An innovative approach for monitoring abiotic factors influencing mangrove forest biodiversity in an estuarine ecosystem

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1 Introduction

The UN's Millennium Ecosystem Assessment (2005) targeted coastal wetlands as environments that “are experiencing some of the most rapid degradation and loss worldwide”.

Mangrove wetlands are important because they provide a buffer, protecting vulnerable coastal and marine ecosystems from rising sea levels and storm tides (Ewel et al., 1998).

In Trinidad West Indies, land-use changes and sea defenses impact water quality and alter mangrove forest distribution and biodiversity.

This research therefore investigates the abiotic water quality factors influencing mangrove zonation along the South Oropouche River, Godineau Swamp.

2 Methodology

An innovative measurement campaign using conventional sensors and high spatial resolution geophysical imaging was adopted to monitor the river water quality and salinity patterns. Seasonally at high tide, measurements were obtained from two river channels, a 6km larger main channel and a 2km shorter side channel (Fig. 1).

•Electromagnetic Induction (boat-mounted geophysical imaging) was used to spatially map the salinity of the water non-invasively (Plate 1). River water was spatially tested in situ for pH, dissolve oxygen (DO), conductivity, temperature and turbidity using a U-10 multi parameter water quality checker (Plate 2).

•Aerial photos were analyzed using GIS for the years 1962 and 2003 to determine mangrove boundary change (Fig. 2). Species abundance was identified using transects at 5m intervals along both sides of the river banks. Data analysis included geostatistics with SGEMS, graphs and GIS.

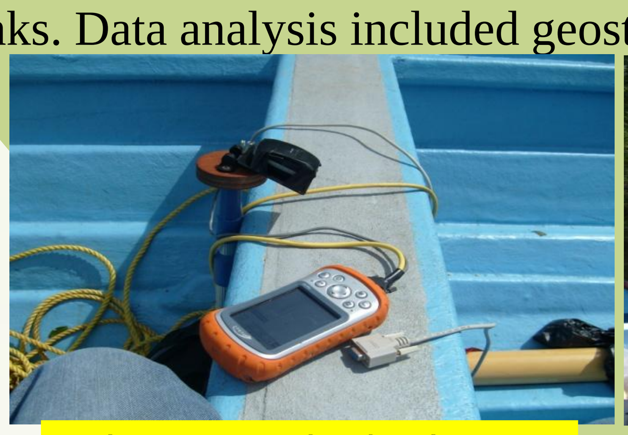


Plate 1. Boat-mounted geophysical imaging

Plate 2. U-10 Water Quality Checker

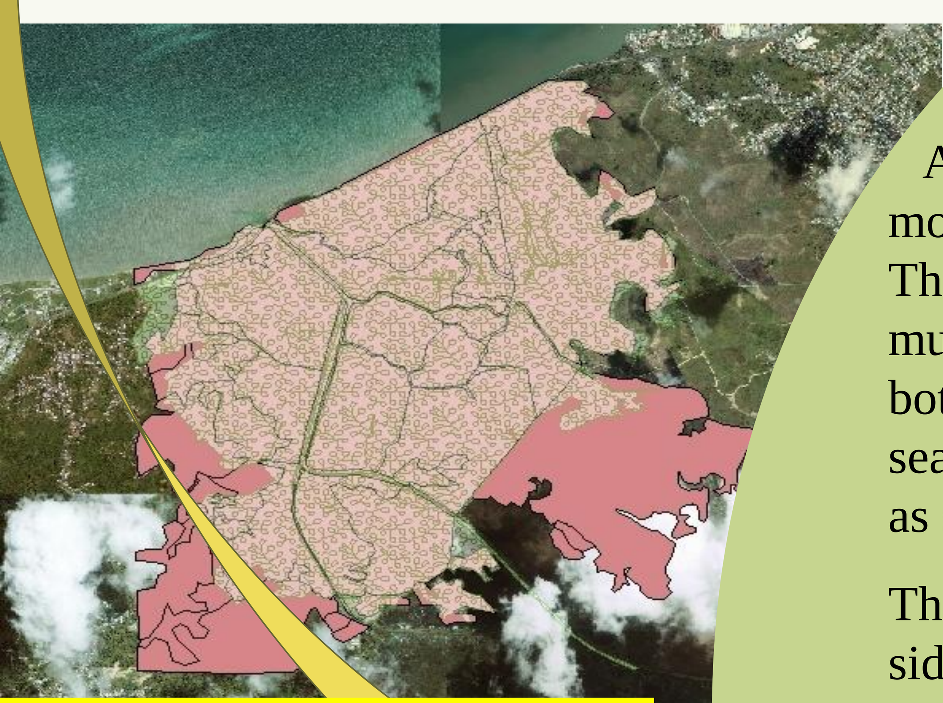


Fig.2: Aerial extent of mangrove boundary for the years 1962 (pink) and 2003 (pattern)

3 Results

Aerial photos (Fig.2) showed an overall decrease of more than 10% in mangrove extent from 1962- 2003. The apparent electrical conductivity (ECa) levels were much lower in the main channel than in the side channel both in the wet and dry season (Fig. 1). In the dry season, however, saline water intrusion was very evident as salt water moved further inland (Fig. 1b).

