17.0 MANGROVES

Figure 17.1 *Ceriops australis* forest.

Mangrove communities consist of a variety of growth forms that include trees, palms, shrubs, vines, epiphytes, samphires, grasses and ferns. They form valuable ecosystems along sheltered tropical and sub-tropical coastal environments that are periodically inundated by tidal waters.

The area of mangroves in Darwin Harbour is 27,350 ha, which constitutes about five percent of the total mangrove area of the Northern Territory. The extent of these mangrove areas is shown in Map 1.1 (p.2). The inter-tidal zone also features a similar area of mud and salt flats.

The mangroves of Darwin Harbour are amongst the most diverse in Australia. Approximately 50 species are regarded as 'mangrove plants' worldwide, of which 36 occur in Darwin Harbour. The most common species are *Rhizophora stylosa, Ceriops tagal, Sonneratia alba, Bruguiera exaristata, Avicennia marina* and *Camptostemon schultzii*. Eleven vegetation associations, including samphire/saltpan, have been mapped within the main body of Darwin Harbour, whilst others may exist in Shoal Bay (see Figure 17.2 below).

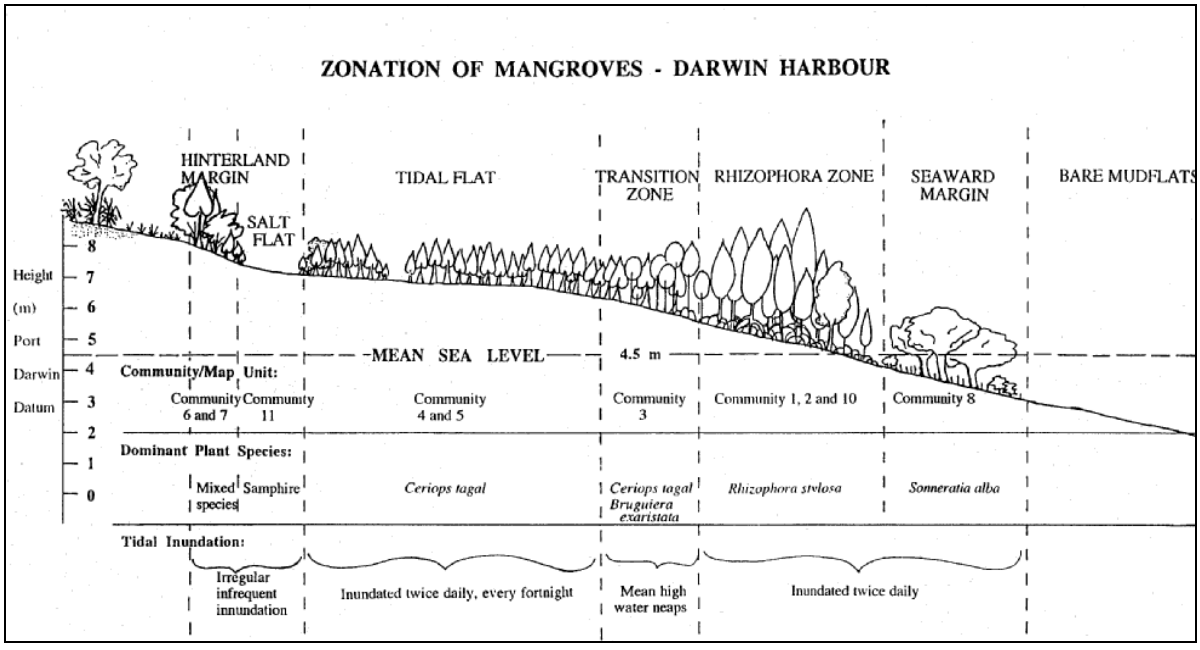

Figure 17.2 Stylised zonation of mangroves in the main body of Darwin Harbour (Source: Brocklehurst and Edmeades, 1996; diagram by Metcalfe)

Mangrove forests perform a vital role in estuarine and coastal ecosystems, and protect the coastline from erosion and storm surge. They form effective, self-repairing barriers against severe storms and tropical cyclones. Their extensive root systems trap and stabilise sediments, making them important 'sediment sinks' by reducing siltation of waterways and estuaries, improving water quality and protecting reefs from upstream sediment loads.

