DEPARTMENT OF MINES AND ENERGY

SOUTH AUSTRALIA

OPEN FILE ENVELOPE SERIES

This report was supplied by a private organisation as part of the requirement to hold a mineral exploration tenement in the State of South Australia or for work sponsored by the Department of Mines and Energy .

The Department accepts no responsibility for statements made , or conclusions drawn in the report or for the quality of the original text or drawings which in some cases are below an acceptable standard for microfilming .

CONTENTS ENVELOPE 6747

TENEMENT: Not Related.

TENEMENT HOLDER: National Parks & Wildlife Service.

NATIONAL PARKS AND WILDLIFE SERVICE: A DIVISION OF THE DEPARTMENT OF ENVIRONMENT AND PLANNING

DRAFT MANAGEMENT PLAN

Gammon Ranges National Park

Northern Flinders Ranges, SOUTH AUSTRALIA

NATIONAL PARKS AND WILDLIFE SERVICE: A DIVISION OF THE DEPARTMENT OF ENVIRONMENT AND PLANNING

DRAFT MANAGEMENT PLAN

Gammon Ranges National Park

Northern Flinders Ranges, SOUTH AUSTRALIA

December 1985

Published by Department of Environment and Planning
December 1985

ISBN 7243 8750 1

Compiled by
Programmes Branch, National Parks and Wildlife Service

Cartography and Design
Drafting Branch, Technical Services Division
DEPARTMENT OF ENVIRONMENT AND PLANNING

Editing
Adelaide Editorial Services

Printed
D. J. Woolman, Government Printer

Cover Photograph
View from above Bunyip Chasm to Mt McKinlay Bluff
(R. E. Clay and H. J. Aslin)

FOREWORD

The Gammon Ranges National Park in the far north of South Australia is an area of considerable biological, geological and cultural interest. The scenic values and wilderness qualities have for many years made it a favourite destination for intrepid travellers. At the same time it has remained the spiritual home of Aboriginal people who live in the region.

The Gammon Plateau and its immediate surrounds was originally proclaimed as a national park in 1970 under the National Parks Act, 1966. The Balcanoona lease area was purchased in 1970 and most of it (including the remainder of the ranges proper, Mount McKinlay, and Weetootla Gorge) added to the park in April 1982. This raised the reserved area to 100 928 hectares. In 1984, a further area, the Balcanoona Plains Block, was added to the park. This was a significant addition, which greatly increased the diversity of flora and fauna represented in the park, and reserved the entire length of Balcanoona Creek to its terminus in Lake Frome. This addition brought the total area of the park to 128 228 hectares. The entire area is now managed by the National Parks and Wildlife Service in accordance with the National Parks and Wildlife Act, 1972-1981 and its Regulations, and this draft management plan has been prepared for public comment in accordance with Sections 38 and 39 of the Act.

Because of increasing public awareness of the park and the establishment of a major new town at Leigh Creek, only a relatively short distance from the park, there has been a steady increase in the number of visitors to the Gammon Ranges area. This increased visitation places new demands upon the park and exacerbates the need for clearly perceived management prescriptions to ensure the intrinsic qualities of the area are maintained and that its cultural and biological values are protected and, where appropriate, enhanced.

Thus, one of the most important roles of this management plan is to clearly set out a management strategy which will ensure the conservation of the area and its significant features, as well as provide adequate opportunities for appropriate visitor uses. As a first step in preparing this draft plan, public comments were sought and a number of submissions were received from interested groups and individuals which provided a variety of ideas as to how the area should be managed. Clearly it is not possible to satisfy everyone's wishes in preparing such a plan. However, it is considered that the plan provides an equitable compromise which will protect the area's natural and cultural resources, particularly those of special significance, while fostering visitor awareness of the area and allowing appropriate visitor use.

Comments from interested members of the public on any of the management proposals outlined in this draft plan are now invited. Submissions will be received for a period of two months after the date of gazettal.

Any enquiries with regard to the plan should be made to either:

The Regional Manager
National Parks and Wildlife Service
Northern Region
Mackay Street
Port Augusta, SA 5700
(Telephone 086 42 3800)

or

The Senior Planning Officer
National Parks and Wildlife Service
10th Floor
55 Grenfell Street
Adelaide, SA 5000
(Telephone 08 216 7892)

Written submissions on the draft plan should be addressed to:

The Director
National Parks and Wildlife Service
Box 1782 GPO
Adelaide, SA 5001

N.P. Newland
ACTING DIRECTOR
NATIONAL PARKS AND WILDLIFE SEPVICE

ACKNOWLEDGEMENTS

This draft management plan has been prepared by the staff of the Programmes Branch of the National Parks and Wildlife Service. Figures and layout of the document were prepared by the Drafting Branch of the Department of Environment and Planning, and final editing was carried out by Adelaide Editorial Services.

The assistance given by all persons and organisations in the preparation of this plan is gratefully acknowledged. Particular thanks are due to:
A. Fox for the preparation of a preliminary draft of this management plan.
N. Hermes and A. Morris for collecting the bulk of the field data.
I. May, R. Young, R. Sprigg, J. Clyde, and N. Reid are thanked for their various contributions.

The South Australian Ornithological Association is thanked for information on birds which was based on information provided by Ms J. Paton.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

THE PLANNING PROCESS

Plans of management are documents prepared by the National Parks and Wildlife Service which contain a set of principles governing the future management of reserves. Such plans are required for all reserves administered by the Service. Section 38 of the National Parks and Wildlife Act, 1972-1981 states that plans of management shall set forth proposals in relation to the management and improvement of a reserve as well as indicate the means by which the objectives of the Act may be accomplished.

Once a draft plan has been prepared, it must be announced in the Government Gazette and placed on public exhibition for at least one month. Any person may then make submissions and these must be referred to the Reserves Advisory Committee, who may make further comments or suggestions.

The Minister, after considering all representations, may then adopt the plan of management with or without any alterations. Notice of such official adoption is published in the Government Gazette and copies of the plan are made available to the public.

A similar process applies for any amendment proposed to a plan of management. Once a plan of management is adopted, its provisions must be carried out in relation to the reserve in question and no operations undertaken unless they are in accordance with the plan.

THE GAMMON RANGES NATIONAL PARK

Interest in establishing a national park in the northern Flinders Ranges region began in the late 1940s when Professor Sir Kerr Grant commented during a visit to the Mount Painter uranium prospects-"This wonderful country ought to be made a national park." Mr Warren Bonython immediately followed this with a radio broadcast emphasising the wilderness and scenic values of the Gammon Ranges. The Adelaide Bushwalkers commenced walking the northern Flinders Ranges in 1947 and from within this group support for the park concept grew. Added incentive to this national park movement came in 1964 with the application for a mining exploration licence over the Gammon Ranges. Bonython, with the support of the Flora and Fauna Advisory Committee, of which he was a member, pressed the Government to create a "primitive" or "wilderness" reserve. Negotiations continued, and four years later the Director of Lands wrote to the National Parks Commission seeking its acceptance or otherwise of 15 500 hectares of the re-organised Yancaninna pastoral lease. The area included Mainwater Pound, Arcoona Pound and Gammon Hill. The Gammon Ranges National Park was proclaimed on 30 September 1970. However, this area was seen as merely the beginning.

Considerable activity by the Nature Conservation Society of South Australia and others culminated in the proclamation of a further 82 000 hectares from the Balcanoona pastoral lease which had been purchased by the Government. Shortly after, the Hon. David Wotton, MP, Minister of Environment and Planning, with Mrs Elsie Jackson representing the Aboriginal people of the region, officially opened the park. More recently, the remaining area of the Balcanoona pastoral lease, the Balcanoona Plains block, was proclaimed and brought the total area of the park in 1985 to 128 228 hectares.

The location of the present park in relation to other parks in the north of South Australia is shown in Figure 1 and details of its major features are illustrated in Figure 2.

The characteristics of the area which motivated action to establish this national park included:

- the wilderness character of the spectacular scenery;
- geological features such as fossils, structures, stratigraphy, and mineralogy;
- the geomorphic story, particularly of the Pleistocene and Recent periods, with drainage systems ranging from a thousand metres altitude to base level;
- the physical and climatic conditions supporting relict species and communities;
- botanic features including regional endemic species (for example, Eucalyptus gillii), relict species (for example, Melaleuca uncinata) and rare species (for example, Acacia araneosa);
- the relative abundance of the Yellow-footed Rock-wallaby and numerous interesting bird species;
- the presence of very significant examples of ancient Aboriginal rock carvings, sites of significance, and occupation sites;
- the possibility that the Gammon Ranges area could become the core for a very much larger national park in terms of size, scenery, geological diversity and its location towards the more arid end of the Flinders Ranges region (in this regard there is growing support for the Arkaroola lands to be added to the park);
- a rapidly increasing user demand for such areas relatively close to major national highways.

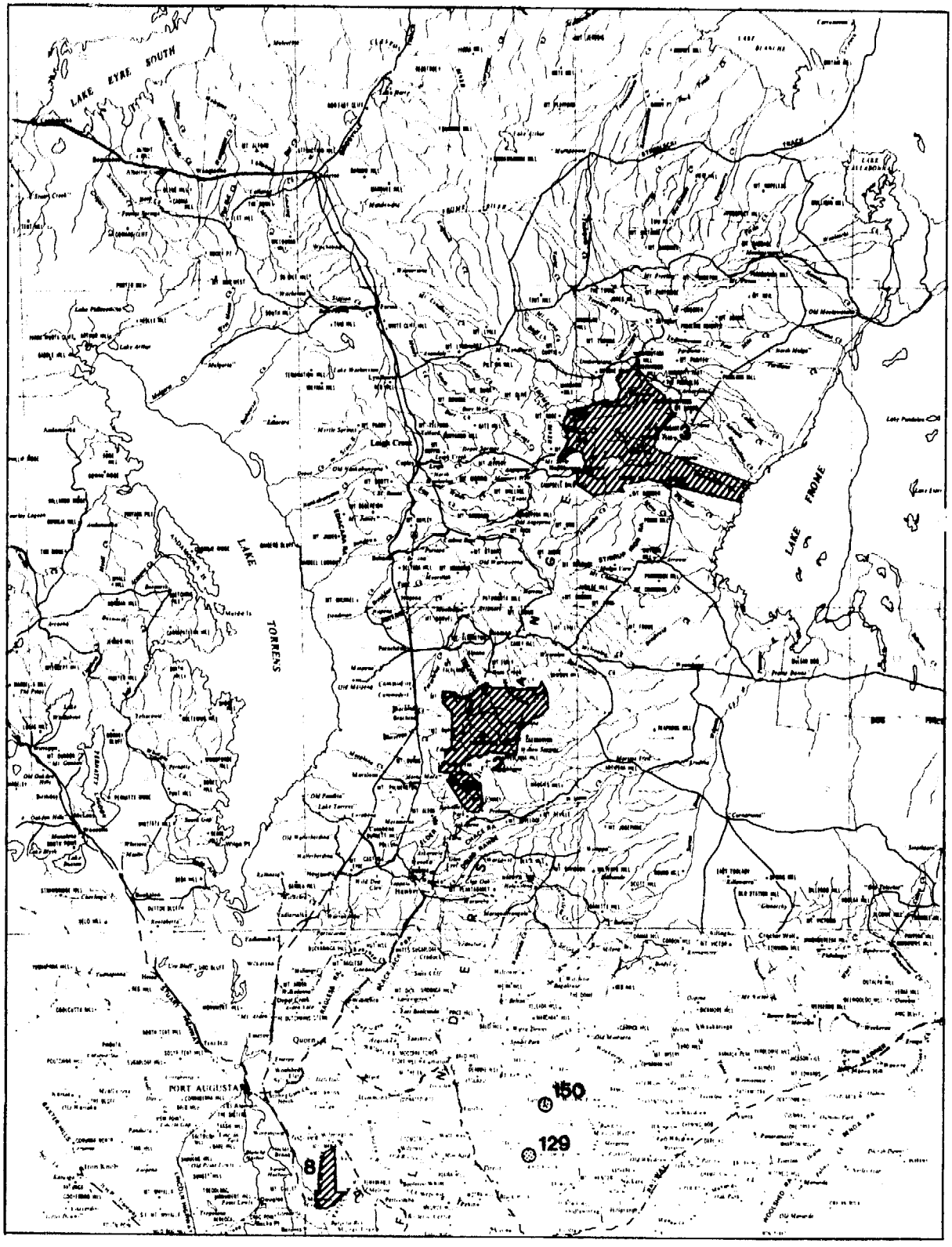
THE MANAGEMENT PLAN

It is the purpose of this plan of management to provide:

- an overview of the physical and cultural resources of the park;
- a review of the human use of the park and the region to date;
- a summary of constraints arising from the resource and human use studies;
- present and future directions for management;
- the derivation and establishment of management objectives;
- the aims of management;
- an outline of a management programme for the next 5 to 10 years.

The document is divided into five principal parts. The first part contains background information on the park and its setting, including the physical environment, history and biology as well as a brief description of current park usage and management. The second part includes a statement on the management philosophy for the park, and provides a general discussion of factors which must be considered in planning the future management of the park. The third part of the management plan lists broad management objectives while the fourth considers in detail the actions necessary to implement these objectives. The fifth and final part of the management plan presents, in summary form, the management actions which are recommended for the park.

Although the proposals in this draft plan provide for the management of the Gammon Ranges National Park as a whole, the recent extension of the park to include the Balcanoona Plains block has meant that some management issues



NATIONAL PARKS

2 Flinders Ranges
3 Gammon Ranges
8 Mount Remarkable

CONSERVATION PARKS

129 Black Rock
150 Yalpara

0 20 40 60 80 100Km

Figure 1

Flinders Ranges Region
Park Locations

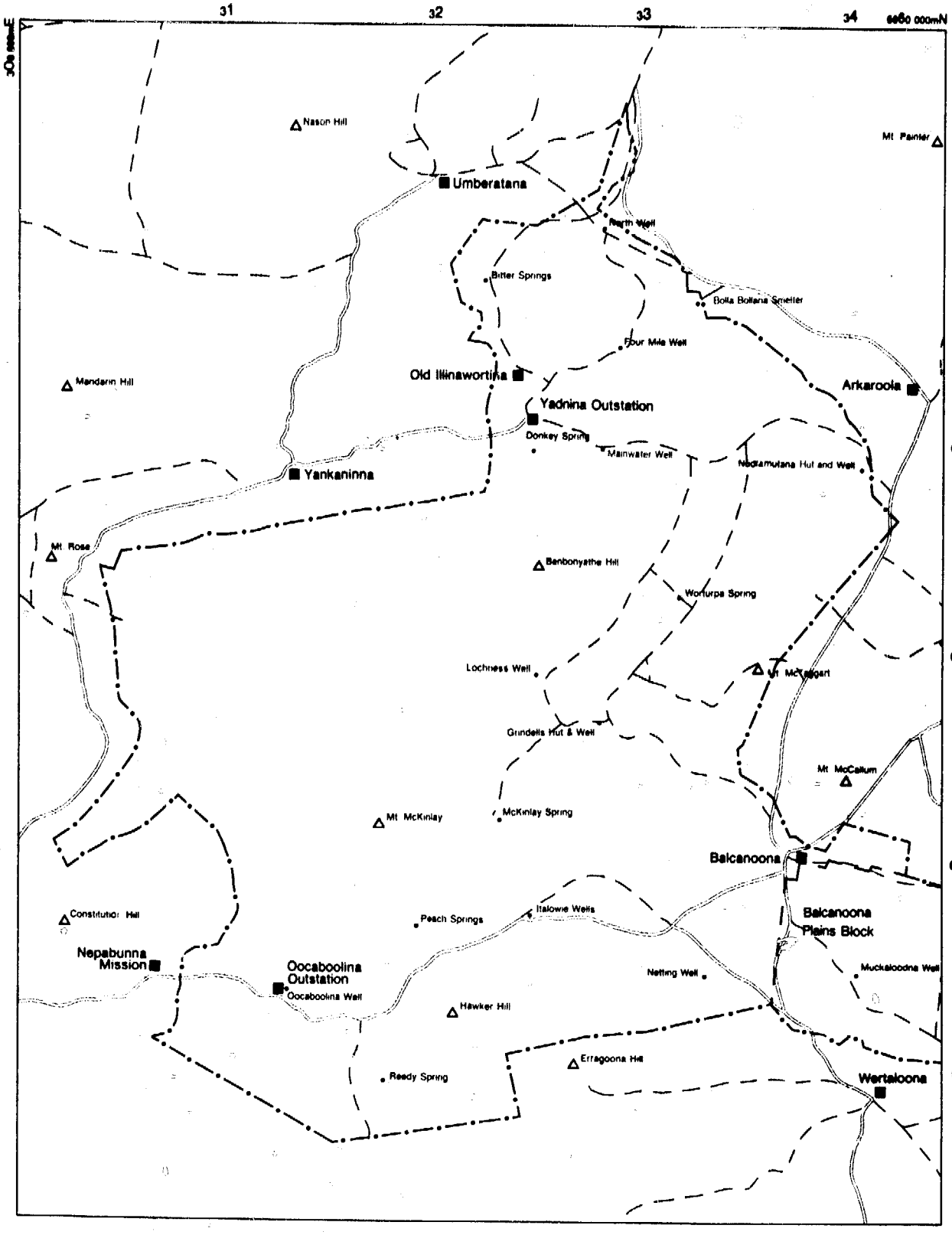


Figure 2

Park Features

relating directly to this new part of the park are yet to be fully examined. The particular needs of this area will be met in a subsequent revision of the management plan for the Gammon Ranges National Park.

Part 1

Background Information

CLIMATE

General

With the exception of the tops of the ranges, the climate of the northern Flinders Ranges is arid and continental. Average annual rainfall for Balcanoona Station is 220 millimetres with January maximum and minimum temperatures averaging 36°C, and 18.5°C respectively. There is a huge moisture deficit with a mean annual evaporation rate of 3 000-3 500 millimetres. Rainfall records have been kept at Balcanoona Station since 1937 and at Wooltana Station from pre-1880 to 1940. Wooltana and Balcanoona records of rainfall are graphed in Figure 3. Both recording stations lie in very similar geographic positions 20 kilometres apart. For the years 1950, 1955, and 1974, the rainfall records from Arkaroola Station are included in the graph to indicate the significant differences which can occur in the area over short distances. These differences are caused mainly by the great altitudinal range in the park (3 metres below sea level to 1 064 metres above sea level), local rain shadow effects, and the north/south trend in the ranges which lies across the general movement of weather systems.

The only predictable factor regarding rainfall is its unpredictability. The summer maxima occurs over January, February and March (Figure 3). The source of this weather is from tropical cyclones which become rain depressions and drift further south than usual. These falls are usually from storms, and violent downpours can occur. If these storms occur after a sustained dry period, intense runoff occurs with soil erosion and flash flooding, but the water from these summer rains disappears rapidly by evaporation.

Driest months are in winter but each month still has from 2 to 3 wet days on the average and the water is likely to remain longer due to the cooler temperatures. However, it is the nature of continental arid climates to make a nonsense of averaged figures and there have been years with 14 wet days in January with 309 millimetres of rain and 9 wet days in June with 100 millimetres of rain.

An important effect of the very rare major falls is the major regeneration of Mulga (Acacia aneura) and Northern Cypress Pine (Callitris columellaris). There is of course an immediate response throughout the flora, but these dominant species require very special falls.

If rains are a seemingly "accidental" phenomenon, then droughts are the norm. The worst drought on record was from 1960 to 1967, which ironically occurred between the wettest years on record. At such times species which may have become established beyond their long-term distribution limits, wilt and die. During the preparation of this plan (1982) a severe drought was in progress. The impact of this drought on wildlife species was noted in Chambers Gorge where an assessed drop of 60 per cent in the Euro population due to starvation occurred in a six-week period.

Over the cooler months of winter, spring-fed streams such as Weetootla and Balcanoona creeks have an increased length of running water regardless of rain due to the decreased evapotranspiration losses.

Temperatures in excess of 38°C are relatively common from November through to February and a maximum of 45°C has been recorded. Diurnal range is considerable and averages 16°C. Frosts may occur in June, July and August, and the lowest temperature recorded was -5°C. Dehydration is a formidable problem for fauna over the summer months of November, December, January, February and early March. A number of human deaths have also occurred in the region from this cause. Many species of birds move out of the area or to higher levels to avoid the extreme heat.

Fire is not usually a problem, however, under certain conditions wildfire can spread over wide areas and be almost uncontrollable. Following several years of above average rain, a dense vegetation cover develops. In following dry seasons much of this material is cured, which increases its flammability.

TABLE I: YEARLY RAINFALL AT BALCANOONA STATION

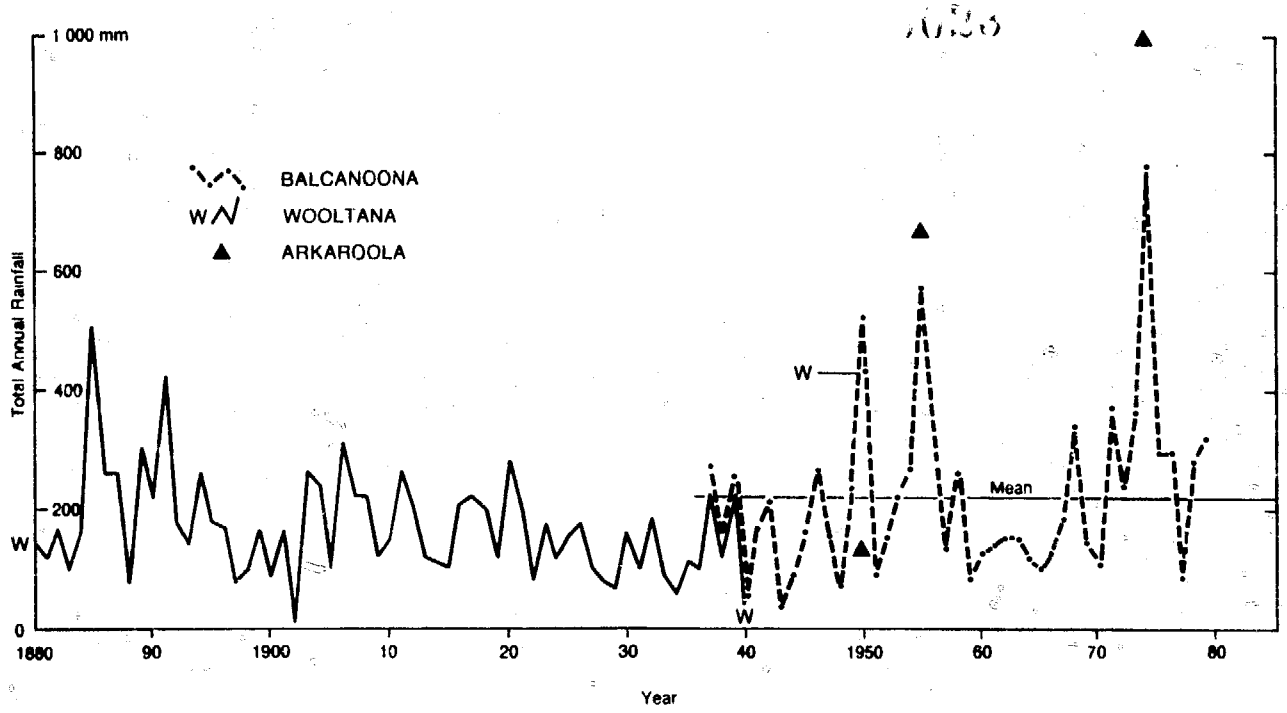
YEAR	NUMBER OF WET DAYS	PRECIPITATION (mm)	YEAR	NUMBER OF WET DAYS	PRECIPITATION (mm)
1937	*	266	1960	24	128
1938	*	130	1961	32	139
1939	*	226	1962	22	152
1940	*	58	1963	31	152
1941	*	164	1964	25	121
1942	*	213	1965	28	98
1943	*	37	1966	33	124
1944	*	89	1967	23	185
1945	32	162	1968	44	343
1946	30	265	1969	36	147
1947	45	154	1970	17	117
1948	16	74	1971	29	310
1949	42	236	1972	21	241
1950	46	526	1973	45	364
1951	12	89	1974	54	779
1952	57	155	1975	47	297
1953	37	220	1976	20	298
1954	34	270	1977	16	93
1955	63	578	1978	32	283
1956	30	342	1979	41	321
1957	25	136	1980	*	*
1958	34	263	1981	24	188
1959	22	83	1982	11	46
1960	24	128	1983	23	121

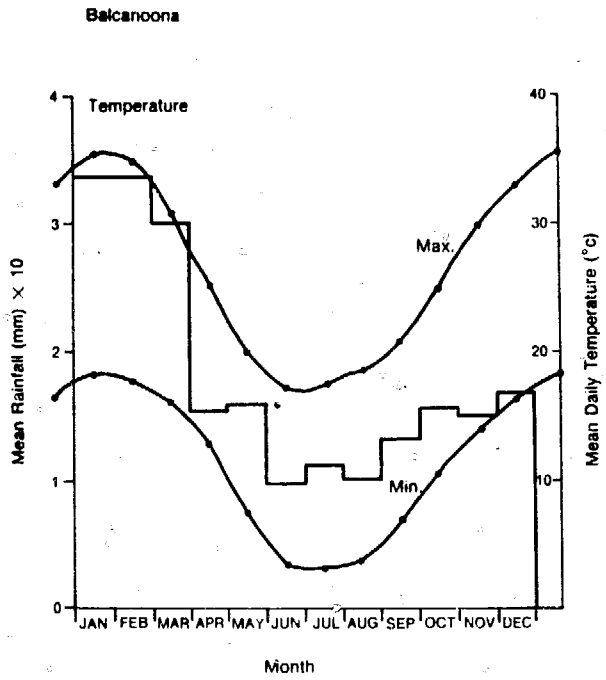
* = missing observations

Implications For Management

1. Visitor safety may be threatened by the climatic characteristics. Problems may include:

   - intense unpredictable rainfall causing flash flooding, particularly in the chasms and narrow gorges;
   - the high risk of dehydration from November to March caused by intense heat and low humidity;
   - the drying-up of water supplies;
   - the presence of unstable air over the mountains may be a hazard for aircraft, particularly over summer months.





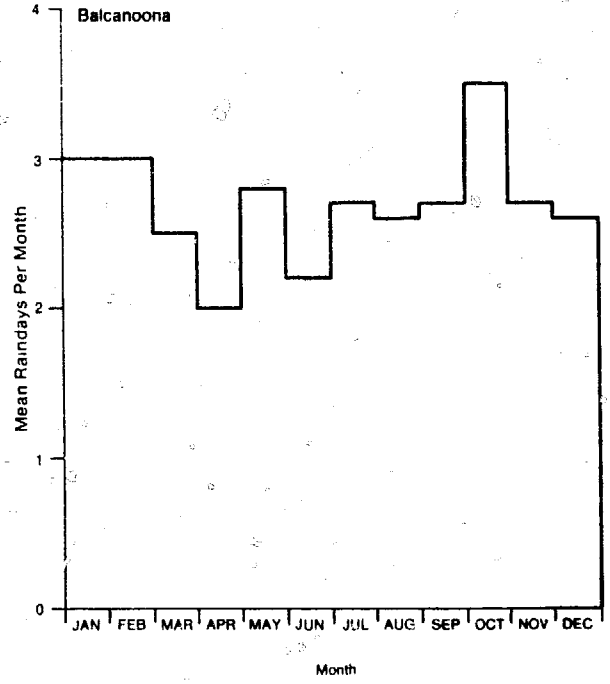


Figure 3

Rainfall and Temperature

2. Lack of knowledge of continental climates may cause visitors to be unprepared for low evening temperatures, particularly from May to August.

3. Infrequent flushing of watercourses requires utmost care with water use, particularly with the use of pollutants such as soap and detergents.

4. Wildlife are totally dependent on the waterholes, wells and springs and camping should not be close to these permanent water sources.

5. Fires ignited by thunderstorms are a problem only after a buildup of fuel following rare high rainfall periods or in particular vegetation communities, for example, mature spinifex.

6. Considerable natural reduction in some wildlife populations occurs towards the latter stages of intense drought from stress induced by lack of water and/or the deterioration of the producer parts of the ecosystem.

7. Because water is such a critical resource, its supply can be used to manage both wildlife and visitors.

8. Severe dust storms which reduce visibility can be a hazard and add much to discomfort.

LANDSCAPE AND GEOMORPHOLOGY

Laut et al. (1977) have divided the area of the Gammon Ranges National Park into part of four environmental associations. These are illustrated in Figure 4 to show their relative locations.

The landscape of the Flinders Ranges is controlled by geological structure and rock type. The cycle of erosion initiated over the fold and fault systems has etched the detail. The Gammon and Warraweena associations dominate the park landscape, both being associated with very resistant Pound Quartzite.

The drainage pattern is concordant with the structure of the resistant quartzites. Where streams rise on the heights and drain across the strike they have cut down minor faults, joints, and sometimes along the strike planes. Consequently, these streams have a trellised pattern. Parts of their courses are in very narrow chasms like Bunyip Chasm and gorges such as Wildflower Creek. Local faulting has produced the McKinlay Bluffs.

Yackie Waterhole, a permanent spring on a south-western headwater of Bolla Bollana creek is a most sacred Aboriginal site, and it is said the "Arkaroo", the great dreamtime ancestor snake which created the sinuous course of Arkaroola Creek, now sleeps in this spring. The rumblings of the local geological faults can still be heard as Arkaroo's belly rumbles from drinking so much of Lake Frome's salt water.

Rising in the stretched and weakened crest of the anticlines, Arcoona Creek has cut a series of gorges and narrow valleys. Waterfalls and plunge pools (rock holes) are a common feature of all streams draining the Gammon Ranges following rain. Runoff is rapid and falls are short lived but seepage occurs for a considerable period. Fern grottos are common in such places as the first waterfall of Bunyip Chasm.

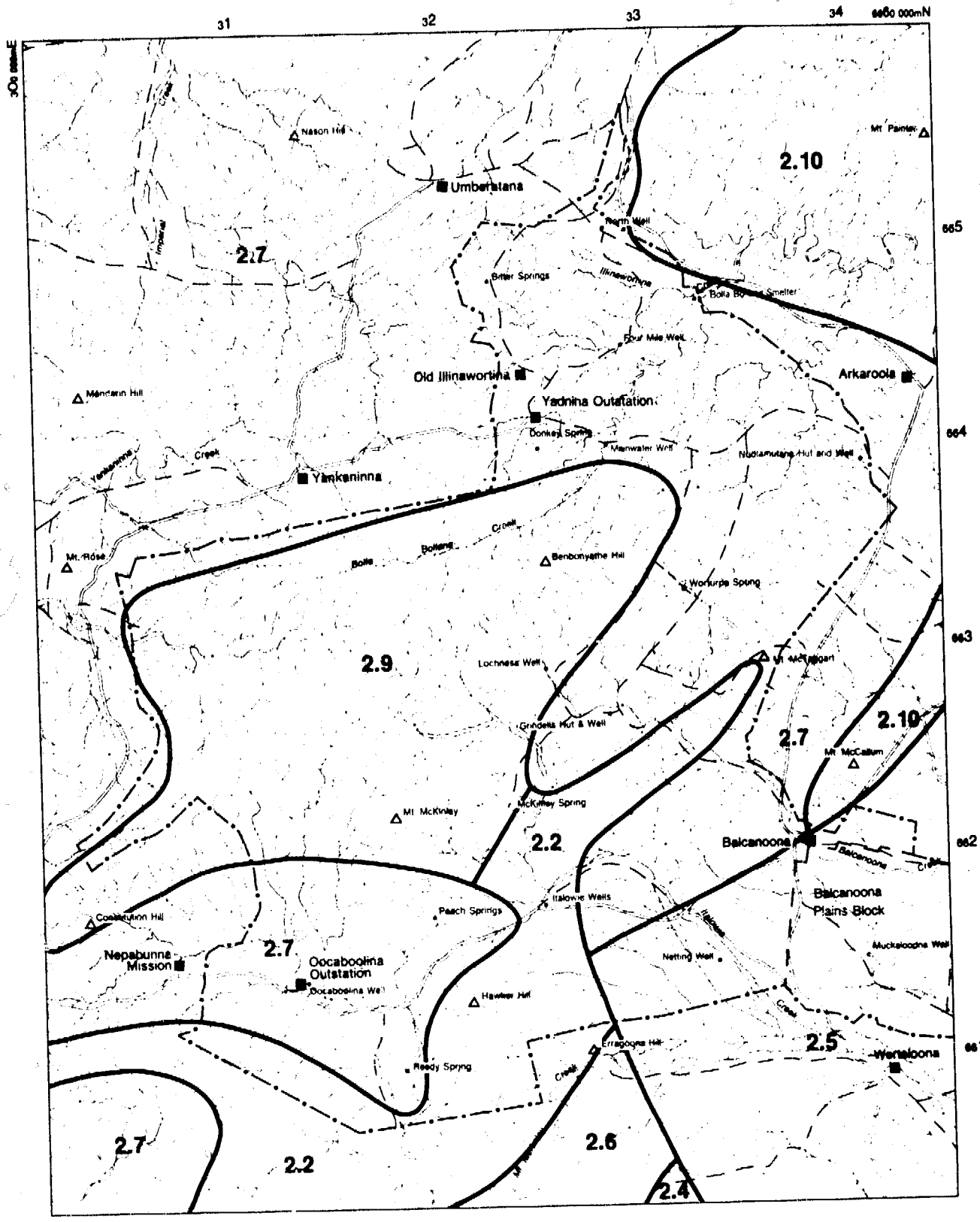
The southern limb of the anticline from Mount McKinlay to Mount Rowe plunges into a deep syncline and rises again to an elliptical dome-like structure; Hawker Hill and Hawker Pound. Cradled between these two features is a broad low area of Hawker Group limestone, siltstone and shale hills. This is part of the Yerelina Environmental Association.

The Hawker Hill complex of resistant Pound Quartzites is part of the Warraweena Environmental Association. Physically it is very similar to the Gammon Environmental Association though it is 250 metres lower in elevation, and being eroded into narrower ridges is more akin to the network of high quartzite strike ridges and corridors which run almost to Wilpena. Here again, the stretched and weakened crest of the anticline has been breached by erosion exposing the older Wonoka Formation of shales, limestones and dolomites, which form a classic pound (Figure 5). Four creeks have transected the plunging quartzite walls to the east and have carved narrow gorges to drain the pound into Big John Creek. The retreat of quartzitic slopes produces massive scree slopes of mobile blocks.

The Balcanoona Range of massive quartzitic tillite is separated from Hawker Hill by Italowie Gorge which has developed where the Pound Quartzites have been pinched off, faulted, and shattered. The older Balcanoona Range block is now juxtaposed against the Pound Quartzites, but erosion has been accentuated in the weakened faulted and shattered area. Some of the matrix binding the tillite boulders has a high proportion of dolomite and subsequent weathering has produced caverns and overhangs which are used by birds, euros, wallabies and carpet pythons for shelter, as at Weetootla Gorge. Because of its similar geomorphic features this block has been added to the Hawker Hill/Warraweena Environmental Association.

Most extensive of the environmental associations in the park is the Yerelina Environmental Association. It consists of low ranges, usually parallel, with hogbacks, hills, and rolling plains. There are two distinct areas separated by Pound Quartzites. First, the north-eastern crescent comprising older parallel ridges and valleys marking the more and less resistant rocks of the basin underlying the Pound Quartzites. Second, the younger Hawker Group cupped in the Pound Quartzites between the Gammon Ranges and Hawker Hill. This latter area is a more subdued landscape of rolling hills drained by the dendritic tributaries of Big John and Mount McKinlay creeks. In the north-eastern crescent, the major streams such as Bolla Bollana, Whywhyana and Oodnaminta appear to have superimposed mature meandering channel patterns on the geometric ridge and valley landscape. This was the area of heaviest stocking during the pastoral lease period prior to 1980 and shows greatest accumulated damage.

With the recent addition of the Balcanoona Plains block to the park, the Balcanoona Environmental Association now forms a significant and scientifically important part of the park. The association includes the Balcanoona Creek outwash fan and completes the story of an arid zone stream. The creek runs from an altitude of 1 064 metres in the Gammon Ranges to sea level at the point where it enters Lake Frome. It is also important because this plain includes the only sample of Mitchell Grass country reserved for nature conservation purposes in South Australia. As such it is the best Red Kangaroo (Macropus rufus) habitat in the park. This environmental association is structurally very young and is part of the coalescing alluvial fans deposited between 30 000 and 40 000 years BP during a period of high rainfall. A dry period during the last glacial maxima, and the increasing humidity since, has caused streams to cut braided courses into the alluvial fans. There is still insufficient rainfall to recommence fan deposition. The Balcanoona to Wertaloona road crosses the plain of coalescing fans at Balcanoona Creek, Italowie Creek and Big John (Mount McKinlay) Creek. Erosion by Italowie Creek across its fan has exhumed mid-Tertiary conglomerates apparently associated with an earlier alluvial fan-building episode.



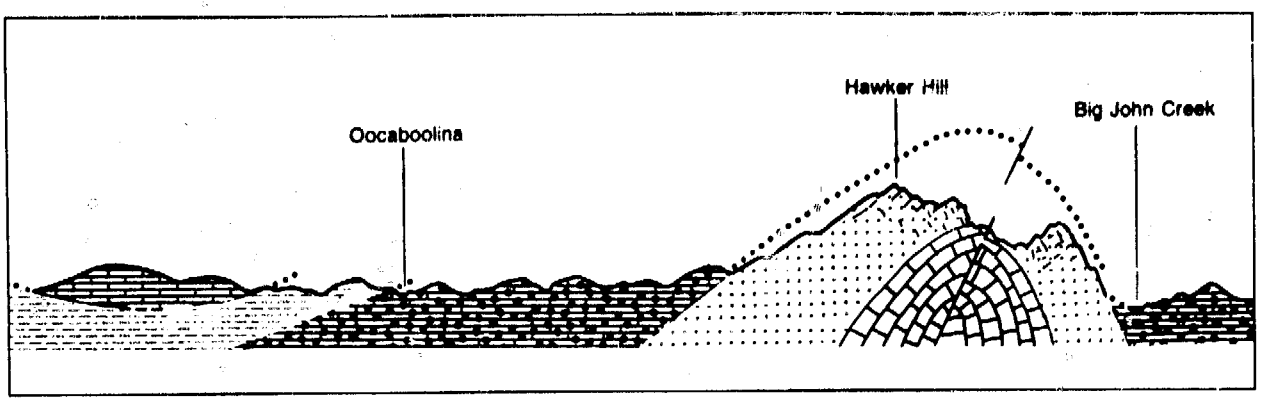
1.4	Environmental association number	2.5	Balcanoona
	Environmental association boundary	2.6	Erragoona
	Park boundary	2.7	Yerelina
2.10	Yudnamutana	2.9	Gammon
2.2	Warrawaena		
2.4	Outouie		

0 5 10 km

Figure 4

Environmental Associations

Source: Laut *et al* (1977)



CAMBRIAN
Hawker Group
Parara Limestone
Nepabunna Siltstone
Wilkawillina Limestone
PRECAMBRIAN
Wilpena Group
Pound Quartzite
Wonoka Formation

Figure 5

Geological Relationship of Pound Quartzite

GEOLOGY

Introduction

South Australia lies on the eastern edge of the Australian Shield, a composite block of crystalline rocks and the oldest part of Australia. This formation stabilised during the Pre-Cambrian era but from time to time areas of downwarping occurred forming basins which filled with sediments. The eastern edge of the Australian Shield began to break into pieces, sink, and some parts drifted off. These outliers include the Mount Painter Block of Arkaroola and the Willyama Block of the Broken Hill region. Onto the subsiding continental shelf were deposited vast depths of sand, muds, and limy muds which included organisms, grits, gravels, and boulders. These outliers became inliers surrounded by the sediments (Figures 6 and 7).

One such formation was the Adelaide Geosyncline which filled and became part of the great belt of sedimentary rocks which extend from Mount Lofty and the Flinders Ranges to the Musgrave Block. At its thickest, the sequence of sediments reaches about 24 000 metres. Although each element of this sequence varies in thickness and type according to the source of the sediments; the method of its transport (water, ice); and the condition of the basin (dry, marshy, freshwater shallows, marine shallows or deep water); there exists remarkable continuity in sedimentation throughout the geosyncline. One implication for park management is that the interpretive programmes for parks within each of the six regions of the Adelaide Geosyncline should present a coherent picture of this great geological province.

For further information on the geology of the Gammon Ranges National Park see Ludbrook (1980).

Features

Figures 8 and 9 show the relationship of the geology to the park and indicate features of management significance.

The rugged scenery of the Gammon Ranges National Park is largely the result of varying weathering and erosion characteristics of the sediments, and the fact that these strata range from hundreds of metres (for example, the Pound Quartzite) to a fraction of a metre in thickness. The strata which are present within the park and range from the deepest to the most shallow formations are described below.

The Callana Group

The Callana Group strata are poorly represented in the park. The deep sediments of this group have been subjected to considerable geological pressures. Folding and faulting began in the Cambrian period when the group became mobile and were squeezed through the fractured cover rocks or into the anticlines towards the surface. Subsequent erosion has exposed these as diapiric areas. Along with the injection of these old plastic sediments, mineral vapours and fluids were mobilised and eventually stabilised in and around the diapirs, which are now the most intensively mined areas.

The Burra Group

The Burra Group of sandstones, siltstones, limestones, and dolomites, were deposited in shallow seas and lagoons and this is evidenced by air-dried mud cracks. Blue-green algae lived layer upon layer, forming organo-sedimentary masses called stromatolites in the carbonate rocks, particularly in the Skillogalee Dolomite.

The Umberatana Group
About 650 million years ago the climate became much colder. Highlands from the Kimberleys to Tasmania carried extensive glaciers. During two distinct glacial periods, 6 000 metres of tillites (ice-carried boulders set in fine mud) and shales were deposited. These tillites form the Umberatana Group.

The Wilpena Group
Formation of the Wilpena Group began with the end of the ice age, when sea level rose and temperatures generally increased. This triggered a new cycle of sedimentary deposition in the region. About 7 000 metres of mainly red and purple shales, ripple-marked mudstones, sandstones, and quartzites were deposited. Interbedded with these were dolomites mixed with muds. Pound Quartzite, the most resistant of the rocks of the geosyncline, forms many of the most dominant features of the park such as McKinlay Bluff and Bunyip Chasm. The Pound Quartzite also contains the earliest known animal fossils in its upper layers. These are known as the Ediacara fossil beds.

