W E T L A N D S I N F O C U S

by

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an MA Qualifying in the Department
of Prehistory and Anthropology,
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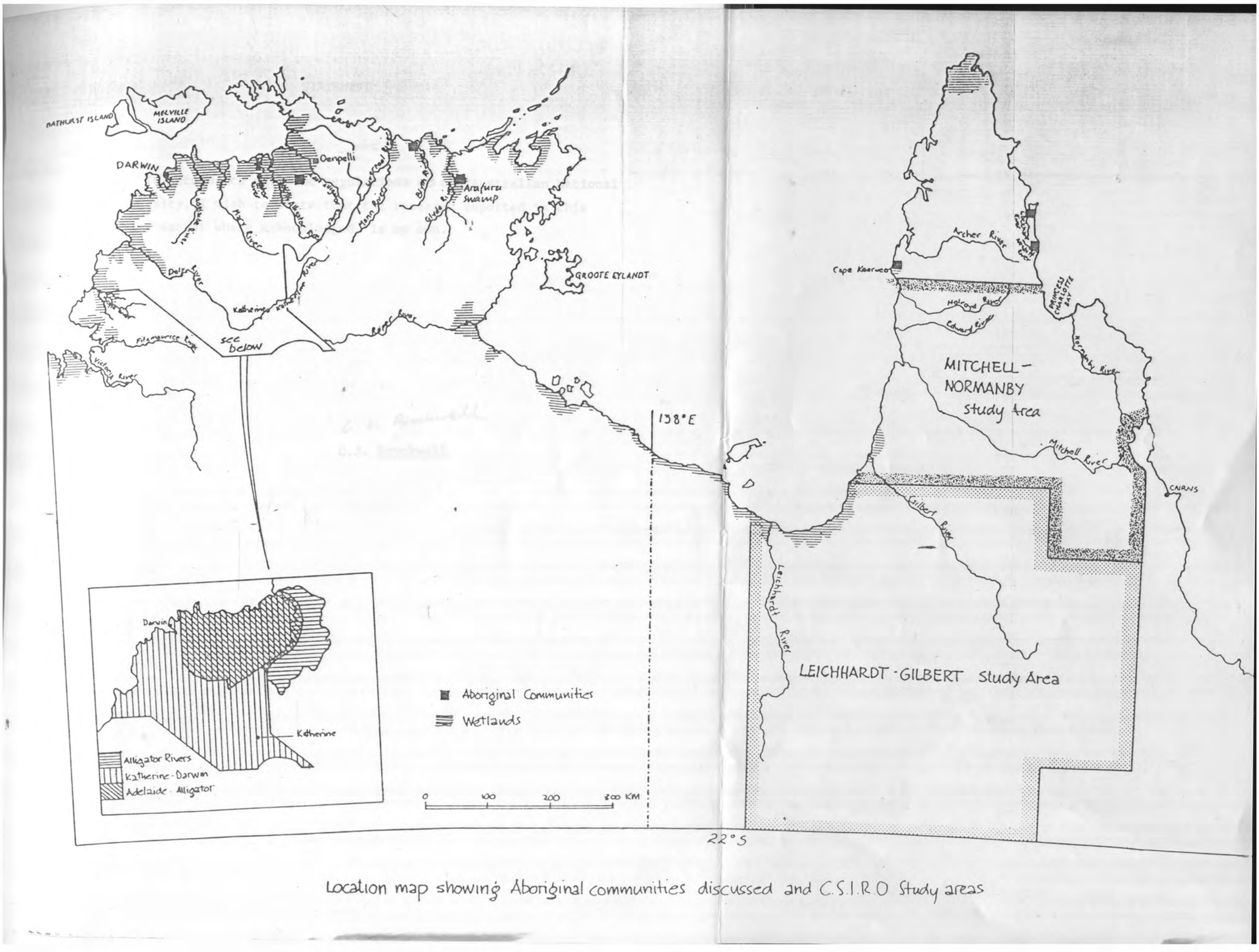

Location map showing Aboriginal communities discussed and C.S.I.R.O Study areas

STATEMENT

In accordance with the regulations of the Australian National University, I wish to state that the research reported in this essay, except where acknowledged, is my own.

C.J. Brockwell

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ACKNOWLEDGEMENTS

I wish to thank the following people for their help, advice and moral support; my supervisor Andrée Rosenfeld, Betty Meehan, Prue Gaffey, my father John Brockwell, Rhys Jones, John Chappell, Jeremy Russell-Smith, Win Mumford, Professor John Mulvaney, Sarah Burns, Dianne Roberts, Nick Peterson and my typists William Howard, Jeanine Mummery and Jill Johnston.

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CHAPTER ONE

WHY WETLANDS?

The freshwater wetlands of northern Australia are an important focus for the hunters who live there. These wetlands are all located within a savanna environment (Harris 1980:8, Figure 2) which lies between 10^{o} and 20^{o} south of the equator (Jones 1980:108). They contain a diverse and abundant supply of plant and animal foods and provide a reliable supply of fresh water towards the end of the dry season when it is scarce elsewhere. They thus influence the demography and seasonal movements of the Aborigines in whose territory they lie and to a lesser extent those occupying land adjacent to them. This is particularly true of the Alligator Rivers wetlands which now lie mostly within the boundaries of Kakadu National Park.

The wetlands archaeological sites of this area are impressive. They are open sites with dense scatters of stone artefacts stretching, sometimes for 2 kilometres along the wetlands edge. In the past, these sites have received little attention from archaeologists working in the region (see Schrire 1967a, 1967b, 1971, 1982; Schrire and Peterson 1969; Kamminga & Allen 1973). They concentrated their investigations on rock shelter sites.

My interest in the wetlands archaeological sites was roused when as a member of an archaeological team from the Department of Prehistory, Research School of Pacific Studies at ANU, led by Dr Rhys Jones, I spent five months working in Kakadu National Park. We devoted three weeks of that time to examining the wetland areas of the South Alligator River and recorded a large number of the open sites which occur there. Several of these sites were surveyed and surface collected (see Brockwell, Meehan & Allen in prep.). Even at this very general level the archaeological evidence supported the ethnographic situation and further investigation seemed worthwhile. A suitable starting point appeared to be an examination of the literature from similar areas for what information it could provide.

This essay contains a preliminary examination of the physical and cultural aspects of the wetlands areas of northern Australia with a view to assessing their importance in Aboriginal life from the time of formal European contact and subsequently. At a later stage results derived from the archaeological work on the open sites of the South Alligator River will be interpreted in the light of the ethnography. It may be possible to discern whether Aboriginal occupation of the wetlands areas since their formation has always followed the same pattern.

The dangers of using ethnographic analogy in archaeological interpretations are well-known. However, in this case its use is justified because the time depth involved is not great. Formation of the freshwater wetlands of the South Alligator River has been dated to 1400 years BP (Hope, Hughes & Russell-Smith in prep.) and an excavated midden at the wetlands site of Ki'ina on the South Alligator River has a basal date of 800 years BP (Brockwell, Meehan & Allen in prep.). The amount of ethnography relevant to the Alligator Rivers region is limited. However, information about freshwater wetlands throughout northern Australia indicates remarkable conformity both in their floral and faunal components, and in the way in which they were/are exploited by Aborigines.

Chapter Two contains an environmental description of the wetlands. Here climate, land systems, floral and faunal populations and the history of the formation of the Alligator Rivers wetlands are discussed. In Chapter Three ethnographic information from various parts of northern Australia is presented. It relates specifically to subsistence, settlement patterns and demography. In the conclusion, Chapter Four, I examine the potential of this data for archaeological interpretation.

CHAPTER TWO

THE ENVIRONMENT

The climate in the areas under consideration is monsoonal with a short wet season and a long dry season. The wet season which lasts from about November through April is brought by the north-west monsoons. A rainless dry season, May to September, is dominated by southeast trade winds. This annual cycle is reliable. As Christian and Stewart (1953:29) point out

> "... the average deviation from the mean, expressed as a percentage of the mean, is 16.6 percent for Darwin and 21.2 percent for Katherine. The only other portions of Australia with as low a variability as this are the southeast and southwest corners of the continent and Tasmania..."

However, in northern Australia, the time of commencement and the duration of the wet season both vary. There are also regional variations, and some areas, upon which this investigation is focussed, receive more rainfall than others, with consequent variations in vegetation.

In northern Australia, the temperatures are high. The coolest months are June, July and August and the hottest months occur at the beginning of the rainy season in October, November and December. In the nothern part of the Northern Territory the mean monthly maximum and minimum temperatures vary from 30.5°C and 19.6°C in July, to 33.8°C and 25.3°C in November. The highest humidity occurs during the wet season and the lowest during the dry season (Tulloch, 1977:12). In terms of human comfort the most unpleasant period is October to November when temperatures and humidity are highest (McAlpine, 1976:42). In general for northern Australia rainfall and humidity are higher on the coast and temperatures are higher inland.

The various CSIRO land studies for the Katherine-Darwin (Christian & Stewart, 1953), Adelaide-Alligator Rivers (Story et al. 1969), Alligator Rivers (Story et al. 1976), Mitchell-Normanby (Galloway et al. 1970), Leichhardt-Gilbert (Perry et al. 1964) provide detailed climatic information for their various areas, which is tabled within each study. Calaby (1980: 324) has tabulated climatic information for northern Australia which covers most of the areas under consideration here (see Table 1). Table of rainfall, temperature and humidity patterns at Oenpelli in the Alligator Rivers area is provided below (Table 2)) for comparison with Calaby's data, and to illustrate seasonal variation there.

Average rainfall (mm) and temperature (°C) in the Australian savanna region

Station (see Fig. 1)	Average Annual Rainfall	% Rainfall Nov.–March	Hottest Month	Average Maximum Temperature	Average Minimum Temperature	Coolest Month	Average Maximum Temperature	Average Minimum Temperature
Kalumburu	1187	90.5	– – – – – – – –	– – – – not available	– – – –	– – – –	– – – –	– – – –
Wyndham	693	91.7	December	39.0	27.0	July	31.2	16.8
Broome	575	85.4	December	33.9	26.6	July	28.5	13.6
Halls Creek	490	87.5	November	38.5	24.3	July	26.9	12.3
Darwin	1535	87.9	November	33.4	25.3	July	30.3	18.9
Oenpelli	1357	91.4	November	37.1	21.9	July	31.6	17.9
Yirrkala	1302	69.7	December	33.1	24.8	July	27.5	20.9
Katherine	959	91.6	November	38.1	24.8	July	29.8	12.9
Daly Waters	653	90.2	November	38.5	23.9	June	27.7	12.4
Borroloola	784	89.4	November	38.0	23.0	July	29.7	11.9
Weipa	1648	90.0	October	34.8	21.1	July	30.2	18.3
Coen	1144	88.1	November	33.5	22.1	July	27.4	16.7
Normanton	934	92.8	November	37.8	24.8	July	29.2	15.2
Innisfail	3641	62.1	January	30.3	22.7	July	23.6	15.1
Townsville	1180	81.1	January	31.3	23.8	July	24.9	13.1
Georgetown	833	90.2	November	36.9	21.6	July	28.2	12.0

TABLE 1 (after Calaby 1980:324)

METEOROLOGICAL ELEMENTS AT COASTAL PLAINS RESEARCH STATION EXPRESSED ON MEAN FORTNIGHTLY BASIS

Fort-night*	Temperature (°F) Mean Max.	Mean Min.	Mean	Mean Relative Humidity (%)	Mean Vapour Pressure† (mb)	Evaporation (in.)	Rain (in.)
1	90·46	75·06	86·27	84·1	9·17	2·87	3·29
2	90·97	75·12	83·04	87·0	9·17	2·94	4·69
3	89·52	75·21	82·62	86·8	9·20	2·66	6·47
4	91·47	75·44	83·46	85·0	9·29	3·08	4·43
5	89·93	75·66	82·80	82·0	9·02	2·87	5·19
6	91·38	75·85	83·62	85·0	9·17	3·08	5·36
7	91·44	75·19	83·32	83·0	8·81	2·94	1·95
8	90·87	73·07	81·99	79·1	8·24	3·36	0·74
9	91·58	69·69	80·71	71·0	7·19	3·57	0·06
10	90·57	66·31	77·47	65·2	5·92	3·78	0·11
11	90·35	65·54	78·08	73·0	6·67	3·36	0·04
12	89·73	63·16	76·59	67·0	5·74	3·50	—
13	87·98	61·22	73·94	61·0	4·65	3·78	0·02
14	88·63	59·63	74·13	63·0	4·86	3·57	—
15	88·78	58·03	73·50	58·0	4·34	3·71	—
16	89·73	60·36	75·08	61·1	4·93	3·85	—
17	91·81	62·69	77·22	66·1	5·92	3·99	—
18	93·70	66·04	79·85	67·5	6·53	4·55	—
19	95·17	70·34	82·78	69·5	7·29	4·62	0·08
20	96·55	72·34	84·45	67·0	7·54	4·90	0·12
21	96·55	74·43	85·69	67·0	7·88	5·04	1·16
22	95·86	74·13	84·96	70·0	8·15	4·41	2·26
23	96·18	75·26	85·75	75·0	8·75	3·57	2·55
24	93·49	74·50	83·99	77·0	8·66	3·57	3·42
25	93·64	75·37	84·51	79·5	9·14	3·36	2·80
26	92·52	76·14	84·33	81·8	9·05	3·36	5·62

* Starting Jan. 1. † At 9 a.m.

TABLE 2 (after McAlpine 1969:53)
Climatic patterns in the Adelaide-Alligator Rivers Region

Holocene Climates

There appears to have been little study done on climatic change during the Holocene, both for northern Australia and the tropics in general (Baker, 1981:24). However, it is held by many that conditions in northern Australia were wetter and/or warmer than now in early to middle Holocene times. The existence of this warmer and/or wetter period in early Holocene times is inferred from palaeo-vegetation studies in high latitude regions in other countries such as New Guinea and Southeast Asia, as well as from work carried out in northern Australia, reviewed below.

Jennings (1975:251-52) concludes that wetter conditions existed in the Kimberly region at about 6000 BP. He bases his conclusions on evidence for the presence at that time of larger communities of mangrove forests and larger mangrove trees than exist in the area today. This indicates "a significantly longer and heavier rainy season than now" (Jennings, 1975:252). Stocker (1971) believes, based on his study of the distribution of jungle fowl mounds on Melville Island, that the extent of monsoon rainforest (which is the sole habitat of Megapodes, the jungle fowl) was greater between 8000 and 2000 years BP than subsequently, due to higher rainfall. Kershaw (1973; 1983) interprets pollen diagrams from the Atherton tableland in northeastern Queensland as indicating wetter conditions from between 7000 and 3700 years BP, and infers highest effective rainfall in the area to have occurred between 5500 and 3700 years BP. Higher temperatures at about the same time are indicated in the Highlands of Papua New Guinea, where the treeline was at least 150 m greater in elevation than at present from 8400 to 4750 years BP (Hope, 1983). The change in treeline corresponds to a temperature change of about $1^{o}C$.

Nix & Kalma (1972) also support the view that a warmer/wetter period existed about 8000 BP (1972:86) on the basis that following the retreat of the glaciers and the consequent rise in sea levels and

> "... At the time when most of the [Sunda and Sahul] shelf was flooded, but the Torres Strait areas [were] still dry land, the movement of cooler Equatorial current water across the shelf would [have been] prevented. Given large areas of shallow pooled water one can envisage rapid heating, increased evaporation and latent heat transport and a resultant climate warmer and wetter than at present ..." (ibid; p.82).

They postulate that climate became similar to today's by 3000 BP (Nix & Kalma, 1972:87). It must be noted that Nix and Kalma's speculations, while applying specifically to northern parts of the Northern Territory, have yet to be confirmed; and should not be directly compared with results from the Atherton Tablelands in northeastern Queensland, or with results from Papua New Guinea's Highlands. However, the results of Kershaw, Jennings, Hope and Stocker do consistently suggest regionally warmer and wetter conditions in mid-Holocene times, probably greatest around 5000 to 6000 years BP. Similar conclusions are reached by Schrire (1982) and Baker (1981), in reviewing several of these same sources during their archaeological studies.

LAND SYSTEMS

About 14,000 years BP, with the warming of the world's temperatures and the melting of the ice caps, the sea-level began to rise. It cut off New Guinea from the Australian mainland about 8000 years BP (Jones & Bowler 1980:14) and ceased rising about 6000 BP when it was one to two metres above present levels, depending on location (Chappell et al. 1982; Jennings 1975). This event has been dated archaeologically and geomorphologically in northern Australia (White 1971:145; Kamminga & Allen 1974; Chappell et al. 1982; Jennings 1975). Following this rise in sea level, downcut river valleys in northern Australia, previously well above sea level, were flooded, bringing estuarine conditions to formerly inland areas, now only marginally above sea level. Baker (1981:36) explains "As a result of this loss of gradient the rivers near the sea would have entered a depositional mode and deposited considerable quantities of sediment". Thus began the formation of the coastal plains of many of northern Australia's major rivers including the Alligators, Mary, Fitzroy, Daly and Blyth Rivers and the rivers of Western Cape York (Jones & Bowler 1980:16).

The combination of rising sea levels and the consequent build up of sediment resulted in coastal progradation in Australia during Holocene times. This process is modified by progressive changes in sub-marine topography, a direct result of the disequilibrium created by the rapid rise in sea levels and its termination about 6000 years ago. Super-imposed on this is the effect of shorter term and episodic processes such as storms and cyclones (Chappell 1982:73-74).

The process works like this. Mangroves trapped the sediments which had been deposited in the estuaries and saline or hyper-saline plains evolved. These plains which are tidal or supra-tidal are punctuated by low ridges (shell cheniers and gravel-plus-shell beach ridges) washed up by wave and storm action. Consequently processes of episodic ridge building alternate with intertidal mud and mangrove progradation which result in coastal progradation (Chappell et al. 1982). This process, begun from the cessation of sea level rise, continues but more slowly to the present (Hope, Hughes & Russell-Smith in prep.).

Several studies of this phenomenon have been done in northern Australia, all of which paint more or less the same picture for Holocene coastal progradation. They include that by Jennings (1975) on the Fitzroy River, in the Kimberly region of Western Australia; Cook & Mayo (1978) at Broad Sound, eastern Queensland; Clarke, Wasson & Williams (1979) near Point Stuart, Chambers Bay in the Northern Territory; Rhodes (1980) near the Edward River and Karumba on the Bulf of Carpentaria and Chappell (1982) at Princess Charlotte Bay, eastern Cape York Peninsula, Queensland (Schrire 1982:9).

Behind the prograding shoreline progressive siltation narrowed and obstructed tidal channels reducing saline flooding. Levees formed and with seasonal inundation non-saline vegetation was able to trap sediment from fresh water moving over the surface and thus build up the black soil plains which exist today on many of northern Australia's rivers. In the Alligator Rivers area the ponding of fresh water against the floodplain and backing up of sediment in the lower river sections created about 650 km^2 of wetlands which appeared within the last 2000 to 3000 years (Hope, Hughes & Russell-Smith in prep.). These wetlands are flooded seasonally often for long periods of time. They comprise both ephemeral and permanent areas of freshwater and support vegetation adapted to both situations.

The land forms and environment occurring in the Alligator Rivers area have been studied intensively by CSIRO (Story et al. 1969; Story et al. 1976). The plain that lies between the Arnhem Land escarpment and the sea is mapped according to four major land systems (Story 1969:20-23);

1. granite hills and lowlands
2. the Koolpinyah surface (made up of level, rolling or dissected lowlands)
3. the alluvial plains (where Quaternary alluvium is spread on sandy or silty soils)
4. the coastal plains (composed of ill-drained estuarine muds and clays)

It is within the coastal plains that the wetlands are located. This area is further sub-divided into four land systems,

> "... since impeded drainage is their chief characteristic, they have been classed according to whether they are seasonally well drained (Cyperus land system), ill-drained (Copeman and Pinwinkle land systems), or liable to tidal flooding (Littoral land system)"

(Williams 1969:93), all of which support their respective vegetation communities.

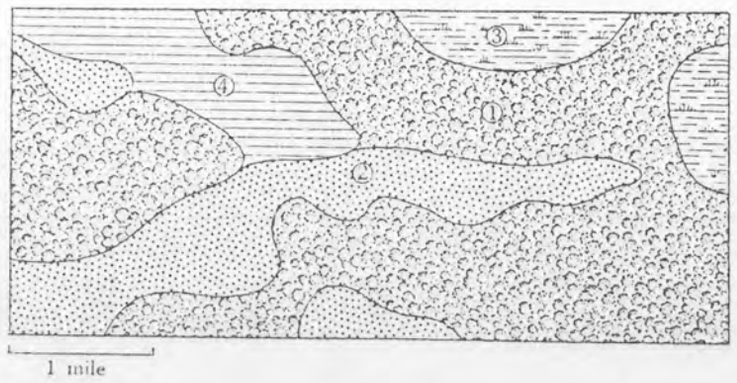
> "...Copeman is low, swampy for most of the year, and under herbaceous swamp vegetation. Pinwinkle is also low and swampy but under paperbark forest. Cyperus is a little higher and mostly under sedges. Littoral is seaward of them all, flooded at times by the tides, and under samphire or mangrove scrub" (Story 1969:23).

Three of these subdivisions - Copeman, Cyperus and Pinwinkle, of which the wetlands are composed are discussed in more detail below (see Figures 2, 3 & 4). The chief soil composition of these three land systems is freshwater black cracking clays (Williams et al. 1969:29, 32, 46; Hope, Hughes & Russell-Smith, in prep.). For the purposes of this essay the wetlands are defined as the seasonally inundated black soil plains and freshwater swamps and lagoons which make up the Copeman, Cyperus and Pinwinkle land systems (see Plates 1 & 2).

The geomorphic history of the wetlands of the South Alligator has been examined by Hope, Hughes & Russell-Smith (in prep.) at a site called Ki'ina by Aborigines currently living in the area. The basal date (about 6200 years BP) of the lower unit, which is made up of estuarine muds with mangrove wood and plant detritus, is consistent with other studies for the drowning of river valleys and the termination of sea level rise in northern Australia (see studies listed above). Freshwater organic clays appear at 1400 ± 100 BP, indicating the formation of the freshwater wetlands in the area. It is possible that the sedimentation history of this area may parallel the evolution of areas of wetlands on major rivers elsewhere in northern Australia.

PINWINKLE LAND SYSTEM (340 SQ MILES, 16 OBSERVATIONS)

Swampy depressions on the coastal plains; black uniform cracking clays over gleyed estuarine muds and riverine sands, texture-contrast peaty loam over clay soils; paperbark forest.

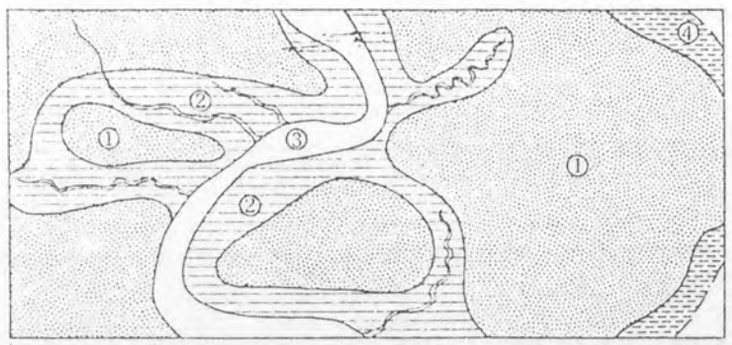


Unit	Area and Distribution	Geomorphology	Soils	Vegetation
1	70% Scattered throughout	Wooded swamps: up to 4 miles wide; slopes to 1·2%; flooded to 3 ft or more except along higher margins which dry out seasonally; freshwater over estuarine clays, slow aggradation	Mostly permanently wet gleyed cracking clays over estuarine muds (Wildman); gypsic at A/C horizon transition (Cairncurry), and Cooinda (texture-contrast black loam over clay)	Paperbark forest, height 50 ft, visibility 70 yd (*Melaleuca cajaputi, M. leucadendron, M. viridiflora*), and occasional clumps of *Barringtonia* over herbaceous swamp vegetation rooted in mud or floating
2	15% Sporadic	Slightly raised treeless areas: width to 500 yd; slopes, to 0·8%, locally to 2%, flooded 4–8 months to 4 ft, drying out rapidly in upper few feet	Predominantly Wildman with minor Cairncurry, Cooinda as in unit 1, and minor Counamoul (clay over acid sands) in inland areas	Bare or with scanty cover of herbs (*Marsilea, Phyla*)
3	10% Along southern margins of coastal plains	Depressions and channels next to the deeply weathered surface: up to 300 yd wide; slopes to 2% along margins, mean slopes 0·4%; channels variable in depth and width, seasonal flooding to 4 ft; freshwater over estuarine clays or wash derived from Kay land system and its derivatives; slow aggradation, sheet wash, eluviation	Murrabibbi (loam over sand over clay) and Koolpinyah (yellow gradational sand to loam)	Paperbark forest or grassland, as in unit 3 of Krokane land system
4	5% Occasional in NE. and SE.	Alluvial plains: flooded 4–6 months to 2 ft; well drained; up to 500 yd wide; slopes to 1·2%	Counameul soils dominant in transition zone between inland alluvium and coastal plains; rare Carmor	Paperbark forest as in unit 1, with occasional *Acacia auriculiformis* and *Terminalia melanocarpa*; sparse ground cover of short annual and perennial grasses or of *Marsilea* and *Phyla*, some parts bare

FIGURE 2 (after Williams et al. 1969:46).

CYPERUS LAND SYSTEM (1225 SQ MILES, 26 OBSERVATIONS)

Seasonally flooded coastal plains, freshwater clays over estuarine clays, north of area; black cracking clays over mainly calcic estuarine muds; sedge land.



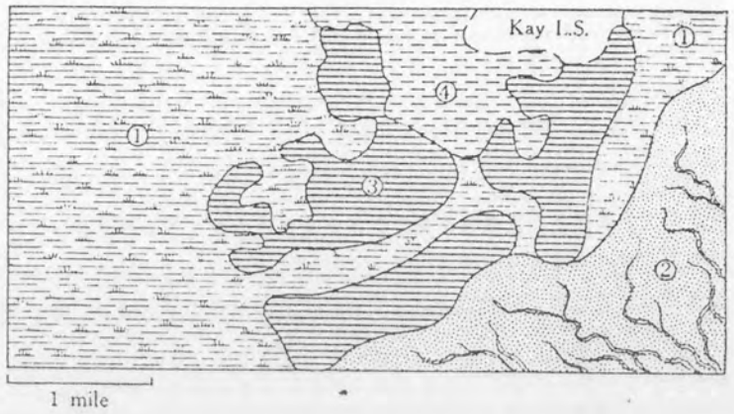
Kay land system and its derivatives

Unit	Area and Distribution	Geomorphology	Soils	Vegetation
1	75%, Mainly southern half	Higher, seasonally dry plains: slopes 0·3–0·8%, elevation 10–40 ft, relief to 4 ft; occasional shallow pans and buffalo wallows; freshwater clays over estuarine clays, in places with subfossil gastropods (*Turritella* spp.); 2–4 miles, in places up to 6 miles wide; flooded 3–6 months to depths up to 4 ft, rapid drying once rains cease; very slow aggradation; rare subparallel dunes up to 4 ft high with slopes to 5%, minor levees	Black cracking carbonate rich clays (Carmor) near old channels and higher areas; Wildman (clays over gleyed muds) in lower sites; Adelaide (self-mulching) soils on old levees; minor Cairncurry (gypsic clays) on former swamp sites; minor dune sands	Sedge land, dense robust sedges up to 2 ft with occasional scattered or patchy *Sesbania*, rarely dense mid-height grassland (*Ischaemum*); dunes, mixed scrub over short grass (*Acacia, Pandanus, Ficus, Canarium*)
2	15%, Mainly northern half	Low, ill-drained, seasonally tidal plains; similar to unit 1 of Copeman land system	Predominantly Wildman soils and organic clays (Dashwood) in wet sites. Carpentaria saline clays near areas of tidal influence	Herbaceous swamp vegetation as for unit 1 of Copeman land system
3	5%, Trending south to north at broad intervals	Main channels: up to ½ mile wide and 30 ft deep; minor tributaries up to 6 ft deep and 40 ft wide, over ½ mile apart; bed-load of silt and clay; lower reaches tidal in dry season	—	Open water, or herbaceous swamp vegetation rooted in mud or floating; occasional clumps of *Barringtonia* or *Melaleuca cajaputi* and *M. leucadendron*
4	5%, Southern margins next to Kay land system and its derivatives	Up to 400 yd wide, slopes to 0·8%; elevation c. 30–45 ft; freshwater clays over buried sands and ironstone gravels derived from adjacent deeply weathered lowlands; minor channels and billabongs up to 6 ft deep and 50 ft wide; rare gilgai areas, pits 3–4 ft across, 6–12 in. amplitude	Acid to neutral clays over sands or rock (Coumamoul)	Sedge land; fine sedges up to 12 in., scattered *Melaleuca argentea*, or *E. papuana*, *Panicum trachyrachis* in gilgai depressions, *Heteropogon contortus* on rises; low-lying areas, herbaceous swamp vegetation as for unit 1 of Copeman land system

FIGURE 3 (after Williams et al. 1969:32).

