

Identifying potential habitat for leopards across Europe

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Abstract

Large carnivores are some of the world's most iconic species and have multiple positive effects on ecosystems, such as regulating herbivore densities and increasing the system's resistance against invasive species. However, their low reproduction rates, large home ranges and their demand for high food intake make them especially vulnerable to extinction. Globally, large carnivores experienced significant range losses and many species are vulnerable to extinction, by either human causes or climate change. In Europe, large carnivores repopulated vast areas of their former habitats in the last decades despite the high modification and pressure caused by humans. Still, many important functions are not being accounted for by the few European predators. The leopard *Panthera pardus* occupied large parts of Europe until the Late Glacial Maximum 25.000 years ago. Today, *Panthera pardus saxicolor* is geographically the closest leopard subspecies and inhabits the Caucasus ecoregion. If reintroduced to Europe, the leopard may enrich the set of European carnivores and take over important but still unoccupied functions. Its ability to adapt to high human densities and its secretive nature make the leopard an especially promising prospect for the human-dominated landscapes of Europe. In this study, potential habitat for the leopard in Europe was identified using confirmed presences of *P. pardus saxicolor* and a set of environmental and anthropogenic covariates. Three Species Distribution Models (SDM) were fitted: A General Linear Model (GLM), a MaxEnt Model and Boosted Regression Trees (BRT). The models were combined in an ensemble model, which was then used to predict suitable habitat in the study area. Habitat patches that were larger than 250 km² were extracted and evaluated on the basis of a set of metrics that assessed the suitability of the patches in regard to their aptitude to host viable leopard populations or parts of a metapopulation. All SDMs performed satisfying, with the BRT receiving the highest AUC (0,93). Suitable habitat was identified in 26 countries and a combined area of 463.773 km². Turkey, Spain and Italy have the largest amount of potential habitat. It is particularly present in rural and forested areas that show intermediate ruggedness of the terrain. Overall, 141 habitat patches larger than 250 km² were detected, with several patches in Spain, the Carpathians and the Balkans showing promising conditions to host reproductive leopards in the long term. Europe offers large amounts of suitable leopard habitat, but the right carnivore management decisions need to be taken in order to reduce livestock depredation and cultural resistance that may hinder the possible repopulation or reintroduction of the leopard *Panthera pardus*.

