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The Blyth-Liverpool wetlands, Arnhem Land, northern Australia

Information for management planning

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Abstract

A large amount of information has been collected in recent decades on the coastal wetlands of northern Australia, in particular those in the wet-dry tropics. This information had been assessed for its usefulness as a resource for further wetland management activities in the wetlands of the Blyth-Liverpool rivers in central Arnhem Land. The information is presented using the guidelines for management planning developed under the Ramsar Wetlands Convention as a logical framework.

The wetlands are described in terms of their biodiversity and the values and benefits currently derived by the local communities who own and inhabit the area. The local people manage the wetlands and are keen to develop a self-sufficent economic base and maintain their traditional values. This provides them with many challenges and opportunites that they are addressing through a combination of traditional and contemporary knowledge. In doing this they have received support from a local umbrella corporation and various other agencies and organisations.

The contemporary information base for the wetlands is patchy, although much can be gleaned from adjacent areas where more scientific research has been conducted. Similarly, a geat deal of information on threats and management issues can be obtained from such sources and many existing databases and reports have been identified. The threats faced by the owners and managers of the Blyth-Liverpool wetlands are currently, on the whole, less intense than in some floodplain systems further to the west, but they are very similar with weeds, feral animals and fire being amongst the most important.

The local people recognise the value of consultation and training and have initiated several productive programs involving educational institutes and governmental agencies. It is intended that such programs will increase local skills, attract external resources and provide a better base for managing the wetlands for the challenges of the future. The information base summarised in this report is one part of the management processes being developed and implemented.

1 Preamble

1.1 Development of a Management Plan for the Blyth-Liverpool wetlands

This report encompasses a review of technical information to determine what has been documented, and to elicit gaps in the knowledge base necessary for developing a wetland management plan for the Blyth-Liverpool wetlands in central Arnhem Land (fig 1). The Blyth-Liverpool wetlands encompass land belonging to a number of Aboriginal clans and fall within the remit of the Bawinanga Aboriginal Corporation (BAC). As well, the report includes a section on work planning options for the local community rangers and a locally based Land Management Coordinator. Thus, the document has been produced largely to set the scene for planning research and management projects. After the production of the report further consultation is planned with the community in order to determine if a formal management plan is required. In this way if a management plan is produced it will belong to the community and not be an imposed process. Further consultation with the community will most likely be undertaken by the BAC. External advice will only be engaged when particular technical expertise is required.

The information in this report is presented using the guidelines for management planning produced by the Ramsar Convention on Wetlands (Davis 1994). These provide a logical framework for further management planning and could assist the local community and the BAC in making a decision as to whether or not they develop a proposal to have the Blyth-Liverpool wetlands considered for listing as an Internationally Important Wetland under the Convention. It is stressed that the purpose of this document is to catalogue information for the use of the local community and the BAC in a manner that can assist them in achieving their aspirations for management of the Blyth-Liverpool wetlands. The framework provided by the Ramsar Wetlands Convention assists in this purpose.

The above mentioned processes have been supported by the Northern Land Council (NLC) and other organisations through the *Top End Indigenous People's Wetland Program* (TEIPWP). As a prelude this program is described along with the history of the BAC and the main features of the Ramsar Convention, in particular the management planning guidelines.

1.2 Top End Indigenous People's Wetland Program

Management of wetlands in the coastal zone of the Top End (land north of 15°N) of the Northern Territory of Australia was enhanced early in 1996 with the launch of the *Top End Indigenous People's Wetland Program* (TEIPWP). The TEIPWP was funded by the Australian Federal Government and implemented by the Northern Land Council's (NLC) Caring for Country Unit (CFCU) to assist Aboriginal landowners prepare management plans for their wetlands. This is an important initiative as Aboriginal people own 85% of the coastline and most of the vast and important sub-coastal wetlands of the Northern Territory (Storrs & Finlayson 1997). The NLC has a statutory responsibility to look after the interests of Aboriginal people across most of the Top End of the Northern Territory and is increasingly providing assistance with land use planning and management (Finlayson et al 1998).

The strategy adopted for the TEIPWP is one of Total Catchment Management coordinated within catchments and where necessary, between catchments. This recognises that not only are the coastal wetlands inter-connected (Storrs & Finlayson 1997, Whitehead & Chatto 1996), but also that Aboriginal land ownership and kinship can extend across catchments. Aboriginal landowners have control of the catchment planning processes and implementation

of the management prescriptions for their wetlands. The planning processes involve continuous consultation and liaison by the NLC and others to identify and articulate the aspirations of the landowners for the management of their wetlands, and to develop priorities for future research and management.

The initial focus of the TEIPWP was the wetlands within the catchments of the Blyth and Liverpool Rivers in central Arnhem Land (fig 1). These wetlands were chosen primarily because of the enthusiasm of the local community rangers, the Djelk Community Rangers. The existence of an extensive administrative structure within the BAC also made the area very attractive to the program. The BAC which has its base in the township of Maningrida, located about 400 km east of Darwin, provides support and services to traditional clans within the Blyth-Liverpool catchments (fig 1).

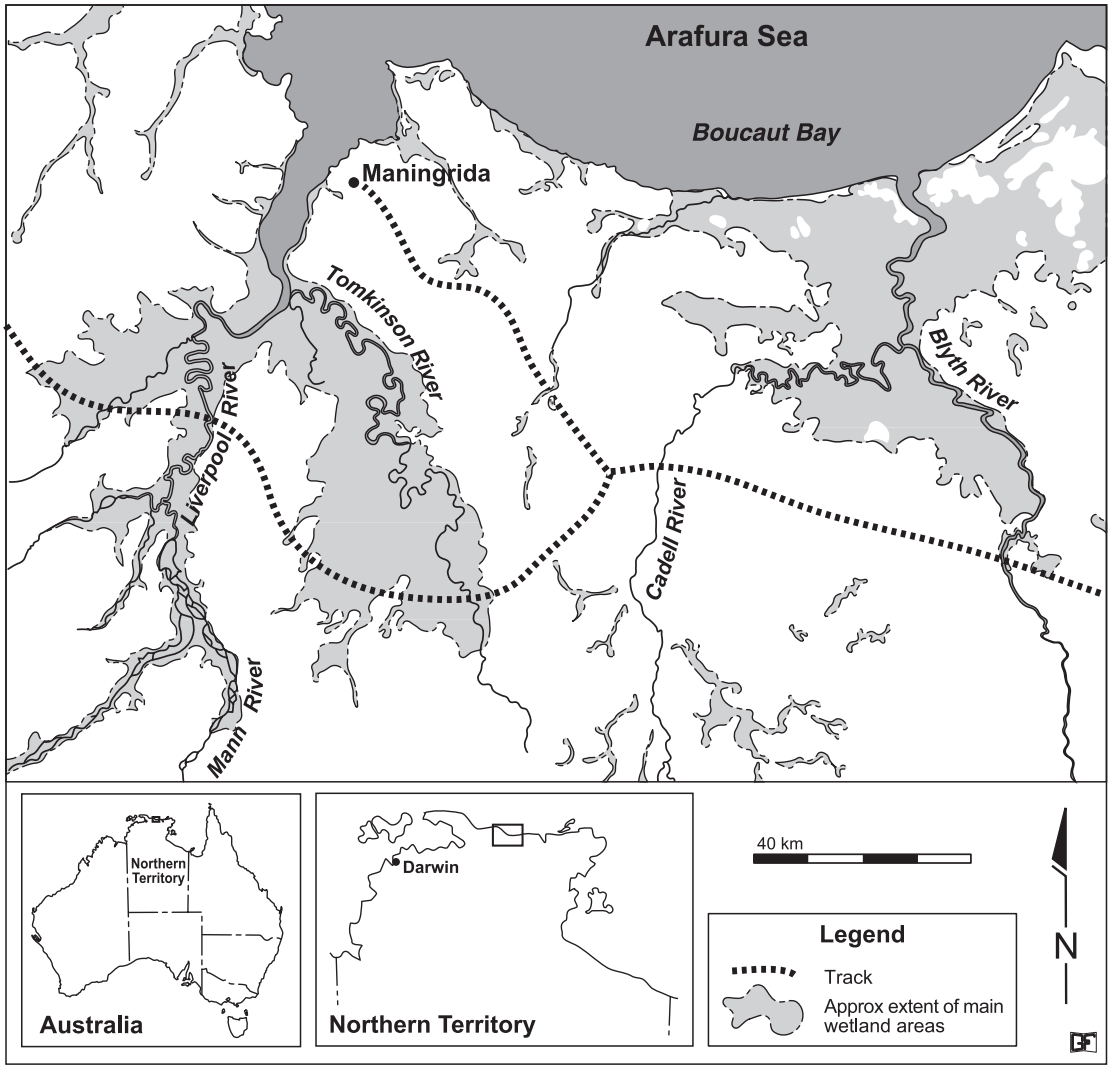

Figure 1 Location of the Blyth-Liverpool wetlands in central Arnhem Land

1.3 The landowners

In the early nineteenth century, following sporadic European contact, Arnhem Land was divided into pastoral leases (Altman 1987). The closest pastoral enterprises to the Maningrida area were at Gunbulunya (Oenpelli) to the west and Florida Station near the Arafura Swamp

to the east. Commencing in 1931 Arnhem Land was progressively proclaimed as a reserve under the Crown Lands Ordinance and contact between Aboriginal and non-Aboriginal people increased through missions and trading posts (Altman 1987). In 1973 the Department of Aboriginal Affairs was established and the Aboriginal Land Rights Commission was formed. Changes associated with the creation of these institutions resulted in the return of many Aboriginal people to their traditional clan estates (Altman 1987). This was known as the outstation movement (outstation = small settlement). The impetus for this return to clan lands was greatly influenced by the desire of traditional owners to protect sacred sites and to demonstrate their land ownership rights.

Under the Federal Governments *Aboriginal Land Rights (NT) Act 1976* (ALRA) Aboriginal people of the Blyth-Liverpool catchments own the land under inalienable freehold title. Co-existing with this statutory title is Native Title that is defined by local customary law. Land ownership in the Blyth-Liverpool region is based on customary law and is passed from generation to generation according to patrilineal linkages. Significant matrilineal linkages provide a secondary level of responsibility for 'caring for country'. Many of these rights are not documented nor detailed in formal legal titles. Individual clans 'speak' for particular areas of land and each has the responsibility to physically protect and look after their own land, in particular, sites of cultural and religious significance, known as 'dreaming sites' (Chaloupka 1993). Landowners may also have the responsibility to look after neighbouring land and dreaming sites on behalf of others who may reside some distance away.

Each Aboriginal language group in Arnhem Land consists of several clans that are the basic unit of social organisation. A strong and intimate bond exists between the clan and their estate. Each clan has the responsibility to physically protect and look after their estate and in particular their dreaming sites. The strong and intimate bond which exists between members of an Aboriginal group and the land begins at birth (Chaloupka 1993). Children grow to develop strong ties to a particular territory through their multiple attachments to the estate and their group's exploitation of the same general range year after year (Tonkinson 1980). Rights of entry, hunting and gathering can be increased through exploitation of kinship links and marital alliances. The bond between people and land strengthens over time as more is learnt about the land and its sacred sites through ceremony and rituals.

1.4 The Bawinanga Aboriginal Corporation

In 1973 a resource service now known as the Bawinanga Aboriginal Corporation (BAC) was established. Its prime role at that time was to support those Aboriginal people who wanted to live on their traditional estates in central Arnhem Land rather than in the government administered settlement of Maningrida. Until Maningrida was established in 1957 the majority of people from the area followed hunter-gatherer lifestyles, largely unaffected by external influence. The BAC is comprised of traditional landowners who live at outstations in the vicinity of Maningrida. The BAC chairman and committee are elected at an annual general meeting and are directly accountable to the traditional landowners. In this manner the hierarchical structure of the BAC is best described as an inverted pyramid.

The BAC developed in response to major changes in settlement patterns. The development of Maningrida in the 1960s attracted many Aboriginal groups who settled in accommodation of varying design and durability. However, within a decade many wanted to return to small family-based settlements on their own traditional lands. Whilst they still wanted access to modern goods and services they also wanted control over traditional estates where they could pursue elements of a traditional subsistence lifestyle and maintain a vigorous ceremonial life. With support from the resource service established in 1973 many people returned to their land

and established outstations. These settlements (outstations) can be established by people with a traditional right to particular land or with agreed access and residence rights.

By the mid-1970s there were about 16 outstations receiving support for material facilities and cultural activities. Over the years, the BAC has grown in response to the increase in outstation numbers, currently about 35, and the populations they support (fig 2). In the Dry season (April–November) there are usually more than 800 people residing on outstations. A further 1200 people reside in Maningrida. The number of people in the outstations falls slightly in the Wet season (December–March) when access to Maningrida is restricted.

As critical social issues, such as housing and health started to be addressed there was a developing awareness in outstation communities of the need for formal land management programs. This awareness was heightened by the discovery of a small, but potentially devastating outbreak of the exotic thorny shrub *Mimosa pigra* (mimosa) on the floodplains of the Tomkinson River in the early 1990s. Negotiations with government agencies secured funding for BAC to undertake an eradication program. This success provided the impetus to establish formal programs and to seek training and resources for a community-based land management program, the Djelk Community Rangers.

1.5 The Ramsar Convention

In 1971 the Convention on Wetlands of International Importance especially as a Waterfowl Habitat was adopted in the Iranian city of Ramsar. The Convention entered into force in 1975 and by March 1999 some 114 states had become Contracting Parties and 957 wetland sites covering 70.5 million hectares were included in the Ramsar List of Wetlands of International Importance (Frazier 1999).

The Ramsar Convention provides a framework for international cooperation for the conservation and the sustainable use of wetlands. The broad objective of the Convention is to ensure the wise use of wetlands. As a consequence, Contracting Parties to the Convention are obliged to:

- designate at least one wetland for the Ramsar List of Wetlands of International Importance, on the basis of biophysical criteria and promote its conservation;
- formulate and implement planning so as to ensure the wise use of wetlands, whether or not they are included in the above list;
- promote the conservation of wetlands in their territory through the establishment of nature reserves, and promote training in the fields of research, management and wardening; and
- consult with other contracting parties about implementation of the Ramsar Convention, especially as regards trans-frontier wetlands, shared water systems, shared species and development aid for wetland projects.

The Convention also recognises a local community's traditional rights of access to biological resources as an important component of the 'wise use' of wetlands. Recognising the multiple benefits of local community involvement in wetland management the Convention adopted a recommendation (Rec 6.3) in 1996 that called for Contracting Parties

> to make specific efforts to encourage active and informed participation of local and indigenous people at Ramsar listed sites and other wetlands and their catchments, and their direct involvement, through appropriate mechanisms, in wetland management.