COPEMAN LAND SYSTEM (200 SQ MILES, 4 OBSERVATIONS)

Low swampy coastal plains, freshwater over estuarine clays, north of area; black cracking clays over gleyed muds; herbaceous swamp vegetation.



Unit	Area and Distribution	Geomorphology	Soils	Vegetation
1	50% Throughout	Low ill-drained plains: up to 3 miles wide, slopes less than 0·3%; flooded 6–12 months to depths up to 5 ft; freshwater over estuarine clays; small islands and infilled meander cut-offs of high ground; forming mud flats in dry season	Black cracking clays over gleyed and saline estuarine muds (Wildman), and weakly cracking clays, wet, with deep black peaty A horizons (Dashwood)	Herbaceous swamp vegetation, mainly sedges, grasses, and waterlilies (*Scleria, Fimbristylis, Cyperus, Oryza, Hymenachne, Pseudoraphis, Panicum trachyrachis, Caldesia, Ludwigia adscendens, Nymphoides indica, Phyla, Utricularia, Azolla, Marsilea, Chara*); higher areas bare or with scanty cover (*Marsilea, Phyla, Fuirena*); wide and indefinite transition to unit 3
2	20% Throughout	Complex of anastomosing narrow channels and intervening higher ground; low levee benches flanking former channels (aerial observations only)	No observations	Herbaceous swamp vegetation as in unit 1, or open water; levees often under *Barringtonia* or *Melaleuca cajaputi, M. leucadendron* (aerial observations only)
3	20% Throughout	Higher seasonally dry plains: similar to unit 1 of Cyperus land system	Carmor (cracking clays over calcic estuarine muds)	Sedge land same as unit 1 of Cyperus land system
4	10% Along landward margins of Cyperus land system	Extensive water-filled depressions (aerial observations only)	—	Open water, or herbaceous swamp vegetation rooted in mud or floating (aerial observations only)

FIGURE 4 (after Williams et al. 1969:29).

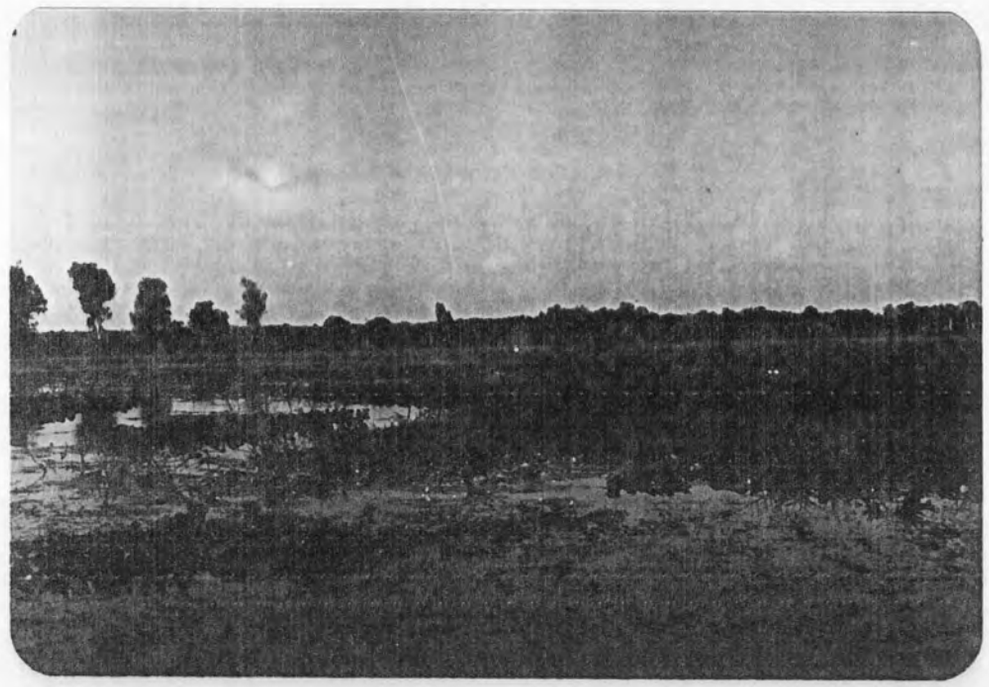


PLATE 1 Full wetlands fringed by paperbark forest, Yellow Water, Kakadu National Park (June 1982)

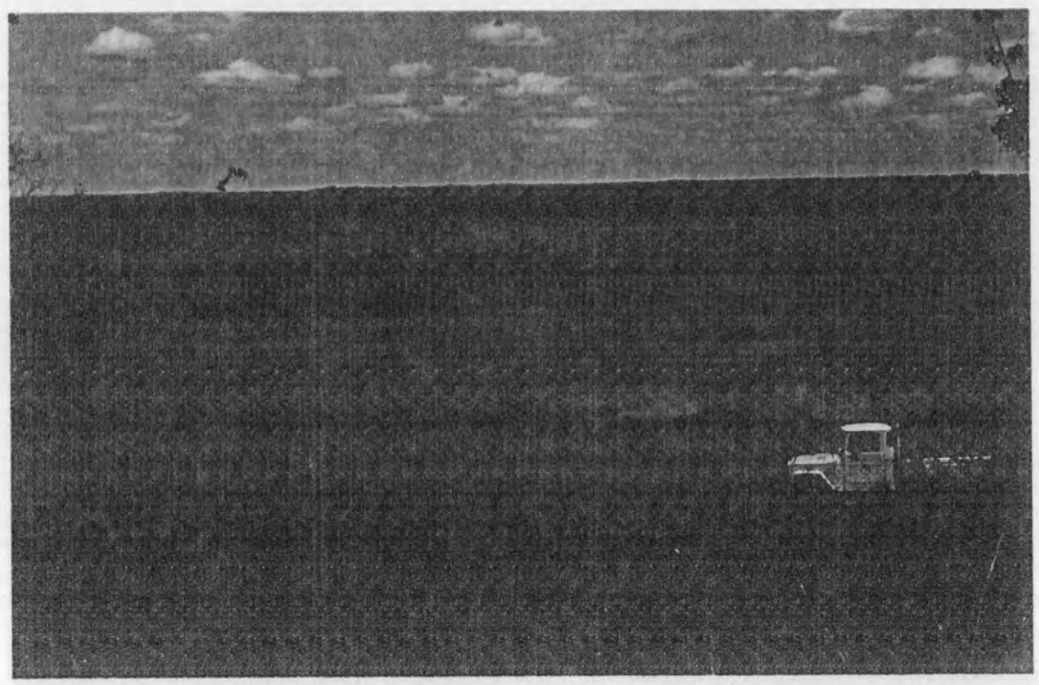


PLATE 2 Dry wetlands on northern edge of Nourlangie Creek (June 1981)

In the 1946 CSIRO Land Use Research survey of the Katherine-Darwin region (Christian & Stewart 1953), an area of 43,200 square kilometres, bounded in the east by the East Alligator River and on the south by a line 33 kilometres south of the Katherine and Daly Rivers, was surveyed. The Adelaide-Alligator Rivers section of the study has since been updated (Story et al. 1969, 1976). In the 1969 survey Williams et al. make a comparison of the land systems delineated in that survey with the land systems of the 1946 Katherine-Darwin survey. The Sub-coastal Plain land system defined by Christian & Stewart (1953:114-16) coincides with the Cyperus, Copeman and Pinwinkle land systems of the Adelaide-Alligator Rivers study proposed by Williams et al. (1969:25) some 20 years after the original survey had been carried out.

The Katherine-Darwin survey indicates that the coastal plains of the Daly and Finniss Rivers (see Map 1) have a similar geology, geomorphology, soil and vegetation pattern to those of the Adelaide, Mary, Wildman, West, South and East Alligator Rivers (Christian & Stewart 1953:40-42, 114-16).

In the extreme east of northern Australia, the CSIRO Division of Land Use Research conducted a study of the Mitchell-Normanby area (Galloway et al. 1970) (see Map 1). The survey area described in the report occupies the lower two-thirds of Cape York Peninsula, covers approximately 92000 square kilometres and has a maximum length and width of about 480 kilometres. The western boundary is defined by the coast of the Gulf of Carpentaria and the eastern boundary is partly the Pacific coast and partly the Great Divide between west-flowing and east-flowing drainage. On the south-west it abuts on the Leichhardt-Gilbert area surveyed in 1953-54 by Perry et al. (1964) (Galloway et al. 1970:7).

The Cumbulla and Radnor land systems of the younger alluvium of the alluvial plains and the Inkerman land system of the coastal sediments of the Mitchell-Normanby survey area, all of Pleistocene to geologically Recent age, correspond to the Sub-coastal Plain land system of the Katherine-Darwin survey and the Cyperus, Pinwinkle and Copeman land systems of the Adelaide-Alligator Rivers surveys (Galloway 1970:50-51) (see Figs. 2,3 & 4). The younger alluvium forms extensive

spreads along the lower Mitchell, Gilbert and Normanby Rivers and north-west of Princess Charlotte Bay (Galloway 1970:50). Coastal sediments of geologically Recent or Pleistocene age fringe the entire west coast, occupy an extensive area around Princess Charlotte Bay and occur sporadically on the east coast (Galloway 1970:51). The younger alluvium covers about 8% of the survey area, and coastal sediments about 4% (Galloway 1970:46).

The Leichhardt-Gilbert area surveyed by Perry et al. (1964), although it abuts the Mitchell-Normanby area has a considerably lower rainfall.

> "...Because the rains occur after a long dry season during which vegetation is depleted, run-off rates are high, soil erosion is severe, and river flow is intermittent". (Twidale 1964:118).

Thus river channels are down cut and there is not the seasonal flooding of large areas of wetlands that occurs in the Alligator Rivers area, although certain land systems of the alluvial plains support the same vegetation as is present in the Alligator Rivers wetlands (Perry et al. 1964:26).

VEGETATION

Both Specht et al. (1977) and Story (in Galloway et al. 1970) stress the similarity of vegetation across tropical northern Australia. Specht et al. (1977:17-18) emphasise this by describing the distribution of the Darwin stringybark (Eucalyptus tetrodonta) and its associated plant community, throughout northern Australia. It is common on sandy soils, and on red, yellow and mottled yellow earths north of 16°S latitude where the annual rainfall is above 750 mm. It spreads from the Kimberly region of Western Australia across the Top End and over much of Cape York Peninsula in northern Queensland. It is absent from the dry southern part of the Gulf of Carpentaria where estuarine soils predominate. The E. tetrodonta plant community varies within the wide climatic range (from 700 to 1500 mm rainfall per annum) in which it grows, from an open forest in the wetter areas to low open forest or woodland in its drier limits (Specht et al. 1977:17).

Story compares the vegetation of the Mitchell-Normanby area with that of the Leichhardt-Gilbert area (Perry and Lazarides, 1964) and the Adelaide-Alligator Rivers area (Story et al. 1969). He notes that the vegetation of all three have affinities. He says

> "The Leichhardt-Gilbert is the driest of the three, as reflected in the rainfall figures and in the vegetation, where the prominence of annual short grasses, low woodland, Triodia and Aristida point to long periods of water stress. The Mitchell-Normanby area is intermediate, with short grasses and low woodland less common and Triodia and Aristida rare and occasional respectively. Mid-height grasses are dominant. In the Adelaide-Alligator area, the wettest of the three, short grasses and low woodland are comparatively scarce. Triodia is rare and Aristida was not recorded. Tall and mid-height grasses are about equally common". (1970:75).

Freshwater wetlands are common features of the northern Australian landscape. The Top End of the Northern Territory, the Gulf of Carpentaria and the western side of Cape York are characterised by wide coastal plains. Except for the dry southern part of the Gulf of Carpentaria, where the lower rainfall means less seasonal flooding and river valleys are downcut,

freshwater wetlands are numerous and often large in these areas. On the eastern coast of Cape York, because it is backed by mountain ranges, the coastal plain is narrow and while occurring frequently the freshwater wetlands are small. All wetlands throughout northern Australia possess similar vegetation. In some areas especially in Queensland, they constitute but a small part of the total ecosystem. In the Alligator Rivers region and on the Moyle and Daly Rivers they comprise the major part of the subsistence environment.

Usually along with the vegetation communities inhabiting a region, wetlands vegetation has been described in various botanical studies undertaken in the Northern Territory, e.g. Christian & Stewart (1953), Blake (1954), Specht (1958), Story (1969, 1976), Williams (1979) and in Queensland, e.g. Perry & Lazarides (1964), Story (1970), Pedley & Isbell (1971), Specht et al. (1977).

Freshwater wetlands can contain elements of three plant communities, (a) paperbark forest, (b) sedgeland, (c) herbaceous swamp vegetation (Fox et al. 1977:52).

These divisions are not absolute but provide a simple framework for making more general comments about wetlands flora. Of course, the species content of these communities varies somewhat within and without any one region

In the Alligator Rivers region, Williams (1979:240-42 subdivides the floodplains of the Magela Creek into six vegetation communities basically covered by the three categories cited above. However, for this study, Story's 1969 vegetation survey of the Adelaide and Alligator Rivers region is the major source of information. In the later report published in 1976 (Story et al.), classifications and descriptions of lowland vegetation remain the same, except for minor amendments (Story 1976:89), e.g. Story notes only minor differences between paperbark forest surveyed in the Alligator Rivers area (1976) and those of the much more extensive areas surveyed in the Adelaide-Alligator Rivers report (Story 1976:103).

(a) (i) Pure Paperbark Forests (Story 1969:125)

In the Alligator Rivers area dense stands of the paperbark Melaleuca leucodendron tend to occur in or near permanent water and along the stream channels of the floodplain, where they are diagnostic of the Pinwinkle land system (see p. 11). In these forests they are almost the only tree present, interspersed with stands of the freshwater mangrove (Barringtonia spp.) along stream channels. Ground cover in paperbark forests varies with the terrain. In swampty places it is an assortment of water weed. In drier areas it consists of a cover of

short Cyperaceae (sedges) and small annual and perennial grasses. The most commonly occurring species are listed below (see Table 3). Pure paperbark forest occurs in central depressions surrounded by mixed paperbark forests on higher ground (Story 1969:126).

(ii) Mixed Paperbark Forests

Along the banks of larger streams grow mixed paperbark forests. Melaleuca spp. is dominant. The other most recorded species for this area are listed below (see Table 3). The species tend to occupy their own narrow zones parallel to the water source (Story 1969:126).

(b) Sedgelands (Story 1969:129, see Table).

Together with swamp vegetation sedgelands are an aquatic community. They occupy the areas of the floodplains which remain under water from two to six months of the year. The number of species located in this area is far greater than the number of those recorded in the CSIRO report (Story 1969:129). Sedges, needless to say, are the dominant vegetation of the sedgelands and characterise the Cyperus land system (see p. 10). They are treeless communities about 50 cm high dominated by Cyperus spp., Eleocharis spp. (an important plant for Aborigines, commonly known as spike rush), Fuirena spp. and Scirpus spp. (clubrush), some grasses and Sesbania spp. (Sesbania pea) (Story 1969:129). On higher ground they form an almost unbroken cover, on lower, less well-drained parts they become mixed and extend into the Copeman land system merging with hygrophilous swamp vegetation (Story 1969:129).

(c) Herbaceous Swamp Vegetation (Story 1969:130)

Herbaceous swamp vegetation is another aquatic community which covers most of the Copeman land system (see p. 13). These are floristically rich communities occurring in areas of prolonged or permanent flooding. Story (1969:130) lists the following species below (see Table 3).

> "...Floating plants such as water lilies and algae occur in deeper water with a wide variety of sedges, herbaceous plants and grasses in the shallower water." (ANPWS Kakadu Plan of Management 1980:106).

The herbaceous swamp community is now "much influenced by buffalo grazing and wallowing" (Christian & Aldrick 1977:33, and below, p.30). Story (1976:104) comments that this community probably plays a part "in the trapping of silt and in building up the soil". It is also home for thousands of waterfowl (Story 1969:130).

It is important to note that several plant species recorded in the

TABLE 3 Vegetation of Adelaide-Alligator Rivers Wetlands

a. Components of Paperbark Forests (Story I969: I25)

Common names are listed where available (Hartley I979)

*Asterisk indicates Aboriginal utilisation (Specht I958)

Pure Paperbark Forest			Mixed Paperbark Forest	
Ground Cover		Canopy Trees	Ground Cover	Canopy Trees
Swampy Places	Drier Places			Morinda spp*
Caldesia spp	Cyperaceae (sedges)	Melaleuca leucadendron*	Chrysopogon spp	Melaleuca spp*
Cyperaceae including Fuirena spp and Eleocharis spp*	Brachiaria spp		Sorghum spp*	Acacia auriculiformis
	Digitaria spp		Vertivera spp	Bambusa spp*
Commelina spp	Echinochloa spp			Barringtonia spp*
Ludwigia spp	Eleusine spp			Eucalyptus papuana
Nymphoides spp*	Eragrostis japonica			Eucalyptus polycarpa
Phylidrum spp	Paspalidium spp			Eugenia spp*
Urticularia spp	Panicum spp			Ficus spp (fig)
	Pseudoraphis spp			Metrosideros spp
	Sporobolus spp			Pandanus spp*
				Parinari spp
				Syzigium spp*
				Terminalia grandiflora
				Terminalia melanocarpa

TABLE 3 continued

b. Sedgeland (floodplain) Vegetation (Calaby I980: 325)

Eleocharis spp

Cyperus spp

Scirpus spp

Grasses up to 60 cm high

c. Herbaceous Swamp Vegetation (Story I969:I29-I30)

Deep water	Swampy Areas	Slightly Drier Places
Nelumbo nucifera *	Caldesia spp	Phylla spp (fogfruit or carpetweed)
Nymphaea spp * (water lilies)	Commelina spp	Echinochloa spp (barnyard grass)
Algaes	Cyperaceae (sedges)	Elytrophorus spp (spike grass)
	Hymenachne spp	Euphorbia spp (caustic plants)
	Ludwigia spp (primrose)	Ipomoea aquatica (potato vine) *
	Nymphoides spp*	Panicum delicatum
	Oryza spp (wild rice)*	Panicum trachyrachis
	Paspalum spp	Sporobolus virginicus (couch)
	Phylidrum spp	
	Pseudoraphis spp (mudgrass)	
	Scleria spp	
	Urtricularia spp (bladderworts)	

Katherine-Darwin survey (Christian & Stewart 1953) are either absent or designated rare in the Story et al. (1969) survey. These include several species directly and indirectly important to Aboriginal subsistence. Wild rice (Oryza spp.) was dense on the coastal plains in 1953 but rare in 1969. Phragmites karka (tropical reed) recorded in 1953 was not recorded at all in 1969 and Hymenachne amplexicaulis and Eleocharis spp. (spike rush) both recorded in 1953 were rare in 1969 (Story 1969:117-18). Blake (1954:108) notes Hymenachne amplexicaulis as being prolific near Cannon Hill. Blake (1954:126) also recorded Nelumbo nucifera (sacred lotus) in lagoons on the South Alligator River. This plant was also important to Aboriginal subsistence. Now it is so rare that officers of ANPWS have begun to collect specimens in the hope that they can restock depleted lagoons and waterways (Schrire 1982:11). Nymphaea gigantea (water lily) (another plant utilised by Aborigines) was not listed by Story (1969). However it was recorded by Christian & Stewart (1953:66) in the Katherine-Darwin region and has been recorded more recently in the Alligator Rivers area (McLaughlin 1982:18).

No doubt the disappearance of some of these plants is due to the invasion into the area of feral pigs and buffaloes. Both species remain close to water on Cyperus, Copeman and Pinwinkle land systems which support the vegetation described above (Story 1969:116).

The collection and preparation of wetlands vegetation which is utilised by Aborigines is described in detail in Chapter Three.

FAUNA

For the Alligator Rivers region as a whole Fox et al. (1977:52) record that "the native mammals, birds, reptiles and frogs of the Region are the biologically richest groups in the Northern Territory and are matched in Australia only in some areas of northeastern Queensland. The ANPWS Kakadu Plan of Management (1980:115) states that "Approximately 51 species of Australian mammals, 250 of birds, 75 of reptiles, 22 of frogs, 45 of fish and about 10,000 of insects have been recorded." Bird species recorded constitute an estimated one-third of Australia's bird species (ANPWS Kakadu Plan of Management 1980:119), and fish species represent "a quarter of all Australian fishes and some 60 per cent more than in the entire Murray-Darling river systems" (Jones & Bowler 1980: 12). In addition to this general faunal richness, some species from the area are rare or totally unknown elsewhere (Christian & Aldrick 1977: 37).

The Alligator River wetlands system is one of the major wetlands systems in Australia (ANPWS Kakadu Plan of Management 1980:123). Their presence in the region accounts in large part for the remarkable diversity and density of the faunal inhabitants. The wetlands are a major refuge for waterbirds during the dry season and as Christian & Aldrick (1977:40) point out the birds that inhabit the wetlands "are outstanding in number of species and endemic forms". The freshwater areas are also an important habitat for frogs and reptiles in the region.

The Alligator Rivers region has been well-studied as regards fauna. Schrire (1982:11) outlines a history of these studies. More recently CSIRO teams compiled lists of fauna in the region as part of the Alligator Rivers Region Environmental Fact-Finding Study. These include mammals (Calaby 1973), birds (Schodde 1973), reptiles and amphibians (Cogger 1973), fish (Midgeley 1973) and invertebrates (CSIRO 1973).

Of these, the species which reside in the wetlands areas are mainly birds, reptiles, amphibians, fish and insects. Those which are utilised by Aborigines are listed below.

Cyperus Land System

This land system (Cyperus) is comprised of the black soil plains which ar seasonally inundated and support sedgeland vegetation (see p. 12). The faunal species important to Aboriginal subsistence which inhabit this area are:

Mammals

Collett's Rat (Rattus sordidus colletti) inhabits cracks which develop in the alluvial clay of the black soil plains or builds burrows through thick sedges and in soft ground, when waters have receded in the dry season and thick grasses cover the floodplain. It retreats to higher ground with the coming of the rainy season (ANPWS Kakadu Plan of Management 1980:117-18, Calaby 1980:329).

Reptiles

Goannas (Varanus gouldii) and long-necked turtles (Chelodina rugosa) forage in this area while it is inundated during the wet season and then dig themselves into the mud to hibernate during the dry season (Jones 1980:114, McLaughlin 1982:7, 9).

Copeman Land System

This land system (Copeman) covers freshwater swamps and lagoons which are either permanently inundated or swampy for most of the year. It supports herbaceous swamp vegetation (see p. 13). The faunal species which live in or near this area and are hunted by the Aborigines are:

Mammals

The amphibious water rat (Hydromys chrysogaster) inhabits this ecosystem (McLaughlin 1982:5, Schrire 1982:11).

Birds

Numerous waterbirds inhabit this ecosystem including ducks, geese, herons, ibises, storks, egrets and cranes (Calaby 1980:327). The magpie goos (Anseranus semipalmata) and two species of whistle-ducks (Dendrocygna spp.) are the most abundant species. Between 1955 and 1958 surveys estimated populations of 350,000 magpie geese in the Alligator Rivers wetlands and 100,000 magpie geese in the South Alligator River wetlands alone (Harris 1980:327-28). Species utilised by the Aborigines in the Alligator Rivers wetlands are listed below (see Table 4 and Plate 3).

Reptiles

Snakes which are caught in this area include the freshwater snake (Amphiesman mairii), the water python (Liasis fuscus), and the Javin file snake (Acrochordus javanicus) (ANPWS Kakadu Plan of Management 1980:126, McLaughlin 1982:9, 10). The species of goanna which live in this area are Varanus mitchelli and Varanus mertensi (ANPWS Kakadu Plan

TABLE 4

Waterbirds utilised by Aborigines in the Alligator Rivers wetlands (McLaughlin 1982:14-15)

Common Name	Scientific Name
Black duck	*Anas superciliosa*
Grey teal	*Anas gibberiffrons*
Pink Eared duck	*Malachorhynchus membranaceus*
Burdekin duck	*Tadorna radga*
Pigmy goose	*Nettapus pulchellus*
Pelican	*Pelecanus conspicillatus*
White faced heron	*Ardea novaehollaniae*
White necked heron	*Ardea pacifica*
Great billed heron	*Ardea sumatrana*
Nankeen night heron	*Nycticorax caledonicus*
White ibis	*Threskiornis aethiopica*
Straw necked ibis	*Threskiornis spinicollis*
Glossy ibis	*Plegadis falcinellus*
Jabiru	*Xenorhynchus asiaticus*
Black necked stork	*Epheppiorhynchus asiaticus*
Brolga	*Grus ribicundus*
Royal soon bill	*Platela regia*
Swamp hen	*Posphyrioz porphyrioz*
Little pied cormorant	*Phalacrocorax melanoleucos*
Magpie goose	*Anseranus semipalmata*
Water whistle duck	*Dendrocygna arcuata*
Grass whistle duck	*Dendrocygna bytonii*

PLATE 3 Wetlands with waterbirds, Amakada, South Alligator River (July 1981)

of Management 1980:126, McLaughlin 1982:7). The estuarine crocodile (Crocodylus porosus), which is adapted to freshwater, and the freshwater crocodile (Crocodylus johnstonii) also inhabit these swamps and lagoons (ANPWS Kakadu Plan of Management 1980:126, McLaughlin 1982:9). Several species of turtle occur here including two species of short-necked turtle (Elseya dentata and Emydura victoria) and the pig-nosed turtle (Carettlochelys insculpta) (McLaughlin 1982:9). The latter is of particular interest as it is rare in Australia (one other specimen was found on the Daly River in 1969) but common in the Fly River district of Papua New Guinea. It is represented in Aboriginal rock paintings at the base of the Arnhem Land escarpment in the Alligator Rivers region. These paintings and the specimens are the only record of this species in Australia (Christian and Aldrick 1977:66).

Fish

To date 45 species of fish have been recorded in the Alligator Rivers region. Of these, 31 species "are thought to be restricted to freshwater during their entire life cycle" (ANPWS Kakadu Plan of Management 1980:132).

Estuarine fish, e.g. Lates calcarifer (barramundi), are adapted to salty and freshwater environments. They move from the sea to feed or to spawn in the fresh water rivers, swamps and lagoons. Many of them spread over the inundated wetlands to feed during the rainy season and return to the river and/or to the sea as the waters retreat (Jones 1980: 114).

Fish species known to be consumed by Aborigines at the Alligator Rivers region today are listed below (see Table 5).

Miscellaneous

Freshwater mussels (Velesunio angasi), freshwater shrimps (Macrobrachium rosenbergii), freshwater prawns (Macrobrachium sp.) and swamp eels (Synbranchus bengalensis) are among the miscellaneous species known to be culled today from freshwater swamps and lagoons (McLaughlin 1982:13).

TABLE 5

Fish utilised by Aborigines in the Alligator Rivers wetlands (McLaughlin 1982:11-12)

Table includes both estuarine and freshwater species

Common Name	Scientific Name
Barramundi	*Lates calcarifer*
Sleep cod	*Oxyeoletris lineolatus*
Boney bream	*Nematolosa erebi*
Long tom	*Strongylura kreffti*
Forktail catfish	*Hexanematichthys leptaspis*
Rifle fish or Archer fish	*Toxotes chatareus*
Eel tail catfish	*Tandanua ater*
Tarpon	*Megalops cyprinoides*
Glass perch	*Ambassis* sp.
Spangled perch	*Madigania unicolour*
Branded grunter	*Amniataba percoides*
Checked rainbow fish	*Melanotaenia maculata*
Black striped rainbow	*Melanotaenia nigrans*
Mouth almighty	*Glassamia aprion*
Marjories hard head	*Crater-ocephalous marjoriae*
Mullet	*Squalomugil? nasutus*

INSECTS

Of the numerous insect species which inhabit the wetlands areas mosquitoes and sandflies influence Aborigines the most, especially in the wet season when they are particularly pestilential. At that time, the Aborigines locate their campsites on higher ground not only to avoid the flood waters but where the breezes help to drive off these marauding insects (Peterson 1973:173; Meehan 1982:26). They also build waterproof shelters in which smoky fires are lit to keep the insects at bay (Thomson 1948-49:26-27; Peterson 1973:179-80; Meehan 1982:152).

