MANGROVES AND COASTAL PROTECTION IN GUYANA

Ecology and distribution

The coastal mangrove vegetation of Guyana is almost exclusively composed of Black mangrove, *Avicennia germinans* (“courida"). The tree seedlings have the ability to establish themselves quickly on rapidly accreting shores, where mud has been deposited in sufficient quantity to raise the flats above the water level at low tide. Moreover, the rapid development of an extensive, shallow, lateral root system allows *Avicennia to* adjust to rapid sedimentation, such as occurring locally along the coast of Guyana. Colonisation of the beach by *Avicennia* can be observed near Mon Chosi, where both young trees and many rooting propagules are met on the shore.

The White mangrove, *Laguncularia racemosa,* prefers more sandy soils, such as found between the localities Brahan and No. 40, where a mangrove vegetation composed of *Avicennia* and *Laguncularia* has invaded an ancient coconut palm plantation, established in the past on the sandy coastal ridges. *Avicennia* and *Laguncularia* can grow on dry soils for some time, whereas *Rhizophora* (Red mangrove) requires regular flooding. Moreover, *Avicennia* trees, if established on clay soil, can survive under hypersaline conditions. However, if hypersaline conditions persist over a longer period, the trees eventually will die.

Avicennia dominates the coastal mangrove vegetation of Guyana*,* whereas *Rhizophora is* virtually absent. Although tolerance for high salinities is less in *Rhizophora* than in *Avicennia,* salinities along the coast of Guyana are not so high as to exclude colonisation of the seashore by *Rhizophora* and therefore can not be responsible for its absence. The special nature of the muddy substrate, which is so little consolidated that it can be fluidised by wave action to a certain depth, would favour the establishment of *Avicennia* (Black mangrove) seedlings over those of *Rhizophora* (Red mangrove).

The mangrove species *Conocarpus erecta* is usually met inland, on higher grounds, at the transition between the mangrove vegetation and the terrestrial vegetation. Noteworthy is its occurrence at the edge of the beach, near the Trafalgar pumping station. In this area subject to recent erosion, remains of drowned *Avicennia* trees can be observed seaward from the zone with C. *erecta.*

Vegetation succession and coastal processes

The dynamics of the mangrove vegetation are closely linked to the geomorphology of the coast. Any attempt to explain the development of mangrove communities through time requires an evaluation of changes in magnitude and frequency of coastal geomorphic processes. These processes create variable environmental conditions, which determine colonisation by mangrove trees, their reproduction and growth.

The succession of the coastal vegetation of Guyana is closely related to the cyclic alternation of accretion and erosion processes along the coast. Accretion of the coast involves both an increase in height and increase in area. The increase in area of the tidal swamp is the main land-reclaiming agency. Change in the height of the swamp bottom will affect the frequency of inundation by the tides and therefore the accretion rate. As the tidal swamp increases in height, the accretion rate will first accelerate with the increasing plant cover and the succession of smaller species by more bushy vegetation, but will decrease when inundation by the tides becomes infrequent. With increasing height of the marsh, species composition will change, for the different succession stages of the vegetation are strongly related to the sedimentation process.

When a mangrove swamp becomes fenced off from tidal influence as a result of changes in coastal morphology or manmade structures, the mangrove forest eventually will die, due to hypersalinity and/or impeded drainage. In the hypersaline environment, salt pans will develop with a halophytic herb vegetation composed of Saltwort *(Batis maritima)* and Sea purslane *(Sesuvium portulacastrum).* When as a result of coastal erosion tidal flushing of the area is restored, *Avicennia* and *Languncularia* may start to regenerate and the herb vegetation is replaced by mangrove vegetation.

Present status of mangrove forests in Guyana

In the recent past, almost the entire coast of Guyana was covered with mangrove formations, dominated by *Avicennia germinans,* locally known as "courida". Tree cutting for construction and fuel wood has contributed to the degradation of the forest. Moreover, in several places along the Guyana coast, the mangrove vegetation has been affected by the construction of sea defence structures fencing off the mangrove area from flushing by the tides. When tidal flushing of the mangrove vegetation is impeded, hypersalinity of the soil and/or water eventually causes the trees to die. Also, prolonged inundation of their pneumatophores (“air roots") by standing water, poor in oxygen, may cause the death of the mangrove trees.

Freshwater input from streams to the coastal mangrove area has been severely reduced by the construction of the façade drain, running parallel to the coastline, which diverts fresh water to only a few coastal outlets. The lack of freshwater supply to the mangrove vegetation in places, where flushing by the tides has become less frequent (accretion coast), may result in hypersaline conditions. Hypersalinity might reduce the ability of the trees to withstand other stress factors. Once a particular stretch of coast is subject again to erosion, the weakened mangrove trees will be more easily uprooted by the waves.

