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Estimate of the Current Condition of Populations of the *Lagochilus olgae* R.KAM. (Lamiaceae Lindl.) in Uzbekistan

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Abstract

Intense human pressure and global warming have caused habitat destruction in these areas and increased the number of endangered species. These species are endemic to the Nuratau ridge and are under high human pressure. We found four populations of both species in the Nuratau ridge. For each population we measured plant density and determined population maturity and ontogenetic spectrum. We also described the plant community where each population grew. At all sites population density was low, with most populations being classified as mature with centred ontogenetic structure.

Keywords

Biodiversity, Conservation, Population, *Lagochilus*

1. Introduction

Ineffective use of plant resources for human welfare has resulted in the loss of plant biodiversity worldwide [1] [2]. In terms of biodiversity, the highest-mountain ecosystems of Central Asia link to the most utility areas in the world called hotspots [3]. "A high level of endemism in the mountains is linked to environmental conditions such as geological structure, high mountain ranges and climatic conditions. Threats to the biodiversity of Central Asia have been recognized since the middle of the 20th century" [4]. Global warming is likely to drive loss of vegetation cover [5]. The ecosystems are exposed to intensive anthropogenic pressure which has caused habitat breakdown [6].

Scenarios climate change is expected to become more extreme and longer drought periods in Central Asia [7]. "The Millennium Ecosystem Assessment estimates a global reduction of vascular plant biodiversity of between 13% and

19%, between 1970 and 2050, and a reduction of between 7% and 9%, from 2000 to 2050 has also been predicted" [8].

Consequently, to the IUCN Red List update in 2008, over 900 species have gone extinct since 1500 (http://www.iucnredlist.org) including many vertebrates, invertebrates, and plants. In parallel, the number of endangered species has increased. In combination with global warming related changes in climatic conditions, these developments have also affected the flora of Uzbekistan, with the number of Red List plant species having almost doubled in the last 30 years: from 163 in 1984 to 324.

This Lamiaceae family has essential oils that are used in the medical, pharmaceutical, cosmetics, and food industries [9] [10]. The genus *Lagochilus* belong to the most economically important from the Lamiaceae family. This genus comprises 46 species worldwide (www.theplantlist.org). In the flora of Uzbekistan, the genus *Lagochilus* is represented by 13 species [11]. Some plants from the genus *Lagochilus* are among the red listed species from the Lamiaceae family. The genus *Lagochilus* includes 13 species and four of which (*Lagochilusvvedenskyi*, *L. olgae*, *L. proskorjakovii* and *L. inebrians*) are in the Red Book of the Republic of Uzbekistan [12].

Species of this genus have great economic importance and are extensively used as medicinal raw material [13]. The leaves contain alcohols, lagochilin (0.6% - 2%), essential oils (0.03%) and vitamin K and most of the genus' members contain narcotic, hemostatic, and other substances [14]. Locally, most species of this genus are used for treating skin illness, controlling bloodletting and nervous disorders [15].

Populations of *Lagochilus* species are affected in their native range by harsh environmental conditions, such as highly eroded soils, rock slides, large rocky slopes, intense winds and few pollinators. In addition, populations of *Lagochilus* species are under pressure from anthropogenic factors, such as overgrazing, harvesting for fodder, fuel, medicinal raw material and trampling which have resulted in a decrease of the natural habitats of these plants, as observed by Beshko [16] [17] [18] [19] [20]. The purpose of this paper is to assess the status of *L. olgae* (Lo) in the wild nature.

2. Material and Methods

2.1. Study Area

The study was conducted in the Nuratau ridge. The Nuratau ridge includes some mountains (Nuratau, Koytash, Gubdintau, Karachatau, Aktau and Karatau) and is located at the north-western edge of the Pamir-Alai mountain range (**Figure 1**). The climate is Mediterranean, the average minimum temperature is 13.4˚C and average maximum temperature 43˚C. Annual rainfall exceeds 206 mm (**Figure 2** and **Figure 3**). Soils are grey-brown, sandy and brown and contain between 4% to 7% humus The highest point of Nuratau reaches 2169 m above sea level (**Figure 4**) [18].

