Study of effective ecological factors on distribution of vegetation types
(Case study: Southern margin of Haj Aligholi Kavir, Damghan)

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Abstract

The objective of current research is to investigate distribution patterns of vegetation types and its relation with environmental factors in southern margin of Haj Aligholi Kavir of Damghan. Three vegetation types including \textit{Halecnemum strobilaceum}, \textit{Sedlitzia rosmarinus} and \textit{Artemisia sieberi} were studied in marginal arid regions and uplands of the study area. Firstly, geographic location of vegetation types was determined using GPS. Then the boundary of the region was delineated on the topographic map in scale 1:50000. Elevation, slope and aspect of vegetation types were determined as well. Ten plots were established in the field based on randomized systematic approach. The area of each plot was determined according to the kind of plant species and distribution of plants. Floristic list, canopy cover and average percent of species canopy cover were determined in each plot. Finally, five soil samples were taken in each vegetation type. The characteristics of soil samples including texture, EC, pH, \%CaCO\textsubscript{3}, \%CaSO\textsubscript{4}, \%OM, SAR and ESP were measured too. ANOVA and Duncan's test were used to analyze the collected data. The results of Duncan's test showed that soil texture, EC, SAR, ESP and pH of \textit{Halecnemum strobilaceum} type is significantly different from two other types. Also, SAR, ESP and slope in habitat of \textit{Artemisia sieberi} and \textit{Sedlitzia rosmarinus} types were significantly different.

Keywords: Vegetation type; Ecologic factors; Analysis of variance; Duncan's test; Haj Aligholi Kavir; Damghan; Iran

1. Introduction

Vegetation type and its species composition is one of important components of rangeland ecosystems. Establishment of plant species depend on climatic, edaphic and biologic conditions which is not a random phenomenon. Due to important role of plants in ecosystem equilibrium as well as direct and indirect utilization of plants by human, it is necessary to define heterogeneity between plants and environmental factors in order to improve natural resources.rostami (1995) studied the ecological factors affecting vegetation cover in Qom province and found soil texture, EC and CaCO\textsubscript{3} content as the most important factors. Lents (1984) studied \textit{Artemisia} sp. rangel and which showed that soil texture, depth of profiles, gravel content and type of soil structure are the factors that classify vegetation types.
The objective of current research is to study vegetation types distribution and its relation with environmental factors in order to provide manager approaches for optimum utilization of natural habitat to avoid soil salinization and desert expansion in the study area and other similar regions.

2. Materials and methods

The study area is part of southern margin of Haj Aligholi Kavir, Damghan in 35°51’28” latitudes and 54°26’51” - 54°26’56” longitudes. The climate based on revised De Marton method is cold dry and annual average temperature is 15.9°C. During the field studies, three vegetation types with apparent border and area of 3-4km extent were determined in the region. Therefore this research investigates the factors affecting distribution of three types including *Halecnemum strobilaceum, Sedlitzia rosmarinus* and *Artemisia sieberi* from marginal areas of playa toward uplands.

Since the region is a relatively small area, climatic and some ecologic factors do not show considerable change. Therefore, soil properties (texture, EC, pH, % CaCO₃, %CaSO₄, %OM, SAR and ESP), topographic factors (slope, aspect, elevation) and lithologic condition were considered as the most effective factors.

At the first, geographic location of the vegetation types were determined using GPS and consequently delineated on topographic map of scale 1:50000. Furthermore, slope, aspect and elevation of each type were determined based on the topographic map.

In each vegetation type, sampling was done in 10 plots. Method of sampling was randomized-systematic. The area of each plot was determined according to the kind of plant species and distribution of plants. The list of plant species in each plot, percent of canopy cover for each species and average percent of canopy cover were determined as well.

Also, in five plots of each vegetation type, soil samples were taken up to 50cm depth (root zone and effective depth) and the samples were analyzed in the lab.

Analysis of data was conducted using one way ANOVA to compare the average of measured characteristics in the vegetation types and as the next stage paired comparison of means using Duncan’s Test was considered.

3. Results

1. Description of soil and vegetation cover characteristics in the vegetation types of the study area:

   1.1. *Halecnemum strobilaceum* type:
   This type covers marginal area of Kavir in the wet surrounding area with average elevation of 1075m, average slope of 0.5%, northern aspect and lies on fine sediments with high salt content. The average canopy cover of the type is 15% and is lack of associate species, surface sand and gravel.

   1.2. *Sedlitzia rosmarinus* type:
   This type covers plain and shows sediment transport zone with average elevation of 1075m, average slope of 1%, northern aspect and locate on fine slaty sediments. Its only associate species is *Artemisia sieberi*. The average canopy cover is 8% and percent of surface gravel and sand is about 45%.

   1.3. *Artemisia sieberi* type:
   This type includes bare pediment (erosion pediment) geomorphological unit and Reg facies. The average elevation and slope are 1090m and 3%. It shows northern aspect and consist of alluvial and colluvial coarse sediment. The associate species are *Atraphaxis* sp. and *Sedlitzia rosmarinus*. The average canopy cover of the type is 3% while surface sand and gravel percent reaches to 10%.

   The physico-chemical characteristics of soil in different vegetation type are summarized in Table 1.

