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Size Structure and Dynamics of *Thymus Capitatus* in Different Habitats in Southern Al-Jabal Al-Akhdar, Libya

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ABSTRACT

The size structure of wild thyme growth in the southern parts of the Al-Jabal Al-Akhdar region, Soil samples were collected from the surface of each site, and were more or less positively correlated with silt, clay, chloride, calcium, fine sand, and carbonate. On the other hand, they were negatively correlated with nitrogen and potassium. The number of individuals of species was counted while the height (H) and mean crown diameter (D) were measured. Generally, the height to diameter ratio was less than unity for *Thymus capitatus*, this means that the diameter of these species tend to expand horizontally rather than vertically, The size index of each individual was calculated and then used to classify population into 7 size classes: 1 cm size 7 cm .Five forms of size distribution along the different elevations were recognized, it was found that *Thymus capitatus* exhibited more or less J-shaped distribution and along elevation levels (High and Low).*Thymus capitatus* exhibited more or less symmetrical distribution (bell-shaped) along the elevation level (Medium). The negative skewed distribution of *Thymus capitatus* indicated the dominance of mature individuals over the juvenile ones.

التركيب الحجمي والديناميكي لنبات الزعتر (*Thymus Capitatus*)
في بيئات مختلفة في جنوب الجبل الأخضر – ليبيا

مبروكة عبدالله جبريل عبدالرحيم

تم دراسة التركيب الحجمي لنبات الزعتر البري في الأجزاء الجنوبية من منطقة الجبل الأخضر، حيث تم جمع عينات التربة من سطح كل موقع، وكانت مرتبطة بشكل أو بآخر إيجابيا مع الطمي والطين والكلوريد والكالسيوم والرمل الناعم والكربونات، ومن ناحية أخرى كانت مرتبطة بشكل سلبي مع النيتروجين والبوتاسيوم، وتم إحصاء عدد أفراد الأنواع وقياس الارتفاع (H) ومتوسط قطر التاج (D) بشكل عام، كانت نسبة الارتفاع إلى القطر أقل من الواحد بالنسبة لنبات الزعتر (*Thymus capitatus*) ، وهذا يعني أن قطر هذه الأنواع يميل إلى التوسع أفقيًا وليس رأسيًا، وتم حساب مؤشر الحجم لكل فرد ثم استخدامه لتصنيف السكان إلى 7 فئات حجمية: 1 سم الحجم 7 سم. تم التعرف على خمسة أشكال لتوزيع الحجم على طول الارتفاعات المختلفة، وقد وجد أن نبات الزعتر(*Thymus capitatus*) أظهر توزيعًا على شكل حرف (J) تقريبًا وعلى طول مستويات الارتفاع (عالية ومنخفضة). أظهرنبات الزعتر(*Thymus capitatus*) توزيعًا متماثلًا إلى حد ما (على شكل جرس) على طول مستوى الارتفاع (متوسط). أشار التوزيع المنحرف السلبي لنبات الزعتر (*Thymus capitatus*) إلى هيمنة الأفراد الناضجين على الأفراد الصغار.

INTRODUCTION

The ecosystem in Al-Jabal Al-Akhdar is at risk of desertification due to the climatic conditions prevailing in Libya (Mahmoud *et al*., 2008).It has been shown that species lifestyles in plant communities are largely influenced by soil characteristics (Hegazy *et al*. 2004), human activities have greatly affected the biodiversity in the study area, and the situation has become very dangerous for the forest as many people took advantage of the chaos and cleared hundreds of hectares to convert the land use to agricultural land. In addition, consider the impact that grazing management will have on the plant, soil, and water components of the ecosystem. (Hobbs *et al*., 1999). A better understanding of the population structure and dynamics is essential for the conservation and management of rare and threatened plant species (Monks *et al*., 2012;Dong, 1987; Svensson &Jeglum, 2001).The ages and sizes of the individuals that make up a plant group can be used to characterize its structure (mabroka., 2023). Here we evaluate the effects of the physical environment (abiotic) and biological environment (biotic) on thyme plants through size structure and dynamics. *Thymus capitatus* is an endemic wild plant in Al-Jabal Al-khdar area; Libya. *Thymus capitatus* growing in southern parts of Al-Jabal Al-khdar showed flower color polymorphism which results in five different phenotypes: white- flowered, dotted white-flowered, purple-flowered, violet-flowered and mosaic-flowered (Ali *et al*., 2019; Ezzudin *et al*., 2022). The present study investigated the size structure and dynamics of thyme plant, in terms of size distribution, height, diameter and density in their different habitats.

