PRELIMINARY RESULTS OF BIOCLIMATIC MODELING OF *PHLOMOIDES OREOPHILA* (*LAMIACEAE*) DISTRIBUTION (MAXENT MODEL)

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ABSTRACT

In recent years, population growth in society has had a significant impact on plant populations in the region, along with increased demand for natural landscapes and their irregular use, as well as soil degradation and fragmentation of natural areas where plants are distributed. Today, one of the main tasks of biogeography is to reveal the laws of territorial distribution of biological taxa (Mordkovich, 2005).

Keywords: Eurasian mountain, Central Tien-Shan, subalpine.

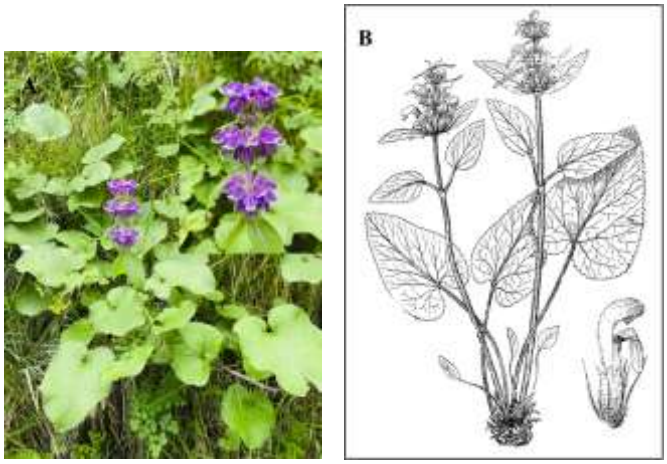
INTRODUCTION

In the last decade, various methods of modeling the distribution of species (MaxEnt, BioClim, Maximum entropy, etc.) have been actively used in different parts of the world (Zimmerman, et al., 2010). Maxcent is an integrated Java application for species modeling (SDM) that deals with environmental variables such as precipitation and temperature for the surrounding research area (Phillips et al., 2006; Phillips and Dudik, 2008). It is widely used because of its high results in comparing species distribution modeling methods (Elith rt al., 2006). These modeling methods are performed directly by 19 bioclimate variables (Bio1-Bio19). They are a spatially interrogated, data set prepared for global land areas using data from 9,000 to 60,000,000 weather scenarios collected between 1970 and 2000 (Fick and Hijmans, 2017).

Due to the fact that *Phlomoides oreophila* (Kar. & Kir.) Adylov, Kamelin & Makhm. is more common than other species in the implementation of bioclimatic modeling, it is the object of study selected to study the distribution of the species and its response to climate change. (Figura 1).

Phlomoides oreophila (*Lamiaceae*) is a Eurasian mountain species, the area of which passes through mountain systems: from Mountain Altai, through the mountains of Southeastern Kazakhstan (Tarbagatai, Dzhungarsky Alatau), Western and Central Tien-Shan to the Pamir-Alai (Gissara-Alai). *Phlomoides oreophila* grows in forest-steppe, forest belts, up to subalpine. Its characteristic habitats are rocky slopes; it prefers carbonate rocks (Komarevtseva and Guseva, 2020).

Figure 1. Photo of the species *Phlomoides oreophila* (A) in nature (author R.K. Gulomov, Sh.Abdullaev), (B) illustration.



This species is distributed in the 1800-3300 m altitude of the Chatkal, Fergana, Alay and Turkestan ridges of the Fergana Valley (Central Asia). Mountain taiga, Mountain mesohpilic grasslands, Juniper forests, Shiblyak, Tall grassland, Iran-Turanian phryganoid vegetation, Tallgrass mountain semisavanna Occurs in florocenotypes such as mountain taiga, mountain mesophilic meadows, spruce forests, Shivalik, high pastures, Iran-Turan frigeneidae plants, mountain grassland. (R. Gulomov's reports).

