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Mangroves - our ecological ugly ducklings

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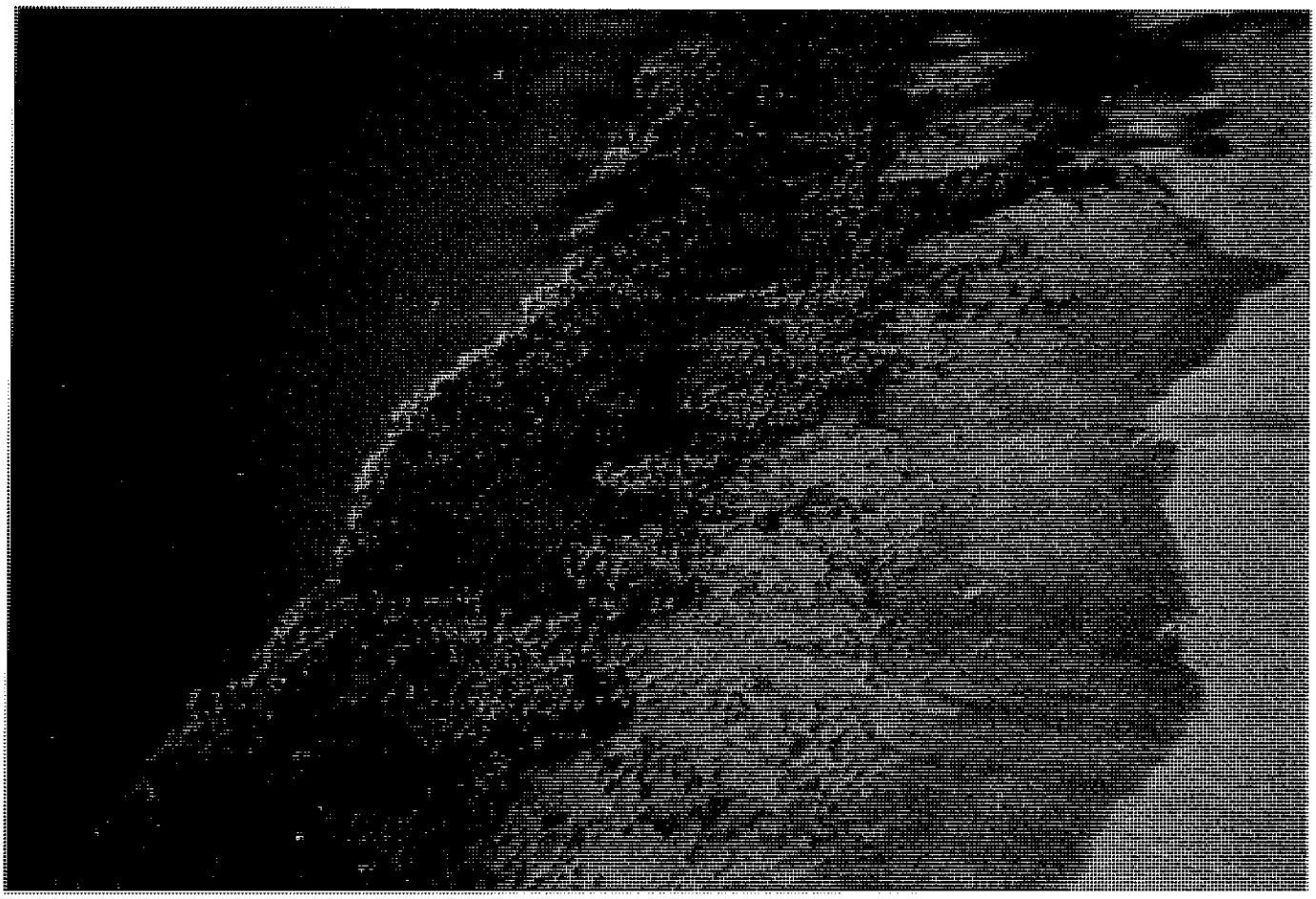
MANGROVES — Our ecological ugly ducklings

In the Celebes fish traps are built from mangrove wood to harvest the rich fish life of the mangroves. In the background can be seen stands of the mangrove palm *(Nypa fruticans).*

Text and photos by Dr. Peter Saenger

One of the many common species of crabs *(Metopograpsus frontalis)* feeding on the surface sediments amongst the mangroves. Bacteria and diatoms form the main constituents of its diet.