MATERIALS AND METHODS

Study area; The study area is located in southern parts of Al-Jabal Al-khdar, Libya (Al-Idrissi *et al*. 1996), between latitude 32°35´52.84" N and longitude 21°28´22" E, at an elevation of around 600 meters, its height is between (455: 600) meters. Fig. 1

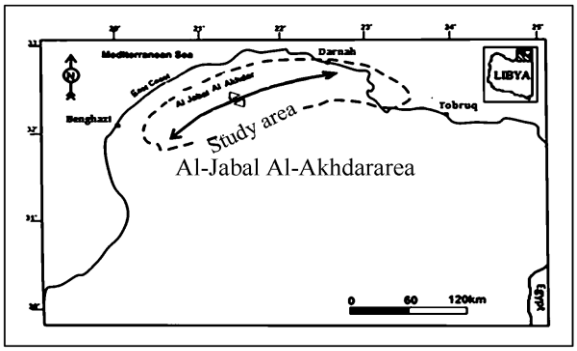

Fig. 1Location map indicating the study

Climate of the area; Climatic data were obtained from some stations (Meteorological data of Shahat station) Fig.2. The distinctive features of the climate of the study area are a concentration of rainfall during cool winter season and summer drought Climate data for study area (El-Tantawi.,2005).Were selected at southern of Al-Jabal Al-Akhder at three different levels (Low, Medium and High).

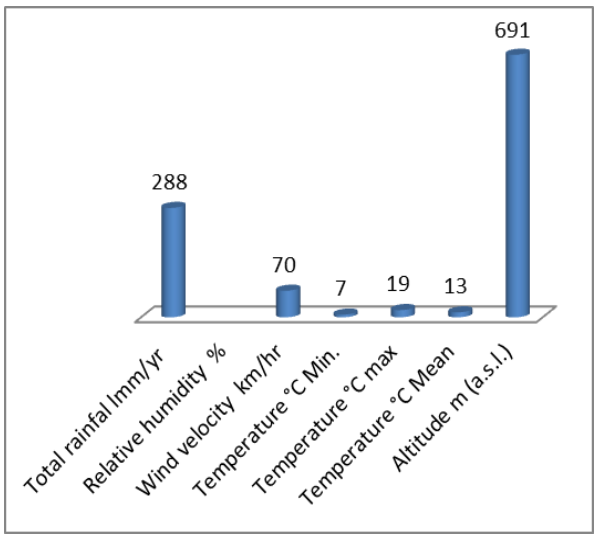

Fig. 2 Climate data for the study area.

Data collection; Thirty quadrats (10m×10m) were selected at the three different levels (Low, Medium and High). At each site, the number of individuals, length, and diameter were calculated (Shaltout *et al*., 2015). The population structure of these species was evaluated in terms of size distribution. For achieving this, the height and mean crown diameter of each individual in the whole locations were measured (based on 2-4 diameter measurements / ind.) and its volume was calculated as a cylinder. The size index of each individual was calculated as the mean of its height and diameter [(H+D)/2]. The size estimates were then used to classify population into 7 size classes (Shaltout *et al*., 2014). The size classes (cm/ ind.) are (1=0< 1, 2=1.1-2, 3=2.1–3, 4=3.1–4, 5=4.1–5, 6=5.1–6 and 7= 6.1–7 cm / ind).