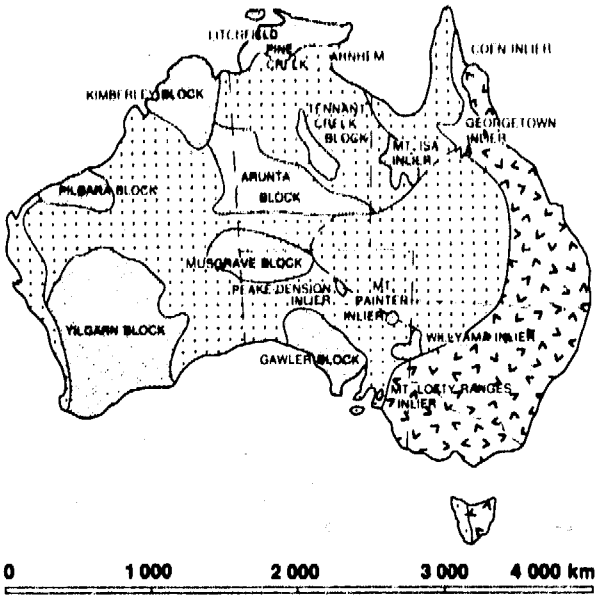
The Hawker Group
The Hawker Group sediments of the early Palaeozoic were deposited on the floor of a shallow basin with warm seas 20° north of the present equator, that is, 50° north of the present position. Coral-like animals (Archaeocyatha), and stromatolite-building algae flourished and formed reef limestones.

The major geological processes which acted on these strata to produce the present landscape are described below. About the middle Cambrian, extensive uplifting, folding, and faulting concluded the major deposition phases. It seems that the northern Flinders Ranges arched upwards in a series of great corrugations with massive faulting and shattering, particularly on the eastern edge of the ranges. At the peak of tectonic activity about 500 million years ago (late Cambrian) the intrusion of granites took place in the Mount Painter Province of Arkaroola. Weathering, erosion, and transport of debris continued; weakened crests of folds (anticlines) were breached; and softer materials etched out by erosion exposed a maze of concentric elliptical ridges and valleys.

During Jurassic and Cretaceous times (150 to 60 million years ago) the great "Flinders Peninsula" was lapped by a vast lake of fresh water. Later, this was invaded by the sea from the north. Sands eroded from the "coastal" ranges were deposited to form the Great Artesian Basin. Dinosaurs lived in the estuaries, coastal swamps and lagoons of the basin. Early drainage and river patterns became superimposed across deeper beds and structural patterns, and were rejuvenated in the Tertiary period when uplift and faulting was reactivated. This activity coincided with the break and drift of Australia from Gondwanaland. The late Tertiary was the time of the uplift of the Flinders Ranges as we know it today, a process which is still continuing, and is the cause of earth tremors and massive rock falls which periodically occur.

The Paralana fault system marks active overthrusting faults. Here, the land is rising in the west and overrides outwash areas to the east. Behind Mount McTaggart, the shear zone has filled with high quality water and now forms a vast reserve.

Thirty to forty thousand years ago, during a wet climatic phase, the huge outwash alluvial fans which fringe the ranges were deposited and the lakes Eyre, Frome, and Torrens formed a perennial lake system. Giant marsupials such as the Diprotodon grazed the marshy edges of these lakes.



Australian Precambrian Shield

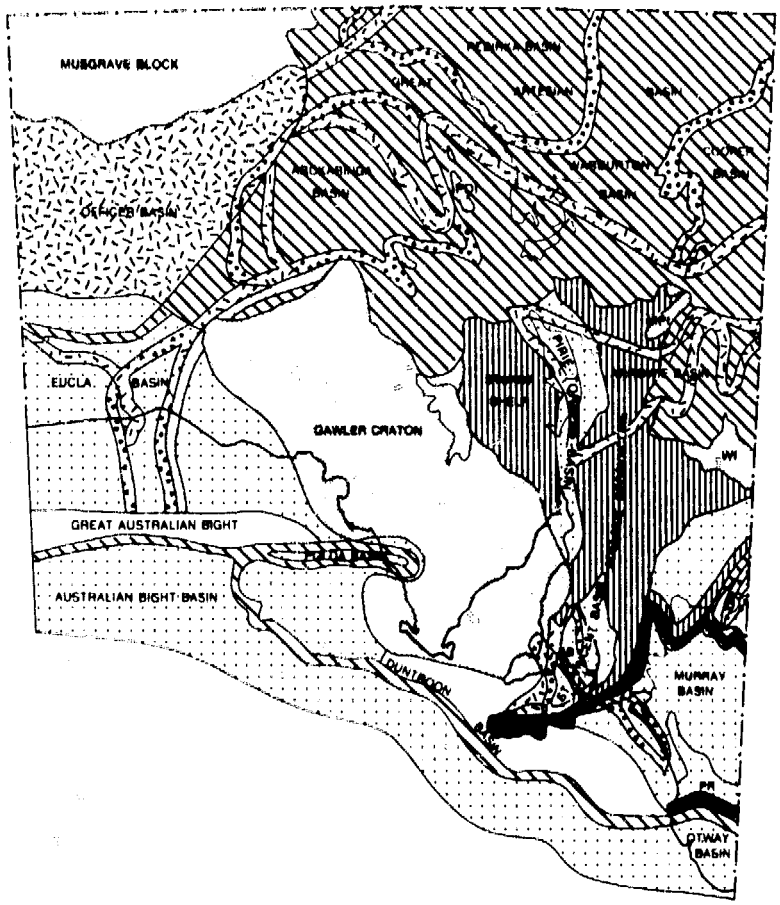
Areas of exposed crystalline basement

Tasman Geosyncline

Figure 6

Main Structural Elements of Australia (Geology)

Source: N. H. Ludbrook (1980)



Tertiary basins

Mesozoic basins

Permian basins

RT Renmark Trough

TB Troubridge Basin

Kanmantoo Trough and Cambrian—Ordovician granites

PR Padthaway Ridge

Cambrian—Devonian basins

SB Stansbury Basin

Adelaide Geosyncline and Stuart Shelf

Basement blocks

PDI Peake-Denison Inlier

MPI Mount Painter Inlier

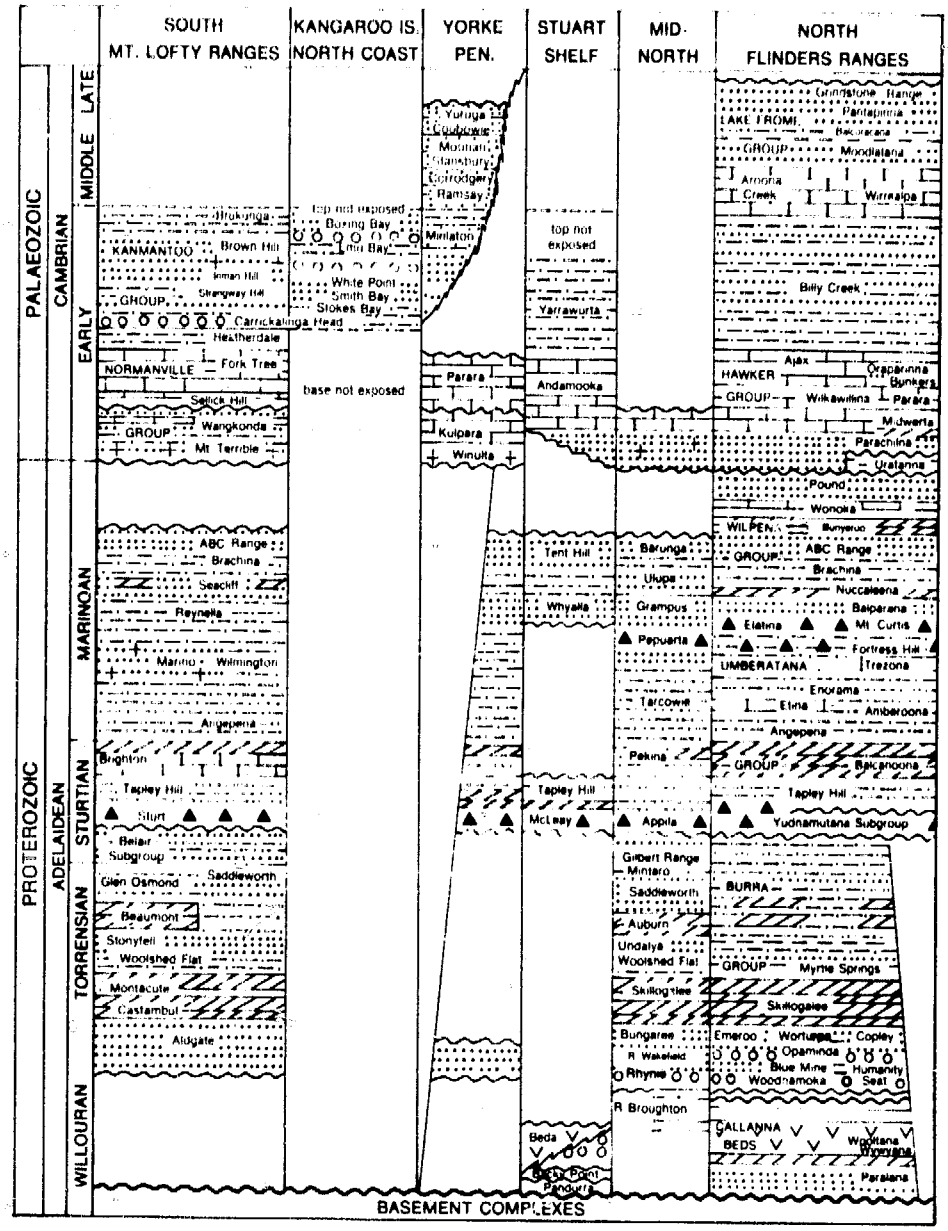
WI Willyama Inlier

0 200 400 600 800 km

Figure 3

Geological Provinces of South Australia

Source: N. H. Ludbrook (1980)



Sandstone, quartzite, greywacke

Conglomerate

Arkose

Shale, siltstone

Limestone

Dolomite

Tillite

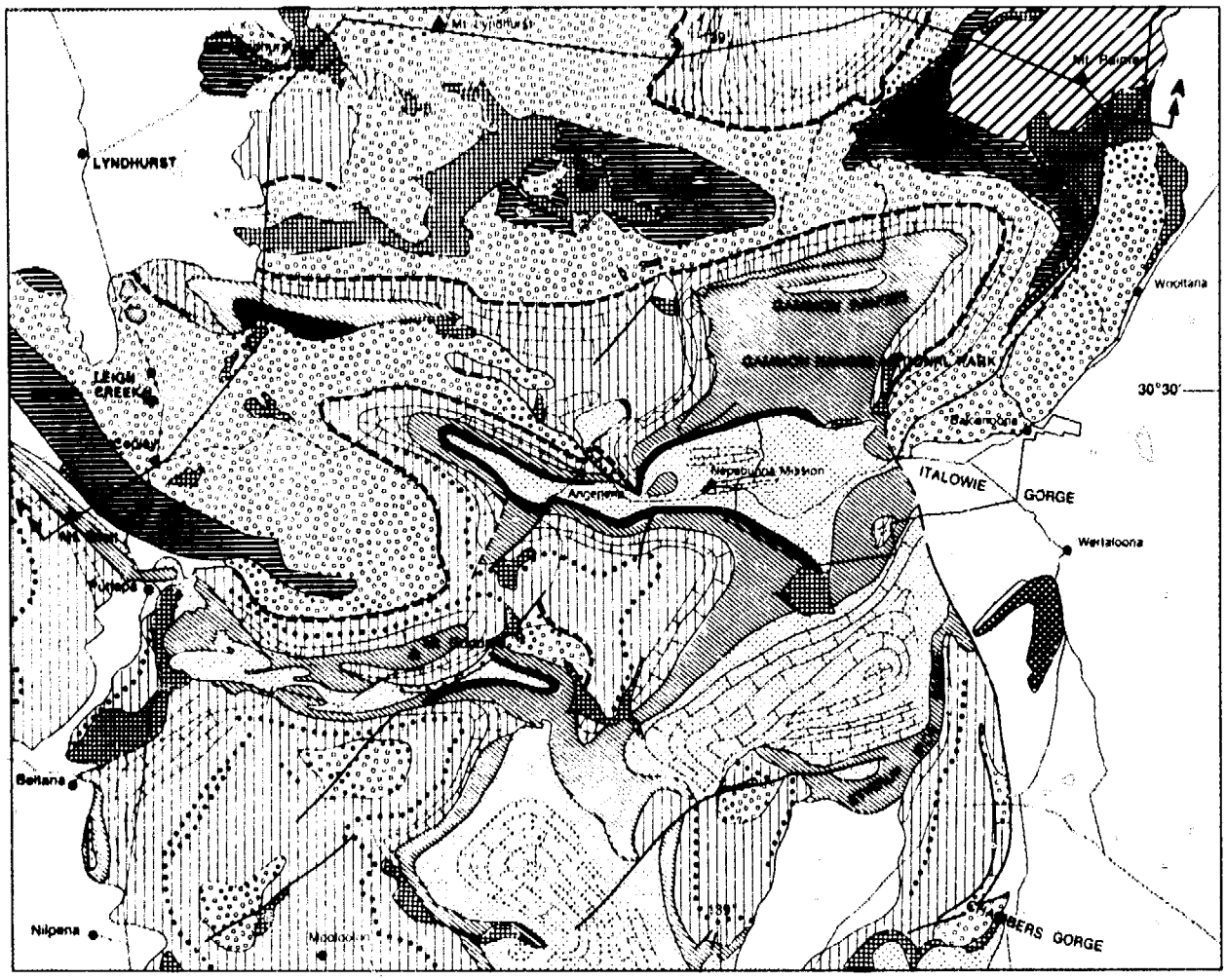
Volcanics

Unconformity or disconformity

Figure 8

Sedimentary Sequence in the Adelaide Geosyncline

Source: N. H. Ludbrook (1980)



SECTION A-A NATURAL SCALE

CAINOZOIC

Alluvium, dunes etc

TRIASSIC—JURASSIC

Leigh Creek Coal Measures

PALAEOZOIC

CAMBRIAN

Lake Frome Group

Billy Creek Formation

Hawker Group

Uratanna Formation

PROTEROZOIC

ADELAIDEAN — Wilpena Group

Pound Quartzite
Wonoka Formation
Bunyeroo Formation
ABC Range Quartzite
Brachina Formation
Nuccaleena Formation

MARINOAN

Umberatana Group

Burra Group

Callanna Beds in diapirs

Mt. Painter Complex

Fault

MARINOAN
TORRENSIAN
WILLOURAN

0 10 20 30 40 km

Figure 9

Folding and Faulting in the Northern Flinders Ranges

Source: Dept. of Mines and Energy, S.A. (1973)

Minerals

A considerable amount of mining has taken place in the park area (Figure10). This activity has been associated with mineralisation which occurs mainly along fault zones or in diapiric areas. Faulks (1980) provides details of the significant ventures.

The main deposits that have been worked and investigated include: McLeashes Copper Prospect-copper in the Blue Mine Conglomerate or the Woodnamoka Phyllite; Mount McTaggart Copper Prospect-copper and cobalt in the Yudnamutana Subgroup; O'Donoghue's Castle Mine-copper, cobalt, silver and gold in the Skillogalee Dolomite; and the Balcanoona Magnesite Deposit in the Balcanoona Formation. About 1,300 tonnes of carbonate and secondary sulphide ore have been raised from O'Donoghue's Castle Mine and about 40 tonnes of copper and gold ore from Monarch Mine. There are no records of production from the Loch Ness and Worturpa mines or the Mount McTaggart Prospect, although workings at Loch Ness and Worturpa are fairly extensive.

McLeashes Copper Prospect, O'Donoghue's Castle Mine, Mount McTaggart Copper Prospect, and the Balcanoona Magnesite Deposit all occur near the Paralana fault zone. There are also numerous occurrences of secondary copper minerals extending between McLeashes Copper Prospect in the north to beyond Mount McTaggart Copper Prospect in the south.

Beyond the Paralana fault zone, metallic mineralisation occurs in the Elatina and Nuccaleena formations at Worturpa Mine and along the margin of the diapir at Loch Ness Mine. Outside the former Balcanoona pastoral lease, a few kilometres to the south near the Arrowie fault zone and near Arrowie Gorge, there are extensive traces of copper, manganese, and some minor mercury mineralisation. A few kilometres to the north in the Umberatana-Yudnamutana-Daly mine area, extensive mineralisation occurs, with copper, gold, bismuth, and cobalt hosted by rocks of the Burra Group and Callana Beds.

Twenty-one licences to explore were granted between 1972 and 1982 and have resulted in coverage of a large part of the area.

The region has considerable mineral potential, particularly the eastern part of the park area near the Paralana and Arrowie fault zones. The main potential is for copper, cobalt, gold, and silver; magnesite in the Balcanoona Formation; barites on faults, especially near or emanating from diapirs, and in the Brachina or Wonoka formations; alunite in the Parachilna Formation; and slates suitable for billiard tables, paving and the like, in the Tapley Hill and Amberoona formations.

The plains marginal to the ranges also have potential for minerals including uranium, copper, kaolin, and bentonite.

Underground Water Resources

"Without water we cannot survive, and groundwater should be regarded as our most vital mineral resource" (Ludbrook 1980).

The resource survey for this management plan took place in 1982 during perhaps the worst drought on record. The importance of the distribution of watering points to wildlife population diversity and numbers was clearly evident throughout most habitats. Free-flowing springs such as Weetootla, Camel Yard and McKinlay springs provide the ultimate key to the survival of aquatic communities in the park. While in total area they are very small, in terms of the scientific importance of preserving environmental examples at the limits of their survival, their value is exceedingly high. Their continued existence is seriously threatened by exotic animals as is demonstrated by the contrast between a

fenced-off area and a freely accessible area at McKinlay Spring. Remarkably, three species of fish survive in these few hundred cubic metres of permanent water.

There are two types of aquifers which yield water for the wells and springs in the park. Unconsolidated sediments of sand, gravel, and boulders filling shallow local basins, valleys, channels and outwash deposits of similar materials in deltaic fans form one type while the other type is of fractured rocks with joints and fissures.

Table II lists the wells and bores of Balcanoona and indicates total depth, depth of water, capacity, and a rough quality assessment. It is critical that analyses of the water of each well and bore is undertaken as they will be used from time to time by the visiting public as drinking water. Almost all of the wells are associated with rubble-filled stream beds or small basins behind restrictions caused by the narrowing or barring of valleys by resistant rocks.

It should be noted that the figures provided in Table II were directly converted to metric equivalents from the Balcanoona Station Windmill and Plant Book. Dates of measurements are not given and the water quality figures appear to be total salts concentration measurements. Flow figures are much more relevant if the conditions at the time of measurement are known.

Potential groundwater resources have been investigated in the shear zone of the Paralana fault system west of Mount McTaggart. Dr R. Sprigg (personal communication) claims that this area contains probably the largest volume of potable water in the mountains, and he estimates that water should be available at more than one million litres per day.

TABLE II: UNDERGROUND WATER RESOURCES

Name	Depth (Incl. drives) (metres)	Quality gms/litre (all salts)	Flow Litres per day	Comment/recorded information
Black Oak Bore	26	?		Water salt, 14 metres of water in bore
Camel Yard Well	15.2	1.56	18 200	
Corral Well	11.0	1.56	9 000	Few problems/sunk July 1954
East Home Rule Bore	36.6	?	Dry	
Four Mile Well	8.2	.78	20 500	Consistent water supply
Fox Spring Well	11.6	2.07	22 000	Water at variable levels. New head required in 1982
Gleeson Well	15.24 (+4.3)	.78	18 200	Well dry in 1963. One metre in 1965

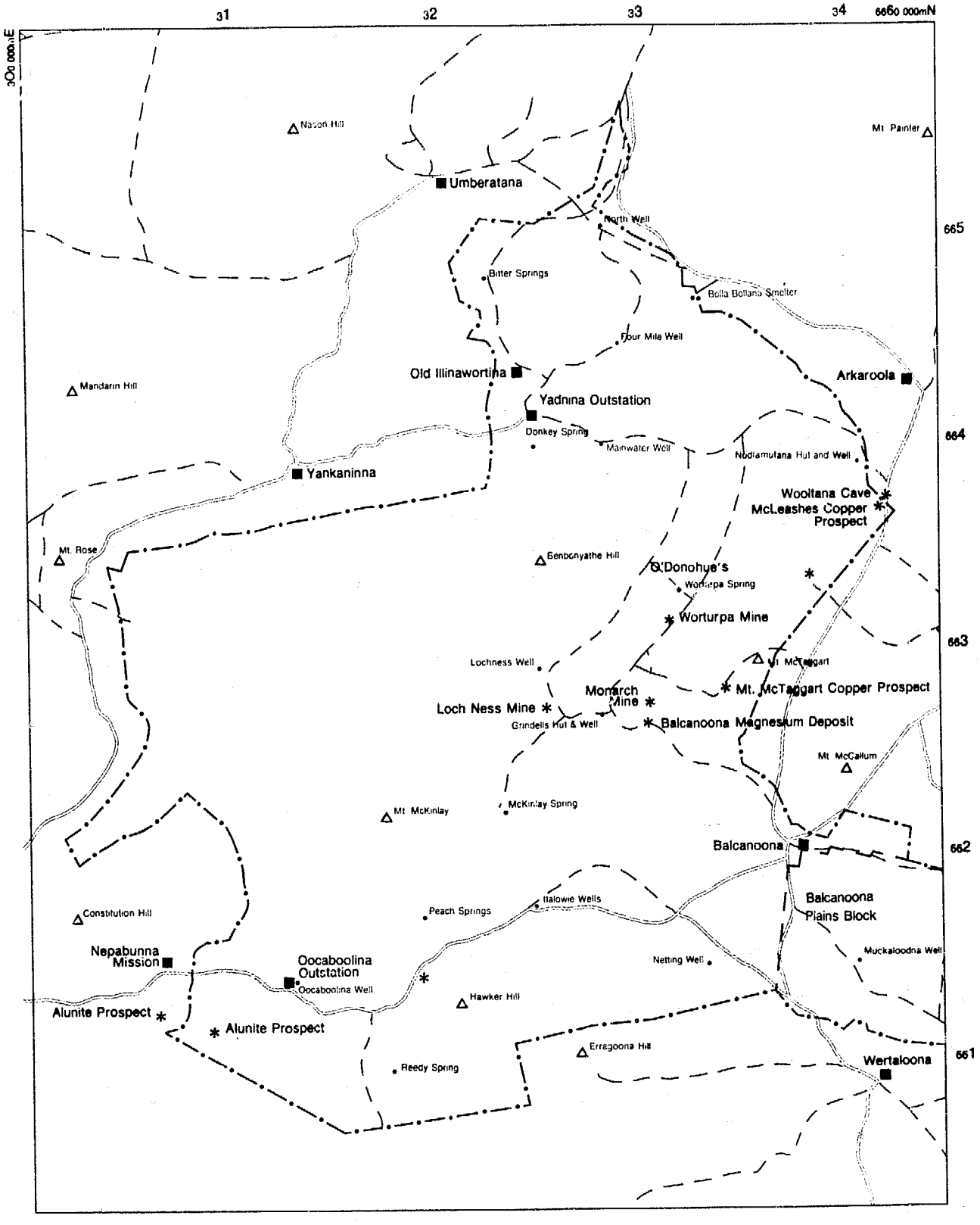


Figure 10

Mines and Mineral Occurrences

Source: Dept. of Mines and Energy South Australia (1980)

ABLE II Continued

Grindells Well	3.6	0	22 750	New mill and few problems when inspected in 1958
Home Rule Well	32.0	3.12	5 500	Requires maintenance
Homestead Well	19.5	3.12	54 500	Contained 12 metres of water but required much maintenance when inspected in 1961
Italowie (1) Well	7.6	.78	32 600	Few problems when inspected in 1955
Italowie (2) Well	16.7 (+18.3)	.78	11 400	In 1959 contained 8.2 metres water and had few problems
Illinawortina Well	21.3	1.56	27 275	New tower installed in 1952. Contained little water in 1965 and 1966
Loch Ness Well	15.2 (+24.7)	4.67	13 600	In 1964 had 1.5 metres of water and corrosion problem
Mallee Well	13.8	1.56	?	Water contains arsenic, kills stock. In 1964 a new pump and column was installed, then had 3.5 metres of water
Mainwater Well	10.7	.78	32 000	No wind wheel in 1982
McTaggarts Well	12.2	.78	21 000	When sunk in 1954 contained 7.9 metres but practically no water in January 1965 and none in 1982
Muckaloodina Well	30.5	6.23	11 000	Had corrosion problems when inspected in 1951
Mulga Bore	58.0	3.12	27 300	-
Netting Well	30.5	6.23	Dry	Loose sand
Nobles Well	24.4	3.12	36 400	New mill installed in 1958. Water hard
North Bore	33.5	3.12	14 550	Serious corrosion problems
Nudlamutana Well	7.3	.78	25 500	Few problems
O'Donoghue's Castle Mine Well	42.7	.78	54 500	Contained 33.5 metres of water when new mill installed in 1953. Top blown off tower in 1962 and again in 1982
Oodnaminta Well	7.3	1.56	13 500	Few problems but water levels variable

TABLE II Continued

Oocaboolina Well	9.7	.78	22 500	Contained 4 metres of water in 1953
Pound Well	12.0 (+3.0)	1.56	13 500	1965 dry; 1966 working; 1968 last record
Weetootla (1) Well	27.4 (+23.0)	2.07	?	Dry
Weetootla (2) Well	7.9	2.07	27 300	New mill installed in 1958; water hard
Worturpa Well	4.6	.78	-	Poor. Silts up from creek
Yadnina (1) Well	12.2	.78	22 000	
Yadnina (2) Well	10.7	.78	9 092	Maintenance problems

SOILS

Introduction

Two main groups of soils dominate the soil profiles of the Gammon Ranges National Park.

The first group is the reddish loams. Of these, two are shallow soils. One loam, which is derived from quartzites and sandstones, is sandy and siliceous and the other, which is derived from shales, siltstones, limestones and dolomites, is powdery and calcareous. Both soils are gravelly throughout their profiles. A third soil type is a loam which is much deeper and related to the valleys and depressions of the quartzite and sandstone country. Some of these soils are also found near the channels of the braided outwashes in the Balcanoona Environmental Association and may have a fairly high content of soluble salts.

The second group are deep duplex soils. The first of these is related to the stony plains, pediments, tablelands, and the broad undissected areas of alluvial fans. The structure of the alluvial horizons is poor and when dry they set hard, which makes moisture penetration from rainfall difficult. Another duplex soil type is found on steeper slopes and hills. The surface of this soil is loamy and of moderate permeability.

Burrowing and tunnelling animals find the powdery, calcareous soils and the lower level stony duplex soils very suitable for burrowing. Some sites on the loamy duplex soils are also favoured.

Erosion

Since settlement by Europeans the rate of erosion has accelerated, particularly on the Yerelina and Balcanoona environmental associations and the lower slopes of the Warraweena Environmental Association. The main agents of erosion have been overstocking, feral goats, donkeys, and rabbits. These animals have almost completely removed the perennial vegetation from wide areas. Hard hooves have considerably damaged soil surfaces and accentuated wind erosion.

As has been seen from the rainfall characteristics, January, February, and March are the wetter months and it is the nature of these summer rains to come in short but intense episodes. Drought-breaking rains are frequently very intense. Runoff has been accentuated by the removal of much of the perennial plant cover by introduced animals and the removal of the surface soil by wind erosion which has been accelerated by the pounding of the surface by hard hoofs. Harder crusts and

pan layers which readily shed water have been exposed. The dry dusty surface also tends to be hydrophobic. Early runoff is consequently extremely rapid and turbid. Great volumes of water, mud, and rubble rush into the channels or watercourses and cause flash flooding. Large stone blocks roll downstream and semi-floating, uprooted River Red Gums, batter trees and banks.

As the ground dampens, runoff slows, but serious sheetwash occurs from raindrop impact. Gullying and tunnelling is a problem in the Yerelina and Balcanoona environmental associations, particularly on the footslopes and in the braided channels. Sheetwash on the gentle slopes of the ancient alluvial fan surfaces moves organic materials, including seed, into cross-slope patterns and affects the distribution of perennial species, particularly across these plains.

Wind erosion is less dramatic though consistent, and moves large quantities of sand and dust particularly from heavily grazed calcareous areas.

During long periods of drought, the springs, wells, and troughs draw animals from a wide area. As a result, surface disturbance near watering points is greatly increased. These piospheres are most pronounced where watering points are widely dispersed.

Implications For Management

1. Flood-prone areas may be swept by floodwaters charged with debris.
2. The atmosphere can become charged with dust and cut visibility to less than 100 metres.
3. Sidecut roads require frequent cross drainage.
4. Duplex soils may cause problems for road building, particularly on steep slopes.
5. Hard-footed animals should be eliminated from the park where possible in order to minimise erosion effects.
6. Soil type will influence siting of artificial watering points.
7. Visitors need to be aware of the dangers of flash flooding and dust storms.
8. Creek and gully crossings are better graded to creekbed level rather than piped since flows are usually at either maximum or minimum level.
9. Roads which follow creekbeds may need re-routing or boulder clearing following major flows.

VEGETATION

Introduction

The Gammon Ranges, at the northern limit of the Flinders Ranges, carries a diverse and botanically significant flora as a result of the extension of the colder, wetter highlands into the arid and semi-arid interior. The flora has affinities with disjunct locations in New South Wales, south-eastern South Australia, and Victoria. In addition, these disjunct communities reflect the geological history of the Flinders Ranges and the semi-arid Barrier Range in New South Wales. In geological times, the ranges have been linked along the Olary spur. Several species occur as relict plants in both the Gammon and Barrier ranges, as well as in isolated populations between them. These species are Acacia beckleri, Eremophila alternifolia, Prostanthera striatiflora and Eucalyptus gillii.

The Gammon Ranges also support a number of endemic species such as Acacia araneosa, and the survival of these species in the ranges is also of botanical significance, as the semi-arid ranges are not considered to have been a centre of species evolution. The restricted endemics are therefore relict species in refuge habitats, surviving from times of more temperate climates.

Barlow (1981) notes that very little evidence exists that suggests that the semi-arid and arid zone functioned as a major centre of species radiation, but rather that most species have been recent colonisers.

The nearest relatives of adapted arid zone Acacia species are mostly in adjacent temperate areas. Numerous parallel lines of adaptation to aridity thus exist rather than a single line leading to radiation of a new arid species group. This situation almost certainly exists for the genera Eremophila and Dodonaea, and the family Euphorbiaceae.

The arid zone including the ranges thus exists as an area which has been colonised by numerous biotypes from more temperate populations in more temperate times and not as a floristic zone in which internal evolutionary radiation has resulted. Barlow (1981) notes that this generalisation does not apply to the Chenopodiaceae with the genera Scleroleana and Maireana having radiated widely in arid and semi-arid regions. Atriplex spp. have also evolved from a common immigrant from which several species clusters have evolved.

Barlow (1981) also considers that cycles of aridity have been important in directing the evolution and subsequent diversity of the arid flora. In very arid periods the flora may have survived only in semi-arid mountain environments and in refuge habitats with more temperate conditions. It is thought that the current distribution of semi-arid and arid species has been a consequence of recolonisation following extremes of aridity. The present restricted endemics therefore have had an adaptive and competitive capacity which has enabled them to survive. The endemics of the Gammon Ranges are consequently of considerable botanical and biogeographic significance and require effective management for their conservation.

Effects Of Former Landuses

Grazing and pastoral activities have been part of the history of the Gammon Ranges and the nearby plains (see Part 1: Background Information) and these years of grazing have had a very considerable effect on the vegetation which is now present. The response to heavy grazing pressure by stock is exhibited in the domination of the vegetation by hard-seeded leguminous species, and species better adapted to regeneration from the seed pool and rootstock.

Open woodlands now support a dense shrub understorey where soil erosion and disturbance has favoured shrub growth with the exclusion of the herbaceous cover species. The loss of these species from the pre-1840 vegetation complex, and long continued suppression of regenerating plants by grazing, has left all communities in an unstable state, allowing dramatic changes in community and population structure. Acacia rivalis, once rare, has colonised extensive areas of eroded and denuded lands. This explosive increase in Acacia rivalis distribution and population certainly ensures its conservation, but has probably been at the expense of other species in the struggle of the ecosystem to reach a new dynamic stability. This is evolution at work.

Past grazing by sheep, and current heavy grazing by goats and rabbits, is continuing to influence the viability of communities such as Acacia aneura to the extent that representative samples of the A. aneura communities may in time be lost from the park. Grasslands which previously covered small areas but were widely dispersed throughout the park, have been reduced to very small communities. Many areas have degenerated and become an understorey to regenerating shrub communities, or have been colonised by adjacent low shrub communities of Bassia, Zygophyllum and Maireana spp. The exclusion of stock with the dedication of the park has enabled some regeneration of communities to occur, but while high feral goat numbers exist within the park, feral communities will be maintained. Management must decide a priority for the exclusion of goats in order to maintain its objectives of vegetation management. The removal of goats by trapping and shooting at present maintains relatively low goat numbers.

Rabbits have been an influence upon the vegetation for as long as pastoral activities have been operative. Rabbit control is as important as goat control in areas of light soil types as their influence upon the vegetation is, and has been more specific. The decimation of the tall shrublands is at least partly due to tree ringbarking by rabbits in drought periods, while regeneration has been suppressed by both goat and rabbit grazing.

Exotic animal control is an essential requirement for effective management of vegetation. Effective exotic animal management will also facilitate the control of exotic weeds. Although the number of weed species is low, eradication will probably never be possible. With an increase in visitor use of camping grounds, roads, tracks, and waterholes, localised weed spread will occur and will require either physical removal or chemical control. !!! Not in a National Park

The existing vegetation landscape is one which is considerably changed from that which occurred before pastoral activities began. Woodlands now support dense shrub understoreys where herbaceous understoreys would previously have existed; and shrubland areas are degenerate with considerable erosion and unstable shrub associations. Grasslands are reduced in area, eroded, and in many areas have been replaced by associations more typical of poorer soils.

The vegetation is now generally depauperate in species, structure, and age diversity and a defined management regime must be imposed to achieve conservation objectives. Defining a management regime is always difficult, but particularly so in relation to fire.

Fire was an infrequent event before settlement, but the advent of grazing reduced or changed the shrub and litter fuels such that fire has not occurred over extensive areas of the park for very many decades. The vegetation has no doubt responded to this although the response has been masked by grazing effects. The rapid spread of several woody species, such as Melaleuca, is a predictable response to the absence of fire. An increase in recreational demands and pressures will lead to accidental fires placing further pressure upon sensitive communities, particularly near the high-use areas. The extensive fires which occurred on Arkaroola during 1981 demonstrates that once stock are removed (eight

years prior to the fire at Arkaroola) and goats controlled, the vegetation will carry wildfire. A major change in fire regime is to be avoided otherwise a further dramatic change in the vegetation landscape will result.

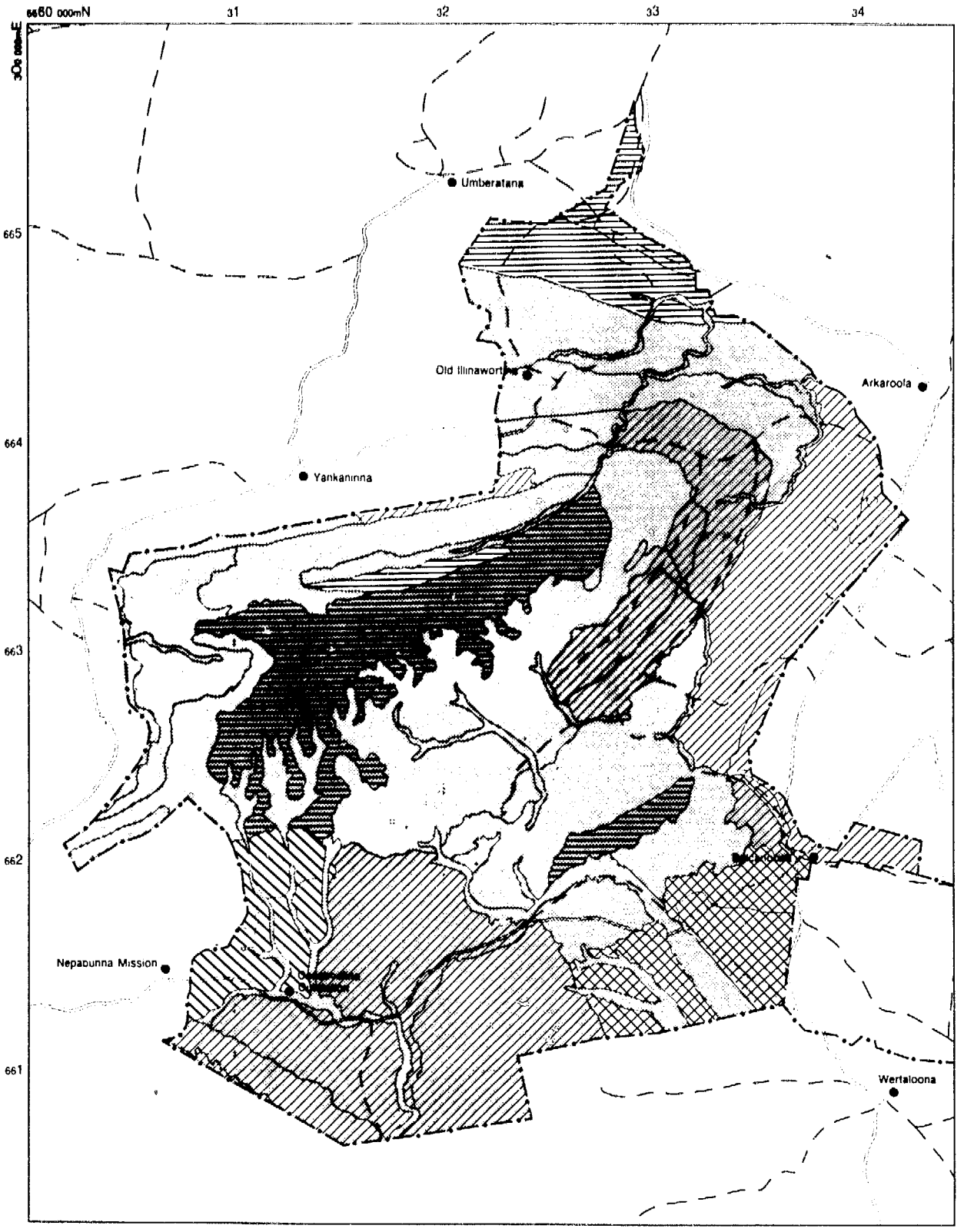
Overview Of Present Vegetation

The park is dominated by woodland, open scrubland, shrublands, and grasslands (Figure 11). Eucalyptus intertexta is the dominant species of the tall open woodlands which occur on the lower slopes of the pound and valley where the lighter soils occur over Balcanoona dolomites and the Wonoka, Bunyeroo, and Brachina siltstones and tillites. An understorey of shrubs is associated with Eucalyptus intertexta and the density and occurrence of the shrub species is influenced by both slope and the aspect of the valley alignments. The shrub understorey is dominated by Acacia victoriae, Cassia spp., Dodonaea lobulata, Acacia tetragonophylla and A. rivalis. The latter species presents specific management problems as the species has to date been considered rare and of limited distribution. It is now widespread in the ranges and in dense stands where disturbance has occurred. Eucalyptus intertexta on the higher slopes is often associated with Triodia irritans and a discontinuous groundcover of low shrubs and herbaceous species such as Sida, Solanum, Senecio, Radyera, Rhagodia, Lavatera spp., Enneapogon avenaceus, Aristida nitidula, and Danthonia caespitosa. Two southern relict species, Calytrix tetragona and Eriostemon angustifolius, also occur in more rocky sites. These two species are commonly found in upper slope and ridgetop shrublands. Other tall shrubs are sparsely distributed throughout the woodland. These occur without defined habitat requirements and so are found in almost all vegetation associations. These species include Pittosporum phylliraeoides, Heterodendrum oleaefolium, Santalum lanceolatum, Capparis mitchellii, Codonocarpus cotinifolius, and Hakea ednieana.

The Eucalyptus intertexta associations merge with E. camaldulensis along the fringes of permanent waterholes and creeks and with Callitris columellaris along watercourses where Callitris sp. has colonised flood-deposited shingle beds. These exist where the stream gradient is low. The Acacia aneura, Casuarina cristata woodland occurs as a low open formation and is widely distributed throughout the park. It is sparsely distributed through the Eucalyptus intertexta woodland but dominates on upper slopes and rocky ridgetops on Pound quartzites and Balcanoona tillites. This is particularly evident in the north of the park. Pure stands of Acacia aneura also occur as discrete groves on the lower slopes and valley floors, where its occurrence has been determined by fire and grazing. Many of these groves are currently very degenerate and senescent trees are being killed by heavy grazing pressure from goats and rabbits. Since no regeneration of young trees is evident, the Acacia aneura communities within the park require a defined management programme for their preservation.

The A. aneura, C. cristata association is also evident on the foothills of the Balcanoona Range on tillites and Angepena siltstones, where heath vegetation units of Dodonaea microzyga and Cassia oligophylla occur. Casuarina cristata exists as a pure stand woodland on areas of limestone and dolomite. Callitris columellaris occurs as a co-dominant species in some woodlands of the lighter calcareous soils but exists as a discrete woodland on the upper slopes and ridges of the main range, particularly on areas with quartzite boulders, such as those on the eastern slopes south from Benbonyathe Hill.

Scrublands of the park are dominated by mallee species and three mallee associations are recognised. Eucalyptus gillii, a species of limited and disjunct distribution occurs on lower slopes of the Skillogalee dolomites. The epicentre for this mallee species within the ranges is considered to be in the vicinity of Mount Warren Hastings (Ball 1978), with well-developed stands in Illinawortina Pound and along the foothills of the Balcanoona Range. Eucalyptus gillii is associated with a sparse occurrence of shrubs (Myoporum spp., Cassia spp., and



Woodland
Scrubland
Shrubland
Grassland
Woodland and Shrubland
Shrubland and Grassland
Woodland and Scrubland
Park boundary

0 5 10 km

Figure 11

Vegetation

Acacia rivalis) and emergent small tree species. In the north of the park Eucalyptus gillii is associated with an understorey of Triodia irritans with few, if any, other species.

