SITE PLANNING AND ARCHITECTURAL DESIGN CONSIDERATIONS OF RESORTS IN MANGROVE FORESTS

Ismail Said
Department of Landscape Architecture, Faculty of Built Environment,
Universiti Teknologi Malaysia, 81310, Sekudai, Johor Bahru, Malaysia.
e-mail: b-ismail@utm.my
fax: 006075566155

Muhammad Ali A. Rahman
Department of Urban and Regional Planning
Kulliyyah of Architecture and Environmental Design
International Islamic University Malaysia, Gombak, Kuala Lumpur

This paper is published in Proceedings CASLE 2000, Expanding Relevance & Enhancing Possibilities in a Knowledge-based Economy, June 21-21, 2000, Kuala Lumpur, Malaysia.

ABSTRACT

The mangrove forest is a coastal wetland ecosystem dominated by halophytic vegetation growing in brackish or saline waters. This complex ecosystem is formed by the integration of a variety of plant and animal communities, living either as aquatic or terrestrial life. It is among the highest biodiversity ecosystems on the planet with net primary productivity of 2000 $gC/m^2/yr$. The survival of living organisms (plants and animals) is directly influenced by physical and climatic factors that become the limiting factors for their growth. The forest also supports the human community that depends on the plants and animals for sustenance. Modification of the limiting factors would result in detrimental effects to the mangrove forest ecosystem. The rustic and soothing ambience of the forest is a resourceful setting for ecotourism. It can accommodate resort development when proper site planning and small-scale architecture are introduced into the ecosystem. Proper site planning means the building layout should minimize the modification of the physical and climatic factors as well as sensitive to visitors needs and local people culture values. The architecture should be low-rise buildings inserted among the tree stands and spread throughout the site rather than concentrated in small areas. All architecture should be raised on stilts and fully or partially ventilated so that visitors could experience and feel the real ambience of the mangrove forest setting.

KEYWORDS
Resort architecture, Site planning, Mangrove forests, Ecosystem, Sustainability.

INTRODUCTION

Mangrove forests in Malaysia are complex estuarine ecosystems that offer plenty of opportunities for ecotourism. Some 641,000 hectares of such forests occupy the part of coastal Peninsular Malaysia, Sarawak and Sabah. In managing the forests, the government has categorized it into two types, namely, forest reserve and state land mangrove reserve. Of these total areas, 445,802 hectares (70%) has been gazetted as forest reserve while the rest of 30% are state land mangrove forests. Since time immemorial, man has depended on the forest for many economic reasons including the supply of timber, the support of commercial fishing and prawn fisheries, the protection of the coastline from erosion, and providing 50 different products of use to local inhabitants (Malaysian Wetland Dictionary, 1987). Tourism has expanded to all landscape resources in this country including the estuarine habitat where one can experience a high biodiversity biome of halophytic vegetation and animals. Experiencing the forest environment will draw nature-loving tourists to the physical, biotic and climatic

factors of the forest. In addition, local human population of the forest could be of interest to tourists who would see and experience these lifestyles. There are several areas of mangroves in Malaysia have been developed into resorts to cater to ecotourism activities. These areas include Marang in Terengganu, Langkawi Islands, Matang Mangrove Forest Reserve in Perak, Kuala Selangor Forest Reserve in Selangor and several forest areas on the eastern coast of Sabah.

