

Plants of the Kavir Protected Region, Iran

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Abstract

The Kavir Protected Region covers an area of 609,438 ha. of desert, sub-desert and dry steppe. Rainfall varies between 50 and 300 mm. Temperature extremes are about +50°C. and -15°C. After 12 years of protection against grazing and fuel collecting the vegetation of the area shows a remarkable recovery. Sketches are presented of the plant cover of some typical habitats: moderately sloping, stony-gravelly ground dominated by *Artemisia herba-alba*; sand dunes with *Haloxylon* spp. and *Calligonum persicum*; salt flats with *Halostachys belangeriana*; sandy-silty ground bordering salt flats dominated by *Seidlitzia rosmarinus*; wet ground by brackish springs with *Phragmites australis* and salt meadows. On mountain slopes one finds remains of a *Pistacia khinjuk* - *Amygdalus scoparia*-association. 283 species of higher plants are listed. More than 50% of these are annuals. The paleoxeromorphs are poorly represented. *Heliotropium kavirense* H. RIEDL, sp. nov. is described. *Chamaesphacos ilicifolius*, *Crozophora gracilis* and *Salsola aperta* are recorded as new to the flora of Iran. Several species new to the central parts of Iran or otherwise rare are recorded.

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گیاهان منطقه حفاظت شده کویر - ایران
از کارل هاینتس رشینگر و پروندلیبو
خلاصه

منطقه حفاظت شده کویر ناحیه‌ای شامل ۶۰۹۴۳۸ هکتار از کویر، نیمه کویر و استپی خشک است. میزان بارندگی متغیر و بین ۵۰ تا ۳۰۰ میلی‌متر در سال است. حداکثر درجه حرارت در حدود ۵۰+ درجه سانتیگراد و حداقل به ۱۵- درجه میرسد. پس از دوازده سال جلوگیری از چرای دام، کندن و جمع‌آوری نباتات، پوشش گیاهی منطقه بطور قابل ملاحظه‌ای تغییر و بهبود یافته است.

خلاصه‌ای از گسترش گیاهی بعضی از نقاط مشخص از نظر رویش بشرح ذیل بیان میگردد:
۱- نقاط کم و بیش دارای شیب ملایم، زمینهای شنی و قلوه‌سنگی غالباً "پوشیده‌از

Artemisia herba-alba

۲- تپه‌های ماسه‌ای دارای *Caligonum persicum*, *Haloxylon* ssp.

۳- زمینهای مسطح شور *Halostachys belangeriana*

۴- شنهای نرم همراه با خاکهای سبک درحاشیه زمینهای شور دارای *Seidlitzia rosmarinus*

۵- زمینهای مرطوب و حاشیه چشمه‌های شور دارای *Phragmites australis*

۶- در دامنه کوه باقیمانه‌ای از اجتماع *Pistacia khinjuk-Amygdalus scoparia* وجود دارد.

بیش از ۲۰۳ گونه تا بحال شناخته شده و لیست آنها تهیه گردیده است. بیشتر از ۵۰ از این گیاهان یکساله هستند.

نمونه‌های پالئوگرومورف *paleoxeromorphs* به تعداد ناچیزی یافت شده است.

Heliotropium kavirense H. RIEDL که گونه جدید می‌باشد.

Salsola aperta و *Crozophora gracilis*, *Chamaesphacos ilicifolium* گونه‌ای جدید برای فلور ایران و همچنین تعداد زیادی گونه‌های جدید یا نادر موجود در قسمت مرکزی ایران مشاهده شده است.

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Introduction

The Kavir Protected Region was established June 20, 1964, primarily to protect the endangered Persian wild ass and the Jebeer gazelle. The area which covers 609,438 hectares is situated on the northwestern margin of the desert region of the Dasht-e Kavir which forms a vast basin in the great central plateau of Iran.

From the date of establishment all grazing by domestic stock as well as fuel collecting were stopped within the area. In response the plant cover has shown a remarkable recovery as has the wildlife. The Kavir Protected Region now has a great potential for desert ecological investigations both in the fields of botany and zoology. Of basic importance for such studies is a good knowledge of the flora.

So far all floristic publications from Iran have been enumerations of species collected during

travels covering different regions of the country. No scientific paper seems to have been devoted to the flora of a limited natural area. Encouraged by the great interest for such lists from the different national parks and protected regions shown by His Excellency Mr. ESKANDAR FIROUZ, Director of the Department of Environmental Conservation, we finally ventured to start the work on the flora of the Kavir Protected Region. Collecting has, however, also started in the Mohammad Reza Shah National Park and the Turan Protected Region with the thought of producing similar lists from these areas.

It is our hope that this list will further the interest in the botanical aspects of the protected regions and that it will be useful as a base for work in fields like ecology, plant sociology, and vegetation mapping as well as for studies on feeding habits of the animals of the area. It is also hoped that this list could be used as a base for a popular

guide to the flora of the area for the benefit of the general public.

Topography and geology

In a mimeographed review of the Kavir Protected Region (anonymous) the area is described thus:

"The Kavir Protected Region constitutes a complex pattern of desert habitat. Situated between the Daryacheh Namak and the Dasht-e Kavir, it comprises a chain of broken, rocky mountains blending into the above-mentioned alluvial plains. Practically any topographic formation found in Central Iran is present in this region.

In the western part of the region, a rather flat alluvial plain at about 2500 feet elevation is present which is dissected by gullies that tend to hold water during the winter months. The terrain rises gradually to form a small chain of rather barren mountains.

In the central portions the terrain rises rapidly to 6611 feet at Siah Kuh. An elliptical chain of mountains is found again in the eastern section. Elsewhere terrain tends to be slightly broken to rolling, seldom flat.

Geologically the area is complex. Extrusive, igneous material predominates over the higher elevations with Miocene formations in the intermediate elevations and Quarternary alluvium at the lower levels.

For the purpose of soil classification, most of the area can be categorized as heavy solonchak soils with calcareous lithosols over the higher terrain. Moving sand dunes are present in the northeast sector. Salt marsh soils predominate at the lowest elevations."

Climate

Records of temperatures and precipitation for long periods from the protected region do not exist. As the nearest meteorological station is Varamin, situated about 30 km to the north-west, the available data may not be totally reliable.

Average precipitation is ± 100 mm, varying from year to year from less than 50 mm to more than 300 mm. It is probably considerably higher

in the western part than in the eastern one. Most of the precipitation is in the form of light rains from November to May. Snow may fall and cover the ground for shorter periods.

Temperatures reach well above $+40^{\circ}\text{C}$. with a maximum probably of about 50°C . The hot months are June, July and August. Minimum temperatures in winter may be as low as -15°C .

Wildlife, grazing

Prior to protection of the area in 1964 the vegetation was seriously degraded from overgrazing by sheep, goats and camels. There is no record of any settlements within the KPR, but people from the nearby villages in the west and the north as well as nomads have grazed their flocks in the area. Around the three caravanserais the grazing of camels, donkeys and horses must have played an important role in the destruction of the plant cover well into this century.

At present there is no grazing by domestic stock in the Kavir Protected Region, but there are considerable populations of wild animals (HARRINGTON, *in litt.*).

Two species of gazelles inhabit the region, the Ahu or Goitered gazelle, *Gazella subgutterosa*, numbering about 100 animals; and the Jebeer, *Gazella dorcas* – 1000 to 1500 animals. The Ahu occupies the western-most one-third of the area, often entering the margins of farmland by night. The Jebeer occupies the drier habitats in the eastern two-thirds of the protected region, often in association with psammophilic vegetation, but seasonally also in areas of halophytic vegetation as well. The Persian wild ass, *Equus hemionus*, – 80 to 100 animals – is found in flat to rolling terrain in the eastern half of the region. They seem to be extending their range westwards. Wild sheep, *Ovis ammon* ssp., – about 1500 animals – occurs throughout the protected region in the foothills of the mountains. In the more rugged terrain one finds the Persian ibex, *Caprea aegagrus*, numbers estimated at 2000. Only rarely they are found at lower elevations.

In all cases the populations of ungulates appear to be increasing. This is not surprising in view of

the increase in vegetation density. The populations are still below the carrying capacity of the area. Traces of grazing are obvious, e.g. on the north side of the Siah Kuh where the wild sheep and the ibexes are plentiful. As botanists we could however, see no indications of what we would call overgrazing.

Smaller animals like the Cape hare, *Lepus capensis*, and rodents, which are common, also live upon the vegetation and may influence it in different ways. RANDALL BROWN (HARRINGTON, *in litt.*) calculated densities of 5 species of rodents (*Meriones libycus*, *M. crassus*, *Gerbillus nanus*, *Allactaga elater* and *Jaculus blanfordi*) at 2.17 ± 1.04 rodents per hectare in the plains north and west of the Shah Abbas Caravanserai in July, 1973.

A number of carnivores partly control the populations of the different animals living upon the vegetation. The following species have been recorded: Red fox, *Vulpes vulpes*; Ruppell's fox, *Vulpes ruppelli*; Leopard, *Panthera pardus*; Cheetah, *Acinonyx jubatus*; and Caracal, *Lynx caracal*. It is probable that also others occur, like: Rock marten, *Martes foina*; Marbled polecat, *Vormela peregusna*; Hyaena, *Hyaena hyaena*; Wild cat, *Felis catus*; Wolf, *Canis lupus*; and Jackal, *Canis aureus*.

Botanical collecting

Previously the area has only been visited more casually by botanists. The collecting that has yielded the most interesting results is that of PAUL AELLEN of Basel together with Dr. G. SHARIF of Tehran, who collected species of *Chenopodiaceae* in November 1948. This collecting resulted in the description of a new genus and three new species jointly published by the two collectors, *Esfandiarica calcarea* gen. et spec. nov., *Horaninowia aptera* sp. nov., and *H. platyptera* sp. nov., all with their type localities within the now protected area.

Members of the staff of the Herbarium of the Ministry of Agriculture, Evin, have visited the area on several occasions, but as the material collected during these trips has been inserted in the herbarium and no special record has been kept, it

has not been used for this study. A collection made by staff members of the Department of Environmental Conservation contained some species that had not been found by us.

Our list is mainly based on the following collections: April, 25-26, 1974 - ANN ALA, G. COBHAM and P. WENDELBO (nos. 10843-10927);

May, 22-26, 1974 - WILLY and K.H. RECHINGER (nos. 46075-46489);

Sept., 9-11, 1974 - H. FOROUGHI and P. WENDELBO (nos. 14599-14668);

Dec., 1-3, 1974 - H. FOROUGHI and P. WENDELBO (nos. 15189-15223);

April, 20-21, 1975 - WILLY and K.H. RECHINGER (collection not yet numbered);

April, 20-21, 1975 - M. ASSADI and P. WENDELBO (Nos. 16001-16082);

May, 26-27, 1975 - M. ASSADI and H. VARNECKE (nos. 17145-17211).

The material of RECHINGER is deposited at the Naturhistorisches Museum, Botanische Abteilung, Wien, with duplicates at the Herbarium of the Ariamehr Botanical Garden, Tehran. The other material is at the latter institution with duplicates in Wien.

Notes on the vegetation

Salt flats

Coming from Varamin in the northwest one enters the Kavir National Park at the small village of Mobarakieh. East of this village the road passes through a low-lying flat area (c.850 m a.s.l.) with salty soil. The white crust is very apparent. The soil is very fine-grained without any trace of gravel. An analysis of 2 samples shows that it contains 41 % silt, 32 % clay and 27% sand. The pH of the two samples was 8.1 and 8.7 respectively.

The vegetation of this salt flat is very scattered and consists mainly of low shrubs up to 1.5 m high, belonging to several different species, growing on small characteristic mounds several to many metres apart (Pl. I fig. 2). The mounds are obviously formed by fine-grained windblown material accumulating around the stems. In between these shrubs there are in many places no or very few

plants, or there may be a very open cover mostly of annuals, most of which belong to *Chenopodiaceae* (*).

Shrubs: **Halostachys belangeriana*, *Lycium ruthenicum*, *Nitraria schoberi*, **Suaeda monoica*, *Tamarix hispida* var. *karelinii*.

Perennials: *Alhagi camelorum*.

Annuals: **Anthochlamys multinervis*, **Bieneria cycloptera*, **Cornulaca leucacantha*, **Salsola crassa*, **Salsola incanescens*.

