

## **Flora and Vegetation of Afghanistan**

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### **Abstract**

Afghanistan is a very mountainous country. It offers a big variety of ecological conditions, this means a big variety of vegetation types is covering land surface. These vegetation types are exhibiting a high biodiversity, since the floristic influence from various neighbour regions is a considerable factor in floristic and vegetation pattern. Afghanistan lies at the “crossroad” of several biogeographical regions. Afghanistan is a very dry country with scarce rainfalls but again very varying between north and south, west and east, lowlands and mountains. The eastern parts receive partly monsoonal rains in summer, which are the basis for the occurrence of various forest types, which, however, are strongly degraded or deforested nowadays. Herewith an overview is given on the main floristic features of the country as well as on the vegetation types by means of the map of the Potential Natural Vegetation (PNV), including the ecological conditions and the recent history of studies.

**Keywords:** Large-scale vegetation mapping, environmental factors, Potential Natural Vegetation

### **Zusammenfassung**

Afghanistan ist ein sehr gebirgiges Land. Es umfasst eine große Vielfalt an Landschafts- und Vegetationstypen mit sehr unterschiedlichen ökologischen Bedingungen. Dementsprechend gibt es eine vielfältige Vegetationsausprägung mit sehr hoher Biodiversität. Dies ist auch dadurch bedingt, dass Afghanistan im Schnittpunkt mehrerer biogeographischer Zonen liegt. Afghanistan ist ein Land, das größtenteils arid ist mit niedrigen Niederschlagswerten, aber wiederum gibt es große Unterschiede zwischen Nord und Süd, West und Ost, Tiefländern and Gebirgen. Der Osten steht im Sommer teilweise unter Monsuneinfluss, was dazu führt, dass dort verschiedene Waldtypen vorkommen, die allerdings heutzutage weitgehend degradiert oder abgeholzt sind. Es wird ein Überblick gegeben über die wesentlichen floristischen

Bedingungen und die wichtigsten Vegetationstypen, ihre Ökologie und Erforschungsgeschichte, einschließlich einer Karte der Potentiellen Natürlichen Vegetation (PNV).

**Schlüsselbegriffe:** Großräumige Vegetationskartierung, Umweltfaktoren, Potentiell-Natürliche Vegetation

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### **Flora of Afghanistan**

The climatic conditions of Afghanistan are characterized by a strong continentality. Afghanistan is a very dry country with scarce rainfalls (Flohn 1969), mostly concentrated during winter; the summers can be dry for more than 6 or 8 months (Volk 1954, Breckle 1983). For the characterization of the ecological conditions the ecological climate diagrams are useful (Miehe et al. 2001). Figure 1 gives a few examples from various parts of Afghanistan. Only the southeastern slopes of the Hindu Kush receive episodically summer rains by monsoonal activity (Weiers 1995, 1998). The mountains receive rather good winter- and spring rains. The northern and southern deserts are very continental with scarce winter rains.

By far the most comprehensive source for the Afghanistan flora is Rechinger's "Flora Iranica", which started in 1963 (Rechinger 1963ff., Breckle and Frey 1976c) and is now almost completed with about 180 deliveries of the various plant families. Additionally many other short research papers on the

flora and vegetation of various parts have been published, e.g. on the Afghan Wakhan (Podlech and Anders 1977). Floristic lists from several expeditions are also available, e.g. Kitamura (1960). Afghanistan is certainly a country which flora and vegetation has been studied quite in detail (Breckle et al. 1969a, 1975, Breckle 1981, 1999), however, mainly before the critical times of the Soviet imperialism and destruction and the subsequent civil wars.

Though Afghanistan is a rather dry country with a high percentage of deserts and semi deserts, the number of vascular plant species is distinctly higher than in the climatically more humid Germany (Heywood and Watson 1995). Groombridge (1992) gives an estimate of 3500 species of vascular plants and 30-35% of endemics, as well as about 5-10% of species, which might be added by future new discoveries. Our estimate is about 5000 species and about 25-30% of endemics.

