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A contribution to the halophytic vegetation and flora of Iran

Hossein Akhani[1] & Mahlagha Ghorbanli[2]
[1]*Natural History Museum of Iran, Department of Botany, 9-Ghaem-Magham Farahani Ave., 15899-Tehran, Iran;*
[2]*Teachers Training University, Department of Biology, 49-Dr. Moffatteh Ave., Tehran, Iran*

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Abstract

An account is given of the halophytic vegetation and flora of Iran. With respect to field studies the halophytic vegetation of Iran is classified into 10 vegetational units. Also, a total of 165 halophytic and salt tolerant species within 73 genera of flowering plants are recognized as a first provisional list of the halophytic flora of Iran. Some data on the life form, distribution, chorotype, halotype and photosynthetic pathway (if available) are given. Finally the role of man in destroying the halophytic vegetation is briefly discussed and a proposal is made to use some of the halophytes for soil improvement.

1. Introduction

Iran is the classical country of great salines and Kavirs (Zohary 1973). Halophytic communities of Iran are still among the most poorly known vegetation units in Iran. This is mainly due to the absence of up-to-date information on the halophytes and the interest of most botanists and ecologists in the rich flora of low-salt or salt-free habitats. Our knowledge of the list of halophytes is restricted to Flora Iranica (Rechinger 1963) where, however, habitats of the plants are rarely given; as well as the local contributions on the desert areas of Iran, such as: Rechinger & Wendelbo (1976), Rechinger (1977), Ghorbanli & Lambinon (1978), Léonard (1981–1989) and Akhani (1990).

The present account is based on various botanical field studies of Iranian saline areas as well as on a taxonomic survey of specific halophytic groups which have performed between 1986–1990. Several saline areas have been visited by us in the provinces of Azarbayjan, Zanjan, Tehran, Arak, Mazandaran, Gorgan, Khorassan, Esfahan, Semnan, Kerman, Yazd, Fars, Hormozgan, Khuzestan, Baluchestan and Ilam. Most herbarium specimens of the more important herbaria in Iran have been studied: TARI, HMIA, TUH, Natural History Museum of Iran (MMTT), Shahid Beheshti and Mashhad Universities.

2. Physico-geographical features

Saline and alkaline soils are expanding in arid and semi-arid regions of Iran and cover 12.5% (204 800 km^2) of the total area of the country. These include: (1) solonchak and solonetz soils; (2) salt marsh soils; (3) desert soils, sierozem and solonchak soils; and (4) saline alluvial soils (Dewan & Famouri 1964; Fig. 1). The elevation of the regions varies between −28 m on shores of Caspian Sea to about 1650 m in Kavire-Meyghan.

A comparison of the annual precipitation with the distribution of saline soils shows that a majority of the areas have total annual precipitation of less than 250 mm/y. Some of the marginal saline basins located in the provinces of Gorgan, Azarbayjan, Arak and Fars receive a total precipitation of up to 400 mm/y.

Different factors are responsible for soil salinity in Iran. Ghobadian (1969) enumerated the following factors as important causes of soil salinity in Khuzestan, viz., saline ground water, the presence of a salt layer in the soil, irrigation, transpiration, the effect of wind, pre-

