



## 16. Threats and Management Issues

### Context and Scope

Unfortunately, many wetlands around the world have been destroyed or highly modified by various threatening processes. Threats include water extraction, draining for agriculture, urban and industrial development, pollution, invasive species of introduced plants and animals with a resultant loss of their beneficial functions and biodiversity (as listed in various publications; e.g. Environment Australia 1997).

In this section we discuss NT legislation that affects wetlands plus the main existing and potential threats: weeds, earthworks, water extraction; mining; feral animals; recreation, pollution, fire and explosives.

Unlike many other parts of Australia and the world, water extraction and river regulation are probably not significant threats to arid NT wetlands.

### 16.1 Legislation

Various pieces of NT legislation and several NT Government departments influence wetland conservation and management. The main ones are:

- the Parks and Wildlife Act;
- the Fisheries Act;
- the Weeds Act;
- the Pastoral Lands Act; and
- the Water Act.

Water resource management is controlled by the Water Act 1992 and an undated public document *NT Water* provides a 'detailed strategic framework for management' (p.1). Another undated NT Government document *NT Water, Blue Print for Future Direction* recognises the importance of environmental water quality but does not specifically address issues of environmental flows for wetlands and biodiversity conservation. The Water Act defines waterways and establishes controls over the use of water, obstruction of, interference with and pollution of waterways. Any construction activity to dam a waterway must be authorised under the Act. The Act does not control the creation of water storage structures that are not in waterways or the draining of land, so long as 'flow or likely flow of water in or into a waterway is not materially diminished or increased thereby' (section 40).

An inter-departmental memorandum sets out an agreement between the Parks and Wildlife Commission of the Northern Territory and the Fisheries Branch for joint responsibilities regarding inland aquatic environments.

### 16.2 Weeds

The spread of introduced plant species is deemed by this study to be the most significant threat to wetlands of the arid NT. This is consistent with Finlayson *et al.* (1988) who stated that weeds are the greatest threat to wetlands in the Top End. Under the Northern Territory Weeds Management Act 2001, noxious weeds are classed as:

- Class A Weeds - to be eradicated;

- Class B Weeds - growth and spread to be controlled; or
- Class C Weeds - not to be introduced to the Territory (also applying to all Class A and Class B Weeds).

Weeds that are known from arid NT wetlands, or likely to occur, are listed in table 51. The list includes species that have a high fidelity to wetlands as well as others that are more widespread in the landscape.

There are several introduced species which are threatening conservation values but are not listed as noxious. Listing them under the act is of great importance if their spread is to be curtailed and coordinated controlled programs developed.

Table 51. Weed species of arid NT wetlands.

