Population structure and dynamics of *Seriphidium herba-alba* (Asso) Soják in different habitats in Jardas Jerrari, Al-Jabal Al- Akhdar, Libya

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Abstract

*Seriphidium herba-alba* (Asso) Sojak is a dwarf shrub fast growing in arid and warm climates and muddy areas at southern Al-Jabal Al-Akhdar, Libya. The present work aims to study the size structure of *Seriphidium herba-alba* populations in relation to their physiographic and soil conditions. Cover percentage of the species was assessed in ten selected quadrates (20 x 20 m) representing three habitats. The number of individuals of species was counted while the height (H) and mean crown diameter (D) were measured. The size index of each individual was calculated and then used to classify population into 7 size classes: 1 cm size 7 cm. Generally, the height to diameter ratio was less than unity for *Seriphidium herba-alba*, this means that the diameter of these species tend to expand horizontally rather than vertically. The total size structure of *Seriphidium herba-alba* in the study area is characterized by the preponderance of the young individuals comparing with the old ones. Five forms of size distributions along the different elevations were recognized: more or less inverse J-shaped distribution, positive skewed distribution, and bell shaped distribution. Soil of the upstream has the highest values of SO4⁻, Cl⁻, Ca⁺⁺, Na⁺, and K⁺, while, while that of mid-stream has the lowest values. The populations of Jardas Jerrari trees, one of the most important tree components of the desert wadis in the central region of Al-Jabal Al-Akhdar area subjected to tremendous pressure from human impacts. Apart from human caused changes in the unprotected habitats, other biotic and abiotic factors may also play a role in the decline of the plant population.

**Key words:** Population dynamic; Size distribution; *Seriphidium herba-alba* (Asso) Sojak; Jardas Jerrari; Al-Jabal Al-Akhdar, Libya.
التركيبة السكانية والديناميكية للشيح Seriphidium herba-alba (Asso) في بيئات مختلفة في جردس جراري، الجبل الأخضر، ليبيا

الملخص:

الشيح Seriphidium herba-alba (Asso) Sojak الشيح هي شجرة قزمة تنمو بسرعة في المناخات القاحلة والدافئة في مناطق جنوب الجزء الشرقي لليبيا. تهدف الدراسة الحالية إلى متابعة التوزيع الحجمي وعدد الأفراد الشيح في جردس جراري، جردسًا على ثلاثة ارتفاعات مختلفة من المجرى، وذلك باستخدام تسلسلات معكسة من النباتات في توزيع الحجم. تم قياس الارتفاع (H) والقطر (D) لعدد من الأفراد. وضع مؤشر الحجم لكل فرد باستخدام التصنيف السكاني إلى 7 فئات: 1 سم إلى 7 سم. وكان النتائج المثلى في المجرى، وهو يعني أن قطر Seriphidium herba-alba في هذه الأنواع تميل إلى التوسع أفقياً بدلاً من عمودياً، ويشير التركيب الحجمي الكلي للشيح (Seriphidium herba-alba) في المنطقة المحيطة بمنطقة الدراسة، وهو يعد من أهم المكونات الشجرية للأودية الصحراوية. تشير هذه النتائج إلى أن الرياح والظروف المحيطة قد تلعب دورًا في انخفاض أعداد الأفراد. الكلمات المفتاحية: التركيب السكاني، التوزيع الحجمي، نبات الشيح، جردس جراري، الجبل الأخضر، ليبيا.
1 Introduction

The structure of a population of plants can be described in terms of the ages, sizes, and forms of the individuals that compose it. Commonly, there is a hierarchy of dominant, subordinate, and suppressed forms, not only represented by different species but also within the populations of each species ([10]-[8]). There is one important feature that distinguish such age structures from those familiar to animal demographers, and that is that precise annual ages are seldom given since they are not usually determinable with accuracy for herbaceous plants. Size or life stage distributions are obviously much easier to assemble than true age distributions, and indeed for those plants that leave no lasting record of age, e.g. in the form of growth rings, the only way to assemble an age distribution may be long term observation of marked individual ([1]-[8]), increasing attention has been dedicated to the role of population density on the dynamics of plant populations. Two important relationships that link the mean and range in plant size with population density have emerged from such investigations ([17]-[2]). The demography of tree species populations, particularly when dealing with field data including density, spatial distribution, size or age classes, seedling establishment, and mortality rates will support species management and conservation efforts ([12]-[13]). Size differences may be caused directly or through differences in growth rates due to age differences, genetic variation, heterogeneity of resources, herbivores, and competition ([21]).