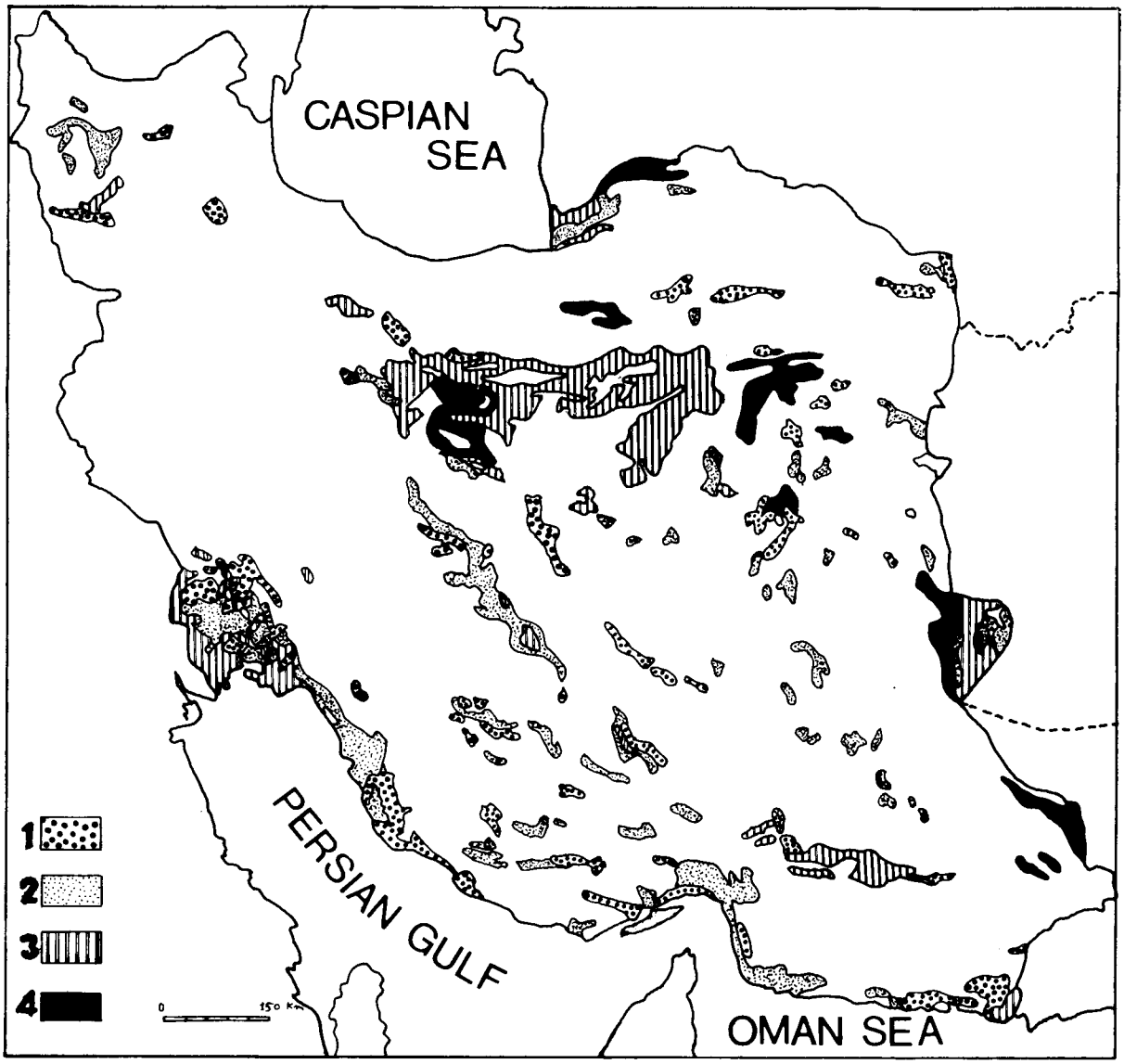

Fig. 1. Distribution of saline soils in Iran (after Dewan & Famouri 1964).
1: Saline alluvial soils.
2: solonchak & solonetz soils
3: salt-marsh soils.
4: desert soils:sierozem and solonchak soils.

cipitation and river flow. In other parts of Iran more or less similar factors affect the soil salinity. In littoral salt marshes and on shores of large salt lakes (e.g. Uromieh Lake and Caspian Sea) salt spray and salt water floods play an important role.

Krinsley (1970) summarized the geological history of Iranian salines in the central playas as follows: central Iran was covered by the Eocene Sea. Orogenic activities of the Late Oligocene caused the emergence of the Alborz Mountains. The basin was filled with erosional material from the surrounding mountains during the Neogene. These deposits were subsequently folded by the Last Plio-Pleistocene phase of the Alpine Orogeny. The central deepest parts of the depressions are covered by

playa deposits and associated dunes and alluvium. The Middle Miocene beds of north-central Iran warped into low anticlines whose adjacent depressions were partly filled with playa deposits. A recent faulting cuts across the playas as well as across the adjoining fans. The Middle Miocene beds provide a source of salt from their extensive salt and gypsum beds. The recycled concentrated salts cause the accumulation of salt deposits.

3. Halophytic vegetation types

Zohary (1973), in his survey of halophytic vegetation of the Middle East, discussed the most of the halophytic communities of Iran with the class *Halocnemetea strobilacei irano-anatolica.* Breckle (1983) classified the halophytic vegetation of Iran and Afghanistan as follows: (1) saline flats (very sparse vegetation, soil with very high salt content); (2) euhalophytic vegetation (halohammada on gravel-sandy but probably on clayey soil); and (3) mesohalophytic vegetation, with less salt in the soil profile. Frey & Probst (1986) provided a geographical classification which includes: (1) salty pans of the central Iranian undrained basins and their peripheries; (2) shore zones of salt lakes; (3) areas on the Persian Gulf; and (4) south Caspian coastal zone.