Five forms of volume distributions have been identified along different elevations:: more or less inverse J-shaped distribution, positively skewed distribution towards the small size, more or less J-shaped distribution, stationary size distribution and more or less symmetrical distribution (i.e bell-shaped) (Colwell and Lees., 2000).
Soil analysis: Soil samples were collected from the surface of each site of the soil profiles (0–25 cm), then air dried and the physical and chemical parameters of these soil samples were analyzed. Soil texture was determined according to Gupta, P.K., 2000. Soil reaction (pH) was determined in the soil paste using a Beckman bench type pH-meter (Watson and Brown., 1998). Electrical conductivity (E.C) of the saturated soil extracts were determined as described by Allen *et al*., (1974) and expressed as dSm^{-1}. The anions and cations (Cl^-, SO_4^{2-}, CO_3^-, HCO_3^-, Na^+, K^+, Ca^{2+} and Mg^{2+} of the soil extracts were analyzed following the method described by lancher *et al*., (1965) and their values expressed as (m.eq./L.).
Statistical analysis; the data were statistically treated using ANOVA and the simple linear correlation

coefficient (SPSS, 1999); species were tested using Pearson's simple linear correlation coefficient (r). One way analysis of variance was applied to assess the significance of variations in soil.

RESULTS

Variation in the characteristics of soil samples collected from the studied sites (Table 1). Upland Soils have the highest pH and HCO_3^- , but the lowest clay, SO_4^- and CI- , while the medium has the highest of E.C, CI^-, $Ca^{+2}$and Na^+.

Table (1): soil characteristics in the study area.

Soil variables	Sites		
	Low	Medium	High
pH	8.2	7.33	7.45
E.C	0.2	0.4	0.6
Sand	25	30	26
Silt	35	49	39
Clay	25	41	35
CO_3^-	0	0	0
HCO_3^-	0.7	0.2	0.5
SO_4^-	1	7	5
CI^-	4	7	10
Ca^{+2}	0.2	0.4	0.9
Mg^{+2}	1	4	2
Na^+	0.9	1	1.2
K^+	0.5	1	0.2

The relationships between the individual heights and diameters of thyme plant population are simple linear with r2 values (Pearson correlation coefficient) of 0.210 (Fig.3).

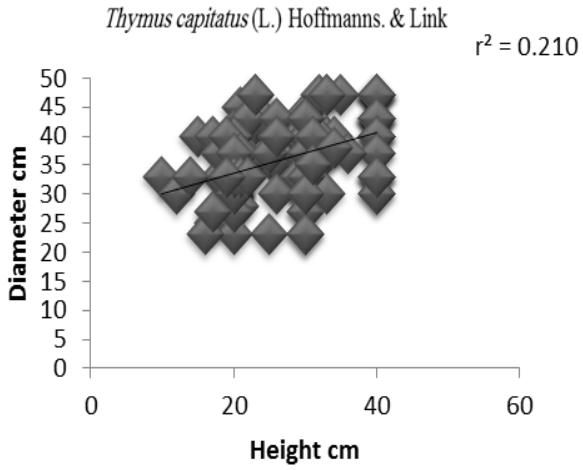

Fig. 3.Height and diameter of thyme plant

On Closer inspection of the data (Table 2), the height to diameter was less, meaning that the diameter of the thyme plant was horizontal.

Table (2): Mean and standard deviation (±) for some dimensions.

Species	Dimensions	Sites		
		Low	Medium	High
Thymus capitatus(L.) Hoffmanns. & Link	Height (cm)	25.6 ± 6.12	22.3 ± 4.52	27.5 ± 5.22
	Diameter (cm)	31.7 ± 3.81	30.9 ± 5.92	39.6 ± 4.91
	Height/ Diameter	0.81 ± 0.63	0.72 ± 0.22	0.7 ± 0.82
	Size index (cm)	28.7 ± 6.81	26.6 ± 4.33	33.6 ± 7.72

The diagrams illustrating the size distribution of thyme plant approximate one of the following size distributions:more or less inverse J-shaped distribution and more or less symmetrical distribution (i.e bell shaped). (Fig. 4).