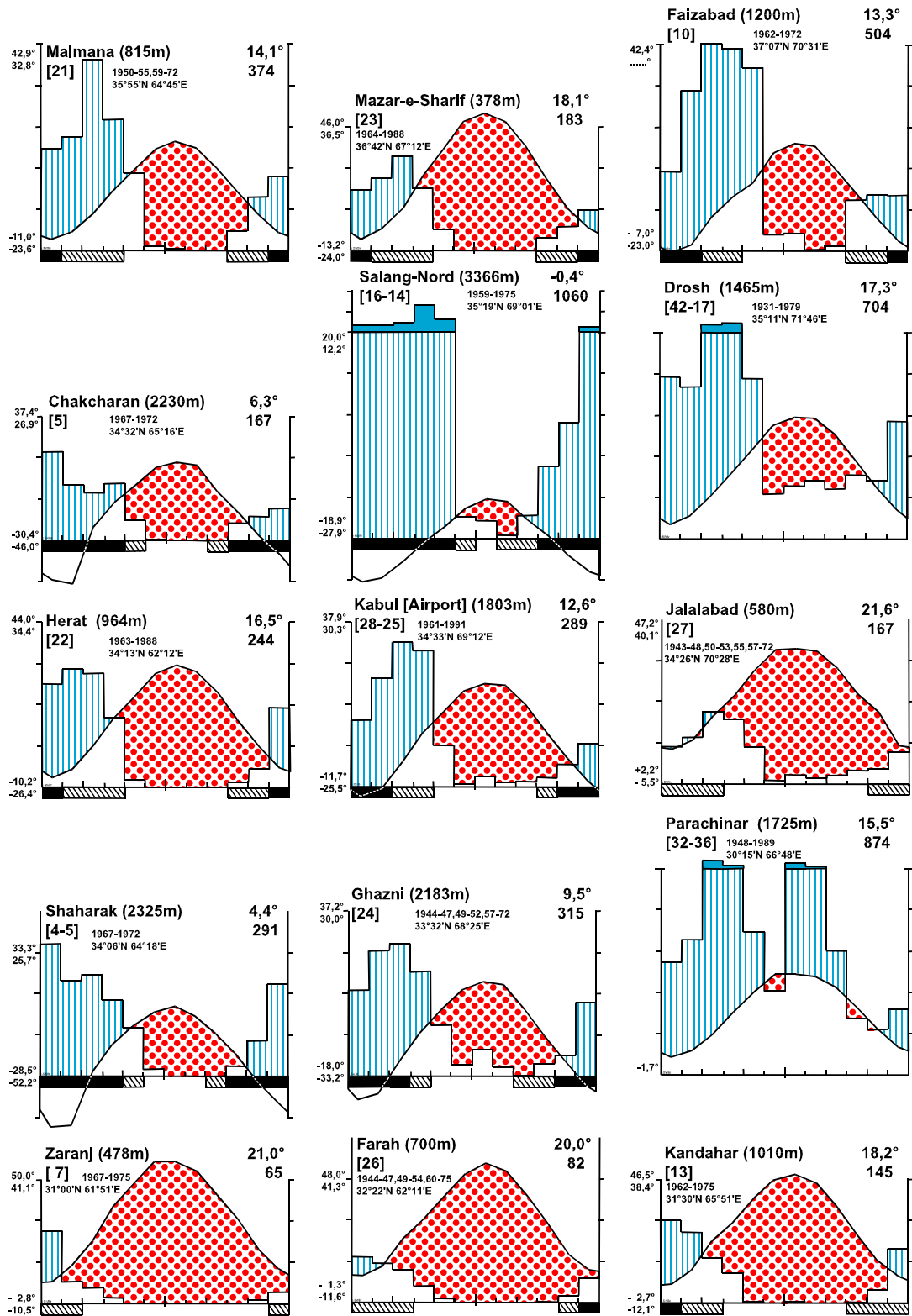


Fig. 1: Ecological climatic diagrams from some typical afghan localities. Arranged roughly according to geographical positions.

The chorological types include species with circumboreal, with holarctic, with central Asian, with himalayan, with irano-turanian, with sahara-sindian, with sudanian, with deccanic floristic relations, but then also those, which are more restricted to specific regions, as e.g. Pamir, Wakhan, Central Afghan mountains, Western, central and/or Eastern Hindu Kush (Breckle 2004). Endemism is a character to be restricted to a distinct geographical unit, not to a state. This makes it difficult to judge, since many floras are written to describe the occurrence of species within political borders, which normally makes not much sense.

Precipitation and altitude are conditioning factors resulting in the diversity of the country's flora. A limited area in the east and southeast receives the impact of the Indian monsoons and belongs to the sub-tropical zone. Altitude, throughout all zones, may allow for the development of different strata of vegetation. Thus, diverse ecological conditions, ranging from barren deserts to lush sub-tropical regions to high alpine and nival regions, have favoured the establishment of a complex and varied flora. Common physiognomic features of the plants of the region are grey or white hairs, grey bark that is particularly thick at the base, reduction of leaf area and cushion growth that protects the plants against the strong insolation, dry wind and sand-drift that threaten to dry them out. Plants are often characterized by spiny stems and

leaves or glands containing etheric (essential) oils or poisonous secondary compounds or other elements that render them unpalatable to the animals that for centuries have exerted heavy impact on the flora.

In order of numerical importance the following major families are found in Afghanistan. More than 500 species are known from the Asteraceae (Compositae) plant family, including about 100 species of *Artemisia*. The second biggest genus in the area is *Cousinia* after *Astragalus*. Within the Flora Iranica Rechinger (1972) mentions 355 species of *Cousinia*, describing not less than 61 as new species. From Afghanistan there are reported 144 species of *Cousinia*, 93 of them endemic to Afghanistan. From adjacent countries: 198 species from Iran, 40 from Turcomania, 31 from adjacent Pakistan, 21 from Iraq.

The family Fabaceae (Leguminosae) is attested with some 400 - 500 species of which the genus *Astragalus* is by far the most numerous. Many papers are dealing with the complex systematics of this group (as e.g. Podlech 1988), which has an evolutionary center here. Some sections of *Astragalus* form the typical thorny cushions. But this tragacanthoid shape is also found in several other genera, as e.g. *Onobrychis*, *Cicer*, *Acantholimon*, *Acanthophyllum*, *Cousinia*, *Lactuca*, *Euphorbia*, but also in Rubiaceae, in *Gaillonia*. With the publication of the Rubiaceae, the treatment

of Flora Iranica is almost complete (Ehrendorfer 2005).

In the Brassicaceae (Cruciferae) family about 250 species are found, especially *Brassica*, which includes cabbage, mustard and radish (Hedge and Rechinger 1968). In the whole Flora Iranica area it is 126 genera. There are more than 150 species of the Poaceae (Gramineae) family including such important cultivated plants as wheat, rice, barley, maize and sugar cane (Bor 1970). Other grasses include the genera *Agropyron* (wheatgrass), *Poa* (bluegrass), *Arundo* (grainreed), *Cymbopogon* (lemon grass) and *Andropogon* (bluestem). In the steppes many *Festuca*, *Bromus*, *Stipa* spp. occur as well.

More than 180 species from Afghanistan are recorded from the Lamiaceae (Labiatae) family, including *Phlomis* (Jerusalem sage), *Thymus* (thyme), *Mentha* (mint), *Nepeta* (cat mint), *Origanum* and *Eremostachys* (Rechinger et al. 1982, Hedge et al. 1987).

The family Apiaceae (Umbelliferae) is represented by more than 100 species; most notable of which is *Ferula assafoetida*, an item of export and other giant hapaxanthic umbellifers from *Ferula* or *Dorema*. There are many other drugs derived from naturally occurring species in the area (Breckle 1979, 1982, Breckle and Unger 1977). About 140 genera of Umbelliferae are distinguished in the Flora Iranica area (Hedge et al. 1987).

Chenopodiaceae halophytes are common (Breckle 2000, 2002), especially *Salsola*,

*Suaeda*, *Arthrophytum*, *Halostachys* and *Halocharis*. But many other genera adapted to partly very adverse soil conditions, occur in the Flora Iranica area, in total 44 genera (Hedge et al. 1997), even some endemics like *Halarchon vesiculosum* (Photo 5). On the other side the orchids (Orchidaceae), which are common in the Mediterranean and in the Himalaya spread only with few species to the area. From Afghanistan only 13 species by Renz (1978) are recorded (Iran: 48, Talysch: 28, Iraq 21, Flora Iranica total: 63).

In Iridaceae, there are recorded 35 species in Afghanistan and the same number from Iran, 18 from Iraq, 10 from Turcomania, a total of 65 from the whole Flora Iranica region. A very typical genus of the drier mountain areas is *Eremurus* (steppe-lilies), where 23 species are known from the Flora Iranica area, 19 of those from Afghanistan and only 7 from Iran. The wild *Tulipa* (tulips) comprise 34 species in the Flora Iranica area, 17 in Afghanistan, 18 in Iran.

### **Vegetation of Afghanistan**

Vegetation all over Afghanistan has been severely influenced by man and only a few high mountain and very dry desert areas retain a quasi-natural vegetation cover. Desertification is a long known problem in most countries of the dry Middle East and Central Asia (Rathjens 1986).