The shrubs look quite young and one would think that they have for generations constantly been kept back by fuel collectors and goats before the area was protected. As both *Halostachys belangeriana* and *Suaeda monoica* may grow into large shrubs or even small trees of 3 to 4 m, it will be interesting to follow the development of this association. Information of practical interest to be gained is naturally how the plants occurring on these salt flats can be used in the regeneration of vegetation on similar and otherwise completely useless land in other, populated areas. What appears to be an extremely futile habitat could probably produce a certain and continuous supply of fuel if treated with care. The production per hectare and year may not be large but under such circumstances little is certainly better than nothing.

Sloping ground next to salt flats

East of Mobarakieh there is a marked belt on gently sloping ground above the salt flat which is dominated by about ½ m high chenopod shrub *Seidlitzia rosmarinus*. The soil is gravelly with the fine grained part consisting of 88% sand, 6% silt and 6% clay. The pH is 7.9 (1 sample). The more important plants of this association are (*Chenopodiaceae* *):

Shrubs: **Seidlitzia rosmarinus* (dominant), *Calligonum persicum*.

Subshrubs, perennials: *Artemisia herba-alba*, **Anabasis setifera* (frequent).

Annuals: *Acantholepis orientalis*, *Alyssum lini-folium*, **Cornulaca leucacantha*, *Diploaxis harra*, **Gamanthus gamocarpus*, **Halotis pilosa* (frequent) *Isatis minima*, *Matthiola chenopodiifolia*, *Sameraria elegans*, *Sterigmostemum acanthocarpum* (frequent)

Higher up on the slope there is a gradual change from the *Seidlitzia* – belt into an association dominated by *Artemisia herba-alba*. The members of *Chenopodiaceae* are gradually falling out as the soils become more stony and gravelly and probably contain less salt.

Stony-gravelly ground

Over large parts of the sloping and undulating country with more or less stony soil, *Artemisia herba-alba* plays an important role but probably there are several different associations. (Pl. I, Fig. 1).

Important plants are:

Shrubs: *Pteropyrum aucheri*, *Zygophyllum eurypterum* (both species frequent but in different facies).

Subshrubs and perennials: *Acantholimon truncatum*, *Artemisia herba-alba* (partly dominant), *Andrachne telephioides*, *Astragalus spinescens*, *Chesneya astragalina*, *Cleome coluteoides*, *Dendrostellera lessertii*, *Ducrosia anethifolia*, *Gaillonia bruguieri*, *Haplophyllum robustum*, *Heliotropium eremobium*, *Jurinea ramosissima*, *Lactuca orientalis*, *Peganum harmala*, *Pulicaria crispa*, *Salsola aurantiaca*, *Salvia macrosiphon*, *Stipa hohenackeriana*, *Stipagrostis plumosa*.

Annuals: *Arnebia decumbens*, *Crozophora hierosolymitana*, *Delphinium rugulosum*, *Goldbachia laevigata*, *Heterocaryum subsessile*, *H. szovitsianum*, *Hyoscyamus pusillus*, *Koelpinia linearis*, *Lachnoloma lehmannii*, *Lactuca glaucifolia*, *L. undulata*, *Lallemantia royleana*, *Lappula spinocarpus*, *Malcolmia africana*, *Papaver tenuifolia*, *Nonnea caspica*, *Paracaryum persicum*, *P. salsum*, *Sameraria elegans*, *Silene setacea*, *Spergularia diandra*, *Thevenotia persica*, *Thuspeinantha persica*, *Valeriana triplaris*, *Ziziphora tenuior*.

Sand dunes

According to FIROUZ and HARRINGTON (1975, 3) the area of the Kavir National Park contained 22000 hectares of moving sand dunes prior to the protection from grazing. After 8 years of protection about 80% had become stabilized.

We have only had the possibility to study part of the sandy area ESE of Siah Kuh on the road to Mulkabad, at about 850 m a.s.l. (Pl. II, fig. 1). This area contains stabilized sand dunes as well as areas with open sand. A sample taken between specimens of *Haloxylon aphyllum* and *H. persicum* contained 92 % sand, 5% clay and 3 % silt and showed a pH of 7.9.

The plant cover of the sand dunes is surprisingly rich. Dominant shrubs are up to 2 m high specimens of saxaul (*Haloxylon aphyllum*, *H. persicum*) but several other shrubs are frequent (see list below). Among the perennials *Stipagrostis pennata* and *S. plumosa* are especially important, but numerous annuals occurring in great numbers are a very conspicuous feature of the plant cover.

List of the most important plants found in the sandy area ESE of the Siah Kuh mountains (species confined to sand are marked by *):

Shrubs: *Aellenia subaphylla*, **Astragalus squarrosus*, **Calligonum persicum*, *Ephedra strobilacea*, **Haloxylon aphyllum*, **H. persicum*, *Salsola arbuscula*, *Seidlitzia rosmarinus*.

Subshrubs and perennials: *Allium borszczowii*, *Asthenatherum forsskalii*, *Cistanche tubulosa*, **Convolvulus eremophilus*, *Haplophyllum glaberrimum*, *Heliotropium nodulosum*, *H. taftanicum*, **Stipagrostis pennata*, *S. plumosa*.

Annuals: **Agriophyllum minus*, *Alyssum linifolium*, *Anthochlamys multinervis*, *Arnebia decumbens*, *Astragalus bakaliensis*, *A. hauarensis*, *A. schimperii*, *A. tribuloides*, **Chamaesphacos ilicifolius*, *Cornulaca leucacantha*, *Crepis sancta*, **Crozophora gracilis*, **Cutandia memphitica*, *Eremopyrum bonaepartis*, *Gastrocotyle hispida*, *Horaninowia aptera*, *Hypocoum pendulum*, *Isatis minima*, *Lappula spinocarpos*, *Launaea mucronata*, *Leptaleum filifolium*, *Matthiola chenopodiifolia*, *Psammogeton brevisetum*, **Salsola* cfr. *aperta*, *S. incanescens*, *Senecio desfontainei*, *Schimpera arabica*, **Spirorhynchus sabulosus*, *Thuspeinantha persica*, *Torularia torulosa*.

The remarkably rapid natural regeneration of the vegetation of the sand dunes as soon as grazing was stopped, is of great interest. FIROUZ and HARRINGTON (1975, 3) pointed out the low

cost of stabilization of the sands through protection from grazing, compared to conventional treatment. It seems to us that this "natural stabilization" becomes very efficient due to the great variety of species involved, comprising shrubs, subshrubs, perennials and not least annuals. Several of the annuals may in fact be of great importance in this respect as they comprise pioneer species being specialists on open sand, e.g. *Agriophyllum minus*, *Chamaesphacos ilicifolius*, *Cornulaca leucacantha*, *Crozophora gracilis*, *Cutandia memphitica*, *Salsola* cfr. *aperta*, *Spirorhynchus sabulosus*. A closer study of the natural regeneration of the sand dunes might lead to results of considerable importance. The use of a wide range of native species might lead to safer, quicker and cheaper results in stabilization of moving sands and reclamation of sandy areas.

The future of the plant cover of these sand dunes will certainly be interesting to follow. *Haloxylon persicum* may according to ILJIN (1936, 311) grow into a tree up to 5 m high with a stout rugged stem, and also *H. aphyllum* reaches considerable size. In the Soviet Union the saxauls form a kind of forest on the sand dunes, and this forest is, due to its importance as a source of fuel, subject to a special branch of forestry. In Iran well grown specimens of saxaul are hard to find at present. With protection and some attention and care saxaul stands on unproductive sand dunes might play a certain role in the economy of nearby villages. Apart from stopping the sands from moving into the cultivated areas, the gradually developing "forest" may produce a significant amount of fuel. The saxauls have a very hard and heavy wood — sinking in water — and the best charcoal is said to come from these plants.

North-facing mountain-slope of Siah Kuh

The north side of Siah Kuh has a comparatively rich vegetational cover. Of special interest are the scattered specimens of shrubs or small trees *Amygdalus scoparia*, *Cerasus microcarpa*, *Cotoneaster* cfr. *kotschyi* and *Pistacia khinjuk*. *Amygdalus scoparia* here and there forms quite dense stands and certain specimens may reach 4 m in height

being tree-like with a thick, well developed stem. These trees and shrubs are undoubtedly the remains of a low, more or less open steppe-forest, an *Amygdalus scoparia* – *Pistacia khinjuk* association. ZOHARY (1973, 196 and 585) mentions this association from Fars and describes it as a steppe forest where “the trees or shrubs are very sparse and exceedingly widely spaced; the interspaces are occupied by a tragacanthic or herbaceous steppe.” Undoubtedly ZOHARY has got a somewhat wrong impression of this association. His photograph (ZOHARY, l.c., fig. 254) shows what seems to be a very poor example of this association destroyed by heavy grazing. As mentioned above, the development of this association on the north side of Siah Kuh indicates that it will be much denser and consist of taller specimens than described by ZOHARY.

Characteristic plants of the rocky and stony north slope are: *Acantholimon talagonicum*, *Acanthophyllum sordidum*, *Aegopordon berardioides*, *Atraphaxis spinosa*, *Bunium persicum*, *Cerastium inflatum*, *Cousinia onopordioides*, *Eremurus luteus*, *Galium setaceum*, *G. spurium*, *Jurinea carduiformis*, *Lepyrodiclis holosteoides*, *L. stellaroides*, *Minuartia meyeri*, *Pennisetum orientale*, *Rheumribes*, *Scandix stellata*, *Tauscheria lasiocarpa*. In crevices of rocks one finds: *Campanula incanescens*, *Gagea chlorantha*, *Parietaria judaica*, *Paronychia kurdica*, *Phagnalon persicum*, *Psychrogeton obovatus*.

On gravelly soil at the bottom of a small valley there were a number of annuals that otherwise seem to be rare or not found at all within the area: *Arabidopsis pumila*, *Heterocaryum laevigatum*, *Holosteum glutinosum*, *Malcolmia strigosa*, *Nepeta micrantha*, *Nigella integrifolia*, *Rochelia* cfr. *bungei*, *Torularia aculeolata*, *Valerianella szowitsiana*, *Veronica campylopoda*, *V. macropoda*.

Brackish springs

There are a number of brackish springs within the area, especially on Siah Kuh. Some of them provided quite drinkable water for the caravanserais. Only a few of these springs have been investigated botanically, viz. those of Shah Abbas Caravanserai

(Cheshmeh Shah), of Eynor Rashid and Cheshmeh Agha Mohammad Khan.

By the springs on more or less wet and salty ground – often salt crusts can be seen – one may find scattered shrubs of *Tamarix hispida* var. *karelinii* and *T. brachystachys* as well as *Lycium depressum* and *L. ruthenicum*. By some of them *Phragmites australis*, makes impressive, dense stands reaching more than 3 m in height. There are patches of a dense meadow-like plant-cover. The only submersed plant found so far is *Zannichellia palustris* growing in a pool at Cheshmeh Agha Mohammad Khan.

The most important of the plants found by the springs are: *Aeluropus littoralis*, *Atriplex thunbergiiifolia* *Asperugo procumbens*, **Cardaria draba*, *Carex divisa*, **Cressa cretica*, **Cynodon dactylon*, *Cyperus distachyus*, **Frankenia hirsuta*, **F. pulverulenta*, *Glaux maritima*, **Glycyrrhiza glandulifera*, **Goebelia alopecuroides*, *Hymenolobus procumbens*, *Juncus rigidus*, **Lepidium latifolium*, **Phalaris minor*, **Polypogon monspeliense*, *Puccinellia anisoclada*, *Taraxacum* sp., *Veronica anagallis-aquatica*.

The species marked * are anthropochorous and have probably come in during the period of great human activity when the caravanserais were in use.

Synanthropic vegetation and flora

When protection first was established, the plant cover was in a poor state (FIROUZ 1974, 13). This was due to overgrazing by camels, goats and sheep and to collecting of plants for fuel and other purposes. The animals partly came from the villages situated to the north-west of the area, partly belonged to nomads and seminomads, but for hundreds of years the animals of the caravans passing through the area also must have played an important role in the destruction of the flora especially around the caravanserais.

No record exists of the synanthropic plant communities that undoubtedly must have developed in the different parts of the area and especially around the caravanserais. At present one only finds scattered specimens of species like *Alhagi camelorum*, *Girgensohnia oppositiflora*, *Goebelia*

alopecuroides, *Lagonychium farctum* and *Peganum harmala* that dominate vast stretches of destroyed and overgrazed areas in different parts of Iran. It seems that these plants cannot survive for very long in competition with the natural flora when grazing stops. The surprising fact is that so many species of the natural flora have been able to survive the hardships of hundreds of years of grazing. Obviously shrubs and subshrubs survive as gnarled specimens hardly raised above ground. Annuals may flower and seed hidden in and protected by spiny or otherwise non-palatable plants.

