

## LETTER

# Asian common toads in Madagascar: an urgent effort to inform surveys and eradication efforts

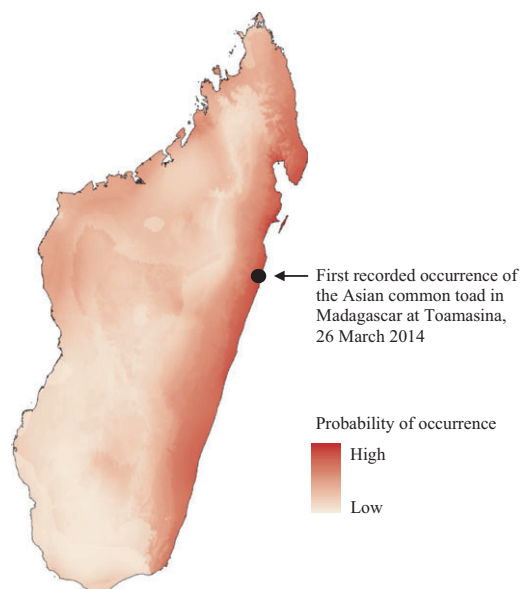
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Kolby (2014) reported the very recent arrival of Asian common toads (*Duttaphrynus melanostictus*) in Madagascar, most likely arriving inside shipping containers from Asia. The species' relative, the cane toad (*Rhinella marina*), has caused widespread ecological destruction in Australia, and there is now concern that an invasion in Madagascar will have disastrous impacts on the island's unique fauna. Over 90% of Madagascar's terrestrial animals are endemic to the island, raising the prospect of substantial loss of biodiversity through poisoning from toxins released by the toads, predation, competition for resources, and spread of disease (though, fortunately, there are no known infections to date of the lethal chytrid fungal disease among Asian common toads; see <http://www.bd-maps.net/>). Potential impacts on agriculture, contamination of drinking water, and parasite transmission also raise concerns for human health and livelihoods (Kolby, 2014).

As urgent survey and eradication efforts begin, it is useful to identify areas in Madagascar where invasive spread is most likely. I obtained 3039 occurrence records for the species in its native range in Asia from the Global Biodiversity Information Facility, and ran an Ecological Niche Model (Phillips *et al.*, 2006) using 18 bioclimate variables from the Worldclim database (Supplementary Methods; Fig. 1). Results confirm that the island provides suitable climate for spread of the toads, with no areas having temperatures or precipitation regimes that are different to those found in the toad's native range. However, the models show that climate is most suitable for the toads in regions along the eastern escarpment, meaning that the first recorded presences at Toamasina are in highly suitable habitat. An invasion of the toads is most likely to spread northward and southward along the escarpment, with conditions less ideal in the island's interior where the climate is drier (Fig. 1).

There are substantial uncertainties in these results, including the possibility that invasive populations will shift their niche and favor climatic conditions that are not preferred in the native range. However, the analyses identify areas where climate conditions in Madagascar are most similar to those in the native range and where the toads are therefore most likely to spread, thus helping to prioritize areas for survey and aiding eradication.



**Fig. 1** Modeled climatic suitability for Asian common toads in Madagascar. The ecological niche model identifies areas in Madagascar with climatic conditions that are most similar to where the species has been observed in its native range in Asia. The toad's recent arrival at Toamasina is in highly climatically suitable habitat, and further spread is most likely along the eastern escarpment where the modeled probability of occurrence is highest.

## Acknowledgements

Christopher Raxworthy provided comments, and Matthew Fisher provided information regarding chytrid infection.

## References

- Kolby JE (2014) Ecology: stop Madagascar's toad invasion now. *Nature*, **509**, 563–563.  
Phillips SJ, Anderson RP, Schapire RE (2006) Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, **190**, 231–259.

## Supporting Information

Additional Supporting Information may be found in the online version of this article:

**Data S1.** Supplementary methods.