



Original research article

Assessing the impact of plantation forestry on plant biodiversity

A comparison of sites in Central Chile and Chilean Patagonia



Andreas Ch. Braun^{a,*}, Danny Troeger^a, Rafael Garcia^b, Mauricio Aguayo^c, Ricardo Barra^d, Joachim Vogt^a

^a Institute of Regional Science (IfR), Karlsruhe Institute of Technology (KIT), 76131 Karlsruhe, Germany

^b Facultad de Ciencias Forestales (Laboratorio de Invasiones Biológicas - LIB), Universidad de Concepción (UdeC), Victoria 631, Concepción, Chile

^c Centro de Ciencias Ambientales (EULA), Universidad de Concepción (UdeC), Casilla 160-C, Concepción, Chile

^d Facultad de Ciencias Ambientales, Universidad de Concepción (UdeC), Casilla 160-C, Concepción, Chile

ARTICLE INFO

Article history:

Received 7 December 2016

Available online 3 April 2017

Keywords:

Plantation forestry

Biodiversity

Pinus spp.

Nothofagus spp.

Chile

Patagonia

ABSTRACT

Effects of plantation forestry on biodiversity are controversially discussed in literature. While some authors stress positive effects, others tend to attribute a largely negative influence to plantations. One important factor steering the influence on biodiversity are management practices. A second important factor is the environmental matrix. Chile offers the option to analyse both factors jointly. The coastal range of central Chile has experienced rapid and widespread replacement of native *Nothofagus* spp. forests in favour of *Pinus radiata* plantations. Here, native forests remain limited to small patches surrounded by an environmental matrix of plantations. Management is rather intensive and not designed to maintain biodiversity. While in the coastal range of central Chile the transformation from native forests to non-native tree plantations has almost come to an end, spatial extension of *P. contorta* and *P. ponderosa* plantations has just recently begun in Chilean Patagonia. While the management is similar to central Chile, plantations rather exist as small patches surrounded by an environmental matrix of native plant formations (e.g. *Nothofagus* spp. forests and *Nothofagus* spp. scrublands). In the framework of this work, effects of the two diametric land usages on biodiversity are assessed and compared. Biodiversity is assessed at the α -, β - and γ -scale. At the α -scale, biodiversity impacts are inferred statistically, using one-way ANOVA and Tukey's PostHoc test. Biodiversity of plants at both sites is significantly reduced in plantations when compared to native forests or scrublands. Plantation forestry lowers α -biodiversity and does not provide additional habitats for specialists. At the β -scale, weak edge effects due to the presence of native forests are observed. In total, plantation forestry tends to promote plant invasions and impairs the survival of endemics. At the γ -scale, plant species communities where predominantly native and endemic in forests, predominantly introduced in plantations. Positive effects of the more native environmental matrix in Patagonia are not found to be stronger than in central Chile, therefore it is concluded that management imposes a much stronger influence. Results show, that the biodiversity impacts in

* Corresponding author.

E-mail addresses: andreas.ch.braun@kit.edu (A.C. Braun), danny.troeger@student.kit.edu (D. Troeger), ragarcia@udec.cl (R. Garcia), maaguayo@udec.cl (M. Aguayo), ricbarra@udec.cl (R. Barra), joachim.vogt@kit.edu (J. Vogt).

<http://dx.doi.org/10.1016/j.gecco.2017.03.006>

2351-9894/© 2017 Karlsruhe Institute of Technology. Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Central Chile are transferable to Chilean Patagonia, where plantation forestry is increasingly established.

© 2017 Karlsruhe Institute of Technology. Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

1. Introduction

The relationship between biodiversity and plantation forestry has been controversially discussed in literature (Bremer and Farley, 2010; Brockerhoff et al., 2008; Stephens and Wagner, 2007; Kanowski et al., 2005). In many case studies, positive or at least neutral effects can be identified (Ferns et al., 1992; Allen et al., 1995; Chey et al., 1997; Murphy et al., 2008; Tomasevic and Estades, 2008). Other case studies pronounce negative effects (Friend, 1982; Freedman et al., 1996; Potton, 1994; Perley, 1994; Fomegas et al., 2004). Nonetheless, some tendencies are rather well established. There is strong agreement that an adequate management of plantations can help to maintain biodiversity. In contrast, unsustainable management can impair biodiversity (Cawsey and Freudenberger, 2008; Program and RIRDC, 2004; Taki et al., 2010). Furthermore, an important influence of the environmental matrix on biodiversity within highly managed landscapes like plantations is observed (Murphy and Lovett Doust, 2004; Baum et al., 2004; Tomasevic and Estades, 2008; Lin and Augspurger, 2008; Faria et al., 2009).

