

Darwin Harbour

Location and Description

Darwin Harbour is a large indented embayment with three main arms – East, Middle and West. Two major rivers, the Elizabeth and Darwin Rivers drain into the Harbour and the city of Darwin is located on the north-eastern shore. The shoreline is dominated by mangroves, which largely remain in undisturbed condition and the Site contains more than 5% of the Northern Territory's entire mangrove area. Darwin Harbour has one of the richest coastal environments anywhere in the Asia Pacific region, and occurs within one of the world's least impacted marine regions. The coastal and mangrove environments are backed by savanna woodlands and patches of monsoon rainforest.

Tenure and Land Use

The Darwin Harbour Site, especially its west and south-west portions, is predominantly vacant Crown land. The remainder is mostly freehold land associated with the cities of Darwin and Palmerston. The land uses within the Site are many and varied - the freehold portions support a mix of commercial, residential and industrial land uses. The Harbour has port facilities and supports tourism, recreation and aquaculture. Approximately 3% of the Site is managed as conservation reserves.

Significance Rating

International Significance

Ecological Values

Darwin Harbour supports a range of estuarine, freshwater and terrestrial environments including extensive areas of tidal mudflats and one of the largest and most diverse areas of mangroves in the Northern Territory. The mangroves of Darwin Harbour support a highly specialised fauna and 14 bird species that are entirely restricted to mangrove environments (e.g. Chestnut Rail, White-breasted Whistler and Mangrove Golden Whistler). The Harbour itself supports a diverse range of marine species including dugongs, dolphins, marine turtles and a large variety of fish. A total of 15 threatened species are reported from within the Site.

Management Issues

Future urban and industrial developments around Darwin Harbour represent a major management issue for this Site. The north-eastern part of Darwin Harbour catchment is already highly developed and native vegetation and tidal flats have been cleared and drained. Further major industrial developments around Middle Arm are currently



