally 1–seeded by abortion of 1 ovule

E. distachya L.

E. regeliana Florin

E. intermedia C.A.Mey.

E. fedtschenkoae Pauls. (not included, from Pamir Alai to Kuen-Lun)

Subgroup *Leptocladae*

Usually 1–seeded, only occasionally 2 ovules developed

E. pachyclada Boiss.

E. major Host (incl. *E. gerardiana* Wallich ex Stapf see vol. 8, p. 5/6)

E. monosperma C.A. Mey. (not included, from W Xinjiang to Mongolia and Sibiria)

E. saxatilis Florin (not included, from E. Karakoram to E. Himalaya)

1. *Ephedra alata* Decne.

Ephedra alata is a robust shrub of 0.5–1(1.5) m in height, occuring in large clumps of 1–3 m in diameter, with glaucous to brownish, 2–3 mm thick annual branches and a milky white to light brown pith. The most conspicuous differences to the closely related *E. strobilacea* Bunge are as follows: bracts of female cones stiff and straight, caused by the thickened dorsal part and the comparatively narrow wings, rarely exceeding the bract's tip; seeds flattened ovoid, tapering into a prominent beak.

The species' total range extends from S Tunesia to the Persian Gulf and from C Iraq far southwards into the deserts of Arabia. Further west it is replaced by the vicariant *E. alenda* (Stapf) Andrz. It is clearly centered in the Arabian sector of the Saharo-Sindian region, and like in many true desert species its area touches the Mediterranean coast only in N Sinai. In N Libya, the Western Desert of Egypt and in Upper Egypt (except the foothills of the G. Elba system at the Sudanian border) the species seems to be truly rare. In contrast, the scattered dots in NW Arabia probably are caused by undercollecting. The main distribution is from sea level to about 500 m, but in the dry mountains of S Sinai and W Arabia it ascends up to 1000 m or even more.

Ephedra alata is probably the most xerophytic species of the genus in our area, being satisfied with c. 5–100 mm of annual precipitation and often enduring rainless years. It is well adapted to full desert conditions of the hot Saharo-Sindian type and there it is a typical and sometimes dominating component of the "végétation contractée" in runnels, on washes and along wider wadis. More rarely it occurs in open diffuse desert vegetation. It grows on very diverse substrates, like coarse sands, gravels, marly limestone, usually on soils with a distinct gypsiferous horizont. Records citing it as growing on rock crevices and being a saxicolous species are probably caused by confusing it with *E. aphylla* Forssk. Due to its pronounced capacity to accumulate aeolian sands *E. alata* often builds up sandy mounds of considerable size (up to 2 m in height).

The most common associates on sandy soils are *Haloxylon salicornicum*, *H. persicum*, *Calligonum comosum*, *Ochradenus baccata*, *Launaea arborescens*, *Anabasis articulata*, *Lygos raetam*, *Zilla spinosa*, *Pulicaria undulata* and *Panicum turgidum*, on coarser textured soils *Farsetia aegyptiaca*, *Halogeton alopecuroides*, *Pituranthos tortuosus*, *Lasiurus hirsutus* and *Gymnocarpos decander*. From S Iraq and N Saudi Arabia, in addition an *E. alata-Rhanterium epapposum* type with *Stipagrostis plumosa* and *Helianthemum lippii* is reported.

Everythere *E. alata* is known as having a good grazing value for camels, but is poor for sheep and goat.

References: 228(1,2), 258, 712, 744, 746, 747, 749.

2. *Ephedra aphylla* Forssk.
Syn.: ***E. alte* C. A. Mey. p.p.**

Ephedra aphylla grows as a 0.8–2.5 m tall shrub with overhanging or almost prostrate stems from which vertical branches emerge. In cliffs, which offer favorable sites, it is almost pendant, whereas is associations with shrubs and trees it behaves as a scandent climber and ascends to more than 4 m. From the related and geographically partly sympatric *E. foliata* Boiss. which has a similar growth form, it differs by the one-seeded female cones, the much shorter leaves (up to 3 mm only) and the young stems which in the latter are almost quadrangular in cross section and covered at least here and there by stiff hair-like papilae. For the otherwise similar *E. fragilis* Desf. see under nr. 5.

The area of *E. aphylla* extends from the Cyrenaica in E Libya near or at the coast of the Mediterranean up to Libanon and W Syria. Outposts are located in mountains with somewhat higher precipitation in inner Syria, Jordan, NW Saudi Arabia, S Sinai and at the Egyptian Red Sea coast down to the G. Elba at the Sudanian border. In the Cyrenaica, Israel and Libanon, *E. aphylla* clearly avoids the true Mediterranean areas, or it grows there only in the driest habitats, giving way for the true Mediterranean species *E. fragilis* Desf. and *E. foemina* Forssk. Altitudinal variation is from -300 m (near the Dead Sea) up to 2000 m on S-exposed cliffs of and around G. Musa in S Sinai and in the mountains of E Egypt.

Ephedra aphylla helds an interesting position as a plant of the transitional belt between the S Mediterranean and the Saharo-Sindian vegetation. Most localities are located in areas with 50–150 mm annual precipitation, but as the species often grows in sites which are drier or receive additional moisture, the rainfall amplitude may vary from 10–400 mm. The temperature requirements are similar to true Mediterranean species. Edaphically, the only essential seems to be a permanent water supply. The needed small quantities of water are extracted by a highly effective rooting system from deep-reaching rock fissures or from the underground of temporarely flooded wadi beds or runnels. Accordingly, the list of plant communities and accompanying species is extremely diverse. Along the coast of Israel it grows in the coastal *Ceratonia-Pistacia lentiscus*-communities, on rocky slopes in Jordan and Sinai from *Moringa peregrina*-woodland up to open mediterranean *Juniperus phoenicea*-woodlands and mediterranean-montane thorny cushion-shrublands of the *Artemisia sieberi-Astracantha bethlehemitica*-communities in 1200 m; in NW Egypt we found it together with *Lycium intricatum*, *Anabasis articulata* on fissured limestone plateaus; in waids it is usually asociated with the *Acacia raddiana*-communities, in Libya also with *Zizyphus lotus*. Along the coast in N Egypt and Israel it climbs in hedges of *Tamarix*, *Elaeagnus*, *Lycium*, *Opuntia* and other shrubs and trees between arable lands.

No information of any specific use is known to us.

References: 510, 671, 690, 746.

3. *Ephedra distachya* L.
Syn.: ***E. monostachya* L., *E. vulgaris* Rich., *E. aurantiaca* Takht. & Pachom., *E. vvedenskyi* Pachom., *E. pseudodistachya* Pachom.**

Normally, *E. distachya* is a rhizomatous dwarf shrub of 15–30 cm, but under high grazing pressure, adverse edaphic conditions or climatic stress (strong winter) it might grow as a hemicryptophyte with perennial woody axes only at or below the soil surface. Usually, branching is very dense in the basal part, and the 1–1.5 mm thick annual twigs are for their most part arranged in a strictly parallel manner. The cones are terminal, usually clearly stalked. The male cones are comparatively long and thin, the females have the inner bracts fused for 1/2 to 2/3 and the free parts lined by a narrow hyaline margin. Sterile plants look much like small individuals of *E. lomatolepis* Schrenk. *E. vvedenskyi* Pachom. and *E. aurantiaca* Takht. & Pachom. are just more robust forms, probably induced by mild

winters, as they occur everywhere along the southern part of the area. In contrast, more delicate plants were described as *E. pseudodistachya* Pachom.

The vast area of *E. distachya* extends from Spain and W France scattered through the Alps and along the northern shores of the Mediterranean to Hungary. From there it continues in a broad zone through Ukraina, S Russia and N Kazakhstan to C Sibiria. Further south, the species reoccurs in Anatolia, W Syria (reported here for the first time), Transcaucasia and N Iran. Usually, it is a plant of the lowlands, but from Anatolia to N Iran often it has been collected from montane zones up to 1800 m. In the Alps, the species is represented by subsp. *helvetica* (C. A. Mey.) Aschers & Graebner with a longer and variously curved micropyle. The Mediterranean and the Eastern populations were sometimes treated as distinct species (*E. distachya* and *E. monostachya* L.), but even subspecific rank is not justified.

In ecological respect, *E. distachya* is a very common constituent of zonal steppe and desert-steppe communities in regions with c. 80–150(200) mm of annual precipitation on all soil types. However, in edaphically dry habitats like S-exposed rock ledges, coastal dunes or pebbles of river terraces it penetrates deeply into semihumid and marginally even into humid areas. Temperature requirements are moderate except for high radiation intensity and high temperatures during summer. Accordingly, the plant communities having *E .distachya* as a subdominant or a frequent associate are highly diverse. In the steppe zone, it accompanies communities with *Stipa capillata*, *S. orientalis*, *Festuca sulcata*, different *Artemisia*-species and *Kochia prostrata*. On stony soils it grows preferably with other dwarf-shrubs and shrubs like *Krascheninnikovia ceratoides*, *Caragana frutex* and *Cerasus tianschanica*. In the desert-steppes most often it is a component of *Artemisia*-communities (e.g. *A. terra-alba*, *A. turanica*, *A. fragrans*), together with *Kochia prostrata*, *Stipa caragana* and others.

After the first frost, *E. distachya* is a valuable fodder plant and preferably grazed by sheep and goat. Furthermore, in some regions it is famous for its medicinal properties. Both demands contribute to the often rather meagre and stunted growth of the plants.

References: 103(1), 156(1), 218(1), 682, 707, 709, 716, 734.

4. *Ephedra foliata* Boiss.

Syn.: ***E. ciliata* C. A. Mey., *E. alte* C. A. Mey. p. p., *E. polylepis* Boiss. & Hausskn., *E. peduncularis* Boiss. & Hausskn., *E. kokanica* Regel, *E. aitchisonii* (Stapf) Nikitin, E. *brerifoliata* Ghahreman.**

In presence of other trees and shrubs, this is an scandent climber reaching up to more than 4 m and forming rather dense, curtain-like drooping masses of delicate branchlets on the periphery of other crowns. In abscence of supporting structures it grows as a shrub, with the whitish stems widelv overhanging or even prostrate and equipped with densely whorled erect branches. The species is most distinct by having the longest leaves in the genus (generally 10–15 and even up to 40 mm, but often they remain much shorter), bearing the cones on long, loosely branched this-year branchlets and producing usually 2–3 seeds per female cone.

The vast area of distribution streches from Morocco through favorable sites in the Saharo-Sindian desert zone to the Panjab in NW India, southwards to the higher mountains of tropical E Africa, and northwards into the Irano-Turanian region to a line from the S Caspian to Uzbekistan. Interestingly, in no place it approaches to the Mediterranean and to C Iran. Altitudinal distribution is from sea-level in the North and South up to c. 1600 m in Egypt and Sinai, c. 600 m in Iraq, 1800 m in SE Iran, 1500 m in E Afghanistan and Pakistan, 900 m in Turkmenistan and Tadzhikistan.

Like in *Ephedra aphylla* Forssk., most sites are located in semi-desert regions with c. 50–150 mm annual precipitation and it has a pronounced ability to extract water from deep, moisture-filled cracks in rocky habitats. In and along temporarely flooded runnels and wadis it penetrates into hyper-arid deserts. With regard to its temperature requirements, in the Eastern part of its area *E. foliata* seems to be much less sensitive against lower winter temperatures than in the central and western parts. This might be explained by floral history and by

competing species like *E. aphylla* Forssk., *E. fragilis* Desf. and *E. altissima* Desf. which are absent in the East. Corresponding to the vast biregional area and the ecological versatility, the plant communities containing *E. foliata* are highly diverse. Nevertheless, a clear preference for Saharo-Sindian savannas and shrublands (with many different *Acacia*-species, *Salvadora oleoides*, *Prosopis cineraria*, *Gymnosporia senegalense*, *Euphorbia neriifolia*, *Zizyphus nummularia*) and for corresponding Irano-Turanian communities (with e.g. *Pistacia vera*, *Amygdalus bucharica*, *A. spinosissima*) is recognizable. Besides, it is present also in sparsely covering semi-desert communities with species like *Pycnocycla aucheriana*, *Gymnocarpus decander* and *Grewia tenax*.

