ELECTRONIC SUPPLEMENTARY MATERIAL

1. Range calculations

The current range of cane toads in Australia was calculated using an adaptive kernel density estimator in the Home Range Tools extension (Rodgers & Carr 2005) for ARCGIS 9.1 (ESRI, Redlands, CA). The kernel range estimator applies a Gaussian probability density function to calculate a 95% probability isopleth indicating the area occupied by a species based on location data (Worton 1989). The adaptive method applied increases the smoothing bandwidth in local regions of low data density. This method can result in a more accurate representation of ranges when points are distributed unevenly (Worton 1989). The bandwidth was set to 0.23 of the reference value. The range area predicted by a previous model (Sutherst et al. 1995) was calculated by georeferencing the original map in ARCGIS 9.1 and creating a point layer delineating predicted locations of cane toads at a threshold of ≥ 50% their eco-climatic index. This threshold equals the approximate probability level used by the current projection. An adaptive kernel estimator then was applied to this data in the same way and with the same bandwidth as the procedure used to calculate current range.

2. Model details

(a) *Predictor variables*

A small set of climatic and land use predictor variables were selected based on prior knowledge of cane toad physiology, habitat requirements, and anthropogenic factors influencing their dispersal. Climate data were derived from ANUCLIM v. 5.1 software (The Australian National University Centre for Resource and Environmental Studies, Canberra, Australia). ANUCLIM interpolates climate variables at point locations based on elevation and weather station data. Temperature terms were centered before calculating squared terms to decrease colinearity (Legendre & Legendre 1998). Elevation values were obtained from Shuttle Radar Topography Mission 3-Arcsecond finished data (http://srtm.usgs.gov/). We calculated the mean and standard deviation of elevation for each grid cell from this higher resolution elevation data in a program written in Matlab v.7 with Mapping Toolbox 2.0 (Mathworks, Natick, MA). Data on roads and populous areas were derived from digital 1:250,000 scale topographic data (http://www.ga.gov.au/). We first created a fine layer of road cells rasterized at 1/100th of a degree minute. This layer was then aggregated in ARCGIS 9.1 (ESRI, Redlands, CA) as the proportion of each minute grid cell covered by road cells. This proportional road layer was then corrected by the physical area covered by each grid cell based on latitude and proportional land cover (along coastal areas). We created layers for all roads and for paved roads, separately. However, because the proportion of all roads was not significantly related to toad presences, this variable was dropped from further analysis. An analogous procedure was used to derive a layer indicating percent built-up area, defined as a high density of urban or suburban buildings (http://www.ga.gov.au/nmd/products/digidat/250k.htm).

Analysis of variance inflation factors (mean VIF = 5.0) did not reveal excessive colinearity for any variable (VIF > 20) (Hall et al. 1999). In addition, we found no leverage estimates that would indicate outliers exerting a large influence on model parameters (Neter et al. 1996). Mapping these points indicated that most high leverages can be found at the northern and southern areas of range expansions, as might be expected for regions characterized by more extreme temperatures.

(b) *Model performance*

We created a receiver operating characteristics (ROC) plot to evaluate the model's specificity and sensitivity. We also performed a trend surface analysis to understand the effect of spatial autocorrelation on model outcomes. Specifically, we added all third-order polynomial terms that were significant predictors of toad presence/absence data according to a standard methodology (Legendre & Legendre 1998) and then performed model simplification/averaging using the methods outlined above.

The model-averaged regression provided accurate predictions of toad presences and absences as determined by the area under the curve of the receiver operating characteristics plot (A = 0.92) and the total percent correct presence/absence assignments (86.7%). The model performed better on presence data; it correctly predicted a true presence 93.0% of the time and a true absence 69.1% of the time. Higher commission (false presence) errors are expected when ranges are not at equilibrium such as might occur during an invasion (Guisan & Thuiller 2005). Also, because 54% of absence data originated from surveys conducted prior to 1975, commission errors also may indicate outdated records that would now reflect a part of the toad's current range. These two factors, non-equilibrial ranges and outdated absences, tend to make the current model somewhat conservative.

Results were not affected by weighted model-averaging compared to the best (minimum-AIC) model that retained all predictor variables except for proportional road area: the total percent of correctly assigned data points remained the same (86.7%), the predicted area of potential toad settlement increased by 1.4 %, and less than 0.1% of grid cells changed from a predicted presence to a predicted absence or vice-versa. In addition, results were not changed significantly after removing anthropogenic variables (percent built-up area and road coverage). Correct assignments increased by 0.2% and total predicted toad range area increased by 5%.

The model was relatively insensitive to spatial autocorrelation. A model explicitly incorporating potential spatial autocorrelation retained the same eco-climatic variables as the initial model plus five spatial terms. Including spatial terms in the model resulted in only minor improvements in model accuracy (87.6% versus 86.7%). This outcome suggested a relatively minor contribution of spatial autocorrelation to prediction in the eco-climatic model. Moreover, the spatial model predicted a broader cane toad range than the model without these variables.