CHAPTER 4

People in two landscapes 1829 - 1860

4.1 Introduction

This chapter examines the environment and food available to Aboroginal populations in the locality of Lake Victoria during the recent past.

The area within 20 km of Lake Victoria is divided into eight landsystems which are based on the vegetation associations which were described for the area between 1829 and 1840. The availability of water and food in each of these systems is described, and on this basis the location and content of occupation deposits are predicted. These predictions are then juxtaposed with (i) ethnohistoric records of population sightings and subsistence activities, and (ii) what is known of the archaeological occupation deposits in the area so far.

The food and water resources in each of the eight landsystems are listed in Table 4.2. It is assumed that lists of edible foods are probably not exhaustive, and that unknown cultural factors must have influenced the selection of foods, and the formation of food waste deposits.

The model of population movement and resource procurement is presented as a framework, within which cultural preferences must have operated. It is hoped by this means to (a) approach an understanding of the limiting factors in the distribution and abundance of human populations in the area during the recent past, (b) to examine the scale and scope of change which might have occurred in resource availability during the past, given the fact that there must have been marked variation in unearned water, and consequently the resources of the river tract, and (c) as a basis for comparison of occupation deposits formed at different times.

Landsystems in the area fall into two broad categories, the riverain and the hinterland. Riverain ecosystems have two sources of water, local precipitation and unearned precipitation derived from distant catchments. Hinterland ecosystems depend on local precipitation alone.

Riverain resources are highly variable. Hinterland resources are scarce, though in some ways they are stable and predictable. In this area it is difficult to model a system of resource procurement which can be termed seasonal - in the sense that there is a predictable flux in resources over a twelve month period. Rather, food availability determined by the interaction of three variables - the air temperature, the local precipitation and the state of the river. As far as humans are concerned, the prime mover of the system is river flow. The single most influential factor in determing exploitation strategy is the season and duration of low flow in the river channel.

4.2 The appearance of the landscape

Fig 4.1 shows that Lake Victoria occupies part of the Murray basin where the ancient river valley is up to 50 km wide. The area within the valley is criss crossed by abandoned water channels and includes many reservoir areas, which store water following floods. Water is also stored in the channels of the Anabranch of the Darling, and the Darling channel, for flood waters which come down the Murray during periods of low flow in the Darling will fill up the lower parts of these channels. Within the flood tract there are some areas of high terrace which are rarely, if ever innundated.

During years when the river overtops its banks, numerous low lying areas in the lower areas of the flood tract fill with water.

The first European records of the landsystems of the Lake Victoria region are summarised in Table 4.1. These records

Table 4.1 Vegetation sightings within 50 km of Lake Victoria 1829 to 1860

1. Hawdon 1838 speaking of 1836, March 1st.

. ... proceeding 7 miles further we encamped on the banks of a creek 7 miles (or 11 km) from the Darling/Murray junction. The country here consists of poor soil, without timber, occasionally sprinkled with small bushes, but with scarcely any appearance of grass. The sandhills did not appear, though we here and there crossed the ridge of pine trees. I shot a new kind of owl which abounds among these bushes, with its maw full of beatles. The crested pigeons were also numerous, rising up in coveys of 6 or 8 at a time. Page 39.

. between the Great Anabranch channel and the Rufus, March 3.

. We passed over plains covered with bushes and salsolaceous plants, to a creek in whose channel there must flow a considerable body of water in times of flood. Following up its course we encamped for the night but found very few reeds for our cattle. Page 42. Probably the Frenchmans creek.

. Passed three miles further when food for stock became more plentiful. Page 42. Probably Frenchmans creek, probably reed beds.

. March 4 I rode out with one of my men about 5 miles (8 km) to the north to the summit of a rather lofty sandhill ... beneath me lay a lake about thirty or forty miles in circumference (48 km) with a line of gum trees scattered along its edge. This was a delightful change from the flat dreary region of sand I had been crossing for many a day. The bed of the lake was of white clay and water deliciously fresh and cool, and not a reed growing in it.

. March 5 Following this creek or rather branch of the river ... we came to ... The Rufus. (on the right bank - the southern and western bank) the scenery is very pleasing, and the air is perfumed with the sweet odour from the herbs and flowers growing on the margin of the Lake. (west of the Rufus) ... our party found plenty of reeds for our livestock to feed on.

2. Sturt (1833) speaking of a boat trip down the Murray in 1829.

. 26th Feb. 'The country through which we passed was extremely low, full of lagoons and thickly inhabited. No change took place in the river, or in the nature and construction of its banks. We succeeded in getting a view of the hills ... they looked bare and perpendicular'

(cliffs of the high terrace between the Anabranch and the Frenchmans creek) page 126.

. 28th Feb. Downriver of the Rufus junction, in the region of the cliffs, upstream of the Lindsey Anabranch. Anxious to gain as correct a knowledge of the country as possible, we had in the course of the day ascended a sandy ridge about a mile from the river ... as far as actual observation went we were not disappointed, although in every other particular the landscape was unpromising.

. To the south and southeast the country might be said to stretch away in one unbroken plain, for it was so generally covered with wood that every inequality was hidden from our observation. To the southwest the river line was marked by a succession of red cliffs... To the north the interior was evidently depressed. It was overgrown by a low scrub, and seemed to be barren in the extreme. The elevations upon which we stood were similar to the sandhills near the coast, and had not a blade of grass upon them. Yet notwithstanding the sterility of the soil the large white amarallis ... was abundant here. Page 130.

. 28th Feb. River flats downstream from the Lindsay. The timber upon them (the alluvial flats) was not of a kind that is found on flooded lands, but wherever reeds prevailed the flooded or blue gum stretched its long white branches over them.

3. Tolmer, writing of events in July 1841, of Langhornes Ferry on the north of the Rufus. Tolmer is quoting from O'Halloran's official report to the governor. 'In such a country as we have gone over, intersected by rivers, lagoons and creeks, and thick with polygonum scrub, and high reeds, it is next to impossible to surprise any blacks, for all know the approach of any party from the time they make the river into which the natives plunge, and at once escape to the opposite side.' Page 231.

Quoting from a letter from Moorehouse written in 1841.

. 4th Sept. at the Rufus river. 'The natives were almost instantly thrown into confusion, one hundred running into the scrub, and about fifty into the water, with the intention of concealing themselves in the reeds.' Page 237.

(the same items are quoted in Bull, 1884, p.230 and 232.)

4. Sturt, writing of observations made in 1844, passing this time up river overland from Adelaide.

. Speaking of the river tracts/tablelands or high terrace:

' The soil of this upper tableland was a bright red ferriginous clay and sand. The vegetation was chiefly salsolaceous, but there was notwithstanding no want of

grass upon it, though the tufts were far apart. ...we encamped on a beautifully green flat about seven miles (11 km) from the Rufus, and about eight (13 km) from the nearest point of Lake Victoria.' Page 90.

. same day Junction of the Rufus with the Murray.

'We were flanked by the Rufus to our left, and had the Murray in front of us. The ground in our rear and to our right was rather bushy, and numerous fusani covered with fruit were growing there.' Page 91.

. I had sent Mr Browne to the eastward to ascertain how far the waters of the Murray had gone up the Ana-branch.

. 'Lake Victoria is a very pretty sheet of water 24 miles (38.5 km) in diameter, very shallow and at times nearly dry. The southern shore of Lake Victoria is very picturesque, as well as the line of the Rufus. The latter is much wooded, whereas the S.W. shore of the lake is low and grassy, and beautiful umbrageous trees adorn it, in number not more than two or three to the acre.' Page 94.

. 'The following day moved camp seven miles (11 km) (from the Rufus/Murray junction) to the westward, on the 15th I again moved to keep pace with him, and was highly delighted at the park like appearance of the scenery.' Page 95.