Ephedra foliata is usually strongly browsed by camel, goat and sheep. Plants growing outside of other protecting shrubs or of inaccesible rocky sites are usually heavily stunted.

References: 177(1), 218(1), 510, 518(10), 608, 666(3), 684, 727, 734, 741, 746, 750.

5. *Ephedra fragilis* Desf.

Ephedra fragilis is (in our area) a shrub of 40–100 cm. From the partly sympatric and closely related likewise 1–seeded *E. aphylla* Forssk. it differs by its erect growth, the dark brown pith, smaller number of anthers (4–6 versus 3–4), pollen structure and – in dry condition – by the more easily disarticulating twigs, furthermore in ecology.

The species has a wide distribution around the W Mediterranean eastwards to W Libya and Sicily. It reoccurs along the coast of the Cyrenaica, and in the higher mountains from the Antilibanon in Syria down to S Jordan. The latter records are noticed here for the first time. Before, some of them have been mistaken for *E. aphylla* Forssk. Altitudinal variation is from sea-level to about 600 m in the Cyrenaica, and usually from 500–1200 m in the mountains of Syria and Jordan.

Ephedra fragilis is a typical species of the Mediterranean floristic region, with preference for the semi-arid parts receiving c. 150–400 mm of annual precipitation. Like the other species of the group it grows on very different habitats, ranging from cliffs, rocky slopes and plateaux to gravels and coastal sands. As a highly light-demanding plant it is associated with different types of open mediterranean bushlands, in Jordan with *Juniperus phoenicea*. More often it is associated with diverse primary and secondary seral communities. The specimens from Jordan are reported growing in *Artemisia*- and in *Helianthemum sacti-antonii*-communities. No informations are avaluable for Libya.

References: 671.

6. *Ephedra intermedia* Schrenk & C. A. Mey.

Syn: ***E. persica* (Stapf) V. A. Nikitin, *E. tibetica* (Stapf) V. A. Nikitin, *E. microsperma* V. A. Nikitin, *E. ferganensis* V. A. Nikitin, *E. glauca* V. A. Nikitin, *E. heterosperma* V. A. Nikitin, *E. tesquorum* V. A. Nikitin, *E. valida* V. A. Nikitin (?)**

Ephedra intermedia is a medium-sized species, usually 30–60 cm tall (exceptionally up to 150 cm) and grows in large groups. The 1.2–2 mm thick twings are green, glaucous or brownish, furnished with a scabrous surface except for the glabrous var. *glauca*. The most specific characters are the 2–seeded female cones and the very long, screw-like micropyle. The inner bracts are fused for 1/3–3/5.

The distribution of *E. intermedia* is restricted to the Irano-Turanian and C-Asiatic floristic regions, from the Transcaucasian semi-deserts to Mongolia, and from the Eastern shore of the Caspian, the Balkhash-Lake and the Altai southwards to the mountains in SE Iran and N Pakistan. In the northern parts of its area, altitudinal distribution is from the lowlands up to the subalpine zones in c. 2000 m, but in the southern parts the respective amplitude is from c. 1200–3500(4000) m. All records from Pakistani Baluchistan are either erroneous and refer to *E. pachyclada*

Boiss., or – if they are based on specimens in vegetative stage – they are doubtful. For the differences between both species see under no. 9. Under conditions of higher rainfall the species is replaced by *E. major* Host.

Ephedra intermedia is a typical species of moderate to extreme semidesert ecosystems and most common in regions with about 50–150 mm of annual precipitation and cold winters. It has a preference for coarse-textured and even sceletal soils on which it is an often dominant component in very different dwarf-shrubland and shrubland-communities entering also open *Juniperus*-woodlands. In the Irano-Turanian region it is sometimes found also on sandy soils. In frequency and coverage, *E. intermedia* surpasses any other species of the genus, certainly due to being unpalatable and equipped with a very effective subterranean branching system. By those characters, the species is distinctly favoured by high grazing pressure. Under most arid conditions, it might be associated with species like *Salsola arbusculiformis* and *Kraschenninnikowia ceratoides*. Usually it grows together with a wealth of dwarf-shrubs like different species of *Astragalus*, *Acanthophyllum*, *Acantholimon*, *Artemisia*, and small shrubs like *Amygdalus spinosissima*, *Zygophyllum atriplicoides*, *Pteropyrum aucheri*, *Atraphaxis spinosa*, *Cerasus microcarpa* beside of numerous hemicryptophytes, geophytes and therophytes.

Ephedra intermedia is almost completely avoided by sheep and goat and poisoning of young animals has been reported. Since ancient times, it is has been used as a dye-stuff, giving silk a yellow colour.

References: 177(1), 218(1), 666(3, 4), 669, 675, 682, 696, 707, 709, 720, 721, 741.

7. *Ephedra lomatolepis* Schrenk

Syn.: ***E. stenosperma* Schrenk & C. A. Mey.**

In vegetative and male individuals, *E. lomatolepis* differs from the widely sympatric *E. przewalskii* Stapf only by smaller size (15–40 cm) and by the less common occurrence of whorled leaves. Only plants bearing female cones are easily distinguishable by their bracts. They are fused for 1/2–3/5, lined in the free upper part by wings up to 1 mm wide and – except the wings – become fleshy at maturity. At its northern border, the species overlaps with *E. distachya* L. which likewise is rather similar in habit. In both species, like in eastern populations of *E. przewalskii* Stapf the upper parts of the 1–year branches are often coiled.

The distributional area of *E. lomatolepis* extends from the Turgai depression in NW Kazakhstan and the northern Kyzylkum through Dzhungaria and Kashgaria to SW Mongolia. It occurs almost everwhere in the sandy semi-desert belt of Kazakhstan which receives about 80–150(200) mm annual precipitation and is much more common as the dots on the map suggest. In our area, the altitudinal amplitude is from 30–400 m, only in the upper Ili valley it extends up to 750 m.

Ephedra lomatolepis is the most typical psammophytic species of the genus. By its large sand-fixing and accumulating patches (up to 10 m in diameter) it contributes effectively to dune stabilization, together with species like *Stipagrostis pennata*, several *Calligonum*-species, *Haloxylon persicum*, *Artemisia tomentella*, *Kochia prostrata*, *Kraschenninnikowia ceratoides* and *Convolvulus divaricatus*. On the other hand, it plays in important part also on stabilized sands, with species as *Haloxylon aphyllum*, *Salsola arbuscula*, *Artemisia terra-albae*, *A. turanica*, *A. songarica* and *Carex physodes*.

As a range plant, *E. lomatolepis* has limited importance only during winter. Besides, it is collected for medicinal purposes.

References: 218(1), 666(2), 682, 707, 709, 721, 723, 745.

8. *Ephedra major* Host. *

Syn.: *E. nebrodensis* Tin., *E. villarsii* Godr. & Gren., *E. macedonica* Kosanin, *E. procera* Fisch. & C. A. Mey., *E. equisetina* Bunge, *E. gerardiana* Wallich ex Stapf, *E. botschantzevii* Pachom.

Ephedra major is most distinct by the lack of subterranean branching and by the tendency instead of forming erect shrubs or even treelets up to 2 m with distinct trunks up to 15 cm in diameter. Only in subalpine environments the trunks may become prostrate. The annual twigs are comparatively thin (0.7–1.5 mm), very numerous and arranged vertically in a strictly parallel manner. In most modern treatments, the taxon is split into 5 units: *E. major* with the subsp. *major* and *procera* Fisch. & C. A. Mey., *E. equisetina* Bunge, *E. gerardiana* Wallich ex Stapf and *E. botschantzevii* Pachom.

But in analyzing the vast material at hand from the area, we found it impossible to follow this traditional concept, because the differential characters show widespread overlapping. *E. major* and *E. procera* are reported to differ by scabrous viz. glabrous surfaces, but in fact from Macedonia up to E Anatolia populations with both characters occur side by side. The same happens with *E. procera*, *E. gerardiana* and *E. botschantzevii* (the two latter again with rough surfaces) further east. The second character used for species delimitation is the fusion of the innermost bracts in the female cones. They are reported as being fused up to 1/3 in *E. major* and *E. procera*, 1/3–1/2 in *E. gerardiana*, and to 2/3 in *E. equisetina* and *E. botschantzevii*. In fact, the differences are smaller, with the respective values in *E. major* and *E. procera* being 1/3–2/5 and – rarely – even 1/2. Furthermore, there is no clear-cut line to *E. equisetina* and *E. botschantzevii*. From the Great Caucasus up to the Hindukush and the Karatau, in most areas all transitions with regard to the degree of bract fusion occur, sometimes on the same plant.

The area of *E. major* extends from the Canary Islands through the drier mountains of the Mediterranean to Anatolia, the Caucasus systems, Iran and Afghanistan. From there it continues along the southern flances of the Hindukush to the NW Himalayas – where it is replaced succesively by *E. saxatilis* Florin – and to the NE through the Pamir-Alai to the Tian Shan and Altai eastwards to Dzhungaria and E Mongolia. Except for the northern regions, it is a plant of the montane zone and often it extends – in smaller forms – into the subalpine and even lower alpine zones. Here just a few examples for the highest localities are given: Anatolia – 2000 m, Armeniya – 2000 m, W Afghanistan – 3200 m, E Afghanistan – 3600 m, Pamir-Alai – 3500 m, Karakoram (Hunza) – 4250 m.

Despite of the vast distribution through the Mediterranean, the Irano-Turanian and the C Asiatic floristic regions, the habitat conditions of *E. major* in the various parts of the area are not too diverse. Moisture requirements with c. 150–400 mm are comparatively high. Long-lasting frost periods are tolerated, but in higher altitudes evidently only in presence of a protecting snow-cover which probably causes the dwarfed growth of the plants in the subalpine zone. The habitats are rocky or other sceletal soils derived from very different geological strata. Phytocoenologically, *E. major* is a common but usually a subordinate component of floristically very diverse montane shrublands, woodlands and seral communities up to thorny cushion – shrublands of the high-mountain areas. It is associated with most woodland communities of the Irano-Turanian region, in particular with communities of *Pistacia vera*, *Amygdalus bucharica*, *Juniperus seravschanica*, *J. semiglobosa*, but likewise with many thorny cushion-shrublands dominated by *Onobrychis cornuta*, *O. echidna* and many different species of *Acantholimon*, *Astragalus*, *Cousinia* etc. In Iran, the amplitude is even wider, starting on the northern side of the Elburz Mts. with thermophilous *Cupressus sempervirens* woodland; and in E Kazakhstan we have seen it as a component in open shrublands of *Juniperus pseudosabinia*, *Rosa platyacantha*, *Cerasus tianschanica* and between boulders entering even into steppe-like communities with *Stipa caucasica* and *St. orientalis*.

Ephedra major contains perhaps the highest quantities of ephedrin and other alcaloides. Consequently, it remains almost untouched by browsing animals. In some areas, most notably in Pakistan (Upper Baluchistan) the plants are collected in large quantities for destillation and further processing for pharmaceutical use.

References: 103(1), 151(1), 177(1), 218(1), 666(2–4), 683, 707, 708, 709, 723, 734, 736.

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* A map of *E. gerardiana*, being here included into *E. major* has already been published in vol. 8. The respective dots are not repeated in our map 8.

