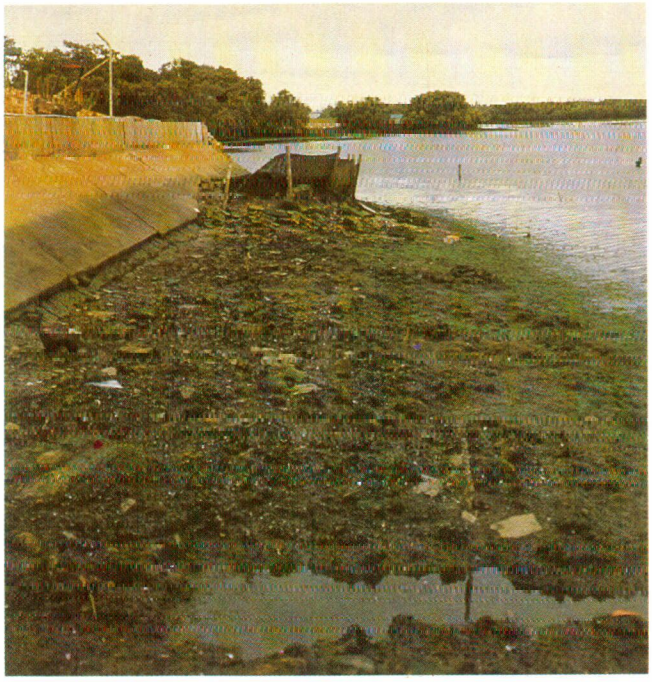
A Guide to
Mangrove Transplanting

State Pollution Control Commission

Division of Fisheries, Department of Agriculture – N.S.W.



The opportunities – "reclaimed" foreshores and industrial frontages – and the solution: the regeneration of attractive ecologically and economically important mangrove forests. Photographs: Phil Gibbs and Peter Freeman

1 Introduction

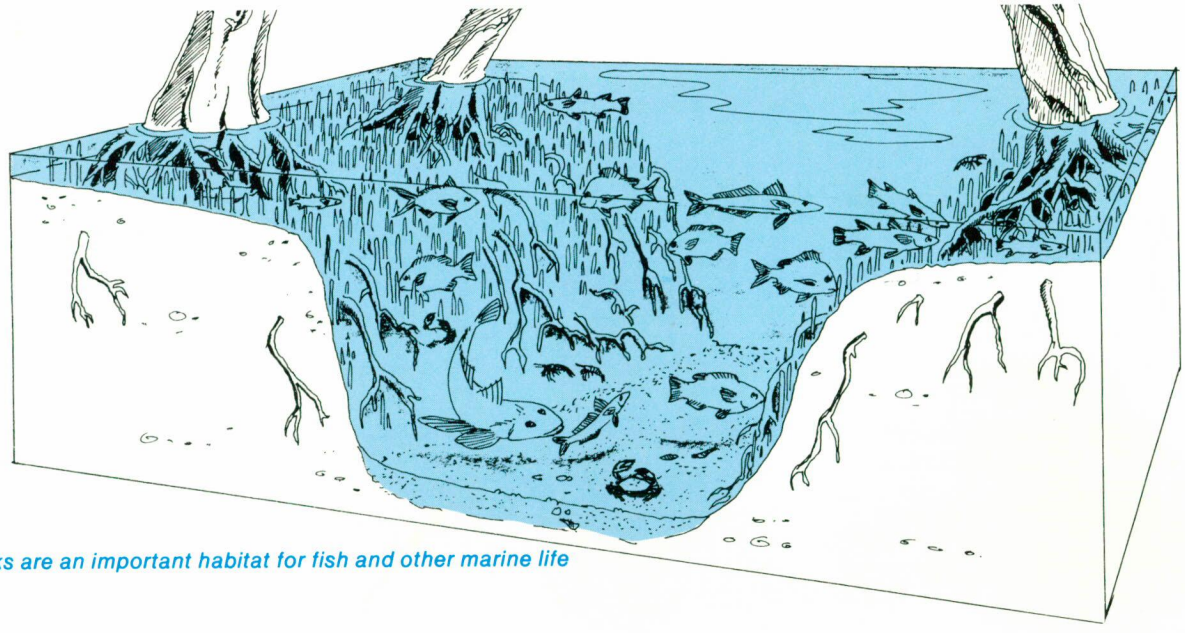
In October 1978 Concord Municipal Council resolved to carry out a mangrove planting programme in its municipality along the foreshores of the Parramatta River.

The principal objective was to revegetate selected sections of the foreshores with mangroves, replacing the important mangrove habitat lost through over a century of riverside development. A secondary objective was to complement the council's ongoing programme of foreshore beautification, especially along the frontages of industrial estates.

