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TEACHING PLANT GEOGRAPHY – AN EXPOSITORY LESSON ON MANGROVES

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Introduction

Mangroves constitute a unique community of plants found throughout the tropical and subtropical zones of the world. They are particularly well developed in Southeast Asia, especially in Indonesia, the Philippines and Peninsula Malaysia. In Singapore isolated patches of mangroves can still be found though they are disappearing at a rapid rate. Mangroves offer many opportunities for classroom and field investigations of related aspects of ecology and plant geography. Such an integrated approach is encouraged at 'A' level and should be of particular interest to pre-university students. Moreover, the mangrove habitat is a highly specialised one differing in many ways from other natural vegetation types in the tropics. Thus mangroves serve as a good case study of local plant geography.

Plan of Lesson

Objectives: At the end of the lesson pupils will be able to:

1 describe the distribution of mangroves

2 List three factors which are favourable to the development of mangroves

3 identify three types of mangrove root systems

4 name four principle species of mangroves from photographs

5 describe two methods by which mangroves adapt to the environment

6 explain the zonation of mangroves

Target Group: Pre-university one Geography students

Key Concepts:

1 Location and Distribution
2 Habitat and physiognomy
3 a) Root systems
   b) pneumatophores
4 a) Dispersion
   b) vivipary
5 Succession and Zonation

Resources: Slides or photographs of mangroves

Texts:

1 Watson, J.G. *Mangrove Forests of the Malay Peninsula.* Malayan Forest Records No 6, 1926.
2 Polunin, N. *Introduction to Plant Geography.* London: Longmans, 1960.

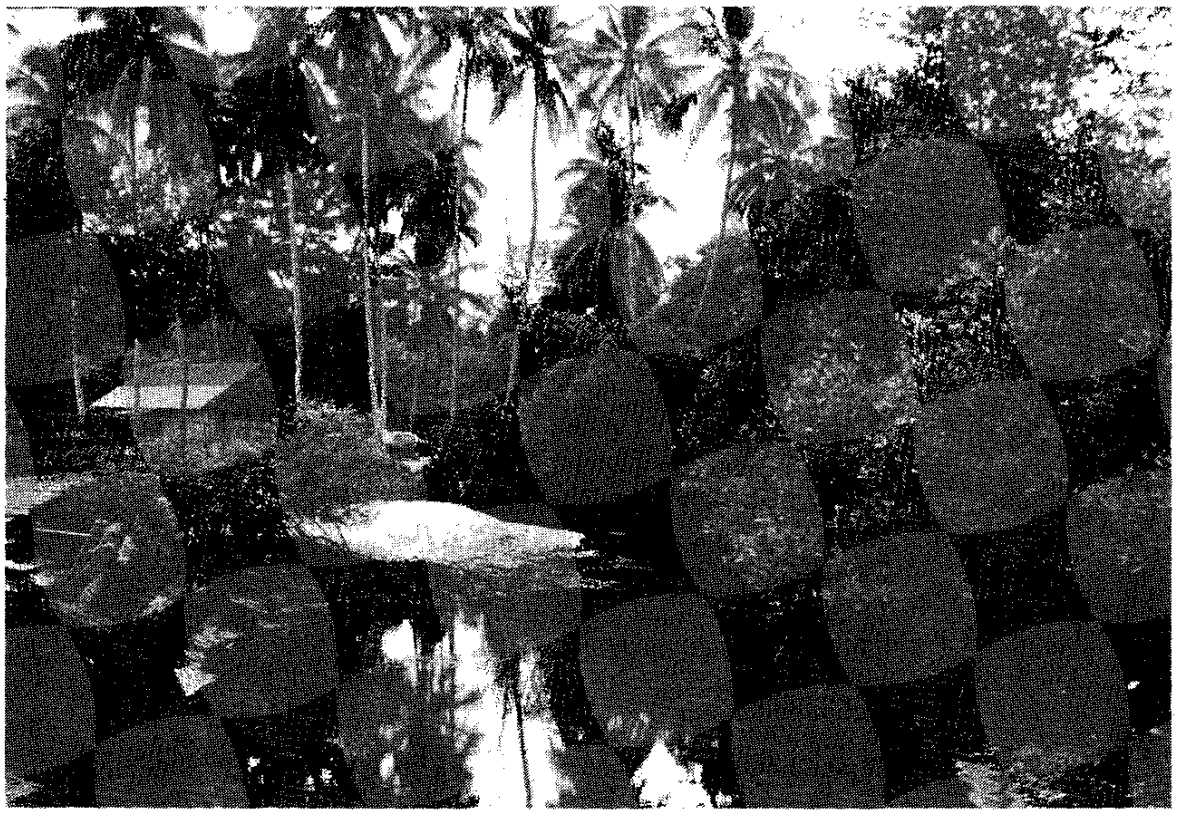
Contents of Lesson

Location and Distribution

Mangrove vegetation is a complex community of plants growing between the level of high water of spring tides and a level close to but above sea level. It varies in character from forest 30m high or more to a poor scrub barely 2m high.

Typically mangroves are found on sheltered muddy shores where the land is encroaching on the sea but they also grow on coral reefs and on sandy shores when there is little accretion.