9. *Ephedra pachyclada* Boiss.
Syn.: ***E. sinaica* Riedl**

In most characters, *E. pachyclada* agrees with *E. intermedia* Schrenk & C. A. Mey. and both species are often confused. As suggested by the name, the annual twigs are always comparatively thick (2–3 mm), furthermore they are always glaucous, and the partly fused leaves are shorter than wide. The male cones bear sessile anthers, and the 1–seeded female cones have the innermost bracts fused for only 1/4–1/3. In subsp. *pachyclada*, the micropyle is up to 1 mm long and straight, whereas in subsp. *sinaica* it is longer and variously curved or even twisted like in *E. intermedia* Schrenk & C. A. Mey. With regard to length and shape of the micropyle, the populations from Oman are intermediate between both subspecies.

Ephedra pachyclada has a very peculiar distribution along the southern margin of the Irano-Turanian floristic region from where it extends southwards deeply into the Saharo-Sindian area and even into the Tropics. The subsp. *sinaica* is known from the higher mountains of S Sinai, Jordan and from NW Saudi Arabia down to N Yemen. The area of subsp. *pachyclada* extends from the J. Akhdar in Oman and the southern Zagros ranges in SW Iran through the mountains of Baluchistan in Iran and Pakistan northwards along the Sulaiman Range to the Safed Koh and the outer ranges of the Hindukush, both in Pakistan and E Afganistan. In all areas, *E. pachyclada* is restricted to the middle and to upper montane zones, with an amplitude of 1500–3800 m for subsp. *sinaica* and of 1000–2800 m in subsp. *pachyclada*.

Ephedra pachyclada is well adapted to semi-arid conditions with annual precipitation of c. 100–300 mm and a cool winter without severe frost. Edaphically, it has a clear preference for rocky soils irrespective of their petrographic characters. It is always a subordinate constituent of dwarf-shrublands, open shrublands and woodlands or the respective seral communities. Acording to the large area, the communities vary considerably, but from Sinai up to the Hindukush *Pistacia khinjuk* is a very faithful companion, and very often also *Juniperus excelsa*, *J. seravschanica* and *Periploca aphylla* are present. Other accompanying species in the Near East are *Noaea mucronata*, *Jurinea staehelina*, *Alyssum sinaicum*, *Artemisia sieberi* and *Poa sinaica*, in S Sinai *Atraphaxis spinosa*, *Phlomis aurea*, *Artemisia inculta* and *Lactuca orientalis*. In Pakistani Baluchistan, together with *E. pachyclada* we have often observed *Amygdalus brahuica*, *Ebenus stellatus*, *Astragalus stocksii*, *Convolvulus leiocalycinus*, *Euphorbia osyroidea*, *Spiraea crenata*, *Salvia cabulica*, *Otostegia limbata*, *Piptatherum baluchistanicum*, *Stipa arabica*, *Pennisetum orientale* etc., in E Afghanistan also species like *Amygdalus kuramica* and *Stipa himalaica*. From Oman to E Afghanistan it goes also together with open woodlands formed by *Monotheca buxifolia*, *Olea ferruginea*, *Dodonaea viscosa* and others.

References: 690, 712, 735.

10. *E. phedra przewalskii* Stapf
Syn.: ***E. kaschgarica* B. Fedtsch. & Bobrov**

This species differs from its close relative *E. strobilacea* Aitch. & Hemsl. by its smaller size (up to 0.8 m), less rigid branchlets, dark brown pith, smaller cones (up to 6 mm) and more delicate, almost completely papery bracts.

The total distribution of *E. przewalskii* reaches from N Turkmenistan and NW Kazakhstan eastwards far into Mongolia. It is centered in western Chinese Xinjiang province and from there it extends across the Karakoram to northernmost Pakistan and to Kashmir. The species is certainly much more common as the scattered dots on the map might suggest, but in vegetative stage it is often mistaken for the sympatric *E. lomatolepis* Schrenk & C. A. Mey. and here only unequivocal female specimens are included. Altitudinal distribution goes from 1–400 m in the northern lowlands to 3600 m on S-exposed slopes of the Karakoram main range.

As a typical Central Asiatic desert species, *E. przewalskii* combines high tolerance to water stress – most localities are within the 100 mm isohyete – with the ability to endure long-lasting very low temperatures. It grows on a wider variety of soils and has a higher salt tolerance than its relatives: dry solonchaks, stabilized sands, gravelly gypsiferous plains, stony slopes and even rock crevices. Accordingly, the species composition of the many different, always very open plant communities where it occurs as a subdominant or even as a dominant, varies very much in each altitudinal belt. In the lowlands of our area, we found it associated with xerohalophytes and gypsophytes, like *Salsola arbusculiformis*, *Anabasis truncata*, *Arthrophytum betpakdalense*, *Nanophytum erinaceum* and *Haloxylon ammodendron*, from Kashgaria it is known as a component of sandy deserts with *Haloxylon persicum* and different *Calligonum*-species, and from the Karakoram it is reported to grow preferably together with *Krascheninnikowia ceratoides* and *Artemisia* species.

About applied aspects, no reliable data are obtainable. In Kazakhstan we found it hardly grazed.

References: 177(1), 218(1), 721, 723, 726.

11. *Ephedra regeliana* Florin
Syn.: ***E. pulvinaris* V. A. Nikitin**

Ephedra regeliana is a minute dwarf-shrub or an almost hemicryptophytic plant with a hight of 2–5(10) cm. The densely fasciculate annual twigs arise from very short perennial branches, or from the branched rhizom. They are ascending to prostrate or even curved downwards. In contrast to the otherwise similar *E. monosperma* C. A. Mey. the female cones are 2–seeded, the inner bracts are fused for 3/4–5/6 and surpass the seeds. The likewise similar *E. fedtschenkoae* Pauls. differs by completely glabrous erect twigs, by being often monoecious, and having the inner bracts fused for only 1/2–2/3.

The area of *E. regeliana* stretches from the W Tian Shan and the C Hindukush eastwards to the Altai, the Kunlun and the E Karakoram. Predominantly it is a species of the subalpine and alpine zones with most localities in the Karakoram and the Pamirs from 2500–4000(4500) m, but particularly in the northern parts, on dry pebbles of river terraces it may descend into the montane belt downwards to c. 1000 m.

Ecologically, *E. regeliana* is a typical species of subalpine and alpine semi-deserts with a low but long-lasting snow cover and annual precipitations scarcely exceeding 100 mm excent for edaphically dry sites. Most often it has been found in gravel, pebble or on rocky slopes, but from the N Karakoram and Kunlun it is reported also from loessic soils. Typical accompanying species on coarsely textured soils in the Pamirs are other dwarf-shrubs like *Acantholimon diapensioides*, *Krascheninnikowia ceratoides*, *Artemisia rhodantha* and *A. leucotricha*, perennial mat-forming species of the genera *Hedysarum* (e.g. *H. cephalotes*) and *Onobrychis* (e.g. *O. poncinsii* and *O. chiliophylla*), perennial grasses, e.g. *Stipa orientalis* and *Piptatherum platyanthum*, and grass-like plants like *Carex stenophylloides*. In the Karakoram it is an important component in *Oxytropis immersa-Koeleria gracilis* and in *Artemisia* spec.-*Ephedra regeliana* communities.

References: 177(1), 689, 696, 701, 711, 721.

12. *Ephedra sarcocarpa* Aitch. & Hemsl.
Syn.: ***E. holoptera* Riedl, E. *oxyphylla* Riedl**

Ephedra sarcocarpa is a stout, 50–100 cm tall clump-forming species, with most branches being about 2–3 mm thick. In vegetative and young male individuals all characters are almost identic with the sympatric *E. strobilacea* Bunge. They are just slightly less rigid and more densely branched. Smaller specimens might resemble *E.*

intermedia Schrenk & C. A. Mey. which likewise occurs in the area. However, the whorled leaves, the structure of the female cones and the pollen-type leave no doubt.

Ephedra sarcocarpa is restricted to the central part of the Irano-Turanian floristic region and is distributed through the hot semi-desert regions from western C Iran to SE Afghanistan and northern Pakistani Baluchistan, mainly in altitudes from c. 800–1200 m. It avoids the driest areas, leaving them to *E. strobilacea* Bange, but both species overlap.

Ecologically, *E. sarcocarpa* exhibits strong affinity to a climate with annual (winter) precipitation of c. 80–200 mm, combined with high resistance to hot summers and moderately strong winter temperatures. As a typical "dasht"-plant it populates mainly the vast pediment plains and alluvial fans built up by gravels or pebbles from very diverse rocks intermingled with sand and having accumulated a distinct gypsum horizon close to the surface. We have seen it also often on weak marly bedrock. Usually *E. sarcocarpa* is a component of open semi-desert shrublands, especially of *Zygophyllum atriplicioides*-communities, together with dwarf-shrubs like *Salsola tomentosa*, *S. orientalis*, *Artemisia meyeri*, different *Astragalus*- and *Acantholimon*-species, perennial grasses like *Stipagrostis plumosa*, several geophytes and many annuals. More rarely it penetrates into the denser *Pteropyrum aucheri* communities along runnels.

Except for camel, the fodder quality is evidently low, because we found it rarely touched, and often favoured by higher grazing and other anthropogenous pressure.

References: 619, 733.

13. *Ephedra strobilacea* Bunge

Syn.: ***E. pentandra* Pachom., *E. intermedia* Schrenk & C. A. Mey. var. *persica* Stapf**

Ephedra strobilacea is very similar to *E. alata* Decne. It differs mainly by the following characters: less extensive subterranean branching resulting in smaller clumps, sometimes even single-stemmed at base and up to 2(3) m tall; bracts of female cones recurved, more tender due to narrover and less thickened dorsal part, wings wider, usually exceeding the bract's tip; seeds without a prominent beak. In vegetative stage it can be easily confused with *E. sarcocarpa* Aitch. & Hemsl., but the branches are coarser.

The full range of *E. strobilacea* is located on our area: from SW Central Iran eastwards to S Afghanistan and Tadshikistan, and northwards through the Karakum to the Aral Sea and the Central Kyzylkum. It is a typical species of the southern Transcaspian lowlands and the vast semi-desert bassins of Iran and Afghanistan. In the North it rarely exceeds c. 300 m, but in Iran and S Afghanistan it is most common from 450–1000 m, with the highest localities known at 2100 m in the dry mountains around Kerman. The localities from and near the southernmost Lut desert belong to subsp. *microbracteata* (Ghahreman) Freitag & Maier-Stolte* which differs by smaller female cones, more numerous whorls of bracts and dark-brown colour of the pith. *E. pentandra* Pachom. from southwest C Iran agrees well with typical *E. strobilacea*.

Ephedra strobilacea is the most xerophytic *Ephedra*-species of the Irano-Turanian area and bound to hot semi-deserts with annual precipitation of about 50–100 mm. It grows both on stabilized sand dunes or sand sheets and on gravelly soils derived from different rocks, here preferably in condensed vegetation lining runnels, often on soils with a pronounced gypsiferous horizont. In the Karakum, many individuals have been found 50–70 years old, and the thickest stem bases proved to have reached more than 100 years. The species occurs as a subdominant or as a subordinate component of different plant communities. Common widespread associates in open semi-desert shrublands on sands are other shrubs and dwarf-shrubs like *Haloxylon persicum*, some species of *Calligonum*, *Convolvulus*, *Halothamnus subaphyllus*, *Salsola richteri*, *S. arbuscula*, *Ammothamnus lehmannii*, *Stipagrostis pennata*, many geophytes like *Carex physodes*, *Emimium lehmannii*, *Dorema sabulosum*, *Eremurus inderiensis*, *Iris songarica*, species of *Heliotropium*, *Allium*, *Gagea* and *Tulipa*, and a wealth of annuals. Along runnels in C Iran and S Afghanistan it grows together with *Zygophyllum tetrapterum*, *Calligonum junceum*, *Pteropyrum aucheri*,

* [Basionym: *E. microbracteata* Ghahreman, Bull. Jard. Bot. Belg. 44: 26 (1974).]