On the calcareous soils of the Angepena siltstones, Eucalyptus gillii is replaced by the Red Mallee association of E. socialis and E. dumosa. This association occurs on the lower slopes mainly with an understorey of low shrubs and grasses of Enchylaena tomentosa, Rhagodia spinescens, Enneapogon nigricans, Danthonia spp., Stipa spp., and Triodia irritans.

Eucalyptus viridis occurs as a mallee species in isolated associations with E. socialis and E. dumosa. On gravelly shallow soils Dodonaea lobulata, Eremophila maculata, E. longifolia, and E. freelingii in association with Stipa, Bassia, and Zygophyllum spp. occur as an understorey. Eucalyptus oleosa may replace E. socialis on the inter-range plains but this has not been confirmed from field survey.

The third mallee comunity is of particular significance as E. flindersii is associated with the southern relict species, Melaleuca uncinata, on the quartzites of the Gammon Ranges plateau. The plateau vegetation therefore requires specific management considerations with respect to fire regimes. Allocasuarina muelleriana and Acacia rigens also occur on the plateau in association with another southern species, Calytrix tetragona. An interesting ecotone between the plateau mallee vegetation and the Callitris columellaris woodland of the upper slopes exists in many areas. Triodia irritans occurs in these sites as a homogeneous community covering large discrete areas. These Triodia spp. hummock grasslands are the largest in the park and should be considered in the formulation of management objectives for the plateau.

The scrublands merge with shrublands and are often synonymous (low open mallee). The most extensive shrubland within the park is that dominated by the Acacia rivalis, A. victoriae association. Acacia rivalis has been considered rare (Leigh et al. 1981) but in the central inter-range plains and valleys it forms discrete and uniform shrubland thickets. It occurs extensively on the Balcanoona and Skillogalee dolomites and the Angepena siltstones. Along most ephemeral creeks Melaleuca glomerata occurs as a tall shrubland; as a fringing community along more permanent streams; and often as an understorey to sparsely distributed Eucalyptus camaldulensis. In the current prolonged drought Cymbopogon ambiguus, Aristida nitidula, Maireana pyramidata, Pterocaulon spp., and Senecio spp. have colonised many dry stream beds, and formed an understorey to the Melaleuca glomerata thickets. This is an important riparian community utilised by a large number of bird species and the Yellow-footed Rock-wallaby, where the community exists within its habitat range.

Increasing visitation to the park will place considerable pressure upon the riparian communities, and they will be the central consideration in the formulation of objectives for the management of fauna and park visitors.

The addition of the Balcanoona Plains block to the park provides for the conservation of a full physical and botanical catena from the base level of Lake Frome (3 metres below sea level) to the highest parts of the ranges (1 064 metres above sea level) (Figure 12). The plains provide a mosaic of vegetation and landforms which are otherwise either not well represented, or are not represented at all in the park. The most important of these are the Astrebla pectinata grasslands which have been greatly reduced by pastoral activities. On the dunes of the plains, Acacia aneura tall shrubland is well developed, but in the vicinity of Lake Frome Acacia aneura is replaced by Sandhill Cane-grass (Zygochloa paradoxa), with the halophytic shrub species Halosarcia spp. and Maireana spp. occurring on the saline interdune swales. Other species poorly represented in the park, yet which occur on the plains include Acacia salicina and A. ligulata.

The Munyallina plain, now part of Wooltana Station, supports a range of communities from open grassland to tall shrubland, and within these communities a high percentage of the shrub and herbaceous species to be found as minor understorey species of other associations within the park are represented. The plains are therefore of botanical significance as well as providing the potential for a very good biophysical interpretive programme. Consideration should be given to the acquisition of this area should it become available.

Species And Communities Of Particular Significance

Acacia araneosa
This species is very restricted in distribution and is endemic to the northern Flinders Ranges. Due to the very small numbers of plants and stands; and the limited distribution; it is listed as 2RC (rare and conserved) on the "plants at risk" list (Leigh et al. 1981).

The species is sparsely scattered over an area north and west of Nudlamutana Hut with three main stands near the hut north-east of O'Donoghue's Castle Mine and north-west of McLeashes Copper Prospect. It occurs on light grey to red alkaline soils in middle to upper slope sites of the Skillogalee dolomites.

While adequately conserved relative to the total population, the species appears to be heavily grazed and browsed by goats, and ringbarked by rabbits during drought periods. Effective management and conservation may necessitate fencing of one or all of the known stands. These stands are close to potential heavy visitor use areas and future management must ensure that protection of the stands occurs so that regeneration will take place. Experimental exclusion of one stand would provide very useful management data.

Eucalyptus gillii, Acacia beckleri, Eremophila alternifolia, Prostanthera striatiflora
These species are all relict plants having disjunct occurrences in the Barrier Ranges (NSW), as well as the populations of the northern Flinders Ranges. Eucalyptus gillii is a South Australian endemic in the northern Flinders Ranges. All species have botanical significance and high interpretive importance.

Melaleuca uncinata, Eucalyptus flindersii, Eucalyptus viridis
Botanical interest exists in the disjunct occurrence of these more southern species. They are not rare, but the community including Allocasuarina muelleriana and Calytrix tetragona does pose a management problem which will have to be addressed. The mallee species requires a perturbation to perpetuate it in its present condition, while the Melaleuca uncinata would be fire sensitive at times during its life cycle. Obviously, a defined fire regime has to be determined. As the Gammon Plateau is a discrete and isolated biophysical area, a very passive approach to management should be taken.

Acacia rivalis
Once considered rare, this species is now known to be widespread on the calcareous soils of the park. Although its distribution is throughout the Flinders Ranges, the Gammon Ranges National Park now contains the largest conserved population of the species and imposes an obligation upon park management to ensure effective conservation. It would appear that the species benefits from environmental disturbances such as heavy grazing pressure upon associated species and hence reduced competition. Soil erosion, fire, and possibly drought may also be advantageous. An understanding of the autecology of the species and the influence of goat grazing upon this, and other rare or unique species and communities is necessary before an active management strategy can be determined.

West								East
Pound Quartzite		Wonoka formation	Bunyeroo formation	Balcanoona formation Tillite		Quaternary alluviums Angepena formation		Angepena Balcanoona
Plateau and Ridges	Slopes and Bluffs	Plains Valleys		Ridges	Dip slopes	Plains		Hogback ridges
Shallow rocky calcareous to neutral red loams		Red neutral loams and alluvials		Shallow red to yellow calcareous soils		Grey to red loams alluvial deposits		Red to loams

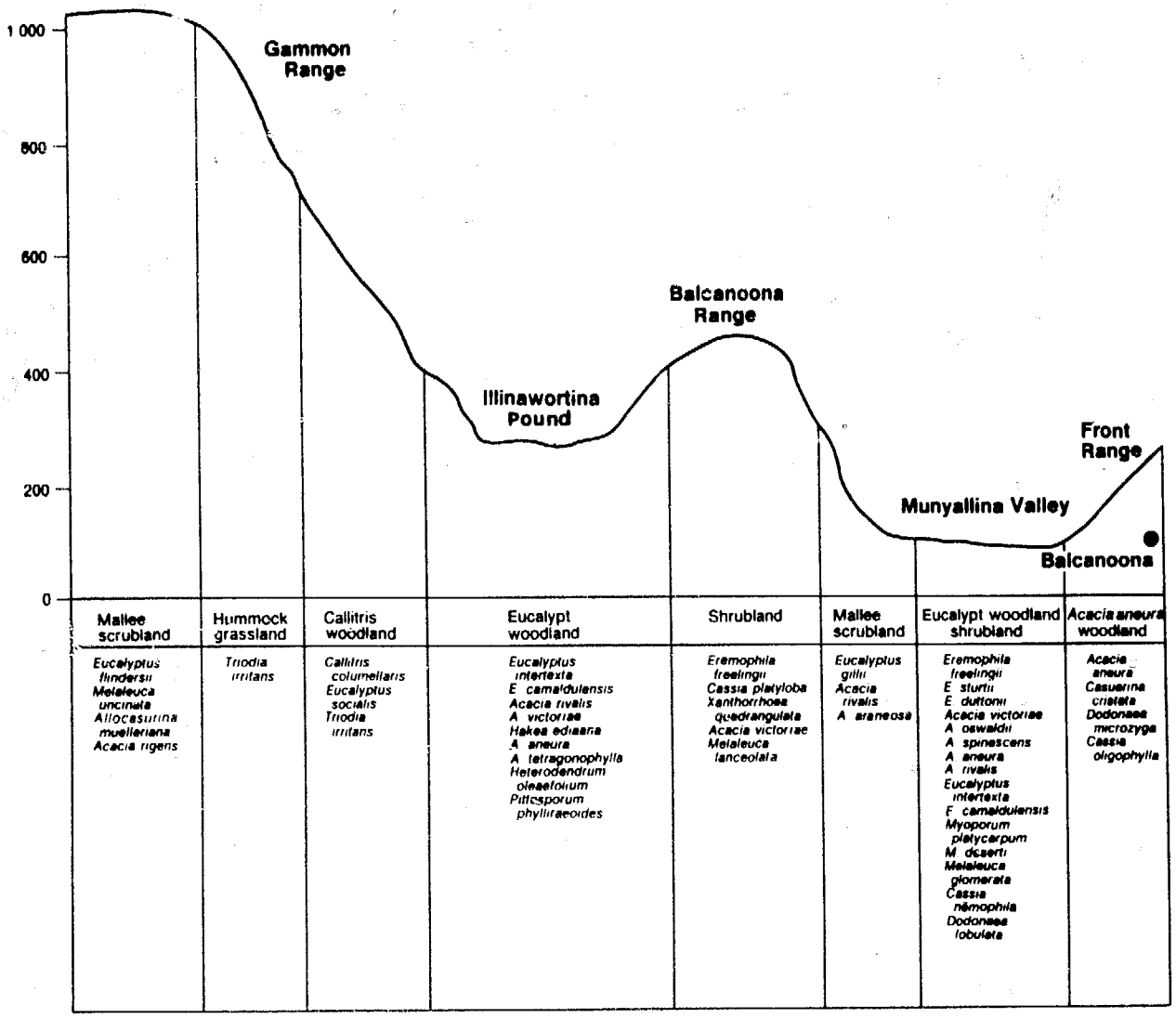
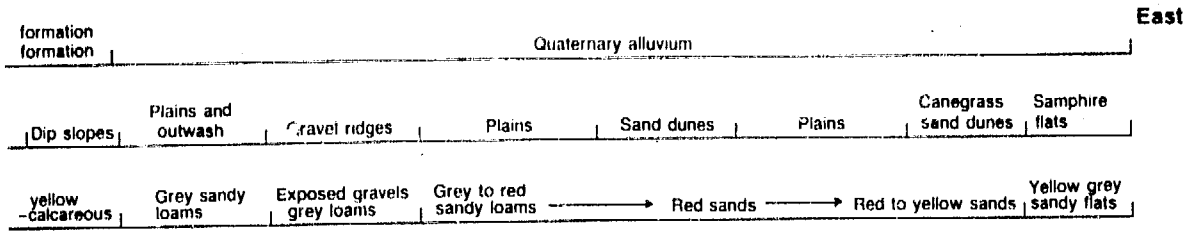


Figure 12

Idealised Cross-section



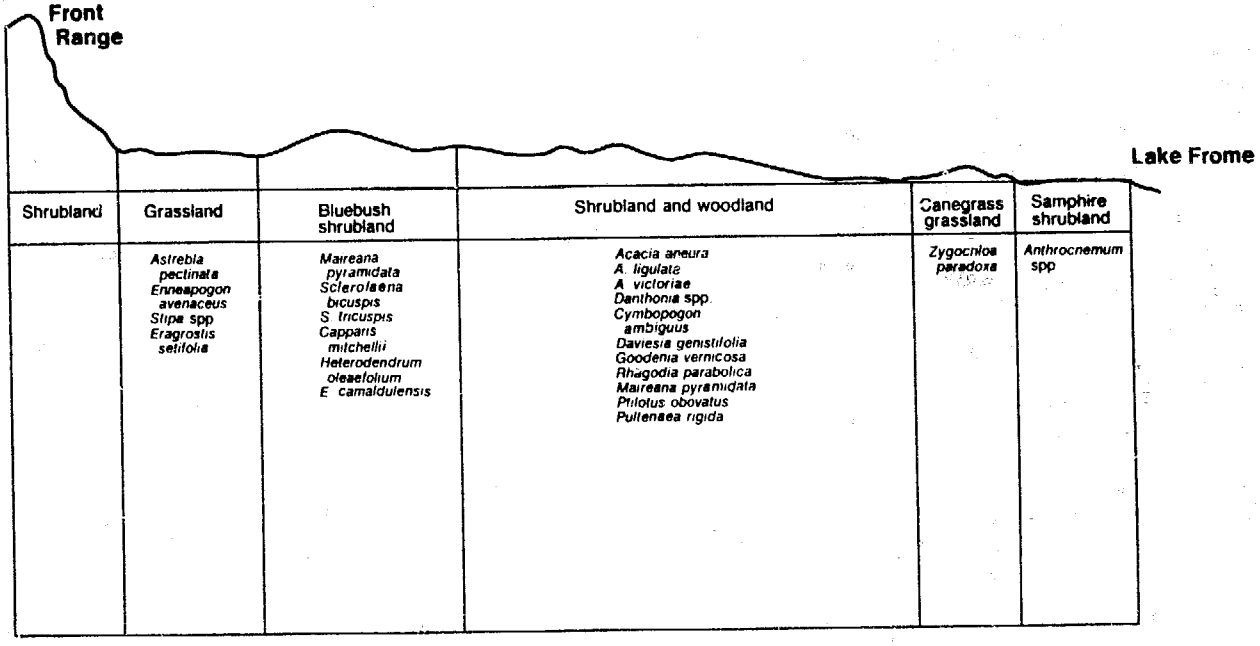


Figure 12

Idealised Cross-section

Codonocarpus pyramidalis
This species occurs in very scattered locations and in very sparse populations to the west of the park. Predictive gradient analyses indicate suitable habitats exist in the park and survey of such areas for the species should be carried out. Despite being quite rare, the species is still cut for fence posts and telephone poles. Consequently, adequate future occurrences found within the park should be given priority in active management programmes.

Acacia confluens
This species has been located on Arkaroola and to the north of the park, but suitable habitats also exist within the park. The species is considered vulnerable and any populations found in the north of the park should be considered along with Codonocarpus pyramidalis for effective conservation.

Acacia aneura
The species is widespread in the park as it is elsewhere in the region. The populations in the park are adequate, but all stands are in a degenerate state due to overgrazing and attack by rabbits. Regeneration is extremely poor and few seedling plants and juveniles are to be found. Fencing off an adequate population of sound mature trees in each community type is recommended. This particularly applies to the A. aneura grassland community which is basically limited to the lower and eastern Gammon Ranges.

A number of other species warrant consideration for active management as resources become available for more specific management programmes. Species such as Templetonia retusa, Grevillea aspera, Callistemon teretifolius, and Xanthorrhoea quadrangulata are of restricted distribution within the park and the surrounding region and therefore deserve particular attention for their conservation management.

Implications For Management

1. The diversity of landforms and vegetation make the Gammon Ranges National Park a significant conservation area for many communities and species.

2. Vegetation management must be based on ecological data which particularly covers the responses of species to disturbance factors.

3. Passive management seems to be the most acceptable strategy and for the greater part of the park such an approach should be continued.

4. In areas of heavy visitor pressure, disturbance factors affecting both plant and animal habitat will prevail, and will impose a requirement for active management of both the native biota and recreational activities alike.

5. Sensitive plant and animal species must be identified and measures taken to ensure their preservation and conservation.

6. Permanent waterholes are the focal points for all recreation and visitor control, and the intensity of management of flora and fauna should radiate from these nodal sites.

7. The direct effect of recreational use on the park is difficult to access, but road and trail access provide for increasing use of sensitive sites and hence, the likelihood of degradation. Access should be planned to maintain some of the current accesses that enable historic sites and features to be visited, while closing and providing alternative access where specific and sensitive habitats and species are threatened by the old roads.

8. Soil erosion is a major problem on sites of heavy use and uncontrolled access would result in severe erosion of tracks, campsites and viewing areas and enable the introduction and spread of exotic plant species.

9. The effects of exotic weed populations are not great at present, but any future introductions should be actively suppressed.

10. As is apparent with Acacia rivalis, disturbance can result in changes to native plant communities and the desirability of such changes must be addressed in the determination of park objectives.

11. Erosion in areas of heavy use will require implementation of revegetation techniques and physical erosion control measures.

12. Few semi-arid plant species are suitable for the recolonisation of eroded sites, particularly where those species are required to provide maximum groundcover.

13. Erosion contr l necessitates the use of fast-growing species. The Acacia spp. are the most suitable, since they are readily propagated from seed and provide an adequate groundcover. In specific sites other species can be used in association with the wattles, for example, Melaleuca and Grevillea spp.

14. In heavy use camping areas, denudation and erosion can be alleviated by rotation of tent sites within the area.

15. Selective and judicious plantings of shade and ornamental trees and shrubs can reduce the potential for erosion.

16. A wider range of species can be used around campsites, buildings, and other facilities, as water will be available. At these sites eucalypts and wattles can be mixed with a range of other small trees (Pittosporum spp.), shrubs, and groundcover.

FAUNA

Fishes

Fishes which are known to or probably occur in the vicinity of the park are recorded as an Appendix to Part 1 of the plan.

Amphibians

The Flinders Ranges, projecting into the arid interior of Australia, carries with it a wedge of more temperate climate which provides the ranges areas with 75 per cent more rain than the sur ounding plains.

> The fact that frogs are present in the Flinders for the most part centres upon the existence of the creek beds ... the steep-sided gullies created by them, and the areas around the Ranges that become flooded during periods of heavy rainfall. These are the criteria that have established the Flinders Ranges as a haven for the colonisation by, and even the evolution of frogs. (Tyler 1980).

There are three sources of origin for the frog species found in the park.

First, a drift of species from the south and south-east. Most of these species were ill-equipped for "dry" land survival and died out following the return of dry times. Some, however, found a habitat in the ranges which suited them. They remain as successful colonisers. The Brown Toadlet (Pseudophryne bibroni) is one

of the colonisers from the south and is probably the only true terrestrial amphibian in the ranges since it has developed independence of water, and lays its eggs in moist litter or soil under the shelter of logs or boulders. Tyler has recorded this animal sharing a scorpion burrow.

Second, a drift of species from the arid interior of Australia to the relatively humid Flinders Ranges where habitat was more suitable. Cyclorana platycephalus, the Water-holding Frog, is one example which takes a supply of water deep into the sand or soil, makes a moist cell, and stays in a state of torpor until drought breaks.

Third, there is a unique component of the amphibian fauna which is confined to the ranges. Ranidella riparia is an example. It is a frog which lives, as its name suggests, in creeks. In dry weather it seeks refuge by penetrating mud cracks or remaining under boulders.

Amphibians which are known to occur in the Flinders Ranges are listed in the Appendices.

Implications for Management

1. The physiological and behavioural adaptations of amphibians have potential for park interpretation programmes.

2. Spring habitats are critical to some species and therefore require protection.

3. Species which occupy dry creeks, gorges and cooler damp sites require only passive management strategies.

4. A continuing monitoring and research programme is necessary.

5. The impact of Gambusia spp. on eggs of amphibians in the area is unknown but park management should ensure that waterholes and springs are not biologically polluted by the introduction of fish.

Reptiles

Reptiles find a range of conditions in the Flinders Ranges eminently suitable for terrestrial vertebrates of their physiology. It is expected that with further surveys carried out in the park, more than sixty species of lizards and eighteen species of snakes will ultimately be listed. The reptile fauna present in the ranges today originates from the south and east (Bassian) and from the arid interior and north (Eremaean). There is also evidence of the evolution of species within the region, for example, Amphibolurus vadnappa, which is very similar to A. decresii from the Flinders Ranges and Mootwingee area.

In common with the rest of Australia, the status of reptiles is poorly known in the Flinders Ranges, but judging from the great changes which have occurred to mammal fauna over the past 200 years, one would expect that significant changes have also taken place in the reptile fauna. It is important that if management is to be effective, some baseline data check points must be established. Photopoints and transects should be established as early as possible in order to monitor changes which occur following the previous century of grazing by stock and feral animals.

Implications for Management

1. The rich reptile fauna represents a resource for park interpretation programmes.

2. The venomous snakes are a hazard to visitors. Notice concerning the identification and habits of the snakes, and first aid instructions in case of snakebite, should be supplied.

3. Some of the reptiles require special protection for example, the Children's Python (Liasis childreni).

4. Feral cats have been found to be almost totally dependent on reptiles for food in summer in arid areas.

5. Fire (wildfire and regulated fire) destroys litter and logs essential for the survival of many species of reptiles.

Avifauna

Introduction

The avifauna of the Gammon Ranges National Park reflects the significant role that the whole Flinders Ranges and Mount Lofty Ranges have played in the biogeography of Australian avifauna. Despite the fact that the Flinders Ranges contain no endemic bird forms, they are significant in accounting for the present-day bird distribution on the southern part of the continent.

The Flinders Ranges is a region of open woodland and scrubland surrounded by shrub, herb and grasslands. As such, the avifaunal affinites lie with the more heavily timbered Mount Lofty Ranges to the south and the central Australian highlands to the north. Birds found in the central highlands and ranging as far south as the Flinders Ranges include the Red-browed Pardalote (recorded at Paralana Springs to the north-east of the national park), Little Woodswallow (recorded in rugged parts of the national park) and the Painted Finch (recorded just north of the national park at Arkaroola). Many species commonly found in the timbered forests of the Mount Lofty Ranges reach their northern limits in the woodlands of the Flinders Ranges. Some of these such as the Silvereye and Sacred Kingfisher are at their northern limit in the area of the Gammon Ranges National Park.

The Flinders Ranges divides the distribution of closely allied species and acts as a barrier to the distribution of many bird species. Of 110 species found in south-eastern Australia, 22 species reach their western limit in the Mount Lofty and Flinders ranges. A total of 39 per cent of the avifauna of the south-east of Australia is stopped or split by the barrier. In addition, of the 73 species in the avifaunal region which includes the south-west of Western Australia and Eyre Peninsula, 7 are restricted or split by the Flinders Ranges.

Many of the patterns observed are the results of climatic and vegetation patterns of the past and it is now possible to observe and study the breakdown of the barrier. The Splendid Wren of western South Australia was once thought to only occur to the west of the Flinders Ranges but has now been recorded at Italowie Gorge in the Gammon Ranges National Park. There is a zone of hybridisation between the Yellow-throated Miner and the Noisy Miner in the southern Flinders Ranges. Similarly, hybridisation has occurred between the Port Lincoln Ringneck and the Mallee Ringneck and there is now a wide zone of hybrid birds in the Flinders Ranges.

The Gammon Ranges National Park represents the avifauna of an area of great significance to the study of modern distribution of birds in southern Australia. This area continues to be of interest to biogeographers as the distribution patterns continue to evolve.

Distribution

In an area such as the Gammon Ranges National Park a variety of natural factors affect the distribution and abundance of birds - the climatic and vegetation patterns of the past, present day patterns, season, the influences of species from adjacent areas due to adverse weather conditions, changes due to man's activities, and the introduction of exotic species.

True grass and herblands are not common within the park and occur along its edge on the eastern boundary, especially around Balcanoona homestead. Many species which are found principally in this habitat are poorly protected by the park and as a consequence occur in the park only in small numbers. Examples include the Spotted Harrier, Stubble Quail, Little Button-quail, and the Plains Wanderer.

Shrublands and woodlands are the principal habitats of the park and these are also the most important for avifauna. In those areas where shrubland and woodland has survived pastoral occupation relatively intact, as it does in parts of park adjacent to Weetootla Gorge, a rich diversity of the more common birds is to be found. Riverine forest, especially River Red Gum, is an important bird habitat. Species favouring this habitat include the Australian Hobby, Peaceful Dove, Elegant Parrot, White-plumed Honeyeater, and Weebill. Due to the degradation of adjacent woodlands it is possible that many bird species now occur more frequently along watercourses due to a lack of other suitable habitat.

Cliff-faces are an important avifaunal habitat in the Gammon Ranges National Park. Species such as the Peregrine Falcon and Little Woodswallow inhabit these areas and breed there. Small patches of gibber plain also occur in the park and several species, including chats and the Banded Lapwing, could be expected to exist in these areas.

Although far less pronounced than in other regions, there is a seasonal movement of species to the Gammon Ranges National Park. It is not well documented and the proportion of migrants to permanent residents within each species is not yet fully understood. However, the cuckoos, Rainbow Bee-eater, White-backed Swallow, Tree Martin, and White-winged Triller show marked seasonal patterns.

More significant than season, it is the climatic conditions which dictate the abundance of many bird species. A large number of species are nomadic. Waterbirds such as the Pacific Heron, White-faced Heron, Pacific Black Duck, Grey Teal, and other vagrants could use the area during passage to and from the ephemeral wetlands in central Australia. The use of the area as a drought refuge for these species is limited. Many birds of prey are opportunistic, and significant variations in the populations of Black-shouldered Kites, Whistling Kites, Wedge-tailed Eagles, Brown Falcons, Australian Kestrels, and Barn Owls could be expected. Similarly, influxes of Cockatiels, Budgerigars, Zebra Finches, Woodswallows, and both Pied and Black Honeyeaters could be expected depending upon climatic conditions, surface water, and the availability and flowering of plants.

Effects of Exotic Mammals

The exotic animals that have been introduced to the Flinders Ranges and have had the most significant impact on avifauna are sheep, goats, rabbits, cats and foxes. The impact of cats and foxes is difficult to determine. The disappearance of species such as the Little Button-quail, Plains Wanderer, Bush stone-curlew, and Australian Bustard is often attributed to spread of the latter predators, but the impact of sheep, goats, and rabbits in altering the structure and regeneration of vegetation, may well have been more significant.

Provision of Artificial Water
The distribution of naturally occurring water is not well known in the park but a series of artificial water points have been installed for stock. From the point of view of the distribution of avifauna, this probably causes no particular problems since birds are highly mobile, and the only birds likely to be affected are the small seed-eating birds.

Implications For Management
1. Much of the management of the avifauna of the park is linked to the management of vegetation.

2. With grazing pressure from sheep, goats, and rabbits removed or greatly reduced, the diversity of the avifauna will increase.

3. A number of rare and endangered species such as the Grey Falcon, Plains Wanderer, Australian Bustard, and Bush Stone-curlew occur, or could occur in the park, and efforts should be made to locate these, study their requirements, and implement appropriate management actions.

An annotated list of the birds that are known or thought to exist in the Gammon Ranges National Park and surrounding region is included in the Appendices.

A total of 67 species have been recorded within the park boundaries including data supplied by the South Australian Ornithological Association and from the literature. An additional 53 rare, nomadic, or extralimital species may be expected and need to be confirmed for the park.

Mammals
It is difficult now to ascertain the composition of the mammal fauna of the park as it was in 1840 just prior to European occupation, but it seems certain that it was much richer in species than now.

It would appear that at present there are seventeen native mammals in the park. Twelve more species occur in the region and may also be in the park. Up to twenty-two additional species have become locally extinct in recent times (see Appendices). It should, however, be noted that these figures are questionable as investigative work in the park has not been intensive. The high country of the Gammon Plateau and the broken gorges around its perimeter could well contain further species.

Macropods
Some native species have benefited from European occupation. It is now widely accepted that the larger kangaroo species have increased their populations in pastoral country due to the establishment of artificial watering points and the conversion of much shrubland/steppe habitat to ephemeral grassland. It seems clear that where water was once a critical limiting factor for these animals, it is now the availability of food which excercises control over population numbers. Grazing by feral goats accentuates this shortage.

The Wallaroo (Macropus robustus), despite periodic feed problems due to drought, remains a very common animal in the park, particularly in the hilly areas.

The Red Kangaroo (Macropus rufus) is common in the park, particularly on the grassland plains. In November 1982, the Mitchell Grass red plain country of Bluff Paddock, south-west of the Balcanoona homestead carried starving animals. At this time there was little feed left, although water was available, and some animals were seen to be travelling five or six kilometres to water. Road traffic also influences the distribution of these animals.

For the Yellow-footed Rock-wallaby (Petrogale xanthopus), conservation is a major objective for the Gammon Ranges National Park. In the past, many of these wallabies were trapped and shot for their skins as well as for food. With a considerable economic incentive to kill the animals, and encouragement of Aborigines to use nets and dogs to take up to 300 animals per day, it is surprising that any remain today. These animals were totally protected by law in South Australia in 1912. Copley (1981) provides a detailed report on the status of the animal and indicates some of the locations of Yellow-footed Rock-wallabies in the northern Flinders Ranges (Figure 13). During surveys undertaken for this management plan, new sites were recorded and it would appear that there are other colonies in the Gammon Ranges yet to be recorded.

The Crescent Nailtailed Wallaby (Onychogalea lunata) is one of a number of species of macropods in the ranges of which the current status is uncertain. It is a nocturnal animal which occupies the dense thickets and scrub of arid areas. The last specimen collected was found dead on the Warburton Road in 1964. This species is believed to have declined due to habitat destruction by sheep, cattle, goats, and rabbits, as well as farmer persecution and possibly increased predation from foxes and feral cats. The fact that this animal was present in the region at least two hundred years ago is indicated by the presence of sub-fossil remains in owl pellets in Chambers Gorge. This is also true of a number of other regionally extinct mammals (Smith 1977).

The Eastern Hare-wallaby (Lagorchestes leporides) was once common on the grassy plains and possibly occupied both the plains and alluvial fan areas of the park. The last specimen was collected in 1890 and the species is now probably extinct.

The Brush-tailed Bettong (Bettongia penicillata) was once distributed across southern Australia. It was abundant in South Australia at the end of the nineteenth century, but was considered extinct in the State by 1923. It was a hills and plains animal which had a broad food spectrum ranging from roots, tubers, grass, fungi and insects, to carrion. Its demise seems to have been associated with habitat destruction by stock, and predation by foxes and feral cats.

The Burrowing Bettong (Bettongia lesueur) was a gregarious burrowing animal which lived in a maze of interconnected warrens. These warrens were invaded by the rabbit which also competed directly for food. The animal was extinct in South Australia by 1910. Bones have been found in owl pellets at Chambers Gorge.

Possums

The Common Brushtail Possum (Trichosurus vulpecula) is declining in the region and has been re-introduced in the Arkaroola area. Material from this species has been found in owl pellets.

The Western Pigmy Possum (Cercartetus concinnus) is small and secretive. While it survives in the southern Flinders Ranges, it could also survive as a relict species in the Melaleuca scrub of the Gammon Plateau. The possum feeds on insects, spiders, nectar, fruit, and leaves.

Bandicoots

It appears from owl pellet remains that four species of bandicoots recently inhabited the Gammon Ranges National Park region, the Golden Bandicoot (Isoodon auratus), Western Barred Bandicoot (Perameles bougainville) (1925 record), Pig-footed Bandicoot (Chaeropus ecaudatus), and the Greater Bilby (Macrotis lagotis) (1885 record).

Reasons for their demise appears to be habitat change caused by introduced herbivores (rabbits, sheep, and goats) and predators (foxes and cats). Troughton (1957) has excellent notes on these animals.

Dasyurids

Of 12 species of Dasyurids known to occur in the region at the time of European settlement or just before it, only three species are now known to exist in the park together with two others in the region.

The Narrow-nosed Planigale (Planigale tenuirostris) is one of the tiny marsupial carnivores with a characteristic flattened head. It is rarely seen since it is generally nocturnal and is a vigorous insectivorous animal though also feeding on skinks and introduced mice. It lives in small holes, cracks in the ground, under rocks, and in logs. Remains have also been found in owl pellets.

The Fat-tailed Dunnart (Sminthopsis crassicaudata) is another very vigorous but tiny carnivore which will take birds, lizards, insects, centipedes, and mice. Recently (1980) a specimen was trapped on the ridgetops of the Flinders Ranges. The animal stores fat in its tail and can go into a state of torpor when food is scarce. It lives among rocks, under and in logs in the grasslands, shrublands and woodlands, and breeds twice a year. Evidence of the presence of this animal has also been found in owl pellets.

The Stripe-faced Dunnart (Sminthopsis macroura) is similar to the preceding species except that its tail is cylindrical, longer than the head and body, and with a tuft of fur on the end. It nests in shallow burrows and eats lizards, mice, and insects. Its habitat is saltbush shrubland of the kind which occurs on the plains block east of Balcanoona airstrip and down towards Lake Frome.

Planigale gilesi probably also occurs in the region. Its remains have also been found in Barn Owl pellets.

The Western Quoll (Dasyurus geoffroii), (1885 record), Red-tailed Phascogale (Phascogale calura), Kowari (Dasyuroides byrnei), Mulgara (Dasycercus cristicauda), Kultarr (Antechinomys laniger), and Numbat (Myrmecobius fasciatus) are now extinct in the region but remains have been found in Chambers Gorge owl pellets.

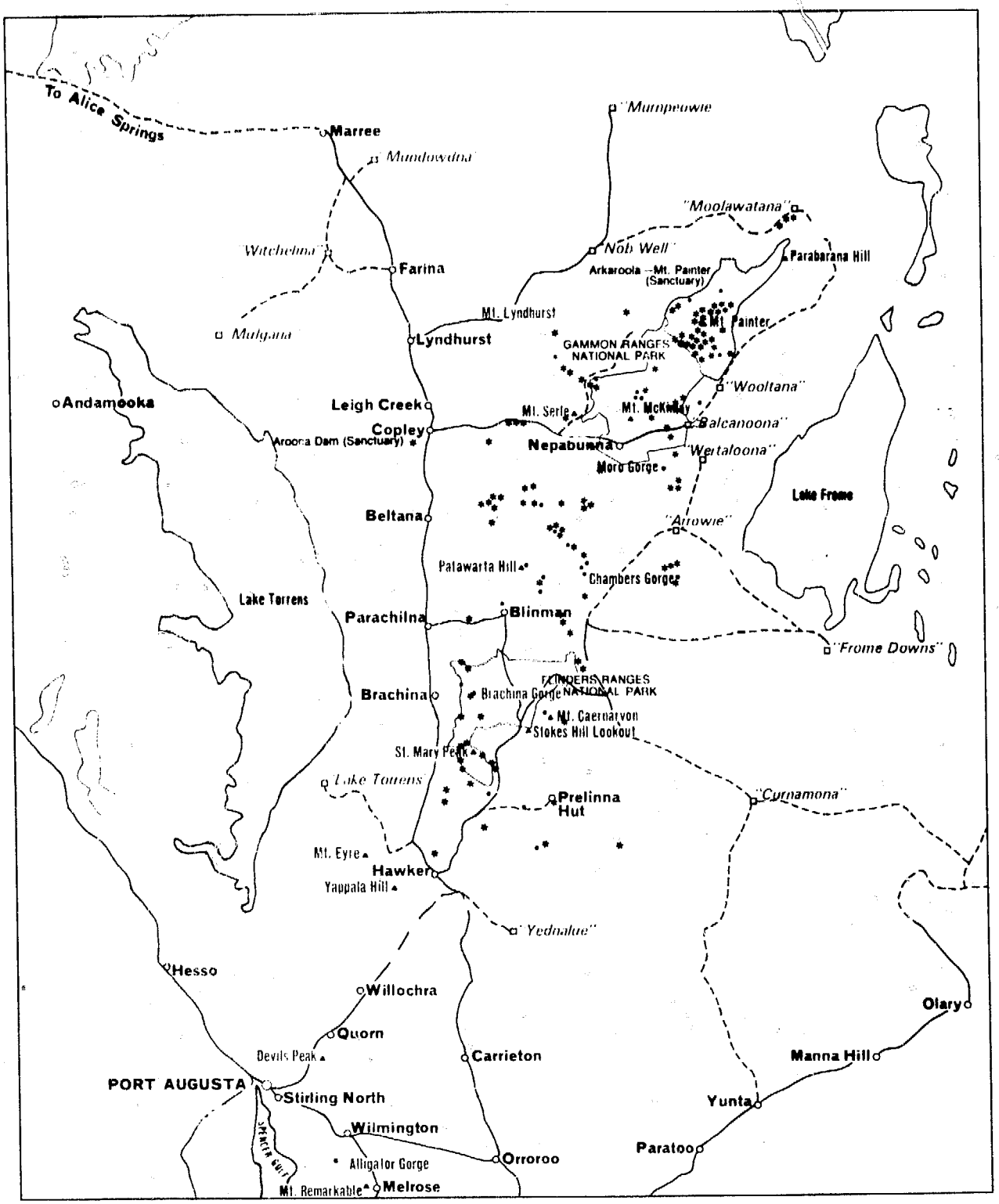
The last species, the Numbat (Myrmecobius fasciatus), was added from a sighting recorded in 1885.

Large areas of the park have been inadequately surveyed largely as a result of the inaccessible terrain. With improved trapping techniques, some of these animals may yet be found to exist in the park area. For example, recent surveys have led to an apparent expansion in the ranges of some species such as Ningaui sp. and Planigale tenuirostris.

Rodents

Only one species of native rodent, Forrest's Mouse (Leggadina forresti) is known to be present in the park. However, there are four other species which may occur, the remains of which have been found in Barn Owl pellets. They are the Dusky Hopping-Mouse (Notomys fuscus), Sandy Inland Mouse (Pseudomys hermannsburgensis), Gould's Mouse (Pseudomys gouldii) (last specimen 1856), and the Desert Mouse (Pseudomys desertor). Another species, the Long-haired Rat (Rattus villosissimus) may also take refuge in the region.

Six species, all represented in Barn Owl pellets now appear to be extinct from the region. They are the Greater Stick-nest Rat (Leporillus conditor) (record in area 1907), Lesser Stick-nest Rat (Leporillus apicalis) (1866), Long-tailed Hopping-mouse (Notomys longicaudatus) (last seen 1901), Short-tailed Hopping-mouse (Notomys amplus), Notomys (undescribed species), and the Plains Mouse (Pseudomys australis).



* Sightings of *P. xanthopus*

\. Faecal pellets (only) of *P. xanthopus*

0 60 120 km

Figure 13

Distribution of the Yellow-footed Rock-wallaby *(Petrogale xanthopus)*

A number of reasons have been suggested to account for these extinctions and near extinctions. Some of the rats favour succulent vegetation which is also favoured by the rabbit. In addition, heavier predation has resulted from the introduction of cats and foxes, and some rats were hunted by man. Probably the most important factor was the fact that the ecosystem as a whole was radically changed by the introduction of pastoralism and farming.

Bats

Little is known of the history of bat species in the park area but some general comments regarding bat conservation are appropriate.

The park area is rich in bat shelter in the form of River Red Gums, caverns in numerous rock types, deeply fractured and cracked rocks, narrow gorges, mines, tunnels, and shafts.

One of the most interesting areas in the park is the Wooltana Guano Cave. This is a limestone cavern with a vertical drop of 64 metres and a chamber at that depth with a width of 50 metres and height of 10 metres. The cave contains significant deposits of bat guano, which was once mined by the Wooltana Fertiliser Company.

The guano mined seems to have been mainly produced by the Ghost Bat (Macroderma gigas) which is now considered to be extinct in southern Australia although there have been reports of this bat in the region recently. Wood Jones (1923) suggests that its disappearance has resulted from major climatic changes which caused a reduction in the numbers of small insectivorous bats upon which the Ghost Bat preyed. This cave contains much fossil bat material as well as some of its prey species and is a valuable interpretive resource. Other limestone caverns exist, about which little is known. Proper exploration by speleologists should be encouraged.

A list of bats which are known to occur in the Gammon Ranges National Park is provided in the Appendices.

Dingo

The Dingo (Canis familiaris) arrived in Australia something less than 10 000 years ago after the land bridge to Tasmania had been cut by rising sea levels. It is an opportunistic predator and takes prey which range in size from kangaroos to insects, as well as carrion. Since the 1880s, the Flinders Ranges have been isolated from dingo populations by the dog fence erected by graziers to protect sheep from these animals. In 1946 these barrier fences were brought under government control. The dog fence cuts through the Balcanoona plains country which has recently been added to the park. The fence, which runs from north to south near the Lake Frome shoreline, excludes dingoes from the park.

Monotremes

The Monotremes are represented by the Short-beaked Echidna (Tachyglossus aculeatus) which is perhaps the most widespread mammal in Australia. Its status is very difficult to assess because of its solitary and secretive behaviour. Aitken (1980) claims that it is largely confined to the high rocky tops of the northern Flinders Ranges. The Short-beaked Echidna however, has been known to move 30 kilometres and has specialised feeding behaviour, selecting ant and termite species at particular times when fat levels are high. The distribution of the animal in the park is therefore unclear.

Feral Animals

Prior to the arrival of Europeans, Australia was the only continent which had been free of cloven-hoofed animals. A common observation of the explorers was of their animals bogging, or at least being held up, by soft, dry ground. The soil

surface has since been pounded by thousands of millions of hoofs. Apart from the domestic animals which the pastoralists introduced there are a number of other introduced species which have run wild. The first to become a problem in the park area was probably the cat in the 1840s.

The Feral Cat (Felis catus) is usually about the same size as the domestic cat but is a much more efficient killer. Some cats may descend from 100 or more generations of the original feral animals which reached the ranges. They are coloured white through to black, though the grey tabby is the most common. Cats frequently live in close association with a regular food supply. At Kinchega they lived in active rabbit warrens, and selected some of the rabbit kittens as a staple food. Around watering points in the park, resident cats were noted and observed very efficiently taking birds. Others came into the homestead area foraging among rubbish. In good seasons cats probably have little impact on native fauna but, in periods of prolonged drought they must take a high percentage of the potential drought survivors.

The European Rabbit (Oryctolagus cuniculus) was released in the Mount Lofty Ranges in about 1865 and by 1878 was in the Flinders Ranges at Holowilena. By 1881 rabbits were in plague proportions in the park area. The sequence of plague and decline is described in the section on the history of the Northern Flinders Ranges in the Appendices. A sequence of wet or humid years which produces continuous green feed enables rabbits to produce four or five litters per year with up to six young per litter. A return of hot, dry seasons markedly reduces breeding success. Groundcover is eaten out, low shrubs, mulga, and tall shrubs are climbed and eaten, and finally bark is consumed. The combined impact of rabbits, sheep, and goats is evident in the conversion of perennial shrublands to ephemeral grasslands and herblands. It is interesting to note that rabbits in the park are not evenly distributed but appear to favour the light calcareous soils. In these areas the ripping of warrens is feasible. Exclusion plots have been maintained for eight years in the Arcoona valley and show clearly the vegetation regeneration that can occur when land is released from the pressure of rabbits.