The pH and DO levels showed a marked decrease in the side channel than in the main channel of the river (Figs. 3-6). *Rhizophora mangle* L. (red) as opposed to *Avicennia germinans* (black) and *Laguncularia racemosa* (white) was found under adverse water quality conditions of low DO, pH levels and high levels of salinity (Figs. 3-6).

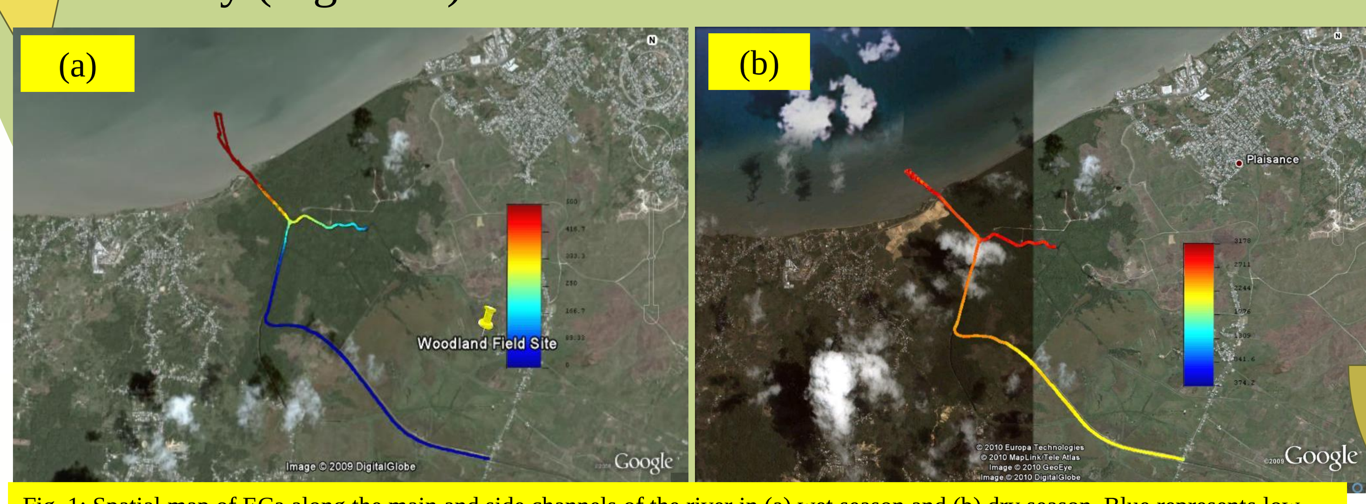
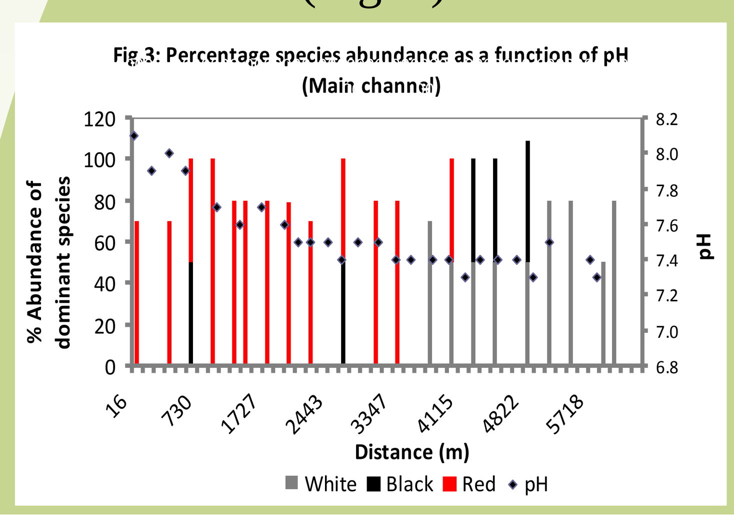
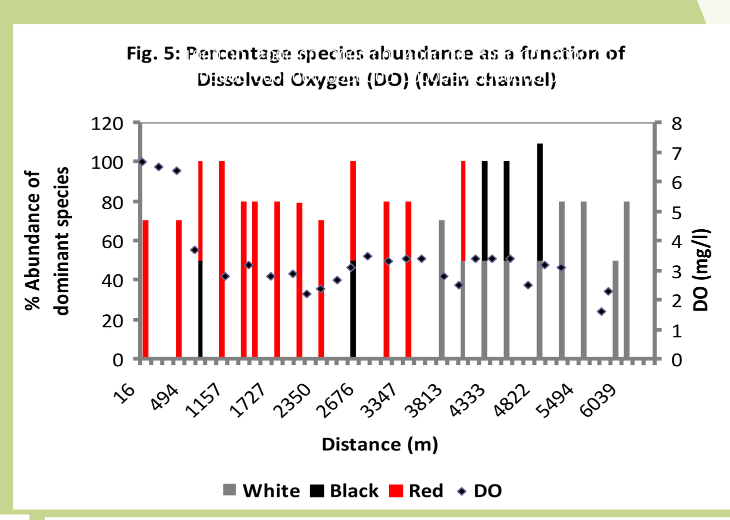


