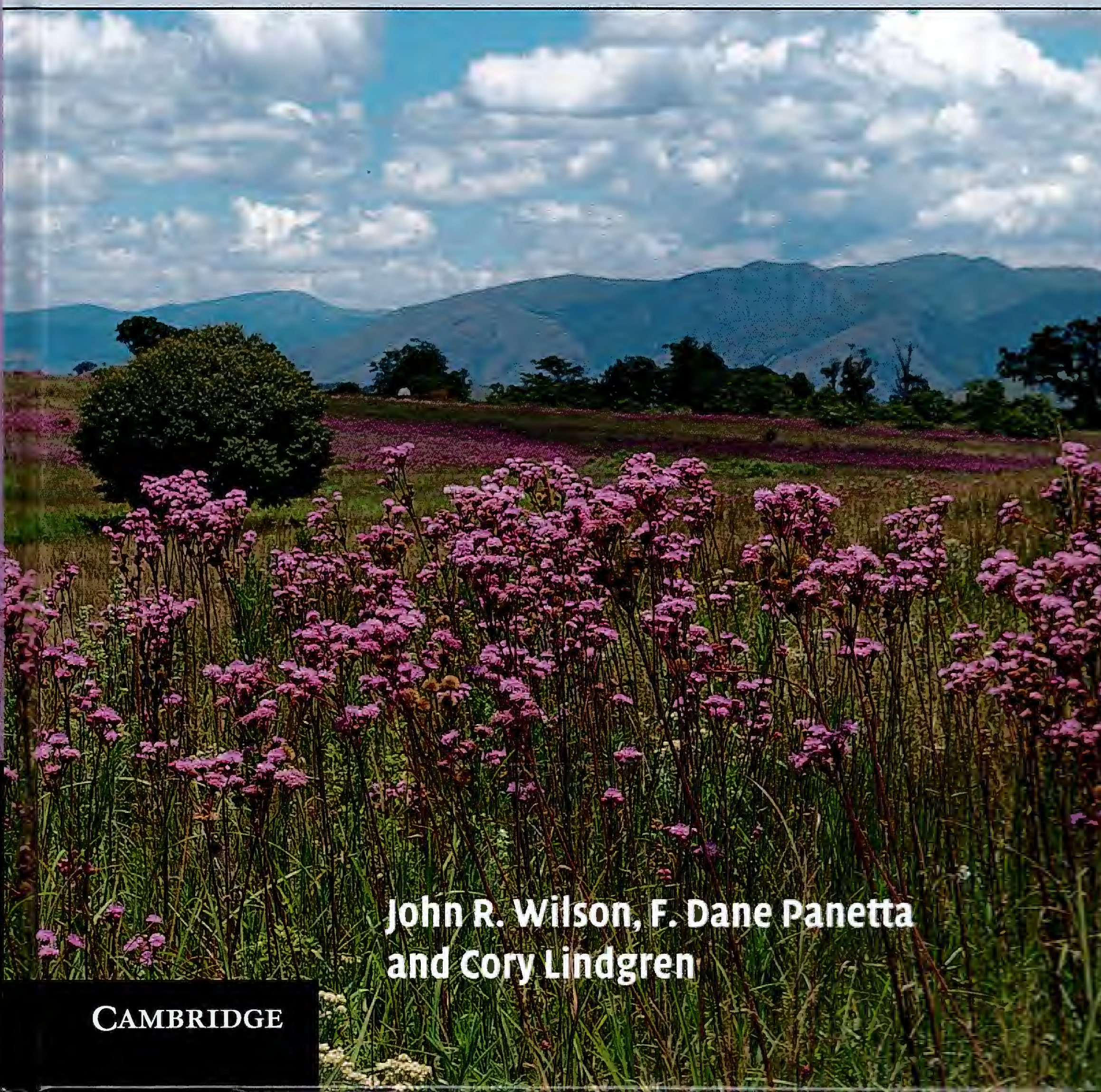
EBC ECOLOGY, BIODIVERSITY AND CONSERVATION

Detecting and Responding to Alien Plant Incursions



John R. Wilson, F. Dane Panetta and Cory Lindgren

CAMBRIDGE

Box 2.1 *Plant Traits Associated with Impact on Native Plant Species Richness (Montserrat Vilà, Rudolf P. Rohr, José L. Espinar, Philip E. Hulme, Jan Pergl, J. Jacobus Le Roux, Urs Schaffner, & Petr Pyšek)*

There has been a considerable amount of research on the particular species traits that might determine why an introduced plant species can establish and become invasive. This information is of great value as it can be used as an important component of risk assessment to screen lists of species for introduction (e.g. for gardening, reforestation, biofuel) to identify those that have the potential to become invasive. The general pattern is that invasive plant species are larger and have higher relative growth and physiological rates than non-invasive plants (van Kleunen, Weber, & Fischer 2010). Are these also plant traits that confer greater ecological impacts on the invaded ecosystem? Not necessarily. It is already well accepted that plant success at different invasion stages from introduction to spread are driven by different factors. Different plant species traits play a significant role in each stage, together with characteristics of the ecosystem and the history of introduction. As the success of a non-native species to invade and the extent of invasion are not linked to the damage the invader can cause, traits associated with the success of invasion do not need to be associated with traits conferring impact. Moreover, the impact of many well-known successful invaders has yet to be investigated in depth (Vilà *et al.* 2011).