Although ecotourism is defined as human activity that does not denigrate the landscape resource, and is biocentric rather than homocentric in philosophy, detrimental effects to the sensitive ecosystem do exist. In principle, ecotourism is concerned about avoiding damage to the environment wherever possible and ensuring that any unavoidable damage is repaired (WWF Malaysia, 1998). Intrusion of man-made features such as buildings, roads and bridges into the tidal habitat have caused some degree of modification to the vegetation, wildlife and hydrology and soil structure. Without doubt, ecotourism bring economic revenue to the nation, and mangrove forests should be understood as a one of the natural resources that can be used as a recreational amenity. Often, resort developments in Malaysia destroyed the ambience of the natural setting, which is the essence of visiting the place (Ismail, 1999). How much intrusion and modification of the physical and biotic resources of the ecosystem is allowed when resorts are constructed in the forest? Can architecture be inserted, rather than intruded, into the forest to minimize the detrimental effects? What are the preferred construction methods for building and infrastructure that will limit the damage to the ecosystem within the tolerance range of plants and animals? How might resorts contribute to the social well being of the local human community living in the estuarine wetland? These are questions that developers, economists, planners, architects and landscape architects should think about before and during the development of resorts in order to sustain the mangrove forests and their human and animal communities. This article discusses the issue of incorporating ecotourism resorts into the pristine mangrove ecosystem through the following steps; (i) defining the ecosystem of the mangrove forests, (ii) the site planning of resort, (iii) the method of building construction, and (iv) a resort management that is responsive to local the human community. A successful ecoresort, Marang Resort and Safaris in Terengganu, is used as case study for this article.

THE ECOSYSTEM OF MANGROVE FORESTS

Understanding mangrove forest characteristics is essential to recognizing the potentials and constraints that the resource can offer for ecotourism. The discussion focuses on the relationships between two limiting factors, physical and climatic, with the biotic, namely, plants and animals.

Mangroves thrive in the intertidal coastlines (Yap, 1991) and estuaries, inundated by seawater. These are the habitat of a variety of salt-tolerant halophytes growing in brackish or saline waters on hydric soils. The plant communities support a variety of animals including aquatic, terrestrial and arboreal, that reside permanently or temporaryly in the wetland ecosystem. The plants have adapted to the frequent inundation by seawater and saline environment through several features including root systems, propagation methods and leaf structures.

The soil of the mangrove swamps is often unstable as well as anaerobic (Mastaller, 1997) but the tidal fluctuations constantly supply nutrients for the vegetation. To counteract the tidal fluctuations and unstable soil, the mangrove trees adapted eight types of root systems for support, respiration and the extraction of freshwater. On order of abundance, the root systems

include stilt, aerial, pneumatophores, cable plank, knee, simple buttress, creeping root and flute buttress. With the dense tree stands, these roots form an idyllic maze with meandering rivers and rivulets that can be explored on boats and viewed from decks or buildings. The Malaysian mangroves are composed of principle and subsidiary tree species growing on sandy and muddy tidal flats, estuaries, brackish watercourses and creeks and coral-terraces at tide levels (Othman, 1995). The principle species that dominate the wetland landscape are *Rhizophora, Avicennia, Bruguiera,* and *Sonneratia* with 20 subsidiary species such as *Hibsicus* and *Heritieria*. The *Rhizophora* developed stilt roots that grow radial from the stem, providing stability in all directions. It also produces prop roots that function as additional support and as a respiration organ in the saline environment. Other species including *Avicennia* and *Sonneratia* possessed long cable roots with pneumatophores protruding vertically through the soil. These are breathing roots that also conduct reverse osmosis process, extracting salt and absorbing freshwater from the saline environment. They contain many small breathing pores called lenticels to allow oxygen to diffuse into the plant. The lenticels are highly susceptible to clogging by crude oil and other pollutants and attacks by parasites.

To produce successfully, the mangroves developed various strategies including a synchronizing flowering period with fragrance and nectar that invite pollinating insects such as bees and sunbirds. Some species of *Sonneratia* and *Bruguiera* adapted their flower structure by forming heavy flower cups with stout sepals allowing birds and bats to extract the nectar and thus assisting the pollination process. But the most successful reproductive strategies developed by *Rhizophora* are through vivipary method. In viviparous species the seed germinates whilst it is still attached to the mother tree so that each dispersed seedling is already well developed and can take root quickly when fallen on the soft sediment. Thus it has a better chance to survive in an environment of fluctuating tides.