The tangled proproots of *Rhizophora stylosa* provide an ideal substrate for the growth of oysters, barnacles and a variety of algae.

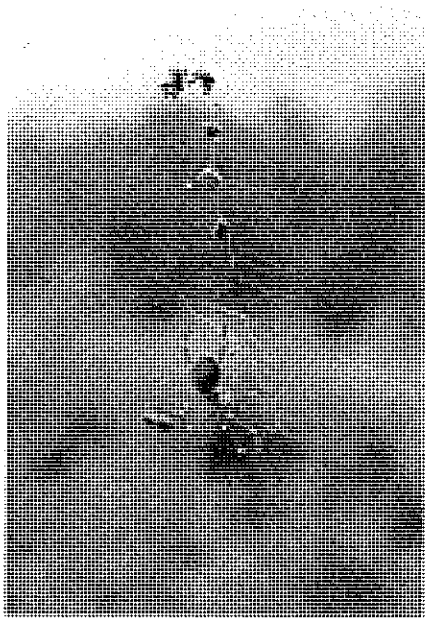


This infrared photo of the mangroves of the shores of the Gulf of Carpentaria clearly shows the different bands of mangroves running parallel to the shoreline. This zonation is typical of the northern mangroves and is caused by the differing responses of the individual species to tidal levels.

MANGROVES have been called the forests of the sea since they inhabit tidal swamps, muddy areas of silt at the mouths of rivers and other low-lying areas which are regularly inundated by the sea. By the standards of land plants, mangroves occur in a difficult harsh environment. They are rooted in saline water-logged soils where conditions fluctuate from high to low tide and for a considerable time, their lower branches and leaves are submerged in seawater. Their seedlings must become established in these conditions despite disturbance by currents and the often large rise and fall of tides.

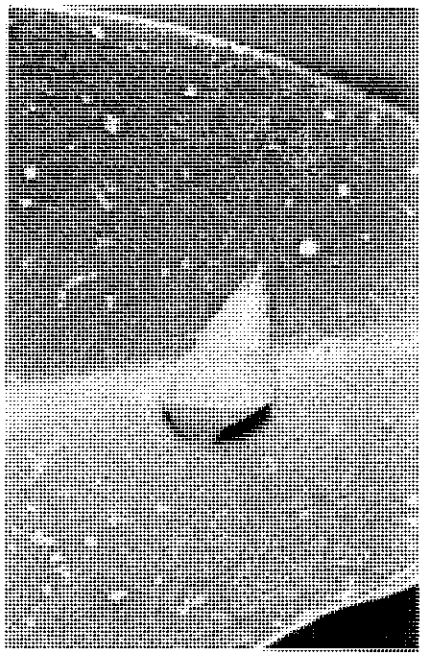
The extensive proproot development of the mangrove *Rhizophora mangle* on the Hawaiian island of Oahu.

At a slightly lower tidal level than the mangroves, seagrass flats may occur, often with a distinct and characteristic fauna. Here at Barwon Heads, *Zostera* and *Heterozostera* form a seagrass flat immediately seawards of the mangroves.



Numerous spiders live amongst the mangroves feeding on the numerous insects such as mosquitoes, flies and bees.

Both the living and dead wood of many species of mangroves serves as a home or food source to several species of invertebrates. The wood-boring mollusc *Teredo tristi* lives in the red heartwood of the mangrove *Rhizophora stylosa.*

