Impacts of Climate Change and Human Activities on the Distribution Pattern of Calligonum mongolicum (Postprint)

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Abstract

Calligonum mongolicum Turcz is an important constructive species in China' s desert vegetation and a preferred species for artificial sand fixation afforestation. To elucidate the impacts of climate change and human activities on its distribution pattern, we constructed suitable habitat prediction models for Calligonum mongolicum Turcz under different climate scenarios and human activity disturbances, based on 119 geographical distribution records of Calligonum mongolicum Turcz and 24 environmental variables, combined with downscaled global model data from CMIP5, and applied the MaxEnt model and ArcGIS spatial analysis technology to quantitatively demonstrate the changes in distribution patterns of Calligonum mongolicum Turcz in China under future different climate change scenarios (RCP2.6, RCP4.5, RCP8.5) and human activity disturbances. The results showed that the AUC value for the training set was 0.958, and the AUC value for the test set was 0.951, indicating that the MaxEnt model predictions were reliable; the main climatic factors affecting the distribution of Calligonum mongolicum Turcz were precipitation and altitude; under human activity disturbance, the proportion of suitable habitat for Calligonum mongolicum Turcz decreased from 13.04% to 9.57%, and the reproduction and habitat of Calligonum mongolicum Turcz were negatively correlated with human activities. Under current climate conditions, the total proportion of suitable area for Calligonum mongolicum Turcz was 13.04%; under the three scenarios of RCP2.6, RCP4.5, and RCP8.5, the predicted total proportion of suitable area by the 2050s was 13.36%, 13.18%, and 14.78%, respectively; by the 2070s, the predicted total proportion of suitable area was 13.39%, 12.76%, and 12.71%, respectively, with varying trends in suitable range and area changes, and different degrees of increase or decrease in area at various suitable levels and total suitable area, with the most pronounced response under the high concentration emission scenario (RCP8.5).

Full Text

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Effects of Climate Change and Human Activities on the Distribution Pattern of *Calligonum mongolicum* Turcz.

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Abstract: *Calligonum mongolicum* Turcz. is an important desert vegetation species and a preferred choice for artificial sand fixation and afforestation programs. This study utilized 119 geographic distribution records of *C. mongolicum* and 24 environmental variables to investigate the impacts of climate change and human activities on its distribution patterns. Using CMIP5 global climate model data, we employed the MaxEnt model combined with ArcGIS spatial analysis to develop predictive models of suitable habitats for *C. mongolicum* under various climate scenarios and human activity levels. This approach allowed us to quantitatively assess potential distribution changes under three Representative Concentration Pathways (RCP2.6, RCP4.5, and RCP8.5). The results demonstrated high model accuracy, with AUC values of 0.958 for the training dataset and 0.951 for the test dataset. Precipitation, topographic factors, and elevation were identified as the primary climatic drivers affecting *C. mongolicum* distribution. Human activity disturbance reduced the proportion of suitable habitat from 13.04% to 9.57%, indicating a significant negative correlation between human activities and suitable habitat availability. Under current climate conditions, suitable habitat accounted for 13.04% of the total area. By the 2050s, the projected proportions of adaptive area under RCP2.6, RCP4.5, and RCP8.5 scenarios are 13.36%, 13.18%, and 14.78%, respectively. By the 2070s, these proportions are expected to be 13.39%, 12.76%, and 12.71%, respectively, with notable differences in both the scope and magnitude of area changes across scenarios.

Keywords: *Calligonum mongolicum* Turcz.; climate change; human activity; distribution pattern; China

Note: Figure translations are in progress. See original paper for figures.