Nitrogen in litterfall and precipitation and its release during litter decomposition in the Chilean piedmont matorral

El nitrógeno en la precipitación y la caída de hojarasca y su liberación durante la descomposición en el matorral premontano de chile

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Abstract Parts of the nitrogen cycle involving two dominants (Lithraea caustica and Quillaja saponaria) in the Chilean piedmont matorral have been studied over a 15-month period. Analyses showed that 8.2 kg N ha\(^{-1}\) yr\(^{-1}\) entered the system in rainfall and dry deposition, though impaction of N-containing compounds on vegetation (not measured) may elevate this value. L. caustica, by virtue of its greater percent cover, contributed more leaf litter than did Q. saponaria to the system (1089, vs 737 kg dry matter ha\(^{-1}\) yr\(^{-1}\), respectively), although on an individual basis Q. saponaria produced more litter (640, vs 350 g dry leaf litter m\(^{-2}\) yr\(^{-1}\) r L. caustica). This plus the greater nitrogen release of L. caustica leaf litter during decomposition (2.61, vs 0.60 g N kg dry litter\(^{-1}\) yr\(^{-1}\) for Q. saponaria) and Q. saponaria’s higher N-content of dropped leaves (0.54, vs 0.37% N for L. caustica) may indicate a more external cycling of nitrogen in Q. saponaria relative to that in L. caustica. These two species may therefore represent two different strategies of individual nitrogen cycling, external and internal.

Introduction

The matorral is a degraded evergreen schlerophyll forest that is the most common vegetation formation in the central zone of Chile. Its structure is very similar to ecosystems of other mediterranean regions of the world. The piedmont matorral located in the foothills of the Cordillera de los Andes near Santiago, Chile, is characterized by almost the same species as those in the plains.

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matorral, though individual shrubs in the piedmont matorral are smaller and species densities differ.

Although the soils of this ecosystem have very low nitrogen concentrations (0.2% N), the standing plant biomass is very high. This suggests the presence of mechanisms which compensate for this apparent soil-nitrogen deficiency. To our knowledge there are a few studies which consider the movement of nutrients in this type of ecosystem \textit{(e.g.}⁶⁻⁷⁻⁸\textit{)}, but comprehensive studies that consider mobilization of nutrients among the different parts of these plant communities are lacking. The aim of this study is to investigate these mechanisms by quantifying nitrogen fluxes among different compartments of the ecosystem during an annual cycle. We have focused our attention on N-fluxes affected by the two dominant species, \textit{Lithraea caustica} and \textit{Quillaja saponaria}. The fluxes and N-pools studied include 1) nitrogen inputs to the system through bulk precipitation, 2) nitrogen transferred to the soil from the canopy in litterfall and throughfall, 3) nitrogen released from decomposing leaf-litter, and 4) nitrogen in different plant compartments such as green leaves, bark, and roots.

**Study site and methods**

The study was conducted in a Cordillera de los Andes piedmont area at 1000 m elevation located 10 kilometers northeast of downtown Santiago. The climate of the area is Mediterranean, with cool moist winters and hot dry summers. The matorral vegetation is dominated by \textit{L. caustica} and \textit{Q. saponaria}, and \textit{Trevoa trinervis}, \textit{Baccharis sp.}, \textit{Kageneckia oblonga}, and \textit{Colliguaya odorifera} are the most conspicuous subordinate species. The canopy of \textit{L. caustica} covers three times more area (31.1% cover) than \textit{Q. saponaria} (11.5% cover). About 25% of the soil of the system is exposed, and 32% of the study site is covered by subordinate shrub species.

Within a sampling site of approximately 1 ha, 10 \textit{L. caustica} and 10 \textit{Q. saponaria} trees were selected at random for nitrogen determinations. Precipitation and throughfall were recorded daily in 9 plastic pluviometers 20 cm in diameter. Stemflow was monitored using a plastic gutter made from 1.3 cm plastic tubing split in half and coiled around the main stem of 4 individuals of each dominant species. All solutions were collected separately in 101 plastic jars, removed after each rainfall and stored for later inorganic nitrogen determinations. One ml of 40% formaldehyde \textit{L}⁻¹ of sample solution was added to all samples and analyses were performed within 30 days of collection.

Sixteen 0.5 m² litter-collecting trays made of 2 mm fine plastic mesh suspended on wooden frames were set out the canopies of eight randomly selected trees of each of the two dominant species. Sampling took place from January 1979 to April 1980. Throughout the 15 months of the experiment, the leaf litter that fell into the trays was collected at monthly intervals, dried at 70°C and stored for later Kjeldahl N-analyses \textsuperscript{1}. Samples were stored for no more than 4 wks before analysis.