Development of mangroves on mud flats.



A mangrove-fringed stream.

Particularly favourable conditions for the development of mangroves are found in quiet creeks and estuaries and bays sheltered from direct action of waves and currents where sediments are deposited to form mud flats and deltas. On the resulting flats and deltas the water-borne seeds or seedlings of the colonizing plants grow soon forming the characteristic rather low and dense forest. In brackish estuarine areas semi-mangroves such as the palm Nipa fruticans form extensive communities often adjoining those of the true mangroves.

This forest is widely distributed throughout the tropics but the best developed mangroves are found near the equator in Indonesia, the Malay Peninsula (Peninsula Malaysia) and the Philippines but with increasing latitude they gradually become poorer.

Mangroves often extend some distance inland along rivers in brackish swamps and lagoons forming fairly continuous fringe. At high tide they appear like a flooded forest. Recession of the tide reveals an ungainly mass of muddy roots. Even the trees are liable to be mis-shapen and lowly while bubbles of stinking gas rise from the rotten mire and a teeming population of crawling creatures adds to the dismal atmosphere.

The mangroves habitat is unsuitable for a majority of plants and animals to live in. At least once a day the mangrove habitat is subjected to flooding by the incoming tides. Constant inundation by tides and river outflow make the soil always water-logged, unstable and anaerobic, and subject to high pH. Above ground level mangroves are also exposed to higher mean annual temperatures, stronger wind and constant salt spray. To survive in such an environment, mangroves must have adaptive features to overcome adverse physical and physiological conditions.

Forest Characteristics

Mangroves show similar habitat preferences and a similar physiognomy. They are also similar in their physiological characteristics and in their structural adaptations, most of them having pneumatophores or breathing roots and a more or less marked tendency to vivipary.

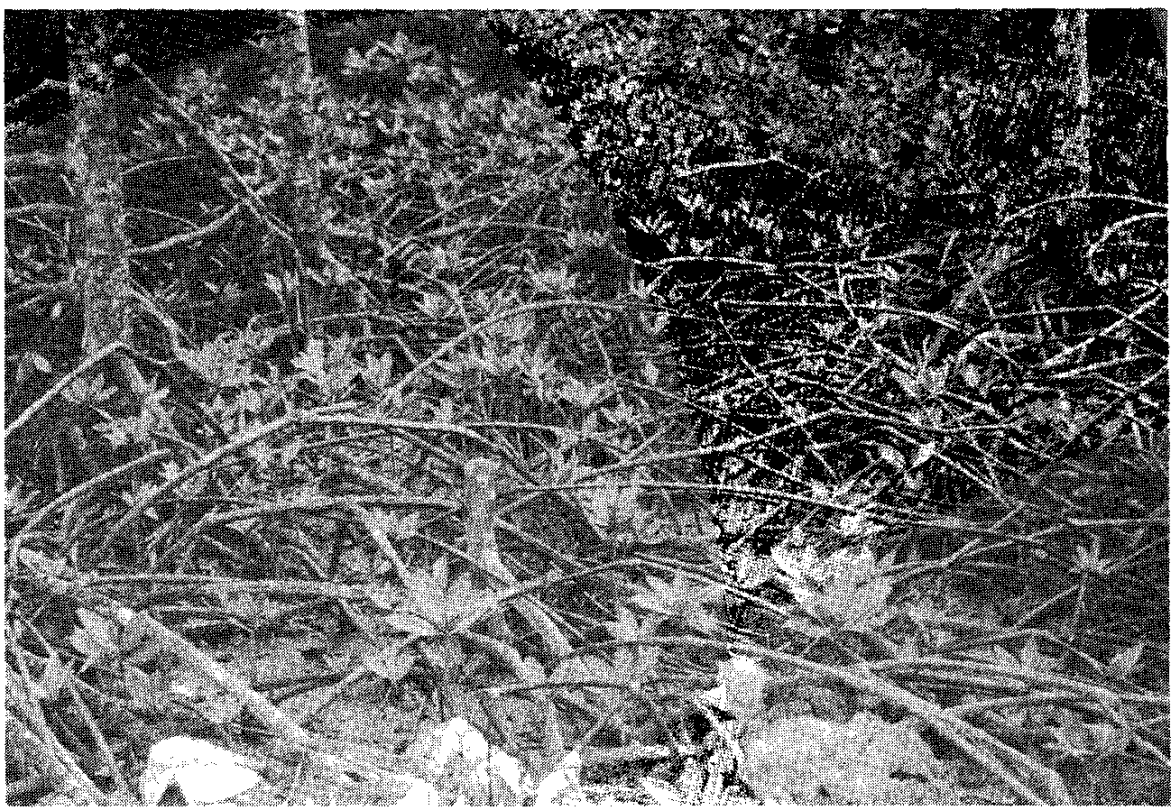
To counter the relatively high rate of transpiration leaves of most mangroves are either succulent or thick and leathery and either covered with a thick layer of waxy cuticle or with matted hairs. In addition, water storage cells or tissues are present in the leaves. Most mangroves are regularly or continuously flowering and fruiting throughout the year to compensate for the high rate of mortality during disposal and establishment.

