



## Studies on ecology of dominant shrub species in Ghazni university campus, Afghanistan

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### ABSTRACT

Afghanistan has around 5,000 plant species out of which 25-30% are endemic. Some of the shrubs in Afghanistan are unique with medicinal and industrial properties and unfortunately every year we loss shrubs in a huge amount by people (uprooting and cutting), over grazing and soil erosion. In Ghazni University campus different species of shrubs are existed but any ecological studies have not been done yet about these shrubs. Unfortunately, less information exists about shrubs in Ghazni province and I kindly recommend for working in this area for enrichment our flora and biodiversity. These seven shrub species are selected in case of popularization and usefulness in the site. The objectives of this ecological research are; population density, frequency and abundance of seven most popular shrubs in Ghazni University campus by quadrat method for the first time. This research can be very useful in future as a start point. In this shrub land some of the shrubs are dense and abundant and some are vice versa in case of more traditional uses (i.e., *Peganum harmala*). Unlike past, the reasons for high density, abundance, and frequency of some shrubs in the campus are artificial wall of the Ghazni University which built in 2011 and prohibition from uprooting by local people, grazing by herd of nomads and awareness of people. Soil erosion caused to loss shrubs species but there are not data about past situation of populations to compare with present time. This study can be useful for lecturers, students and pharmaceutical concerns in Ghazni University.

**Key words:** Abundance, density, frequency, Ghazni University, quadrat method and shrubs

### INTRODUCTION

Afghanistan lies between 29°30'-38°30' N latitude and 60°30'-74°50' E longitude. Around 45% of Afghanistan is classified as rangelands (FAO, 2016). The north parts of the country consist of fertile plains, while the south-west parts consist of deserts, where temperatures can get very hot in summers (Podlech, 2012). The south-central parts which include Ghazni province also have deserts with warm summer and cold winter. Afghanistan has been subjected to impacts by people and their livestock for thousands of years. There are no parts of the Afghanistan, apart from high alpine areas

that have not been affected (Pa, 2008). There is always a struggle between environment and biota. Afghanistan offers a big variety of ecological conditions; vegetation types are exhibiting a high biodiversity, since the floristic influence from various neighbor regions is a considerable factor in floristic and vegetation pattern (Breckle et al., 2013). Different physical features and climate situations resulted in a diversity which harbor and sustain the immense biodiversity of ecological habitats like shrub lands, forests, wetlands, grasslands, ecosystems and desert ecosystems. Actually Afghanistan lies at the 'crossroad' of

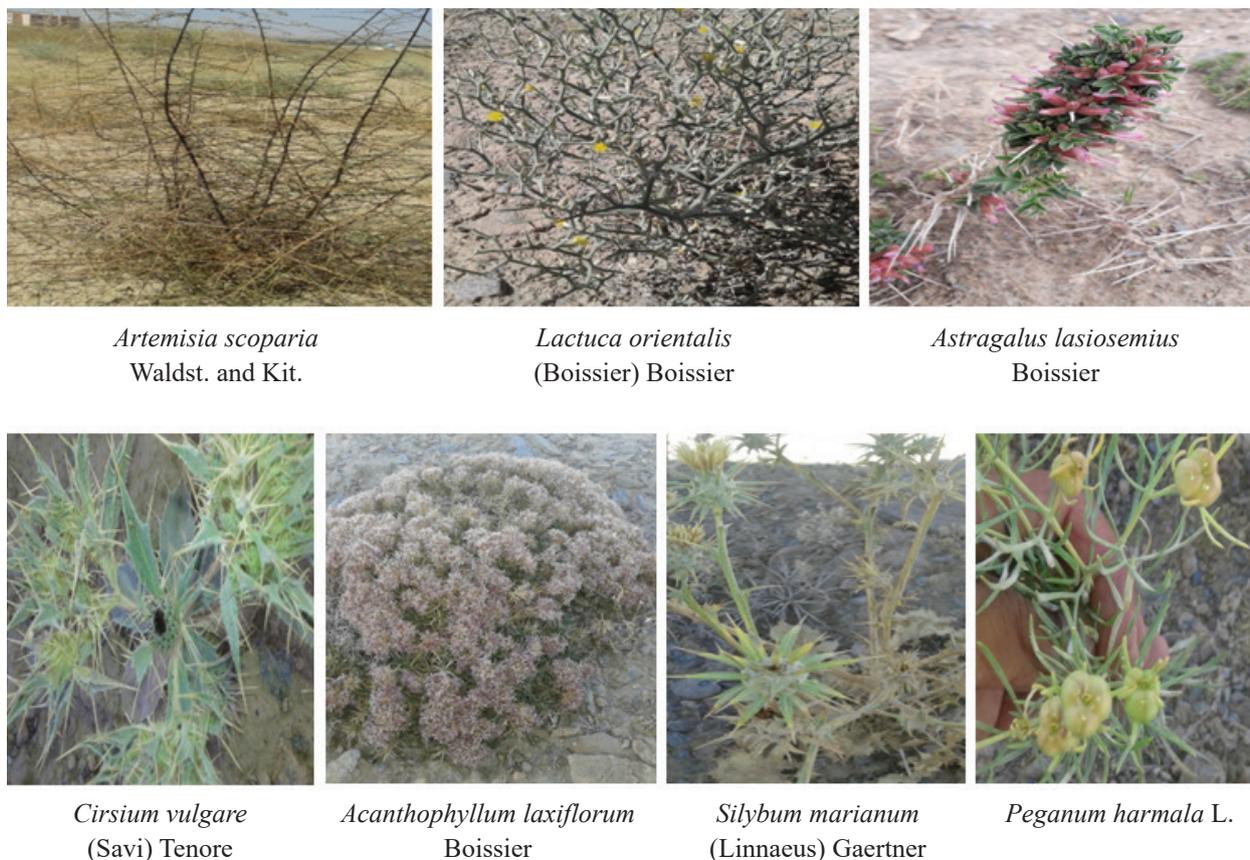
several biogeographically regions (Breckle, 2007). It has a unique plants flora comprising around 5000 species out of which 25-30% are endemic to this country (Breckle and Rafiqpoor, 2010). In nature, there is a close relationship between shrubs and their environment (Alam, 2011). People use many of these shrubs as medicines in Afghanistan. Now 80% of the people in the developing countries depend upon traditional medicines (Pullaiah et al., 2015).