At an early stage the council consulted with the Maritime Services Board and State Fisheries, and both departments approved the council's proposed programme. State Fisheries was particularly interested in the rehabilitation of this mangrove habitat, both in terms of the possible benefits to fish in Sydney Harbour and in terms of broader applications to estuaries elsewhere in New South Wales.

The State Pollution Control Commission, which is responsible for co-ordinating the activities of all public authorities in the fields of pollution control and environmental protection, also became involved in the programme. In line with its responsibilities in the administration of the Clean Waters Act, the SPCC was particularly interested in the potential benefits for water quality in New South Wales estuaries.

On this basis a co-operative programme was initiated, and this booklet is one of the results.



Mangrove creeks are an important habitat for fish and other marine life

2 Why mangroves are important

Mangroves are important for a number of reasons:

- They are major producers of organic material and may have a special role in supporting estuarine fisheries (finfish, crustaceans and shellfish)
- They are involved in nutrient recycling
- They help to reduce water pollution
- They provide shelter, refuge and food for many forms of wildlife
- They help prevent bank erosion and provide protection from storm surge
- They act as visual screens along industrial foreshores, improving the amenity of the waterway
- Mangrove habitats act as important nursery areas for many economically important (commercial and angling) fish species.

The dominant economically important fish species found in mangrove habitats include bream *(Acanthopagrus spp)*, blackfish *(Girella tricuspidata)*, mullet (Mugilidae spp), flathead *(Platycephalus fuscus)*, silver biddy *(Gerres ovatus)* and whiting *(Sillago spp)*.

These species are present in the mangrove habitat both as temporary residents when juveniles, principally in autumn and winter, and as transient residents when adults. The major reasons for the selection of this habitat by juveniles appear to be shelter and the availability of food. Flat-tailed mullet feed at high tide on the myriad insect life amongst the mangrove peg roots (pneumatophores), while bream, silver biddy and whiting feed on aggregations of microcrustaceans and blackfish feed on algae attached to the peg roots and exposed roots on the creek banks.

It is not possible to place an exact figure on the monetary value of the mangrove habitat. However, in the ten years prior to 1972 the estuarine-dependent fish catch in New South Wales, including fish from mangrove habitats, was about 66 per cent by weight and over 70 per cent by value of the total fish catch in the State. The NSW fish catch in 1981/82 was valued at $72.5 million, and the estimated gross value of production from fisheries throughout Australia in 1981/82 was $396 million. In addition, the important recreational fishery in Australia makes a contribution to the economy possibly equal to or even greater than that of the commercial fishing industry, when one considers both sales and associated service industries.