In this paper the halophytic vegetation of Iran is classified into ten vegetational units. In this geographico-ecological classification a syntaxonomical scheme is not provided, because the study is still provisional and needs intense phytosociological analysis and further information on the relation of plant communities to soil and hydrological properties.

3.1. Halocnemum strobilaceum *communities on muddy salt flats*

Halocnemum strobilaceum is typical of vast areas of saline flats with high salinity and high ground-water level, both inland salines and littoral marshes. In the peripheries of most of the inland salines it forms a pioneer halophytic community, or the second one after the *Salicornia* zone. The *Halocnemum* vegetation is very poor in species; often it is monodominant. The associated species occur on margins or in transition zones towards the neighbouring types of the saltland vegetation.

3.2. Obligatory hygro-halophytic communities

This vegetation type is unique on high salty and wet soils at margins of salt lakes, banks and estuaries of high saline rivers and streams and of littoral marshes of the Persian Gulf. It can be divided into two main subunits, i.e.: (a) inland salt marshes and banks of saline rivers dominated by *Salicornia europaea;* and (b) littoral salt marshes of the Persian Gulf dominated by *Arthrocnemum macrostachyum.*

3.3. Tamarix *communities*

Besides the *Halocnemum strobilaceum* communities, those with *Tamarix* are the most important vegetation units of the Iranian saltland vegetation. Several species of the genus inhabit a variety of saline habitats, particularly saline river beds, saline and sandy soils, estuaries of central depressions and vast areas of inland salines with a relatively high water table.

3.4. Hydrophilous euryhalophytic communities

The vegetation on the margins of salines and moderately saline lakes, salty and brackish swamps, streams and springs and areas with high ground-water are composed of hydrophilous euryhalophytic (including mesohalophytes and facultative halophytes). The dominant species are monocot perennials belonging to the genera *Juncus, Phragmites, Bolboschoenus,* and *Typha.* The vegetation of this type is affected both by salinity and water floods. Some of the taxa found in this type of vegetation have a wide range of salt tolerance (Euryhalophytes), e.g. *Phragmites australis var. australis* growing on banks of fresh-water to high salinity wetlands. *Phragmites australis var. stenophylla,* on the other hand, is a typical halophytic variety adapted to extremely saline habitats.

One of the most outstanding subunits within this type are *Juncus* communities. *Juncus acutus, J. maritimus* and *J. rigidus* play the most important role.

3.5. Mangrove communities

The mangrove vegetation is confined to shores of the Persian Gulf (including islands) and the Oman Sea. *Avicennia marina* is the typical component of this vege-

tation. The *Avicennia marina* forest zone is mostly surrounded landwards by *Halocnemum strobilaceum* or *Arthrocnemum macrostachyum.*

3.6. Hydrohalophytic plant communities

Ruppia maritima is a characteristic component of aquatic plant communities in the marshes along inland salt lakes and brackish and saline streams. *Ruppia* is associated with *Phragmites australis* in the Gorgan Peninsula and was found to grow together with *Chara* species in Kavire-Meygahn.

3.7. Halophytic shrub communities on salty and dry soils

The plant communities classified within this group are geographically distinct in central and southern salines. In central Iran this group is mostly represented by the *Seidlitzia rosmarinus, Nitraria schoberi* and *Reaumuria fruticosa* associations. In southern Iran, on the other hand, the halophytic shrub communities are mostly represented by *Suaeda fruticosa* stands.

3.8. Herbaceous perennial and hemicryptophyte halophytic communities

In most parts of the Iranian salines there are mosaic stands of herbaceous perennial and hemicryptophyte halophytic plants such as: *Salsola dendroides, Limonium iranicum, Aeluropus lagopoides, A. littoralis, Atriplex leucocalda, Halimione verrucifera, Camphorosma monspeliaca, Puccinellia* sp., *Alhagi maurorum* and *Glycyrrhiza glabra.* Such species grow mainly in mosaic stands between patches of the halophytic shrubby and semi-woody communities. These stands also occur as transitional belts between main halophytic communities of *Halocnemum, Salicornia* and *Juncus.*

3.9. Xerohalophytic communities with salt-tolerant xerophytes

The Iranian salines are surrounded by dry gravelly steppes, sandy dunes, limestone and gypsum hills. Subsequently, transitional types between these habitats and the saline soil habitats occur. Such habitats are mostly covered by xerohalophytic communities with salt-tolerant xerophytes. Communities of *Anabasis setifera, A. calcarea, Haloxylon aphyllum,* and *H. salicornicum* are more common in xerohalophytic formations. Some species of the genera *Anabasis, Lycium, Halothamnus, Salsola* (viz. *S. tomentosa, S. orientalis, S. dendroides, S. kerneri*), *Seidlitzia, Reaumuria, Zygophyllum* and some salt-tolerant xerophytes colonize in such conditions.

