Spatial Patterns of Belowground Biomass and Productivity along two Mangrove Vegetation Landscapes in the Florida Coastal Everglades

Edward Castañeda-Moya (* 1), Victor H. Rivera-Monroy (1), Robert R. Twilley (1), Carlos Coronado-Molina (2), Sharon Ewe (3)
(1) Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA 70803
(2) South Florida Water Management District, West Palm Beach, Florida 33416-4680
(3) Department of Biological Sciences and SERC, Florida International University, Miami, Florida 33199
(*) Presenting author

Belowground production represents a significant proportion of total annual net productivity in most ecosystems. Increased root production plays an important role in ecosystem processes such as nutrient cycling, nutrient storage, soil organic matter composition, and vertical accretion. Mangrove forests in particular, may allocate a large proportion of their biomass to the belowground component, up to 40-60% of the total production. Fine roots increase nutrient cycling and availability within the soil, facilitating acquisition, rapid root turnover, and recycling. Mangrove forests in the Florida Coastal Everglades (FCE) are one of the most conspicuous vegetation communities, representing a combination of different mangrove types distributed across a carbonate environmental setting with gradients in resources, regulators, and hydroperiod. Despite their relevance, there are large information gaps on ecosystem properties such as primary productivity and nutrient cycling and on the factors regulating these processes. We pay particular attention to the belowground compartment to estimate its contribution to total net primary productivity, due to the lack of information regarding this theme in the area. Thus, the objective of this study is to evaluate the spatial and temporal patterns of belowground biomass and productivity along two FCE mangrove transects (Shark River and Taylor River Sloughs) with distinct hydroperiods and nutrient resource gradients. We tested the hypothesis that gradients in nutrient resources and hydroperiod play a role in the structure, turnover, and productivity of belowground mangrove systems.

Results and Discussion

We performed two separate field experiments (from December 2000 to December 2002 and from December 2002 to February 2006) to estimate standing crop root biomass, belowground productivity, and root distribution with depth (top: 0-45 cm and bottom: 45-90 cm) in six mangrove sites (SRS4, SRS5, SRS6, TsPh-6, TsPh-7 and TsPh-8). Six of the indicated sites were sampled: SRS-4, SRS-5, SRS-6, and TsPh-6, TsPh-7 and TsPh-8.

After cores for biomass estimation were removed, ingrowth bags of equal dimension (10.2 x 45 cm) filled with Sphagnum peat moss replaced each soil core. Ingrowth cores were allowed to incubate in situ from 5 to 24 months (experiment 1) and from 12 to 38 months (experiment 2).

Root cores were collected once at the beginning of the experiment to estimate standing crop biomass by using the sequential coring technique. Prior to separation, roots were rinsed with water through 1 mm mesh sieve to remove soil particles. Live root fractions were separated into diameter size classes of <2 mm, 2-5 mm, and >5 mm. Live roots were oven-dried at 60 ºC until constant weight.

Location of ingrowth bags in the inland section of mangrove islands.

Location of ingrowth bags in the edge section of mangrove islands.

Variation (Mean ± SE) in root biomass and distribution with depth (0-45 cm top and 45-90 cm bottom) and location (inland vs. edge) within the forest. Mean total root biomass was significantly greater in the top vs. the bottom section and in the inland vs. the edge section of the forests.

Conclusions

Our results confirm our hypothesis that mangroves under P-limited conditions such in the Taylor River sites and one upstream site in Shark River (SRS4), allocate more resources to roots when compared to the landscape site (SRS6) with the highest soil P concentrations (93 g m$^{-2}$) in the region. Root biomass and productivity are variable across the two freshwater-estuarine transects of the FCE mangroves and are influenced by gradients in resources, regulators, and hydroperiod.