. 'Mr Browne informed me that the day he left me he rode for some miles along the shore of the Lake, and that after leaving it he encamped in the scrub, having travelled 17 miles (27 km) from the Rufus/Murray junction.) The brush was very dense although there were open intervals; it consisted of trees and shrubs of the usual kind; the soil was very sandy, and there was a good deal of spinifex on it.'

. 'The next day, still on a due east course, and at five miles from where he had slept (8 km), Mr Browne came on a salt lake about 800 yards in circumference... About five miles further on, there were two other lakes of the same kind. At five miles further, Mr Browne intersected the Anabranch of the Darling. To within a short distance of the Anabranch, the country was similar to that through which he had passed the day before, but on nearing it he crossed an open plain.' Page 95,6.

. Sturt, 14th 'from our tents there was a green and grassy slope, with a group of two or three immense trees at distances of several yards apart...' Page 97.

. 'The picturesque scenery ... ceased at two miles, when we suddenly found ourselves travelling on sand, at the same time amidst reeds. The rich soil disappeared, the trees becoming stunted and low.' Page 98.

. 'We traversed about eight miles (13 km) of as dreary a shore as can be imagined, backed, like Lake Bonney by bare

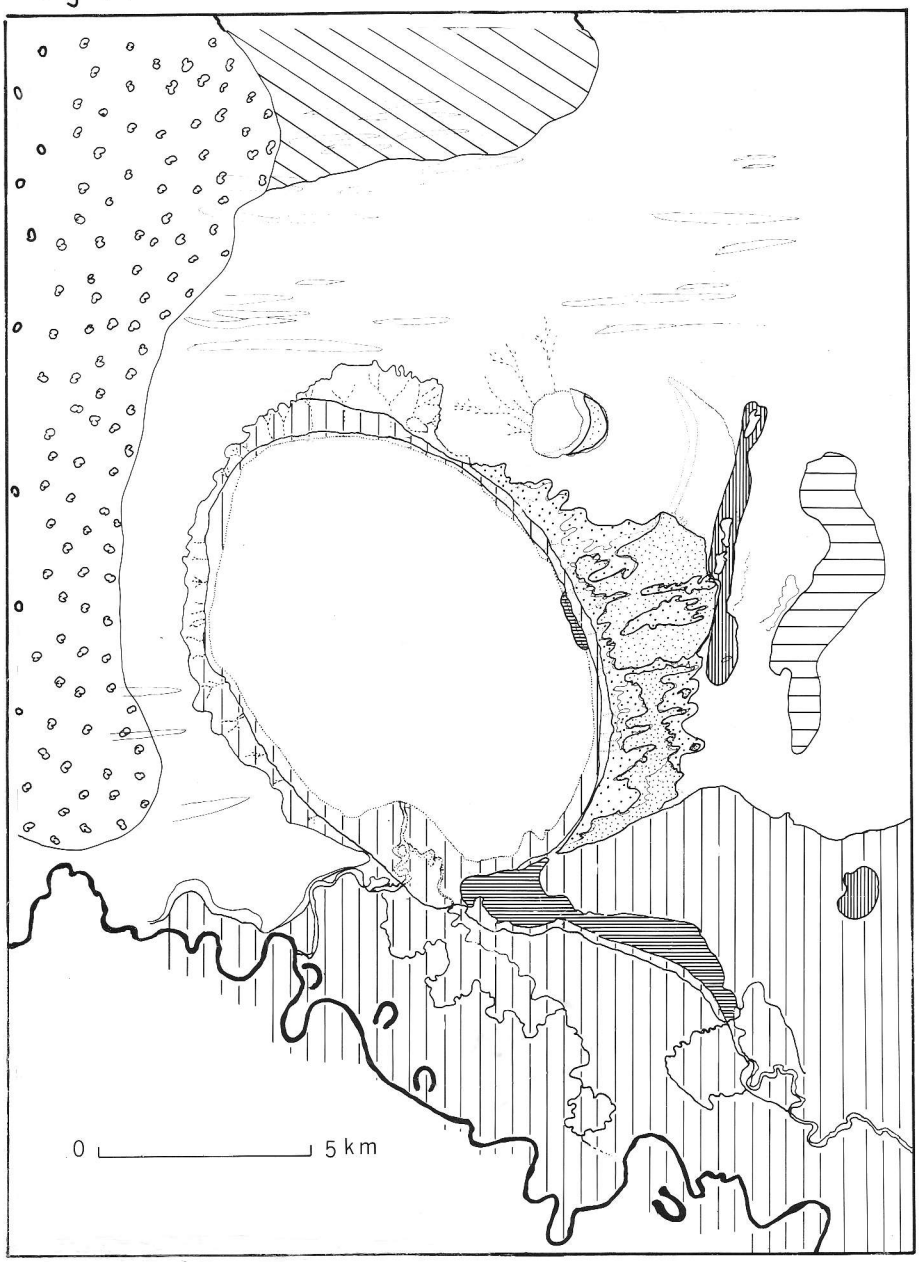
sand hills and barren flats, and encamped after a journey of 13 miles (21 km) on a small plain, separated from the lake by a low continuous sand ridge, on which the oat grass was most luxuriant.' (c.9 km from the Rufus) Page 100.

'On leaving Lake Victoria, travelling east, we traversed plains of great extent, keeping on the overland road until at length we gained the river, and encamped on a small neck of land leading to a fine grassy enclosure.' Page 101.

Land System	Key	Vegetation	Edaphic characteristics
1		Wetlands, saline wetlands	Interdigitated alluvial sands and clays, low angle slope, periodically inundated
2		Riparian forest, grasslands	Alluvial sands and clays, point bars, levees some calcareous paleosols, low angle slope
3		Lunette shrubland, woodland, grassland	Undifferentiated sands with calcareous paleosols in some areas, dune configuration
4		Saltbush/bluebush shrubland	Clayey sands, occasionally overlain by sand sheets, occasionally calcareous
5		Salsolaceous	Solonchak soils, low slopes
6		Casurina woodland and grassland	Sandy calcareous soils, dune formation
7		Mallee scrub	Calcareous sands of the Woorinen formation, dune formation well drained, carbonates at >1 metre
8		Marginal saltbush/ mallee	Sand plain, variable slope

Landsystems in the Lake Victoria area

Fig 4·1



Key

- landsystem 1
- landsystem 2
- landsystem 3
- landsystem 4
- landsystem 5
- landsystem 6
- landsystem 7
- landsystem 8

document a mosaic of Eucalypt riverain forest with an understory of tussock grassland or Scirpus sp interspersed with wetland areas; more saline areas vegetated by lignum swamp, and other areas occupied by phragmites and bullrush swamp. The heavier soils of the high terraces or high level alluvium were then vegetated as they are today by saltbush/bluebush shrublands.

Sandy areas of the hinterland were vegetated by dense to open mallee eucalypt scrubland, areas of open tussock grassland, and pine scrub. Areas where saline water tables intersected the surface were vegetated by salt tolerant annuals and succulent perennials. Although the species composition of association may have varied considerably since European stock were introduced, the basic distributions of vegetation remain similar today.

The area is characterised by high diversity in vegetation systems.

4.3 Land systems

The land systems of the Lake Victoria region are set out in tabular form in Table 4.2 below and mapped in Fig 4.1.

4.4 Water and food in the riverain

Table 4.2 shows that the most important foods in the riverain system were probably (i) fish and other aquatic resources such as crustacea and turtles, (ii) aquatic birds, including birds which were moulting, fledglings and eggs, (iii) tubers and roots, (iv) leafy green vegetables and (v) arboreal animals, at least, these are the most frequently mentioned items of diet given by people who observed traditional Aboriginal life in the Murray valley and in the Lake Victoria area and they are common and easily procurable items, even today (Allen 1972:Appendix 1). For the purpose of this analysis of the availability of food, good seasons are equated with the availability of these resources.

