

### 3. Mangrove Ecosystems

#### 3.1. Distribution of Mangroves

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**B**iodiversity is the basis for human existence. It is of critical importance for meeting the needs of food, health and other needs of the growing human populations. Among the various biodiversity regions, the coastal marine ecosystems are known to be most productive, biologically diverse and exceedingly valuable areas. These have been estimated to cover more than double the number of species on land. Man has turned to these organisms to harness energy, food, medicine, fertilizer, fuel and many other industrial products. A vast majority of global human population is getting concentrated along the seacoasts. It is estimated that about 55% of the world's population lives in coastal areas. In East Asia, more than 70 % of the population depends on coastal resources for food, employment and generation of income. In south Asia, coastal populations are surviving regrettably on diminishing coastal resources. The western Pacific region suffers degradation significantly to its coastal resources due to unplanned developmental activities and probably as a result of climatic changes. Added to it, the increasing human habitation in the coastal areas of the world that is estimated to reach 6 billion by 2030 provides the inevitable need for biodiversity conservation. In most of the developing countries, priority of necessity is given to food production and socio-economic development, which are often at the expense of biodiversity conservation (Adeel & Caroline, 2002).

#### **Why to Conserve the Coastal Biodiversity?**

Coastal areas have a greater variety of habitats than the open ocean and these are subjected to various pressures related to developmental needs and often over-exploited. This inevitably leads to degradation of ecosystems, destruction of species, which form resources of biodiversity and finally leading to an overall reduction in productivity. In the mid-1990's, the level of seafood consumption in Asia and the Pacific regions exceeded that of the world's per capita seafood consumption. This was because fish prices were relatively lower than those of other sources of animal protein (Tan *et al.*, 1997). Nearly 50% of coastal mangroves which form, vital nurseries for the life histories of many species of commercial



conditions make them profusely rich in biodiversity. Over a long period of time the mangroves and their components have been studied extensively but still remain poorly understood as far as their biodiversity is concerned.

The word "mangrove" dates its origin as 1613, and it is usually considered a compound of the Portuguese word "mangue" and the English word "grove". According to Marta Vannucci, the word 'mangue' derives from the national language of Senegal, and it was probably adopted by the Portuguese. The corresponding French words are "manglier" and "paletuvier" (Macnae, 1968), while a Spanish term is "manglar". The Dutch use "vloedbosschen" for the mangrove community and "mangrove" for the individual trees. German use follows the English. The word "mangro" is a common name for *Rhizophora* in Surinam (Chapman, 1976). It is believed that all these words originated from the Malaysian word, "manggi-manggi" meaning "above the soil". The word is no longer used in Malaysia, but is used in eastern Indonesia to refer to *Avicennia* species.

### **History and Evolution of Mangroves**

Mangroves are quite old, possibly arising just after the first angiosperms (Duke, 1992). However, mangrove plants do not exhibit very primitive plant characteristics. It is believed that the first appearance of mangroves as early as 80 million years ago. *Avicennia* and *Rhizophora* were probably the first genera to evolve, appearing near the end of the Cretaceous period (Chapman, 1976).

Mangroves evolved from terrestrial or fresh water plant species rather than marine plants. In the distant past, these land plants adapted to brackish water and became the "core" mangrove flora. It is not clear why only a few members of many plant groups adapted to saline water.

It is believed that the break-up of continental land masses provided conditions, favourable for the development of mangroves in the fringe areas. Some 200 million years ago, there was only one continent known as Pangaea. This broke up initially into subcontinents like Gondwanaland that subsequently divided into South America, Africa, Antarctica, India and Australia, some 60 million years ago. About 50 million years ago, the island continent of India bore down upon Asia. When the two met, new mountains began to rise, and biological species started spreading into the new extensions, some 40 million years ago. Like wise, all other continents drift over the surface of the globe, resulted increased coastal habitats suitable for mangrove development. These geological changes and evolution of flowering

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plants happened simultaneously during the long period. Thus it is suggested the mangrove species evolved and diversified due to the break-up of Gondwanaland.

The origin of mangroves is still under debate. It is not clear whether the origin and spread of mangroves are

- i. from the Malaysian peninsular and spread to a region between Australia and Papua New Guinea, and or
- ii. between Malaysia and Northern Australia. These two theories were based on fossils and pollen.