It is often difficult to say which plants are anthropochorous or benefit from human activity. A plant like *Bromus tectorum* seems to be spread by sheep as the awns of the glumes easily get stuck in the wool. But also this species may gradually disappear.

As indicated above, a number of anthropochorous species seem to persist by the brackish springs. The reasons for this may be that the many wild animals that come to drink, keep the conditions very much like they would have been if human influence had continued.

Generally there is no doubt that the traces of human influence on vegetation in the Kavir Protected Region are disappearing quickly. But it will still take a long time before a climax vegetation is reached especially where larger shrubs or small trees are involved as on the salt flats, the sand dunes and on the northern side of Siah Kuh.

Notes on the flora

The list of species from the Kavir Protected Region contains 283 species, 2 gymnosperms and 281 angiosperms. So far, no fern has been discovered within the area. There are reasons to believe that the number of species will increase considerably. A total of about 350 species may be a fair guess, when the area has been fully investigated. Till now only a limited number of localities have been visited, although it is hoped that these localities are fairly representative. The collecting has also been limited in time.

The 283 species belong to 42 families and 197

genera. The largest family is *Chenopodiaceae* (35 species). This family is completely dominating in the autumnal aspects of flora and vegetation. Other large families are: *Compositae* (33 species), *Cruciferae* (28), *Boraginaceae* (25), *Gramineae* (22), *Leguminosae* (17) and *Caryophyllaceae* (14). The largest genus is, not unexpectedly *Astragalus* with 11 species, followed by *Heliotropium* (8) and *Salsola* (7). Generally one can say that the true Irano-Turanian genera, including the palaeoexomorphs, as *Cousinia*, *Acanthophyllum*, *Acantholimon*, many sections of *Astragalus*, etc. are poorly represented. Species of these genera are mainly found in the steppes of the mountain slopes and do not belong in desert-like areas.

About 150 of the species, somewhat more than 50%, are annuals; 25 species, about 9%, are phanerophytes; 22 species, about 8 %, chamaephytes; whereas the rest are hemicryptophytes and geophytes.

No species can be expected to be endemic to the area. *Heliotropium kavirense* H. RIEDL which is described as a new species in this paper, will probably also be found in other areas marginal to the Kavir, and with similar ecological conditions.

New records to the flora of Iran are the following species: *Chamaesphacos ilicifolius*, *Crozophora gracilis*, and if correctly named, *Salsola aperta*. New records for the central regions of Iran are: *Cutandia memphitica*, *Heliotropium nodulosum*, *H. popovii*, *H. taftanicum*, *Launaea mucronata*, *Moricandia sinaica*, and *Schimpera arabica*.

Species which have been recorded only a few times before from Iran and then mostly from the east and south-east, are: *Asthenatherum forsskalii*, *Euphorbia azarbajdzana*, *E. nderiensis*, *Heterocaryum laevigatum*, *Lachnoloma lehmanii*, *Paracaryum salsum*, *P. stellatum*, *Salsola richteri*, *Spirorhynchus sabulosus*.

List of species

Gymnospermae – Ephedraceae

Ephedra intermedia SCHRENK & C.A. MEY. – Frequent within area on stony slopes. Both the varieties var. *intermedia* and var. *persica* STAPP

occur.

Ephedra strobilacea BUNGE ex A. LEHM.
— Rather frequent, mostly on more or less sandy soils.

Angiospermae – Dicotyledonae

Anacardiaceae

Pistacia khinjuk STOCKS – Here and there on the slopes of Siah Kuh one finds small shrubby specimens of this species. Also on dry mountain near Cheshmeh-ye Sefid Ab.

Asclepiadaceae

Cynanchum acutum L. – Near Shah Abbas Caravanserai.

Boraginaceae

Arnebia decumbens (VENT.) COSS & KRAL. – Common in steppic vegetation and on sand.

Arnebia linearifolia DC. – Common in steppic vegetation and on sand.

Asperugo procumbens L. – Near Hows-e Agha Mohammad; also seen by brackish spring of Shah Abbas Caravanserai. Anthropochorous.

Gastrocotyle hispida (FORSSK.) C.B. CLARKE
— On sand SE. of Siah Kuh; in desert 18 km. N. of Cheshmeh-ye Sefid Ab.

Heliotropium dolosum DE NOT. – Near Mobarakieh.

Heliotropium ellipticum LEDEB. – C. 25 km W. of Shah Abbas Caravanserai on road to Mobarakieh; stony desert near Hows-e Gheylughey.

Heliotropium eremobium BUNGE – Several places in the region of Cheshmeh-ye Sefid Ab.

Heliotropium kavirense H. RIEDI spec. nov.
Sectio *Hedyosma* BUNGE. Species habitu valde variabilis annua pluricaulis vel a basi fere ramosa caulibus mox erectis mox prostrato-ascendentibus 5-28 cm altis viridibus pilis appressis vel patentibus interdum tuberculis albis minutissimis insidentibus vix 1mm longis hispidulis asperis. Folia bicoloria subtus pilis densis tuberculis subglobosis insidentibus canescenti-viridia super pilis laxis iis faciei inferioris similibus viridia petiolo dense patule albo-piloso (5-) 7-15 mm longo suffulta lamina ovata

vel ovato-suborbiculari petiolo subaequilonga apice obtusa basi truncata 6-25 mm plerumque 8-20 mm longa 5-15 mm lata, margine integro vel obsolete undulato vix vel indistincte tantum revoluta. Inflorescentiae numerosae longe pedunculatae secundae dense bracteatae apice subrevoluta; flores infima ceteris interdum remoti breviter pedicellati, ceteri sessiles vel subsessiles. Calyx florifer 1.5 mm fere longus patule pilosus usque ad basin in laciniis 5 ovato-lanceolatis acutis divisus fructifer usque ad 2-2.5 mm auctus, nuculis deciduis aut primo stellatim explanatus demum et deciduus aut una cum nuculis deciduus. Corolla minutissima calycem paulo tantum superans 2.5 mm fere longa tubulosa limbo valde indistincto lobis 5 brevissimus aestivatione imbricatis tubo extra dense piloso intus glabro. Antherae sessiles apice acutae interdum paulo incurvatae 3/4 longitudinis corollae attingentes. Stigma sessile, e basi annulliformi dumosa subcylindricum apice obtuso breviter pilosum. Nuculae 4 ovato-oblongae 1.8 mm fere longae, 0.8 mm fere latae brunneae vel olivascenti-brunneae glabrae laeves obtusae. — Species nova habitu *H. samolifloro* BGE similis sed propter lobos 5 imbricatos sectioni *Hedyosmati* adnumeranda calycibus deciduis *H. noeano* BOISS. affinis esse videtur. Ab eo differt imprimis corollis multo minoribus.

Iran. Prov. Tehran: Kavir Protected Region, c. 50 km W of Shah Abbas Caravanserai, 780 m, 9.9. 1974, P. WENDELBO & H. FOROUGH 14603 (Holotypus W, Isotypus TARI); in deserto usque ad 18 km a Cheshmeh-ye Sefid Ab, 34° 19' N, 52° 20' E, septentriones versus, 900 m, 25.5.1974, K.H. RECHINGER 46411-b.

The new species is similar in habit to other desert-inhabiting or halophytic species of the genus *Heliotropium*, especially *H. samoliflorum* BUNGE, but it is the only one as far as I am aware belonging to the section *Hedyosma*. It is characterized mainly by its long-peduncled dense inflorescence and the extremely small corollas.

Heliotropium nodulosum RECH. f., AELL. &

ESF. – East of Siah Kuh by road to Mulkabad.

Heliotropium popovii H. RIEDL ssp. *gillianum* H. RIEDL – Near Mobarakieh, and 24 km east of Mobarakieh.

Heliotropium samoliflorum BUNGE – In stony desert 34 km from Cheshmeh-ye Sefid Ab towards Hajji Ali Abbas.

Heliotropium taftanicum RECH. f., AELL. & ESF. – On sandy area SE. of Siah Kuh.

Heterocaryum laevigatum (KAR. & KIR.) A. DC. – N. side of Siah Kuh. Previously in Iran only known from Kerman and E. Khorassan.

Heterocaryum subsessile VATKE – N. side of Siah Kuh near Shah Abbas Caravanserai.

Heterocaryum szovitsianum A. DC. – Together with the preceding species.

Lappula ceratophora (M. POP.) M. POP. – Stony desert near Howz-e Agha Mohammad.

Lappula spinocarpos (FORSSK.) ASCHERS. & O. KUNTZE – Common.

Mattiastrum bungei (BOISS.) RECH. f. & H. RIEDL – Near Shah Abbas Caravanserai; 18 km N. of Cheshmeh-ye Sefid Ab.

Nonnea caspica (WILLD.) G. DON. ssp. *zygomorpha* H. RIEDL – N. side of Siah Kuh near Shah Abbas Caravanserai.

Nonnea turcomanica M. POP. – Steppic vegetation near Shah Abbas Caravanserai, sandy area SE. of Siah Kuh.

Paracaryum intermedium (FRESEN.) LIPSKY – Rather frequent.

Paracaryum persicum (BOISS.) BOISS. – In open *Artemisia*-steppe near Shah Abbas Caravanserai, and north of the Caravanserai.

Paracaryum salsum BOISS. – Near Shah Abbas Caravanserai.

Paracaryum stellatum H. RIEDL – Here and there.

Rochelia cfr. *bungei* TRAUTV. – North side of Siah Kuh.

Campanulaceae

Campanula incanescens AUCH. – In shady rock crevices on north side of Siah Kuh. Small-flowered but otherwise typical.

Capparidaceae

Capparis spinosa L. – Here and there in the region of the Shah Abbas Caravanserai.

Cleome coluteoides BOISS. Syn.: *Buhsea coluteoides* (BOISS.) BUNGE – Frequent in the *Artemisia* steppe.

Cleome quinquenervia DC. – 25 km W. of Shah Abbas Caravanserai on road to Mobarakieh, on barren stony slopes. Flowering and partly fruiting in October. Our plant shows tendencies towards *C. noeana* BOISS. These two species are obviously closely related.

Caryophyllaceae

Acanthophyllum bracteatum BOISS. – SE. of Siah Kuh.

Acanthophyllum sordidum BUNGE – North side of Siah Kuh; dry mountain near Cheshmeh-ye Sefid Ab.

Cerastium inflatum LINK – Stony slope, N. side of Siah Kuh.

Gypsophila pilosa HUDS. – Here and there in the Siah Kuh region.

Herniaria hirsuta L. – Shade of rocks, N. side of Siah Kuh.

Holosteum glutinosum FISCH. & C. A. MEY. – Stony slopes, N. side of Siah Kuh.

Lepyrodiclis holosteoides C. A. MEY. – In shade of rocks, N. side of Siah Kuh.

Lepyrodiclis stellarioides SCHRENK – Shade of rocks, N. side of Siah Kuh.

Minuartia meyeri (BOISS.) BORN. – N. side of Siah Kuh.

Paronychia kurdica BOISS. – Crevices of rocks, higher region of Siah Kuh on north side.

Saponaria floribunda (KAR. & KIR.) BOISS. Syn.: *Gypsophila floribunda* (KAR. & KIR.) TURCZ. – S. side of Siah Kuh, across pass from Eynor Rashid.

Silene setacea VIV – Here and there both on sand and in *Artemisia*-steppe on stony ground.

Spergularia diandra GUSS. – Here and there.

Stelleria blatterii MATTF. Syn.: *Gypsophila alsinoides* BUNGE = *Arenaria bungei* BARKOUDA – Fig. 2 – Here and there on stony ground. For discussion of the synonymy see McNEILL (1973).