<table>
<thead>
<tr>
<th>Vegetation type</th>
<th>EC (ds/m)</th>
<th>pH</th>
<th>Clay (%)</th>
<th>Silt (%)</th>
<th>Sand (%)</th>
<th>Lime (%)</th>
<th>Gypsum (%)</th>
<th>OM (%)</th>
<th>SAR</th>
<th>ESP</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Halecnemum strobilaceum</em></td>
<td>122.96</td>
<td>7.78</td>
<td>4.84</td>
<td>19.63</td>
<td>75.8</td>
<td>16.83</td>
<td>2.082</td>
<td>0.63</td>
<td>484.602</td>
<td>97.6</td>
</tr>
<tr>
<td><em>Sedlitzia rosmarinus</em></td>
<td>21.74</td>
<td>7.44</td>
<td>1.4</td>
<td>10.68</td>
<td>87.92</td>
<td>18.16</td>
<td>0.674</td>
<td>0.48</td>
<td>72.91</td>
<td>90</td>
</tr>
<tr>
<td><em>Artemisia sieberi</em></td>
<td>6.98</td>
<td>7.4</td>
<td>0.100</td>
<td>8</td>
<td>92</td>
<td>19.16</td>
<td>1.35</td>
<td>0.45</td>
<td>15.29</td>
<td>62.8</td>
</tr>
</tbody>
</table>
2. The result of analysis of ecological factors using one-way ANOVA and Duncan's Test:

Analysis of variance for the means of studied factors was conducted to find the reason of change in vegetation types. The result is on F test in 0.01 were significant for all of studied factors except %CaCO3, % CaSO4, %OM and elevation. Then a significant difference between at least one pair of the means was anticipated (Table 2).

Table 2. The result of analysis of variance of the studied ecological properties

<table>
<thead>
<tr>
<th>SOV df</th>
<th>EC (ds/m)</th>
<th>pH</th>
<th>Clay (%)</th>
<th>Silt (%)</th>
<th>Sand (%)</th>
<th>Lime (%)</th>
<th>Gypsum (%)</th>
<th>OM (%)</th>
<th>SAR</th>
<th>ESP</th>
<th>Slope (%)</th>
<th>Elevation (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>2</td>
<td>27.196</td>
<td>8.175</td>
<td>7.741</td>
<td>30.364</td>
<td>35.873</td>
<td>2.832</td>
<td>2.335</td>
<td>0.381</td>
<td>22.687</td>
<td>56.107</td>
<td>136.32</td>
</tr>
</tbody>
</table>

To find out the characteristics which are different in various types, Duncan’s Test was considered. The result showed significant differences in 0.05 in many cases but Artemisia sieberi and Sedlitzia rosmarinus t type showed higher similarity while were considerably different with Halocnemum strobilaceum type e (Table 3). In the tab le in s Significance characteristics have similar alphabet letters and vice versa.

Table 3: Classification of the studied properties in vegetation types using Duncan’s Test

<table>
<thead>
<tr>
<th>Vegetation type</th>
<th>EC (ds/m)</th>
<th>pH</th>
<th>Clay (%)</th>
<th>Silt (%)</th>
<th>Sand (%)</th>
<th>SAR</th>
<th>ESP</th>
<th>Slope (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halocnemum strobilaceum</td>
<td>122.96a</td>
<td>7.78a</td>
<td>4.24a</td>
<td>19.76a</td>
<td>76.2a</td>
<td>484.30a</td>
<td>97.6a</td>
<td>0.5a</td>
</tr>
<tr>
<td>Sedlitzia rosmarinus</td>
<td>21.74b</td>
<td>7.44b</td>
<td>2b</td>
<td>9.20b</td>
<td>88.8b</td>
<td>72.91b</td>
<td>90b</td>
<td>1.0b</td>
</tr>
<tr>
<td>Artemisia sieberi</td>
<td>6.98b</td>
<td>7.40b</td>
<td>1b</td>
<td>8.00b</td>
<td>91.00b</td>
<td>15.29b</td>
<td>62.8b</td>
<td>3.0b</td>
</tr>
</tbody>
</table>

4. Discussion and Conclusion

The results showed that in the study area, among different enviromental factors, the distribution of vegetation types was most strongly correlated with the same soil characteristics such as salinity, texture, and pH. In arid and semiarid regi ons, the relation between soil texture and EC is high capacity of ESP in increasing alkalinity to tolerance of the species. ESP, SAR and slope were different in the types and led to distinguishing three types, but Artemisia sieberi type had differences based on slope and other factors of the species.

The overall results of the research indicates that Halocnemum strobilaceum has the highest resistance to soil salinity compared to other plant species surrounding the pl ay a. This species disappears and replaced by Sedlitzia rosmarinus and Artemisia sieberi with decrease of salinity. Another considerable issue is high capacity of ESP in Sedlitzia rosmarinus and Halocnemum strobilaceum types that at increases alkalinity to tolerance of the species. Jafari (1989) found Halocnemum strobilaceum as the highest resistant species in saline condition of Damghan region.

Among topographic factors, the slope is an important parameter which affects the hydrological characteristics and distinguishes different vegetation types. Azarnivand (1990) implies that the slope is an impo rtant factor in change of vegetation cover. It is necessary to consider physico-chemical properties of soil as well as eco-logical condition and resistance of the species for different
environmental factors in any remediation project planned for the study area.

References


Nikoo, Shima, 2006. Study of environmental effective factors on distribution of vegetation cover in Damghan Region, MSc. thesis University of Tehran.


