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# THE SPECIES ACANTHOLIMON ZAKIROVII, ACANTHOLIMON SUBAVENACEUM, AND ACANTHOLIMON SUBAVENACEUM, WHOSE NATURAL POPULATIONS ARE EXPANDING IN THE NUROTA BOTANICAL-GEOGRAPHICAL DISTRICT

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**Abstract**
The article presents information about the species Acantholimon zakirovii, Acantholimon subavenaceum, and Acantholimon subavenaceum, whose natural populations are expanding in the Nurota botanical-geographical district.

**Keywords:** Herbarium, illustration, TASH database, endemic species, morphological characters, botanical-geographical district.

**Annotatsiya**
Maqolada Nurota botanika-geografik okrugida tabiiy populyatsiyalari kengayib borayotgan Acantholimon zakirovii, Acantholimon subavenaceum va Acantholimon subavenaceum turlari haqida ma’lumotlar keltirilgan.

**Kalit so‘zlar:** Gerbariy, illyustratsiya, TASH ba’zasi, endem turlar, morfologik belgilar, botanik-geografik rayon.

The results of the ecological model showed that the distribution of Acantholimon zakirovii depends on climatic and geomorphological factors. Between 1970 and 2000, the species was mainly found in the Nurota ranges, the foothills of Jizzakh and Samarkand regions. The results predicted under the RCP8.5 scenario for 2070 show that as a result of climate change, the species' habitat may expand southward, creating optimal conditions in the foothills and mountains of Kashkadarya and Surkhandarya regions.

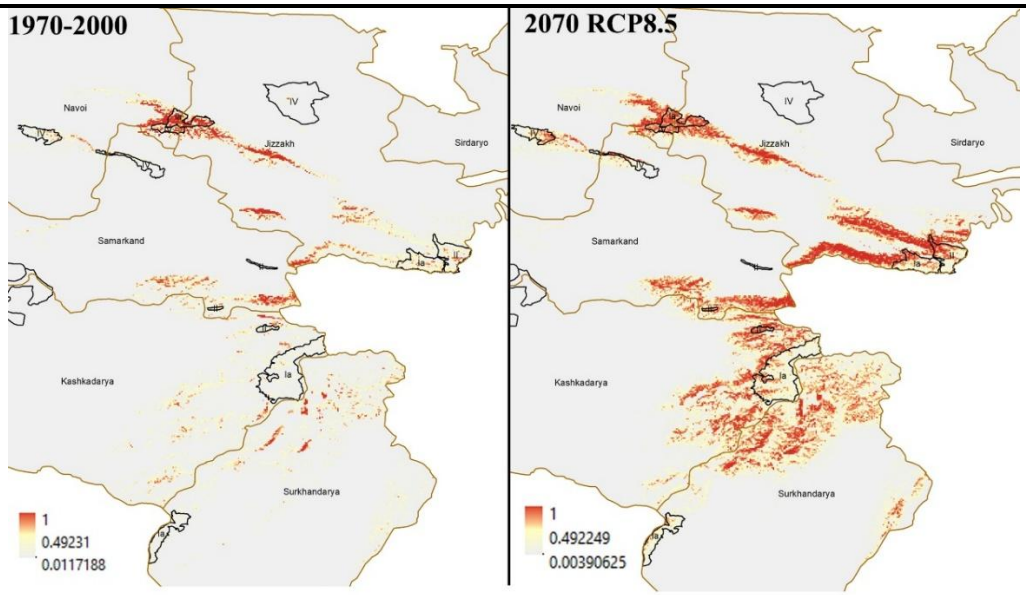


**Figure 1. Bioclimatic modeling map of the species Acantholimon zakirovii for the historical period 1970–2000 and the year 2070 under the RCP8.5 scenario.**

The main ecological factors shaping the habitat of Acantholimon zakirovii for both periods (1970–2000 and 2070 RCP8.5) are: Temperature seasonality (BIO4) – An important factor affecting the distribution of the species, and annual temperature fluctuations determine ecological adaptation. Annual temperature range (BIO7 = BIO5 - BIO6) – The temperature difference between the warm and cold seasons is the main parameter determining the habitat of the species. Slope (GloSlopesCl2 0.5% ≤ slope ≤ 2%) – The species is adapted to relatively flat or very low slopes. Slope (GloSlopesCl7 30% ≤ slope ≤ 45%) – However, relatively steep areas may also be suitable for the species.