Mangroves as a natural sea defence

Mangrove vegetation provides not only a natural protection of the coastline, but also may play a role in protecting the more inland located manmade sea defence structures. A belt of mangrove vegetation dampens the wave action and therefore may protect manmade sea defence structures from the direct impact of the waves.

Vegetation colonising the tidal zone prevents or reduces the erosion of the shore through three main processes:

- dissipation of wave and current energy;
- trapping of sediments in suspension by the root systems of mangrove trees and other pioneer species colonising the tidal zone, thus accelerating the sedimentation process;
- stabilisation of the substrate by the plant roots.

The seedlings of Black mangrove, *Avicennia germinans,* have the ability to establish themselves rapidly on accreting shores in places, where mud has been deposited in sufficient quantity to raise the flats above the water level at low tide. The extensive, shallow, lateral root system of the Black mangrove contributes to the stabilisation of the shore substrate and accelerates the sedimentation process by trapping sediments in suspension. The grass *Spartina brasiliensis,* locally met seaward from the mangrove vegetation, is very well adapted to colonise the lower parts of the mud flats, which are longer submerged by the tides. Its extensive root system stabilises the substrate and the trapping of mud particles by the grass cover results in a gradual rise of the mud flat to a level sufficiently high for colonisation by the mangrove trees.

At those sites along the coast, where coastal protection is needed at short term, the erosive forces not only impede the spontaneous establishment of a mangrove forest, but would also be the limiting factor for mangrove afforestation. In those places, where coastal erosion is severe, mangrove vegetation will not establish itself along the coastline and a manmade sea defence seems to be the only option for coastal protection. In places, where accretion of the coast is currently taking place and therefore coastal protection measures are less urgent, spontaneous colonisation by mangrove vegetation is rapid.

Protection and management of mangrove vegetation

The mangrove formations of the coast of Guyana are of considerable value not only as a wildlife habitat and as a nursery area for important coastal fishery resources, but also for their function as a natural sea defence. Therefore, the mangrove vegetation should be protected from cutting and destruction, both for its value as an important wildlife habitat and for its value as a protection of the man made sea defence structures.

Although legally the mangrove forests are not protected as a forestry resource, they could be assigned a protective status for being located on state owned land. Moreover, according to the Sea Defence Act, the mangrove formation can be considered a sea defence and, as such, no living and non-living matter can be removed from the mangrove area, unless authorised by the Sea Defence Board.

Not only should wood cutting in the mangrove area be prohibited, but also interventions should be avoided, which could bring about such changes in the physical environment that the ecological requirements for mangrove growth are no longer met. More in particular any activity, which causes a long-lasting inundation of the mangrove roots by hypersaline or stagnant water, will be detrimental to the mangrove vegetation.

The successful establishment of mangrove vegetation depends on many parameters. Therefore, colonisation of the coast by mangroves should depend rather on selective natural forces than on planting of seedlings in places presently devoid of vegetation, where physical conditions for optimal growth of mangrove trees seemed to be lacking.

Monitoring of coastal vegetation

The occurrence of young *Avicennia* trees and rooting propagules along the shoreline is an excellent indicator of land accretion in process, for *Avicennia* represents usually the most seaward belt of the mangrove formation along the coast of the Guyanas. Also the presence of the grass *Spartina brasiliensis* reflects coastal accretion, for it tends to colonise mud flats emerging above mean sea level. However, the presence of *Conocarpus erecta* along the beach, as observed near the Trafalgar pumping station, is a sign of severe beach erosion, for usually this species is met at the transition of mangrove swamp vegetation and terrestrial vegetation and then represents the most land inward mangrove zone.

In view of the importance of mangrove vegetation for coastal protection, parameters should be monitored, which provide information on the development of the coastal vegetation. In this respect, important parameters are:

- composition and status of the mangrove vegetation;
- area occupied by mangrove vegetation.

(i) *Composition of mangrove vegetation*

Important baseline data can be obtained, concerning the status and composition of the mangrove vegetation by means of surveys along transects through the mangrove vegetation at representative sites. During the surveys, information would be collected on species composition (main species only), status (presence of rooting propagules, young trees, dead trees etc.) and zonation of the vegetation along these transects perpendicular to the coast.

(ii) *Monitoring of increase /decrease in mangrove area*

The only way to assess the increase or decrease in mangrove area seems to be by means of aerial photographs of the coastal fringe. These photographs, if taken at regular time intervals, would allow to monitor not only changes in the extension of the mangrove vegetation, but also changes in the coastal morphology, which have a strong impact on the development of the mangrove vegetation.

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Georgetown, 5 February 2004