In most parts the vegetation depends on the winter rain, in the south winter rains are

often irregular. Rainfall increases to the north and east resulting in better vegetation conditions in these parts. The eastern parts receive additionally some monsoon rains in summer (Rathjens 1972, 1974).

Vegetation types have been studied in detail by Freitag (1971a,b, 1972, 1986). His survey is still the most complete of the area, especially also for the eastern, monsoonal influenced more humid parts with Himalayan forest types. Nedjalkov (1983a) gives a similar classification of vegetation types with naming associations, also especially for the forest region around Kunar Province in E Afghanistan (Nedjalkov 1983b). Main plant communities are characterized by often abundant species, but rather few dominant ones, within the various parts of Afghanistan (Gilli 1969, 1971). Mountain vegetation and the flora of the Central Hindu Kush was studied by Frey and Probst (1978) and Pavlov and Gubanov (1983) and many others (Breckle et al. 1969, 1975).

The altitudinal belts in the various mountains, mainly in the Hindu Kush are characterized by a typical biogeographical pattern, too. The lower belts have rather many saharo-sindian plant species in common, the mountain belts are predominantly iranoturanian with many endemics, and of course, the forest vegetation on the southeastern slopes of the mountains in Eastern Afghanistan, here many Himalayan floristic elements can be found. The alpine belt is rich in species with a rather wide

distribution area, partly euro-sibirian or even boreal and arctic (Breckle 1974, 1988).

The main vegetation types, which are shown on the map, Figure 2 (Potential Natural Vegetation of Afghanistan, modified from Freitag 1971a) are:

*Calligonum-Aristida*-Sanddesert (1a)

*Haloxylon salicornicum*-Desert (1b)

Other Deserts (rich in *Chenopod.*) (1c)

Ephemeral Desert (1d)

Dwarf *Amygdalus*-Semidesert (2)

Subtropical dry Scrub and Savannah (3)

*Pistacia vera*-Woodlands (4a)

*Pistacia atlantica*-Woodlands (4b)

*Juniperus*-Woodlands (5a)

*Amygdalus*-Woodlands (5b)

Sclerophyllous Oak Forests (6)

Conifer Forests (7)

*Rhododendron*-Krummholz (8)

Thorny Cushions, subalpine and alpine semi deserts and meadows (9)

Nival belt, glaciers (10)

Azonal vegetation: riverine vegetation (11a)

Azonal vegetation: swamps, salt swamps, lakes (11b)

These vegetation types indicated on the map (Figure 2) represent the "Potential Natural Vegetation" (PNV), which would be the vegetation cover without human activities. It gives an idea on the natural potential and resources of the various regions. Today, by long-lasting exploitation, grazing, agriculture and irrigation, deforestation, many of these original vegetation types are

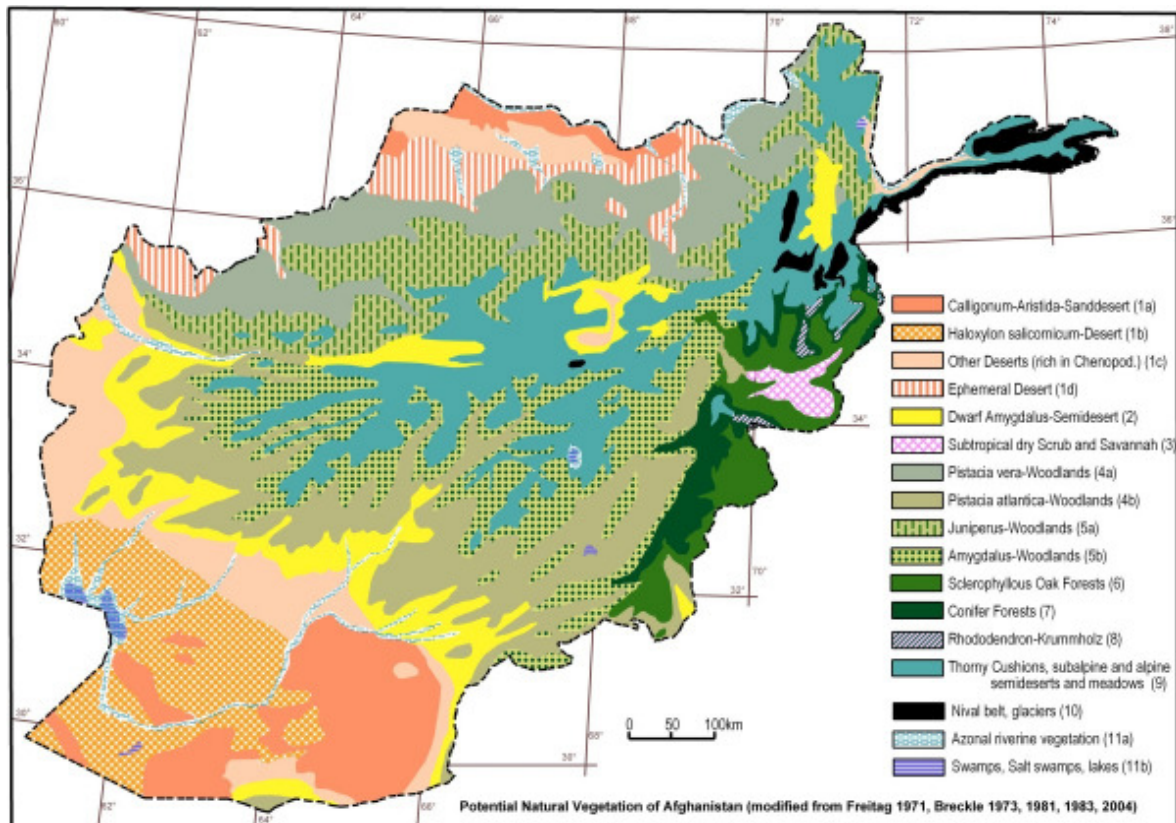


Fig. 2: Map of the Potential Natural Vegetation (PNV) of Afghanistan (source: <http://www.ag-afghanistan.de>)

only left on few spots, remote places, and are replaced by substituted associations poorer in shape, diversity and productivity, as well as also the soils are often degraded, eroded or totally destroyed.