In the present study, it was found that thyme plant exhibited more or less J-shaped distribution along (High and Low) but symmetrical distribution (bell shaped) along (Medium)

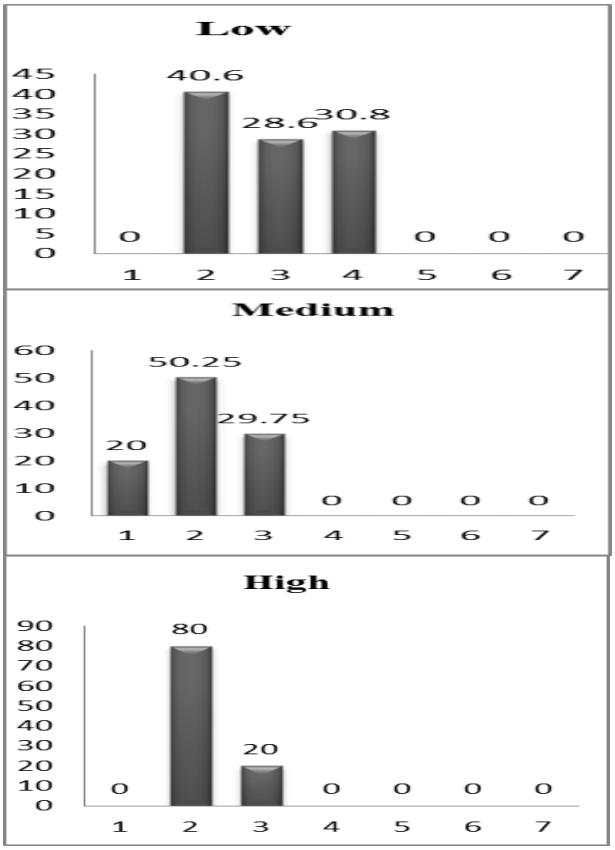

Fig4 Distribution of Thyme frequencies.

DISCUSSION

Climate, topography, soil, human activities and other biotic factors are the most influential factors on the distribution of thyme in different habitat types in the southern Al-Jabal Al- Akhdar, physical and chemical analysis of soil samples showed positive correlation with silt, clay, chloride, calcium, fine sand and electrical conductivity which may be related to soil fertility. Abd El-Wahab (2008) reported that altitude, soil pH, EC, silt, clay, water holding capacity and organic matter were the most important factors that influencing the availability of soil nutrients and controlling the coverage and structure of vegetation. Plant size structure has been frequently used to assess regeneration status and to predict future. In the current study, it was found that the diameter of the thyme plant is horizontal, which leads to a decrease in temperature, an increase in soil moisture, and the provision of shade, according to the results of Mosallam (2005). The height and stem diameter of the studied individual species of different species are particularly important because they revealed the maximum size attained by functionally different species groups, which are crucial to a variety of ecological and evolutionary hypotheses (Niklas *et al*., 2006). On the other hand, the diagrams illustrating the size distribution (Fig. 4) of thyme plant, it was found that Thymus capitatus exhibited less J-shaped distribution and more or less symmetrical distribution (bell-shaped), this distribution characterizes a declining population; because the population has a large proportion of larger individuals than smaller ones (i.e. limited regeneration capacity). This may indicate that the recruitment of these species is rare which may be related to hyper-aridity and low fertility (Shaltout *et al*., 2014 and Shaltout *et al*., 2015).

CONCLUSION

In conclusion, the total size structure of *Thymus capitatus* populations in southern Al-Jabal Al- Akhdar is characterized by the preponderance of the larger individuals comparing with the smaller ones. This study suggests that reducing pressure on human activity may be the solution to halting degradation and desertification.

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