Land System 1		
River channel, lake edges swamps	Animal foods	Fish - bony bream, Murray cod, catfish, golden perch, silver perch, smaller fish
		Shell fish - Alathyria jacksonii (river freshwater mussel) Velesunio ambiguus (lake freshwater mussel, Notopala ssp. freshwater gastropod)
		Amphibians - frogs
		Crustacea - Murray crayfish, yabby, freshwater shrimp
		Birds - water birds, fledgling birds, eggs
		Reptiles - turtles and snakes
	Season available	Fish are most common in spring and summer, following a flood; waterbirds similarly; crustacea similarly; most plentiful in spring; shellfish available year round, but less pleasant to collect in chilly weather.
	Vegetable foods	Nardoo, Typha, water lily, Triglochin, Phragmites, Cyperis rotundus (nutgrass), Scirpus tubers, Codonocarpus (Van der Sommen 1980).
	Season available	Leaves of Typha and Phragmites in spring, nardoo after floods, Typha roots all seasons, with peak nutrition in winter (Gott 1982).
	Comment	This area is highly productive of protein, carbohydrate and leafy vegetables in spring and summer, it experiences a growth productivity flush following summer floods. In winter two factors operate - lowered access to fish, more difficult access to shellfish/crustacea. Briefly, in winter fish have to be actively pursued, and more energy is expended in collecting in winter.

Land system 2		
	Animal foods	Reptiles - snakes, lizards (Thompson 1980).
Floodplain local variants		Amphibians - frogs (Pillman 1980)
		Birds and eggs
(a) freshwater swamp communities		Rodents - mice, rats
(b) saline swamp communities		Grazing and browsing macropods
		Insects, grubs
(c) raised levee bank or point bar communities on sandy soils	Season available	All seasons. Frequency of contact with animals travelling to water increased during droughts.
	Vegetable foods	Leaves of leafy vegetables Atriplex robustus, Tetragonia, trigonella, Lomandra effusa, seeds of acacias; grasses; Cyperus rotundus, scirpus tubers, Bulbine bulbosa tubers, Picris hieracioides roots (Gott pers comm) Clematis microphyllus
(d) Riparian Redgum woodlands		
(e) Black box Eucalypt woodland	Vegetable foods	Including Eragrostis dielsei and Panicum decompositum possibly seeds o river red gum, Lignum, pigface. Fruits - native cherry, mistletoe, ruby saltbush, dillon bush.
		Tubers - Eleocharis ssp Microseris scapigera (cf Pretty 1977; Gott 1982). Productive of carbohydrates, fruits and leafy vegetables.
	Season available	This is a highly diverse land system, but in general is most productive of vegetable foods in late spring to mid summer. At times vegetable resources may be inaccessible during periods of flood innundation. Animal food resources as for Land system 1.

Table 4.2 Continued

	Comment	This is likely to prove the most productive environment. When combined with System 1, riverain resources are fruitful, and available year round.
Land system 3		
Lunette dune	Animal foods	Small burrowing and tussock sheltering animals - hare wallaby bettong, wombat, stick nest rat, mice, bandicoots.
Local variants		Reptiles - lizards, snakes
(a) dune		Birds, emus, eagles, small shrub dwelling birds, mud nesting birds.
(b) swale, lee face		Large macropods in subsystem (b) particularly abundant, including red kangaroo, grey kangaroo and wallaroo. Transient through subsystem (a) to drink (as are emus).
	Season available	Small burrowing species year round. Large macropods and emus particularly abundant during regional droughts.
	Vegetable foods	Bulbs of lillies, orchids. Fruit - saltbush, dillon bush, Acacia seeds, grass seeds.
	Season available	Vegetable foods available spring (bulbs, orchids) and after local rainfalls in spring/summer. Animal foods year round.
	Comment	The lunette, source bordering dune area resources are scattered rather than clustered. It is an excellent environment for tracking stalking or ambushing game, as animal tracks can be followed on sandy ground from the edge of the lake. Large macropods shelter in lunette gullies and may be easily surprised by walking upwind along the face of the lunette. Large animals are more common during droughts.

Table 4.2 Continued

Land system 4		
Saltbush	Animal foods	As for lunette - shrub dwelling small animals, although fewer burrowing animals in clay soil areas.
Bluebush		Emus, large macropods, particularly during seasons of local grass growth.
Clay plains	Season available	Small tussock sheltering reptiles and birds are available year round
	Vegetable foods	Saltbush leaves and fruits, edible chenopods, goosefoot, plus seeds.
	Comment	The saltbush/bluebush is an area of scattered resources requiring much expenditure of energy in searching. This is balanced by the fact that some animal food should be available in shrub country year round.
Land system 5		
Salt lake	Animal foods	As for System 4. Salt lake basins themselves inimical to life. Possible to trap animals in salt lakes during hunting drives.
	Vegetable foods	Succulents, Sarcozona, Portulaca spp seeds and fruit, Salicornia.
	Season available	Seeds of Portulaca spp available late summer/autumn, fruit available summer.
	Comment	The salt lake margins were probably sources of Portulaca Oleracea seeds, which were a valuable source of oil in the diet. Seeds were available during a period of otherwise low resource availability.
Land system 6		
	Animal foods	Large macropods, reptiles, some birds

Table 4.2 Continued

Casuarina woodlands	Season available	Not a productive environment. No season can be singled out.
	Vegetable foods	Grass seeds following heavy rain in spring.
	Comment	This association does not appear to be highly productive.
Land system 7		
Mallee	Animal foods	Large macropods, including mallee kangaroo, large birds, emus, mallee fowl, reptiles, snakes and lizards, insects, wombats, rodents, small birds.
Local variants		
(a) Mallee/triodia	Season available	Accessible when either within walking distance of water, or when pools of water form following locals rain.
(b) Mallee saltbush	Vegetable foods	Mallee root cambium, orchid bulbs, grass seeds, Acacia seeds including mulga seeds, fungi, native cherry.
	Season available	When accessible following rain, seeds available late summer.
Land system 7		
Sandy plain with leopardwood, bluebush Pitossporum and wilga, gidgee	Animal foods	As mallee.
	Season available	As mallee.
	Vegetable foods	Fruits - quandong, wild orange, native cherry, possibly other fruits, grass seeds.
	Season available	Following rain, fruit and seeds spring, summer.

Three variables interact to determine productivity in plants and animals in the riverain. These are (i) the flood surge regime, (ii) the area innundated by floods and the area of 'reservoir' storage available in the areas and (iii) local precipitation patterns. Of these, the most important for riverain species is undoubtedly the river flow regime.

Good times

Fish in the Murray are easily procurable during times they are moving. They are relatively immobile in winter, but move between river and backwater channels during floods, particularly during the spring. This is characteristic of all species of edible fish (Lake 1971).

The availability of aquatic birds is related to the state of the food available in the river. In many cases the birds feed on fish or crustacea. Migratory birds flock into the river basin to feed and to nest whenever floods occur in the warmer months.

Tubers and roots respond to winter/spring floods by leaf growth, and subsequently produce and store starch in tubers. Tubers are most nutritious in the cooler months (Gott 1982). There is also a response to local precipitation in the spring. There is a lag between flood innundation and peak productivity in many other vegetable foods (Wickham 1983), which means that some resources will be available for up to twelve months following a flood.

The season of most abundance undoubtedly follows the passage of flood surges which occur in this area in October ± one month (see below). Floods in late spring or early summer also produce a 'flood flush' which will last as long as waters are draining back from the wetlands to the river, and be prolonged until young aquatic birds have left their nests - an approximate period of seven weeks. The flood flush of the year is termed Phase 1 (Table 4.3). Phase 1 is characterised by abundant clustered resources in wetland areas, landsystems 1 and 2.

Phase 2. As flow in the trunk steam decreases after a flood, areas which produce wetlands resources are the trunk river, and the reservoir areas within the river tract. In Phase 2, aquatic animals are less mobile, less frequently encountered, and perhaps more difficult to exploit in the cooler waters. Starch rich tubers would be at their best, as a result of the lag effect of spring floods (Gott 1982). Landsystems 1 and 2 would remain the most productive.