Mangroves have a long historical link with human culture and civilization. Spirit houses are common in Asian countries especially in India, Myanmar, Thailand and Cambodia. At the entry point of Sundarbans, 'Bano bibi' temples are present for worship by local people. This temple consists of Bano bibi for the Muslims, and 'vano devi' for the Hindus religious people. In the third century, a Hindu temple to the mangrove *Excoecaria agallocha* was erected in south India (Fig. 2a). The city where this temple is found bears the name of the mangrove species. In Kenya, shrines built in the mangrove forests are worshipped by the local people, who believe spirits of the shrine will bring death to those who cut the surrounding trees (Fig. 2b). In the Solomon Islands, the bodies of the dead are disposed off and special rites are performed in the mangrove waters (Vannucci, 1997).

The Portuguese, probably the first Europeans to visit the mangrove forests of the Indian Ocean (around fourteenth century), learned the traditional Indian technique of rice-fish-mangrove farming, as demonstrated by letters from the Viceroys the King of Portugal. Some six centuries ago, this Indian technology was also transferred by Jesuit and Franciscan Fathers to the African countries of Angola and Mozambique (Vannucci, 1997). In the nineteenth century, the British used the practical knowledge gained over centuries by the Indians to manage mangroves at Sundarbans for commercial timber production (Vannucci, 1997).



Fig. 2a. A rock carving of *Excoecaria agallocha* for worship in a Hindu temple in South India.



Fig. 2b. A shrine for worship, inside a mangrove forest in Gazi Bay, Kenya.

A creative use of mangroves is described in a traditional story from India about two countries at war. The larger country planned to invade their small neighbours during the night. The smaller nation, which has mangrove forests on its coastline, plotted to discourage its enemies by placing lighted lamps on the aerial roots of mangroves. What appeared to be a large flotilla of ships discouraged the invaders and ended the hostilities (e.g. Kathiresan & Bingham, 2001).

Mangroves have been studied since ancient times. Descriptions of *Rhizophora* trees in the Red Sea and the Persian Gulf by Nearchus (325 BC) and Theophrastus (305 BC) are the earliest known records. Plutarch (70 AD) and Abou'l Abass (1230) wrote about *Rhizophora* and its seedlings (Macnae, 1968; Chapman, 1976). Rollet's (1981) bibliography of mangrove research shows only 14 references before 1600, 25 references from the seventeenth century, 48 references in the eighteenth century, and 427 in the nineteenth century. In contrast, there were 4500 mangrove references between 1900 and 1975, and approximately 4466 between 1978 and 2001, illustrating the spurt of interest in mangrove research.

### Global Distribution

Mangroves are distributed circumtropically, occurring in 112 countries and territories. Total global mangrove coverage is 18 million hectares and it is just about 0.45% of world forests & woodland (Spalding, 1997). Of the total mangrove coverage, 41.4% exist in South and Southeast Asia (Table 1). Mangroves are largely restricted to latitudes between 30° N

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and 30° S. Northern extensions of this limit occur in Japan (31°22' N) and Bermuda (32°20' N); southern extensions are in New Zealand (38°03' S), Australia (38° 45' S) and on the east coast of South Africa (32°59' S) (Spalding, 1997).

Table 1. Areal coverage of mangrove forests

Region	Area (sq km)	Percent
South and Southeast Asia	75,170	41.4
The Americas	49,096	27.1
West Africa	27,995	15.4
Australasia	18,788	10.4
East Africa and Middle East	10,348	5.7

Mangroves have broader ranges along the warmer eastern coastlines of the Americas and Africa than along the cooler western coastlines (Fig. 3). This difference in distribution is due to the presence of warm and cold oceanic currents.

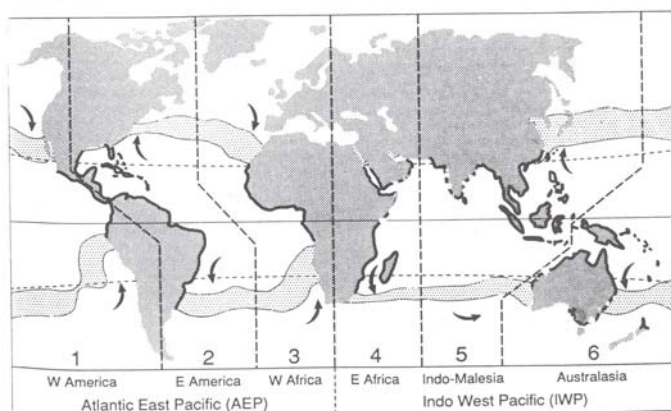


Fig. 3. Global distribution of mangroves with six geographic regions (Duke, 1992)

### Old and New World Mangroves

There are two main centres of mangroves: the Eastern hemisphere and the Western hemisphere (Fig. 3). The Eastern hemisphere is Indo-West Pacific region that includes East Africa, Indo-Malesia and Australasia. The Western hemisphere is Atlantic East Pacific region that includes West America, East America and West Africa. The Eastern hemisphere is considered as a place of origin for mangroves, and hence the region is called as the Old World mangroves and the Western hemisphere as the New world mangroves. The Eastern hemisphere has more species than the Western hemisphere. The number of mangrove species is 49 in the

former and 11 in the latter (Duke, 1992). Some genera are specific to the regions. The genera like *Peliciera*, *Conocarpus*, and *Laguncularia* are present only in the new world, whereas *Osbornia* and *Camptostemon* exist only in the old world.

