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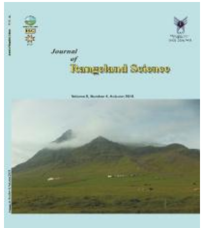


**Research and Full Length Article:**

# Ecological Effects of Climate Factors on Rangeland Vegetation (Case Study: Polour Rangelands)

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**Abstract.** Climate is the most important factor of plants distribution in global and regional scale. Understanding the current distribution of vegetation cover and its interaction with climate regularity is important for predicting its future. In order to determine the effective climate factors in plant life-form in Polour rangelands in the Damavand summit (2400 to 4100 m above sea level), Iran, a study was carried out in May to July 2016. Climatic diagram for the average data of 2006-2016 was obtained by Emberger's method. Regression method was used for determining the relationships between altitude and climatic factors and the output was employed to draw isothermal and isohyet maps as well as phytoclimatic map using Arc GIS v.10.2 software. One square meter plots were established randomly in the stand area and vegetation cover data were collected. The results showed that the study area has cold arid climate with six months of drought period. The stepwise regression analysis between total vegetation cover and the climate factors showed that minimum temperature was the most effective variable (r=0.875) that may influence the vegetation cover. The plant growth was started when environmental temperature copes with 10°C which was mid-April. Hence, the upland rangeland plants of Polour are grown in severe condition and the most life forms such as grass-shrubs need sufficient climatic components such as precipitation and temperature. Therefore, the range management approach can be achieved by limiting the grazing periods for two months to maintain the current vegetation cover which finds an opportunity to balance themselves with expressive climate changes.

**Key words:** Climate factors, Precipitation, Temperature, Rangeland, Polour

## Introduction

Climate is the most important factor for distribution of plants on global and regional scale (Imbach *et al*., 2013). Global climate changes will likely cause profound effects on terrestrial ecosystems (Fay *et al*., 2000; Franklin *et al*., 2016) by the means of three timescales: In tiny scales (e.g. seconds to hours), the coupled system is dominated by the rapid biophysical and biogeochemical processes that exchange energy, water, carbon dioxide, and momentum between the atmosphere and the land surface (Foley *et al*., 2000). In the interposed time scale (i.e., days to months), the climate impacts change processes in the reserve of soil moisture, altering in the rate of carbon allocation, and vegetation phenology (e.g., budburst, leaf-out, dormancy, senescence) (Foley *et al*., 2000; Estiarte and Peñuelas, 2015). The impacts can be fundamental changes in the vegetation structure (disturbance, land use, stand growth) on longer time scales such as seasons, years, and decades (Foley *et al*., 2000). Imposing of greater selection and distancing of populations from environments are challenged by swift climate changes (Davis and Shaw, 2001; Shaw and Etterson, 2012). Climate factors indicate the other natural phenomena predominantly promoting rangelands (Carder, 1970; Havstad *et al*., 2016). During climate changes, the threshold of rangeland habitats occurs sooner (Colautti *et al*., 2017). Similarly, species suffer more from climate changes in a fragmented habitat (Travis, 2003; Ash *et al*., 2016).

Precipitation and temperature are two important components of climate (Flannigan *et al*., 2016) which have an undeniable impact on vegetation structure, composition, and density (Olsen *et al*., 2016). Some reports claim that the vegetation response is toward the changes in precipitation regime (Calef *et al*., 2005; Damavandi *et al*., 2016; Grossiord *et al*., 2017). Meanwhile, Cheng and Nakamura (2007) identified a strong correlation of vegetation with climatic factors indicating that temperature and precipitation may influence the species composition of the east Kazakhstan steppe, Iran. Moreover, it has been reported that prediction of plant response to temperature does not account for natural variability (Hollister *et al*., 2005; Prevey *et al*., 2017). However, Kikvidze *et al*. (2005) pointed out that June maximum temperature represents general growing conditions in alpine and subalpine environments with more favorable warm temperatures increasing biomass accumulation as it has been reported that cold conditions delayed the flowering dates in reproductive stage of some perennial grasses (Baghdadi *et al*., 2013). Moreover, rising temperature may act negatively and in directionally in the sense of increasing requirements for soil moisture, decreasing water content in the upper layers of soil, decreasing ground water levels, and discharge in rivers (Ghahraman, 2006; Ter Heerdt *et al*., 2017). Sometimes, growth of species depends on low temperatures as well (Marqez *et al*., 2004; Kandel, 2010).

In the upland area because of severe environmental conditions, changes in precipitation would likely have significant impacts that would differ between alpine plant communities and species (Walker *et al*., 1994; Camaca *et al*., 2017) accordingly it is an important factor in determining plant community and ecosystem dynamics (Burke *et al*., 1998; Maleknia *et al*., 2017; Speed and Austrheim, 2017). Bayat *et al*. (2016) have revealed that the growing season rainfall of March was the most effective index for *Bromus tomentellus* and *Agropyron trichophorum* vegetation cover so that on the basis of climate changes scenarios, the spring and summer rainfall will be declined during 2011-2039 for some internal parts of Iran (Saadatfar *et al.*, 2013).