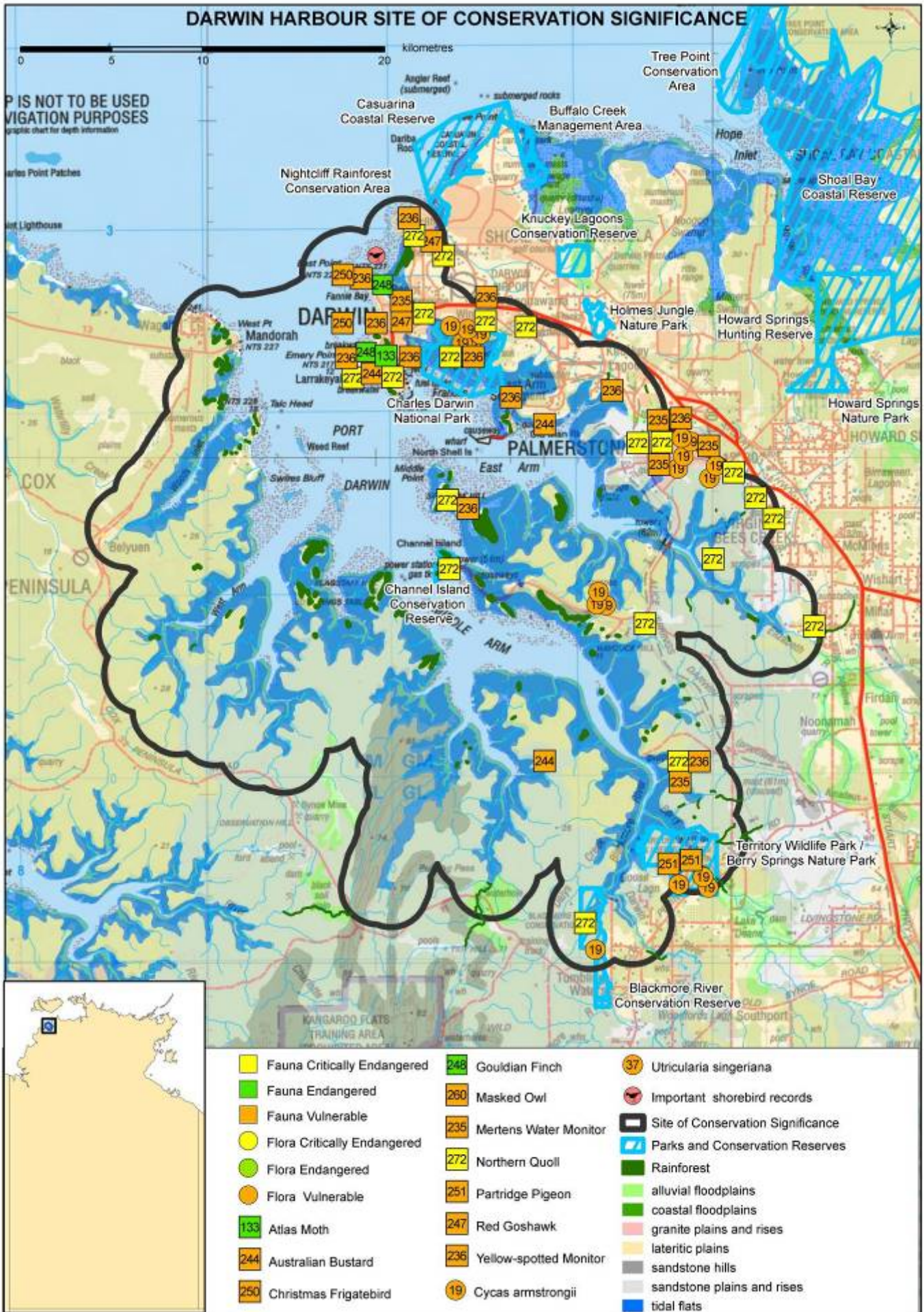
being considered. Water pollution from run-off and industry and sea-level rise will also potentially affect the Harbour environment.

Condition

In comparison with marine areas near other major cities, Darwin Harbour is in good condition. However, a range of human activities do impact on the marine and coastal environments and these are likely to intensify in future years.

Current Conservation Initiatives

A regional plan of management has been developed for Darwin Harbour and its catchment area, and priority actions are being implemented. Ecosystem monitoring and research groups have been established to direct strategic research and co-ordinate monitoring activities within the Harbour.