This means: many regions exhibit typical signs of a long-lasting desertification-process caused by improper human activities (Rathjens 1986). Partly, the PNV can be derived also from comparisons with the vegetation around the holy graves (ecology of ziarats, Burnes 1842, Freitag 1971a, Kull and Breckle 1972, Breckle 1983, Walter and Breckle 1994), which gives an impression what could be the potential vegetation in a

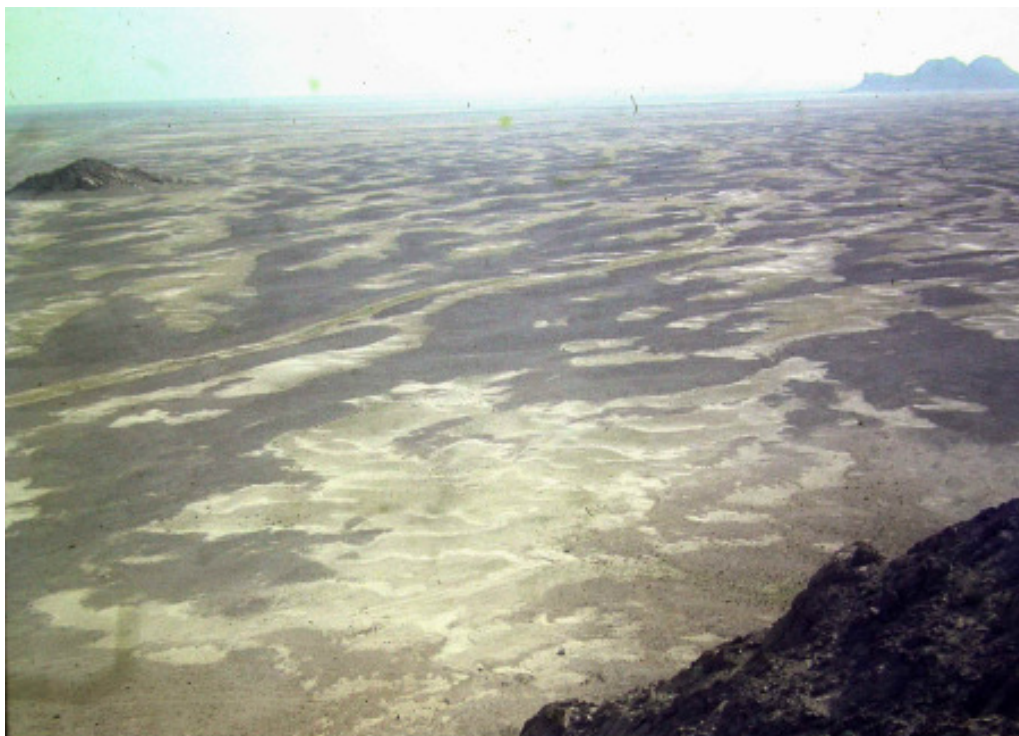
distinct area. From historical sources it is known that e.g. around the mountain-basin of Kabul and in many parts of the Koh-e-Daman plain (Masson 1842) on most hills and slopes a cover of *Cercis griffithii* was present probably until the end of eighteenth century (Talbot 1909, Freitag 1971a). From the remnants of *Quercus baloot* trees (see below) it also can be deduced that this rather drought resistant evergreen oak had open stands almost until the whole eastern part of the Koh-e-Daman plain and the southern Salang Pass region (Breckle and Kull 1971).

In the following the main vegetation types, indicated on the map, are characterized.

### **Desert Vegetation (1)**

The deserts of the north, west and south, in Registan and Dashte Margo contain active sand dune areas and dunes fixed by a rather open vegetation (1a, Photo 1). The flora here is scarcely modified by man. The main plants are *Haloxylon persicum*, *Calligonum* spp. and perennial *Aristida* spp. In lower lying saline areas, Chenopodiaceae are dominant (1c, 11b) and in the salt plains of Seistan the vegetation (1b) is characterized

by *Haloxylon salicornicum*, *Salsola* spp., *Ephedra scoparia* and *Tamarix* spp. In some parts the ephemeral vegetation (1d, Photo 2) is very characteristic, in summer these areas look totally dry and dead (Photos 3 - 9). In slightly saline flats in the north the black saxaul *Haloxylon aphyllum* can form open woodlands, but has been heavily used, strong saline plains are colonized by *Halocnemum strobilaceum*; see also paragraph azonal vegetation below. An overview on the Irano-Afghan deserts is given by Breckle (1983).



**Photo 1:** View from top of an Inselberg on the desert mosaic, near Farah, SW-Afghanistan (type 1 on map, Fig. 2)





**Photo 2:** Ephemeral desert vegetation with *Carex physodes* on sandy soils, 350 m asl (type 1d on map, Fig. 2)



**Photo 3:** *Calligonum-Aristida* sandy desert with various psammophytes, near Andkhoi, N-Afghanistan, 350m asl (type 1a on map, Fig. 2)



**Photo 4:** Mobile barchans, moving across the stone pavement desert, Dasht-e-Margo, 700m asl, south of Farah (type 1 on map, Fig. 2)



**Photo 5:** *Halarchon vesiculosum*, a south-Afghan endemic halophytic Chenopodiaceae, south of Kandahar, 1000m asl (type 1c on map, Fig. 2)



**Photo 6:** Dry steppe vegetation on loessic hills with many geophytic species in North Afghanistan, near Khanabad, 500m asl (type 1d on map, Fig. 2)



**Photo 7:** High mountain semi-desert with chenopodiaceous subshrubs, near Bamiyan, 2800m asl (type 1c on map, Fig. 2)

### Steppe and Semidesert Vegetation (2)

The steppes in Afghanistan are scarce in typical steppe grasses; they often should be named semi-deserts, since many sub-shrubs and ephemeral plants (annuals, geophytes) are common. The annuals complete their life cycle often within only a few weeks (Breckle 1971a, Breckle and Kull 1973, Kull and Breckle 1975). Anyhow, these regions are the most important grazing areas where large number of nomads graze their livestock on a seasonal basis (lowlands in winter, mountains in summer (see Jentsch 1973), apparently since centuries (Trinkler 1925), and in an adaptive way to be more nomadic in good years and more sedentary in bad years (Glatzer 1981).

The low lying steppes and semi deserts in the west and south are dominated by an open vegetation of *Artemisia herba-alba* (Photo 8) and other species of this genus, *Zygo-phyllosum* spp., other dwarf shrubs are spiny *Amygdalus*, partly *Acantholimon* spp., *Acanthophyllum* spp., *Atriplex* spp., *Alhagi camelorum*, and *Cousinia* spp., the graminoids are often reduced by heavy grazing. *Poa*, *Agropyrum*, *Stipa*, *Festuca*, *Carex* and others are more common only on remote or inaccessible areas. But also invertebrates, like *Hemilepistes* or ants (e.g. *Cataglyphis bicolor*) can heavily influence vegetation structure (Breckle 1971d). An *Amygdalis brahuica* community is found between 1000 and 2000 m altitude also in the dry valleys



**Photo 8:** *Artemisia herba-alba* semidesert (type 2 on map Fig. 2), subshrubs used for fuel and cooking, in W-Afghanistan, near Shindand, 900m asl

of the east.