Bad times

A combination of circumstances may reduce the availability of foods in the riverain. These are:

Phase 3. When the river maintains high riverbank flow for several months. In this area, the flood tract is not narrow as it is in other areas, but nevertheless there will be intervals when productive wetlands of systems 1 and 2 will be inaccessible, and fishing will be difficult. If we assume that people left the flood tract in these times, some food would have been available as animals likewise displaced would have been available. Food stress might occur if vegetable staples were innundated by flood water during late summer or winter. During these periods landsystems 3 - 7 would become more attractive.

Phase 4. When floods only occur during cool seasons. The period of flooding is important in inducing fish to move and breed, and enticing aquatic birds. If floods occurred only in the cooler months, the availability of these two important resources would be diminished.

Phase 5. When the river maintains low flow for twelve months. Lengthy low flow intervals in the river deplete reservoir storage standing water. Reduction in standing water is initially favourable, since aquatic resources may be more easily located in shallow water, but after a brief period of plenty, long term prospects are less favourable as aquatic habitats are cleaned out. At times without a flood in twelve months,

vegetable resources may have become more important, as their availability lags behind the season of innundation by up to 12 months (Wickham 1983). Effects of low flow in the river may also be mitigated by the occurrence of local precipitation. At these times food availability would be more patchy, possibly stimulating increased use of all systems by people in smaller groups.

Phase 6. When the river maintains low flow for more than twenty-four months, with periods of cessation of flow.

Under prolonged conditions of low flow, riverain resources would be restricted to the trunk river, and eventually to deep pools in the apex of meander bends. Pools downstream of saline aquifers could become saline (Lindsay 1972; Boucaut, Curry and Pels 1977), and some areas of surface would develop a salt bloom, which would inhibit the growth of grasses. Desiccation and salinization of wetland areas would result in failure of tuber and root crops, and leafy vegetables would decrease.

For a brief period, fish and shellfish penned in pools would become visible or accessible. As pools dried these resources would fail.

During Phase 6, whenever droughts occurred in the hinterland (defined here as more than three months with below median precipitation), the entire structure of available resources must have changed. Normally, larger terrestrial animals and birds could maintain themselves on water resources of the local hinterland. Prolonged failure of local precipitation would have caused larger animals of the hinterland to move in closer to the forage and potable water of the riverain. Even today, when large macropods and emus have access to many water sources previously unavailable, there is an increase in large macropod populations along the river in times of drought. This phenomenon has been reported by Simpson (1973:278) in the Lake Victoria area.

Thus, when intervals of river failure coincided with hinterland droughts the quantity of accessible large game must have increased, at the same time riverain resources decreased. Some of the implications of this observation are further explored in Chapters 6 and 7. There is no ethnohistoric evidence for the behaviour of Aboriginals during river and hinterland droughts, but there may have been strong pressure to increase predation on large game.

The location and contents of midden occupation deposits within the riverain may be predicted on the basis of these observations. Some predictions are given in Table 4.5. It is however, unlikely that sites on low lying areas within the riverain would survive for long, given the nature of the river meander belt, and the scour and fill which occurs during bank full and flood flow periods.

River flux

Statistics on flood surges and river flow regimes are available for the Murray River at Lock 9, which is upstream from the Lake Victoria offtake channel. Records cover the period from January 1931 to June 1982 (Reports of the River Murray Commission 1930/1 to 1981/2). These statistics are taken from a river whose catchment has been altered by agriculture and grazing, and whose flow has been artificially regulated by locks, dams and weirs. The effects of river regulation have been to alter the flow regime in several ways (i) to mitigate flood peak heights and to increase the duration of flood high flow, (ii) to maintain high levels of flow in the summer and autumn. River control schemes have had little effect on extreme situations - which is what is of interest here, for severe droughts and large protracted floods are still reflected in river flow (T. Jacobs, River Murray Commission, pers comm).

For the purposes of discussion, a flood at Lake Victoria is defined as a river flow greater than 500,000 acre feet per month at Lock 9. A major flood is defined as a flow greater than one

Table 4.3 River Flow Patterns 1931 - 1981, Lock 9, Murray River

River Flow Regime	Recorded	Frequency	% years
Flood occurence, over 500,000 ac ft	50	42	84
Major flood, over 1,000,000 ac ft	50	29	58
Phase 1 - Flood flush periods			
Flood occurence October ± one month	46	35	76
Major flood " " " "	46	23	50
Phase 3 - Prolonged high flow, more than three million ac ft per month, lasting three months or more.			
All seasons	50	2	4
October ± one month	50	2	4
Phase 4 - Years with floods only occuring in winter, July ± one month	46	4	8.9
Phase 3 - Low flow, under 500,000 ac ft per month, July to July	46	7	15.2
Phase 6 - Low flow, under 500,000 ac ft per month July to July			
Two or more successive years	46	2	4.3
Phase 7 - No floods for more than 12 months, plus failure of local precipation for longer than three months	46	2	4.3

million acre feet per month, and exceptionally high flow is defined as greater than three million acre feet per month at Lock 9.

Table 4.3 presents the number of episodes of Phase 1 to Phase 7 which were recorded between 1931 and 1981.

Yearly flux

Commonly, but not invariably, water levels in the trunk river begin to rise with a small surge in May. Flow slowly increases through the cool season until flooding (defined as a flow greater than 500,000 acre feet per month) occurs in late spring. This flooding occurs in 84% of years. The river falls quickly. Low water levels can be expected through January to March, although flood surges occurred in these months in 11% of years. These are only probabilities. Within any one year, or between years, the river flow is characterised by high variability, with a rate of discharge between 0 and 7,600,000 acre feet per month.

In terms of food availability, there is a high probability of a flood reflux period occurring in this area between September and November. There is also a high probability that riverain reservoirs will be replenished each year by flood waters.

In the course of a year, it is likely that a brief period of food stress will occur in late summer, when low flow is extremely probable. If low flow is maintained for more than 24 months, it is likely that riverain reservoirs will be depleted, and even Lake Victoria, the largest reservoir, will begin to contract into a pool on the eastern side. Periods of prolonged river failure may be expected four times a century. Periods of drought and failure of precipitation in the hinterland have been correlated on two occasions.

Long term flux

Riverain resources, such as those on which the Aboriginals in the riverain depended would be adversely affected by

- a change in the season of flood flux. Floods in winter are far less beneficial. Floods int he summer or the autumn would not be as productive as spring floods

- increased frequency of overbank discharge, maintained for long periods. High overbank discharge can restrict access to important vegetable resources, and decrease availability of small game, fish and birds. Large floods can destroy areas of once productive Typha swamp

- a high frequency of 'paired drought years'. Dry intervals which lead to increased river tract salinization may have important long term consequences for the vegetation of the riverain (see Section 8.), as well as increasing food stress periods for populations depending on riverain foods. The lag effect in vegetation and reservoir carryover effects diminish sharply after paired drought years. A sequence of paired drought years, or a run of drought years over two years long might cause extreme hardship in a population which was solely dependent on riverain foods (cf Chapter 6).

4.6 Water and food in the hinterland

Records of food procurement in the hinterland of the Murray (landsystems 3 - 7) tend to emphasize the procurement of animals including large and small macropods, possums, rodents and reptiles (Krefft 1865:370; Clow 1898; Cudmore 1898; Hoffmaier 1960; May and Fullagar 1980). Curr (1883) noted Aboriginals of the Lake Boga district made regular visits to the mallee during

the spring to collect an edible exudate (lerp) which grew in previously burnt areas. (Eyre (1845 Vol 2:250) suggests green scrub (mallee) and other tree roots were occasionally eaten.

Although there are not satisfactory records describing the exploitation of vegetables and seeds, the widespread presence of grinding dishes suggests that grain and seed exploitation also occurred in hinterland areas.