Root Systems

The trees have unusual root systems. Some, Rhizophora for example, have many roots supporting the trunk which begins above mud level. In others such as the Avicennia and Sonneratia, the main roots are horizontal with many small branches protruding through the mud to stand above its surface in great numbers covering a wide area around the tree.

These special root adaptations have breathing pores or lenticels which permit only the entry of air but not water. Their function may be to oxygenate the roots but they also enable fresh rootlets to be put at higher and higher levels as the mud and silt increases and stifles the older roots.

Pneumatophores growing out of the mud.



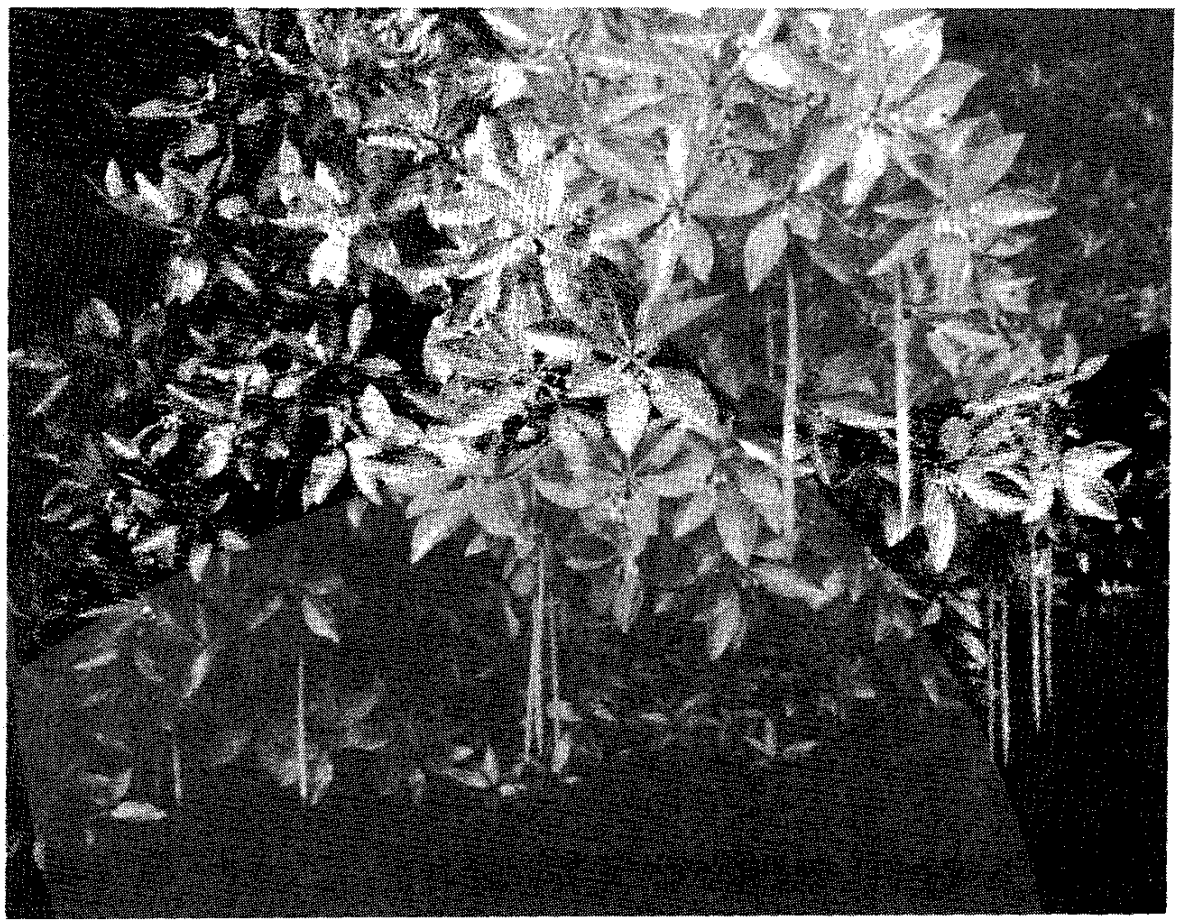
Stilt roots of Rhizophora.

