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symposium summary

Introduced conifer invasions in South America: an update

One-day symposium at 6th Southern Connection Congress – Bariloche, Argentina, 16th February 2010

Species in the family Pinaceae are currently among the most widely distributed trees in the world. Although almost exclusively native to the northern hemisphere, many species have been introduced and widely planted throughout the southern hemisphere. Introduced conifers have been mainly used for plantation forestry, amenity, shelter and erosion control, and in the last few decades a number of species have become increasingly invasive. On February 16th, 2010, we held a symposium entitled “*Pine Invasion In South America: Patterns, Process, and lessons to be learned*” during the 6th Southern Connection Congress in Bariloche, Argentina (<http://www.sccongress2010.com.ar>). The symposium was organized by the Southern Hemisphere Network on Conifer Invasion (SHNCI), a group of concerned scientists working on conifer invasions in the southern hemisphere (details in Richardson et al. 2008). Speakers from different parts of the world, especially the Southern Hemisphere, shared their research experiences and presented studies on the ecology and management of invasive conifers. The aim of this note is to highlight the key ideas presented and discussed at the meeting on the study and management of conifer invasions in South America.

An introduction by Dan Simberloff et al. suggested that there are few problems more unique to the southern hemisphere, specifically to

parts of the former Gondwanaland, than introduced conifer invasion. Pinaceae native to the northern hemisphere have been widely planted in the last few decades. Today the invasion of these species is occurring outside managed areas, and is expected to increase in the next decades. Given the ecological and economic impacts that invasive conifers can produce, a better understanding is essential if they are to be most cost-effectively controlled and managed in the future (Simberloff et al. 2010).

History, Patterns & Processes

A better understanding of the history and the current status of conifer invasions in South America is urgently needed. For Chile, Aníbal Pauchard et al. described how the Chilean government and forestry companies began massive reforestation programs during the late 20th century, using fast-growing conifer species to stop soil degradation, even in protected areas. Commercial *Pinus radiata* plantations began in the late 1960s and boomed in the 1980s. In southern areas, other species such as *Pinus sylvestris*, *P. ponderosa*, *P. contorta* and *Pseudotsuga menziesii* were also planted and are now becoming invasive, especially *P. contorta* (Langdon et al. 2010).

Pine invasions have been used as a model for understanding plant invasions (Richardson 2006) and South America provides exciting new

opportunities for furthering this research. For Central Chile, Ramiro Bustamante et al. indicated that the availability of light, regardless of other local and landscape attributes, is probably the main driver of *P. radiata* invasion in fragmented *Nothofagus* forests. Pines fail to establish in the interior of closed canopy forests but become abundant when the canopy cover is reduced significantly. Consequently, management to prevent pine invasion should be focused on the conservation of continuous canopies in remnant forests. In forests of Argentina, Martin Nuñez et al. tested different factors that limit the invasion of Pinaceae on Isla Victoria, Nahuel Huapi National Park. They found that intense seed predation and the lack of proper mycorrhizal fungi may be limiting the invasion of exotic plants, while deer herbivory seems to have a positive effect on the invasion, by reducing the competitive abilities of native species. Propagule pressure and the intrinsic invasiveness of certain species appear to play lesser roles in these invasions. On the same island, María Andrea Relva et al. tested whether exotic herbivores (deer) promote the invasion of exotic conifers. They suggested that the animal type (domestic vs. wild), intensity of herbivory, and local plant community (forest vs. non forest) can be key factors in determining the type of response (facilitation or inhibition). These results, together with those gathered from other continents, show that the response of invasive conifers to exotic herbivores is highly context-dependent, but that some general response patterns do exist (Relva et al. 2010).

Impacts and Management

Invasive conifers have caused important changes in natural communities (Simberloff et al. 2010). In Patagonia, several pine species including species with adaptations to cope with (and regenerate vigorously after) fire, have been planted in areas that were formerly treeless. Estela Raffaele et al. studied the establishment of pines after fires in 17 sites where pine plantations had been burnt between 1985 and 2002 in the Argentinean northern Patagonia. They found high levels of invasion both inside the burnt plantations and in native areas around them, and concluded that there is a risk

that pines will increase fire regime intensity and frequency in Patagonia, creating a positive feedback between invasion and wildfires.

To date, there has been little control of introduced conifer invasions in South America, and international experience could guide efforts to control them in the region. New Zealand is a leading country in strategies to control invasions. Nick Ledgard described a project aimed at improving spread risk assessment and mapping, the determination of cost-effective means for controlling wilding conifers, the assessment of vegetation successions associated with conifer management, and improving public awareness of wilding spread and its control. The project, supported by the South Island Wilding Conifer Management Group, has produced a wilding risk assessment decision support system, maps of wilding-affected areas, a wilding control manual and several academic and non-academic papers and articles which are available to the public via their website (www.wildingconifers.org.nz). A synergic association between those affected by conifer spread and specialist researchers has proved to be a successful means of improving the ecological understanding of wilding spread, risk assessment, control techniques and awareness.

The future: taking control

Based on the history of conifers introduced elsewhere in the southern hemisphere, and current reports from within South America, it is likely that invasions in that continent will increase in number and size. Large-scale conifer plantings began about 50–80 years later in South America than in Australia, New Zealand, and South Africa. It is likely to be a similar story for reports of invasion and subsequent impacts, such as replacement of non-forests areas by conifer forests, modifications of hydrological and fire regimes, changes in soil nutrients, and alterations in above-ground and below-ground biotic communities. A number of these effects have already been recorded in different parts of South America. There are large areas planted with exotic conifers in Chile, Argentina and Brazil and many of these are growing rapidly and producing large quantities of seeds. In spite of

this negative scenario, governments continue to give public subsidies to stimulate pine plantations. Regulations for conifer invasion in other parts of the southern hemisphere are being enforced by legislation, which has yet to be introduced to South America. The conditions in a country such as New Zealand seem to be quite different from those in South America, where there are many challenges to establishing successful control strategies – these are mainly due to lack of awareness and economic resources (Nuñez & Pauchard 2010). However, based on discussion at the symposium, we are confident that local research and the experiences gained from areas with more expertise and history on invasions can be used to develop programs and legislation to mitigate introduced conifer invasions in South America. The commitment of private and public agencies as well as the education of people will be critical to achieving these objectives.

Acknowledgements

AP funded by ICM P05-002 and PFB-23. MAR funded by Conicet (PIP 5066) and Universidad Nacional del Comahue.

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