Mountainous regions are composed of the two contrasting physical conditions such as different geomorphological relief-structures and different substrates (Bayet-Goll *et al*., 2016), which determine a distinctive flora and different vegetation patterns (Schaefer *et al.*, 2016). An accurate estimate of the effects of climate elements on mountain systems is difficult because of uncertainties associated with the climatic circumstances (Nogues-Bravo *et al*., 2007; Chapple *et al*., 2017). Notwithstanding that plant species often persist in mountain areas during unfavorable climatic events (Anthelme *et al*., 2008); alpine plant species show different rates of migration due to rapid climate warming, leading to change of vegetation patterns (Pauli *et al*., 1996; Gao *et al*., 2017). Understanding the current distribution of plants and its interaction with climate regularity are important for predicting its future change (Fernández-Cancio *et al*., 2007; Blinova, 2008). As the area is going to severe condition under climate changing impacts based on the observation and ranchers' interviews; therefore, knowing of plant requirements founded upon climatic feedback can give a reasonable ability to rangers who make better decisions about utilization of rangeland. The aim of this study was to determine the effective climate factors in vegetation cover and traits, the upland rangeland of Polour, Iran.

## Materials and Methods

### Study area

The Polour upland with the area of 9000 ha around the Damavand summit from 2400 to 4100 m was chosen. The most parts of the area are geologically formed by magnetic formations and it is alluvial formations near to Lar dam. A natural feature of the area is covered by grasses and shrubs and seemed to be grassland-shrub land. Some grasses such as *Agropyron elongatum* Drobov, *Bromus tomentellus* Boiss., *Stipa barbata* L., *Festuca rubra* L., and shrubs such as *Astragalus jodotropis* (Boiss. & Hohen.), *Astragalus ochroleucus* (Boiss. & Hone.), *Onobrychis cornuta* (L., Desv.) subsp. and *Cornuta*, *Acantholimon erinaceum* (Jaub. & Spach, Lincz.) are notable in the area (Shokrollahi et al., 2011).

### Research methodology

Studying climate is started by determining climate diagram for 2006-2016 in a given area (Kargar *et al*., 2016). Hence, to reach this goal, Emberger's method was used. The areas climate was drawn into the ombrothermic index and the ombrothermic diagram and then extracted into excel software. The lack of climate data on the upland is an important issue for researchers. Hence, it needs to use the adjacent stations data to obtain the study area's gap data. Statistical method like regression one is suitable if the distance of the study area is less than 70 Km (Ziaii and Behnia, 2002).

First of all, based on spatial analysis of Arc GIS v.10.2 software, the 70 Km radian was determined for the area. The temperature data (maximum, minimum, and average) and precipitation of stations, which include synoptic, climatology, and data logger, were collected from Meteorology Administrative and Energy Ministry's stations. Because the study area has more than 2400 m altitude, the stations below 1500 m from sea level were omitted. Simple linear regression was employed to determine the correlation between altitude and precipitation and/or maximum, minimum, and average temperatures (Karger *et al*., 2017). If r and $r^2$ were strong and significant, the equation is suitable to determine the given objects such as temperatures and precipitation. The significance of correlation was determined by F-ratio (Fishers' ratio) (Vittinghoff *et al*., 2005). The predictive equation of the study area is given in Table 1 which has strongly demonstrated a robust correlation between dependent (Temperatures and precipitation) and independent (A) variables.

**Table 1.** The summary of regression analysis between altitude and precipitation and temperatures in the Polour area

| Equation | R | $R^2$ | F test | Sig. F |
|---|---|---|---|---|
| $T_{max} = 22.7 - 0.0034A$ | 0.893 | 0.813 | 234.67 | 0.000 |
| $T_{min} = 11.12 - 0.0046A$ | 0.915 | 0.874 | 76.54 | 0.000 |
| $T_{ave} = 19.93 - 0.004A$ | 0.868 | 0.759 | 342.76 | 0.000 |
| $P = 998.78 - 0.205A$ | 0.895 | 0.801 | 152.767 | 0.000 |

Tmax: maximum temperature, Tmin: minimum temperature, Taver: average temperature, P: precipitation, A: Altitude (m above sea level), R: correlation coefficient, $R^2$: coefficient of determination, F: Fishers ratio, and Sig.: significant level

Based upon the equations, each line of the contour was consisted of three climatic variables including precipitation and maximum and minimum temperatures. The regression lines were transferred into Arc GIS v.10.2 software and the isothermal and isohyet's maps were extracted (Tables 2 and 3).