Wickham, writing of the hinterlands near Mootwingee, 300 km to the north of Lake Victoria suggests that the most commonly available hinterland foods were seeds, particularly acacia seeds and grass seeds (especially those of native millett Panicum decompositum (Allen 1973; Wickham 1983). In the Lake Victoria area the distribution of available resources appears to have differed from areas to the north in that this area lies just to the south of the natural range of two staple crops, Acacia aneura, a prolific seeder, and Panicum decompositum, a valuable grass seed resource thrives (although there are some isolated areas where this grass may be found in the river tract).

Table 4.1 lists some of the seed resources which are available in the Lake Victoria hinterland. One of the most common seed plants is found in saline heavy soil areas - Portulaca oleracea This may well have provided a staple food in autumn.

Portalaca seeds, leaves and fruit, Acacia and grass seeds would tend to be clustered and reasonably reliable following local rain, but most hinterland resources are characterised by their patchy occurrence. Animal foods, judging by Krefft's (1865) descriptions of the animal life (see also Morton 1869), were plentiful. Today, lizards, rodents, small birds and macropods are frequently observed. Animal food procurement methods would have involved lengthy search time, and possibly procurement time (for many were obtained by digging), but, judging by the current distribution of resources, the search for animal food in the hinterland would always be rewarded by procurement of at least some small game, particularly reptiles even during the most arid periods.

As Wickham has pointed out, a foraging strategy which aimed to exploit vegetable resources away from the river would have to be designed to exploit foods given a suitable lag period after local rain. The availability of these resources then would be conditional on the availability of potable water coincident with the production of the resource. Decision making strategies in distant mallee exploitation would have to consider the value of a resource, in relation to the risks of water deprivation during the journey to exploit it (Hofmaier 1960; May and Fullagar 1980). The hinterland would be always accessible within a day's journey of standing water.

When standing water was available in the Great Anabranch and the Darling 'reservoirs' a large area of hinterland was accessible from the Lake Victoria/Murray valley area within a day's walk (say 20 km) (Fig 4.2). Foraging range would be extended for a time after rain by the availability of water in clay pans, or in lateral root systems of E. oleosa and some kinds of Hakea sp (Morton 1860:129). E. oleosa is common in the Lake Victoria area. Lateral roots store moisture following winter precipitation (Noble 1982 and pers comm) which may be available in considerable amounts. Cleland described how he 'cut a few feet of one of the radiating surface roots and blowing on one end quite a torrent of tasteless drinking water was expelled' (1957:159; see also Morton 1860). Since this moisture is apparently drawn upon by the plant during summer it is likely that the availability of this form of water may be limited to a period of 12 - 24 months following local rainfall. It is likely that following prolonged failure of local precipitation, this water source vanishes, and it certainly diminishes following a fire in the mallee (Noble, J., pers comm). Thus, the people at Lake Victoria could exploit quite a large area of hinterland without risk of water stress, provided water was either carried in skin bags or was available in clay pans or water bearing plants.

Good times and bad times

Hinterland resources respond to local precipitation. Allen points out:

> there are perennial plants which can seed twice or more times a year, perennials that will flower after rain in winter and others during summer and also annuals that have a winter or summer growing period. Thus as long as a minimum amount of precipitation occurs there will be plant foods available all over the area most of the year (1973:72, and Appendix 1, in reference to the hinterland of the Darling).

Local precipitation is shown below for Ned's Corner, 15 km from Lake Victoria

J	F	M	A	M	J	J	A	S	O	N	D	Total
15	20	17	18	21	20	24	21	18	18	14	18	243

Precipitation in millimetres, Ned's Corner, Victoria 1927 - 1972

The total annual precipitation is just below the 250 mm which is used to separate semi arid regions from desert.

Details of monthly and annual rainfall deciles, average number of rain days and highest 24 hour rainfall are given in Maher (1973:335). Maher points out that the simple averages conceal the basic characteristic of the precipitation pattern - unreliability and variability (loc cit). Precipitation certainly cannot be associated with any particular season.

Productivity and accessibility of vegetable resources in the hinterland in this area are typified by unpredictability. Animal food resources, in contrast, are characterised by low frequency but high availability, wherever water is available in the hinterland.

4.7 Systems interacting

If the 'carrying capacity' of an area is determined by the duration of the poorest season, then between 1940 and 1980 the phasing of resource availability as here defined would have resulted in one major stress period - in 1944/45, when local precipitation was combined with riverain failure.

The data on river flow patterns and local precipitation for a period of 24 months is presented below. The previous years had been years of prolonged low flow in the river, so we may suggest that at this time reservoir storage in the river had become very low, and riverain foods were exhausted.

1944	J	F	M	A	M	J	J	A	S	O	N	D
River	148	103	125	56	118	149	115	72	45	76	9	12
Precip	61	10	0	12	85	0	57	19	7	61	70	61

1945												
River	0	0	0	43	3	5	122	328	503	260	193	134
Precip	0	24	8	0	36	187	112	91	33	124	94	96

Precipitation in points, Ned's Corner, Victoria; River flow, acre feet per month. Lock 9. January 1944 to December 1945

January 1945 to May 1945 would have been a period of extreme food stress in the riverain tract, certainly the worst in the 50 years of record. During this time, some foods may have been available in the hinterland, following the moderately good local precipitation during the October to December period, which would have produced vegetative response in grasses, and meant that seeds and fruits would have been available outside the riverain tract. As earlier suggested, it is likely that at this time mallee animal resources, small game in particular, would have been available. Some large macropods could be expected to congregate in the area around the edges of the remaining water sources, between January and April, but these animals might have left the river in June, when a local fall of 187 points would

have filled hinterland clay pans. At the same time, the June 1945 downpour would have also opened much of the hinterland to Aboriginals.

As the above example shows the interaction of two systems would have lessened the chances of total resource failure in the long term. Larger groups could have been maintained during prolonged periods of riverain failure, such as those which occurred during the Pleistocene, by optimising the water resources of the riverain tract, and the food resources of the hinterland.

The shell midden deposits which are found on the lunette and in the hinterland are thus likely to reflect a foraging strategy which related strongly to intervals of drought stress in the river.

4.8 Population sightings, population mobility and subsistence in the ethnohistoric record, 1829 - 1860

Total population estimates

Table 4.4 summarises pre European settlement sightings of population in the Murray Darling Junction to Lake Victoria area, between 1829 and 1860. Two points must be made. First, these sightings were made during and immediately after the passage of a severe epidemic disease through the area. Second, all small groups observed in the first contact period were surprised. It is likely that small groups were rarely observed, thus the ethnohistoric record of population is biased in favour of large, and apparently formal groups. These two factors must be considered - however, the point to emerge from consideration of all available records from 1829 to 1854 is that the Lake Victoria area was comparatively populous (Figs 4.2, 4.3, Tables 4.4, 4.5) at least seasonally. Most of this population was probably restricted to the river and ecotone (Fig 4.1), through most of the year, because of the lack of standing water in the hinterland.

Table 4.4 Population sightings, Murray flood tract, Darling Junction to Lake Victoria between 1831 and 1841

Observer	Month, Year	First Contact	Sex	Activity	Group size
Sturt	Jan 26, 1831	Yes	M/F	Communicating, greeting	200*
	Jan 26, 1831	Yes	M/F	'greeting us'	250
	April 1831		M/F	Armed display	500
Hawdon	March 4 1836	Yes	M/F	Greeting	200
	March 4 1836	Yes	M/F	Greeting	200
	March 5 1836	Yes	M/F	Eating turtles on the river bank	50
	March 5 1836	Yes	M/F	Sighted, junction of Murray	'a tribe'
Buchannan	November 1839	No	M	Aggressive pursuit	'a good many'
Inman/Field	April 1841	No	-	Armed pursuit	300-400
	June 1841	No	-	Armed	30
Moorhouse	June 1841	No	M/F	Conflict	150
O'Halloran	July 1841	No		Fleeing from whites	8 canoes full

Table 4.4 Continued

Observer	Month, Year	First Contact	Sex	Activity	Group size
Tolmer	July 1841	No	-	Conflict	300
Moorhouse	July 1841	No	-	Retreating down the river	100
Moorhouse	July 1841	No	-	Dead, wounded	30 - 50
Sturt	October 1844	No	M/F	Fishing, kangarooing	69
	October 1844	No	M/F	Living in a village of 12 huts	87
Eyre	'Summer'	No	M/F	Fishing and collecting yabbies	600
Krefft	July 1869	No	M/F	Corroboree	200

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Sturt recognised head counts were unreliable estimators. He states:

> from the size and number of huts and from the great breadth of the footpaths we are led to conclude that we are passing through a very populous district. What the actual number of inhabitants are it is impossible to say, but we seldom communicate with less than 200 daily (1833:125-126).