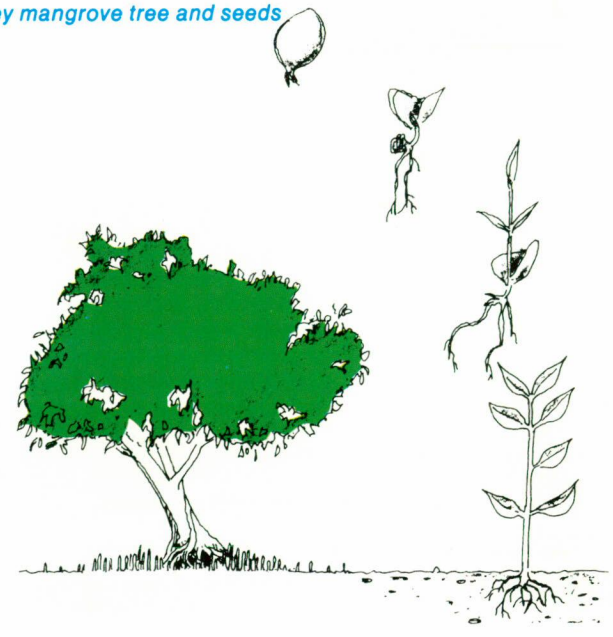
3 Mangrove species

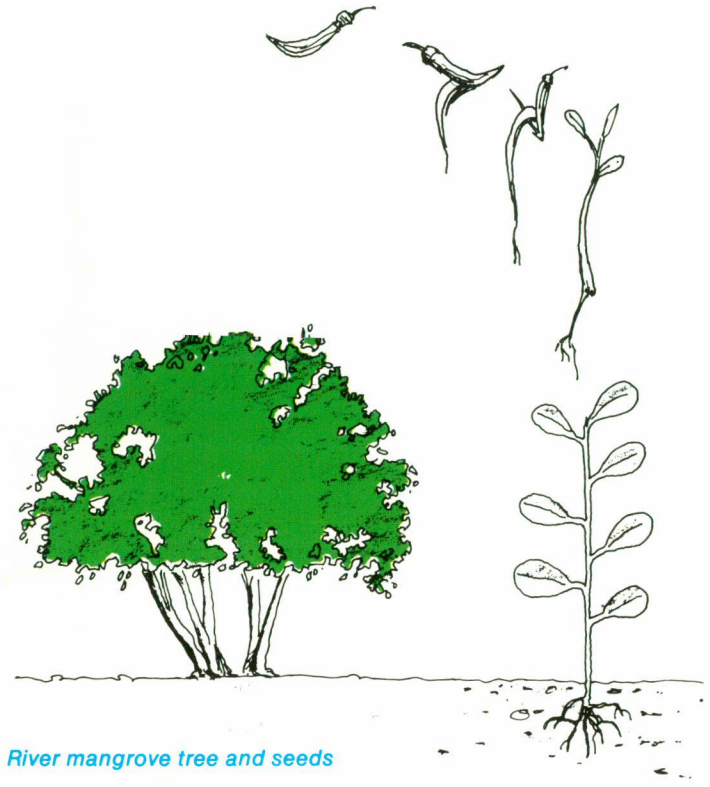
Within the Sydney region two species of mangrove are commonly found:

- The grey mangrove *(Avicennia marina* (Forsk.) Vierh.)
- The river mangrove *(Aegiceras corniculatum* (L) Blanco.).

The grey mangrove is a medium-sized tree, or occasionally a shrub, with a well-defined trunk and numerous vertical peg roots (pneumatophores).

Grey mangrove tree and seeds





River mangrove tree and seeds

Seedlings planted along exposed foreshores need to be protected from waves and flotsam and jetsam

The leaves are green above and greyish below, are ovate in shape with an acute apex, and occur opposite one another on the stems. The seed is viviparous (ie, it germinates on the tree), and has a large pair of seed leaves (cotyledons) which give it the appearance of a large flat bean. Seed fall is normally in summer.

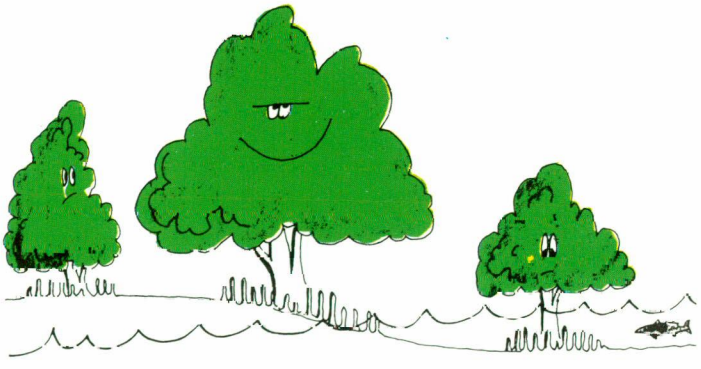
The river mangrove is generally a small shrub, often with several small trunks and no peg roots. The leaves are glossy green above and paler underneath, are ovate in shape but with a rounded apex, and occur alternately along the stem. The seed is small, curved and viviparous, and normally falls in late winter.

Both of these species have been successfully transplanted in the Sydney region. They are exceptionally adaptable to varying environmental conditions within estuaries. This adaptability is further shown by their ability to be grown as ornamental plants in pots. Transplanting success rates are improved, however, when a number of environmental parameters are taken into account.

4 Environmental considerations

Both mangrove species will grow in substrates ranging from gravel to fine mud or clay, with most mature forests occurring in areas of sandy mud. Frequently the substrate is anaerobic (lacking in oxygen). The two species of mangrove are also found throughout the salinity range from virtually fresh water to sea water. Both species occur together in suitable areas, although the grey mangrove prefers salinities close to sea water and the river mangrove prefers brackish water.

Before transplanting mangroves, the foreshore tidal plane must be considered. Trees can be found growing both terrestrially and fully submerged, but optimum growth and establishment success appear to occur just above the mid-tide level.



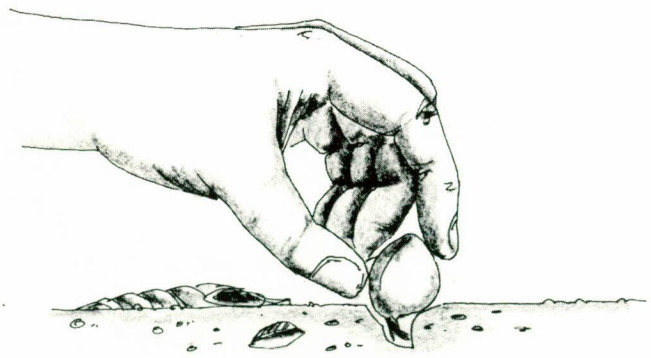
Another factor to consider is exposure to waves. It has been demonstrated that the major cause of transplanting failure is seedling damage caused by high wave action and associated flotsam and jetsam.