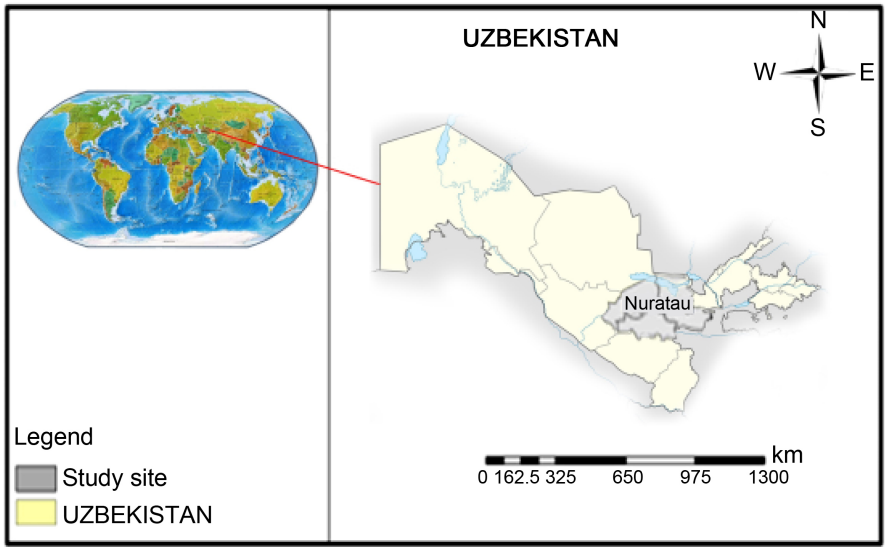

Figure 1. The location of the study area in Uzbekistan (ArcGIS 10.3.1).

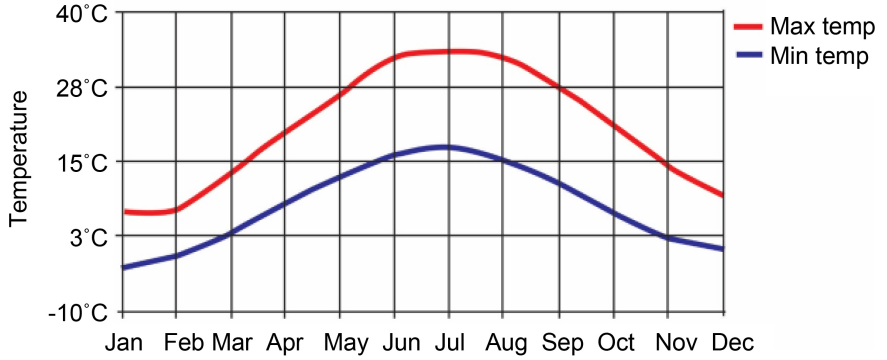

Figure 2. Average minimum and maximum temperature during the year.

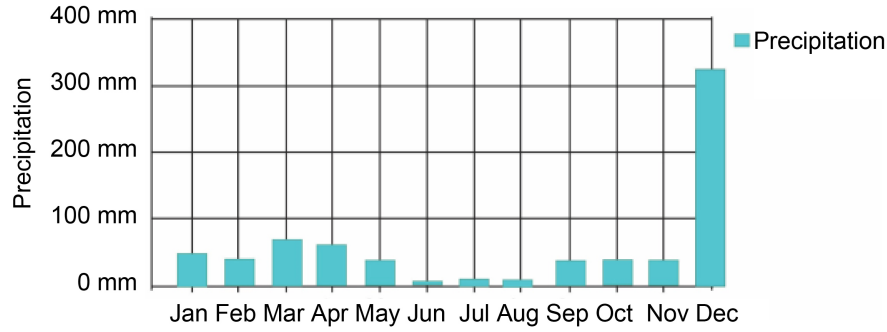

Figure 3. Average precipitation during the year.

This mountain system forms part of the tectonic range in Central Asia. This system comprises middle-dry lowlands and mountains, and hosts high biodiversity.

This ridge is one of the key botanical regions of Central Asia. The flora of the Nuratau mountains includes about 1285 species of vascular plants, out of them 29 are endemic species [16].

Figure 4. General view of Nuratau mountains and *Lagochilus olgae* (Photos: A. Akhmedov 2020).

2.2. Study Species

The study focuses on red-list species is *L. olgae*.

L. olgae was described by Beshko in 1997 [16]. The species is endemic for Nuratau. The species belonged to caudex, polycarpicdwarf shrubs, whose perennial axes form a short multiaxial caudex. Renewal buds are at a height of 1 - 2 cm above the substrate. Flowering occurs in June - July. Reproduction is mainly by seeds but the species also vegetative reproduce by particulation. Mostly *Lagochilus* species are C3 plants [19] (**Table 1**).

2.3. Study Design

Due to the united distribution of *L. olgae* only four populations of *L. olgae* have been described in the wild. All these populations are included in this study, were studied in the Nuratau mountains.

In this study, we focus on the four populations *L. olgae*.