3.10. Annual halophytic communities

As with other plant formations, the annual species also play an important role in the vegetation of salty habitats. The annuals occurring in saline areas could be divided into three categories: (1) non-halophilous therophytes; (b) spring halophytic therophytes; and (c) late summer annual halophytic chenopods.

4. The halophytic flora

Table 1 gives a first provisional list of the halophytes of Iran. The criteria that have been considered for the preparation of the list of halophytes occurring in Iran are: direct observation and experience in field and laboratory; check with pertinent literature; and, in a few cases, information gained from herbarium labels. The main criteria applied in the field studies were the absence of a species from non-saline habitats and the association with species already known as halophytes. Most of the non-halophytic plants which are also capable of resisting salinity are not included, except the most common ones. Nomenclature follows various sources, mostly the Flora Iranica (Rechinger 1963) and for *Chenopodiceae* Iljin (1936), Grubov (1966), Botschantzev (1981) and Pratov (1986). The account of the genus *Tamarix* is based on Baum (1978), Assadi (1988) and Zohary (1973). Some of the species of the genera *Climacoptera, Halothamnus* and *Salsola,* which have been described from Iran but are not known to us, are not included here. Information on photosynthetic pathways have been taken from Batanouny *et al.* (1988), Borchers *et al.* (1982), Carolin *et al.* (1975, 1982), Frey & Kürschner (1983), Frey *et al.* (1984, 1985) and Voznesenkaya (1976).

The information in Table 1 leads to the following results.

Table 1. List of halophytic and salt-tolerant plants of Iran. Life form: CH = Chamaephyte, H = Hemicryptophyte, P = Phanerophyte, T = Therophyte; Chorotype: IT = Irano-Turanian, SS = Saharo-Sindian (mostly omni-Saharo-Sindian species), AS = Arabo-Sindian, OS = Omano-Sindian, IS = Irano-Sindian, M = Mediterranean, SM = Somalia-Masai, T = Tropical, Cosm = Cosmopolitan, PL = Pluriregional, (Saharo-Sindian and Somalia-Masai species after Léonard, 1988–1989); Halophytic type: E = Euhalophyte, XH = Xerohalophyte, PH = Psammohalophyte, X = Xerophyte, HG = Hygrohalophyte, HY = Hydrohalophyte, P = Parasite. New and noteworthy records are marked with an asterisk.

Species	Life form	Distribution								Chorotype	Halotype	Photo. Path.
		NW	N	NE	W	C&E	SW	S	SE			
Aizoaceae												
Mesembryanthemum nodiflorum L.	T						+	+	?	AS	XH	CAM
Asparagaceae												
Asparagus sp.	H					+				IT	E?	
Asteraceae												
Artemisia fragrans Willd.	CH	+				+				IT	XH	
Aster tripolium L.	H	+	+							ES.M.IT	HG	
Avicenniaceae												
Avicennia marina (Forssk.) Vierh.	P							+	+	T	HG	C_3
Boraginaceae												
Heliotropium bacciferum Forssk.	CH,H							+	+	SS.SM	XH,PH	C_3
H. aucheri DC. subsp. aucheri	CH,H					+				IT	XH	
H. dissitiflarum Boiss.	T	+								IT	XH	
Tournefortia sibirica L.	H		+							ES	PH	
Brassicaceae												
Arabidopsis parvula (Schrenk) Schulz	T	?				+				IT		
Lepidium cartilagineum (J. Mayer) Thell.												
-subsp. cartilagineum	H					+				IT	E	C_3
-subsp. pumilum (Boiss. & Bal.) Hedge	H	+				+				IT	E	C_3?
Caryophyllaceae												
Gypsophila aff. perfoliata L.	T					+				IT	PH?	
Spergularia marina (L.) Griseb.	T,H	+	+	+	+	+	+	+	+	PL	E	C_3
S. media (L.) C. Presl.	H	+	+	+	?	+	?	?	+	IT.ES.M	E	C_3
Sphaerocoma aucheri Boiss.	CH							+	+	SS.SM	PH?	C_3
Chenopodiaceae												
Anabasis aphylla L.	CH	+	+	+		+				IT	E	C_4
A. calcarea (Charif & Aellen) Bokhari & Wendelbo	H					+				IT	XH	
A. eriopoda (Schrenk) Benth.	H			+		+				IT	XH	
A. hausknechtii Bge. ex Boiss.	CH					+				IT	E	C_4
A. salsa (C.A. Mey.) Benth.	H					+				IT	E	
A. setifera Moq. (= *A. annua*Bge.)	H,T					+	+	+	+	AS(IT)	XH	C_4
Arthrocnemum macrostachyum (Moric.)												
Moris & Delponte*	CH							+		SS.M	E	C_3
Atriplex dimorphostegia Kar. & Kir.	T			+		+		+		IT.SS	E	
A. flabellum Bge.	T		+	+						IT	E	C_4
A. griffithii Moq.	CH					+				IT	XH	
A. hastata L.	T	+		+		+				IT.M.ES	E	
A. leucoclada Boiss.	H	+	+	+	+	+	+	+	+	IT.SS	E	C_4
A. micrantha C.A. Mey.	T	+								IT.ES	E	
A. moneta Bge.	T			+		+				IT	E	
A. nitens Schkuhr	T	+				+				IT.ES	E	
A. tatarica L.	T	+				+				IT.ES.M	E	C_4?
Bassia eriantha (Fisch. & Mey.) Kuntze.	T			+		+				IT	E	
B. eriophora (Schrad.) Aschers.	T					(+)	+	+	+	AS	E	
B. hyssopifolia (Pall.) Volk.	T	+				+				IT?	E	C_4
Bienertia cycloptera Bge.	T	+	?	+		+	+	+	+	IT	E	

