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EDAPHIC AND CLIMATIC CONDITION WITH DISTRIBUTIONAL PATTERN OF CERTAIN HALOPHYTES IN NORTH EAST OF IRAN

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ABSTRACT

Arid regions of Khorassan province mostly include salty lands (kavir) that receive less than 200 millimeters of rainfall annually. Dryness and saltiness conditions have caused special situation for growing plants named halophytes. This study was carried out in order to determine the region territory and identification of the vegetation.Method of study was to investigate plants and soil samples of the field in order to collect data and identify samples in laboratory. Results indicate that the salty regions have a characteristic and uniform feature so that depending on general topographic conditions, there are several belts of halophyte plant types and societies around salty center of the regions that in turn, depending on microclimates and microtopography there are changes and gaps along the belts. Therefore the vegetation is completely related to geomorphology, soil type and level of underground water. In most salty zones of khorassan, common specification of these societies is as following: The salty center (where the water table reaches the surface) is mostly bare and has no vegetation for the soil is very salty. The first belt outward salty center usually has only one species *Halocnemum strobilaceum* or occasionally together with *Halostachys belangeriana* and *Tamarix spp.* (Kal-e-Shoure Sabzevar). In the latest belts depending on distance of the center and water table depth, gradually, numbers of plant species are increased and also, halophytes depending on salt-tolerance are added to the vegetation cover. Afterward, the halophytic species having less salt tolerance were appeared such as *Aeluropus littoralis, Alhagi persarum* and *Limonium iranicum.* Finally, the belts are ended to the plant types including non-halophyt plants. Plant species of S*eidlitzia rosmarinus, Salsola arbuscula* and *Reaumuria fruticosa* are formed in certain types together with species of *Asteragalus squarosus* and *Limonium iranicum*. Sometimes, it is seen that some freshwater flows occured into salty zones, which cause to establish plants with somewhat tolerance to salinity such as *Artemisia santolina* and *A. sieberi*.

KEY WORDS: salinity, halophytes, *Halocnemum strobilaceum, Seidlitzia rosmarinus, Aeluropus littoralis, Salsola arbuscula, Reaumuria fruticusa, Alhagi persarum, Limonium Iranicum.* Kal-e-Shoure Sabzevar, Kavir-e- Namak

INTRODUCTION

Salinity phenomenon is accounted as the greatest environmental threat and wide areas of arid and semi-arid regions of Iran are affected by salinity conditions. It occurs mainly in agricultural lands that have lost most traces of native fauna and flora, and which retain little aesthetic appeal to most people. Salinity takes place slowly, over decades, gradually reducing productivity, replacing rangelands with salt tolerant species and eventually creating bare patches of soil. Arid regions of Khorassan province mostly include salty lands that receive less than 150 m.m. of rainfall anually. Dryness and saltiness conditions have caused to form special situation for certain plants named halophytes to grow. Different resistance of such plants to saltiness resulted to the appearance of different plant types and societies according to their distance from salty center respectively. Khorassan province consist of six main watershed basins that four of them are salty lands and located in the studied region (fig. 1) including Kavir-e- Markazi, consisting of Kal-e-shoor of Jajarm and Kal-e-shoor of Sabzevar, Kavir-e-Namak, Eastern province and Kavir-e-Loot

MATERIAL AND METHODS

Salty regions were specified by using resources like maps of climate, land use and satellite photos. Different plant types in each salty region were identified by using topographic maps with method of Physiognomy – floristic and border of types by using GPS. Then measurement in each plant type was carried out by determination of the plant coverage percent and density of samples collected from quadrates which were placed near transects that were 6 –12 plots in each type. Size of each plots differed from 4 to 100 m^2 depending on kind of dominant plant. The information was recorded on special. Additionally, these information also consist of geographic information of the regions including height, latitude, longitude, area of the region etc. Climate factors were exploites from data of holistic project on water in Iran. Soil salinity (EC) and SAR were measured by standard methods in soil laboratory of Mashhad Research Center of Agriculture and Natural Resources.

