Spatial and Temporal Variation of Porewater Variables in Mangrove Forests along the Shark River and Taylor Sloughs, south Florida

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Abstract

The spatial and temporal variation in porewater variables was monitored along the Shark River and Taylor Sloughs during 2001-2003. The were significant differences in sulfide concentrations and redox potential between the two regions due to differences in hydroperiod. Porewater salinity in all sites was < 40 g kg^{-1} and it is not a stress factor for mangrove tree growth and development in both regions.

Research Problem

The Everglades ecosystem in southwest Florida is a carbonate environmental setting that includes a combination of different mangrove ecological types along a freshwater-marine gradient. The structure and function of mangrove forests of two regions, the Shark River Slough (SRS) and Taylor Slough/Panhandle (TS/Ph) are regulated by a combination of gradients of resources, regulators, and hydroperiod across the coastal gradient.

The SRS TS/Ph an located in the Everglades National Park are part of a network of research sites studied by NSF-Long Term Ecological Program (LTER). Since the SRS and TS/Ph will be impacted by changes in freshwater diversion as result of the Comprehensive Everglades Restoration Plan, one of the major questions is how mangrove forests productivity and species composition will change as a result of inter-annual and long-term changes in freshwater discharge. The reserach questions we addressed in this study are how different soil biogeochemical properties are in SRS and TS/Ph and how hydrology affect these properties.

Approach

•Porewater samples were collected in Shark River (SRS-4, SRS-5, SRS-6) and Taylor (TS/Ph-6, TS/Ph-7, TS/Ph-8) Sloughs dry and wet season for the period 2001-2003.

•Measurements of porewater salinity, sulfide concentrations, porewater nutrients, and soil redox potential (Eh) were measured at each site in the dry (May) and wet season (October). Soil Eh (0, 10, and 45 cm depth) was measured in situ using a multi-depth platinum probe attached to a Digi-Sense millivolt meter and a calomel reference electrode.

•Porewater samples were collected at 30 cm depth using a plastic siphon and syringe. One sample of pore water was assayed for salinity using a portable YSI salinity/conductivity/temperature meter. A second sample was added to an equal volume of antioxidant buffer in the field, then brought to the laboratory within 12 h to be analyzed for sulfide concentrations with a ORION sulfide electrode. A third porewater sample was filtered using a GF/F filter and stored frozen until assayed for inorganic nutrients. Ammonium (NH_4^+) and orthophosphate (PO_4^{-3}) concentrations of porewater samples were determined by colorimetric methods.

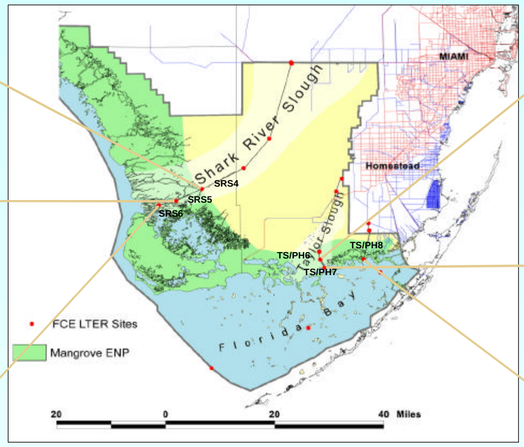
Research Questions

1. What is the spatial and temporal variation in porewater nutrient concentrations and salinity along the Shark River and Taylor Slough regions?
2. How does hydroperiod affect redox potential and sulfide concentrations?

Study Site and Sampling Stations

UPSTREAM (Up) → *DOWNSTREAM* (Down)