Artemisia sieberi, *Fortuynia garcinii*, *Astragalus squarrosus*, *Stipagrostis plumosa* and likewise some geophytes and many annuals.

Due to the far reaching and in part shallow root system, *E. strobilacea* has high sand-binding capacities. In Middle Asia it is estimeed as a most valuable fodder plant for goat, sheep and camel in all seasons of the year, being virtually not poisenous and having contents of proteins (up to 16%), caroten, vitamin C, amino-acids and minerals (Ca up to 2.6% etc.)

References: 177(1), 218(1), 518(10), 666(2), 692, 706, 708, 715, 718, 720, 721, 734, 745.

14. *Ephedra transitoria* Riedl

The 20–50 cm tall species looks much like the related, but geographically separated *E. sarcocarpa* Aitch. & Hemsl. but it is a less robust plant and all bracts are – like the leaf sheaths – delicately ciliate. Otherwise, in vegetative stage, grazed specimens might be similar to *E. distachya* L. which comes down to W Syria and differs by dark brown pith and abscence of ciliate bracts and sheath margins. The latter characters might help to distinguish tall specimens from *E. alata* Decne. of the neighbouring Saharo-Sindian deserts.

Ephedra transitoria is endemic to the Syrian or Mesopotamian subregion of the Irano-Turanian region. It is known only from Syria, Jordan, Iraq (here centered in the Western Desert) and northernmost Saudi Arabia where it replaces the more xerophytic and thermophilous *E. alata* Decne. of the neighbouring Saharo-Sindian deserts. The altudinal distribution is from c. 100–600 m.

Ecologically, the species is adapted to semi-desert conditions under annual (winter) rainfall of 100–250 mm and the combination of hot summers with cold winters. It is most common on gravelly plains with a distinct gypsum horizon. Sometimes it is forming small hillocks by the accumulation of aeolian sand. The vegetation types with *E. transitoria* are described as open sub-desert and dry steppe, but no detailed phytocoenological studies are known to us. *Artemisia sieberi*, *Achillea fragrantissima*, *Noaea mucronata*, *Haloxylon articulatum*, *Helianthemum lippii* and *Poa sinaica* seem to be the most common accompanying species.

The plant is grazed by flock and used by the Bedouin for fuel.

References: 228(1,2), 732, 734.

Pinaceae

Pinus L.

15. *Pinus brutia* Ten.

Syn.: ***Pinus halepensis* Miller var. *brutia* (Ten.) Holmboe; *P. pityusa* Steven; *P. stankewiczii* (Sukatschew) Fomin; *P. eldarica* Medw.**

A tree up to 25 m, or sometimes more, high, with irregular pyramidal or ovoid crown and rather lax branches. Leaves in pairs, up to 180(200) mm long, light green. Cones subsessile, ovoid-conic, 5–8 cm long, usually more than 2 borne together. The species is closely related to *P. halepensis* Miller and both species are often confused,

but it differs in having subsessile and spreading cones versus stalked (1–2 cm) and pendulous. Because geographical ranges of both species overlap, for instance on Peninsula Khalkhidiki in Greece, they readily cross and form hybrids.

An eastern Mediterranean species, having the main part of its range in western, southern and northern (here is less frequent) Anatolia and in adjacent Greek islands including Crete in the west, Cyprus in the east as well as in north-western Syria and the Lebanon. Moreover, some isolated stations are known to occur in Calabria in southern Italy, the Crimea and eastern shores of the Black Sea (slopes of the Caucasus) from whence this pine was described as *P. pityusa* Steven as well as in the eastern Transcaucasia. Populations from the latter area have been considered as a separate species, *P. eldarica* Medw.

Pinus brutia is forest tree growing in pure or mixed stands, dominated with oaks and trees and shrubs typical of maquis. The species is drought-tolerant and grows on various types of well drained grounds, with special preference to limestone slopes. It is widespread from almost sea level to 1000–1200 m, but in mountains of southern Anatolia it ascends up to 1600–1800 m, and in the Lebanon to 1700 m.

The species is important forest tree for its timber and resin.

References: 64 (1), 103 (1), 151 (1), 163 (1), 218 (1), 250, 674, 678, 685, 702, 713, 724, 725, 744.

16. *Pinus gerardiana* Wallich ex Lambert

A tree up to 18–20 m tall with smooth bark peeling off in large flakes. Leaves 6–12 cm long, in clusters of 3, dark green and stiff. Cones up to 20 cm long and 11 cm wide. Seeds cylindric, ca. 20 mm long, with a short wing.

A West Himalayan species whose range covers eastern Afghanistan, western and northern Pakistan, Kashmir and north-west India. In the west it does not exceed long. 69°E, whereas in the east it extends to long. 80° in Kumaun. It does not occur in Nepal. This range overlaps largely the western part of the range of *Pinus wallichiana* A. B. Jackson, but in contrast to this species *P. gerardiana* appears in drier areas. It forms open forests and is often associated with *Cedrus deodara* (D. Don.) D. Don. and *Quercus baloot* Griff.

In Afghanistan *P. gerardiana* occurs between 1700 and 2700 m, and in Pakistan it appears at an elevation of 1000 m and ascends to 3000 m or even higher.

Timber of this pine is hard and tough and very resinous. The most useful, however, are its seeds, known as "chilghoza", which are edible and are very important food for autochthons, especially in the wintertime.

References: 30, 85, 179, 186, 196, 225, 608, 685.

17. *Pinus nigra* Arn.

A tree reaching up to 30–40 m or sometimes higher, with dense, widely ovate crown, having flatted tree-tops with age. Leaves in pairs, 5–18 cm long, forming dense tufts at the end of the branches. Cones ovoid, 3–8 cm long, 4–5 cm wide, often larger up to 12 cm long, subsessile, erect or ascending, light brown and somewhat lustrous.

A very polymorphous species, especially with regard to the height and the length and flexibility of the needles. On the basis of these characters some subspecies have been recognized which sometimes are considered as species of their own. These are: subsp. *mauretanica* (Maire & Peyer) Heyw. from northwest Africa, subsp. *salzmannii* (Dunal) Franco from Spain and France, subsp. *laricio* (Poiret) Maire from southern Italy, Sicilia and Corsica, subsp. *dalmatica* (Vis.) Franco from the coastal region and offshore islands of the former Jugoslavia, subsp. *nigra* from Austria, Albania, northwestern Greece, Italia and the former Jugoslavia and subsp. *pallasiana* (Lamb.) Holmboe from the Balkans, the Crimea, Turkey and Cyprus.

A sub-Mediterranean montane species. In southwest Asia it is represented exclusively by subsp. *pallasiana* with dark green, rigid, twisted or irregulalrly curved leaves, 12–18 cm long. *P. nigra* is widely distributed in western, northern and southern Anatolia extending eastward to long. 39°E. This is one of the most important forest trees in this region, forming both monospecific and mixed stands, usually with *Pinus sylvestris* L., *Fagus orientalis* Lipsky and various oak species such as *Q. pubescens* Willd., *Q. petraea* (Mattuschka) Liebl., *Q. cerris* L. and *Q. coccifera* L. as well as with *Cistus laurifolius* L. in the undergrowth and at the forest margin.

Pinus nigra as a rule occurs, especially in the south, in a zone between forest dominated with *Pinus brutia* Ten. below and *Cedrus libanii* A. Richard above. In Anatolia it is usually grows at an elevation between (900)1000 and 1600(1800) m. Nonetheless, both lower and higher stations are also recorded at 300–600 m and 1900–2100 m, respectively, for example on Murat Dagi. In Cyprus, the main centre of the occurrence of *P. nigra* is in the massif of Troödos between 1200 and 1600 m, while in Greece its altitudinal range extends between 600 and 1500(1800) m.

References: 64 (1), 103 (1), 218 (1), 250, 667, 674, 679, 685, 691, 702, 738.

18. *Pinus pinea* L.

A tree up to 25–30 m high, with a globose crown when young, becoming widely umbrella-shaped with age. Bark greyish-brown, twigs glabrous. Buds non-resinous, leaves in pairs, to 20 cm long, light green, acute. Cones large, broadly ovate to almost spherical, to 15 cm long, woody; they require three years to reach maturity. Seeds unwinged, large, to 2 cm long, with hard husk, edible.

A Mediterranean species, widespread in southern Europe from Portugal to Greece and additionally known from Turkey and the Lebanon. It occurs most abundantly in Spain on the Iberian Peninsula. In other countries it is scattered in maritime areas. Most probably in many places it is planted from the antiquity, especially in the gardens and along avenues, for instance on Crete, Cyprus and in Syria. In south-west Asia the species is known from few stations in western, southern and occasionally in northern [e.g. near Artvin ("Fistikli")] Anatolia. The naturalness of certain localities is sometimes not clear and doubtful, for instance a grove of *P. pinea* by Cide. In some stands there occur only solitary trees, but in western Anatolia (Kozak near Bergama in the Province of Izmir) this pine forms extensive pure forests and its cones are reaped on a large scale, seeds hulled and their embryos are exported as consumable goods.In the Lebanon *P. pinea* occurs in the western part of the country, around and south of Beiruth.

Pinus pinea is a photophilous species, growing on sandy soil, from sea level to 300–600 m, reaching its highest elevation of 1200 m in the Lebanon.

References: 64 (1), 163 (1), 672, 673, 685, 702, 713.

19. *Pinus sylverstis* L.

Syn.: ***Pinus kochiana*** **Klotzsch ex Koch;** ***P. hamata*** **(Steven) Sosn.**

A tree up to 40 m high with reddish bark on young shoots, becoming yellowish on older shoots and dark brown on boles. Leaves in pairs, 3–7 cm long, glaucous, somewhat twisted. Cones ovoid, dull brown, up to 6 cm long, deflexed with a flat or shortly pyramidal apophysis on scales. This is a variable species, especially in respect to the shape of cones and the length and colour of leaves. Consequently, a number of forms and varieties or even subspecies have been recognized within this species, some of which are sometimes considered as separate species.

An Euro-Siberian species widespread throughout much of Europe, especially in its central, eastern and northern parts and extending as far north as lat. 70°20' N, and northern Asia. The southern limit of its distribution runs through northern Greece in the Balkans in Europe and northrn Anatolia and the Central Caucasus in Asia. In Anatolia pure stands of *P. sylvestris* cover an area of 450 000 hectares and mixed stands with that species cover additionally

500 000 hectares. The southernmost occurrence of the species in Turkey slightly exceeds lat. 39°N on Murat Dagi (Kütahya Distr.) and in the Sicanli Forest south of Pinarbaçi (Kayseri Distr.) at lat. 38°34' N.

Within the wide geographical range of *P. sylvestris*, there exists also a marked disfferentiation in its elevational range. The species occurs both in the lowlands, especially in Europe and northern Asia, and in the mountains. The highest stations in Europe are in the Alps at an elevation of 2400 m, in Greece at 1800 m, in Spain at 2100 m and in Bulgaria at 2200 m. On the other hand, in the Caucasus in southwest Asia *P. sylvestris* ascends to 2 600 m and in Anatolia, where its elevational range extends from (100)500 to 1800(2100) m, the highest locality is on Ala Dag near Sarikamis (Kars Distr.) at 2 600–2 700 m.