Scientific Name	Common Name(s)	Class	Num Sites
<b>Declared Noxious Weeds</b>			
<i>Acanthospermum hispidum</i>	Starburr, Goats Head	B	2
<i>Argemone ochroleuca</i> subsp. <i>Ochroleuca</i>	Mexican Poppy	B	1
<i>Calotropis procera</i>	Rubber Bush, Rubber Tree, Calotrope, Kings Crown	B	0
<i>Cenchrus echinatus</i>	Mossman River Grass, Burr-grass	B	2
<i>Parkinsonia aculeate</i>	Parkinsonia, Jerusalem Thorn	B	11
<i>Prosopis pallida</i>	Mesquite, Algaroba	B	1
<i>Ricinus communis</i>	Castor Oil Plant	B	4
<i>Senna occidentalis</i>	Coffee Senna, Sickie Pod	B	2
<i>Tamarix aphylla</i>	Athel Tree, Athel Pine	B	6
<i>Xanthium strumarium</i> s.lat.	Noogoora Burr	B	14
<i>Tribulus terrestris</i> s.lat. (introduced & native forms occur)	Cat-head, Caltrop, Bindieye	B	
<b>Other Weeds of Wetlands</b>			
<i>Acetosa vesicaria</i>	Rosy Dock, Wild Hops, Ruby Dock		2
<i>Arundo donax</i> var. <i>Donax</i>	Giant Reed, False Bamboo		0
<i>Aster subulatus</i>	Bushy Starwort, Aster-weed, Wild Aster		1
<i>Bidens bipinnata</i>	Cobblers Pegs, Beggars Ticks		3
<i>Brassica tournefortii</i>	Wild Turnip, Turnip Weed, Mediterranean Turnip		22
<i>Carrichtera annua</i>	Wards Weed		1
<i>Cenchrus biflorus</i>	Gallons Curse		3
<i>Cenchrus ciliaris</i>	Buffel Grass		69
<i>Chloris inflata</i>	Purple-top Chloris, Purple-top Rhodes Grass		0
<i>Chloris virgata</i>	Feathertop Rhodes Grass, Furry Grass, Feather Finger-grass		7
<i>Citrullus colocynthis</i>	Colocynth, Bitter Paddy Melon, Colocynth Melon		17
<i>Citrullus lanatus</i>	Paddy Melon, Pie Melon, Wild Melon, Camel Melon		5
<i>Conyza bonariensis</i>	Tall Fleabane, Flax-leaf Fleabane		9
<i>Conyza bonariensis</i>	Tall Fleabane, Flax-leaf Fleabane		0
<i>Corchorus trilocularis</i>			1
<i>Crotalaria incana</i>	Woolly Rattlepod		1
<i>Cucumis myriocarpus</i>	Prickly Paddy Melon, Gooseberry Cucumber		2
<i>Cynodon dactylon</i>	Couch Grass		36
<i>Cyperus involucratus</i>			0
<i>Dichanthium annulatum</i>	Sheda Grass		4
<i>Digitaria ciliaris</i>	Summer Grass		2
<i>Echinochloa colona</i>	Awnless Barnyard Grass, Swamp Grass, River Grass		10
<i>Eragrostis barrelieri</i>	Pitted Lovegrass		3
<i>Eragrostis cilianensis</i>	Stinkgrass		0
<i>Gomphrena celosioides</i>	Gomphrena Weed		1
<i>Helianthus annuus</i>	Sunflower		0
<i>Heteropogon contortus</i> †	Bunch Speargrass, Black Speargrass		5
<i>Hyptis suaveolens</i>	Hyptis, Mint Weed		0
<i>Juncus acutus</i> subsp. <i>Acutus</i>	Sharp Rush, Spiny Rush		0
<i>Juncus bufonius</i>	Toad Rush		0
<i>Lactuca serriola</i>	Prickly Lettuce		5

<i>Leptochloa fusca</i> subsp. <i>Uninervia</i>	Beetle Grass		0
<i>Malva parviflora</i>	Small-flower Mallow		2
<i>Malvastrum americanum</i>	Malvastrum, Spiked Malvastrum		85
<i>Melia azedarach</i>	White Cedar		0
<i>Melinis repens</i>	Natal Red Top, Red Natal Grass		2
<i>Nicotiana glauca</i>	Tree Tobacco		4
<i>Pennisetum pedicellatum</i>			0
<i>Phoenix dactylifera</i>	Date Palm		1
<i>Polypogon monspeliensis</i>	Annual Beardgrass		1
<i>Rumex crispus</i>	Curled Dock		0
<i>Sida cordifolia</i>	Flannel Weed		0
<i>Sida spinosa</i> †	Spiny Sida		18
<i>Sisymbrium erysimoides</i>	Smooth Mustard		4
<i>Solanum nigrum</i>	Black Nightshade, Black-berry Nightshade		15
<i>Sonchus asper</i>	Rough Sow-thistle, Prickly Sow-thistle		1
<i>Sonchus oleraceus</i>	Milk Thistle, Common Sow-thistle		22
<i>Sorghum bicolor</i>	Forage Sorghum, Grain Sorghum, Cultivated Sorghum		1
<i>Stylosanthes hamata</i>	Verano Stylo, Verano, Carribbean Stylo, Stylo		0
<i>Tridax procumbens</i>	Tridax Daisy		0
<i>Urochloa mosambicensis</i>	Sabi Grass		0
<i>Verbena supine</i>	Trailing Verbena		0
<i>Xanthium spinosum</i>	Bathurst Burr		0

† native to arid NT but possibly introduced in some bioregions.