Research on plant impacts has mostly focused on assessing the type and magnitude of impacts of non-native species on native plant populations, on plant community structure, or on a handful of ecosystem processes, such as nutrient cycling (Hulme *et al.* 2013). However, in recent years the first attempts have been made to compile and analyse these studies to provide more generic insights into which plant attributes lead to particular impacts (e.g. Pyšek *et al.* 2012). More recently, we have conducted a meta-analysis based on 155 studies that looked at the effect of non-native plants on plant species richness in invaded communities (Vilà *et al.* 2015). We compared the number of native plant species in plots dominated by a single non-native plant species with paired uninvaded control plots to assess whether the magnitude of impact was dependent on some of the major characteristics of the non-native species and/or the broad characteristics of the invaded site. As the data set accounted for 81 different species from 31 families, we also considered the influence of shared evolutionary history among species. Specifically, we used six categorical variables and the phylogeny of the non-native species as predictor variables. Three of these variables were non-native species descriptors: life form (tree, shrub, perennial forb, annual forb, perennial grass, and annual grass); presence of either clonality or vegetative reproduction (yes or no); and ability to fix nitrogen (yes or no). The three other variables were related to the type of invaded ecosystem (forest, shrubland, grassland, old field, ruderal, desert, riparian, coastal, wetland); biogeographic region (temperate, Mediterranean, tropical, sub-tropical, arid, and semiarid); and insularity (whether the study was conducted on an island or not).

On average we found that non-native plants reduced plant species richness by 20.5%. Of the six categorical variables assessed, clonal growth and N-fixing were the only ones influencing the magnitude of the impact. Clonal plants or plants with vegetative reproduction reduced species richness more than non-clonal plants (Box 2.1 Fig. 1).

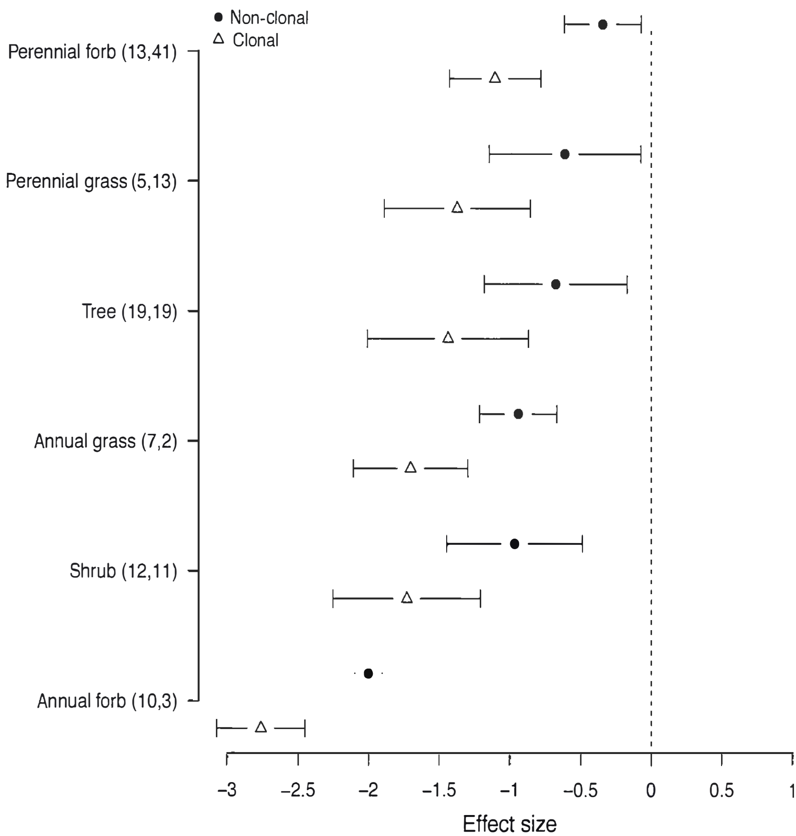


Figure 1. The impact of non-native plant species on native plant species richness. Effect size (±1.96 SE, i.e. 95% confidence interval) is computed as the log-ratio of the number of species in the invaded plot over the control plot. An effect size is significantly different from zero when its 95% confidence interval does not bracket zero. A negative effect size indicates a decrease in plant species richness. Sample sizes for non-clonal and clonal species are indicated respectively in parentheses. Reproduced from Vilà *et al.* (2015) with permission.

In plant invasion biology there has been a lot of emphasis on the impact of N-fixing species on N-cycling (Castro-Díez *et al.* 2014). However, contrary to the general wisdom, N-fixing species reduced plant species richness less than non-N-fixing species. In fact, there have been many cases of N-fixing non-native species (e.g. *Acacia* spp.) not reducing local species richness in all study sites.

The most striking result was the presence of a phylogenetic signal on the magnitude of impact. Closely related species tend to have impacts of comparable directionality and strength. The cause of this signal is probably due to closely related species sharing traits that might increase competitive ability. Although our study did not precisely identify these traits, our results support the use of information from closely related species to infer potential impacts of an unknown invader in risk assessments.