**Table 2.** Specification of isothermal curve map

| Code | Temperature Class ($C^{\circ}$) | Absolute Frequency | Absolute Frequency% | Partial Area (ha.) |
|---|---|---|---|---|
| 1 | 3-4 | 1 | 6.25 | 94.47 |
| 2 | 4-5 | 2 | 12.5 | 433.73 |
| 3 | 5-6 | 2 | 12.5 | 1001.26 |
| 4 | 6-7 | 3 | 18.75 | 1872.40 |
| 5 | 7-8 | 1 | 6.25 | 2579.61 |
| 6 | 8-9 | 2 | 12.5 | 1778.11 |
| 7 | 9-10 | 4 | 25 | 945.33 |
| 8 | >10 | 1 | 6.25 | 22.77 |
| SUM | | 16 | 100 | 8755.72 |

**Table 3.** Specification of isohyet curve map

| Code | Precipitation Class (mm) | Absolute Frequency | Absolute Frequency® | Partial Area (ha.) |
|---|---|---|---|---|
| 1 | 133-185 | 1 | 11.11 | 12.26 |
| 2 | 235-285 | 2 | 22.22 | 6754.69 |
| 3 | 335- 385 | 2 | 22.22 | 836.41 |
| 4 | 435-485 | 3 | 33.33 | 1136.74 |
| 5 | >485 | 1 | 11.11 | 15.60 |
| SUM | | 9 | 100 | 8755.72 |

The same approach was used to determine the most dominated life forms of plant species in the area based upon each interval line (Table 4.) and finally to obtain the phytoclimatic map for the area which is emphasized on the plant life form distribution along with climate factors (Cain, 1950).

**Table 4.** Specification of life-form cover in the Polour site

| Code | Elevation Class (m) | Life Form | Absolute Frequency | % Absolute Frequency | Partial Area (ha.) |
|---|---|---|---|---|---|
| 1 | 2400-2800 | Shrubland | 1 | 25 | 1379.3 |
| 2 | 2800-3600 | Grassland-Shrubland | 1 | 25 | 6406.9 |
| 3 | 3600-4000 | Shrubland | 1 | 25 | 888.7 |
| 4 | >4000 | Rock-Bare Soil | 1 | 25 | 80.5 |
| SUM | | | 4 | 100 | 8755.7 |

In order to obtain field data of vegetation cover, the one square meter plot due to size of species (Cain, 1950) was randomly employed in the area where percentage of life forms such as Annual Grass (AG), Perennial Grass (PG), Annual Forb (AF), Perennial Forb (PF), and Shrub (SH) was recorded in each plot and total vegetation cover was also calculated by summing life-forms' percentages.

Achieving the best correlation between vegetation and climatic factors was drawn by a multivariate regression using the stepwise method in the SPSS v.22 software. First step, the correlation was surveyed between climatic elements and total vegetation cover and secondly, between total cover and life forms data.

## Results

Based on the Emberger's coefficient (28.97) and average minimum temperature (-1.47°C), the climate of the study area was obtained as cold arid climate where there is a six-month period of drought starting from the beginning of May to the end of October (Fig. 1). Four months had less than 10 mm precipitation and the distance between two temperature and rain curves are so far. Then, it has more evaporation and dryness conditions in the area.

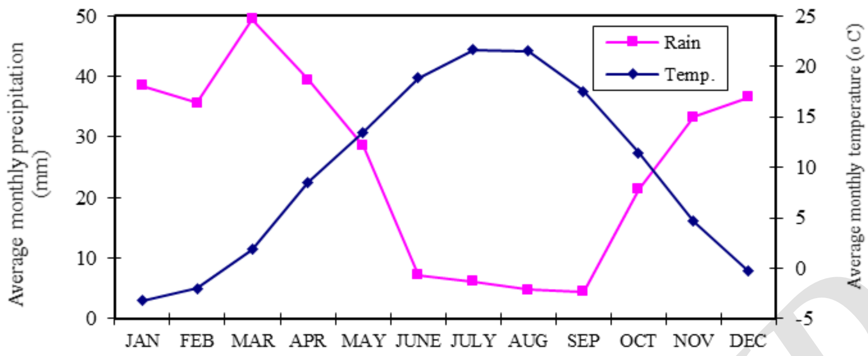


**Fig. 1.** The *ombrothermic diagram of climate in the* Polour site

The stepwise analysis between total vegetation and the climate factors showed that minimum temperature was the most effective variable on vegetation (P<0.01) and finally, the regression equation was also obtained (Table 5).

It was important in the second step to find which life form was influenced by the climatic factors. In this step, the multivariate regression method was used again and the results showed that it had two steps: first step is the entrance of annual grasses to equation (R=79.6%) and second step is the entrance of perennial forbs to the equation as well (Table 7). Based on coefficient for the annual grass (1.911) in the step two, there were the most effective elements of total vegetation and it was so less (0.208) by adding perennial forb in the second step to the equation. Hence, it can be said that the most effected life form of minimum temperature was the annual grasses.

**Table 5.** The summary of regression analysis between vegetation cover and climate factor and between vegetation cover and life forms and for the area

| Variables | step | Equation | R | $R^2$ | F test | Sig. F |
|---|---|---|---|---|---|---|
| Veg vs. climate factor | | $Veg. = 146.54 + 10.13 T_{min}$ | 0.875 | 0.765 | 163.107 | 0.000 |
| Veg vs. life form | 1 | $Veg. = 34.192 + 1.98 AG$ | 0.796 | 0.633 | 86.376 | 0.000 |
| | 2 | $Veg. = 46.77 + 1.911 AG + 0.208 PF$ | 0.846 | 0.716 | 61.805 | 0.000 |

Veg= total vegetation cover, $T_{min}$: minimum temperature, AG=annual grass, PF= perennial forb

The output data of Tables 2, 3, and 4 were shown in the Figs. 2, 3 and 4. The most parts of the area were covered by grass-shrub life forms (Fig. 2) and precipitation and average temperature were reduced from low altitude to upland (Figs. 3 and 4). The final map, Phytoclimatic map, has shown that the dominated life forms such as grasses and shrubs require 335-385 mm of precipitation and 6-8°C average temperature for the suitable growth (Fig. 5).

