Ecophysiology of mangrove seedlings: Responses to Waterlogging, Salinity, Light and Nutrient Enrichment

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Although flooding and salinity variations occur commonly in mangrove systems, their frequency and severity have, however, been increasing with increased global warming (GW) to an extent that GW induced phenomenon such as heavy rainfall and subsequent floods, increased terrestrial runoff, and sea level rise are frequently associated with massive mangrove mortality and/or failure to regenerate. Manipulative mesocosm experiments were therefore set to assess the interactive stress effects of mimicked waterlogging/submergence, salinity, light and nutrient enrichment on growth and photosynthesis of seedlings of the mangroves Avicennia marina (Forssk.) Vierh., Bruguiera gymnorrhiza (L.) Lamarck and Heritiera littoralis Dryand. Three main experiments were conducted: (i) interactive effect of waterlogging, salinity and light, (ii) interactive effect of waterlogging, salinity and nutrient enrichment and (iii) underwater photosynthesis in varied salinities. Growth was assessed through structural and biomass traits, and photosynthesis through assessment of photosynthetic yield and leaf chlorophyll content. It was found that H. littoralis growth was drastically suppressed and its photosynthetic yield significantly declined during prolonged waterlogging and submergence, increased salinity, and when shifted from shade to light. Comparably, B. gymnorrhiza seedlings maintained high tolerance across the variably interactive stresses than A marina and H. littoralis. Nutrient enrichment did not provide enhancing effect to override the stressful conditions of waterlogging and elevated salinities. The varying ability of B. gymnorrhiza and A. marina to acclimatisation and the inability of H. littoralis to withstand the stresses suggest possible disruptions in mangrove forests regeneration in conditions of prolonged inundations due to flooding or sea-level rise. Results of the present study demonstrated that climate change driven environmental conditions may influence the performance of seedlings. They are useful in explaining the phenomenon of retarded natural regeneration in mangrove stands in major river estuaries of the region following flooding events, like that of 1997/98 El Nino. They are also useful in guiding management decisions on mitigation and adaptive mangrove restoration and management especially where reforestation and afforestation may be necessary.