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Risk analysis of potential invasive plants in Spain

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Summary

Once non-native species become established in a new region, they are extremely difficult to eradicate or control, suggesting an urgent need for the development of early warning systems to determine the probability of a given species becoming invasive. Risk assessment schemes are valuable tools to diminish the risk of invasion and to concentrate resources on preventing the entrance and spread of those species with higher risk of invasion. For many European countries, plant species not yet introduced to the country and with high invasive potential have not been identified. The present study aims to identify and rank non-native plant species that could potentially become invasive in Spain if introduced. As a first step, a plant data set was pre-selected for screening, containing invasive plants in neighbouring countries and in other Mediterranean regions of the world but not present in Spain. A preliminary list of 80 species was obtained, Leguminosae being the most represented family (15%) and gardening (62%) the most common pathway of introduction. As for the potential European Nature Information System (EUNIS) habitats to invade, heath land and scrubland habitats types (F; 19%), followed by constructed, industrial and artificial habitats (J; 14%) and woodland and forest habitats (G; 13%) seem to be the habitats most at risk despite F and G habitats currently being the least invaded in Spain. We ranked these potential invasive species using the Australian Weed Risk Assessment system and a Risk Assessment for Central Europe developed by Weber & Gut (2004) [Weber, E., & Gut, D. (2004). Assessing the risk of potentially invasive plant species in central Europe. *Journal for Nature Conservation*, 12, 171—179]. Most species received intermediate values in both tests. The species with higher scores were mainly aquatic plants and should be prohibited or kept out of trade. *Chromolaena odorata* (Asteraceae) obtained the highest score in both tests and therefore is the species with the highest risk to become invasive in Spain if introduced.

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Introduction

Invasion by non-native species represents one of the greatest threats to biodiversity worldwide and is considered a major component of global change (Mack et al. 2000; Mooney & Hobbs 2000). In addition to affecting ecosystems and contributing to the local extinction of native species, invasive non-native species can also cause major socio-economic damage (Pimentel et al. 2005). The introduction of non-native species has increased dramatically in frequency and extent in recent decades, as human movements have become more global and international trade has increased (McNeely et al. 2001). This trend has entailed an increase in the likelihood of new invasion events with subsequent negative ecological and socio-economic impacts (Levine et al. 2003; Mack et al. 2000; Pimentel et al. 2005; Vitousek et al. 1997).

Once introduced plant species are established in a new region, they are extremely difficult to eradicate or control (Duncan et al. 2003; Rejmánek et al. 2005). Thus, preventing new non-native invasions is, by far, the most environmentally desirable and cost-effective management method (Wittenberg & Cock 2001). Consequently, there is an urgent need for the development of early warning systems to determine the probability of a given species becoming invasive (Groves et al. 2001; Panetta & Scanlan 1995).

For plants, research on (1) the historical events related to introduction (Pyšek & Jarosík 2005; Pyšek & Richardson 2007; Rejmánek et al. 2005), (2) the key species traits associated with invasive species (Goodwin et al. 1999; Reichard & Hamilton 1997; Rejmanek & Richardson 1996) and (3) the characteristics of invaded habitats (Burke & Grime 1996; Lonsdale 1999) have provided the basic information to predict the invasion success in the new region (Pyšek & Richardson 2007; Richardson & Pyšek 2006; Williamson 1999), and therefore for risk assessment analysis (Daehler & Carino 2000; Keller et al. 2007; Wittenberg & Cock 2001).

Risk assessment schemes are science-based predictions which attempt to identify species that have not yet been introduced to a region but have a high likelihood of becoming invasive (Whitney & Gabler 2008). The implementation of risk assessment protocols produces net economic benefits (Keller et al. 2007), but only few countries, such as Australia and New Zealand, have implemented science-based risk assessment schemes as a screening routine to detect potential invasive species posing environmental and economic hazards.

In Spain, potential invasive plants not yet introduced in the country have not been identified, despite the Law of Natural Heritage and Biodiversity (42/2007), issued by the Spanish Environmental Ministry (http://www.boe.es/aeboe/), which mentions the need for prevention and management of those invasive species which threaten native species, natural habitats and economic resources. The present study aims to identify and rank non-native plant species that, if introduced, could potentially become invasive in Spain. This research is a basic tool to reinforce gardening, landscaping and plant trade regulations. We also provide information on the basic traits of these species in terms of taxonomy, origin, life form, and potential habitats to invade compared to invasive species that have already become established in the country (Sanz-Elorza et al. 2004).

Species ranking has been performed by applying two different risk assessment protocols: the Australian Weed Risk Assessment system (hereafter 'WRA'; Pheloung et al. 1999) and a Risk Assessment for Central Europe developed by Weber and Gut (2004) (hereafter, 'WG–WRA'). The first one has been selected due to its success and consistency in different regions (Gordon et al. 2008). The second protocol has been chosen because it has been developed specifically for Europe, albeit in central Europe, and uses a similar quantitative grading system than WRA. Both protocols rate species with an index as a measure of invasive potential, facilitating the comparison between them. We compared whether results were consistent among the two tests and discussed main differences.

Methods

Preselection of species

A plant data set was pre-selected for screening. This plant data set comprised all invasive plants of neighbouring countries and Mediterranean regions, but not yet present in Spain. All plant species listed as invasive in Portugal, France, Italy and in the Mediterranean Basin areas of Northern African countries, as well as, invasive species in other Mediterranean regions of the world (i.e., Chile, California, Australia and South Africa) were included in the list.

Although, Spain houses a heterogeneous climatic mosaic being oceanic in the North, alpine at high altitudes and somehow continental in the central plateau (but far less extreme than the Central Europe continental climate) most of its territory is influenced by Mediterranean climate (Ninyerola et al. 2000). Moreover, hot spots of invasive plant