Chile is a well suited country to assess the influence of plantation forestry on biodiversity. Central Chile is considered a centre of biodiversity by various concepts (Brooks et al., 2006). At the same time, forestry with non-native tree species plantations is one of the strongest economic sectors of the country (Gwynne, 1996). Since the neoliberal turn of the Pinochet government, Chile has strongly subsidized plantation establishment in the central zone (most strongly in the VII. Región del Maule, VIII. Región del Biobío) (Clapp, 1995a,b, 2001). Thus, native forests of *Nothofagus glauca* (PHIL.) KRASSER, *N. obliqua* (MIRB.) OERST. and *N. alessandrii* ESPINOSA have been rigorously replaced by plantations (mainly of *Pinus radiata* D.DON and *Eucalyptus globulus* HABILL.) (Smith-Ramirez, 2004). Since 1974, native forests have almost completely disappeared in the coastal range (Echeverría et al., 2006). Today, they cover only a few percent of their original habitats as small remnants. These remnants are surrounded by extensive plantations (Bustamante and Castor, 1998). Thus, the environmental matrix consists almost exclusively of non-native tree plantations. Plantations are managed in a rather unsustainable manner (Clapp, 1995a,b, 2001). Stands are mainly mono-specific and composed of cohorts of trees at the same age. No native trees are preserved within plantations. Harvesting is done by clear-cutting which is frequently followed by pesticide application. In the past, harvested sites were burned to avoid plant diseases. This practice has officially been abandoned, though, it is infrequently applied until today (Clapp, 1995a,b, 2001). Many Latin-American authors familiar with the situation expect negative influences on biodiversity e.g. Pauchard et al. (2006), Paritsis and Aizen (2008), Armesto et al. (1998) and Smith-Ramirez (2004) but see Estades and Temple (1999), Gomez et al. (2009) and Tomasevic and Estades (2008).

However, empirical evidence based on systematic comparisons of vegetation assessments for this assumption is not available.

A different image of land usage is found in Chilean Patagonia (XI. Región de Aysén). There, human-provoked fires between 1920 and 1960 cleared large areas of forests exposing soils to erosion and landslide risks (Langdon et al., 2010; Sanchez Jardon et al., 2010). In order to reduce erosion and landslide risks by exploiting the soil-stabilizing effect of tree ecosystems, thousands of hectares with fast growing non-native species, mainly *P. contorta* DOUGL. EX LOUD. and *P. ponderosa* DOUGL. EX P. ET C. LAWS. were planted for soil protection. However, in the 1970s plantation establishment continued, though, with productive purposes. Despite continued establishment, plantations cover less than one percent of the area (e.g. *N. antarctica* (G. FORST.) OERST., *N. pumilio* (POEPP. AND ENDL.) KRASSER) (Langdon et al., 2010). While in central Chile, native formations are integrated into an environmental matrix of plantations, in Patagonia the situation is different. Plantations do not represent an environmental matrix but are themselves integrated into an environmental matrix of near-natural scrublands, grasslands and forests. However, management practices are adopted from central Chile and plantations are operated by the same companies. Therefore plantation management – except that another *Pinus* species is planted – is largely comparable in Patagonia.

This analysis aims to discuss the relative impact of two factors influencing plantations biodiversity in the two study regions. The relative impact of plantation management as one aspect of habitat quality is compared to the impact of the environmental matrix.

2. Study sites

2.1. Geography of central Chile

The VII. Región del Maule, VIII. Región del Biobío, which are part of Central Chile, belong to the temperate zone of the country extending from 35° to 37°S. It has a Mediterranean Csb climate (Koeppen–Geiger) with an annual mean temperature around 12 °C and an annual precipitation of around 1300 mm. The zone is morphologically determined by the coastal range,

Download English Version:

<https://daneshyari.com/en/article/5742383>

Download Persian Version:

<https://daneshyari.com/article/5742383>

[Daneshyari.com](https://daneshyari.com)