Fig. 4.3. indicates where sightings were made.

After 1850 the parts of the Lake Victoria area area were settled, and stocked by sheep and cattle. In the summer of 1853 Goodwin travelled along both banks of the Murray from the Junction to the South Australian border, and also some way up the Darling (Fig 4.3) with the specific purpose of making a census of Aboriginal populations (Massola 1970:56). In the 1853/4 Report to the Melbourne Church of England Mission to the Aboriginals of Victoria Goodwin stated that if a mission station was set up at Yelta (Fig 4.3) on the Murray opposite the Darling Junction, missionaries would be 'brought into communication with 1,200 Aboriginals'.

Population movements

Mission records from Yelta are a valuable source of information on the cycle of clustering and dispersal - although it must be remembered that the numbers would be reflecting local food availability at the mission station as the Aboriginals incorporated the mission flour and sugar into the foraging strategies. With this caveat in mind, the annual reports of population at Yelta (Table 4.5) appear to confirm the initial impression of a high population moving between Lake Victoria, Yelta on the Darling and the Darling Anabranch (Fig 4.2).

Goodwin reported:

> they wander much and seldom remain many weeks in the same place. At the present time we have not many at Yelta, the greater part are away fishing (1858:7).

Aboriginals visited the Yelta mission and the junction fron Yartla on the Darling, from the South Australian border,

Fig 4.3 Population movements in the flood tract

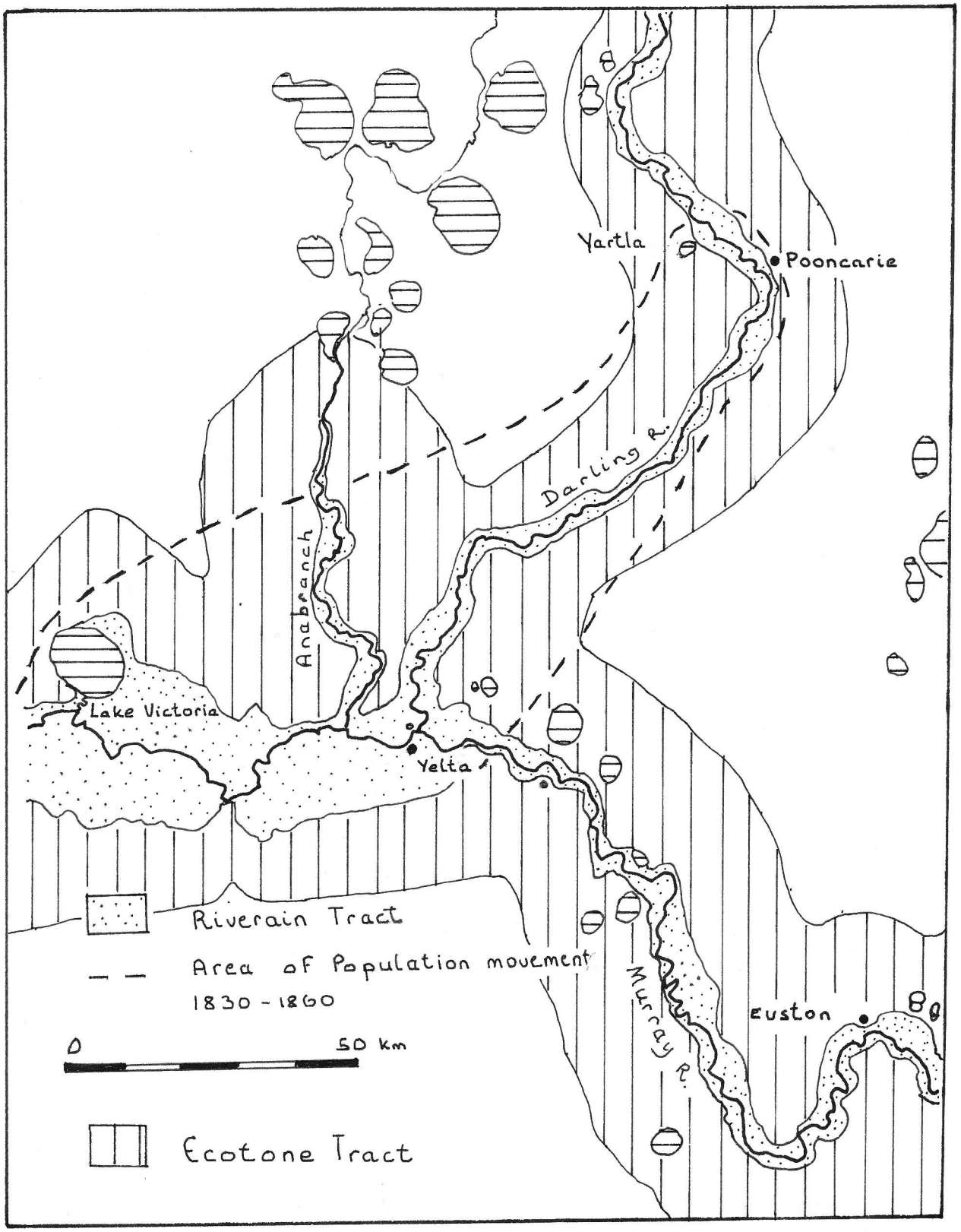

Table 4.5 Population movements to and from Yelta mission, Murray Darling junction 1854 - 1866

Year	Month	Number	Activity
1854		6 'tribes'	Living in the Murray/Darling junction area
1855			'Into communion with about 1,200 natives' from Yelta (1855:6)
1857	February 25		'All away to settle quarrels'
	January		'Gone 100 miles up the Darling to Yatala [Yartla]'
			'Returned on 25th January'
	April	80	80 adults present at Yelta
	April 25		'A large number assembled to corroboree'
1858	July		'They wander much, this July not many - away fishing (1858:7)
	December		The lower Darling tribes come to the junction to annual corroborees
186)	December		Adults away at corroboree time
1861	December		'Blacks here from Lake Victoria and the Rufus, so I do not expect them to remain long'
	March	45	45 blacks, some from the South Australian boundary
1863	January	60 - 70	60 - 70 blacks from Euston
	April		200 at the Wentworth camp 3 to 4 miles from Yelta
1964	April	150	A large number from upper river at Yelta, 150 to corroboree
	November		'As usual... few blacks at the station for the last 2 months, most employed shearing or fishing and ducking'
1865	February	150	150, more expected, a general assembly to corroboree
1866	March	25	25 at Lake Victoria

downstream of Lake Victoria, and from Euston, upstream of the junction, and the visits were reciprocated. Numbers at the mission varied from nine or ten up to two hundred or more (Goodwin 1860:1; Krefft 1865).

The flux of population was most marked between December and April. At this time corroborees were held. 'Corroborees' wrote Goodwin, despairing of his flock, 'are of the first importance in their eyes' (1864:6). He observed:

> their corroborees are generally held in summer, when fish and other kinds of food are more plentiful, so they can congregate in large numbers without fear of famine (1856:6; cf Sullivan 1977).

Eyre likewise noted the association between resource available in the flood flush period, and large gatherings:

> At Lake Victoria which is filled with the backwaters of the Murray I have seen six hundred natives encamped together, all of whom were living on the fish procured from the lake (1845:252).