Wave energy along exposed reclaimed foreshores fronted by retaining walls is dissipated over a short distance below the wall. This makes such foreshores an unstable environment in which to establish mangrove transplants. In these situations physical protection of the transplants is necessary (see section 5).

Seedlings should be collected from large, mature mangrove stands.

5 Methods of establishment

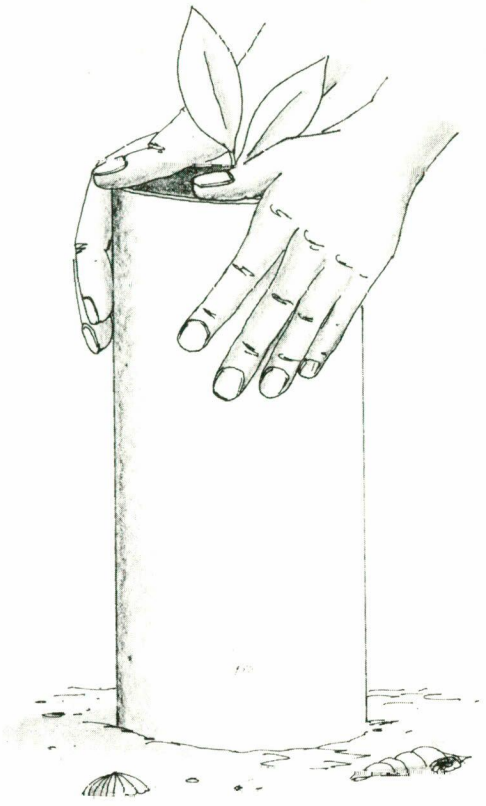
Both species produce large quantities of viviparous seeds which can be collected in the appropriate months (see section 3). The seeds can be easily transported and hand sown in selected locations by placing the sprouting seed 1 to 2 centimetres into the substrate. This technique is not suitable for locations where wave and tidal action can easily dislodge the seed, but is highly appropriate for increasing the density of existing mangrove stands, where the seeds can be lodged amongst the peg roots, or for sites which are well protected.



The most common transplanting method, however, is to use seedlings. Seedlings should be collected from large, mature mangrove stands where regular natural seeding occurs, so that their removal will not affect the viability of the forest. Within these mature forests most seedlings germinate, grow to about 0.6 metres, remain at this stage of development for up to five years and then die. This inhibition of growth appears to be related to competition for light and space in the understorey of mature forests. An estimate of seedling age can be made from the degree of woodiness (lignification) of the trunk base.

Seedlings chosen for transplanting should be about 0.5 metres long with a straight trunk. They should be no more than 18 months old and should have 6 to 10 leaves and no peg-root development. Collection and planting are best carried out during low tide.

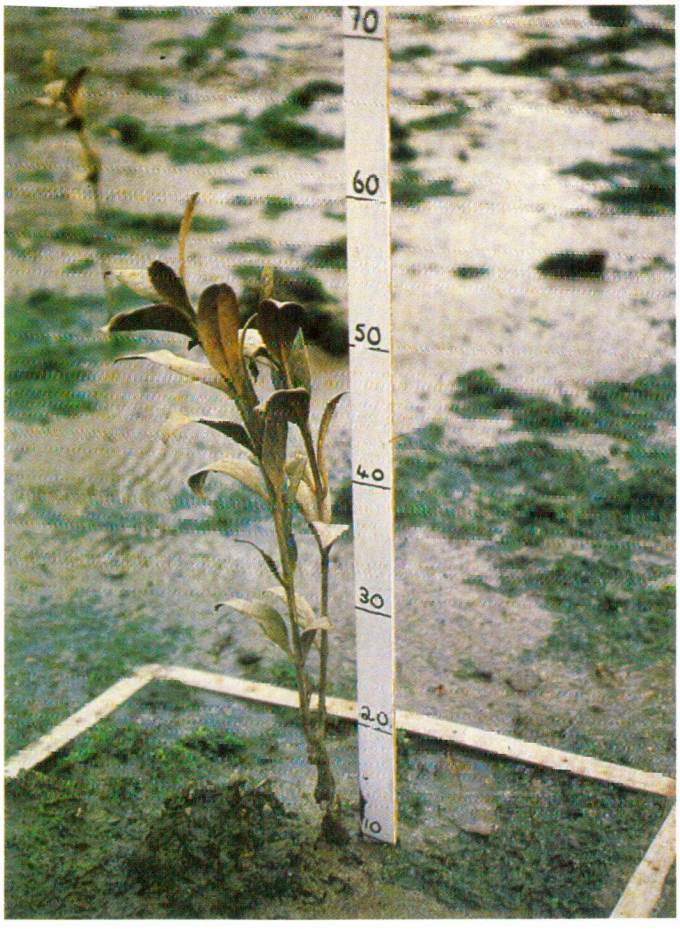
An example of a seedling suitable for transplanting.