To date, no targeted research has been conducted on the impact of bioclimatic factors on the species (R. Gulomov, A. Rakhmatov are conducting targeted research for 2020-2022 in order to conduct a comprehensive study of the series in the Fergana Valley). This study is the first attempt to study the spatial distribution of the species *Phlomoides oreophila*.

The aim of the study is to provide theoretical data for predicting future distribution areas based on a deeper understanding of the distribution characteristics and ecological adaptation of the *Phlomoides oreophila* species and the study of the positive and negative effects of bioclimatic factors on their conservation. The results of this study serve in a sense in knowing the distribution and natural resources of the species.

MATERIALS AND METHODS

Herbarium addresses stored in the funds (TASH, FRU), the results obtained from the growth areas identified in the targeted field research in the Fergana Valley in 2020-2021 and the Global Biodiversity Information Facility (GBIF, https://www.gbif.org/) were used to determine the location of the species. The data in this database are enriched on the basis of samples stored in various funds (LE, MW, BRNU, CSBG (NS), PE, P, W, NY). The location of the species in nature was determined using a GPS navigator, and the locations in the herbarium samples were determined using the Google Earth application. A total of 287 coordinate addresses were identified (Table 1), duplicate coordinates were excluded (165 available records were used for training, 55 for testing. The media layers used were all continuous). Maxent software (version 3.4.4) S.J. Phillips et al., (2006). To assess the predictive significance of the model, the coordinates were randomly divided into training (75%) and test (25%). Weather data was downloaded from the WorldClim database (http://www.worldclim.org/) (2.5 min, spatial resolution ~ 4.64 km). They all include 19 bioclimate variables.

RESULTS

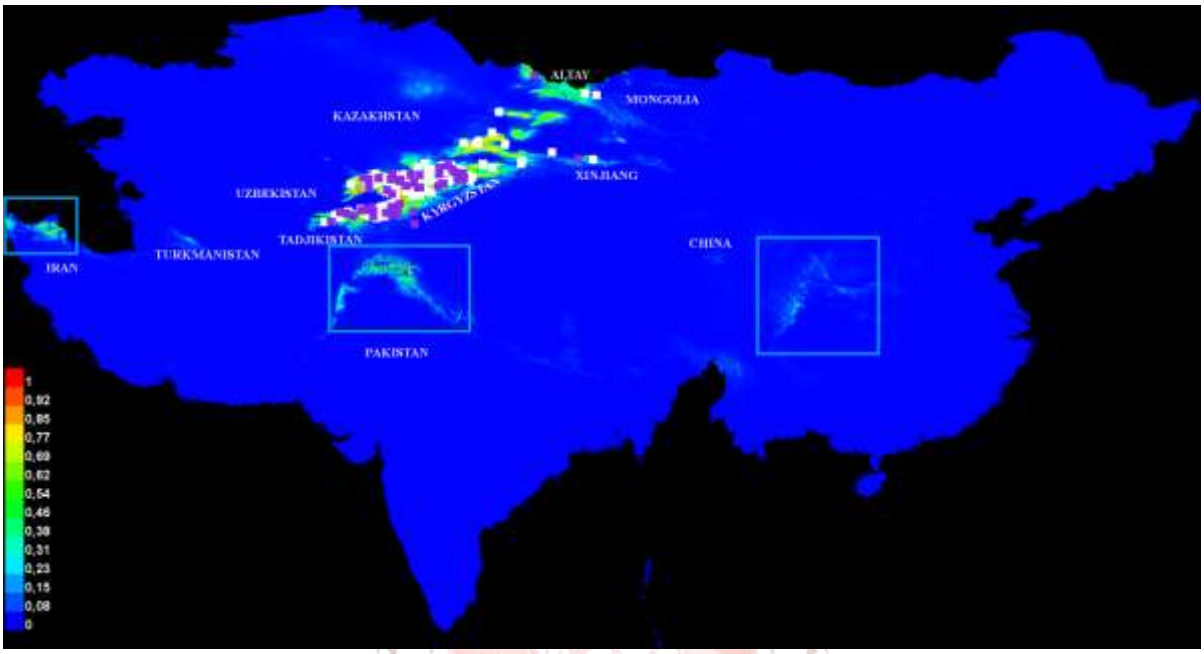
The detected coordinates were transferred to the ssv file, the algorithm was performed using 100 iterations (17 seconds) in 500 interactions with different random partitions (Bootstrap). Preliminary results were analyzed

Table 1. Number of herbarium specimens and sources from which they were obtained.