Mangrove trees are prolific leaf producers and can produce up to 20 tons of leaf litter per hectare per year (Mastaller, 1997). To protect their leaves from micro-organisms, insects and herbivorous mammals, mangroves have developed chemical mechanisms such as toxic substances in the leaves. Others developed anatomical means such as thick waxy leaves to defend against insect and fungal infestations as well as being distinctly unpalatable to most grazing animals (Mastaller, 1997). But this mechanism does not deter the proboscis monkeys from consuming the *Sonneratia* leaves in the swamps of Sarawak and Sabah. They have large stomach equipped with fermentation chambers for digestion which facilitated by special bacteria. What fascinates us is not the intestinal tract but their grotesque, oversized nose that functions as sexual display and voice amplifier (Mastaller, 1997). They live in a group and shriek loudly at each other when settling down for the night.

When the leaves fall to the sediment they are biologically decomposed by bacteria and lower fungi, and form a grey slimy film on the leaf surface which provides a vital source of protein for many organisms including fish, crabs, shrimp, and many small bottom-dwelling animals. Other micro-organisms among the primary producers living in this wetland waters are algae and diatoms. These organisms inhabit on pneumatophores, prop roots and stilt roots of the mangrove trees that invite consumers such as fish, gastropods, molluscs and crustaceans to share the habitat, receiving nutrition and shelter from predators.

The plant community supports two types of wildlife, (i) aquatic such as fish, crustaceans, molluscs, snakes and crocodiles, and (ii) terrestrial and arboreal animals including insects, spiders, birds, lizards, primates, otters, cats and wild boars. Many of the animals found in the

mangroves are temporary visitors, using this habitat as a spawning or nursery ground, a feeding place or a stopover (Mastaller, 1997). Some of them such as monkeys, bats, passerine birds and insects move into the mangroves from terrestrial fringes only for short periods, usually in response to seasonal flowering or fruiting of the trees (Mastaller, 1997). The dependence of the animals upon the plants and climatic factors results to a highly productive ecosystem, about 2000 $g/m^2/yr$, higher than either the adjacent fresh or marine waters (Bush, 1997). A prominent example of the ecosystem is the estuary of Kinabatangan River, which is the largest estuary with mangroves in Sabah. It is the home for many wildlife including proboscis monkeys, orangutan, elephant, flat-headed cat, oriental darter, eight species of hornbill, many waterbirds, estuarine crocodile and fisheries. The estuary has great tourism potential and is attracting large numbers of local and foreign tourists (WWF Malaysia, 1999). Another example is Kuantan River mangroves in Kuala Selangor, which is the habitat of many animals notably the fireflies, the genus *Pteroptyx*, which have become the main attraction of the place.

The dynamism of the wetland habitat is directly influenced by the physical-biotic and climatic factors. The physical-biotic factors that influence the planning and design of structures in the forest are water, soil, vegetation and wildlife. Water in the mangrove ecosystem determines the existence of life in the estuary. Daily fluctuation of water levels by tide and current, and fresh water from the river constantly nourishes the aquatic plants and animals by supplying nutrients to micro-organisms. The nutrients are also derived from forest detritus, consisting of leaves and branches from the mangroves. The organisms are plankton and benthic algae, the primary producer of the aquatic food chain, supporting varieties of neustons, nektons and benthos. The larger aquatic animals become food for higher trophic levels animals, either in the water or on land and in the trees. Thus intervention of the ecosystem must not impede the flow of tides into the plant and animal habitats. Water diversion structures, such as channels, ditches and levees alter the hydrology of the wetland. Such structures should be limited to minimize hydrologic alteration in the ecosystem.

The interweaving structure of stilt roots not only supports the tree but offer refuge for juvenile fish, crabs, shrimp and molluscs from predators and strong occasional waves. In fact, the root system helps protect coastlines from erosion, storm damage, and wave action. The hydric soils of the mangroves are generally composed of silt on sandy layers. The soft mud and tidal inundation limit most visitor's access to navigable waterways.

