The potential of non-vascular epiphytes in water storage in the Montane Atlantic Forest

Berro, G.B.[1*]; Ramos, R.[1]; Joly, C.A.[2]; Vieira, S.A.[3]

1.Biology Institute, University of Campinas; 2. Emeritus Professor, University of Campinas; 3. Center for Environmental Studies and Research, University of Campinas.
*gabi.berro@gmail.com

Introduction

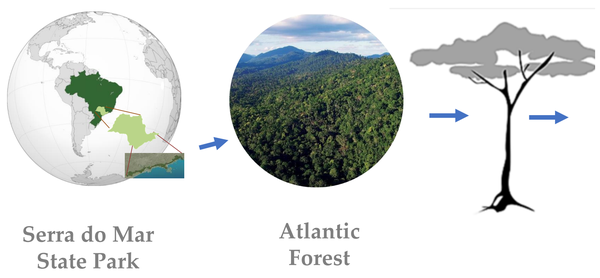
The non-vascular epiphytes play important roles for the functioning of ecosystems providing habitat for organisms and participating in nutrient cycling. They also contribute to local diversity and are good indicators of forest integrity known as biological indicators due to their sensibility to environmental conditions. The biomass of this group indirectly informs us about the water storage capacity of Montane Forest areas, since they have in their structure different arrangements for the interception of atmospheric water and thus contribute significantly to the hydrological cycles in these ecosystems.

Objective

The main objective was to evaluate the potential of non-vascular epiphytes to store water in Tropical Forests.

Methods

The study was carried out in Atlantic Forest, in Serra do Mar State Park (Núcleo Santa Virgínia), São Paulo, Brazil. We selected 5 permanent plots of 1ha each established under the BIOTA/FAPESP Functional Gradient Project: 3ha of old growth forest, 1ha subjected to selective logging and 1 ha of late succession forest. In each plot all live stems with DBH ≥ 4,8cm had their height and DBH measured and were classified according to ICE-av, an index adapted and implemented to classify stems according to trunk and branch coverage by non-vascular epiphytes.



ICE-av 0: absence of non-vascular epiphytes;

ICE-av 1: up to 25% of the trunk and branches covered by non-vascular epiphytes;

ICE-av 2: 25% to 75% of the trunk and branches covered by non-vascular epiphytes;

ICE-av 3: more than 75% of trunk and branches covered by non-vascular epiphytes.

To estimate biomass, water content and how water storage by non-vascular epiphytes varied along tree trunks we randomly selected 30 trees, 10 of which class of ICE-av and collected samplings in 4 height zones and in the 4 cardinal directions (N, S, W, E). We used height and ICE-av applied to an allometric equation to estimate non-vascular epiphyte biomass per single trunk and then summed up to estimate non-vascular epiphyte biomass per plot. Water content was estimated as 80% of the estimated biomass. We performed a Linear Mixed Model fited by REML where Water ($g.cm^{-2}$) was considered a response variable, while DBH (cm), Zone, Face, ICE-av and Disturbance were considered explanatory variables.

Results and discussion

I) Among all the phorophytes visited in the plots, almost 93% had non-vascular epiphytes.

II) Non-vascular epiphytes store large amounts of water, creating wet microhabitats along tree trunks and contributing to the system's water flows. In old growth forests they can store until 1330.7l, but in areas that suffered human disturbance, this values are lower.

Plot	Dry biomass of non-vascular epiphytes (kg/ha)	Water stored in non-vascular epiphytes (l/ha)
Old growth 1	203.24	913.46
Old growth 2	200.63	1154.98
Old growth 3	220.24	1330.75
Selective logging	179.83	530.96
Late sucession	185.97	703.84

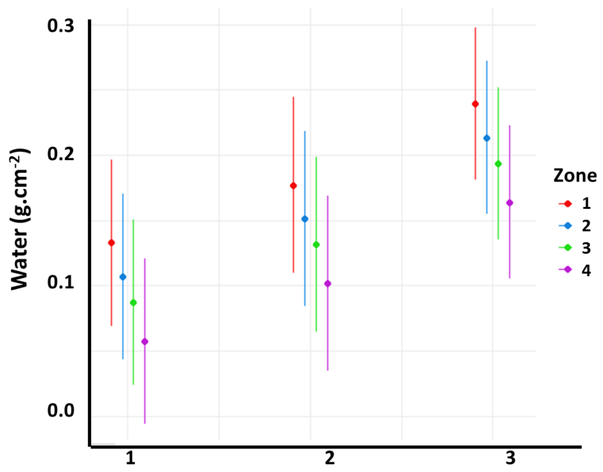
Values of dry biomass of non-vascular epiphytes (kg/ha) and of water stored in these epiphytes (l/ha) in each of the permanente plots studied.

III) The non-vascular epiphytes that occur in understory trees (4.8 to 30 cm of DBH) store approximately 50% of the total water stocked.

Class of diameter (cm)	Water stored in non-vascular epiphytes (l)
4.8 to 10	372.73
10 to 30	2191.16
30 to 50	1372.44
more than 50	696.15

Water stored in non-vascular epiphytes (l) for each diameter class (cm)

IV) According to the model only Zone and ICE-av significantly affected water storage ($p<0.5$). Water storage decreased in higher zones and increased with higher ICE- av's.



Amount of water in non-vascular epiphytes in each ICE-av class (0 to 3) and in each ecological zone of the phorophyte (1, 2, 3 and 4). Bars indicate 95% confidence interval.

Conclusions

The capacity of non-vascular epiphytes to intercept and store water is a feature that makes them essential components for the ecosystem's functioning. In a scenario of land use and climate changes, they may be the first ones to be impacted by shifts in forest structure, the increase in temperature and variation in rainfall seasonality. Those factors impact not only non-vascular epiphytes but also the entire community where they belong.