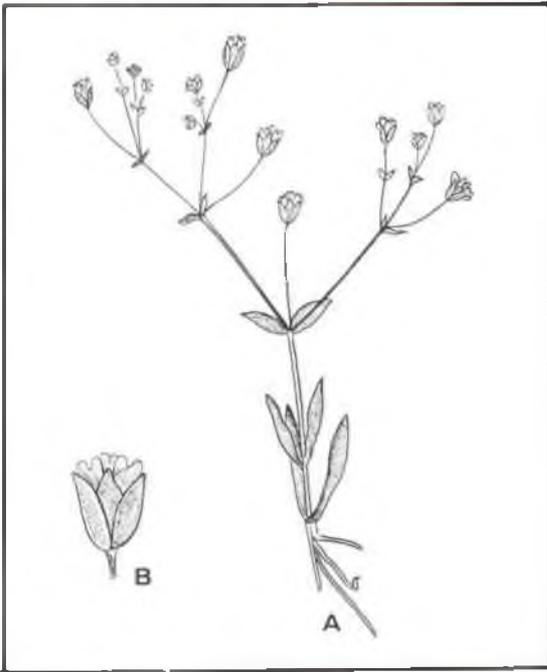


FIG. 2 *Stellaria blatteri*: A. Habit., nat. size; B. Flower, x 4

Chenopodiaceae

This family, which is the largest in number of species within the Kavir Protected Region, plays a very important role in the autumnal aspect of the vegetation. Many parts of the area are surprisingly green and lush-looking in the autumn thanks to the dominance of members of *Chenopodiaceae*. Most species are flowering as late as September-October and there is a colourful display in late autumn, especially of *Salsola* species with large-winged fruits in shades of grey, brown, pink, rose and orange to dark or blackish red. The species are specialists on different kinds of more or less extreme soils mostly with high contents of salts, but occur also on sands and stony ground (see pp. 28-30).

As the family has not yet been treated for Flora Iranica several of the determinations are preliminary, especially those of *Salsola*. Probably several more species of this genus occur within the area.

Aellenia glauca (M.B.) AELLEN – East of Siah Kuh.

Aellenia subaphylla (C.A. MEY.) AELLEN – Frequent within area, often in association with *Artemisia herba-alba*.

Agriophyllum minus FISCH. & C.A. MEY. — On open sand in sandy area SE. of Siah Kuh. Two different forms occurred together on the sand, one of them with large bracts called ssp *arganense* AELLEN.

Anabasis annua BUNGE – Fig.3A – Rare, but here and there on sterile soil.

Anabasis setifera MOQ. – Frequent on gravelly soil, but also on sand. A rather confusing group of forms with or without spine-tipped leaves and obviously flowering already the first year so as to give the impression of being annual.

Anthochlamys multinervis RECH. f. – Occurring on soil rich in lime with poor vegetation, e.g. near Eynor Rashid but also on sand.

Atriplex dimorphostegia KAR. & KIR. – Here and there, stony desert.

Atriplex thunbergiifolia BOISS. – By brackish spring of Eynor Rashid and Shah Abbas Caravanserai.

Bienertia cycloptera BUNGE – Noted on salt flat near Mobarakieh (P.W).

Cornulaca leucacantha CHARIF & AELLEN – On salt flats near Mobarakieh; on sand dunes SE. of Siah Kuh.

Esfandiarica calcarea CHARIF & AELLEN – Growing on whitish soil rich in lime which forms a sterile crust with a pH of 7.7; near Eynor Rashid and north of Shah Abbas Caravanserai. Eynor Rashid is in fact the type locality for this species belonging to a monotypic genus. For a long time this peculiar plant (Fig. 6A) was thought to be endemic to Siah Kuh, but it has recently been found between Abadeh and Yazd (FOROUGHI and AS-SADI) and also in some localities north of the Kavir (RECHINGER). The genus is obviously very closely related to *Anabasis*.

Gamanthus gamocarpus (MOQ.) BUNGE — Apparently rather rare within the area. Collected in the *Seidlitzia rosmarinus*-association on gravelly-sandy soil east of Mobarakieh.



FIG. 3 A. *Anabasis annua*, branch with fruits; B. *Seidlitzia rosmarinus*, branch with young fruit, x 2/3.

Girgensohnia oppositiflora (PALL.) FENZL –

Here and there.

Halanthium rariflorum C.KOCH – Fig. 4. Here and there on sterile soil slopes. Soil probably rich in salts and somewhat clayey becoming very hard when dry.

Halocharis sulphurea MOQ. – Rather frequent within area.

Halocnemum strobilaceum PALL. – A sheet labelled Kavir-e Varamin, CHARIF and AELLEN, may have been collected within the area. VAHEDI No. 47 is from the area but lacks exact locality.

Halostachys belangeriana (MOQ.) BOTSCH. Fig. 6B Salt flats east of Mobarakieh. C. 1.5 m high plants occur scattered on small mounds Pl.I, fig. 2.

Halotis pilosa. (MOQ.) ILJIN – On sandy gravelly soil, frequent in *Seidlitzia rosmarinus* – association along road east of Mobarakieh.

Haloxylon aphyllum (MINKW.) ILJIN – Frequent on the sand dunes SE of Siah Kuh. Up to 2 m high shrubs.

Haloxylon persicum BUNGE ex BOISS. – Frequent together with the preceding species. Up to 2 m high shrubs with + drooping branches. Using the character of the leaves (Fig. 6 C,D) there seems to be no difficulty in distinguishing between the two species, but the leaf character does not seem to be properly correlated with characters of the branches, mostly slender and drooping in *H. persicum* and somewhat thicker and more erect in *H. aphyllum*. Fruits were not well developed and could not be compared. Hybrids may occur.

Horaninowia aptera CHARIF & AELLEN – On sand dunes, SE. of Siah Kuh. Described from this region and may be endemic to the area.

Horaninowia platyptera CHARIF & AELLEN – On sterile sandy-clayey soil rich in salts. Described from the Siah Kuh area and like the preceding species previously only known from a single specimen. Recently collected also north of the Kavir.

Hypocylix kernerii WOLOSZC. – Stony ground on pass S. of Eynor Rashid.

Londesia eriantha FISCH. & C. A. MEY. Fig. 5. Here and there, locally frequent. In the spring of 1975 a nest, probably of bar-tailed desert lark

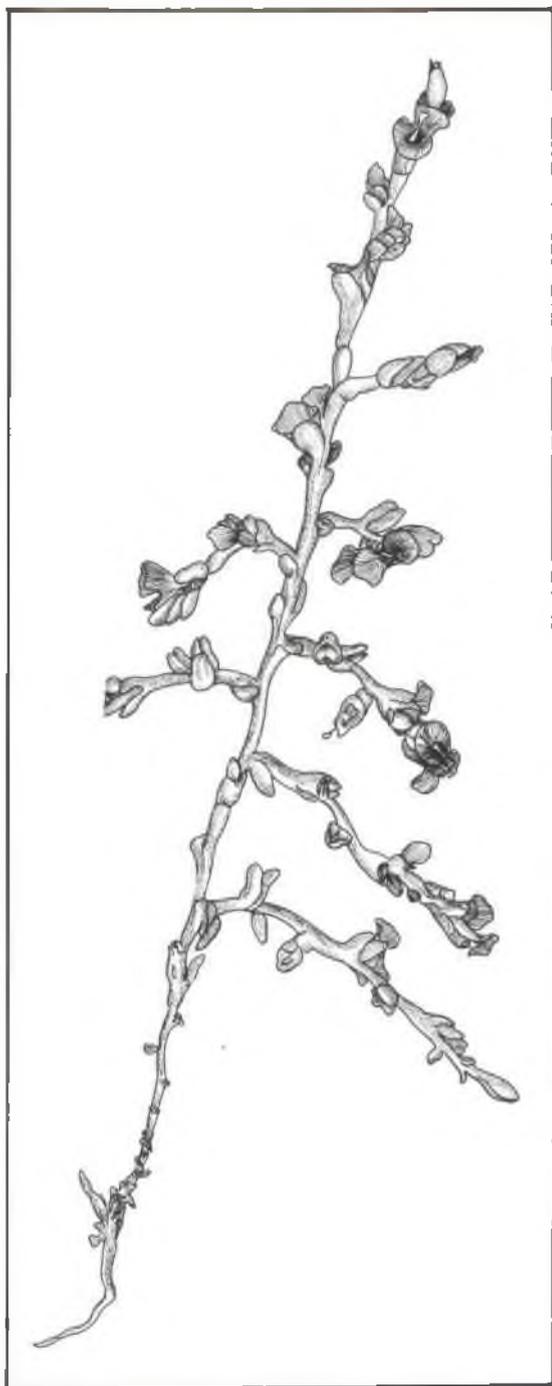


FIG. 4 *Halanthium rariflorum*, branch with fruits, x 2/3.

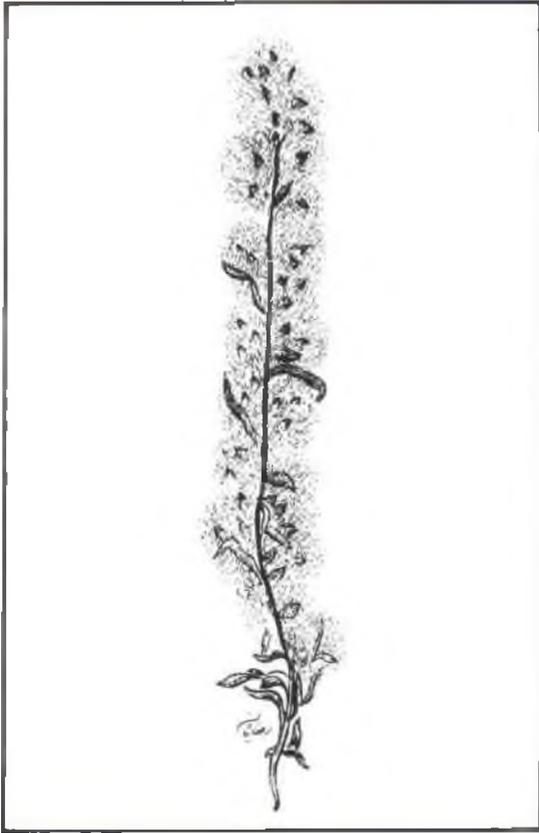


FIG. 5 *Lonsdesia eriantha*, plant in fruit, nat. size.

(*Ammomanes cincturus*), was found to be built mainly of the very woolly fruits of this species

Salsola cfr. *aperta* PAULS. – On open sand, sandy area SE. of Siah Kuh. If correctly named this species is new to Iran, previously known from Turkmenistan and Central Asiatic part of USSR.

Salsola arbuscula PALL. – Characteristic, c. ½ m high shrub on sand dunes SE. of Siah Kuh, but also found on stony ground in several places.

Salsola aurantiaca BUNGE – Frequent, often in the *Artemisia*-steppe. A low shrub which is very variable in pubescence, from glabrous to rather densely hairy with somewhat crisped scabrid hairs. The colour of the wings of the fruiting perianth may be bright orange to red or black-red.

Salsola crassa M.B. – Here and there, usually on salty ground.

Salsola incanescens C.A. MEY. – A frequent annual found in many places within area, on different kinds of soil.

Salsola richteri KAREL. – One sheet of this very characteristic species with 6.5 cm long, very slender leaves is kept at the herbarium of the Department of Environmental Conservation (VAHEDI 89). No exact locality is given. The plant should be a tall shrub growing on sand.

Salsola rigida PALL. – Stony ground, Siah Kuh area.

Seidlitzia rosmarinus (EHR.) BUNGE Fig. 3B This low shrub forms a characteristic belt on the gently sloping ground above the salt flat along the road from Mobarakieh to Shah Abbas Caravanserai. It also occurs in the *Artemisia*-steppe.

Suaeda arcuata BUNGE – Near Eynor Rashid.

Suaeda cfr. *fruticosa* (L.) FORSSK. – Between Eynor Rashid and Shah Abbas Caravanserai.

Suaeda monoica FORSSK. ex J.F. GMEL. – Salt flats east of Mobarakieh. C. 1.4 m high shrub scattered with *Halostachys belangeriana*.

Compositae

Acantholepis orientalis LESS. – Frequent within area, often in *Artemisia*-steppe.

Aegopordon berardioides BOISS. – Stony slopes.

Amberboa turanica ILJIN – Frequent within area, on sandy and on stony or gravelly soil.

Anthemis brachystephana BORNHM. & GAUBA – Locally frequent, here and there on stony slopes.

Artemisia herba-alba ASSO s.l. – Frequent on stony or gravelly soil and often the dominant plant over wide stretches.

FIG. 6 A. *Esfandiaria calcarea*, stem with fruits and part of caudex; B. *Halostachys belangeriana*, branch with fruiting "cones". C. *Haloxylon persicum*, bit of branch with scale leaves. D. *Haloxylon aphyllum*, bit of branch with scale leaves. A,B: x 2/3. C,D: x 2.



Centaurea bruguierana (DC.) HAND. – MAZZ.
ssp. *belangerana* (DC.) BORNH. – Seen around
Eynor Rashid, of weedy character.

Cousinia onopordioides LEDEB. – Higher re-
gions of Siah Kuh on north side.

Cousinia prolifera JAUB. & SPACH – Here and
there.

Crepis kotschyana BOISS. – Rather frequent,
mostly on stony slopes.