Aesthetically, the estuarine wetland and its vegetation formed a pristine environment with slight diurnal change in temperature ranging from 23^oC in early morning to 33^0C at noon. Generally, the scenic views are confined or framed by the mangrove trees and *nypa* palms that grow along the banks of the water channels. Night setting is tranquil with the sound of insects and other nocturnal animals and sound of wave splashing the banks. In Peninsular Malaysia, the ambience of the mangrove setting changes significantly from November to February when the monsoon takes its course. The raindrops ripple the calmness of the water, and the sounds of animals are muted by winds and rain.

The forest is also the habitat for human settlement throughout the estuarine wetland such as Matang in estuary of Perak River and Kinabatangan estuary in eastern region of Sabah. The local people built their buildings on stilts using the native materials including mangrove trees and nibong palms (*Oncosperma tigillarum*) for posts and beams. In addition, they utilized hardwood boards and planks for making walls, roof structures, boardwalks and decks. The people depend directly upon the mangrove forests; harvesting fish from the water, wood from

the forest for making charcoal and firewood, making medicine from leaves, flowers, fruits and barks of some tree species, collecting building materials from tree trunks, fibres from and *nypa* fronds, and sugar from *nypa's* inflorescence (Whitmore, 1977).

The abundance of flora and fauna, the attractive and pristine landscape of the intertidal environment with a warm favorable climate throughout the year, and cultural value of local communities have attracted tourists to the wetland landscape. Some mangrove areas have been developed by resorts to cater to the nature-loving tourist who seeks to experience the wetland setting. Marang Resort and Safaris (MRS) at Kampong Sungai Kerengga, Marang, Terengganu has successfully exploited the mangrove flora and fauna for leisure purposes, and the forest as its trademark. The success comes through sensitive site planning with respect to the ecosystem and compact building designs and layouts that relate to local architecture, the availability of building materials and construction skills. This practice sustains the ecosystem and supports the biodiversity conservation, as well as contribute to the development of the rural communities.

Therefore, determining the characteristic of physical factors (water and soils) and biotic factors (vegetation and animals) in a site is the preliminary step to recognize the potentialities and constraints of the ecosystem for resort development. Inventories and analyses of these factors should be thoroughly conducted on site for development of proper planning strategies so that buildings and infrastructure development that will not degrade the ecosystem. The planning of the resort must also consider the socio-economics of the local human communities so that substantial benefits such as jobs and trading of local produce to resort guests occur.

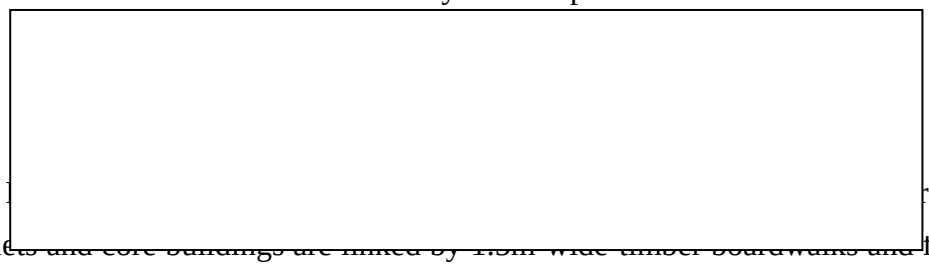
SITE PLANNING OF THE RESORT

The major planning and design consideration in the development of ecoresorts in the estuarine or intertidal wetland is to conserve the relationship between the physical and biotic factors within the limitation of climatic factors. Conservation of these relationships will ensure that no linkages in the food chains or food webs are broken and no change takes place in the microclimate of the ecosystem. Thus the ideal approach would be minimal disturbance and modification to the physical and climatic factors by benignly inserting the architecture and infrastructure rather than forcing an intrusion into the biome.