Table 1. continued

Species	Life form	Distribution								Chorotype	Halotype	Photo. Path.
		NW	N	NE	W	C&E	SW	S	SE			
Beta maritima L.	T						+	+		IT.M.SS	E?	C_3
Camphorosma monspeliaca L. (s.l.)	H.CH	+	+	+	+	+				IT.M	XH	C_4
Climacoptera brachiata (Pall.) Botsch.	T	+	?	+		+				IT	E	
C. crassa (Bieb.) Botsch.	T	+								IT	E	C_4
C. lanata (Pall.) Botsch.	T		+	+		+				IT	E	C_4
C. turcomanica (Litw.) Botsch. (incl. C. ferganica (Drob.) Botsch.)	T		+	+		+				IT	E	
Cornulaca leucacantha Charif & Aellen	T					+	+	+	+	AS?	PH	C_4
C. monacantha Del.	CH				+	+	+	+	+	SS	XH	C_4
Gamanthus gamocarpus (Moq.) Bge.	T			+		+				IT	E	
G. pilosus (Pall.) Bge.*	T	+								IT	E	
Halanthium rariflorum C. Koch	T	+	+	+		+				IT	E	
Halimione verrucifera (Bieb.) Aellen	H	+	?	+		+				IT	E	
Halimocnemis mollissima Bge.	T			+		+				IT	E	
Halocharis hispida (C.A. Mey.) Bge.	T		+	+		+				IT	E	
H. sulphurea (Moq.) Moq.	T				+	+	+	+	+	IT?	E	C_4
H. violacea Bge.	T					+			+	IT	E	
Halocnemum strobilaceum (Pall.) Bieb.	CH	+	+	+	+	+	+	+	+	IT.SS.M (ES)	E	C_3
Halopeplis perfoliata Forssk.	CH							+	?	SS	E	C_3
H. pygmaea (Pall.) Bge.	T	+				+				IT	E	C_3
Halostachys caspica (Bieb.) C.A. Mey. (= *H. belangeriana* (Moq.) Botsch.)	CH	+	+	+		+				IT	E	C_3
Halothamnus auriculus (Moq.) Botsch. (incl. *H. acutifolius* (Moq.) Botsch.)	H,CH	+		+		+				IT	XH	
H. glaucus (Bieb.) Botsch.	CH	+	+	+		+				IT	XH	C_4
H. hierochunticus (Bornm.) Botsch.	T		(+)			(+)	+	+	?	SS	E,XH	
H. subaphyllus (C.A. Mey.) Botsch.	CH			+		+				IT	XH	C_4
Halotis pilifera (Moq.) Botsch.	T	?	?	+		+				IT	E	
Haloxylon aphyllum (Minkw.) Iljin	P		+	+		+				IT	E,XH	C_4
H. recurvum (Wall.) Bge. ex Boiss.	CH								+	IS?	E	
H. salicornicum (Moq.) Bge. ex Boiss.	CH				+		+	+	+	AS	E,XH	C_4
Kalidium caspicum (L.) Ung.-Sternb.	CH	+	+	+		+				IT	E	C3
Kochia iranica (Hausskn. & Bornm.) Litw.	T	+		+		+				IT	XH	C_4
K. odontoptera Schrenck	T			?		+				IT	XH	C_4
Microcnemum coralloides (Loscos & Pardo) Buen	T	+				+				IT	E	C_3
Panderia pilosa Fisch. & Mey.	T				+	+				IT	E	C_4
Petrosimonia brachiata (Pall.) Bge.	T	+	+	+		+				IT	E	C_4
P. glauca (Pall.) Bge.	T	+	+	+		+				IT	E	
Piptoptera turkestana Bge.*	T					+				IT	E,PH	
Salicornia europaea L.	T	+	+	+		+	+	+		ES.M.IT	E	C_3
S. cf. ramosissima J. Woods*	T					+				ES.M(IT)	E	
Salsola abarghuensis Assadi	CH			+		+				IT	E	
S. arbuscula Pall.	CH			+		+				IT	E	
S. baryosma (Roem. & Schult.) Dandy	SS						+	+	+	SS	E	C_4
S. chorassanica Botsch.	T					+				IT	E	
*S. dendroides*Pall.	H	+	+	+		+				IT	E	
S. drummondii Ulbr. (= *S. obpyrifolia* Botsch. & Akhani)	CH							+	+	IS	E	
S. gossypina Bge.	T			+						IT	E	
S. incanescens C.A. Mey.	T		+	+		+				IT	E	
S. jordanicola Eig*	T				+					SS	E	
S. kerneri (Woloszak) Botsch.	CH					+				IT	XH	
S. leptoclada Gand. (= *S. carinata* C.A. Mey.)	T			+		+				IT	E	C_4

