ARE MANGROVES REALLY NECESSARY?

C D FIELD

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Mangroves are a common sight on mudflats and the banks of the estuaries along the seaboard of Australia. There are some twenty-seven different species of mangrove known in Australia, mostly in the northern region. However, throughout the countries of Asia there are many more species and much larger land areas occupied by mangrove forests. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) has recently expressed concern at the rate that mangrove vegetation is being destroyed throughout the Asian and Oceania regions and it has called for an urgent study of the problems surrounding the management of mangrove forests.

The mangroves are a special form of vegetation as they exist at the boundary of two environments and receive nutrients from terrestrial and marine sources. Inherent in this habitat is their ability to survive in a highly saline environment. Traditionally mangrove swamps have been considered as wastelands with little intrinsic value and they have been actively destroyed. The usual approach has been to dredge them, drain them and fill them, converting their natural habitat into dry land on which no mangrove can survive. Mangroves also tend to occupy sites valuable for use as ports, industrial complexes, mining and man-made recreation centres and so they have been subject to considerable development pressure.

In recent years it has been realised that mangroves may have a special role in supporting fisheries and in stabilizing the coastal zone. It has also been appreciated that mangrove forests can yield useful forest products and that they offer a unique wildlife habitat. In parallel with the slowly emerging discovery that mangrove forests can be useful, the exploitation pressures and environmental disruption has increased dramatically so decreasing the availability of the value of all resources associated with mangrove forests. The conflict between the natural value of mangrove land and alternative uses of the resource is accentuated by the fact that mangrove resources are limited and the causes of their loss seldom have significant long-term economic value justifying the loss. In fact, most decisions to destroy a mangrove stand are based on near-sighted planning and an ignorance of the value of mangroves on the part of the people who make the policy decisions relating to natural resources.

The problems confronting scientists, who are concerned about the long term viability of mangrove resources, is to acquire sufficient data and information so that governments and developers can be persuaded to manage mangrove resources for sustained yield and maximum value to the community.

The approach that is needed can be usefully divided into three categories:

- Catalogue of the existing situation.
- Conditions for the survival of mangrove community.
- Economic values.

Consider each of these main categories in more detail:

Catalogue of the existing situation

- It has only been recently that attempts have been made to estimate the areas covered by mangrove forests in various parts of the world. Initial values show that Asia and Oceania support about 7 million hectares of mangrove forests, which may amount to almost one half of the total world resource. It is interesting to note that Australia possesses a mangrove resource in excess of 1 million hectares and that 93% of that resource lies in tropical Australia. These figures represent a rather crude analysis of the situation and much more detailed information is required in the form of a quantitative resource inventory. Such an inventory would include: base maps of existing forest cover, plant and animal life in the intertidal zone; tables showing forest height, basal area, age structure, species abundance and densities, soil types and flooding patterns; economic-use maps showing the kind and extent of existing human uses. Such information would be invaluable for gauging the success of management strategies, and for setting a base line.

Conditions for the Survival of a Mangrove Community

It is important to fully understand how direct and indirect actions of man affect the existing and future resource value of the mangrove forest. Mangroves throughout the Asian and Oceania regions are disappearing at an alarming rate for primarily economic reasons connected with the development of natural resources. The causes include direct action such as: clear felling, wood chipping, charcoal production, conversion to fish ponds, conversion to agriculture, urban and industrial development and indirect action such as: diversion of fresh water, nearshore mining, oil pollution, industrial pollution, and soil erosion due to construction activities.

It must be accepted that many of these activities are necessary for the economic welfare of the countries concerned but a thorough knowledge of the habitat requirements of the mangrove community could minimise the impact of undesirable actions.

It has already been established that the following environmental factors should be disturbed as little as possible if the mangrove communities are to be protected:

- timing and quantity of freshwater run off entering the mangrove community;
- surface circulation pattern of water in the mangroves as a result of tidal action;
- physical structure, chemical properties, biological activity of the sediment in which the mangroves are growing.

There is an urgent need to understand the habitat requirements of individual species better through a clearer understanding of their physiology and growth patterns and their response to environmental stress.

Harvesting mangrove timber in Malaysia.

Economic Values

The most important aspect of the management, utilization and conservation of mangrove ecosystems is the determination of their value as forest crops, sustainers of nearshore fisheries and as a stabilizing influence in the coastal zone environment. It is important that economic planners take all these factors into account rather than the direct value of one particular aspect. The developers and planners must be educated to understand the total resource represented by a mangrove forest so that management utilization and the conservation of the mangrove environment can be optimised for the maximum benefit of the community. In turn, there is a need to support research activities throughout the regions of Asia and Oceania so that much better data on the real economic value of mangroves will be available to the planners. It is not sufficient to say that mangroves need protection without justifying the reasons behind such a statement.