FERAL ANIMALS

The wetlands of northern Australia are a sensitively balanced ecological area. "The sensitivity of the ecosystem is largely due to its low topographical position with parts below the level of spring tides and the boggy nature of the swamp soils" (Stocker 1977:30). Freshwater wetlands are a geomorphologically recent feature (see p. 9) and they have probably always been relatively unstable. Factors which have exaggerated the natural instability of these areas have been the effect of the activities of Aborigines, in particular their regular burning of the landscape (see p. 35, also Schrire 1982:14-15), and the damage done by feral animals present in the area.

Feral animals have been present in northern Australia for about 150 years, since their introduction by Europeans. Buffaloes and pigs have had the most noticeable effect on the wetlands in the Alligator Rivers area (see Schrire 1982:15-17).

Buffaloes

The exact number of buffalo (Bubalus bubalus) in the northern part of the Northern Territory today is unknown. An estimate based on information collected in the 1950s and 1960s put it between 150,000 and 200,000 head (Letts et al. 1979:12-13). In 1974 the greatest concentration of these animals occurred between latitudes 11°S and 14°S and longitude 130°E and 134°E (Letts et al. 1979:13), which includes the Alligator Rivers region.

Buffalo were introduced into western Arnhem Land at Fort Wellington in Raffles Bay in 1828 and Victoria in Port Essington in 1838. Leichhardt (1847:521) sighted their tracks in the vicinity of the East Alligator River in 1845.

More buffalo were brought from Timor to Escape Cliffs, Cape Hotham, in 1864 and turned loose when that settlement too was abandoned in 1866 (Letts et al. 1979:12). In 1875 Lewis wrote that they were numerous on the Coburg Peninsula and near the Alligator Rivers (Letts et al. 1979:12).

Robinson commenced commercial shooting of buffalo on the Adelaide River in 1885 and was followed soon by many others. Between 1886 and 1911, 100,000 hides were exported.

Buffalo exploit a wide range of habitats but favour swamps, lagoons and associated areas of the coastal plains and estuaries (Stocker 1977:30).

The grazing, trampling and wallowing habits of buffalo have had a particularly destructive effect on the freshwater wetlands in the northern part of the Northern Territory. Buffalo prefer to eat water plants, upon which waterfowl rely for sustenance, and they can denude any area subject to high stocking rates (Byrnes 1977:34-35). The plant species particularly affected are Hymenachne spp. and Phragmites spp. Over-grazing has led to weed invasion in the northern end of the Northern Territory. Hyptis suaveolens (horehound) is now common on the Adelaide and Mary Rivers frontages and the noxious weed/shrub Mimosa pigra is spreading on the lower reaches of the Adelaide River (Letts et al. 1979:33).

In addition to the detrimental effects of their grazing buffalo wallowing and trampling destroys floating vegetation mats composed mainly of the species Hymenachne spp. These mats are used as resting platforms by saltwater crocodiles and other reptiles and birds. Buffalo activity also disturbs fine mud, which takes a long time to resettle, causing fish, snakes and turtles to die in the murky water (Schrire 1982:16).

The combination of defoliation and trampling, exacerbated by the tendency of buffalo to return to the same paths and pads, hastens the drying out of swamps and causes severe erosional problems. During the wet season buffalo swim in the swampland areas forming what are called "swim channels". Swim channel formation and the breaking down of levees through trampling and consequent erosion, allow spring tides to enter freshwater swamps poisoning freshwater flora and fauna (Stocker 1977:30; Schrire 1982:16). This has occurred on the wetlands of the Finniss, Adelaide, Mary and Alligator Rivers (Letts et al. 1979:33 see Plate 4). These saltwater incursions accompanied as they are by saline clays have returned some areas of the South Alligator wetlands to a condition which probably resembles those existing prior to 1400 year ago (Hope, Hughes & Russell-Smith in prep.). On the South Alligator River attempts have been made to halt this intrusion by the construction of levees across swim channels.

Pigs

The number of feral pigs (Sus scrofa) in the Northern Territory today is estimated to be between 100,000 and 200,000 (Letts et al. 1979:39).

This population probably spread from many different foci. Originally they were brought into the country by Europeans as a food source beginning

with the early settlement on Melville Island and in the Coburg Peninsula in the first half of the nineteenth century. This habit has continued to the present.

Pigs exploit watercourses and billabongs during the dry season but tend to range more widely during the wet season. They are omnivorous, consuming grass, roots, shoots and leaves as well as the carcasses of dead animals. They prey upon living fauna when they can (Letts et al. 1979: 39). A stomach analysis of feral pigs in New South Wales showed Phragmites rhizomes were part of their diet (Letts et al. 1979:42). The rooting habits of pigs are most destructive in wetland areas.

Feral pigs are common from the Moyle River in the west, along the Daly Basin and northward and eastward to the coast into Arnhem Land. Smaller populations are found in the Roper River valley or on the northern catchment of the Victoria River (Letts et al. 1979:39; see Plate 5).

Cats (Felis catus)

At present feral cats do not affect the environment of the Alligator Rivers area to any great extent. However, on the Blyth River where they exist in large numbers where they have devastated the small mammalian population (Meehan pers. comm.). It is possible, with the increase of the European population in the Alligator Rivers region that more feral cats may be introduced (ANPWS Kakadu Plan of Management 1980:145). In the Northern Territory they feed on reptiles, insects and native rodents (Letts et al. 1979:75), all of which inhabit wetland areas.

Clearly the impact of buffaloes and pigs causes problems in attempting to reconstruct the environment of the Alligator Rivers area in immediate pre-contact time.

Wetlands before feral animals

By consulting early explorer's reports it is possible to build up a picture of what the wetlands looked like before they were affected by the presence of feral animals.

Leichhardt (1847:488, 511) observed "fine reedy and rushy lagoons" on the South Alligator River and again on 4 December at Cannon Hill "enjoyed the pleasing sight of large lagoons with a belt of reeds". Letts et al. (1979:16) comment "It is probable that these reeds were Phragmites - an important aquatic plant which has almost disappeared from the area".

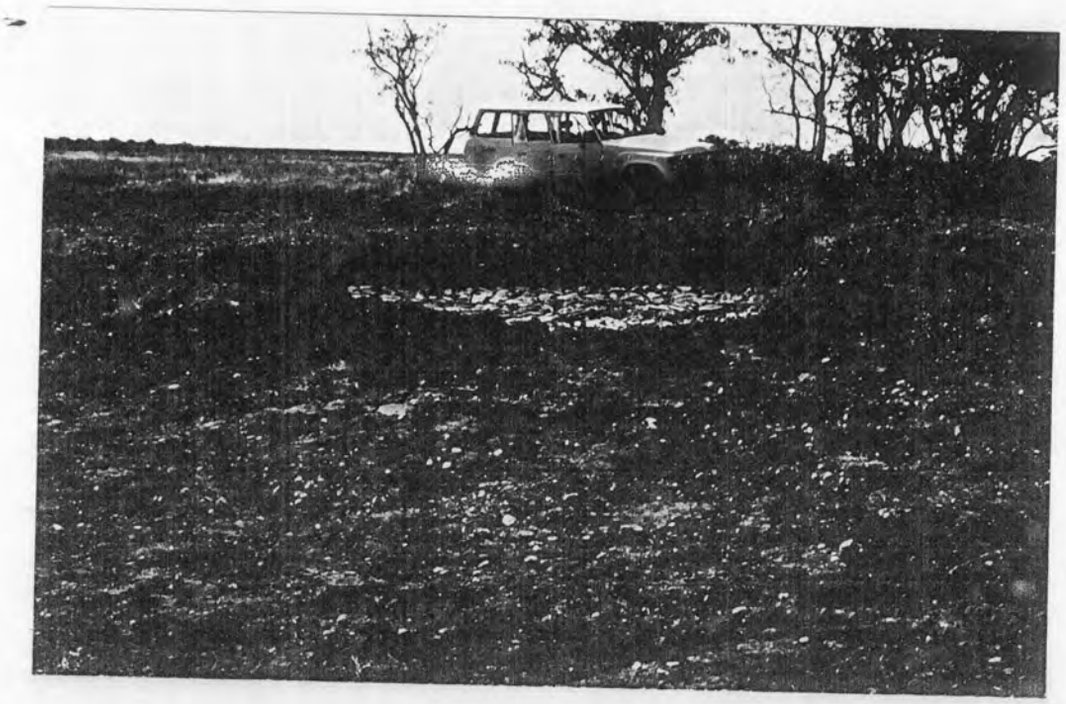


PLATE 4 Buffalo damage at Kun-kundurnku, South Alligator River (June 1981)

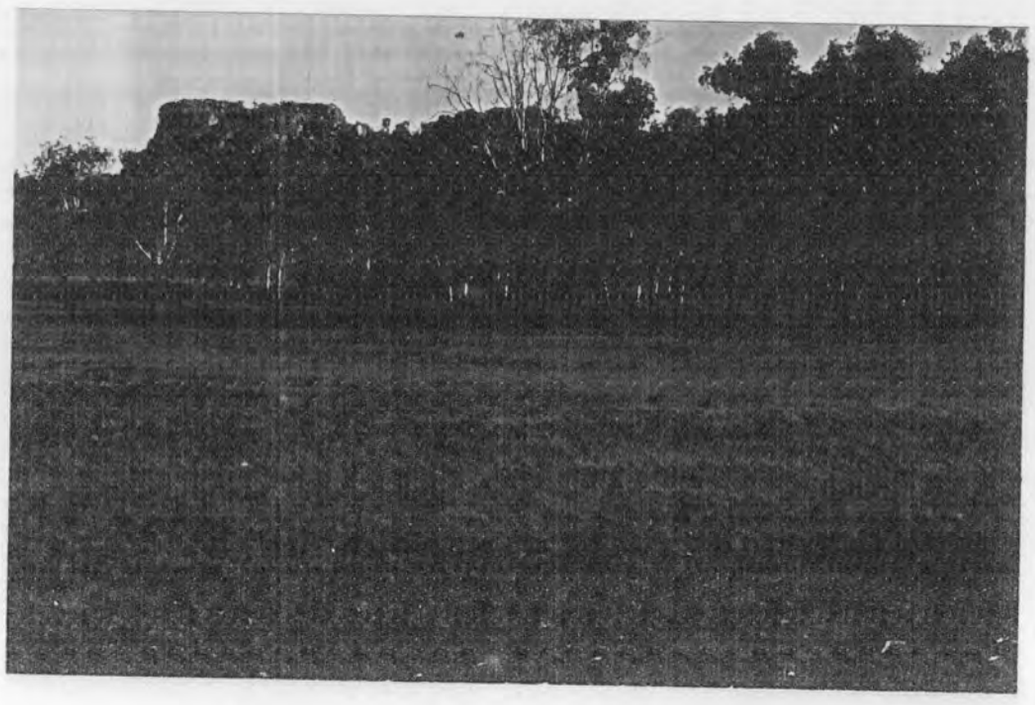


PLATE 5 Dried out lagoon on way to Anbang-bang, Nourlangie Rock. Pigs in middle distance (July 1981)

Stuart (1865:402) on 21 July 1862 at Leichhardt Point on the Mary River describes the borders of marsh as being "of the richest description of black alluvial soil, and when the grass has sprung after it has been burnt, it has the appearance of a rich and very thick crop of green wheat." On 23 July, on the flooded Swim Creek Plain he (1865:405) describes a marsh he is unable to cross as "covered with luxuriant grass which gives it the appearance of extensive grassy plains." The above descriptions probably refer to the swamp plant Hymenachne spp. (Letts et al. 1979:17).

Lewis (cited from Letts et al. 1979:190) in 1875 while travelling to the Coburg Peninsula wrote of a crossing on the East Alligator River: "We got two of the strongest horses over, and cut the reeds to form a corduroy. The reeds were about twelve feet high. We left Reid, Crossman and the Chinaman at the camp, and Levi and I and the two blackboys cut the reeds and any necessary timber to make a crossing". This is probably a description of Phragmites spp. Phragmites spp. is important in wetland environments for waterbirds, especially geese, which nest among it. It also provides shade for wetland muds, keeping them moist well into the dry season (Schrire 1982:16).

Warburton (1944:75-76) writes while at Cannon Hill near Oenpelli,

> "...Finding ourselves getting into water, we moved on to a large patch of green water couch; no sooner had we walked a few yards on it than it began to dip and rise beneath our feet. It had become matted together and formed a floating carpet ... Later we found that the matted grass covered water-holes which were infested with crocodiles, and a shiver went through me as I thought how easy it would have been for us to have fallen through."

He is describing vegetation mats on a base of Hymenachne spp. grass. He (1944:78) also notes the existence of reeds (Phragmites spp.) around the Cannon Hill and Oenpelli areas.

FIRE

The dry season is the time for fires. The tall grasses which spring up during the wet season on the black soil plains and in the open woodlands and forests when dried out, burn readily. Some of these fires may be started by lightening strikes but most are deliberately lit by Aborigines and Europeans (Calaby 1980:325, ANPWS Kakadu Plan of Management 1980:193).

The Aborigines systematically burn the plains during the dry season for a variety of reasons. Fire facilitates the capture, via organised game drives of small animals (Chase and Sutton 1981:1832, 1838; Sutton 1978:48) and as well rids the country of snakes and mosquitoes (Jones 1980:124, Thomson 1948-49). The burnt areas attract birds like the ibis which feed on the charred grubs and insects (Chase & Sutton 1981: 1832). Burning, while there is still moisture in the ground, also ensures a new growth of grass. This fresh growth attracts kangaroos and wallabies.

The firing of the country is carefully timed so that the medium yield may be gained from the post wet vegetable harvest, as fire destroys the vines of tubers thus eliminating all signs of their whereabouts (Thomson 1948-49:27). Burning is carefully monitored so that it does not destroy fire sensitive species, such as those found in monsoon rainforest pockets, which are a valuable source of food (Thomson 1948-49:27, Jones 1980:124). However, occasionally mistakes occur and fire destroys areas the Aborigines did not intend to burn (ANPWS Kakadu Plan of Management 1980:194).

CHAPTER THREE

THE ETHNOGRAPHY

Information about Aboriginal society in the northern end of the Northern Territory comes from the writings of explorers, buffalo hunters, miners, settlers and more recently, anthropologists. Some of these describe a society which then had only just come into contact with Europeans. It is thus possible to make some assessment about Aboriginal life in pre-contact times. Of course, the information contained in these documents, as in all historical sources, must be used with caution. Nevertheless, this type of data, if carefully assessed and then interpreted by scholars who possess general anthropological skills, can provide useful insights into Aboriginal life at the time of European contact.

Explorers

Explorers enter landscapes carrying in their minds the preconceptions about Aborigines that are current at that time in their society (Brockwell 1977:1). Normally, observation of Aboriginal society is not the major objective of their expeditions. As they move through the countryside the observations they make are fleeting and confined to a particular time of year. Also they are not trained in anthropology and related disciplines. It is still uncertain to what extent Aboriginal society on the north coast of Australia was influenced by the presence of Macassan fishermen, who visited the coast for at least several hundred years (Mulvaney 1975:37); visits by European marine traders and explorers; the presence of British settlements at Fort Dundas, Melville Island (1824-29), Fort Wellington, Raffles Bay (1827-29) and Port Essington, Coburg Peninsula (1838-49) (Allen 1980:33); and possible contacts, which at this stage are only conjecture, with other cultures e.g. Chinese or Papua New Guinean.

Buffalo hunters, miners and settlers

Detailed accounts of European settlement in the Kakadu area appear in Fox et al. (1977:36-39), Christian and Aldrick (1977:4-7), Keen (1980:172-74), Schrire (1982:18-19).

By the 1880s buffalo hunters, miners and settlers had moved into the area causing major changes in the Aboriginal lifestyle. By the turn of the century European diseases had severely lowered the Aboriginal population in the northern end of the Northern Territory, especially in the Kakadu area and by 1927 few Aborigines were left around the lower region of the Alligator Rivers (Keen 1980:176). Many had died and some, along with Gunwinggu people from the north and east, had moved to the settlement at Oenpelli; originally Paddy Cahill's dairy farm but from

1925 a Church Missionary Society Mission (Keen 1980:174, 178).

The discovery of gold at Pine Creek in 1871 caused an influx of miners to the region. Aborigines were attracted to the towns which had sprung up around the mines. There, among other European things, they sought alcohol and opium. In exchange, some traded female relatives in prostitution.

Some of the Aboriginal men of the area worked for buffalo shooters. Their families travelled with them. They also moved onto stations to work for settlers. Gradually the Aborigines became less and less reliant on hunting and gathering for their food. European food such as flour and sugar largely replaced indigenous plant foods as their carbohydrate source. However, "bush tucker" was still popular, and people continued to cull items such as goose eggs (Cahill letters to Spencer 20/3/14, 26/3/16).

So, while much information is contained in the records left by buffalo hunters, miners and settlers, it must be remembered that the Aboriginal society they were observing had already been modified by its contact with European and other peoples. Furthermore, many of their observations were made whilst on the move and thus out of a normal temporal and spacial context and inevitably spectacular events would have received more attention than those of a more mundane nature. Most observers were men and may not have recorded many, except the most obvious, activities of women. Thus the view of the Aboriginal way of life presented by these reporters may be somewhat unbalanced.

Anthropologists

By the time anthropologists such as Spencer (1914, 1928) began their work, Aboriginal society had changed considerably from what it had been like at the time of formal European entry into northern Australia. Then, anthropology as a discipline was still developing. It was fashionable at the time to investigate the social aspects of small scale societies rather than those associated with economic life. Consequently, writings from this period (and even later) often contain only tantalising scraps of information about subsistence activities (e.g. Spencer 1914:27, Warner 1937:140-45, Hiatt 1965:26). Within the last 30 years anthropologists have begun to look more closely at the economies of Aboriginal societies. However, they now undertake this kind of research in societies whose subsistence has changed markedly over the last 150 years. It is frustrating to contemplate the fact that early anthropologists, who were in a position

to record information about an Aboriginal economic life, much of which has now been modified or abandoned. chose not to do so.

Instead of contemplating a "positive", uncontaminated and static Aboriginal society in pre-European days it is useful to attempt to construct a model approximating the society and its way of life as it existed before formal European entry into an area. It is perhaps possible, from this position, to trace changes and/or consistencies in the lifestyle up to the present day, from the ethnographic record; and into the past, through the archaeological record.

ABORIGINAL USE OF WETLANDS

Despite the piecemeal nature of and weaknesses in the data available on Aboriginal subsistence in northern Australia, enough exists to allow vivid, if somewhat incomplete, description of Aboriginal use of the wetlands to be compiled.

Although a naturalist by training Leichhardt was a keen observer of the Aboriginal way of life. He recorded useful details about their subsistence strategies and the landscape in which they lived, on his journey of exploration from Brisbane to Port Essington in 1845. McKinlay travelled from the Escape Cliffs settlement on Cape Hotham to the East Alligator River in 1866 and his descriptions added to those of Leichhardt's (Christian and Aldrick 1977:5). Reminiscences of buffalo hunters (e.g. Warburton 1934) and settlers (e.g. Cahill, Letters to Spencer) provide additional data. It is fortunate that Paddy Cahill recorded his observations. He lived at Oenpelli from 1906 to 1925 and was interested in Aboriginal life. Spencer, the biologist who practised anthropology, stayed with him while he was in the area during 1912. Later, Cahill furnished him with details of Aboriginal exploitation of resources in a series of letters which are still available.

Many anthropological studies have been carried out in the northern part of the Northern Territory and in northern Queensland and while many are not directly concerned with wetland exploitation many contain some relevant information. These studies include those carried out by Spencer (1914, 1928) with the Kakadu people; McConnel (1930) with the Wik Munkin from the west coast of Cape York Peninsula; Hale and Tindale (1933-34) with the people of Princess Charlotte Bay; Thomson (1939) with the Wik Munkin; McArthur (1960) with the Yolngu from the east coast of Arnhem Land and the Gunwinggu community from Fish Creek near Oenpelli; Thomson (1948-49) with the Yolngu of eastern Arnhem Land; Peterson (1973) with some bands of Ritharngu-speaking Aborigines living on the edge of the Arafura swamp; Meehan (1975, 1982, in prep.) with the Gidjingali people of the Blyth River; Scarlett (1976) with the Yolngu; Harris (1977) with the people from the Lockhart River in northern Queensland; Sutton (1978) with the Wik Munkan; Jones (1980, Jones & Bowler 1980) with the Gidjingali; Chase & Sutt (1981) with the Wik Munkan of western Cape York and the Nesbitt River people in northern Queensland; and Altman (1982) with the Gunwinggu of the Mann and Liverpool Rivers region in Arnhem Land.

THE ABORIGINAL YEAR

The Aborigines of northern Australia usually divide their year into five or six phases, according to seasonal cycles, prevailing winds and available resources. These divisions are remarkably similar right across northern Australia. See Figure 1 below for the Aboriginal calendar used in the Alligator Rivers area. Descriptions of calendars for other Aboriginal groups in northern Australia are found in Thomson (1939:214, 216); Thomson (1948-49: Table opposite p. 28); Sutton (1978:46); Chase and Sutton (1981:1835, 1838); Altman (1982:48); and Meehan (1982:25).

SEASONAL CALENDAR FOR THE
KAKADU REGION IN GUNDJEIDMI (MAIILI) LANGUAGE

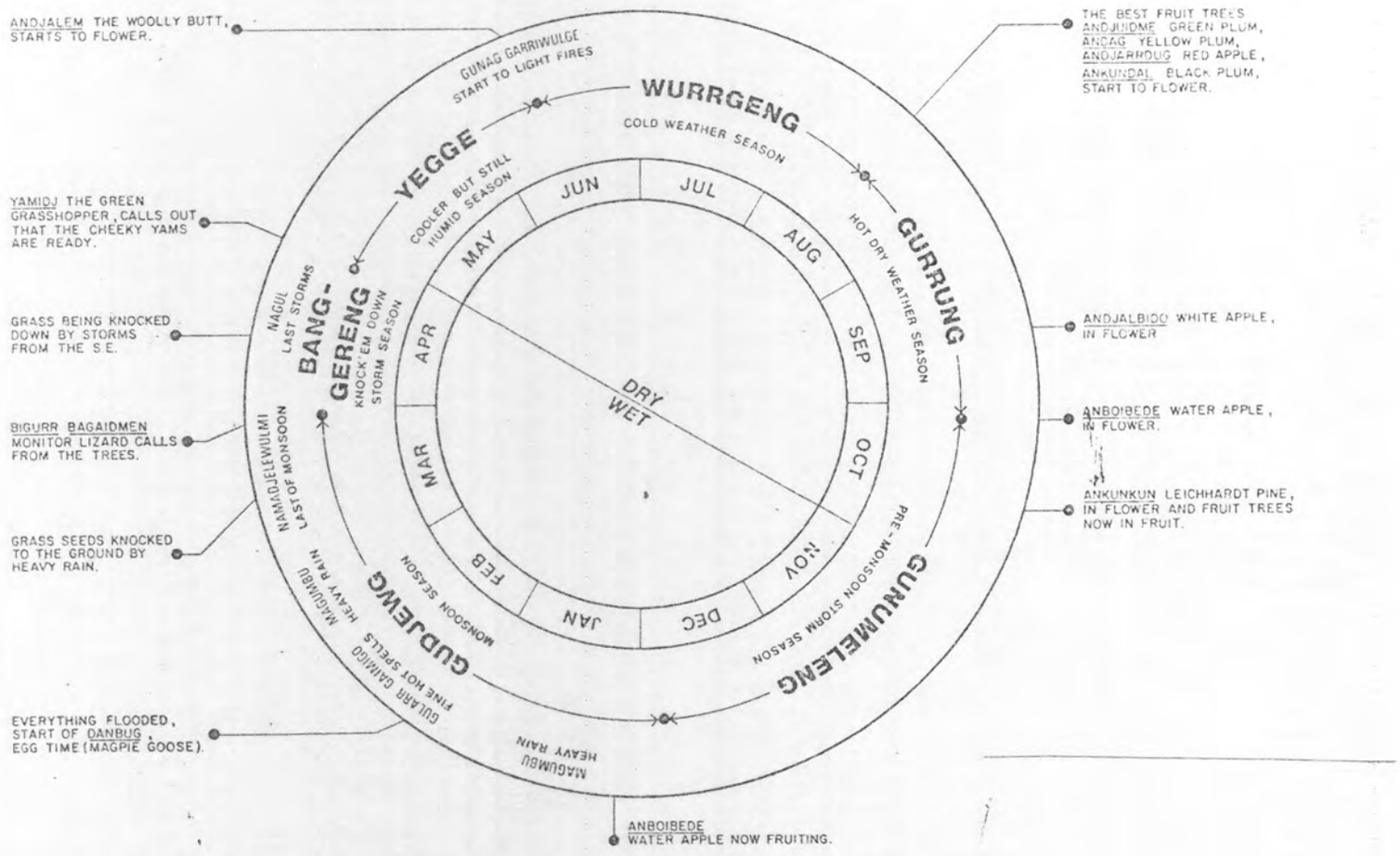


FIGURE 1 Aboriginal Seasonal Calendar in Alligator Rivers Region
(after ANPWS Kakadu Plan of Management 1980:41)

SUBSISTENCE

Freshwater wetlands contain abundant supplies of food which Aborigines exploit. These sources are especially important twice during the year, in the late wet season/early dry season and in the late dry season. At these times food production is at its peak. The resources which are culled from the wetlands are described and tabulated below (see Appendix 1).

Water birds (and their eggs).

During the late wet/early dry months the magpie geese (Anseranus semipalmata) lay their eggs on swamp vegetation. At that time the black soil plains are covered with water and it was necessary to use canoes to reach the nests (Thomson 1948-49:32).

Thomson (1948-49:32-33) observed goose hunting expeditions that took place on the Arufura Swamp. Men took canoes onto the swamps for several days at a time to collect eggs and capture geese. At night they slept on special platforms which had been constructed in the branches of trees. Fires were lighted on these platforms on a base of swamp mud, both to ward off mosquitoes and cook geese. Dead branches from trees fuelled the fires. Goose wing fans were used to beat off mosquitoes. Lack of wood, the mosquitoes and boredom with the diet eventually drove the men back to the shelter of the wet season camps on the edge of the swamps. They returned with a cargo of geese and eggs to enjoy the vegetables the women had collected in the meantime. The canoes had to dry out and harden before the hunters returned to the swamp. The Wik Munkin of Cape Keerweer exploited the swamplands in their territories in a manner similar to that used by the people of the Arafura Swamp. They used canoes made from the bark of Eucalyptus tetradonta trees. (Nowadays aluminium dinghies are more popular (Chase and Sutton 1981:1838)). The first eggs collected by the Wik Munkin were buried in the ground because the people believed that if these were eaten the geese would not lay any more (Chase and Sutton 1981:1838).

For the Alligator Rivers area, only Paddy Cahill in his letters to Spencer (20/3/14 and 20/3/16) documented the collection of goose eggs at the end of the wet season. Many references exist however, describing the hunting of geese and other water birds there, and in other areas (see Appendix 1). Goose eggs are still exploited in the Alligator Rivers area today.

During the late dry season the black soil plains dry up and fresh water becomes concentrated into permanent swamps and lagoons. Birds flock to these diminishing water sources, where the aquatic plants upon which they feed proliferate with the drop in water level (Chase and Sutton 1981:1832). They were thus easy targets for the Aborigines. Many species of water bird such as geese, ducks, ibis and herons were captured. Various methods were used to kill them. Nowadays, shotguns are popular.

Leichhardt (1847:491, 493), who happened to travel through the Alligator Rivers area late in the dry season (November/December), noted waterbirds in their thousands along the South and East Alligator Rivers. He (1847:505) described the Aborigines hunting them with spears and "woomalas" (woomeras). Spencer (1928:774-75) described late dry season camps where the Aborigines caught geese in abundance. He observed the hunters waiting quietly in the water until they could grab a pigmy goose by the legs. Warburton (1944:134), who hunted buffalo in the area, also noted this method being used to catch ducks. Gillespie (pers. comm.) reported that the Aborigines from the region of the South Alligator River used to soak their "clubs" in water before use so that they increased in weight (Brockwell, Meehan & Allen, in prep., see attached). Warburton (1944:134) saw pelicans killed in this way near the East Alligator River. Waterbirds are still caught by Aborigines in the area today (McLaughlin 1982:14-15).

Roth (1901:207) stated that the Aborigines from the hinterland of Princess Charlotte Bay and along the Palmer River stalked ducks, geese and other waterbirds with pronged spears and woomeras while gliding through water camouflaged by water plants. Warner (1937:141) described a similar hunting technique for the Murngin of Arnhem Land.

Meehan (pers. comm.) reported that the Gidjingali of the Blyth River used blunt spears to fell the waterbirds before they acquired guns.

Mammals

After the first rains at the beginning of the wet season, the small rat (Rattus colletti) becomes easy prey for a short time as it retreats from its dry season burrows in the black soil plains to shelter on higher ground (Jones 1980:114).

