Challenging the view that invasive non-native plants are not a significant threat to the floristic diversity of Great Britain

Conservation scientists and practitioners have long recognized that not all non-native species pose a threat to biodiversity, yet some ecologists still fail to grasp this message (1). The conclusions drawn by Thomas and Palmer (2) that non-native plant species are not a threat to floral diversity in Britain highlight how this lack of understanding can lead to inappropriate analyses and misleading inferences regarding the impacts of non-native species. Thomas and Palmer base their conclusions on an analysis of the Countryside Survey (CS): this valuable dataset depicts large-scale vegetation changes in common habitats, but its stratified random design does not provide a comprehensive assessment of the impacts of non-native plant species on native biodiversity.

First, CS records only about 10% of the non-native flora of Britain and so cannot be considered representative of all non-native species, having an emphasis on casual plant species, feral crops, wayside weeds, and planted trees. Second, of 1,377 established non-native plants in Britain, only 103 (6.3%) are perceived as having ecological impacts (3). However, Thomas and Palmer (2) overlook previous research highlighting that, because the CS is a broad-scale survey, it undersamples non-native plants regarded as having significant ecological impacts (4). The Wildlife and Countryside Act* enacts legislation to manage 23 widespread terrestrial non-native plant species that represent a threat to the nation's biodiversity. Only four of these species are recorded in the CS, and they occur in few quadrats. Third, the CS records a tiny proportion of highly threatened native species requiring conservation action† and these also occur infrequently in the dataset. Thus, the CS has limited statistical power to address the likelihood of native species extinctions. Fourth, the CS does not sample sufficiently the habitats of high-conservation value for which non-native species are a major threat: for example, hybrid rhododendron (*Rhododendron* × *superponticum*) in Atlantic oakwoods, Hottentot fig (*Carpobrotus edulis*) in coastal cliff communities, and pirri-pirri burr (*Acaena novae-zelandiae*) in sand dunes. Thomas and Palmer (2) suggest that such non-native species remain too localized to have national-scale effects, but simply because they are not widespread does not mean that they should be disregarded. Rhododendron threatens one of the few endemic plant species to Britain, the Lundy cabbage (*Coincya wrightii*), even though this native species only occurs on one small island.

Given these caveats, Thomas and Palmer's (2) unrefined exploration of an extensive stratified random sample of plant species simply documents previously reported trends (4) and further does not adequately characterize the hazards posed by non-native plants to species and ecosystems of greatest conservation concern in Britain. A major conservation goal is to understand, predict, and mitigate the biodiversity threats posed by non-native species. Research on the impacts of non-native species therefore must move away from correlative approaches and instead increasingly focus on the non-native species causing the most significant harm to threatened species and ecosystems (5). Thomas and Palmer (2) fail to contribute to this goal and if conservation bodies and governments simply take their headline provocations and apply them to the management of plant invasions, then this will be to the detriment of conservation worldwide.

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The authors declare no conflict of interest.

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1 Simberloff D; 141 signatories (2011) Non-natives: 141 scientists object. *Nature* 475(7354):36.
2 Thomas CD, Palmer G (2015) Non-native plants add to the British flora without negative consequences for native diversity. *Proc Natl Acad Sci USA* 112(14):4387–4392.
3 Roy HE, et al. (2012) *Non-Native Species in Great Britain: Establishment, Detection and Reporting to Inform Effective Decision Making* (Department for Environment, Food and Rural Affairs, London).
4 Maskell LC, Firbank LG, Thompson K, Bullock JM, Smart SM (2006) Interactions between non-native plant species and the floristic composition of common habitats. *J Ecol* 94(6):1052–1060.
5 Hulme PE, et al. (2014) Greater focus needed on plant invasion impacts in protected areas. *Conserv Lett* 7(5):459–466.