ISSN 1880-7682
Volume 7, No. 3 **August 2009**

ISME/GLOMIS Electronic Journal

An electronic journal dedicated to enhance public awareness on the environmental importance of mangroves

Preliminary analysis of soil properties of an eroding mangrove shore in Selangor, Malaysia

Background

Mangrove shores are stable, accreting or eroding (Chan & Baba, 2009). An accreting mangrove shore typically has a low crop of *Avicennia* trees colonizing newly formed mud flats. An eroding shore is characterised by the general lowering of the near-shore profile, formation of retreating scarps due to scouring of mangrove substrate, collapsing of mangrove trees, and deposition of shell fragments. The lowering of the shore profile leads to the stronger wave actions which accelerate the rate of erosion. In Malaysia, a national coastal erosion study was conducted to assess the severity of coastal erosion, to map the locations of eroding shores, and to recommend remedial measures (EPU, 1986).

The physiochemical characteristics of soils such as salinity, pH, aggregates, etc. are closely related to mangrove forest productivity (McKee & McGinnis, 2002). Thus, changes in soil characteristics may affect the growth and stability of mangrove forests. In this study, the soil properties of an eroding mangrove shore are analyzed.

Methodology

The study site was located adjacent to D'Muara Resort, Kampung Sungai Haji Dorani (3° 38' N, 101° 01' E), about 5 km from Sungai Besar in Selangor. Annual rainfall, diurnal temperature and relative humidity are ~130 mm, 24–32°C, and 70–95%, respectively.

A 150 m transect was established. Soil samples were taken every 50 m to determine bulk density, chemical composition, and pH. Three soil cores (0-10 cm) were collected. Soil samples for chemical analysis were collected by augering at 20 cm depth.

Soil pH was determined by pH electrode. Percentage of carbon and nitrogen were determined using the Walkley & Black, and Kjeldahl digestion methods, respectively. Electrical conductivity was measured using a conductivity meter (Metler Toledo).

Results and discussion

The eroding mangrove shore was dominated by sparsely distributed *Avicennia* trees. In an area of 1.2 ha, mortality of trees was almost 60%. The high rate of mortality was partly due to crown die-back which led to defoliation (Fig. 1a). Trees at the foreshore were uprooted (Fig. 1b) due to the formation of retreating scarps (Fig. 1c). Deposition of shell fragments on the soil surface was 0.5–3 cm thick (Fig. 1d). Patches of these shell fragments are mobile, highly abrasive, and can cause trees to die (Chan & Baba, 2009).

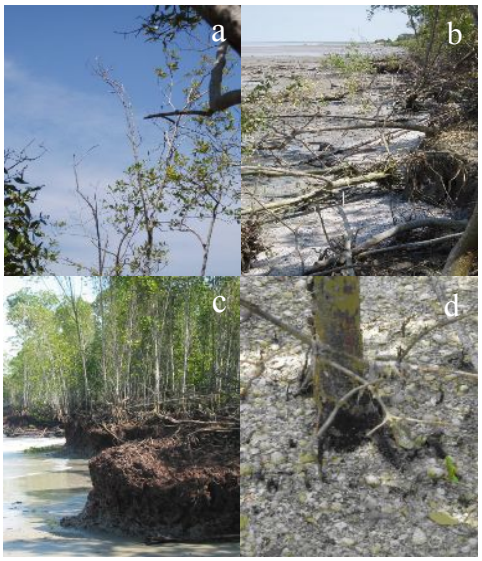

Fig. 1. Mangrove crown die-back (a), uprooting of trees (b), formation of retreating scarps (c), and deposition of shell fragments (d)

Tree mortality could be related to salinity and water percolation. Although, *Avicennia* species were known to be salt tolerant, the threshold level remains unclear. Salinity level of about 12 mS/cm (Table 1) was considered high. In an adjacent mangrove area with normal growth of *Avicennia*, soil salinity was found to be 9.4 mS/cm. pH of the soil was near neutral due to the dynamic water percolation in the soil which is influenced by tides. Salinity in excess of 4 mS/cm has been reported to be detrimental to plant growth (Brady & Weil, 1998). Salinity is also known to cause low water permeability for roots, ion toxicity, drought stress, and non-availability of nutrients (Flower & Imbert, 2006). This may explain the low levels of contents of soil moisture, carbon and nitrogen in the area.

Table 1. Some soil properties of mangrove forest of the study area

Soil parameter	Values
pH	7.7 ± 0.02
Bulk density (g/cm^3)	0.80 ± 0.05
Electrical conductivity (mS/cm)	12 ± 0.12
Carbon content (%)	1.4 ± 0.01
Nitrogen content (%)	0.11 ± 0.01
Moisture content (%)	45 ± 7.9

McKee and McGinnis (2002) have reported the adverse effects of shell and calcareous chip deposition. These sediments gradually covered aerial roots and pneumatophores, blocking aeration which deterred growth of the trees. Based on hydrodynamic data, the area experiences high intensity wave actions (Jeyanny *et al*., 2008) and this may have led to the severe shore erosion, tree uprooting, and soil inconsistency which adversely affected the growth of mangrove vegetation.

Acknowledgements

The authors are grateful to the Project on Mangrove Rehabilitation of Coastal Shoreline of FRIM for financial support.

References

Brady, N.C. & Weil, R.R., 2008. *The Nature and Properties of Soils* (14th Edition). Prentice Hall, Upper Saddle River, New Jersey, 960 pp.

Chan, H.T. & Baba, S., 2009. *Manual on Guidelines for Rehabilitation of Coastal Forests damaged by Natural Hazards in the Asia-Pacific Region.* ISME and ITTO publication, 66 pp.

EPU, 1986. *National Coastal Erosion Study – Final Report.* Report of the Economic Planning Unit of the Prime Minister's Department Malaysia.

Flower, J.M. & Imbert, D., 2006. Recovery deficiency following tree mortality in mangroves of two Caribbean islands: field survey and statistical classification. *Wetlands Ecology & Management* 14: 185–199.

Jeyanny, V., Suhaimi W.C., Adzmi, Y. & Wan Rasidah, K., 2008. Soil monitoring in the coastal rehabilitation area in Kuala Selangor. In: *Proceedings of Soils 2008 Conference.* Malaysian Society of Soil Science, Ipoh, p. 35–39.

McKee, K.L. & McGinnis, T.E., 2002. *Hurricane Mitch: Effects on Mangrove Soil Characteristics and Root Contributions to Soil Stabilization.* USGS Open File Report 03-178, 57 pp.

Jeyanny, V., Suhaimi, W.C., Wan Rasidah, K., Adi, F. & Azian, M.

Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia

E-mail: jeyanny@frim.gov.my