

# PROSPECTS FOR THE DISTRIBUTION OF EXOTIC AQUATIC TURTLES *VERSUS* NATIVE *EMYS ORBICULARIS* (LINNAEUS, 1758) IN EUROPE IN A CHANGING CLIMATE

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According to the latest IPBES Report Assessment on Invasive Alien Species (Roy et al. 2023), **biological invasions pose major global threats to nature**, economies, food security and human health. They indeed play a key role in 60% of global plant and animal extinctions, with annual costs nowadays >\$423 billion. As an example, **exotic freshwater turtles** (i.e. *Trachemys scripta* sp.) are considered as one of the 100 most invasive species, due to strongest competition with native species, e.g. the European pond turtle *Emys orbicularis*. Inappropriate legislation still permits exotic turtles as pets, especially juveniles, that eventually end in the wild or in urban areas. This raises one major question: **in the context of climate change, how likely can these thermophilic exotic turtles establish in outdoor habitats throughout Europe?**

## MATERIALS AND METHODS

Databases were created based on the available points of registration of the target species using original records as well as data published in literature and dataset GBIF etc. We were using Species Distribution Models (SDMs) based on literature and original field data, CliMond climate dataset (<https://climond.org/>), and NGEI for freshwater ecosystems (<https://www.earthenv.org/>), we determined potential (probabilistic) model of distribution for the **native European pond turtle and seven exotic freshwater turtles**. We identified the major environmental drivers of species specific distribution and potential overlaps for identifying priority areas for future conservation initiatives.