Along dry riverbeds there are thorny belts of *Stocksia brahuica*, *Amygdalus communis* and *Convolvulus spinosus*. The floral composition is very variable and depends on humidity, length of winter, sand composition, wind force and grazing pressure. More humid azonal places have denser vegetation with a richer species composition (11a). In areas west of Herat with cold winters and in some parts in the north, *Artemisia* spp. and *Ferula* spp. dominate (in some places *F. assa-foetida* is found as an old used drug, which Moorcroft and Trebeck in 1841 already had mentioned from the travels of Moorcroft in 1819-1825 from the N Hindu Kush). These steppes and semi deserts are all along rich in geophytes like *Iris songarica*, *Tulipa*, *Iris* and *Allium* spp.

The northern loess zone supports a grass steppe dominated by *Poa bulbosa* or *Carex pachystylis* with *Bromus* spp., *Agropyron* spp., *Festuca* spp., etc. Poppy and herbaceous bulbs such as *Anemone*, *Gagea*, *Tulipa*, *Iris*, *Merendera* and *Muscari* are the first flowering plants in spring (Photo 6). Shrubs are completely absent (1d). In the spring the ground cover is 30-90%, but most of the plants die back from lack of water in the summer.

In the higher mountains there are other areas of semi desert. Around Bamiyan they are dominated by *Salsola* spp. (Photo 5). High-level steppes benefit from a higher precipitation as well as lower evaporation. Over-

grazing generally favours the less palatable *Artemisia* shrubs and annuals at the cost of the palatable perennials. In dry years when the annuals do not germinate, heavy mortality of domestic animals takes place.

### **Arid Sub-tropical Woodlands and Savannah (3)**

Perennial grasses and thorny evergreen shrubs and small trees predominate in the lower Kabul valley which experiences hot summers with few occasional monsoon rains and moderate winters. Heavy grazing and fuel wood collection have reduced the shrubs and led to an increase of annuals. A *Zizyphus nummularia* community occupies the lower regions up to 750 m. This is replaced at higher levels with a *Salvia-Pistacia* community. In the dry valley *Acacia modesta* penetrates the vegetation, it resembles already a subtropical savannah with a few C4-grasses (*Aristida*, *Panicum*). In Pakhtia also the dwarf palm *Nanorrhops ritchieana* occurs (Photo 9), which leaves are heavily used for furniture and wattlework. Between 700 and 1300 m there is sometimes a *Reptonia buxifolia* and *Olea ferruginea* woodland or savannah (Photo 10) which is heavily utilized for fodder and as pastureland. In the lower Kabul valley between Jalalabad and the Khyber Pass the subtropical semi desert often exhibits *Calotropis procera* shrubs (Photo 11), which extend from the Indus lowlands.



**Photo 9:** *Nanorrhops ritchieana* from the subtropical open woodlands in Paktya, 600m asl, near Khost (type 3 on map, Fig. 2)



**Photo 10:** *Acacia modesta* from the dry subtropical savannah in Paktya, 600m asl, near Khost (type 3 on map, Fig. 2)



**Photo 11:** Subtropical semidesert with *Calotropis procera*, between Jalalabad and Khyber-Pass, 700m asl, E-Afghanistan (type 3 on map, Fig. 2)

#### ***Pistacia* Woodlands (4)**

To the north of the Hindu Kush on the extensive loess plains between 600 and 1600 m woodlands of *Pistacia vera* (4a) with some *Amygdalis bucharica* and in the north-east as well as around Herat in the west remnants of *Cercis griffithii* have been characteristic (Photo 12 and 13).

On the lower slopes of the Hindu Kush open *Pistacia* woodlands replace the *Amygdalus* community in higher parts in the south, resp. the *Juniperus* woodlands in the north. The southern slopes of the Hindu Kush are char-

acterized by 4-6 m high *Pistacia atlantica* (*cabulica*, *khinjuk*) (4b) (Photo 14) and are rich in geophytic herbs like *Gagea*, *Anemone* (Breckle and Rasoul 1969) and *Allium* and *Eremurus* spp. (Photo 15). On valley slopes *Pistacia khinjuk* and *Cercis griffithii* are sometimes found, especially in the Kabul and Logar Valleys. In the last century *Cercis* woodlands were much more common all around Kabul, also around Herat (see above). Many other wild fruit trees are known from those areas, some are the ancestors of cultivated trees, as it was already known by Elphinstone (1815).



**Photo 12:** *Pistacia vera* woodland in North Afghanistan, near Khulm, 800m asl, (type 4a on map, Fig. 2)



**Photo 13:** *Cercis griffithii* open woodland north of Kabul, Koh-e-Daman plain near Charikar 1700m asl, (type 4b on map, Fig. 2)





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**Photo 14:** *Pistacia atlantica* ssp. *cabulica* trees on hills south of Kabul, Logar-Valley 2200m asl, Ziarat-remnants (type 4b on map, Fig. 2)



**Photo 15:** *Eremurus stenophyllus* steppe, east of Kabul; 2000m asl, (type 4b on map, Fig. 2)

The *Pistacia vera* and *Juniperus excelsa* woodlands are heavily exploited for charcoal production, but also used for honey-production by bee-keepers, which move from site to site (Breckle and Breckle 1977).

#### ***Amygdalus* and *Juniperus* Scrublands (5)**

The upper part of the forest belt on the northern slopes of the Hindu Kush is formed by an open mixed woodland (Photo 16) dominated by *Juniperus excelsa*, intermixed with other *Juniperus* species (5a).

many scrub species and geophytes such as *Eremurus*, *Corydalis*, *Rheum*, *Gagea*, *Tulipa*, *Iris*, *Allium* spp. also occur in both types (Photo 17). *Amygdalus* scrublands are often intermixed with the *Pistacia* woodlands, and can be intermediate between the semi deserts of the south and west and the woodlands of the Hindu Kush. These areas are important for winter pasture. These woodlands are heavily used and badly degraded.