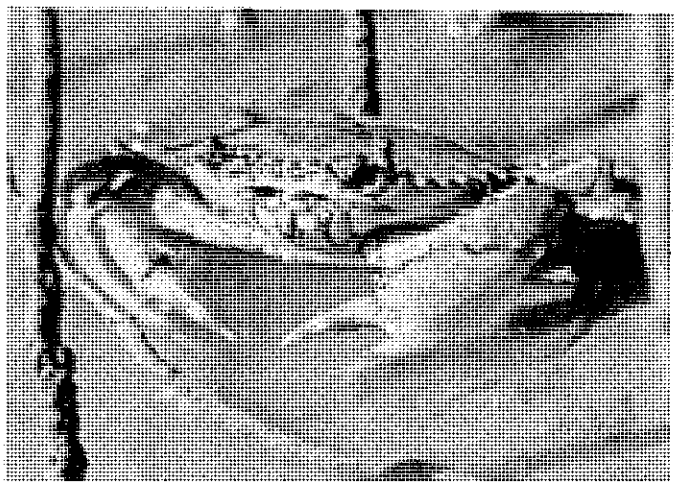


The mangrove australwind *Melarapha (Littorina) scabra* is a common inhabitant of the foliage of mangroves. The white spots on the leaf are salt crystals.

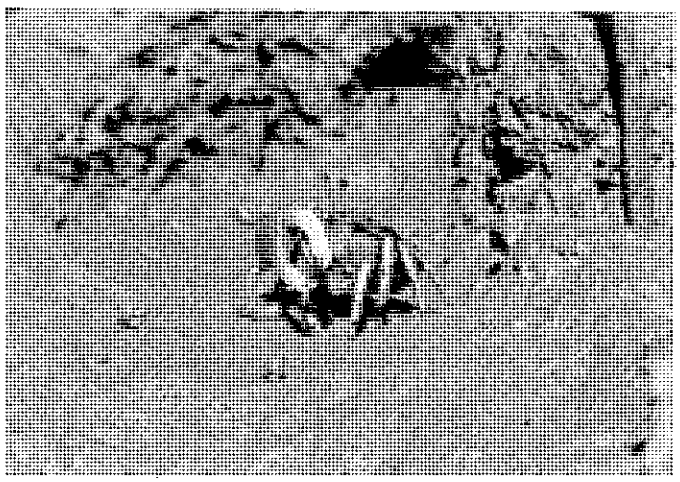
Despite these advserse conditions, mangroves are one of the most widely distributed plant community in Australia and around the tropics generally. Mangrove communities occur around the entire Australian coastline although along the southern and south-western shores, their occurrence is very sporadic.

Little is known about the early uses of mangroves; Nearchus (325 BC) and Theophrastus (305 BC) referred to seedlings of the stilt-rooted mangrove Rhizophora as having an aphrodisiac effect when ingested and of their use in various love-potions in Arabia. A Moorish botanist, Abou'l Abbas en-Nebaty described in 1230 how mangroves were used as food, fuel and medicine for curing sore mouths and tanning leather! In 1795 Sloane described how the people of Trinidad mixed the bark of mangroves with milk or fresh butter, a mixture which aided the curing of diseases of the liver; in other parts of the West Indies a wine was made from the mangrove seedlings. Mangrove wood has long been used in the construction of ships and even today, many of the houses in south-east Asia are covered by Nypa leaves, the mangrove palm.

It seems almost ironical that such a widespread plant community has received so little scientific attention, particularly in Australia. A recent compilation of scientific investigations carried out on Australian mangroves included about 150 scientific publications, mostly botanical, ecological and physiological. Of these more than two-thirds were less than 10 years old. Why have mangroves been largely ignored by scientists and why are they generally unpopular with the public? To find answers to these questions, it is necessary to examine the 'ugly' aspects, both real and imagined, of mangrove areas.



The mudcrab *(Scylla serrata)* is one of the carnivorous crabs amongst the mangroves. It is exploited for the delicious flesh of its large claws.



One of the most characteristic crabs of the more tropical mangroves is the fiddler crab *(Uca longidigitatum).* The one enlarged claw is neither for feeding nor defence but is used only for sexual displays.

Mangrove areas are difficult of access and generally unpleasant. Since mangroves occur in swampy muddy situations access is limited and even after access has been achieved, movement is limited by the adhesive nature of the substrate. Many insects use mangroves as breeding or hunting grounds including such notables as mosquitoes and biting midges. Mangroves tend to block the view of the open water; to the developer and land-owner such a vista increases the value of their land holdings. Mangroves tend to be best developed where the substrate is naturally accreting. This process of accretion is assisted by shelter from strong wave action and onshore winds. However, being areas of natural deposition also means that floating rubbish introduced into the sea by man, will also be deposited in all probability in a mangrove area. And those who have walked through a mangrove area will undoubtedly not have failed to find a light bulb and one plastic thong. In many areas this natural tendency for rubbish deposition has been extended to the point where mangrove communities, especially near population centres, are looked on purely as potential council dumps.