Pinus sylvestris is one of the most important conifers and its hardwood is of great technical value. It is therefore commonly used as building material and is an important stock in physico-chemical processing. The species provides a large amount of resin substances and its dry litter of needles and crumbled bark is used in horticulture.

References: 64 (1), 103 (1), 218 (1), 250, 674, 677, 678, 679, 685, 687, 688, 702, 703, 713.

20. *Pinus wallichiana* A. B. Jackson

Syn.: *Pinus excelsa* Wallich ex Lambert; *P. griffithii* McClelland non Parl.

A tree to 30–50 m high, reaching a circumference of about 3.5 m, and with a characteristic widely pyramidal, open crown. Leaves in clusters of 5, up to 18 cm long, slender and drooping, greyish or bluish-green (the common name "blue pine" alludes to this character). Cones cylindric, to 25 cm long, pendulous, on stalks 2–5 cm long, with broadly opened, slightly woody scales when mature.

A Himalayan species having a narrow but extended continuous range, from eastern Afghanistan (especially Nuristan) through northern Pakistan, Kashmir and north-west India to Bhutan. Some isolated and disjunct stations are known from China (north-east Tibet, Yunnan) and northern Burma and Pakistan (Waziristan and northern Baluchistan). The range extends from long. ca. 68°–69° in the west to long. 100° in the east and from lat. about 35° in the north (Kashmir) to lat. 26° in the south (China and Bhutan).

Pinus wallichiana is an important constituent of mountain forests at middle and high elevation, especially in temperate zone with annual precipication ranging from 1100 to 1900 mm. It forms pure or mixed forests along with species such as *Cedrus deodara* (D. Don.) G. Don., *Abies spectabilis* (D. Don.) Spach and *Picea smithiana* (Wallich) Boiss., but in comparison to these species *P. wallichiana* is a more light demanding species. In Afghanistan it occurs between 2000 and 3300 m, in Pakistan between 2400 and 3750m and in Nepal at 1800–3300 m. In places, for example in the West Himalayas, it descends to 1400–1600 m, but most abundantly and frequently this species occurs above 2000 m.

The species is often attacked by a minute semi-parasite shrub of the family *Loranthaceae*, *Arceuthobium minutissimum* Hook. f., which reaches merely about 8 mm. It frequently forms characteristic small swellings which occurr in masses on thin bark in the upper part of the crown of young trees and cause serious harm, for instance in Pakistan and in the West Himalayas.

Timber of *P. wallichiana* is whitish, soft, even-grained, easy to work and highly resinous. It is locally used for various constructions, in carpentary and for production shingles, matches, tea-chests and other implements. *P. wallichiana* yields terpentine and tar as well as an excellent charcoal.

References: 30, 179, 186, 196, 214, 225, 608, 669, 685.

Chenopodiaceae

Haloxylon Bunge ex Fenzl

21. *Haloxylon ammodendron* (C. A. Mey.) Bunge ex Fenzl
Syn.: ***Haloxylon aphyllum* (Minkw.) Iljin; *Anabasis ammodendron* C. A. Mey.**

A profusely branched shrub or tree, 5–8 m tall, sometimes even taller, with trunk to 25 cm in diameter. Annual shoots green, articulate, ascending or pendant. Leaves reduced to cupe-like scales as long as wide. Flowers hermaphrodite or minute male flowers present. Fruit winged, ca. 1 cm in diameter including wings. It lives to 40–50 and even to 100 years.

An Irano-Turanian species widely distributed throughout Middle Asia (Turkmenistan, Uzbekistan, Tadzhikistan, Kyrgystan, southern Kazakhstan), extending in the north almost to lat. 50°N along the valley of Emba river. In the east its range covers north-western China and southern Mongolia, while in southwest Asia the species occurs only in Iran, especially in north-eastern and eastern parts of this country. It is likely the species occurs also in Afghanistan, but relevent and reliable data are not available.

Haloxylon ammodendron, which is called "black saxaul", is a psammophyte and halophyte associated with warm and sunnay sites. It is therefore one of the most typical elements of the desert vegetation in Central and Middle Asia. In grows in semideserts and deserts, on quicksands and stabilized sands, both shallow and deep. It is characterized by having a deep root system and a considerable burying resistence. It forms dense or thin thickets, so-called "saxaul forests". They are monospecific or mixed, which are known as *Haloxyletum ammodendri* with *H. ammodendron* being a dominant species. It is associated with species of such genera as *Salsola* L., *Anabasis* L., *Calligonum* L., *Artemisia* L., *Kraschenikovia* Guldenst., *Tamarix* L. and others. It occurs most often in the lowlands, for instance in Tadzhikistan between 350 and 720 m and in Iran between 300 and 1200(1300) m, reaching a highest elevation of 1720 m.

Haloxylon ammodendron is a valuable camel fodder and charcoal plant. In desert regions it is an excellent shade tree and a source of fuel.

References: 177 (3), 218 (2), 518 (7), 610, 698, 710.

22. *Haloxylon persicum* Bunge ex Boiss. & Buhse

The species is a close relative of the former species, from which it slightly differs in its scalelike leaves which are longer than wide and have a prominent arista. It is usually called a "white saxaul". Both species often grow together in mixed stands and their geographical ranges overlap each other in major part.

An Irano-Turanian species which, contrary to *H. ammodendron*, extends south-westward to the Saharo-Sindian Region. In the east its geographical range ends in Dzhungaria in China but does not cover Mongolia. In southwest Asia, *H. persicum* is scattered in north-eastern and eastern Iran, in southwestern and northern Afghanistan as well as in Baluchistan in southwestern Pakistan. A few stations are also known from Iraq. The westernmost localities

of this species are in southern Israel and in southern Jordan, where it grows along the Arava Valley (Wadi Araba) and also on the Sinai Peninsula. It has recently been redorded from Egypt. On the Arabian Peninsula, the species is an important constituent of desert plant communities in the United Arab Emirates, Oman and Saudi Arabia, but in the latter country is not yet fully known.

Ecologically, *Haloxylon persicum* is close to *H. ammodendron* growing in similar termic and edaphic conditions and forming a similar associaition – *Haloxyletum persici*. In Israel and Jordan it appears in depression areas (-380 m). It usually does not ascend as high as *H. ammodendron*. In Tadzhikistan it is widespread at an elevation of 400–480 m, in Egypt at 300–350 m, in Afghanistan at 280–750 m, in Pakistan at 600–900 m and in Iran at 370–1000 m. The highest stations have been recorded from Jordan – 1360 m and Iran – 1400–1500 m.

Both species are used for the same purposes. They are also cultivated in many places, mostly for stabilization of dunes and have been propageted from planes.

References:177 (3), 218 (2), 225, 259 (1), 510, 518 (7), 610, 649, 665, 671, 680, 698, 710, 742.

23. *Haloxylon salicornicum* (Moq.) Bunge ex Boiss.

Syn.: ***Haloxylon schweinfurthii* Asch.; *Hammada salicornica* Iljin; *H. elegans* (Bunge) Botsch.**

A diffuse, much branched shrub, 50–100 cm high, with pale brown or white stems. Shoots fleshy, articulate, light-coloured to glaucous. Leaves reduced to short triangular connate scales, membranous at margin and woolly within. Flowers minute in dense lateral or terminal spikes. Fruits winged, 6–8 mm in diameter. In an overall appearance this shurbs resembles species of the genus *Anabasis* L.

A widespread Saharo-Sindian species, extending from North Africa (Algeria, Tunisia, Lybia, Egypt) to Pakistan and eastern India. In southwest Asia it occurs mainly in central and southern Iran, Iraq, south-western Afghanistan, southern Pakistan as well as in Syria, Jordan, Israel and on the Sinai Peninsula. Some disjunct stations, isolated from the continuous range, are in north-eastern Afghanistan (Nangarhar, Nuristan) and north-western Pakistan. In the north the species only slightly exceeds lat. 34°N (Syria, Iraq, Afghanistan). The range of the species covers also the major part of the Arabian Peninsula - Kuwait, Bahrain, Qatar, United Arab Emirates, Oman, Saudi Arabia. The southern limit of the range is still imcompletely known. It seems that in western India *H. salicornicum* occurs only in desert regions of the district of Jaisamlar, but closer data are lacking. Likewise, no detailed information is available on the occurrence of the species from central and southern Egypt and the most part of Saudi Arabia where *H. salicornicum* is very abundant.

This shrub grows first of all on plains and hillsides, on hotter sand desert showing a various degree of salinity and on more elevated stations it thrives also on rocks. It is often a dominant species of *Haloxyletum salicornici*, an association covering large expanses in which it forms more or less scattered stands. The most frequent associates include other desert species of the genera *Calligonum* L., *Zygophyllum* L., *Seidlitzia* Bunge, *Salsola* L., *Retama* Raf., *Leptadenia* R. Br., *Anabasis* L., *Helianthemum* Mill. as well as other species of *Haloxylon*.

Haloxylon salicornicum occurs mainly in lowland areas, from the depression of the Dead Sea and Arava Valley (Wadi Araba) to about 700–900 m (in Iraq only to 300 m and in Afghanistan to 750 m). The highest stations are reported from the Sinai Peninsula – 1300 m, southern Pakistan – 1400 m and the district of Yaz of Iran – 1600 m.

In the summer and autumnal dry wether season, when herbaceous plants are already totally withered, *H. salicornicum* is an important camel fodder. Additionally, it is used as a source of fuel, in the folk medicine and as a detergent.

References: 225, 258, 259 (1), 518 (7), 610, 649, 665, 686, 698, 750.

Convolvulaceae

Convonvulus L.

24. *Convolvulus acanthocladus* Boiss.

An intricately branched, dense and spinescent shrub up to 1 m high, but usually smaller, about 50–60 cm, with sericeous, greyish branches and leaves. Leaves sessile, up to 15 mm long, oblanceolate. Flowers pink, axillary or terminal, ca. 20 mm long. The species is closely related to *C. leiocalycinus* Boiss., from which it differs, among others, in its sessile leaves (versus petiolate), hairy sepals (vs. glabrous) and pubescent seeds (vs.glabrous).

An Iranian species, occurring almost exclusively in southern Iran and additionally known only from a single, isolated locality in the district of South Waziristan in western Pakistan. In Iran *C. acanthocladus* occurs in the provinces of Fars, Kerman and Makran, abundantly in places and forming a subdominant element in steppe communities. It is found most often between 800 and 1700 m, although sometimes it descends at lower elevations, for example in coastal areas to 30–50 m. Its highest locality is at 2300 m in Khabr SSW of Kerman town in the province of Kerman.

References: 690, 728.

25. *Convolvulus leiocalycinus* Boiss.
Syn.: *C. lycioides* Boiss.

A small shrub or undershrub to 90 cm high, densely short and white pubescent, with spiny branches; older branches and spines with brownish bark. Leaves 12–20 mm long, 3–6 mm wide, adpressedly pubescent. Flowers axillary, solitary with a distinct pedicel, to 1 cm long. Corolla ca 25 mm long, white to pink. A very variable species, especially with respect to the leaf width and pubescence.

Convolvulus leiocalycinus is known mainly from southern Iran and southern and western Pakistan (Beluchistan, Makran), generally at lat. 26°–32°N. Some scattered stations are also reported from central Iran and western Afghanistan (Farah Province, between lat. 32 and 34°N).

This shrub grows in steppe and semi-desert calcareous areas at the mountain foothills, on open, dry and insolated rocky hillsides and in rocky gorges. Its most frequent associates are other spinescent shrubs, such as *Ebenus stellata* Boiss., almond shrubs of the subgenus *Dodecandra* and *Astragalus* species. It is quite abundant in places and sometimes is an almost subdominant element in plant communities.