Crepis sancta (L.) BAK. – Here and there.

Echinops leucographus BUNGE – S. and SE.
side of Siah Kuh. Stony desert.

Echinops robustus DC. – North slope of Siah
Kuh; west of Siah Kuh on road to Mobarakieh.

Epilasia sp. – Near Shah Abbas Caravanserai.

Filago hurdwarica (DC.) WAGENITZ – N. side
of Siah Kuh.

Gymnarhaena micrantha DESF. – Frequent.

Heteroderis pusilla BOISS. – Here and there.

Jurinea carduiiformis (JAUB. & SPACH) BOISS.
– Here and there on stony slopes.

Jurinea ramosissima DC. – Rather frequent,
usually associated with *Artemisia herba-alba*.

Koelpinia linearis PALL. – Rather frequent.

Lactuca glaucifolia BOISS. – Rather frequent.

Lactuca orientalis BOISS. – In *Artemisia* –
steppe near Eynor Rashid, apparently rather rare.

Lactuca undulata LEDEB. – Rather frequent.

Launaea mucronata MUSCHL. – On sand dunes,
SE. of Siah Kuh. This is a Saharo-Sindian species
previously only found in the south of Iran.

Oligochaete minima (BOISS.) BRIQ. – Frequent,

Phagnalon persicum BOISS. – Crevices of rocks,
N. side of Siah Kuh.

Psychrogeton obovatus (BENTH.) GRIERS. –
In crevices of rocks on N. side of Siah Kuh in the
higher region.

Pulicaria crispa (FORSSK.) DC. Syn.: *Francoe-
uria crispa* (FORSSK.) CASS. – West of Siah Kuh
on road to Mobarakieh in open vegetation on
gravelly-sandy soil; dry mountain near Cheshmeh-
ye Sefid Ab.

Scorzonera picridioides BOISS. – Dry moun-
tain near Cheshmeh-ye Sefid Ab.

Scorzonera pusilla PALL. – Near Eynor Rashid

S. of Shah Abbas Caravanserai.

Senecio desfontainei DRUCE Syn.: *S. coron-
o-pifolius* DESF. – Frequent.

Taraxacum sp. – In wet meadow by brackish
spring of Shah Abbas Caravanserai, Cheshmeh
Shah.

Thevenotia persica DC. – Frequent in *Artemisia
herba-alba* steppe.

Zoegea purpurea FRESEN. – Here and there.

Convolvulaceae

Convolvulus eremophilus BOISS. & BUHSE –
Frequent on sand dunes SE. of Siah Kuh.

Convolvulus pilosellifolius DESR. – Here and
there near to springs.

Cressa cretica L. Near brackish springs of Eynor
Rashid and Shah Abbas Caravanserai.

Cuscuta brevistyla A. RICH. – Frequent. Parasit-
ing on different hosts: *Aellenia* sp., *Amberboa
turanica*, *Artemisia herba-alba*, *Calligonum persicum*,
Londesia eriantha, *Pteropyrum aucheri*.

Cuscuta pedicellata LEDEB. – Here and there.
Found on following hosts: *Amberboa turanica*,
Hyoscyamus pusillus, *Psammogeton brevisetum*.

Cruciferae

Alyssum linifolium STEPH. – Here and there on
gravelly soil.

Alyssum marginatum STEUD. ex BOISS. –
Stony slope between Mobarakieh and Shah Abbas
Caravanserai.

Arabidopsis pumila (STEPH.) N. BUSCH – N.
side of Siah Kuh together with other annuals.

Brassica deflexa BOISS. ssp. *leptocarpa* (BOISS.)
HEDGE – Fig. 7C. Near Mobarakieh.

Cardaria draba (L.) DESV. – Near spring of
Shah Abbas Caravanserai. Anthrochorous.

Diptychocarpus strictus (FISCH.) TRAUTV.
Fig. 7D – N. side of Siah Kuh; between Siah Kuh
and Mobarakieh. Stony slopes.

Diplotaxis harra (FORSSK.) BOISS. Fig. 7E.
No pressed material exists, but we have a definite
feeling of having seen this species on several occa-
sions.

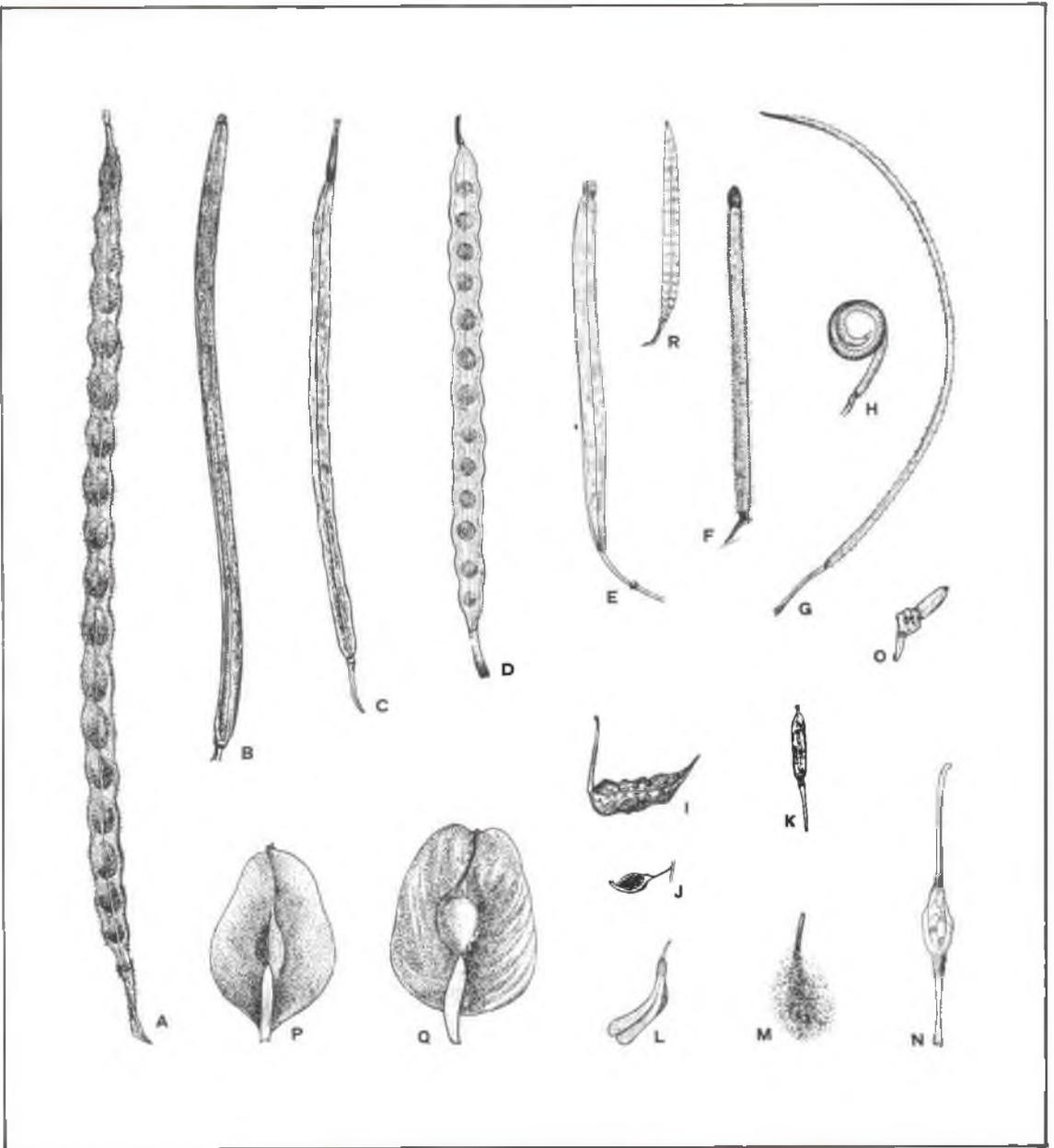


FIG. 7 Fruits of members of Cruciferae: A. *Matthiola chenopodiifolia*; B. *Moricandia sinaica*; C. *Brassica deflexa* ssp. *leptocarpa*; D. *Diptychocarpus strictus*; E. *Diptotaxis harra*; F. *Malcolmia africana*; G. *Torularia aculeolata*; H. *Torularia torulosa*; I. *Goldbachia laevigata*; J. *Tauscheria lasiocarpa*; K. *Pseudocamelina glaucophylla*; L. *Isatis minima*; M. *Lachnoloma lehmannii*; N. *Spirorrhynchus sabulosus*, young straight fruit; P-Q. *Fortuynia bungei*, from different collections; R. *Leptaleum filifolium*. All x 1,1/3.

Fortuynia bungei BOISS. Fig. 7P,Q. In the Cheshmeh-ye Sefid Ab region, in stony desert. There is much variation in the fruit shape and some specimens are very similar to *F. garcinii* (BURM.) SHUTTLEW. which occurs in the southern part of Iran. Possibly the two species are identical, in which case the latter name is the valid one (see HEDGE 1968, 53).

Goldbachia laevigata (M.B.) DC. Fig. 7I. Near Shah Abbas Caravanserai.

Hymenolobus procumbens (L.) HEDGE & LAMOND – Wet ground near brackish spring of Shah Abbas Caravanserai.

Isatis minima BUNGE – Very frequent both in the *Artemisia* - steppe and on sandy soil. Fig. 7L.

Lachnoloma lehmanii BUNGE Fig. 7M – Near Eynor Rashid and Shah Abbas Caravanserai. This species which is widespread in the lowlands of Central Asia was previously known from only two localities in Iran, on the eastern border of the Kavir.

Lepidium latifolium L. – Noted near brackish spring of Shah Abbas Caravanserai. Anthropochorous.

Leptaleum filifolium (WILLD.) DC. – Fig. 7R – Sandy area SE. of Siah Kuh.

Malcolmia africana (L.) R. BR. – Near Shah Abbas Caravanserai. Fig. 7F.

Malcolmia strigosa BOISS. – Together with other annuals, N. side of Siah Kuh.

Matthiola chenopodiifolia FISCH. & C.A.MEY. Fig. 7A. Very frequent. Flowers variable in colour sometimes greenish yellow, sometimes with a strong tinge of violet.

Moricandia sinaica (BOISS.) BOISS. Fig. 7B. Found near Shah Abbas Caravanserai, near Eynor Rashid and in sandy area SE of Siah Kuh. Not previously recorded from Central Iran.

Pseudocamelina glaucophylla (DC.) N. BUSCH – Locally frequent in open semi-desert vegetation ESE. of Siah Kuh on road to Mulkabad. Fig. 7K.

Sameraria armena (L.) DESV. Fig. 8A,B. Rather frequent in *Artemisia* – association.

Sameraria elegans BOISS. – Fig. 8C. – Rather frequent, often together with the previous species.

Schimpera arabica HOCHST. & STEUD. Fig. 7O – Frequent in sandy area SE. of Siah Kuh. Previously in Iran only known from the southern parts.

Sisymbrium irio L. – N. side of Siah Kuh. Anthropochorous.

Spirorrhynchus sabulosus KAR. & KIR. – Fig. 7N. – On open sand, sandy area SE. of Siah Kuh. Previously only three records from Iran, in the Kerman and Khorassan provinces.

Sterigmotemum acanthocarpum FISCH. & C.A. MEY. Fig. 8D,E. Very frequent, mostly in *Artemisia* – steppe on gravelly soil.

Tauscheria lasiocarpa FISCH. ex DC. – Ridge of Siah Kuh. Fig. 7J.

Torularia aculeolata (BOISS.) O.E. SCHULZ Fig. 7G. – N. side of Siah Kuh together with other annuals.

Torularia torulosa (DESF.) O.E. SCHULZ – Frequent, both on sand dunes and on more stony ground. Fig. 7H.

Dipsacaceae

Scabiosa olivieri COULT. – Frequent.

Euphorbiaceae

Andrachne fruticulosa BOISS. – Open semidesert vegetation on gently sloping, stony ground, east of Siah Kuh along road to Mulkabad.

Andrachne telephioides L. – Frequent, mostly in *Artemisia*-association.

Crozophora gracilis FISCH. & C.A. MEY. – Fig. 9A,B. – Sandy area SE. of Siah Kuh. No locality was previously known for this species in Iran. Its main area is in Turkmenistan and Uzbekistan where it is always found on sand.

Crozophora hierosolymitana SPRENG. – In *Artemisia*-association near Eynor Rashid.

Euphorbia azerbaijanica BORDZ. – Cheshmeh Shah, KARIMI no. 130. This species has apparently only been collected once or twice before in Iran.