Dispersion

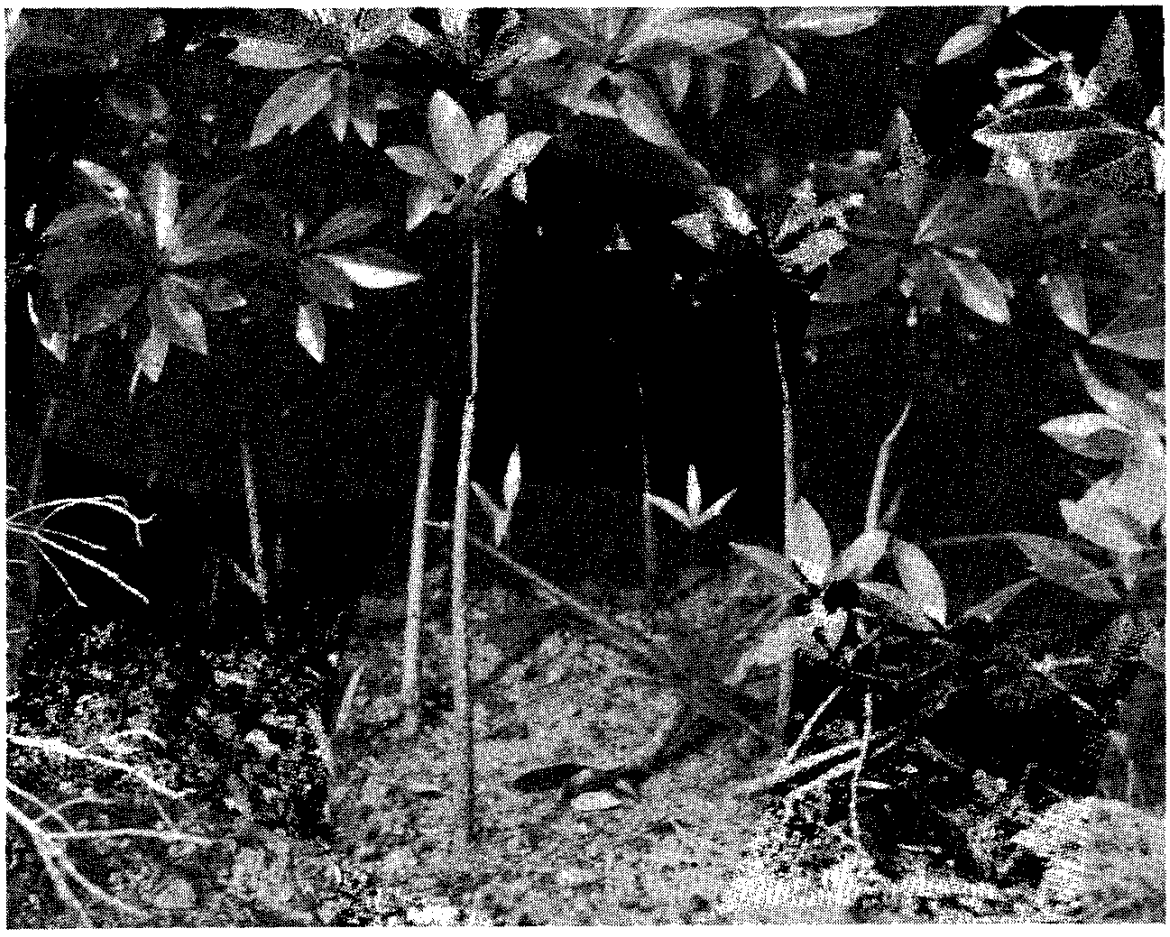
To overcome the problems associated with unstable and water-logged substrate and constant movement of water, many mangroves, for example, Avicennia, Bruguiera and Rhizophora adopt the viviparous habit of seed germination which means that the seeds germinate while they are still contained within the fruit walls and while the fruits remain attached to the parent plants.

The typical arrangement is for the primary root of the seedling to burst through the hanging fruit and to grow down as a long and dark-like slender but bottom-heavy structure.

Later on the seedling drops, root downwards so that the tip pierces the mud if the tide is out and forms anchoring lateral roots in a matter of hours. If the seedling is unable to establish itself, it floats and may strike root on some distant shore. In this way and by this process the seeds of the mangrove are dispersed.



Viviparous development of seeds.



Young seedlings of Rhizophora.

Zonation

In mangroves in general there is often to be found a fairly definite zonation. This zonation is generally governed by the frequency of tidal flooding, salinity and water logging of the soils. The stages of this are usually characterized by different species and range from the pioneers growing on almost continually submerged surfaces to a mature mangrove forest of often tall trees whose bases may be innundated by only the highest tides or in some instances scarely ever reached at all.

The pioneers or seaward plants, are most tolerant of salt water, the inland fringe is of the least salt tolerant types and as silt is progressively built up, tidal effects diminish and the vegetation gradually turns into a fresh-water swamp with different associations.

Economic Value

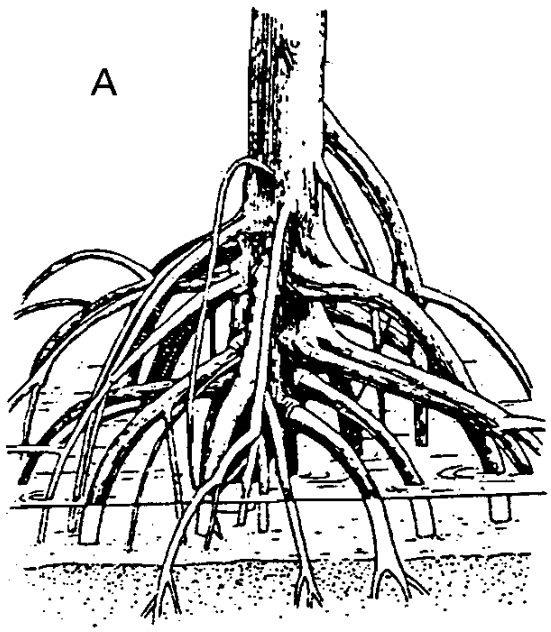
Mangroves constitute a valuable resource. From it, timber, poles, firewood, wood chips, charcoal can be obtained and several edible prawns, crabs, bivalves and snails are harvested. Apart from these, large tracts of mangroves have been reclaimed and converted into agriculture land or transformed into ponds to culture fish and prawns or for salt production. Under natural and undisturbed conditions, mangroves act as seaward barriers thus preventing coastal erosion and at the same time helping to extend the coastline.