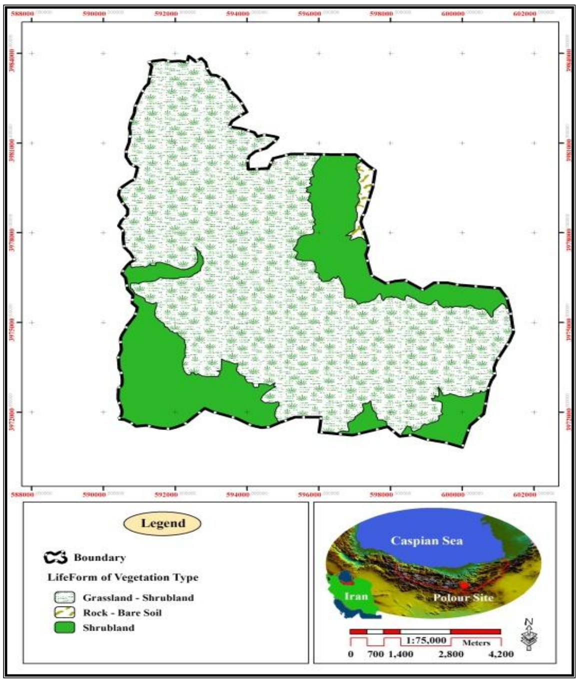


**Fig. 2.** Life-form map of Polour site

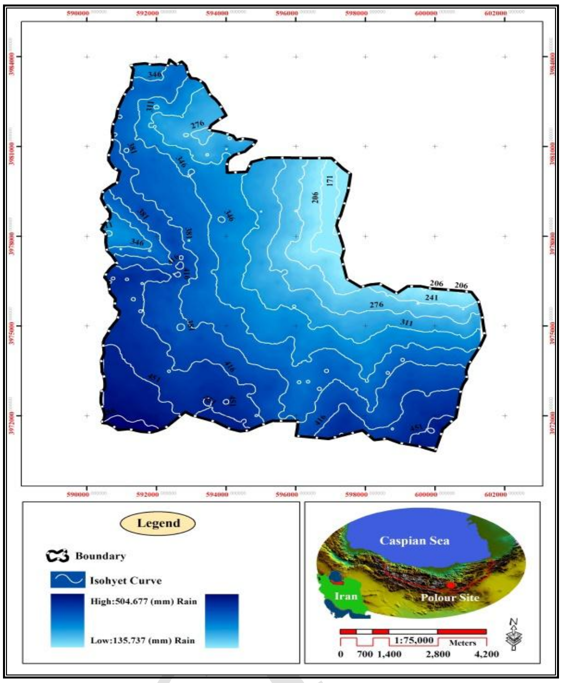


**Fig. 3.** Isohyet map of the Polour site

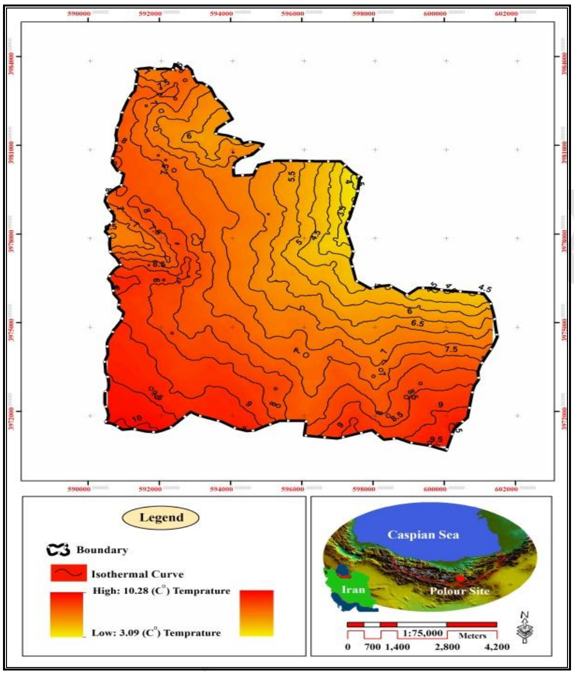


**Fig. 4.** Isothermal map of the Polour site

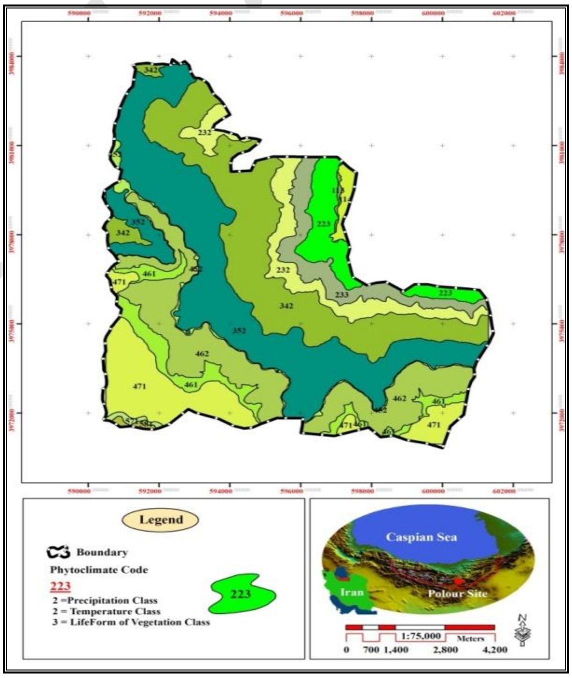


**Fig. 5.** Phytoclimatic map of the Polour site

## Discussion and Conclusion

As ombrothermic diagram has shown, the most periods of vegetative growth stage are connected to temperature factor, especially the minimum temperature based on the results of Table 5. Growth temperature for grasses like *Festuca* is averagely 10 to 15°C and it is different for the other perennial grasses, but it is not below (Nasri and Doesher, 1995). The apical buds of the most grasses are in accordance to leaf elongation zone where is the main site of shoot growth in grasses (Arredondo and Schnyder, 2003). Hence, they can resist against low temperature and reversely annual grasses require adaptable temperature to grow from seeds (Shabala, 2012). In the area, the average temperature is below zero Celsius degree which is not adaptable for a wakening seed of therophytes form (e.g. annual grass). The growth stage is occurred when environmental temperature copes with 10°C which is mid-April. Some researchers have supported the obtained result such as Baghdadi *et al.* (2013) who had claimed that the cold condition can delay the flowering stage of some perennial grasses. The perennial forbs has also influenced by the climate factor that these species have so less preserved nutrients in the below ground organs and hence, they should be assured to grow with the minimum temperature. This finding is along with the result reported by Marqez *et al*. (2004), Kikvidze *et al*. (2005), Cheng and Nakamura (2007), and Kandel (2010) and against to other researchers who suggested that precipitation was the most effective factors of climate on vegetation pattern and structure (e.g. Walker *et al*., 1994; Calef *et al*., 2005; Flannigan *et al*., 2016; Grossiord *et al*., 2017; Camaca *et al*., 2017; Speed and Austrheim, 2017). In spite of that, the research done by Bayat *et al*. (2016) proposed that the growth of *Bromus tomentellus* and *Agropyron trichophorum* depended on rainfall of early spring month, March.