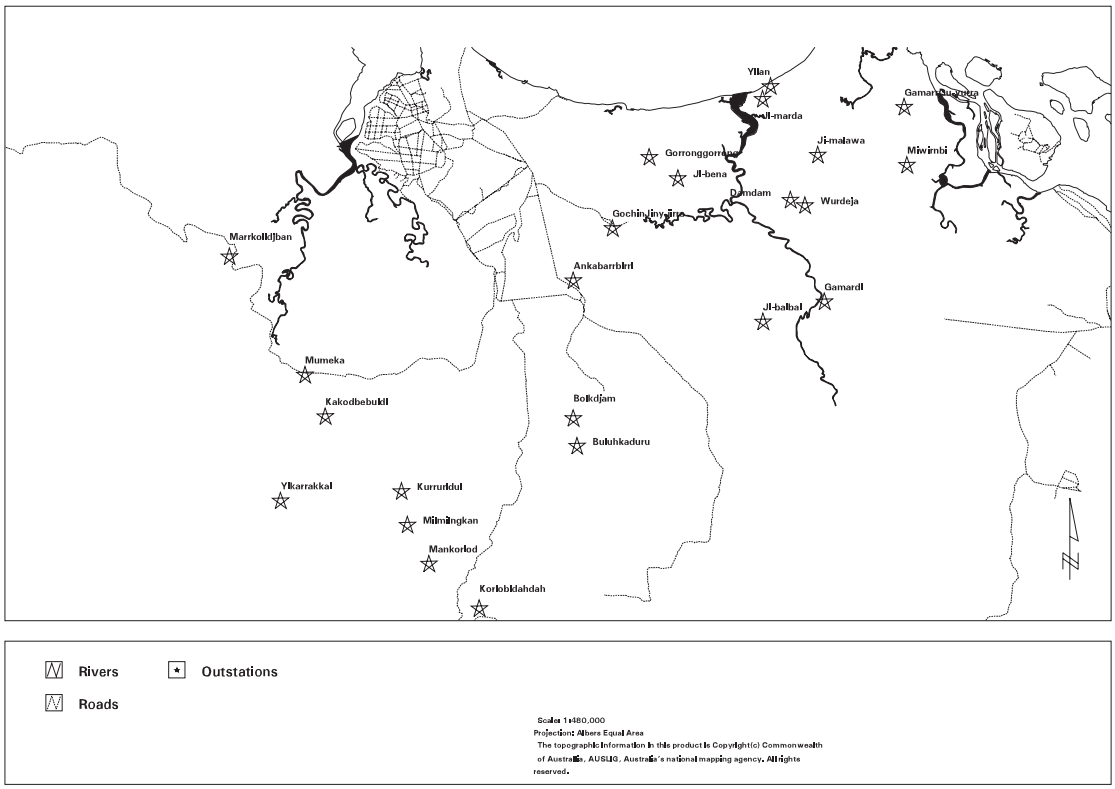

Figure 2 Bawinanga Aboriginal Corporation outstations

Four institutions, IUCN (The World Conservation Union), WWF (World Wide Fund For Nature), Kushiro International Wetlands Centre and Caddo Lake Institute, were called upon to develop a global study of community-based management practices. The global study comprised a number of site-based case studies and consensus workshops. As envisaged, this led to the drafting and eventual adoption of specific criteria and guidelines for Ramsar parties for debate at the May 1999 Conference of the Contracting Parties to the Convention.

In addition to the Ramsar Convention the Convention on Biological Diversity (CBD) stipulates (under Article 10) that a Contracting Party should:

> Protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements.

This initiative allows countries, which may be signatories to both Ramsar and CBD, to address their obligations with respect to both international conventions.

Under the Ramsar Convention the concept of 'wise use' of wetlands has been promoted and expanded (Davis 1993, Finlayson 1996a,b). The concept of 'wise use' was incorporated into the Ramsar Convention text in 1971 but it was not until 1987 that guidelines addressing 'wise use' were developed for Contracting Parties (Davis 1993).

> The ***wise use*** of wetlands is their sustainable utilization for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem.

Ramsar's strategic plan seeks to integrate conservation and 'wise use' of wetlands through national, provincial and local planning and decision making on land use, groundwater management, catchment/river basin and coastal zone planning. In order to make wise use of a wetland it is implicit that the ecological character of the wetland is maintained. Thus, whilst usage of the wetland and its resources is encouraged it is stressed that this should not be at the expense of the essential ecological features that underpin the values and benefits derived from

the wetland (Finlayson 1996c). The values and benefits derived from a wetland are many and varied and can include the following (from Finlayson 1996c).

- ***Functions*** performed by wetlands are the result of the interactions between the biological, chemical and physical components of a wetland, such as soils, water, plants and animals, and include: water storage; storm protection and flood mitigation; shoreline stabilisation and erosion control; groundwater recharge; groundwater discharge; retention of nutrients, sediments and pollutants; and stabilisation of local climatic conditions, particularly rainfall and temperature.
- ***Products*** are generated by the interactions between the biological, chemical and physical components of a wetland, and include: wildlife resources; fisheries; forest resources; forage resources; agricultural resources; and water supply.
- ***Attributes*** of a wetland have value either because they induce certain uses or because they are valued themselves, and include the following: biological diversity; geomorphic features; and unique cultural and heritage features.

The combination of wetland functions, products and attributes give the wetland ***benefits and values*** that make it important to society.

The complexity of wetland ecosystems and their 'blurred' boundaries makes them easily affected by external events. Changes in nutrient and sediment loads and the hydrological cycle, or the introduction of pollutants such as pesticides can all threaten the ecological character of a wetland. In 1996 ecological character was defined under the Convention as

> the structure and inter-relationship between the biological, chemical, and physical components of the wetland. These derive from the interaction of individual processes, functions, attributes and values of the ecosystem(s).

However, there is a proposal before the 1999 meeting of the Convention to change this and more clearly illustrate the link between the natural properties of the wetland and its uses (potential and actual). Thus, the proposed revised definition is:

> Ecological character is the sum of the biological, physical, and chemical components of the wetland ecosystem, and their interactions which maintain the wetland and its products, functions and attributes.

The latter is an explicit attempt to demonstrate that wetland conservation goes hand in hand with (wise) use of the wetland, and hence is inseparable from the people who use and manage the wetland and its resources.

More and more long-term conservation and management programs are now acknowledging the importance of local community involvement in ensuring that the ecological character of important wetlands is maintained. However, in northern Australia (if not elsewhere) this is not a simplex process with many disagreements over the relative roles of community groups and governmental agencies (O'Brien et al 1996, Julius 1996, Finlayson et al 1998). It is now a generally held belief that management plans created by, or at least involving, the local community tend to be more successful than those imposed by 'external' authorities; there is a greater chance that once completed they will not be 'left on the shelf'. The Ramsar Convention's recognition of the success of these types of management plans or programs is demonstrated by the 'wise use' and management planning guidelines (Davis 1993) through which local people may become empowered to determine the use and future of their wetlands. The guidelines identify the importance of traditional use of wetland resources and include it as an important component of the conservation and wise use strategies for wetlands.

The BAC and Djelk Community Rangers are interested in assessing the usefulness of the Ramsar Convention and its guidelines for developing a management plan for the Blyth-Liverpool wetlands. The BAC invited a number of locally-based research and management organisations to become involved in the processes to develop a management plan that would be modelled on those suitable for Ramsar listed sites. ***eriss***'s role has been to conduct baseline ecological studies (Pidgeon & Boyden 1997, Thurtell 1997, Thurtell et al 1997, Finlayson et al 1999) and gather information (Finlayson et al 1997b, 1999) which will contribute to creating the best possible management plan for the BAC and their wetlands. This document will be presented to the BAC for their use as an information resource during their management planning consultation phase. As such it will become part of the expert information resource held by the BAC.

In line with the Ramsar management planning guidelines this information resource is presented under the following three headings: description of the site; evaluation and objections; and action plan/prescriptions.

2 Description of the Blyth-Liverpool wetlands

Detailed habitat descriptions and species surveys have not on the whole been undertaken in the Blyth-Liverpool wetlands. Information on these habitats has basically been derived from various visual observations backed by general surveys across the wider Top End (eg Whitehead & Chatto 1996, Wilson et al 1991) and reviews of Top End wetlands (Taylor & Dunlop 1985, Finlayson et al 1988, 1990, Finlayson & von Oertzen 1993, Storrs & Finlayson 1997).

2.1 Bio-physical region

The coastal floodplains of the Northern Territory contain Australia's largest areas of relatively unmodified wetlands (Briggs 1981, Whitehead & Chatto 1996, Storrs & Finlayson 1997). Some of the best examples of these wetlands can be found in the catchments of the Liverpool and the Blyth River systems. These lie within latitudes 12–14° S and longitudes 132–134°50′ E. Altitude varies from about 3 m above sea level on the coast to around 200–300 m above sea level in the upper catchment. Offshore from the mouth of the Liverpool and Blyth the sea floor falls away very gradually, dropping to only 20 m below sea level 50 km seaward of Entrance Island.

2.1.1 Geology and major landscape features

The major features of the area are the sub-coastal alluvial floodplains bordering the river channels. The Liverpool River system is the largest of the tidal river systems of northern Arnhem Land and drains a catchment of about 8125 km^2 (Messel et al 1979). The Liverpool has two major tributaries, the Mann River and the Tomkinson Rivers. The Blyth River system is located further to the east and drains a catchment of 6200 km^2 (Messel et al 1981). The Cadell River is a major tributary of the Blyth.

The floodplains formed following the sedimentation of river estuaries drowned during the last post-glacial sea level rise and many are only 2000–3000 years old. The floodplain soils are predominately heavy black cracking clays overlaying estuarine muds that resemble those on the floodplains of the Alligator Rivers further to the west (Finlayson & Woodroffe 1996).

The areal extent of wetlands is estimated at 100 000 ha. These wetlands are located within the Top End Coastal (TEC) biogeographical region (Thackway & Cresswell 1995) which includes the northern coastal floodplains and much of their catchments. The catchments are

generally open woodland and forest with a sorghum grass understory. The gently undulating wooded lowlands have formed on lateritised Cretaceous sandstones and siltstones. Predominant soils are sandy red and yellow earths and siliceous sands.

Further to the south the 200–300 m high Arnhem Land Plateau rises out of the lowlands. The plateau is heavily dissected sandstone terrain with skeletal soils and rocky outcrops (East 1996). The narrow valleys within the plateau are wooded and well watered. The plateau contains the mid-sections of the major rivers and the upper reaches of the coastal floodplains. Occasional outliers from the plateau show retreat of the escarpments. These outliers have been used for thousands of years as shelters and sacred sites by Aboriginal people (Altman 1987, Chaloupka 1993).

2.1.2 Geomorphology

The geomorphological history of the floodplains has been described, in a general sense, by Williams (1991) and summarised in an overview of the Alligator River wetlands by Finlayson and Woodroffe (1996). 1800 million years ago the Top End floodplains were a broad subsiding basin in which sediments eroded from adjacent uplands accumulated to a depth of 1400 m. Deposition was arrested by earth movements and the resulting landscape of low relief was buried beneath several hundred metres of the Arnhem Land sandstones. 110 million years ago a brief incursion of the sea submerged much of the region and when the seas retreated the land was covered with a thin blanket of marine sands and muds. The land remained low lying and exposed to deep weathering until slow uplift began 15 million years ago which resulted in increased erosion and accentuated relief.

According to Chappell (pers comm 1998) both the Blyth and Liverpool tidal rivers and wetlands inherit meandering channels from the rivers that followed the present-day courses before being invaded by rising sea level, about 6000 years ago. Wide estuaries have developed in the lower Blyth and Liverpool since 6000 years ago but ancient river meanders, upstream from the Cadell junction in the Blyth and from about 20 km in the Liverpool, have remained stable through their transition from riverine to estuarine. Adjacent wetland plains probably stabilised about 4000–6000 years ago, over a former mangrove substrate, and are susceptible to marine invasion and acid sulphate degradation. Coastal beachridge plains of the Blyth contrast with lateritic downs bordering the lower Liverpool, and tidal and sedimentary processes in the two estuaries probably differ correspondingly. The alluvial and coastal elements of the landscape are still evolving rapidly (Williams 1991).

The environmental history and future behaviour of the lower Blyth and Liverpool, and their associated wetlands, could be established by undertaking geomorphic and associated research, similar to that previously undertaken in the lower Alligator Rivers (Clark & Guppy 1988), Mary River (Clark et al 1979), Adelaide River and the Daly River systems (Chappell & Ward 1985), but with less emphasis on drilling and radiocarbon dating.

2.1.3 Hydrology

The low flat topography of the Top End coastal plains and seasonally wet monsoonal climate produces widespread and prolonged flooding (Finlayson & Woodroffe 1996, McQuade et al 1996). The duration, depth and extent of flooding on the plains is highly variable, although a generalised pattern with five distinct phases was discerned by Sanderson et al (1983) and modified by Finlayson et al (1990): i) intermittent heavy rain storms (Nov–Dec); ii) consistent rain and creek flow inundates the floodplain (Dec–Apr); iii) rain ceases and water draw-down occurs (May–Oct); iv) flow ceases and the floodplain dries out (May–Oct); v) floodplain is dry (Oct–Nov). The floodwaters on the coastal plains are derived from three sources: direct

inputs from rainfall (precipitation dominated); tidal influence; and excess flow from channels (streamflow dominated) (Kingston 1991).

The flooding on precipitation dominated sections of coastal floodplains is a function of topography, antecedent soil moisture, rainfall intensity and duration (Kingston 1991, Vardavas 1989). Runoff occurs after the initial saturation of the soil and evaporative losses are surpassed. This usually happens two to three months after the rains begin. Areas on the coastal floodplains subject to inundation from direct rainfall may pond water well ahead of peak flow in the rivers draining onto the fringes of the plains. The general pattern for these plains is for coastal reaches to be inundated by direct rainfall and the upper floodplain reaches to be inundated by local runoff and periodic overflow from principal rivers (Kingston 1991). The upper reaches often contain perennial freshwater lagoons sustained by groundwater inflow.

Coastal processes have a major influence on flooding in coastal wetlands (Kingston 1991). A combination of coastal and fluviatile processes created the coastal floodplains and ground levels may be lower than high tide levels. The flow balance is complicated as surface slopes, storage changes and infiltration components affect flooding patterns on the coastal floodplains (McQuade et al 1996).

2.1.4 Climate

The climate consists of uniformly high temperatures with average daily maximum temperatures above 30ºC and average annual temperatures around 27ºC. The highest maximum temperatures are generally experienced in November. Average annual rainfall at Maningrida is 1291 mm, most of which falls between November and March. Average annual potential evaporation is approximately 2800 mm. A detailed description of the climate of the nearby Alligator Rivers region is given by McQuade et al (1996).

Traditional owners divide the year into six seasonal cycles. Using Gunwinggu names, an Aboriginal language used by some clans in central Arnhem Land, western Arnhem Land and Kakadu National Park, the seasons are as follows (Altman 1987, Brockwell et al 1995) (fig 3):

Gurrung occurs in September and October and is the time of hot, dry weather with increasing humidity.

Gunumeleng is the time of first rains and usually begins in November.

Gudjewg, from January to March, is when heavy rainfall is experienced.

Bang gereng begins around April and continues to May. It is when the last of the rain falls.

Yekke is the dry, cool time and lasts from May to June.

Wurrgeng is the dry time between July and August, with increasing temperature.

Figure 3 Gunwinggu seasons (adapted from Brockwell et al 1995)

2.2 Major wetland types

A variety of wetland types occur in the seasonally inundated wetland ecosystems of the Blyth-Liverpool rivers. These are characterised by degrees of inundation from permanent to seasonal and at times are extremely difficult to classify due to the temporal hydrological variability (Storrs & Finlayson 1997). Nevertheless, an indication of wetland types which occur, based on the Ramsar Convention typology, is given in table 1. Classification on this basis is preliminary and not yet supported by field-based habitat delineation, except for the broad-scale aerial surveys of Wilson et al (1991). It is further anticipated that for the purpose of a national wetland inventory (CM Finlayson pers comm) these habitats will be reclassified using the more accurate terminology of Semeniuk and Semeniuk (1997).

Table 1 Wetland types in the Blyth-Liverpool wetlands based on terminology of the Ramsar wetland typology

Habitat type – Marine/coastal wetlands	Habitat type – Inland wetlands
Permanent shallow marine waters	Permanent rivers/creeks
Sand shores	Seasonal rivers/creeks
Estuarine waters	Seasonal freshwater floodplain lakes
Intertidal mud/saltflats	Permanent brackish lakes
Intertidal marshes	Seasonal brackish lakes
Intertidal mangrove swamps	Seasonal brackish lakes
Coastal brackish lagoons	Permanent freshwater marshes/inorganic soils
	Freshwater flooded forest
	Freshwater springs

2.3 Major habitats

Distinct vegetation types of the Blyth-Liverpool wetlands are associated with geomorphic features of the plains, such as high floodplains, low lying depressions, palaeochannels (old river courses) and drainage depressions (fig 4).

