Predicting the worldwide potential distribution of the boatman *Trichocorixa verticalis verticalis* (Fieber, 1851) (Order: Heteroptera; Fam: Corixidae)

S. GUARESCHI[1], C. COCCIA[2], D. SÁNCHEZ-FERNÁNDEZ[1], J. A. CARBONELL[1], J. VELASCO[1], L. BOYERO[2], A. J. GREEN[2] & A. MILLÁN[1]

[1] Department of Ecology and Hydrology. Faculty of Biology, University of Murcia, Espinardo, Spain ■ [2] Wetland Ecology Department, Estación Biológica de Doñana - CSIC, Sevilla, Spain
Email: simone.guareschi@um.es

Trichocorixa verticalis verticalis (Fieber, 1851) is a species originally distributed in North America and the Caribbean islands. However, this boatman has been cited as an exotic species in different countries of Africa, Europe and Oceania. The aim of this study was to estimate worldwide areas with suitable environmental conditions for *Trichocorixa v. verticalis* so as to identify potential new areas of invasion.

We compiled all available information on the distribution of this species from literature in the last 100 years (1911-2011), the GBIF database and field sampling in some recently invaded areas. The dataset gathered contains 82 records where the taxon is present around the world, including both native and invaded zones.

Here, we estimated its potential distribution using both i) distribution models based on species records and relevant climatic data (identified using an ecological niche factor analysis (ENFA)) using a multidimensional envelope procedure (MDE), and ii) thermal physiological data derived from experimental analyses. As individual procedures to estimate species fundamental niches are likely to misrepresent the true range of climatic variation that taxa are able to tolerate, we made a combined potential distribution map showing the climatically inhabitable areas for *T.v. verticalis* using both methods (CPD). Then, as this species mostly inhabits water bodies related with marine and wetland environments, we refined this CPD map using altitude as a surrogate of marine-related environments. So, we deleted mountainous areas, i.e. all areas that present an altitude higher than the highest altitude at which the species has been detected. Thus, we obtained a potential distribution map (PD) showing climatically suitable lowland areas (Figure 1). Finally, Mahalanobis distances (Farber & Kadmon 2003) were calculated in order to obtain continuous climatic suitability values within this PD.

Isothermality and *Temperature Annual Range* were the most relevant climatic variables, and therefore these variables were used in the MDE procedure. *T. v. verticalis* seems to have inhabitable conditions in temperate areas along a wider range of latitudes, with an emphasis on coastal areas of Europe (including Mediterranean islands), Argentina, Uruguay, Australia, New Zealand, Myanmar, India, the western boundary between USA-Canada and some areas of the Arabian Peninsula and Persian Gulf.

Prevention is the most cost effective way to avoid biodiversity problems (Miller *et al*. 2005), and this work may aid the detection of new *T. verticalis verticalis* invasions. Our results predict likely expansion trends from recently invaded areas, as for example to France from Spain, or to other countries of Northern Africa from Morocco. Moreover our potential distribution map may be used as auxiliary tool, together with new field research, to confirm questionable records coming from areas identified as unsuitable by our model. Furthermore, present and potential distribution patterns seem to be related with the main trade routes and commercial harbours, especially between America and Europe. Whether this invasive species is causing loss of native aquatic invertebrate populations is still under study. Anyway, the widespread geographic range, the capacity to be passively-transported and the establishment of this species out of its native range may be considered as a threat to aquatic biodiversity, especially to native corixid species.

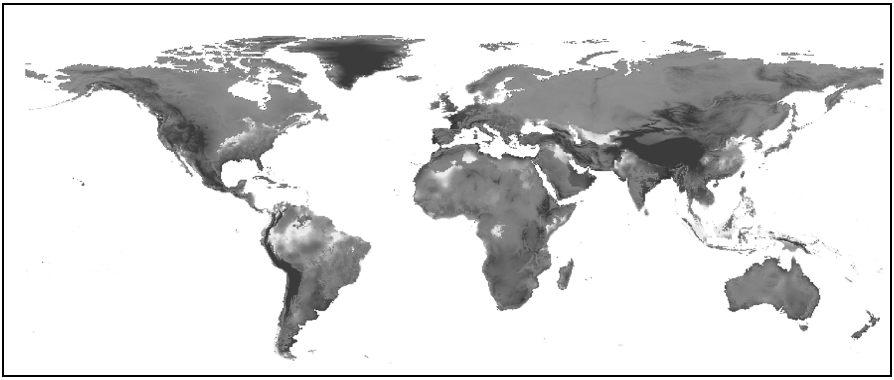

Figure 1. Worldwide potential distribution of the boatman *Trichocorixa verticalis verticalis*. From red colour (maximum suitability) to blue (minor suitability).

References

Farber O, Kadmon R (2003) Assessment of alternative approaches for bioclimatic modelling with special emphasis on the Mahalanobis distance. Ecological Modelling, 160: 115–130.

Miller N, Estoup A, Toepfer S, Bourguet D, Lapchin L, Derridj S, Kim KS, Reynaud P, Furlan L, Guillemaud T (2005) Multiple transatlantic introductions of the western corn rootworm. Science 310: 992.