In 1864, The Melbourne Hunt Club released the Red Fox (Vulpes vulpes), and by 1903 it had become a common animal in the northern Flinders Ranges. It is usually seen early in the morning, at dusk, and at night foraging for invertebrates, lizards, birds, eggs, and mammals up to the size of a wallaby. Foxes are known to prey on the Yellow-footed Rock-wallaby. The fox breeds in spring and produces a litter of up to 7 pups, usually in an excavated earth den or a hollow log. Foxes appear to suffer more than cats in drought conditions and at these times can be seen in full daylight at short distance.

The first Goats (Capra hircus) in the ranges were introduced by the explorers of the 1840s and have been known to exist in the park area since the late 1930s. Goats are herd animals and can cover a large area in a very short time. In drought conditions their main feed plants appear to be Acacia victoriae and Bullock Bush (Heterodendrum oleaefolium), but goats are quite opportunistic. and under stress, their browse line is higher than that of the Wallaroo and this is known to result in high Wallaroo mortality in severe drought. In very hot weather goats also take over caves and overhangs which are essential to the survival of the Wallaroo.

Large numbers of goats have recently been mustered and trucked live to abattoirs and experiments are under way to develop an effective trapping programme to further reduce numbers. These animals have had a serious and detrimental effect on native flora and fauna.

The Donkey (Equus asinus) was imported from North Africa in 1862 to be used as a beast of burden for the Blinman mines.

They were commonly used to carry ore, wool and supplies in and out of the ranges. They have diurnal movements, and feed at night on lower open country. In early morning they move to springs and spend the day high in the ranges. Donkeys are not common in the park although herds of 20 to 30 have been observed. They tend to be restricted to favoured areas, for example near Gleeson and Wortupa springs.

Thomas Elder was the first to introduce the Arabian Camel (Camelus dromedarius) to the ranges when he imported 122 animals from Karachi for breeding and use on Beltana Station. From time to time camels became feral but usually headed into the sand and gibber country. They were used extensively in Arkaroola country for mineral transport.

Research Possibilities

1. An evaluation of the ecosystems of the high plateau and Gammon Range ridgetops, and a survey of species there.

2. The investigation of effective strategies for reducing the populations of feral goats, foxes, and cats.

3. An examination of the impact of drought on the numbers and distributions of wildlife populations.

4. An investigation into interactions between Red Kangaroos in the pounds with those of the plains. Are the pound populations isolated groups without recruitment from outside?

5. A long-term programme to monitor the status of the Yellow-footed Rock-wallaby in the park.

6. Fixed photographic transects should be established to monitor seasonal habitat change.

7. The behaviour of visitors to animal areas should be recorded as an aid to planning visitor facilities.

8. Goat/wallaby interactions require study, particularly as the wallaby piosphere is well within the goat piosphere.

9. Encouragement should be given to the further study of owl caverns in the Balcanoona area, for example, Weetootla Gorge, Italowie Gorge and Bunyip Chasm, to ascertain owl food/fauna relationships.

10. Monitoring of the introduced Common Brushtail Possum population is required to ascertain rates of expansion, contraction, or stability in the populations, and the causes thereof.

11. Exclusion areas should be established in all of the major habitat types and monitored over a long-term period.

12. A systematic search should be made for Dasyurid species in the park.

13. A speleological and palaeontological study of Wooltana Guano Cave and similar sites should be undertaken.

14. Encouragement should be given for research into the operation of the environmental factors which limit the range of species in the ranges.

Implications For Management

1. The high plateau of the Gammon Ranges must be managed as a wilderness area because of the relict communities which survive there and the potential refuge it provides for locally threatened species.

2. The destruction of perennial vegetation by feral goats, rabbits, and domestic stock increases stress on native herbivores in extreme droughts.

3. Feral goat numbers must be kept as low as possible.

4. Bluff Paddock, which is crossed by the main Leigh Creek to Balcanoona road is good Red Kangaroo habitat. Road traffic may disrupt the ecology of this animal.

5. The open and easily accessible Red Kangaroo habitat in the Yancaninna/Yadnina area may attract illegal shooters.

6. Activity by campers in the vicinity of Yellow-footed Rock-wallaby colonies should be prevented, particularly where it occurs between colonies and their water supply.

7. Wallaby management and interpretation at Arkaroola should be integrated with park management.

8. Areas to be developed should be surveyed first to ensure habitat of threatened species is not damaged.

9. The Wooltana Guano Cave, the owl cave deposits, and habitat change at Balcanoona are very rich interpretive resources.

10. Before any development of caves or caverns takes place, possible microclimatic effects should be assessed.

11. To conserve the park's fauna, habitat diversity must be maintained.

12. Because of the secretive nature of much of the fauna, interpretive programmes will be needed to allow visitors to enjoy and appreciate the animals.

13. The waterholes and springs are essential for the maintenance of wildlife but access to watering points by wildlife may be affected by park visitors.

14. The use of fallen wood by visitors will remove habitat for some species of invertebrates, amphibians, reptiles, and mammals.

15 Keep dingoes away from campsites.

ABORIGINAL CULTURE

Introduction

The date when Aborigines arrived in Australia is uncertain although it has continuously been pushed back to about 50 000 years ago. Until recently, very little archaeological work had been done in the park area although Ross and Snoek (1981) have undertaken work in the Flinders Ranges National Park and some of their information is relevant to the Gammon Ranges. More recently, the Heritage Conservation Branch has carried out an extensive survey of cultural sites within the park.

Over their 38 000 years or more of occupation the Aborigines have lived through many major changes in the environment such as periods of humidity, cold, and aridity with the consequent extension and contraction of particular plant communities and their dependent animals. There have been changes in water supply, lake levels (Lake Frome), and the extinction of many animal species, particularly large species. For example, Tedford (1955) found that 23 species of mammals that once lived on the Lake Menindee lunette 18 000 to 25 000 years BP are now extinct (Fox 1976).

Accumulated Aboriginal experience included adjustment to these changes and was involved in the evolution of traditional behaviour, song cycles, stories, and legends (Figure 14).

Nevertheless, for thousands of years, water has been the dominant limiting factor which has controlled human distribution in the region. There are many reports, including Ellis (1978), which describe various techniques devised by the people to conserve water in the arid zone. Within the park area, it would seem that permanent springs became critical in periods of extreme drought. Not only did they provide water but they also acted as a lure for game. The springs consequently have a high status in the mythology and ceremonial life of the Aboriginal people and frequently represent important resting places for creation beings, for example, Yackie Waterhole, Mainwater Pound, and the resting place for Arkaroo (Wilton et al. 1980).

Relationship With The Land

Throughout the long period of Aboriginal occupation, a very complex physical, social and psychic relationship between the Aborigines and their world evolved. "The fundamental truth about the Aboriginal's relationship to the land is that whatever else it is, it is a religious relationship." (Pratt 1978).

In the same paper, Pratt quotes Strehlow on the relationship of the Aborigine with the universe noting:

- that the land rights of all tribal units were believed to have been laid down for all time by the supernatural beings;
- that there is no division between time and eternity;
- that every person carried within himself an immortal spark of life derived from the original supernatural beings, and thus they are all inseparably linked;
- that the perpetual wellbeing of the universe - the whole welfare of the material world - depends upon the continual singing of the original creative words and the performance of the creative acts of the supernatural beings by their human re-incarnations from generation to generation;

- that theirs is a land where the supernatural creative beings are living not in the sky or in the past but at clearly marked sites in the mountains, and the springs, so that religious acts have an immediate personal intimacy;

- that the visible totemic landscape is considered to be an integral part of the reality of eternity, and each major sacred site was the - "...geographic fountain of authority for the territory surrounding it."

Silas Roberts is quoted in the same article, explaining the meaning of their lives:

> Aboriginals have a special connection with everything that is natural. Aborigines see themselves as part of nature. We see all things natural as part of us. All the things on earth we see as part human. This is told through the idea of dreaming. By dreaming, we mean the belief that long ago, these creatures started human society, they made all natural things and put them down in special places.
>
> These dreaming-creatures were connected to special places and special roads or tracks or paths. In many cases the great creatures changed themselves into sites where their spirits stayed. My people believe this and I believe this. Nothing anyone ever says to me will change my belief in this. This is my story as it is the story of every true Aborigine. All the land is full of signs, and what these great creatures did and what they left we see as very important. We see this just as much as before.
>
> These creatures, these great creatures are just as much alive today as they were in the beginning. they are everlasting and will never die. They are always part of the land and nature as we are. We cannot change and nor can they. Our connection to all things natural is spiritual. We worship spiritual sites today. We have songs and dances for those sites and we never approach without preparing ourselves properly.
>
> When the great creatures moved across the land they made small groups of people like me in each area. These people were given jobs to do.

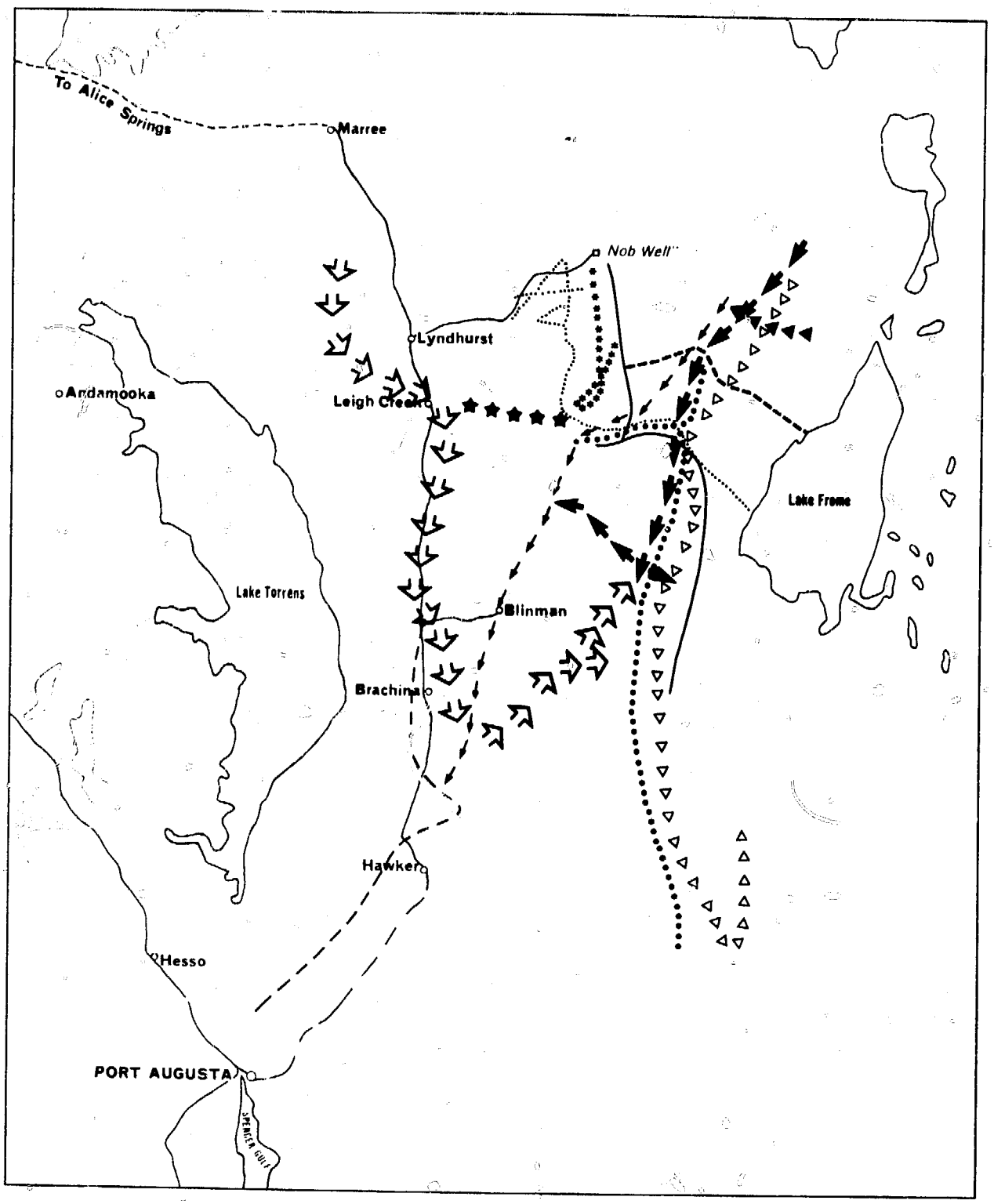
The system within which Aboriginal lives moved were the highly variable ecosystems and environments of the Balcanoona area, and within the ritual of the Aborigines was the accumulated wisdom of tens of thousands of years of experience. The lack of such wisdom in Europeans may in part explain the great succession of failures which accompanied their attempts to effectively utilise this land.

Much of this wisdom and knowledge unfortunately may have been lost for the Gammon Ranges National Park. However, this is a unknown factor until a well-designed programme of research is undertaken with the Adnyamathanha people, particularly the old people. This is an urgent work before more is lost.

Fortunately, there are a significant number of Adnyamathanha people whose great capacity for clear observation of the environment may be able to assist in the management of the park. There is a clear role for these people in helping the Service understand the relationships of the Aborigines with this land.

The People And Their Traditions

The Adnyamathanha people belong to the Central Lakes Cultural Complex (Ellis 1978) along with some 20 separate tribal groups sharing a common organisation of two matrilineal sections or moieties requiring inter-moiety marriage. The moieties were Araru and Matheri. Each person also belonged to a particular totem which was associated with a specific territorial allegiance. A person of the Araru moiety might be of the Red Kangaroo totem (Urdlumukuna - Urdlu = kangaroos; Mukuna = totem) with links to the particular plains country of the Red Kangaroo.



Snakes
Lullaby
Secret
Native Orange
Wild Dogs
Turkey & Kingfisher
Eagle
Emu
Whip Snake
Euro & Kangaroo
Kangaroo
Eagle & Crow

0 60 km

Figure 14

Mythological Cycles

Another Araru man might be of the Euro totem linked to Mount Serle habitat (Ellis 1972). These groups practised circumcision at initiation. The last full initiation of an Adnyamathanha man was in 1948.

The relationship of land to totems was established by the traditional sagas of creation times. A number of these have been recorded but much more work is this field in urgently required while the traditions survive.

Population And Distribution

At the time of European settlement, Black (1966) estimated a population of about 500 Aborigines for the area of the Flinders Ranges and pediment running from the latitude of Port Augusta to Marree and including Oodnadatta. At best this is an educated guess.

Among hunter-gatherers, food is almost always consumed within the boundaries of the local group, and most within 48 hours of collection. The conservation of effort to supply this food has become a dominant factor in economic life (Lee 1969).

If Aborigines have been in Australia for over 40 000 years and their population in 1788 was about 300 000 with little evidence of much fluctuation, then one must assume that the population levels had reached some equilibrium with the available resources long ago. Peterson (1976) makes the supporting point that most hunter-gatherer societies are characterised by a long-term stability of numbers. Food demands remain relatively constant from year to year. While other factors remain constant, most effort will be directed toward reducing the work required for acquiring food. Hunter-gatherers seem to have an abundance of leisure time.

However, increasing efficiency by reducing the distance to food sources implies that this will reduce successive harvests and force a change of base camp locations. Tradition however, has a long memory, and the hunter-gatherer is able to schedule his location or intake of specific food types to optimise the benefits of seasonal change. The more extreme the climate, the more finely honed has to be his adaptation.

The other controllable human factor is the size of the population, and this is related to the division of labour in the group. This ensures variety in diet, as success in acquiring one food item or another may depend upon the development and maintenance of specialist skills. Once the hunters and/or gatherers return, effective exchange of items demands a base camp. Sharing and exchanging is sanctioned by an ethic which ensures that success or failure is evened out.

Clearly it is an advantage to work in a group larger than that of a single family, that is, the band. Once the band has been established, its integrity is likely to be maintained. There will be continual pressures set by the conservation of effort for the size of the band to be well adapted to the resources of the Aboriginal habitat. The size of the bands operating in the park area when Europeans settled the continent is not known because disease, among other new pressures, swept through the land ahead of the European pioneers.

What can be stated however, is that the bands worked particular areas of habitat, and tended not to infringe on neighbouring areas since the carrying capacity of these areas was already reduced by its traditional users. The people who knew most about a particular area, its resources and traditions, were the people of the bands living there. At the same time, Aborigines feel most comfortable and work most effectively when in their own band, and in their own clan area. Aboriginal ceremonies associated with visits, marriage obligations, and trade, prevent the bands from becoming socially or culturally isolated (Peterson 1976).

Availability of water is a prime factor in determining the numbers and distribution of bands throughout the area where climatic events are both extreme and unpredictable. R.M. Williams (personal communication), who has based his comments on wide experience in the ranges in the north and north-west of the State, stresses the relationship between finding water and locating the Aboriginal people, but goes further to say that "...no good Aboriginals ever camp right on the water in dry times because of its effect on game and on the water itself." Both of these comments are borne out by the location of extensive cultural deposits away from the actual springs at McKinlay Spring, Camel Yard Spring, and Munyi although there may have been deeper significances at the Munyi site.

With Aboriginal bands being the critical landuse unit, rapid response in terms of population size to changing environmental conditions on a large scale is possible. Considering potential resources, band size was probably 20 to 30 individuals, with perhaps 4 bands operating in the park area - upper McKinlay Creek to Camel Yard, Illinawortina Pound and central valleys, Balcanoona and Nepouie/Munyallina Valley, and the Mainwater/Bolla Bollana area.

Food Resources

The biology section describes the total food resource which was quite rich, particularly with small mammals, before the habitat disruption caused by Europeans and their domestic animals. Much of the potential food resource was unavailable to the Aborigines because of certain plant and animal characteristics and because of customs which directed the behaviour of the people. Even so, some poisonous plants which required complex preparation strategies to render them edible or otherwise useful were used by Aborigines. One such example is pituri.

Contrary to common belief there were Australian grasses and monocotyledons which bore masses of seed following favourable seasons, particularly the millets. Allen (1979) describes the use of Panicum decompositum which grows on flood-out country and in valley bottoms. The grass had to be picked while the seeds were still slightly green, then stacked in heaps to be sun-dried or burned, after which the seeds could be easily collected from the ground. Threshing, husking, and winnowing was done by trampling, pounding, and finally shaking the grain on long bark dishes. The dirt and husks could then be blown off and the seeds used immediately. The seeds were ground into a paste with water on large flat grinding stones, and then eaten either raw or cooked into cakes. Any surplus seeds were stored in containers which included open bark dishes, kangaroo-skin bags, net bags, or grass and mud containers.

Seeds of Pigweed (Portulaca sp.) were gathered in a similar way. The spores of Nardoo (Marsilea drummondii), were used only as a drought food when nothing else was available. During the seed-harvesting season, grinding stones were carried by the women from camp to camp and left at a favourite camping spot at the end of the season. Broken and worn-out grinding stones or "nardoos" can be seen among the artefacts at the occupation site near Camel Yard Spring.

There are a number of fruit-bearing trees and shrubs which were also used for food. These include Bullock-Bush (Heterodendrum oleaefolium), Wild Orange (Capparis mitchelli), Wallowa (Acacia calamifolia), Quandong (Santalum acuminatum), Mount Lofty Grass-tree (Xanthorrhoea quadrangulata), which provided seeds, honey, and young leaf bottoms, Harlequin Mistletoe (Lysiana exocarpi), Mulga (Acacia aneura), and Native Pear (Marsdenia australis). Allen (1979) comments that in the cooler months, surface water stayed longer and this freed the hunter-gatherers from their permanent watering points in the ranges and allowed them access to the plains and a different range of foods. At this time seeds of saltbush and acacias were among those collected.

Whether the Aboriginal people lived on the plains, in the Mulga scrub, the saltbush shrublands, or the Mitchell Grass plains, the major animals hunted were Red Kangaroos and other macropods associated with these vegetation communities. Emus and their eggs were hunted or gathered in late spring. But inevitably, the basis for survival was the permanent waters of the ranges. In the ranges, as on the plains, "...the recognised rule among the natives is that the men hunt for game, and the women for seeds, yams, fruits and bulbs. Neither, however, passes anything edible." (Chewings 1936). Items such as invertebrates, small mammals, and small reptiles were fair game for all.

Robert Bruce in one section of his very entertaining Reminiscences of an Old Squatter (1902) describes a hunt in the 1850s for Yellow-footed Rock-wallabies by a band of Aborigines. It should be remembered however, that this took place a number of years after settlement. It is recounted to indicate traditional methods and strategies used.

> What hunters those blacks were! When they went to drive the rock wallabies and euros on the big range (Elder Range) they did so in a hunting costume consisting of miltee, .pecular iron ore, and pocket handkerchiefs, and a very appropriate rig out it was for the job. As for the lubras, they were not quite so dressy, while the piccaninnies did not even sport paint. However, they were all there when it came to scaling the steep rocks, throwing their knob-kerries at the wallabies or driving them into nets fixed across the terraced paths where they usually ran. It would surprise many a sportsman at Home who prides himself on his snapshots to see a blackfellow knock over big game with a simple throwing waddie or a boomerang, for verey [sic] seldom indeed does he miss his aim ...
>
> ... What feasting there would be late into the night after those mountain hunters had streamed into the camp loaded with the great furry euro and banded rock-wallabies on the shoulders of the men, and the varied assortment of snakes and lizards carried by the lubras and piccaninnies. After a short rest, during which large fires blazed in order to heat the excavations wherein to bake the big game and furnish hot ashes to top up with, the men would singe and disembowel the animals to be cooked and generally superintend the baking, while the lubras skilfully drew the saurians and cooked them in the ashes of the wurley fires as snacks to amuse the company until the big-one tuck-out was ready ...
>
> ... Talk about a Lord Mayor's Feast! One is not fit to be named in the same day with a native wallaby gorge.

Many hunting strategies were used including nets, snares, pit-falls, ambushes, stalking, sweeplines of bush into palisades (Terrapinna Waterhole), and particularly in spinifex country, fired circles. However, it was the overall operation of the band itself which ensured a continuous supply of food. The co-operative activity is well described by Chewings (1936), from first-hand experience north of the Flinders Ranges but in very similar habitats, where the problems of the hunt are similar.

> When locality to be hunted over lies at some distance from water (the natives know every rock-hole or sand-water within their beat) all the pittjis are filled, and a general exodus of men, women, children, and dogs takes place. I have witnessed many departures; some from large camps. The men usually lead off. They take a slow and very big drink before they start, and only carry their spears, spear-throwers, boomerangs, and a fire-stick. The fire-sticks are replenished from time to time, and are used to fire the spinifex and thickets for any game that may be sheltering there. They soon separate, to cover as wide a strip of ground as possible.

The women, with much shouting from camp to camp and calling for dogs, follow, laden with water, yam-sticks, nulla-nullas, pittjis (in which hair and bark string, bound-up tjurunga, stone knives, ochre, personal adornments such as necklaces of string or beans, headbands, kangaroo teeth set in spinifex gum or what not) children and dogs that cannot or will not follow. Originally there were no clothes or blankets to carry; all were naked. But of late years some possess both, and the blankets are carried by the women. They also gather seeds, fruits, bulbs, yams, grubs, lizards, and snakes while on the journey. The contents of their pittjis after a day's hunt are surprising in their variety; often very rough stuff, but filling if not very nourishing.

If the way be long, the children young, and the weather hot, the father will often carry his children in turn. He does this by placing the child on his neck with legs hanging in front, and for support the child clings to his head. I have seen a woman carrying a child that way, another on one hip with her arm around it, and a pittji on the other hip with her arm over it and a yam-stick in that hand. Sometimes she carries one child, a dog, and a pittji. One or more of the women in each party invariably carry fire-sticks.

They are never in doubt as to the whereabouts of any member of the party or the direction in which he or she may have gone; for they know the footprints of everyone, and can if necessary follow them.

Trade

Apart from the longer hunting excursions which took place when environmental conditions allowed, there was considerable movement between Aboriginal groups for the purposes of trade, reciprocal gift exchange, ceremony, special harvests, and for the passage of messages (usually to do with future ceremonies).

Mulvaney (1976) lists the travels centering on the Flinders Ranges ochre resources and the Lake Eyre pituri as the longest regular travels. While the main ochre quarries were south and west of the Gammon Ranges, the waters of the ranges must have played a significant role in maintaining accessibility. It is possible that there are unrecorded quarries in the park particularly in the southern section. If not, then the Gammon Range and Arkaroola bands would have visited the quarries themselves to obtain the very special "greasy", and "shiny" red ochre. The following passage written by Gason (1879) describes one such ochre trip by people from near Lake Eyre. Ellis (1978) states that the route was marked by stone cairns on prominent hills.

Every winter, in July or August, a council of all the old men is held, relative to the starting of an expedition for red ochre, to a place called Burratchunna Creek (west of the Blinman township), where there is a large mine of it. Old and young men are selected, a day fixed, a leader appointed to take command; all being kept secret from the women, in fear they would persuade their husbands not to leave. On the day the party must start, the old men rise with the sun, and grasping their weapons and singing, promptly depart, without any leave-taking or farewell to their wives or children. The women then, conscious of the men's intentions, commence screaming, screeching, yelling, hooting, hissing, and making all kinds of hideous and uncouth sounds - calling on their husbands, sons, brothers, and friends, to remain, and not to be led into a strange and hostile country; they unheeding proceed on their way for about five hundred yards, for the purpose of arranging with the old men who are left behind, to build wurleys (Bookatoo Oorannie), for the reception of the party when it returns. The site being selected and instruction given to build substantial huts, farewell is taken, the expedition singing ... a rather mournful ditty, encouraging the young lads to keep up their spirits; and indeed some of them require encouragement, knowing that besides having to travel over three hundred miles through strange country, many a hungry belly they will have before

> reaching their destination, independent of the load of ochre they will have to carry back. The party travels about twenty miles a day, and on arrival at the mine each member of it digs out his own ochre, mixes it with water, making it into loaves of about 20 lbs. weight, which are dried. (Just after collecting the ochre, having all the hair of their faces plucked out (not cut or burnt off)). Each man carries an average weight of 70 lbs. of ochre invariably on the head, and has to procure his own food; the party seldom resting a day while on the journey, which lasts usually from six to eight weeks, until within one day's stage of their camp - the Bookatoo Oorannie. On the return route they barter with the tribes they pass, giving weapons for old clothes.
>
> ... The ochre party, who having, for fear of hostile tribes, made their way home, only resting at night, are now within two hundred yards of the camp prepared for them. They drop on their hands and knees, so as not to awake its inhabitants, whom they do when within a few yards distance, by loud yelling and clapping their hands and dancing two or three times round the Bookatoo Oorannie, after which they retire a little way. The men of the camp then rush out to ascertain whether all of the party have arrived safe. Women crying, children screaming, dogs fighting, altogether make up a discord language is unequal to describe. Now the sugarloaf bags are placed on the heads of the adventurers, the women prepare the food for them, and dancing is kept up during the whole of the night, until sunrise, when the ceremony is over, and until then the women are not allowed to speak to their husbands or relatives. Afterwards, days are spent by the members of the expedition, in recounting anecdotes and incidents of their travel.

Another account of the arrival and departure of a Cooper Creek group at the quarries is given by Bruce (1902). He comments that some of the 80 lb. (35 kilogram) loads were partly exchanged for pituri on the way home. Pituri, an opiate in effect, was brought to the Flinders Ranges in narrow, netted bags by trading bands. According to Haegi (1981), Pituri (Duboisia hopwoodii), is "...used as a stimulating drug by the Aborigines who chewed the crushed dried leaves which were mixed with ashes and formed into a wad. The leaves contain alkaloids poisonous to stock." Mulvaney (1976) describes the sources of trade pituri, ochre, and sandstone and their movements in relation to the Gulf of Carpentaria/Lake Eyre axis (Figure 15). Most suggested routes are clearly tied to watercourses and ridges within which are rockholes. The extent of the movements can be gauged, since baler shell objects, originating from the south-eastern part of the Gulf of Carpentaria, have been found in the vicinity of the northern Flinders Ranges.

In theory at least, it was possible for a Gammon Ranges man who was using pituri from the Cooper Creek area, and ochre from Parachilna, to own a Cloncurry axe, and wear shell pendants from the Gulf of Carpentaria.

Trade and walkabout has at least one other very important side effect - a genetic one. Apart from specific sexual practices during certain ceremonies, the rights of visitors to the services of women was universal, a practice which was greatly misconstrued by the European settlers.

Rock Art

Probably the most spectacular artefacts of the Aborigines in the park area are the rock art sites. Both of the known sites, Mount McTaggart and Munyi, occur on a small outcropping of fine sandstone, slightly quartzitic in character, of the Proterozoic Elatina Formation. The Mount McTaggart site, which lies just outside the boundary of the park, has been visited frequently and has been damaged by vandals. It is still an interesting and very valuable site worthy of strong protection, and its situation makes it highly useful for park education

programmes. As with the sites at Munyi and Chambers Gorge, the peckings are mainly of circles, said to be related to initiation, and animal tracks. To protect this site, the unsurveyed road may have to be re-routed.

Munyi is a much larger site with a greater range of rock art motifs and the Adnyamathanha people of Nepabunna speak of it with great respect. Clearly, this gorge site on Whywhyana Creek has been rarely visited though near its entrance some "modern" geological pick peckings have been executed along with some scratched names. The site is very important and very fragile since the main gallery is a slowly moving gorge face of broken flags with a dip of approximately 60 to 70 degrees. Even without people moving about the face, the site is fracturing and moving. Walkers and climbers will rapidly accelerate the process. This site poses perhaps the most urgent and difficult stabilisation and conservation problem in the park. It is essential that a thorough study of the site's geomorphology be undertaken before stabilisation work can commence. This should only be undertaken with the full understanding and involvement of the Adnyamathanha community.

Until the stabilisation process is well underway the site should not be opened to the public. The potential cost of allowing people to wander and photograph this point is far too great. However, its present relative inaccessibility should not be seen as adequate protection for the future. The motifs present at Munyi pose many interesting problems for the interpreter. If, as has been suggested by Ellis (1978), the art is in excess of 10 000 years old, then we may in some instances be looking at the footprints of now pre-historic animals. Some of the motifs are of sacred significance.

Other Archaeological Sites

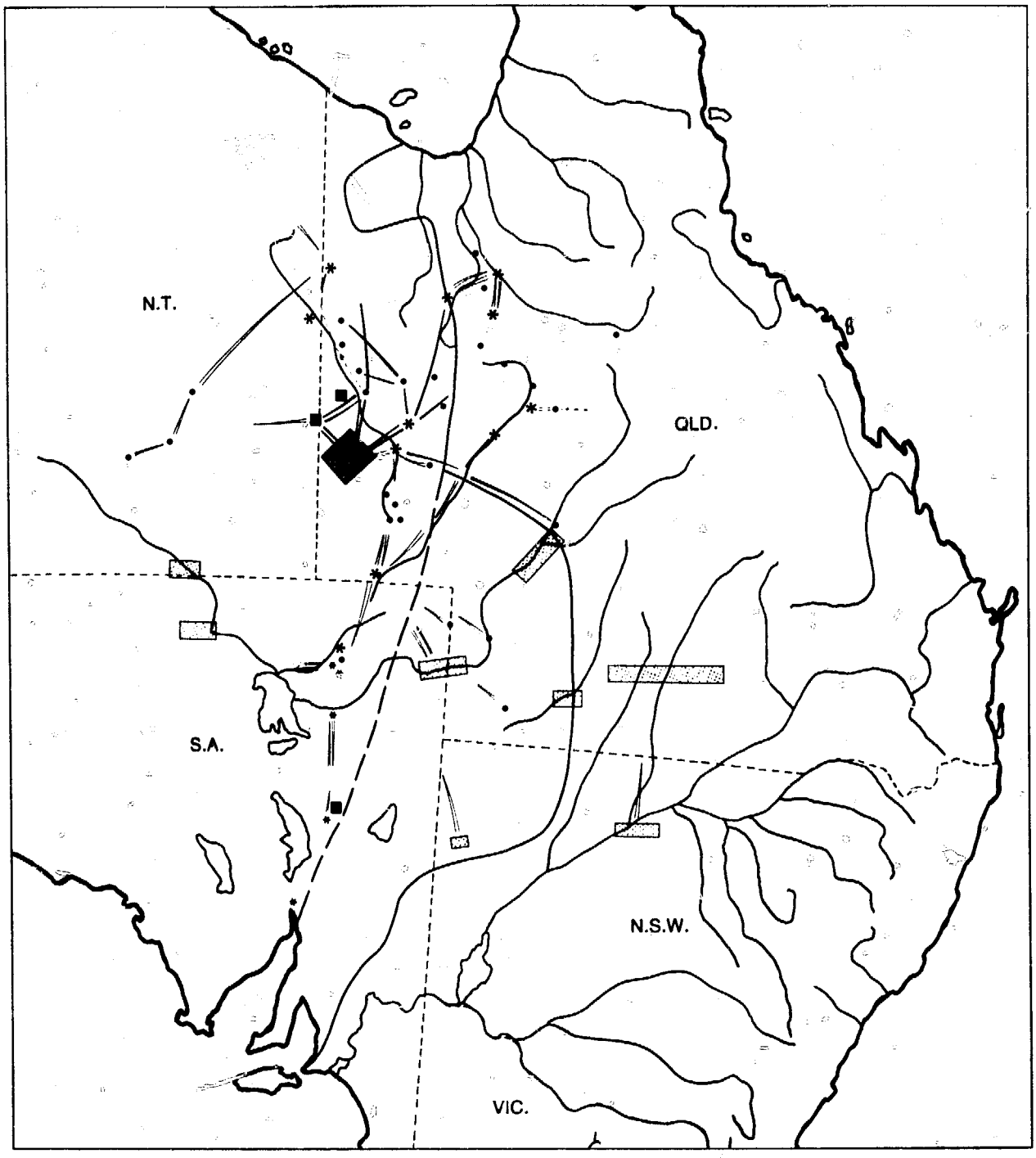
Archaeological information is concerned with past evidence of Aboriginal occupation in an area. Such sites are:

Quarries
For the supply of stone for tools and for ochre. Ochre for ceremonies at Minerawuta came from Parachilna mines (for the most important ceremonies) and from 5 kilometres east of Copley for the rest. No quality ochres or ochre mines have yet been recorded in the park area.

No information on the possible sites of tool stone quarries is available but in such a large area of sedimentary and partially metamorphosed rocks, some with very fine and homogeneous grain, it is probable that there are such sites. However, main supplies of stone for these purposes was probably from igneous intrusives and metamorphic rocks in Arkaroola.

Surface scatters of stone artifacts
Have been observed in a number of locations although no systematic examination has yet been made. The largest scatter is east of Camel Yard Spring and is quite extensive and varied. The site is well worth detailed examination as it lies on permanent water and at a major break in east/west ridges cut by McKinlay Creek. Other scatter locations include the ridgetop north of McKinlay Spring, the rises west and north of the Mount McTaggart rock engravings, the flood terrace east of Italowie Gap and in the gap, and Balcanoona Spring. Many other minor sites were noted. Map references for these will be held by the National Parks and Wildlife Service.

Burial sites
One site has already been identified by a Nepabunna informant who was concerned that people visiting the McKinlay Spring would disturb the site. Other sites must be in the park, and before any developments take place, Aborigines of standing in the local community should inspect the proposed development site to clear it.



Pituri traded

Pituri source

Roth Pituri route

Stated routes

Circumcision

Subincision

Sandstone

Ceremonial centre

Ochre

Participating groups

0 500 1 000 Km

Figure 15

Sources of Trade
Source: Mulvaney (1976)

Verbal agreement with no inspection leads to confusion and no real clearance. What is said about burial sites applies also to other sites of a sacred or customary nature.

Paintings
Two major sites lie south of Nepabunna, and the Aboriginal people are considering providing a guided tour activity which could well be integrated with the park interpretive programme and included in the Aboriginal Ranger Training Programme.

Stone Arrangements
None have been expressly indicated by local Aborigines, but numerous hilltop cairns, particularly towards Arkaroola, are visible. It is probable that many were built by Europeans in more recent years. Many hundreds of metres of stone walls have been constructed in the vicinity of the Lady Buxton Mine in Arkaroola. They make little sense from a domestic stock point of view, and no-one has yet suggested a plausible solution as to who might have built them. If they are Aboriginal constructions to trap or ambush animals, then the story will have considerable use in a regional interpretation programme.

The area of the park is large and has many interesting archaeological features for even untrained persons. A thorough and professional archaeological survey of the park will prove of considerable value to the park manager, the interpreter, and will help to recreate the self-esteem of the local Aboriginal people.

Aboriginal Place Names

In May 1984, Dorothy Tunbridge, a Ph.D. student in linguistics from the Australian National University, spent two weeks in the park with the older Aboriginal people gathering information on the Adnyamathanha names of natural features and phenomena. Many of the traditional names of places describe the vegetation that was associated with the area.

The Geographical Society has expressed interest in the renaming of some areas in South Australia using Aboriginal names. The report prepared by Ms Tunbridge will also provide basic material for future interpretive programmes. The National Parks and Wildlife Service will seek to adopt Aboriginal place names in the park where this is appropriate.

Past Aboriginal/European Interaction

This section perhaps more correctly belongs to the European section of this management plan, for it was the Europeans who initiated the relationship by arriving in land which had already been occupied for probably more than 50 000 years. A review of the history of the interaction, albeit from a European point of view, is given in Mincham (1964), which is essentially a pre-Land Rights point of view. The analytic description in the case study from Berndt and Berndt (1951), traces attempts by European society to "westernise" Aborigines and the disastrous results which followed. Robert Bruce (1902) reminisces as a squatter and describes the Aborigines in an environment being rapidly changed by Europeans. Bruce's views on the Aboriginal story will allow us to interpret the process of change with some understanding. If the South Australian National Parks and Wildlife Service is to successfully train and place Aborigines in staff positions, then an understanding of the Aboriginal and European states of mind is essential.

Implications For Management

1. Water is and probably has been the dominant limiting factor for the intensity of human occupation.

2. Waterholes and springs are frequently of mythological and sacred significance.

3. Aborigines believe that:

   - land rights of all tribal units were laid down for all time by the supernatural beings;
   - every person carries within himself an immortal spark of life derived from the creation beings and thus they are all inseparably linked;
   - the wellbeing of the universe depends upon the regular "singing" of the original creative words and acts of the supernatural beings by their human reincarnations from generation to generation;
   - in their land, the supernatural creative beings live today in clearly marked sites in places such as the mountains and springs;
   - the visible totemic landscape is considered to be an integral part of the reality of eternity.

4. Aborigines have a special capacity to observe the ecosystem at work.

5. There is a need to record surviving Aboriginal knowledge, traditions, and beliefs of the Gammon Ranges landscape.

6. There is a need to encourage the local Aboriginal people to maintain a knowledge of their Aboriginal heritage, particularly with and for the children and young people. The Nepabunna School can be a key tool in this, and the park represents a special link between Europeans and Aborigines.

7. Sympathetic Aboriginal employment provided by the Service for the park's operation will reflect the Service's desire to have Aborigines help manage a resource of which the Aborigines are an integral part.

8. The Aborigines knowing most about a particular place are the bands which lived there, or the nearest possible groups of the tribe.

9. Aborigines feel happiest and work best on their own clan lands.

10. The themes "Aboriginal Food Plants" and "Trade and Walkabout" are stimulating topics for visitor interpretation.

11. The Mount McTaggart art site is accessible and could be developed as a special interpretation site.

12. Munyi Art Site:

    - A geomorphological study of the site, slope instability and predicted problems with visitor use, should be undertaken as a high priority work by a competent arid-zone geomorphologist.
    - A management programme for stabilisation and interpretive use of the site should be undertaken. This must be a co-operative project between geomorphologist, archaeologist, and interpreter with input from a soil conservation specialist. The leader should be the archaeologist.
    - No more development work should be undertaken beyond a single, drained and stabilised track.
    - Open access to the site should not be allowed.
    - All works should be planned and executed with the agreement of the Adnyamathanha people from initiation of the project.

The over-riding planning principle will be that the site is more important than the visitor. This is a major heritage site if for no other reason than that it has had very little disturbance from Europeans to date.

13. Because of the lack of information on archaeological sites, all areas which will be disturbed by park management practices should be checked on the ground with archaeologists and Adnyamathanha people so that informed management decisions can be made.

14. The Adnyamathanha people wish to see the adoption of traditional Aboriginal place names.

EUROPEAN SETTLEMENT

The chronological sequence of events since Europeans settled in the Flinders Ranges is detailed in the Appendices. Not all events relate directly to the park, but most influenced the direction other events were to take. The ramifications of some are still being felt today.

Present Occupation

Pastoral Development
Figure 16 shows an old survey plan of the Balcanoona lease area and major pastoral developments.

Balcanoona Homestead Site
This is the principal building complex and includes the manager's residence, shearing shed and quarters, meathouse and washrooms, office/store, fuel and machine shop, garaging facility, original homestead, sheep yards, stone tanks, gravity-fed water tanks, windmill and well with troughs, and dog kennels.

This layout is everybody's idea of a complete sheep station and as such is an important resource relating to the history of Australia. Buildings generally are of recent construction but of traditional design in stone and corrugated iron.

Most of these facilities are used, for example, the homestead for the ranger-in-charge's residence; the shearers' quarters for park workers (contract and staff), and temporary accommodation; the woolshed for a display on the park; and the office and machine/fuel sheds are used for their original purpose. Four new staff residences were constructed in 1984.

Grindell's Hut Site
An outstation site controlling Wortupa and Illinawortina pounds as well as access downstream into Weetootla Gorge. The complex comprises the original Grindell's Hut, outstation residence of stone with iron roof, bushwalker's hut of stone, 30 000 gallon (140 000 litre) round stone tank and windmill, sheep yards, and an 8 000 gallon (35 000 litre) round stone tank which is gravity-fed from the main tank. These tanks were constructed in 1957. There is also a timbered well which is still in use.

Oocaboolina Outstation
An outstation controlling the McKinlay Creek Valley and adjacent to the road entrance from Leigh Creek. Facilities include the outstation house which has a concrete floor, stone walls, and iron roof, a vehicle shed, sheep yards, and a circular stone tank. Water is gravitated to a trough near the road about 500 metres away. The building is currently not in use.