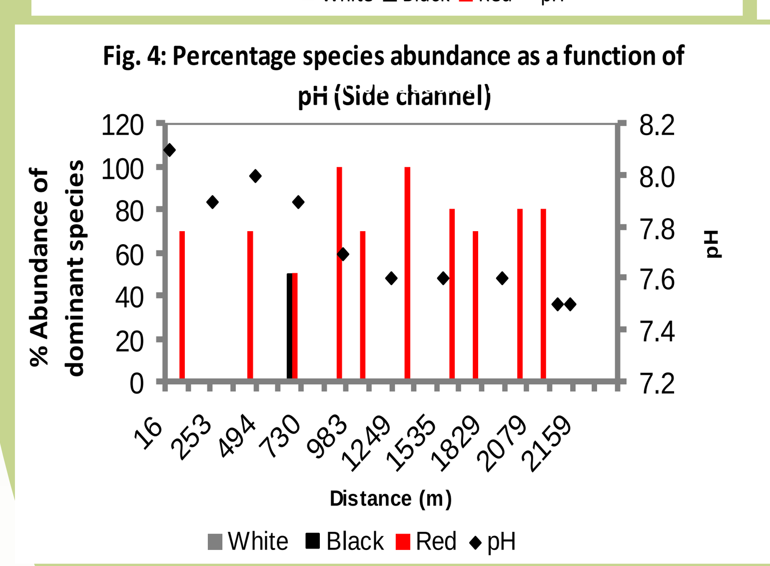
Fig. 1: Spatial map of ECa along the main and side channels of the river in (a) wet season and (b) dry season. Blue represents low salinity while red represents high salinity.

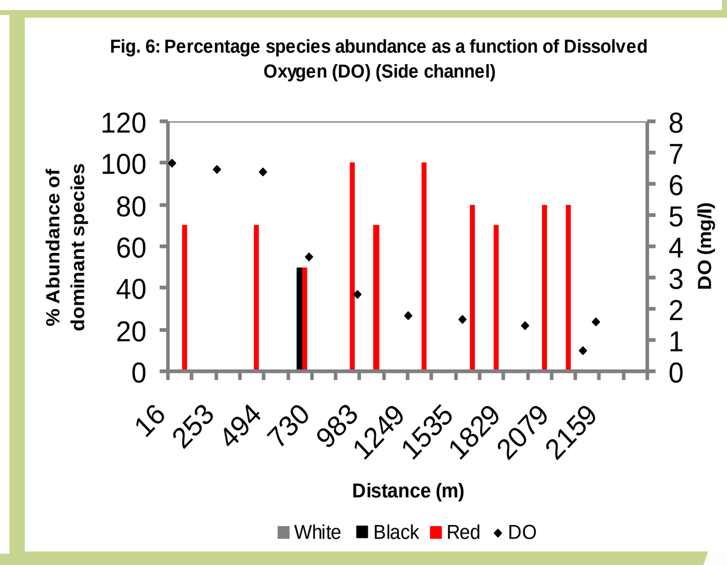
4 Discussion

Our results showed a significant decrease in mangrove species diversity as adverse water quality conditions prevailed. This is partly due to saline water intrusion particularly in the dry season, which takes place with increased tidal inundation extending as far as 6km upstream (Fig. 1).









This adverse water quality may also be due to low levels of pH and DO in the stagnant side channel as a result of decomposition of organic matter and run-off from acidified mangrove soils (Figs. 4 and 6). In the side channel where adverse water quality conditions were prevalent, only the red mangrove predominates, indicating a loss of mangrove species diversity.

5 Summary & Conclusion

Rhizophora mangle (red), *Avicennia germinans* (black) and *Laguncularia racemosa* (white) species of mangroves were identified along the river banks. The red mangroves thrived in areas of adverse water quality conditions and indeed are the hardiest of the three species.

Salinity and water quality parameters play a major role in determining mangrove species diversity in a tropical estuarine ecosystem.

The novel use of boat-mounted geophysical imaging has therefore proven to be a useful tool in determining saline water intrusion and in the characterization of spatial and temporal patterns of the abiotic factors affecting mangrove zonation pattern.

* References

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