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CHARGAFF READINGS

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RANGE SIMULATION OF *REYNOUTRIA* × *BOHEMICA* CHRTEK & CHRTKOVÁ IN UKRAINE

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Distribution of invasive plant species is a major threat to biodiversity, ecosystem services and sustainable development. In particular, a special place is occupied by the *Reynoutria* × *bohemica* hybrid, which comes from the crossing of *R. japonica* and *R. sachalinensis*. High plasticity, the ability to form dense thickets and effectively displace native species make this taxon one of the most aggressive invasive weeds in Europe. In Ukraine, its distribution has been recorded in many regions, but the dynamics of the range and the factors that determine its expansion remain insufficiently studied. In this context, forecasting potential distribution areas in the future, taking into account climate change, is of particular importance.

To analyze the potential distribution of *R. × bohemica, the MaxEnt* algorithm (Maximum Entropy Modeling) was used, which has established itself as one of the most accurate methods for species distribution modeling (SDM). Unlike traditional statistical approaches, it operates exclusively with points of presence of the species and a set of bioclimatic variables, which makes it especially valuable for the study of invasive species. Our study used 806 georeferenced registrations of the species from various sources: herbarium funds, online databases (GBIF, iNaturalist, UkrBin), as well as scientific publications.

Bioclimatic predictors (bio1–bio19) were obtained from the WorldClim database. The global climate model (GCM) MPI-ESM1-2-HR and the Shared Socioeconomic Pathway SSP2-4.5 were used to build models of future distribution. Spatial modeling was carried out for two time slots: 2021–2040 and 2041-2060. To assess the accuracy of the models, the data was divided into a training (75%) and a test (25%) sample. The AUC values (Area Under the Curve) were 0.992 for the training dataset and 0.991 for the test dataset, indicating the extremely high quality of the predictions.

The analysis of the contribution of environmental variables showed that the key predictors were: the precipitation of the driest month (bio_14), the minimum temperature of the coldest month (bio_6) and the temperature seasonality (bio_4). In particular, bio_14 consistently showed the largest contribution to the explanation of variation (42-47%), confirming the crucial role of water scarcity in the survival and dispersal of the species. The minimum temperature of the coldest month (bio_6) ranked second in importance (up to 23.6% in mid-century scenarios), emphasizing the importance of winter climatic conditions for the survival of underground organs of the plant. Although the temperature seasonality (bio_4) had a slightly smaller contribution (about 10-12%), still it reflected the significant influence of the amplitude of temperature fluctuations on the life cycle of the hybrid.

Spatial models showed that in the short term (2021–2040) *R. × bohemica will* continue to expand its range in the northern, northeastern and central directions. A high probability of species presence is predicted for the Forest-Steppe zone, the northern part of the Steppe and most of Polissya. At the same time, in the southern regions, especially in the zone of arid steppes and the Black Sea region, the suitability of the environment will gradually decrease. In the long term (2041-2060), there will be a certain narrowing of the range in the southeastern regions and a partial return of the distribution boundaries to modern ones. However, areas with a high probability of presence ($p>0.7$) will increase by mid-century, posing potential risks to natural ecosystems and agricultural landscapes.

An important aspect of the work was the use of multivariate data analysis (PCA and K-means clustering methods), which made it possible to confirm the identification of bioclimatic variables that are of utmost significance for the invasive process. This enhances the reliability of the results and enables a deeper environmental interpretation of the model.

The results obtained have an applied value. They give grounds for highlighting high-risk regions, where it is advisable to focus monitoring and biosecurity measures. In particular, attention should be paid to controlling soil translocation and plant residues, limiting the ornamental use of the species, and implementing integrated management programs in places where it has already formed stable populations.

In general, the results of our study demonstrate that the combination of the MaxEnt algorithm with multivariate data analysis methods is an effective tool for predicting the spatial dynamics of invasive species in the context of climate change. For *R.* × *bohemica*, the determining factors of distribution in Ukraine are the rainfall regime and winter temperatures. Taking these factors into account makes it possible to predict the further species expansion and to formulate adequate biosecurity measures adapted to the conditions of different regions of the country.