At each of the sites we described the plant community and, we inventoried all plant species occurring in one randomly selected 25 × 25 mplot. Unidentified plant species were collected for identification. Total vegetation cover was estimated in each plot using the method developed by Braun Blanquet [20], where each species cover was assessed based on cover classes (0 - 5%, 5% - 25%, 25% - 50%, 50% - 75%, and 95% - 100%). The life form of plants was described according to the 9th volume "Plant Identifier of Central Asia" [21], into trees, shrubs, semi-shrubs, dwarf-shrubs, herbs (perennial, biennial and annual). Plant taxonomy was in accordance to Cherepanov [22] and www.plantlist/.

Each transect was 1 m wide and 10 m long and was subdivided into 10^{-1} m^2 squares. In each of the squares we counted the number of individuals in each ontogenetic stage-seedlings, j—juvenile, im—immature, v—virginile, g1—young generative, g2—mature generative, g3—old generative, ss—subsenile, s – senile [23] [24] [25].

The ontogenetic spectrum of the population was then determined according to a standard method by Uranov [24] and Uranov, Smirnova [26]. Four types of ontogenetic spectrum can be distinguished [27], dependent on the proportion of individuals in the pre-generative state (seedlings, juvenile, immature, virginile), generative state (young generative, mature generative, old generative) and

Table 1. Characteristics of the focal species *L. olgae*.

Characteristics	*L. olgae*
Life form	Dwarf-shrub
Height (cm)	30 - 40
Colour of flower	White
Form of leaves	Divided
Flowering	May - June
Uses	Fodder
Red List category	II-rare
C_3 plants (doesn't have photosynthetic adaptations to reduce photorespiration)	+

post-generative state (subsenile, senile).

Average density of individuals per 1 m^2 was measured as the average number of individuals in each of the 30 1 m^2 quadrates within a population. Ecological density was measured according to Odum [28] [29] [30] [31].

3. Results and Discussion

The first population of *L. olgae* was in the northern part of Nuratau ridge, it was far 4 - 6 km from Ukhum village (Table 2). The soil was described as fine gravelly. Total vegetative cover was 30%, total cover of *L. olgae* in the community was less than 4%. We found 30 species of plants in the community. Out of them four were shrubs, semi-shrubs three, dwarf-shrub one, perennials 17 and annuals five.

The second population *L. olgae* (Buloksoy) located of 10 - 12 km north of the Ukhum village. The soil of the described area is fine-grained - gravelly. Total vegetation cover was 40%, and total cover of *L. olgae* was about 5% (Table 2). I found 22 species in the population of which three were shrubs, dwarf-shrubs two, perennials 16, annual one (Table 2).

The third population of *L. olgae* (Toshtashlarsoy) was 8 - 10 km of the north of Mekhayamvillage. The soil of the described area was gravelly with large stones. Total vegetative cover was ca. 25%, in it the share of focal species was about 3% (Table 2). We found 26 species of vascular species in the population, of which four were shrubs, semi-shrubs three, dwarf-shrub one, perennials seven and annuals two.

The last fourth population of *L. olgae* recorded on the south-eastern slope of Nuratau ridge. This population was near the settlement of Mekhayam (2 km east of the village). The soil of the surveyed area was stony gravelly. Total vegetative cover of this population was 35% and total cover of *L. olgae* was less than 3% (Table 2). We found 14 species of vascular species in the population, of which two were semi-shrubs, dwarf-shrub one, perennials nine and annuals two.

Our study has revealed that the studied populations do not span the entire

Table 2. Description of current population of *L. olgae.*

Population №	N	E	Elevation	Community/dominant species	Total vegetation cover %	Total cover of focal species %
1	40˚29.258'	66˚46.702'	1784	*Amygdalus bucharica*, *Artemisia tunuisecta*, *Galiumpamiroalaicum*, *Poabulbosa*	30	4
2	40˚50'085"	66˚44.414'	1672	*Phlomisnubilans*, *Thalictrumsultanabadense*, *Loniceranummulariifolia*, *Cotoneaster nummularius*, *Tulipaturkestanica*, *Iris maracandica*	40	5
3	40˚43.904'	66˚94.819'	1412	*Amygdalus bucharica*, *Loniceranummulariifolia*, *Artemisia tunuisecta*, *Perovskiascrophulariifolia*, *Taeniatherumcrinitum*, *Ferula ovina*, *Bromusscoparius*	25	3
4	39˚67.153'	66˚92.155'	1127	*Artemisia tunuisecta*, *Carexpachystylus*, *Hepyricumperforatum*	35	3