Snakes

The Javin file snake (Achrochordus javanicus), which inhabits fresh water swamps, are another species exploited by the Aborigines. They are

easily captured in the late dry season because then, like fish, they become trapped in the swamps as they shrink in size (Peterson 1973: 183).

Spencer recorded their capture by the Kakadu in the mid-dry season. He (1928:787) said that the Aborigines "catch a good number of them and actually carry them about alive in bags killing them when they want some fresh meat". The file snake is still part of the diet of the Alligator Rivers region Aborigines today according to McLaughlin (1982:10).

Other watersnakes besides the file snake were also procured as food. Thomson (1948-49:19, 1948:41-49) mentioned in particular Macleay's water snake (Hypsirhina sp.) and the water python (Liasis olivaceus) in Arnhem Land. McArthur (1960:113) described the Aborigines from Oenpelli on the East Alligator River culling watersnakes from the lagoon.

Tortoises

Fresh water tortoises (Chelodina sp.) are another important faunal resource contained in wetlands.

The long-necked tortoise (Chelodina rugosa) was a staple for the people of the Arafura Swamp from about the end of the wet season to the middle of the dry season. Women dug them out from the mud where they had burided themselves as the freshwater evaporated (Peterson 1973:183).

In the Alligator Rivers area McArthur (1960:113) described the women from Oenpelli Mission locating long-necked tortoises "by probing the mud [in lagoons] with their digging sticks".

Several species are still utilised by the Aborigines living in the region today. These include long-necked turtle (Chelodina rugosa), two species of short-necked turtle (Elseya dentata and Emydura victoria) and the pig nosed turtle (Cattelochelys insculpto).

Crocodiles

Crocodiles, both fresh and saltwater varieties, were taken from freshwater swamps and streams and eaten. Roth (1901:24) records this for the Aborigines of Cape York, Meehan (in prep.) for the Blyth River and Thomson (1949:41) for the Aborigines of Arnhem Land. McLaughlin (1982:9) records that the saltwater crocodile (Crocodylus porosus) is still eaten today by the Aborigines of the Alligator Rivers region.

Goannas

Goannas are another popular item of fresh food for Aborigines exploiting wetlands. They are found in a variety of habitats but also in wetlands areas because of the availability of fresh water.

The goanna was captured whenever possible, however they were often captured when the Aborigines fired the long grasses on the black soil plains about June to early August "after the southeast winds have blown down the tall grasses and when there is a dew and cool weather to extinguish the fires by nightfall" (Jones 1980:124). This was reported by Thomson (1949:18, 1948-49:39) for the Arnhem Land Aborigines and Chase & Sutton (1981:1838) for the Cape Keerweer Wik Munkin. Several species of goanna are still eaten in the Alligator Rivers area including two species of water goanna (Karanus mitchelli) and varanus mertensi (McLaughlin 1982: 7-8).

Fish

Fish became an important food resource during the late dry season as progressively they became confined to the diminishing patches of fresh water. Here they were easily speared or stunned by the use of vegetable poisons introduced to the water supply. This type of food procurement was performed by both men and women. Culling of fish at this time of year is widely reported (see Appendix 1).

Thomson (1948-49:19-20) speaking generally about Arnhem Land stated that during the late dry season Aborigines congregated on the swamps that still contained freshwater and there harvested fish, tortoises and snakes "by swimming 'drives' and by use of dams, weirs, traps, nets, and special poisons".

At this time the Gidjingali of Arnhem Land speared and poisoned fish that inhabited shrinking waterholes (Jones 1980:125). The Gunadpa people, inland neighbours of the Gidjingali used the bashed leaves and bark of the freshwater mangrove (Barringtonia gracilis) as a poison (Jones 1980:114).

Spencer (1928:774-75) mentioned the abundance and spearing of fish from lagoons throughout the Alligator Rivers region in July.

When water begins to retreat in the dry season, fish which during the rainy period have moved all over the floodplains, return to major streams and waterways. At this time fish traps were constructed at strategic positions along creeks to ensnare these fish as they migrated. This practice is well documented in all areas under consideration (see Appendix 1)

Jones (1980:114) lists several species which are caught by the Anbarra during the early dry season, including barramundi (Lates calcarifer), eel-tailed catfish (Neosilurus sp.), some Tachysuridae (including Neoarius australis), mullets, herring (Megalops cyprinoides) and the Archer fish (Toxotes jaculator). At this same time the Arafura Swamp people captured saratoga (Suleropages leichhardti) and Neoarius australis (Peterson 1973:182). The Wik Munkin used fish weirs and fish traps when the floodwaters receded in the same way as do the Aborigines in Arnhem Land (Thomson 1939:220). Roth (1901:23) reported that "bush fences" and weirs were employed by the Aborigines of eastern Cape York to catch fish after the floods.

All the fish species listed above are recorded as being eaten today by the Aborigines inhabiting the Alligator Rivers region, except Neoarius australis (McLaughlin 1982:11-12).

Shellfish

Freshwater mussels Velesunio sp. are found in freshwater swamps and lagoons. Meehan (1982:59) and Jones (1980:115) recorded the occasional consumption of Velesunio ambiguus by the Gidjingali. In the Alligator Rivers area, Leichhardt (1847:488-89) reported that along the South Alligator River, "They were Unio eaters to a great extent judging from the heaps of shells we saw along the river ..."

Warburton (1944:65) reports for the same area the storage by Aborigines of hundreds of mussels (Velesunio sp. ?) beside a waterhole and explains "the blacks collected the mussels and placed them fairly deep in the sand to fatten, and to keep them from the reach of water birds. They would return in a couple of weeks and collect their store."

In the Alligator Rivers area today Velesunio angasi are still gathered by the Aborigines (McLaughlin 1982:13; Morris pers. comm.; Meehan pers. comm.).

Reptile Eggs

Besides the eggs of water fowl (see p. 42), eggs of turtle, crocodiles, goannas and snakes, found in the wetlands areas were a popular addition to the diet.

Among the Anbarra "Eggs ... were greatly prized and most of the above species were eaten"(Meehan 1982:147). The first rains of the wet season brought abundant egg supplies including those of turtles and crocodiles. They were an important protein supply for the Wik Munkin of Western Cape

York (Thomson 1939:215; Sutton 1978:49). McConnel (1957:4-5) reported that these people fried turtle eggs in the juices of the upturned turtle shell.

In Arnhem Land, the organised burns in the dry season yielded not only large snakes but uncovered their eggs (Thomson 1948-49:27). Peterson (1978:183) lists eggs of turtles and waterfowl as an important staple on the Arafura Swamp. The eggs of the freshwater crocodile (Crocodylus johnstoni) are eaten in the Alligator Rivers area today (McLaughlin 1982:9).

Plant foods

Many wetlands floral species were utilised by the Aborigines, not only as food but also in the manufacture of items of material culture, e.g. Melaleuca spp., the flexible bark of which is used for wrapping food, lining ovens, fashioning containers etc. (Jones 1980:115) and Phragmites sp., which was used for making spear shafts in the vicinity of the South Alligator River (Kapirrigi pers. comm.). The two most important food plants were spike rush (Eleocharis spp.) and water lily (Nymphaeceae), both of which were staples in northern Australia (see Plate 6).

Spike Rush (Eleocharis spp.)

During the late dry season the corms of two species of spike rush (Eleocharis dulcis and Eleocharis sphacelata) were exploited. These were dug up by women with digging sticks (nowadays iron bars have replaced the traditional wooden implement) from the exposed black soil plains and drying swamp beds (Jones 1980:124). It seems that at this time of year Eleocharis spp. were a staple carbohydrate food before European carbohydrates were adopted.

The importance of Eleocharis spp. as a food source is supported by many authors (see Appendix 1) McConnel (1957:4) described the Wik Munkin women of the Archer River chest deep in mud digging out the corms of "rushes". McArthur (1960:101, 130) recorded Eleocharis dulcis as a food (eaten raw or cooked) on Groote Eylandt and Port Bradshaw in the late dry season. It was collected by women and girls who sat in the water and freed the corms with their digging sticks, in the late dry season.

In the Alligator Rivers area Leichhardt (1847:504) reported that in early December 1845, "the nut-like swelling of the rhizoma of either a grass or a sedge", was eaten by the Aborigines. He (1847:504) described it as having "a sweet taste" and being "very mealy and nourishing, and

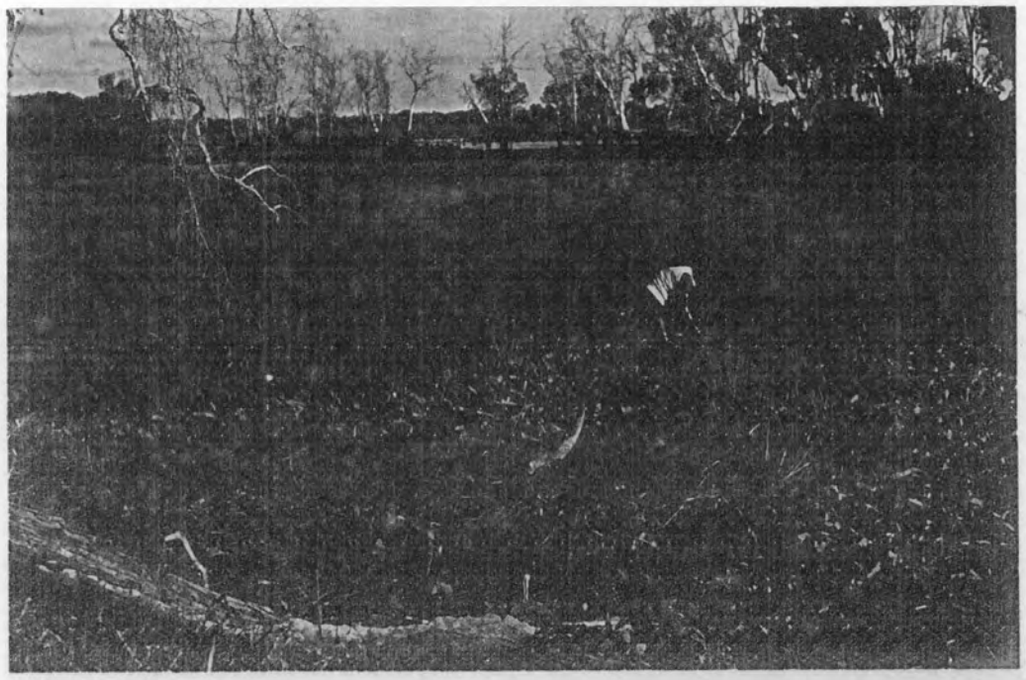


PLATE 6 Violet Alderson collecting water plants at Ki'ina, South Alligator River (July 1981)

the best article of the food of the natives we had yet tasted". It is still consumed in the Alligator Rivers region today (Smyth & von Sturmer 1981:18; McLaughlin 1981:18; Russell-Smith in prep.; see Plate 6).

Water lilies (Nymphaeceae)

All written sources list the water lily (Nymphaeceae) as being an important wetland plant utilised by Aboriginal people especially during the dry season (see Appendix 1). All parts of the lily were eaten, seed pods, roots, stems and flowers.

Water lilies harvested from small freshwater swamps on the Lockhart River, eastern Cape York were an important carbohydrate source for the Aborigines there (Harris 1977:433). No seasonal details were provided. Thomson (1939:215, 216) mentioned Nymphaea spp. as part of the great dry season vegetable harvest and as an element of the "chief food supply" for the Wik Munkin in the late dry season. Flowers and stems of the water lily were eaten raw and the roots and seed pods cooked in ant bed ovens (McConnel 1957:5). At the beginning of the water lily harvest, the Wik Munkin ceremonially cooked the roots and seeds of the first crop. These were not eaten but kept until they could be washed away during the wet season. The performance of this rite ensured a good crop the following season. When it had been completed harvesting continued as usual (McConnel 1957:5-6).

In Arnhem Land, Chaseling (1957:44) observed that after the wet season was over water lilies grew in profusion on low-lying inundated land. He (1957:44) described Yulengor women diving for the roots and roasting large amounts of them. The Gidjingali exploited Nymphaea spp. in the early dry season, once the water had begun to drain from the plains.

There is ample evidence of "similar" exploitation of Nymphaeceae in the Alligator Rivers region. Leichhardt (1947:512) while in that area on 4 December 1845 said "when the natives became hungry, they ate the lower part of the leaft-stalks of Nelumbium, after stripping off the external skin". Spencer (1914:394) records that "in parts where they grow, the seeds, stem, and roots of the Red Lotus (Nelumbo nucifera ?) and the ordinary Lily (Nymphaea sp.?)" are eaten. He (1914:394) goes on to say, "In places such as Oenpelli, where the backwaters are full of lilies, you can see the little black faces of the women just above the water all day long gathering lily "tucker", which they call Wuridjonga. The seeds they pound up and make into a damper, which is baked on the fire; the stalks they eat raw, and the roots they cook in the open fire." Later

he (1928:774) makes similar observations during the mid dry season in the East Alligator area. Berndt and Berndt (1970:36) record that among the Gunwinggu people of Oenpelli "Pink and blue (Nelumbo nucifera and Nymphaea sp.) water lily roots and stems are popular; the seeds are crushed, ground, shaped into oval cakes, and cooked." McArthur (1960:98) also reports these species as eaten at Oenpelli. Several species of Nymphaeceae are still consumed in the Alligator Rivers region today (Smyth and von Sturmer 1981:26-27; Russell-Smith in prep.; (see Appendix 1).

Other plant species

The wetlands provide several other plant species, apart from the major series discussed above, that were exploited by the Aborigines. Wild rice (Oryza spp.) grows on the better drained parts of the black soil plains and was harvested in the early dry season (Specht 1958:484; Jones 1980: 114).

In swampier areas, several plants with edible roots or tubers grow. These include wild cowpea (Vigna vexillata), Cayratia trifolia, arrowgrass (Triglochin procera) and Polynesian arrowroot (Tacca leontopetaloides). Many of these plant species can be harvested from other habitats as well. Exploitation of them is well-documented throughout northern Australia (see Appendix 1). Taro (Colocasia sp.) was utilised in eastern Cape York (Harris 1977:433).

SEASONAL IMPORTANCE OF WETLANDS

It is obvious from the above that wetlands have peak productivity seasons, the late wet/early dry and towards the end of the dry season. During the rest of the year smaller quantities of food were harvested from them.

Ceremonial importance

Because wetlands provided reliable and abundant food sources at the end of the dry season, large ceremonies were often carried out then at sites adjacent to areas of productive swampland.

Meehan (1982:41) described a visit she made in 1960 to Balpildja, a swamp lying about eight km from the Anbarra coastal home bases, for the finale of a Kunapipi ceremony:

> "About 100 people were camped around the shores of the swamp for the final days of this event. Ducks, geese and water plants were some of the abundant food sources utilised".

In 1979, while she was attending a ROM ceremony at Anadjerramiwa, the Anbarra exploited the northeastern side of Balpildja swamp for fish, spike rush, tortoises and geese (Meehan in prep.).

Similar descriptions of large numbers of people gathered together for ceremonial purposes at the end of the dry season occur elsewhere. In Cape York, large groups of Wik Munkin gathered together for ceremonies at that time (McConnel 1957:14; Chase and Sutton 1981:1838) and exploited "the corm of a rush-like plant which grows in great abundance in the brackish swamps of the coast" (Thomson 1939:216). In Arnhem Land, Chaseling (1957:44) recorded some 200 Yulengor gathered for six weeks performing ceremonies. These groups subsisted mainly on spike rush.

Limitations on exploitation

The only time of year when the wetlands were not exploited was when they were inaccessible, covered by sheets of water at the height of the rainy season. Vegetable resources were drowned or not ready (Jones 1980: 123) and the murky and abundant water made fish hard to find let alone catch (Peterson 1973:182). The Aborigines described this as a lean and difficult period (Jones 1980:129). They had to shelter from rain and wind and mosquitoes (Chase and Sutton 1981:1833). However, they were never

really hungry or went short of food (Harris 1977:437-38; Chase and Sutton 1981:1833; Meehan 1982:157).

Depending on where they lived they concentrated their subsistence activities on whatever foods were available. The Anbarra spent this time on the coast where the wind drives off the hordes of mosquitoes. They exploited mainly saltwater fish and shellfish, wet season fruits when they were ready such as 'red apple' (Syzigium suborbiculare) and Morinda citrifolia and products of the monsoon rainforest and jungle thicket such as yams (Meehan 1982:153, 162).

The Aborigines of the Arafura Swamp moved to higher ground to escape the flooded plains and exploited emu, bustard and kangaroo which were more localised at this time. Hunting them was made easier by wind noise and the fresh growth of grass. Wet season fruits were gathered from the sandy fan delta complex between the swamps and higher ground, and towards the late wet yams were ready in the monsoon rainforest (Peterson 1973:183, 186).

CHANGING SUBSISTENCE PATTERNS IN THE ALLIGATOR RIVERS AREA

Today the Aborigines of the Alligator Rivers area no longer rely as heavily on bush foods as they did in the past. They have a constant supply of European carbohydrates, mainly flour and sugar. The major change in their diet has been caused by the arrival of buffalo and pigs in the area. These exotic animals have provided a new and abundant source of protein but have partially depleted other food resources because of the damage they have caused to the wetlands (see p. 30).

Buffalo provide a nutritious relatively accessible form of protein especially when rifles are used. Nowadays the protein component of the Aborigines diet is supplied mainly by buffalo meat, although those parts of the wetlands not affected overly by the buffalo and pig destruction are still exploited for their traditional meat foods (Meehan in prep.).

SETTLEMENT PATTERNS AND DEMOGRAPHY

The literature indicates that freshwater wetlands in northern Australia have two reliable peak production periods, one in the late wet season/early dry season and one in the late dry season (see Table 6 At these times the wetlands were capable of supporting large numbers of people and neighbouring groups moved to them to join their owners in their exploitation. When these large groups had converged on the wetlands, ceremonies often took place, especially during the late dry season.

It appears that patterns of settlement depended on whether the people focussed their exploitation on wetlands or whether this focus lay elsewhere and exploitation of wetlands was only a seasonally important activity. Relatively sedentary occupation of wetlands further depended on the nearby availability of alternative resources on higher ground for when the swamps were in flood and their resources inaccessible.

Clearly, the richness of resources of the wetlands of the Alligator Rivers region was sufficient to support year found a population similar in density to that of the coastal areas of Arnham Land and western Cape York.

Lockhart River

The Lockhart River people of eastern Cape York described themselves as "people of the sand beach" as they lived mainly on the coast.

Although some terrestrial animals and birds were called, procurement of animal foods was concentrated on marine resources such as fish, shellfish, turtle and dugong (Harris 1977:438, 454).

In this area there was no major dietary focus onto plants (Harris 1977:437). The people there exploited all the ecosystems available to them; riparian rainforest, open-canopy forest and woodland, heath, grassland, mangrove vegetation, freshwater swamp and littoral thicket, according to season and accessibility (Harris 1977:431) However, within this broadly based subsistence strategy freshwater swamps "made a major contribution to food supplies" (Harris 1977:433).

TABLE 6

Periods of Optimum Exploitation of Wetlands species

	Late wet season	Early dry season	Dry season	Late dry season	Wet
Waterbirds	X	-	-	X	-
Waterbird eggs	X	-	-	-	-
File Snakes	-	-	-	X	-
Tortoises	-	X	X	X	-
Fish	-	X	X	X	-
Eleocharis spp.	-	-	-	X	-
Nymphaeceae	-	X	X	X	-

Nesbitt River

The Nesbitt River people of eastern Cape York also focussed their subsistence activities onto coastal resources (Chase and Sutton 1981: 1824-34). These were highly reliable and occurred in abundance. They also exploited the seasonal resources of the small freshwater swamps and other ecosystems which lay behind the beach on their land. They moved inland only rarely to take advantage of the specific seasonal resources available there, e.g. at the end of the dry season to poison freshwater pools containing fish (Chase and Sutton 1981:1849). Thus these people lived a relatively sedentary life on the coast, moving along the beach when their camp sites became dirty rather than because of scarcity of resources nearby (Chase and Sutton 1981:1831). This sedentism is reflected in their camp site location which "for a group over an annual period had a total range of only a few kilometres of beachfront and immediate hinterland" (Chase and Sutton 1981:1831). Because of their highly productive environment, the Nesbitt River people had a consequent high population density. Chase and Sutton (1981:1830), while acknowledging the difficulties in calculating population density for pre-contact times, estimate that in this area Aborigines occupied the land at the rate of one person to every 2.5 km^2.

Cape Keerweer

In contrast with the Anbarra (see p.57) and the Nesbitt and Lockhart Rivers people, the Wik Munkin of Cape Keerweer, western Cape York, tended to focus their exploitation away from the sea onto the dune woodland complex situated behind their coastal home bases. Large freshwater wetlands occur in this zone (Sutton 1978:47; Chase and Sutton 1981:1838, 1839, 1849-50). Lawrence (1968:190-91) notes this dissimilarity and suggests that the presence of a wide coastal plain, containing many swamps and watercourses that are rich in bird and other animal life on Wik Munkin territory, in contrast with the narrow coastal plain on the eastern coast of Cape York, may explain the differences in patterns of exploitation.

Chase and Sutton (1981:1839) say that in the region of Cape Keerweer the people can be divided into three groups "with territorial, kinship, ritual and other associations mainly on the coast, those mainly on the sclerophyll uplands, and those midway between them who have links with both but who basically belong with the coastal dwellers". The people with coastal territory spent the wet season on the beach and moved inland to exploit the wetlands when the rains ceased. Those whose territory lay behind the beach spent the wet season on high ridges in the floodplains (Chase and Sutton 1981:1838). Both groups generally moved their base camps about four or five times a year, following available resources (Chase and Sutton 1981:1839). Their inland exploitation focus was reflected in the dense distribution of named camping sites and ceremonial areas in the environmental complex which contains the wetlands and lies between the beach and the dry sclerophyll zones, a distance of a few kilometres (Chase and Sutton 1981:1850). The coastal territories of the Cape Keerweer people were smaller than those of their neighbours in the dry sclerophyll uplands and population densities higher reflecting the richness, in terms of resources, of the coastal plains.

Neither Chase and Sutton (1981) nor Sutton (1978) give a population estimate for the coastal Wik Munkin, except to say that it was higher than their inland neighbours (see above). Lawrence (1968:189) quotes figures from McConnel (1930) for the Wik Munkin which indicate that they occupied the land at about one person per 3.2 km^2. This, is an estimate for the whole of the region occupied by the Wik Munkin people and not just for those living on the coast. Lawrence (1968:189) concludes:

> "As far as this scanty information warrants any conclusions, it would appear that the population density of the two groups living continually on the coast was greater than that of the Munggan [Wik Munkin] who lived on the coast only at certain seasons of the year".

Arafura Swamp

The Ritharngu speaking people lived next to the Arafura Swamp in Arnhem Land and harvested the products of tall open forest, monsoon forest, sandy fan delta and freshwater streams and swamps according to season and availability of resources (Peterson 1973:182). These resources supplied all the subsistence requirements of the people over a twelve month period and their concentration in a relatively small area meant that, like the Wik Munkin of Cape Keerweer, the people did not have to travel long distances to procure food (see Fig. 5).

Over a twelve month period from 1966 to 1967 they moved their base camps only six times (Peterson 1973:186). From the early dry season to the early wet season they concentrated their subsistence efforts on the products of the sandy fan delta complex and the freshwater swamps (Peterson 1973:182-83). As the dry season progressed they moved their camps from the sandy fan delta onto the swamp fringes following the dwindling water sources (Peterson 1973:186). They moved onto higher ground when the first rains made the ground boggy (Peterson 1973:186). In the full wet season when the swamps were flooded they moved onto a plateau where they had access to the wet season fruits of the trees in the sandy fan delta complex and the resources of woodland and monsoon forest (Peterson 1973:186). In the early dry season the cycle began again. (See Fig. 5 for location of base camps). Peterson (1973) supplies no population estimates.

Blyth River

In a similar manner to the Lockhart and Nesbitt Rivers peoples, the Anbarra, one of the Gidjingali clans from the Blyth River in Arnhem Land concentrated their subsistence efforts onto coastal and also riverine resources, occasionally moving inland to harvest the late dry season products of Balpildja and other smaller swamps (Meehan 1982:41). These wetlands are not in any sense a constant foraging focus, but they are important at specific times of year (Meehan in prep.). Wetlands are a more important resource for the Matai, the inland neighbours of the Anbarra, whose territory contains extensive areas of swamplands (Meehan 1982:39). They use the sea as the Anbarra use the wetlands, in that they only seasonally exploit coastal resources (Jones

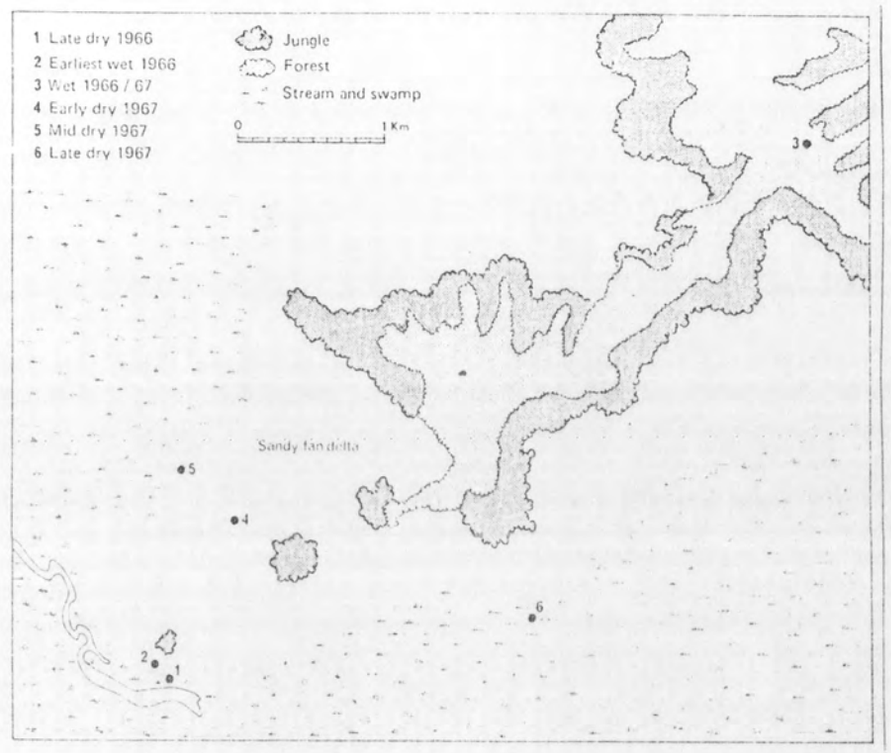


FIGURE 5 The location of base camps with respect to plant communities of Mirrngadja, Arafura Swamp, from November 1966-67 (after Peterson 1973:185).

1980:129, Meehan 1982:39). The Anbarra, like the Lockhart River Aborigines, see themselves as sedentary saltwater people who exist mainly on a diet of fish and shellfish (Meehan in prep.). Meehan (1982:40) comments on the remarkable sedentism of the Anbarra during her study months of 1972 to 1973, when they occupied only four home bases. The Anbarra regularly travelled up to 20 km on hunting expeditions but invariably returned to the coast date in the evening (Meehan 1982:40). In contrast, both the Matai and the Gulala (the Anbarra's coastal neighbours) moved at least a dozen times during the same period (Meehan 1982:40). One of Meehan's informants offered an explanation:

> "The Gulala, he said, spent most of their year sprinting up and down the coast and sailing their canoes in the open sea. They were 'rough sea people'. Matai people were afraid of the open sea and were inclined to stay, for most of their time, in their inland environment of forest, mangrove, mudflat and black soil plain. They were 'forest people'. The Anbarra 'sat down' at the mouth of the river living off their abundant resources - the bourgeoisie of An-gatja wana! [the Blyth River]" (Meehan 1982:40).

The Gidjingali have a population density of one person per two km^2, or six people per kilometre of coast, while the Anbarra in particular, who own the prime territory of the area, are distributed at about one person for each 0.5 km^2 (Jones 1980:129). Hiatt (1965:17) estimates the Gidjingali population to be one person per 0.8 km^2, a figure that lies somewhere between the two given above. Chase and Sutton's (1981:1830) estimate for the Nesbitt River people (one person for every 2.5 km^2) agrees well with Jones' estimate for the Gidjingali as a whole. These figures contrast with an inland Arnhem Land population density of about one person per eight km^2, even in well-watered areas (Jones 1980:129). White (1978:45) concurs with this estimate.