Additional information is presented below for the species of most concern, in approximate order of importance. This includes a summary of their distribution, abundance and invasiveness. The order of importance is based on a subjective assessment of the current and potential impact. Additional information is also included for some other species of less (or uncertain) concern.

Further analysis of the distribution of weed species is required including creating maps from distribution records. Further documentation of the degree of threat posed by each species will involve assessing the degree to which native species are being replaced and consequential changes to the ecological function of effected wetlands.

The first two species described below are of greatest concern: Couch Grass and Buffel Grass.

### ***Cynodon dactylon* (Couch Grass)**

*Cynodon dactylon* (Couch, Lawn Couch, Bermuda Grass) is the single worst threat to the flora of arid wetlands. *Cynodon dactylon* is widespread in most rivers including some relatively remote tributaries. It is also starting to encroach on various swamps. In rivers it often forms a virtual monoculture on steep and elevated banks. It has extremely deep reaching and persistent rhizomatous roots from which it can resprout.

The endangered sedge *Eleocharis papillosa* has apparently been displaced by Couch at Illparpa Swamp on the edge of Alice Springs and Couch is dramatically spreading at Stirling Swamp, another key locality for *E. papillosa*. Couch Grass, together with *Cenchrus ciliaris* (Buffel Grass) is displacing a variety of species along river margins, where both weeds are extremely widespread and abundant. This may be causing a widespread decline in *Cyperus bulbosus* (Nut Grass) which is an important food source for the Bilby, an endangered marsupial (P.Latz pers. comm. based on unpublished data from thirty years of monitoring at Simpsons Gap National Park). These introduced grasses dramatically alter fire regimes by allowing more intense and frequent fires in riverine environments.

The description of the Toko Gorge and Waterhole wetland (Blackman & Craven 1996) in *A Directory of Important Wetlands in Australia* (2nd edition p.232) lists *Cynodon dactylon* under notable flora, stating: 'Relatively undisturbed couch .....understory are uncommon in Queensland'. That account should be revised since the couch grass is probably threatening other values at the site..

Couch Grass is still actively planted and is very common as a lawn grass around dwellings and is probably also planted to stabilise soil in the vicinity of bores and to stabilise earthworks such as dams. It may also spread as seed or vegetatively via vehicles and possibly by waterbirds.

### **Cenchrus ciliaris (Buffel Grass)**

*Cenchrus ciliaris* (Buffel Grass) is extremely widespread as a result of planting for dust control, revegetation projects and pasture improvement. It is now the dominant understorey plant in many rivers and is present in most riverine systems. It is also present in some swamps and in the vegetated fringe of claypans. *Cenchrus ciliaris* is probably still expanding in range and abundance in these environments. It is a highly competitive species that has a significant impact on biodiversity (Albrecht *et al.* Unpublished data). In rivers it is responsible for a drastic alteration to fire regimes due to its ability to produce a high biomass. It has apparently displaced Yalka (*Cyperus bulbosus*) an important traditional aboriginal food and food source for native animals such as the Bilby (*Macrotis lagotis*) (P.Latz pers. comm.).

### **Tamarix aphylla (Athel Tree, Athel Pine)**

Athel Pine (*Tamarix aphylla*) is one of the major weeds of riverine environments in arid Australia. In the past it was very widely planted as a shade tree and is a typical part of many outback homesteads. In the arid NT it has a vast wild population in the Finke River system, having established down-stream of shade trees at Hermannsburg and Glen Helen, following a major river flow in 1974 (Griffin *et al.* 1989). A minor outbreak in the Ross River was controlled in the 1990's.