Ecologists describe a plant community in terms of the number of species it contains and the relative abundance of these species in the community. World's biodiversity are mostly near the equator (Athappan, 2014). Ecologists usually can use such information to underpin the health of an ecosystem or to determine if communities are prone to invasion. Composition of the plant community can inform us further about the quality

of the habitat: to know is it wet, does it have high or low nutrient load and is it heavily grazed or used? Presently, 31 per cent of all gymnosperm species in all over the world face the threat of extinction (Gross, 2016). The objectives of this article are to find the population density, frequency, and abundance of seven most popular shrubs species in Ghazni University campus (Fig. 1).

## MATERIALS AND METHODS

Field of study was in Ghazni University campus in 2020. Ghazni University is located in the east of Ghazni province city on the foot of a mountain with native shrubs species as well as endemic species (Fig. 2). Ghazni University altitude and water table are between 2,100 m-2,200 m and more than 50 m respectively. It has 100 hectares area and 5 faculties with around 4000 students from different parts of Afghanistan. Ghazni province



**Fig. 1.** Seven most popular and useful shrubs species in Ghazni University campus

is one of the 34 provinces in Afghanistan and is located in the south-central part of Afghanistan at 33°31' N latitude, 68°25' E longitude. Ghazni is situated in or near the cool temperate desert scrub biome according to the Holdridge life zones system of bioclimatic classification. It has a mid-latitude steppe/ semi-arid cool climate (Köppen-Geiger classification: BSk). The wetter seasons are from 3<sup>rd</sup> of February to 25<sup>th</sup> of August and the drier

seasons from 25<sup>th</sup> of August to 3<sup>rd</sup> of February. The annual mean temperature is 9.7<sup>0</sup>C. Total annual Precipitation average is 297 mm which is equivalent to 297 l m<sup>-2</sup>. In addition to medical treatment, shrubs are useful for soil conservation, water storage, climate regulation, habitat for wildlife especially birds, runoff controlling and other environmental services in Ghazni University campus.



**Fig. 2.** Population of 7 shrub species in Ghazni University campus

Materials required in this research were one measuring tape, four nails, sixteen meters of rope, data sheets, pen and collection file. Quadrat method was adopted in this study. Under the method, a shrub land was selected for the determination of ecological density, frequency, and abundance of shrubs. 10 quadrats of appropriate size randomly placed in the shrub land. The best quadrat size to use depends

on the items to be measured. The recommended quadrat size for shrub vegetation is 4 m × 4 m or 16 m<sup>2</sup> (Mueller-Dombois and Ellenberg, 1974; Krebs, 2000). Quadrats made 4 m × 4 m by measuring tape and rope. The numbers of every seven species counted in every quadrat and recorded every individual number in data sheets (Table 1). The data sheets collected in a collection file for office works.