## CURRENT DISTRIBUTION OF STUDY NATIVE (green arrow) and exotic (red arrow) SPECIES

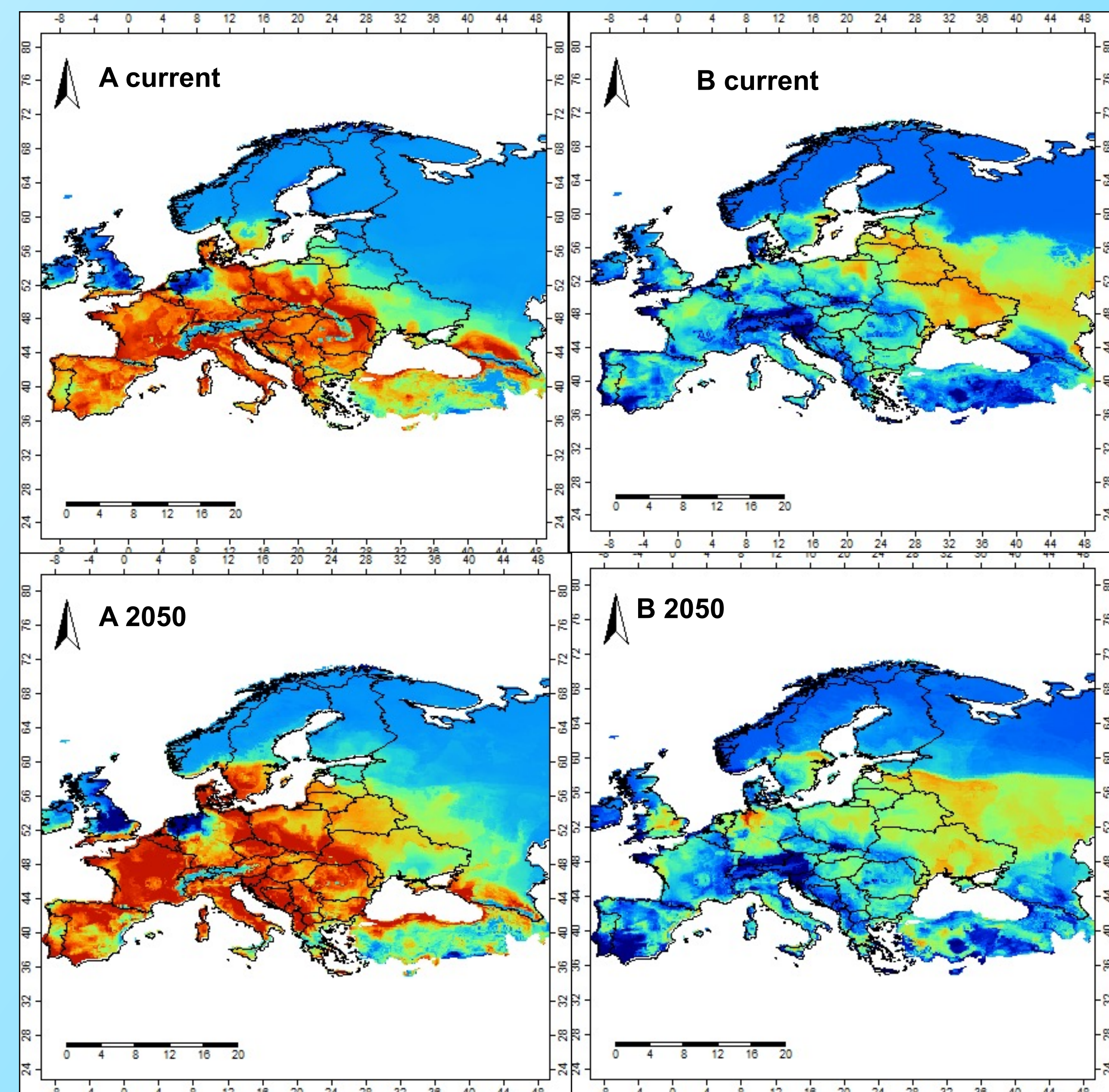
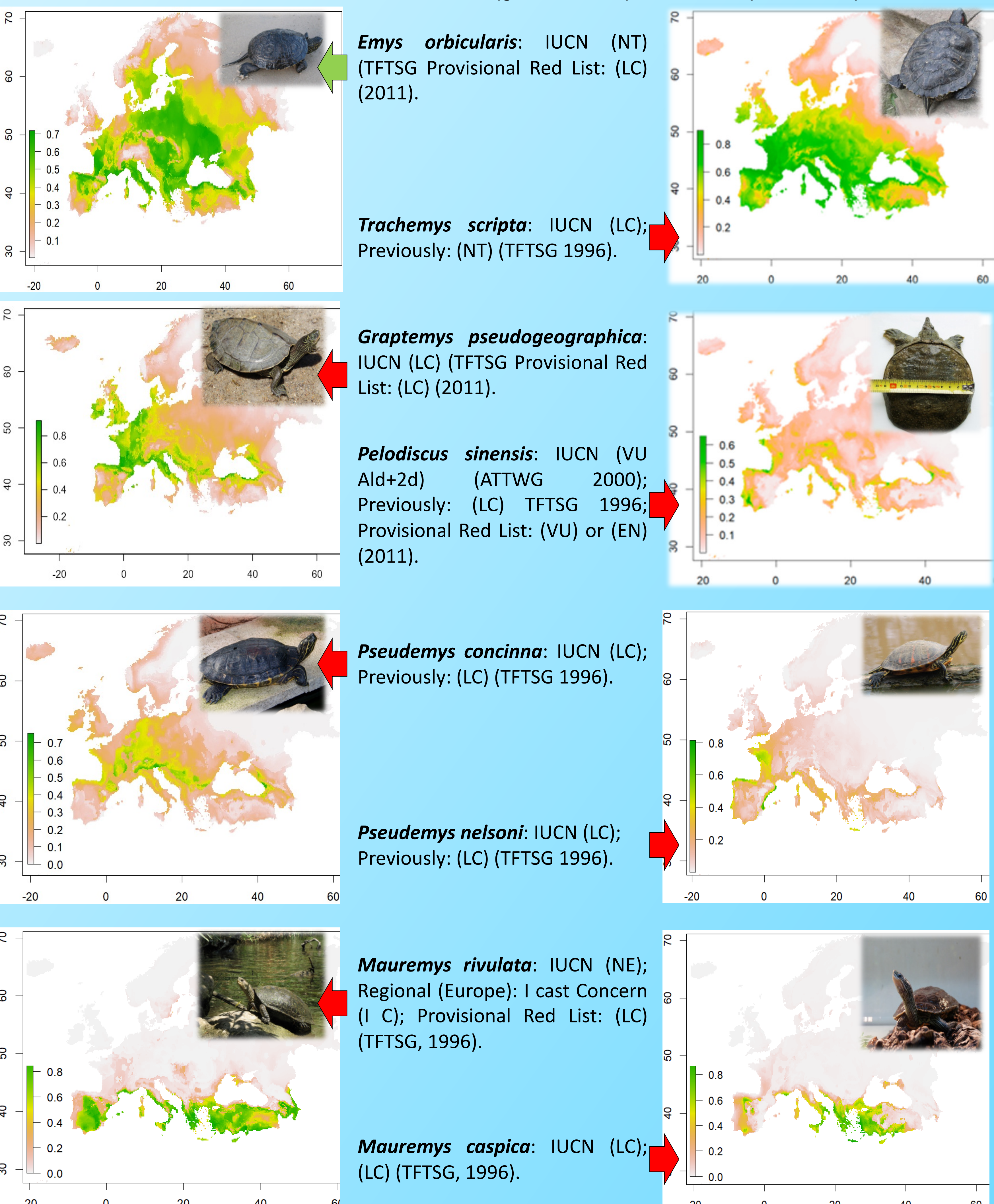


Fig. 1. Current and forecasted (by 2050) SDMs: A - area of intersection of current promising habitats of all 8 species of turtles; B - area of promising habitat for *E. orbicularis*, without 7 species of invasive aquatic turtles.

## DISTRIBUTION DRIVERS AND PROSPECTS

Our results indicate that the native European pond turtle, yet also the America originated *Trachemys scripta* and *Graptemys pseudogeographica* have the largest temperature tolerance and consistently the widest geographical distribution covering 37%, 34% and 24% of the total area of Europe, respectively, with significant overlap except at the most Eastern border of distribution of the native species. Importantly, the distribution of these three species is strongly driven by annual mean upstream temperature, making them prone to stronger competition in the context of climate change. Interestingly, other America and Asia originated species appear to distribute according to rainfall whereas Middle East originated species distribution was mainly driven by solar radiation, highlighting indirect effects of climate change on forthcoming competition between native and exotic freshwater turtles.

Our models are consistent with present field observations reporting *Trachemys* as the major competitor for the European pond turtle in present times, but also a major threat in the making in the context of climate change. Importantly, the northeast part of the present range of the European pond turtle is predicted to remain promising territories for this species only, but not for the exotic ones. Therefore, conservation initiatives such as reintroduction projects should focus on the Eastern border of distribution of the European pond turtle, namely Baltic countries and Ukraine.



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