**Photo 16:** *Juniperus* woodland on the Northern slopes of Hindu Kush, Salang Pass, 2400m asl (type 5a on map, Fig. 2)

On the same elevation between 2000 and 3000 m and in areas with more than 400 mm of precipitation in the south a 2.5-6 m high *Amygdalus* community (5b) is dominant;



**Photo 17:** Mountain semidesert with many geophytes, e.g. *Tulipa linifolia*, near Unai-Pass, 3000m asl (type 5b on map, Fig. 2)

### **Himalayan type Evergreen Forests in East Afghanistan (6)**

Between 1200 and 2200 m the oak *Quercus baloot* (6) dominates a forest which is up to 15 m high (Photo 18); it has a rich undergrowth and several tree species including almonds *Amygdalus kuramica* and *Pistacia khinjuk*. It is heavily utilized for fodder, fruits and fuel wood and large parts have been destroyed to provide fuel for the main cities. The remnants of *Qu. baloot* forest in the Panjshir valley, northeast of Kabul, forms the westernmost extension of the Himalayan forest belt. A few trees were even occurring near Top Dara in the Koh-e-Daman Plain near Charikar (Photo 19). Formerly

also at the Latahband pass (some 25km east of Kabul) there were *Qu. baloot* remnants (Photo 20). In very humid places with high summer rainfall in the higher mountain belts *Qu. baloot* is replaced by *Qu. dilatata* and between 2400 and 2900 m by *Qu. semecarpifolia*. Azonal associates in river valleys are *Juglans regia*, *Acer turkestanicum* and *Pyrus pashia*. Close to the tree line *Salix*, *Betula* and *Hippophaë* is replacing the former ones (Photo 25).

### **Temperate Coniferous Forests of East Afghanistan (7)**

The forest belt between 2200 and 2500 m in moderately humid parts is a 5-12 m high *Pinus gerardiana* woodland (Photo 21) with local stands of *Betula*. A thorny *Cotoneaster-Sophora-Rosa* scrubland colonizes the areas after the pine has been felled.

Between 2500 and 3100 m *Cedrus deodara* forest is found (Photo 22). Depending on soil and humidity the cedars may be up to 30 m high and form a very dense forest. Large parts of the *Cedrus* forest have been exploited since decades (Photo 23) and replaced by a stable *Artemisia* community. Logging has now reached even the western parts of Nuristan.

In the humid areas the upper belt of the forest, up to an altitude of 3300 m, is formed by a 20-25 m high *Picea smithiana-Abies webbiana* forest (Photo 24), varying from valley to valley (see also Schickhoff 2005).



**Photo 18:** *Quercus balout* forest in the Pech Valley, 1500m asl, Nuristan (type 6 on map, Fig. 2)



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**Photo 19:** *Quercus balout* remnant trees near Charikar (Ziarat place), 1800m asl (type 6 on map, Fig. 2)



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**Photo 20:** Small demolished trees of *Quercus balout* at Latahband Pass in winter-time, East of Kabul, 2100 m asl (type 6 on map, Fig. 2)



**Photo 21:** *Pinus gerardiana* woodland in Northern Nuristan, 1800m asl, Bashgal Valley (type 7 on map, Fig. 2)

In the dry areas a 10 m high *Juniperus seravschanica*-*J. semiglobosa* woodland is found. However, most areas have been cut for fuel wood and mature stands are rare. The herbaceous ground cover, especially along the streams is heavily grazed.

It is very interesting to note, that fossile conifer needles (similar to *Pinus roxbourgii*) and many other fossil leaves from a rather humid vegetation have been found in marl sediments at the Latahband Pass (Breckle 1967), probably being from about early Quaternary. This is indicating that monsoonal climate has reached much far to the west.



**Photo 22:** Well-developed *Cedrus deodara* forest at the southern slopes of Safed Koh, near Kotgai, 2500m asl (type 7 on map, Fig. 2)



**Photo 23:** Remnants of *Cedrus deodara* trees, east of Gardez, 2500m asl, at the western most limit (type 7 on map, Fig. 2)



**Photo 24:** Dense *Picea-Abies* forest, upper Laghman-valley, 2400m asl (type 7 on map, Fig. 2)



**Photo 25:** Riverine vegetation close to the treeline, with *Salix*, *Betula* and *Hippophae*, Bashgal-Valley 3000m asl, Nuristan (type 8, 10 on map, Fig. 2)

### **Krummholz (8)**

In areas of the east with monsoonal summer rains a dense 0.5-1 m high vegetation of *Juniperus squamata*, *Rosa* spp., *Ribes* spp. and *Rhododendron* spp. develops between 3000 and 3500 m, but only few sites are left (Photo 26).



**Photo 26:** *Rhododendron collettianum*-Krummholz on the upper south-facing slope of Safed Koh, 3200m asl (type 8 on map, Fig. 2)

On deep soils, *Salix* spp. may dominate this community, especially along creeks and rivers (Photo 25). On lower sites, at the tree line, the very rare *Rhododendron afghanicum* occurred (Photo 27), but is most probably extinct now (Breckle 1972). A few plants are kept in the Botanical Garden Göteborg from our expedition to the Safed Koh by Per Wendelbo and Ian Hedge in 1968 (Breckle 1972, Hedge and Wendelbo 1970).

In parts of the Hindu Kush, a *Juniperus nana* community with many thorny dwarf shrubs occurs. Between 3600 and 4000 m in the dryer central and northern Hindu Kush, there is a cushion scrubland with many dif-



**Photo 27:** *Rhododendron afghanicum*, one of the rarest plants in Afghanistan, today most probably extinct, at the upper forest line at south slopes of Safed Koh, 2900m asl (type 8 on map, Fig. 2)

ferent species of *Acantholimon*, *Artemisia*, *Astragalus*, *Cousinia*, *Ephedra* and *Onobrychis* (Photo 28). A similar thorny cushion shrubland, with very varying species composition changing from mountain ridge to mountain ridge is found in many of the Central Afghan high mountain areas (Paghman, Western Hindu Kush, Koh-e-Baba). Many endemics occur in this area (see type 9).



**Photo 28:** Thorny cushion shrubland above timberline, at Dasht-e-Nawor mountains with various *Astragalus* and *Acantholimon* cushions, 3500m asl (type 9 on map, Fig. 2)

Subalpine thorny cushions, semi deserts and deserts, alpine semi deserts and deserts and meadow vegetation (9)

This category is a mixture of several plant formations, which at the moment is difficult to differentiate on a land-wise map. Several steppe species are known to have a very wide amplitude of elevational occurrence in drylands (Walter 1975). There is no tree barrier between lowland steppes and high mountain steppes (Agakhanjanz and Breckle 1995).

On mountain ridges, above the tree line at about 3300 m subalpine and alpine shrubland, alpine heaths and meadows occur which have often a rather high cover percentage and thus offer a good range forage for domestic animals. The subalpine and alpine vegetation of the Hindu Kush on dry sites is open and poor in species, but each slope may have another species pattern. This belt is therefore typical for a high and endemic biodiversity. On wet sites (melting snow water etc.) a closed meadow canopy rich in species may occur (Photo 29 and 30). That of the Pamirs and Eastern Hindu Kush often is somehow denser with a great variety of herbs, caused by eventual additional summer precipitation (Photo 30). But still across many parts of the Karakorum and West-Himalaya various steppe vegetation types are found (Peer et al. 2007). Usually, the alpine meadows, dominated by grasses and a variety of herbs, are heavily utilized



during two months as summer pastures by nomads and the pastoral people (Photo 31).