DARWIN HARBOUR - SITE OF CONSERVATION SIGNIFICANCE

LOCATION	SOCS Number	6 (NT Parks and Conservation Masterplan Map Number 12)
	Latitude/Longitude	12° 34' South, 130° 52' East (at centre)
	Bioregion	Darwin Coastal (98%), Pine Creek (2%)
	Description	<p>The site includes the tidal flats (222 km²) within the Harbour from East Point around to West Point (including the major sub-embayments of East Arm, Middle Arm, West Arm, Woods Inlet, Frances Bay and Fannie Bay) and a buffering terrestrial area (527 km²). Sub-tidal waters of the Harbour are not included in this assessment.</p> <p>The rivers that flow into the Harbour (including the Darwin, Blackmore and Elizabeth Rivers and Berry Creek) have small catchments and lack the large floodplains and freshwater wetlands that characterise many other coastal areas around the Top End. Much of the area behind the extensive tidal flats in this site is high ground forested with woodland rather than wetlands (Darwin Harbour Advisory Committee 2003).</p> <p>The extensive tidal flats associated with nearby Shoal Bay and the sand sheets of the Howard River are also recognised as sites of high conservation significance in the NT.</p>
THREATENED SPECIES	Significance Rating	International Significance
	Threatened plants and animals (Listings at National/NT level CR - Critically Endangered, EN - Endangered, VU - Vulnerable, NT - Near Threatened, LC - Least Concern, DD - Data Deficient)	<p>15 threatened species are reported from this site.</p> <p>Plants</p> <ul style="list-style-type: none"> ▪ <i>Cycas armstrongii</i> (-/VU) ▪ <i>Utricularia singeriana</i> (-/VU) <p>Vertebrates</p> <ul style="list-style-type: none"> ▪ Australian Bustard <i>Ardeotis australis</i> (-/VU) ▪ Christmas Frigatebird <i>Fregata andrewsi</i> (VU/-) ▪ Gouldian Finch <i>Erythrura gouldiae</i> (EN/EN) ▪ Masked Owl <i>Tyto novaehollandiae kimberlii</i> (VU/VU) ▪ Partridge Pigeon <i>Geophaps smithii</i> (VU/VU) ▪ Red Goshawk <i>Erythrotriorchis radiatus</i> (VU/VU) ▪ Northern Quoll <i>Dasyurus hallucatus</i> (EN/CR) ▪ Merten's Water Monitor <i>Varanus mertensi</i> (-/VU) ▪ Yellow-spotted Monitor <i>Varanus panoptes</i> (-/VU) ▪ Flatback Turtle <i>Natator depressus</i> (VU/DD) ▪ Green Turtle <i>Chelonia mydas</i> (VU/LC) ▪ Hawksbill Turtle <i>Eretmochelys imbricata</i> (VU/-) <p>Invertebrates</p> <ul style="list-style-type: none"> ▪ Atlas Moth <i>Attacus wardi</i> (-/EN) <p>There are only historic records of <i>Utricularia singeriana</i> and the Atlas Moth from this site, and suitable habitat may no longer be present.</p>
ENDEMIC SPECIES	Significance Rating	Not Significant
	Notes	<p>Endemic to the bioregion: One vertebrate (<i>Ramphotyphlops nema</i>) and two plant species (<i>Spermacoco phalloides</i>, <i>Typhonium praetermissum</i>) recorded in this site are NT endemics and are only known from the Darwin Coastal bioregion.</p> <p>Endemic to the NT: 77 plant and 12 vertebrate species recorded in the site are only known from the NT.</p> <p>Other: 12 plant and one vertebrate species (Lewin's Rail) are only known from the site or the Darwin Coastal bioregion within the NT, but are also found in other states. There is a collection of records of vagrant bird species from Darwin Harbour/Shoal Bay that have not been recorded elsewhere in the NT.</p>
WILDLIFE AGGREGATIONS	Significance Rating	Not Significant
	Marine turtles	Flatback, Hawksbill, and Green Turtles frequent the waters of Darwin Harbour but the lack of sandy beaches within the Harbour inhibits nesting activity.
	Seabirds	Significant aggregations of seabirds are not known from this site (Chatto 2001).
	Waterbirds	This site lacks a large area of freshwater wetland and supports relatively low numbers of waterbirds (Chatto 2006).
	Shorebirds	Although large areas of mudflats occur around Darwin Harbour during periods of low tide, high numbers of shorebirds have not been recorded. The highest count is 3000 individuals in 1994 (Chatto 2003).
WETLANDS	Other aggregations	None known
	Significance Rating	National Significance
	Ramsar criteria met	Not assessed
	DIWA criteria met	Darwin Harbour is listed as a wetland of national significance in the Directory of Important Wetlands in Australia (DIWA: NT029 Port Darwin). The site meets criteria 1, 2, 3, 4, 5, 6 and includes wetland types: A1, A2, A3, A6, A7, and A9.
Notes	<p>Darwin Harbour is a good example of a shallow branching embayment of the Top End Region, supporting one of the largest discrete areas of mangrove swamp in the NT (DIWA).</p> <p>Within the Darwin Harbour catchment there are series of ponding systems (Dambos) that may play an important role in filtering organic material before it is delivered to the harbour. Many of these are not included within the current boundary of the site (R. Wasson, Charles Darwin University, pers. comm.).</p>	