2.3.1 Intertidal marshes and saltflats

Saltwater marshes are found in Boucaut Bay which is associated with the Blyth-Cadell Rivers. These areas are significant stop-over areas for migratory shorebirds (Storrs & Finlayson 1997). In the narrow palaeochannels of the lower reaches of the Blyth floodplain, often adjacent to mangroves, the marshes are dominated by a tall sedge (*Schoenoplectus litoralis)* (Wilson & Brocklehurst 1990). The small flowered beetle grass (*Diplachne parviflora)* and a spikerush (*Eleocharis spiralis)* have been found in some saline depressions on the Blyth-Liverpool. Rice grass (*Xerochloa imerbis)* and sand couch (*Sporobolus virginicus)* grasslands fringe tidal channels, mudflats and mangrove woodland/forest communities on the Liverpool and Blyth lower floodplains.

2.3.2 Mangrove swamps

Saltwater and freshwater mangrove habitats exist in the Blyth-Liverpool wetlands and are an important resource for the local people (Messel et al 1981). Mangroves occupy 315 km^2 along the Blyth River and large areas of the Liverpool River. Mangrove swamps along the Australian coastline often contain six distinct zones: landward fringe; landward *Avicennia* zone; *Ceriops* thickets; *Brugiera* zone; *Rhizophora* zone; and a seaward fringe – all of which occur in the area (Messel et al 1981).

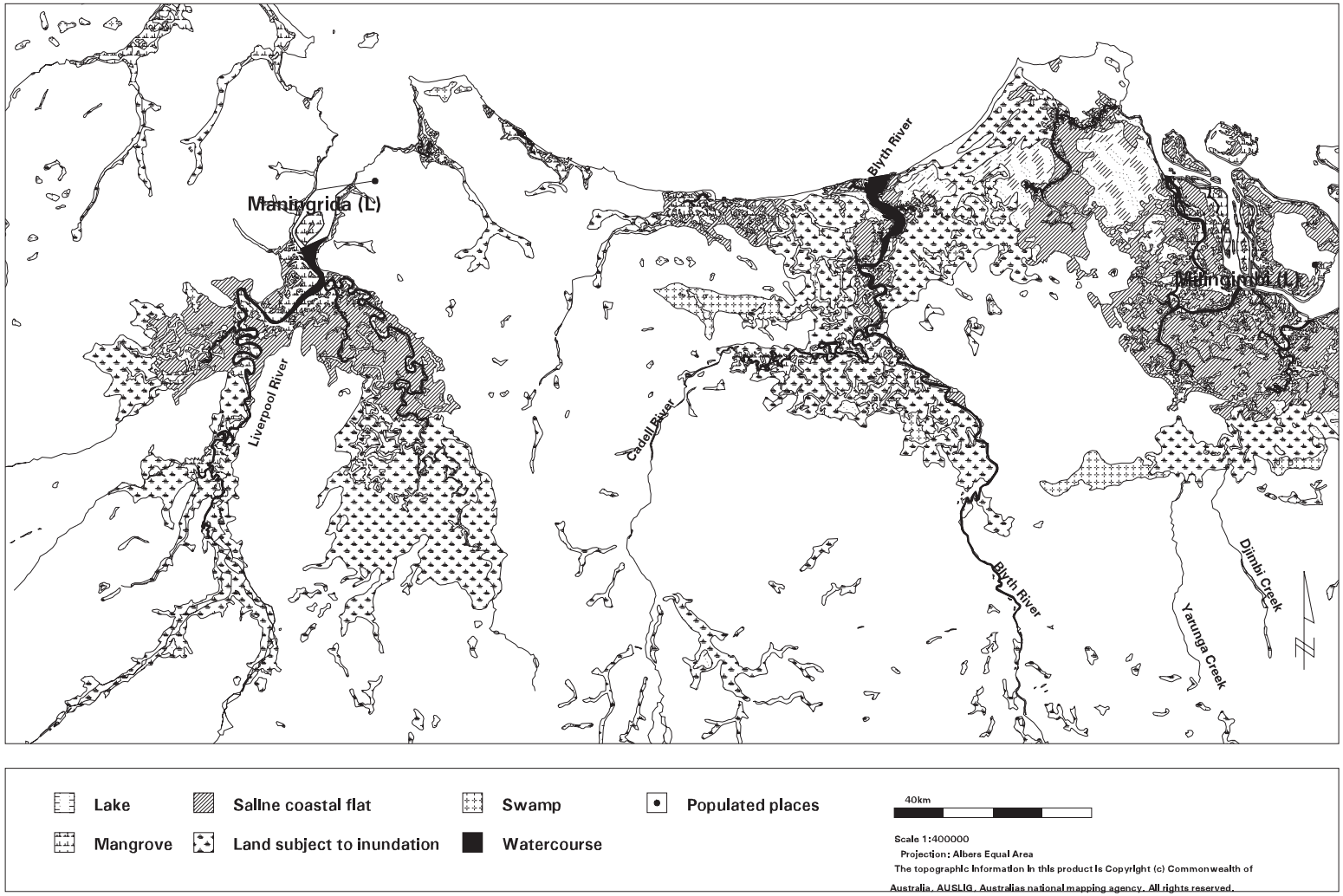

Figure 4 Blyth-Liverpool wetland habitat types

Plants from the mangroves provide food, medicine and implements, and mangrove fauna makes a large contribution to food resources (Wightman 1989). Shell fish, crabs, worms and fish are all important components of the diet of local people along the coast (Meehan 1982). The mangroves provide significant nurseries and habitats for many fish including barramundi (*Lates calcarifer*), mangrove jack (*Lutjanus argentimaculatus*), bream (*Mulio berda*), several species of mullet (*Liza* spp) and catfish (*Arius* spp) (Finlayson et al 1988). The mangroves on a small rocky islet close to Haul Round Island (Ngarraku), off the coast from Maningrida, are a significant breeding area for the pied cormorant (*Phalacrocorax varius*) (R Chatto pers comm).

The dominant mangrove species in the tidal portions of the Liverpool and Tomkinson Rivers is the stilt-rooted mangrove (*Rhizophora stylosa),* which grows with intermittent bands of the pornupan mangrove (*Sonneratia alba),* the kapok mangrove (*Camptostemon schultzii)* and the white mangrove (*Avicennia marina)* (Messel et al 1979). The river mangrove (*Aegiceras corniculatum)*, *Acanthus ebracteatus,* a small shrub with rich purple flowers, and the rib-fruited spurred mangrove (*Ceriops decandra),* are also frequently observed in these tidal mangroves (Messel et al 1979).

Freshwater mangroves require water and soils with much lower salinities than that of seawater (Wightman 1989). These habitats require freshwater input on a perennial basis and species found in this niche include the tall-stilted mangrove (*Rhizophora apiculata),* the cannonball mangrove (*Xylocarpus granatum)* and two other mangrove species, *R. lamarckii* and *Sonneratia lanceolata* (Wightman 1989, Messel et al 1979).

2.3.3 Lakes

Permanent lakes and swamps are rare in the Northern Territory and generally restricted to the northern coast (Storrs & Finlayson 1997). Several permanent waterholes can be found in the Blyth-Liverpool wetlands. The brackish Marngalgadjurrmeh Billabong in the Mann River catchment supports dense stands of the tall sedge (*Schoenoplectus litoralis)* and spikerushes (*Eleocharis* spp) around its edges and is surrounded by paperbark (*Melaleuca* spp) forest. Balbbanarra Swamp to the west of the Blyth is an important food gathering area as well as a place with great spiritual significance.

Seasonal lakes and swamps occur extensively across the northern and central regions of the NT (Storrs & Finlayson 1997) and frequently occur along the water courses and flood plains of the Blyth-Liverpool wetlands. These areas provide important breeding areas for water birds, salt water crocodiles and freshwater crocodiles (*Crocodylus porosus* and *C. johnstoni*) and provide Dry season refuges to fish populations. They also contain rich communities of aquatic macroinvertebrates, many still undescribed.

2.3.4 Freshwater marshes and flooded forests

Extensive floodplains occur along the northern draining rivers of the Northern Territory. These are of considerable conservation value and subject to many uses and threats (Storrs & Finlayson 1997). The floodplains are inundated seasonally and contain freshwater marshes and forests that may be inundated for 3–6 months of the year (Finlayson et al 1989, Whitehead et al 1990, Wilson et al 1991). The marshes are major breeding areas for crocodiles, turtles, fish, and many bird species. They also provide a major Dry season refuge for waterbirds and a significant migration stopover for shorebirds.

The high black soil plains associated with the lower reaches of the main river channels are dominated by a sedge (*Cyperus scariosus)* and a variety of grasses. Less common are the paperbark (*Melaleuca* spp) woodlands often composed of coastal paperbark (*Melaleuca acaciodes)* and broad-leaved paperbark (*M. viridiflora)* with an understory of grasses. The low

black soil plains are dominated by wild rice (*Oryza rufipogon)*, spikerushes (*Eleocharis dulcis* and *E. sphacelata)*, lippia (*Phyla nodiflora)* and a shrub (*Melochia corchorifolia)*. Restricted to the Blyth River floodplain are monospecific clumps of a type of bluegrass (*Ischaemum rugosa)*.

2.4 Noteworthy flora and fauna

No detailed flora or fauna surveys have been conducted for the Blyth-Liverpool wetlands. However, in nearby Kakadu National Park which is located within the same biogeographical region and which contains similar wetland types, over 1700 plant species, 55 freshwater fish species, 25 frog species, 76 lizard species, 39 snake species, 6 turtle species, 2 crocodile species, 289 bird species, 60 native mammals, 6 introduced mammals, and an estimated 10 000 species of insect can be found (ANCA 1996). Altman's (1987) study on a community located at Mumeka (Momega) outstation, which comes under the BAC umbrella, identified 110 plant and animal species which are utilised by traditional owners (appendix 1). These numbers include non-wetlands species as well. The continuing importance of wildlife in the diet of the people at this outstation was confirmed by Vardon et al (1998) in a further but less comprehensive analysis of food items. Further information on the flora and fauna can be found in databases held by various governmental agencies, as listed by Storrs and Finlayson (1997) and reproduced in appendix 2.

A large number of plant species from the Maningrida area have been identified by Leach et al (1992) as rare or threatened, many of which are endemic to the Northern Territory (Appendix 3). Species such as water lilies (eg *Nymphoides exiliflora)* and freshwater mangrove (*Rhizophora lamarckii*) are confined to the wetlands area. The kapok tree (*Bombax ceiba*), though not on the endangered list for the Northern Territory is becoming increasing rare within the Blyth-Liverpool wetlands because of the commercial uses associated with this tree (I Munro 1997 pers comm). The large corypha palm (*Corypha utans)*, which flowers and fruits once in 50–100 years and then dies, is also found in a number of coastal areas of the Blyth-Liverpool wetlands (Thurtell et al 1997). The corypha palm is not listed as rare or threatened because of its existence elsewhere in Asia, but it has only been recorded from three areas in the Northern Territory.

Recent surveys of freshwater fish in the Blyth-Liverpool wetlands (Pidgeon & Boyden 1997) extended the range for one fish species. The threadfin rainbowfish (*Iriatherina werneri*) was only previously found in the one other river of the Northern Territory; it is also found at Cape York and in New Guinea (B Pidgeon pers comm). Further survey work in the area may reveal unusual occurrences of other species.

Endangered waterbirds which are associated with Blyth-Liverpool wetlands include the Radjah shelduck (*Tadorna radjah*), also known as the Burdekin duck, and the little tern (*Sterna albifrons*). The low, sandy sections of Haul Around Island have been recognised as important breeding areas for the roseate tern (*S. dougallii*) and the bridled tern (*S. anaethetus*) (R Chatto pers comm).

Commercially important species occur in various habitats of the Blyth-Liverpool wetlands. Messel et al (1981) described the Blyth-Cadell and Liverpool-Tomkinson Rivers systems among the best tidal waterways in northern Australia for saltwater (estuarine) crocodile populations. Trepang (sea cucumber), which is in demand in many Asian countries is currently the focus of a distribution study by the Northern Territory University (NTU) in conjunction with the BAC and the CFC Rangers. It is hoped this study will determine the viability of commercially harvesting trepang without depleting the population (Carter & Yibarbuk 1996). Black cockatoos, turtles, fish, shell fish and magpie geese also have

commercial potential, but will require population studies and harvesting guidelines before commercial activities go ahead. The latter are provided for in a strategy for conservation through the sustainable use of wildlife in the Northern Territory (Parks and Wildlife Commission of the Northern Territory 1997).

3 Social and cultural issues

From an ecological perspective, the maintenance of the biological integrity of the Blyth-Liverpool wetlands would assist the protection of water quality and species diversity associated with the area (Thurtell 1997). Thus, when addressing the cultural aspects of the wetlands it is necessary to link the maintenance of a viable lifestyle with maintenance of the biophysical resource that the people both use and care for. Within the wetlands there are many sites and pathways between sites that have specific cultural and spiritual significance. Not all of these have been documented in a contemporary manner, but are well known to many local inhabitants.

3.1 The local economy

In the past studies by Altman (1987) and Meehan (1982) found that the subsistence economies of outstations in Arnhem Land had remained both resilient and significant. However, the maintenance of this lifestyle is increasingly dependent on outside factors. For many outstation communities the Blyth-Liverpool wetlands provide a very essential supplement to the income received from government unemployment benefits and a 'work-for-the-dole' scheme called the Community Development Employment Program (CDEP). Without the use of this resource base the lifestyle and nutritional standards of the outstation communities would be reduced. Altman (1987) found that this 'mixed' regional economy of welfare state, which had only existed for the previous 30 years, and the original hunter-gatherer economy has enabled traditional owners to continue to live in outstations and manage their traditional estates. The maintenance of outstation life facilitates the passing from generation to generation of traditional Aboriginal knowledge of the country and culture.

Information on the importance of the wetland resources for the outstation communities in or near the Blyth-Liverpool wetlands is not available. Information available elsewhere in western Arnhem Land (eg Russell-Smith et al 1997, Vardon et al 1997) may provide an indication of the type of resources potentially used, but specific analyses of assessments have not been conducted. However, it is generally assumed that the wetlands are an important source of materials for the local communities, as indicated below.

3.1.1 Hunting

A large variety of mammals are hunted by wetland communities, as documented for western Arnhem Land by Russell-Smith et al (1997). These include the feral Asian water buffalo (*Bubalus bubalis*) and feral pigs (*Sus scrofa*) (present only since the early 1980s), field rats (*Rattus colletti*), and brown and black flying foxes (*Pteropus alecto* and *P. scapulatus*). Marsupials form a large part of the nutritional base of outstations, the bandicoot (*Isoodon macrourus*) and many types of macropods are regularly hunted. Snakes, such as the file snake (*Achrochordus arafurae*), larger goannas (*Varanus* spp) and many lizards (eg *Chlamydosaurus kingii* and *Tiliqua scincoides*) are also hunted in surrounding wetlands. Turtles (eg *Carettochelys insculpta* adults and eggs and *Chelodina rugosa* adults), which rely on the billabongs and lakes, are highly sought. Freshwater and saltwater crocodiles are hunted and their eggs gathered. A large variety of fish species are also regularly caught, these include

barramundi, mouth almighty (*Glossamia aprion*), mullet (*Liza* spp), catfish (*Arius* and *Neosilurus* spp) and others.

Aquatic birds inhabit the wetlands and during the late Dry season can be found in densely populated camps and are easily hunted. The magpie goose (*Anseranas semipalmata* adults and eggs) is particularly sought after, but other species which are hunted include the Pacific black duck (*Anas superciliosa*), Radjah shelduck (*Tadorna radjah*), grass whistling duck (*Dendrocygna eytoni*), grey teal (*Anas gibberifrons*), pelican (*Pelecanus conspicillatus*) and various herons (*Ardea* spp).