№	Ridge	Administrative territories	Number of coordinates	Sources of information
1	Tien-Shan, Tarbagatai, Dzhungarsky Alatau	Uzbekistan, Kyrgyzstan, Kazakhstan	148	TASH
2	Western and Central Tien-Shan,	Kyrgyzstan	35	FRU
3	Western and Central Tien-Shan, Pamir-Alai, Tarbagatai, Dzhungarsky Alatau	Uzbekistan, Kyrgyzstan, Kazakhstan, Xinjiang, Altay, Tadjikistan(?)	93	GBIF (LE, MW, BRNU, CSBG (NS), PE, P, W, NY)
4	Tien-Shan, Tarbagatai, Dzhungarsky Alatau	Kyrgyzstan, Kazakhstan	11	https://www.plantarium.ru

Certain criteria are important in conducting analyzes using each method. In particular, during the study, the growth rate of the results of species modeling is set from 0 to 1. In the map showing the distribution of the species, the upper range of the species is classified as "Red", and the rare areas are classified as "Yellow".

Figure 2. Species distribution range ((b) current, (c) future(addresses in the box).



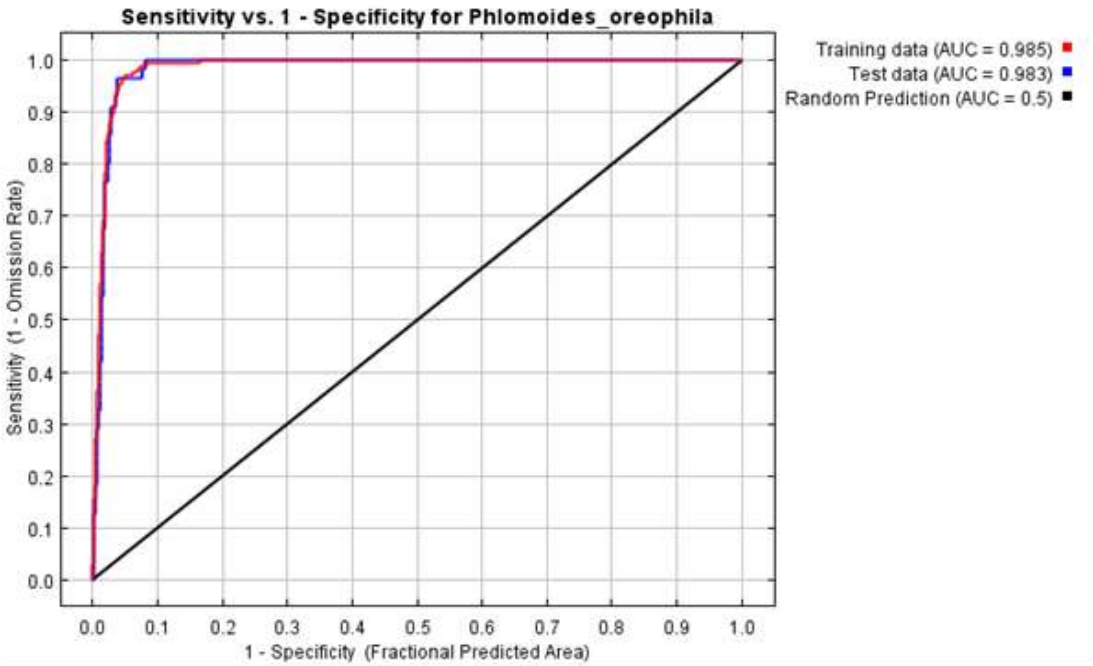
Areas with low probability of spread and almost no probability of occurrence are depicted in black and dark blue. The rest of the colors have an average rating (Figure 2).