Luckily mangroves also possess some 'good' qualities although like those of the ugly duckling, these may not be obvious at first inspection. It is this value of the mangroves that is forstering the widespread concern for the misuse of these communities.

For some time it has been known that mangroves act as geomorphological agents in that they shape the topography of the intertidal area on which they grow. By sheltering the nearshore zone at high tide from the effects of offshore winds they are able to trap and fix sediments that would otherwise remain mobile. In this way they assist in building up depositional areas by as much as 15 cm in three years. While such deposition may lead to shallowing, it is far outweighed by its stabilizing and protecting influence on our coastline, especially one subjected to accasional cyclones and storm surges. Suspended matter washed down by rivers is trapped amongst the mangroves. This suspended matter contains not only clay, silt and sand particles but organic matter rich in nutrients such as phosphates and nitrates. Most of these nutrients would without the mangroves, be simply washed out to sea. Instead they are stored in the sediments accumulated amongst the mangrove roots. If one takes bore samples from these sediments one finds the largest organic content lines between 60 - 200 cm below the surface and that the most intense microbial activity which releases the various nutrients from the organic matter is also taking place at this depth. Examination of the mangroves themselves shows that their root development occurs at the same depth and it would appear that the mangroves take up these nutrients, incorporate them into their leaves and thereby return the nutrients to the surface of the sediments. In returning the nutrients to the surface of the sediments, they can subsequently be re-used by other organisms such as algae etc. The high nutrient status of mangrove areas has been recognised for some time by the Indonesians. They discovered that small ponds dug amongst the mangroves could be successfully used to culture prawns and fish. Recent measurements have shown that these types of ponds produce the highest return of protein per hectare of any area of cultivation in the world.

Based largely on work carried out in Florida and Puerto Rico, it has become apparent that mangroves and other associated marine habitats — such as salt-marshes and seagrass beds — are amongst the most naturally fertile areas in the world. Australian estimates for the rate of production in mangroves fall between 70 to 280 kilograms per hectare per day. Something of the order of 45% of the organic matter produced is released into the near-shore waters where it can be used by a variety of other organisms. The combination of an abundance of organic material with generally shallow, sheltered conditions makes mangrove areas highly suitable as fish nursery areas. Few Australian fish species actually spawn in estuarine inshore waters but many species spawn outside and the juveniles subsequently move into the mangrove estuaries where conditions are favourable for their rapid growth and development. Many of our commercial and sports fisheries are dependent on the mangrove environments. Estimates by the N.S.W. State Fisheries indicate that 67% of the total New South Wales commercial catch was of species that at some stage of their life, were dependent on estuaries. In fact the figure of 67% is likely to be conservative because of the difficulty of identifying very young fish less than 2 cm in length. In a two year study of the juvenile fish of the Nerang River in Queensland, a river highly modified by the construction of residential canal estates which involved large scale clearing of the mangrove vegetation, it was found that the juvenile fish population was only about one half of that in unmodified mangrove areas. Although some other factors are undoubtedly involved, the removal of the intertidal vegetation including the mangroves, played an important role in the reduction of the juvenile fish populations using these areas.

In addition to fish, mangrove estuaries are also important to a number of other species at some stage of their life. These species include such commercial ones as most of our prawns, the rock oyster and the mud crab.

The last of the 'good' qualities of the mangroves that needs to be mentioned is their 'simple complexity'. If that sounds contradictive it only serves to emphasize the contradictive nature of mangrove communities. The tree and shrub species found in the mangrove community have many biological and morphological peculiarities; these peculiarities are forms

In New South Wales and southern Queensland, mangrove estuaries are used for the cultivation of rock oysters *(Saccostrea cucculata)*. The oyster spat is allowed to settled on wooden rafts which are then placed in the most favourable part of the estuary. The young oysters are filter-feeders straining bacteria from the water. The bacteria in turn grow on the mangrove leaf detritus.