Mangroves produce large amounts of organic matter and nutrients, which support not only fauna and flora of the mangrove system itself, but also adjacent habitats. Many fish and prawn species, including species significant to recreational and commercial fisheries, utilise the mangroves as nursery habitat and spawning grounds. Mangrove fauna, such as crustaceans and fish, migrate out of the mangrove ecosystem to contribute significantly to the marine food chain. Estuarine and near-shore fisheries harvest the products of this complex food chain.

Development Pressures

As the Darwin region has developed, 400 ha of mangroves representing 1.5 % of the total mangrove area have been cleared. The land has been reclaimed for residential, industrial and infrastructure developments, for example the East Arm Port. In 2003, 46516 ha in Darwin Harbour, between the mean low water mark and 4 m above sea level (Australian Height Datum) was zoned "conservation" under the NT Planning Scheme, and require ministerial approval following public consultation to be developed. The area comprises 26,200 ha of mangroves, with the remainder being salt and mud flats, and fringing hinterland vegetation. An area of 1149 ha was zoned for development.

Mangrove community types in Darwin Harbour have been mapped between Charles Point and Sadgroves Creek by Brocklehurst and Edmeades (1996a). This represents about 80% of the harbour, and excludes the mangroves between Sadgroves Creek and Gunn Point. The areas of each mangrove community type that have been cleared are summarised in Table 17.1 and range from negligible (e.g. community 3) to 0.67% (community 4). The area of samphire/salt flats reclaimed for development is about half the area of mangroves cleared. The table shows that the hinterland, salt and tidal flats are the main zones that have been cleared for development.

The reclamation of mangrove and tidal flats has the potential to alter the hydrodynamics (i.e. patterns of water movement) of the harbour, and hence the transport of sediment in the harbour. The loss of mangroves in the upper parts of tidal creeks typically results in sedimentation in the lower reaches of the creek, which, unless dredged, are colonised by mangrove plants. At the moment, such impacts are localised and not well documented.

Table 17.1 Darwin Harbour mangrove communities cleared between Charles Point and Sadgroves Creek, 2004. The total area of mangroves in this area is 20,450 ha.

Community Code	Description	Area Cleared (%)
	Mangrove Closed Forest	
1	*Rhizophora stylosa* closed forest/low closed forest (shoreline forest)	0.01
2	*Rhizophora stylosa/Camptostemon schultzii* closed forest (tidal creek)	0.07
3	*Rhizophora /Bruguiera/Ceriops* closed forest/open forest (transition)	<0.01
4	*Ceriops tagal* low closed –forest (mid tidal flat)	0.67
5	*Ceriops tagal/Avicennia marina* low closed forest/open forest (high tidal flat)	0.08
6	Mixed species low closed forest/open forest (hinterland)	0.40
	Mangrove Woodlands/Open Woodlands	
7	Mixed species low woodland	0.25
8	*Sonneratia alba* woodland	0.03
9	*Rhizophora stylosa* low woodland (islands, rocky shores)	<0.01
10	Low open woodland (low tidal mudflat)	0.01
Mangroves cleared (Subtotal)		**1.52**
	Salt Flats	
11	Samphire/Salt flat	0.80
Total Mangroves and salt flats cleared		**2.32**

Water Quality and Mangrove Communities

Urban land-use increases the amount of freshwater, sediment, nutrients and metals entering the harbour (see Sections 5, 6 and 7). Because this land-use is small, so too is the area of mangroves that are potentially affected by urban run-off. Nevertheless, the health of these mangroves is important because they are valued by Darwin residents.

Pollutants from urban areas can accumulate in mangrove sediments and result in chronic (long term) and acute (short term) effects on mangrove flora and fauna. The heavy metal and nutrient concentrations in the mangrove sediments downstream of the industrialised Winnellie catchment (Figure 17.3) have been compared to other parts of the harbour not affected by urban run-off. Concentrations of the nutrients nitrogen and phosphorus were found the same as in others parts of the harbour. Concentrations of copper, lead and zinc were marginally higher in the Winnellie mangrove sediments compared to other sites, however, the concentrations were less than the recommended maximum limits for heavy metals in estuarine and marine sediments. Nevertheless, over time and with increasing catchment urbanisation, the mangrove

Figure 17.3. Run-off from the Winnellie industrial area flows into the fringing mangroves of the harbour and creeks.

sediments will continue to be polluted with heavy metals. It is not known how long the metals remain adsorbed to the mangrove sediments, whether they are available for uptake by flora and fauna, whether the metals accumulate, or whether contaminated sediments are transported to other parts of the harbour.