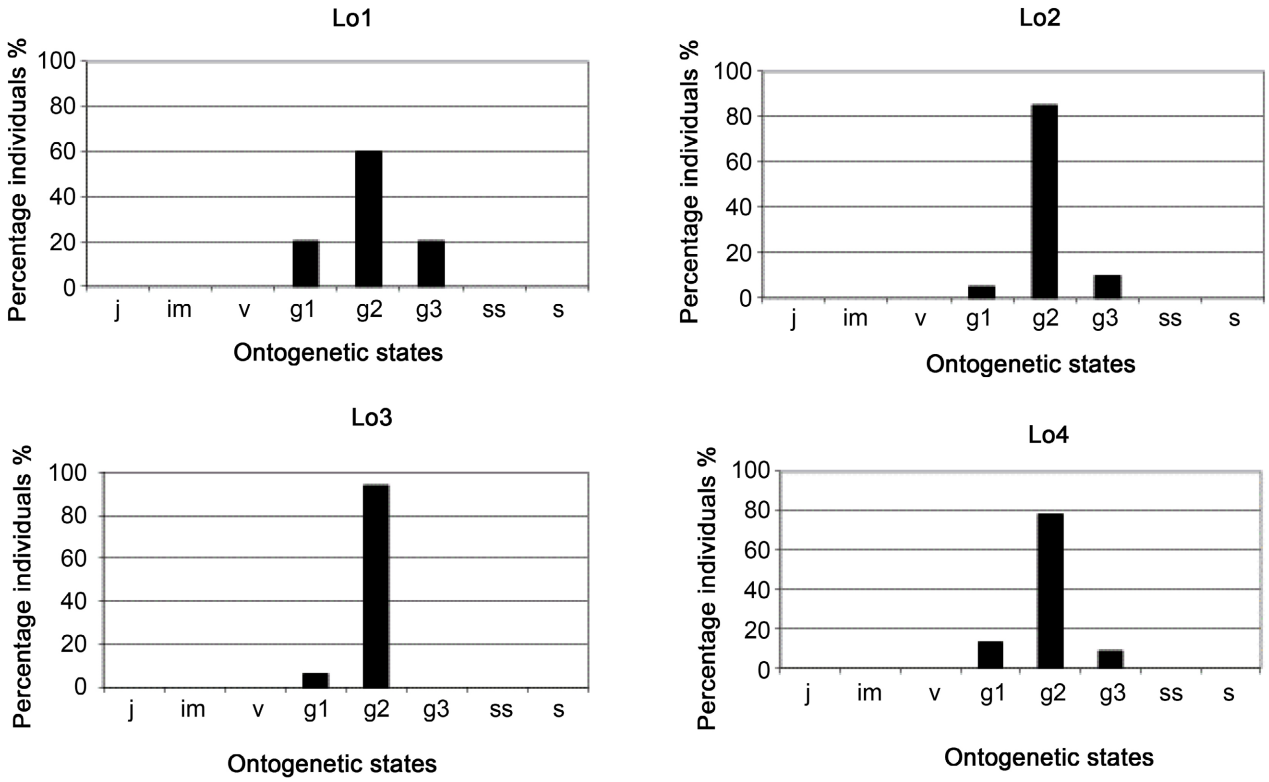

Figure 5. Developmental population spectra of each of the populations *L. olgae*. *Note*: x—developmental state, y—distribution of individuals on developmental states, %.

ontogenetic spectrum as there were no seedlings, juvenile, immature, and senile individuals. The characteristic spectrum of the populations of *L. olgae* was the centred type, with a peak on the mature generative individuals. The ontogenetic structure of the populations of *L. olgae* has not previously been studied. We found that the peak in the spectrum of the studied populations corresponds to a group of middle generative plants. The first population has the percentage ratio of these age groups is 60%, in the second population has 85%, in third is 93.75%, and last one has 78.2% middle generative plants (**Figure 5**). Proceeding from the ontogeny described, we can assume that the characteristic ontogenetic spectrum of *L. olgae,* should be centred.

Centred spectra, according to Zaugolnova (1994), are formed in caudex herbaceous plants with a long-life span of individuals in the middle age ontogenetic state, their least elimination and difficult germination of seeds. Accumulation of middle generative plants in populations is associated with long-term development and minimal elimination of individuals of this ontogenetic group.

4. Conclusions

During the field research, we studied four populations of *L. olgae* and determined 102 vascular species in Nuratau Mountain. *L. olgae* was very rare in this study area. Populations of these focal species were unsatisfactory. The study revealed that ontogenetic structure was predominantly centred, with most plants in the generative (g2) state. Because mature plants (g2) were more tolerant than others under the natural and human pressure in this study area.

The investigation indicated that the populations were all in all mature with most plants in the generative state. Mature generative plants were dominated in the populations because g2 was tolerant to abiotic and anthropogenic influences that's why basically populations were mature.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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