Climate Change, Global Trade, and the Future Expansion of the Asian Tiger Mosquito

Jorge Rocha, Eduardo Gomes and Cláudia M. Viana (Portugal)

Key words: Geoinformation/GI; Risk management; Spatial planning; invasive species; climate change; ecological suitability; international trade; species dispersal; predictive modelling; urban areas

SUMMARY

The Asian tiger mosquito, Aedes albopictus, a known carrier of dengue, Zika, and other arboviral diseases, has become one of the most invasive mosquito species globally. First introduced in Europe in the 1970s, it continues to expand its range, driven by environmental changes and human activities. Key among these are global trade practices, such as the movement of used tyres and live plants, which have significantly contributed to its long-distance dispersal. As its range grows, concerns about public health risks have increased, leading to numerous studies aimed at predicting both current and future suitability areas for the species across Europe and other regions.

This study offers the first comprehensive assessment that combines predictive models of environmental suitability across Europe with estimates of the expected arrival times in countries where the species has not yet been established. By analysing outputs from previous ecological suitability models collectively, we identify areas of consensus on high or low suitability and highlight zones of considerable uncertainty. Consistent agreement among models is seen in the northwest of the Iberian Peninsula, southern France, Italy, and the coastal regions from the western Balkans to Greece under current climate conditions. Most models also agree on a substantial future expansion of suitable areas into northern and eastern Europe, with about 83% of major urban centres projected to become suitable under future climate scenarios, compared with roughly 49% at present.

To complement this environmental perspective, we created a model that incorporates 15 years of data on international trade, climatic similarity, and geographic distance to predict when Aedes albopictus will first be detected in newly invaded countries. Using partial least squares regression, the model accurately forecasted the year of first detection within two years for 90% of nations. Key predictors included temperature differences between countries and the number of exporting

countries already hosting the species. Projections indicate that Aedes albopictus could reach all evaluated countries by 2035, with earlier arrivals in Africa and South America compared to eastern and northern Europe.

Overall, these findings highlight the importance of incorporating climate change, global trade, and mobility trends into surveillance and control efforts. Without coordinated international action, the ongoing spread of Aedes albopictus will strain public health systems, emphasizing the urgent need for timely prevention to reduce future risks of vector-borne diseases.