Table 1. continued

Species	Life form	Distribution								Chorotype	Halotype	Photo. Path.
		NW	N	NE	W	C&E	SW	S	SE			
S. nitraria Pall.	T	+				+		?		IT	E	C_4
S. nodulosa (Moq.) Iljin	CH	+								IT	E	
S. orientalis Gmel.	CH			+		+				IT	XH	
S. sclerantha C.A. Mey.	T			+		+				IT	E	
S. soda L.	T	+	+			+				ES.M.IT	E	
S. tomentosa (Moq.) Spach	CH		+	+		+				IT	XH	
Seidlitzia florida (Bieb.) Boiss. (incl. *S. cinerea* (Moq.) Botsch.)	T	+	+		+	+		+	+	IT	E	C_4
S. rosmarinus (Ehr.) Bge.	CH			+	?	+		+	+	IT	E	C_4
Suaeda acuminata (C.A. Mey.) Moq.	T	+			+	+	+	+		IT	E	
S. aegyptiaca (Hasselq.) Zoh.	T				(+)		+	+	+	AS	E	C_4
S. altissima (L.) Pall.	T	+	+	+	+	+				IT.M	E	C_4
S. arcuata Bge.	T			+		+				IT	E	
S. crassifolia Pall.	T	+	+							IT	E	
S. fruticosa Forssk. ex J. Gmelin	CH					+	+	+	+	SS	E	C_4
S. maritima L. (s.l.)	T	+	+			+		+		ES.M.IT	E	
S. microphylla Pall.	CH	+	+	+		+				IT	E	C_4
S. microsperma (C.A. Mey.) Fenzl*	T		+	+		+				IT	E	
S. physophora Pall.*	CH	+	+							IT	E	
Convolvulaceae												
Cressa cretica L.	H	+	+	+	+	+	+	+	+	PL	E	C_3
Cymodoceaceae												
Halodula wrightii Aschers.	HY							+		T	HY	
Thalassodendron ciliatum (Forssk.) Den Hartog	HY								+	T	HY	
Cyperaceae												
Bolboschoenus maritimus (L.) Pall.	H					+	+	+	+	PL	HG	
Cyperus laevigatus L.	H	?	?	?	+	+	+	+	+	PL	HG	
Schoenoplectus litoralis (Schrad.) Palla	H						+	+		PL	HG	
Frankeniaceae												
Frankenia hirsuta L.	H	+	+	+	+	+	?	+	+	IT.M.SS	E	C_3
F. pulverulenta L.	T	+	+	+	+	+	+	+	+	PL	E	C_3
Hypericopsis persica Boiss.	H					+				IT	E	C_3
Hydrocharitaceae												
Halophila ovalis (R.Br.) Hook. f.	HY							+		T	HY	
Iridaceae												
Iris spuria L.	H	+	+	+		+				IT.ES	HG	
Juncaceae												
Juncus acutus L.	H		+							PL	HG	
J. maritimus Lam.	H	+				+				PL	HG	
J. rigidus Desf.	H				+	+	+	+	+	IT.SS.M	HG	C_3
Mimosaceae												
Prosopis farcta (Banks & Sol.) Macbride	CH				+	+	+	+	+	IT.M.AS	XH	C_3
Orobanchaceae												
Cistanche tubulosa (Schrenk) Hook. f.	H					+		+		IT.SS.SM	P	
Papilionaceae												
Alhagi maurorum Medikus	H	+	+	+	+	+	+	+	+	IT.IS	X	
Plantaginaceae												
Plantago maritima L. *subsp. salsa* (Pall.) Rech.f.	H	+		+		+				IT	E	
Plumbaginaceae												
Limonium axillare (Forssk.) O. Kuntze* (= *L. wendelboi* Bokhari)	H							+		SS	E	C_3
L. bellidifolium (Goun) Dumort (= *L. caspium* Willd.)	H	+								IT.ES	E	