There are several factors that explain the outbreak of Athel Pine in 1975 despite many previous flow events which did indicate an outbreak. The 1974 flood is estimated to be the largest in 850 years in the upper Finke (Pickup 1991). It was large enough to carry Athel Pine debris from which new trees could establish vegetatively. This was combined with the removal of many River Red Gums by flood waters. However, the key factor may have been highly elevated discharge of saline groundwater flushed out of the Karinga Creek Paleodrainage system (Griffin *et al.* 1989). The following period of high salinity inhibited regeneration of River Red Gums and favoured the salt-tolerant Athel Pine. Continuing expansion of Athel Pine was favoured by the salt-laden leaf litter which it produces.

A second species of Tamarix (*T. ramosissima*) has also been planted as a shade tree in the arid NT, including on the floodplain of the Todd River in Alice Springs and at Finke Community adjacent to the lower Finke River. Although this species has not established wild populations in the NT, it is a major riverine weed in the south-west of the United States of America (M.Fuller *in litt.*).

In the Finke River, the infestation of Athel Pine occurs across the broad open sandy bed of the river, over 1km wide in parts, but also extends into the dense fringing Coolabah woodlands, which are impenetrable to vehicles in many areas, severely hampering monitoring and control activities (observations from this survey). The infestation has now reached the Finke Floodout Forest, (J.Gavin pers. comm.); an area of very dense Coolabah (*Eucalyptus coolabah subsp. arida*) and Cooba (*Acacia salicina*) woodland/forest.

Until recently, the wild population of Athel Pine was virtually restricted to the Finke River below Glen Helen Gorge. Following heavy rains in 2000 and 2001 it has infested Karinga Creek and associated semi-saline lakes (first recorded during the wetlands inventory). It has also been recorded from some isolated claypans and part of the Lucy Creek catchment which is another tributary of the lower Finke. Possibly this is due to a combination of widespread seeding in the Finke River, wind dispersal of seed and unusually high and persistent soil moisture in the broader landscape.

A control program has been making inroads into the Finke River infestation over the past decade, run by landholders, through the Centralian Land Management Association, and in cooperation with the NT Government. A national strategy has been released for the control of Athel Pine, which includes more details of its distribution and impact (ARMCANZ 2001).

### **Xanthium strumarium s.lat. (Noogoora Burr)**

Noogoora Burr (*Xanthium strumarium s.lat.*) has a strong preference for drainage lines and alluvial flats in the arid NT but also occurs on heavy clays of the 'black soil plains'. The burrs are easily transported by flood waters and contain two seeds of which one may remain dormant but viable for over a decade. It

forms large dense thickets which can virtually exclude other understorey plants and thus is a threat to the biodiversity of wetland plants.

There has been a persistent population in Trepkina Creek which has been monitored and controlled but not eradicated. There are infestations along Sixteen Mile Creek on the Burt Plain and in the interim floodout of the Todd River (near the Alice Springs Airport) (J.Gavin pers. comm.). There is an infestation in the lower floodout of Kurundi Creek which has been fenced off from stock (A. Clough pers. comm.). It is presently a typical component of riverine environments in all the parts of the Georgina system surveyed for the wetlands inventory and is abundant on parts of the Bunday River in the Sandover system. It seems inevitable that it will spread throughout the lower Sandover River and floodout. It is not recorded in the Dulcie Ranges, much of which is a catchment for the Sandover system. The Dulcies are botanically important and efforts should be made to keep them free of Noogoora Burr.

It has apparently been present in the tributaries of the Georgina River for several decades (R.Dance pers. comm.) but pastoralists report a rapid increase in abundance in the past two years.

The Finke River system includes areas of prime habitat for Noogoora Burr such as the Finke Floodout forest and the linear Coolabah swamps fringing long sections of the mid and lower reaches of the main river. At present there are no records of Noogoora Burr in the catchment.

A coordinated response between landholders is essential if this species is to be controlled and will require a long-term commitment of resources.