**Table 1.** Number of every 7 species in ten quadrats

Shrub species	Quadrats									
	1	2	3	4	5	6	7	8	9	10
<i>Lactuca orientalis</i>	16	14	11	6	7	12	5	0	3	2
<i>Artemisia scoparia</i>	12	7	12	6	7	3	0	20	3	7
<i>Astragalus lasiosemius</i>	3	2	0	1	2	1	0	0	1	0
<i>Silybium marianum</i>	5	1	0	1	1	1	2	0	1	1
<i>Cirsium vulgare</i>	6	4	2	1	1	2	16	8	1	18
<i>Acanthophyllum laxiflorum</i>	3	3	2	1	5	6	4	0	2	3
<i>Peganum harmala</i>	0	0	0	1	0	1	2	1	3	0

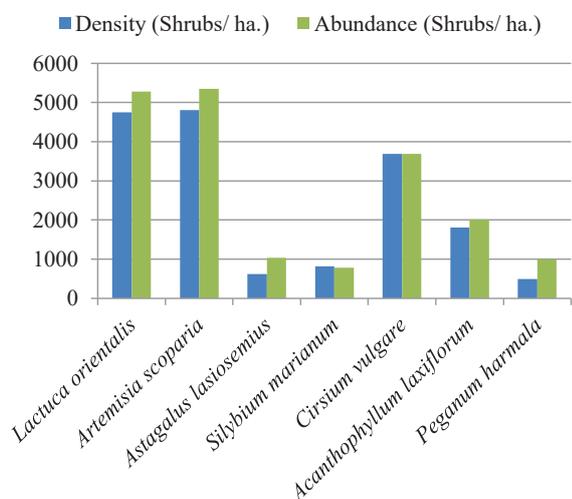


Fig. 3. Density and abundance of 7 species

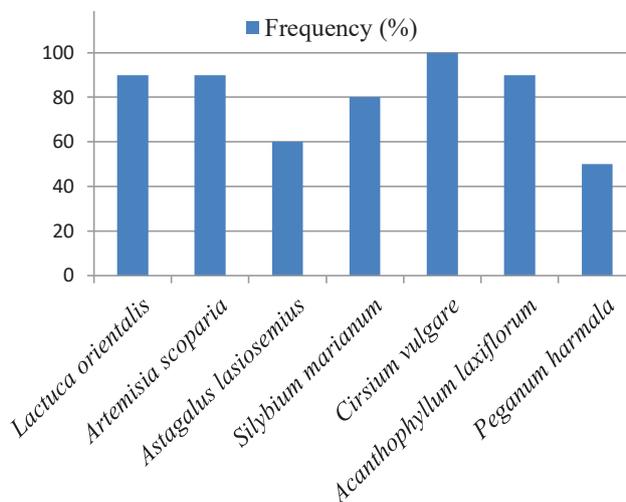


Fig. 4. Frequency of 7 species

**RESULTS AND DISCUSSION**

Every seven species shrubs in the Ghazni University campus represented different ecological density, frequency and abundance by quadrat method (Fig. 3, 4). This research accomplished for the first time in aforementioned area. Easily and quickly, by artificial and natural sexual propagation these shrubs can be more dense, frequent, and abundant after 4-5 years. The things we should consider to have a rich biodiversity in the campus are to avoid shrubs from uprooting by people and sheep’s herds.

**Density**

Density is the number of individuals per unit area. Density is expressed as the number of individuals per unit area (e.g., shrubs per hectare).

Density = Total number of individuals / Total number of quadrats studied

The density of every shrub species found in each quadrat (16 m<sup>2</sup>) as (Table 2). The density can change in per hectare as: density / 16 × 10000 (shrubs per hectare).

Now, the density in hectare found as: *Lactuca orientalis* 4750 shrubs per hectare, *Artemisia scoparia* 4812.5 shrubs per hectare, *Astragalus lasiosemius* 625 shrubs per hectare, *Silybium marianum* found 812.5 shrubs per hectare, *Cirsium vulgare* found 3687.5 shrubs per hectare, *Acanthophyllum laxiflorum* found 1812.5 shrubs per hectare, and *Peganum harmala* found 500 shrubs per hectare.