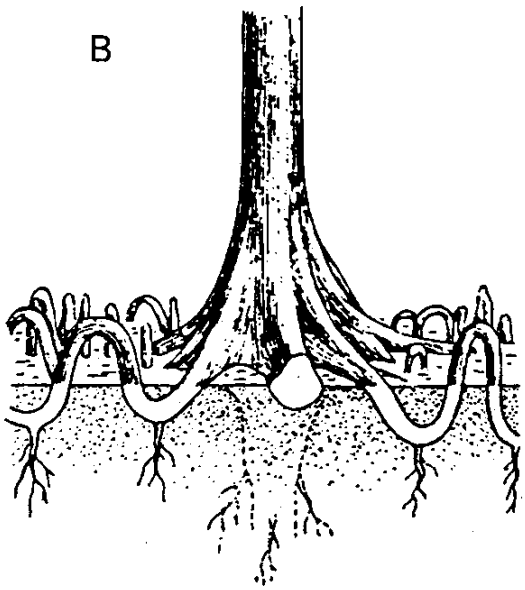
A battery of charcoal kilns – Matang, P. Malaysia.

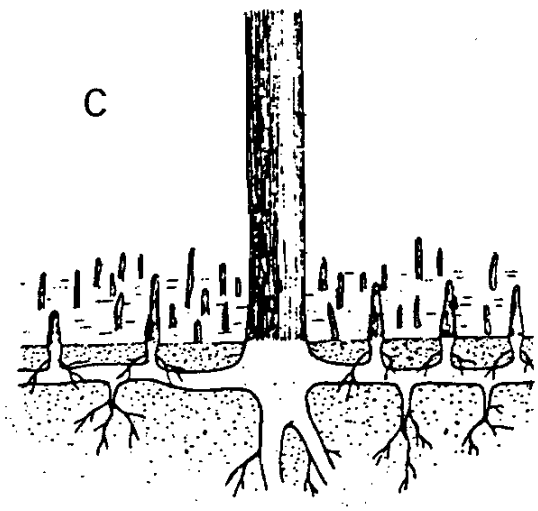
Learning Activities/Exercises

1. Where are mangroves mainly found?

2. What conditions are particularly favourable to mangrove formation?



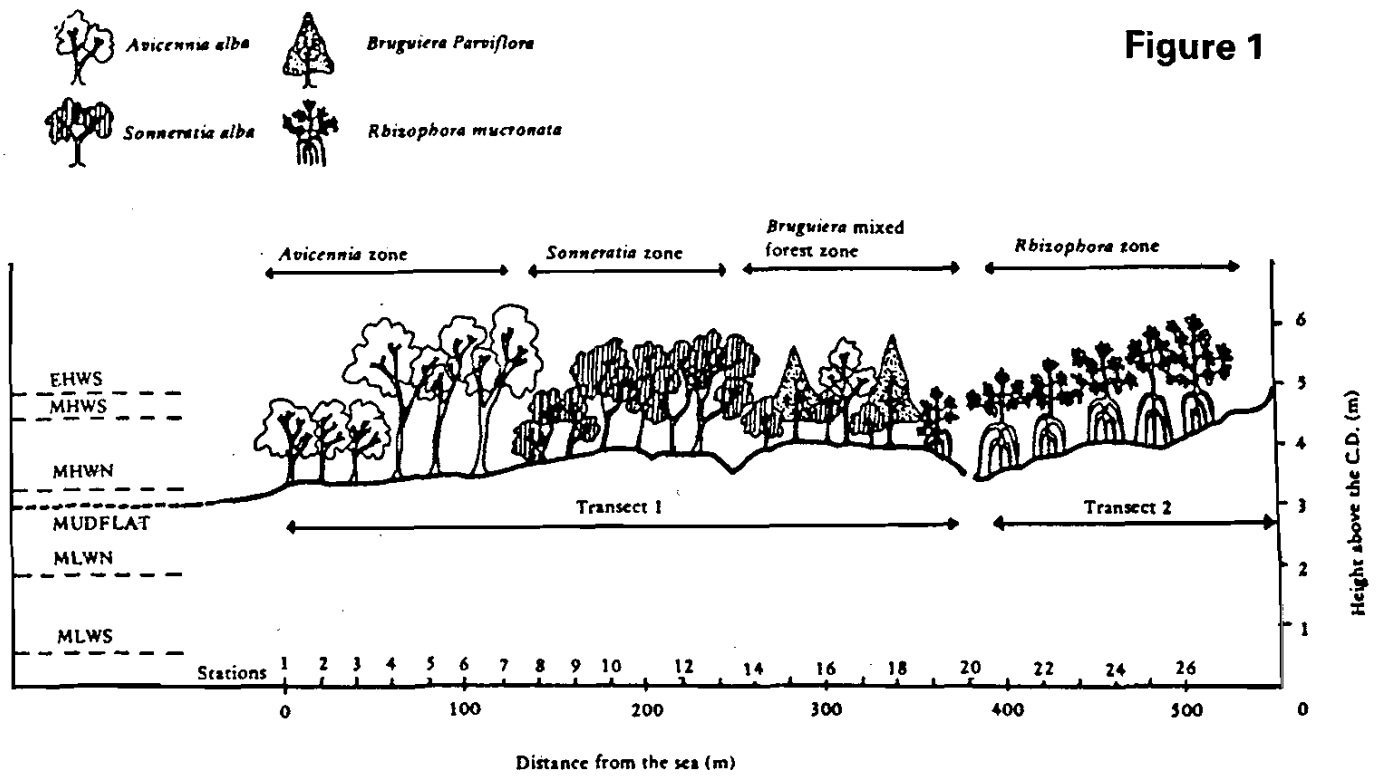




3. a) Identify and name each of the three root systems shown by the letters A, B, C, in the spaces provided.