The distribution areas of all three Acantholimon species have been found to be susceptible to significant changes due to climate change. Compared to the distribution patterns of 1970–2000, projections for 2070 (RCP8.5) show shifts and expansions in various directions (especially to the south and east).

While current optimal habitats are mainly located in national reserves (e.g. Nurota State Reserve, Koshrabot State Wildlife Reserve, etc.), new optimal areas are expected to emerge under climate change.

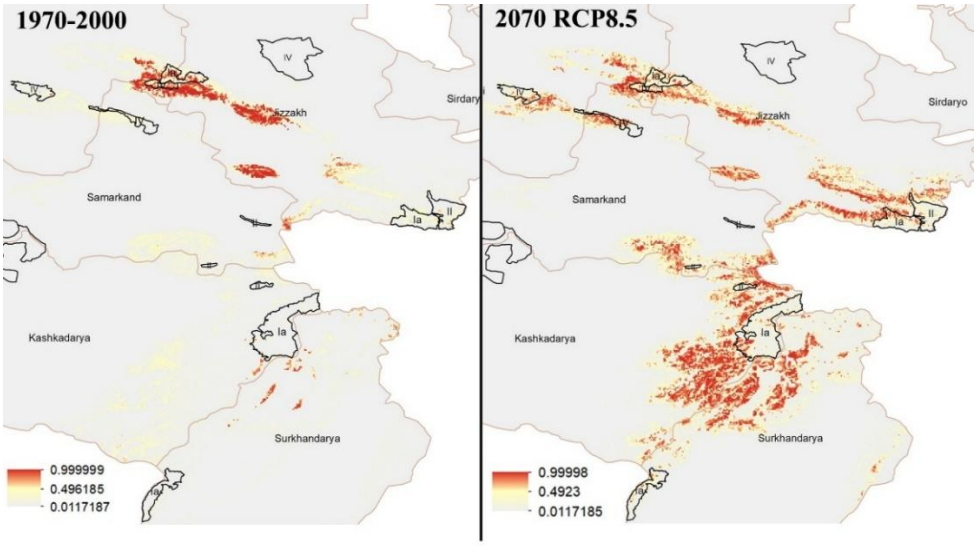


**Figure 2. Bioclimatic modeling map of the species Acantholimon subavenaceum for the historical period 1970–2000 and the RCP8.5 scenario for 2070.**

The distribution dynamics of Acantholimon subavenaceum have shown significant changes under the influence of climate change. While in 1970-2000 the distribution of the species was mainly limited to the Jizzakh region, the Nurota ridges and the Surkhandarya-Kashkadarya regions, future predictions show that the distribution area of Acantholimon subavenaceum will expand significantly. In particular, an expansion is observed from Jizzakh region to the south, to Samarkand, Kashkadarya and Surkhandarya regions. The southward shift in distribution indicates the possibility of adaptation to climate change.

The distribution of ecological factors during the period 1970–2000 is mainly associated with areas between 0.5% ≤ slope ≤ 2% and 15% ≤ slope ≤ 30%, which indicates its ecological adaptation to relatively flat or moderately steep slopes. Seasonality of temperature (BIO4) is one of the important factors shaping the habitat of the species, and significant annual temperature variability affects the ecological strategy of the species. At the same time, annual temperature difference (BIO7) - that is, the temperature difference between the warmest and coldest seasons - appears as a significant ecological factor within the habitat of the species.

The RCP8.5 scenario for 2070 predicts that flat areas in the range of 0.5% ≤ slope ≤ 2% will remain suitable habitats for the species in the future. However, analyses of slope aspect (Aspect) suggest that the species may be more likely to spread in areas with undefined slope aspects or slopes of less than 2%. Such changes are related to the dynamics of the landscape and the influence of climate factors. Temperature seasonality (BIO4) and annual temperature difference (BIO7) may become more important factors with the intensification of climate change. This means that the ecological constraints affecting the species' habitat and adaptation strategies may change.

Model results confirm that the optimal habitats of Acantholimon subavenaceum are currently located mainly in the Nurota State Reserve (IUCN Category Ia) and Koshrabot State Wildlife Reserve (IUCN Category IV). However, under climate change, the species' suitable habitats are predicted to expand by the 2070s, with new optimal areas emerging in the Zamin, Hisar, and Surkhan State Reserves (IUCN Category Ia).

In conclusion, it can be said that the species Acantholimon zakirovii, Acantholimon subavenaceum, and Acantholimon subavenaceum, whose natural populations in the Nurota botanical-geographical district are currently expanding, can be cited.

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