The fundamental approach to site planning is to divide the site in relation to the intensity of human activity and building development. Intensive activities such vehicle parking, registration, sport games, swimming and dining should be concentrated at the core building area. If the accessibility is from the land, typical planning would divide the site into three zones, namely, public, semi-public and private. The public zone is where visitors enter the resort complex; it is located on the highest ground. Here amenities such as parking, a guard house or even staff accommodations are placed so as to be segregated from the semi-public and private zones. This area would be subjected to tidal forces and thus little blockage of tides would occur. To accommodate the parking spaces, access roads and buildings, the ground would sometimes require backfilling. This is an intrusive intervention to the natural system of the forest but necessary to provide safety and comfort for the resort's guests. Minimizing the number of vehicles to be parked would lower backfilling needs. Furthermore, the segregation of parking from lodging would distance guest accommodations from the vehicle's noise. This planning approach would optimize the opportunity for the guest to experience the serenity of the forest's natural setting. If the accessibility to the resort is by boat, the public zone would not be in the site; guests would board a boat at an off-site jetty. Then they are taken straight to

the semi-public zone and disembark at the core building for registration. This is a transition zone between the public and private zones. Here registration, dining space, and sport and recreational facilities such as a swimming pool are provided to cater to the leisure needs of the guests. The volume of architecture will be the largest in this zone, possibly sprawling throughout the designated areas. By controlling the size of the core building, for example, by limiting it to be not larger than 120m^2 would minimize the large scale clearance of mangrove stand. Dining and gathering spaces should take advantage of the views either towards the tree stands, far distance views of the river and sea, or might focus on looking at the intimate views of rivulets and the changing tides.

Finally, the guests will reach the accommodation units located in the private zone. Here privacy and intimacy of living spaces are requisites in the planning allowing the guests to maximize their interaction with the landscape features of the wetland. Only passive activities such as site-seeing, meditating, fishing, and canoeing are recommended to facilitate the guests to feel and respond to the placidity of the wetland setting. The accommodation units (chalets) should be laid in juxtaposed position orienting towards the scenic views such as a colony of *Sonneratia* that harbors the fireflies or *nypa* palms where lizards and monkeys can be seen. The orientation and final layout of each unit must be decided on site after analysis of the views, vegetation and wildlife, and microclimate of the site. Spacing intervals for the units would depend on the denseness of the tree stands. In a site with mature *Rhizophora* or *Avicennia* trees could accommodate units at intervals of 10 to 15 meters whereas a sparser stand would require larger intervals allowing thicker screening by the vegetative stands. The Marang Resort and Safaris (MRS) distanced its chalets at about 10 meters apart in a forest stand composed of a mixture of *Rhizophora, Avecinnia* and several species of coastal trees and palms. Within this interval, privacy and a sense of intimacy is clearly felt by the guests (Ismail, 1999). The area of the tree stand is cleared equivalent to the size of building (25 to 50m^2) and its boardwalks. Figure 1 illustrates a typical example of resort architecture and circulation facilities appropriate for the mangrove forest. Furthermore, the resort preserves the *nypa* stands that niche a colony of primates and lizards of the Kampong Kerengga's estuarine community. The *nypa* forest also supplies the locals with sugar, fruits and fronds as building materials. Such practices sustain the human and animal populations that have coexisted long before the introduction of the leisure facility into the pristine wetland.



rest

The chalets and core buildings are linked by 1.5m wide timber boardwalks and footbridges to facilitate the movement of people and small vehicles such as buggy carts and bicycles. The circulation structures are built on stilts to allow free movement of tides into the vegetation. The boardwalks are made from treated durable wood and laid in sinuous alignments to minimize cutting of dense tree stands or animal feeding spots, and optimize the chance to view scenic features. The seaward lines of trees are left undisturbed to batter the erosive effect of waves and tides. Traversing the resort site on foot through the circulation route enables the guests to experience the serenity of the forest at a variety of viewpoints.