Moreover, as a reality, the central Alborz is going to increase the temperature in the recent decades (Noroozi *et al.*, 2008). Hence, the period of drought is longer and it can increase the requirements for soil moisture while decreasing water content in the topsoil, and decreasing ground water levels as Ghahraman (2006) and Ter Heerdt *et al*., (2017) pointed out. Unfortunately, the increase of temperature will be continued in next two decades as well (Saadatfar *et al.,* 2013) and it means less rainfall and longer drought periods which will cause to migrate the species to upland and obviously, it will change the vegetation patterns of the area. Pauli *et al*. (1996) and Gao *et al*. (2017) have reported the same results.

In conclusion, the upland rangelands of Polour are going to narrow line to live based upon the results because most life forms like grass-shrub need sufficient climatic components such as precipitation and temperature. Right now, this situation is insufficient for confident growth because the most areas of the region are limited by low precipitation and temperature. On the other hands, the severe climatic conditions, which are laid down the recent period, are caused for decreasing plants regular growth. Hence, to manage the situation of area for better utilization, decreasing livestock is necessary along with increased temperature and precipitation. Therefore, it can be achieved by reduction of grazing periods into two months to maintain the current vegetation cover which finds an opportunity to balance themselves to quick climate changes.

## References

Anthelme, F., Waziri Mato, M., Maley, J., 2008. Elevation and local refuges ensure persistence of mountain specific vegetation in the Nigerien Sahara. *Jour. Arid Environments*, 72: 2232-2242.

Arredondo, J.T., Schnyder, H., 2003. Components of leaf elongation rate and their relationship to specific leaf area in contrasting grasses. New Phytol. 158: 305-314.

Ash, J.D., Givnish, T.J., Waller, D.M., 2016. Tracking lags in historical plant species' shifts in relation to regional climate change. Global Change Biology, 23(3):1305-1315.

Baghdadi, E., Jafari, A.A., Alizadeh, M.A., Gorji, A.H., 2013. Studying the Impacts of Cold Temperature on Morphological and Phonological Development of Poa pratensis and Poa trivialis Regarding GDD. Jour. Rangeland Science, 3(3): 223-230. (In Persian).

Bayat, M., Arzani, H., Jalili A., Nateghi, S., 2016. The Effects of Climatic Parameters on Vegetation Cover and Forage Production of Four Grass Species in Semi-steppe Rangelands in Mazandaran Province, Iran. Jour. Rangeland Science, 6(4):368-376. (In Persian).

