New record of the invasive Asian House Gecko (*Hemidactylus frenatus*) in Canberra

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Until recently, biotic distributions were largely dictated by the interactions of dispersal, evolution, and plate tectonics (Huggett 2004; Cox and Moore 2005). Now, merchandise and people are transported at unprecedented rates in an embrace of globalisation, thereby providing pathways for flora and fauna to breach previously impervious geographic barriers (Lowe *et al.* 2000; Stachowicz *et al.* 2002). Despite Australia's geographic isolation, it has not escaped this phenomenon as there are an estimated 80 invasive, non-indigenous vertebrate species, an order of magnitude more for invertebrates, and approximately 2700 species of non-indigenous plant that have established populations in Australia (Low 1999; Bomford and Hart 2002; Pimentel 2002).

Invasive organisms generally have numerous impacts attributed to them (Bomford 2008; Gong *et al.* 2009). The direct economic impact attributed to invasive vertebrates in Australia is $743.5 million annually with invasive flora costing in excess of $4 billion per annum (Sinden *et al.* 2004; Gong *et al.* 2009). Though quantifying a fiscal value for environmental costs is problematic, impacts can be contextualised in terms of species under threat (Bomford 2008). The International Union for Conservation of Nature and Natural Resources (2010) showed that invasive organisms are implicated as a key threat to more than 35% of Australia's threatened species.

The Invasive Animals Cooperative Research Centre (IA CRC 2010) stated that more than 90% of invasive organism impacts in Australia are confined to just five species: red fox (*Vulpes vulpes*), feral cat (*Felis catus*), European rabbit (*Oryctolagus cuniculus*), feral pig (*Sus scrofa*), and feral dog (*Canis familiaris*). In fact, the impacts from the four non-indigenous reptile species that have established on mainland Australia (Table 1) appear comparatively negligible; probably for two reasons (Burgin 2007; Newberry and Jones 2007). Firstly, as Hoskin (2011) identified, little research has been done within the Australian context to assess impacts that these non-indigenous reptile species cause. Secondly, the majority of the non-indigenous reptile species that have established are confined to small, local populations (Bomford and Hart 2002). However, the Asian House Gecko (*Hemidactylus frenatus*) is the exception of the latter as its established distribution now spans much of northern Australia (Fig. 2a), with the most southerly population occurring in Taree on the mid-north coast of New South Wales (Hoskin 2011).

Spread to the South: a new record from Canberra

In March of 2010 a Coca-Cola truck driver making a delivery to a cafe in the Gold Creek Village, Nicholls, ACT 2913 (-35.1905S, 149.0832E), alerted the author (working at the Canberra Reptile Sanctuary located at the same address) to a small lizard on one of the crates being delivered. The specimen was captured (Fig. 1) and positively identified by the author and confirmed by the ACT Government Vet, Dr Will Andrew (ACT Government 2010), as *H. frenatus*. The author confirmed with the driver that the truck had come directly from a warehouse in the Queanbeyan area that morning where regular bulk deliveries are received from the Sydney Coca-Cola depot. This event represents the

Figure 1. Specimen of *H. frenatus* collected from a crate of beverages being delivered to cafe in the Gold Creek Village, Nicholls, ACT 2913 (-35.1905S, 149.0832E).

Photo, D. Welbourne (Mar 2010).

Table 1. Non-indigenous reptile species known to have established on mainland Australia.

Species	Scientific Name	Extent of Establishment
Asian house gecko	*Hemidactyluls frenatus*	Broad
Mourning gecko	*Lepidodactylus lugubris*	Few localised
Red-eared slider	*Trachemys scripta elegans*	Few localised
Flowerpot snake	*Ramphotyphlops braminus*	Many localised

Source: Bomford and Hart (2002)

first confirmed record of *H. frenatus* to the Canberra region and supports the suggestion that individuals often disperse via airport, seaport, or terrestrial transport hubs (Low 1999, Hoskin 2011).

A cause for concern

The lack of establishment in southern areas of Australia by *H. frenatus* may be due to physiological constraints given the cold winters. Avery *et al.* (2010) showed that despite warm weather temperatures being adequate for breeding, the major limiting factor for invasive reptiles to persist is cold weather. Indeed predictive models (Fig. 2) that attempt to identify suitable habitat for *H. frenatus* do not identify areas south of Taree as suitable. However, these models are limited since they cannot generally account for microclimatic variation (*e.g.* the thermally buffered environment created by heating houses), or for short-term adaptive or long-term evolutionary responses in dispersing populations (Kearney *et al.* 2010). Hence, given that *H. frenatus* is highly commensal with disturbed sites and human dwellings and due to its impacts (*e.g.* competition with native species and carrying of parasites) more attention to this species is warranted (Hanley *et al.* 1995; Lever 2006; Newberry and Jones 2007; Hoskin 2011).

In Australia there has been little research addressing the impacts of *H. frenatus* on native gecko populations, a problem compounded by the varied threat status applied to *H. frenatus* by different Australian government bodies. Hoskin (2011) noted that *H. frenatus* is not listed as a pest species or a species of concern at the federal level. Csurhes and Markula (2009) identified this species as a serious threat for QLD and in NSW it is of such little concern that it is listed as a pet species (National Parks and Wildlife Service 2006). Continued management of *H. frenatus* in this manner could create a source population within NSW that stifles management efforts in other states and territories. Thus, any management strategy will require congruent efforts across all states and territories to be effective (Hulme 2009).