Experiencing the wetland setting on foot allows the guests to see the aquatic life particularly brackish-water fish and lizards searching for food or prey. Observing primates such as leaf and proboscis monkeys can be experienced in *Sonneratia* colonies in mangroves of Kudat,

Sandakan and Lahad Datu in Sabah. The tree stands, as high as 40m, also produces ephemeral flowers that attract nectar-feeding bats and birds. Occasionally, large iguana might be seen snatching the monkeys when they come too close to the ground during the low tide. At low tide the guests will be fascinated with communities of molluscs and crustaceans. Throughout the day and evening the tranquility of the mangroves is orchestrated by many sounds of birds and insects. This phenomenon is different from the inland hill forests due to different animal species inhabiting the wetland ecosystem.

ARCHITECTURE AND CONSTRUCTION METHODS

Sprawling layout and small size structures are the two design considerations for the wetland resort. Massive architecture should be rejected and rather small scale buildings should be distributed in the designated area. This practice would cause minimal modification to the water flow, soil structure and plant and wildlife communities of the forest. This architectureal form replicates the typical structure built by local people living in the estuarine wetland. The buildings should generally not be higher than the tree canopy, and the concept of buildings and boardwalks should be that they become structures within the forest. Observation towers may protrude above the tree canopy, but should be few in number, and unobtrusive in appearance.

Marang Resort and Safaris (MRS) laid their chalets along the Kerengga River only in the *Rhizophora* and *Aviccenia* stands, leaving the *nypa* community for wildlife habitat. All buildings are built within one storey high, not exceeding the height of the mangrove stand. The dimension of a typical chalet is 5 x 10m ($50m^2$) which is ample to accommodate two guests. Only stilts, either planted to the ground or laid on concrete footings and stumps, are used to support the architecture, boardwalks and bridges. This construction method does not impede the flow of tides and nutrients to the root systems of the mangroves, thus leaving the ecosystem undisturbed.

To achieve the ambience of a village setting, MRS chalets are designed in the spirit of a typical Malay house with spaces being defined in hierarchical layout, namely, public, semi-public and private spaces. In the chalet, the verandah acts as a deck and is the public space from which guests to view the surroundings. As the guests enter the building, the lounge becomes a transitional space, a semi-public zone, separating the bedroom from the deck. Thus the guest is able to feel the solitude staying in the building.

Utilizing the forest products such as timber for the construction of the stilt system and *nypa* fronds for thatch roof would economize the construction cost of the resort. But structural components of the buildings including posts, beams and walls should be made from durable materials such as hardwood and concrete. The post-and-beam construction method is recommended for the building construction since this is the typical technique applied by the villagers living in the forest. Consequently, constructing the resort building similar to the scale of the local architecture would bring employment opportunities to local people during the construction stage. The local people could even supply building materials such as mangrove trees and nibong palms *(Oncosperma tigillarum)* for stilts and *nypa* fronds for thatch roofs. MRS applied this practice during the first phase of construction, consisting of 25 units chalets and a core building in 1991.

The chalets were built in the traditional Malay way using only hand-held tools and light machinery by carpenters and craftsmen recruited from the surrounding villages. The traditional approach helps to minimize disturbance to the natural features particularly

vegetation, water quality and soil structure. Most of the materials, including timber and roof tiles, are sourced locally. They were transferred across the river on rafts and temporary pontoon bridges. Other than a concrete stump for the foundation, the floor, the wall and roof structure of the chalet are made from cengal, a heavy hardwood species, easily worked even in making fine details. Light and small size (130 x 230mm) clay tiles, formed the 30^0 pitch roof of the chalet. The tiles are easy to install and replace, and readily protect the interior form heat and rain within the human comfort zone.