Nudlamutana Hut and Well
An outstation at the eastern end of the road from Yadnina outstation to the Arkaroola road near McLeashes Mine and the Wooltana Bat Cave. The facility includes a concrete-floored house, with stone walls and an iron roof; cattle yards; windmill and well; and a round, stone 15 000 gallon (70 000 litre) tank built in 1954. The facility is used from time to time by goat-catching teams and travelling staff.

Yadnina Outstation
An outstation controlling access to the northern and western sectors of the park as well as the Illinawortina ruins. It is a critical management location. The facility includes a large, concrete-floored, stone and iron house; 15 000 gallon (70 000 litre) stone tank; windmill and well; sheep yards, and crutching shed. This is a very isolated location which needs one of the internal roads to be maintained for reasonable access to the park headquarters.

Access

Roads
Perimeter roads are maintained by the South Australian Highways Department.

Nepabunna to Italowie Gorge is connected by a gravel road which has narrow embankments and bad cambers on the hilly corners. The road has patches of bulldust and demands careful driving.

Italowie Gorge to Balcanoona is connected with a well-formed gravel road which is wide with some loose boulders on the early hill sections. The plains crossing has a definite kangaroo hazard for motorists.

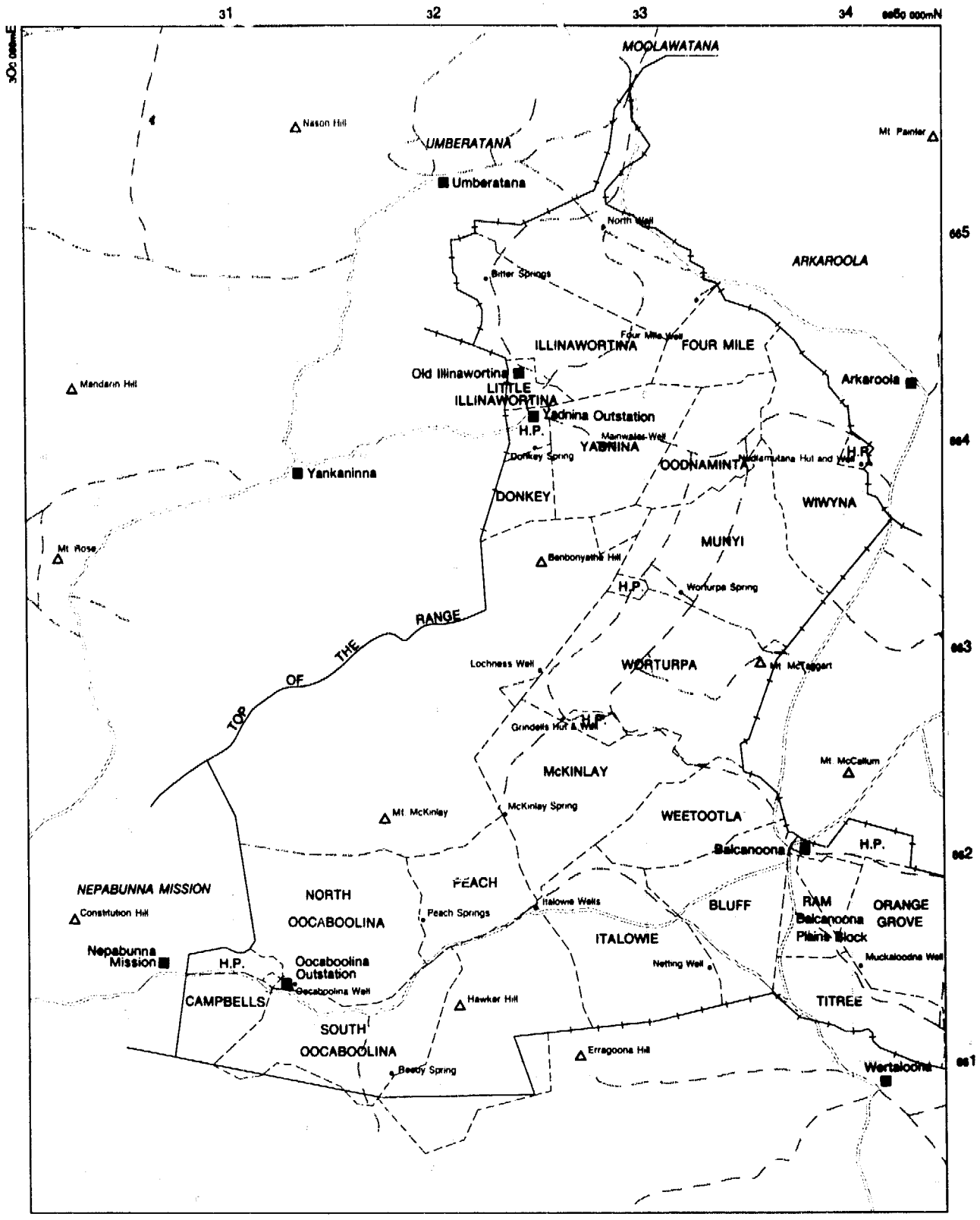
Balcanoona to Arkaroola has an excellent gravel-surfaced road with at least one "whiplash" dip. From Arkaroola airstrip the road enters the hills and degenerates slightly, although it is still quite good if care is taken on corners.

Arkaroola to Bolla Bollana is negotiable by a narrow dirt road which is rarely graded and care is needed.

The Bolla Bollana to Yankaninna road via Umberatana is a better road, but care is still needed. The route via North Well and Yadnina to the outstation is passable to 4-wheel-drive vehicles only, but from Yadnina to Yankaninna 2-wheel-drive vehicles can be used with care. The road is unformed and has a natural surface.

Yankaninna to Nepabunna has a serviced mail road which is generally well graded. Bulldust and gates are present and care is needed on crests and in gully crossings. Just past Mount Serle Station, the road joins the main Leigh Creek to Nepabunna road.

Internal Roads are difficult to maintain as they all have critical sections running up creekbeds. Although two-wheel-drive vehicles with lower clearance cannot use these portions, they are adequate service tracks.



Unsealed Roads
Tracks
Boundary
Boundary Fence
Fence
FALL Paddock Names
WERT Abutting run names
H.P. Holding Paddock

0 5 10 15 20 km

This plan is a survey of the old lease and does not correspond to Park Boundaries

Figure 16

Pastoral Development

Bus Transport
A linking service runs via Leigh Creek, Hawker and Port Augusta to Adelaide.

Access by Air
A naturally surfaced, but graded airfield has been constructed three kilometres east of the Balcanoona homestead. The airfield, which can handle twin-engined aircraft, is made up of two airstrips. One strip, bearing $040^{0}/220^{0}$, is 1 400 metres long and 60 metres wide. The second strip, which bears $090^{0}/270^{0}$, is 1 000 metres long and 100 metres wide. Balcanoona is on the Royal Flying Doctor Service radio network.

An alternative airstrip is located at Arkaroola in the Munyallina Valley on the footslopes of the western range. It is a short field, surfaced with gravel. Emergency fuel is also available at Arkaroola.

Mining Operations
No current mining operations are being carried on within the park area although BHP has Mineral Leases 4059-4066 ~~which expired on 7 February 1980. These leases have since been renewed~~. The leases lie over the magnesite deposits in Weetootla Gorge.

The evidence of old mining operations usually lies on or near geologically interesting features, and all are accessible by foot along old tracks. Bolla Bollana, Wooltana Cave, McLeashes Copper Prospect and O'Donoghue's Castle Mine sites are accessible by two-wheel-drive vehicles.

Loch Ness Copper Prospect
Old collapsed shafts with scattered malachite, azurite, cuprite and chalcocite pieces lying about the surface mark the site of this prospect. A number of pits, trenches, and four bulldozed costeans are interesting features and are safe to wander among. The nearby Loch Ness Well is the major first night camp before commencing wilderness walking. Access is by four-wheel-drive only, and connects with the western internal road to Yadnina. Aboriginal informants claim that near Loch Ness is a "dangerous site", and they expressed fear for European visitors. More investigation is required in this regard.

McLeashes Copper Prospect
This site is shown by an old collapsed shaft of early workings with scattered malachite, coloured dolomite, and kaolinitic lumps on the surface. New workings include platforms bulldozed for drilling works. Interest is in the very clear fault line related to the Paralana Fault, and differences in rock types, colours, soils and vegetation. The prospect is accessible by conventional vehicle through Arkaroola along the park boundary. This is a feature in the northern end of the day visitor area.

Wooltana Cave Phosphate
Over the rise to the east of McLeashes Copper Prospect, and in the Balcanoona limestones, is the sink and cavern of Wooltana Cave which has a 65-metre vertical shaft 5 to 10 metres wide, and terminates in a cavern 60 metres in diameter, with a roof 10 metres high. A number of tunnels penetrate the vertical walls of the cavern. The cave floor is covered with the remains of the bat guano mining operation of the 1920s and 1930s. The entrance is open, and dangerous to ordinary park users. All headworks have disappeared. Slatted platforms at the mine level and on the footslope, a loading cut, an old chimney, and old campsites all make very interesting interpretive material. Since visitors will collect anything novel in the scattered rubbish of the mining period, a Service archaeologist

should survey the site before the public causes further interference. The site is rich in links with a wide range of interests; geology, bats, fertiliser/guano deposits, and human occupation.

O'Donoghue Castle Mine
Six kilometres south of McLeashes Copper Prospect is the O'Donoghue Castle Mine. Before 1900, two tunnels were driven with a stope in Adit No. 1 which extends to the surface. Adit No. 2 has been blocked at the entrance by wash from a new road. There are numerous recent (1965-1969) bulldozer cuts, tunnels, and pits. The whole area is littered with items of interest to the amateur geologist and for those interested in mining methods. One recent tunnel into the top of the ore-bearing shear zone is very dangerous, but interesting enough to attract the unwary. Adit No. 1 is through hard rock, but there is danger from falls in the stoped area. Numerous ore piles contain samples of azurite, malachite, iron and manganese oxides, chalcocite, chrysocolla, and traces of cobalt ores.

This area is at the southern end of the proposed day visitor area and has water available at the well and tank. Before making this area and Wooltana Cave open to the public, both should be checked by a mining specialist to advise on safety.

Mount McTaggart Copper Prospect
A number of shallow pits, a collapsed shaft, trenches, and an adit are scattered across the northern and eastern faces of the ridge behind Mount McTaggart. Interesting exposures of malachite-stained rocks and masses of quartzite and boulder tillite lie on the surface. The Paralana Fault is immediately to the east and is marked by the valley through which the road passes. This area is adjacent to the proposed four-wheel-drive access road which will replace the road that runs through Weetootla Gorge, and will attract wanderers and fossickers. The area appears to be safe. Some artefacts of the mining operations, such as broken drill bits, are scattered about and should be collected for possible future interpretive use.

Monarch Mine (Parkhill's Claim)
Two long pits up to two metres deep and about four metres long, a shallow shaft 2.5 metres deep, and a trench are all that remain of this 1907 mining operation. There is now no evidence of the track which once led to it. Gold specks are evident in some of the quartz.

Worturpa Mine
West of the track from Grindell's Hut to Worturpa Well are a number of workings which follow 1.3 kilometres of strike. Pits, trenches, three shafts, and two adits are scattered along the strike. Gold, and some silver, was won between 1899 and 1905. A rare compound of Nickel has also been reported here.

B. and H. Stubbs discovered the site in July 1899 and found good coarse gold. Parkhill had the contract to carry ore during 1904-1905 for the Wortupa Exploration and Mining Co. Ltd and T.S. Backhouse. The area is an interesting but unprofitable area to fossick, although a number of campsite artefacts litter the surface.

The site is near the proposed four-wheel-drive road from Mount McTaggart/Grindell's Hut to Yadnina at Worturpa Well. The adit should be checked for safety.

1676

Balcanoona Magnesite Deposit
Three adits, two metres high and one metre wide, and between 70 and 75 metres in length, run into the orebodies of almost pure magnesite. These were driven in 1964. The 1500 tonnes of magnesite mined from the adits is stockpiled. A permanent spring which contains fish is located in the magnesite orebody where it crosses the creekbed. The site is a very effective environmental education resource as it presents greatly conflicting forms of landuse in a critical wildlife area. The safety of the entrances to two of the adits is dubious.

Tourism

Introduction
The landscape peripheral to the Gammon Ranges has attracted people from the first Aborigines to the present generations. The gorges, with their waterholes, springs, the deep shade of the cliffs, and the great River Red Gums, gave water and shelter in the hot dry land to all travellers. Places such as Italowie Gorge, Weetootla Gorge, McKinlay Spring, Camel Yard Spring, and many more, show evidence of camps going back thousands of years. Italowie, Camel Yard Spring, and Balcanoona had the added attraction that they were on through routes to the ochre mines or the pituri crops.

With settlement and the commencement of the pastoral era, the same places gave campsites to itinerant shearers, drovers, rouseabouts, travellers, and those just "humping their bluey". Lonely graves on the plains are a reminder that some didn't make it to the springs in the hills or else didn't know that they existed.

The motives of today's visitors are changing. Ready and improving access from Adelaide, Melbourne, and Sydney (via Broken Hill), along with a wave of literature, paintings, films, and the word of mouth telling of the mountain grandeur, the wildlife, the wildflowers, the quiet of the mountains, the desert experience and the night skies, is drawing recreationists from the cities. Those who have been to Mount Remarkable, Alligator Gorge, Wilpena, and Chambers Gorge have the Gammon Ranges National Park and Arkaroola in their sights to complete the Flinders Ranges adventure. Here is the "wild" end of the ranges. Management must aim to maintain the core of these places in the wild state, for even though the wild heart will be unattainable to nearly all visitors, the ranges can always be thought of as wild, untamed nature simply because the back country, those distant clifflines and treelines, are unattainable to most people. That provides an essential atmosphere for those who use only the edges of the park. It is all available to those who will spend the time and the effort to venture into these areas on foot. The achievement of wilderness experience for the physically disadvantaged is of a different dimension, but no less real.

Visitor Activities
Observations on visitor patterns have revealed the following:

- Most park visitors spend time at Arkaroola and usually participate in the ridgetop tour (geology, scenery, and excitement).
- Most unguided visitors to Arkaroola wanted to use park areas for picnics, walks, and better camping.
- Bus groups rarely arrive to gain recreation in the park. Rather, they are scheduled visits to Arkaroola in the tour's itinerary. The majority of bus groups are older people, many of whom are participating in retirement activity.

- Special interest groups such as school groups and church groups comprise a significant proportion of visitors. School groups are usually involved in field curriculum activities such as geology, ecology, biology, environmental studies, and history. These group activities range from contemplation on mountain tops to rock climbing.

- Bushwalking groups usually arrive by car or minibus and walk into destinations such as Bunyip Chasm, Wildflower Creek, and Cleft Peak. Parties most frequently range from 3 to 8 persons, and Grindell's Hut and Loch Ness Well are important sites for water replenishment.

- Little use of four-wheel-drive vehicles as off-road vehicles has been observed. Most seen are on Service roads and are driven as a means of access to camping places near springs or wells.

- Eighty-two per cent of all vehicles observed in a seven-week period in 1982 were camped by the roadside, usually near water. The four-wheel-drive vehicle was clearly at an advantage when seeking the ultimate camping site, climbing or barging into quiet corners among the paperbarks, or behind masses of boulders.

- Most of the above vehicles carried families or multiple males and their observed activities included:

  (i) painting;

  (ii) photography of nature and wildlife;

  (iii) walking;

  (iv) nature and wildlife observation (usually Yellow-footed Rock-wallaby spotting);

  (v) camping;

  (vi) being in a wild place;

  (vii) contemplation;

  (viii) bird spotting (compiling lists);

  (ix) fossicking.

- Few visitors know anything of the geography of the country or of places to visit.

- Some visitors park and camp as close to water as possible, and clearly disturb wildlife in Weetootla Gorge. The movement of vehicles up and down Weetootla Gorge in busy periods has been a continual cause of irritation to walkers trying to observe wildlife.

- The five most used areas are Italowie Gorge, Weetootla Gorge, Balcanoona Creek near Wooltana boundary, Coral Well, and Arcoona Creek.

- Of the vehicles using Weetootla Gorge in the 1982 spring school vacation, 50 per cent were of Victorian origin, 30 per cent South Australian origin, and 20 per cent New South Wales origin. The preponderance of Victorian vehicles at this time could be attributed to the fact that the Victorian holidays were one week later than South Australia. Staggered spring holidays in 1982 spread the visitors over 4 weeks.

- Most visitors select the park as a destination after hearing about it from friends. This corresponds with the Flinders Ranges National Park survey, and with work done on the Queensland Gold Coast, which spends vast sums of money on television and pamphlet advertising, and airline brochures.

- Many air tourists land on the Balcanoona airstrip for accommodation at Arkaroola. On the June 1982 long weekend, nine aircraft were parked there. Part of their itinerary was a trip up Weetootla Gorge in a four-wheel-drive vehicle.

From July 1981 to December 1982 two traffic counters were installed at Nepabunna and Wertaloona to record vehicular movements past Balcanoona. During that period over 18 000 vehicles were recorded as having travelled these roads. As expected, the heaviest traffic occurred during the August/September school holidays, and averaged around 2 000 vehicles for that period. Throughout the hottest months from November to February vehicle counts were low; below 400 vehicles per month at each site. Exact figures are unknown due to a faulty counter.

TABLE III: SUMMARY OF ROAD VEHICLE COUNTS - BALCANOONA

Month	Nepabunna	Wertaloona
1981:		
August	973	1 310
Sept.	1 139	832
Oct.	887	953
Nov.	411	494
Dec.	298	279
1982:		
Jan.	?	?
Feb.	?	?
March	581	323
April	770	247
May	986	?
June	818	?
July	317	291
Aug.	?	?
Sept.	182	1 042
Oct.	452	910
Nov.	?	369
Dec.	?	254
Total	8 214	7 304

The Impact of Visitors

Campsites of heaviest use such as Italowie, Weetootla, and Arcoona, are exhibiting an unattractive, worn-out appearance and the ground is bare, with trees broken or trimmed in the search for firewood or to enable "edge" camping with more privacy. Worst affected is Italowie Gorge, which has been a major camp on the main through route ever since humans have been coming to the area. Tracks, dispersed boulder fireplaces, and severely trimmed trees and stumps, link and surround the bare campsites. Buried rubbish coming to the surface and broken glass litter the surface of this European midden. The spring upstream is trampled by both goats and humans, and the vegetation near this length of running creek is battered. Since becoming part of the park, a vast amount of rubbish has been

removed, and some cosmetic treatment has rendered the area more attractive. However, this area of traditional camping will continue to degrade unless it is periodically spelled and managed for relatively heavy public use.

In the short term there will be complaints from those who have become accustomed to using the area and who are willing to camp among rubbish and on a worn-out site. In the long term, a designed site will have a higher carrying capacity, yet retain a greater degree of attractiveness with an easier maintenance problem. An alternative site must be developed before moves are made to rehabilitate this area. It is an urgent job.

All gorge camping near water disturbs more than the vegetation. Wildlife access to water is disturbed by the presence of campers to a lesser or greater extent depending on the campers. Waters near camps are also more likely to be polluted with soaps, detergents, and camp refuse. This is the case at Italowie and Weetootla gorges.

The type of vehicles in use have an effect on maintenance work. Inadequate vehicles, generally two-wheel-drive, using the creeks and Service roads for access, get into trouble which then necessitates digging, and removal of rock and timber. They also spin wheels on steeper slopes, which rips out creek crossings and hill slopes. Four-wheel-drive vehicles can become a greater problem when they travel off-road although fortunately, most owners do not travel to the northern Flinders Ranges just to test a vehicle's capacities. The cost of damage to the vehicle is too great. However, a problem may arise with vehicles and travellers from nearby Leigh Creek.

Because of the limited water supplies there is a tendency for wilderness campsites used only by backpackers to be overused. While bushwalkers are usually very sensitive users, in such a location they will need to be more so if campsites are to remain a high quality viable resource. Water is the critical limiting factor, as is space, in many wild but watered locations.

The Impact Of Park Management

The Gammon Ranges National Park was proclaimed when 15 538 hectares of very rugged country was reserved. The only change that occurred as a result of dedication was that sheep from Yancaninna, of which this land was once part, no longer grazed the Mainwater Pound area. From time to time Service staff visited the periphery. An important experiment was initiated in about 1974 in the lower Arcoona Creek Valley when large selective exclusion plots were erected on outwashes, footslopes and stony rises. These were designed by the Vertebrate Pest Control Authority and the South Australian National Parks and Wildlife Service and have been serviced throughout. They are some of the longest-serviced exclusion plots in Australian national parks. The information they contain will help greatly in understanding the role of herbivores from rabbits through to goats, sheep, and kangaroos, in the structure of grazed communities. More such plots should be erected and serviced in a wide variety of soils and communities. They form an essential baseline for the management of wild lands.

In 1980, the South Australian Government purchased the Balcanoona lease and the property was vested in the Minister for the Environment. All the lease area, except the plains paddocks running to Lake Frome, was added to the Gammon Ranges National Park on 17 April 1982. These plains paddocks have now been added to the park. In the two years since purchase, management has essentially been a holding operation. During this time the resident officer, and later the ranger-in-charge, supervised and maintained campsites, and actively helped visitors with advice and information. An information display is located in the woolshed. The following works or programmes have had a positive impact since acquisition.

Balcanoona Homestead
The Balcanoona homestead and building complex has been electrically rewired and a new generating unit installed. A "street lighting" system tied to automatically timed switching has been installed to provide added night-time security for buildings, gear, and staff. During 1982, The Public Buildings Department completely renovated the homestead, shearer's quarters, office, and water reticulation system, including the installation of a 100 000 litre tank. The area generally has been cleaned up.

Bolla Bollana Round House
Bolla Bollana round house, listed by the National Trust, caused concern as the walls were spreading and roof collapse was imminent. It was inspected by the Service archaeologist and stabilisation of the building recommended. A steel strap was tied around the upper part of the wall and stressed. Further work on the footings is continuing. In the meantime, there is a danger to the public from roof collapse.

Goat Control
The strongest single attempt to reverse the degradation of habitat since sheep were removed has been the goat catching programme undertaken by the Nepabunna Aboriginal community. This programme was actively supported and fully encouraged by the National Parks and Wildlife Service. Many thousands of goats had been removed before the drought reached critical levels, and the programme continues. However, the animals are now in small widely dispersed flocks which makes the economic return very slight. The full cost of the operation to the Aborigines has never been adequately assessed nor the economic profits measured. This is a pest control programme of national importance.

Proclamation
The national park proclamation itself has had, and will have, a continuing impact on attitudes and relationships to this piece of land. With each passing landuse conflict affecting a park, or proposed park, there is a growing public awareness of the consequences of the national park concept. This produces, along with personal experiences in managed parks, an expectation of what parks and responsible management is about. This is a hidden but very potent long-term impact.

Implications For Management

1. The park contains significant relics and artefacts of European settlement and industry.

2. The park story is rich in links with the State and national stories relating to exploration, landuse, resource development, European/Aboriginal relationships, the pastoral industry, and the nature of Australia.

3. The BHP mining leases on the Balcanoona Magnesite Deposit are in the middle of a critical area of the park. Any exploitation of the magnesite will require very careful management.

4. Improved highway access and a wider public relations programme along with improved facilities will greatly increase usage of the park.

5. The number of artificial stock watering points are in excess of those needed for park management purposes.

6. There will be greater wildfire risk with the removal of the two major herbivores - sheep and goats.

7. As well as causing direct scars on rock faces, increased mineral and rock fossicking could become an attractant to areas deep in the park, and create a demand to allow unrestricted four-wheel-drive access.

8. The major building complex and the outstations, wells, windmills, and tanks will require a major specialist maintenance input from now on.

9. The original Grindell's Hut was severely damaged in the removal of station equipment and is urgently in need of stabilisation and repair.

10. Oocaboolina outstation is well sited for an information post for those visitors entering the park from Leigh Creek.

11. Some of the old mines and Wooltana Cave are potentially dangerous places for visitors.

12. Yadnina outstation is in a location which controls the whole of the northern and western boundaries of the park.

13. The Illinawortina ruins, Bolla Bollana smelter site, the O'Donoghue Castle Mine, and Worturpa Well are all places of high park interpretive prospects.

14. Boundary fencing is in poor condition in numerous places, for example, with Wooltana near Weetootla/Mount McTaggart.

15. Operating windmills require regular specialist maintenance.

16. Loch Ness Well provides essential permanent water for wilderness walkers.

17. Wooltana Cave, McLeashes Copper Prospect, the O'Donoghue Castle Mine, and the Balcanoona eastern range are all ideally suited for day use areas.

18. Caverns and mine tunnels to be used must be checked by a mining safety expert and cleared before use.

19. The Balcanoona Magnesite Deposit and the mining leases provide an excellent environmental education issue.

20. The BHP lease area has been left in a most untidy condition and iron and rubbish present a hazard to the public. The company should be required to clean up the site because of its location within a national park.

21. Rapid four-wheel-drive access by one road is needed through the park to adequately protect and service the total area and boundary.

22. A second general access road through the park is not required.

23. The Italowie Gorge campsites are very significantly degraded, and require withdrawal from use for rehabilitation work.

24. The haphazard siting of camps in Weetootla Gorge is inimical to wildlife, and to a quality experience for walkers, photographers, and observers of nature or wildlife.

25. Weetootla Gorge and Italowie Gorge contain colonies of Yellow-footed Rock-wallabies accessible to the viewing public.

26. Both Weetootla and Italowie gorges have potentially good camping and caravan sites downstream from the gorge entrances.

27. Goat trap fences, and traps in some instances, are seriously damaging large old River Red Gums by springs (for example, McKinlay Springs). Living trees should not be used as fence posts.

28. Damage and cultural erosion of artefact deposits occurs when the public has unencumbered access without guidance or pre-visit information.

29. The Arkaroola ridgetop tour is an excellent introduction to the geology and mining history of the region. — made by exploration company for exploration purposes. —

30. Many visitors to Arkaroola wish to use the park resources to diversify their activity.

31. Lack or shortage of water is a severe limiting factor for summer activities in the park.

32. Destinations for walkers within the park are commonly; McKinlay Springs, Wildflower Creek, Cleft Peak, Mount McKinlay, McKinlay Bluff, Bunyip Chasm, Arcoona Creek and Bluff, and Mainwater Pound.

33. Destinations for vehicles within the park are commonly; Balcanoona Gorge, Italowie Gorge, Weetootla Gorge, Mount McTaggart carvings and mines, Grindell's Hut, Loch Ness Well (jumping off place for walkers), Worturpa Diggings, Worturpa Well, Yadnina, Old Illinawortina (ruins), Snake Gully Well, Bolla Bollana, McKinlay Spring, Arcoona Creek, and The Needles.

34. Destinations for vehicles in neighbouring country are commonly; Arkaroola, Tillite Gorge, Yudnamutana mines, Lady Buxton Mine area, Paralana Hot Springs, Stubbs Waterhole, Arkaroola Waterhole, Wertaloona area, Moro Gorge, Chambers Gorge, Big John and McKinlay creeks, Wooltana area, Nepouie Spring, and Nepouie Gorge.

35. The visiting public expects to get information on all of these places from the rangers.

36. Yellow-footed Rock-wallabies spend much time on open, sunny rocks on the ridge terraces from May to September, and stay close to water in hot, dry periods.

37. Floods through the gorges sweep the campsites clean. New developments in such locations are best established following such an event.

38. Four-wheel-drive vehicles do not appear to be damaging the landscape as they tend to keep to roads which are good four-wheel-drive tracks.

39. Four-wheel-drive vehicles rapidly place people far from the control of the ranger.

40. The carnivorous feral animals affect the populations/compositions of wildlife.

41. The herbivorous feral animals selectively and/or grossly alter vegetation volume and composition.

42. The biological systems are still in the process of adjustment to the introduced animals. The removal of feral animals will initiate a new process of adjustment. — is this good or bad

43. Vegetation biomass will eventually be higher in the park than when it was stocked.

44. Feral animals may compete directly or indirectly with native animals for food, shelter, water, and space.

APPENDICES

PLANTS OF THE GAMMON RANGES NATIONAL PARK

ACANTHACEAE
Rostellularia pogonanthera F. Muell. (337)

AIZOACEAE
Tetragonia eremaea. Ostenf.

AMARANTHACEAE
Ptilotus exaltatus Nees.
Ptilotus obovatus (Gaudl.) F. Muell.

AMARYLLIDACEAE
Calostemma purpureum R.Br.

APOCYNACEAE
Nerium oleander

ASCLEPIADACEAE
Cynanchum floribundum R.Br.
Leichhardtia australis R.Br.
Sarcostemma australe R.Br.

BORAGINACEAE
* Echium plantagineum L.
Heliotropium asperrimum R. Br. (290)
Heliotropium curassavicum L. (290)
Omphalolappula concava (F. Muell.) Brand (293)

CAMPANULACEAE
Wahlenbergia gracilis (Forst. f.) Schrad. (349)

CAPPARACEAE
Capparis mitchellii Lindl. (93)

CARYOPHYLLACEAE
Gypsophila australis (Schltdl.) A. Gray (48)
Silene nocturna L. (48)
Spergularia rubra (L.) J. & C. Presl sens. lat. (46)

CASUARINACEAE
Allocasuarina muelleriana
Casuarina cristata Mig. (201)

CHENOPODIACEAE
Atriplex eardleyae Aellen (56)
Atriplex lindleyi Mog. (55)
Atriplex rhagodioides F. Muell. (58)
Atriplex spongiosa F. Muell. (54)
Atriplex stipitata Benth (58)
Babbagia scleroptera F. Muell. & Tate (72)
Chenopodium cristatum (F. Muell.) (50)
Chenopodium desertorum (J.M. Black) (51)
Chenopodium melanocarpum (J.M. Black) (50)
Chenopodium murale L. (51)
Chenopodium nitrariaceum F. Muell (50)
Dissocarpus paradoxa (R. Br.) F. Muell.
Einadia nutans R. Br.
Enchylaena tomentosa R. Br. (64)
Maireana pyramidata (Benth) P.G. Wilson (62)
Maireana sedifolia (F. Muell.) P.G. Wilson (62)
Monolepis spathulata A. Gray (53)
Pachycornia triandra (F. Muell.) J.M. Black (85)
Rhagodia parabolica R. Br. (52)
Rhagodia spinescens R. Br. (53)
Salsola kali L. (75)
Sclerolaena divaricata (R. Br.) F. Muelli.
Sclerolaena intricata R.H. Anders
Sclerolaena parallelicuspis R.H. Anders

COMPOSITAE
Actinobole uliginosum (A. Gray) Hj. Eichl. (392)
Brachycome ciliaris (Labill.) Less (371)
Brachycome heterodonta (370)
Calotis latiuscula F. Muell & Tate (374)
Cassinia laevis R.Br. (372)
Centaurea melitensis L.
Craspedia pleiocephala F. Muell (386)
Dichromochlamys dentatifolia F. Muell (375)
Glossogyne tenuifolia (Labill.) Cass. (379)
Gnaphalium luteoalbum L. (399)
Gnaphalium sphaericum Willd. (399)
Gnephosis foliata (Sond.) Hj. Eichl. (389)
Helichrysum ambiguum Turcz. (404)
Helichrysum apiculatum (Labill.) DC (404)
Helipterum australe (A. Gray) Druce.
Helipterum floribundum DC (407)
Helipterum moschatum (A. Cunn ex DC)
Helipterum pygmaeum (DC) Benth. (407)
Helipterum strictum (Lind.) Benth. (407)
Minuria cunninghamii (DC) Benth. (367)
Minuria leptophylla DC (368)
Myriocephalus stuartii F. Muell (390)
Olearia decurrens (DC) Benth.
Olearia magniflora
Olearia muelleri
Pterocaulon sphacelatum (Labill.) Benth & Hook f. ex F. Muell (410)
Senecio anethifolius A. Cunn. (385)
Senecio cunninghamii DC. (385)
Senecio lautus Forst. f. ex Willd. (384)
Senecio magnificus F. Muell. (384)
Sigesbeckia orientalis L. (378)
Sonchus asper (L.) Hill. (414)
Sonchus oleraceus L. (414)

CONVOLVULACEAE
Convolvulus erubescens Sims. (287)

CRASSULACEAE
Crassula colorata (Nees). Ostenf. (102)
Crassula sieberana J.A. & J.H. Schultes. (102)

CRUCIFERAE
Arabidella filifolia (F. Muell.) Schulz. (100)
Arabidella glaucescens Shaw (101)
Arabidella trisecta (F. Muell.) Schulz (101)
Lepidium papillosum F. Muell. (97)
Sisymbrium erysimoides Desf. (100)

CUCURBITACEAE
Citrullus lanatus (Thumb.) Mans. (230)

CUPRESSACEAE
Callitris columellaris F. Muell. (14)

CYPERACEAE
Cyperus exaltatus Retz (505)
Cyperus gymnocaulos Steud (503)
Cyperus vaginatus R. Br. (503)
Isolepis marginata

DILLENIACEAE
Hibbertia stricta var. canescens

EHRETIACEAE
Halgania cyanea Lindl. (292)

EPACRIDACEAE
Astroloma humifusum var. denticulatum

EUPHORBIACEAE
Beyeria lechenaultii Boiss. (186)
Euphorbia australis Boiss (1986)
Euphorbia drummondii Boiss (1986)
Euphorbia tannensis var. eremophila A. Cunn. (188)
Sauropus rigens (F. Muell.) H. Eichler.

FRANKENIACEAE
Frankenia pauciflora DC. (226)

FUMARIACEAE
Fumaria densiflora

GERANIACEAE
Erodium aureum Carolin (178)
Erodium cicutarium (L.) L'Her ex Ait. (178)
Erodium crinitum Carolin (178)
Erodium cygnorum Ness (179)

GOODENIACEAE
Goodenia argentia J.M. Black (356)
Goodenia calcarata F. Muell. (355)
Goodenia chambersii F. Muell (355)
Goodenia vernicosa
Scaevola ovalifolia R. Br. (360)
Scaevola spinescens R. Br. (359)
Velleia arguta

GRAMINEAE
Aristida nitidula (Henr.) ex J.M. Black. S.T. Blake (450)
Cymbopogon ambiguus A. Camus (489)
Danthonia caespitosa Gaud. (439)
Dichanthium affine (R. Br.) A. Camus. (488)
Digitaria brownii (Roem. & Schult.) Hughes (473)
Enneapogon caerulescens (Gd.) Burbidge (455)
Enneapogon nigricans (R. Br.) Beauv. (455)
Enneapogon oblongus N.T. Burbidge (455)
Enneapogon polyphyllus (Domin.) Burbidge (453)
Eragrostis cilianensis (All.) link ex Vign.-hutt. (459)
Eragrostis dielsii Pilger (458)
Paspalidium constrictum (Domin) C.E. Hubbard (478)
Podocoma cuneifolia R. Br. (375)
Schismus barbartus (L.) Thell
Stipa eremophila Raeder
Stipa nitida Summerh & Hubbard (436)
Stipa variabilis Hughes (438)
Themeda australis (R. Br.) Stapf. (493)

GYROSTEMONACEAE
Codonocarpus cotinifolius A. Cunn. (33)

HALORAGACEAE
Haloragis aspera Lindl. (264)
Myriophyllum verrucosum Lindl. (266)

JUNCACEAE
Juncus aridicola L. Johnson (426)
Juncus bufonius L. (426)
Juncus subsecundus N.A. Wakefield (426)

JUNCAGINACEAE
Triglochin procerum L. (47)

LABIATAE
Marrubium vulgare
Plectranthus intraterraneus S.T. Blake
Prostanthera striatiflora F. Muell (309)
Westringia rigida R. Br. (311)

LEGUMINOSAE
Acacia aneura F. Muell. ex Benth (138)
Acacia araneosa Whibley
Acacia havilandii. Maiden
Acacia ligulata A. Cunn. ex Benth. (133)
Acacia oswaldii F. Muell. (135)
Acacia rigens A. Cunn ex G. Dow (117)
Acacia rivalis J.M. Black
Acacia salicina Lind. (118)
Acacia spinescens Benth.
Acacia tetragonophylla F. Muell. (129)
Acacia victoriae Benth (131)
Cassia artemisioides Gaud. 111)
Cassia helmsii Symond. (109)
Cassia nemophila var. nemophila A. Cunn. ex Vogel (111)
Cassia nemophila var. platypoda (R. Br.) Benth (112)
Cassia oligophylla F. Muell (109)
Cassia sturtii R. Br. (111)
Clianthus formosus (G Don.) Ford & Vickery (160)
Daviesia genistifolia
Indigofera basedowii Pritzel (1958)
Indigofera brevidens Benth (157)
Lotus cruentus Court (1974)
Petalostylis labicheoides R. Br. (105)
Psoralea patens Lindl (167)
Swainsona oligophylla F. Muell. (163)
Swainsona stipularis F. Muell. (163)
Swainsona viridis
Templetonia egena (F. Muell.) Benth. (151)
Templetonia retusa

LILIACEAE
Arthropodium strictum
Lomandra dura
Xanthorrhoea quadrangulata

LOGANIACEAE
Logania vaginalis

LORANTHACEAE
Amyema maidenii
Amyema miquelii (Lehm. ex Mig.) Leigh
Amyema miraculosum (Mig.) Leigh
Lysiana exocarpi (Behr.) Leigh

MALVACEAE
Abutilon fraseri Hood ex Walp (214)
Abutilon leucopetalum (F. Muell.) F. Muell. ex Benth (207)
Alyogyne hakeifolia
Gossypium sturtianum J.H. Willis (207)
Lavatera plebeia Sims (213)
Malva parviflora (L.) (212)
Malvastrum americanum (L.) Torrey
Radyera farragei (F. Muell.) Fryseell & Hashoni (208)
Sida calyxhymenia Gay ex DC.
Sida corrugata Lindl. (216)
Sida cunninghamii C.T. White (216)
Sida intricata F. Muell. (216)

Sida sp. D? (ex Sida virgata Hood) (218)

MYOPORACEAE
Eremophila alternifolia R. Br. (347)
Eremophila duttonii F. Muell. (347)
Eremophila freelingii F. Muell. (344)
Eremophila longifolia (R. Br.) F. Muell. (34)
Eremophila maculata
Eremophila scoparia (R. Br.) F. Muell. (339)
Eremophila sturtii F. Muell. (342)
Myoporum acuminatum R. Br.
Myoporum deserti A. Cunn. ex Benth. (339)
Myoporum platycarpum R. Br. (338)

MYRTACEAE
Callistemon teretifolius F. Muell
Calytrix tetragona Labill
Eucalyptus camaldulensis Denh. (249)
Eucalyptus dumosa A. Cunn. ex. Schrau. (242)
Eucalyptus flindersii
Eucalyptus gillii Maid
Eucalyptus intertexta R.T. Baker (251)
Eucalyptus socialis F. Muell. ex Mig. (242)
Melaleuca glomerata F. Muell. (256)
Melaleuca lanceolata Otto.
Melaleuca uncinata R. Br. (256)

NYCTAGINACEAE
Boerhavia diffusa L. (34)

OLEACEAE
Jasminum lineare R. Br. (173)

OXALIDACEAE
Oxalis corniculata L. (177)

PAPAVERACEAE
Papaver aculeatum Thumb
Papaver hybridum L. (91)

PITTOSPORACEAE
Bursaria spinosa Cav.
Pittosporum phylliraeoides DC (103)

PLANTAGINACEAE
Plantago drummondii Decne (349)

POLYGONACEAE
Rumex brownii Campd. (32)
* Rumex vesicarius L.

POTAMOGETONACEAE
Potamogeton pectinatus L. (418)

PRIMULACEAE
Anagallis arvensis Gouan. (271)

PROTEACEAE
Grevillea aspera R. Br.
Hakea ednieana Tate (19)
Hakea leucoptera R. Br. (20)

RANUNCULACEAE
Ranunculus hamatosetosus Hj. Eich.

RUBIACEAE
Galium australe DC.
Galium gaudichaudii DC
Pomax umbellata (Gaetn) Soland. ex mig. (283)

RUTACEAE
Eriostemon angustifolius Paul G. Wilson

SANTALACEAE
Santalum acuminatum (R. Br.) DC (26)
Santalum lanceolatum R. Br. (25)

SAPINDACEAE
Dodonaea angustissima DC.
Dodonaea baueri End.
Dodonaea lobulata F. Muell.
Dodonaea microzyga F. Muell. (201)

SCROPHULARIACEAE
Limosella curdieana F. Muell. (332)

SOLANACEAE
Datura leichhardtii F. Muell ex Benth (320)
Lycium australe F. Muell. (321)
Nicotiana glauca Gaud. (324)
Solanum chenopodinum F. Muell. (316)
Solanum ellipticum r. Br. (317)
Solanum petrophilum F. Muell. (318)
Solanum sturtianum F. Muell. (317)

THYMELAEACEAE
Pimelea microcephala R. Br.

TYPHACEAE
Typha domingensis Pers. (496)
Typha orientalis Presl. (497)

UMBELLIFERAE
Hydrocotyle trachycarpa F. Muell (268)*
Trachymene glaucifolia F. Muell (270)*

URTICACEAE
Parietaria debilis G. Forst
Urtica urens L.

ZYGOPHYLLACEAE
Nitraria billardierei DC (180)
Zygophyllum ammophilum F. Muell. (181)
Zygophyllum apiculatum L. (182)
Zygophyllum aurantiacum (Lindl.) F. Muell. (183)
Zygophyllum iodocarpum F. Muell. (182)

FERNS

ADIANTACEAE
Cheilanthes lasiophylla Pichi-Serm.
Cheilanthes tenuifolia (Burm F.) Swartz.

BLECHNACEAE
Doodia caudata (Cav.) R.Br.

Numbers relate to Jessop (1981).