3.1.2 Gathering

Many plants associated with the wetlands are regularly collected and used for food, various tools or crafts. Spikerush (*Eleocharis dulcis*), spiny mudgrass *(Pseudoraphis spinescens*), water lilies *(Nymphaea macrosperma, N. violacea*, *N. pubescens),* the red lotus lily *(Nelumbo nucifera),* screw palm (*Pandanus spiralis*), pond weed (*Potamogeton elongatus*) and wild rice (*Oryza rufipogon*) are some of the wetland plants which are gathered. Closer to rivers/monsoon forests round yams (*Dioscorea bulbifera*) are also sought, and very popular (Russell-Smith et al 1997).

3.2 The cultural setting

Aboriginal people living in Arnhem Land have social relationships based on a model which divides the humans, as well as the known universe, into two halves or moieties (Chaloupka 1993). The moieties are further divided and each division is associated with a specific set of totemic identities. Totemism is the central feature of Aboriginal religious life, which is based on a philosophy that regards humans, nature and land as one. Much of the daily life of Aboriginal people revolves around ceremony and totemism which has its roots in a mythology based on creation ancestors, art, ceremonies and an oral history. These traditional beliefs are very strong and link people and their culture to the landscape.

'Ceremony is part of our job'

(Nicodemus, Djelk Community Ranger)

3.3 Community aspirations

Developing employment opportunities and generating local revenue sources are key issues for outstation populations and consequently for the BAC. The BAC administers the federally funded CDEP with more than 400 participants engaged in activities such as art and craft production, mudbrick manufacture for local use, road construction and maintenance, building and administration as well as new projects in conservation and sustainable harvesting of native wildlife.

The BAC is conscious of the reliance of the outstation people on CDEP funding and is committed to pursuing much greater economic independence. However, underlying this economic imperative is a determination not to sacrifice traditional social structures and to maintain a relationship with the land which preserves both spiritual and natural values within a continuing and dynamic tradition. As a consequence, applications from external commercial interests have, in the main, been rejected or greatly restricted. Wildlife and habitat

management priorities remain oriented towards the maintenance of subsistence harvest. It is anticipated that the outstation communities will benefit through the implementation of management strategies that focus on sustainable harvesting of native wildlife. For these to be successful they must be formulated through appropriate consultation.

The BAC have identified the special values of their wetlands which, in one of seven local languages, are called Djelk. In the Gurrgoni language Djelk means 'land' and 'caring for the land'. Thus, the word intricately links the land to its care. In the early 1990s following the discovery and eradication of a small, but potentially devastating outbreak of the exotic thorny shrub *Mimosa pigra* (mimosa) on the floodplains of the Tomkinson River a formal land management program was instituted by the Djelk Community Rangers.

The Community Rangers logo (fig 5) identifies key issues for the community. The fish trap signifies bringing and holding people together for decisions about the land; the water lily links the earth, water and air, it is a thing of beauty and a source of food; the two stems stand for two laws – traditional and balanda (non-Aboriginal); the lily bulbs and roots represent people in the district; and the dilly bag holds important messages for the people of the Blyth-Liverpool wetlands (BAC 1996).

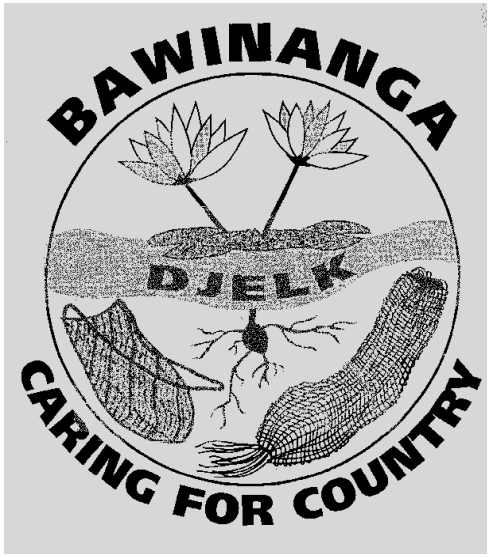

Figure 5 Djelk Ranger logo

4 Impacts and threats

Archaeological evidence indicates that central and western Arnhem Land have experienced human-induced ecological change for a minimum of between 40 000 and 30 000 years before present with less conclusive evidence suggesting an older date of 50 000 to 60 000 (Bowdler 1993). Fire management by traditional owners has undoubtedly altered vegetation patterns across the wetlands, creating an environment which favours fire resistant or fire adapted plant species (Andersen 1996, Russell-Smith et al 1997). These species now dominate most of the floodplain and influence the faunal populations. Hunting and gathering may also have affected the floodplain fauna and flora, but the nature of these effects is unknown.

As with other coastal wetlands the Blyth-Liverpool wetlands are under threat of potentially massive change as a consequence of climate change, sea level rise and saltwater intrusion

(Bayliss et al 1997, Eliot et al 1999). Other coastal wetlands in the Northern Territory are currently experiencing the destruction of freshwater habitats from saltwater intrusion (Woodroffe & Mulrennan 1993, Lindner 1995, Finlayson et al 1997a). The reasons for saltwater intrusion that has and is still occurring on some floodplains are not clearly elucidated and may have resulted from a combination of factors including the impact of feral water buffalo, destruction of off-shore shoals and changing land management practices. It is expected that climate change and sea level rise will exacerbate these changes and potentially lead to the destruction of many highly productive freshwater wetlands.

Exotic animals, such as cane toads (*Bufo marinus*), buffaloes and pigs threaten the ecological integrity of the Blyth-Liverpool wetlands. These species can alter the ecological character and the economic value of the areas they invade (Jonauskas 1996, Finlayson & von Oertzen 1993, Storrs & Finlayson 1997). Increasing pig populations have the potential to pollute waterholes and destroy surrounding vegetation. Greater control of feral animals, particularly pigs, is considered to be vital to maintaining the water quality and vegetative cover of the wetlands. The BAC has received limited assistance from government agencies for feral animal management. The potential affect of the cane toad on the wetland fauna has not been ascertained. Assessments from elsewhere (Coracevich & Archer 1975, Freeland 1984, Freeland & Kerin 1988) suggest that short-term, not long-term changes are to be expected.

The potential threat from the exotic weed mimosa (*Mimosa pigra*) needs to be addressed in a concerted and ongoing manner. The best approach to preventing mimosa from becoming established is 'search and destroy' as has been done reasonably successfully in Kakadu National Park (Lindner 1995, Cook et al 1996). This entails an ongoing commitment to surveillance supported by the immediate implementation of appropriate control measures (eg spraying or hand and mechanical removal of infestations when they are first detected). The experience of personnel from the Northern Territory and Federal Governments is well recognised and the BAC has enlisted their assistance. However, to be successful such programs need to be maintained with sufficient resources for training and continued implementation.

There is also concern that paragrass (*Brachiaria mutica*), an exotic pasture species (Lonsdale 1994) may invade and adversely affect the ecological character of the wetlands, as it is asserted to have done elsewhere (Clarkson 1991, 1995). Paragrass is already widespread across northern Australia and has been actively spread by pastoralists for grazing purposes and by weed managers as an immediate coloniser of areas that have been treated for mimosa removal (Storrs & Finlayson 1997).

Greater economic returns for the traditional owners of the Blyth-Liverpool wetlands through sustainable use of their wetlands could be used to improve the living conditions of outstation communities and in addition provide more resources for traditional owners to control feral animals and weeds. Such control and management procedures will depend upon external resources and expertise, but to be successful in the long term, they need to engage the local population who have a cultural/spiritual responsibility for protecting the land.

5 Wetland management planning

The BAC has a further major role to play in developing appropriate land use strategies. The strong feelings that already exist have been formalised through the NLC's Caring for Country Unit (CFCU) and the TEIPWP. Through the TEIPWP, staff and consultants of the CFCU have assisted BAC to begin a process of wetland management planning as well as providing assistance in locating appropriate funding and research resources.

> Land management is not a need which stands apart from other needs in a community. It must be integrated with those other needs. It involves physical elements in the environment, such as soil, water, vegetation, and fauna, and considers how these are directly affected by uses introduced by the human population. It also considers how the human population values these uses, for commercial worth, for conservation purposes, or to ensure future sustainability; and to what extent individuals can offer the appropriate skills to meet the management and planning needs required. Land management is also linked with cultural and social beliefs and structures which determine ownership and responsibility for land and resources and finally, community health (Young et al 1991).

A catchment management plan is being developed progressively through a bottom-up process. Responsibility for land is exercised at the level of estates by patrilineal clans and their matrifiliates. Thus, development of land management strategies at this scale involves the 'right people', from a cultural perspective. Involvement of such people in participatory planning approaches will increase local commitment to strategic plans developed from the land assessment. Ideally, the planning process will 'belong' to the local communities who call upon appropriate technical advice and assistance when required. Catchment scale strategies will be built from information derived from the estate-scale evaluation. The process of management planning includes a number of major components that are outlined below.

5.1 Consultation and knowledge

The NLC has ensured that the BAC has retained ownership of the management planning processes initiated under the TEIPWP. This was done through extensive consultation with the local community. Thus, the community are defining the most important land management issues and identifying potential projects. They have also actively participated in all surveys and projects developed in collaboration with other organisations and government agencies. Further, all research and development enterprises are directly related to identified issues and encompass education and training components. In this manner the community has retained ownership of the research and planning process and the management outcomes.

Meetings have been arranged and facilitated between government and research groups that could contribute to their wetland management programs. The most important issues identified by the community are used to direct the planning, research and development processes of these programs. These processes have been outlined by Finlayson et al (1999) and have further contributed to an international program under the Ramsar Wetlands Convention to develop guidance to assist governmental agencies in ensuring that local communities do own the management processes for their wetlands.

'Knowledge is being lost, cause we are losing all our old people'

(Peter Bunda Bunda, Assistant Senior Ranger,
Djelk Community Rangers)

5.2 Land assessment and inventory

A process of assessing the current state of health of country, estate by estate, is being undertaken involving traditional owners and managers with collaborative survey input from outside agencies. Results from these assessments will be assembled in a database form and installed on the Caring for Country Unit (CFCU) GIS system for transfer to community managers as required by hardcopy and in digital form when there is a local GIS capacity.

Priorities for action will be developed and on-ground work undertaken according to these priorities and the extent of community resources. It is anticipated this will lead to issues-based management and consequent research.

Funding has been obtained from the federal Natural Heritage Trust for a Land Management Coordinator to assist the Community Rangers in their efforts to formalise the management prescriptions for the wetlands and their resources (see capacity-building below). The coordinator and the Rangers will have a significant role in refining existing management practices and engaging expert assistance, for example, to assist with coarse-scale vegetation mapping of the area. This is expected to involve collaboration with various governmental agencies and universities and include ground truthing of remotely sensed information. Mapping of local roads and tracks using GPS technology is also anticipated given that existing official maps are generally more than 25 years out of date and omit information important for land management. A GIS facility is being developed to assist with these tasks (Hill & Carter 1999).

In the past, detailed studies documenting cultural and economic aspects of outstation communities have been completed (eg Gillespie et al 1977, Meehan 1982, Altman 1987, Chaloupka 1993). These studies have described rock art, the economy of outstations and the types and amounts of plants and animals consumed by outstation communities. Ecological surveys and studies of the area are limited and tend to concentrate on one taxa, such as crocodiles (eg Messel et al 1979, 1981) or waterbirds (Bayliss & Yeomans 1990a,b), or are part of a broad classification of Top End wetlands (Wilson et al 1991).

Over the past few years the Djelk Community Rangers have worked with staff from ***eriss*** to survey macroinvertebrates and fish in the two river systems (Thurtell 1997, Pidgeon & Boyden 1997, Thurtell et al 1997). These surveys will serve as a baseline for future water quality and ecological monitoring and can also assist in an assessment of the ecological health of the habitats sampled. The surveys have been done jointly and knowledge from the traditional owners and survey staff combined. In this manner the documentation and recording of ecological knowledge has been enhanced and information shared on an equal basis. Interaction and exchanging information is treated as an important part of the documentation processes.

'Have to know not to take too much, move around from place to place, in our own traditional knowledge we know how to manage our land, but we need to be recognised'

(Lisa Jelenic, Djelk Community Ranger)

5.3 Local networking

The gradual adoption of a more sedentary residence pattern have forever altered the system of traditional cooperative on-ground management which persisted in this area until recent times. The development of new operational modes for management through informal workshopping and networking is required to provide communities and individual resource managers with the understanding, skills, self-reliance and commitment necessary for sustainable management of land, water and related vegetation. The CFCU will support this process with in-house production of strategic issues mapping and through NTU remote sensing and GIS (Hill & Carter 1999).

5.4 Capacity-building

Sustainable management of the wetlands is dependent on the capacity (skills and resources) of the Aboriginal landowners and community agencies to deliver that management. Capacity-building is identified as a priority in the Ramsar wetlands strategy guidelines. This is being achieved by the implementation and enhancement of a land management program based on CDEP and the initiation of formal and field-based training in non-Aboriginal land management techniques, bringing together Aboriginal and non-Aboriginal experts for field survey and on-ground action and the sharing of results through local workshops.

'I have strong ambitions for my people's training, to be able to have better employment or even further study. I want to prepare my people so they can build the bridge better'

(Dean Yibarbuk, BAC Chairman and Senior Ranger, Djelk Community Rangers)

The Djelk Community Rangers play an important role in the planning and consultation process. The Rangers mission statement is:

To maintain and improve outstation life by keeping their land, culture and people strong using traditional and non-traditional ways to care for country.

The program now comprises a senior ranger and 15–20 rangers, although a far greater number of local people may be involved with ranger projects through CDEP funding. The Community Rangers are keen to develop land management and training projects and to make use of the best available knowledge. They recognise two types of knowledge – traditional and non-traditional or scientific knowledge. The Rangers are encouraged to learn non-traditional management methods to complement their own traditionally-based knowledge which, in many instances, has been passed on by their elders and consolidated through experience. In this manner traditional knowledge can be linked with non-traditional knowledge and not ignored, as happened in the past when a now defunct government-owned forestry program operated in the area.

The TEIPWP facilitates and secures training in non-Aboriginal land management for land management workers and landowners. The Rangers received basic training through the CFC program during 1994 and are currently undertaking formal resource management training through the Faculty of Aboriginal and Torres Strait Islander Studies at the Northern Territory University. As well, a variety of other training programs have been accessed, ranging from feral animal control to coxswains courses. The value of knowledge and training is well recognised within the local communities. Similarly, the dangers of losing traditional knowledge are recognised and treated with great concern with younger members of the community being encouraged to undertake training through traditional and non-traditional means.

A land management coordinator has been employed for a three year term (from April 1998) on a 'Bushcare' grant provided by the Federal Government's Natural Heritage Trust fund. A core function of the Land Management Coordinator will be to provide a local link between training agencies and the BAC. The Coordinator will also have the job of ensuring that follow-up work programs provide opportunities to reinforce learning through action.

Capacity building will integrate formal land management training for the core land management workers, indigenous knowledge transfer to younger members of the community and field training during collaborative research and survey projects. Such training could also be undertaken through collaboration with research and management projects. An example of this occurred in 1996 when two Community Rangers visited ***eriss*** along with two technical staff from the Ok Tedi mine in Papua New Guinea and participated in a stream monitoring program in Kakadu National Park.

It is expected that broader community understanding of issues will spread from the land management teams to homeland residents and other landowners and to the community-based governing committees and councils. Clear identification of particular land management needs will assist community associations and the like to obtain outside resources where necessary.

5.5 On-ground action

On-ground work is essential to controlling escalation of threatening processes. The TEIPWP will assist Community Rangers to effectively manage fire, weed and feral animal invasion. The focus will be on on-ground action which will assist in strengthening feelings of responsibility for country by making landowners and land managers more aware of changes being brought about by invasive species and other changing circumstances. Success at on-ground action will build confidence as well as technical and institutional capacity.

5.5.1 Weed management

The weed management objective is to maintain the environmental integrity of the area through strategic control of incursions by new weeds. There is an opportunity to act before weedy species establish and become a naturalised component of the environment.

Weeds originate from a number of sources and require a range of responses to achieve control. A major potential source is from increased traffic on the Maningrida/Kunbarllanjnja road as it is upgraded. Weed seeds are carried by vehicles and may be dislodged at water crossings or at stop-over points. Importation of 'road-base' or gravel for road building is also a significant potential source of weeds along road sides.