A feeling of comfort and safety is a major concern in accommodating visitors to a wilderness setting. All buildings should be naturally ventilated, with many openings including louvered windows and doors, perforated walls and gable-ends. Such architectural features facilitate sea breeze ventilation through the building, and reduce the temperature 2^0 to 4^0C lower than unshaded area. One-horsepower air-conditioning units could be installed to each chalet to give extra comfort to guest for use during the night. In MRS resort, the timber floors of the chalet's bedrooms are carpeted and the bathroom is equipped with hot-water showers. Only low-wattage incandescent lamps were used to draw the sense of the serenity of the night.

The sewerage system is the most difficult problem facing the resort development in the wetland. Many resorts use septic tank systems to dispose of the sewerage. Thus the most suitable location for buildings is the inland belt of the forest whereby the septic tank can be placed in the ground without being flooded by high tides. Excavated mud from the construction of the sewerage system must not be left in exposed heaps. Such mud oxidizes when dry and causes acid sulphate conditions, contaminating water and making it unsuitable for many forms of life.

SOCIAL-ECONOMICS CONTRIBUTION AND RESORT MANAGEMENT

The establishment of resorts in the mangrove forests can provide job opportunities to local people living within the vicinity of the development. Since the buildings are constructed manually using hand-held tools, many semi-skilled workers and craftsmen could be part of the work team. MRS is an example that worthy of emulation. It employs many local workers and some craftsmen in Marang, Terengganu during the construction stage. During the process, the locals were able to gain new construction skills including how to set up electrical and plumbing systems. When the buildings are completed, almost 70% of the workers are recruited as the resort staff for operation and management.

The locals may also benefit from the development by having a venue for which to sell their crafts to the tourists coming to the resort. Purchasing the crafts such as utensils, mats, fish traps and baskets, using indigenous materials and design, could enhance the experience of the visitors. This is an income generating practice benefiting the local people. The locals could also benefit from the ecotourism by offering tourists boat trips, traversing in the forest and river channels, especially during high tides. Tourists may discover more than they expected on such trips because the locals know detailed phenomena about the mangrove forest that is typically more than the resort management would know. Thus resort management should integrate their programs with the services that local people can supply. This includes allowing local fishermen to sell their catch straight to the restaurant of the resort. The mutual relationship will sustain all parties, local residents and resort visitors and staff, forming an integrated community.

Among the maintenance work in the resort is the collection and disposal of litter. Litterbins should be made vandal proof against monkeys and other wildlife. Garbage and litter should be disposed away from the site. In addition, the management should inform the guests that biting insects must be accepted as a part of the mangrove ecosystem, and visitors may require advice on how to avoid or reduce the problem by using appropriate clothing and repellents. The guidelines on health and safety should be borne in mind with respect to insect-borne diseases.

CONCLUDING REMARKS

Mangrove forests are a resourceful landscape for ecotourism. The physical, biological and climatic factors can be modified to certain limits to accommodate the recreational activities and buildings and structures. Modification of the physical-biotic factors, especially vegetation, water and soil, should be minimal so that it will not disturb the ecosystem of the plant and animal communities. Tide flows should not be hindered by any man-made structures, thus allowing the plant roots and aquatic microorganisms to attain sufficient nutrients and air.

The introduction of buildings in the estuarine sensitive ecosystem should be approached by zoning the site into public, semi-public and private zones. The zoning approach will ensure that buildings and structures of the resort integrate into the physical and climatic characteristics of the mangrove forest as well as the need of guests experiencing the natural wetland resource. The architecture should be planned and designed by being inserted into the vegetation above the highest water level rather than intruding into the ecosystem. Furthermore, the resort architecture should be designed to integrate climatic factors, wind and temperature, as part of the resource of the tropical biome. Thus all buildings, especially accommodation units, should be naturally ventilated allowing the guests to feel the real ambience of the estuarine climate.

