Regeneration patterns and persistence of the fog-dependent Fray Jorge forest in semiarid Chile during the past two centuries

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Abstract

The persistence of rainforest patches at Fray Jorge National Park (FJNP) in semiarid Chile (30°40′S), a region receiving approximately 147 mm of annual rainfall, has been a source of concern among forest managers. These forests are likely dependent on water inputs from oceanic fog and their persistence seems uncertain in the face of climate change. Here, we assessed tree radial growth and establishment during the last two centuries and their relation to trends in climate and canopy disturbance. Such evaluation is critical to understanding the dynamics of these semiarid ecosystems in response to climate change. We analyzed forest structure of six forest patches (0.2–22 ha) in FJNP based on sampling within 0.1 ha permanent plots. For the main canopy species, the endemic *Aextoxicon punctatum* (Aextoxicaceae), we used tree-ring analysis to assess establishment periods, tree ages, growing trends and their relation to El Niño Southern Oscillation (ENSO), rainfall, and disturbance. The population dynamics of *A. punctatum*can be described by a continuous regeneration mode. Regeneration of *A. punctatum* was sensitive to different canopy structures. Growth release patterns suggest the absence of large scale human impact. Radial growth and establishment of *A. punctatum* were weakly correlated with rainfall and ENSO. If water limits forests patch persistence, patches are likely dependent on the combination of fog and rain water inputs. Forest patches have regenerated continuously for at least 250 years, despite large fluctuations in rainfall driven by ENSO and a regional decline in rainfall during the last century. Because of the positive influence on fog interception, forest structure should be preserved under any future climate scenario. Future research in FJNP should prioritize quantifying the long-term trends of fog water deposition on forests patches. Fog modeling is crucial for understanding the interplay among physical drivers of water inputs under climate change.