The Community Rangers will be trained in recognising various weeds and in dealing with newly identified spot outbreaks quickly to minimise spread. The Rangers should systematically search for and destroy new weed species at water crossings, along the main road and on various off-shoots as well as stopover points along the road. Residents of outstations will be assisted to deal with environmental weeds which have potential for significant spread into wider areas. Continued monitoring of the area in which mimosa has been treated will be necessary. Weed data will be fed back to the CFCU for inclusion in a GIS database on weeds on Aboriginal land in the NLC area.

5.5.2 Feral animal

The threat from feral animals has increased with concern being expressed over the following species – pigs, buffalo, cattle, horses, cane toads, cats, fish, European bees and big-headed ants. Large-sized feral animals contribute to the decline in the quality and extent of native vegetation through trampling, grazing and providing conditions suitable for weed invasion. Feral animals can also disperse weed propagules over long distances. All feral animals can have adverse impacts upon the biodiversity of the wetlands through habitat destruction or direct predation etc.

The land management coordinator will gauge awareness of feral animal issues amongst landowners. As part of the land assessment program the spread and concentration of feral

animals will be charted and areas of most significant habitat impact identified. Areas surveyed will be mapped to record information on feral animal occurrence and evidence of expanding range. Opportunities to systematically reduce the numbers of pigs and buffalo will be pursued in cooperation with landowners and government agencies. The Parks and Wildlife Commission of the NT (PWCNT) can provide advice regarding various options for feral animal control.

'We are working for Caring for Country. That means the whole land, community, outstation, etc. It means jobs like keeping buffalo out of our waterholes and stopping pigs messing up the land and keeping our roads clear and open so we can travel from one place to another.'

(John Ryan and Winston Smith, Djelk Community Rangers)

5.5.3 Fire management

Traditionally, the right time to burn is when the grass will burn easily but still retains some moisture so that the fire is not too hot. This is usually at the time the local people call yekke (sometimes also spelt 'yegge') or 'cold' weather time around June or July. Wind direction is watched to make sure the fire will go in the direction they want it to go. When burning on floodplains the fire is directed toward wet areas. On floodplains there are often two periods of burning. The first is the early burn at the edges while the plains proper are still moist and keeping grass green and then a later burn when those grasses are dried out. The early burn acts as a firebreak to keep fire out of surrounding monsoon forest. Men and woman work together when burning the floodplains with men moving fast and over great distances lighting the fires, and women carefully coming along gathering the resources revealed on the burnt areas (D Yibarbuk pers comm).

The land management coordinator will assist traditional owners who do not have their own transport to access country for early Dry season burning. Links between areas of land and people with particular responsibilities for fire management will be fed into the developing plan. Local on-ground action will be related to satellite imagery to refine interpretation of remote sensing data. Areas requiring special fire management will be identified and management prescriptions developed.

5.5.4 Erosion management

Areas where erosion is a problem will be identified in the land assessment program. Major linking roads and hunting and access tracks will be monitored for erosion (and weed spread). The Department of Lands Planning and the Environment was successful in obtaining Natural Heritage Trust monies to employ a soil conservation officer whose primary area of operations will be the Maningrida region. Local resources will be used to deal with erosion issues where they are within the capacity of local stakeholders.

5.6 Collaborative activity

Collaboration with outside research and management agencies is seen as essential to dealing with new problems with which landowners are unfamiliar. The TEIPWP and Coordinator will facilitate and integrate involvement of outside agencies in issues based collaborative work.

Developing effective collaboration which leads to an increase in local knowledge requires focused coordination at the local level.

The biological survey work undertaken by ***eriss*** has been conducted with an emphasis on collaborative process and local landowners and scientists attest successful outcomes for both parties. On such occasions staff from ***eriss*** provide training in sampling techniques (figure 6). On one occasion Djelk Community Rangers joined technical staff from Ok Tedi mine in a stream sampling and training program conducted in Kakadu National Park. Where possible such activities are incorporated within the the regular work program being conducted at ***eriss*** in order to instill a sense of purpose and reality to the training. Further training and research will continue to build on the success of such collaboration. Through the TEIPWP and the land management coordinator an effort will be made to set new benchmarks in collaborative outcomes through focused planning of collaborative work, innovative local workshopping of collaborative research results and review of collaborative process after each exercise.

The BAC has established a close working relationship with the PWCNT on a basis of mutually beneficial collaboration, rather than any formalised management agreement. This also facilitates an exchange of information. As an example, the PWCNT hosted a ranger training camp in the area that involved Aboriginal rangers from other areas as well as PWCNT rangers and researchers.

A herbarium is planned for the near future to contain specimens of useful plants; these will include food, medicinal and commercially valuable plants. The provision and sharing of facilities by the BAC has been done in order to attract outside experts to work with the Rangers and others. It also provides a mechanism for possible employment of local people and training in biological survey and sampling techniques.

The BAC has recognised the need for further research and have successfully taken steps to support research staff from other organisations and to develop training programs for their Rangers and others. Land management and research activities in the Blyth-Liverpool wetlands will largely take place through the Djelk Community Ranger Program. However, the existence of the Djelk Community Rangers does not circumvent the rights of traditional landowners. The Rangers only undertake work on particular clan estates at the invitation of the landowners, thus operating as ‘contract’ land management workers.

The BAC has completed building a ranger station about 20 km out of Maningrida which incorporates a field laboratory that will allow more technical aspects of collaborative research to be carried out and where rangers may observe, receive training and participate in scientific studies and surveys. The vision for the Djelk Community Ranger program includes construction of an extensive training and research centre. This will be used to attract further collaborative research and capacity building aimed at maintaining the near-pristine natural biota and in developing sustainable uses for wildlife.

In this process the research and information collation are seen as means of providing training and assisting the land owners develop their land in a manner that suits their aspirations and lifestyle. In turn, the BAC and land owners are exchanging knowledge and experience with the visiting research personnel. This mutual cooperation is seen as a key to providing an information base that will enable effective management prescriptions to be developed.

Figure 6 Djelk Community Rangers undertaking training activities in collaboration with technical staff from Ok Tedi mine, Papua New Guinea, and ***eriss*** staff (photographs by (TL) James Boyden, (TR) Ray Hall, (BL) James Boyden, (BR) Kym Brennan

5.7 Integration of conservation and development

The future of the Blyth-Liverpool wetlands and the people are inextricably linked. Both people and land are confronting radical changes in circumstances which will require adaptive strategies to integrate conservation and development. Development is needed to provide a basis for sustainable settlement and conservation is needed to ensure the sustainability of natural resources. People are needed to look after the land and the land is needed to sustain those people so that they may continue to look after the land. The TEIPWP will assist landowners and their organisations to achieve an appropriate integration of conservation and development strategies to provide for integrated biodiversity and human outcomes.

The BAC is involved in two major sustainable commercial wildlife use projects, one involving saltwater crocodiles (R Hall pers comm) and the other trepang (Carter & Yibarbuk 1996), particularly the sea cucumber or sandfish (*Holothuria scabra*). Since 1990 the crocodile project has entailed the provision of liaison and administrative services to facilitate the gathering of crocodile eggs from a number of central Arnhem Land river systems. The collection is regulated by the Northern Territory Government's federally-approved Crocodile Management Program and also by the requirements for informed consent and fair dealing prescribed under by the land rights act (ALRA). As the University of Sydney's main field study centre on crocodile biology was located at Maningrida in the early 1970s, there is extensive and detailed data on which to base population monitoring (Messel et al 1979, 1981). Monitoring continues to be carried out annually by a commercial firm under contract from PWCNT.

For some years the participation of local community members in the crocodile harvesting program was limited to annual egg collection for incubation elsewhere. However, in the 1996/97 Wet season and under licence from PWCNT the BAC installed an incubator and successfully produced hatchlings from eggs collected locally. The Community Rangers received training in operation of the incubator, recording of hatchling data required under the licence for monitoring purposes and packaging and dispatch of hatchlings to crocodile farms elsewhere. The hatchling project has generated a great deal of enthusiasm amongst the Rangers and proceeds from the first year have paid for equipment and operating costs, although monitoring costs continue to be met by the PWCNT which levies a fee on eggs, hatchlings and adult crocodiles harvested.

The crocodile program has been extended further with the BAC in association with PWCNT undertaking a harvest of adult saltwater crocodiles for the skin trade and for subsistence consumption of meat. The trial harvest will involve the Djelk Community Rangers collecting 100 adult animals and looking at value-adding, such as tanning and taxidermic mountings (R Hall pers comm).

'Part of our program (Caring for Country) is to do with the future of our children and grandchildren and I would like a better future for my son and myself in the long run.'

(Lisa Jelenic, Djelk Community Ranger)

Plans by the BAC to take a leading role in the revitalisation of the trepang industry along the central Arnhem Land coast are less well advanced (Carter & Yibarbuk 1996). Since the large scale trepang industry involving Aboriginal people and the Macassans was stopped early this century, there has been only desultory activity despite the fact that Australia probably holds a

large proportion of the global trepang resource. Australian resources are currently lightly fished while in other localities stocks have been overfished and management programs neglected. International demand for sandfish is currently high. However, little relevant biological information is available to guide the development of a sustainable use strategy. In response to a request for cooperative research in the central Arnhem Land area, BAC nominated trepang as a locally preferred research subject, with a view to establishing indigenous participation in the industry under a sustainable harvest strategy.

With funding from a variety of sources the BAC have attracted interest in studies to examine distribution and abundance fluctuations at a broader scale to determine preferred habitat characteristics and core areas of abundance. In areas of known occurrence the research will model biomass dynamics and measure the effects of harvest following depletion of selected sites (Carter & Yibarbuk 1996). The research arrangements emphasise local benefit from collaboration and involve the Community Rangers as an essential part of the research team. Research planning is carried out collaboratively and the community receives ongoing reports of research results. Although it will be some time before there is an adequate information base to create a scientifically based management prescription for sustainable harvest, BAC is committed to the 'long haul'.

5.8 Monitoring

To assess the ecological integrity of wetlands, effective surveillance and monitoring programs are required (Storrs & Finlayson 1997). There have been few surveillance or monitoring (as defined by Finlayson 1996b) programs undertaken in the Blyth-Liverpool wetlands. Increasingly, however, locally-organised surveillance programs for pest species are being planned and organised (R Hall 1999 pers comm). Such surveillance and monitoring which would be helpful to better manage the wetlands includes weeds and feral animal distribution and abundance, saltwater intrusion and water quality.

5.9 Regional linkages

The TEIPWP and the various land management coordinators around the region will assist in building and extending links and cooperative working arrangements to neighbouring land management initiatives (Djelk Rangers, northern Arafura Swamp land management workers, south-eastern Arafura Swamp land management workers, Bulman Community). Development of agreed responsibilities at the margins between the groups will be a major step in larger scale land management coordination in central Arnhem Land. The Community Rangers participated in a workshop on the use of wetlands by indigenous communities in September 1998 (Whitehead et al 1999) that enabled traditional landowners and managers from across northern Australia to meet and discuss land management problems and their possible solution.

6 Management outcomes

The Blyth-Liverpool wetlands are currently managed by small communities of indigenous people who have a strong cultural and spiritual connection with the land. As a consequence there is widespread continued maintenance and inter-generational flow of traditional ecological knowledge between people who largely live a subsistence lifestyle. However, the wetlands are facing increasing pressures. Foremost amongst these pressures are those imposed by invasive weeds and animals. At the same time, the local communities are facing difficult economic choices that could lead to improved living conditions, but which could also potentially erode the basis of their subsistence lifestyle. Many communities, however, are

committed to pursuing economic independence. This commitment combined with the continued existence of a strong traditional knowledge base provides a distinct advantage for developing appropriate management prescriptions for the resource rich wetlands.

Under guidance from the BAC, a wetland management philosophy has been articulated and a community ranger program successfully implemented. The Community Rangers have received training and provide a focus for management and research activities that have been agreed through a process of consultation and exchange of ideas and information. This exchange has been encouraged and mediated by the NLC in conjunction with the BAC and has successfully attracted assistance for developing sustainable harvest programs, control of pest species and ecological surveys for specific purposes. All such activities have included a training element and an exchange of knowledge between indigenous and scientific personnel.

The success of these programs has been facilitated by the existence of the administrative structure provided by the BAC and the active involvement of people from the outstations. This structure has reinforced the determination to maintain customary values and to maintain traditional land tenure as a foundation for land management planning. This has been augmented by a commitment to dialogue and consultation which has further empowered the local people to make decisions and feel comfortable when dealing with non-indigenous people and their technical expertise. In this manner ownership of the planning processes and outcomes have been retained by the local communities.

Throughout the consultation process there has been a commitment to 'care for country' using methods developed through cross-cultural information sharing and the development of trust. The feelings of trust and ownership have been integral to the successes achieved and provide a basis for developing long-term beneficial programs that encompass sustainable development and conservation.

Training and information exchanges have also been key outcomes of the consultation processes and are seen as a major component of further activities, whether commercial or scientific in nature. The Djelk Community Rangers are keen to supplement their traditional land management knowledge and practices with non-traditional scientific approaches and appreciate the value of sharing information and ideas. This reflects a confidence that comes with empowerment and trust.

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Appendix 1 Inventory of Djelk Aboriginal Food

(from Altman 1987)

Latin name	Gunwinggu Name	Euro-Australian Term	Moiety	Use
Fruit				
Acacia difficilis	Man.gurrk, Mandjo	Wattle	Yirritja	Gum used as adhesive in painting
Antidesma ghaesembilla	Mandjulukun	Black plum	Yirritja	Small plum or berry available during the Wet season
Brachychiton paradoxum	Manbutbut		Dua	Fruit eaten – yellow. Stem of plant used to make bush string
Buchanania obovata	Mandudjmi, Manmoyi		Dua	Sweet green plum. Available from late October till early wet
Canthium lucidum	Manmaremdolum		Dua	Red fruit eaten during late Wet season
Capparis umbonata	Manjiliwin		Dua	Green edible fruit
Carallia brachiata	Manwidu	Billabong tree	Yirritja	Red berries eaten – available early Dry season
Cassytha filiformis	Manburrung-burrung	Devil's twine	Dua	Vine with small white/ transparent berries edible in late Dry season
Cordia subcordata	Gabilingun (?)	White apple	Dua	Fruit with small seeds, eaten raw
Curcurmis melo	Mandawk	Bush cucumber or melon	Yirritja	Small green fruit eaten late Wet to mid Dry season
Dechaisnina signata	Mandjiniridj	Black plum		Plum eaten during mid Wet season
Elaeocarpus arnhemicus	Mangulta		Yirritja	Purple fruit eaten during Wet season
Eugenia armstrongii	Man.gindjilk-gindjilk		Dua	Small white apple; eaten during mid Wet season – little bitter
Eugenia bleeseri	Borgon	White love apple	Dua	Edible white fruit eaten from late Dry to mid Wet season
Eugenia eucalyptoides	Borgon		Dua	Edible white/pink fruit eaten from late Dry to mid Wet season
Eugenia suborbicularis	Mandjaduk	Red apple	Yirritja	Edible large red apple eaten from late Dry to mid Wet season
Ficus coronulata	Nangalehmerrk	Fig		Green fruit edible during Wet season
Ficus platypoda	Manbutbirri	Fig	Dua	Edible fruit matures early Dry season in rock country
Ficus racemosa	Manmanawaru	Cluster fig		Fruit available late Dry season to early Wet. Dug out canoes made from trunks
Ficus scorbina	Manlarra	Sandpaper fig	Yirritja	Black fruit edible during early Wet
Grewia retusifolia	Mandjutmo		Yirritja	Edible red fruit eaten during Dry season
Leea rubra	Manwalk	Bush grape	Dua	Black grape like fruit. Ripe mid Wet to Dry season

Appendix 1 Inventory of Djelk Aboriginal Food (continued)