Monitoring of pesticides in the streams of Darwin Harbour has found they are rarely present in rural streams. The highest incidence of pesticides is in urban run-off, which has been found to be contaminated by organo-chlorine compounds such as dieldrin. These have been used in the past for termite control but have been banned due to their persistence in the environment. The concentrations of organo-chlorine pesticides were generally low, but sometimes exceeded national guidelines. The impact of pesticides on the mangroves is not known, but is likely to be minor owing to the low concentrations detected in urban run-off and the small area that receives urban run-off.

Urbanisation increases the amount of freshwater run-off from a catchment to the harbour and could affect the composition of mangrove communities by reducing the water and sediment salinity. This is likely to result a change in the composition mangrove community, rather than a reduction in area of forested mangroves, unless the effect of urbanisation is severe. Another source of freshwater to the mangroves is sewage effluent from the Leanyer, Berrimah and Palmerston treatment plants. This freshwater is rich in plant nutrients, with observations indicating it promotes mangrove plant growth, though the impact on sediment fauna has not been investigated.

Mangrove Monitoring

In 1997, a monitoring program commenced to obtain baseline data on the productivity and ecology of mangrove plants (Map 6.2, p. 23). A total of 27 sites were established that monitored the following variables: basal area, stem density and growth, seedling/sapling count, canopy cover, phenology, soil attributes and litter production. Litter production comprises leaves, buds, flowers, fruit, propagules and twigs that fall from a mangrove plant. Some of these variables, excluding basal area and stem density, show a substantial seasonal variation, as shown for litter fall in Figure 17.4, whilst soil attributes also vary with the tides. Mangrove plant productivity is highest in the wet season and lowest in the dry season. This monitoring information, which is most extensive for the years 1997 to 1999, provides a reference for comparison with other sites that may be impacted by development.

Between 2000 and 2002, additional monitoring was undertaken by community groups (Map 6.2, p.23). The aims of this program were to determine the impacts of development on Darwin hinterland mangroves, facilitate community education and gain a better knowledge about the mangrove environment. Overall, the monitoring results indicated that mangroves adjoining the urban areas are in a relatively healthy state.

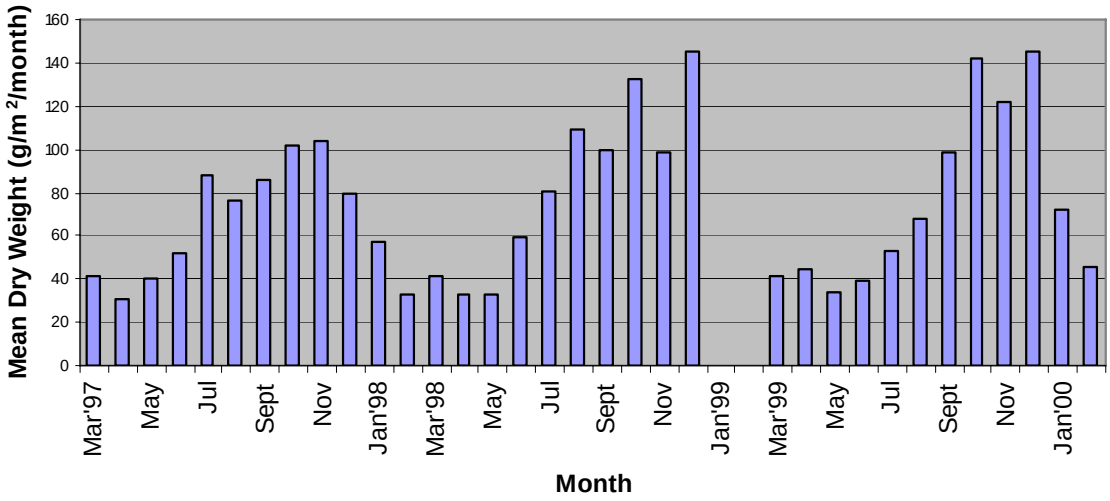

Figure 17.4 Darwin Harbour mangrove litter production in the hinterland (Community 6). Average production for six sampling sites, March 1997 to February 2000. No data for January and February 1999.