Table 2. Estimated mangrove coverage areas of the 15 countries with the largest mangrove areas (after ITTO/ISME, 1993).

Country	Mangroves (1000 ha)	Global percentage (%)
Indonesia	4250	30
Brazil	1376	10
Australia	1150	8
Nigeria	970	7
Malaysia	641	5
Bangladesh	611	4
Myanmar	570	4
Vietnam	540	4
Cuba	530	4
Mexico	525	4
Senegal	440	3
India	360	3
Colombia	358	3
Cameroon	350	2
Madagascar	327	2

#### Extent of Mangroves in Various Countries

Table 2 shows the extent of mangroves in 15 countries that have significant mangrove coverage. Mangrove areas are the largest in Indonesia, Brazil, Australia and Nigeria contributing respectively 30, 10, 8 & 7% of global coverage (ITTO/ISME, 1993). It is difficult to get accurate estimates of mangrove areas for individual countries for the following reasons.

1. No adequate data exists for some countries primarily in western Africa and Asia.
2. Mangrove areas in many developing countries are fast disappearing. To cite an example, there was more than 50% loss of mangrove area after 1960 (Aksornkoae, 1993).
3. There is no standard methodology followed uniformly in different countries to estimate mangrove areas. As a result, it is difficult to compare.

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4. It is difficult to differentiate between terrestrial forests and mangroves in places where tall mangrove trees merge into other forests (Kjerfve and Lacerda, 1993).
5. There is also no clear cut demarcation between the extents of water bodies and mangrove forest land, due to tidal water problems.
6. Above all, there is no clear cut definition for mangrove species and hence other associated species of salt marsh and other vegetation are also included in many cases.

## References

- Adeel, Z and Caroline, King (Ed.) (2002). *Conserving our Coastal Environment: A summary of UNU's research on sustainable management of the coastal hydrosphere in the Asia Pacific region*. United Nations University, Tokyo, Japan. pp.39.
- Aksornkoae, S. (1993). *Ecology and Management of Mangrove*. IUCN - The World Conservation Union, Bangkok, Thailand. 176 pp.
- Chapman, V.J. (1976). *Mangrove Vegetation*. J. Cramer, Vaduz.
- Duke, N.C. (1992). In: Robertson, A.I. and Alongi, D.M. (Eds). *Coastal and Estuarine studies: Tropical Mangrove Ecosystems*, American Geophysical Union, Washington DC., USA, pp. 63-100.
- ITTO/ISME, (1993). *The World of Mangroves Part I*. Japan, pp. 1-63.
- Kathiresan, K. and Bingham, B.L. (2001). *Biology of mangrove and mangrove ecosystems*. *Advances in Marine Biology*, **40** : 81-251.
- Kjerfve, B. and Lacerda, L.D. (1993). *Mangroves of Brazil*. In : Lacerda, L.D. (Ed.), *Technical report of the project : Conservation and sustainable management of mangrove forests in Latin America and Africa regions-Part I- Latin America*. International Tropical Timber Organization / International Society for Mangrove Ecosystems (ITTO/ISME) Mangrove ecosystem technical reports ITTO TS,-**13** (2) : 245-272.
- Macnae, W. (1968). *A general account of a fauna and flora of mangrove swamps and forest in the Indo-Pacific region*. *Advances in Marine Biology*, **6** : 73-270.
- Qasim, S. Z. (1998). *Mangroves*, In : *Glimpses of the Indian Ocean*, (University Press, Hyderabad), pp. 123-129.
- Rollet, B. (1981). *Bibliography on mangrove research 1600-1975*. UNESCO, U.K., 479 pp.
- Spalding, M. (1997). *The global distribution and status of mangrove ecosystems*. *International Newsletter of Coastal Management-Intercoast Network*, Special edition, **1** : 20-21.

- Tan, X. and Zhang, Q. (1997). Mangrove beaches' accretion rate and effects of relative sea-level rise on mangroves in China. *Marine Science Bulletin, Haiyang*, **16** (4) : 29-35.
- Vannucci, M. (1997). Supporting appropriate mangrove management. *International Newsletter of Coastal Management-Intercoast Network*, Special edition, 1:1-3.