

## OPINION

# Invasive ants—are fire ants drivers of biodiversity loss?

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Invasive species have long been associated with biodiversity declines (MEA, 2005), and many invasive species that have devastating effects on native faunas are insects (e.g. Majerus *et al.*, 2006; Brown *et al.*, 2011). Whilst there is good evidence that some invasive insects are drivers of declines of native species (e.g. the alien Harlequin ladybird *Harmonia axyridis* in the UK; Brown *et al.*, 2011), there is less consensus for some other invasive insect species.

The red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae) was accidentally introduced into southern USA in the 1930s from South America (Fadamiro *et al.*, 2009). It has subsequently extended its range and is now widespread throughout south-eastern USA. Previous studies have shown that *S. invicta* is associated with declines in native ants (Stuble *et al.*, 2009). However, fire ants are usually associated with habitat disturbance, leading to an area of contention amongst ant researchers, and leading to the alternative suggestion that these invasive species 'are "passengers" of human habitat alteration, rather than "drivers" of biodiversity loss' (King & Tschinkel, 2013a). Untangling these two factors, and understanding whether fire ants are passengers or drivers in native ant declines, is a challenge that merits further research by invasion biologists.

A recent paper (King & Tschinkel, 2013a), reported results from an experimental manipulation of fire ants in an undisturbed pine-savannah ecosystem. The authors report little impact of fire ants on native ants even though there was about five fold difference in fire ant abundance across treatments in the first year of the experiment. Thus the authors conclude that preventing habitat disturbance is the most important way of reducing fire ant impacts. Here we report two responses to the paper.

In the first response, Stuble *et al.* (2013) criticise King & Tschinkel's experiments because there was no treatment where fire ants were completely excluded, there may not have been sufficient time for new species to colonise experimental plots with reduced fire ant abundance, and that threshold effects may result in plots with very low fire ant abundance having detrimental impacts on native ants. Stuble *et al.* (2013) also highlight other studies which have shown negative effects of fire ants in the absence of habitat disturbance. In reply, King and Tschinkel (2013b) defend their experimental design and conclusions, and support their arguments with evidence that

under natural conditions mature colonies of fire ants rarely occur in undisturbed habitats. They agree that there is some evidence showing that where fire ants colonise undisturbed habitats they have a negative effect on native ants, but King and Tschinkel (2013b) argue these examples are of limited importance, especially since these are usually poor quality habitats where overall ant diversity is low. There is clearly more research to be done to determine the importance of habitat disturbance, and whether or not the impacts of fire ants (and indeed, other invasive insect species) are context-specific. Given global climate change and its accompanying range shifts by insects, the present discussion is relevant, timely and highlights the need for considerable further research if we are to successfully assess the potentially complex impacts of invasive insects.

## References

- Brown, P.M., Frost, R., Doberski, J., Sparks, T., Harrington, R. & Roy, H.E. (2011) Decline in native ladybirds in response to the arrival of *Harmonia axyridis*: early evidence from England. *Ecological Entomology*, **36**, 231–240.
- Fadamiro, H.Y., He, X. & Chen, L. (2009) Aggression in imported fire ants: an explanation for shifts in their spatial distributions in Southern United States? *Ecological Entomology*, **34**, 427–436.
- King, J.R. & Tschinkel, W.R. (2013a) Experimental evidence for weak effects of fire ants in a naturally invaded pine-savanna ecosystem in north Florida. *Ecological Entomology*, **38**, 543–545.
- King, J.R. & Tschinkel, W.R. (2013b) Fire ants are not drivers of biodiversity change: a response to Stuble *et al.* (2013). *Ecological Entomology*, **38**, 543–545.
- Majerus, M., Strawson, V. & Roy, H.E. (2006) The potential impacts of the arrival of the harlequin ladybird, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae), in Britain. *Ecological Entomology*, **31**, 207–215.
- Millennium Ecosystem Assessment (2005) *Ecosystems and Human Well-being: Synthesis Report*. Island Press, Washington, District of Columbia.
- Stuble, K.L., Kirkman, L.K. & Carroll, C.R. (2009) Patterns of abundance of fire ants and native ants in a native ecosystem. *Ecological Entomology*, **34**, 520–526.
- Stuble, K.L., Chick, L.D., Rodrigues-Cabal, M.A., Lessard, J.-P. & Sanders, N.J. (2013) Fire ants are drivers of biodiversity loss: a reply to King and Tschinkel (2013). *Ecological Entomology*, **38**, 540–542.