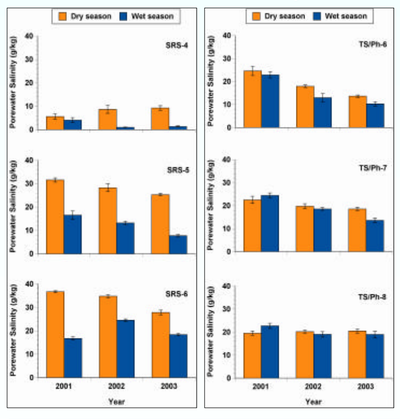
Shark River Slough



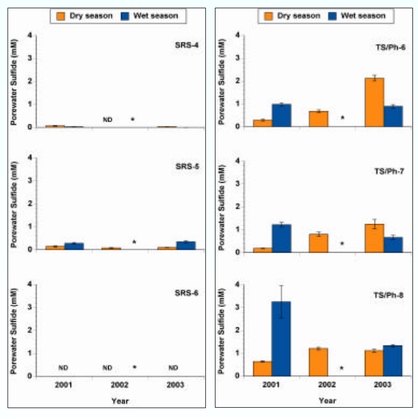
Taylor Slough

Results and Discussion

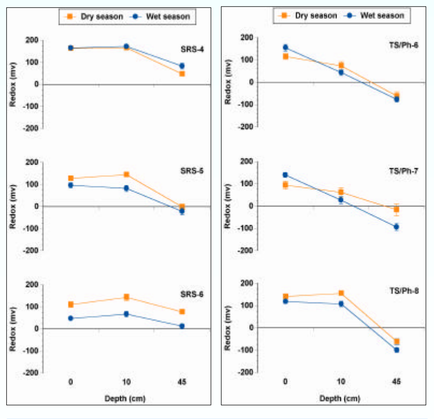
Up → Down



•Mean (± SE) porewater salinity values in all sites are <40 g kg^{-1} and do not represent a stress factor for mangrove tree growth and forest development in both regions.

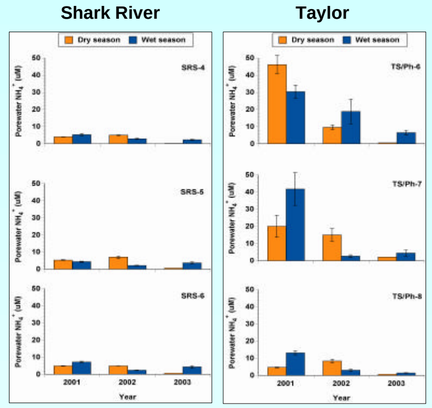


•Porewater sulfide concentrations (mean ± SE) along the Shark River sites are overall below levels of detection (ND) compared to values along the Taylor sites (range 0.1-4 mM).

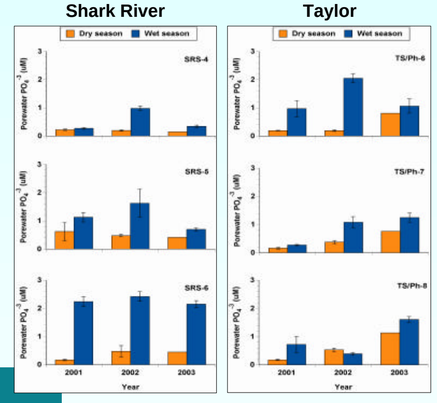


•Redox potential (mean ± SE) were positive along Shark River due to frequent tidal exchange, in contrast to longer duration of inundation in Taylor sites.

Results and Discussion (cont'd)



•Porewater NH_4^+ concentrations (mean ± SE) were on average greater in Taylor Slough than in Shark River. Maximum and minimum average NH_4^+ concentrations were measured in TS/Ph-6 (46 µM), and in SRS-6 (< 1 µM) during the dry season of 2001 and 2003, respectively.



•Porewater soluble reactive phosphorus (SRP) concentrations (mean ± SE) were similar in both areas during the dry and wet seasons. Higher concentrations were observed in SRS-6 during the wet season throughout the study period.

Conclusions

• Porewater salinity along the Shark River and Taylor sites was below levels of stress (< 60 g kg^{-1}) for mangrove forest development and growth.

• The low sulfide concentrations values along the Shark River sites contrast to higher values measured in the Taylor sites, where mangrove trees are subjected to more permanent flooding conditions. Sulfide values ranging from 1.5 to 4.0 mM are considered a stress factor for mangrove development.

• The higher soil redox potential values observed in the Shark River sites indicate the influence of daily tidal exchange in the Shark River region. This oxidized conditions result in low sulfide concentrations (<0.3 mM) in all sites.

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