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	Rivers	The Darwin, Blackmore and Elizabeth Rivers and Berry Creek flow into Darwin Harbour. All are relatively small Top End rivers.
FLORA	Significance Rating	National Significance
	Notes	<p>Rainforest: About 1150 ha of mostly dry rainforest (or 0.4% of the NT rainforest estate) occur as small patches around the margin of the tidal flats in this site. One patch is >100 ha but most patches are small (<10 ha) (Russell-Smith 1991).</p> <p>Large areas of rainforest or vine-thicket habitat occur within the Harbour on peninsulas or 'hinterland islands' such as Blaydin Point, Wickham Point, Flagstaff Hill and Kings Table. Fire-sensitive vine-thicket communities have become particularly well developed in these habitats due to the protection offered by the surrounding mangroves, which unlike savannah woodlands, do not burn.</p> <p>Other: Mangroves fringe the whole embayment of Darwin Harbour and comprise one of the largest (~20 400 ha) and most floristically diverse (~41 species) areas of mangroves in the NT (Duke 2006). Mangrove communities within the Harbour have been identified and mapped by Brocklehurst and Edmeades (1996).</p>
OTHER ENVIRONMENTAL VALUES		<p>The mangroves of Darwin Harbour support a highly specialised fauna including over 306 invertebrate species and 112 species of mammals, bats and birds (Metcalf 2007).</p> <p>Mangroves in north-western Australia support distinctive fauna and more mangrove-endemic bird species than any other region in the world (Noske 1996). Some of the highly specialised bird species that occur in Darwin Harbour include the Mangrove Gerygone, Mangrove Robin, Mangrove Golden Whistler and Chestnut Rail.</p> <p>A group of colubrid snakes including the White-bellied Mangrove Snake <i>Fordonia leucobalia</i>, are also part of the distinctive mangrove fauna found in Darwin Harbour, and compliments the wider, but poorly-known, community of sea-snakes in the area (Whiting 2003).</p> <p>In terms of faunal diversity, Darwin Harbour is one of the richest mangrove systems in the Indo-west Pacific region. Each of the eight different floristic assemblages defined in Darwin Harbour mangroves (Brocklehurst and Edmeades 1996) supports a distinctive faunal community. In particular, the most seaward assemblage, with <i>Sonneratia alba</i> dominant, is an exceptionally productive mangrove community with the highest primary productivity (Metcalf 1999) and faunal diversity and abundance of any assemblage in the harbour (Metcalf 2007).</p> <p>Eight sites around Darwin Harbour are listed on the Register of the National Estate for their natural values including: Berry Springs Nature Park, Darwin Foreshores, <i>Pachystoma pubescens</i> Sites 1 and 2, Channel Island Reefs, Imaluk Creek Area, Southport Area, and the Darwin Harbour Wetlands (Australian Heritage Council).</p> <p>80 species recorded from this site are listed under international conventions or bilateral agreements protecting migratory animals.</p> <p>Dugongs are common in the Harbour (Whiting 2004).</p> <p>The marine areas within this site are likely to encompass other significant biodiversity values and these are currently being explored and collated in a project by the Marine Biodiversity Group of NRETAS (K. Edyvane, NRETAS, pers. comm.).</p>
MANAGEMENT ISSUES		<p>Fire: The current fire regime in the Darwin region differs from that in other sparsely populated savanna areas of the NT and is ad hoc and closely linked to tenure (Price and Baker 2007). The frequency of late dry season fires is lower in the Darwin region than other areas (Price and Baker 2007), but exotic grasses are increasing fuel loads and the intensity of fires (Kean and Price 2003). In the period 1993-2004, 43% of the site was burnt in fewer than three years, and 24% was burnt in more than six years.</p> <p>Feral animals: Feral cat, dog, rat, pig and Cane Toad are present in the site. Marine pest incursions remain a concern given the proximity of Darwin Harbour to Asia (Smit 2003).</p> <p>Weeds: Four Weeds of National Significance (<i>Lantana camara</i>, <i>Mimosa pigra</i>, <i>Salvinia molesta</i>, <i>Parkinsonia aculeata</i>), 25 declared Category A and B weeds and 12 other undeclared but problematic environmental weeds (high priority weeds: Smith 2001) are recorded from this site. The aquatic weed <i>Cabomba caroliniana</i> is reported from Darwin River (Smith 2002).</p> <p>Other: The north-eastern part of Darwin Harbour catchment is highly developed and native vegetation and tidal flats have been cleared and drained. With the current rapid growth of the city of Darwin, further pressure is likely to come from future recreational, residential and industrial developments within the Harbour (Wightman 2006). Major industrial developments around Middle Arm are currently being considered.</p> <p>Nutrient enrichment from sewerage discharge and storm water run-off may affect mangrove communities in the Harbour (Dames and Moore 1984 in Wightman 2006).</p> <p>Despite having a macrotidal range of 7.8 m, the waters of Darwin Harbour are not particularly well flushed and recent research and modelling indicates that pollution may circulate within the upper reaches of the Harbour for considerable periods (Williams, 2006). Pollution and increased turbidity (e.g. from dredging) associated with future developments within the Harbour, may therefore affect water quality and the biodiversity values.</p> <p>The potential rise in sea level predicted in response to global climate change may affect mangrove communities in Darwin Harbour, especially in areas where coastal developments exclude the landward retreat of coastal ecosystems.</p> <p>Although mangroves are generally well adapted to the dynamic conditions at the land-sea interface, recovery from severe disturbance (e.g. storms, cyclones, clear-felling) may be very slow (Metcalf, 2007). Indeed, severely damaged mangroves may take several decades to recover and such delayed recovery times increase their vulnerability to disturbance (McGuinness 1992).</p>