Bayet-Goll, A., Monaco, M., Mahmudy-Gharaei, M.H., Nadaf, R., 2016, Depositional environments and ichnology of Upper

Cretaceous deep-marine deposits in the Sistan Suture Zone, Birjand, Eastern Iran: Cretaceous Research, 60:28-51.

Blinova, I.V., 2008. Populations of Orchids at the Northern Limit of Their Distribution (Murmansk Oblast): Effect of Climate. Russian Jour. Ecology, 39(1): 26-33.

Burke, I.C., Lauenroth, W.K., Vinton, M.A., Hook, P.B., Kelly, R.H., Epstein, H.E., Aguiar, M.R., Robles, M.D., Aguilera, M.O., Murphy, K.L., Gill, R.A., 1998. Plant-Soil Interactions in Temperate Grasslands. Biogeochemistry, 42(1/2): 121-143.

Cain, S. A., 1950. Life-Forms and Phytoclimate. Botanical Review, 16(1): 1-32.

Calef, M.P., McGuire, A.D., Epstein, H.E., Rupp, T.S., Shugart, H.H., 2005. Analysis of vegetation distribution in Interior Alaska and sensitivity to climate change using a logistic regression approach. Jour. Biogeography, 32: 863-878.

Camaca, J.S., Williams, R.J., Wahren, C.H., Hoffmann, A.A., Vesk, P.A., 2017. Climatic warming strengthens a positive feedback between alpine shrubs and fire. Global Change Biology, 23(8): 3249-3258.

Carder, A.C., 1970. Climate and the Rangelands of Canada. Jour. Range Management, 23(4): 263-267.

Cheng, Y. and Nakamura, T., 2007. Phytosociological study of steppe vegetation in east Kazakhstan. Grassland Science, 53: 172-180.

Chapple, D.E., Faber, P., Suding K.N., Merenlender, A.M., 2017. Climate Variability Structures Plant Community Dynamics in Mediterranean Restored and Reference Tidal Wetlands. Water, 9(3):209; doi: 10.3390/w9030209.

Colautti, R.I., Agren, J. and Anderson, J.T., 2017. Phenological shifts of native and invasive species under climate change: insights from the Boechera–Lythrum model. Phil. Trans. R. Soc. B 372: 20160032. http://dx.doi.org/10.1098/rstb.2016.0032.

Damavandi, A.A., Rahimi, M., Yazdani, M.R., Noroozi, A.A., 2016. Assessment of Drought Severity Using Vegetation Temperature Condition Index (VTCI) and Terra/MODIS Satellite Data in Rangelands of Markazi Province, Iran. Jour. Rangeland Science, 6(1):33-42. (In Persian).

Davis, M.B. and Shaw, R.G., 2001. Range Shifts and Adaptive Responses to Quaternary Climate Change, Science. New Series, 292(5517): 673-679.

Estiarte, M., and Peñuelas, J., 2015. Alteration of the phenology of leaf senescence and fall in winter deciduous species by climate change: effects on nutrient proficiency. Glob Chang Biol., 21(3):1005-1017.

Fay, P.A., Carlisle, J.D., Knapp, A.K., Blair, J.M., Collins, S.L., 2000. Altering Rainfall Timing and Quantity in a Mesic Grassland Ecosystem: Design and Performance of Rainfall Manipulation Shelters. Ecosystems, 3: 308-319.

Fernández-Cancio, A., Navarro Cerrillo, R.M., Fernández, R., Gil Hernández, P., Menéndez, E.M., Calzado Martínez, C., 2007. Climate classification of Abies pinsapo Boiss. Forests in Southern Spain. Forest Systems, 16(3): 222-229.

Flannigan, M.D., Wotton, B. M., Marshall, G.A., de Groot, W.J., Johnston, J., Jurko, N. and Cantin, A.S., 2016. Fuel moisture sensitivity to temperature and precipitation: climate change implications. Climatic Change, 134(1-2):59-71. Doi: 10.1007/s10584-015-1521-0.

Foley, J.A., Levis, S., Costa, M.H., Cramer W., Pollard, D., 2000. Incorporating dynamic, vegetation cover within global models. Ecological Applications, 10(6): 1620-1632.

Franklin, J., Serra-Diaz, J.M., Syphard, A.D., Regan, H.M. 2016. Global change and terrestrial plant community dynamics. Proceedings of the National Academy of Sciences (PNAS), 113(14): 3725–3734.

Gao, T., Xu, B., Yang, X., Deng, S., Liu, Y., Jin, Y., Ma, H., Li, J., Yu, H., Zheng, X., Yu, Q., 2017. Aboveground net primary productivity of vegetation along a climate-related gradient in a Eurasian temperate grassland: spatiotemporal patterns and their relationships with climate factors. Environ Earth Sci., 76:56, DOI 10.1007/s12665-016-6158-4.

Ghahraman, B., 2006. Time Trend in the Mean Annual Temperature of Iran. Turk Jour. Agric. For., 30: 439-448. (In Persian).