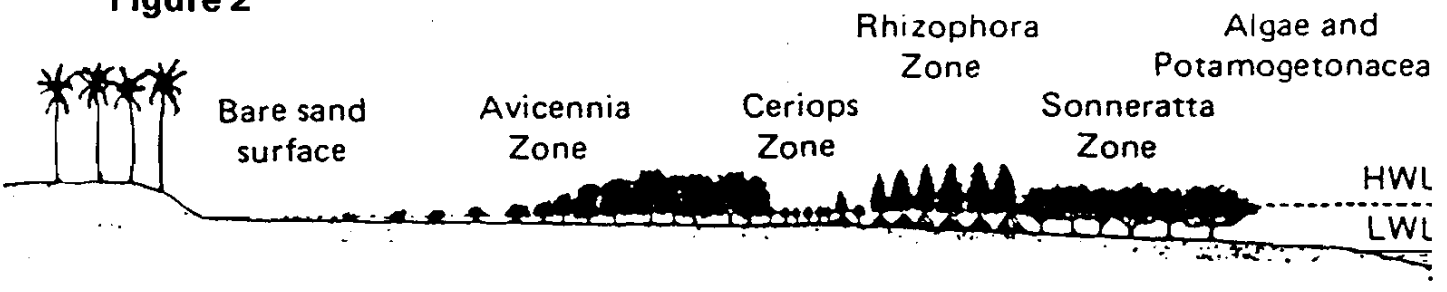
   b) Explain the function of each root system.

Figure 1



Source: Malay Nature Journal 35, 1982

Figure 2



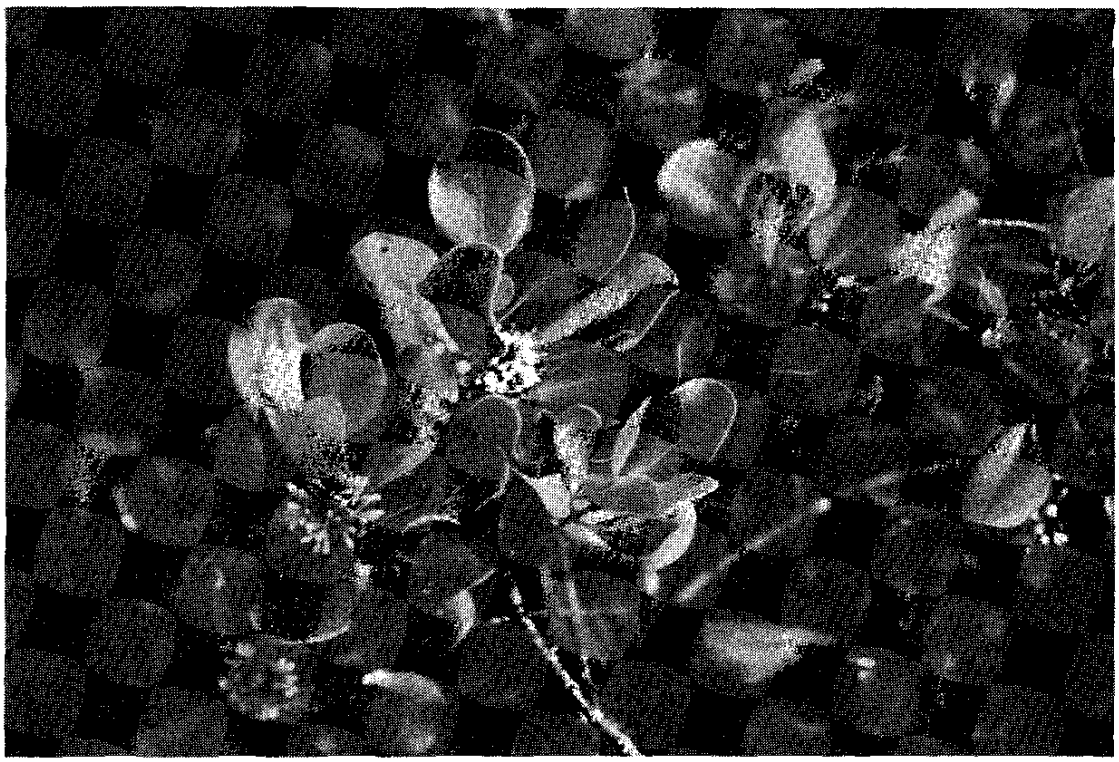
4. Fig. 1 shows the zonation of mangroves in the Banjar Mangrove Forest Reserve (Peninsula Malaysia).

   a) Which of the species shown is the pioneer specie?