RESULTS

The habitat of halophytes in Khorassan are located around six main kavirs, including Kavir-e- Markazi, consisting of Kal-e-shoor of Jajarm and Kal-e-shoor of Sabzevar, Kavir-e- Namak, Namakzare Khaf, Dagh-e-Petergan, Kavir-e-Mohamadabade and Kavir-e-Tabas. Figure 3 shows the map of plant types around these regions.

On the basis of Demarton method, climatic conditions of the existing kavirs of the provience were different so that, kinds of climates differ from cold extra dry to cold desert dry except of Tabas which is temperate extra dry, annually mean precipitation 50-150, rarely 200 m.m., annually mean temperature 15-20 degree centigrade and annually mean evaporation 2800-3900 m.m. (kavir of Sabzevar and Tabas respectively). (Table 1).

Our results indicated that certain plant genera existed frequently in most plant types such as *Halocnemum, Salsola, Tamarix, Seidlitzia, Reaumuria, Aelorupus*. Plant types number and related plant species are shown in tables 2-7.

Plant species which frequented mostly in these environments is *Halocnemum strobilaceum*. It forms the first strip of vegetation in all the regions (except in Kal-e-shoor of sabzevar and Namakzare Khaf and Dagh-e-Petergan). This species indicates tolerance against salt and also water logging (because in some places, underground water is very close to the surface) and creates a mono species plant society.

In addition to the mentioned species, *Halostachys belangeriana* and Tamarix spp. are found in Sabzevar Kalshour and where *Halocnemum* does not exist, they are observed in form of scattered shrubs.

Although, the frist vegetation borderline in the region is *H. strobilaceum*, but soil analysis shows that soil saltiness in *S. arbuscula* habitat is more than elsewhere (figure 2). Therefore, the further reason for resistance of *H. strobilaceum* is water logging tolerance that causes to reach the playa. Also, high regeneration of this species in the borderline of the basin is because of the upper ground water to the surface and constancy of humidity. Additionally, occurance of water flow from raining cause to wash layer of salt and this phenomenon allows the germination *H. strobilaceum* seeds. Then, in dry season when the salt has risen to the soil surface, the plant has completely settled and protected from surface salt harms (figure 4).

Suaeda froticosa is one of the other species which can resist against saltiness. Although, it has less frequency, but can grow in the regions with high level of salt and form a plant type in the north east of Kal-e-shoor of Sabzevar.

Another plant species is *Nitraria schoberi* that is valuable for soil protection because of its stolon. It grows in Sabzevar Kal-e-shoor with *H. strobilaceum* and exists in the type of *Seidletzia rosmarinus – Reaumuria* in the form of individual bushes that are distributed scatterly in south of Kavir-e-Namak and around Kavir-e-Mohammad Abad.

Aeleropus littoralis and *Alhagi persarum* are the other species which are tolerant against saltiness and form the plant types around playas of khorassan.

Presence of hills around Kavir-e-Mohammad allows the growing of non- halophyte plants near the Playa (figure 5).

In most salty regions, soil washing phenomenon causes the establishment of plant species with low tolerance against saltiness such as *A. santholina* and *Artemisia siberi* (figure 6 and 7).

DISCUSSION

Obtained results from present research show that *Halocnemum strobilace*um, *Halostachys belangeriana, Salsola arbuscula* and *Suaeda spp*. have enough resistance against saltiness. Although, *Halocuemum* can grow in wet soils with high level of undergrowed water, but EC of the related soil is much higher than *S. arbuscala* in Kavir Namak. in his research around Houz-e-Soltan of Ghom city Moghaimi (1368 HS[1].) recorded different vegetation types according to their distance and direction from center of the playa. The results indicated that there are in the northwest face, *H. strobieaceam, Tamarix passerinoides, Seidlitzia rosmarinus* and *Artemisia sieberi*, in the west face, first, *Suaeda arcuata* and then *A.sieberi and* At last in west surface profile first, *Halostachys belangeriana* and then *A. sieberi*. (8)

Soil moisture is one of the important factors to distribution of margin plants in playa. Mohajeri(1377) in a reaserch in Tangestan region confirmed(9) this result and concluded that halophytes are suitable index to indicate soil characteristics.