Alligator Rivers

It is difficult to describe population density and settlement patterns that may have existed in the area of the Alligator Rivers because so little information exists. Leichhardt observed the inhabitants of this region before their lifestyle had been much modified by the presence of Europeans and the feral animals that came with them. Whilst travelling through the countryside during the late dry season, he observed large groups of people; "The natives were very numerous, and employing themselves either in fishing or burning the grass on the plains, or digging for roots" (1847:493). In the vicinity of the East Alligator River he (1847:507) reported: "There could not have been less than 200 of them present". This and Leichhardt's enthusiastic accounts of the richness and diversity of animal and plant life in the region seems to indicate that the wetlands did indeed support a high population. However, these are late dry season observations when the production of the wetlands would have been at their height and other groups besides the wetlands owners may have been present to take advantage of this.

Later information is derived from a period when the Aboriginal population had been dramatically lowered by the effects of European diseases and the people living in the area were not necessarily its original inhabitants (Keen 1980:176; see p. 36).

The vegetation communities on the higher ground adjacent to the wetlands of the Alligator Rivers include pockets of monsoon rainforest. The moisture contained in the floodplains ensure that they survive and flourish. Many trees and plants and their associated fauna, which were/are of economic importance to Aborigines, exist in the open woodland which also lie on higher ground close to the wetlands. This means that on the Alligator Rivers the people who exploited the wetlands had only to move a short distance behind the wetlands onto higher ground to take advantage of the products available there, such as jungle fowl (Megapodes sp.) and their eggs, and yams which are all located within monsoon rainforest. The existence of these alternative resources would have been particularly important during the wet season, when those of the wetlands were either unavailable or inaccessible.

Keen 1980 (171-72) using Birdsell's (1953) formula for population density, based on rainfall and consequent carrying capacity, and information derived from Warner (1958) and Hiatt (1965) calculates a figure of one person per eight km^2. This figure accords with estimates proposed by Jones (1980:129) and White (1978:45) for inland Arnhem Land. Based on Keen's calculations the Alligator Rivers area may have supported altogether a population of 2000. The average membership of the land owning units (gunmogurrgurr) was about 38 people a figure which agrees well with Warner's estimates for eastern Arnhem Land (Keen 1980:172). The present population represents about three per cent of the original (Keen 1980:171).

However, given the resource richness of the Alligator Rivers wetlands and nearby availability of alternative resources it is possible that the region supported a somewhat higher population density than that estimated by Keen and could be along the lines of that recorded for the Cape Keerweer region. This land was occupied at the rate of one person for every 3.2 km^2 (Lawrence 1968:189). The settlement patterns of the region could be compared with those of the peoples of the Arafura Swamp and Cape Keerweer. Both these groups exploited resources within a small range and remained beside the wetlands during the dry season. They moved to higher ground adjacent to the swamps in the wet season, or onto the beach in the case of the coastal Wik Munkin of Cape Keerweer.

In this chapter the similarities and differences between the peoples exploiting freshwater wetlands has only been examined from a subsistence angle. A more complete examination would require investigation of other cultural features such as ritual, material culture, music and linguistics. In the Alligator Rivers region, settlement patterns may be more fully understood by carrying out an examination of local linguistic boundaries and by the systematic collection of oral testimony about such matters from contemporary survivors of the original groups inhabiting the area.

CHAPTER FOUR

THE ARCHAEOLOGY : A MIRROR OF THE ETHNOGRAPHY?

The South Alligator River wetlands provided food resources capable of supporting large numbers of people. They also lay adjacent to other vegetation communities, which ensured year round subsistence to the people inhabiting the area. Wetlands may have been to the Aborigines of the Alligator Rivers what the coast was to the Anbarra, Lockhart and Nesbitt Rivers peoples. Both zones provided people with abundant supplies of reliable food. People exploiting the wetlands may have been resident there for most of the year.

As discussed in Chapter Two, these resource-rich wetlands have been created only recently. The process began some 6000 years ago culminating in the formation of freshwater conditions a mere 1400 years BP. It seems likely that their appearance had a major effect upon Aboriginal life in the region.

The archaeology of the Alligator Rivers wetlands so far has not received the attention it warrants. Schrire (1967) investigated rock-shelter sites located in outliers on the estuarine plains of the East Alligator River. She was well aware of the importance of the wetlands as a resource zone both from the ethnographic record and from her archaeological data, which included plant species remains and freshwater shellfish (Schrire 1982:58-59, 233-34). However, she did not examine the open sites located on the wetland edges at all.

The importance of these sites has been noted in other regions, e.g. Meehan (1982:30, 41) observed abundant archaeological evidence at wetlands sites still occupied today in the Blyth River area of Arnhem Land. This has not yet been published in detail. Kamminga and Allen (1973:10-15, 108) recorded several open sites on the South Alligator wetlands and recognised the necessity for further investigation of these sites.

This suggestion was not followed up until the ANU expedition of 1981. During that time a detailed survey was made of two stretches of the wetland edge of the South Alligator River; one on the east, consisting of a survey of 15 km of the wetland edge from the Jim Jim Creek to the confluence of Nourlangie Creek, and the other on the west for the same distance, from Leichhardt Billabong to Bulkin, a headland into the river. Altogether thirteen major open sites were found and their locations are shown on Figure 6 . These large sites with dense surface scatters are located

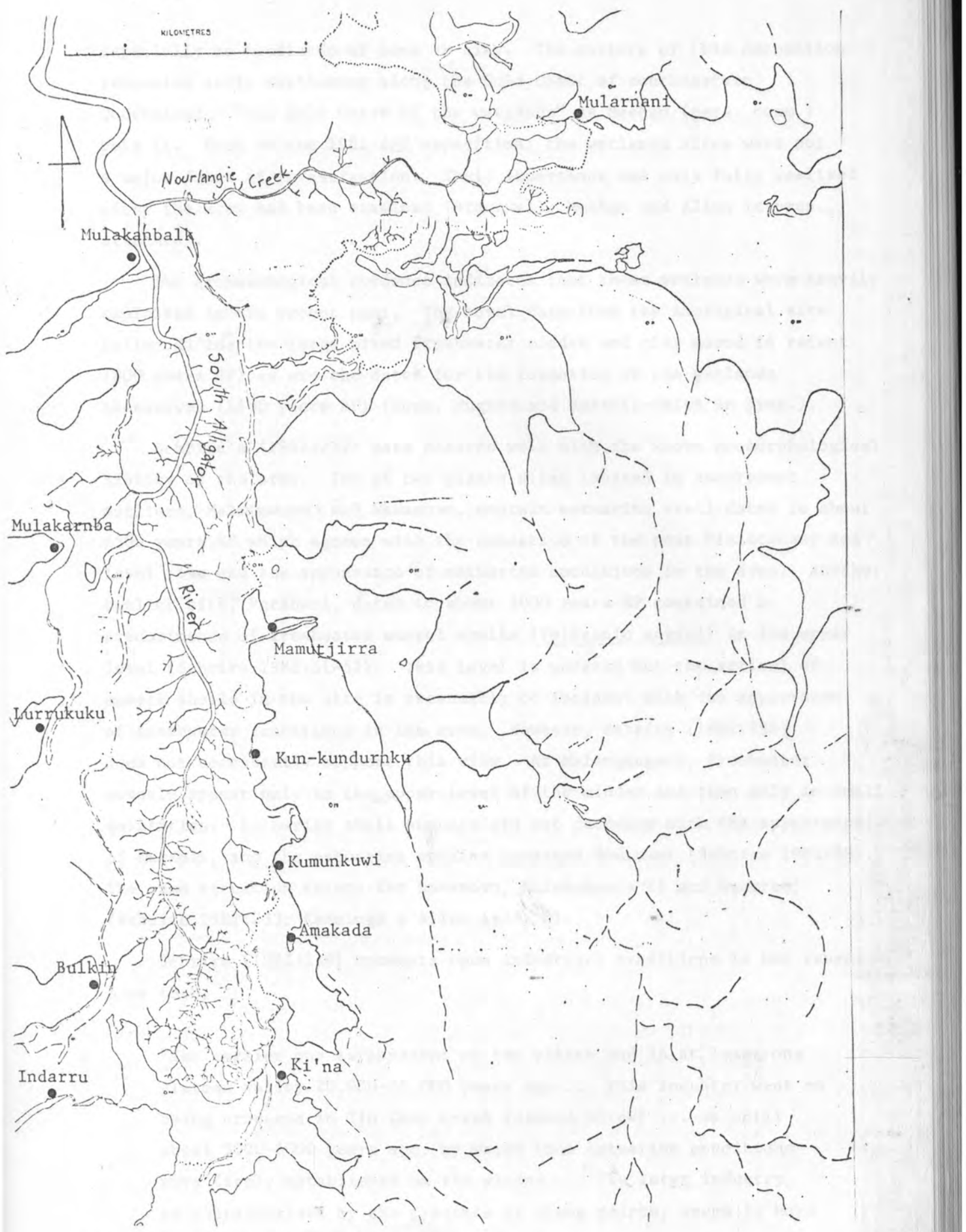


FIGURE 6 Location Map of Wetland sites

especially on headlands of sand or clay. The pattern of this occupation resembles strip settlement along the Gold Coast of southeastern Queensland - "the Gold Coast of the wetlands" as Meehan (pers. comm.) puts it. Even on the 1981 ANU expedition, the wetlands sites were not a major focus of investigation. Their importance was only fully realised after the area had been examined (Brockwell, Meehan and Allen in prep., attached).

The archaeological evidence indicates that these wetlands were heavily exploited in the recent past. The basal date from the Aboriginal site called Ki'ina the large mixed freshwater midden and clay mound is recent (800 years BP) as are the dates for the formation of the wetlands themselves (1400 years BP) (Hope, Hughes and Russell-Smith in prep.).

Schrire's (1982:232) data accords well with the known geomorphological history of the area. Two of her plains sites located in escarpment outliers, Malangangerr and Nawamoyn, contain estuarine shell dated to about 6500 years BP which agrees with the cessation of the post Pleistocene sea level rise and the appearance of estuarine conditions in the area. Another outlier site, Paribari, dated to about 3000 years BP contained a predominance of freshwater mussel shells (Velesunio angasi) in its upper level (Schrire 1982:51-52). This level is undated but the arrival of mussel shells in the site is presumably co-incident with the appearance of freshwater conditions in the area. However, Schrire (1982:234) does not necessarily support this view. At Malangangerr, freshwater mussels appear only in the upper level of the midden and then only in small quantities. Estuarine shell numbers did not decrease with the appearance of mussels, and the estuarine species remained dominant (Schrire 1982:89). The same situation exists for Nawamoyn, Malakunanja II and Ngarradj (Schrire 1982:233; Kamminga & Allen 1973:30).

Schrire (1982:239) comments upon industrial traditions in her research area that,

> "The earlier one is apparent on the plains and in at least one plateau valley 20,000-24,000 years ago ... This industry went on being produced in Tin Camp Creek (Jimeri sites) ... up until about 5000-6000 years ago, by which time estuarine conditions were firmly established on the plains ... The later industry, as characterised by the presence of stone points, seems to have appeared around 4000-5000 years ago."

Owing to insufficient dating of plains middens, their first appearance in her site is less well established than one might like.

The ANU 1981 research programme established the first appearance of flaked points at the escarpment valley site of Nauwalabila (Lindner) between circa 3800 and 6200 BP (Jones & Johnson in prep.). In Schrire's (1982:249) research this late tradition is represented in the outlier rock shelters and consists of shell, wood, bone and stone tools. There are relatively few stone artefacts, but the most distinctive "are points and, to a lesser extent, small rectangular scraper-adzes" (Schrire 1982: 242). These artefacts were made elsewhere as there is a low ratio of secondarily retouched artefacts to waste flakes (Schrire 1982:242). Plant remains preserved at Paribari and shell and bone at all three of Schrire's plains outlier sites indicate that then the Aborigines living there were exploiting both freshwater and estuarine resources (Schrire 1982:233-35).

In contrast, in the plateau valley sites Jimeri I and II, while the stone assemblage is similar to the point/scraper industry in the plains sites, organic remains were not well-preserved and therefore it is impossible to make any detailed statement about the economy. The lack of shell seems to indicate that the people did not regularly exploit the resources of the coastal plains. However, claws of crab suggest occasional forays to the mudflats. (Schrire 1982:189, 226). It appears that stone implements have been made on the spot as the ratio of secondarily retouched artefacts to waste flakes is high and the number of implements present is very much greater than in the plains sites (Schrire 1982:242).

Further excavations in rock shelters of outliers on the plains, and in sites in the plateau region confirm Schrire's findings (Kamminga & Allen 1973:30, 88, 97).

Schrire (1982:251) concludes that the archaeological differences between the plains and the plateau sites are due to seasonal variation of residence, diet and economy, though in her original thesis (1967) she argued that they represented the artefacts of two different peoples. She explains her newer hypothesis in terms of a dry season occupation of the plains and some movement to the plateau during the wet season. However, she (1982: 250) does not regard this general model as inflexible and suggests (1982: 251),

> "... that the plain was more congenial to year-round occupation before the impact of feral animals took its toll on plants and animals. One might well imagine minor retreats to higher ground

at peak Wet, rather than major movements into plateau valleys. In this light the technological variations seen in the prehistoric sites should be regarded as less a mirror of major human transhumance than a reflection of the relative availability of certain resources in relation to particular sites".

Schrire emphasises the major impact that the appearance of estuarine resources had in the area about 6000 BP. She does not discuss the appearance of the freshwater wetlands about 1400 BP, despite her own evidence for freshwater exploitation and the existence of freshwater wetlands, previously estuarine, in the vicinity of her plains sites. Her dating methods do not pinpoint the timing of the appearance of freshwater mussels in the upper sections of her middens which may coincide with the formation of freshwater wetlands themselves.

Further detailed examination of these sites and the archaeology of the wetland sites found during the 1981 ANU expedition may elucidate whether or not the appearance of the major freshwater wetlands also had an impact on the economies of the people occupying the outlier rockshelters.

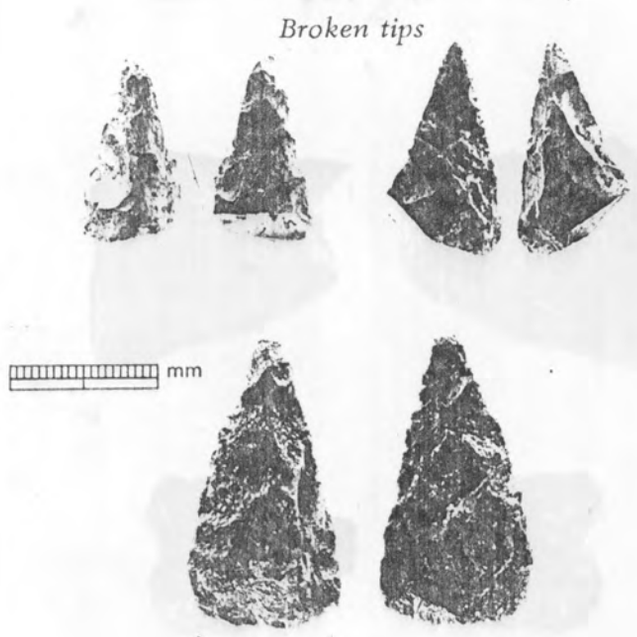
It seems likely, given the biological evidence presented in Chapter Two, that once formed, these freshwater wetlands would have become the major focus for Aboriginal exploitation in the area. In the light of this a more specific pattern of seasonal movement, both in the region and on the river-edge plains themselves can be discerned.

Wetlands seasonal movement

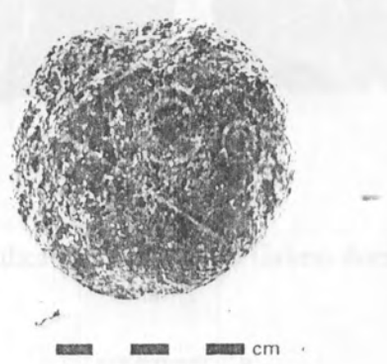
The South Alligator River wetlands may have supported a population on a year round basis, with seasonal movement being confined to a very small area around the wetlands, in a manner similar to that reported for the Cape Keerweer and Arafura Swamp area. A preliminary examination of the stone material from three of the wetlands sites, Ki'ina, Kumunkuwi and Kunkundurnku, surface collected during 1981 indicates stone tools, especially adze slugs, flakes with plant polish, grinding bowls, edge ground axes and spear points (see Figs.7-11), were used and probably manufactured here, although the materials used were exotic. The adze slugs and some flakes are made of fine grained chert, the points from silcretes and the axes and bowls from igneous rock. Kamminga & Allen (1973:11, 16-17) conclude that tools were made in situ for one of the wetlands sites (G.C.-1) they examined, though they assume that occupation of wetlands was limited to the dry season.

It was not necessary for the people to travel fully into the escarpment to collect material for the manufacture of all the stone tools for igneous

Kun-kundurnku: adze slug; dorsal and ventral views



Kun-kundurnku: bifacial points; opposite views.



Kun-kundurnku: pestle

FIGURE 7

Kun-kundurnku: 'silica gloss' polished flakes; dorsal and ventral views

FIGURE 8

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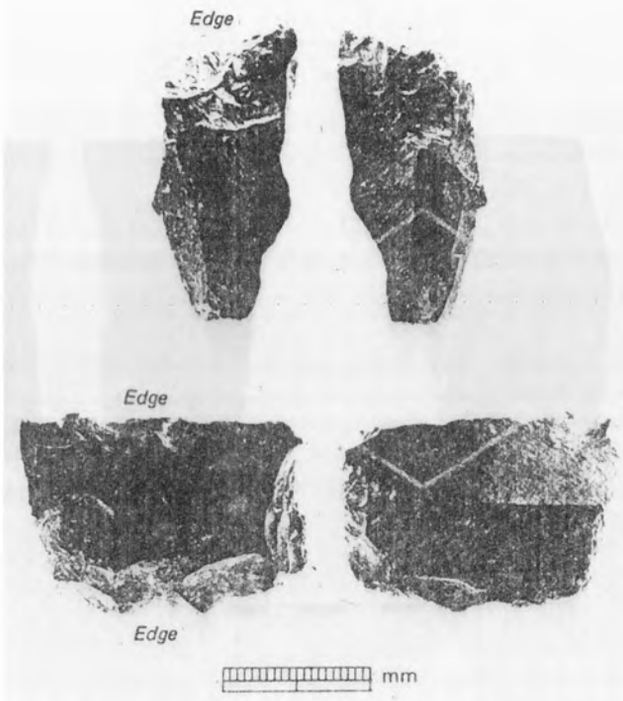
Kumunkuwi: broken point; opposite views



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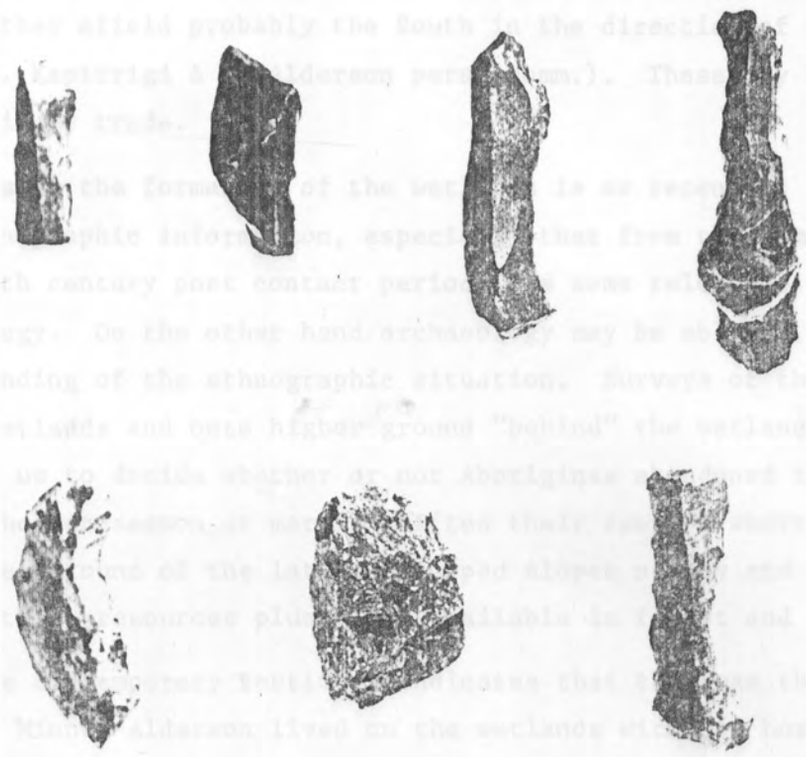
Kumunkuwi: adze slugs; opposite faces

FIGURE 9

Kumunkuwi: Leilira blades; dorsal and ventral views

FIGURE 10



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Ki'na: adze slugs.

FIGURE 11

rock is available from outcrops, nearby; and silcretes could be obtained from certain outlier outcrops. However, the fine ground chert must come from further afield probably the South in the direction of Barramundi Creek (N. Kapirrigi & M. Alderson pers. comm.). These may have been brought in by trade.

Because the formation of the wetlands is so recent it is highly likely that ethnographic information, especially that from the immediate mid nineteenth century post contact period, has some relevance to the archaeology. On the other hand archaeology may be able to enlarge our understanding of the ethnographic situation. Surveys of the sites both on the wetlands and onto higher ground "behind" the wetlands themselves may help us to decide whether or not Aborigines abandoned them totally during the wet season or merely shifted their camps a short distance onto the higher ground of the laterite topped slopes nearby and continued to exploit these resources plus those available in forest and thicket.

Some contemporary testimony indicates that this was the case. For example, Minnie Alderson lived on the wetlands with her husband, the late Yorky Billy and their family during the buffalo shooting days in the middle of this century, and has folk memory extending back to a period prior to the establishment of the Oenpelli Mission in the mid 1920s. During the dry season she says, they used to camp on some of the sites which were surveyed (e.g. Kumunkuwi and Mamutjirra; see Plate 7) in 1981 by the ANU team but that when the rains came they sometimes shifted less than a kilometre onto higher ground adjacent to these sites. This is precisely what Peterson (1973:186; see Fig. 5) found to be the case near Mirringadji on the eastern edge of the Arafura Swamp.

In the South Alligator case these putative wet season sites have still not been properly documented, and this task would be a prime target for proposed future work in the area.

Regional Seasonal Movement

In my model for the pattern of Aboriginal seasonal resources in the Alligator Rivers plains and adjacent valleys and escarpment, the wetlands were the major focus of exploitation. I envisage that the people whose clan territories embraced the wetlands resided there all year round exploiting swamp resources not only at their peak periods of the late wet/early dry season and late dry season but also right through the dry season. They retreated to the adjacent higher ground for the wet season where they exploited resources available in monsoon rainforests and woodland in

PLATE 7 Mamutjirra open archaeological site, South Alligator River (July 1981)

addition to what they could still cull from the wetlands themselves.

Based on ethnographic evidence derived from other areas rich in food resources (e.g. coastal Arnhem Land, Cape York), the territories of the wetlands inhabitants would have been small and their population density high.

On the open woodland plains located between the wetlands and the escarpment Aborigines had access to a limited number of seasonally inundated swamps, as well as terrestrial resources. They may also have joined the wetlands people in order to exploit the abundant resources there, in the peak season but then retreated to their rock shelters in the outliers during the rainy season. Their territories were probably larger and their populations less dense.

The people inhabiting the plateau valleys and the edge of the escarpment perhaps spent the wet season in rock shelters there, after which they too may have moved to the wetlands in the late dry season to join everyone else in large seasonal gatherings, which were probably sanctioned by ceremonial needs similar to those recorded in central and eastern Arnhem Land and Cape York.

One of Chaloupka's informants, Nipper Kapirrigi (pers. comm.; also in Schrire 1982:252) provides evidence for this. He said that the Badmardi clan, resident at the foot of the escarpment in Deaf Adder Gorge, moved down to join the people of the wetlands in the late wet season, at the height of the goose egg harvest. While on the South Alligator River they gathered "bamboo" (Phragmites sp.) for spear shafts. During this time they traded stone spear points which they took with them from their valley quarries. Kapirrigi's father was a skilled stone tool maker, whose quarries were investigated by the ANU team in 1981. Kapirrigi referred to this trade as "bulk", in the Maiali language.

Changes in exploitation over time

It is clear that the appearance initially of estuarine conditions about 6000 years BP and later freshwater conditions about 1400 years BP must have had profound impacts on Aboriginal economies in the area. Baker (1981:32) also believes that the retreat of monsoon rainforest in the region following the wetter and/or warmer climatic period extant between 5000 and 8000 years BP, may have led to a change in exploitation emphasis from these rainforests onto the developing wetlands. These changes need to be investigated archaeologically in the light of the models outlined above.

FUTURE RESEARCH

At this preliminary stage of my research I have formulated some ideas about the significance of the freshwater wetlands to the Aborigines of the Alligator Rivers region of the Northern Territory. However, if answers to some of the questions raised above are to be resolved further research needs to be carried out. For example:

1. A detailed analysis of the archaeological material already collected under controlled circumstances from the South Alligator wetlands sites.

2. A survey to establish the location and context of the postulated wet season sites.

3. The ethnographic model proposed above needs refinement. Wider reading of Australian and overseas literature is necessary, as is further case study testament from elderly people of the region.

The key question is to establish to what extent there is a coherent relationship between the pattern of site and landscape usage derived from archaeological research, and that set up from a consideration of the ethnographic literature and oral testimony.