Resort development can bring social-economic gains to local communities residing in the forest. Resort management should program ecotourism activities to include opportunities for the local residents to participate in providing necessary materials and services. This level of planning, design and management would not only sustain the estuarine ecosystem but also the human population of the place.

REFERENCES

Bush, M.B., 1997. Ecology of a Changing Planet, Prentice Hall, New Jersey.

Haron A.H., 1981. A Working Plan for the Second 30-Year Rotation of the Matang Mangrove Forest Reserve Perak, State Forestry Department Perak, Ipoh, Perak, Malaysia.

Ismail S., 1999. Ecoresort in a Coastal Wetland in Malaysia- A Case Study at Marang Resort and Safaris, Terengganu, Malaysia, Proceedings of the Research Seminar on Construction, Material and Technology, 3-4 Feb., Univ. Teknologi Malaysia.

Malaysian Wetland Directory, 1987. Department of Wildlife and National Parks, Peninsular Malaysia.

Mastaller, M., 1997. Mangroves: The Forgotten Forest Between Land and Sea, Tropical Press, Kuala Lumpur.

World Wildlife Fund, 1998. Protected Areas in Peninsular Malaysia – An Overview, published by WWF Malaysia (Project No. MYS374/97): Critical Ecosystems for Conservation, Malaysia.

Othman B., 1995. Sonneratiaceae. In: E. Soepadmo and K.M. Wong (Eds.), Tree Flora of Sabah and Sarawak, Vol.1, FRIM, Kuala Lumpur.

Rao, M.B., 1995. Coastal Ecosystems: Structure and Function, in Hay, J.E., Ponniah, W., Pradhan, M. (Eds), Resource Volume for Tertiary Level Education and Training in Coastal Zone Management, UNEP, Nettlap Publications No.13.

Saenger, P., E.J. Hegeri, and D.J. Macintosh (eds.) 1998. Proceedings of the Asian Symposium Environment, Research and Management, Univ. of Malaya, UNESCO.

Schwanke, D., 1997. Resort Development Handbook, ULI Development Handbook Series, The Urban Land Institute, Washington D.C.

Strange, M. and Jeyarajasingam, A., 1993. Birds: A Photographic Guide to the Birds of Peninsular Malaysia and Singapore, Sun Tree Publishing Limited, Singapore.

Whitmore, T.C., 1977. Palms of Malaya, Oxford Univ. Press.

Yap, S.K., 1991. Plants for Coastline Planting in Malaysia, FRIM Technical Report Information No.23, FRIM, Kuala Lumpur.

Author Biographies

Ismail Said is an associate professor at Department of Landscape Architecture, Faculty of Built Environment, Universiti Teknologi Malaysia since 1993. He teaches several landscape architectural subjects including landscape community planning, urban design and plant materials. He has published two books on plant materials and timber species for woodcarving and has written 10 articles in journals and presented 23 papers in conferences. Since 1988, he has completed 12 research studies in landscape architecture and architecture including cultural landscape and woodcarving in vernacular architecture. His current research is investigation on garden as environmental intervention to recuperate ill children in hospital environment.

Muhammad Ali A. Rahman is a lecturer and currently the head at Department of Urban and Regional Planning, International Islamic University Malaysia. He holds Masters in Tourism Planning from Universiti Teknologi Malaysia and has being teaching in urban planning for three years.

Dr. Denis A. Saunders
Associate Editor for Asia, Australia and New Zealand
Landscape and Urban Planning
C/-CSIRO Sustainable Ecosystems
GPO Box 284
Canberra ACT 2601

Dear Editor,
With this letter I am submitting an article *The Site Planning and Architectural Design of Resorts in Mangrove Forests* for Landscape and Urban Planning journal.

Thank you.

Sincerely,

ISMAIL SAID
Department of Landscape Architecture, Faculty of Built Environment
Universiti Teknologi Malaysia, 81310, Sekudai, Johor, Malaysia
Email: b-ismail@utm.my
Fax: 006075566155