* introduced species

ANNOTATED LIST OF FISHES OF THE NORTHERN FLINDERS RANGES

Species Common name	Notes	Present in park	Present in region
Chlamydogobius eremius Desert Goby	Tolerates high temperatures, low oxygen and high salinities.	*	*
Craterocephalus eyresii Central Australian Hardyhead	Reported in Paralana Hot Springs-tolerant of water to 37°C and salinities up to three times that of weawater.		*
Gambusia affinis Mosquito Fish	A very tolerant fish of high temperature and salinities. Possible invader.		*

Madigania unicolor Spangled Perch	Adaptable to high temperatures and low oxygen. Claimed to aestivate in mud. Limiting factor low temperatures 5°C - 10°C.		*
Melanotaenia tatei MacDonnell Ranges Rainbow Trout	A possible irregular visitor when conditions suiting the animal occurs.		*
Mogurnda mogurnda Purple Spotted Gudgeon	Common in Weetootla Spring and the spring immediately on the magnesite deposit. Not tolerant of hot water.	*	*
Fluvialosa richardsoni Bony Bream	Reported in Terrapinna Waterhole, northern Flinders Ranges - possible to enter park waters during very rare continuous wet periods. Not enough permanent water to support this fish.		*

AMPHIBIANS OF THE NORTHERN FLINDERS RANGES

Species Common Name	Occurs in Gammon Ranges National Park	Occurs in Flinders Ranges	May occur in Flinders Ranges
HYLIDAE			
Litoria ewingii. Brown Tree Frog		*	
Litoria rubella. Desert Tree Frog	*	*	
LEPTODACTYLIDAE			
Cyclorana platycephalus. Water-holding Frog	*	*	
Limnodynastes dumerilii. Eastern Banjo Frog		*	
Limnodynastes tasmaniensis. Spotted Grass Frog	*	*	
Neobatrachus centralis. Trilling Frog	*	*	
Neobatrachus pictus. Meeowing Frog			*
Pseudophryne bibroni. Brown Toadlet	*	*	
Ranidella riparia.	*	*	
Ranidella signifera. Brown Froglet		*	

REPTILES OF THE NORTHERN FLINDERS RANGES

Species Common name	Occurs in Gammon Ranges National Park	Occurs in Flinders Ranges	May occur in Flinders Ranges
AGAMIDAE			
Amphibolurus cristatus. Crested Dragon			*
Amphibolurus decresii. Tawny Dragon	*	*	
Amphibolurus fionni			*
Amphibolurus fordi. Mallee Dragon (Lake Frome)		*	
Amphibolurus nobbi. Nobbi		*?	
Amphibolurus pictus. Painted Dragon		*	
Amphibolurus vadnappa	*	*	
Amphibolurus vitticeps. Central Bearded Dragon	*	*	
Tympanocryptis intima	*	*	
Tympanocryptus tetraporophora	*	*	
BOIDAE			
Liasis childreni. Children's Python	*	*	
Morelia spilotes. Diamond Python	*	*	
CHELIDAE			
Emydura krefftii. Krefft's River Turtle		*	
ELAPIDAE			
Demansia psammophis. Yellow-faced Whip Snake	*	*	
Furina diadema. Red-naped Snake	*	*	
Pseudechis australis. Mulga Snake	*	*	
Pseudonaja modesta. Ringed Brown Snake		*	
Pseudonaja nuchalis. Western Brown Snake	*	*	
Suta suta. Myall Snake	*	*	
Unechis gouldii. Black-headed Snake		*	
Vermicella annulata. Bandy Bandy		*	
GEKKONIDAE			
Diplodactylus byrnei	*	*	
Diplodactylus elderi. Jewelled Gecko	*	*	
Diplodactylus intermedius. Eastern Spiny-tailed Gecko	*	*	
Diplodactylus stenodactylus			
Diplodactylus tessellatus. Tesselated Gecko		*	
Diplodactylus vittatus. Wood Gecko	*	*	
Gehyra variegata. Tree Dtella	*	*	
Heteronotia binoei. Bynoe's Gecko	*	*	
Lucasium damaeum. Beaded Gecko			*
Nephrurus levis		*	
Oedura marmorata. Marbled Velvet Gecko	*	*	
Phyllodactylus marmoratus			
Rhynchoedura ornata. Beaked Gecko		*	
Underwoodisaurus milii. Thick-tailed Gecko	*	*	

PYGOPODIDAE			
Aprasia inaurita			*
Aprasia pseudopulchella	*	*	
Delma australis		*	
Delma molleri		*	
Delma nasuta		*	
Delma tincta		*	
Lialis burtonis. Burton's Snake-lizard		*	
Pygopus lepidopodus. Common Scaly-foot	*	*	
Pygopus nigriceps. Hooded Scaly-foot		*	
SCINCIDAE			
Cryptoblepharus plagiocephalus. Snake-eyed Skink	*	*	
Ctenotus brooksi		*	
Ctenotus leae			*
Ctenotus leonhardii		*	
Ctenotus regius		*	
Ctenotus robustus. Robust Striped Skink	*	*	
Ctenotus schomburgkii			*
Ctenotus strauchii		*	
Ctenotus uber	*	*	
Egernia margaretae	*	*	
Egernia multiscutata		*	
Egernia stokesii. Gidgee Skink or Spiny Tailed Skink	*	*	
Egernia striolata. Tree Skink	*	*	
Hemiergis decresiensis. Three Toed Skink		*	
Hemiergis millewae	*	*	
Lerista bipes	*	*	
Lerista bougainvillii. Bougainville's Skink		*	
Lerista labialis			*
Lerista muelleri		*	
Lerista punctatovittata		*	
Lerista terdigitata			*
Menetia greyii. Snake-eyed Skink	*	*	
Morethia adelaidensis	*	*	
Morethia boulengeri	*	*	
Sphenomorphus fasciolatus. Narrow-banded Sand Swimmer			*
Sphenomorphus richardsonii. Broad-banded Sand Swimmer		*	*
Tiliqua branchialis	*	*	
Tiliqua occipitalis. Western Blue-tongued Lizard	*	*	
Tiliqua scincoides. Eastern Blue-tongued Lizard	*	*	
Trachydosaurus rugosus. Shingle-Back	*	*	
TYPHLOPIDAE			
Typhlina australis	*	*	
Typhlina bituberculata	*	*	
VARANIDAE			
Varanus gilleni. Pygmy Mulga Monitor			
Varanus gouldii. Gould's Goanna	*	*	

ANNOTATED LIST OF BIRDS OF THE GAMMON RANGES NATIONAL PARK AND NORTHERN FLINDERS RANGES

Species Common name	Notes	Occurs in Gammon Ranges National Park	Occurs in the region and may occur in the park
Dromaius novaehollandiae Emu	Moderately common in open country; single birds recorded in 1982 but no groups.	*	
Ardea pacifica Pacific Heron	Occasional visitor to creeks and waterholes, for example, Weetootla Gorge.	*	
Ardea novaehollandiae White-faced Heron	Occasional visitor to creeks and waterholes, for example, Weetootla Gorge.	*	
Anas superciliosa Pacific Black Duck	Visitor to creeks and water-holes, for example, Weetootla Gorge.	*	
Anas gibberifrons Grey Teal	Visitor to creeks and water-holes, for example, Chambers Gorge, not recorded in park.		*
Chenonetta jubata Maned Duck	Possible visitor to surface water in park; more common further south in the Flinders Ranges, no park records.		*
Milvus migrans Black Kite	Moderately common in region: one park record from Balcanoona 17 April 1982.	*	
Haliastur sphenurus Whistling Kite	Moderately common in region; one park record from Italowie Gorge 26 August 1975.	*	
Accipiter fasciatus Brown Goshawk	Uncommon bird of timbered country; no park records.		
Accipiter cirrhocephalus Collared Sparrowhawk	Moderately common in timbered areas.	*	
Aquila audax Wedge-tailed Eagle	Common in all areas of the park; maximum observed, 18 on one kangaroo dead on road, November 1982.	*	
Hieraaetus morphnoides Little Eagle	Uncommon in region; one record for park at Italowie Gorge, 26 August 1975.	*	

Circus assimilis Spotted Harrier	Moderately common in northern Flinders Ranges in open grasslands; no park records.		*
Falco subniger Black Falcon	Uncommon in open plains northern Flinders Ranges; no park records.		*
Falco peregrinus Peregrine Falcon	Uncommon in region; found in areas with cliff faces; no park records.		*
Falco longipennis Australian Hobby	Uncommon in region; found in open plains and river courses; no park records.		*
Falco hypoleucos Grey Falcon	Very rare inland nomad; found in lightly timbered country; no park records.		*
Falco berigora Brown Falcon	Common and widespread.	*	
Falco cenchroides Australian Kestrel	Common and widespread in open country; breeding activity observed in park in November 1982.	*	
Coturnix novaezelandiae Stubble Quail	Moderately common in grassland regions; not recorded in park.		*
Turnix velox Little Button-quail	Moderately common in grassland in the region; not recorded in park.		*
Pedionomus torquatus Plains Wanderer	Rare grassland species; no recent records in region and none in park.		*
Ardeotis australis Australian Bustard	Rare grassland species; few recent records in region and none in park.		*
Burhinus magnirostris Bush Stone-curlew	Rare; open woodland species; few recent records in region and none in park.		*
Vanellus tricolor Banded Lapwing	Common on open stony plains; no records in park.		*
Geopelia striata Peaceful Dove	Common and widespread species of riverine woodland.	*	
Geopelia cuneata Diamond Dove	Uncommon species of dry woodlands; no park records.		*
Phaps chalcoptera Common Bronzewing	Moderately common and widespread, noted frequently near water but may fly long distances from woodland habitat to drink.	*	

Ocyphaps lophotes Crested Pigeon	Common and widespread in 1982 but can be of irregular occurrence; maximum observed 50+ at Balcanoona 14 June 1982; usually in woodland near water.	*	
Cacatua roseicapilla Galah	Common and widespread; concentrations occur at watering places and along watercourses to roost, for example, Italowie Gorge.	*	
Cacatua pastinator	Common and widespread; comments as for Galah; can occur in very large roosting flocks in the region, for example, 5000+ Chambers Gorge June 1982 and has been attributed with blame for considerable damage to River Red Gums.	*	
Nymphicus hollandicus Cockatiel	Nomadic and widespread in open country in region; no park records.		*
Melopsittacus undulatus Budgerigar	Nomadic and widespread in open country in region; no park records.		*
Barnardius barnardi Mallee Ringneck	Uncommon but widespread; the ringnecks in the Gammon Ranges National Park are in a zone of hybridisation between two subspecies but have greater affinities with the western subspecies rather than those occurring to the south and east.	*	
Psephotus haematonotus Red-rumped Parrot	Moderately common further south in Flinders Ranges; favours riverine woodland and adjacent woodland; no records for park.		*
Psephotus varius Mulga Parrot	Moderately common and widespread; open forest or shrubland.	*	
Northiella haematogaster Blue Bonnet	Moderately common in arid shrublands in the region; not recorded in the park.		*
Neophema bourkii Bourke's Parrot	Very rare, one record of specimen collected on Balcanoona in 1974 (Eckert 1975).	*	

Neophema splendida Scarlet-chested Parrot	Moderately common in region; favours riverine woodland especially River Red Gum; no records in park.		*
Cuculus pallidus Pallid Cuckoo	Moderately common in region; shrublands; no records for park.		*
Ninox novaeseelandiae Southern Boobook	Moderately common in region; forest and woodland; no records for park.		*
Ninox connivens Barking Owl	Rare; records for Mount Serle and Paralana (Parkes 1977); no park records.		*
Tyto alba Barn Owl	Uncommon but widespread; open woodland; no park records.		*
Podargus strigoides Tawny Frogmouth	Widely distributed in region; woodland; no records in park.		*
Aegotheles cristatus Australian Owlet-nightjar	Widespread in region; woodland; no park records.		*
Caprimulgus guttatus Spotted Nightjar	Uncommonly seen; prefers semi-arid mallee or shrubland. Record September 1982.	*	
Halcyon pyrrhopygia Red-backed Kingfisher	Uncommon; lightly timbered areas.	*	
Halcyon sancta Sacred Kingfisher	Common in southern Flinders Ranges and rarer in the north; record of several pairs at Mount McKinlay Creek November 1982.	*	
Merops ornatus Rainbow Bee-eater	Spring and summer migrant; uncommon; several pairs around Mount McKinlay Creek and displaying breeding activities at Pigeon Springs November 1982.	*	
Cheramoeca leucosternum White-backed Swallow	Seasonably common in open country; a record for just outside the park on Balcanoona Creek 17 June 1982, no records within park.		*
Hirundo neoxena Welcome Swallow	Regular but in small numbers; pairs around homesteads and tanks.	*	
Cecropis nigricans Tree Martin	Very common spring and summer migrant; uncommon in winter; frequently seen around River Red Gums where it breeds.	*	

Cecropis ariel Fairy Martin	Seasonal; less common than Tree Martin; not recorded in the park.		*
Anthus novaeseelandiae Richard's Pipit	Common on plains and open rolling hills.	*	
Coracina novaeseelandiae Black-faced Cuckoo-shrike	Uncommon and widely distributed; lightly timbered country and forests.	*	
Coracina maxima Ground Cuckoo-shrike	Uncommon; open country and lightly timbered areas; not recorded in park.		*
Lalage sueurii White-winged Triller	Moderately common in spring and summer; open or lightly timbered country.	*	
Drymodes brunneopygia Southern Scrub-robin	Uncommon in the southern Flinders Ranges and rare in the north; a possible species in mallee and shrublands; no park records.		*
Petroica goodenovii Red-capped Robin	Common and widespread.	*	
Melanodryas cucullata Hooded Robin	Uncommon; lightly timbered country.	*	
Microeca leucophaea Jacky Winter	Uncommon in northern Flinders Ranges; lightly timbered areas; not recorded for the park.		*
Pachycephala inornata Gilbert's Whistler	Uncommon species in mallee; one park record by SAOA at Italowie 26 August 1975.	*	
Pachycephala rufiventris Rufous Whistler	Common and widespread; confined to dense vegetation particularly along watercourses.	*	
Colluricincla harmonica Grey Shrike-thrush	Common but widespread; found mainly in River Red Gums and adjacent dense vegetation.	*	
Oreoica gutturalis Crested Bellbird	Uncommon in woodland and shrub-land; records for Italowie Gorge and Balcanoona.	*	
Rhipidura fuliginosa Grey Fantail	Uncommon winter visitor; wood-lands and riverine woodlands.	*	
Rhipidura leucophrys Willie Wagtail	Common and widely distributed; woodlands and shrublands.	*	
Psophodes cristatus Chirruping Wedgebill	Common in areas outside park; favours arid shrublands particularly Nitre Bush; records for between Balcanoona and Lake Frome; no records in park.		*

Cinclosoma castonotum Chestnut Quail-thrush	Uncommon in region; mallee; records from adjacent to the park, for example, Mount Serle, Arkaroola, but not in the park.		*
Cinclosoma cinnamomeum Cinnamon Quail-thrush	Common in northern Flinders Ranges; stony open country; no park records.		*
Pomatostomus supercilliosus White-browed Babbler	Common and widely distributed; favours Callitris sp. but found in shrubland and woodland.	*	
Pomatostomus ruficeps Chestnut-crowned Babbler	Uncommon; favours more arid areas than previous species; one record for Italowie Gorge 26 August 1975.	*	
Acrocephalus stentoreus	Uncommon in spring and summer; in reeds along watercourses; records adjacent to park but not within boundaries.		*
Cinclorhamphus mathewsi Rufous Songlark	Uncommon in region; lightly timbered country, not recorded in park.		*
Cinclorhamphus cruralis Brown Songlark	Uncommon in region; favours open grasslands; not recorded in park.		*
Malurus splendens Splendid Wren	Rare, shrublands near watercourses; regularly recorded but only at Italowie Gorge.	*	
Malurus lamberti Variegated Wren	Widely distributed within the park; frequents areas with a thick shrub layer.	*	
Malurus leucopterus White-winged Wren	Common in herblands on plains and rolling country; only common in the park where suitable habitat occurs, for example, around Balcanoona.	*	
Sericornis pyrrhopygius Chestnut-rumped Hylacola	Rare in the region; occurs near the park in bluebush; not recorded within park.		*
Sericornis brunneus Redthroat	Moderately common in arid shrublands in the northern Flinders Ranges; not recorded in park.		*
Sericornis fuliginosus Calamanthus	Moderately common in region in arid shrublands; not recorded within the park, and local status and habitat preferences uncertain.		*

Smicrornis brevirostris Weebill	Common all areas with dense stands of River Red Gums.	*	
Acanthiza apicalis Broad-tailed Thornbill	Common and widespread in areas of low thick shrubs.	*	
Acanthiza uropygialis Chestnut-rumped Thronbill	The most common thornbill; found in a variety of woodland habitats.	*	
Acanthiza chrysorrhoa Yellow-rumped Thornbill	Uncommon; widespread in woodland habitats.	*	
Aphelocephala leucopsis Southern Whiteface	Common; found in most open habitats.	*	
Daphoenositta chrysoptera Varied Sittella	Moderately common in region; forests and woodland; not recorded in the park.		*
Climacteris affinis White-browed Treecreeper	Uncommon; limited to Black Oak/Callitris communities; only two records, both at Mallee Well November 1982.	*	
Climacteris picumnus Brown Treecreeper	Common in region; irregularly recorded within the park; favours open forest.	*	
Acanthagenys rufogularis Spiny-cheeked Honeyeater	Common in all arid shrub and woodlands in the region; within the park it is the most common honeyeater away from watercourses.	*	
Manorina flavigula Yellow-throated Miner	Common; often found associated with watercourses but also in dry woodlands.	*	
Lichenostomus virescens Singing Honeyeater	Common in arid shrublands.	*	
Lichenostomus plumulus Grey-fronted Honeyeater	Regularly seen; most commonly observed alongside streams in River Red Gums.	*	
Lichenostomus penicillatus White-plumed Honeyeater	Common; favours River Red Gums along water courses or around tanks.	*	
Melithreptus brevirostris Brown-headed Honeyeater	Uncommon, observed in small groups in streamside vegetation in gorges near Bunyip Chasm and Mount McKinlay Springs.	*	
Phylidonyris albifrons White-fronted Honeyeater	Moderately common in region in shrublands; not recorded within the park.		*

Certhionyx niger Black Honeyeater	Irregular nomad; arid woodlands; not recorded in park.		*
Certhionyx variegatus Pied Honeyeater	Irregular nomad; arid woodlands; not recorded in park.		*
Ephthianura tricolor Crimson Chat	Moderately common in region; arid country; one park record near Balcanoona November 1982.	*	
Ephthianura aurifrons Orange Chat	Moderately common in region; open arid country; recorded on plains country near park but not within park boundary.		*
Dicaeum hirundinaceum Mistletoebird	Common and widely distributed.	*	
Pardalotus rubricatus Red-browed Pardalote	Rare in region; recorded at Paralana Springs in tall riverine eucalypts; not recorded in park.		*
Pardalotus striatus Striated Pardalote	Common and widespread; found in all areas with eucalypt forest.	*	
Zosterops lateralis Silvereye	Uncommon in park; near to the northern limit of this species in the region; usually in small flocks along watercourses; recorded at Italowie Gorge and near Balcanoona.	*	
Passer domesticus House Sparrow	Locally common; in park only found around Balcanoona.	*	
Emblema picta Painted Firetail	Rare in region; breeding records from Arkaroola to the north of park; no park records.		*
Poephila guttata Zebra Finch	Common on plains on edge of park; found around water; penetrates along watercourses into park, for example, Italowie Gorge.	*	
Grallina cyanoleuca Australian Magpie Lark	Uncommon; usually found around waterholes and tanks, records in park around Balcanoona.	*	
Artamus leucorhynchus White-breasted Woodswallow	Uncommon in region; occurs irregularly in small flocks; no records in park.		*
Artamus personatus Masked Woodswallow	Uncommon in region; occurs in shrublands; not recorded in park.		*

Artamus superciliosus White-browed Woodswallow	Irregular and uncommon; open woodland; one record near Balcanoona June 1982.	*	
Artamus cinereus Black-faced Woodswallow	Common and the most common woodswallow; open arid areas.	*	
Artamus cyanopterus Dusky Woodswallow	Uncommon in region; open woodlands; records from near the park but not within it.		*
Artamus minor Little Woodswallow	Rare; favours areas around rocky peaks; one park record of two pairs possibly breeding in Bunyip Chasm 18 November 1982.	*	
Cracticus torquatus Grey Butcherbird	Uncommon but widespread; woodlands.	*	
Gymnorhina tibicen Australian Magpie	Common and widespread.	*	
Corvus coronoides Australian Raven	Common and widespread; more common than Little Crow.	*	
Corvus bennetti Little Crow	Uncommon; small flocks especially on plains; only park records from around Balcanoona.	*	

MAMMALS OF THE NORTHERN FLINDERS RANGES

Species Common name	Known to occur in park	Present in region	Recently extinct (200 years)	
BURRAMYIDAE				
Cercartetus concinnus. Western Pigmy Possum		?		
CANIDAE				
Canis familiaris. Dingo		*		
DASYURIDAE				
Antechinomys laniger. Kultarr			*	CG#
Dasyurus geoffroii. Western Quoll (1885)			*	CG#
Dasycercus cristicauda. Mulgara				
Dasyuroides byrnei. Kowari			*	CG#
Myrmecobius fasciatus. Numbat			*	
Ningaui sp.			*	
Phascogale calura. Red-tailed Phascogale			*	CG#
Planigale gilesi. Paucident Planigale		*		CG#

Planigale tenuirostris. Narrow-nosed Planigale	*			CG#
Sminthopsis crassicaudata. Fat-tailed Dunnart	*			CG#
Sminthopsis macroura. Stripe-faced Dunnart	*			
EMBALLONURIDAE				
Taphozous flaviventris. Yellow-bellied Sheathtail Bat	?			
MACROPODIDAE				
Bettongia lesueur. Burrowing Bettong			*	CG#
Bettongia penicillata. Brush-tailed Bettong			*	
Caloprymnus campestris. Desert Rat-kangaroo			*	CG#
Lagorchestes leporides. Eastern Hare-wallaby			*	
Onychogalea lunata. Crescent Nailtail Wallaby			*	CG#
Petrogale xanthopus. Yellow-footed Rock-wallaby				
Macropus fuliginosus. Western Grey Kangaroo	*			
Macropus robustus. Wallaroo	*			
Macropus rufus. Red Kangaroo	*			
MEGADERMATIDAE				
Macroderma gigas. Ghost Bat (Fossil, Wooltana Cave)		*		
MOLOSSIDAE				
Tadarida australis. White-striped Mastiff-bat	*			
Tadarida planiceps. Little Mastiff-bat	*			
MURIDAE				
Leggadina forresti. Forrest's Mouse	*			CG#
Leporillus apicalis. Lesser Stick-nest Rat	*			CG#1866
Leporillus conditor. Greater Stick-nest Rat			*	CG#1866
Mus musculus. House Mouse	*			
Notomys alexis. Spinifex Hopping-mouse	?			
Notomys amplus. Short-tailed Hopping-mouse			*	CG#
Notomys cervinus. Fawn Hopping-mouse		?		CG#
Notomys fuscus. Dusky Hopping-mouse (L. Frome dunes)	?	*		CG#
Notomys longicaudatus. Long-tailed Hopping-mouse (Chambers Gorge fossil)			*	CG#
Notomys. (new species)			*	CG#
Pseudomys australis. Plains Mouse (Chambers Gorge fossil)		?	*	CG#
Pseudomys desertor. Desert Mouse	?		*	CG#
Pseudomys gouldii. Gould's Mouse	?		*	G#
Pseudomys hermannsburgensis. Sandy Inland Mouse	?	*		CG#
Rattus villosissimus. Long-haired Rat (plague vagrants)	*			CG#
PERAMELIDAE				
Chaeropus ecaudatus. Pig-footed Bandicoot			*	CG#
Isoodon auratus. Golden Bandicoot			*	CG#
Perameles bougainville. Western Barred Bandicoot			*	CG#

PETAURIDAE			
Petaurus breviceps. Sugar Glider	?		
PHALANGERIDAE			
Trichosurus vulpecula. Common Brushtail Possum	*		CG#
TACHYGLOSSIDAE			
Tachyglossus aculeatus. Short-beaked Echidna	*		
THYLACOMYIDAE			
Macrotis lagotis. Greater Bilby		*	CG#
VESPERTILIONIDAE			
Chalinolobus gouldii. Gould's Wattled Bat	*		
Chalinolobus morio. Chocolate Wattled Bat	*		
Chalinolobus picatus. Little Pied Bat	?		
Eptesicus pumilus. Little Cave Eptesicus	*		
Nycticeius balstoni. Western Broad-nosed Bat	?		
Nycticeius greyii. Little Broad-nosed Bat (L. Frome)	*		
Nyctophilus geoffroyi. Lesser Long-eared Bat	*		
EXOTIC ANIMALS			
Capra hircus. Goat	*		
Equus asinus. Donkey	*		
Equus caballus. Horse	*		
Felis catus. Feral Cat	*		
Oryctolagus cuniculus. European Rabbit	*		
Ovis aries. Sheep	*		
Vulpes vulpes. Fox	*		

#CG = Sub-Fossil remains in owl cave in Chambers Gorge

HISTORY OF THE NORTHERN FLINDERS RANGE REGION WITH SPECIAL REFERENCE TO THE GAMMON RANGES NATIONAL PARK

Year	Event	Comment
1840	Edward John Eyre penetrated the northern Flinders Ranges, named and climbed Mount Serle in August.	From Mount Serle: "At one glance I saw the realization of my worst forebodings ... on every side we were hemmed in by a barrier." Eyre mistook lakes Eyre, Torrens and Frome to be a single, huge "horseshoe" shaped lake.

1843	E.C. Frome, Surveyor-Gen. travelled eastern edge of the ranges - saw Mount McKinlay but thought it Mount Serle.	Reported on the Chambers Gorge and country running from the eastern ranges. Both reports daunted further immediate investigation. James Henderson's drawings are very descriptive.
1840s	Feral cats reach the ranges	Feral cats begin to force their way into the natural ecosystems affecting small reptiles, mammals and birds.
1844-45	Charles Sturt outflanks Eyre's "Lake Torrens" but cannot find a break towards the northern Flinders Ranges which he could see while on a scouting trip from Fort Grey.	Eyre's impressions of the salt lake "horseshoe" is reinforced by Sturt.
1845	Copper discovered at Burra	Interest in mineral exploration generated.
1846	Two shepherds killed by Aborigines at Mount Arden run. Three Aborigines shot for sheep stealing.	Rapidly deteriorating Aboriginal relations-pastoralists begin to be perceived as permanent. Domestic stock driving out game.
1946	Horrocks killed in shooting accident while exploring north of settlement accompanied by artist S.T. Gill.	Aborigines met with were aggressive and threatening.
1851	Goldrushes to NSW and Victoria.	Holdings denuded of shepherds.
1851	Fourteen-year pastoral leases replace occupation licences on "unsurveyed Waste Lands"	Fees and responsibilities greatly increased. Demand by the law to run more stock than the "Third Grade" northern Flinders Ranges country could carry. Law made survey essential. Wilpena, Arkaba, Aroona and Oraparinna surveyed by Sinnett.
1852	Two Europeans murdered at Aroona and Mount Arden. Four Aborigines shot during pursuit.	Further deterioration of relations. Hayward on Aroona wrote: "The campaigns against the niggers gave a zest to the wild life I led."

1852	Poisoning of dingoes begins in the northern Flinders Ranges.	Commencement of attempted eradication campaign in the ranges to allow sheep runs to be managed, that is, a large increase in sheep populations.
1853	"Big John" McKinlay claims Mount Serle, Angepena, and six other runs beyond currently settled areas.	McKinlay and Rose were explorer surveyors working partially for wealthy backers - Chambers, Fisher, and Baker - a result of the Pastoral Lease system.
1854	Port Augusta surveyed and opened-seasons were average.	Settlement of the region developing with service support.
1854	Yellow-footed Rock-wallaby (Petrogale xanthopus), named and described.	
1855	William and Thomas McFarlane establish Owieandana run.	Part of Arcoona area of Gammon Ranges National Park.
1856	Police station opened in the area at Angepena following the murder of a stockman.	
1856	Babbage finds the permanent Blanchewater and Saint Mary's Pool - glowing reports. Presence of malachite reported to Babbage by one of Chambers' stockmen.	Stimulated further interest in pastoralism to Lake Eyre. A report in the Register - "However far inland we may penetrate there are not only native tribes to be found, but these tribes are aware of the existence of other tribes yet more remote ..."
1857	Thomas Bros, Gleeson, Phillip Love, John Chambers, John Scott, Grane and Moyle took up holdings or part holdings which later became part of the Gammon Ranges National Park.	The result of McKinlay's work and partly the surveys of John McDouall Stuart.
1857	Very heavy tropical depression caused rains in March.	Outwash areas and lake edges filled with fresh water.

1857	Painter and Goyder began the triangulation of the northern Flinders Ranges.	An attempt to properly plot the new leases.
1857 (May)	Goyder discovers great freshwater lakes and the mound springs - highly optimistic report.	Caused an unprecedented influx of lease applications - special legislative amendments needed. Govt. forced to resign.
1857	Lease conditions amended to halve the required carrying capacity.	To reduce the degradation of the plant communities.
1857	Surveyor Freeling takes boat to the outwash area - 8km from edge still only 15cm deep.	Freeling - "Much misconception as to the value of the country in the extreme north seems to exist." Press reports were very confused - potential pastoralists confused.
1857	Wooltana area taken up by John McTaggart.	Derivation of name for Mount McTaggart.
1858	Triangulation of Wertaloona area by Parry.	
1858	McDouall Stuart begins sorties which finally take him across the continent.	Opens 8 000 square miles of country.
1858	Gregory, Warburton, Babbage all break through Eyre's "horseshoe of salt lakes". Gregory from Moreton Bay while searching for Leichhardt.	Opens huge area for pastoral occupation.
1859	Rabbits released near Geelong.	Beginning of the plague.
1858	Very dry with late winter rains, massive locust plague.	Many stock and beasts of burden lost - costs of transport rocket.
1858	Frost with Aboriginal help discovered the Yudnamutana mine area - and other "green rocks". 1858-60 Appealinna mine worked.	Interest in minerals increasing rapidly. Some 20 leases applied for.

1858	Parry surveys much of northern Flinders Ranges and places many cairns of rock on hills.	Many cairns are on the hilltops with many competing claims of origin - Aboriginal trade track markers - Absalom's water markers.
1860	Hares imported and released for coursing.	Do not become established in the northern Flinders Ranges.
1859-60	Consolidation of properties in the Chambers Gorge, Frome Downs, Wertaloona, Wooltana, Illinawortina and Mount Serle areas. Thomas Elder, James Thomas, John Scott, John McCallum, Phillip Levi, John H. Angus, Crane and Moyle the lessees.	With consolidation an air of management performance develops - profits accumulate and large permanent stone buildings become the symbol of prosperity.
1860	Survey for railway being considered.	Cost of moving ore, machinery and supplies to mines causing pressure for government assistance.
1861	Angepena race meeting.	First in the northern Flinders Ranges - prosperity increasing for some.
1862	Donkeys imported from N. Africa to work in Blinman Mines.	Beginning of introductions for many mines and stock from which present feral animals were derived.
1862	Work at Yudnamutana Mines begins.	
1861-63	The best years the pastoralists had known.	Buildup of stock numbers far beyond long-term carrying capacity.
1864	Beginning of the Great Drought.	Shepherd system breaks down as the narrow range used by shepherds is completely eaten out - there is a curtailed piosphere.
1864	Foxes released by the Melbourne Hunt Club.	Beginning of a new and significant ecological pressure on native animals.
1865	Shepherds at Beltana attacked while trying to restrict Aboriginal access to ochre mine.	Aboriginal population residues are decimated by starvation. Many pastoralists let Aborigines die of starvation to rid them of a "pest".

1865	Worst year of the drought.	Losses-minimum figures 235 000 sheep; 29 000 cattle. P. Levi lost 7 000 cattle and 11 000 sheep. Umberatana lost 17 000 sheep and 2728 cattle. Few Aborigines left are now begging to survive.
1865	Road to the north littered with dead bullocks, donkeys and horses. Transport all but ceases.	About 200 mineral lessees request Government to waive 2 years rent.
1866	Drought continues, dust storms.	The land is laid waste by over-grazing. Wildlife decimated - many smaller species pass stage of recovery.
1866	Drought breaks with major floods (summer rains). Many graziers abandon runs.	Lack of cover and very dry ground sheds water excessively. Massive destruction of River Red Gums in heaviest, most intense rainfall area.
1856	Rabbits released in the Mount Lofty Ranges.	
1866	Thos. Elder imports 122 camels from Karachi for Beltana Stn. where they will be bred for use and sale. First major import of camels. "Some dozens" of Afghan drivers accompanied the animals. (see Warburton Ch. VI.)	Elder noted that the animals flourish on Saltbush, Prickly Acacia (Dead Finish), Sandalwood, Mulga and Casuarina and if hungry, Mallee and many other shrubs and trees.
1867	Change in regulations to reduce stocking rates.	An admission of past errors.
1868-72	Fencing of runs begins seriously.	Cuts out shepherding jobs and frees stock to wander further - reduces area of very intensive grazing about watering points. Cypress Pine and straight mulga decimated for posts.

1868	Further consolidation as deserted runs are cut up and added to major holdings. Some deserted areas revert to Crown Lands.	The big properties which included the later Gammon Ranges National Park - Sir. T. Elder - Umberatana, Sir. T. Elder - Illinawortina, McCallums - Nepouie, Henry Ayres - Big John Ck. north of Chambers Gorge, John Angus - Arrowie, Mal McCallum - S.E. Nepouie Park
1868	Angora goats introduced to the Flinders Ranges.	A further potential native animal habitat destroyer added to the ranges.
1869	Legislative provision to allow farmlands to be acquired on credit, that is, 640 acres (1 sq. mile).	This was an attempt to break up the large holdings and to encourage grain production.
1870s	Generally a decade of good rainfall.	With increase in mining activity - Blinman's population exceeds 1 000 - a boom period.
1873-76	Bolla Bollana built by S.A. and Vic. Bismuth Co. for Stanley and Daley Mines - Open-hearth smelter, buried flue and chimney.	Round-house kiln built to make bricks for rest of smelter. Fuel from Britain - transport costs wreck its feasibility when the ore supplies exhausted. Was never commercially operational. Ceased operations in 1876.
1873	Further rationalisation of national park "parent" properties.	
1874	Railway from Port Pirie commenced.	
1874	Waste Lands Amendment Act passed.	Permits agricultural exploitation throughout the State.
1877	Severe drought year.	More graziers desert holdings. Consolidation of longer-term leases.
1878	Rabbits moved up the eastern flanks of the northern Flinders Ranges.	Adding overstocking pressure to land - takeover of Bilby warrens.
1878	Railway north from Port Augusta commenced.	Aimed at use by wheat farmers and miners.

1880	Severe drought commences - finishes 1883.	Knocks out most northern cropping at Blinman and many farmers taking advantage of Strangways Act and Waste Lands Amendment Act.
1880-90s	Bonuses paid for wallaby scalps.	Economic incentive to destroy wallabies.
1881	Locust plague	Intensifies drought problem.
1881-	Rabbit plagues commence.	Very adversely affect the vegetation - young pines and mulga particularly.
1882	Railway reaches Parachilna.	
1883	Drought ends.	Extreme erosion and surface damage. Towns further south deserted. Many ruins stem from this drought.
1883	Dog fences constructed by graziers to isolate the ranges from dingoes.	The buried fence in dunes near Lake Frome is of this period.
1880s	Mining and agricultural depressions.	Many unemployed turn to shooting Yellow-footed Rock-wallabies for bounty and skins.
1889	Further boundary rationalisation following hard times.	Mount Lyndhurst becomes a vast holding under Nathaniel Phillipson and George Noble.
1883	Goats released in ranges.	Vigorous herbivore to compete with native fauna.
1889	Leigh Creek Coal Mining Co. formed.	
1889	Aroona homestead in ruins.	
1889	Wettest year for a decade.	
1891	Copley township surveyed.	Service town on the junction of the Lake Frome road and the northern road.

1892 1893 1896	Gold discovered at Angepena. Gold field opens-300 miners. In December 1893, 60 miners remain. Angepena goldfield closes.	A typical mining story from the northern Flinders Ranges.
1896	John Lees establishes Italowie out of Mount Lyndhurst.	
1897	Sir Thomas Elder dies.	Financier with a personal interest supporting local settlers dies.
1897 1898*	George Noble partly establishes Balcanoona from section of Mount Lyndhurst. Noble adds the plains blocks to Balcanoona.	Balcanoona being structured as an independent holding.
1898	W.B. Greenwood takes up the Yudnamutana mines.	
Before 1899	McLeashes Copper Prospect opened prior to 1899 (see Appendices).	Old mine shafts at north end of day visit area (eastern unit).
1899	Rising copper prices causes Yudnamutana mine to reopen.	Gives Greenwood the incentive to further explore the Arkaroola and adjacent areas.
1900-2	Tasmanian Copper Company re-opens Blinman with a large capital input.	The company's input to this local industry encourages general develment and growth.
Before 1900	O'Donoghue Castle Mine registered in this period.	Prior to 1900 over 67 tonnes of ore raised - copper, silver, gold and cobalt won.
1900 -06	Monarch Mine (Parkhill's Claim) registered in this period.	Located about 1km north of the Balcanoona Magnesite Deposit. 1907-12 tonnes of ore treated for 1.8 tonnes of copper.
1899-1905	Worturpa Mine registered after discovery by B. & H. Stubbs.	Gold and silver from 3 shafts and 2 tunnels. Rare nickel mineral recorded in 1899.

1903	Fox become a common animal from 1903 onwards.	Places further survival pressure on small mammals, reptiles and birds.
1903	Mount Rose mine opens.	Uses donkey teams of 55 animals to transport gear, supplies and concentrates.
1904-05	Depressed workers pick the wattle A. pycnantha. This work and rabbits seriously endanger the survival of the plant.	As standard employment is reduced, exploitation of native plants and animals increase.
1904	Crown Land blocks in the rugged mountain country are advertised.	Blocks include Worturpa Illinawortina Pound, McKinlay Pound.
1908	Arkaroola holding is assembled from mountain blocks of major holdings.	This is basically the same as today but with stock.
1908	Yudnamutana smelter built by the Union Copper Co.	Prices for copper ore holding - 50 employees and some families live in the ranges nearby.
1909	The consolidated Balcanoona now owned by Margaret Ness, Mary Smith and Ellen Kemp. Bayley Wilson takes over Wertaloona.	Properties now almost have the boundaries known today.
1910	W.B. Greenwood discovers radium at Mount Painter.	The beginning of a major effort to mine radium and later uranium.
1910	Foxes are now established throughout the Flinders Ranges.	Like feral cats, take most prey near watering places.
1911	John Flynn of Beltana Mission commences the Aust. Inland Mission in 1912.	Will lead to a network of radio contact and the Royal Flying Doctor Service.
1914	Drought again followed by floods.	Last wheat grown at or north of Wilpena Pound in S.A.
18.8. 1918	George Snell missing - Worturpa tragedy.	Grindell's Hut, an outstation of Balcanoona, becomes famous.

1919	Mount Serle sold as a sheep run, and Adnyanamathanha settle at Ram Paddock Gate near main road.	That area now has special significance for it was where the people separated themselves from Europeans who had brought so much pain and destruction. A place to "mind one's own business".
1912	Yellow-footed Rock-wallabies protected.	Animals Protection Act, 1912.
1915	Mount Lyndhurst lease surrendered.	
1917	Ellen Kemp transfers Balcanoona to Peter MacDonald Morrison while Kemp, Smith and Ness transfer Worturpa and Illinawortina Pound to Morrison.	Balcanoona now has its complete boundary.
1918	Murder of George Snell at Worturpa	Grindell, who lived at the hut now called Grindell's Hut, convicted on circumstantial evidence.
1920	Great floods on the Willochra Plain.	
1923 -28	Soldier Settlement Plan - smaller properties cut from large areas.	Encouragement once again to overuse the environment.
1924	Headworks built and extraction commences of bat guano at Wooltana Cave. Operated briefly.	Vertical cave about 60 metres deep with large cavern at bottom 50-60 metres across. Interesting headworks, that is, loading platform and flying fox to a lower level into wagons. Only platforms survive - this is part of day visitor area (eastern unit).
1924	Yellow-footed Rock-wallaby is a threatened species over its entire range.	
1924	N.B. Tindale and H.M. Hale of S.A. Museum study Wailpi tribe in Mount Serle/Gammon Range locality.	Europeans begin to show an interest in Aboriginal society for more reasons than coversion.

1925	Australian Radium Corporation work the Mount Painter field - ore was low grade and lack of water a severe problem.	Torbernite masses, autunite in crystalline masses of mica, uraninite, and monazite discovered by Greenwood and Mawson about 1910. Transport by camel.
1925	Roy Thomas acquires whole of Balcanoona.	
1926	Hans Heysen makes his first trip to the Flinders Ranges.	Heysen's subsequent work has attracted many visitors to the Flinders Ranges.
1926	Spa opened at Paralana Hot Springs.	Hot springs associated with deep faulting - radon gas bubbles up with the water.
1927	Paralana Spa venture fails.	Access and rugged accommodation against its popularity.
1929	Jim Page, missionary, built his hut at Ram Paddock Gate but in same year the Adnyamathanha people were forced to move to Nepabunna - the original mission settlement.	The United Aborigines Mission operated the Nepabunna settlement providing a place of retreat for Aborigines and where the people could stay together for mutual support. Other problems are clearly spelled out by Berndt and Berndt (1951).
1930s	Severe general economic depression to 1935.	What follows is related to the economic depression.
1931-33	Wooltana Fertiliser Co. extracted and blended cave bat guano.	Cheap labour.
1929-36	Sandalwood collection denudes the ranges of this species.	As in earlier depressed times many people resorted to harvesting some common property - for example, the Yellow-footed Rock-wallaby and sandalwood.
1934	R.M. Williams in Italowie Gorge camp builds his stockmen's boot and saddle business from nothing.	His most frightening experience-camp completely covered by a dust storm - does not remember many, if any goats in the ranges, but there were wild donkeys.