Table 1. continued

Species	Life form	Distribution								Chorotype	Halotype	Photo. Path.
		NW	N	NE	W	C&E	SW	S	SE			
L. carnosum (Boiss.) O. Kuntze	H	+				+				IT	E	
L. gmelinii (Willd.) O. Kuntze	H	+	+	+		+				IT.ES	E	
L. iranicum (Bornm.) Lincz.	H.CH				+	+	+	+	+	IT	E	
L. meyeri (Boiss.) O. Kuntze	H	+	+	+	+	+				IT	E	
L. reniforme (Girard) Lincz.	H		+			+				IT	E	
L. sogdianum (M. Pop) Ik.-Gal.	H			+		+				IT	E	
L. stocksii (Boiss.) O. Kuntze	CH								+	IS?	E	
L. suffruticosum (L.) O. Kuntze	CH					+				IT	E	
Psylliostachys beludshistanica Roshk.	T					+				IT	E	
P. leptostachya (Boiss.) Roshk.	T	+	+			+				IT	E	
P. spicata (Willd.) Nevski	T	+	+	+		+	+	+	?	IT.SS	E	
Poaceae												
Aeluropus lagopoides (L.) Trin. ex Thwaites	H	+	+		+	+	+	+	+	IT.SS	E	C_4
A. littoralis (Gouan) Parl.	H	+	+	+	+	+	+	+	+	IT.SS.M	E	C_4
Hordeum marinum Hudson	T		+			+		+		IT.ES.M	HG	C_3
Phragmites australis (Cav.) Trin. ex Steud												
-var. australis	H	+	+	+	+	+	+	+	+	Cosm.	HG	C_3
-var. stenophylla (Boiss.) Bor	H	+				+				IT.M	HG	
Polypogon maritimus Willd.	T	+	+			+		+		PL	HG	C_3
Puccinellia cf. koeieana Melderis	H					+				IT	E	
Primulaceae												
Glaux maritima L.	H	+	+			+	+			ES.IT	HG	
Ruppiaceae												
Ruppia maritima L.	HY	+	+			+	+			Cosm.	HY	
Solanaceae												
Lycium depressum Stocks	CH,P	+	+	+		+		+		IT	X	
L. ruthenicum Murray	CH,P	+	+		+	+				IT	X	
Tamaricaceae												
Reaumuria alternifolia (Labill) Britten	H,CH	+	+	+	?	+		+	+	IT	E,XH	
R. fruticosa Bge. ex Boiss.	CH			+		+				IT	E	
R. stocksii Boiss.	T,H							+	+	AS	E	
T. androssowii Litw.	P		+	+		+				IT(ES)	E	
T. aphylla (L.) Karst.	P					+		+	+	SS.SM	E,XH	
T. aralensis Bge.	P		+	?		+				IT	E	
T. arceuthoides Bge.	P	+	+		+	+	+			IT	E	
T. hispida Willd.	P					+		+		IT	E	
T. karakalensis Freyn	P		+			+				IT	E	
T. kotschy Bge.	P		+			+				IT	E	
T. mascatensis Bge.	P					(+)	+	+	+	OS	E	
T. octandra (Bieb.) Bge.	P	+				+				IT(ES)	E	
T. passerinoides Del. ex Desv. (= *T. aucheriana* (Decne.) Baum, *T. macrocarpa* (Ehrn.) Bge.)	P	+	+	+	+	+				IT.ES	E	C_3
T. ramosissima Ledeb.	P	+	+	+	+	+				IT.ES	E	C_3
T. rosea Bge.	P	+				+				IT	E	
Typhaceae												
Typha domingensis Pers.	H						+			IT.SS.M.	HG	C_3
Zygophyllaceae												
Malacocarpus crithmifolius (Retz.) Fisch. & Mey.*	CH			+		+				IT	XH	
Nitraria komarovii Iljin & Lava	CH	+								IT	E	
N. schoberi L.	CH	+	?			+				IT	E,PH	C_3
Tetradiclis tenella (Ehrn.) Litw.	T	+				+	+			IT	XH?	
Zygophyllum eichwaldii C.A. Mey.	CH			+		+				IT	PH	
Z. propinquum Decne.	CH							+	+	SS	XH,PH	C_3