Grossiord, C., Sevanto, S., Adams, H.D., Collins, A.D., Dickman, L.T., McBranch, N., Michaletz, S.T., Stockton, E.A., Vigil, M., McDowell, N.G., 2017. Precipitation, not air temperature, drives functional responses of trees in semi-arid ecosystems. Jour. Ecology, 105(1): 163-175.

Hollister, R.D., Webber, P.J., Bay, C., 2005. Plant Response to Temperature in Northern Alaska: Implications for Predicting Vegetation Change. Ecology, 86(6): 1562-1570.

Havstad, K.M., Brown, J.R., Estell, R., Elias, E., Rango, A., Steele, C., 2016. Vulnerabilities of Southwestern U.S. Rangeland-based animal agriculture to climate change. Climatic Change, November, 1–16. doi: 10.1007/s10584-016-1834-7.

Imbach, P.A., Locatelli, B., Molina1, L.G., Ciais, P. and Leadley, P.W., 2013. Climate change and plant dispersal along corridors in fragmented landscapes of Mesoamerica. Ecology and Evolution, 3(9): 2917-2932.

Kargar, M., Jafarian, Z., Tamartash, R. and Alavi, S.J., 2016. The Study Distribution and Some Ecological Indicators of Plant Species, Siahboneh Rangeland, Haraz. Plant Research Jour. (Iranian Jour. Biology), 29(4):844-855. (In Persian).

Kandel, T.P., 2010. Response to temperature of upland and lowland cultivars of switchgrass. MS thesis, Faculty of the Graduate College, Oklahoma State University, USA, 79p.

Karger, D.N., O. Conrad, J. Böhner, T. Kawohl, H. Kreft, R.W. Soria-Auza, N.E. Zimmermann, H.P. Linder and M. Kessler, 2017. Data Descriptor: Climatologies at high resolution for the earth’s land surface areas. Scientific Data, 4:170122 | DOI: 10.1038/sdata.2017.122.

Kikvidze, Zaal, Pugnaire, F. I., Brooker, R.W., Choler, P., Lortie, C.J., Michalet, R., Callaway, R.M., 2005. Linking patterns and processes in alpine plant communities: a global study. Ecology, 86(6):1395-1400.

Maleknia, R., Khezri, E., Zeinivand, H., Badehian, Z., 2017. Mapping Natural Resources Vulnerability to Droughts Using Multi-Criteria Decision Making and GIS (Case Study: Kashkan Basin Lorestan Province, Iran). Jour. Rangeland Science, 7(4):376-386. (In Persian).

Marqez, E.J., Farinas, M. R., Briceno, B., Rada, F.J., 2004. Distribution of grasses along an altitudinal gradient in a Venezuelan Paramo. Revista Chilena de Historia Natural, 77: 649-660.

Nasri, M., Doescher, P.S., 1995. Effect of temperature on growth of cheatgrass and idaho fescue. Jour. Range Manage, 48: 406–409.

Nogues-Bravo, D., Araujo, M.B., Errea, M.P., Martinez-Rica, J.P., 2007. Exposure of global mountain systems to climate warming during the 21st Century. Global Environmental Change, 17: 420-428.

Noroozi, J., Akhani, H., Breckle, S.W., 2008. Biodiversity and phytogeography of the alpine flora of Iran. Biodivers Conserv., 17: 493-521.

Olsen, S.L., Topper, J.P., Skarpaas, O., Vandvik, V., Klanderud, K., 2016. From facilitation to competition: temperature-driven shift in dominant plant interactions affects population dynamics in semi natural grasslands. Global Change Biology, 22(5): 1915-1926.

Pauli, H., Gottfried, M., Grabherr, G., 1996. Effects of climate change on mountain ecosystems-upward shifting of Alpine plants. World Resource Review, 8(3): 382-390.

Prevey, J., Vellend, M., Ruger, N., Hollister, R.D., Bjorkman, A.D., Myers-Smith, I.H., Elemendorf, S.C., Clark, K., Cooper, E.J., Elberling, B., Fosaa, A.M., Henry, G.H.R., Hoye, T.T., Panchen, I.S., Jonsdottir, K. Klanderud, E., Levesque, M., Mauritz, U., Molau, S.M., Natali, S.F. Oberbauer, Z.A., Post, E., Rumpf, S.B., Chmidt, N.M., Schuur, E.A.G., Semenchuk, PH. R. Troxler, T. Welker J.M., Rixen, CH., 2017. Greater temperature sensitivity of plant phenology at colder sites: implications for convergence across northern latitudes. Global Change Biology, 23(7): 2660-2671.

Saadatfar, A., Barani, H., Bahremand, A.R., Massah Bavani, A.R., Sepehry, A., Servestani, A.A., 2013. Statistical Downscaling HadCM3 Model for Detection and Prediction of Seasonal Climatic Variations (Case Study: Khabr Rangeland, Kerman, Iran). Jour. Rangeland Science, 3(3): 265-275. (In Persian).