There are established infestations of the related species Bathurst Burr (*Xanthium spinosum*) in the arid NT. Infestations in the upper catchment of the Hugh River in the Finke River system have been mapped by PWCNT rangers and some control work undertaken (Chris Day pers. comm.). The infestation may have been present for over a decade but has probably expanded during the wet years of 2000 and 2001 (C. Schmidt pers. comm.). Relatively little is known about the habitat preferences of this species in the arid NT. In higher rainfall regions it is a weed of pasture and cropping lands but may have a stronger preference for wetlands in the arid zone. In the upper Hugh River area it occurs in watercourses, including the Hugh River, but is not restricted to them. The main areas of the infestation are not currently in the drainage lines. There is a strong possibility that seeds have spread into the mid-lower reaches of the Finke River, via the Hugh.

### ***Malvastrum americanum* (Malvastrum, Spiked Malvastrum)**

Malvastrum is a very widespread and common weed in wetlands including river banks, swamps and flood prone flats. It occasionally forms dense stands.

### ***Parkinsonia aculeata* (Parkinsonia, Jerusalem Thorn)**

Parkinsonia is moderately widespread in latitudes to the north of the Tropic of Capricorn. Several new locations were recorded during the wetlands survey and forwarded to the NT Government Weeds Branch. Only one dense thicket was encountered but it is known to have the capacity to form extensive dense thickets. In 2001 the Lake Eyre basin Coordinating Group gained \$295,000 for controlling *Parkinsonia aculeata* in the Lake Eyre Basin (Newsletter of the Lake Eyre Coordinating Group, Issue 19). The funding is from the Natural Heritage Trust through Agriculture, Forestry and Fisheries Australia (Commonwealth Government) and is part of the National Parkinsonia Program.

### ***Argemone ochroleuca* subsp. *ochroleuca* (Mexican Poppy)**

Mexican Poppy is a major weed of the Finke and Todd river systems. In our survey it was also recorded at an isolated wooded swamp in the Mitchell Grass Downs bioregion, where it was extremely abundant.

### **Dichanthium annulatum (Sheda Grass)**

Sheda Grass is not widespread in the arid NT but is considered highly invasive. There are infestations at Illparpa Swamp and various other locations around Alice Springs. In the inventory survey it was recorded at two sites. One was a large grassy swamp in the Georgina River system (Channel Country bioregion) on the north side of the Toko Range, where it was one of two dominant grasses. The other site was Running Waters on the Finke River. The presence of Sheda Grass in the Finke River is of particular concern as it may compete aggressively with *Eriachne benthamii* s. lat., which dominates some grassy swamps in the mid to lower sections of the Finke system.

### **Juncus species (rushes)**

Toad Rush (*Juncus bufonius*) was first recorded in 1983 at Ross River Homestead (tourist lodge) in the Ross River. It has been recorded at Illparpa swamp. Of greater concern is Spiny Rush (*Juncus acutus* subsp. *acutus*). Spiny Rush is displacing the native *Juncus kraussii* in some areas of coastal Australia (Adam 1994) and is present in the arid NT. It was first recorded here in 1996, from the Finke River, downstream of Ormiston Gorge. Despite control efforts, it has now spread downstream as far as Finke Gorge (D.Albrecht observations 2001).

### **Melinis repens (Natal Red Top, Red Natal Grass)**

Red Natal Grass is moderately widespread and abundant in riverine habitats.

### **Cenchrus echinatus (Mossman River Grass, Burr-grass)**

Mossman River Grass is far less widespread than the closely related Buffel Grass but is a declared noxious weed due to the burrs. It appears to favour moist areas such as creek lines and was observed at various locations in addition to formal survey sites. A major infestation has been reported at the creek below Muranji Rockhole (P. Laughton pers. comm.).

### **Brassica tournefortii (Wild Turnip, Turnip Weed, Mediterranean Turnip)**

Turnip Weed is a very widespread and common weed that occurs in both wetlands and drylands. Wetland types in which it is common include river banks, linear wooded swamps and other swamps and flood prone flats. It occasionally forms moderately dense patches.

### **Ricinus communis (Castor Oil Plant)**

Castor Oil Plant is common along the mid to lower Finke River, where it can form dense clumps, but appears to be controlled by pathogens or insects (H. Murphy pers. comm.) including caterpillars (P.Latz pers. comm.). It is recorded from Chrissie Creek in the Petermann Ranges.