Morinda reticulata	Manwukman	Morinda	Dua	Edible yellow fruit. Roots used for yellow dye
Nauclea undulata	Manyalbowah	Leichhardt pine	Yirritja	Edible brown fruit available after Wet season
Opilia amentacea	Manmulanbarr	Yellow plum	Dua	Yellow fruit that ripens during first storms
Passiflora foetida	Djalamartawk	Bush passionfruit	Dua	Fruit eaten from late Wet to Dry season. Extremely common
Planchonella pohlmaniana	Manbulmet			Green edible fruit. Ripens early Wet
Planchonia careya	Manwordberr	Billy goat plum	Yirritja	Large green fruit edible from early Wet. Bark used to make bush string
Melodrum sp.	Manbutbirri			Yellow elongated fruit ripens during early Wet
Securingea melanthesoides	Man.gowan		Dua	Small white fruit edible during Wet seasons
Syzigium rubiginosum	Gitjaidjan		Dua	White, slightly cheeky apple eaten during Wet seasons
Tacca leontopetaloides	Mandjotno		Yirritja	Red fruit eaten during late Wet season
Terminalia carpentariae	Manmopan	Wild peach	Yirritja	Small fruit eaten raw during first storms
Terminalia ferdinandiana	Mandjirribitj	Billy goat plum	Dua	Small green plum eaten during early Wet season
Terminalia platyphylla	Mandjirribitj	Billy goat plum	Dua	Small green plum eaten during early Wet season
Terminalia sericocarpa	Manyugu			Small dark plum eaten raw, early Wet
Vitex glabrata	Manmimkodok		Yirritja	Edible fruit from early to mid Wet seasons
Vegetables				
Amorphophallus glabra	Ngan.gobuk	Bush potato	Yirritja	White root which is cooked
Aponogeton elongatus	Man.godbang			Aquatic plant with edible tuber. Available during Wet season
Cartonema spicatum	Dikula	Bush potato	Dua	Root of this bush is lightly roasted and eaten
Cartonema parviflora	Dikula	Bush potato	Dua	Root of this bush is lightly roasted and eaten
Cayratia trifolia	Man.godbeh	Bush potato	Dua	Vine with long roots. Available late Wet to mid Dry season
Corynotheca lateriflora	Manburrbarr	Herb	Dua	Herb used to flavour meat
Curculigo ensifolia	Manngalgadj	Bush potato	Dua	Tuber of plant cooked; late Wet to early Dry season
Cyperus aquatilus	Dorrt		Yirritja	Black seeds are eaten raw. Early Dry season
Decaschistia byrnseii	Manburri	Bush potato	Dua	Tuber is roasted
Dioscorea sativa var. rotunda	Manyawok	Cheeky yam	Dua	Large root available Dry season. Must be leached overnight

Appendix 1 Inventory of Djelk Aboriginal Food (continued)

Dioscorea transversa	Garrabardar	Long yam	Dua	Large root available late Wet to late Dry
Drynaria quercifolia	Mangobin	Fern		Rhizome eaten when cooked
Eleocharis dulcis	Man.gulaidj	Reed; spike rush	Dua	Edible corm eaten raw or cooked
Eriosema chinense	Manbulupi	Bush potato	Dua	Tuber cooked and eaten late Wet season
Gardenia fucata	Mandjun.gurr		Dua	Used to flavour wallaroos
Gronophyllum ramsayi	Goln	Kentia palm	Dua	New leaves eaten raw. Water containers made from old leaves
Heteropogon triticeus	Mayatjah	Bush sugar cane	Dua	Stalks chewed when green. Sweet juice
Ipomoea abrupta	Garrbilk	Bush carrot	Dua	Carrot shaped root eaten raw or roasted
Ipomoea graminea	Garrbilk	Bush carrot	Dua	As above
Ipomoea velutina	Manngalim	Bush carrot	Dua	As above
Livistonia humilis	Djendek, Gulwirri	Fan palm	Dua	Stem eaten raw - coconut paste. Fruit eaten also
Microstemma tuberosum	Badjo	Bush potato	Dua	Small bush potato that can be eaten raw or cooked
Murdania graminea	Man.gawung	Bush potato	Yirritja	Small bush potato that can be eaten raw or cooked
Nymphaea sp.	Wayuk	Water lily	Yirritja	Stem of water lily that is eaten raw once outside skin removed
Nymphaea sp.	Ganwerr	Water lily	Yirritja	Seed head eaten raw or crushed and baked into bread (manggo)
Nymphaea sp.	Bulparrt	Water lily	Yirritja	Root is eaten raw or cooked
Oryza perennis	Manrol	Bush rice	Dua	Seeds of this grass are crushed and baked into bread
Persoonia falcata	Mandak		Dua	Green plum with stringy flesh
Triglochina procera	Manbidwuk, Manbulet		Dua	Aquatic plant with small tubers eaten raw or roasted
Vigna vexilata	Bulgut, Bartuba		Dua	Bush potato eaten in Wet seasons
Nuts				
Eucalyptus porrecta	Mandorrdorrt	Bloodwood gall		Soft inside of gall eaten
Grevillea heliosperma	Manbarrbarrt			Hard flat gall opens in late Dry
Pandanus basedowii	Manmurgeh	Sandstone pandanus		Nut edible after roasting
Pandanus spiralus	Gundayar	Screw palm	Dua	Fruit inside nut eaten late Dry season
Sterculia quadrifida	Man.gol	Monkey nut	Dua	Peanut type fruit eaten early Wet
Honey				
Trigona sp.	Bobitj	Bush honey or ‘sugar bag’	Dua	Eaten raw, plentiful during early mid Dry
Trigona sp.	Man.gung	Bush honey or ‘sugar bag’	Yirritja	Eaten raw, plentiful during early mid Dry
Melophorus spp	Walidong	Honey ant		Eaten whole

Appendix 1 Inventory of Djelk Aboriginal Food (continued)

Mammals				
Bos taurus	Buluki	Feral cattle		Eaten
Bubalus bubalis	Nganaparru	Feral water buffalo		Eaten
Lagorchestes conspiculatus	Wulungalu/Ulala	Spectacled hare wallaby	Yirritja	Eaten sometimes
Macropus agilis	Gonopolo Waradjanggal (male) melperrt (female)	Agile wallaby	Dua	Eaten; shoulder bone used for yams
Macropus antilopinus	Kandakeet (male) Kandite (female)	Antilopine kangaroo	Yirritja	Eaten; bones used for decoration (nasal). Also used as needle to recover Pandanus seed
Macropus bernadus	Nadjinem (male) Djugereh (female)	Black wallaroo	Dua	Eaten; bones used for decoration (nasal). Also used as needle to recover Pandanus seed
Macropus robustus	Nadjinem (male) Djugereh (female)	Euro; Hill kangaroo	Dua	Eaten; bones used for decoration (nasal). Also used as needle to recover Pandanus seed
Petrogale brachyotis	Patpong	Short eared rock wallaby	Dua	Eaten
Peradocas concinna	Narbalek	Little rock wallaby	Dua	Eaten
Perameles macroura	Yok	Bandicoot	Yirritja	Eaten
Pteropus alecto	Murru	Black flying fox	Dua	Eaten
Pteropus scapulatus	Ngayelak	Brown flying fox	Yirritja	Eaten
Rattus sp.	Dogon	Field rat	Dua	Eaten
Sus scrofa	Bigibigi	Feral pig		Eaten
Birds				
Anas gibberifrons	Diweet	Grey teal	Yirritja	Eaten
Anas superciliosa	Nanggul	Black duck	Dua	Eaten
Anseranas semipalmata	Munuparr	Magpie goose	Yirritja	Highly prized food. Wings used as fans
Ardea noveahollandiae	Lumbuk	White faced heron	Dua	Eaten
Ardea pacifica	Minigolgol	White necked heron	Yirritja	Eaten
Ardeotis australis	Benok	Bustard, Bush turkey	Dua	Eaten
Butorides striatus	Ngalgirbel	Mangrove heron	Dua	Eaten sometimes
Cacatua galerita	Narratj	Sulphur crested cockatoo	Yirritja	Eaten sometimes
Calyptorhynchus magnificus	Nganarr	Red tailed black cockatoo	Yirritja	Eaten sometimes
Coturnix australis	Djirribitj	Brown quail	Dua	Eaten
Coturnix chinensis	Laplap	King quail	Dua	Eaten
Dendrocygna arcuata	Djeeleekweebee	Water whistling duck	Yirritja	Prized food

Appendix 1 Inventory of Djelk Aboriginal Food (continued)

Dromaius novaehollandiae	Ngurrudu	Emu	Dua	Eaten; feathers used in ceremony
Egretta alba	Gomolo	Large egret	Yirritja	Sometimes eaten. Feathers used in ceremony
Grus rubicundus	Ngalgordoh	Brolga	Dua	Eaten
Nycticorax caledonicus	Durukmut	Nankeen night heron	Dua	Eaten
Pelecanus conspicillatus	Weneh	Pelican	Dua	Occasionally eaten
Platea regia	Muluymuluy	Royal spoonbill	Dua	Eaten sometimes; spoon bill used as utensil
Phalacrocorax varius	Bonbon	Little pied cormorant	Yirritja	Good food
Plegadis falcinellus	Bindu	Glossy ibis	Dua	Eaten
Porphyrio Porphyrio	Nalgodjurmi	Swamp hen	Dua	Eaten
Rallus philipensis	Bogung	Buff barred rail	Yirritja	Eaten
Tadorna radjah	Karkirala	Burdekin duck	Yirritja	Eaten
Threskiornis molucca	Garala	White ibis	Yirritja	Eaten
Threskiornis spinicollis	Genalk	Straw necked ibis	Dua	Eaten
Xenorhynchus asiaticus	Gundji	Jabiru	Yirritja	Prized meat; wings used as fans
Fish				
Ambassis agrammus	Djabel	Sail fin perch	Yirritja	Eaten
Ambassis macleayi	Djabel	Chanda perch	Yirritja	Eaten
Amniataba percoides	Dolpo	Black striped grunter	Yirritja	Eaten
Aseraggodes klunzingeri	Morpon	Tailed sole	Dua	Eaten
Carcharhinus mckaili	Nakorro	River whale shark	Dua	Eaten
Craterocephalus marianae	Bududu	Marjorie's freshwater hardyhead	Yirritja	Eaten
Cynoglossus heterolepis	Morpon	Tongued sole	Dua	Eaten
Dasyatis sp	Nawala	Brown river stingray	Dua	Eaten
Nematalosi erebi	Warrak	Freshwater herring	Yirritja	Eaten
Glossamia aprion	Djabel	Mouth almighty	Yirritja	Eaten
Glossogobius giuris	Djanbel	Flat headed goby	Yirritja	Eaten
Hephaestus fuliginosus	Dumbatman	Sooty grunter, Black bream	Dua	Eaten
Arius leptaspis	Nadjalek	Lesser salmon catfish	Dua	Eaten
Hypseleotris compressa	Djanbal	Northern carp gudgeon	Yirritja	Eaten

Appendix 1 Inventory of Djelk Aboriginal Food (continued)

Lates calcarifer	Bilmo, Namonggol	Silver barramundi	Yirritja	Eaten
Liza alata	Puduru	Ord river mullet	Dua	Eaten
Liza dussumieri	Puduru	Green bodied mullet	Dua	Eaten
Leiopotherapon unicolor	Botok	Spangled grunter	Dua	Eaten
Megalops cyprinoides	Walkara	Ox eye herring, Tarpon	Yirritja	Eaten
Melanotaenia nigrans	Dargeh	Black-banded rainbow fish	Yirritja	Eaten
Lutjanus spp	Leking	Mangrove jack	Yirritja	Eaten
Mogurnda mogurnda	Kapungurr	Purple spotted gudgeon	Dua	Eaten
Melanotaenia splendida inornata	Dargeh	Checkered rainbow fish	Yirritja	Eaten
Neosilurus spp	Bikur Marngun	Eel tailed catfish	Yirritja	Eaten
Oxyeleotris lineolata	Kapungurr	Sleepy cod	Dua	Eaten
Pristis pristis	Denggundamit	Leichhardt's sawfish	Dua	Eaten; saw used as a comb
Pseudomugil tenellus	Bududu	Arnhem Land blue-eye	Yirritja	Eaten
Scleropages jardinii	Ngaldatmurr	Saratoga	Dua	Eaten
Strongylura krefftii	Galerr	Freshwater long tom, Garfish	Yirritja	Eaten
Ophisternon gutturale	Nagar	Swamp eel	Yirritja	Rarely eaten today
Toxotes chatareus	Djolobon	Archer fish	Dua	Eaten
Shellfish				
Geloina coaxans	Nadbagan	Salt water cockle	Dua	Eaten
Velesunio angasi	Gurruk	Freshwater mussel	Yirritja	Meat eaten; shell used as cutter
Crustaceans				
Macrobrachium spp	Yat	Freshwater prawn	Yirritja	Eaten; used as bait
Atyidae spp	Ngal	Freshwater shrimp	Yirritja	Eaten; used as bait
Reptiles				
Acrochordus javanicus	Beka	File snake	Dua	Eaten
Chlamydosaurus kingii	Dangarr	Frill-necked lizard	Dua	Eaten
Chelodina rugosa	Komdow	Northern snake-necked turtle	Yirritja	Eaten
Crocodylus johnstoni	Gumugen	Johnstone's crocodile	Dua	Eaten
Crocodylus porosus	Namajwarreh	Estuarine crocodile	Yirritja	Eaten – especially eggs

Appendix 1 Inventory of Djelk Aboriginal Food (continued)

Elseya dentata	Ngartt	Northern snapping turtle	Dua	Eaten
Liastis amethistimus	Guridjado	Rock python	Dua	Eaten
Liastis olivaceus	Mandjudurk	Olive python	Dua	Eaten
Tiliqua scincoides	Gurri	Blue tongue lizard	Dua	Eaten
Varanus acanthurus	Bongga	Ridge tailed monitor	Dua	Eaten
Varanus glebopalma	Birrem	Spotted tree goanna	Dua	Eaten
Varanus gouldii	Galawan	Sand monitor	Yirritja	Eaten
Varanus indicus	Garranbulutmi	Mangrove monitor	Dua	Eaten
Varanus mertensi	Burarr	Merten's water monitor		Eaten
Varanus mitchelli	Djeli	Mitchell's water goanna	Dua	Eaten
Varanus timorensis	Biku	Tree monitor	Dua	Eaten
Varanus tristis	Garrek	Spotted monitor	Yirritja	Eaten

Appendix 2 List of datasets that pertain to Northern Territory wetlands

(as collated by Storrs and Finlayson 1997 with minor modification)

PAN-TERRITORY					
Dataset	**Custodian**	**Purpose**	**Nature**	**Status**	**Access**
Biogeographic regions of the NT	DLPE Dave Howe	To identify the major ecosystems of the NT for defining priority natural resource management programs.	Polygons on maps defining geographic, landform and climatic combinations.	Active	Open
Conservation and Recreation Values Register (CRVR)	PWCNT Libby Sterling	As a record of information on the conservation and recreation attributes of land in the NT.	A register of conservation and recreation uses and values for locations in the NT.	Active	Restricted
Environmental Domain Classification for the NT	PWCNT Angus Duguid	To explore the use of terrain and climate data to define biophysically homogenous regions or domains within the NT using a raster GIS.	The classification was done by CRES under contract to the CCNT.	Closed	Open
Fauna – Arachnids	NT Museum Graham Brown	To catalogue the NT Museum's collection of spiders, mites, etc	A catalogue of the arachnid specimens including taxonomic and collection details.	Active	Restricted
Fauna – Barramundi database	DPIF Roland Griffin	For the management of the commercial and recreational barramundi fisheries of the NT.	Length, frequency, reproduction, growth, recruitment, migration, sex and composition data linked to location of capture.	Active	Restricted
Fauna – Biological Records Scheme	PWCNT John Woinarski	As a fauna database for observation records within the NT.	Taxonomic and collection data for observed mammals, birds, reptiles, frogs. Includes presence/absence information, date, time and location (to nearest degree or km) of sighting.	Active	Open
Fauna – Birds	NT Museum Paul Horner	To catalogue the NT Museum's collection of bird specimens.	A catalogue of bird specimens including taxonomic and collection details.	Active	Restricted
Fauna – Birds, coastal raptor and jabiru nesting sites	PWCNT Ray Chatto	To document coast and island nesting sites for sea eagles, ospreys, brahminy kites and jabiru.	Audio tapes of aerial survey counts and ground truthing.	Active	Restricted
Fauna – Birds, waders significant sites of the coast and Islands of the NT	PWCNT Ray Chatto	To locate and document significant wading bird feeding, breeding and roosting sites in the NT.	Audio tapes of aerial survey counts, ground truthing, distribution status of birds and sites.	Active	Restricted