Results of Zao-Ming Fong study showed that among 11 tree species, *Haloxylon ammodendron* was the most tolerant species and the other species are *Tamarix ramosissima, T. chinensis, Populus uphratica* and *Lycium chinensis* (15).

TA Glogole and MV Chulanovskaya examind several C4 halophytes such as *Salsola iberica, Bassia hyssopifolia, Suaeda altissima, Petrosimonia brachiata* and *Climacoptera crassa*. The results showed that these plants were exposed to various soil salinities in their natural habittats, differed significantly in their photosynthetic and assimilate translocation rates (2).

Sarah Bennett and Michael Rea in an examination of marsh grass diversity in a Brackish marsh showed that the plant species in a salt marsh seperated into 3 zones along the edges of marsh, are *Spartina alterniflora* , then *S. alterniflora* and a mixture of *Salicornia spp., Limonium carolinianum* etc.(1).

[1] - Hejri-e-shamsi

Table 1 - Climate data of Khorassan kavirs

kavir	Climate	Annual Mean rainfall (mm)	Annual Mean temperature (0^oC)	Annual Evaporation(mm)
Jajarm	Cold dry desert	100-200	10-17.5	2400-3000
Sabzevar	Cold Extra dry to dry desert	50-200	15-17.5	2800-3000
Kavir-e-namak	Cold Extra dry to dry desert	50-200	15-17.5	2900-3300
Dagh-e-Petergan	Cold dry desert	100-200	15-17.5	3500-3600
Kavir-e-Mohamadabad	Cold Extra dry to dry desert	50-200	15-17.5	3200-3700
Tabas	Extra dry temperate	50-150	15-20	3300-3900

Table 2 - Plant-types of Kal-e-shoor of Jajarm

Sign on the map	Plant Type	Area (Hectars)	Altitude of sea level
Ha	*Halocnemum strobilaceum*	4918.75	900
Ha – Li	*Halocnemum strobilaceum – Limonium iranicum*	16875	900
Se – Sa	*Seidletzia rosmarinus – Salsola arbuscula*	32387.5	950- 900
Sa – At	*Salsola arbuscula – Atripelex verrucifecula*	4137.5	950
Se- Ar	*Seidletzia rosmarinus – Artemisia santulina*	14575	950
Ar- Re	*Artemisia santulina – Reaumuria fruticusa*	7568.75	900
Sa – Al	*Salsola arbuscula – Alhagi persarum*	7956.25	950
Sa	*Salsola arbuscula*	1556.25	1050
Se- Ha	Seidletzia rosmarinus - Halocnemum strobilaceum	4137.5	900
BL	Bare Land	9543.75	900

Table 3 - Plant-types of Kal-e-shoor of Sabzevar

Sign on the map	Plant Type	Area (Hectars)	Altitude of sea level
Ha	*Halocnemum strobilaceum*	20012.5	800
Su	*Suaeda fruticosa*	106.25	850
Se	*Seidletzia rosmarinus*	58518.75	801
Se - Re	*Seidletzia rosmarinus – Reaumuria*	8368.75	900
Se- Sa	*Seidletzia rosmarinus – Salsola arbuscula*	9806.25	1000
Ae	*Aeluropus littoralis*	806.25	<800
Al	*Alhagi persarum*	431.25	800
At	*Atripelex canesence*	837.5	<850
BL	Bare Land	11431.25	<800

Table 4 - Plant-types of Kavir-e- Namak

Sign on the map	Plant Type	Area (Hectars)	Altitude of sea level
Ha	*Halocnemum strobilaceum*	39506.25	800
Sa	*Salsola spp*	2875	800
Re	*Reaumuria fruticosa*	9043.75	800
Se	*Seidletzia rosmarinus*	30031.25	800<
Sa – Ar	*Salsola arbuscula – Artemisia sieberi*	27100	800 - 850
Su	*Suaeda fruticosa*	19961.75	850
BL	Bare Land	236356.25	<800

Presentation of *Artemisia sieberi* near *Salsola arbuscula* was for reason of salt wash by floodwaters in Kavir-e- Namak.