1. A total of 165 halophytic and salt-tolerant species within 73 genera and 26 families of flowering plants are known from Iran.
2. 53% of the species belong to *Chenopodiceae*. Other well represented families are: *Boraginaceae, Caryophyllaceae, Poaceae, Tamaricaceae* and *Zygophyllaceae.*
3. Genera with higher numbers of halophytic species are: *Anabasis, Atriplex, Climacoptera, Halothamnus, Limonium, Salsola, Suaeda* and *Tamarix.*
4. Therophytes, hemicryptophytes and chamaephytes are predominant life forms, with 88% of the species. The largest group are the therophytes with 38%. The majority of the therophytes, i.e. 80%, belong to the family *Chenopodiceae.*
5. A great number of species (ca. 130) are found in central Iran. However, northeastern and northwestern parts of the country are also rich in halophytic species.
6. 58% of the species are Irano-Turanian floristic elements and 11.5% are Saharo-Sindian (including regional subdivisions). The only mono-regional Euro-Siberian species is *Tournefortia sibirica.* The rest are bi- or pluriregional in distribution.
7. Of 65 species of which the photosynthetic pathways have already been reported, 32 species are C_4, 31 species C_3 and one species CAM.
8. The following species are newly record or noteworthy records from Iran: *Arthrocnemum macrostachyum* (Moric.) Moris & Delponte, *Gamanthus pilosus* (Pall.) Bunge, *Piptoptera turkestana* Bunge (a new genus record), *Salicornia* cf. *ramosissima* J. Woods, *Salsola jordanicula* Eig., *Suaeda microsperma* (C.A. Mey.) Fenzel, *S. physophora* Pall., *Limonium axillare* (Forssk.) O. Kuntze, and *Malacocarpus crithmifolius* (Retz.) Fisch. & Mey.

5. Man and halophytic vegetation in Iran

As in other areas, natural vegetation in Iranian halophytic communities is rapidly being destroyed. In most areas that have been studied disruption of the vegetation covers leads to increased desertification and salinization. There is also invasion by weedy species. The most widespread of these are *Alhagi maurorum* and *Prosopis farcta.* Other species, such as: *Anabasis aphylla, A. haussknechtii, Salsola dendroides, Glycyrrhiza glabra, Rosa persica, Lycium ruthenicum, L. depressum,* and some of the halophytic annual species, are more or less restricted to degraded lands.

Protection of vegetation is the responsibility of the Department of the Environment, but saline areas are not given any high priority. Some of the protected areas which occur in saline regions were visited by us. Unfortunately mismanagement has caused the destruction of some previously well-conserved sites; the Touran and Kavir protected regions are outstanding examples.

The Forest and Range Organization is responsible for the reclamation and improvement of plant cover with an accent on afforestation and pasture development. The use of halophytes for improvement programs is limited to exotic xerohalophytes, e.g. *Atriplex canescens, A. halimus, A. lentiformis* and the native species *Haloxylon persicum* (including *H. ammodendron*). This latter species is cultivated for use in sand dune stabilization and on saline sandy soils (Nemati 1986). In most cases rehabilitation is not carried out on the basis of prior ecological investigations.

There are several native species which might be useful for the improvement of saline soils. The authors propose to investigate the ecology and possible use of the following species.

Atriplex griffithii
A. leucoclada
Avicennia marina
Camphorosma monspeliaca
Halimione verrucifera
Halothamnus glaucus
H. subaphyllus
Haloxylon aphyllum
H. salicornicum
Nitraria schoberi
Puccinellia spp.
Salsola arbuscula
S. drummondii
S. kerneri
S. orientalis
S. tomentosa
Seidlitzia rosmarinus
Suaeda fruticosa
S. microphylla
Tamarix spp.
Zygophyllum spp.

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