Schaefer, C.E., Corrêa, G.R., Candido, H.G., Arruda, D.M., Nunes, J.A., Araujo, R.W., Rodrigues, P.M.S., Fernandes Filho, E.I., Pereira, A.F.S., Brandão, P.C., Neri, A.V., 2016. The Physical Environment of Rupestrian Grasslands (Campos Rupestres) in Brazil: Geological, Geomorphological and Pedological Characteristics, and Interplays. Chapter 2, G.W. Fernandes (ed.), Ecology and Conservation of Mountaintop Grasslands in Brazil, DOI 10.1007/978-3-319-29808-5_2.

Shabala, S., 2012. Plant Stress Physiology, Hobart, Australia, CABI.

Shaw, R.G. and Etterson, J.R. 2012. Rapid climate change and the rate of adaptation: insight from experimental quantitative genetics. New Phytologist, 195(4): 752-765.

Shokrollahi, Sh., Moradi, H.M., and DianatiTilaki, Gh.A., 2011. An introduction of flora, life-form, and phytogeographical distribution of Polour rangelands’ plants. Research Journal of Plant Sciences, 23(3): 1-15. (In Persian)

Speed, J.D.M. and Austrheim, G., 2017. The importance of herbivore density and management as determinants of the distribution of rare plant species. Biological Conservation, 205:77-84.

Ter Heerdt, G.N.J., Veen, C.G.F., Van der Putten, W.H., Bakker, J.P., 2017. Effects of temperature, moisture and soil type on seedling emergence and mortality of riparian plant species. Aquatic Botany, 136: 82-94.

Travis, J.M.J., 2003. Climate Change and Habitat Destruction: A Deadly Anthropogenic Cocktail, Proceedings. Biological Sciences, 270(1514): 467-473.

Vittinghoff, E., Shiboski, S.C., Glidden, D.V., McCulloch, C.E., 2005. Regression Methods in Biostatistics: Linear, Logistic, Survival, and Repeated Measures Models. Springer Science+ Business Media, Inc.

Walker, M.D., Webber, P.J., Arnold, E.H., Ebert-May, D., 1994. Effects of Inter annual Climate Variation on Aboveground Phytomass in Alpine Vegetation. Ecology, 75(2): 393-408.

Ziaii, H., Behnia, A., 2002. Principles of Engineering of watershed management, Astane Ghods' Publication, press Mashhad, Iran.

# اثر اکولوژیکی عوامل اقلیمی روی پوشش گیاهی مراتع (مطالعه موردی: مراتع پلور)

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**چکیده.** یکی از فاکتورهای مهم برای پراکنش گیاهان در مقیاس جهانی و منطقه‌ای عامل اقلیم است. آگاهی از پراکنش پوشش گیاهی فعلی و ارتباط متقابل آن با عوامل اقلیمی برای پیش‌بینی تغییرات آینده حائز اهمیت است. بنابراین به منظور مطالعه اثر عوامل اقلیمی بر روی فرم پوشش گیاهی، این تحقیق در سال ۱۳۹۶ در مرتع کوهستانی پلور، واقع در دامنه کوه دماوند (ارتفاع ۲۴۰۰ تا ۴۱۰۰ متر) انجام شد. زمان انجام نمونه گیری میدانی در ماه‌های خرداد، تیر و مرداد سال ۱۳۹۶ به انجام رسید. دیاگرام اقلیمی در بازه زمانی سال‌های ۱۳۹۵-۱۳۸۵ با استفاده از روش آمبرژه بدست آمد. به‌منظور تعیین روابط بین طبقات ارتفاعی با عوامل اقلیمی از روش رگرسیونی استفاده شد و خروجی نقشه‌های همباران، همدما و نقشه اقلیم-پوشش با استفاده از نرم افزار Arc GIS v.10.2 تعیین گردید. با استفاده از روش نمونه برداری تصادفی از طریق پلات‌های یک متر مربعی، درصد پوشش گیاهی اندازه‌گیری شد. نتایج تحقیق نشان داد، مناطق مورد مطالعه دارای اقلیم سرد و خشک دارای ۶ ماه دوره خشکی هستند. نتایج رگرسیون گام به گام بین پوشش گیاهی و عامل اقلیمی نشان داد که دمای حداقل بیشترین تأثیر (r=۰/۸۷۵) روی فرم‌های رویشی دارد. در اواسط اردیبهشت ماه زمانی‌که دمای هوای محیط به ۱۰ درجه سانتیگراد می‌رسد مرحله رشد گیاه آغاز می‌شود. از اینرو، مراتع ارتفاعات پلور در شرایط بسیار سختی جهت رویش قرار دارند که اغلب فرم‌های رویشی (بوته-گراس) نیاز به شرایط اقلیمی (بارندگی و دما) مناسب جهت رویش دارند. بنابراین، برای نگهداری پوشش گیاهی فعلی می‌توان دوره چرایی را در این مراتع به دو ماه تقلیل داد تا فرصتی برای تعادل بین پارامترهای اقلیمی و پوشش گیاهی با توجه به تغییرات اقلیمی صورت گیرد.

**کلمات کلیدی:** عوامل اقلیمی، بارندگی، درجه حرارت، مراتع، پلور