### **Assorted Observations on Other Weed Species**

Annual Beardgrass (*Polypogon monspeliensis*) is abundant at Illparpa Swamp but was only recorded at one survey site (Running Waters). It has also been recently recorded in the Musgrave Ranges of northern South Australia (A. Duguid, obs. 2002), where it was common along a rocky upland creek with flowing spring water. This species may become a serious weed of long-term swamps and could potentially compete with rare wetland plants such as *Eleocharis papillosa* and *Imperata cylindrica*.

Tree Tobacco (*Nicotiana glauca*) was abundant and conspicuous at sites on the mid and lower Finke River during the wetlands survey. It was also present in the floodout forest. However, it did not form dense stands and was not obviously competing with natives.

### 16.3 Water Retention Earthworks

Numerous instances of excavated tanks or 'dams' were encountered where holes have been excavated by landholders to create a relatively deep water storage for stock, in which water withstands the losses of evaporation far longer than in the surrounding wetland. These are frequently called dams, however they do not block the flow of water and in general, do not greatly change the flow or distribution of surface waters. Such structures were encountered in claypans and swamps. The main impact is on the wetland vegetation, due to increased grazing and trampling that occurs by domestic stock in the vicinity of watering points.

Only one instance was encountered in which a large wetland had been deliberately drained, being a claypan that was blocking an access track when inundated. The enlargement of existing wetlands by trapping water behind dams or levee banks was, in contrast, relatively common. It is not possible to tell from this broad inventory whether these type of earthworks have caused a net gain or loss for wetland biota.

Waterbirds have undoubtedly been advantaged by the great increase in long-term and permanent waters resulting from various types of stock dams. Some of the true aquatic plants are relatively common in artificial waters in the study area. The picture for predominantly ephemeral swamp plants is less clear. In some places, levee banks that channel water to dams across relatively flat terrain, have created or increased wetland areas. Indeed, such earth works are frequently done in areas prone to some natural inundation. Dams across more clearly defined creek lines generally have limited effect on existing swamps and neither do they generally create much swamp habitat. There is no recorded instance of such structures acting as a barrier to upstream movement of fish in the study area. It is likely that the permanent and semi-permanent dams created by the cattle industry have allowed the survival of fish in river systems in to which they have been introduced.

Artificial waterbodies can be a focal point for feral horses and as a result may have an adverse effect on conservation values of the surrounding drylands. A small number of instances were encountered where springs or seepage areas have either been dammed or inundated by water from damming a watercourse.

A major flood mitigation dam was proposed for the Todd River up stream of Alice Springs, with preliminary construction work taking place in 1992. Work was suspended for 25 years by order of the Commonwealth Minister for Aboriginal affairs. The dam would have significantly altered flow regimes with an unknown impact on the downstream ecology. Earlier proposals for a recreation dam for the town of Alice Springs were investigated (e.g. *Alice Springs Recreational Dam – Preliminary Water Quality Investigation* 1979) but have not been carried through.

There was also once a proposal to build a recreational lake on the Hugh River (R. Read pers. comm.) and another proposal for Ilparpa Swamp (P. Latz pers. comm.).

### 16.4 Water Extraction

Water extraction for commercial horticulture, domestic use, mining and for stock is predominately from ground water. There are no documented effects on surface waters in swamps or waterholes, however, the possibility exists in some areas. Impacts may be hard to detect due to the high natural variation in the water regime of arid NT wetlands and the lack of baseline information prior to the commencement of extraction.

Ground water extraction for horticulture is increasing. The impacts on wetlands are unquantified but are considered to be minimal. Stirling swamp is described here as an example. The swamp is a discharge zone for the Ti Tree ground water basin. Although substantial volumes of ground water are extracted for horticulture, the volume is small compared to the large volume that is likely to be discharging through soil and vegetation at the swamp (P. Cook pers.comm.).