Euphorbia densa SCHRENK – Here and there.

Euphorbia inderiensis KAR. & KIR. – Fig. 10.



FIG. 8 A-B. *Sameraria armena*: A. Habit, x ½; B. Fruit, nat. size. C. *Sameraria elegans*, fruit, nat. size. D-E. *Sterigmostemum acanthocarpum*; D. Habit, x ½; E. Fruit, nat. size.

— Stony ground with other annuals across pass of Siah Kuh from Eynor Rashid, also near Eynor Rashid. Only three localities were previously recorded for this species in Iran, all in Khorassan.

Frankeniaceae

Frankenia hirsuta L. — Near Cheshmeh Shah. Anthrochorous.

Frankenia pulverulenta L. — Near Eynor Rashid. Anthrochorous.

Geraniaceae

Erodium oxycarrhynchum M.B. ssp. *oxycarrhynchum* — Rather frequent on stony ground.

Labiatae

Chamaesphacos ilicifolius SCHRENK Syn.: *Ch. longiflorus* BORNHM. & SINT. -Fig. 11C - On open sand; sand dunes SE. of Siah Kuh. This small plant which is confined to open sand, has probably been overlooked in many places. It is known from de-

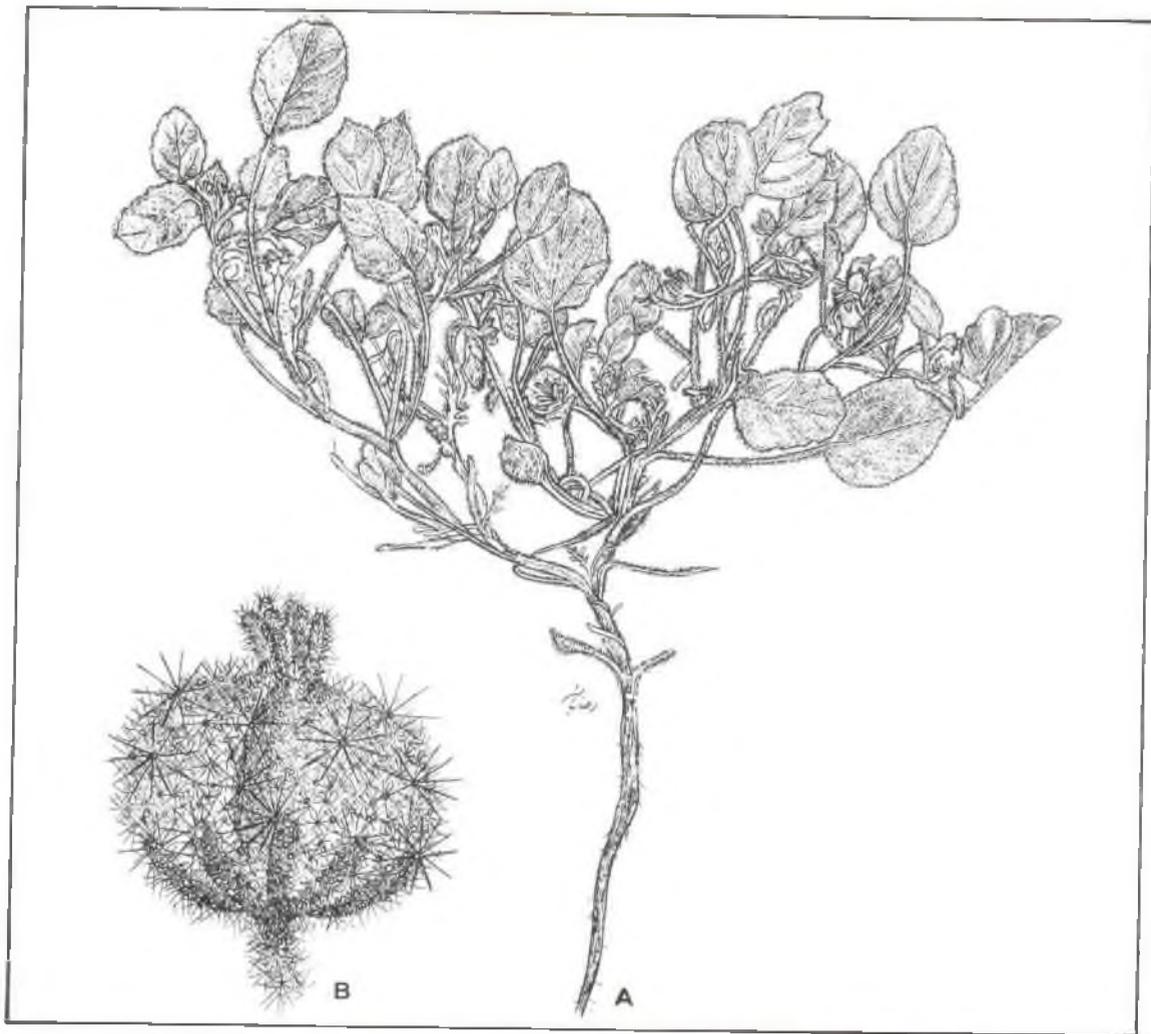


FIG. 9 *Crozophora gracilis*: A. Habit, nat. size; B. Fruit, x 10.

sert areas of Soviet Central Asia and W. Afghanistan.

Lallemantia royleana (WALL.) BENTH. - Frequent, mostly on stony ground.

Nepeta ispahanica BOISS. - Fig. 11A. - Frequent

Nepeta micrantha BUNGE ex LEDEB. - Frequent.

Nepeta pungens BENTH. - Here and there.

Salvia macrosiphon BOISS. - Here and there on stony slopes. Very variable in size.

Thuspeinantha persica (BOISS.) BRIQ. - Fig. 11B. - Rather frequent on gravelly-stony soil, but also on sand.

Ziziphora tenuior L. - Very frequent in steppic vegetation.

Leguminosae

Alhagi camelorum L. - Here and there.

Astragalus (Oxyglottis) ammophilus KAR. & KIR. – Only found near Mobarakieh.

Astragalus (Falcinellus) bakaliensis BUNGE – Here and there.

Astragalus (Poterium) glaucacanthus FISCH. – In steppic vegetation, near Mobarakieh.

Astragalus (Aulacolobus) guttatus BANKS & SOLAND. – Here and there.

Astragalus (Harpilobus) hauarensis BOISS. – Here and there, on sandy soil.

Astragalus (Ophiocarpus) ophiocarpus BENTH. Near Shah Abbas Caravanserai.

Astragalus (Oxyglottis) schimperii BOISS. – Sandy area SE. of Siah Kuh.

Astragalus (Chronopus) spinescens BUNGE – Fig. 12; Pl. II fig. 2 – In *Artemisia* – steppe near Eynor Rashid; dry mountain slope near Cheshmeh-ye Sefid Ab.

Astragalus (Ammodendron) squarrosus BUNGE – C. ½ m high shrub which is frequent on sand dunes SE. of Siah Kuh.

Astragalus (Oxyglottis) tribuloides DEL. – Frequent.

Astragalus (Chronopus) vanilla BOISS. – Near Mobarakieh; stony desert near Howz-e Gheylughey.

Chesneya astragalina JAUB. & SPACH – Here and there, mostly on barren, stony slopes.

Glycyrrhiza glandulifera WALDST. & KIT. – Wet ground near Cheshmeh Shah. Anthropochorous.

Goebelia alopecuroides (L.) BUNGE ex BOISS. Syn.: *Sophora alopecuroides* L. – Near Cheshmeh Shah. Anthropochorous.

Lagonychium farctum (BANKS & SOLAND.) BOBR. Syn.: *Prosopis farcta* (BANKS & SOLAND.) MACBRIDE; *Prosopis stephaniana* (WILLD.) KUNTH ex SPRENG. – Near Shah Abbas Caravanserai. Only a few stands were seen of this plant which is considered a noxious weed. Most probably it has been more frequent in the previously badly degraded vegetation of the area, but is now gradually losing ground as the natural flora is recovering.

Onobrychis aucheri BOISS. ssp. *teheranica* BORNH. – Rather frequent.

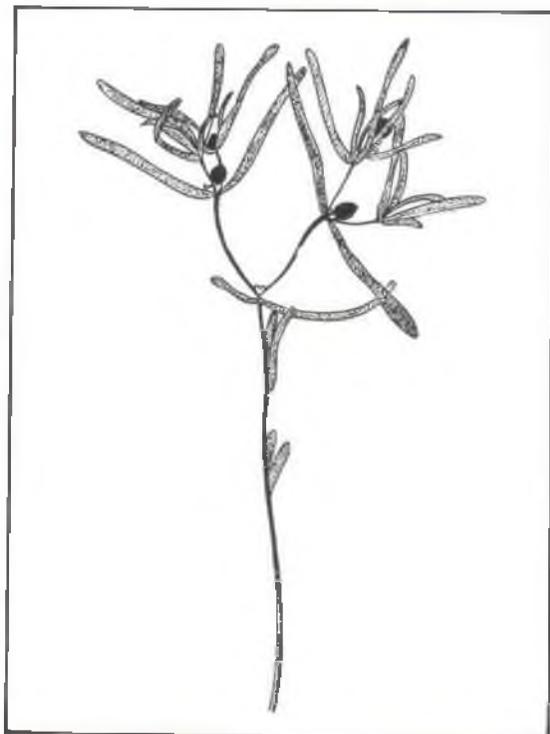


FIG. 10 *Euphorbia indieriensis*, nat. size.

Malvaceae

Alcea cfr. *aucheri* (BOISS.) BOISS. – One sheet kept at the Department of Environmental Conservation, VAHEDI no. 35, is in a rather poor state with disintegrating fruits and no basal leaves. The whole plant is covered with brownish, stellate hairs. Western part of Siah Kuh.

Althaea ludwigii L. – Dry mountain near Cheshmeh-ye Sefid Ab.

Orobanchaceae

Cistanche salsa (C.A. MEY.) G. BECK – Only found east of Siah Kuh by road to Mulkabad.

Cistanche tubulosa (SCHRENK) R. WIGHT – In the spring of 1974 only a few specimens were found. In the much drier spring of 1975 this species was seen in many places. Found on *Pteropium aucheri* and on different *Chenopodiaceae*, e.g. on *Haloxylon aphyllum* and *H. persicum* in the



FIG. 11 A. *Nepeta ispanica*. B. *Thuspeinantha persica*. C. *Chamaesphacos ilicifolius*. All nat. size.



FIG. 12 *Astragalus spinescens*: A. Habit; B. Fruit, x 2/3.

sand dunes SE. of Siah Kuh.

Orobanche cernua LOEFL. var. *desertorum*
G. BECK - Here and there.

Papaveraceae

Glaucium elegans FISCH. & MEY. - Rather frequent.

Hypecoum pendulum L. - Here and there.

Papaver decaisnei HOCHST. & STEUD. ex
BOISS. - Stony slopes between Mobarakieh and
Shah Abbas Caravanserai; also seen on north slope
of Siah Kuh.

Papaver tenuifolium BOISS. & HOHEN. - Here,
and there in steppic and semidesert vegetation.

Roemeria hybrida (L.) DC. - A few plants
found on stony slope between Mobarakieh and
Shah Abbas Caravanserai.

Plumbaginaceae

Acantholimon leucacanthum (JAUB. & SPACH)
BOISS. - Only found on dry mountain slope
near Cheshmeh-ye Sefid Ab.

Acantholimon talagonicum BOISS. - Top re-

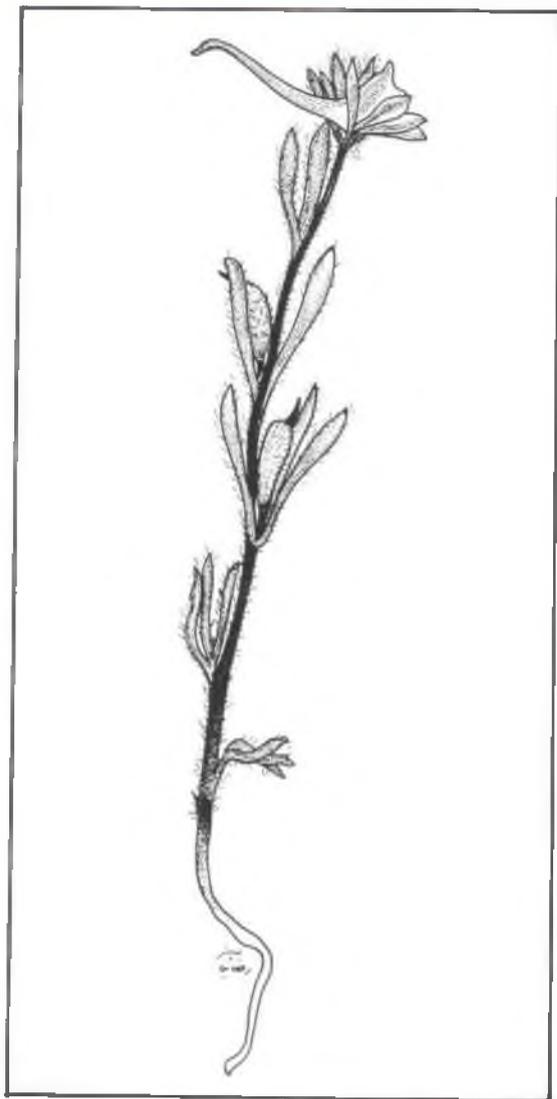


FIG. 13 *Delphinium rugulosum*, nat. size.

gion on north side of Siah Kuh. The plants collected do not quite fit the description of this species as the leaves are shorter (less than 25 mm long) and the calyx nerves are glabrous on the outside. Similar specimens have been found west of the Qom Lake on road from Tehran to Qom.