An apparently simple approach would be to develop a correlation between the land area of mangroves and the value, for example, of the fisheries

captured in the neighbouring nearshore environment. Such data is not yet available for a specific mangrove area and the total associated fisheries. At a somewhat higher level of sophistication the relationship between the net primary production of the mangrove forest — that is the material produced by a mangrove forest after some of the products have been used to sustain the growth and maintenance of the forest — and fisheries production could be used to predict fisheries production as a function of time on the basis that material from the mangrove forest will vary with the seasons.

The same model could be used to predict the economic loss through a fall in amount of fish caught if a mangrove forest is totally cleared to make room for an allegedly more profitable purpose.

In some areas the lack of fresh water is critical to the process of economic development. Engineers tend to view fresh water running into the oceans as wasted and they therefore divert the fresh water into dams or reservoirs. The consequent damage to local mangrove forests and the relationship that this may have to a fall in fish productivity must be weighed against the economic advantages perceived by the engineers.

It must be understood that at this time the economic significance of the mangrove forests is very poorly documented. Much work is urgently required to make the appropriate data available before the mangroves are destroyed for want of a better alternative.

UNESCO has expressed its concern about the uncontrolled destruction of mangroves in our part of the world. It has called for a joint scientific, sociological and economic study of the problems. Australia, as a well developed country scientifically, has an important role to play through scientific leadership and education to enable such a joint venture to be a success. The implications for the long term economic future of the region are enormous and the Australian Government should not hesitate to support the proposals of UNESCO by providing significant resources in terms of scientific manpower and research funding.

PHYTOPHTHORA IN QUEENSLAND MANGROVES

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During the past three years many white mangrove trees *(Avicennia marina* [Forsk.] Vierh.) have died in the Gladstone area of central coastal Queensland. A few dead trees were first observed in 1978 in the vicinity of the Gladstone power house by Dr Peter Saenger, a biological consultant with the Queensland Electricity Generating Board. The number of deaths increased considerably in 1979 and at present approximately 70 per cent of white mangrove trees growing near the mouths of the Calliope River and Auckland Creek have died (Figure 1). Twelve species of mangrove occur in the Gladstone area (Saenger and Robson, 1977), but only *Avicennia marina* is affected.

The first visible symptom in the aerial parts of affected trees is a wilting of the leaves. These leaves then become yellow and gradually fall so that trees are almost completely defoliated. The lateral absorbing rootlets which are borne at the base of the pneumotophores become black and decayed. A trunk rot is also occasionally present. This originates at ground level and may extend two metres up the trunk. Trunk lesions are a deep purple colour, and when this discoloured tissue is cut it has a sweet, sickly odour.

At the request of the Queensland Fisheries Service, a study was initiated by the Plant Pathology Branch of the Queensland Department of Primary Industries to determine whether a plant pathogen was responsible for the death of these trees. Isolations were made from decayed absorbing rootlets and from trunk lesions. A fungus belonging to the genus *Phytophthora* was consistently recovered.

The genus *Phytophthora* has come into prominence in Australia in recent years following the discovery that the disease known as "jarrah dieback" in Western Australia is caused by *Phytophthora cinnamomi* Rands. This fungus also caused severe damage to some eucalyptus forests in Victoria. Diseases such as avocado root rot, pineapple root and heart rot, collar rot of citrus, root and stem rot of soybeans, blight of potato and black rot of cocoa pods are also caused by species of *Phytophthora*. The name *Phytophthora* (Greek: *phyton,* a plant; *phtheiro,* destruction) literally means "plant killer".

In any plant pathological investigation the isolation of a fungus from an ailing plant cannot alone be accepted as evidence that the fungus has caused the disorder. To be ascribed a causal role the fungus must first be grown in pure culture and then be used to inoculate the same plant species in which the disorder appears, and it must produce the same disease symptoms. Therefore, small pieces of mycelium of the fungus isolated from white mangrove roots and grown in pure culture were placed in slits in the stems of two-month old white mangrove seedlings raised in a glasshouse. Within two weeks the fungus grew upwards and downwards in the stem to produce lesions up to 40 mm in length (Figure 2). This experiment demonstrated that the fungus is a wound pathogen of white mangrove stems. However, in nature *Phytophthora* species infect plant roots by means of motile zoospores and, less commonly, by direct invasion by fungal hyphae. Therefore, two-month old seedlings raised in the glasshouse were inoculated with concentrated zoospore suspensions of the fungus. These seedlings developed a slight necrosis of the root tips but otherwise remained quite healthy. If plant roots were severely damaged prior to inoculation, considerable decay of root tissue resulted. From these experiments it was concluded that the *Phytophthora* species isolated from declining mangroves is not an aggressive pathogen of healthy white mangrove trees and could not be considered the primary cause of mangrove deaths in the Gladstone area.

Figure 1. Declining white mangrove trees along the Calliope River, Gladstone.