The upside-down jellyfish *(Cassiopeia* sp.) is sometimes found in the shallow sheltered areas amongst the mangroves. It traps small animals amongst its many tentacles but it also contains symbiotic algae or zooxanthellae, which supply it with nourishment in the presence of light.

A number of different organisms inhabit the foliage of the mangroves; here a species of wasp is initiating a new 'nest' in the branches of the mangrove *Avicennia australasicum*.

of adaptation to the conditions of their environment. Some of these adaptations are specialised root structures, salt tolerance, seeds that germinate on the tree rather than on the ground and which are adapted to dispersal by flotation. The fauna, especially the invertebrates, is also diverse and specialised in their muddy intertidal existence. Crabs are abundant amongst the mangroves and provide a variety of colourful and often amusing displays. The insect and spider fauna is obvious, diverse and often annoying. Even the vertebrates which live permanently amongst the mangroves, have adapted to their life-style. The mudskippers which amused Captain Cook in 1770, literally walk on their fins and carry their own water supply with them. Yet all of these organisms rely in one way or another on the mangroves, their litter or decaying wood. The various interactions are complex and in Australia still poorly understood. Despite these complex interactions and the extremely high productivity of mangroves, the number of species permanently resident is surprisingly low. Because mangroves are relatively simple in terms of species composition yet show all the complex interactions of other more complex communities, they constitute an ideal system for teaching purposes and for scientific investigations aimed at determining what makes the ecosystem as a whole function the way it does.

In this context it is pleasing to see that the plans for a 'Mangrove Study Centre' at Careel Bay in New South Wales are well advanced. With suitably laid out boardwalks, this centre will allow students to visit and appreciate the mangrove community with minimal disturbance.

Understanding of the ecosystem as an entire entity is a fundamental requirement for the management and manipulation of that ecosystem and as mangroves are such highly productive communities, the need is urgent to manage at least a part of them rather than allowing the present thoughtless destruction to continue.

Further Reading:

Macnae, W. 1966, Mangroves in eastern and southern Australia. Australian Journal of Botany, Vo. 14, pp. 67 - 104.

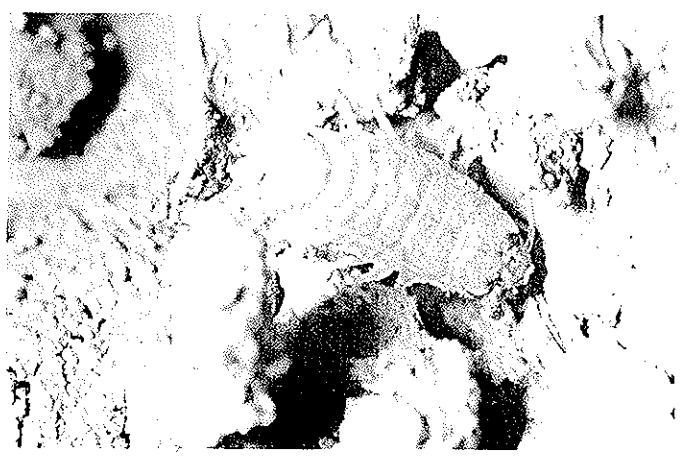
Saenger, P., R.L. Specht and M.M. Specht, 1977, Mangal and coastal salt-march communities in Australasia. In: Ecosystems of the World. Edited by V.J. Chapman. Elsevier Scientific Publishing Co., New York, pp. 293 - 345.

Lear, R. and T. Turner, 1977, Mangroves of Australia. Queensland University Press.

An Indonesian prawn farmer with some of his catch of the prawn *Penaeus monodon*. The prawns were grown in mangrove ponds on the island of Celebes and attained their size in three months.

The lesser noddy *(Anous tenuirostris)* builds nests of the seaweed *Sargassum* in the branches of the mangrove *Avicennia australasicm* on Woody Island in the Abrolhos Group of Western Australia.

Mangroves and their associated faunas are remarkably uniform throughout the world. The breathing roots or pneumatophores of *Avicennia marina* with their coating of algae as well as the fiddler crabs and mudwhelks look identical to their Australian counterparts although photographed in Mocambique on the east African coast.



Woodlice, crustaceans belonging to the order Isopoda, burrow and feed in the wood of most of the tropical species of mangroves.

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