**Photo 29:** Snow water fed alpine meadows along small watercourses at the Koh-e-Baba, Fuladi-Valley, 4000m asl (type 9, 11a on map, Fig. 2)



**Photo 30:** Snow water fed large meadow plains, grazing summer grounds for yak, 4500m asl, with huge bloc glaciers, (type 9 on map, Fig. 2), Wazit-Pass, Wakhan, E-Afghanistan

Studies on flora and ecology of vegetation have been performed by Breckle (1971b, e, 1973, 1974, 1975, 1988, 2002, 2004), Breckle and Frey (1974, 1976a, b). Additional data on the Wakhan and Pamir area are given in Agachanjanz (2002), Agachanjanz and Breckle (1995, 2002, 2004), Ahmadov et al. (2006), Breckle (2003),

Breckle and Wucherer (2006), Breckle et al. (1969b), Wennemann et al. (2002).



**Photo 31:** Nomad camp in summer, at Fuladi-valley, Koh-e-Baba, with heaps of thorny cushions for cooking and heating, 3800m asl (type 9 on map, Fig. 2)

### Nival Vegetation (10)

In the Pamirs and in Central and Eastern Hindu Kush, the lower boundary of the nival zone is 4900 m on the northern exposed slopes and 5300-5400 on the southern exposed slopes. The higher peaks and ridges are not dominated by alpine heaths (*Ericaceae*), as it is sometimes wrongly recorded, but by a low and very open, very frost resistant herbaceous and semifruticose vegetation. The high peaks of the Hindu Kush have been the frequent goal by mountaineers only after 1955 (Rathjens 1955), however, even later few data on nival flora and vegetation have been collected. The mountaineering exploration took place mainly in 1960-1980.

In the alpine belt, open rocks and scree are the most common sites. Vast stretches are almost devoid of vegetation, since rocks,

blocs and scree are covering large percentages of the mountain areas. On scree very isolated specially adapted plants can occur, like *Corydalis metallica* or *Didymophysa fedtschenkoana* (Photo 32).

There are even woody plant species growing above 5000m (Breckle 1974, 1988) on south-facing rocky slopes in the Hindu

*cuneata* is also known from about 5500m. Mosses and lichens occur even higher, up to the highest peaks on rocky surface. The decrease in number of species with increasing altitude for various mountains in Central Asia is shown by Breckle (1974) and by Norouzi et al. (2007), in general see Körner (1999). The snowline in the Western Hindu



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**Photo 32:** *Didymophysa fedtschenkoana*, on scree above Salang-Pass 4100m asl (type 9, 10 on map, Fig. 2)

Kush: *Juniperus semiglobosa* and *Lonicera microphylla* as well as ferns like *Cystopteris dickieana* (Photo 33) (Breckle 1987). There are 37 species recorded from above 5000m (Breckle 1974). The highest record of a vascular plant in Afghanistan is the beautiful *Primula macrophylla* (Photo 34) in the central Hindu Kush at 5600 m. *Sibbaldia*

Kush is about 4800-5100m asl, in the Central and Eastern Hindu Kush and in Wakhan about 5400m asl (see also Grötzbach and Rathjens 1969, Rathjens 1972); the eternal snow and cover of glaciers in summer is often by typical Penitentes formation from the high radiation (Photo 35).



**Photo 33:** *Cystopteris dickieana*, a very high climbing fern in the Hindu Kush between lichen-covered rocks, 5100m asl, (type 10 on map, Fig. 2)



**Photo 34:** *Primula macrophylla*, a nival plant species, from Mir Samir region 5100m asl (type 10 on map, Fig. 2)



**Photo 35:** Penitentes snow and ice of the nival zone (5300m asl) south of Mir Samir, C Hindu Kush (type 10 on map, Fig. 2)

#### **Azonal vegetation (11): Rivers, Lakes, Swamps**

These systems have been drastically altered by human activity. The original forests of major river valleys have been replaced by irrigated crops. Dense vegetation is found in regularly flooded areas. This is dominated by *Tamarix* spp., *Salix* spp. and reeds (*Phragmites australis*, *Typha*) and, depending on the frequency of inundation, species such as *Populus* spp., *Myricaria* spp., *Berberis* spp., *Crataegus* spp., and *Hippophaë*. Along the river beds (11a) on well drained areas with deep soils, many of the wild ancestors of cultivated fruit trees occur. These include the apple (*Malus* spp.), pear (*Pyrus*

spp.) and almond (*Amygdalus* spp.) as well as grapes (*Vitis* spp., Photo 36). Trees of *Fraxinus* spp., *Acer* spp., and *Platanus* spp. are also found here. But undisturbed natural riverine vegetation cannot be found today.



**Photo 36:** Wild *Vitis* in riverine gallery vegetation near Jalalabad (type 11a on map, Fig. 2)

Little information is available on the vegetation of the lakes (11a) but Hamun-e-Puzak and Kol-e-Hashmat Khan are covered with reeds (Photo 37). One of the few higher plants in the Ab-e-Istada lake is the pondweed *Ruppia maritima* with colonies of *Taraxacum monochlamydeum* forming conspicuous vegetation on mudflats around the lake. Some Characeae occur in Dasht-e-Nawar, as well as in Band-e-Amir.



**Photo 37:** Reed vegetation at Hamun-e-Puzak, SW-Afghanistan (type 11a on map, Fig. 2)

The travertine dam of Band-e-Amir is covered by a dense scrub of various species of swamp and water plants (Photo 38).



**Photo 38:** Reed Vegetation and willows at the border of the Band-e-Amir Lakes (2900m asl) with their natural travertine dams (type 11 a on map, Fig. 2)

Most of the Tugai Forests along the larger rivers and creeks have been used for fuel, for grazing, thus, most of them have disappeared. Remnants of formerly extensive Tugai vegetation along the meandering Ab-e-Wakhan, Ab-e-Pamir and the upper Amu Darya (called Ab-e-Panj) with several Salix-

and *Populus*-species, and *Hippophaë rhamnoides* scrub are still rich in species (Photo 39).

1971c, 1986, 2000, 2002, Mirazai and Breckle 1978). Chorology of some typical Chenopodiaceae is discussed by Freitag (1991). The irano-turanian region is an evolutionary center for Chenopodiaceae.