The present study aimed at analyzing the population structure of *Seriphidium herba-alba* in different habitats in Jardas Jerrari Al-Jabal Al- Akhdar. *Seriphidium herba-alba* (previously named *Artemisia herba-alba*) is a plant of semi-arid regions in the Mediterranean and is not very harding in regions with cold winters. Species in this genus are generally easily grown, succeeding in a well-drained circumneutral or slightly alkaline loamy soil, preferring a sunny position. They tend to be longer lived, hardier and more aromatic when they are grown in a poor dry soil ([9]). In terms of its chemical composition *Seriphidium herba-alba* has five main substances: -thujone; campholene aldehyde; 2, 4-Hexadiene, 2, 3-dimethyl-; Artemisia triene and Sabinene ([15]). This species also known as desert wormwood is wide used in folk medicine for the treatment of gastric disturbances such as diarrhea, abdominal cramps and for healing external wounds ([22]).
The present study aimed at analyzing the population structure of and dynamics of *Seriphidium herba-alba* in different habitats in Jardas Jerrari Al-Jabal Al-Akhdar., Libya.

2 Materials and Methods

Jardas Jerrari is a village in Jebel Akhdar, Libya. It was named Jardas Jerrari after the tribe living on it; Jardas Jerrari is located about 35 km south of the city of Bayda. The study area as shown in Fig. 1 is located on the southern slope of the Al-Jabal Al-Akhdar area, ([11]). It is located between latitudes 33° and 31° N, and longitudes 20.30°–21.30° E (Fig.1). The distinctive feature of the climate of the study area is the few rainfall during winter, while summer is virtually dry with mean annual rainfall of 235 mm year-1. The lowest mean minimum air temperature varies between 3 °C in January and 16.5 °C in August, while the highest varies between 20.5 °C in January and 39.3 °C in May. The relative humidity varies between 52% in June and 70.3% in January (Fig.2) ([6]).
Ten quadrates (each of 20x20m) were selected to represent the main habitats of *Seriphidium herba-alba* populations along Jardas Jerrari. 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 8 size classes ([16]). The size classes (m/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 \(7=6.1-7\). Soil samples were collected from the surface of each location, or up to the rocks or hard pans in case of shallow. In each location, one composite soil sample was collected from soil profiles (0 – 25cm), air dried then physical and chemical parameters of such soil samples were analyzed. Soil texture was determined by ([7]). Soil reaction (pH) was determined in the soil paste using a Beckman bench type pH-meter ([20]). Electrical conductivity (EC) of the saturated soil extracts were determined as described by Richards ([14]) and expressed as dSm⁻¹.

**3 Results**

The size was estimated by measuring the height and mean diameter. simple linear correlation coefficient \((r^2)\) and size index, were shown in Table (1) Generally, the height to diameter
ratio was less than unity for *Seriphidium herba-alba*, this means that the diameter of these species tend to expand horizontally rather than vertically.

**Table 1** Mean (±) standard deviation of some demographic variables: (H: Height, D: Diameter, r: simple linear correlation coefficient between height and diameter and size index

<table>
<thead>
<tr>
<th>Sites</th>
<th>Species</th>
<th>H (m)</th>
<th>D (m)</th>
<th>r²</th>
<th>Size index (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downstream</td>
<td><em>Seriphidium herba-alba</em></td>
<td>22 ± 0.346</td>
<td>35 ± 0.866</td>
<td>0.196</td>
<td>33 ± 0.49</td>
</tr>
<tr>
<td>Midstream</td>
<td><em>Seriphidium herba-alba</em></td>
<td>25 ± 0.473</td>
<td>40 ± 0.626</td>
<td>0.196</td>
<td>35 ± 0.634</td>
</tr>
<tr>
<td>Upstream</td>
<td><em>Seriphidium herba-alba</em></td>
<td>22 ± 0.311</td>
<td>30 ± 0.422</td>
<td>0.196</td>
<td>28 ± 0.344</td>
</tr>
</tbody>
</table>

The relationships between the individual heights and diameters of *Seriphidium herba-alba* are simple linear with r values of 0.196 (Fig. 3).