Table 2. Individuals in ten quadrats with their density

Shrub species	Quadrats and number of individuals in each quadrat										Density (shrubs 16 m <sup>-2</sup> )
	1	2	3	4	5	6	7	8	9	10	
<i>Lactuca orientalis</i>	16	14	11	6	7	12	5	0	3	2	7.6
<i>Artemisia scoparia</i>	12	7	12	6	7	3	0	20	3	7	7.7
<i>Astragalus lasiosemius</i>	3	2	0	1	2	1	0	0	1	0	1.0
<i>Silybium marianum</i>	5	1	0	1	1	1	2	0	1	1	1.3
<i>Cirsium vulgare</i>	6	4	2	1	1	2	16	8	1	18	5.9
<i>Acanthophyllum laxiflorum</i>	3	3	2	1	5	6	4	0	2	3	2.9
<i>Peganum harmala</i>	0	0	0	1	0	1	2	1	3	0	0.8

### Frequency

The degree of dispersion of a species in a forest is called frequency. Frequency is expressed as (%) value (Table 3). Individuals of some species are sparsely distributed while others are found in clumps.

Frequency = Number of quadrats in which the species occurs / Total number of quadrats studied  $\times$  100

### Abundance

Abundance is simply the number of individuals of a species. It refers actually to the density of population in those quadrats in which a given species occurs. Abundance expresses as number of individuals per unit area, i.e., shrubs per hectare.

Abundance = Total number of individuals in all quadrats / Number of quadrats in which individuals occurred

The abundance of every shrub species found in each quadrat (16 m<sup>2</sup>) as (Table 4). The abundance can change in per hectare as: abundance / 16  $\times$  10000 (shrubs per hectare).

Now, the abundance in hectare found as follows *Lactuca orientalis* 5277.5 shrubs per hectare, *Artemisia scoparia* 5346.9 shrubs per hectare, *Astragalus lasiosemius* 1041.25 shrubs per hectare, *Silybium marianum* 781.25 shrubs per hectare, *Cirsium vulgare* 3687.5 shrubs per hectare, *Acanthophyllum laxiflorum* 2013.75 shrubs per hectare, and *Peganum harmala* 1000 shrubs per hectare.

**Table 3.** Occurrence of species in ten quadrats with their frequency

Shrub species	Quadrats										Frequency (%)
	1	2	3	4	5	6	7	8	9	10	
<i>Lactuca orientalis</i>	16	14	11	6	7	12	5	0	3	2	90
<i>Artemisia scoparia</i>	12	7	12	6	7	3	0	20	3	7	90
<i>Astragalus lasiosemius</i>	3	2	0	1	2	1	0	0	1	0	60
<i>Silybium marianum</i>	5	1	0	1	1	1	2	0	1	1	80
<i>Cirsium vulgare</i>	6	4	2	1	1	2	16	8	1	18	100
<i>Acanthophyllum laxiflorum</i>	3	3	2	1	5	6	4	0	2	3	90
<i>Peganum harmala</i>	0	0	0	1	0	1	2	1	3	0	50

**Table 4.** Individuals in ten quadrats with their abundance

Shrub species	Quadrats										Abundance (shrubs 16 m <sup>2</sup> )
	1	2	3	4	5	6	7	8	9	10	
<i>Lactuca orientalis</i>	16	14	11	6	7	12	5	0	3	2	8.444
<i>Artemisia scoparia</i>	12	7	12	6	7	3	0	20	3	7	8.555
<i>Astragalus lasiosemius</i>	3	2	0	1	2	1	0	0	1	0	1.666
<i>Silybium marianum</i>	5	1	0	1	1	1	2	0	1	1	1.25
<i>Cirsium vulgare</i>	6	4	2	1	1	2	16	8	1	18	5.9
<i>Acanthophyllum laxiflorum</i>	3	3	2	1	5	6	4	0	2	3	3.222
<i>Peganum harmala</i>	0	0	0	1	0	1	2	1	3	0	1.6

## CONCLUSION

Every seven shrubs species presented different density, frequency, and abundance. The total density of the shrub land was 17000 shrubs per ha. The highest density showed by *Artemisia scoparia* and lowest by *Peganum harmala* species in the shrub land. The maximum frequency showed by *Cirsium vulgare* species and minimum by *Peganum harmala* species. The higher frequency indicates even dispersion of individuals and the lower frequency indicates the poor dispersion of the species. The highest abundance showed by *Artemisia scoparia* and lowest by *Silybium marianum*. The reason which *Peganum harmala* showed the lowest density and frequency is over cutting of this shrub for its seeds and branches because people use the seeds and branches for traditional treatments as a medicinal plant. People also cut and use *Artemisia scoparia* as brooms in Afghanistan but the reason which this shrub showed the highest density and abundance in Ghazni University campus is the officials' prevention of cutting. *Cirsium vulgare* showed maximum frequency because does not cut by people for any purposes and also it produces many achenes that can disperse widely.

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