APPENDIX 1

APPENDIX I Seasonal Exploitation of Wetlands Areas in Northern Australia

+ Species	+Where	+ When	+ Who	+ Reference
Rattus colletti small rat	A.R. black soil plains	Early wet		Jones (I980: II4) Schrire (I982: I3)
Water birds and their eggs				
Ducks, geese and other waterbirds	Princess Charlotte Bay hinterland and Palmer River	Late wet; early-late dry	Gidjingali	Roth (I90I: 207)
Geese and eggs	Blyth River	early dry	Gidjingali	Jones (I980: II5,I24)
Water birds	Arafura Swamp	middle dry onwards		Peterson (I973: I83)
Water birds	Blyth River	middle dry onwards	Gidjingali	Jones (I980: I25)
Water birds	Nesbitt River	middle dry onwards		Chase & Sutton (I98I: I832)

+Species	+Where	+When	+Who	+Reference
Water birds	Alligator Rivers Region	middle dry onwards		McLaughlin (I98I: I832)
Geese	Alligator Rivers Region	dry		McLaughlin (I98I: I832)
Geese		late dry		Spencer (I928: 744-5)
Waterfowl incl. *Anas superciliosa* *Nettapus pulchellus*	Daly River	late dry		Dahl (I926: 8I-83)
Eggs	Cape Keerweer	wet	Wik Munkan	Thomson (I939: 2I7)
Geese	Cape Keerweer		Wik Munkan	Sutton (I978:)
Geese and eggs	Cape Keerweer		Wik Munkan	Chase & Sutton (I98I: I838)
Goose eggs	Alligator Rivers Region	late wet		Paddy Cahill (Letters to Spencer 20.3.I4; 20.3.I6)
Pelicans, Ducks	East Alligator River			Warburton (I944: I34)
Waterbirds	South & East Alligator Rivers			Leichhardt (I847: 49I, 493)
Geese and eggs	Arafura Swamp			Thomson (I949: 32-33)
Geese	Lockhart River			Harris (I977: 433)

Reptiles

+Species	+Where	+When	+Who	+Reference
Snakes.				
Snakes	Kakadu	mid dry		Spencer (I928: 787)
Achrochordus javanicus file snake	Arafura Swamp	late dry		Peterson (I973: I83)
Hypsirhina and Liasis olivaceus	Oenpelli	late dry		McArthur (I960: II3)
Achrochordus javanicus file snake	Alligator Rivers Region			Thomson (I949: 49)
Achrochordus javanicus file snake	Alligator Rivers Region			McLaughlin (I982: 9-I0)
Amphiesna mairii freshwater snake				
Liasis fusca water python				
Hypsirhina sp	Arnhem Land			Thomson (I949a: I9; I948-9: table opposite p 28, 4I)
McLeay's water snake				
Liasis olivaceus water python				

+Species	+Where	+When	+Who	+Reference
Crocodiles				
a Crocodylus sp	Cape York			Roth (I90I: 24)
"	Blyth River			Meehan (in preparation)
"	Arnhem Land			Thomson (I949: 4I)
Crocodylus porosus	Alligator Rivers Region			McLaughlin (I982: 9)
Goannas				
goanna	Blyth River black soil plains	mid dry	Anbarra	Jones (I980 : I24) Meehan (I982: I47)
goanna	Arnhem Land			Thomson (I949a: I8; I948-9: 39)
goanna	Cape Keerweer		Wik Munkan	Chase & Sutton (I98I: I838)
Varanus mitchelli land goanna	Alligator Rivers Region			Mclaughlin (I982 : 7)
Varanus mortensi water goanna				

Reptiles continued

+Species	+Where	+When	+Who	+Reference
Tortoises				
Chelodina sp fresh water turtle	Arnhem Land	late dry		Thomson (I949a: I9; I948-9: table p28)
Chelodina sp ? swamp turtle	Archer River		Wik Munkan	McConnel
swamp tortoise	Cape Keerweer		Wik Munkan	Chase & Sutton (I98I: I838)
Chelodina sp	Blyth River	early dry	Gidjingali	Meehan (I975: 62; I982: 35) Jones (I980 : II4)
Chelodina sp	Blyth River		Anbarra	Meehan (I982: I47)
Long necked turtle	Arafura Swamp	end of wet		Peterson (I973: I83)
Long necked turtle	Alligator Rivers Region			McArthur (I960: II3)
Chelodina rugosa				McLaughlin (I982: 9)
Elseya dentata				
Emydura victoria				
Carettlochelys insculpts				

Appendix I continued

Fish species

+Species	+Where	+When	+Who	+Reference
Neosiluris sp eel-tailed catfish	Blyth River Alligator Rivers Region	early dry	Anbarra	Jones (I980 : II4) McLaughlin (I982: II-I2)
Tachysuridae (incl Neoarius australis) "mullet" excluding Neoarius australis	Blyth River Alligator Rivers Region	early dry	Anbarra	Jones (I980 : II4) Mclaughlin (I982: II-I2)
Megalops cyprinoides herring	Blyth River Alligator Rivers Region	early dry	Anbarra	Jones (I980 : II4) McLaughlin (I982: II-I2)
Toxotes jaculator archer fish	Blyth River Alligator Rivers Region	early dry	Anbarra	Jones (I980 : II4) McLaughlin (I982: II-I2)
Scleropages leichhardti saratoga	Arafura Swamp Alligator Rivers Region	early dry		Peterson (I973: I82) McLaughlin (I982:II-I2)
Neoarius australis	Arafura Swamp	early dry		Peterson (I973: I82)

+Species	+Where	+When	+Who	+Reference
Fish sp	Cape Keerweer	early dry	Wik Munkan	Thomson (I939: 220)
Fish sp	Eastern Cape York	early dry		Roth (I90I: 23)
	Alligator Rivers Region			McLaughlin (I982: II-I2)
Lates calcarifer barramundi	Blyth River	early dry	Anbarra	Jones (I980 : II4)
	Alligator Rivers Region			McLaughlin (I982: II-I2)
Fish sp	Alligator Rivers Region	mid dry		Spencer (I928: 774-5)
Fish sp	Blyth River	mid dry	Gidjingali	Jones (I980: I25)
Fish sp	Blyth River ?	mid dry	Gunadpa	Jones (I980: I25)
Freshwater fish sp	Cape Keerweer	mid-late dry	Wik Munkan	Sutton (I978: Fig 2)
Fish sp	Arnhem Land	late dry		Thomson (I949: I9-20)
Fish sp	Nesbitt River region	late dry		Chase & Sutton (I98I: I832)
Megalops cyprinoides	Bulpildja Swamp	late dry	Anbarra	Meehan (in prep)

Appendix 1 continued — Fish continued

+Species	+Where	+When	+Who	+References
Oxyeleotris lineolatus a mud fish	Arafura Swamp	late dry		Peterson (I973: I82)
	Bulpidja Swamp	late dry	Anbarra	Meehan (in prep)
Fish sp	Alligator Rivers Region	late dry		McLaughlin
		Shellfish		
Velesunio ambiguus	Blyth River		Gidjingali	Meehan (I982: 59) Jones (I980 : II5)
Unio	South Alligator River			Leichhardt (I847: 488-9)
Velesunio sp	South Alligator River			Warburton (I944: 65)
Velesunio angasi	South Alligator River			McLaughlin (I982: I3)
		Eggs		
Turtle and crocodile eggs	Western Cape York	early wet	Wik Munkan	Thomson (I939: 2I5); Sutton (I978: 49)
Snake eggs	Arnhem Land	dry		Thomson (I948-9:27)

Appendix I continued

Eggs continued

+Species	+Where	+When	+Who	+Reference
Turtle eggs	Arafura Swamp			Peterson (I973: I83)
Turtle eggs			Wik Munkan	McConnel (I957: 4-5)
Snake, goanna, turtle	Blyth River		Anbarra	Meehan (I982: I47)
Crocodylus johnstoni freshwater crocodile	Alligator Rivers Region			McLaughlin (I982: 9)
Plant Foods				
Nymphaea sp	Cape Keerweer	late wet	Wik Munkan	Sutton (I978: 48)
Cayratia trifolia	Alligator Rivers Region	end of wet to mid dry		Smyth & von Sturmer (I98I: I6)
Triglochina sp	Alligator Rivers Region	end of wet to cols time		Smyth & von Sturmer (I98I: I6)
Nymphaea	Blyth River	early dry	Gidjingali	Jones (I980: II4, I23; and Bowler I980 : I8) Meehan (I975: 62; I982: 35; in prep)
Oryza rufipogon	Blyth River	early dry	Gidjingali	Jones (I980 : II4)

Appendix I continued

Food Plants continued

+Species	+Where	+When	+Who	+References
Eleocharis dulcis	Blyth River	early dry	Gidjingali	Meehan (I982: 35, I56)
Oryza fatua	Oenpelli, Liverpool River	early dry		Specht (I958: 484)
Nymphaea	Arnhem Land	early dry	Yulengor	Chaseling (I957: 44)
Nelumbo nucifera ? Nymphaea sp ?	East Alligator Area	mid dry		Spencer (I928: 774)
Nymphaea sp	Daly River	mid dry		Dahl (I926: 83)
Nymphaea sp	Arnhem Land	dry		Thomson (I949: table p28, 40)
Nymphaea violacea	Arnhem Land	dry		Specht (I958: 489-90, 502)
Nymphaea gigantea	Groote Eylandt	dry		Levitt (I982: 4I, 42)
Nymphaea coerulea	Eastern coast	dry		Roth (I90I: 7, I4)
Nymphaea gigantea	Cape York			
Eleocharis dulcis	Oenpelli	dry		Smyth & von Sturmer (I98I: I8) McLaughlin (I982: I8)

Appendix 1 continued — Food Plants continued

+Species	+Where	+When	+Who	+Reference
Eleocharis dulcis spike rush	Alligator Rivers Region exposed black soil plains & drying swamp beds	late dry		Jones (I980: I24)
Eleocharis spacelata tall spike rush	Alligator Rivers Region exposed black soil plains & drying swamp beds	late dry		Jones (I980: I24)
Eleocharis sp	Alligator Rivers Region	late dry		Leichhardt (I847: 504)
Eleocharis dulcis	Arnhem Land	late dry		Specht (I958: 50I)
Eleocharis sp	Northern Arnhem Land	late dry		Thomson (I949a: 20; I948-9: table opposite p28)
Eleocharis dulcis	Groote Eylandt and Port Bradshaw	late dry		McArthur (I960: I0I, I30)
Eleocharis dulcis	Groote Eylandt	late dry		Levitt (I98I: 40)
Roots of water plants	Arafura Swamp	late dry		Peterson (I973: I8I)

Appendix I continued

Food Plants continued

+Species	+Where	+When	+Who	+Reference
Rushes, probably *Eleo* spp ?	Arafura Swamp	late dry		Peterson (I973: I8I)
Eleocharis spp	Blyth River	late dry	Gidjingali	Meehan (in prep)
Nymphaea macrosperma *Nymphaea violacea* *Nelumbo nucifera*	Kakadu	late dry		Russell-Smith (in prep)
Nymphaea	Cape Keerweer	late dry	Wik Munkan	Thomson (I939: 2I5)
Eleocharis spp	Arnhem Land	late dry	Yulengor	Chaseling (I957: 44)
Eleocharis dulcis	N.E. side of Balpildja Swamp	end of late dry	Anbarra	Meehan (I982: 4)
Vigna vexillata	Oenpelli	wet season		McLaughlin (I982: 27)
Haliocharis sphacetata	Cape Keerweer		Wik Munkan	Sutton (I978: 48)
Nymphaea ? sp	Cape Keerweer		Wik Munkan	McConnel (I957: 5)
Eleocharis spp	Cape Keerweer		Wik Munkan	Thomson (I939: 2I6) Leichhardt (I847: 504)

+Species	+Where	+When	+Who	+Reference
Rushes	Cape Keerweer		Wik Munkan	McConnel (I954: 4)
Eleocharis spacelata	Eastern Cape York			Roth (I90I: I3)
Oryza sativa	Eastern coast of Cape York			Roth (I90I: I4)
Nelumbium speciosum Nymphaea gigantea	Eastern coast of Cape York			Fletcher et al (I948: 4)
Nymphaea	Lockhart River			Harris (I977: 433)
Colocasia sp taro	Lockhart River, Cape York			Harris (I977: 433-4)
Colocasia sp taro	Cape York			Roth (I90I: II, I6)
	Cape Keerweer		Wik Munkan	Thomson (I939: 2I5)
	Nesbitt River			Chase & Sutton: (I98I: I833)
	Groote Eylandt			Levitt (I982: 39, 40)
	Groote Eylandt, Bickerton Island, Hemple Bay			McArthur (I960: I27)
	Groote Eylandt, Yirrkalla, Oenpelli			Specht (I958: 483, 487, 49I, 493)

+Species	+Where	+When	+Who	+References
Nymphaea violacea Nymphaea gigantea Nelumbo nucifera	Groote Eylandt, Bickerton Island, Port Bradshaw, Yirrkalla, Oenpelli			McArthur (I960: 98, I29)
Vigna vexillata wild cowpea	Blyth River		Gidjingali	Jones (I980 : II4)
Cayratia trifolia	Blyth River		Gidjingali	Jones (I980 : II4)
Triglochin procera arrow grass	Blyth River		Gidjingali	Jones (I980: II4)
Tacia leontopetaloides Polynesian arrowroot	Blyth River		Gidjingali	Jones (I980: II4)
Oryza perennis	Alligator Rivers Region			McLaughlin (I982: 27)
Nelumbium	Alligator Rivers Region			Leichhardt (I847: 5I2)
Nelumbo nucifera ?	Alligator Rivers Region			Spencer (I9I4: 394)
Nymphaea sp ?	Oenpelli			
Nelumbo nucifera pink water lily	Oenpelli		Gunwinggu	Berndt & Berndt (I970: 36)
Nymphaea sp blue water lily				
Nymphaea sp blue water lily	Oenpelli		Gunwinggu	McArthur (I960: 98)

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Chapter 7

METHODOLOGY AND RESULTS OF THE WETLANDS FIELDWORK

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FIELDWORK STRATEGY - DEFINING THE PROBLEMS

When fieldwork began, the sites bordering the wetlands of the South Alligator River were little known archaeologically. In 1973, Kamminga had reported briefly on nine open sites on the eastern bank of the river, most of which were shown to him by the Aboriginal traditional owner Toby Gangali (Kamminga and Allen 1973:10-13). In 1979, he again visited some of these in the company of Dave Lindner and they noted in many places an advanced state of deterioration of their surfaces due to intense trampling by buffaloes followed by erosion. This state of affairs resulting in extensive exposure and disturbance of large numbers of stone artefacts was reported by them to the ANPWS authorities. Consequenty, Danny Gillespie especially asked our Consultancy to inspect these sites, to comment on their nature, the degree of erosion present, and to suggest means of site management. Brief exploratory visits to the wetland edges were made during an early stage of fieldwork, by several expedition members under the guidance of Dave Lindner and these enabled a general assessment to be made of the archaeological potential of the area, and a strategy for their investigation. Although the sites visited were large and artefact scatters were in places almost continuous along the fringes of important wetlands, several pertinent observations were made.

1. Sites usually occurred on headlands of dry land which jutted out into an adjacent swamp, and which were a metre or two higher than the surrounding swamplands. They usually consisted of silts and fine sands derived from the adjacent laterised higher ground and mixed with fluvial sediments from former courses such as levees of the river. They thus afforded a dry and well drained location for a base camp strategically placed close to surrounding swamps with their rich food resources.

2. Only at one site Ki'na did there appear to be a significant build up of archaeologically derived deposit, consisting of fresh water midden shells in a clay-loam matrix, which gave immediate prospect for excavation. This does not mean that there are no sub-surface remains at other sites investigated but rather that most archaeological remains may be close or even on the surface, and that systematic surface collection

may be the appropriate initial study to be done at these sites.

3. It seems likely that these sites formed suitable swamp-side locations at different times of the dry season. As the dry season progresss and water in the swamps retreat to the central deepest parts or closer to the main river, then sites initially close to swamp land would become increasingly distant from it. Conversely, sites initially covered by water become exposed as suitable camping spots late in the season. The timing of these events are different in various locations due to details of the local topography. By studying these it is possible to hypothesise that certain sites would have been occupied in succession throughout the dry season, or alternatively if there was simultaneous occupation, then different activities might have been carried out on them.

4. A cursory examination of the stone tools on their surface showed differences between sites in terms of artefact density, raw materials and artefact types. Since stone tools are the major archaeological component of these sites, it was considered that an examination of the variation in assemblages would be the most effective way to test the hypotheses outlined above. Locational analyses of the sites in the landscape settings are also extremely important.

5. During discussions with David Lindner, it emerged that as with other areas of the Park, contemporary Aborigines have a good knowledge of the entire wetlands region, including the specific sites we were examining. It was imperative to incorporate some of this knowledge into the research programme. In particular, information was sought on the season each site was occupied and the main foods eaten. In the case of old people, memories of direct experiences related back to the 20's and 30's of this century, when the sites were occupied by Aboriginal people engaged in or related to buffalo hunting with European Australian teams. Nevertheless, parts of these patterns of behaviour may reflect those of pre-European times.

6. As a final consideration, all of the sites visited were degraded to

some extent, some of them extremely so. The sites are inundated annually, and then exposed to the full heat of the Dry. In addition to these climatic factors, their surfaces have been grazed and eroded by intensive buffalo use. In some cases there were numerous buffalo wallows up to half a metre deep, and in others large artefacts such as grinding dishes had been trampled on and cracked. Heat cracks especially associated with these wallows were deep. Trampling over these fissured sites only added to the disturbance, so that restraint was called for in our own surveying and other investigative activities.

These initial visits to the wetlands established limitations as to the work that might be carried out there. We decided to concentrate our initial operation along a 16 km section of the eastern edge of the South Alligator wetlands between Red Lily Lagoon on the south and Chirracarwoo Lagoon in the north. Six major sites were investigated in some detail. The most northerly, Mularnani is situated north of the confluence of Nourlangie Creek with the main South Alligator River, but the other five Mamutjirra, Kun-Kundurnku, Kumunkuwi, Amakada and Ki'na are to the south (Fig. ??). The research had two main objectives - firstly to describe the locations and contents of these sites recognised in the initial survey and secondly to gather Aborginal testimony concerning their occupation and the economic strategies undertaken at each one. It was considered that this ethnographic information could be used as an independant check on the results of the archaeological research and in particular to test the functional ascription of stone tools from these sites. It would also serve as a source of relevant information, not readily available directly from the archaeological material.

SITE MAPPING

With the exception of Mamutjirra and Amakada which were surveyed using air photographs only, the other sites were surveyed using compass, tapes, dumpy level and stadia poles. Ground plans and elevations were drawn from these data (see detailed site descriptions below). While the water-side margins of sites were discrete in terms of artefact distribution and thus easily determined, the landward boundaries were

often more difficult to define, especially in the case of Mamutjirra and Ki'na where the northern boundary is particularly arbitrary. In other instances such as Kun-Kundurnku and Amakada, the landward boundary is much more definite. For the ground-surveyed sites, distances and elevations were measured along a central traverse with two or more traverses made at right angles to the first, depending on the particular configuration and size of the site.

ARTEFACT SAMPLING

Because the surface of all these wetland sites were disturbed and heavily eroded, it was difficult to devise a suitable sampling strategy. However there was a need to give some quantitative description of the artefacts themselves, their relative proportions, their density, and their distribution on the surface of each site. Three sampling procedures were adopted.

(a) Transect sampling

Along the transect lines set out to map each site, the total surface material including artefacts, faunal material and manuports was collected from one metre squares spaced at intervals of 10 metres from each other, their locations being shown on the relevant site plans. This procedure provided samples along each major axis of the site, thus giving information as to variation in density of surface material on its surface. When such intra-site variability in concentration indices had been established it was hoped that comparisons in density could then be made between sites. Also, of course, some assessment could be made as to within-site patterning of various elements of the total archaeological record; for example were there areas with higher concentrations of various elements such as flaked tools as opposed to others with baked-clay nodules or waste lumps of quartz, etc.

(b) Area sampling

On each site at least one square area with sides 5 metres long was

laid out and subdivided into 25 x 1 metre squares. A total collection of all surface archaeological material was made within this area, each metre square being collected and bagged separately. At Kumunkuwi and Ki'na, each metre square was also photographed vertically before collection so as to provide extra information on the configuration of the surface archaeological elements. These photographs are archived in the Kakadu collection (Department of Prehistory, Research School of Pacific Studies, Australian National University). The location of the 25 square metre collection area(s) was arbitrarily determined after an initial survey, so as to provide as large and varied a sample as possible. Clearly they were placed to record what were probably important 'activity areas' on the sites. At Ki'na and Kun-kundurnku, squares were located on high areas where the surface of the sites were least disturbed. At Kumunkuwi however, we decided to locate it a heavily eroded area where recent deflation of the surface due to buffalo damage had removed up to 80 cm of the deposit, leaving a large number of artefacts exposed. The fresh edges of the flakes showed that this erosion was very recent and that the artefacts had not been moved far from their original position.

These 25 square metre samples were designed to provide an adequate sized controlled collection to allow some meaningful description of the artefactual assemblage at each site, including analysis of the parameters of various tool types. These 'area' samples need to be considered in conjunction with the traverses for a reasonable characterisation of the artefact assemblage variation over the entire site. Our sampling strategy was designed in order to gain 'first order' information as to the nature of the tool types used, their relative proportions and artefact and other concentration indices for each site. As such we have been parsimonious in removing material for analysis, both in order to leave the vast majority of material in position for future more intensive work, and also so as not to over-burden our own capacity to analyse the samples obtained. Even so, with these limited objectives, the sites were so rich that over ??? kg of material was obtained numbering more than ??? pieces.

NON-STRUCTURED COLLECTION

Some artefact items were so rare on a site that our limited sampling areas either missed them altogether or only obtained a few examples, not sufficient to allow an adequate description of the type. This was particularly true of grinding stones, which on these sites consisted usually of fragmentary pieces. On some sites, such as Mularnani, Kumunkuwi and Ki'na, there were small caches of such objects, which had been collected and hidden behind a tree by one of the Aboriginal Park officials as a temporary protection aganst fossicking tourists. These caches were removed for our collection, their original position noted and the Park authorities informed, full details being recorded in the relevant field notes. On the other sites, the location of objects collected was not recorded. Although this might make it slightly more difficult to carry out future systematic surveys at these sites, since part of the total 'universe' of objects has been removed, our procedure was considered justified in that only a tiny proportion of relevant pieces were collected, the sites have been subject to a persistent though unknown degre of casual fossicking by souvenir collectors since at least the late 1950's; and during the past decade or so have been subject in places to significant damage due to buffalo treadage.

In view of these uncertain agents of alteration of the components of the archaeological sites, it was deemed proper at this stage to make collections comprehensive enough to allow an adequate description of the assemblages for this 'first order' description of these sites.

EXCAVATION

As stated previously, Ki'na was the only site which was obviously suitable for excavation. Here part of the site consisted of a low but extensive mound and goanna holes revealed a stratigraphy of fresh-water mussel shell in a friable dark brown soil matrix. A test excavation measuring only 1 x 0.5 metres in area was carried out, revealing a depth of 0.7 metres for this mound. Both excavation and laboratory processing followed the standard methods described elsewhere in this report (section 4:11). The aims of the excavation were to examine the importance of

fresh-water shell fish in this site, since shell was virtually or totally absent on the surfaces of the other wetland sites; to determine the depth and absolute chronology of the deposit, especially the date of initial occupation of the site; to see whether or not there were any changes in shell fish species in the sequence which might give information to the palaeo-environments of the neighbouring wetland swamps. This work was closely related to the geomorphological and palaeo-botanical investigations of the adjacent swamp by Hughes and Hope (section ?????).

EXPLORATORY SURVEY OF THE WEST BANK OF THE SOUTH ALLIGATOR RIVER

In late September, a further week was spent carrying out a brief exploration of the sites on the west bank of the South Alligator River. This was carried out under the guidance of Dave Lindner and in the company of some traditional owners and other Aborigines with detailed knowledge of the wetlands, including Butcher Night, Minnie Alderson, George Namingum, Nipper Kabirriki, Judy Alderson and Topsy Mungkiwa. Gaffey and Brockwell vsited several sites located along a 25 kilometre section on the western side of the South Alligator River between the South Alligator River on the old Darwin road and the South Alligator Motor Inn on the Arnhem Highway.

After the initial location of the sites they returned to them over several days for a more detailed examination. The sites investigated were, from north to south, Malakanbalk, Malakarnba, Lurrukuku, Bulkin, Indarru and Biliringba.

Due to the lack of time only simple survey methods were employed. These were basically the same for each site; the site was located on the relevant Australia 1:100,000 Topographic Survey Map; the approximate dimensions of the site were calculated either by pacing it out or driving along it and checking the distance on the odometer; the site was roughy mapped; any outstanding features (e.g. middens, hearths) were noted; ranges of raw materials and tool types were recorded and the site and any notable features were photographed. The site reports are contained in the next chapter.

As on the eastern side of the river, site boundaries are well-defined on the waterside margin and less well so on the landward side where artefact scatter tends to become sparser gradually. Random small surface collections of artefacts were taken on those sites where buffalo damage and salt water intrusion were particularly severe and had caused extensive erosion and loss of material from the site.

The survey revealed that the sites on the western bank are worthy of

far more detailed investigation particularly if they are to be compared with those studied more fully on the eastern bank.

ETHNOGRAPHY

Although the major thrust of the Kakadu Project was archaeological it was envisaged from the outset that ethnographic information, particularly that elicited from Aborigines, would provide a small but integral part of it. A number of Aborigines residing in the Park own the land on which many of the wetland sites are located. Some of these people possess considerable knowledge about the ecology of the region and while this knowledge is small compared with that retained by people living in the old Arnhem Land reserve, nevertheless it has the potential to add a useful dimension to archaeological investigations of the area.

While it is clear that many Aborigines from the Alligator Rivers region retain considerable knowledge about the use of the wetlands it is important to understand fully the status of that information in terms of its relevance to the archaeological interpretation of the wetland sites. None of the people now living have ever occupied the wetland sites as they were prior to the arrival of Europeans and buffaloes - some 150 years ago. So the economic regimes that they describe may be different from those followed by the original inhabitants. It is well documented (O. Gillespie pers. comm., Ken 1980 for example) that the combination of white man and buffaloes (plus a number of other less-well documented factors) has wrought great economic and social change in the region. This is not to say that contemporary Aboriginal testimony about the significance of the wetland sites is irrelevant to the prehistory of the region, simply that until the intricate process of cultural and social change are unravelled in a systematic manner, its relevance cannot be properly evaluated. Information collected in haste may provide fragile data about a series of unrelated facts on the use of a particular plant or a stone tool, but in the long run this approach may turn out to have significant methodological limitations.

The Alderson family are the traditional owners of much of the

wetlands and it is from them that the bulk of the ethnographic information was obtained. Mrs Minnie Alderson and her daughter Violet, now a Ranger in the Park, were of great assistance in this respect, though other members of her family such as Mick and Nellie Alderson were also most co-operative.

THE EASTERN SURVEY

Information was sought from the Aboriginal owners of the wetland sites that was thought to be relevant to the archaeological reserch being carried out there: names of sites, names of site owners, seasons of the year when sites were occupied, foods eaten at each site, the location of stone quarries...and so on. It was hoped that this information could be used to test the validity of at least some of the conclusions arrived at from the wetlands archaeology. It was also possible that the ethnographic enquiries might provide additional information - for example, about the ceremonial uses of the sites, which might not be reflected in the archaeological material.

Violet Alderson supplied information for us while she was a member of the archaeological team at Ki'na and Kumunkuwi. As well, special expeditions were organised to visit the wetland sites with Minnie, Violet and other members of the family so that information could be gathered in a more straightforward manner away from the constraints of an archaeological excavation. During these sessions, information was recorded in note form and on tape. Activities and food items were photographed in black and white and colour and botanical specimens were collected for identification and to be added to the reference collection housed in the laboratory at Nourlangie.

Ethnograhic enquiries were carried out at one time or another by almost every member of the team. Those particularly involved in the eastern survey were Betty Meehan, Cathy O'Sullivan and Jeremy Russell-Smith.

Preliminary information derived from these efforts has been

incorporated into the description of the sites in the next chapter. The small amount of time allocated to this work, and the difficulty of carrying it out in the context of a primarily archaeological project, have rendered the results tentative. While they are interesting, they must be regarded as the merest indication of what might be achieved under different circumstances.

Further ethnographic enquiry has the potential to add an exciting dimension to this project but it would be unwise to carry out those enquiries at the same time as the archaeology. The field methodology used for archaeology and ethnography are different. On the one hand, excavations tend to require a large number of people working physically hard and tied to a tight schedule with little time left to devote to contemplative pursuits. By contrast, good ethnography is best carried out with a minimum number of researchers (two at the most) and ample time to record and then re-check information. To carry out ecologically-oriented ethnography, that type which is likely to be of considerable relevance to archaeology, researchers must be able to spend a prolonged time in the field with the Aborigines who know the country well so that they themselves are able to observe the changing faces of the landscape at first hand.

SITE NAME: AMAKADA, "DISGRACEFUL SITE", "DESTRUCTION SITE"

This site was shown to us by Dave Lindner (1) who calls it "The Disgraceful Site" and "The Destruction Site". The Aboriginal name, Amakada, was given to us by Minnie Alderson (2).

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map; 337 803 Cahill Sheet (5472)
Air photo: Alligator Rivers NT 6337 Run 23 No. 5252 8/7/75
Colour 1:12,500. Available A,N,P,W,S.

This site lies beside a swamp on the eastern side of the South Alligator River. It occupies an entire long, narrow peninsula which juts into the wetlands. The peninsula is only slightly higher than the swamp floor.

VEGETATION (3):

At the time we carried out our archaeological survey (July 1982) Eleocharis dulcis (3) was flourishing in the swamp. Huge numbers of geese were feeding on it. Some Livistona benthamii were growing on the site. Many more were dead but their trunks were still standing. This plus the heaving buffalo treadage and consequent erosion gave the site a look of devastation, which had prompted Dave Lindner to call it "The Disgraceful Site". (A huge amount of buffalo dung has accumulated on this peninsula. This indicates to some extent the heavy and repeated use it gets from the buffalo population). His view is that excessive buffalo use of the area has facilitated saltwater intrusion and that this in turn has killed vegetation and exacerbated erosion processes.

It is possible that the swamp vegetation was once dominated by Hymenachne sedge but that the grazing upon this by buffaloes has resulted in the increase of Eleocharis dulcis. Hymenachne swamps apparently harbour larger populations of freshwater turtles than do those dominated by Eleocharis dulcis. Thus this particular part of the wetlands may have changed from being a producer of turtles to one in which Eleocharis dulcis, also a fine food, flourishes and upon which geese feed.

DESCRIPTION:

The site is about 300m long and 150m wide. On the main part of the site visibility (28) of artefacts is between 95% and 100%. There is a medium density (4) of artefacts scattered all over it. This site was not mapped, nor were any transects carried out here. However, at the northern end of the site, where the surface appeared to be less disturbed by buffalo movement (Fig. ?), one 5m# was laid out and all artefacts embraced by this were collected; each square was bagged separately.

ETHNOGRAPHIC INFORMATION:

Minnie Alderson and her daughter Violet Alderson (5) talked about this site to us. They said that Amakada belongs to the Murumburr estate and the Dhuwa moiety.

Both women said that "old people" used to camp in this vicinity, that is on the northern shore of the billabong (Fig. ?). Violet called

that spot Kinna.

Amakada itself was occupied at the end of the dry season, in November and December. People gathered fresh water turtles from here.

PRESENT CONDITION:

Although only a few buffalo remain in the area they are still causing a lot of damage. The entire site has a ravaged look about it.

JOURNAL REFERENCES:
22 July.

VISUAL RECORDS:

SITE WORKERS:

Violet Alderson, Jim Allen, Sally Brockwell, Prue Gaffey, Betty Meehan, Lesli Sykes, Paul Tacon.

SITE NAME: BILIKINGBA, ALLIGATOR BILLABONG, NUMBER TWO RED LILY BILLABONG

This site was first shown to Prue Gaffey and Sally Brockwell by Dave Lindner on their trip up the western side of the South Alligator River in September. The Aboriginal name, Biliringba, was given to us by Butcher Night (6), Nipper Kabirriki (7) and George Mingum (8).