## 16.5 Mining

Mining can have direct and indirect impacts on wetlands. Direct impacts include excavation in a wetland. Potential indirect impacts include pollution and adverse changes to ground water. One example of Gypsum extraction from the bed of a salt lake was encountered during the survey and investigations have been conducted into the viability of extracting minerals from salt lakes in the area (B. Kilgarif pers. comm.). Jacobson (1996) reports that mineral exploration leases have been issued for various parts of the Central Australian Groundwater Discharge Zone (the chain of playas that includes Lake Amadeus and the Karinga Creek Lakes) for the mineral content of the brines. The brines may also have commercial use as a medium for cultivating 'valuable algae (*Dunelliella*) and cyanobacteria (*Spirulina*)' (Jacobson 1996, p. 265).

One instance of surface gravel stripping is recorded for a large stony claypan (Lehman & Edgoose 1996).

An instance of indirect mining impact occurs at Lake Lewis where hypersaline water is disposed from a petroleum extraction operation. The impacts of this are being monitored by an environmental consultant.

## 16.6 Introduced Aquatic Animals and Translocations

There are several records of introduced fish and invertebrates in the arid NT and these are discussed in the overview of fish in chapter 10 and observation on aquatic invertebrates in chapter 11. It is feared that Mosquito Fish (*Gambusia spp.*) could gradually out compete native fish if they become established in river systems with fish populations. This is of particular concern for those drainages with endemic species: the Finke River and possibly the Frew River. The effect of introduced Yellowbelly (*Macquaria sp.*) on indigenous species in the drainages of the Davenport Ranges is unknown. The effects of introduced crustaceans such as Redclaw (*Cherax quadricarinatus*) and the Yabby (*Cherax destructor*) are also unknown, but Davis (1995) regards them as a serious threat. Since Yabbies in the Finke River system may pre-date the arrival of non-Aboriginal people it is possible that genetically distinct populations are being lost as they interbreed with escapees from stocked dams.

Introductions of fish and crustaceans to places that could overflow into natural river systems is quite possibly ongoing.

There is no commercial aquaculture business currently operating, however, there have been past attempts to establish commercial enterprises and there is current interest. These operations may bring a risk of the escape of fish, aquatic macro-invertebrates or pathogens, to native waterways.

Cane Toads (*Bufo marinus*) could potentially colonise the permanent waterholes in the northern part of the study area where frosts do not occur.

## 16.7 Exotic Terrestrial Animals

The effects of introduced predators on arid zone fauna in general are well documented. There is little or no specific data for wetland birds but there is undoubtedly some impact. The impacts of introduced herbivores, both domestic and feral, are hotly debated, yet there remains a lack of good data to make assessments. Observations in this study were not made in such a way as to enable quantitative assessment of the impact of stock on wetlands and it would be impossible to do so with rapid one off visits. Nevertheless, fresh water wetlands of virtually all types are focal points for domestic stock, for water and often for feed as well, and there is inevitably a great deal of soil disturbance that would otherwise not occur. This may increase erosion rates and therefore potentially increase siltation of some wetlands, due to reduction in ground cover plants and physical disturbance of ground.

The Australian Society for Limnology includes grazing in a list of critical challenges for wetland conservation, in a policy document on its website (internet site for ASL: [asl\\_poldoc\\_challenges.htm](http://asl.poldoc_challenges.htm) 25/9/01). Impacts on plants occur by 'compacting, pugging and trampling, selective grazing and nutrient increases' (Brock 1997, p.132). Aquatic fauna may be adversely affected by increased turbidity and disturbance to fringing and emergent vegetation and by decreased longevity of the surface water when drinking by stock is added to evaporation. Bunn and Davies (2001, p.20) state that 'extensive and

repeated disturbance of the margins of waterholes by stock and feral animals could limit algal production and threaten the very food base of crustaceans, snails and fish’.

There is anecdotal evidence that some species, which are selectively grazed, can be removed altogether by heavy grazing. *Chenopodium auricomum* (Northern or Queensland Bluegrass) is an example.