Convolvulus leiocalycinus occurs most frequently at elevations between 1000 and 2000 m. In Afghanistan it is found at an elevation 900–1500 m, and its highest stations have been recorded in Pakistan at 2100 m, while in Iran even at 2900–3100 m in the mountains in the province of Kerman.

References: 690, 728.

The species is occurring also in SW Tadzhikistan, unfortunately it is not marked on the map.

Labiatae

Otostegia Benth.

26. *Otostegia persica* (Burm. f.) Boiss.
Syn.: ***O. kotschyi* Boiss.**

An erect shrub, 1.5 m high, occasionally somewhat higher. Leaves suborbicular-obovate, ca 12 mm long, pubescent, crenato-dentate and spinescent, supported up with thin and sharp spines, to 20 mm long. Flowers in verticillastres. Calyx limb membranous, stramineous; corolla whitish, ca 20 mm long.

A maximum of its occurrence is in southern Iran and south-westernmost Pakistan (Makran), where it is very rare. The northernmost localities are at lat. 30°N and in the south its range extends to lat. 26°N, whereas in a west-east direction its range cover an area between long. 51° and 63°E.

Otostegia persica occurs in the Saharo-Sindian vegetation zone, on steppes and semi-deserts, both in the lowlands and on the mountain slopes, mostly on rocky, sandy and clay soil, accompanied with species of *Artemisia* and *Astragalus* and spinescent, shrubby species of *Amygdalus*. Its elevational range extends from almost sea-level (10 m) on the Persian Gulf to 2000 m, with the highest station 2400 m in the mountains south of Kerman in Iran.

References: 518 (2), 697, 699, 729.

Leguminosae

Chamaecytisus Link

27. *Chamaecytisus drepanolobus* (Boiss.) Rothm.
Syn.: ***Cytisus drepanolobus* Boiss.**

An erect shrub, reaching to 1.0–1.5 m with hairy, subpatent branches. Leaves trifoliate. Leaflets to 25 mm long and to 8 mm wide, oblanceolate to obovate, subglabrous to sparsely hairy. Flowers yellow in heads of 4–15. Legume to 3 cm long, linear-lanceolate, sericeous.

An eastern Mediterranean species. It occurs in southern Anatolia (Provinces of Içel, Adana and Hatay), north-western Syria and in the central Lebanon with maximum occurrence in the Amanus Mts. This shrub grows primarily on limestone slopes, in woodlands and in open pine and oak forests, at an elevation from 200 to 1200 m, with most abundant occurrence at 500–900 m.

References: 64 (3), 163 (2).

Crotalaria L.

28. *Crotalaria persica* (Burm. f.) Merrill
Syn.: *C. furfuracea* Boiss.

A bushy, spinescent shrub, 0.5–2 mm high, with appressedly pubescent branches. Spines terminal. Leaves trifoliolate, but often absent, making the plant almost scoparious in habit. Flowers small, single, in elongate and lax racemes, deep red or orange, with yellow wings. Legume 6–7 mm long, bilocular, pubescent.

A Nubo-Sindian species, whose south-west Asian range is restricted exclusively to a narrow, coastal belt in southern Iran and south-western Pakistan, between long. 54° and 62°E. However, a major part of its range covers eastern part of the Arabian Peninsula and East Africa. The species was reported from the United Arab Emirates (between Abu Dabi and Ras al Khaimah), Oman and Yemen as well as from northern Ethiopia (Eritrea) and northern Somali Republic.

Crotalaria persica thrives on dry and sunny maritime dunes, from sea-level to 40 m, although in Dhofar in Oman it was found at an elevation of 100 m.

References: 506, 665, 730.

Desmodium Desv.

29. *Desmodium elegans* DC.
Syn.: *D. tiliifolium* (D. Don) G. Don

An erect shrub, to 2.5–3 m high, with densely pubescent branches. Leaves trifoliate, with petiole to 7.5 cm long. Leaflets variable in shape and pubescence, varying from roundish to obovate, obtuse to acuminate, bilaterally glabrous or pubescent. Flowers about 10 mm long, pale lilac to dark purple, in panicles up to 45 cm long.

A Himalayan species ranging from southern China and Bhutan in the east through Nepal and north-western India to northern Pakistan and north-eastern Afghanistan in the west, in the latter country being rare and scattered at a few stations only. In the Himalayas the species is common and grows gregariously on grassy hillsides and in open forests, often in river valleys on sandy and gravelly clay loam. It has an optimum of its altitudinal range at 1500–2500 m, although occasionally it is found at an elevation of 1000 m. In Kashmir it ascends to 2750 m and in Nepal to 3000 m.

Desmodium elegans is an ornamental shrub having a long and late florescence, from August to October. It was introduced to cultivation in England in 1879.

References: 225, 506, 719, 730.

Genista L.

30. *Genista albida* Willd.

Syn.: *G. armeniaca* Spach, *G. scythica* Pacz.

A small, prostrate, unarmed, hummock-form shrub, 5–15 cm high, with densely pubescent branches. Leaves elliptic to obovate, 3–10 mm long, with appressed to patent hairs, sometimes glabrous above. Flowers singular or in pairs, yellow, ca 10 mm long, with a densely sericeous standard. A very variable species with respect to the pubescence and the size of flowers. It resulted in recognition of several separate microspecies which, however, are not generally accepted.

Genista albida is known to occur primarily in Anatolia, except for its north-westernmost and south-easternmost parts. It is the commonest species of this genus in Turkey, although nowhere it is found abundantly. Outside Anatolia it is known from the Crimea, especially from southern part of the peninsula, from where it was described for the first time almost 200 years ago. Some solitary stations are recorded also from Dobruja in Romania and from Jebel el Ansariye in north-western Syria.

This small shrub grows on calcareous ground, in rocky and open places or in degraded pine (*Pinus brutia* Ten., *P. nigra* Arn.) and cedar (*Cedrus libanii* A. Rich.) forests, especially at 1000–2000 m. It turns up, however, at lower elevations of 400 m, and in places it ascends up to 2600 m in the mountains, for example on Ak Dag near Akseki or on Binboga Dag by Göksun in southern Anatolia.

References: 64 (3), 163 (2), 295, 705.

Indigofera L.

31. *Indigofera heterantha* Wallich ex Brandis

A shrub up to 2–2.5 m high with canescent branches when young. Leaves imparipinnate, with 9–31 leaflets, pubescent on both sides. Flowers purple to pale red, in racemes on the terminal part of the shoots. Legume cylindric, glabrous with 10–12 seeds.

It is a Himalayan species widely distributed from north-eastern Afghanistan and northern Pakistan throughout the Himalayas (Kashmir – Bhutan) eastward to China. Within its wide geographical range it is represented by two varieties: (1) var. *heterantha* – a lower shrub, up to 60 cm, with smaller leaflets (5–8 mm) and subsessile racemes; (2) var. *gerardiana* (Wallich ex Baker) Ali (=*Indigofera gerardiana* Wallich ex Baker), a higher shrub, with larger leaflets, to 15 mm long and pedunculate racemes.

Indigofera heterantha is a common and gregarious shrub which thrives in the undergrowth in open forests dominated with oak (*Quercus baloot* Griffith, *Q. dilatata* Royle), pine (*Pinus gerardiana* Wallich ex Lambert) and cedar (*Cedrus deodora* (D. Don) G. Don) as well as on grassy hills and on river banks among granite boulders. Its altitudinal range extends from 600–800 m to 2400–2800 m with the highest occurrences in Kashmir (2900 m), Afghanistan (3000 m), Nepal (3100 m) and Bhutan (3300 m).

In the Himalayas twigs of this shrub are largely used for basket-work. *I. heterantha* was introduced into the culture in 1840 and was considered as a valuable ornamental shrub due to its long florescence, from April to August. In culture, in the temperate region it often freezes on to the ground, though it quickly revives.

References: 30, 179, 506, 730.

32. *Indigofera oblongifolia* Forssk.

An erect shrub, 0.6–1.3 m high, occasionally reaching 2 m (in Ceylon), much branched, with young stems densely, white or grey appressed-pubescent. Leaves imparipinnate, usually 3–5–foliolate, rarely unifoliolate. Leaflets oblong to lanceolate or obovate, 15–26 mm long, bilaterally pubescent. Flowers 5–10 mm long, reddish, in racemes up to 10 cm long. Legume up to 2 cm long, 6–8–seeded.

It is a Sudano-Sindian species, with a maximum of its occurrence in East Africa. In the north it penetrates into the Arabian Peninsula (SW Saudi Arabia, Yemen, Oman, the United Arab Emirates, Bahrain), southern Iran, southern Pakistan and south-western India, where radically it does not exceeds beyond lat. 28°N. Only occasionally reaches more northerly latitudes in Pakistan, extending to lat. 33°N in North and South Waziristan districts, and in Palestina in the Dead Sea area at lat. ca 31°N.

Indigifera oblongifolia is associated with desert, coastal areas, occurring in plains and on the lowlands in dry and sunny places. Occasionally it can rapidly colonize abandoned fields. This shrub is willingly grazed by goats and sheeps. Its highest localities at 1100–1250 m are known to occur in Pakistan in Southwest Asia.

References: 259 (2), 364, 506, 665, 730.

Sophora L.

33. *Sophora mollis* (Royle) Baker in Hook.

Syn.: ***S. hortensis*** **(Boiss. & Buhse) Rech. f.,** ***S. persica*** **(Boiss. & Buhse) Rech. f.,** ***Edwardsia mollis*** **Royle,** ***E. hortensis*** **Boiss. & Buhse,** ***E. persica*** **Boiss. & Buhse,** ***Keyserlingia mollis*** **(Royle) Boiss.,** ***K. hortensis*** **(Boiss. & Buhse) Yakovlev,** ***K. buxbaumii*** **Bunge ex Boiss.**

A copiously branched shrub, up to 2–3 m tall. Leaves up to 25 cm long, imparipinnate, composed of 8–17 pairs of leaflets. Leaflets oblong, entire, variable in size (9–23 mm) and pubescence. Flowers fragrant, yellow, 1.5–2.5 mm long in axillary racemes, appearing shortly before the leaves. The species is divided into two subspecies: (1) subsp. *mollis* with concolorous, green leaflets, loosely tomentose on the lower face and (2) subsp. *griffithii* (Stocks) Ali (=*Sophora griffithii* Stocks) having smaller, thicker leaflets, densely, appressedly white sericeo-tomentose at the lower face.

The range of this species covers primarily eastern Afghanistan, northern, western and south-western Pakistan, Kashmir and north-western India and western Nepal. Two isolated localities are known from Tadzhikistan and Kyrgystan, where the northernmost localities reach at lat. 42°N. Additionally, some solitary, scattered stations are known from the province of Herat in north-western Afghanistan and Iran. It is very likely that in Iran the westernmost localities refer to cultivates plants of this species.

Sophora mollis grows on clay-sandy or deep clay soil, on stony plains and amongst high hills, at forest margins and in *Artemisia* steppes, in river valleys and on gravel on river bottom, in places, for example in Pakistan (Kurrum Valley, Chitral) it occurs in abundance. In Kyrgystan and Tadzhikistan it is found and elevation between 600 and 1500 m, in Iran at 1000–2300 m and in Afghanistan and Pakistan at 800–2750 m.

References: 179, 218 (3), 225, 506, 730, 749.

Clematis L.

34. *Clematis grata* Wallich

Syn.: ***C. vitalba* L. subsp. *grata* (Wallich) Kuntze**

A woody climber. Stems furrowed, pubescent when young. Leaves simple, pinnate with 4 leaflets, ovate-cordate, often 3–lobed, coarsely serrate, up to 9 cm long. Flowers creamy-white, numerous, paniculate. Sepals oblong-elliptic, ca. 10 mm long. The species is closely related to European *C. vitalba* L. from which it differs in its tendril petioles and distinctly serrate leaflets that are pubescent, not glabrous, beneath.