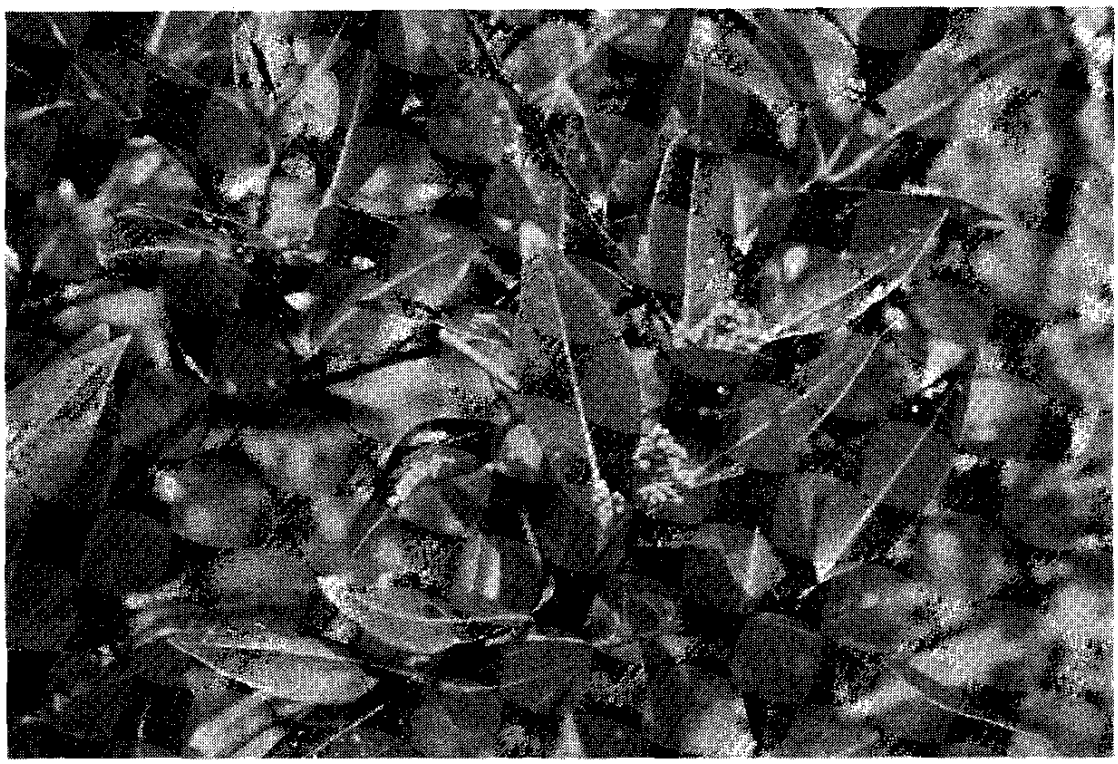
   b) How and why does the floristic composition of the forest differ from shore to land?

   c) How does this zonation differ from that of the East African Coastal mangroves shown in Fig. 2.