**Photo 39:** Extent Tugai-Vegetation (Riverine flat) at the junction of Wakhan River to Pamir River, forming Ab-e-Panj and upper Amu Darya near Qala Panja (3000m asl) (type 11a on map, Fig. 2)

#### **Azonal vegetation: saline flats (11b)**

Deserts are arid areas, where salinity close to the erosion basins is a common natural phenomenon. By irrigation without drainage in agricultural areas also salinity is enhanced, and after a few decades those fields are unproductive and have to be abandoned. They are taken over by halophytic vegetation. The irano-turanian floristic region is very rich in halophytic species (Breckle

Some of the above mentioned endorrheic lakes (Hamun-e-Puzak and Kol-e-Hashmat Khan, Ab-e-Istada, Dasht-e-Nawar (Photo 40, 41, 42) are in part huge salt swamps, where a rich halophytic vegetation occurs with *Limonium* spp., *Zygophyllum*, *Nitraria*, *Frankenia* spp., *Tamarix* spp., *Reaumuria* spp., *Cressa cretica* etc., but especially rich are represented the various genera of the Chenopodiaceae, as e.g. *Salsola* spp., *Suaeda* spp., *Halocnemum strobilaceum*

(Photo 42), *Halostachys caspica*, spp.,  
*Halocharis* spp., *Halimocnemis* spp., *Ga-*

great variety of landscapes and ecosystems.  
In the whole Central Asian area as well as in



**Photo 40:** View to the huge saline flat of Dasht-e-Nawor 3100m asl (type 11b on map, Fig. 2)

*manthus* ssp., with *Seidlitzia rosmarinus* and many other genera from Chenopodiaceae.

### Final remarks

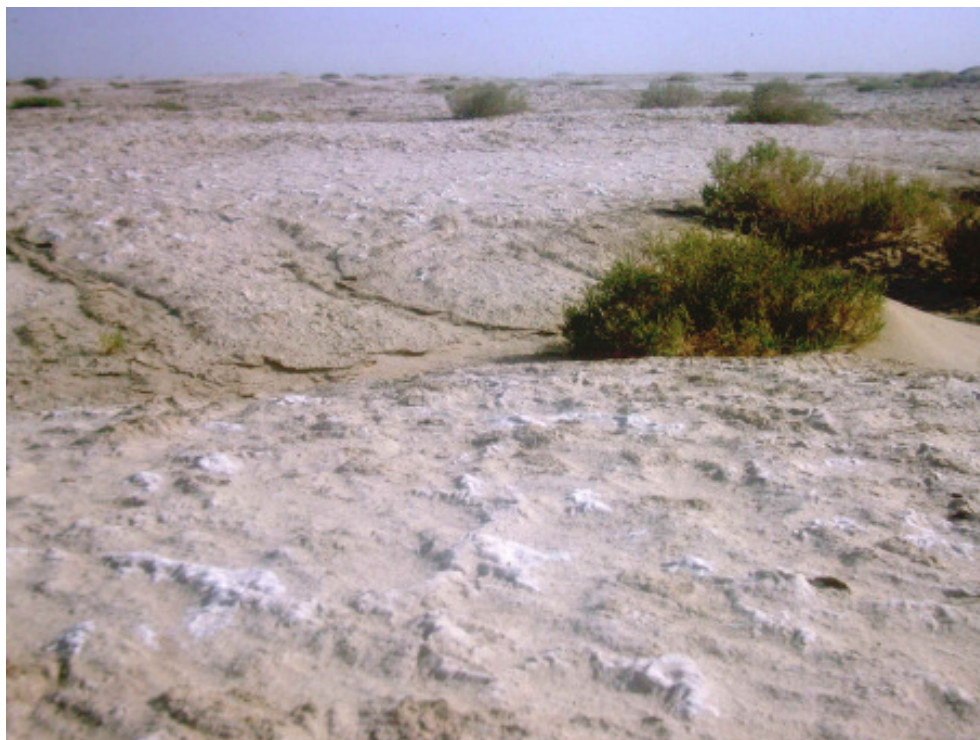
Afghanistan is certainly one of the most interesting drylands of Central Asia. The diverse flora and rich mosaic of vegetation types would need to more research in future in several directions: taxonomic, ecologic and nature management. Afghanistan is a transition zone with many different chorological elements (Zohary 1973, Hedge and Wendelbo 1978, Meusel et al. 1964, 1978, 1992, Walter and Breckle 1994), with a

the Middle East, hundreds, if not thousands of years, there has been a grazing tradition with many different ecological consequences (Peer 2000, Peer et al 2001, 2007), particularly for the plant communities in steppes, semideserts and deserts of almost all altitudinal belts, and even in the monsoonal forests (Schickhoff 2002). The numerous and diverse plant communities are generally poor in particular character species, thus a syntaxonomical classification seems to make no sense (Peer et al. 2007); this is true not only for the Pakistan mountains but for the whole area. Additional dif-

difficulties arise from taxonomy, owing to seasonal diversity of shape and poverty of traits of species, as well as in some taxa of a recent “explosive” evolution of new varieties, subspecies and species, as in *Astragalus*, *Oxytropis*, *Acantholimon*, *Acanthophyllum*, *Cousinea* etc.

Many of these vegetation types, restricted to small areas are rather sensitive to climatic variations. Since some of the last years have been extraordinary dry additional damage by overgrazing and subsequent by strong ero-

sion by wind has reached partly irreversible stages. On the other hand, episodic strong rains, mud streams, land slides (Byron 1937) and several strong earth quakes have demonstrated that the natural dynamic forces are very intensive and need specific adaptations of flora, vegetation and of human beings with their settlements, agriculture and livestock farming. On the other hand, since centuries, this area is full of unrest and wars (Forbes 1892).



**Photo 42:** Heavily salinized salt-flat with thick salt crusts, and very open halophyte vegetation, mainly with the extreme halophyte *Halocnemum strobilaceum*, near Ankhoi (350m asl) (type 11b on map, Fig. 2)

A more stable political situation in future could strongly help to develop a sound and sustainable agricultural system again as well as a system of nature protection areas in-

following civil war situation didn't allow to realize these eager plans of nature protection (Breckle, in preparation). Afghanistan is certainly still on the crossroad of political



**Photo 41:** *Cressa cretica* and other halophytes, on saline flats, near the old city wall of Balkh, 350masl, North Afghanistan, (type 11b on map, Fig. 2)

cluding National Parks in order to conserve the high biodiversity and mountainous vegetation pattern of the country. There have been several attempts to establish a system of nature conservation areas but the long war against the Soviet Union and the

and strategic interest but it should come to the crossroad of scientific interest again, since geology, climate, flora and fauna are distinctly diverse and worthwhile.

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