Table 5 – Plant-types of Namakzare Khaf and Daghe Petergan

Sign on the map	Plant Type	Area (Hectars)	Altitude of sea level
Sa	*Salsola arbuscula*	12731.25	600
Ar- Zy	*Artemisia sieberi – Zygophyllum atriplecoides*	30512.5	850 - 1000
Ae	*Aeleropus literalis*	6187.5	650
BL	Bare Land	29512.5	<600

Table 6- Plant-types of Kavir-e- Mohamadabad

Sign on the map	Plant Type	Area (Hectars)	Altitude of sea level
Ha	*Halocnemum strobilaceum*	14031.25	1285 - 1316
Ha - Re	*Halocnemum strobilaceum – Reaumuria fruticosa*	13150	1301 - 1295
Ha - Su	*Halocnemum strobilaceum – Suaeda fruticosa*	4075	1294 - 1300
Re - Su	*Reaumuria fruticosa- Suaeda fruticosa*	4587.5	1283 - 1289
Se	*Seidletzia rosmarinus*	625	1285 - 1286
Re – Sa	*Reaumuria fruticosa - Salsola arbuscula*	5100	1290 – 1300
Ta	*Tamarix sp.*	18.75	1286 - 1290
Ta – Ha	*Tamarix sp. – Halocnemum* strobilaceum	925	<1322
Ha- Ta	*Halocnemum* strobilaceum - *Tamarix sp*	3343.75	1286 - 1290
BL	*Bare Land*	34512.5	1278 - 1314

Table 7 - Plant-types of Kavir-e- Tabas

Sign on the map	Plant Type	Area(Hectare)	Altitud of sea level
Al	*Alhagi persarum*	6412.5	<650
Se	*Seidlitzia rosmarinus*	142575	650 - 750
Ta	*Tamarix sp.*	37056.25	650
Sa	*Salsola arbuscula*	12518.75	<650
BL	*Bare Land*	67018.75	650