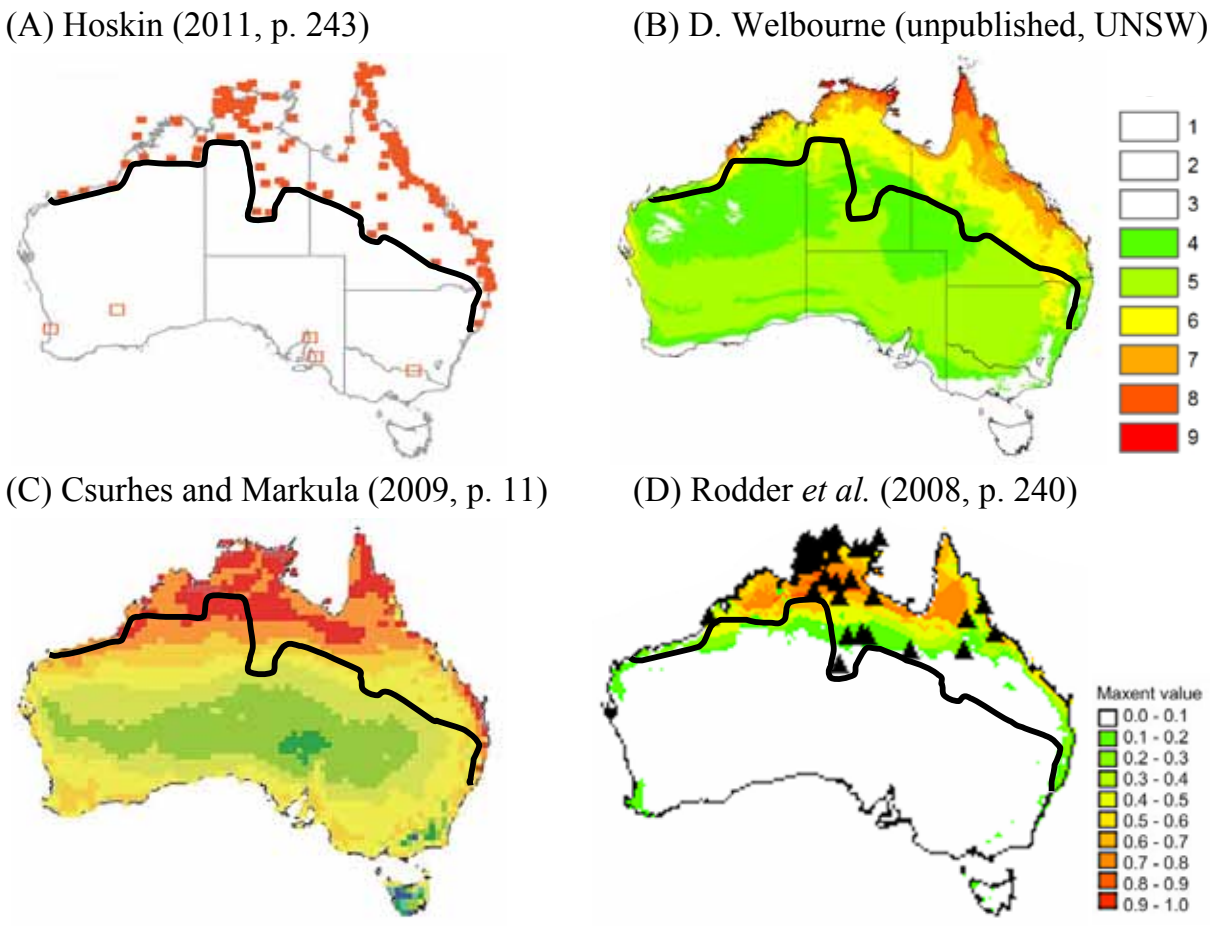

Figure 2. Known distribution and comparative *H. frenatus* models. (A) Known distribution of *H. frenatus* in Australia. (B-D) are predictions of potentially suitable habitat using different modelling techniques. Prediction (B) generated using a mechanistic modelling approach accounting for physiological conditions with legend of higher scores relating to higher establishment suitability of *H. frenatus* and threshold level of score 6. Prediction (C) generated by CLIMATCH software, red shows most suitable climate; orange and yellow indicate marginal suitability; and light green, dark green, light blue and dark blue indicate areas with generally unsuitable climate. Prediction (D) generated by Maxent, legend shows the probability for the cell to contain a presence record and the black triangles represent presence data used in the modelling. Heavy black line illustrates the southerly extent of the known range of *H. frenatus*.

Conclusion

This new record of *H. frenatus* may indicate that further population spread has taken place south of Taree in New South Wales to the Sydney region and possibly beyond. Though it does not provide evidence that an established population is present in the ACT area, it clearly exhibits that human-mediated dispersal continues to be a major pathway for invasive species dispersal. Ultimately, it provides another direct example that supports the need for congruent management strategies across State borders.

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