1935	Bastin's Coaches open a tourist service as far as Blinman.	Tourism spreading the public on holiday.
1936	Francis Ratcliffe's CSIRO report on "Soil Drift in Arid Pastoral Areas of South Australia" (Pamphlet No. 64 (CSIRO). Rabbit plague.	First national assessment of the impact of overstocking and poor pastoral management - sympathetic but hard hitting. Special rabbit studies - myxomatosis suggested as control. Also examines pastoral policy.
1938	Balcanoona transferred to Hurtle Lord.	Roy Thomas bought Balcanoona in the mid-1920s drought, had a fair season following, but the nation was in economic depression, and he sold the property just following the mid-1930s drought.
1940	Serious drought.	
1930-40	First goats appear on Balcanoona.	Ideal goat habitat - set to eat what the sheep had left.
1943	Balcanoona transferred to Byron and Ian McLachlan.	Balcanoona not proving to be a sound investment in terms of sheep.
1944	Mount Fitton talc deposits discovered by G.A. Greenwood.	The mine is the largest producer in Australia.
1944	Detailed survey of Mount Painter Uranium Field-road built from Balcanoona.	Towards the end of World War II uranium seen to be an important mineral. Aerial survey and mapping.
1945	Wilpena proclaimed a National Pleasure Resort.	Official recognition of the magnificent scenic resource.
1946	Dingo-proof fences consolidated under government control.	Complete fences around range, completed 1920s or 1930s.
1946	Dr R. Sprigg discovers the Ediacara fossils.	Earliest animal fossils to be discovered in the world at this time.
1946	Wilpena chalet built.	Evidence of growing public interest in visiting the ranges.

1946	Warren Bonython explores the Gammon Ranges.	Attracted by a photograph in the newspaper of the unexplored land in S.A. The start of activities culminating in Gammon Ranges National Park.
1946	100 000 tons of coal mined at Leigh Creek.	Interest in large expansion of the field and growth of a large local population who would regularly use the northern Flinders Ranges for recreation.
1948	The last full Adnyamathanha initiation.	These are the last people who will have the Aboriginal right to the full Adnyamathanha traditions and ritual. Importance of confidential recording of traditions becomes critical.
1948	The Leigh Creek coalfields are acquired for the S.A. Electricity Trust.	The way is cleared for major growth.
1953-57	L. Dodson erects Balcanoona's stone tanks.	Productions of a prosperous period.
1955	Massive flood in Hookina Creek, 270mm of rain.	Great damage to landscape, roads and rail.
1956	634 tonnes of 95.7% MgCO3 (Magnesite) mined and shipped to Newscastle for testing.	20 million tonnes of more than 40% MgCO3 in the deposit. BHP hold Mining Leases 4059-4066 over this area expiring on 7.2.1980.
1957	Thomas Playford Powerhouse opened.	Entirely dependent on Leigh Creek coal. More coal required and more people at Leigh Creek.
1955-56	High rainfall.	Rabbit plague.
Late 1950s	Myxomatosis decimates rabbits.	Effective during wet years with mosquitoes present.
1961	Radium Hill mines close down.	
1960	Yellow-footed Rock-wallaby numbers increasing slowly.	

Mid-late 1960s	Feral goat populations exploding in the northern Flinders Ranges.	Goats forced into less accessible areas (even for goats)by population pressures - springs being severely damaged and disturbance greatly increased.
1967	Peak production of Leigh Creek coal to date.	2 064 000 tonnes produced.
1968	Reg and Griselda Sprigg buy Arkaroola.	The Arkaroola tourist and nature conservation project begins.
1968	Extremely wet year.	Crimson Chat population explodes.
1968	Moomba Gas Pipeline No. 1 starts contruction.	Creates much disturbance across the Lake Frome/Balcanoona plains.
1968	Loch Ness mine reopened.	No early records with Dept. of Mines and Energy - not a feasible prospect.
1969	McLeashes Copper Prospect drilled and re-explored.	No early records - not a feasible prospect.
1970	Gammon Ranges National Park and Oraparinna National Park proclaimed 22.10.1970.	Gammon Ranges National Park 15 538 ha. of unusable Yancaninna land includes Mainwater Pound, the Gammon Plateau, and Arcoona Bluff.
1970 and 1972	Flinders Mines N.L. re-explore by drilling Mount McTaggart Mine area.	Not a feasible prospect - but discover the best water supply in the ranges - fracture zone can supply 1 000 000 litres per day.
1971	Good rains. Heysen Range named.	More rabbit problems.
1972	Explosive regeneration of Acacia rivalis.	(see Vegetation section for possible reasons).
1972	Wilpena and Oraparinna become Flinders Ranges National Park	Rationalising management.
1972-75	Wet years in the ranges.	Rabbits inhibit shrub regeneration.

1973	Last full blood Adnyamathanha person dies.	Traditions are slipping away.
1973	Flinders Ranges Planning Area Development Plan authorised by Govt.	Integrated planning and development ideal beginning to take shape.
1976	Nature Conservation Society of S.A. propose a northern Flinders Ranges national park.	Movement gathers momentum.
1976	Drought returns.	Starving rabbits do much damage to perennial vegetation.
1976-77	Summer - extensive lightning-ignited bushfires on Arkaroola.	Vegetation buildup greater than elsewhere in northern Flinders Ranges because of very low stock numbers and campaign against goats.
1978	Estimate of goat populations. 20 000 Arkaroola 50 000 Balcanoona 10 000 Gammon Ranges National Park.	Causing a vast amount of damage to the habitat.
1980	Balcanoona purchased by S.A. Government for $360 000.	Most of the property was purchased for the national park. The scientifically valuable plains block was offered for sheep grazing.
1981	Extensive lightning-ignited wildfires in the spinifex, mulga, and oak country of Hawker Hill.	The clear burned area is very obvious from the road.
1982	17.4.1982 The enlarged Gammon Ranges National Park was oficially opened by Minister D. Wotton.	South Australian National Parks and Wildlife Service formally assumed management responsibility.

1982	Nepabunna people carry out a very successful goat control programme.	Without stock and with fewer goats, vegetation will begin its reconstruction after the next good rains increasing the risk of severe fires in the future. See Arkaroola sequence of events.
1981-84	Extreme drought	
1984	Balcanoona Plains block proposed for addition to the park.	

RESOURCE MATERIALS AND REFERENCES

MAPS

The maps listed below are held either in the South Australian Archives or the Department of Lands.

Frome's Route (Department of Lands DR 8/2).

Frome's Map. From Williams: S.A. Explorations to 1856 (1843).

Plan of settled districts around Adelaide S.A. 1843 (Department of Lands DR 8.6).

"Boone Map". From Eyre's Journals 1845 (Archives cabinet 14A).

Sketch map of runs north of Mount Remarkable 1853. Reproduced in Proceedings of the Royal Geographical Society (S.A.) volume XVII.

John McDouall Stuart - Survey Map of Pastoral Leases 379, 367, 404, 422, 427, in 1855 (Department of Lands).

Map showing settled districts of the State - 1854. Prepared by officers of the Survey Department for presentation to Surveyor-General Freeling in 1855 (Department of Lands DR 8/24).

Detailed map of Pastoral Leases in S.A. dated 10/8/1865 (Department of Lands Pastoral Subsection).

SOUTH AUSTRALIAN PARLIAMENTARY PAPERS

Number 153, (1857) Map showing Frome's tracks.

Number 72, (1857/58) Goyder's report (his first trip north in April 1857).

Number 25, (1858) Northern exploration map showing Mount Chambers.

Number 58, (1858) Map.

Between Numbers 181-182, (1858) Map of recent discoveries. Shows Mount Chambers and a copper mine nearby.

Numbers 102-106, (1864) Valuation of runs made by Mr Goyder in 1864. None of the runs in the NE Flinders Ranges mentioned.

Number 183, (1864) Map of surveyed land November 1864 (R. Gardiner pro. Surveyor-General). (No runs shown above Port Augusta.)

Number 38, (1865/66) Return of pastoral leases 1851 to 1864.

Number 55, (1865/66) Claims for preferential rights (Leases).

Number 14, (1867) Minutes of evidence of state of the northern runs plus plan of the Pastoral Leases.

Number 89, (1867) Report of valuations of runs by Goyder, Bonney, and Valentine; refer to stock losses.

Number 135, (1867) Pastoral Leases - statistics.

Number 182/182A, (1867) Pastoral lessees who held leases in Districts A, B and C from 1862 to 1866.

REFERENCES

Aitken, P.F. (1971). Planigale tenuirostris Troughton, the Narrow-nosed Planigale, an addition to the mammal fauna of South Australia. South Australian Nationalist, 46, 18.

Aitken, P.F. (1972). Planigale gilesi (Marsupialia, Dasyuridae); a new species from the interior of south eastern Australia. Records of the South Australian Museum, 16 (10), 1-14.

Aitken, P.F. (1975). Two new bat records from South Australia with a field key and checklist to the bats of the State. S.A. Nat., 50, 9-15.

Aitken, P.F. (1979). The status of endangered Australian wombats, bandicoots and the marsupial mole. In M.J. Tyler (Ed.), The status of endangered Australasian wildlife. Adelaide: Royal Zoological Society of South Australia.

Aitken, P.F. (1980). Mammals. In D. Corbett (Ed.) A field guide to the Flinders Ranges. Adelaide: Rigby.

Allen, H. (1979). Aborigines of the western plains of N.S.W. In "The Aborigines of New South Wales. Parks and Wildlife, 2, 5.

Anonymous (1979). The Adnyamathanha tribe - Flinders Ranges. Adelaide: Taperoo High School.

Anonymous (1981). Minerawuta (Ram Paddock Gate). Adelaide: Heritage Unit, S.A. Department of Environment.

Archer, M. (1979). The status of Australian Dasyurids, Thylachnids and Myrmecobiids. In M.J. Tyler (Ed.), The status of endangered Australasian wildlife. Adelaide: Royal Zoological Society of South Australia.

Auhl, I., & Marfleet, D. (1977). Journey to Lake Frome 1843: paintings and sketches by Edward Charles Frome and James Henderson. Adelaide: Lynton Publications.

Ball, D. (1978). The Northern Flinders Ranges. A report on the requirement for extensions to the present national park system in the far northern Flinders Ranges of South Australia. Adelaide: Nature Conservation Society of S.A.

Barlow, B. (1981). Evaluation of the Australian flora. In Flora of Australia. Canberra: Aust. Govt Printing Service.

Berndt, R., & Berndt, C. (1951). From black to white in South Australia. Melbourne: Arbuckle Woddell.

Black, E.C. (1966). Population and tribal distribution. In B.C. Cotton (Ed.), Aboriginal man in south and central Australia. Adelaide: Government Printer.

Bonython, C.W. (1982). Events leading to the creation of the Gammon Ranges National Park. South Australian Parks and Conservation, 2, 2-5.

Boomsma, C.D., & Lewis, M.B. (1980). The native forest and woodland vegetation of South Australia. (Bulletin 25.) Adelaide: S.A. Woods and Forests Department.

Brown, H.Y.L. (1899 and 1980). Record of mines of South Australia (3rd ed.). Adelaide: Govt Printer.

Bruce, R. (1902). Reminiscences of an old squatter. Adelaide: W. K. Thomas. (Facsimile ed. S.Th. Aust. Libraries Board, 1973.)

Bull, J.W. (1884). Early experiences of life in South Australia, and an extended colonial history. Adelaide: Wigg and London: Sampson Low.

Burbidge, A.A. (1977). The status of kangaroos and wallabies in Australia. Canberra: AGPS.

Bureau of Meteorology (1974). Climate atlas of Australia. Canberra: AGPS.

Callen, R.A., & Tedford, R.H. (1976). New Late Cainozoic rock units and depositional environments, Lake Frome area, South Australia. Trans. R. Soc. S. Aust., 100, 125-168.

Chewings, C. (1936). Back in the Stone Age. Sydney: Angus and Robertson.

Coats, R.P., & Blissett, A.H. (1971). Regional and economic geology of the Mt. Painter Province. (Bulletin 43, Geol. Surv. of S.A.) Adelaide: Government Printer.

Cogger, H.G. (1975). Reptiles and Amphibians of Australia. Sydney: Reed.

Compston, W., Crawford, A.R., & Bofinger, V.M. (1966). A radiometric estimate of the duration of sedimentation in the Adelaide Geosyncline, South Australia. Journal of the Geological Society of South Australia, 13, 229-276.

Copley, P. (1981). Distribution and status of the Yellow-footed Rock-wallaby, Petrogale xanthopus in the Flinders Ranges, South Australia. Adelaide: Conservation Society of South Australia.

Corbett, D. (Ed.). (1980). A field guide to the Flinders Ranges. Adelaide: Rigby.

Corbett, J.R. (1969). The living soil. Sydney: Martindale Press.

Costermans, L.F. (1981). Native trees and shrubs of South Eastern Australia. Adelaide: Rigby.

Crocker, R.L. (1946). Post-Miocene climatic and geologic history and its significance in the genesis of the major soil types of South Australia. CSIRO Aust. Bull. No. 193.

Davey, A., Worboys, G., & Stiff, C. (1981). A report on cave classification. Paper presented to 4th Australian Conference on Cave Tourism and Managment. Yallingup, W.A.: unpublished.

Dawson, T.J., & Ellis, B.A. (1979). Comparison of the diets of Yellow-footed Rock-wallabies and sympatric herbivores in western New South Wales. Aust. Wildl. Res., 6, 245-254.

Division of National Mapping (1980). Soils and land use. (Atlas of Australian Resources, Third Series, Vol 1.) Canberra.

Ealey, E.H.M. (1967). The ecology of the euro, Macropus robustus (Gould), in north western Australia. 1. The environment and changes in euro and sheep populations. CSIRO Wildl. Res., 12, 9-25.

Eckert, J. (1975). Range of Bourke Parrot. SAO, 27 (1), 18-19.

Edwards, R., & Stewart, J. (Eds.). (1980). Preserving indigenous cultures: A new role for museums. Canberra: AGPS.

Ellis, R.W. (1972). Aboriginal man in the ranges. In The Flinders Ranges - problems and prospects. Proceedings of a seminar, University of Adelaide, Department of Adult Education Publication No. 28.

Ellis, R.W. (1978). Aboriginal culture in South Australia. Reprint from S.A. Year Book 1978. Adelaide: Government Printer.

Eyre, E.J. (1841). Journals of expeditions of discovery into Central Australia and overland from Adelaide to King George's Sound in the years 1840-41, sent by the colonists of South Australia with the sanction and support of the government: Including an account of the manners and customs of the aborigines and their relations with Europeans. London: Boone.

Faulks, I.G. (1980). The mineral resources and mineral potential of the proposed Balcanoona National Park. (Rept. Bk. No. 80/15.) Adelaide: Geological Survey, Department of Mines and Energy.

Fitzpatrick, A.E., & Nix, H.A. (1970). The climatic factor in Australian grassland ecology. In R. M. Moore (Ed.), Australian grasslands. Canberra: ANU Press.

Fox, A.M. (1976). Man and natural systems. Parks and Wildlife, 1(5), 140-149.

Fox, A.M. (1976). The unwritten compact. Australian Natural History, 11, 404-411.

Frith, J.H. (1973). Wildlife conservation. Sydney: Angus and Robertson.

Frith, J.H. (Ed.). (1979). Complete book of Australian birds. Sydney: Reader's Digest.

Frith, J.J., & Calaby, J.H. (1969). Kangaroos. Melbourne: Cheshire.

Frome, E.C. (1843). Frome's report. Journey into the north east interior. Extract from Government Gazette 1843.

Gason, S. (1879). The Dieyerie Tribe. In J.D. Woods (Ed.), The native tribes of South Australia. Adelaide: Wigg.

Gibbs, W.J. (1969). Meteorology and climatology. In R. O. Slatyer & R. A. Perry (Eds.), Arid lands of Australia. Canberra: ANU Press.

Glaessner, M.F., & Daily, B. (1959). The geology and Late Precambrian fauna of the Ediacara Fossil Reserve. Rec. S. Aust. Mus., 13, 369-401.

Glaessner, M.F., & Parkin, L.W. (Eds.). (1958). The geology of South Australia. Melbourne: Melbourne University Press.

Golstein, W. (Ed.). (1979). Australia's 100 years of national parks. Sydney: NSW National Parks and Wildlife Service.

Griffiths, M.E. (1968). Echidnas. Oxford: Pergamon.

Haegi, L. (1981). Duboisia R. Br. In J. Jessup (Ed.), Flora of Central Australia. Sydney: Reed.

Hall, L.S., & Richards, G.C. (1979). Bats of eastern Australia. (Queensland Museum Booklet No.12.) Brisbane: Qld Museum.

Hamilton-Smith, E. (1970). Biological aspects of cave conservation. Journal of the Sydney Speleological Society, 14, 157-164.

Hamilton-Smith, E. (1979). Endangered and threatened Chiroptera of Australia and the Pacific Region. In M. J. Tyler (Ed). The status of endangered Australasian wildlife. Adelaide: Royal Zoological Society of South Australia.

Hardy, B. (1969). West of the Darling. Adelaide: Rigby Seal Books.

Harris, C.H. (1903). Wilpena Pound and St. Marys Peak. The Public Service Review, Oct 5-6, Nov. 21-22.

Hayward, J.F. (1928). Reminiscences of J.F. Hayward. Proceedings of the Royal Geographical Society of Australasia (S.A. Branch), 29, 79-170.

Henderson, J. (1843). Sketch book. (S.A. Archives B2434.)

Henderson, J. (1844). Narrative of an expedition to Lake Frome in 1843. Proc. Roy. Geol. Soc. Aust. (S.A.), 26.

Jessop, J. (Ed.). (1981). Flora of Central Australia. Sydney: Reed.

Jessop, R.W. (1962). Stony tableland soils of inland Australia. Aust. Journal Science, 24 (11), 456-57.

Johns, R.K. (1963). Limestone, dolomite and magnesite resources of South Australia. Bull. Geol. Surv. S. Aust., 38, 99.

Laut, P., Heyligers, P.C., Keig, G., Loffler, E., Margules, C., Scott, R.M. & Sullivan, M.E. (1977). Environments of South Australia, Province Flinders Ranges. Canberra: Division of Land Research, CSIRO.

Lee, R.B. (1969). Kung Bushman subsistence: an impact and output analysis. In A.P. Vayda (Ed.), Environment and culture-behaviour: Ecological studies in cultural anthropology. New York: Natural History Press.

Leigh, J., Briggs, J., & Hartley, W. (1981). Rare and threatened Australian plants. Canberra: A.N.P.W.S.

Ludbrook, N.H. (1980). A guide to the geology and mineral resources of South Australia. Adelaide: Govt Printer.

McBryde, I. (1979). Patterns of change and continuity: New South Wales prehistory. Parks and Wildlife, 2, 5.

McGilp, J.N. (1919). Notes from the Lake Frome District. SAO, 4, (3), 70-74.

Medlin, G.C. (1979). Mawson High School Chambers Gorge field trip (4th ed.). Adelaide: Mawson High School.

Mincham, H. (1964). The story of the Flinders Ranges. Adelaide: Rigby.

Mincham, H. (1980). A brief history. In D. Corbett A field guide to the Flinders Ranges. Adelaide: Rigby.

Morgan, A.M. (1931). A trip to Moolawatana. SAO, 11 (2), 53-61.

Mulvaney, D.J. (1976). The chain of connection. In N. Peterson (Ed.), Tribes and boundaries in Australia. Canberra: Aust. Inst. Aboriginal Studies.

National Parks and Wildlife Service (1982). Plan of Management - Flinders Ranges National Park. Adelaide: SA National Parks and Wildlife Service.

Newland, B.C. (1958). The mountain that moved. Proceedings of the Royal Geographical Society of Australasia (S.A. Branch), 60, 107-125.

Newland, B.C. (1962). Edward Charles Frome. Proc. Roy. Geol. Soc. Aust. (S.A.), 63.

Newsome, A.E. (1962). The biology of the Red Kangaroo Microfus rufus (Desmarest) in central Australia. M. Sc. thesis, Univ. of Adelaide.

Newsome, A.E. (1965). The distribution of red kangaroos, Megaleia rufa (Desmarest) about persistent food and water in central Australia. Aust. Journal of Zool., 13, 289-299.

Newsome, A.E. (1971). The ecology of red kangaroos. Aust. Zool., 16, No. 32-50.

Northcote, K.H. (1975). A description of Australian soils. Australia: CSIRO.

Northcote, K.H. (1979). A factual key for the recognition of Australian soils (4th ed.). Glenside, S.A.: Rellim.

Osterstock, A. (1976). Time: In the Flinders Ranges. Adelaide: Austaprint.

Parker, S.A. (1973). An annotated checklist of the native land mammals of the Northern Territory. Records S. Aust. Mus., 16, 1-57.

Parker, S. (1977). Records of Barking Owl from South Australia. SAO, 27 (6), 204-206.

Parkin, L.W. (Ed.). Handbook of South Australian geology. Adelaide: Government Printer.

Peterson, H. (1976). The natural and cultural areas of Aboriginal Australia: A preliminary analysis of poulation groupings with adaptive significance. In N. Peterson (Ed.), Tribes and boundaries in Australia. Canberra: Aust. Inst. of Aboriginal Studies.

Pizzey, G. (1980). A field guide to the birds of Australia. Sydney: Collins.

Poole, W.E. (1979). The status of endangered Australian Macropodidae. In M.J. Tyler (Ed.), The status of endangered Australasian wildlife. Adelaide: Royal Zool. Soc. of South Australia.

Pratt, E.C.E. (1978). Aboriginals and mining. Search, 9(3).

Ratcliffe, F.N. (1936). Soil drift in the arid pastoral areas of South Australia. (Pamphlet No. 64.) Melbourne: CSIRO.

Reid, N., Paton, J.B., & Paton, D.C. (1977). Critical range limits of the Turquoise and Black-backed Wrens in SA. SAO, 27 (6), 216-221.

Ride, W.D.L. (1970). A guide to the native mammals of Australia. Melbourne: Oxford Univ. Press.

Roberts, A., & Roberts, M.J. (1981). Dreamtime - the Aboriginal heritage. Adelaide: Rigby.

Ross, B., & Snoek, W. (1981). A preliminary survey of archaeological sites in the Flinders Ranges National Park. Internal report funded by Australian Heritage Commission for South Australian National Parks and Wildlife Service.

Royal Australian Ornithologists Union. (1978). Recommended English names for Australian birds. Supplement to Emu, 77.

Smith, M. (1977). Remains of mammals, including Notomys longicaudatus (Gould) (Rodentia: Muridae) in owl pellets from the Flinders Ranges. S.A. Aust. Wildl. Res., 4, 159-170.

Specht, R.L (1972). The vegetation of South Australia. Adelaide: Govt Printer.

Sprigg, R., & Sprigg, G. (1976). Arkaroola - Mt. Painter in the Flinders Ranges, South Australia. Arkaroola: The Authors.

Tedford, R.G. (1955). Report on the extinct mammalian remains at Lake Menindee, N.S.W. Rec S. Aust. Mus., 11, 299-305.

Thomson, B.P., Daily, B., Coats, R.P., & Forbes, B.G. (1976). Late Precambrian and Cambrian geology of the Adelaide 'Geosyncline' and Stuart Shelf, South Australia. (Excursion guide 33A). 25th. Int. Geol. Congress, Sydney.

Tindale, M.B. (1937). Two legends of the Ngadjuri Tribe from the middle north of South Australia. Trans. Roy. Soc. Aust., 61, 149-153.

Troughton, E. Le G. (1957). Furred animals of Australia. Sydney: Angus and Robertson.

Twidale, C.R. (1967). Hillslopes and pediments in the Flinders Ranges, South Australia. In J. N. Jenning & J. A. Mabbutt (Eds.), Landform studies from Australia and New Guinea. Canberra: ANU Press.

Twidale, C.R. (1976). Analysis of landforms. Sydney: Wiley.

Tyler, M.J. (1966). Frogs of South Australia. Adelaide: South Australian Museum.

Tyler, M.J. (1976). Frogs. Sydney: Collins.

Tyler, M.J. (1979). The impact of European man upon Australasian amphibians. In M.J. Tyler (Ed.), A field guide to the Flinders Ranges. Adelaide: Rigby.

Tyndale-Biscoe, C.H. (1973). Life of marsupials. London: Edward Arnold.

Uren, M., & Stephens, R. (1945). Waterless horizons. Melbourne: Robertson and Mullens.

Vestjens, W.J.M., & Hall, L.S. (1977). Stomach contents of forty-two species of bats from the Australian region. Aust. Wildl. Res., 4, 25-35.

Warburton, P.E. (1875). Journey across the western interior of Australia. London: Sampson Low, Marston, Low and Searle.

Watts, C.H.S. (1979). The status of endangered Australian rodents. In M.J. Tyler, (Ed.), The status of endangered Australasian wildlife. Adelaide: Royal Zool. Soc. of South Australia.

Watts, C.H.S., & Aslin, H.J. (1981). The rodents of Australia. Sydney: Angus and Robertson.

Whibley, D.J.E. (1980). Acacias of South Australia. Adelaide: Govt Printer.

Williams, R.M. (1982). Early experiences. Taped discussion with A.M. Fox. South Australian, National Parks and Wildlife Service.

Wilson, G.R., Geritson, J., & Milthorpe, P.L. (1976). The Yellow-footed Rock-wallaby, Petrogale xanthopus (Macropodidae) in western New South Wales. Aust. Wildl. Res., 3, 73-78.

Wilton, C., Coulthard, C., & Coulthard, D. (1980). The Flinders Ranges - an Aboriginal view. Adelaide: Aboriginal Heritage Unit, Department of the Environment.

Winton, L.J. (1924). Report on the Occurrence of Natural Ammonium Sulphate and Chloride associated with Guano in a cave deposit near Wooltana Head Station. Min. Rev. Adelaide, 40, 46-54.

Wood Jones, F. (1923). The mammals of South Australia (Parts I-IIII.). Adelaide: British Science Guild Handbooks Committee, South Australian Branch.

Part 2

Derivation of Management Objectives

MANAGEMENT PHILOSOPHY

National parks are public lands and the Director of the the National Parks and Wildlife Service has the statutory responsibility for the management of these lands under Section 36(1) of the National Parks and Wildlife Act, 1972-1981. Section 37 of the same Act specifically lays down nine objectives of management to which the Director shall have regard. They are:

(a) the preservation and management of wildlife;

(b) the preservation of historic sites, objects and structures of historic or scientific interest within reserves;

(c) the preservation of features of geographical, natural or scenic interest;

(d) the destruction of dangerous weeds and the eradication or control of noxious weeds and exotic plants;

(e) the control of vermin and exotic animals;

(f) the control and eradication of disease and injurious affection of animals and vegetation;

(g) the prevention of bushfires and other hazards;

(h) the encouragement of public use and enjoyment of reserves and education in, and a proper understanding and recognition of, their purpose and significance; and

(i) generally the promotion of the public interest.

It is a clear responsibility of the Service to promote and encourage public use of the Gammon Ranges National Park and provide the means by which visitors may experience and enjoy the natural and cultural attributes of the area. However, it is also the responsibility of the Service to manage the area to ensure that those values upon which public enjoyment depends are not diminished. To a degree, these are conflicting objectives and responsibilities. Promotion of the area and provision of facilities and access may ultimately increase visitor pressures to a level which is detrimental to significant features of the park and its unique character.

The role of the park in the South Australian reserve system, and the particular attributes which are central to the value of the park must be fully considered in formulating management priorities. Despite improving access and rapidly increasing levels of visitation, the Gammon Ranges proper continue to be valued as the wildest and possibly the most spectacular part of the Flinders Ranges. They are regarded as one of the last areas to be explored in South Australia and have wilderness values of an order of national significance. It will be the primary goal of the Service in managing this park to ensure that these values are conserved.

Patterns of visitor use must be carefully managed if the character of the park and the unique opportunities it provides are to be retained. This will be no easy task. Already there are signs that the park is degrading at points of heavy use. The fragile environment, while resilient to stress of many kinds, is sensitive, and undergoes irreversible change when subject to constant, long-term pressure.

In general, the approach to management should be conservative. Once established, patterns of use which may at some future time be regarded as inappropriate, are difficult to control and redirect.

The spectacular scenery of the Gammon Ranges, and the northern Flinders Ranges in general, offers considerable potential for tourist development. The Arkaroola Resort to the north of the park has tapped this to some extent, but it is clear that with growing public awareness and interest in the region there will be very real opportunities for further growth. The National Parks and Wildlife Service will cooperate with the Department of Tourism and other authorities in seeking to realise this potential. It will, however, ensure that any developments allied to tourist promotions are located outside the park and planned in such a way as to minimise impact on the park environment and its conservation values.

ZONING

The concept of zoning for particular uses and purposes has become accepted as a basic tool of park management planning, as indeed it has with landuse planning and management in general. It is specifically provided for in the National Parks and Wildlife Act, 1972-1981 and zones have been designated in management plans for many reserves in South Australia. A zoning strategy may be especially useful in rationalising and managing patterns of park use which are incompatible or threaten particular park values.

A strong and effective zoning strategy is considered to be essential in providing a framework which will guide development within the Gammon Ranges National Park. For example, many of the natural and cultural attributes which the park possesses, as well as the scientific and recreational opportunities it provides, are susceptible to development and may be threatened by the inevitable demands for increased visitor facilities and access that will accompany growth in the park's popularity. By effective zoning, development may be directed into areas which will satisfy these demands, and at the same time safeguard the features of the area which are critical to its value as a national park.

RELATIONS WITH THE LOCAL ABORIGINAL POPULATION

Park Management

The Gammon Ranges National park lies over land which was traditionally the home of the Adnyamathanha people. About 50 per cent of the remaining Adnyamathanha live as neighbours to the park's western boundary at Nepabunna. Recently, the neighbouring Mount Serle station was purchased by the Aboriginal Development Commission to be managed as a viable sheep and cattle station. It is to the mutual advantage of both the park and the Aborigines that co-operative relations be developed and maintained.

Because Nepabunna is extremely isolated, there are very few employment opportunities for the young people locally. The park has already, and will continue to, offer opportunities to some local people, and with this in mind the Service has developed training opportunities for the Adnyamathanha people.

Feral animal control also provides significant work opportunity and the Aborigines have undertaken a large and successful feral goat control programme.

A further area of significance is the knowledge of the older people of the country and its traditions. Recording of this material should continue, and approval should be sought from the Aborigines for relevant material to be used in park interpretation programmes and in naming features of the park.

A considerable amount of Aboriginal cultural material is located in the park. Recording of this material should continue, and with the agreement of the Aboriginal community, mutually acceptable management programmes instituted.

The Service should provide regular contact with the Adnyamathanha people with a view to promoting a growing interest in, and involvement with, the park management programme; particularly with regard to education, training and interpretive programmes.

Hunting

Although living as a semi-urban community, the Adnyamathanha people retain a number of traditional ways of life which include the taking of protected native plants and animals which constitute traditional food sources. Kangaroos are of particular significance in this regard and estimates have been made that the members of the community at Nepabunna take of the order of 120 animals per annum from the region.

The Balcanoona plains country, in common with other areas on the plains between the ranges and Lake Frome, is regarded as fine Red Kangaroo habitat and has been used by the Aboriginal people at Nepabunna for hunting. The Service, in consultation with the Adnyamathanha people, will provide opportunities for the non-commercial hunting of kangaroos by Adnyamathanha Aborigines within a designated area of the park.

A move to allow Aboriginal hunting within the park has rather far reaching implications. Legislative amendment will, for instance, be necessary. As an example, Regulation 14(4) of the Hunting Regulations under the National Parks and Wildlife Act prohibits the taking of animals by Aborigines in reserves. Difficulties of defining an Aborigine, a traditional way of life, and problems associated with access, appropriate use of firearms, safety, nuisance to other park users, and damage to vegetation and other animals have also been anticipated.

Conversely, it is argued that such a landuse is compatible with the philosophy of a national park; that over-exploitation has not and will not occur; and that any conflicts between hunting, conservation, and visitor use may be resolved by appropriate planning and management. It is further argued that this initiative will be an essential element in establishing a basis for the co-operative management of the park by the National Parks and Wildlife Service and the Adnyamathanha people.

ACCESS

The Gammon Ranges National Park is in an isolated area 700 kilometres from Adelaide, 380 kilometres from Port Augusta, and 480 kilometres from Broken Hill. There is road and air access by private or commercial transport. Under normal circumstances some form of private vehicular transport is required to move from point to point within the park.

There was an existing network of roads within Balcanoona for the purposes of sheep station management. Some of these roads are not compatible with the management of the area as a national park and a number of realignments and

closures will be instituted. A significant number of four-wheel-drive vehicles are used in visits to the park although there is little evidence that these vehicles and their drivers have been irresponsible in their use of the area. It is neither possible nor desirable to upgrade the roads through the main park area to two-wheel-drive standard. There is, nevertheless, an opportunity for a through road to remain open to four-wheel-drive vehicles.

The trunk road from Copley to Arkaroola passes through the southern and eastern park area and gives both two-wheel-drive and four-wheel-drive vehicles access to the main development areas.

Walking tracks can and should be kept to a minimum because of the open nature of the country. All road and track standards should be in accordance with the zoning plan.

Two airstrips at Balcanoona and Arkaroola service the park. Before contemplating use, their condition should be checked through the Federal Department of Transport. A sealed airstrip exists at Leigh Creek, and daily commercial flights from Adelaide are available to this town which is approximately 80 kilometres from the park.

COMMUNICATIONS

The isolation, size, and form of the Gammon Ranges National Park makes an effective communications system essential. The park should be covered by an efficient and effective radio communications system tied into the State-wide South Australian National Parks and Wildlife Service network. A single wire telephone system dating from sheep station days links the Balcanoona headquarters with Leigh Creek, but due to the condition of the line, and environmental conditions, is only satisfactory for a short time each day and cannot be depended upon in times of emergency. A Single Side Band (SSB) radio network is in operation which links the park headquarters and vehicles directly with district ranger stations, the Port Augusta Regional Office, and with head office in Adelaide. The Balcanoona headquarters is also able to broadcast and receive on Royal Flying Doctor Service frequencies.

VISITOR SERVICES

Walking Routes And Self-Guiding Tracks

The nature of the landscape and the vegetation does not at this stage warrant the formation of a walking track system for general access. As vegetation regenerates following the removal of stock, cut tracks may in some instances become necessary. Some routes may also need to be marked to points of specific interest, and provision made for clear, accurate, and understandable maps of particular management units - for example, Italowie development area, the north-eastern day-use area, and Bolla Bollana historic site. It is important from safety and visitor guidance points of view, that adequate mapping be provided. This is considerably less expensive than constructing and maintaining tracks.

Because of staff shortages and the variable nature of visitation, perhaps the most effective forms of visitor interpretive programmes are through self-guiding tracks and complementary brochures. There are six areas within the park which are eminently suited to this form of interpretation, though the particular approach would differ for some sites. The areas are; the Bolla Bollana smelter, Wooltana

Cave and mining relics, O'Donoghue's Castle Mine, Weetootla Gorge, and Rampart Range lookout. The Mount McTaggart Aboriginal engraving site, which is a desirable addition to the park, should also be developed in this way.

Bushwalking Routes And Camps

There are three main access points for the park used by almost every bushwalker - Arcoona Creek, Snake Gully Bore (Yancannina), and Loch Ness Well. The latter provides the most direct access to Mount McKinlay, Cleft Peak, Wildflower Creek, and Bunyip Chasm and is the most commonly used bushwalking access point in the park. Bush-camping permits need to be obtained from the ranger-in-charge to ensure the safety of the walkers, and so that some record will be maintained of user pressure on the environment. Almost all bushwalking takes place in the Wilderness or Primitive Zone and requires no physical improvements or facilities. However, it is essential that entry points for bushwalkers have permanent potable water supplies, and the current location of entry points has evolved to be dependent on this criteria.

The park programme accepts bushwalking by responsible parties as a desirable use of the national park and will foster such use. There appears to be no reason to exclude bushwalkers from any bush area of the park in the immediate future. The only possible occasions would be: if an approved research area was established which required no disturbance; if vegetation is being re-established in a defined area; if the park is closed in case of bushfire; if there is irregular or excessive use or misuse of an area or water supply; or, if the area is of special significance to Aborigines. The rugged character of the landscape and its aridity make the efficient operation of the bush-camping permit system essential.

Rock-Climbing Activities

The Service accepts rock climbing by responsible parties as a bona fide use of the Gammon Ranges National Park and will, as the need arises, designate areas for this use in consultation with climbers. As rock climbing can conflict with other park activities and with wildlife conservation considerations, the Service may need to designate specific rock-climbing areas. Should increased participation levels require such designation, the Service will consult with climbing organisations to determine appropriate areas.

Parking Areas

There are no defined parking areas in the park at present even though almost all visitors and park users travel within the park by vehicle. Much damage has been done to vegetation and soils by indiscriminate parking. The tendency is for vehicles to be pushed as close to trees as possible thereby compacting soil around the roots and physically damaging surface root systems which, in an arid climate, are used by the plant for the rapid uptake of the water from light showers. With the closing of Weetootla Gorge to traffic and opening of new visitor facilities, defined parking areas will be required. There will usually be facilities to cater for approximately six cars at first stage development for all except Italowie and Weetootla gorges. These areas will also be required to accept the occasional bus. Parked vehicles should be left in parking areas where they will not interfere with use of the park by other visitors or damage vegetation and disrupt wildlife.

Interpretation

Park interpretation is an educational method designed to motivate and create in the park visitor a greater awareness and understanding of park and nature conservation values through the immediate examples and experiences in a park.

Visitors may be classified according to background and interest as:

- family groups travelling by car - South Australians;
- family groups from interstate - Victoria and NSW;
- bus tours focused on Arkaroola;
- specialist tour groups in car convoy, mini-buses, and buses on a camping trip, for example, ornithologists, park associations, natural history associations, conservationists, school and educational groups, bushwalking groups;
- a small number of international visitors;
- Adnyamathanha Aborigines;
- local graziers, friends, and relatives;
- local visitors from Leigh Creek.

The Gammon Ranges National Park is no longer the preserve of the hardy bushwalkers. An increasing proportion of visitors to the park are members of family groups travelling by car. At least 50 per cent of the cars have four-wheel-drive. Many of these groups camp and most carry a camera and binoculars. Their visit generally lasts from three to six days. They will visit Arkaroola and probably join the ridgetop tour. On the way to or from home they may call at Chambers Gorge and/or Wilpena Pound and Flinders Ranges National Park.

The park's special attributes include geological and mining features, grand scenery of a rugged, semi-arid nature, Aboriginal engravings, spectacular seasonal wildflower displays, an interesting and appealing macropod and bird fauna, a very rich reptile fauna, and a sheep station building complex. Survival within a rigorous physical environment is an ever present theme in the ecosystem dynamics of the region.

The discovery of these attributes by way of the many techniques of park interpretation can make a visit to the national park a rich experience providing inspiration, pleasure and knowledge. The Service will, as a priority, prepare a Gammon Ranges Interpretation Plan so that park interpretation can play a significant role in effectively siting appropriate facilities and developing staff needs and budgets. The plan should be implemented progressively and integrated as much as possible with that of Arkaroola, Chambers Gorge, and Flinders Ranges National Park.

Education Programmes

The northern Flinders Ranges contain many resources valuable to schools and groups for education. Field trips can highlight the history, geography, geology, biology, ecology, art, arid zone plant studies, pond studies, chemistry, archaeology, and anthropology of the park.

Not all school groups are well prepared and some arrive at national parks with just a vague idea that field trips are good experiential education. Many of these so-called educational tours tend to be dumped on unsuspecting rangers. Others become uncontrolled with consequent damage to the park, and a lesser park experience for other park users. The information in Part 1 of this plan provides a basic reference source for school use and could be used to produce a teacher handbook which would stimulate more effective park use.

The Service should have special school-oriented environmental education packages prepared which encourage use of park resources by well-prepared school groups.

Picnic Areas

There are a number of places within the park which have intrinsic interest. The development of educational/interpretive programmes will provide incentives for visitors to stay at these locations for a meal. Distances within the park are such that when a base camp is made at Italowie Gorge, Weetootla Well, or Arcoona

Creek, day trips will be needed to properly utilise the available park resources. The Service will provide day-use picnic areas. In the first instance these should have fireplaces but, if wood supply is overused, then either a wood supply or possibly gas-heated barbecue plates should be provided in relevant areas. At popular picnic areas simple unisex toilet blocks may need to be provided as well as restricted parking areas.

Camping Areas

The isolation of the park from settlement, its size, and diverse natural and cultural values makes camping an essential activity. Historically, vehicle-based camping (excluding bushwalking) has occurred anywhere along accessible roads, but particularly in Italowie Gap, on Balcanoona Creek adjacent to the Wooltana boundary, and in Weetootla Gorge. It is intended that such camping should remain in these general areas but on more appropriate, well-located, and well-defined sites. While water is seen as a critical resource, the lower Balcanoona Creek site is dry. Numerous other sites are used to a much lesser degree.

The present pattern of vehicle-based camping is almost impossible for the Service to control and in a number of areas has been detrimental to conservation values. The Service will rationalise vehicle-based camping and provide visitors with safe, simple camping facilities in a number of sites central to a diversity of the features of the Gammon Ranges National Park.

RESEARCH AND MONITORING

Effective management requires comprehensive monitoring of the natural environmental and visitor use. Unlike many other national parks which are proclaimed over pristine or near-pristine communities, the Balcanoona part of the Gammon Ranges National Park has been overgrazed by exotic animals for over 100 years and the ranges have become severely degraded. The original structure of plants and animals is largely unknown. While it is likely that most plant species remain, it is certain that many animal species have become extinct since 1850 (see Part 1: Mammals). Some species remain in low numbers.

The removal of goats, sheep, donkeys and control of other feral animals and weeds is not the only outcome of management. People are being encouraged to visit and stay for a time in the park. Change in landuse will lead to secondary changes, for example, less need for artificial watering points; greatly increased groundcover resulting in an increased wildfire hazard; and removal of grazing competition from Euros and Yellow-footed Rock-wallabies. Many problems have been identified (see Part 1: Implications for Management).

Research and monitoring of change is an inherent part of management. Nevertheless, the National Parks and Wildlife Service cannot afford to squander funds on inappropriate research projects. Firm objectives need to be established before any such projects are undertaken. The Service will encourage the monitoring of changes to the physical, biological, ecological, and cultural values of the park. Research programmes which help to explain the conditions of these values will be encouraged, and other programmes which measure the perceptions, needs, and impacts of the users of the park will be initiated by the Service.

PROTECTION

The Gammon Ranges National Park is part of a region which has been managed by the pastoral industry for more than a hundred years and a number of feral grazing and browsing animals such as goats and donkeys have been present in high numbers. Severe modification has occurred to the vegetation and accelerated erosion has been initiated. Many species have become locally extinct and feral predators continue to take many insects, reptiles, amphibians, birds, and mammals. The hunting efficiency of feral cats and foxes around watering points during drought is high. At the same time some natural predators, for example, dingoes, have themselves been almost totally displaced by pressure from the pastoral industry. Changes initiated by park management philosophies necessitates some strategies of protection to be used to allow natural processes to rebuild the ecosystems.