This is a Western Himalayan species restricted in its distribution to a narrow zone between lat. 36° and 31°N ranging from western Afghanistan (Nuristan) through northern Pakistan, Kashmir and north-western India to Central Nepal, where it reaches more southerly latitude of 28°N. It occurs commonly mostly in shrubs, more rarely in forests, along river valleys. In Afghanistan the species is found at elevations of 1350–1950 m and in Pakistan it occurs at 650–2300 m. It attains its highest elevations of 2600 and 2700 m in Kashmir and Nepal, respectively.

References: 58, 179, 225, 731, 737.

35. *Clematis hillariae* Kovalesk.

Syn.: ***C. sarezica* Ikonn.**

A slender, climbing or scrambling shrub with thin stems, softly pubescent, sometimes reddish-purple. Leaves twice pinnatisect with leaflets distinctly and distantly incisely-serrate. Flowers solitary, axillary or occasionally terminal, yellow, with lanceolate or ovate-lanceolate sepals, more or less pubescent. Filaments purplish-red or marron.

A Central Asiatic species, restricted in its distribution to south-eastern Tadzhikistan (West Pamir) and north-eastern Afghanistan where it is known to occur in the Badakhshan Province (Distr. Wakhan) and, more rarely, in Nuristan. It grows on rocky slopes and pebbles by riversides, in shrubs dominated with *Salix*, *Rosa*, *Myricaria* and *Hippophaë*, sometimes at considerable elevations. In Tadzhikistan it was found at 2500–3400 m and in Afghanistan at an elevation of 2300–4200 m.

References: 177 (4), 218 (2), 695, 731, 737.

36. *Clematis orientalis* L. s.l.

A climbing shrub with stems 4–8 m long, ribbed, glabrous or puberulent. Leaves loosely pinnate or bipinnate, glaucous-green. Leaflets very variable in size and shape, suborbicular to linear or lanceolate, entire, incised or lobate, obtuse or acute, glabrous or puberulent. Flowers axillary, usually in multiflowered dichasia with ovate-lanceolate, yellow inside sepals, 12–20 mm long, 3–7 mm wide, spreading or strongly reflexed on pedicels 1–6 cm long.

The species is exceedingly variable in all elements of plants, this resulting in recognition within it several "small species" and description of a number of varieties of unclear taxonomic value. For this reason the broader species concept is accepted in the present account to include *C. graveolens* Lindley in subspecies rank - *C. orientalis* subsp. *graveolens* (Lindley) Kuntze. This subspecies occurs in Afghanistan, Pakistan and in the Himalayas and this range more or less overlaps the geographical range of the type subspecies – subsp. *orientalis* in this part of its much wider range. In the east, the range of *C. orientalis* meets geographical ranges of some closely related species such as, for example, *C. tangutica* (Maxim.) Korsh. which extends to Mongolia and China, and *C. thibetana* Kuntze which is known to occur in northern India, Nepal and Tibet.

This is an Irano-Turanian species which reaches eastward to Central Asia. Its geographical range extends from western Anatolia and the Caucasus through Iran, Afghanistan, Pakistan, Kashmir, north-western India to western Nepal (in this country as subsp. *graveolens*). In the north the range covers southern Turkmenistan, Uzbekistan, Tadzhikistan, Kyrgystan and southern Kazakhstan as well as southern Siberia up to lat. 51°N. In Europe, *C. orientalis* is recorded from the south-eastern Ukraine as well as from some Greek islands. The latter localities seem to be doubtful because they date back from before a century and have not been rediscovered since. *C. orientalis* shows unequal abundance throughout much of its wide geographical range, being much more scattered in the south and in the west.

Clematis orientalis is a heliophilous and moderately mesophilous species. It grows most often in the valleys of rivers and streams, in thin poplar groves on riversides and in thickets of *Tamarix, Salix, Hippophaë, Elaeagnus, Halimodendron* and similar shrubs. Likewise, it shows a wide elevational range with a clear west-east gradient of increasing elevation. Thus, in Turkey, *C. orientalis* occurs most often at 300–1600(2000) m, in Iran at 1000–2000(2300) m, in Tadzhikistan at 580–2800 m, in Afghanistan at 1000–3100 m, whereas in Kashmir its stations ascend to 3500 m and in Ladakh even over 4000 m.

References: 64 (1), 103 (4), 177 (4), 218 (2), 225, 610, 669, 681, 695, 731, 737.

Rhamnacae

Rhamnus

37. *Rhamnus oleoides* L. s.l.

Syn.: ***Rh. lycioides* L. subsp. *oleoides* (L.) Jah. & Maire, *Rh. oleoides* L. subsp. *microphylla* (Hal.) P. Davis, *Rh. oleoides* L. subsp. *graeca* (Boiss. & Reuter) Holmb., *Rh. graeca* Boiss. & Reuter, *Rh. heldreichii* Boiss., *Rh. palaestina* Boiss.**

An erect, spreading or prostrate shrub, much branched and very spiny, up to 2–3 m tall. Leaves deciduous or more or less persistent, alternate or clustered, obovate, spathulate to almost orbicular, usually entire, rarely remotely crenulate, glabrous or little pubescent, distinctly or indistinctly veined, 7–30 mm long and up to 15 mm wide. The species is very variable with regard to the size and shape of the leaves, the degree of their persistence and the distinctness of their venation. For that reason taxonomy of this species is still not clarified and often confusing and the species is variously interpreted by European taxonomists.

An eastern Mediterranean species. In Europe *Rh. oleoides* occurs only in continental and insular Greece and in southwest Asia it is known from southern and very rarely northern Anatolia, western Syria, Lebanon, northern Israel, Jordan and Cyprus. It is also reported from Lybia (Cyrenaica) and northern Egypt (?) in northern Africa. In

the south-eastern part of the range as well as on the Sinai Peninsula and in Egypt *Rh. oleoides* occurs together with *Rh. disperma* Boiss. which should be better considered as its subspecies.

Rhamnus oleoides grows in open, sunny places, mostly on stony, calcareous ground in phrygana, thin maquis and thin pine forests dominated with *Pinus brutia* Ten. and *P. halepensis* Miller. It occurs usually as solitary specimens, but occasionally also in small stand, from sea-level to 400–600(1000) m. A maximum elevation it has in Anatolia – up to 1600–1800 m and in Lebanon – 2100 m.

References: 64 (2), 151 (1), 163 (2), 188, 259 (2), 381, 679.

38. *Rhamnus pichleri* C. Schneider & Bornm. ex Bornm.
Syn. ***Rh. eriocarpa*** **O. Schwarz**

Prostrate and and spiny, tortuose shrub with branches apressed to the ground. Leaves obovate to spathulate, 8–12 mm long, 4–5 mm wide, concolorous, bilaterally densely pubescent, with entire margins. Petiole and pedicels puberulent. Fruits small, 3–4 mm in diameter, puberulous.

An eastern Mediterranean species with a very narrow range in south-western Anatolia (Prov. Izmir, Aydin, Mugla and Antalya) and three eastern Greek islands of Samos, Simi and Rhodos. It grows on cracked and often crumbled limestone rocks. On Greek islands it grows at an elevation of 300–1140 m and in Anatolia between 800 and 1600 m.

References: 64 (2), 188, 381.

39. *Rhamnus punctata* Boiss.

An erect evergreen shrub, up to 2/3 m tall with rigid, spinescent branches. Leaves leathery, oblong-obovate to elliptic, sometimes linear-oblanceolate (in var. *angustifolia* Post), to 25 mm long, tomentellous and prominently nerved beneath. Fruits glabrous, ca. 6 mm long, reddish-brown. *Rh. punctata* is well distinguished from all other congeners occurring in the study area in its entire revolute leaf margins.

An eastern Mediterranean species with a range restricted to the easternmost regions of the Mediterranea Sea including Anatolia (especially Amanus Mts. in the Province of Hatay), north-western Syria, the Lebanon and northern Israel. It is reported also from Jordan.

This shrub occurs usually in maquis as well as in open forest dominated with oak and pine, on limestone cliffs, usually between 100 and 1000 m. The highest localities are known from the Lebanon (ca. 1200 m) and in Kurd Dagh in Anatolia (1300–1700 m).

References: 64 (2), 163 (2), 259 (2).

Tamaricaceae

Reaumuria L.

40. *Reaumuria alternifolia* (Labill.) Britten

Syn.: ***R. hypericoides* Willd., *R. billarderi* Jaub. & Spach, *R. cystoides* Adam in Web. & Mohr, *R. sogdiana* V. Komarov, *R. turkestanica* Gorschk., *R. refelexa* Lipsky, *R. kusnetsovii* Sosn. & Manden., *R. korovinii* Lincz.**

A small shrub or undershrub, reaching to 80 cm, with numerous erect stems, branched from the base, glabrous. Leaves 0.5–1.5 cm long, flat, ovate, elliptic to lanceolate, entire, pitted-punctate, subsessile. Flowers singular, terminal, 13 mm in diameter, pink. Capsule cartilaginous, dehiscing by 5 valves. A very variable species, especially in the shape and size of the leaves; as a result the species was described for many times under different names (see a list of synonymous names).

An Irano-Turanian species with a wide geographical range, extending from central Anatolia (long. 33°E) in the west to Kashgaria in north-western China (long. 82°E) in the east, and from the Caucasus (lat. 43°N) and southern Kazakhstan (lat. 46°N) in the north to lat. 26°N in Pakistan in the south.

Frequency of the species varies considerably throughout its wide range; it is quite frequent in the south-eastern Caucasus or in south-western Turkmenistan, but most often its localities are scattered and widely isolated (Sinai Peninsula, Jordan, northen Afghanistan).

Reaumuria alternifolia occurs in steppes and on semi-deserts, both in plains and on slopes of hills and mountains; it grows on clay, sandy or stony soil, usually on salt and gypsum. Most often it is found at an elevation between 900 and 2000 m. The lowest locality is at 500 m in Tadzhikistan, while the highest one is at 3000 m in the mountains of southern Iran.

References: 64 (2), 103 (6), 163 (2), 177 (6), 225, 258, 610, 612, 676, 693, 743, 752.

Tamarix L.

(J. Zieliński)

The genus *Tamarix* is very richly represented in southwestern Asia, taxonomically, however, is one of the most unclear and difficult group of this region. The species are not well delimitated, they hybridize freely and as a result there are serious problems with their practical distinguishing. Not long ago the genus was a subject to general revision (Baum 1978), but many questions still need further studies. In present work a broad species concept has been adopted and only the most characteristic, well recognizable species have been discussed.

Some species, especially, those growing in desert, are most probably undercollected. They flower usually very early, often in winter, before the "main" botanizing season.

41. *Tamarix arceuthoides* Bunge

A densely branched shrub or small bushy tree 2–3(4) m high. Leaves scaly, narrow at base. Inflorescence densely racemose 3–4 mm broad arising from both the year-old branches or current year's twigs. Flowers pentamerous, very small with caducous petals.

It is an Irano-Turanian species with the wide range extending from western Iraq in the east to Lat. 96–98 in western Mongolia. Its northern border runs from northern Iraq along the Caspian seashores, through southern Tadshikistan to Dshungarskij Alatau in eastern Kazakhstan. The southern border of the species range is marked out by the run of Euphrates river and the coasts of the Persian and Arabian Gulf.

Tamarix arceuthoides, like the majority of tamarisks, is the light requiring species, occurring in open places in plains, steppes in semidsert or desert areas. It grows on sandy or stony soils but also on marshes around lakes, on sandy or pebbly river terraces, along canals both with fresh ans salt water. It forms pure thickets or grows together with the species having similar ecological requirements. Along rivers it is often accompanied by *Myricaria germanica* (L.) Desv., *Salix blakii* Goerz and *Hippophaë rhamnoides* L. In desert it is usually met in depressions, hollows or in small wadis together with the species of *Calligonum*, *Haloxylon*, in steppe areas most often with such genera as *Artemisia*, *Zygophyllum* etc.