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map; 213 753 Kapalga Sheet (5372)
Air photo: Alligator River CAG 307 Run 8 No. 91 17/5/69 black and white 1:25,000. Available A,N,P,W,S.

This site is located on the western side of the South Alligator River. It lies on the eastern side of a deep freshwater billabong known also as Alligator Billabong or Number Two Red Lily Billabong.

VEGETATION (3):

The edges of the billabong were intact and covered with green grass at the time of observation. The area we examined was on a bank above the billabong about 2m from the water's edge. Here the ground was sparsely covered in dead grass and leaf litter.

The billabong is surrounded by paperbarks e.g. Melaleuca leucadendron, Melaleuca cajaputi and other species - Tristania lactiflua, Eucalyptus tetrodonta, Eucalyptus polycarpa and Barringtonia acutangula.

DESCRIPTION:

This site was not examined in detail so I am not able to estimate its size. Dave Lindner informed me that there is a sparse scatter of artefacts all the way around the billabong which is approximately 5km long and 0.5km wide.

There is an old trapping yard for buffaloes beside the billabong.

VISIBILITY (28):

In the dead grass patches and among the leaf litter visibility is about 75% to 80% with a low artefact density (4). In the exposed areas visibility is 95% to 100%. Here also there is a low artefact density.

In the area we examined we found a few silcrete flakes.

Features

Midden:

About 50m north of the old trapping yard on the bank above the billabong there is a midden about 1m in diameter eroding from beneath the roots of a tree.

The midden contains fresh water mussels (Alathyia sp. or Velesunio sp.) (15) and gastropods (Vivipara sp.) (15)

ETHNOGRAPHIC INFORMATION:

Nipper Kabirriki identified the freshwater mussels as kurruk and the gastropods as korramduberrk. Minnie Alderson (2) calls the gastropod, duberrk. She said some people eat them but she does not like them.

Butcher Night told us that biliringba used to be a buffalo camp. Bill Ross, a white buffalo hunter, whom Butcher Night used to work for, built the trapping yard after World War II. So this site was still being used as a camp at that time.

OTHER INFORMATION:

Dave Lindner (1) told us that this site is also known as Number Two Red Lily Billabong.

PRESENT CONDITION:

The edges of the billabong are intact and there is no sign of buffalo damage in the area we inspected.

JOURNAL REFERENCES:

Brockwell, 1981. Kakadu Field Journal, Book 1: 13 September.

VISUAL RECORDS:

Colour slides

SITE WORKERS:

Sally Brockwell, Prue Gaffey, Nipper Kabirriki, Ross Kaires, Robert Levitus, Dave Lindner, George Mingum, Topsy Mungkiwa, Butcher Night, Jeremy Russell-Smith.

SITE NAME: BULKIN, MANGKUNUWIRRKU

This site was first shown to Prue Gaffey and Sally Brockwell by Dave

Lindner (1) in September, when they travelled up the western side of the South Alligator River. Later in September they returned to the site to examine it in more detail. Butcher Night (6) calls this site Bulkin. Minnie Alderson (2) calls it Mangkunuwirrku.

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map; 505 796 Cahill Street (5472)
Colour 1:12,500 Available $A_1N_1P_2W_1S$.

This site is located on the western bank of the South Alligator River. It lies on a headland beside a billabong, once freshwater. However, recently there has been saltwater intrusion and a consequent dieback of freshwater species of trees and extensive erosion. This erosion has exposed the site.

VEGETATION (5):

Stands of Cathormion unbellatum border the site and mangroves (Sonneratia casseolaris) populate the billabong edges. The southern and western sides of the site are lightly covered with dead grass.

DESCRIPTION

This is an open site about 500m long and about 100m at its widest point.

Visibility (28):

The main part of the site is eroded and exposed providing 100% visibility. Artefact density here is medium (4). In the grassy area on the western side of the site visibility is about 80% and artefact density is low.

Stone material observed on the site includes quartz, silcrete, chert, sandstone, dolerite and some granitic material (14). Quartz and silcrete predominate and sandstone occurs in considerable quantities. Some purple ochre was also found. Artefacts noted include flakes, dolerite mortars and axes. No shells were seen.

Features:

On the northern end of the site about 3m from the edge of the billabong there is a series of small, relatively intact, low mounds. These are about 3m in diameter and covered with dead grass at the time of observation. There is about 80% visibility on these mounds. Artefacts are eroding from their surfaces and sides.

ETHNOGRAPHIC INFORMATION:

There was some dispute between Nipper Kabirriki (7) and Butcher Night about the name of the site. Butcher calls it Bulkin and Nipper calls it Kurundju. Nipper said that Bulkin is a site on the eastern side of the river. However, this not Nipper's country. So we have used butcher's name.

According to Minnie Alderson the area around the site was once rich

in food; turtles, water snakes, mussels, yams and waterlilies.

OTHER INFORMATION:

Aborigines have not occupied the site since before 1950. Dave Lindner believes that perhaps in the past it resembled Namutjirra as that site is now except that it would have been richer. That richness might explain the high density of raw materials and artefacts present on the site.

PRESENT CONDITION:

Because of the saltwater intrusion and consequent dieback of freshwater species of plants erosion is extensive and Dave Lindner estimates that the site loses approximately 6cm each wet season.

JOURNAL REFERENCES:

Brockwell 1981. Kakadu Field Journal, Book 1: 15 September, 16 September.

VISUAL RECORDS:

Colour slides

Brockwell 1981: Box 1, 30-35

##########Box 4, 17-18, 28-30

SITE WORKERS:

Sally Brockwell, Prue Gaffey

SITE NAME: INDARRU, NULKURKUR, LEICHHARDT BILLABONG

This site was first shown to Prue Gaffey and Sally Brockwell by Dave Lindner (1) in September, on their trip up the western side of the South Alligator River. Butcher Night (6) calls this site Indarru. Minnie Alderson (2) calls it Nulkurkur.

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map; 294 778 Cahill Sheet (5472)
Air photo: Alligator Rivers N.T. C337 Run 24 No. 5303 8/7/75 Colour 1:12,500. Available from A.N.P.W.S.

This site is located on the western side of the South Alligator River. It lies on the western side of a deep billabong also known as Leichhardt billabong. This is the northernmost fresh water billabong on this side of the river.

VEGETATION (3):

The edge of the billabong is lined by thick clumps of Cathormion umbellatum. The western side of the site is covered with patches of dead grass.

DESCRIPTION: ➡

The site is about 300m long and 65m at its widest point. The edges of the billabong are relatively stable. However, about 5m from the water's edge buffalo damage is severe and this has caused extensive erosion and the exposure of the site.

Visibility (28):

On the main part of the site, which is largely eroded and exposed, visibility is about 99%. A medium density (4) of stone material and artefacts occurs here. On the grassed area on the western side of the site visibility is about 80% exposing a low density of stone material and artefacts.[NP] The stone material on the site includes quartz, silcrete, dolerite, chert, marine chert and glass (14). Artefacts include flakes, points and retouched, flaked glass.

Features

Midden:

A small midden is located at the southern end of the site. This contains freshwater mussels (Velesunio sp. or Alathyia sp.) (15) and gastropods (Vivipara sp.) (15).

Mound:

About 150m from the northern end of the site a small bank or mound exists. The top of it is intact but artefacts and stone material have been exposed in the eroding walls. The flat-topped mound is approximately 20cm high, 2.5m wide and 15m long.

Cache:

At the northern end of the site a small cache of mortars and pestles was found: this contained two broken mortars, one long pestle and one smaller, circular pestle. The cache lay in a grove of trees on the northern end and away from the main part of the site. It seems likely that they were gathered and placed there deliberately by someone, whether Aboriginal or European it is impossible to say.

ETHNOGRAPHIC INFORMATION:

Nipper Kabirriki (7) identified the fresh water mussels and gastropods found in the midden as Kurruk and Korramduberrk repectively. Minnie Alderson called the snails duberrk. She said that some people eat them but that she does not like them.

PRESENT CONDITION:

The severe buffalo damage in places on the site has caused extensive erosion.

JOURNAL REFERENCES:

Brockwell, 1981. Kakadu Field Journal, book 1: 13 September, 15 September.

VISUAL RECORDS:

Colour slides Brockwell, 1981: Film 1, 18-22.

SITE WORKERS:

Sally Brockwell, Prue Gatley, Nipper Kabirriki, Ross Kaires, Robert Levitus, Dave Lindner, George Mingum, Topsy Nungkiwa, Butcher Night, Jeremy Russell-Smith.

SITE NAME: KI'NA, RED LILY LAGOON

This site was first shown to Rhys Jones, by Dave Lindner (1). Subsequently, the site was visited by other team members. Minnie (2) and Violet Alderson (5) call this site Ki'na.

LOCATION: Australia 1:100,000 Topographic Survey Map; 334 780 Cahill Sheet (5472)

Air photo: Alligator Rivers N.T. C337 Run 24 No. 5301 8/7/75 Colour 1:12,500. Available A.N.P.W.S.

Ki'na, the archaeological site, is located on the eastern bank of the South Alligator River. It lies on a peninsula that juts into a freshwater billabong. The billabong is also called Ki'na. A buffalo channel runs in an easterly direction from the main river into the swamp. During the wet season it sometimes lets in saltwater. At the time the site was examined (June-July) the swamp was full of fresh water and associated luxuriant plant growth.

VEGETATION (3):

The swamp itself contains a variety of water plants including Eleocharis dulcis, Eleocharis sphacelata and several Nymphaea sp. bamboo (Bambusa arnhemensis and Bambusa arnhemia) and trees such as Pandanus Spiralus, Cathormion umbellatum and paperbarks (Melaleuca leucadendron and Melaleuca cajaputi grow on its banks and at the water's edge.

Behind the site there are the relics of a former monsoon forest containing such species as Bombax ceiba, Wrightia saligna, Wrightia pubescens, Gettis philippinnensis. Cotton (Gorsypium hirsutum) and scattered eucalypts, Eucalyptus contertiflora, Eucalyptus polycarpa and Syzigium suborbiularis also grow in the open woodland behind the site.

DESCRIPTION

The archaeological material found on the Ki'na peninsula occurs on several discrete mounds as well as being scattered between and around these and for a further 200m north along the fringe of the swamp to an area signposted by A.N.P.W.S. as Red Lily Lagoon. A precise contour map was not drawn at this site because every year it is inundated by water during the wet season and must subsequently change its shape considerably.

Many flakes, broken spearpoints, pieces of shell and some European

objects are scattered over the site.

Surface Collection:

Using dumpy, staff and tapes one north-south traverse measuring 210m and two east-west traverses, measuring 110m and 100m respectively were taken (see Fig. ?). Some spot heights and distance points on the perimeter of the largest (excavated) mound were also taken. Every 10m along each of the three traverse a 1m2 was laid out. Human artefactual material contained in these squares was collected and bagged separately. A spear point was found in one of these squares (?).

A 5m2 was laid out on the eastern slope of the large mound and the material contained in each 1m2 was collected and bagged separately. One spoon-shaped piece and several other fragments of a Melo amphora shell, and a bullet case were found in this area. (A person visiting the site with Dave Lindner during the excavation said that the case belonged to a 1942 bullet and that it had been shot from a damaged gun because the firing mark on the bullet butt was well off centre). A considerable amount of stone artefactual material and other shell, the latter being mainly the remains of fresh water mussels, were also collected in the 5m2.

The remains of another shellfish species, a brackish water bivalve (probably Geloina sp. or Batissa sp.) was collected for identification.

Excavation:

The large mound capped with dark soil contained the remains of shellfish, mostly freshwater mussels, and other artefacts. This extends for a radius of about 8-10m. A 1m2 was laid out on the crown of this mound and excavated. The mound in this area was covered with a thick layer of "mint bush" and contained many burrows made by goannas. A relatively undisturbed surface was chosen for the excavation.

A detailed description of each "context" (4 "buckets" = one "context") is contained in the field sheets. The top 5 to 10cm were very compact giving way to softer grey-black shell midden and then to a more chocolate brown soil. At 70cm red laterite soil containing an increased number of pebbles was reached. After a further 10cm more shell remains and artefacts were found in situ. After that the pit was sterile. Some finds from the lowest "context" were retrieved from goanna burrows which makes their original provenance questionable. However, the charcoal from the bottom "context" came from an undisturbed area and can thus be used for radio carbon dating.

Only the northeast and southeast quadrants of the square were removed, the excavation pit thus ended up measuring 100cm long, 50cm wide and 80cm deep. The stratigraphy visible in the east wall only was drawn as the other sections all resembled it. Soil samples were taken from the drawn section and the hole was back-filled.

The excavation produced moderate quantities of shell, bone and stone tools throughout.

ETHNOGRAPHIC INFORMATION:

The information contained in this section comes mainly from Violet

Alderson or via Violet from other members of her family such as her mother, Minnie and her sister Nellie (10). Ian Morris (9) of the $A_{i}N_{i}P_{i}W_{i}S_{i}$ was also most generous with relevant information which he has collected since he has been employed in Kakadu National Park.

The foods available within the general Ki'na area include plants which grow in the billabong such as the water chestnut an-guleitj (Eleocharis dulcis), lily products (Nymphaea sp.) (18), mogo (pandanus nuts) (17), long necked turtles, file snakes and various species of fish such as barramundi, cat fish, and djulutji ('mud cod').

Though the remains of kurruk, freshwater mussels, (Velesunio sp. and Alathyia sp.) are found in the archaeological deposits excavated at Ki'na,Violet did not mention them as a food source. She said that they were available in the main river channel. The Geloina/Batissa sp. shells, remains of which also occurred on the Ki'na site, could also be procured from the main channel, according to Violet. A small aquatic gastropod called duberrk (Vivipara sp.) by Violet was not a food. Nipper Kabirriki (7) called this mollusc korramduberrk.

Violet said that she and her family used to camp at Ki'na at the end of the dry season - November and December, and that they looked for turtles there.

On one occasion, during a tour of the eastern wetland sites with Violet, her mother and several other members of her family, we inspected the Ki'na billabong and discussed the dam that she and Dave Lindner had constructed to prevent saltwater from flowing into the billabong. She observed that the billabong appeared to be much more productive this year since the dam had been operating.

PRESENT CONDITION:

Some areas of this site are grassless and heavily eroded.

JOURNAL REFERENCES:

Allen, 1981. Kakadu Field Journal, Book 1, 6 July; Book 2: 9 July; in Jones, 1981, Kakadu Field Journal, Book 1: 9 July.

Jones, 1981. Kakadu Field Journal, Book 1: 14 June.

Meehan, 1981. Kakadu Field Journal, Book 1: 26 June, 2 July, 4 July, 6 July; Book 2: 9-10 July, 22 July, 6 August.

VISUAL RECORDS:

Colour slides

. Allen, 1981: (Get from Rhys)

Meehan, 1981: Film 1, 1-7.
##################Film 3, 1-16.

Black and white prints

Allen, 1981: (Get from Rhys)

Meehan, 1981: Film 1, 4-17.

SITE WORKERS:

Violet Alderson, Jim Allen, Margot Ford, Betty Meehan, Cathie O'Sullivan, Ian Whit

SITE NAME: KUMUNKUWI, "HORSESHOE SITE"

This site was shown to Rhys Jones by Dave Lindner (1) and later to Betty Meehan by Violet Alderson (5) in the company of the other Trainee Rangers and Ian Morris (9). It was called "horseshoe Site" by Dave Lindner because he had seen a horse's shoe on the site when he first visited it. Minnie Alderson (2) and her daughter Violet, call the site Kumunkuwi.

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map; 323 615 Cahill Sheet (5472).

Air photo: Alligator Rivers N.T. C337 Run 23 No. 5252 8/7/75 Colour 1:12,500. Available A.N.P.W.S.

The site is situated on a hook-shaped headland that juts into the wetlands on the eastern side of the South Alligator River. It is surrounded on three sides by swamp. Only the eastern boundary leads onto higher ground. It seems likely that this site is inundated during every wet season and this process, plus the effect of buffalo damage, is causing considerable erosion in the area. Several severe erosion gullies were noted on the southern edge of the site and the site viewed on a colour aerial photograph (N.T. C337, 5252) is only marginally visible giving the impression that very soon, it too may be part of the swamp, not of the land.

VEGETATION (3):

When we visited the site (June-July 1981) it still contained water and large quantities of Eleocharis dulcis were flourishing in it. (Because of this, huge numbers of magpie geese and other water birds had converged upon the swamp to feed). Scattered stands of Cathormion umbellatum occur on the eastern side of the site, and about 500m to the southeast a rainforest pocket flourishes, with species such as; Bombax ceiba, Randia conchinchinensis, Gamophyllum falcatum, Wrightia pubescens, Litsca glutinosa, Amorphophallus galbra, Dioscorea transversa, Abrus precatorius and scattered eucalypts; Eucalyptus confertiflora, Eucalyptus polycarpa; and Syzigium suborbicularis, Terminalia carpentariae, Erythrophlocum chlorostachyus.

Grass cover over the site is sparse and patchy. As can be seen by examining the relevant aerial photograph, most of the site today is treeless. It has a barren and exposed appearance, the only deep shade being provided by Cathormion umbellatum trees.

DESCRIPTION:

Kumunkuwi is approximately the same size as Ki'na, Amakada and Kunkundurnku, that is 300m long and 150m wide.

Visibility (26):

On the main part of the site visibility of stone tools, the only archaeological evidence there, was between 95% and 100% at the time of our inspection. No doubt after each wet season, and following more buffalo damage, new stone tools scatters appear and others previously exposed become once again covered with silt. What we are seeing at Kumunkuwi is a regularly disturbed site with very little, if anything, still in situ.

Pounding stones, flakes, stones, flakes, stone points and axes were noted amongst surface scatters. One "Oenpelli" polished flake was seen.

Surface collection:

After an inspection of the site, it was decided to use a sampling procedure similar to that which had been employed at Ki'na. Thus, one north-south traverse covering 150m and three travelling approximately east to west amd covering 190m, 100m and 50m respectively, were surveyed to enable four cross-sections of the site to be drawn (Fig. ?). Every 10m along each of these traverses, a 1m2 was laid out and all artefacts contained in them were collected.

On the eastern side of the peninsula (Fig. ?) in an area where buffalo usage and subsequent erosion has caused the accumulation of a large number of artefacts a 5m2 was laid out and artefactual material contained in each of the 25 squares was collected. In this collection area many tree (Cathormion umbellatum) roots were exceedingly exposed giving the impression that the surface of the site here had been deflated nearly a metre or so. A buffalo track traversing the area indicated the reason for this.

The archaeological material from Kumunkuwi is similar to that found at Ki'na, some 3km away in a direct line, except that only one fragment of freshwater mussel shell was observed at Kumunkuwi. A piece of metal ("horse trappings") may tie the occupation of the site into the historic period, as at Ki'na.

Lumps of quartz are common at Kumunkuwi and all other wetland sites. Most of these are not human artefacts. At first it was thought (by Jim Allen) that these lumps occurred naturally on all the sites. Later this explanation was rejected because: there appears to be no natural depositional mechanism for getting the material onto the promontories where the sites are located; the quartz is obviously coincident with the human artefacts as even a few metres off the sites it disappears; in all places that have been examined such as erosion gullies and buffalo wallows, no sub-surface quartz has been observed. A 1m deep auger hole sunk at Kumunkuwi, designed to get soil samples, produced no quartz below surface level. The quartz may have been carried onto sites for use as oven stones. Several clusters noted at Kumunkuwi support this interpretation.

ETHNOGRAPHIC INFORMATION:

Information about this site was collected from Minnie Alderson and Violet Alderson. They maintain that the site and the surrounding swamp are called Kumunkuwi. The site lies in the Murumburr estate and belongs

to the Dhuwa moiety.

The site was occupied by Aborigines during the dry season (April, May). During the wet season, when the present site is flooded, people camped on the high ground to the east, where the forest meets the open land that runs down to the dry season billabong. At that time they used canoes to gather the eggs of geese and cormorants.

Minnie remembers having camped at the site with some of her children. While there they procured goannas, possums, wallabies (no kangaroos), file snakes, turtles and a variety of plant foods such as yams ("long" yam, Dioscorea transversa; "water" yam (29), Dioscorea bulbifera; "cheeky" yam. Amorphophallus variabulus), lilies (Nymphaea sp.) (18) water chesnuts (Eleocharis dulcis), kun-durn (a dark red plum) and andjurruk-kumarlba (a black plum).

PRESENT CONDITION:

Some buffalo related damage can be seen on the edges of the billabong as well as on various parts of the site. This damage is not as extensive as that observed at sites such as Amakada and Kun-kundurnku. However, because the site is covered with water during the wet season, and because grass cover in the area is sparse, it must lose a considerale amount of top soil each year.

JOURNAL REFERENCES:

Allen, 1981. Kakadu Field Journal, Book 2: 10 July and in Jones, 1981, Kakadu Field Journal, Book 1: 14-15 July.

Jones, 1981. Kakadu Field Journal, Book 1: 14 June.

Meehan, 1981. Kakadu Field Journal, Book 1: 2 July, 4 July; Book 2: 10 July, 14-15 July, 22 July, 8 August.

VISUAL RECORDS:

Colour slides

Allen, 1981: (Get from Rhys)

Meehan, 1981: Film 1, 17-19, 27.
Film 2, 14-18.

Black and white prints

Allen, 1981: (Get from Rhys)

Meehan, 1981: Film 1, 8-25.

SITE WORKERS:

Survey Group: Violet Alderson, Jim Allen, Margot Ford, Betty Meehan, Cathie O'Sullivan, Ian White.

Work Group: Violet Alderson, Jim Allen, Sally Brockwell, Prue Gaffey, Betty Meehan, Lesli Sykes, Paul Tacon.

SITE NAME: KUN-KUNDURNKU, "BUFFALO WALLOW SITE"

This site was shown to us by Dave Lindner (1). He calls it "The buffalo wallow Site" because of two large, dried out, buffalo wallows which occur in the middle of it. Minnie (2) and Violet Alderson (5) call this site and an expanse of country to its north and south, Kun-kundurnku.

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map 5350 629 Cahill Sheet (5472).
close up gap
Air photo: Alligator Rivers N.T. C357 Run 23 No. 5252 8/7/75
Colour 1:12,500. Available A.N.P.W.S.

This site lies on a small headland on the eastern side of the South Alligator River. While buffalo damage has occurred on all sites it is most extensive on this one. Apart from two large wallows, one in the richest part of the site, buffalo movement has caused denudation and deflation over most of the area. The entire site is criss-crossed with large, open cracks.

VEGETATION:

When the site was examined (July 1981) it resembled a small island in a sea of dry grassy plains. To the south an Eleocharis dulcis swamp was still green. It seems likely that form of the site and its immediate environment have altered considerably since the site was last used by Aborigines. To the north/east where the site joins higher land, it is separated from it by a dense stand of paperbarks. This suggests that the site, may always have been in an island situation. In the northern part of the site a group of living Cathormion umbellatum trees have protected the surface from erosion and there may indeed be some archaeological deposit still extant there. A buffalo wallow between these trees and higher ground contains artefacts.

DESCRIPTION:

The site is about 180m long and 60m at its widest point. On the main part of this site, visibility (28) is good, ranging from about 95% to 100%. Of the five sites sampled in the survey on the eastern side of the South Alligator River, this one has the highest artefact density (4). It appears to contain a different range of artefacts, or at least they occur in different proportions, from those observed at the other sites. At Kun-kundurnku large tools such as axes and grinding stones are rare - small tools, points, are more common. Leilira blades are uncommon here but pirris occur in considerable numbers. The only other pirri point in the area was noted by Jim Allen at Red Lily Lagoon north of Ki'na. Among the many flakes found at this site were several with a "silica gloss" on their edges.

Surface collection:

One east-west transect measuring 176m and two north-south ones measuring 56m and 40m respectively were made on the site. These were carried out so that profiles of the site could be drawn. Collections

were not made, as in some other sites every 10m along these transects. However, a small unstructured collection of artefacts considered to be of diagnostic importance was made.

Mound:

One area of the site, approximately 10m2 appears to have escaped the ravages caused by buffalo use and other environmental factors. There, a small mound remains intact. Its surface is free of cracks, and stabilised with grass and laterite pebbles. In this area a 5m2 was laid out and all artefacts within it were collected. It was felt that it might be useful to excavate a test pit in this site at a later date.

ETHNOGRAPHIC INFORMATION:

Kun-kundurnku lies on Murumburr estate and belongs to the Dhuwa moiety.

Mick Alderson (21) (now 33 years old) says that when he was a boy the present day Eleocharis dulcis swamp to the south of the site was a deep billabong.

Minnie Alderson camped at this site with her husband (now deceased), after her children were born. The site was occupied during yeke/ bung-karren or "cold weather time" (April, May) and they camped on the higher ground to the east of the site when the swamp was full of water. Their drinking water came from the billabong.

While camped at Kun-kundurnku, the Aborigines procured "long" yams, "water" yams and water lily products (18). Geese and Eleocharis dulcis were not gathered, it was said. It seems that this was very much a vegetable food camp.

Both Violet and Mick Alderson spoke about the area of swamp lying to the southeast of the site which has the same name. Now, they said, during the wet season, it contains "only grass". In the past, it supported large red lilies and Fragmites. Mangroves, that are now growing in the area, to the north west of the site, are only recent introductions. They probably indicate the presence of saltwater intrusion.

One of the Trainee Rangers who visited this site (?) thougnt that the green-coloured stone that had been used to make some of the axes found on the site, probably came from an outcrop at Barramundi Creek.

PRESENT CONDITION:

The site is severely eroded.

JOURNAL REFERENCES:

Allen, 1981. In Jones, 1981, Kakadu Field Journal, Book 1: 15 July.

Meehan, 1981. Kakadu Field Journal, Book 1: 4 July; book 2: 15 July, 22 July, 6 August.

VISUAL RECORDS:

Colour slides

Allen, 1981: No photos taken here as camera had jammed.
Meehan, 1981: Film 1, 30.

SITE WORKERS: Jim Allen, Sally Brockwell, Prue Gaffey.

SITE NAME: LURRUKUKU

This site was shown to Prue Gaffey and Sally Brockwell by Dave Lindner (1) in September 1981. Later in September they returned to the site and examined it in detail. Only Minnie Alderson (2) offered a name, Lurrukuku, for this site. Butcher Night (6), the owner of this land, could not remember the name.

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map; 290 827 Cahill Sheet (5472) to 298 836 Cahill Sheet (5472)

close up gap

Air photo: Alligator Rivers N.T. C337 Run 23 No. 5252 8/7/75 Colour 1:12,500. Available A.N.P.W.S.

This site lies on the western side of the South Alligator River. It is situated on the peninsula of the river north of Bulkin. One of the river channels marks its eastern border. This channel and its associated swamp areas, once freshwater, have been altered by saltwater intrusion causing dieback of the freshwater plant species in it and considerable erosion.

VEGETATION (3) AND GEOMORPHOLOGY:

The site is fringed on its western side by stands of Cathormion Umbellatum and Pandanus spiralus and on the river side by freshwater mangroves (Barringtonia acutangula). The stump of one dead cabbage palm (Livistona benthamii) stands about 250m from the northernmost point of the site.

At the southern extreme of the site a beach area exists which is composed of grey-yellow sandy soil and gravel, mainly quartz. Whether this gravel is naturally occurring or washed in from elsewhere is unknown. This gravel beach continues to the second headland (Fig. ?). North of there the soil is brown silt though much gravel is still present. Five hundred metres north of the second headland the gravel disappears and the soil becomes black-brown silt. This continues to the northern extremity of the site. The soil behind the treeline is black.

DESCRIPTION:

The site is about 2km long. Because of its size it was examined at six areas which coincided with natural divisions occurring along it. Each area is described separately, beginning in the south.

Area 1:

The first headland (see Fig. ?) marks the southern extreme of the site and the beginning of Area 1. This is a beach composed of grey-

yellow sandy soil and gravel, mainly quartz. Here visibility (2b) is about 99% on the beach decreasing to about 75% where the treeline starts. The artefact density (4) is comparatively low and consists of quartz, silcrete and chert objects (14).

Area 2:

The gravel beach continues along a small bay to the second headland which is Area 2. Here the beach meets open woodland about 20m back from the edge of the swamp. The beach is still grey-yellow sand but it changes to black soil when it reaches the woodland. A stand of Cathormion umbellatum grows here and behind it a grove of Pandanus spiralus. Visibility is about 99% and the density of artefacts is greater than in Area 1.

Raw materials include dolerite, chert, quartz and silcrete. Much of the quartz has an orthoclase component (14). A sample of tools was collected from here.