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MANAGEMENT INFORMATION	NRM groups	Belyuen Land Management Group (Belyuen), Larrakia Rangers (Darwin) (Northern Land Council 2006).
	Protected areas	Blackmore River Conservation Reserve (4 km ² / 0.6% of site), Channel Island Conservation Reserve (1 km ² / 0.1% of site), Charles Darwin National Park (10 km ² / 1% of site), Territory Wildlife Park/Berry Springs Nature Park (11 km ² / 1% of site).
	Current management plans	<p>Site-specific plans: Charles Darwin National Park Plan of Management (PWCNT undated); Darwin Harbour Regional Plan of Management (Darwin Harbour Advisory Committee 2003).</p> <p>National recovery plans for threatened species: marine turtles (Environment Australia 2003); Northern Quoll (Hill and Ward in prep.); Partridge Pigeon and Masked Owl (Woinarski 2004a), Gouldian Finch (O'Malley 2006); Red Goshawk (Baker-Gabb in prep.).</p> <p>Other management plans: Australian Weeds Strategy (NRMCC 2007); Threat Abatement Plan for Predation by Feral Cats (Environment Australia, 1999); Threat Abatement Plan for Predation, habitat degradation, competition and disease transmission by feral pigs (DEH 2005); FIREPLAN: Fire management for the savanna community (Russell-Smith <i>et al.</i> in prep.).</p>
KEY REFERENCES	Monitoring programs and research projects	<p>Fire in the tropical savannas is mapped continuously under the North Australia Fire Information Project http://www.firenorth.org.au/nafi/app/init.jsp</p> <p>Numerous programs and sites exist for monitoring water quality and ecological condition within the Darwin Harbour catchment area and a summary of them is reported by the Darwin Harbour Advisory Committee (2005).</p> <p>Fauna and vegetation are monitored at permanent sites in NT parks within the Darwin region including the Territory Wildlife Park and Charles Darwin National Park (Calnan <i>et al.</i> 2008).</p> <p>Populations of the rare ground orchid <i>Nervilia peltata</i> (D. Liddle, NRETAS unpubl.) and <i>Cycas armstrongii</i> (Liddle 2004) are monitored under different fire regimes at permanent plots in Charles Darwin National Park.</p> <p>There is an ongoing program of monitoring and removal of Saltwater Crocodiles from within Darwin Harbour and Shoal Bay (Nichols and Letnic in press).</p> <p>Dolphins are surveyed monthly along transects within Darwin Harbour and Shoal Bay (C. Palmer, NRETAS unpubl.).</p> <p>Research on the biodiversity of mangrove habitats in Darwin Harbour involving surveys of vertebrate and invertebrate fauna in disturbed and undisturbed mangroves was conducted from 1999-2002 (Metcalf 2007). The methodology developed has since been applied for mangrove monitoring purposes.</p> <p>A two year study of primary productivity within the eight different mangrove assemblages was conducted at eight sites in the three arms of Darwin Harbour from 1997-1999 (Metcalf 1999). Monitoring of mangrove productivity was continued for a 3rd year by DIPE.