Altitudinal range of *T. arceuthoides* is also very extensive. In Iraq it has been noted between 100–850 m, in Iran it occurs from sea level to 1900 m, in Afghanistan from 500–2500 m, in Tadshikistan between (900)1200–3000 m.

References: 218 (3), 228 (4), 362, 518 (3), 612, 613, 649, 694, 739, 740, 743.

42. *Tamarix dioica* Roxb. ex Roth

This is a shrub or small tree to 3 m high, very characteristic owing to vaginate leaves combined with deep pink or purple, dioecious flowers congested in very dense racemes.

The range of *T. dioica* is confined to southern foot of Himalaya. It extends from Burma and Bangladesh, through Nepal, northern India to northern Pakistan. Beyond this area there is some concentration of localities in southern Pakistan and southwestern Iran.

The species is a typical plant of alluvial places. It grows usually gregariously on pebbly or sandy grounds along streams and rivers forming more or less extensive thickets or grooves. It can also be found by channels or in wayside ditches. In Afghanistan it grows between 300–1250 m, in Iran from sea level to 1500 m, in Pakistan to 1350 (1800) m.

The branches of *T. dioica* are used for making baskets, in treeless region for fuel and for making primitive fences. It is also planted as ornamental.

References: 578, 612, 613.

43. *Tamarix hampeana* Boiss. & Heldr.

A spreading shrub or tree to 7 m high. Leaves scaly with narrow base. Inflorescence racemose 8–10 mm broad on the year-old branches and often on current year's twigs. Bracts erect, often shorter than pedicels. Petals 4–5(6). Stamens 4–10 or more, inserted at the top of disc lobes and also between them.

An eastern Mediterranean species occurring mainly in Greece and along southwestern shores of Anatolia. Beyond these countries it has its single localities on Cyprus and in Israel.

Tamarix hampeana grows mainly along seashores, on sandy dunes, around lagunes, at the river estuaries, where it sometimes forms pure communities. Further inland it goes very rarely and usually along the bigger rivers as in European Turkey. It is a lowland species noted from sea level to 100 (150) m. Locally it is planted as ornamental, being propagated vegetatively by means of wooden pieces of branches.

References: 64 (2), 151 (1), 362, 679.

44. *Tamarix hispida* Willd.

An erect shrub or small tres 1–5 m high, usually densely hairy on all parts. Leaves scaly, auriculate at base. Flowers pentamerous, pink, in long racemes compound in rich panicles. Disc lobes confluent with the base of filaments.

An Irano-Turanian species confined mainly to central Asia, where its range covers the large area between the eastern shores of Caspian Sea and western Mongolia. In southwestern Asia *T. hispida* is rather rare species known only from a few scattered and strongly isolated localities in Iran and Afghanistan. The information on its occurrence in Pakistan concern *T. karelinii* Bunge, which is sometimes treated as a glabrous variant of *T. hispida*. The realation of both taxa needs further studies.

Tamarix hispida grows mainly in desert regions, almost exclusively on more or less salty grounds, along salty streams and rivers, in saline depressions, on solonchaks on sandy or clayey soils. In central Asia it occurs from sea level to 500 m, in Iran it has been noted up to 1600 m (Fars province).

References: 218 (3), 362, 612, 613, 694, 740, 743.

45. *Tamarix kotschyi* Bunge

An erect shrub 1–3 m high. Leaves amplexicaule. Inflorescence racemose on previous year's branches. Flowers tetramerous with stamens inserted at the top of disc lobes.

The range of *T. kotschyi* is almost entirely limited to southwestern Asia. The species occurs from southern Caucasus and northwestern Iran in the west to eastern Afghanistan and central Pakistan (Quetta) in the east. In the north it crosses hardly Lat. 40°, while in the south it reaches 27°N in Iran.

Tamarix kotschyi grows mainly along streams and rivers, not infrequently in river beds and withstands the high concenration of salt both in soil and water. It grows in thickets with other shrubs or forms pure riveraine grooves. Altitudinally it occurs most often between 700–1500 m but sometimes it goes down to 300 m. Its highest localities are known from Bam province in Iran at 2250 m.

References: 103 (7), 228 (4), 362, 518 (3) 612, 613, 694, 740, 743.

46. *Tamarix mascatensis* Bunge

An erect shrub or very small small tree 2–3 m high. Leaves scaly, auriculate at base. Racemes 3–4 mm broad arising from the year-old branches. Flowers pentamerous with stamens inserted at the top of the disc lobes.

This is a rare species known till now from scattered localities in southeastern regions of Arabian Peninsula (Oman, Yemen, Sokotra) and northaestern Africa (Somalia and Ethiopia). The species grows in saline places, in

sandy wadi beds, in muddy, wet salt depressions in saline valleys etc. It has been noted between 900 and 1900 m. The altitudnal maximum has been reported from Kerman province in Iran.

References: 362, 518 (3), 578, 612, 613, 743.

47. *Tamarix passerinoides* Delile ex Desv. s.l.

Syn.: ***T. aucheri*** **(Decne) Baum,** ***T. macrocarpa*** **(Ehrenb.) Bunge,** ***T. pycnocarpa*** **DC.**

This is a halfevergreen shrub or small bushy tree 2–3 m high with fleshy, amplexicaule leaves. Inflorescence racemose appearing on the year-old branchlets. Flowers relatively large with 5 petals and 6–14 stamens.

A very characteristic but extremally variable taxon especially in the number of stamens, their insertion and the type of indumentum. Several small species have been recognized within it, there is, however, much disagreement in literature about their value and geographical distribution. The proposed divisions seem to be rather theoretical and are deceptive in practice.

An extensive range of *T. passerinoides* streatches from eastern Morocco through Lybia, Egypt, the Near East, northern regions of Arabian Peninsula, Iran, southwestern Turkmenistan, Afghanistan to central and southern Pakistan. Except for Iraq, where the species is very common, localities of *T. passerinoides* are rather scattered, but in some regions it is probably undercollected.

Tamarix passerinoides belongs to the plants which are most resitant to the high salinity of soil. It occurs both inland and along seashores, on desert or semidesert in coastal salt marshes, along salty streams, in brook beds, on banks of salt lakes, in humid river estuaries near the sea, by drainage channels, around saline depressions etc. It grows often gregariously forming pure thickets or with other hydrohalophytes as *Zygophyllum album* L. f., *Nitraria retusa* (Forssk.) Asch., *Arthrocnemum macrostachyum* (Moric.) Moris and *Halocnemum strobilaceum* (Pall.) M. Bieb. or in drier habitats with *Haloxylon persicum* Bunge ex Boiss. & Buhse.

This is a lowland species growing from sea level to 200–300 m, only in Afghanistan it has been noted at 500 m. Young branches are used locally as a camel fodder.

References: 218 (3), 228 (4), 362, 518 (3), 578, 612, 613, 649, 686, 694, 740, 743.

48. *Tamarix ramosissima* Bunge s.l.

Syn.: ***T. smyrnensis*** **Bunge**

A spreading shrub or rarely small shrubby tree to 3 m high. Leaves scaly with narrow base. Inflorescence racemose appearing on current year's twigs or rarely also on previous year's branches. Flowers small, pentamerous. Stamens inserted between the disc lobes. Petals persistent after anthesis.

This is a very variable species, especially in the shape of petals and size of inflorescences. Plants with ovate and keeled petals, dominating in the western part of the species range, are often recognized as *T. smyrnensis*, but these characters vary significantly and are not correlated with other features.

Tamarix ramosissima has an extensive geographical range streatching from southeastern Europe in the west, through southwestern and Middle-Asia to eastern China and Korea in the east. Its northermost localities it has in northern Kazakhstan approximately at Lat. 52°, while in the south it has been noted at Lat. 26°, at the frontier between Iran and Pakistan.

It is the commonest tamarisk of central and southwestern Asia characterized by a wide ecological scale. It grows often gregariously on sandy dunes along seashores, around coastal lagunes, on marshy grounds around lakes, on alluvial places along streams and rivers, also by cannals and in wayside ditches. In drier parts of Iran and

Middle-Asia it can be observed on salty grounds in semidesert regions. It forms there pure thickets or grows together with other tamarisks or with such genera as *Halimodendron*, *Salsola*, *Lycium*, *Calligonum*, *Artemisia* etc. In Turkey it occurs from sea level to 2500 m (Bolkar Daglari), in Iran and Afghanistan to 2600 m, in Pakistan to 3000 m (Baluchistan).

References: 64 (2), 103 (7), 218 (3), 228 (4), 362, 612, 613, 649, 679, 694, 740, 743.

49. *Tamarix tetragyna* Ehrenb.

Syn.: ***T. brachystachys* Bunge, *T. meyeri* Boiss.**

A spreading shrub or tree up to 5–15 m high, similar to *T. hampeana* Boiss. & Heldr. from which it differs by tetramerous flowers and white, very long, often reflexed bracts.

Tamarix tetragyna has a wide but very fragmented range extending from Lybia through Egipt Cyprus, southern Turkey, where it has been recently discovered, to Pakistan and Tadshikistan. In the north, along the coasts of Caspian Sea, it enters Europe in the delta of Volga river.As majority of tamarisks, *T. teragyna* is confined to wet places, both with fresh and salt water. It grows along seashores, around coastal lagunes and brackish lakes, on marshes, on sandy dunes, but also along freshwater rivers and streams. It produces very easy adventitious roots, then it is able to withstands long-lasting inundations as well as the burying by sand. The species is especially common in the Near East, where it forms pure extensive communities or grows with other halophytic plants. A number of plant associations have been described in which *T. tetragyna* is one of the leading species e.g. *Tamarix tetragyna-Nitraria retusa*, *Tamarix tetragyna-Sueda monoica*, *Tamarix teragyna-Arthrocnemum macrostachyum*, *Populus euphratica-Tamarix tetragyna* etc. *T. tetragyna* is generally a lowland species occurring from sea level to 500 m, only in Afghanistan and Tadshikistan it grows a little higher, between 500–900 m.

References: 103 (7), 151 (1), 218 (3), 228 (4), 258, 362, 612, 613, 694, 740, 743.

50. *Tamarix tetrandra* Pall. s.l.

Syn.: ***T. parviflora* DC.**

An erect or spreading shrub to 3–4 m high. Twigs dark reddish-brown or black. Leaves scaly with narrow base. Inflorescence racemose arising from year-old branchlets. Flowers tetramerous. Disc lobes confluent with the base of filaments.

A very variable species in colour of stems, size of flowers etc. Plants with reddish twigs are usually separated as *T. parviflora* DC., there is, however, no sufficient correlation between the above character and other features.

Tamarix tetrandra belongs to the commonest tamarisks of southwestern Asia. Its compact range covers southeastern Europe, Anatolia, Cyprus, Lebanon, Crimea and southwestern coastal region of Caucasus. It grows in number of habitats, in saline places just near the saeshore, around coastal lagunes, on coastal cliffs as well inland along freshwater rivers and streams, also in fallow fields, at edges of orchards or in wayside ditches. It occurs usually in open insolated places but it has been also observed in loose, open woods e.g. with *Pinus brutia* Ten. and *Cupresssus sempervirens* L. In Greece and on Cyprus it grows from sea level to 500 m, in Turkey it attains the altitude of 1500 m (Aydos Dagi in Konya province).

The species is often planted as ornamental.

References: 64 (2), 103 (7), 218 (3), 362, 612, 613, 694.