Area 3:

The area bordering the swamp here consists of brown silty soil and is extensively eroded. This area has suffered considerable buffalo damage. Much gravel is present. Visibility is about 99%. Patches of dead grass lie about 90m from the swamp's edge and extend into the open woodland, which contains isolated groves of Pandanus spiralus. In the woodland visibility is about 80%.

Artefact density is about the same as in Area 2 with a similar range of materials. The density drops considerably in the woodland. Two shells (species unknown) were noted.

Area 4:

The gravel disappears here and the channel bordering the site is filled with water. There is a narrow strip (2-5m wide) of short green grass (probably Sporobolus Virginicus) (16) along the edge of the channel. Visibility here is about 80%. Ten metres west of the channel edge a row of trees (species unknown) occurs. Several of them are dead probably due to saltwater intrusion. This 10m wide strip is composed of black-brown silty soil exposed by erosion with intermittent patches of dead grass. In the exposed areas visibility is 100%. Under the trees and in the grassy patches it is slightly less (i.e. 99%). Behind the dead trees a stand of Cathormion umbellatum was noted. The grassy patches here are less common than they are in the treed areas of Area 3. Buffalo damage here is severe.

Artefact scatter is densest in the eroded and exposed 10m strip and drops considerably in the Sporobolus virginicus border along the channel edge and among the Cathormion umbellatum. Density of stone artefacts is medium to high in the exposed area and the proportion of worked to unworked stone is greater. Stone materials noted include chert, quartz, silcrete, dolerite and sandstone (14). Dolerite mortars were noted.

Feature:

A small eroding midden was observed between the roots of two dead trees (species unknown).

Area 5:

The exposed area here is about 45m wide and consists of the same black-brown silt described in Area 4. Some patches of grass exist where the treeline begins and a strip of Sporobolus virginicus 2m wide marks the edge of the channel. Visibility is about 100% on the exposed area, 80% in the Sporobolus virgincus on the edge of the channel and 99% in the grass patches under the trees.

Again, as in Area 4, artefact density is medium to high on the exposed areas and sparse along the channel edge and among the trees. The trees bordering the area are Cathormion umbellatum. These are backed by groves of Pandanus spiralus.

The range of materials is the same as in Area 4.

Area 6:

The 2m strip of Sporobolus virginicus described in Area 5 continues along the channel edge of Area 6 and to the end of the site. Exposed black-brown silt extends from the channel edge and about 25m inland to an eroded bank and a stand of dead trees (species unknown). Behind these trees the site, now lightly grassed, extends another 25m or so. Visibility is about 99% on the eroded bank where artefacts occur in large numbers. Numbers are fewer on the lightly grassed areas where visibility is about 98%.

The same range of materials appears as described in Areas 4 and 5.

On the third headland, past the last grove of Cathormion umbellatum (see Fig. ?), stone materials and artefacts are scarce.

ETHNOGRAPHIC INFORMATION:

Minnie's daughter, Jessie Alderson (19), now 31 years old, was born here.

Minnie said that Lurrukuku was once a rich swamp containing the same food resources that were once available at Bulkin.

OTHER INFORMATION:

Dave Lindner said that only 10 years ago, poachers were exploiting this area for barramundi, information that indicates how swiftly deterioration has occurred here.

PRESENT CONDITION:

As a result of buffalo damage and saltwater intrusion the site has suffered severe dieback of its freshwater floral inhabitants. It is intensely eroded and projects a picture of utter devastation.

JOURNAL REFERENCES:

Brockwell, 1981. Kakadu Field Journal, Book 1: 13 September, 15 September, 16 September.

VISUAL RECORDS:

Colour slides

Brockwell, 1981: Film 1, 27-29.
Film 3, 17-21.
Film 4, 2-16.

SITE WORKERS:

Sally Brockwell, Prue Gaffey.

SITE NAME: MALAKANBALK

Jeremy Russell-Smith (20) told Sally Brockwell and Prue Gaffey about this site. They visited and examined it in September 1981. The name for this area was obtained from Nipper Kabirriki and George Mingum (6) via Jeremy, who visited the site with him.

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map; 320 914 Cahill Sheet (5472)
Air photo: Alligator Rivers N.T. C324 Run 21 No. 0255. Available A.N.P.W.S.

This site consists of a series of discrete mounds. It is located in a pocket of monsoon rainforest which lies on a headland on the western side of the South Alligator River.

VEGETATION:

The main species of trees and vines which make up the rainforest are listed in Appendix 1.

DESCRIPTION:

The three mounds we examined lie close to two large scrub fowl mounds in the rainforest pocket (Fig. ?) They are littered with artefacts and stone material. It is possible (because of their distinctive smell) that these mounds are old scrub fowl mounds. If so, they must be relatively ancient because they are extremely weathered, have a gently sloping profile and are consistent with the contours of the surrounding area. The artefacts and raw materials lie on the mounds and do not spread beyond their confines. There may be more of these mounds in the area as our survey was not exhaustive.

Mound 1:

The mound is 40m x 32m, roughly circular and about 1 metre high in the middle. It is composed of dark grey silt and contains much gravel (haematite, sandstone and quartz). It is possible that this gravel has been kicked up by the scrub fowls as no gravel occurs in the surrounding environment.

The mound itself is exposed but is surrounded by trees. Visibility (28) is about 99% on its surface and a medium density (4) of artefacts,

omposed of a variety of raw materials including silcrete, chert, olerite, quartz, quartzite and granitic pegmatite can be seen (14). The rtefacts include mortars, points, adzes, one flake with "silica gloss" dges and a piece of broken axe or pestle.

ound 2:

This mound is similar to Mound 1 except that it is smaller (20m x 5m x 0.5m). It is also roughly circular in shape. The soil is light rey and sandy and contains some haematitic and quartz rubble.

The mound too is exposed and surrounded by trees. Visibility is bout 98% and the artefact range is similar to that observed on Mound 1. aw materials noted include sandstone, chert, quartz and silcrete. (14) large mortar and pestle were found together under one of the trees on he edge of the mound.

ound 3:

This mound is about 10m x 40m x 0.5m. It is composed of dark grey ilt. The artefacts and stone materials are similar to those found on the ther mounds except that here the artefacts are sparse in the middle, ccurring around the edges of the mound. One pestle was observed.

THNOGRAPHIC INFORMATION:

No informants visited this site with us.

Malakanbalk and Malakarnba, the name of the headland immediately outh of here, are similar words and according to Nipper Kabirriki and eorge Mingum mean simply "a headland" or "peninsula".

RESENT CONDITION:

The sites are well preserved and are unlikely to suffer any water amage as they are on high ground above the floodplains of the river. ney are also protected by the thick vegetation growing in the pocket.

OURNAL REFERENCES:

rockwell, 1981. Kakadu Field Journal, Book 1: 16 September.

ISUAL RECORDS:

olour slides

rockwell, 1981: Film 4, 19-22.

TE WORKERS:

ally Brockwell, Prue Gaffey.

TE NAME: MALAKARNBA

This site was shown to Prue Gaffey and Sally Brockwell by Dave indner (1) in September 1981, on their trip up the western side of the outh Alligator River. Later in September they returned and examined it n detail. Butcher Night (6), George Mingum (6) and Nipper Kabirriki (7)

all agree that the name of this site is Malakarnba:

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map; 295 860 Cahill Sheet (4472)

dose not get

Air photo: Alligator River CAC 306 Run 7 No. 84 15/5/69 Black and white 1:25,000. Available A.N.P.W.S.

This site lies on a headland on the western side of the South Alligator River. To the east it is bordered by a river channel. The area has suffered saltwater intrusion and is extensively eroded, thus exposing the site.

VEGETATION (3) AND GEOMORPHOLOGY:

The western side of the site is lightly covered with dead grass. About 50m beyond the edge of this grassed area stands of Cathormion umbellatum and Barringtonia acutangular occur. A strip of 5cm high, green grass (probably Sporobolus virginicus) (16) ranging from 1 to 3m in width, mangroves (Sonneratia casseolaris), line the edge of the channel.

On the main part of the site the soil is dark brown-black silt. In the erosion gully, Area A, (fig. ?) the fill consists of dark brown silt and on the floor of the gully the silt is black. In the erosion gully, Area B, the fill is light grey in colour in the wall of the eastern bank, and on the floor of the gully it grades into dark brown as it approaches the western bank.

DESCRIPTION:

The site is about 650m long and 60m wide at its broadest point. In the north it narrows into an erosion gully about 200m long and 25m at its widest point.

Visibility (28):

In the grassy edge of the channel visibility is 75% to 80% with a low artefact density (4). In the grassy area on the western side of the site visibility is 80% and artefacts are scarce. On the remainder of the site, which is largely eroded, visibility is 95% to 100% with a medium to high density of stone material and artefacts.

In the eroded areas there is a high density of quartz and sandstone rubble, as well as a considerable number of artefacts. Artefact types cover a wide range - axes, blades, pestles, scrapers, cores, points. Raw materials represented include chert, silcrete, dolerite and quartz (14).

The site continues on the eastern side of the channel but this area was not inspected.

Features

Erosion Gully:

Erosion gully, Area A (Fig. ?): No artefacts are visible on the top of the bank which is covered with dead grass. However, they can be seen eroding from the walls of the bank where they occur in medium density. Quartz and sandstone gravel is common. Visibility in the gully is about 99% decreasing to 80% on the bank. Artefact density is high on the floor of the gully; visibility here is about 95%. The range of artefacts and raw materials in this area is similar to that on the main part of the site.

Erosion gully, Area B (Fig ?): A high density of quartz and sandstone rubble plus a significant number of artefacts occur here. The banks are sparsely covered with dead grass and visibility here is 80%. Artefacts occur on top of the bank but are not eroding below. On the eroded gully floor visibility is 100%. The range of artefacts and raw materials in this area is similar to that on the main part of the site.

Hearth:

Erosion has exposed a possible hearth about 150m from the southern edge of the site (Fig. ?).

ETHNOGRAPHIC INFORMATION:

Malakarnba is similar to the name of the next headland on the river to the north, Malakanbalk, given to Jeremy Russell-Smith (20) by George Mingum and Nipper Kabirriki and according to them means simply "a headland".

OTHER INFORMATION:

Dave Lindner believes that this area could once have been a Fragmites swamp before it was destroyed by saltwater intrusion. He said that the site loses about 10cm of soil every wet season. Dave also suggested that it would be useful to carry out two experiments at this site:

1. Drive four star pickets at least 1m into the ground in a square on the eroded area and tie wire between them at the present ground level in order to determine the rate of erosion during one wet season.

2. Take surface collections from a vegetated and non-vegetated area, and then excavate both to determine whether there is any difference between them in terms of the density of stone tools on the surface and in the underlying soil.

These experiments could also be carried out at other sites which are heavily eroded during the wet season.

PRESENT CONDITION

Because of the saltwater intrusion the site has been severely eroded and continues to lose a substantial amount of soil during each wet season.

JOURNAL REFERENCES:

Brockwell, 1981. Kakadu Field Journal, Book 1: 15 September, 16 September

VISUAL RECORDS:

Colour slides

Brockwell, 1981: Film 1, 30-35.
Film 4, 17-18, 28-30.

SITE WORKERS:

Sally Brockwell, Prue Gaffey.

SITE NAME: MAMUTJIRRA, "HYMENACHNE SITE"

This site was shown to us in July 1981 by Dave Lindner (1). He refers to it as the "Hymenachne Site" because today the billabong on the southern side of the site is dominated by that plant. When we saw it, this billabong still contained lush green vegetation and some fresh water. Minnie (2) and Violet Alderson (5) call this site Mamutjirra.

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map 535 852 Cahill Sheet (5472)
close up grid
Air photo: Alligator Rivers N.T. C524 Run 22 No. 0297 30/5/75 Colour 1:12,500. Available A.N.P.W.S.

This site is located on a levee on the eastern side of the South Alligator River. It is situated beside a billabong which lies adjacent to a freshwater swamp, also called Mamutjirra.

VEGETATION (3):

The swamp which lies on the southern side of the site supports Hymenachne sp. as well as some Eleocharis dulcis and Nymphaea sp. Freshwater mangroves (Barringtonia acutangula) grow in clumps along the swamp edge on its northern side. Wild passionfruit (Passiflora foetida) is also found on the site. The levee on which Mamutjirra is located would have been more densely vegetated in the past. It would have been covered with clumps of bamboo among other things. (20) Its denudation may have been exacerbated by buffalo damage to the fragile environment and subsequent saltwater intrusion.

DESCRIPTION:

The Mamutjirra archaeological site runs along the length of the Hymenachne billabong, being about 1km long and 100m wide.

Visibility (28):

. On the main part of the site visibility is between 95% and 100%. A few stone tools are thinly scattered right along the levee but a few (two) areas of medium density (4) also occur. In these areas two 5m2 were laid out and surface collections taken from them. (Fig. ?).

A great variety of artefacts occur on the site, ranging from the smallest of flakes to axes, mortars and pestles. Some tools possess the "gloss" described by Joe Kamminga as an indication of use wear acquired by the processing of plants. At least eight different kinds of raw

material were noted among the artefacts. Many times, several flakes made from one material were found together. The site may not be as disturbed as we originally thought.

ETHNOGRAPHIC INFORMATION:

Mamutjirra is in Murumburr estate and belongs to the Dhuwa moiety. It was occupied in July but also earlier in the dry season. Minnie camped here with her husband before her children were born. (Her oldest child, Nick Alderson (21) was born in November 1948). Violet recalls camping on the mainland edge of the main swamp at 'Number Two Goose Camp'. This site, she said, is also called Mamutjirra. While camped in this area people collected geese, long-necked turtles, file snakes and a range of plant foods including Nymphaea sp. (18) and Eleocharis dulcis. Wild honey was also said to have been procured here. People's drinking water came from the swamp and they slept on the levee site. Then it supported more vegetation. Aparently, people used to travel from Spring Peak to this site on horseback. From here they went on to Nourlangie Camp (Anlarr) and further east to Ming-kung (Nourlangie Creek where it becomes freshwater).

Women used a large pebble to crush/grind lily seed and a flat stone was used as a 'plate' (mortar). Of small stone tools it was said: 'Old people bin use im'. Men used lauwuk (stone spear point). Karramulk (axes) were used to fashion sticks for throwing at geese. People climbed into trees and threw these sticks at the geese as they flew over. Goose sticks were made from an-kurdu tree. Danny Gillespie (11) reported that the Aborigines foraging in this area used to soak their goose clubs in water to make them heavy before they used them to fell the birds.

During the wet season this site is covered with water. Then people sometimes used to camp to the south (?) of the levee site on high ground.

PRESENT CONDITION:

The site is almost denuded of trees and damaged in various places by buffalo and pig movements. The day we worked there a herd of 15 pigs was grazing at the eastern end of the billabong.

JOURNAL REFERENCES:

Meehan, 1981. Kakadu Field Journal, Book 1: 4 July; Book 2: 15 July, 22 July, 8 August; in Jones, 1981, Kakadu Field Journal, book 1: 16 July.

VISUAL RECORDS:

Colour slides

Brockwell, 1981: Film 5, 11.
Meehan, 1981: Film 1, 28-29.
Film 2, 1-13.

Black and white prints

Meehan, 1981: Film 1, 26-35.
Film 2, 13-14.

SITE WORKERS:

Betty Meehan, Lesli Sykes, Paul Tacon.

SITE NAME: MULARNANI, BANIDJI, "THE PALMS"

This site was shown to Betty Meehan by Des Pike (12) and Michael Preece (12), officers of the A.N.P.W.S. in June 1981. She was also shown many other sites in the general area (Meehan, 1981, Kakadu Field Journal, Book 1: 30 June). When we went to the site to carry out some formal archaeological work (July 1981) we were guided by John Day (12). That same day Mick Alderson (21), President of the Gagadju Association and landowner in the park, also visited the site and discussed it with us.

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map 588 936 Cahill Sheet (5472).
close up gap
Air photo: Alligator Rivers N.T. C324 Run 20 0210 30/5/75 Colour 1:12,500. Available A.N.P.W.S.

VEGETATION (3):

The site is situated on an exposed and barren levee in an extensive area of swamp land on the eastern side of the South Alligator River and on the south-eastern side of the Chirracarwoo lagoon. Nowadays it is treeless except for some twenty long, thin Livistona benthamii palms and two solitary pandanus. The presence of dead trees and branches strewn over the site suggests that it was more vegetated in the past.

Des Pike said that during the wet season this site is an island though it seems likely that some years, when the rainfall is particularly heavy, it may even be covered. At the moment the site is heavily eroded in some areas especially where buffaloes have made tracks across it to the water. During our stay at this site we observed a large herd of pigs which were foraging in and on the edge of the stagnant channel which lies along the southern side of the site. Their presence in the area was also causing some damage to the site especially at the water's edge.

DESCRIPTION:

The archaeological site on this levee stretch is some 400m from east to west and 100m from north to south. On the main part of the site Visibility (28) was between 95% and 100% for when we visited the site (July) it possessed very little grass cover. Artefact density (4) here varied from medium to high. In those areas of the site which were badly damaged by buffalo treadage visibility was again between 95% and 100% but artefact density here was low. This may be because many artefacts had disappeared down the large cracks which characterised the area or because, as these areas were mostly on sloping ground, they had not been so heavily occupied.

Surface collection:

At Mularnani we carried out four transects. One which was laid out in an east-west direction covered 400m, the other three, all of which ran generally in a north-south direction varied between 100m and 30m in

length (Fig. ?). Along all four transects we laid out a one m2 every 10m and from these collected, and bagged separately, all artefacts. In a particularly rich area on the site we set up a 5m2 and collected all artefacts from that area as well. We also collected a cache of large stone tools which had been brought to our attention by Mick Alderson when he visited the site. We also picked up some stone tools that we felt might be of importance for our analysis including some made from bottle glass.

We were told that many people (non-Aboriginal) used to visit this site to catch barramundi, so we must assume that much of the artefactual material on the site has already been picked over for cabinet specimens.

At a point along our east-west transect we used our auger to obtain samples for soil analyses. This went down approximately 3m.

Whilst work took place at Mularnani, some members of our team went to inspect sites which lay south in the vicinity of "Little Banyon". These contained stone artefacts but were only small not resembling, in any sense, the Mularnani site.

Mick Alderson also alerted us to a place where Aborigines camped beneath a banyon tree. This site lay to the north-east of the main Mularnani archaeological site and consisted of a thin scatter of stone artefacts. Associated with this thin scatter were several small mounds about 0.5m high and 0.5m in diameter. All had flakes lying on their surface. They could represent the remains of ovens but, of course, need to be sectioned and investigated in more detail before such a use could be seriously assigned to them.

When Des Pike and Michael Preece first brought me to the Mularnani site they also took me to a series of sites including possible quarries and small mounds all of which lay on the edge of the greater swamp to the north west of "The Palms". (See sites on map given to Rhys ? and Meehan, 1981, Kakadu Field Journal, Book 1: 30 June.)

ETHNOGRAPHIC INFORMATION:

Mick Alderson told us that in the past, the muddy, stagnant channel skirting the archaeological site of Mularnani, used to be a beautiful, fresh water channel. Due to saltwater intrusion it is now non-productive. He also said that he remembers people camping around a banyon tree which grows a few hundred metres to the north east of the site on the edge of the forested area (391 940 Cahill Sheet 5472).

PRESENT CONDITION:

The site is severely eroded and devastated due to saltwater intrusion and buffalo damage. It must also lose some topsoil during each wet season.

JOURNAL REFERENCES:

Meehan, 1981. Kakadu Field Journal, Book 1: 30 June; Book 2: 23-24 July 1 August, 6 August.

VISUAL RECORDS:

Colour slides
Meehan, 1981: Film 1, 9-12 (sites visited with Des Pike and Michael Preece)
Film 1, 13-16 (Mularnani)
Film 3, 17-35 (Mularnani)
Film 4, 1-2 (Mularnani)
Film 4, 3-6 (Banyon tree site)

SITE WORKERS:

Sally Brockwell, Betty Meehan, Cathie O'Sullivan, Ian White.

SITE NAME: NURRUNGURRUDJBA

This site was first shown to Rhys Jones by Dave Lindner (1) in September 1981. Later in the month it was visited by other team members. Nipper Kabirriki (7) and George Mingum (8) agree that the name of the site is Nurrungurrudjba, presumably after the billabong, also called Nurrungurrudjba, that lies adjacent to it.

LOCATION:

Map: Australia 1:100,000 Topographic Survey Map; 522 743 Cahill Sheet (5472).
Air photo: Alligator Rivers N.T. C330 Run 25 No. 3436 1/7/75 Colour 1:12,500. Available A.N.P.W.S.

This site is situated on a small exposed hillock. It lies on the western side of the South Alligator River about 50m from the wetland edges at the junction of two freshwater billabongs, Narangku and Nurrungurrudjba.

VEGETATION (3) AND GEOMORPHOLOGY:

On top of the hill Strychnos sp., Wrightia sp. and Bombax sp. trees occur singly and in small clusters. Cathormion umbellatum grow in scattered stands around the base of the hill and a large, dense grove of them lies between the hillock and the wetlands.

Large medium and coarse grained basic igneous boulders with varying grades of mica and granite occur all over the hillock, in the Cathormion grove and in the area between them. On the hill the soil is hard packed light brown silt. In the Cathormion grove it is fine brown silt.

DESCRIPTION:

The hillock is about 2m higher than the wetland plain. It is roughly oval in shape being about 65m in width and 95m long. The boulders in the Cathormion grove cover an area measuring about 30m by 50m.

Visibility (28):

On top of the hill visibility is about 99% with a high artefact density (4). In the area between the hill and the Cathormion grove visibility is 99% with a medium artefact density. In the Cathormion grove visibility is less than 50% because of leaf litter. There is a low

artefact density here.

It appears that the area has been used as a quarry by Aborigines as negative flake scarring occurs on several boulders and the hill is littered with flakes and chips of the same material as the boulders. Many of the boulders have grinding holes on them. There is much haematitic and quartz rubble on the hill.

Raw materials include dolerite, chert, silcrete, quartz, basalt and micacious material.

In the area between the hill and the grove the range of stone materials and artefacts is similar to that on the hill.

The boulders in the Cathormion grove also have grinding holes on them. The occurrence of artefacts and stone material here is sparse except for the occasional chert or quartz flake or quartz crystal. The grove contains no gravel.

OTHER INFORMATION:

Dave Lindner reported that a similar stone outcrop suitable for quarrying occurs on the western bank of the South Alligator River opposite the site of Ki'na.

PRESENT CONDITION:

The billabongs beside the site contain fresh water and there appears to be little buffalo damage,although there are buffaloes in the area. Hence minimal erosion has occurred on the site, which is well preserved.

JOURNAL REFERENCES:

Brockwell, 1981. Kakadu Field Journal, Book 1: 17 September.

Jones, 1981. Kakadu Field Journal, Book 1: 8 September.

VISUAL RECORDS:

Colour slides

Brockwell, 1981: Film 1, 4-14.

SITE WORKERS:

Sally Brockwell, Prue Gaffey.

(1) Dave Lindner is the Environmental Consultant employed by the Gagadju Association. He has spent many years in the Northern Territory and is very familiar with ecological issues there.

(2) Minnie Alderson (Kulinowa) was born into the Ngalmaring patrilineal clan of the Kunmarung language group which is very close to the Kunwinggu language group. She came to the Alligator Rivers region as a child and was adopted by a Badmardi man and lived in the Deaf Adder Creek area until she was married to William Alderson 'Yorky Billy' (Nakandjelwili) of the Murumburr clan and went to live with him in his country - the floodplains of the South Alligator River. 'Yorky Billy', now deceased,

was a buffalo shooter and travelled all over the floodplains. Minnie followed the buffalo camps and thus came to know the country very well. 'Yorky Billy's' language was Mbukarla. Minnie and 'Yorky Billy' had eight children; in order, Mick, Jessie, Violet, Elizabeth, Kenny, Nellie, Judy and Philip.

(3) ?

(4) A medium density of artefacts and raw materials is defined as approximately 20 pieces of stone per square metre. High density is more than 30 pieces per square metre and low density in less than 10 pieces per square metre. These are estimates.

(5) Violet Alderson is the daughter of Minnie and 'Yorky Billy' Alderson. She belongs to her father's clan Murumburr and speaks the Mbukarla language. Her country is the floodplains of the South Alligator River. Violet was brought up on the floodplains, following her father's buffalo camps so she knows the country very well. Violet is now a Ranger with Kakadu National park.

(6) Butcher Night (Namandarrak) comes from the Murumburr clan and his father's language is Mbukarla, although he speaks several other languages as well. His country is the floodplains area of the South Alligator River around Jim Jim Creek and Yellow Waters and northwards on both sides of the river to Kabalka.

(7) Nipper Kabirriki was born into the Badmardi clan and speaks the Kunjetmi language which, according to George Chaloupka, is synonymous with the Nayali language. (cited from Keen 1980: Appendix) Nipper is traditional owner of the Deaf Adder Creek area in Deaf Adder Gorge, Kakadu National Park.

(8) George Mingum is Nipper Kabirriki's brother. They had the same father and a different mother. George is from the Badmardi clan and speaks the Kunjetmi language. His country is the Deaf Adder Creek area in Deaf Adder Gorge, Kakadu National Park.

(9) Ian Morris is an A$_1$N$_1$P$_1$W$_1$S$_1$ Ranger in Kakadu National Park, N.T.

(10) Nellie Alderson is the daughter of Minnie and 'Yorky Billy' Alderson. She belongs to her father's clan Murumburr and speaks the Mbukarla language. Her country is the floodplains of the South Alligator River. Nellie does not know the area as well as her sister Violet. When Minnie gave birth to Kenny Alderson, her fifth child, she decided she had too many children to keep moving around. By the time Nellie was born the family was living a relatively stationary life. Nellie is now a Ranger with Kakadu National Park.

(11) Danny Gillespie is a scientific officer with A$_1$N$_1$P$_1$W$_1$S$_1$ in Kakadu National Park, N.T.

(12) John Day, Des Pike and Michael Preece are all officers of the A$_1$N$_1$P$_1$W$_1$S$_1$ and are stationed in Kakadu National Park, N.T.

(13) Mick Alderson is the oldest child of Minnie and 'Yorky Billy' Alderson. He belongs to his father's clan Murumburr and speaks the Mbukarla language. His country is the floodplains of the South Alligator River. Mick was born in November, 1948, and now works as a ranger with

ANPWS in Kakadu National Park. He is president of the Gagadju Association.

(14) All geological identification of stone material examined during our survey on the western banks of the South Alligator River was done by Prue Gaffey.

(15) Tentatively identified by Ross Kaines, a zoology graduate from the University of Adelaide.

(16) Identified by Gerry O'Neil, an ANPWS Ranger in Kakadu National Park, N.T. Gerry has a special interest in the ecology of the region.

Sorobolus sp. is also known as "salt water couch". Dave Lindner thinks that it is a sign of salinity and indicates tidal and fresh water boundaries.

(17) Pandanus nuts (mogo) are extracted from the fruit and eaten either raw or after the fruit has been roasted in the fire. Minnie and Violet Alderson said that roasting made the fruit easier to open and gave the nuts a nicer flavour. Nowadays the fruit is cut open with an axe and the nuts are removed with a "piece of stick".

(18) All parts of the waterlily (Nymphaea sp) are eaten; the corm (an-ngam), the stem (an-badmor), the root (an-dem) and the flower (an-ngor).

(19) Jessie Alderson is the second child of Minnie and "Yorky Billy" Alderson. She belongs to her father's clan Murumburr and speaks the Mbukarla language. Her country is the floodplains of the South Alligator River. She was born at Lurrukuku in August, 1950.

(20) Jeremy Russell-Smith is a research scholar with the Geography Department, The Faculty ANU. He is a botany graduate and spent the dry season of 1981 with the archaeological team in Kakadu National Park, studying the effects of fire on monsoon rainforest in the Alligator Rivers region.

(21) Topsy Mungkiwa comes from the north coast from the Manjuram and Maniningali clans. She speaks the Iwadja language. She used to be married to Nipper Kabirriki.

(22) Philip Alderson is the youngest child of Minnie and "Yorky Billy" Alderson. He belongs to his father's clan Murumburr and speaks the Mbukarla language. He is 10 years old.

(23) Margaret McGregor is the daughter of Violet Alderson and her husband Kevin McGregor, a European, who are now separated. Margaret belongs to her mother's clan Murumburr and speaks the Mbukarla language. She is seven years old.

(24) Judy Alderson is the second youngest child of Minnie and "Yorky Billy" Alderson. She belongs to her father's clan Murumburr and speaks the Mbukarla language. She is 14 years old.

(25) Robert Leritus is an anthropologist employed through the Australian Institute of Aboriginal Studies by ANPWS to record the oral history of the Aborigines who worked in the buffalo hunting industry in the Alligator Rivers region. He spent the dry season of 1981 in the field.