Large gatherings were brief. Aboriginals, visiting from Yarlta, the South Australian border and Euston, were not expected to remain long at Yelta, which the missionaries remarked as an unfortunate circumstance. Yelta itself was usually deserted in November:

> as usual at this time of the year, there have been very few blacks at the station, most of the able bodied blacks are employing themselves fishing and ducking in the lagoons and creeks (1864:6).

Yelta records indicate a population which was highly mobile during the summer months, and sociable whenever possible - whenever food resources at the mission or in the riverain permitted. They assembled for games, barter, ritual activity and the settlement of disputes (Eyre 1845; Goodwin 1869; Beveridge 1883, 1889; Krefft 1865:365-367).

Group size

Groups of several hundred could assemble for specific purposes, summer and winter. It is apparent that excellent systems of communication existed between groups - they all spoke the same

language, Marowra, they had large footpaths, messengers and ambassadors (Goodwin 1845; Sturt cited above and 1833:125; Mitchell 1839:93).

There are few records of activities at other times. Eyre suggests that:

> they are probably scattered over their district in detached groups of separate families (1845: Vol 2:218).

As earlier indicated, small groups would apparently tend to avoid contact with parties of armed Europeans, which may have been a sensible strategy in view of the numbers of murders which parties of overlanders and travellers committed (Buchannan 1839; Tolmer 1882; Mitchell 1839).

Foraging range

The evidence from ethnohistoric records tends to suggest that Aboriginals in the Lake Victoria area were normally resident on the river (Sturt, 1833:92; Krefft 1865). Curr described, in the ecotone between the river and the hinterland, exploitation of large kangaroos, possums and burrowing rodents. As earlier mentioned, Curr described regular forays into the hinterland to procure lerp in the mallee eucalypt scrub (1883:430).

There is no other indication that hinterland foraging was seasonal or regular, rather it appears to have been fortuitous.

Population variation

In the areas of the Darling, it has been suggested that populations on the river were seasonally swollen by populations in retreat from summer stricken hinterlands (Allen 1973). Wickham had debated this claim, suggesting in the Mootwingee area, sufficient resources were available in hinterlands locally to support a population without the necessity to move each year to the river. In this area rock holes are available which store local precipitation. Good seasons in the hinterland, says Wickham, are synchronous with good seasons in the riverain in

this area. He suggests that the river was visited by people from the hillier hinterland for social reasons, and not out of economic necessity (1983:72).

In the Lake Victoria district, there are no records of a permanent hinterland population. There are no rocky outcrops within 200 km of the river which could act as long term reservoirs, as they do at Mootwingee and elsewhere on the Darling. Here, subsurface water which might be available in soaks tends to be saline. It is thus concluded that, given the erratic nature of local precipitation, and the absence of water reservoirs - it is unlikely that the hinterland outside the range of water was ever permanently populated, however, one record of residence in the area exists:

> It appears that about thirty years ago 'Nonnia' for some reason not rightly known bolted from Popiltah Lake with one or two lubras, and hid himself in the dense tract of mallee which covers the country for about 600 miles along the SA/NSW boundary, from the thirtieth to the eighty first milepost. Here he has carefully concealed himself from the whites and blacks, living on kangaroo and whatever he could get hold of, and obtained water from the roots of the red mallee and needle or waterbush (Cudmore 1898:534).

The fact that Nonnia and his family were able to live in the mallee immediately to the north of Lake Victoria for thirty years between 1860 and 1890 demonstrates that this area could have supported a low permanent population. They may, however have been assisted in the water quest by the provision of stock watering points. They were finally 'brought in' during the height of one of the most intense droughts in Australia's history - which may be significant. Nonnia's people were all in good health, and appeared fit, with the ususal 'splendid white teeth'. The mallee hinterland may have supported some people on a permanent basis, although it is unlikely that the population was ever particularly large, in view of the scarcity of water.

4.9 Food and water availability, and the ethnohistoric record

The area shown in Fig 4.3 may have been permanently occupied by at least 1,200 Aboriginals, during the years between 1829 and

1860. Of this number, most were living in the river tract. Population density, calculated over the area showing in Fig. 4.3 is one person to 6.6 sq km or one person to 1.3 sq km of riverain (1,600 sq km) plus 5.3 sq km of hinterland accessible from the riverain.

This population was apparently supported in the main by the resources of the river tract. Fish, aquatic birds and bullrush roots appear to have been the main foods.

The ethnohistoric record strongly suggests that the socio-cultural system took advantage of the post flood flush of foods occurring in either trunk river, both the erratic Darling and the Murray, which produced a flood in 79% or more of years.

Maintenance of a communications network would have facilitated the exchange of information. Collective exploitation of the post flood flush is documented on several occasions (Krefft 1864:359; Eyre 1845 Vol 2:251; Beveridge 1893:48). Large groups could manipulate the technology of weir construction, mound construction, large scale fish drives, large scale netting and egg collecting - all of which provided the food necessary to sustain large gatherings (Sullivan 1977). It is likely that 'flood following' was the most efficient way to exploit such variable resources, and that this contributed to the maintenance of such high populations in the area.

The ethnohistoric record leaves many gaps in information about exploitation during both times of 'normal flow' and drought.

The ethnohistoric record documents hinterland foraging - with stress on exploitation of animal foods in the area within 20 km of the river, but draws parallels between hinterland exploitation and the state of the river. With the exception of the collection of lerp, there is no indication that hinterland foraging was regular or seasonal.

4.10 Site prediction, the ethnohistoric record and the river record

The ethnohistoric record suggests that three main types of archaeological occupation deposit should be found in the riverain

(i) evidence of large brief gatherings, located near Lake Victoria, Lake Yartla, and on the bank of the Murray opposite Yelta mission station. Preferred locations for large gatherings, predicted on the basis of optimal resource availability, should have been areas with access to wetland vegetable resources, access to lake reflux and riverain reservoir reflux channels (where fish could be taken on spawning runs), and access to riverain forest where possums could be obtained

(ii) evidence of smaller, longer term gatherings, which would have occurred during 'normal' river flow periods with evidence for groups up to sixty, located in areas where river and reservoir resources could be obtained.

The availability of resource in the river predicts a pattern which would be related to river flow regime

(a) large groups, assembled to exploit the post flood flush, cf (i) above.

We would expect this type of site to be characterised by young fish, small bird bones and eggshells

(b) smaller groups exploiting the reservoirs in the river tract and the trunk river, cf (ii) above

(c) large groups, taking refuge from large floods on high banks of the river exploiting riverain and displaced animals, possibly supplementing them with terrestrial resources of the hinterland (Krefft 1864:310).

We would not expect to find shellfish associated with these flood refuge deposits, since high and turbid water would make shellfish difficult to procure during floods

(d) large groups, occupying the banks of trunk river channels, during extreme droughts.

We would expect to find in these sites the remains of extremely large fish, plus shellfish, which would become accessible as waters fell. It is likely that these sites would exhibit some stratification, as occupation as in (c), could be prolonged. We should also expect to find evidence for late summer exploitation in these sites

(e) small groups, exploiting resources of the hinterland. These groups would be associated with small scale, wide range foraging in the mallee at any season, in search of game or scattered vegetable resources

(f) groups, unpredictable size, exploiting predictable vegetable resources in the hinterland areas which carried grasses, seeding trees or portulaca.

These sites would be associated with evidence for seed/grain processing, such as grinding stones

(g) groups exploiting the ecotone between the riverain and the hinterland, remaining within reach of available water, and combining resources of the flood tract with resources of the hinterland.

This type of site should be characteristic of water stress conditions in the riverain and in the hinterland, possibly this would be reflected in the faunal content

(h) groups exploiting large terrestrial animals in the hinterland.

These sites should be characterised by ovens and large hearths, rather than middens.

The archaeological record

Available information on the archaeological occupation deposits in the Lake Victoria area of the Murray is limited to that discussed in the previous chapter.

Briefly this evidence consists of:

1. A large site with grindstones, artefacts and hearths on the south eastern shore of Lake Victoria adjacent to the wetlands, and to the lake outlet (Thomas 1969:322).