Acantholimon truncatum BUNGE —Here and there, mostly on stony ground. Around *A. trun-*

catum there is a complex of closely related species which do not seem to be very well delimited either geographically or taxonomically. P.W.

Limonium iranicum (BORN.M.) LINCZ. — Near Eynor Rashid.

Polygonaceae

Atraphaxis spinosa L.— North slope of Siah Kuh.

Calligonum persicum BOISS. — Frequent on sand dunes SE. of Siah Kuh.

Polygonum rottboellioides JAUB. & SPACH — Here and there on stony ground.

Pteropyrum aucheri JAUB. & SPACH — Frequent, often in association with *Artemisia herba-alba* on stony ground. Up to 1 m high.

Rheum ribes L. — Rather frequent on north slope of Siah Kuh.

Primulaceae

Glaux maritima L. — One sheet in the herbarium of the Department of Environmental Conservation, (VAHEDI no. 83) has no exact locality. Must have been collected near one of the brackish springs.

Ranunculaceae

Anemone biflora DC. s.l. — Crevices of rock, north side of Siah Kuh. A few small - flowered specimens found.

Ceratocephalus falcatus PERS. — Siah Kuh, north side in higher regions.

Delphinium rugulosum BOISS. Fig. 13. — Here and there in steppic vegetation, in the area of Shah Abbas Caravanserai.

Nigella integrifolia REGEL — North side of Siah Kuh together with other annuals.

Resedaceae

Reseda aucheri BOISS — Frequent. Vegetating and flowering both in spring and in autumn.

Rosaceae

Amygdalus scoparia SPACH — North side of Siah Kuh; mountain near Cheshmeh-ye Sefid Ab. In small valleys on the north side of Siah Kuh there are rather dense stands of shrubby specimens, but

specimens more than 4 m high with a stem as thick as an arm occur. It seems as if this species is now spreading into the *Artemisia*-steppe at the foot of the mountain near Shah Abbas Caravanserai.

Cerasus microcarpa (C.A. MEY.) BOISS. ssp. *microcarpa* — Up to 1 m high shrubs scattered on the north side of Siah Kuh.

Cotoneaster cfr. *kotschyi* KLOTZ — One gnarled shrub, about 1 m high, was found at 1750 m on the north side of Siah Kuh. Seems to fit the description of this species well. The material lacks fruits.

Rubiaceae

Callipeltis cucullaris (JUST.) ROTHM. — Stony slopes with annuals.

Gaillonia bruguieri A. RICH. — Here and there in *Artemisia*-steppe and in open vegetation on stony ground.

Galium humifusum M.B. — Foot of Siah Kuh above Cheshmeh Shah.

Galium setaceum LAM. — In shade of rocks N. side of Siah Kuh.

Galium spurium L. s. l. — In shade of rocks N. side of Siah Kuh.

Leptunis trichodes (C. GAY) EHREND. — Here and there on stony ground.

Rutaceae

Haplophyllum glaberrimum BUNGE ex BOISS. — Frequent on sand dunes SE. of Siah Kuh; otherwise rare in *Artemisia*-steppe.

Haplophyllum robustum BUNGE — Frequent in *Artemisia*-steppe and in open vegetation on stony, more or less flat ground.

Haplophyllum tuberculatum (FORSSK.) JUSS. s.l. — Dry mountain slope near Cheshmeh-ye Sefid Ab.

Salicaceae

Salix acmophylla BOISS. — Small tree in valley on the north side of Siah Kuh, above Cheshmeh Shah.

Scrophulariaceae

Anthirrhinum sp. — One small, white-flowered specimen found in sandy area SE. of Siah Kuh, but was lost.

Linaria michauxii CHAV. — Rather frequent on dry open ground around Shah Abbas Caravanserai, Cheshmeh Shah and Eynor Rashid, as well as near Cheshmeh-ye Sefid Ab.

Scrophularia striata BOISS. — Rather frequent on rocky slopes. Obviously much appreciated by the wild sheep as all specimens seen on the north side of Siah Kuh were grazed.

Veronica anagallis-aquatica L. — Wet ground by Cheshmeh Shah.

Veronica campylopoda BOISS. — North side of Siah Kuh.

Veronica macropoda BOISS. — North side of Siah Kuh.

Veronica rubrifolia BOISS. — Apparently rare, but probably overlooked due to its small size. North-facing stony hill west of Shah Abbas Caravanserai.

Solanaceae

Hyoscyamus pusillus L. Fig. 14. — Rather frequent on gravelly soil.

Lycium depressum STOCKS — Scattered c. 1 m high specimens on salt flat near Mobarakieh; 1.5-2 m high shrubs near Cheshmeh Shah. Flowers pale lilac to whitish with a dark stripe at the base of the corolla lobes.

Lycium ruthenicum MURRAY — Near Cheshmeh Shah. Shrub about 1 m high with violet flowers.

Tamaricaceae

Reaumuria turcestanica GORSCHK. — Salt flats near Mobarakieh; near brackish spring of Eynor Rashid.

Tamarix brachystachys BUNGE — Near brackish spring of Eynor Rashid. Shrubs about 1.5 m high. Petals 3-3.5 mm long (not 4¼mm), but otherwise it fits the description of the species very well.

Tamarix hispida WILLD. var. *karelinii* (BUNGE) BAUM — Near brackish spring of Eynor Rashid and Cheshmeh Shah; scattered specimens on salt flats near Mobarakieh. Up to 2 m high shrubs with pink or white flowers, fragrant.

Thymelaeaceae

Dendrostellera lessertii (WIKSTR.) VAN TIEGH.

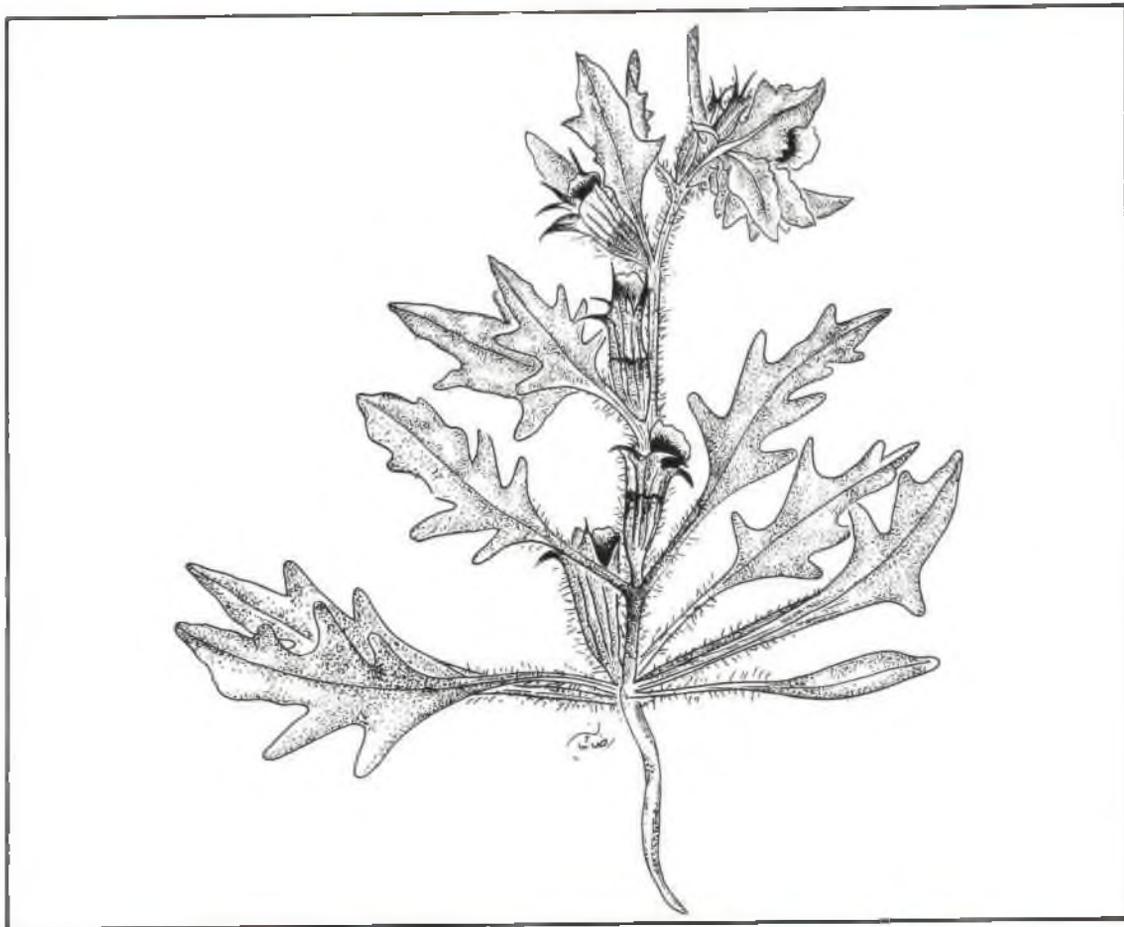


FIG. 14 *Hyoscyamus pusillus*, nat. size.

— Frequent on stony and gravelly ground, mainly in the *Artemisia*-steppe .

Diarthron vesiculosum (FISCH. & C.A. MEY.) C.A. MEY. — Only found near Eynor Rashid once, but very probably overlooked in other places.

Umbelliferae

Bunium persicum (BOISS.) FEDTSCH. — Frequent on north slope of Siah Kuh.

Ducrosia anethifolia DC. — Frequent, in many places on stony ground. Whereas most other plants were poorly developed in the dry spring of 1975, this species seemed to flourish and to be more plentiful than the year before.

Ferula cfr. *hirtella* BOISS. — Here and there on stony ground. A rather low plant, 30-40 cm, with comparatively broad sessile, pinnatisect secondary leaf segments. The species is little known and we have seen no material for comparison.

Psammogeton brevisetus BOISS. — Frequent on both sandy and stony soil.

Scandix stellata BANKS & SOLAND. — Frequent on north side of Siah Kuh.

Schumannia karelinii (BUNGE) KOROV. — Scattered, but seen in many places. Both on stony ground and on sand.

Zozimia absinthifolia (VENT.) BOISS. — Here and there on stony slopes.

Urticaceae

Parietaria judaica L. – In crevices of rocks, north side of Siah Kuh.

Valerianaceae

Valerianella szovitsiana FISCH. & C.A. MEY. – Here and there on stony ground.

Valerianella triplaris BOISS. & BUHSE – Here and there on stony ground, but more rare than the preceding species.

Zygophyllaceae

Fagonia bruguieri DC. – Dry mountain near Cheshmeh-ye Sefid Ab.

Nitraria schoberi L. – Scattered, low shrubs on salt flats east of Mobarakieh.

Peganum harmala L. Here and there, mostly in *Artemisia*-steppe.

Tribulus longipetalus VIV. ssp. *longipetalus* – Near Cheshmeh Agha Mohammad Khan (VAHEDI no. 74).

Zygophyllum eurypterum BOISS. & BUHSE – Frequent, often associated with *Artemisia herba-alba*. The material has 4-valved fruits and should thus belong to this species. There is, however, disagreement as to whether this taxon really is specifically distinct from *Z. atriplicoides* FISCH. & C.A. MEY.

Zygophyllum fabago L. – One specimen in the herbarium of the Department of Environmental Conservation is without collector and without exact locality.

Monocotyledonae

Cyperaceae

Carex divisa HUDS. – Wet ground near Cheshmeh Shah.