5. Identify and name each of the four species of mangroves shown in A, B, C and D.

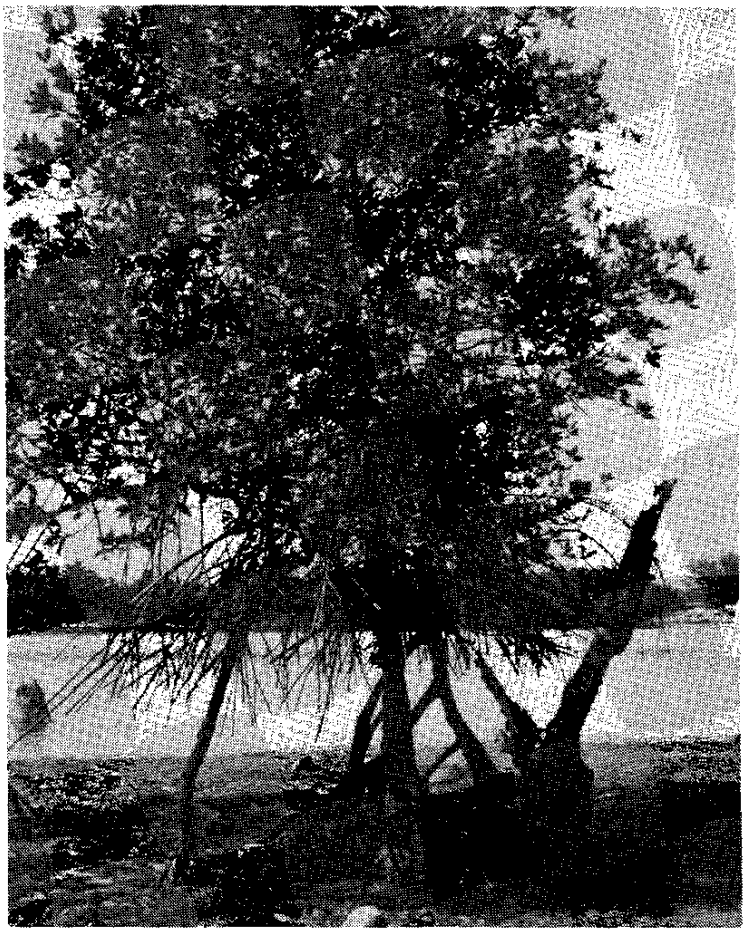


A _____

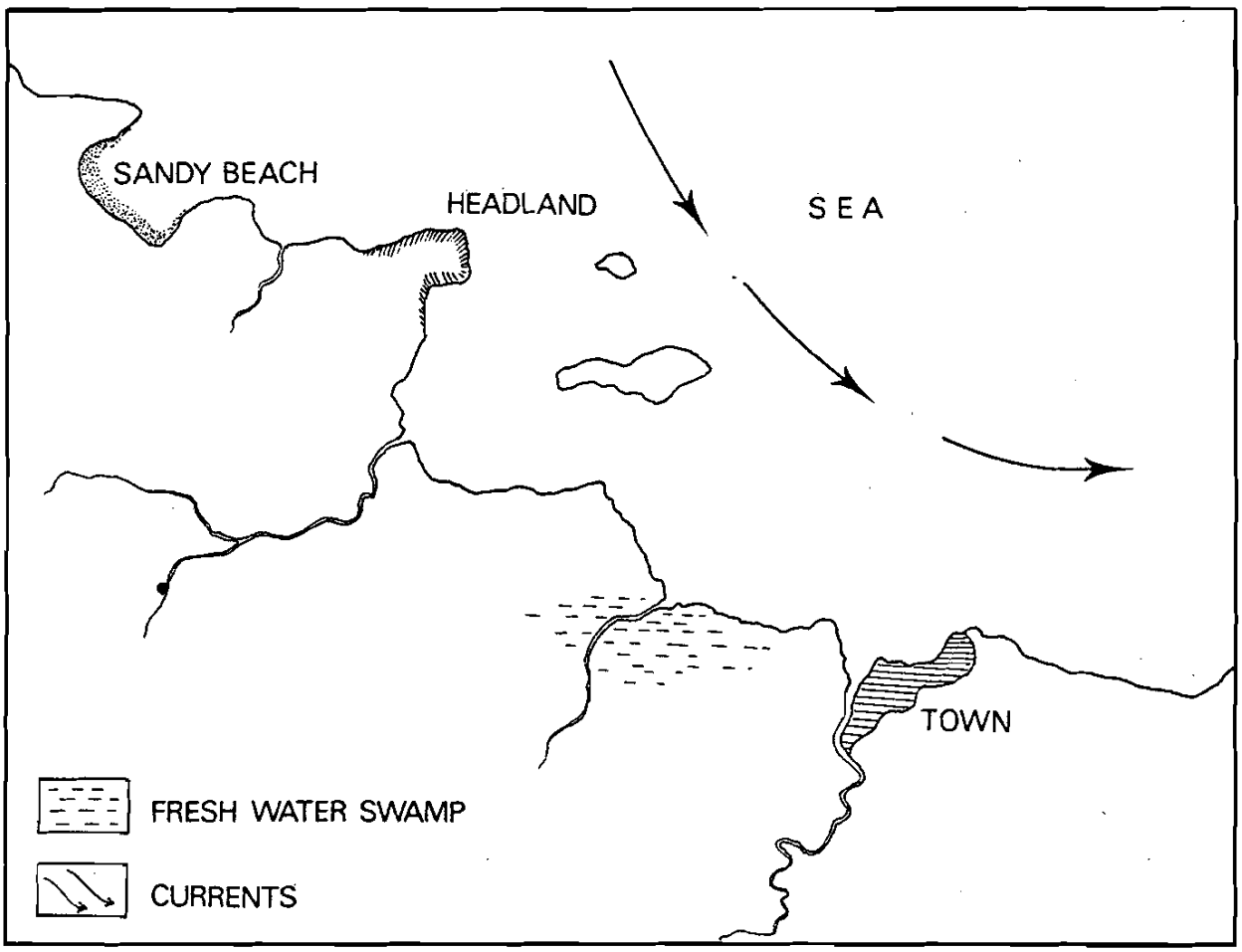


B

C _____



D _____



6. a) On the given map indicate with a 'x' where mangroves are most likely to develop.

   b) Give 2 reasons in support of your choice.

7. a) Do mangroves cause accretion of sediments or are they a consequence of sedimentation?

   b) What is the geomorphic role of mangroves?