2. Extensive (greater than a kilometre) long thin unstratified shell midden deposits in the river bank, within 100 metres of the water (Djekic 1980; personal observation).

3. Shell midden deposits on the high bank of the Murray, at Red Cliffs, Merbein, and on the river downstream from the Lake Victoria outlet (Coutts et al 1981; Walker 1981; Victorian Archaeological Survey Records nd).

4. Scarred trees, adjacent to the river channel and also on the high western bank of the lake basin (Djekic 1980).

5. Oven and hearth sites, found in areas of fine sediment, to the north, west and east of the lake basin, and also up to 10 km from the lake to the east (Gill 1973a; personal observation).

6. Extensive shell middens, known from the shoreline of Lake Victoria (personal observation), the lunette (Gill 1973; Thomas 1967; personal observation) up to 8 km from the lake margin towards the east (personal observation), and on the western bank and northern bank for up to 50 km from the lake margin (Djekic 1980; personal observation).

The contents of these deposits are not well known, but the available evidence suggests that the large site (1) occupies an optimal position for exploiting a large range of wetlands resources, plus access to an area of local grassland, which occurred in the area east of the horn of the lunette.

Similarly site (2) could be explained as the results of a single brief large gathering. Shell middens on the high banks may prove to have been formed during long stays on the river bank in floods or extremes of drought (in the case of the Red Cliffs midden, the contents, including gastropods, suggest a period of low water (Victorian Archaeological Survey Records ms 1979)).

The most perplexing of all archaeological traces are the large shell middens which appear in the hinterland up to 50 km from the nearest source of shell.

The existence of these shell middens at such considerable distances from the lake supports the hypothesis that people moved out into the hinterland - but the content of the deposits suggests that people in the hinterland were still dependent on resources of the river. (Possibly the more visible shell is masking more substantial evidence for hinterland foraging. Aspects of the patterns of shell midden distribution around Lake Victoria will be further discussed in the following chapter.

4.11 Conclusion

Consideration of the available resources and the extant records of Aboriginal population in the Murray Darling junction to Lake Victoria area demonstrate the importance of the resources of the river tract in supporting people throughout most of the year, and in particular, in providing most of the resources which enabled the area to support a relatively dense population, in comparison with populations in areas of desert to the north and south of the river tract.

Since the resources of the river depend on the passage of flood fluxes, the season and duration and frequency of floods is singled out as the most significant factor in population movements in the Lake Victoria region.

The availability of resources is modelled on the assumption that river flow patterns in the period 1829 - 1860 would have been similar to those of the period between 1932 - 1982 for which river discharge is known for the area immediately upstream of Lake Victoria.

Flood pulses were received at Lake Victoria in 80% of years. Flooding would have filled flood plain 'reservoirs' including Lake Victoria, and ensured (i) a period of post flood abundance, during which fish, birds and vegetable resources would have been abundant, and adequate to maintain large groups for periods up to six weeks, and (ii) as floods subsided, water resources in the flood plain, and associated food resources, particularly the roots of the bullrush (Typha spp) would have been available for up to two years. If floods failed for more than 24 months, water and wetlands resources would have been reduced to very low levels, which might have adversely affected food availability to a population, assuming that population was solely dependent on the resources of the river tract. In the 50 years on record, such 'paired drought years' occurred twice. Given the flow patterns of the last 50 years, riverain resources would have failed at least once in each human generation (estimated at 24 years).

Assuming that the populations of the river tract were also exploiting the resources of the hinterland within reach of water (estimated at c 20 km from the trunk rivers), hinterland expoitation would have increased during periods of low flow in the trunk river, and particularly during 'paired drought years', or long intervals of riverain failure.

Table 4.6 Predicted location and content of occupation deposits, riverain

Phase	State of river	Predicted contents	Predicted location
1	Flood flush	Large thin deposits, containing young fish, aquatic birds eggs, fledgelings shell fish and crustacea if a low flood.	Lake edge, river tract, inlets to river.
	Seasonal		
2	Reservoir exploitation	Hearths for cooking roots, tubers, possums. small game, birds in moult, large game.	River tract, reservoir, wetland margins, raised areas.
	Seasonal		Mallee/river boundary.
3	Low flow Seasonal (late summer)	As Phase 2, aquatic supplemented by arboreal animals, shellfish and fish	Close to river, deeper pools
4	High floods	As Phase 1 but outside the river tract, no shellfish, reptiles, amphibians.	High banks of river.
5	Low flow, more than 12 consecutive months	Large fish from drying pools, shellfish, crustacea.	Pools, river meanders bends, reservoir deep pools or soaks, lunette.
	Low flow, more than 24 consecutive months	Shellfish, crustacea, large terrestrial fauna, which need to drink, 'carried' hinterland foods.	Pools, springs or soaks in river bed, lunette.

The hinterland is likely to have been exploited by small groups, in view of the patchy resource distribution - in particular water. It is argued that the exploitation of the hinterland added variety to the diet in most years, and provided a major proportion of the resources during paired drought years.

Implications for the formation of archaeological occupation deposits

If the area around Lake Victoria is divided into three zones, (i) the riverain, (ii) the ecotone - the area within a day's walk of standing water in the hinterland, and (iii) the hinterland more than 20 km from standing water (Fig 4.3) we would predict differing patterns of occupation in each zone, and consequently differing patterns of archaeological deposits.

The distribution of resources, and the ethnohistoric record both suggest that most occupation deposits would have been formed in the river flood plain, zone (i), which is an extremely poor preservation environment, given river meander migration and flood sedimentation. What little is known of archaeological deposits in the riverain suggests that there may be some evidence for large middens.

In the mallee away from the trunk rivers, zone (iii), we would expect evidence for exploitation of mallee root or clay pan water supplies, and the exploitation of mallee kangaroo, small game such as lizards, and available fruit and seed resources. In view of the absence of large sources of water, we would predict that exploitation of zone (iii) would lead to the formation of small hearth sites, possibly in areas where soaks would be expected, or clay pans fill after heavy rain, or around swales where mallee roots contained water.

In zone (ii), the ecotone zone, the distribution of available resources suggests that we might find evidence for the exploitation of large animals which require drinking water, riverain foods, plus the resources of the hinterland.

Ethnohistoric sources suggest that we might find the traces of exploitation of large game, of specialized resources like lerp mallee fowl eggs or Portulaca seeds, in addition to the resources of the mallee. We would expect the ecotone to be (i) rich in hearths, (ii) contain evidence for specialized seasonal exploitation of lerp, Portulaca and mallee fowl in localized areas, and (iii) to contain the traces of small groups which would have been exploiting hinterland resources during river failure periods.

When the known archaeological evidence for foraging is examined it becomes clear that the ecotone is rich in hearths (as yet uninvestigated), but that the most common and visible deposits in the area to 10 km or more from the riverain are shell middens. Shell middens are, so far as is known, unstratified, and range in size from 1 metre in diameter to 50 metres across. As previously discussed, the presence of these extensive middens cannot be explained by reference to ethnohistory, nor by the distribution of available resources. Shells must have been carried from lakes and river billabongs out into the ecotone zone. In some cases tonnes of shell were carried up to 5 km from the riverain and deposited in thin occupation horizons, suggesting a single brief meal by a large group.

It is proposed (i) that shellfish were a low ranked food, not normally exploited (Appendix B), (ii) that shellfish were more easily available during periods of low water, in riverain drought, and (iii) that the extensive shell middens in areas up to 10 km from the nearest water were deposited by groups temporarily camping outside the river tract, away from standing water - possibly to avoid disturbing game - and that these groups were exploiting the resources of both riverain and hinterland, in such a way that large groups could still be maintained.

If shell midden deposits were formed during periods of drought, the evidence should survive in the geomorphic context, and in

the contents of the middens, and in the growth patterns of midden shells (Feary 1981).

Aspects of these problems are further discussed in the following chapter.