Stemflow variation in Mexico's northeastern forest communities: Its contribution to soil moisture content and aquifer recharge

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Stemflow hydro-ecological importance was measured in trees and assessed in Mexico's northeast forest stands by answering three basic questions: (a) what are the intra and inter-specific stemflow variations; (b) is the stemflow coefficient constant from tree level to stand scales? and (c) what is the stemflow area and wetted soil volume in individual trees and the stemflow volume discharged at the stand scale in two plant communities of northeastern Mexico? Gross rainfall and stemflow flux measurements were conducted on 78 trees of semi-arid, sub-tropical (31 Diospyros texana; 14 Acacia rigidula; four Bumelia celastrina; five Condalia hookeri; three Cordia bioissieri; three Pithecellobium pallens) and temperate forest communities (six Pinus pseudostrobus Lindl. and 12 Quercus spp.). Stemflow was extrapolated from individual
trees to the stand scale using 98 inventory plots (1600 m2 ha_1 each) placed in oak–pine forests and 37 quadrats (5 m _ 5 m each) distributed across the Tamaulipan thornscrub forest range. Stemflow infiltration flux and infiltration area measurements assessed the wetted soil volume. Daily measurements were conducted from May of 1997 to November of 1998. Results showed that stemflow coefficients varied between plant communities since they averaged (confidence intervals, a = 0.05) 2.49% (0.57), 0.30% (0.09), and 0.77% (0.27) of the bulk precipitation for Tamaulipan thornscrub, pine, and oak forests, respectively.
Intra-specific stemflow variations could not be identified in Tamaulipan although in temperate tree species. Basal diameter explained intra-specific stemflow variation in both plant communities. Stemflow increased threefold since it accounted for by 6.38% and 2.19% of the total bulk rainfall for Tamaulipan thornscrub quadrats and temperate oak–pine inventory plots, respectively. Small shrubs growing underneath large trees, in combination with the presence of small-diameter trees that recorded the largest stemflow coefficients appear to explain the increase of the stemflow coefficient from trees to stands. Stemflow replenishes soil moisture on the average 4.5 (1.4) times larger than does incident rainfall in open soils and appear to contribute to aquifer recharge in temperate forests due to a combination of shallow soils, high infiltration fluxes and the stemflow volume generated during rainfalls with depths >15 mm. Tracing studies should be conducted to test the hypothesis of the stemflow contribution to aquifer recharge in temperate forests of northeastern Mexico.

Keywords:
Stemflow volume and coefficient
Tree and stand scales
Intra and interspecific variation
Aquifer recharge