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Influence of native forest cover on water yield in southern Chile: a comparative study of small watersheeds

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In this work we compare water yield in five small watersheds (surface area from 7 to 70 hectares) with different native forest cover, located in Southern Chile (39.5° Lat S). Forest covers include unmanaged second-growth forest of deciduous Nothofagus obliqua - Nothofagus nervosa ("Rsm", 7,4 ha), thinned second-growth forest of deciduous N. obliqua - N. nervosa with 35% of basal area extraction ("Rcm", 12,6 ha), altered evergreen old-growth forest dominated by Laurelia philippiana ("Tran", 7,5 ha), pristine old-growth forest of Nothofagus dombeyi ("Enc", 72,1 ha) and grassland as a control ("Prad", 12,3 ha). It is expected that differences in water yield are related mainly to differences in native forest structure, given that all watersheds have similar geomorphology and are located close to each other. We monitored daily streamflow and precipitation during four hydrological years (April 2003 through Dec 2006). Data were collected on each watershed and analyzed, first by recession curve classification, then by separating base flow and direct runoff. Subsequently, storm events were individualized, in order to isolate the effect of different antecedent soil moisture conditions. Variations in hydrograph recession curves as well as rainfall-runoff coefficients are analyzed in relation to differences in land cover type, storm magnitude and duration, antecedent soil moisture and presence of leafs. In agreement with the literature, all forested watersheds consume more water than a grassland watershed, but display a slower release of soil water storage. On the other hand, results show that managed forest basins yield more total, direct and base runoff in comparison to unmanaged watersheds. Further, unmanaged natural forests display flatter recession curves, implying a longer duration of base flow after storm events. This behavior has important implications for valuation and management of water yield, as an Ecosystem Service of native forest in Chile; it suggests that it would be possible to manage native forest-covered watersheds both for timber and water production, thereby increasing the total value obtained from these natural systems. Further research is needed in order to increase the robustness of our conclusions and to isolate the effect of the different controlling factors such as land cover, basin scale and meteorological conditions.

Keywords: Recession analysis, base flow, storm separation, forest management, ecosystem services.