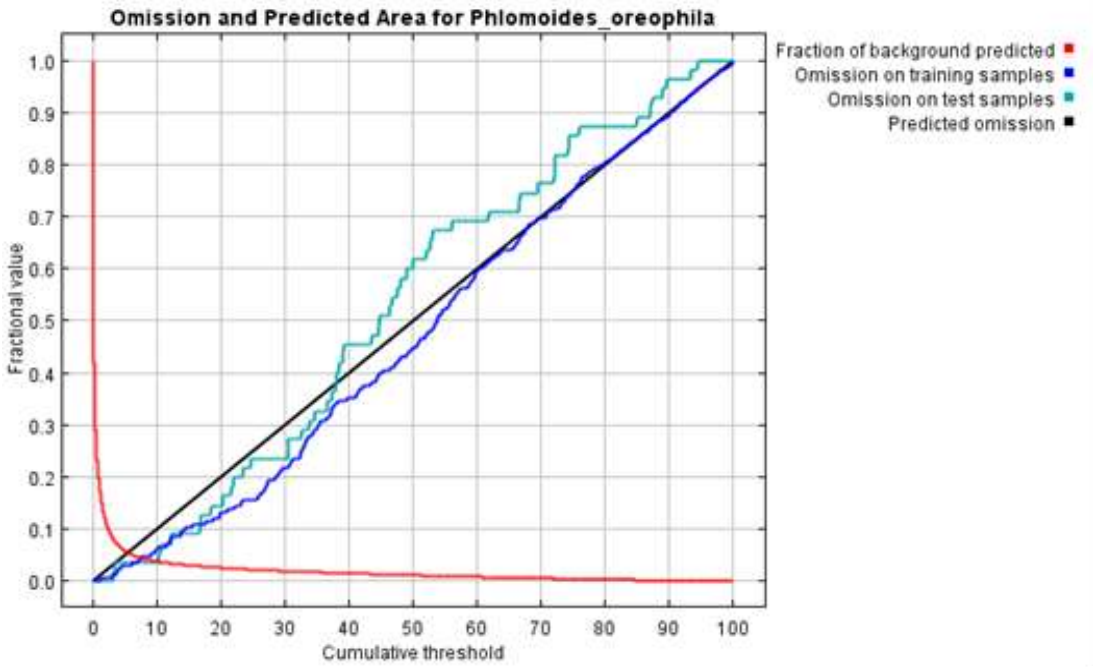
There are 2 types of errors in modeling: omissions - the absence of quality and the presence of a forecast contribution, and commission - the absence as a contribution to the prediction of availability. In this case, the graph (Diagram 1) shows the contribution of the background points on the lower variable cumulative boundary included in the modeled distribution region by the red curve (percentage of the predicted background). The blue line is the residue in the study samples, which describes the performance of the model and shows the contribution of the existing point that extends beyond the boundary of the region, from the bottom to the top of the boundary value, limiting the prediction of the available. The blue line is to skip the taste samples. The black line is the predicted line (Mavlonov et al., 2021).

The area under the curve formed by the distribution zone (Maxent) of the genus *Phlomoides oreophila* (AUC) consists of 3 lines. Red line (Traning data) - Limits the AUC, and the closer this line is to the upper left corner, the larger the area under the curve, and the better the model predicts the availability points. Blue curve (Test data) - means that it is well described by the model under study. Black Random (Random Prediction) - delimits the area.

The AUC in the final model was 0.985 for the training set and 0.983 for the test set. This situation is interpreted as a perfect model. It also means that the spatial distribution of the species is well explained by the factors applied and does not require additional information. The AUC of the test was 0.983, the standard deviation was 0.002 (calculated as in DeLong, DeLong and Clark-Pearson 1988, Equation 2).

Diagram 1. Feasibility of a species prediction model.





CONCLUSION

Research and analysis are underway to better understand the ecological adaptation of the *Phlomoides oreophila* species mentioned in the research task and to study the positive and negative effects of bioclimatic factors on the protection of natural resources.

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