Appendix 2 List of datasets that pertain to Northern Territory wetlands (pan Territory) continued

Dataset	Custodian	Purpose	Nature	Status	Access
Fauna – Crocodile (saltwater) nests	PWCNT/WMI Grahame Webb	Monitoring and management of saltwater crocodiles.	Egg and nest characteristics and locations.	Active	Restricted
Fauna – Crocodile (saltwater) surveys	PWCNT/WMI Grahame Webb	Population monitoring and management of saltwater crocodiles.	Spotlight and helicopter count data in different river systems.	Active	Restricted
Fauna – Crocodile (freshwater) surveys	PWCNT/WMI Grahame Webb	Population monitoring and management of freshwater crocodiles.	Spotlight and helicopter count data in different river systems.	Active	Restricted
Fauna – Crocodile (saltwater) problem individuals	PWCNT/WMI Grahame Webb	Management of saltwater crocodiles	Size and location data of problem saltwater crocodile captures.	Active	Restricted
Fauna – Crocodile (freshwater) problem individuals	PWCNT/WMI Grahame Webb	Management of freshwater crocodiles.	Size and location data of problem freshwater crocodile captures.	Active	Restricted
Fauna – Crocodile (saltwater) marked individuals in the wild	PWCNT/WMI Grahame Webb	Management and research of saltwater crocodiles.	All marked saltwater crocodiles in the wild; location, size, sex, etc.	Active	Restricted
Fauna – Crocodiles (freshwater) marked individuals in the wild	PWCNT/WMI Grahame Webb	Management and research of freshwater crocodiles.	All marked freshwater crocodiles in the wild; location, size, sex, etc.	Active	Restricted
Fauna – Crocodiles (saltwater) attacks on humans	PWCNT/WMI Grahame Webb	Management of saltwater crocodiles.	Saltwater crocodile attacks on humans since 1971.	Active	Restricted
Fauna – Dugong and sea turtle dataset	PWCNT Keith Saalfeld	Monitoring and management of dugong and sea turtle in NT waters.	Count data by observations recorded on transect based aerial surveys.	Active	Open
Fauna – Fishstat	NT Museum Helen Larson	To catalogue fish localities in the NT.	A catalogue of fish locality data.	Active	Restricted
Fauna – Fishspec	NT Museum Helen Larson	To catalogue the NT Museum's collection of fish specimens.	A catalogue of fish specimens including taxonomic and collection details.	Active	Restricted

Appendix 2 List of datasets that pertain to Northern Territory wetlands (pan Territory) continued

Dataset	Custodian	Purpose	Nature	Status	Access
Fauna – Frogs	University of Adelaide Mike Tyler	To determine the species of frogs that occur in the NT, their biology, physico-chemical features of their habitat and biogeographic interpretation.	Territory wide transect information with occasional short-term studies. Database largely exists as written records with published information. Data span the last 3 decades.	Active	Open
Fauna – Herps	NT Museum Paul Horner	To catalogue the NT Museum's collection of reptile and amphibia specimens.	A catalogue of reptile and amphibia specimens including taxonomic and collection details.	Active	Restricted
Fauna – Insects	NT Museum Graham Brown	To catalogue the NT Museum's collection of insect type specimens.	A catalogue of insect type specimens including taxonomic and collection details.	Active	Restricted
Fauna – Invertebrate (freshwater) database	University of Adelaide Mike Tyler	To obtain information on freshwater invertebrate communities of the NT.	Territory wide transect information with occasional short-term studies. Database largely exists as written records with some published information. Data span the last 3 decades.	Active	Open
Fauna – Myriapods	NT Museum Graham Brown	To catalogue the NT Museum's collection of centipedes etc specimens.	A catalogue of myriapod specimens including taxonomic and collection details.	Active	Restricted
Fauna – Macroinvertebrates – Monitoring River Health Initiative NT	PAWA Jane Suggit	To characterise Top End rivers and creeks using macroinvertebrate data as part of an Australia wide program to assess the health of the nation's rivers.	A database of macroinvertebrate fauna, water quality and river characteristics from 120 sites across the NT north of 18°S.	Active	Open
Fauna – Mammals	NT Museum Paul Horner	To catalogue the NT Museum's collection of mammal specimens.	A catalogue of mammal specimens including taxonomic and collection details.	Active	Restricted
Fauna – NT Wildlife Atlas	PWCNT Owen Price	To identify significant areas where rare or threatened animals live or have been recorded. To generate fauna bioregions and as a research tool to investigate the distribution of species.	Point records of species observations, including mammals, birds, reptiles and frogs. Includes NT data from all state and territory museums, CSIRO's main collection in Canberra, the RAOU's bird atlas and EIS fauna surveys.	Active	Restricted
Fauna – Specimen Records Scheme	PWCNT John Woinarski	As a fauna database for observation records within the NT. Similar to the Biological Records Scheme but includes more information.	Taxonomic and collection data including location, date and time of observation. Also morphology, breeding condition etc. Data collected by trapping. Some specimens forwarded to the NT museum, remainder released.	Active	Open

Appendix 2 List of datasets that pertain to Northern Territory wetlands (pan Territory) continued

Dataset	Custodian	Purpose	Nature	Status	Access
Fauna – Turtle (marine) breeding sites NT	PWCNT Ray Chatto	To locate and identify marine turtle breeding sites, breeding species and timing.	Audio tapes of aerial surveys with ground truthing.	Active	Restricted
Fauna - Wildlife Conservation Status List (NT)	PWCNT Owen Price	To record the list of species seen in the NT, their relative abundancy and conservation status.	A summary of the NT Wildlife Atlas, A list of species observed (1 record per species), the ANZECC conservation status and the number of reserves in which that species has been observed.	Active	Restricted
Fauna - Wildlife Reserves List (NT)	PWCNT Owen Price	To record the wildlife (mammals, frogs, birds, reptiles) present in NT parks and reserves.	A list of species recorded from each park by sighting, surveys and data from the NT Wildlife Atlas.	Active	Restricted
Flora – NT Herbarium Dataset	PWCNT Clyde Dunlop	To document the distribution and habitat notes of NT flora.	Point data, field observations, species names, collection dates, phenological data, specimens.	Active	Restricted
Flora – Vegetation survey of the NT	DLPE Peter Brocklehurst	To provide a systematic standardised vegetation map of the NT. To obtain an ecological perspective over the NT.	Florisitic and environmental plot data over all regions in the NT. Data includes a digital map, database and a report with a published map.	Closed	Open
Hydrography – Surface water hydrographic dataset	PAWA Robert Masters	To determine the quantities of water in NT surface waters (river systems, estuaries).	Tidal and river heights, flow measurements. Approx. 100 gauging stations currently in operation.	Active	Open
Hydrography – Ground water hydrographic dataset	PAWA Robert Masters	To determine the quantities of water in NT ground water systems	Bore flows and depth measurements. Approx. 30 000 bores NT wide.	Active	Open
Hydrology – Heavy metals in freshwater ecosystems of the NT	NTU David Parry	To establish baseline levels of heavy metals in NT freshwater ecosystems, minesite monitoring and research.	Point site data for cadmium, lead, zinc, copper, mercury, arsenic, manganese, etc.	Active	Open
Hydrology – Water quality dataset - NT	PAWA John Childs	To catalogue the characteristics of all naturally occurring ground and surface waters of the NT. To store water data for ongoing resource management.	Records of a series of physical, chemical and bacterial parameters.	Active	Open

Appendix 2 List of datasets that pertain to Northern Territory wetlands (pan Territory) continued

Dataset	Custodian	Purpose	Nature	Status	Access
Land Resources – Monitoring sites	DLPE Blair Woods	A record of monitoring sites in the NT where scientific data has been collected including research trials and flora and fauna surveys.	Location and area of sites, description of data collected, whether data is digital or hard copy, accessibility, reasons for establishing site.	Active	Restricted
Park estate register – NT	PWCNT Libby Sterling	A record of tenure history, ownership and classification of parks and reserves in the NT.	Details of park area, portion numbers, land claim status, mining reserves, ownership, declaration and gazettal dates and IUCN status.	Active	Open
Parks and Wildlife Commission data directory	PWCNT Ann Fuchs	To record all known datasets held by the Commission, both digital and non-digital.	Metadata about data.	Active	Open
Weather records	Bureau of Meteorology Climate Consulting Services Geoff Smith	To provide a NT wide record of climatic variables.	Long-term written or electronic databases for various sites throughout the NT. Includes temperature, rainfall, humidity etc	Active	Open
Weeds – Management of noxious aquatic weeds	DPIF Ian Miller	To protect the aquatic environment from the effects of noxious aquatic weeds.	Details of physical, chemical and biological control.	Active	Open
Weeds – Noxious weeds recording system	DPIF Graham Schulz	To record localities of noxious weeds in the NT and detail control action undertaken.	Weed surveys and control. Ground and aerial surveys, aerial photos, public reports, chemical, mechanical biological and ecological control.	Active	Restricted
NORTHERN REGION					
Fauna – Crocodiles (saltwater) in Kakadu National Park	ANCA – Kakadu Garry Lindner	To monitor the status of saltwater crocodile populations in the waterways of Kakadu.	Spotlight surveys, plus data on trapped and marked individuals in Wildman, West Alligator, South Alligator and East Alligator Rivers.	Active	Open
Fauna – Fish biological and ecological information, Alligator Rivers Region	ERISS Bob Pidgeon	To provide information on the biology and ecology of freshwater fish to assist with the development of environmental management procedures.	Data derived from measurements of fish and habitat parameters during surveys in 1978 to 1979.	Closed	Restricted

Appendix 2 List of datasets that pertain to Northern Territory wetlands (northern region) continued

Dataset	Custodian	Purpose	Nature	Status	Access
Fauna – Fish community structures, upper South Alligator River	ERISS Bob Pidgeon	Monitoring of mining impact from proposed Coronation Hill Mine.	Point records of fish species abundance using visual counts from a canoe. 10 sites in early Dry season for 3 years.	Closed	Restricted
Fauna – Fish community structures, near Narbalek Mine, Alligator Rivers Region	ERISS Bob Pidgeon	Assessment of impact of mine operation on aquatic ecosystem and effectiveness of rehabilitation works.	Point records of fish species abundance using creekside visual counting procedure in Cooper and Gadjarigamundah Creek. 4 counts at monthly intervals, mid Wet/early Dry season.	Active	Restricted
Fauna – Fish communities in lowland billabongs, Alligator Rivers Region	ERISS Bob Pidgeon	To develop biological monitoring protocols to assess environmental health through describing natural variation of fish community structure	Point records of fish species abundance using a 'pop-net' sampling and 'visual counting' techniques. 10 billabongs are sampled annually. Broad environmental variables (water quality and vegetation structure) are also recorded.	Active	Restricted
Fauna – Fish distribution and abundance in Gulungal Creek, Alligator Rivers Region	ERISS Bob Pidgeon	Describe seasonal changes in patterns of fish distribution and examine the influence of hydrology on the dynamics of fish communities (potential spatial control from migration data from Magela Creek).	Point records of fish species abundance using visual counts made by diving. 10 sites along the creek at monthly intervals from 1980 to 1988.	Closed	Restricted
Fauna – Fish gillnet surveys in lowland billabongs of Magela Creek, Alligator Rivers Region	ERISS Bob Pidgeon	Provide information on the dynamics of fish communities and develop a monitoring system for detecting changes resulting from mining.	Point records of fish species abundance of biomass using multi-panel gillnets. 10 sites (5 times per year).	Closed	Open
Fauna – Fish migration, Alligator Rivers Region	ERISS Bob Pidgeon	To describe fish migration patterns in Magela Creek and migration pattern response to environmental factors.	Point records of Up-stream / Down-stream migration at sites on Magela and Nourlangie Creeks	Active	Restricted
Fauna – Insects of Darwin Harbour mangroves	NTU Richard Noske	To determine diversity, seasonality and abundance of insects in the mangroves of Darwin Harbour.	Interception, malaise, window and sticky traps. 2 of each of 3 sites in 3 mangrove zones. Also some branch clipping sampling.	Closed	Restricted

Appendix 2 List of datasets that pertain to Northern Territory wetlands (northern region) continued

Dataset	Custodian	Purpose	Nature	Status	Access
Fauna – Lead shot levels	PWCNT Peter Whitehead*	To assess the risk of lead poisoning in water fowl and other species from lead shot. Data available for Howard Swamp, Harrison Dam and Lambell's Lagoon NT.	Sediment cores, counts of lead shot, grit and food in cores. Samples from birds are tested for presence of lead in gizzards, bone, muscles and liver.	Closed	Open
Fauna – Macroinvertebrate (benthic) communities, upper South Alligator River	ERISS Chris Humphrey	Initially instituted in 1987 to assess possible effects of mining at Coronation Hill and received continued in 1991 as part of the national Monitoring River Health Initiative .	Site data of benthic macroinvertebrate communities in riffle substrates. Also includes data on physico/chemistry, habitat structure and hydrology. Contains nearly 10 years of continuous data.	Active	Restricted
Fauna – Magpie Geese dataset	PWCNT Keith Saalfeld	To monitor the Magpie Goose population in the Top End wetlands and to detect changing trends in population structure and distribution.	Count data by observations recorded on transect based aerial surveys.	Active	Open
Fauna – Magpie Geese population in the Top End – status	PWCNT Peter Whitehead*	To monitor the population of Magpie Geese in the Top End of the NT.	Count and banding data. Systematic aerial surveys of distribution and abundance allowing comparisons over time. Data on reproductive activity, numbers of nests. Data supplemented by radio tracking. Data was collected for all Top End wetlands in 1983-84. Data was only collected from Murganella to the Moil Floodplain from 1986-89.	Closed	Open
Fauna – Magpie Geese – vegetation associated with nesting sites	PWCNT Peter Whitehead	To characterise the sites used by Magpie Geese during the reproductive period. For management and retention of sites. To assess the effect of grazing on Magpie Geese habitats.	Floristic descriptions of each nest and brood site. Broad descriptions of dominant vegetation types in the vicinity. Transect based floristic and broad habitat descriptions on brood and nesting sites.	Active	Open
Fauna – Oenpelli Floodplain	CSIRO TERC Garry Cook	To monitor environmental effects of mimosa control.	Count data by observations recorded on individual sites 1991–95.	Active	Open
Fauna – Significant waterbird sites for the NT flood plains	PWCNT Ray Chatto	To locate and document significant coastal waterbird breeding, feeding and roosting sites.	Audio tapes of aerial survey counts, ground truthing, distribution status of birds and sites.	Active	Restricted
Fauna – Significant seabird sites of the NT coastal flood plains	PWCNT Ray Chatto	To locate and document significant seabird breeding and roosting sites and breeding times in the NT.	Audio tapes of aerial survey counts, ground truthing, distribution status of birds and sites.	Active	Restricted

Appendix 2 List of datasets that pertain to Northern Territory wetlands (northern region) continued