</p> <p>Recommended methodology for monitoring of flora and soils in mangrove habitats of Darwin Harbour was developed by DIPE (Moritz-Zimmeman <i>et al.</i> 2002), developed further in a research framework (Comley 2002) and later applied at the Darwin LNG plant (McHugh 2004).</p> <p>Commercial mangrove monitoring programs for aquaculture developments in Darwin Harbour including Wild River and Tiger International subsequently adopted this monitoring methodology for impact assessment purposes.</p> <p>Research on the distribution and role of Dambo wetland systems in the Darwin Harbour catchment (R. Wasson, Charles Darwin University, pers. comm.).</p> <p>Research on the use of mangrove habitats by fish in Darwin Harbour was conducted from 1998 to 2001 including development of a trophic model for the harbour (Martin 2004).</p> <p>As part of the Environmental Management Plan for the Darwin LNG Plant, Conoco Phillips established in 2002 a mangrove monitoring program at Wickham Point with matched control sites in Darwin Harbour. The monitoring program has provided over 6 years of valuable baseline data on mangrove flora and invertebrate fauna (URS 2003; Metcalfe 2005; 2006).</p>
	Management recommendations	<p>Continue to implement the Darwin Harbour Regional Plan of Management (NRETA 2005).</p> <p>Develop a fire management strategy for the Darwin region that identifies clear objectives, roles and responsibilities (Price and Baker 2007).</p> <p>Prevent the spread of exotic grasses, especially mission grasses and gamba grass, into new areas in the Darwin region and reduce populations in areas with high conservation value or where fires threaten properties (Kean and Price 2003).</p> <p>Assess the data for Darwin Harbour against Ramsar criteria and consider listing as a wetland of international significance (S. Blanch, Environment Centre NT, pers. comm.).</p> <p>Consider expanding the boundary of the site to the catchment boundary to incorporate Dambo wetland systems (R. Wasson, Charles Darwin University, pers. comm.).</p>
KEY REFERENCES	Papers and reports	<p>Darwin Harbour Advisory Committee (2003). <i>Darwin Harbour Regional Plan of Management</i>. Department of Infrastructure, Planning and Environment, Darwin.</p> <p>Darwin Harbour Advisory Committee (2005). <i>A Review of Environmental Monitoring of the Darwin Harbour Region and Recommendations for Integrated Monitoring</i>. Darwin Harbour Advisory Committee, Darwin.</p> <p>DIWA (A Directory of Important Wetlands in Australia). <i>Australian Wetlands Database</i>. Department of Environment, Water, Heritage & the Arts, Canberra ACT (accessed November 2007).</p> <p>Metcalf, K. (2007). <i>The biological diversity, recovery from disturbance and rehabilitation of mangroves in Darwin Harbour</i>. PhD thesis. Charles Darwin University, Darwin.</p>
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