A removed seedling and its "plug" of earth

Typical growth of a grey mangrove:

(a) six months after being transplanted



(b) 2½ years after being transplanted

Removal of seedlings from the substrate is facilitated by using a length of hollow, 100 millimetre diameter p.v.c. pipe as a corer pushed 20 to 25 centimetres into the substrate around the seedling. The pipe, containing the seedling and a "plug" of earth, is then removed intact. A litttle water poured gently down the pipe will help to shake the seedling and earth plug out of the corer.

During collection and transportation the seedling and earth plug should be kept moist in a container (eg, a plastic bin), protected from direct sunlight and wind. To reduce the possibility of drying out, transplanting in summer is not recommended.

Investigations are currently in progress to design a corer which can be applied to large-scale transplanting (contact the persons listed in section 8 for further information).

When planting, a preparatory hole is dug and the earth plugs placed in position. Depending on the degree of exposure to wave action, each seedling may be tied to a garden stake using "budding" tape so that it remains in an upright position. Additional protection may be provided by the use of a shade-cloth fence or by piling rocks around the seedlings to prevent algae and flotsam and jetsam being left stranded on the seedlings by receding tides.

Best results are achieved by planting seedlings in close clumps at 20 to 25 centimetre intervals rather than by planting them in neatly spaced rows. Clumping offers the central plants additional protection.

The cost of seedling transplanting can be determined on the basis of a transplanting rate of 80 seedlings per two-person team per day. This includes collection, minimal transport time and planting.

Transplanting success rates and individual tree growth rates are highly variable. As explained in section 4, they depend greatly on the areas into which the seedlings are transplanted.

Along the Parramatta River foreshores, for example, success rates after four years have ranged from 0 per cent (below exposed retaining walls with no additional protection given to transplants) to 45 per cent in more protected situations, with the greatest loss of seedlings occurring in the first two months after planting.

6 Typical applications

The possible situations in which transplanting of mangroves can be applied are many and varied. They range from culture in pots to the restoration of the degraded wetland areas which are so vitally important to estuarine ecosystems.

Examples of situations in which mangrove transplanting has been successful are:

- Along reclaimed foreshores formerly occupied by wetlands.
- As a fringing strip along retaining walls, where both screening for aesthetic reasons and habitat restoration are desirable. This is particularly relevant where "terrestrial" landscaping may be impractical (eg, where buildings or other structures abut the foreshore).

(c) 4½ years after being transplanted

A fringing strip of seedlings at Chipping Norton.

Foreshore-restoration works at the Hawkesbury River

- On shallow areas created either by nature or by foreshore restoration following development. One example is at Chipping Norton in the Georges River, where ponds remaining after sand extraction have been redeveloped as a State Recreation Area with a variety of wildlife habitats, both terrestrial and aquatic.

- As a requirement of habitat restoration following a development which involved some initial mangrove removal. An example is the foreshore-restoration works being undertaken at the Hawkesbury River following construction of the Sydney/ Newcastle oil and gas pipeline.

7 Legal considerations

Mangroves in New South Wales are protected under the Fisheries and Oyster Farms Act 1935. This Act prohibits the cutting of mangroves on Crown Lands, which are defined so as to include any foreshore below the high-water mark, unless a permit has been obtained under the Act. Approval under the Act is therefore required to remove established seedlings and transplant them in another location.

In the case of lands vested in the Maritime Services Board, including Newcastle, Sydney, Botany Bay, and Port Kembla Harbours, approval under the Board's Act is required before removal of mangroves can occur.

Advice on these various legal requirements may be obtained from the persons listed in section 8 below.

8 Further information

Additional advice on planting techniques and legal requirements may be obtained by contacting:

Mr P Gibbs,
Fisheries Research Institute
PO Box 21,
Cronulla, NSW 2230.

The Secretary,
Coast and Wetlands Society,
PO Box A 225, Sydney South 2000.

General information may also be obtained from the

State Pollution Control Commission
157 Liverpool Street,
Sydney 2000.
Telephone: 265 8888