Dataset	Custodian	Purpose	Nature	Status	Access
Feral animal survey – Top End 1981	PWCNT Dave Berman	To determine the numbers of buffalo and other large vertebrates in the Top End (North of 15°S) of the NT.	Feral animal population counts by aerial transects 20 km apart at altitude of 250 ft.	Closed	Open
Feral animal survey – Top End 1985	PWCNT Keith Saalfeld	To determine feral animal abundance in the Top End of the NT	Count data by observations recorded on transect based aerial surveys.	Closed	Open
Feral animal survey – Bali Cattle (Banteng)	PWCNT Keith Saalfeld	To monitor banteng numbers and to provide management advice for the banteng population on Coburg Peninsula, NT.	Count data by observations recorded on transect based aerial surveys.	Closed	Open
Flora – Cattle grazing study – Mary River	PWCNT Dave Liddle	Long term monitoring of cattle and buffalo grazing on coastal flood plains.	Three different vegetation types with grazed and ungrazed plots. Four replicates in each vegetation type. 12 sites.	Active	Restricted
Flora – Melaleuca survey of the NT 1990	DLPE Peter Brocklehurst	To determine the community distribution, description and potential logging volumes of Melaleuca species in the NT north of 18°S.	Environmental and floristic data.	Closed	Restricted
Flora – Oenpelli Floodplain	CSIRO TERC Garry Cook	To monitor the environmental effects of mimosa control.	Cover estimates by species recorded on individual sites 1991-93.	Closed	Open
Flora – Vegetation communities of Arafura Swamp	DLPE Peter Brocklehurst	To provide vegetation data for the Arafura Swamp region of the NT.	Floristic and environmental data.	Closed	Restricted
Flora – Wetlands floristic survey	DLPE Peter Brocklehurst	An inventory of flora occurring in coastal region wetlands of the NT.	Grid based survey with 2.5 km gridlines. Data includes floristic survey, pH, salinity.	Closed	Open
Marine bioregionalisation database	PWCNT Laurie Ferns	To formulate biophysical and bioregional attributes for the entire NT coastline.	A collation of datasets relevant to the NT marine environment including; sea surface temperatures, salinity, oxygen, nitrates, phosphates, tidal ranges etc.	Active	Restricted
Saline intrusion - Lower Mary River Catchment	DLPE Paul Frazier	To monitor the effect of barrage construction on saline intrusion.	Landsat 5 thematic mapper, 30 metre pixals.	Active	Restricted
Weeds – *Mimosa pigra* – impacts of biological control agents	CSIRO TERC Naomi Rea	To evaluate the establishment and spread of biological control agents for mimosa.	Observations of impact and occurrence of agents on the Adelaide River Floodplain. From 1989.	Active	Open

Appendix 2 List of datasets that pertain to Northern Territory wetlands (northern region) continued

Dataset	Custodian	Purpose	Nature	Status	Access
Weeds – *Mimosa pigra* in Kakadu National Park	ANCA Kakadu Garry Lindner	To manage *Mimosa pigra* in Kakadu National Park.	Point site data of Mimosa incursions with details of control measures undertaken.	Active	Open
Weeds – *Mimosa pigra* management	DPIF Ian Miller	To protect industry and the environment from the effects of *Mimosa pigra*. To contain mimosa in the NT and prevent its further spread.	Details of chemical, biological, mechanical and ecological control. Assistance to landholders.	Active	Open
Weeds – *Mimosa pigra* (Oenpelli)	PWCNT Kate Sanford-Readhead	To evaluate the *Mimosa pigra* control program on the Oenpelli Floodplain.	Field observations of herbicide application.	Closed	Restricted
Weeds – *Mimosa pigra* on CCNT estate	PWCNT Kate Sanford-Readhead	Strategic planning of *Mimosa pigra* control program including a record of herbicide use on the CCNT's estate.	Field observations of herbicide application on CCNT land in the Adelaide and Mary River Floodplains.	Active	Restricted
Weeds - *Mimosa pigra* research data	DPIF Ian Miller	To develop integrated management plans for the control of *Mimosa pigra*.	Biological studies, quarantine, rearing, release, and monitoring of biological agents. Herbicide efficacy trials. Ecological control by fire, competitive pastures.	Active	Restricted
Weeds - *Mimosa pigra* seed production	CSIRO TERC Naomi Rea	To evaluate the impact of control agents on mimosa seed production.	Observations of seed production by mimosa on the Adelaide and Finniss River Floodplains. From 1991.	Active	Open
Weeds - *Salvinia molesta* in Kakadu National Park	ANCA Kakadu Buck Salau	To manage the *Salvinia molesta* infestations in Kakadu National Park.	Monthly mapping of salvinia plus counts of weevil biological agent and assessment of damage.	Active	Open
Wetlands - semi urban/rural status	PWCNT Peter Whitehead	To assess the importance of wetlands to regional populations of waterbirds. To assess the affects of urban sprawl on wetland condition.	Floristic descriptions of wetlands and counts of waterbirds over time.	Active	Open
CENTRAL REGION					
Fauna – Waterbird usage of the wetlands of the sub-humid tropics of the NT	PWCNT Peter Whitehead new custodian?	To provide information on the distribution, abundance and breeding of waterbirds.	Point data from ground and boat surveys.	Active	Restricted

Appendix 2 List of datasets that pertain to Northern Territory wetlands (central region) continued

Dataset	Custodian	Purpose	Nature	Status	Access
Feral animal survey – Gulf Region 1984	PWCNT Dave Berman	To estimate feral horse numbers and numbers of other large vertebrates in the NT Gulf Region.	East west aerial transects 20 km apart at 250 ft altitude.	Closed	Open
Feral animal survey – Victoria River District 1981	PWCNT Dave Berman	To estimate the number of feral donkeys and other large vertebrates in the Victoria River District of the NT.	Feral animal population counts by aerial transect.	Closed	Open
Feral animal survey – Victoria River District 1992	PWCNT Keith Saalfeld	As an aid to the management of feral animals in the Victoria River District of the NT.	Horse and donkey count data by observations recorded on transect based aerial surveys.	Active	Open
Flora – Longreach Waterhole Vegetation Survey and Mapping	PWCNT Brenda Pitts	To provide data for the conservation management of a protected area.	Point site data for flora including species abundance and distribution, floristics, weeds, rare species and locations.	Closed	Restricted
Flora – Nomenclature, distribution and conservation status	PWCNT Dave Albrecht	Store information on the nomenclature, distribution and reservation status of plants in the arid zone and Mitchell grass plains.	Fields include family, native or introduced, name, Barlow region, bioregion, no. reserved and non-reserved occurrences in each bioregion, risk code, relict status, extra NT distribution, interstate distribution for rare taxa. This database is a precursor to a larger database on the biology of the Southern Region.	Active	Open
River assessment – Katherine Region 1995- 1997/98.	DLPE Wolf Sievers	To provide information on the physical and environmental condition, current/future use and management of 4 river systems (Katherine/Daly, Victoria, Roper and McArthur Rivers) in the Katherine Region to establish a baseline for long-term monitoring of the condition of these rivers.	Site data and longitudinal profiles from field/boat surveys and aerial photography/satellite image interpretation. Information will include sub-catchment boundaries; rivers and flood plain features, physical characteristics, vegetation, land use/land tenure, impacts and factors affecting river stability, and flow and water quality information.	Active	Open
Wetlands of the sub-humid tropics of the NT	PWCNT Peter Whitehead	To obtain a functional classification of the wetlands for management planning and obtain information on the distribution and abundance of waterbirds in the NT.	Point data, field visits, aerial transects, map interpretation.	Closed	Restricted
SOUTHERN REGION					
Feral animal survey – Alice Springs 1984	PWCNT Dave Berman	To estimate the number of feral horses and other large vertebrates in the Alice Springs area.	Aerial transects running north and south 20 km apart at altitude 250 ft.	Closed	Open

Appendix 2 List of datasets that pertain to Northern Territory wetlands (southern region) continued

Dataset	Custodian	Purpose	Nature	Status	Access
Feral animal survey – MacDonnell Ranges 1988	PWCNT Dave Berman	To estimate the number of feral horses and other large vertebrates and to monitor population changes since the 1984 survey.	Feral animal population counts by aerial transects spaced 10 km apart.	Closed	Open
Flora – Finke Gorge National Park vegetation Survey	PWCNT Brenda Pitts	To provide data for the conservation management of Finke Gorge National Park.	Rare species locations, fire regime data, flora distribution and abundance, floristics, data on soils and soil erosion, landforms, geology and weeds.	Active	Restricted
Flora – Nomenclature, distribution and conservation status	PWCNT Dave Albrecht	Store information on the nomenclature, distribution and reservation status of plants in the arid zone and Mitchell grass plains.	Fields include family, native or introduced, name, Barlow region, bioregion, no. reserved and non-reserved occurrences etc. This database is a precursor to a larger database on the biology of the Southern Region.	Active	Open
Flora – West MacDonnell Ranges vegetation Survey	PWCNT Brenda Pitts	To provide data for conservation management in the West MacDonnell Ranges National Park.	Rare species locations, fire regime data, flora distribution and abundance, floristics, data on soils and soil erosion, landforms, geology and weeds.	Closed	Restricted
Palaeodrainage study dataset	PWCNT Geoff Foulkes	To determine whether certain flora and fauna species are associated with moisture and nutrient gradients.	3 study sites (2 in Tanami Desert, 1 in Uluru) 3 transects per site with 5 quadrats per transect. Traps and photo centre points.	Closed	Open
Weeds of the Southern Region	PWCNT Dave Albrecht	Provide information on the distribution, biology, etc of southern region weed species.	Fields include life form, no. of localities, last collection, origin, dispersal type, extent of infestation, potential range, control methods, ecological impact, relationship with disturbance.	Active	Open

* Dr Whitehead is now contactable at the Key Centre for Tropical Wildlife Management, Northern Territory University, Darwin

Appendix 3 Rare or threatened vascular plants from northern central Arnhem Land

(Derived from Leach et al (1992) (Area codes 1133, 1233, 1234))

Genus Species	FAMILY
Adiantum aethiopicum	ADIANTACEAE
Acacia suberosa	MIMOSACEAE
Acacia D2252 (E)	MIMOSACEAE
Anagallis pumila	PRIMULACEAE
Asteromyrtus arnhemica	MYRTACEAE
Atalaya salicifolia	SAPINDACEAE
Blumea benthamiana	ASTERACEAE
Boronia A44419 (E)	RUTACEAE
Boronia D17279 (E)	RUTACEAE
Boronia D60356 (E)	RUTACEAE
Borya jabirabela	LILIACEAE
Caesia setifera	LILIACEAE
Calytrix micrairoides (E)	MYRTACEAE
Corchorus macropterus (E)	TILIACEAE
Cryptandra D4783 (E)	RHAMNACEAE
Decaschista byrnesii (E)	MALVACEAE
Dicliptera australis	ACANTHACEAE
Dichapetalum timoriense	DICHAPETALACEAE
Drosera subtilis	DROSERACEAE
Dubouzetia australiensis (E)	ELAEOCARPACEAE
Dysoxylum D50230	MELIACEAE
Ectrosia confusia (E)	POACEAE
Fimbristylis caloptera (E)	CYPERACEAE
Fimbristylis dipsacea	CYPERACEAE
Fimbristylis spiralis (E)	CYPERACEAE
Fimbristylis thouarsii	CYPERACEAE
Gomphrena involucrata (E)	AMARANTHACEAE
Graptophyllum spinigerum	ACANTHACEAE
Grevillea versicolor (E)	PROTEACEAE
Habenaria elongata	ORCHIDACEAE
Hedyotis thysanota (E)	RUBIACEAE
Hibbertia muelleri (E)*	DILLENIACEAE
Hibiscus menzeliae (E)	MALVACEAE
Lechenaultia ovata (E)	GOODENIACEAE
Micraira compacta (E)	POACEAE

Micraira dentata (E)	POACEAE
Micraira spinifera (E)	POACEAE
Micraira viscidula (E)	POACEAE
Microcitrus D4100 (E)*	RUTACEAE
Nymphoides exiliflora (E)*	MENYANTHACEAE
Ophioglossum lineare	OPHIOGLOSSACEAE
Pityrodia byrnesii (E)	VERBENACEAE
Pityrodia gilruthiana (E)	VERBENACEAE
Pityrodia lanceolata (E)	VERBENACEAE
Pityrodia megalophylla (E)	VERBENACEAE
Pityrodia puberula (E)	VERBENACEAE
Pityrodia serrata (E)	VERBENACEAE
Plectrachne aristiglumis (E)	POACEAE
Plectrachne uniaristata (E)	POACEAE
Podocarpus D30581 (E)	PODOCARPACEAE
Ptilotus comatus (E)*	AMARANTHACEAE
Remusatia vivipara	ARACEAE
Rhizophora lamarckii *	RHIZOPHORACEAE
Sarcolobus ritae (E)	ASCLEPIADACEAE
Selenodesmium obscurum	HYMENOPHYLLACEAE
Sorghum macrospermum (E)	POACEAE
Stylidium longicornu	STYLIDIACEAE
Stylidium nominatum (E)	STYLIDIACEAE
Taenitis pinnata	HEMIONITIDACEAE
Toechima D55598 (E)	SAPINDACEAE
*Trachymene lacerata**	APIACEAE
Tristicha trifaria	PODOSTEMACEAE
Trithuria lanterna	HYDATELLACEAE
Utricularia cheiranthos (E)	LENTIBULARIACEAE
Vigna adenantha	FABACEAE
Vittaria ensiformis	VITTARIACEAE
Xanthostemon D18954 (E)	MYRTACEAE

(E) = Endemic to the NT

* = PWCNT (formerly CCNT) herbarium checklist – Maningrida area (Latitude 1150 – 1225, Longitude 13400 – 13445)

Appendix 4 BAC Outstations (surveyed by NT Department of Lands, Housing and Local Government)

Name	Language	Status	Population	Northings	Eastings
Ankabarrbirri	Rembarrnga	Occupied	20	436759	8644808
Bolkdjam	Rembarrgna	Occupied	40	436887	8627726
Buluhkaduru	Rembarrnga	Occupied	50	437138	8625387
Damdam	Burarra	Occupied	10	461297	8654949
Gamardi	Djinang	Occupied	50	465458	8642608
Gamarr Gu-yurra	Burarra	Occupied	20	474114	8666605
Gochin Jiny-jirra	Burarra	Occupied	60	440896	8651142
Gorronggorrong	Burarra	Occupied	1	444937	8659549
Ji-balbal	Gunartpa	Occupied	20	458518	8640333
Ji-bena	Burarra	Occupied	60	448295	8657218
Ji-malawa	Burarra	Occupied	25	464374	8659850
Ji-marda	Burarra	Occupied	70	457942	8666984
Kakodbebuldi	Guwinggu	Occupied	30	408325	8628028
Korlobidahdah	Kune/Dangbon	Occupied	20	426450	8605368
Kurrurldul	Guwinggu	Occupied	10	417227	8619249
Mankorlod	Guwinggu	Occupied	40	420633	8610681
Marrkolidjban	Guwinggu	Occupied	80	398099	8646821
Milmilngkan	Guwinggu	Occupied	10	418082	8615270
Miwirnbi	Djinang	Occupied	10	474621	8659390
Mumeka	Guwinggu	Occupied	40	405991	8632984
Wurdeja	Burarra	Occupied	20	462982	8654394
Yikarrakkal	Guwinggu	Occupied	20	403297	8617355
Yilan	Burarra	Intermit.	5–100	458759	8668570

Other Outstations (BAC and neighouring area)

Babori	Gupanga	Kubumi	Malworn	Namarladja
Barnamarrakka Kanora	Gumugumuk	Kumarrirnbang	Mamadawerre	Namokardabu
Barrihdjowkkeng	Jakalabona	Kumurrulu	Manmoyi	Nangak
Berraya	Kabalyarra	Kurrukkurrh	Mikkinj	Nabbarla Kunindabba
Birba	Kamarrkawarn	Lalarr Gu-jirrapa	Mimanjarr	Ndjudda
Bod Karri	Karddjarrama	Malmal A-jirra	Mu-gurta	Nimerrili
Gartji	Kinidjangka	Malnjangarnak	Nagalarramba	Yinangarnduwa