The community groups also monitored the amount and type of rubbish in the mangroves. They found that the mangroves around Darwin are a trap for large volumes of litter. Litter is washed up by tides and carried by stormwater during the wet season. Over seven months, 256 kilos of rubbish was collected from six sites in three catchments. The most common litter was aluminium cans, plastic bottles and plastic bags. Their presence made the mangroves look like a 'dumping ground'.

In 2003, further monitoring was undertaken to assess the health of mangrove plants adjacent to the LNG plant development on Wickham Point. The accumulation and loss of mangrove sediments is also being monitored to assess whether soil erosion control measures at the development site are working. Preliminary results indicate that there is no discernible impact of the development on the adjacent mangroves or sediment levels.

Conclusion

The mangrove communities in the harbour are in a healthy state. There is no widespread degradation, though there may be some localised impacts associated with run-off from urban areas. Monitoring adjacent to urban areas found the mangrove plants to be productive and identified rubbish as a significant issue. The most obvious and significant impact on mangroves in the harbour is their clearing, though this is currently small, being 1.5% of the total mangrove area. About 95% of harbour mangroves are now zoned conservation.

Further Reading

Brocklehurst, P.S. and Edmeades, B.F. (1996). The Mangrove Communities of Darwin Harbour. Technical Memorandum No. 96/9. Department of Lands, Planning and Environment, Darwin.

Brocklehurst, P.S. and Edmeades, B. (1996). Regionalisation of Mangrove Communities along the Northern Territory Coast. Technical Memorandum No. 96/17. Department of Lands, Planning and Environment, Darwin.

Brocklehurst P, Edmeades B. (1996). The Mangrove Associations of Darwin Harbour. Technical Report No. R96/7. Resource Capability Assessment Branch, Department of Lands, Planning and Environment, Northern Territory Government.

Department of Infrastructure, Planning and Environment (2002). Mangrove Management in the Northern Territory. Department of Infrastructure, Planning and Environment, Darwin.

Lewis, D. (2002). Community Mangrove Monitoring Program: Impact Assessment of Coastal Development on Estuarine Mangrove Environments in Darwin Harbour – Technical Manual and Final Report. Report No. 26/2002. Department of Infrastructure, Planning and Environment, Darwin.

Lee,G.P. (2003). Mangroves in the Northern Territory. Department of Infrastructure, Planning and Environment, Darwin.

McGuinness, K. (2003) The mangrove forests of Darwin Harbour: a review of research on the flora and invertebrate fauna. In 'Proceedings: Darwin Harbour Region: Current knowledge and future needs' (Ed. Working Group for the Darwin Harbour Advisory Committee), pp19-36.

Moritz-Zimmermann A., McGuinness K., Kuppers M. (2002). Impacts of urban storm-water drainage channels on a northern Australian mangrove forest. *Trees-Structure and Function:*16 195-203.

Padovan, A.V. (2003). Darwin Harbour Water and Sediment Quality. In: 'Proceedings: Darwin Harbour Region: Current knowledge and future needs'. (Ed. Working Group for the Darwin Harbour Advisory Committee) pp. 5-18. Department of Infrastructure. Planning and Environment, Darwin. *(See: http://www.ipe.nt.gov.au/whatwedo/dhac/presentations).*

Padovan, A. (2001). The Quality of Run Off and Contaminant Loads to Darwin Harbour. Report Number 29/2000D. Department of Infrastructure, Planning and Environment, Darwin.

Working Group of the Darwin Harbour Advisory Committee (2003). Management Issues for the Darwin Harbour Region (Mangroves). Department of Infrastructure, Planning and Environment, Darwin. *(See:http://www.ipe.nt.gov.au/whatwedo/dhac/presentations/pdf/midhr.pdf)*

Whelan P. (1988). Urban stormwater drainage and its effect on mosquito breeding habitats in an intertidal creek at Casuarina, Darwin, NT. In 'Proceedings of the workshop on research and management held in Darwin Harbour'. Museum of Arts and Sciences, Darwin. (Eds H.Larson, M.Michie and J.Hanley) pp.181-197. (North Australian Research Unit, Australian National University).