Figure 1 Relation between salinity and plants types in Kavir-e- Namak

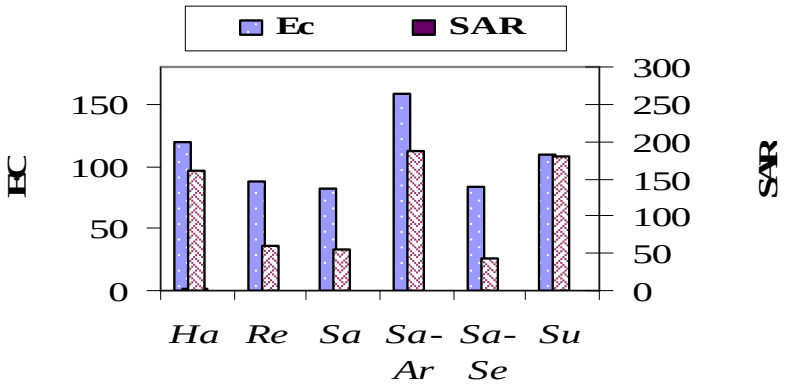

Figure 2- – Watersheds of Khorassan and situation of areas which were studied

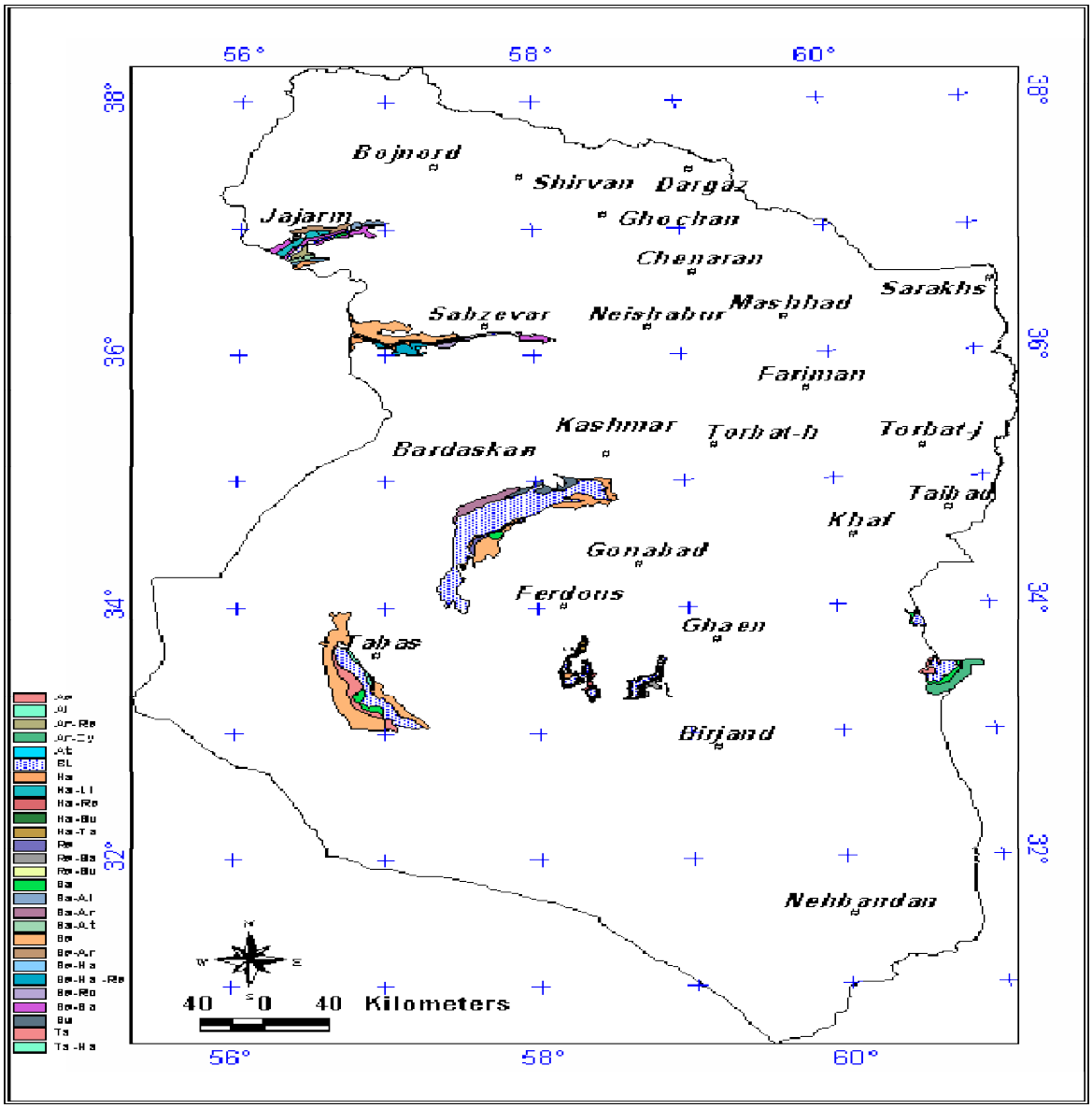

Figure 3 – map of plant types of Khorassan kavirs

Figure 4- Presence of hills around Kavir-e-Mohamadabad allows to non halophyte plants growth near the Playa

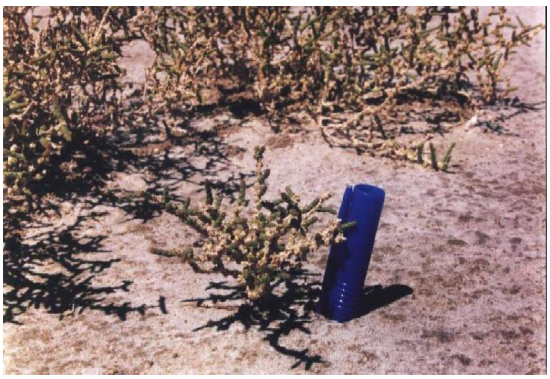

Figure 5- seedlings of *H. strobilaseum* on salty surface of Kavir-e- Namak growth near the Playa

Figures 6 and 7– Floodways amounts of playas cause changes in species composition

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