Cyperus distachyus ALL. – Wet ground near brackish springs of Cheshmeh Mohammad Agha Khan.

Gramineae

Aeluropus littoralis (GOUAN.) PARL. – Wet ground near brackish springs of Cheshmeh Shah and

near Eynor Rashid.

Asthenatherum forsskalii (VAHL) NEVSKI – On sand dunes SE. of Siah Kuh. This grass is known from the sandy deserts of North Africa to Central Asia but is previously only recorded once from Iran – the province of Esfahan.

Boissieria squarrosa (BANKS & SOLAND.) NEVSKI – Stony ground.

Bromus rechingeri MELDERIS – Here and there, stony ground.

Bromus tectorum L. – Stony ground.

Cutandia memphitica (SPRENG.) BENTH. – On sand dunes SE. of Siah Kuh. In Iran previously only recorded from the shores of the Caspian Sea and the Persian Gulf.

Cynodon dactylon (L.) PERS. – Wet ground near brackish spring of Cheshmeh Mohammad Agha Khan. Anthropochorous.

Enneapogon persicus BOISS. – Fig. 15A. – Stony desert near Hows-e Agha Mohammad; dry mountain slope near Cheshmeh-ye Sefid Ab.

Eremopyrum bonaepartis (SPRENG.) NEVSKI – Here and there, on sandy and on stony ground.

Eremopyrum distans (C. KOCH) NEVSKI – Near Shah Abbas Caravanserai.

Melica inaequiglumis BOISS. – In crevices of rocks on north side of Siah Kuh; stony desert near Hows-e Agha Mohammad.

Pennisetum orientale L. C. RICH. – Rocks on north side of Siah Kuh; stony desert near Hows-e Agha Mohammad Khan.

Phalaris minor RETZ. – Wet ground near Cheshmeh Shah. Anthropochorous.

Phragmites australis (CAV.) STEUD. – Dense stands of plants from 1.5 to 4 m high are found near the brackish springs of Eynor Rashid and Cheshmeh Shah.

Poa bulbosa L. – Here and there.

Polypogon monspeliense (L.) DESF. – Hows-e Agha Mohammad Khan. Anthropochorous.

Puccinellia anisoclada V. KREZ. – Wet ground by brackish spring, Cheshmeh Shah. The taxonomy of this genus is difficult but our plant seems to match the description of this species in all details. Previously only a few scattered finds are re-

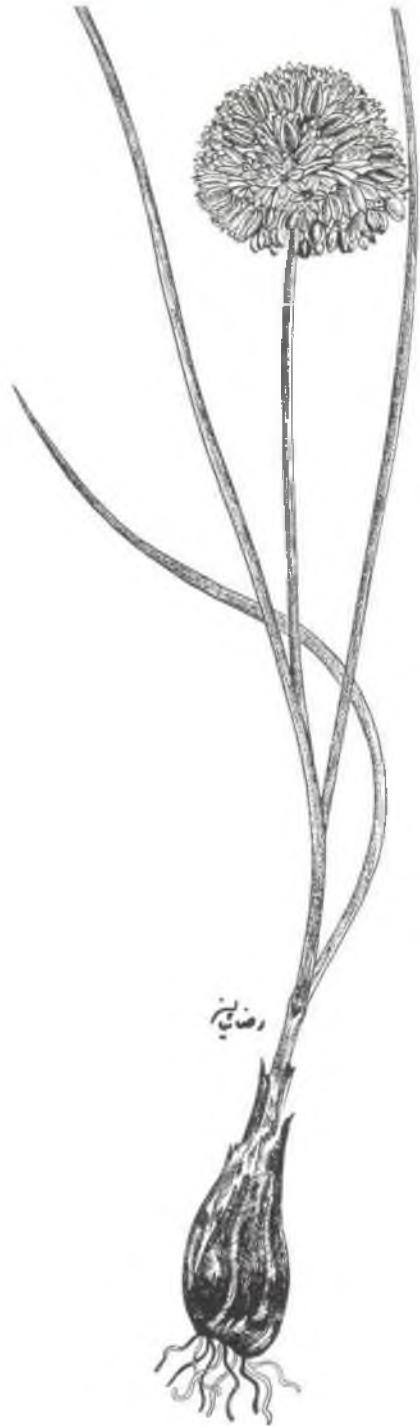
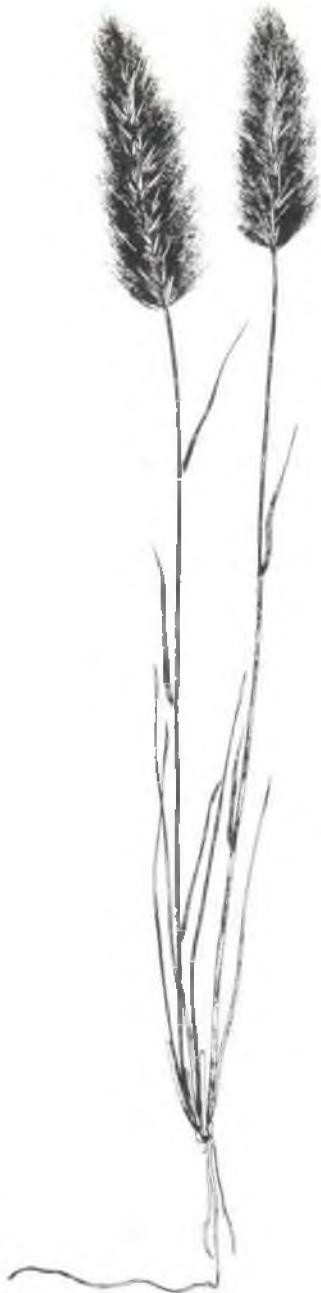


FIG. 15 A. *Enneapogon persicus*, x $\frac{1}{2}$.

B. *Allium bungei*, x $\frac{3}{4}$.

ported from Iran.

Schismus arabicus NEES. —Sandy area ESE. of Siah Kuh.

Stipa arabica TRIN. & RUPR. — Siah Kuh, 1400 m.

Stipa hohenackeriana TRIN. & RUPR. — Here and there on stony ground in *Artemisia*-steppe.

Stipagrostis pennata (TRIN.) DE WINTER — Sand dunes ESE. of Siah Kuh.

Stipagrostis plumosa (L.) T. ANDERS. — Frequent on the sand dunes, but also on stony ground e.g. in the *Artemisia*-steppe.

Juncaceae

Juncus rigidus DESF. — By brackish spring near Eynor Rashid.

Liliaceae

Allium borszczowii REGEL — Rather frequent on sandy soil, but also on stony ground.

Allium bungei BOISS. Fig. 15B—Here and there, stony ground in the *Artemisia*-steppe. Previously rather few localities were known for this species endemic to Iran, but in recent years it has been collected many times in the province of Tehran.

Eremurus luteus BAKER — No herbarium specimen exists, but late fruiting specimens were seen in the autumn of 1974 and sterile rosettes in the spring of 1975 on the northern side of Siah Kuh (P.W.). This species seems to occur mainly in a belt around the Kavir, but is also recorded from Turkmenistan and W. Afghanistan. It is obviously the most xerophytic of the Iranian species of the genus.

Gagea chlorantha (M.B.) J.A. & J.H. SCHULTES — Shade of rocks in the top region on the north side of Siah Kuh.

Zannicelliaceae

Zannichellia palustris L. — In a small pool with brackish water, Cheshmeh Agha Mohammad Khan.

Acknowledgements

We are much indebted to His Excellency Mr. ESKANDAR FIROUZ, Director of the Department of Environmental Conservation, and members of his staff Dr. FRED HARRINGTON, Mr. DALEKI

and Mr. VAHEDI for information and help in different ways, as well as to the staff at the Shah Abbas Caravanserai, headquarters of the Kavir Protected Region, for assistance during our visits there.

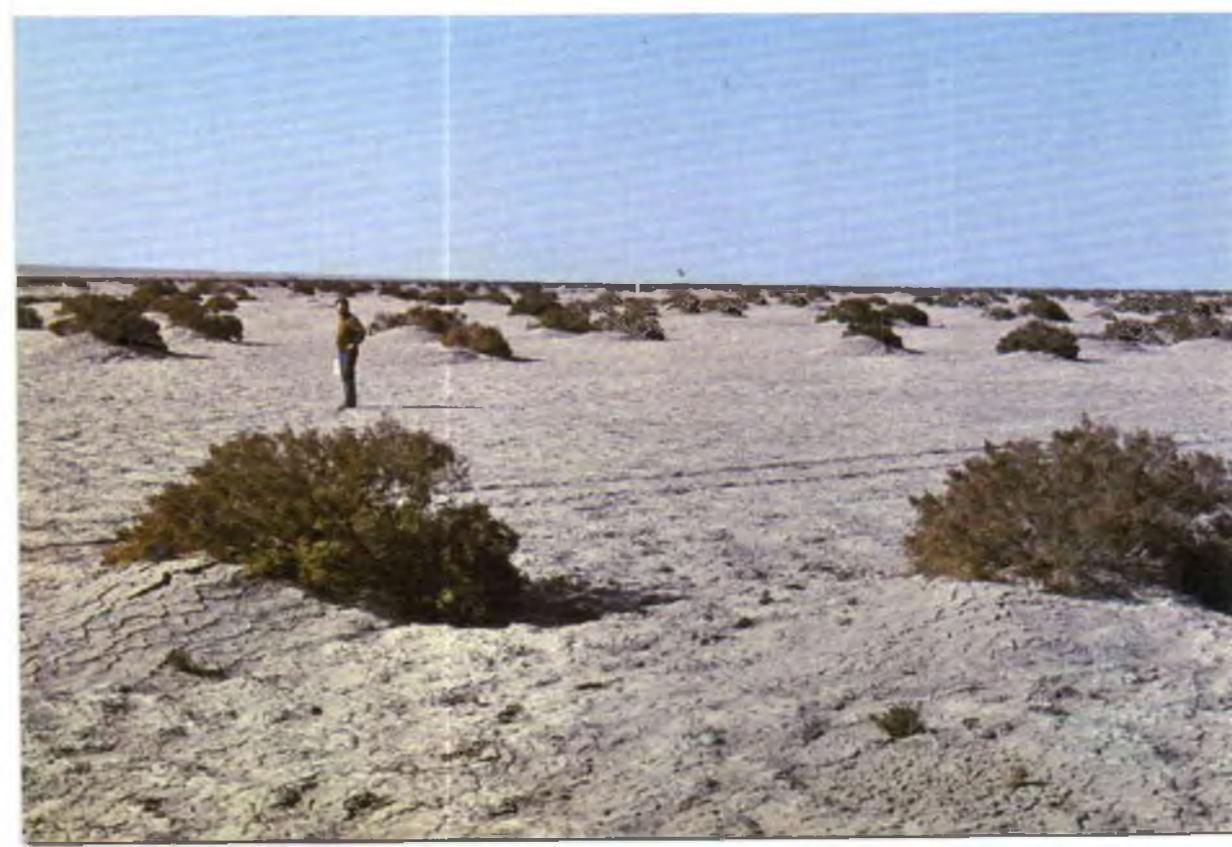
We gratefully acknowledge help with determinations from the following botanists: Mr. M. ASSADI of Tehran (most of the *Caryophyllaceae*), Prof. Dr. H. FREITAG of Göttingen (*Stipa*), Dr. A. GILLI of Wien (*Orobanche*), DR. H. RIEDL of Wien (larger part of the *Borraginaceae*, *Ephedra*), Mrs. I. RIEDL of Wien (*Silene*), Dr. H. SCHIE-MAN — CZEIKA of Wien (*Acanthophyllum* and partly *Acantholimon*), Prof. Dr. G. WAGENITZ of Göttingen (*Filago*).

All drawings have been made by Mr. M. REZAYAN, artist at Ariamehr Botanical Garden.

The soil samples have been analyzed at the Soil Institute, Tehran.

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Pl. 1, Fig. 1.

Pl. 2, Fig. 1

Pl. 1, Fig. 2.

Pl. 2, Fig. 2

Pl. 1, Fig. 1 Siah Kuh (Black Mountain) with Artemisia-steppe in foreground. Photo P.W.

Pl. 1, Fig. 2 Salt flat with *Halostachys belangeriana*, east of Mobarakieh. Photo H. Forough

Pl. 2, Fig. 1 Sand dune with *Haloxylon aphyllum*, SE. of Siah Kuh. Photo P.W.

Pl. 2, Fig. 2 *Astragalus (Chronopus) spinescens*, near Eynor Rashid. Photo P.W.