

Centennial and millennial-scale dynamics in *Araucaria- Nothofagus* forests in the southern Andes

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JOURNAL OF BIOGEOGRAPHY

Volume: 48

Issue: 3

Pages: 537-547

DOI: 10.1111/jbi.14017

Published: MAR 2021

Early Access: NOV 2020

Document Type: Article

[View Journal Impact](#)

Abstract

Aim To assess the relative roles of long-term (millennial-scale) climatic change, fire and volcanic disturbance on the dynamics of *Araucaria-
Nothofagus* forests of south-central Chile. Through this analysis, we provide insight into how these iconic ecosystems may respond to future ash-fall events under anticipated changes to climate and burning regimes.

Location Lago Cilantro is a small lake located in south-central Chile (38 degrees 51 ' 36.72 S, 71 degrees 17 ' 14.52 W, 1,400 m asl), proximal to several active volcanos within the Southern Volcanic Zone of the Andes Mountain range.

Taxon *Araucaria araucana* (Araucariaceae); *Nothofagus* spp. (Nothofagaceae).

Methods We developed a continuous 8,700-year long pollen and charcoal record from Lago Cilantro. We compared these results with proxies of regional climatic change and used a combination of principal component analysis and superposed epoch analysis to test the relationship between tephra deposition and pollen composition.

Results We detect a shift in dominance from *Araucaria araucana* to *Nothofagus* species between similar to 8.7 and similar to 5.5 ka (ka = 1,000 years before present-1950 CE), in concert with increasing regional precipitation and decreasing local-scale fire activity. A reversal in this trend occurred after similar to 4 ka, contemporaneous with a reduction in regional precipitation. Centennial-scale increases in *Araucaria araucana* from similar to 0.2 to 0.9 ka, similar to 5.2 to 4.2 ka and similar to 8.6 to 7 ka are associated with reductions in fire return intervals. We found 24 tephra layers in this record; tephra >2 cm thickness are associated with short-term (<100 year) compositional shifts in the pollen spectra, while a

single large (255 cm) tephra at similar to 3 ka is associated with a substantial reduction in Nothofagus and no change in Araucaria.

Main Conclusions Climate change drove millennial-scale shifts in Araucaria-Nothofagus forests and fire regimes near Lago Cilantro. A shortening of the fire return interval is associated with an increase in the importance of Araucaria, supporting the notion that recurrent fires are required to allow this tree species to compete with Nothofagus. Tephra deposition triggered short-term compositional responses in this system that appears to be overwhelmed by climate and fire at longer time-scales. Araucaria araucana can survive and potentially outcompete Nothofagus following the deposition of very thick tephra, thanks to its thick bark and tall canopy (>15 m).

Keywords

Author Keywords:[Araucaria araucana](#); [climate](#); [fire](#); [Nothofagus dombeyi](#); [Nothofagus pumilio](#); [palaeoecology](#); [south-central Chile](#); [tephra](#); [volcanism](#)

KeyWords Plus:[TEMPERATE RAIN-FOREST](#); [CLIMATE-CHANGE](#); [REGIME SHIFTS](#); [FIRE REGIMES](#); [PATTERNS](#); [DISTURBANCE](#); [VEGETATION](#); [POLLEN](#); [CHILE](#)

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Funding

Funding Agency Show details	Grant Number
Comision Nacional de Investigacion Cientifica y Tecnologica (CONICYT) CONICYT FONDECYT	1191435 3110180
Millennium Science Initiative of the Ministry of Economy, Development and Tourism	

[View funding text](#)

Publisher

WILEY, 111 RIVER ST, HOBOKEN 07030-5774, NJ USA

Journal Information

- **Impact Factor:** [Journal Citation Reports](#)

Categories / Classification

Research Areas:Environmental Sciences & Ecology; Physical Geography

Web of Science Categories:Ecology; Geography, Physical

Document Information

Language:English

Accession Number: WOS:000594933100001

ISSN: 0305-0270

eISSN: 1365-2699