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Potential Geographic Distribution of the Monkey Goby (*Neogobius fluviatilis*) as Predicted from Native Range Presence Data by a BIOCLIM Model

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Aim of the study: The gobiid fishes (Actinopterygii: Gobiidae: Benthophilinae) are a large group of about 50 species found in coastal habitats of the Black and Caspian seas. Many species from this region constitute a major part of the introduced aquatic taxa in northern/central Europe and North America. As, for instance, *Neogobiusmelanostomus* (round goby), multiple other Ponto-Caspian species are also predicted to become successfully established if introduced. Compared to the round goby, *N. fluviatilis*, or the monkey goby, has shown moderate success in colonization and establishment outside of its native range. Robust methods for anticipating the geographic potential of possible invaders on a continental scale would allow decision-makers and managers to make informed decisions and take effective actions towards species before they are established.

Material and Methods: The BIOCLIM approach in ecological niche modelling was applied to estimate the potential distributional area for the monkey goby in Europe and North America using models based on *native range* distribution data (together 138 georeferenced records taken from museum and literature sources, for instance, Movchan et al., 2002). Previous investigators have applied ecological niche modelling to this problem in both terrestrial and aquatic ecosystems (Peterson, 2003, 2008). Environmental data included 19 bioclimatic variables from *WorldClim* (worldclim.org) that are commonly used in ecological analyses. Model evaluation focused on their predictive performance and included the determination of a minimum threshold of quantitative output for the potential presence of the species.

Results: The models (using various combinations of bioclimatic variables to cope with patterns of inter-correlation) performed between 'good' and 'very good', composing an average AUC of 0.756±0.008. The best predictive performance was reached by a model considering three prime bioclimatic variables: 'Precipitation of Driest Month', 'Mean Temperature of Coldest Quarter' and 'Mean Temperature of Warmest Quarter'. These have been used as proxies for distinguishing the potential distribution of the species beyond its native home range. Point data from places where the species is considered to be invasive fit sufficiently into the potential geographic distribution for the monkey goby in Europe predicted from native range presence data. Particularly suitable conditions for the species are found in the Pannonian Basin and large areas of 'highly suitable' habitat appear across Poland, extending into Germany. In the meantime, the monkey goby is successfully invading European waters via two major migration corridors of Ponto-Caspian species – the Central and the Southern, which is consistent with the BIOCLIM model indicating the predominant expansion of the species into Europe in an 'east to west' direction. A worldwide extrapolation of the model indicated the suitability of the Great Lakes in North America as a habitat for the monkey goby, particularly Lake Michigan, where the conditions are predominantly 'high' and 'very high'; another suitable area turns out to be the Korean Peninsula that houses a full range of bioclimatic suitable habitat for the species.

Keywords: *Neogobius fluviatilis*, BIOCLIM model