![Fig. 3. The relationships between the individual heights and diameters of *Seriphidium herba-alba*](image)

*Seriphidium herba-alba (Asso)*

\[ r^2 = 0.196 \]
For the whole population of *Seriphidium herba-alba*, the size-class frequency distribution reflected, more or less, normal distribution (Fig. 4). Regarding the habitat types, the size frequency distribution of the population in downstream was positively skewed, while that of upstream beds tended to be negatively skewed (Fig. 4). On the other hand, its frequency distribution along the elevation gradient, for the whole population and its habitats, had negative skewed or J-shape towards the relative preponderance of the plant population at higher elevations (Fig. 4).

**Fig. 4.** Size frequency distribution of *Seriphidium herba-alba* populations from three habitats. The mean volume within each size class is also indicated. The ranges of size classes are: 1>1 , 2=1.1-2, 3=2.1-3, 4=3.1-4, 5=4.1-5, 6=5.1-6, 7=6.1-7. Note: measures of *Seriphidium herba-alba* was by centimeter (cm).

The soil and morphological differences between habitats were statistically treated using one-way ANOVA, and the response curves were drawn to assess the relationships between the spatial variations in the estimated soil variables of *Seriphidium herba-alba*. Soil of the upstream has the highest values of $\text{SO}_4^{2-}$, $\text{Cl}^-$, $\text{Ca}^{++}$, $\text{Na}^+$, and $\text{K}^+$ (11.23, 8.3, 0.9, 2.55 and 1.11 respectively), while that of mid-stream has the lowest values. Downstream had the highest values of $\text{HCO}_3^-$ and $\text{Mg}^{++}$ (0.6 and 0.11 respectively), (Table 2).
Table 2. Means ± standard errors of some soil variables in each of the three habitats recognized in the study area.

<table>
<thead>
<tr>
<th>Site descriptions</th>
<th>Ph value</th>
<th>EC ds/m</th>
<th>physical Analysis</th>
<th>Chemical Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downstream</td>
<td>7.66</td>
<td>0.3</td>
<td>22.26 38.78 34.55</td>
<td>Anions (ppm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CO₃⁻  HCO₃⁻  SO₄⁻  Cl</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.6  1.0  0.5  0.1  0.11  2.3  0.44</td>
</tr>
<tr>
<td>Mid-stream</td>
<td>7.22</td>
<td>0.2</td>
<td>17.5  44.22 30.11</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upstream</td>
<td>7.34</td>
<td>0.1</td>
<td>31.23 47.11 12.22</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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</table>

4 Discussions

The height/diameter ratio gives an idea about the growth habit of the plant. In the present study, this ratio is less than unity for Seriphidium herba-alba which means that the individual diameter exceeds, the relation between height and diameter of trees was positive adapted to escarp from drought seasons. This may be a strategy of the desert plants to provide safe sites for their self-regeneration, as the horizontal expansion usually provides shade, which leads to decrease the severe heating effect and increase the soil moisture ([18]-[5]).

The results of the size distribution study indicated that all population of Seriphidium herba-alba in Jardas Jerrari Area seems to be young as the proportion of small and medium individuals is greater than that of large individuals. The results of the size distribution study indicated that all population of Seriphidium herba-alba in Jardas Jerrari Area seems to be young as the proportion of small and medium individuals is greater than that of large individuals. Due to aridity and anthropogenic disturbances, floristic diversity of the study area is characterized by a paucity of trees and annuals. The Al-Jabal Al-Akhdar ecosystem is at risk of desertification due to the prevalent climatic conditions of Libya. Though the rangelands are situated to the south of the Al Jabal Al Akhdar zone, they are still in a pristine state, and self-sustainable enough to deal with minor ecosystem problems. Degradation effects are propagated through processes of commencing with inappropriate or unsustainable land use practices, which eventually result in a substantial, near permanent decline in
ecosystem health and productivity. Signs of degradation in the south of the Al Jabal Al Akhdar include marked reduction or complete loss of vegetation cover, accelerated soil erosion, increases in dust storms, edaphic drying, reduced biodiversity, as well as reduced habitat diversity and primary productivity. ([19]), the distribution of plant species along elevation gradients was governed by a series of interacting biological, environmental and historical factors ([4]). Further, elevation gradients create varied climates, along with resultant soil differentiation; both can promote diversification of plants ([3]).

In conclusion, the total size structure of *Seriphidium herba-alba* populations in in Jardas Jerrari Area is characterized by the preponderance of the young individuals comparing with the old ones, seems to be young as the proportion of small and medium individuals is greater than that of large individuals.
References