Davis and Froend (1998) suggest there is evidence of nutrient enrichment from introduced herbivores: ‘The wetlands of central Australia, in particular the wetlands of the Finke River and the gorges and river pools within the West MacDonnell Ranges display varying degrees of nutrient enrichment due to pastoral activities within their catchments and their use by feral animals (e.g. horses, camels). [] Excessive growth of macrophytes such as *Myriophyllum* [] and *Typha*, is believed to be a consequence of nutrient enrichment arising from pastoral activities.’ (Davis & Froend 1998, p.5&6). However, Williams and Siebert (1963) discuss generally high nitrate levels in ground water of central Australia and the possibility that it is partly due to nitrogen fixation by *Acacia* species. In our survey we observed dense areas of *Myriophyllum* and patches of *Typha* in drainage lines in rocky hill country where there is little if any cattle grazing although probably some feral donkeys and horses.

Storrs and Finlayson (1997) briefly discuss the benefits of excluding stock so as to protect wetland and other biodiversity values. This included the possibility of fencing off permanent and near-permanent waterholes. However they note that excluding stock from wetlands could affect enterprise viability for some stations. They suggest a more radical proposal that as much as 10% of current cattle production areas in central Australia should be removed from grazing, with negotiated compensation. Regardless of financing of stock exclusion fencing, it is essential that such works be done with the full support of landholders in order that fences and appropriate stock management be maintained.

Beds of Water Reeds (*Phragmites australis*) are believed to have declined due to impacts from exotic grazing animal, for example at Running Waters (Latz 1982; PWCNT 1997a). However, substantial recovery is reported when grazing is stopped such as following feral horse control at Palm valley (D.Matthews pers. comm.).

In addition to trampling and grazing impacts, both stock and feral herbivores may negatively affect wetland plants and animals by drinking large quantities of water from small wetlands, resulting in reduced duration of inundation. Feral camels are widespread in the study area, including the remotest parts, and their impact may be significant, although hard to quantify.

## 16.8 Recreation

The permanent and long-term waterholes of the West MacDonnell Ranges and the George Gill Ranges are focal points for tourism and many are popular swimming spots. Sunscreen and insect repellent are potential threats to waterholes (Davis 1995 and Storrs & Finlayson 1997). Many of the permanent and semi-permanent waterholes that serve as a refuge for some species during droughts are also intensively used for commercial tourism. There is little quantified data on the impacts involved (e.g. Rippon *et al.* 1994 cited in Storrs & Finlayson 1997).

Recreational boating is known from at least three large saline lakes and two freshwater lakes that were inundated during this study. At least one is moderately intensively used for water skiing with possible loss of bird breeding opportunities due to frequent disturbance. Other potential but unquantifiable impacts include habitat modification and contamination of water by sunscreen and insecticide, fuel and oil. Recent reports on disturbance of waterbirds by human recreation activities in Australia may be useful in assessing impacts in arid NT (Paton *et al.* 2000; and Collins *et al.* 2000).

## 16.9 Pollution

Pollution from industrial or agricultural chemicals or from domestic effluent is undocumented in the area. Runoff from the streets of Alice Springs undoubtedly transports some pollutants to the Todd River. Defecation and urination of stock at intensively used waterholes is expected have some effect on water chemistry but is unquantified and the consequences for native plants and animals unknown. Nutrient enrichment of Illparpa Swamp has resulted from overflow of treated effluent water from the adjacent

Alice Springs Sewage Ponds. The degree to which the dramatic vegetation changes at the swamp are a result of changed water regime or changed nutrient status is unknown.

## **16.10 Fire**

Fire can be a significant form of disturbance in wetlands. Woodland, shrubland and grassland components of wetlands can all burn in some circumstances. The rapid expansion of some introduced grasses in riverine wetlands has dramatically increased the biomass and continuity of ground fuel loads. As consequence bushfires can burn more intensely and frequently. There is some observational evidence that wetlands can be covered over by sand drifts following wildfires (Gibson *et al.* 1994).

## **16.11 Explosives**

Several spring outlets have been blasted with explosives in an attempt to increase water flows for stock, however, not only does this impair the natural values, it sometimes has the effect of actually reducing surface flow (P. Latz pers. comm.).