The nature of the park poses many safety problems for visitors and staff. These include: the aridity of the area; heat and dehydration; the physical structure of the park (cliffs, gorges, shafts); the size of the park; water quality and supply; density of the scrub after 6 to 10 years of regrowth, bushfire, and floods.

Visitors will generate new and different pressures on the natural systems of the park which will require the implementation of other protective strategies.

Human Safety

Part 1 of this plan has identified a number of safety issues. For example: visitor safety may be threatened by climatic characteristics; wildfires may follow dry storm ignition of vegetation, particularly in regrowth stands of 6 to 10 years in age; escape of campfires in summer windstorms; dust storms may reduce visibility; the presence of some very venomous snakes and venomous spiders, for example, Mulga Snake, Red-backed Spider; the Adnyamathanha people are concerned about some "dangerous" sites for visitors, for example, some gorges near Loch Ness Well; wells, windmills, mine shafts, tunnels and old buildings; Wooltana Bat Cave and other caverns; unstable walls of gorges cutting through Pound Quartzites; deep parallel ridges, valleys and gorges lead to an underestimation of time needed to cover a given distance; and water quality may not be of potable standard.

The Service will develop education programmes, rules and regulations, and works programmes to ensure a reasonable degree of public and staff safety while visiting or working in the Gammon Ranges National Park.

Pollution

Pollution is not a major problem in the park primarily because of its isolation from large population centres, industry, and because the area is at the head of drainage basins.

Pollution of waterholes, springs and troughs with soaps, detergents, and rubbish; and effluent from future concentrated campsite areas are two problems which are foreseen.

A third problem may arise with the mining of the Balcanoona Magnesite Deposit. The whole of the gorge floor below the operation would be quickly covered by a milky deposit of powdered magnesite, and the largest spring-fed run in the northern Flinders Ranges would be very severely polluted (R. Sprigg personal communication).

The Service will endeavour to prevent pollution of the park by visitors and by its own management. It will also endeavour to constrain mining activities in the park which may cause pollution.

Mining

No mining activity occurs in the park at present. However, a number of BHP exploration licences and mining leases are current within the former Balcanoona station area. These exploration licences and mining leases existed prior to the acquisition of Balcanoona station, and as a consequence this area was proclaimed as an addition to the park subject to the provisions of the Mining Act.

While no mining activity is currently proposed, BHP has been granted a renewal of its exploration licence over the Balcanoona Magnesite Deposit. As already indicated, should mining of this deposit occur, severe pollution of the gorge, as well as other severe impacts on the park environment may well follow. In view of the importance of the park and the very significant impacts which mining operations may have on its landscape and biology, it is essential that this management plan set in place a framework of controls which will guide mining activity and ensure minimal disturbance to the natural environment.

Erosion

Exotic stock and feral herbivores have left much of the park surface unprotected during drought periods. Perennial groundcover has been largely replaced by annuals and ephemerals which respond rapidly after rain. However, because the open terrain is broken by rocky ridges and the ruggedness of the plateau itself, there are probably seed sources for regeneration of most plant species. This seems to be borne out by the growth appearing in the Arcoona exclusion plots, and the regrowth over Arkaroola which had stock removed in 1970. There is likely to be continuing accelerated sheet erosion and gullying for some time to come, particularly on the light dolomitic soils where the problem is accentuated by rabbit infestation.

Particular problems for park management will remain along road alignments and picnic/campgrounds where disturbances will continue. Recently mined or prospected areas may also need some stabilisation, particularly near the O'Donoghue Castle Mine. Channel deepening or braiding of streams will cause road damage during rare flood periods.

The Service will actively try to eliminate exotic and feral animals which have caused vegetation damage and will design roads, tracks, and development sites so as to minimise damage by soil erosion.

Fire

Because of the dominating influence of the rugged ridges on perception of the landscape, there is a tendency to overlook the land system diversity of the park area. The four environmental associations which have been identified in the park can be expected to respond differently in the short term following the removal of sheep and goats.

The Gammon Environmental Association

The high plateau and ridges of Pound Quartzite which are covered with Melaleuca scrub, low woodland and Spinifex have not been severely affected by grazing. This area, like the top of Hawker Hill, could burn severely following ignition. Fortunately, it is broken into compartments by major rock faces and exposures.

The Yerelina Environmental Association
The high arcuate parallel ridges of softer rocks are very severely overgrazed and the dolomitic soils have heavy infestations of rabbits. Perennial ground vegetation will be slow to return except on the rocky outcrops where it has survived sheep attack. Some pockets of Spinifex can carry fire now, but such fires would be very localised.

The Warraweena Environmental Association
The lower rugged ridges of quartzite and tillite have had lighter grazing pressure. Shrub and scrub growth of Mulga, Belah, Eremophila, and patches of Spinifex will all carry local fires now.

The Balcanoona Environmental Association
The vegetation of this association would appear to respond most quickly after rain because it is basically a Mitchell Grass grassland. Without pressure from stock the grassland will rapidly become a fire hazard, particularly where it is crossed by roads.

The Service will investigate the fire history of the park and encourage research leading to the establishment of a fire management plan setting out strategies for fire protection.

Boundary And Extensions
Few national parks are proclaimed over areas of ideal size, shape, and conformation with landform. Rationalisation of boundaries occurs later. For example the Balcanoona plains block, which runs from the south-eastern park boundary to Lake Frome, was not dedicated as part of the park in 1982 because it was then considered to be good land for sheep grazing. It was only later that the Government accepted the conservation arguments for proclaiming the land as a part of the park. The area has now been proclaimed as an addition to the park.

The Service will aim to extend the boundaries of the park where such extensions add significantly to park resources and where they will not cause unacceptable hardship to neighbours. There are two areas which should be carefully considered as future additions to the Gammon Ranges National Park. They are Arkaroola and the Munyallina Valley of Wooltana.

Arkaroola
This addition would add very greatly to the biological, historic, cultural, and scenic values of the park. It would also add very significantly to the geological basis for a world quality national park. Government policy may require exclusion of the tourist development area. Regardless of ownership or tenure it is desirable that both the park and Arkaroola are managed on a complementary basis.

The Munyallina Valley of Wooltana
This area, which appears to have only been lightly stocked, has been recognised as containing the most diverse flora in the ranges (see Part 1: Vegetation). Aboriginal art sites, including the Mount McTaggart Aboriginal engraving site, also occur in the locality. Consequently, the southern part of the Munyallina Valley is considered to be a very worthwhile addition to the park if the lessees are prepared to negotiate a release.

Great difficulty has been experienced in identifying the boundary of the park. Fences do not always cross the very rugged sections of the ranges and much give and take is evident. This is not immediately a problem. However, some sections

of the boundary fence which separates the park from grazing lands are in a very bad state of repair and need immediate reconstruction or repair. Boundaries where stock incursions could occur will be given priority during re-fencing programmes.

Feral Animals And Weeds

The natural vegetation over most of settled Australia has been substantially altered by two main factors: grazing, and the introduction and establishment of feral animals and weeds. With the removal of sheep from the Balcanoona section of the park in 1980, and the subsequent removal of thousands of feral goats, a considerable vegetation change is to be expected.

One of the major aims of management of national parks is to retain or attempt to restructure as nearly as possible, the area's natural ecosystems. If this is to occur in the Gammon Ranges National Park a continuing programme controlling plant and animal pests, especially those that are proclaimed pests under the Pest Plants Act, 1975, and the Vertebrate Pests Control Act, 1975, is necessary. The Service will aim to destroy dangerous or potentially invasive weeds, eradicate or control proclaimed pest plants, and control vermin and exotic or feral animals.

Grazing By Domestic Stock

With such a long boundary, much of it affected by crossing wide, braided, desert creekbeds subject to flash flooding, and with much of the boundary in wilder country unfenced, incursions by straying stock are inevitable. The Service will not permit grazing by domestic stock in the Gammon Ranges National Park unless it is designed to achieve a desired park management objective.

Aboriginal Culture And Sites Of Significance

Part I of this plan showed something of the rich human story relating to the northern Flinders Ranges and the park. Reminders of that story are scattered throughout the park and are part of the common heritage of Europeans and Aborigines. To the latter people, landscape and history are one, so the heritage values they perceive are greater. In the stirring words of Galarruy Yunupinga:

> I think of land as the history of my nation. It tells us how we came into being and in what system we must live. My great ancestors who lived in the times of history planned everything that we practise now. The law of history says that we must not take land, fight over land, steal land, give land and so on. My land is mine because I came in spirit from that land, and so did my ancestors of the same land.
>
> Without land I am nothing. Only a blackfeller who doesn't care about anything in the world.

Part 1: Implications for Management identified the following:

- There is a need to record surviving Aboriginal knowledge, traditions and beliefs of the Gammon Ranges landscape. Significant Aboriginal sites occur in the park which should be recorded as soon as possible so that effective management decisions can be made. Because of the lack of information on archaeological sites, all areas which will be disturbed by park management practices should be checked on the ground with archaeologists and Adnyamathanha people.

- At the Munyi site, the over-riding planning principle will be that the site is more important than the visitor. This is a major heritage site if for no other reason than that it has had very little disturbance from Europeans to date.

- Waterholes and springs are frequently of mythological and sacred significance, for example, Yackie Spring.

- There is an urgent need to encourage the local Aboriginal people to maintain a knowledge of their Aboriginal heritage, particularly with and for the children and young people. The Nepabunna School can be a key tool in this and the park presents a special link between Europeans and Aborigines. The Adnyamathanha people are desirous that Aboriginal place names be used in the park. Sympathetic Aboriginal employment provided by the Service for the park's operation will reflect the Service's desire to have Aborigines help manage a resource of which they are a part.

The Service recognises the deep and continuing relationship between the landscape, its biota, and the Adnyamathanha people and will actively foster study of the area's archaeology and prehistory.

In the first instance, emphasis will be given to places to be affected by management, then later, the Gammon Ranges National Park as a whole. The Service will also aim to protect sites of significance to Aborigines and will encourage the maintenance of the Adnyamathanha culture through employment of Aboriginal personnel in the park, through the adoption of Aboriginal place names, through interpretive and educational programmes and through Aboriginal community involvement in management programmes. It is proposed that hunting opportunities within a portion of the park, or in the Gammon Ranges region, will be made available to the Adnyamathanha people (see Relations with the Local Aboriginal Population).

Historic Sites And Relics

One of the major themes for protection and interpretation in national parks is that of colonisation of the region by people. This story is recorded in the landscape as the remains of human endeavour. In the Gammon Ranges these include roads, tracks, place names, special places with historic relationships, mines, smelters, shepherd's huts, outstations, homestead areas, stockyards, watering points, plantings, rubbish heaps, fireplaces, mullock heaps, and so on. All of these types of objects and places are represented in the park. An excellent sample of the story of European exploration, settlement, trial and error industry, transport, and communication for arid Australia is there.

Some of the historic implications were listed in Part 1: European Settlement and they included the presence in the park of significant relics and artefacts of European settlement and industry. The park history is rich in links with State and national histories relating to exploration, landuse and resource development, European/Aboriginal relationships, the pastoral industry, and the nature of Australia.

Damage to, and the cultural erosion of, artefact deposits occur when the public has unencumbered access without guidance or pre-visit information. The major building complex and the outstations, wells, windmills, and tanks will require a major specialist maintenance input from now on. Restricted maintenance is economic nonsense. The Illinawortina ruins, Bolla Bollana smelter site, the O'Donoghue Castle Mine and Worturpa are all places of high park interpretive prospects. The original Grindell's Hut, severely damaged in the removal of station equipment, is urgently in need of stabilisation and repair. Mineral and rock fossicking could denude some areas. The remains of the mining industry will need special treatment (see Human Safety; Visitor Services).

The Service will encourage the study of historic relics and stories relating to the park. It will also endeavour to stabilise and protect the remaining historic fabric, and prepare interpretive and educational materials for visitors to appreciate these stories and places.

Enforcement

Enforcement in national parks is a broad term which describes the many subtle techniques which are used to encourage the visiting public to co-operate with the objectives of park management. The single most important element in the enforcement programme is the firm, friendly, and efficient corporate image presented by the National Parks and Wildlife Service. The perception the public has of park resources affects this image. The public perception of the ranger follows closely, and this is affected by the exposure rangers get in the press and in the media, as well as by direct contact. When direct enforcement action has to be carried through to court, it must be direct, efficient, unfaltering, and well publicised. The Regulations of the Act provide adequate and wide powers for the ranger if they are needed, and reasonably clear field management policies are also available to clarify Service policy.

What the visitor does and how he behaves in the park is usually set long before the visit and many hundreds of kilometres away. Management at the park level should aim to reinforce positive attitudes, values, and behaviour of the visitor.

The Service will aim to ensure that the public understands the policies and actions needed to protect and to manage the national park and its resources. The visitor should understand the limitations placed on the uninhibited use of the resources, and the responsibility of the Service in enforcing these constraints.

Garbage And Litter

The disposal of garbage and litter generated by the visiting public is a continuing and growing problem. Almost all visitors will arrive by vehicle, and many will bring food and drink with them which generates much litter. The Service will take action to ensure the park is kept free of garbage and litter.

WILDLIFE MANAGEMENT

Wildlife management is the manipulation of individuals or populations of a species or of their habitat to produce a desired effect. Clear objectives are therefore essential before any effective programme can be devised. No objectives can be set without current knowledge of the status of wildlife in the park. Part 1 of this plan reviews current knowledge and provides a summary of key ecosystem management issues.

The Service will endeavour to manage wildlife and wildlife habitat of the park so as to ensure that there is no further loss of native species and so that species in dangerously low numbers will have a chance to increase. Special management status will be accorded the Yellow-footed Rock-wallaby.

ADMINISTRATION

Introduction

Effective implementation of this management plan depends upon the efficiency of its administration, particularly where management is as multifaceted as it must be in the case of a park with sensitive physical, biological, and cultural resources coming under growing visitor pressure.

A first step in establishing a management system for the park is to inventory the available resources. Surveys need to be carried out of physical, biological, and cultural resources and should include potential park use. This facet of management should taper off after a few years.

In order to gain and maintain public support for the park there should be a continuous high level of communication with park users. After the required amendment and subsequent acceptance of this management plan, there will be a requirement for detailed site planning for specific development and management programmes. After their implementation has been initiated, there will be a reduction in the planning effort until such time as the plan of management is to be reviewed. Because of demands already exerted by the visiting public and the government, some development will necessarily commence before the finalisation of the planning process. With establishment of developments and increasing visitor use, the maintenance factor and resource management will become the predominant activities. The establishment of priorities, and co-ordinating and funding this development and management work is the function of the Service's administration system.

I thought it was the core purpose of a management plan

Staffing

Until 1983, the park was staffed by one permanent officer with supervision provided from the National Parks and Wildlife Service District Office at Leigh Creek for special projects, for example, goat control. With the graduation of three Aboriginal rangers, this staff contingent will be increased to four. However, in terms of maintenance of the present developments and historic sites alone, additional maintenance staff will be necessary.

The following points support the staffing programme detailed later. (see Part 4: Administration)

- The continuing improvement in road access from Adelaide and Broken Hill will increase the number and of variety of visitors.
- The steady increase in costs of visiting central Australia will make the equally if not more attractive northern Flinders Ranges a preferred vacation destination for south-eastern Australians.
- Publicity given to the area will stir interest and as visitation grows, those with first-hand experience will promote the area to other people.
- Tourism is a potential growth industry for South Australia and the area will receive a public relations thrust from South Australian tourist publicity. This will increase public pressures on the park.
- The proposed developments in this plan are designed to sustain the present visitation level without damage to the park and its resources. These will cause an increase in visitor interest.

Full-time ranger roles include: resource evaluation, planning and management; education and park interpretation; public relations; developing new sites and areas; general maintenance of areas and equipment; control and enforcement; rescue and disaster control; and administrative duties.

An additional role of ranger staff in the Gammon Ranges National Park is management of Aboriginal cultural resources and the maintenance of a co-operative relationship with the Adnyamathanha people.

In Part 1 of this plan the following management implications were indicated in relation to the Adnyamathanha people:

- There is a need to record surviving Aboriginal knowledge, traditions and beliefs of the Gammon Ranges landscape.

- There is a need to encourage the local Aboriginal people to maintain a knowledge of their Aboriginal heritage particularly with and for the children and young people. The Nepabunna School is a key tool in this and the park presents a special link between Europeans and Aborigines.

- Sympathetic Aboriginal employment provided by the Service for the park's operations will reflect the Service's desire to have Aborigines help manage a resource of which the Aborigines are an integral part.

- The Aborigines knowing most about a particular place are the bands which lived there, or the nearest possible groups of the tribe.

- Aborigines feel happiest and work best on their own clan lands.

The Service will aim to provide adequate numbers of effective staff to implement this plan of management and to maintain the programme of development, interpretation, conservation, and protection.

Headquarters

The focal area for local administration was tried and tested by the earlier pastoral lessees. An isolated park with important visitor potential also requires a major, identifiable, administrative focus.

The Service will provide a local administrative headquarters at Balcanoona homestead for the Gammon Ranges National Park.

Staff Accommodation

The provision of effective staff accommodation of appropriate architectural quality and siting is accepted by the Service as an important contribution to maintaining happy staff relationships, and to the provision of a pleasing visual presentation to park visitors. Part 1 of this plan emphasises the importance of maintaining the sheep station infrastructure of buildings because of its quality of workmanship and its completeness.

The Service will normally provide accommodation for permanent staff of the park. Some opportunities will be made available for staff to reside off the park if they should prefer.

Training

The successful execution of any strategy of management depends upon effective staff who are well trained and well prepared for their role.

Trained staff are required to provide for the protection of the park resources; the protection of, and satisfaction of, the visiting public; the monitoring of trends in the condition of the park, and of the present needs of the public; and the training of local Aboriginal people (the Adnyamathanha) who are to assist in the park management programme. The Service will provide opportunities and encourage staff to maintain and develop their skills, experience, and professional quality and will also provide special programmes of training to encourage Aborigines to play a significant role in park management.

Aims for the latter programme are to provide the necessary basis in knowledge, practice, and skills for the planning and management of the park; to provide an opportunity for Aboriginal people to effectively express their land management

ethics in the maintenance, protection, and preservation of the park; and to ensure the park is used as an effective vehicle to interpret the indigenous culture for non-Aborigines.

To implement this management plan, ranger staff require a basic appreciation of the philosophy of nature conservation, and a knowledge of reserve systems, traditional Aboriginal resource use, history of Europeans in Australia, relationships with Australia and the world, social science, use of English (spoken and written), public relations, mechanics, communication, natural history/biology/ecology, wildlife management, landscape management, office management, visitor management, law enforcement, fire control and management, skills in park interpretation, first aid and rescue, site planning, field skills, driving skills, the law and regulations, and finally, the plan of management itself.

Training is an ongoing commitment because change is continually occurring in the science and art of management as well as with technology and public expectations of the park and the Service as a whole.

Workshops And Equipment

The proper servicing of staff with effective equipment is essential to the maintenance of management strategies. In a large park with such rugged terrain, efficient transport and communication is most important to the safety of staff and visitors. Excellent communications already exist.

Part of the development programme and the maintenance programme require rugged four-wheel-drive vehicles. There is significant plant in the park headquarters area, and this requires regular maintenance. In the medium-term future additional fire protection equipment may be required.

Part 3

Management Objectives

INTRODUCTION

The following objectives for the management of the Gammon Ranges National Park are statements which are designed to indicate the goals and limitations of uses and developments permitted in the park. These objectives are designed to fulfil the requirements of Section 38 of the National Parks and Wildlife Act, 1972-1981. The South Australian National Parks and Wildlife Service shall manage Gammon Ranges National Park in accordance with these objectives.

ZONING

Zone for the most appropriate use of the resources of Gammon Ranges National Park, to ensure the maintenance in perpetuity of these resources, recognising always that there will be an evolving drift in the nature of these resources with changing natural environmental conditions.

RELATIONS WITH THE LOCAL ABORIGINAL POPULATION

Park Management
Provide regular contact with the Adnyamathanha people with a view to providing a growing interest in, and involvement with, the park management programme.

Hunting
Seek to provide for the hunting of kangaroos by the Adnyamathanha people within the Gammon Ranges National Park.

ACCESS

Provide access to and within the park in accordance with the zoning plan, Regulations of the Act, and Field Management Policies.

COMMUNICATIONS

Provide an efficient and effective radio communications system for the park, tied into the South Australian National Parks and Wildlife Service State-wide network.

VISITOR SERVICES

Walking Routes And Self-Guiding Tracks
Establish walking routes and self-guiding track facilities as a visitor service.

Bushwalking Routes And Camps
Foster bushwalking by responsible parties as a desirable use of the park.

Rock-Climbing Activities
Allow rock climbing by responsible parties in designated areas.

Parking Areas
Provide parking areas where they will be used by visitors participating in park activities (see Access).

Interpretation Programmes
Prepare a park interpretation plan which will embrance the northern Flinders Ranges region as a whole (see Walking Routes and Self-guided Tracks; Education Programmes).

Education Programmes
Prepare resource and methods handbooks for teachers on the northern Flinders Ranges region, with special reference to the Gammon Ranges National Park, and encourage the use of such handbooks (see Walking Routes and Self-guided Tracks; Interpretation Programmes).

Picnic Areas
Provide picnic area facilities for the day-use areas of the park.

Camping Areas
Provide camping areas for overnight use of the park.

RESEARCH AND MONITORING

Encourage and initiate the monitoring of changes to the physical, biological, ecological, and cultural phenomena of the park.

Encourage and initiate research programmes which explain the condition of physical, biological, ecological, and cultural phenomena of the park, and promote research programmes which measure the perceptions, needs, and impacts of park users.

PROTECTION

Human Safety
Develop rules and regulations, education and interpretation programmes, and works programmes which will ensure a reasonable degree of public and staff safety while visiting, or working in, the Gammon Ranges National Park.

Pollution
Develop public relations, and education and management programmes which will minimise pollution of the park.

Mining
Ensure that all mining and exploration activity in the park is undertaken in a manner which minimises conflict with the general role and purpose of a national park.

Erosion
Manage park ecosystems, park developments, and patterns of use, in a manner that will minimise damage by soil erosion.

Fire
Investigate the fire history of the park and similar areas in the region and encourage research which will lead to the establishment of a fire protection plan for the park.

Boundary And Extensions
Extend the park where appropriate in order to add to park resources and values.

Fence park boundaries where this is required, in order to restrict the entry of stock in accordance with Service policy.

Feral Animals And Weeds
Eradicate or control noxious weeds and exotic plants and control vermin and exotic or feral animals.

Grazing By Domestic Stock
Prohibit grazing by domestic stock in the park unless the practice is designed to achieve a desired management objective.

Aboriginal Culture And Sites Of Significance
Recognise the deep and continuing relationship between the national park landscape, its biota, and the Adnyamathanha people, stimulate this relationship, and protect park values and sites of significance to the culture of the Aboriginal people.

Historic Sites And Relics
Survey and study the historic relics and related stories of the park, stabilise and protect the remaining historic fabric, and prepare interpretive and educational materials so that visitors may appreciate the history of the park.

Enforcement
Ensure that the public understand the policies and actions needed to protect and manage the Gammon Ranges National Park.

Ensure that the public understands the restrictions placed on the use of the park resources and the responsibility of the Service in enforcing these constraints.

Be able to interpret, and enforce, the laws associated with the management of national parks and reserves.

Garbage And Litter
Maintain the park in a clean and tidy condition.

WILDLIFE MANAGEMENT

Manage the park ecosystem to ensure that there is no further loss of native species, and ensure that threatened species recover.

Ensure the conservation of the Yellow-footed Rock-wallaby.

ADMINISTRATION

Staffing
Provide adequate staff to implement this management plan and maintain programmes of development, conservation, and protection.

Headquarters
Provide a local administrative headquarters for the park.

Staff Accommodation
Provide accommodation for park staff.

Training
Provide special training programmes which encourage Aborigines to play a significant role in park management.

Workshops And Equipment
Provide park staff with the equipment needed to allow efficient and safe employment.

Part 4

Management Actions

ZONING

Zone for the most appropriate use of the resources of Gammon Ranges National Park, to ensure the maintenance in perpetuity of these resources, recognising always that there will be an evolving drift in the nature of these resources with changing natural environmental conditions.

About 70 per cent of the park is included in the class A Environmental Area of the Flinders Ranges Planning Area Development Plan of 1973. This area comprises the area of Pound Quartzites together with approximately one kilometre of foothills, all of the highest country, and Mainwater Pound. The zoning proposal of this plan of management essentially adopts that principle and extends it, limiting developments in the life of this plan to the southern, eastern, and northern peripheries, with a linking four-wheel-drive road between Yadnina and Balcanoona outside of the Class A area. Proposed park zoning is illustrated in Figure 17.

Wilderness Zone

These lands represent the most important and often the most fragile natural values within the park. No human activity will be permitted within this zone that will degrade these values. Only those structures necessary for the management and preservation of wilderness qualities will be permitted. Management actions aimed at protecting park users from the environment and/or providing artificial means to facilitate any visitor activities should be excluded. The erection of signs, markers, and other management devices should also be excluded.

Primitive Zone

These lands often abut the Wilderness Zone. They too contain outstanding natural features. However, the lesser overall environmental quality of these lands and/or the need to make the park's significant features available to visitors brings about the need for this zone. The Primitive Zone lands also serve as transition or buffer areas which separate the Wilderness Zone from more accessible park zones. Facilities will be restricted to rudimentary foot trails, undeveloped campsites, and minimal research facilities. Public access by vehicle will be prohibited. Service vehicles may utilise designated Service tracks for management or emergency purposes (see Access).

Extensive Use Zone

This classification is necessary to provide visitors with high quality park environment that is of easier access. Within this zone, public access by four-wheel-drive vehicle on designated public tracks will be permitted. Trails and simple campsites will also be permitted. Facilities that will encourage high-density use such as visitor centres and formal camp grounds will be precluded. Physical development works will be avoided where possible in this zone. As with the Primitive Zone, these lands will often function as buffers for more protected zones.

Intensive Use Zone

This is the zone of higher-density visitor and management use. Such lands, which usually comprise a small percentage of a national park's total area, designate lands to be used for roads, visitor centres, visitor supply stores, formal camp grounds, overnight accommodation, and park administration offices. These are the lands that are most affected by visitor use. As with development in other zones, extreme care must be taken to lessen the impact of physical development on park

values. Caution must be exercised to prevent any development that will hint of urbanisation. Facilities for public use placed in this zone should be the minimum required to promote visitor enjoyment and safety, as well as resource protection.

Historic Zone
This classification is given to lands within the park boundary containing nationally and internationally significant archaeologic, historic, or contemporary cultural resources.

Physical development will be only that necessary for the preservation, restoration, and interpretation of cultural values. Public activities should be generally limited to sightseeing and education.

Special Wildlife Zone
These are very special sites which need specific protection and/or management because of their significance to rare, threatened, or unique species or communities. Two species at this time have areas listed. Acacia araneosa because of its rarity, and the Yellow-footed Rock-wallaby (Petrogale xanthopus), because of potential interference by visitors. Significant populations occur in other parts of the park, however, the areas shown are in critical locations for public viewing, education, and interpretation.

Prohibited Areas Zone
A number of sites of particular significance to the Adnyamathanha people occur within the park. These sites are presently inaccessible to the public and their existence and location is not generally known. These areas are not identified in this plan. However, if at some future time any site of importance is considered to be under threat then that site may be declared a Prohibited Area under the Aboriginal and Historic Relics Preservation Act, 1965. People may only enter a Prohibited Area if they hold an entry permit issued by the Minister.

RELATIONS WITH THE LOCAL ABORIGINAL POPULATION

Park Management
Provide regular contact with the Adnyamathanha people with a view to providing a growing interest in, and involvement with, the park management programme.

The following activities will maintain and develop a positive relationship between the Adnyamathanha people and the National Parks and Wildlife Service.

- The maintenance of regular formal contact with the Adnyamathanha people through their management committee.
- The provision of assistance to the Nepabunna School on a regular basis. Such assistance may include visits by officers of the Service to talk with school classes, the encouragement of individual and group projects in the park, arranging for interesting park visitors or specialists to visit the school, and the maintenance of liaison with the head teacher. The school children should know the park staff.
- Where possible the local Aboriginal people should be given first opportunity to contract for jobs associated with the programme of park works.
- The maintenance of an Aboriginal Ranger Training Programme for potential park staff positions.

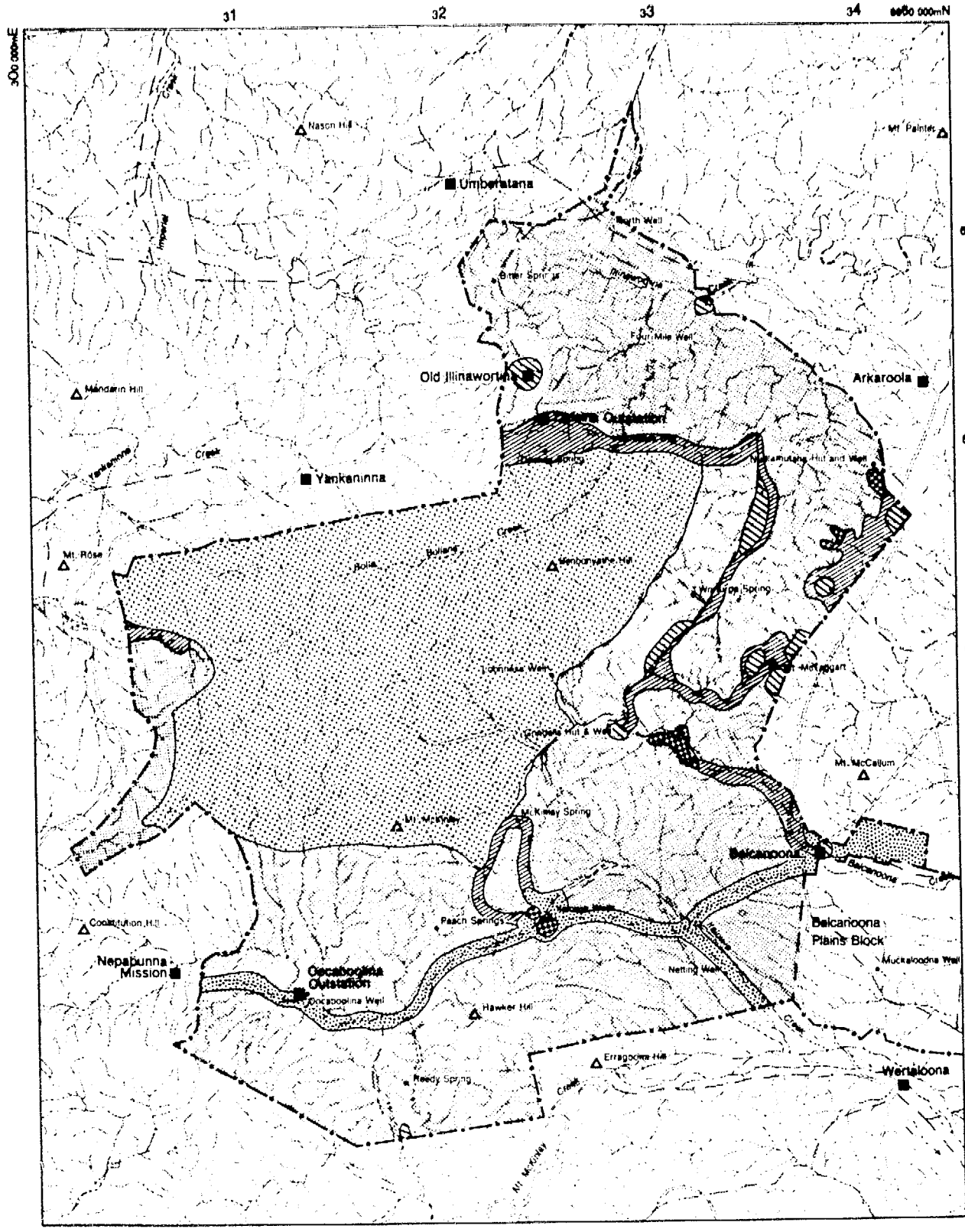


Figure 17

Zoning

- The provision of assistance to the Adnyamathanha people through special and applicable parts of the Aboriginal Ranger Training Programme to properly manage and interpret the Aboriginal painting sites which occur in the ridges to the south of the settlement.

- The inclusion of local people as specialist teachers in staff training programmes, where their knowledge and understanding of the Aboriginal culture is of value.

- The continuation of moves to seek out appropriate Aboriginal place names for incorporation into park maps, and other appropriate park interpretation and information services.

Hunting

Seek to provide for the hunting of kangaroos by the Adnyamathanha people within the Gammon Ranges National Park.

As it is an established Aboriginal landuse on the Balcanoona Plains Block, the Service will endeavour to provide opportunities for the hunting of kangaroos for non-commercial purposes by members of the Adnyamathanha community in the Gammon Ranges region.

How this may be achieved is yet to be resolved, as the matter is a complex one with rather far-reaching implications both in terms of setting landuse and management precedents within reserves, as well as in defining the role which the Adnyamathanha people, and indeed Aborigines in general, will play in reserve use and management.

A number of alternative approaches to this issue are under consideration. One option is to set aside a dedicated area of plains country as a zone for hunting use by the Nepabunna Aboriginal community. This zone would be specified and managed by the National Parks and Wildlife Service in consultation and cooperation with the Adnyamathanha community. If there is to be provision for Aboriginal hunting within the park, legislative amendment will be required.

ACCESS

Provide access to and within the park in accordance with the zoning plan, Regulations of the Act, and Field Management Policies.

Apart from the trunk road passing through the southern sections of the park, there are 14 points of entry into the park. This presents a very difficult management problem as the park headquarters are located at Balcanoona homestead in the eastern extremity of the park.

Six entry points give access to the Illinawortina Pound area in the centre of the park. Three of these, North Well, Bolla Bollana, and Nudlamutana, will be closed to the public and become Service tracks. The Mount McTaggart track will be upgraded to two-wheel-drive standard and single car width as far as the Aboriginal carving site. Beyond this point, this track will form the principal entrance to the Illinawortina Pound and provide public access through to Yadnina on the north-western boundary. It will remain at four-wheel-drive standard.

Two-wheel-drive access will be provided to the eastern end of Weetootla Gorge, and the road through the gorge closed to all traffic. Walking the Weetootla Gorge will be encouraged. Without vehicular disturbance this area should become much more effective for viewing wildlife, in particular, Yellow-footed Rock-wallabies, which find the gorge prime habitat.

The Loch Ness Well to Mainwater Spring track, which is located directly across the gullies running off the Blue Range, is subject to maintenance and safety problems. Consequently, this route will be closed at its junction with the Mount McTaggart-Yadnina road. In addition, in order to protect wilderness values and limit increasing environmental impact, the track to Loch Ness Well from Grindell's Hut will be closed. This track will be retained for Service use only. The four-wheel-drive track through Illinawortina Pound via Mount McTaggart will terminate at Grindell's Hut and will be the major access route for wilderness walkers.

Access will be maintained for the public to the Arcoona Creek picnic area, but will not be upgraded during the period of this plan. Service roads of four-wheel-drive standard will be maintained as indicated in Figure 18.

Rerouting parts of the through four-wheel-drive road to directly avoid the Mount McTaggart and Munyi rock art sites is a high priority job. Detailed on-ground survey will be needed for rerouting works.

In general, designated public four-wheel-drive tracks should be maintained in a condition which will allow the safe passage of vehicles. Track works should cause minimal disturbance to soil and vegetation and should not be undertaken with the objective of improving the ease and speed of access.

The use of Service tracks by the general public should be prevented. The existence and location of these tracks should not be publicised, and if public use becomes evident, track entrances should be camouflaged or physically barred as appropriate. Service tracks should be used only when essential for park management purposes, and track maintenance works carried out only where necessary to maintain them in a passable condition.

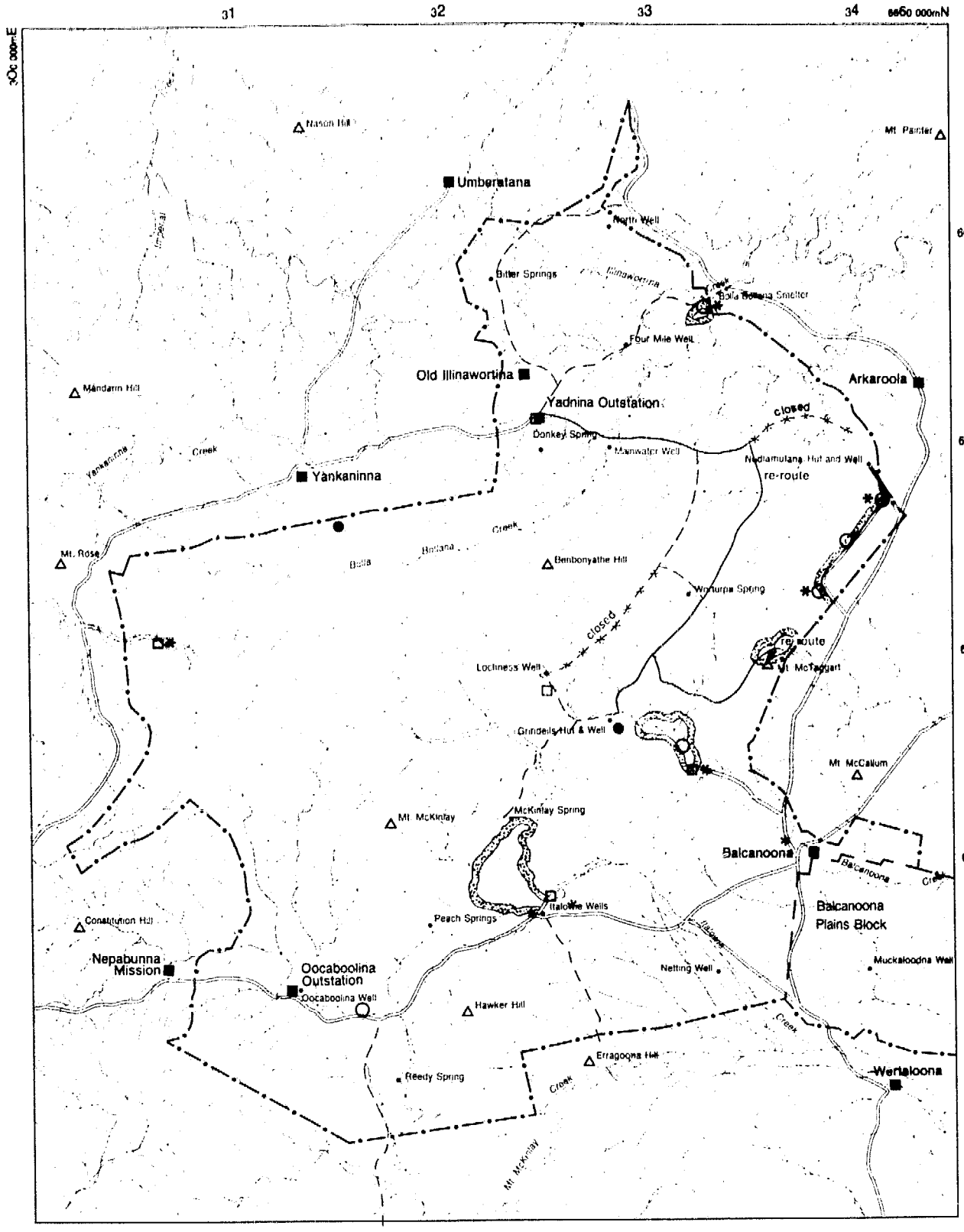
Preliminary investigation has been made of the Italowie Gap day-use area, the Weetootla Gorge area, and the north-eastern public day-use area (McLeashes Copper Prospect/O'Donoghue's Castle Mine loop). Together with the Mount McTaggart carvings and mine area, and the Bolla Bollana smelter site, these areas are highlighted in this plan for development for public use. The access needs of these areas is considered below.

Italowie Gap Principal Visitor Campsite

Italowie Gorge has been a traditional camping place for visitors since people first travelled through the ranges, principally because of the presence of a strong spring and shelter. The area most heavily used is in a very debilitated condition and is not able to cope with current visitor demands. The strategy suggested is to prepare a new site within the Italowie environs, close and rehabilitate the old site, and cater for a series of visitor activities in the area. Walking route development should be undertaken in the manner described for the north-eastern day-use area (see Figure 19).

Weetootla Gorge Access

With the closure of the road through the gorge and its use as a walking track only, the road to the Weetootla stockyards and trough will be upgraded to two-wheel-drive standard with a parking area near the bank of the creek. The road crosses a potentially boggy red plain and will require appropriate surfacing and other works. Steep embankments should be graded in such a way as to reduce the erosion hazard.



Park boundary

Public access roads

Public four-wheel-drive access

Service Tracks

Development areas to be covered by leaflets and maps for visitors

Camping areas

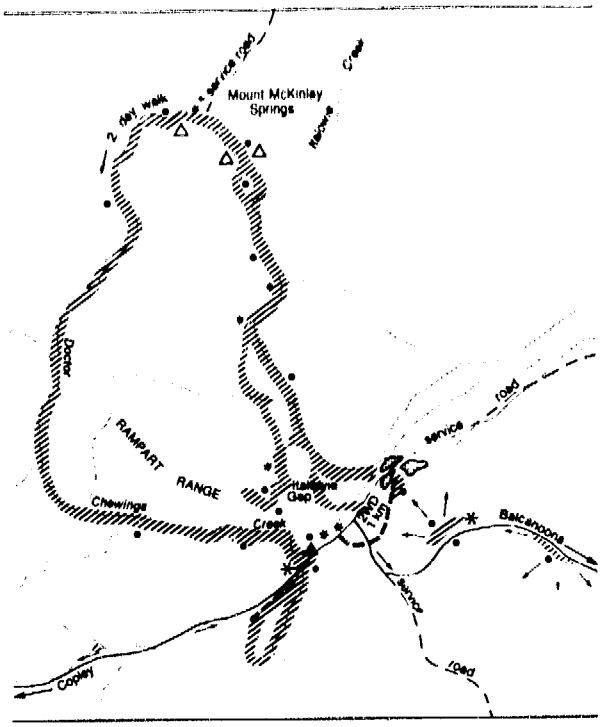
Picnic areas

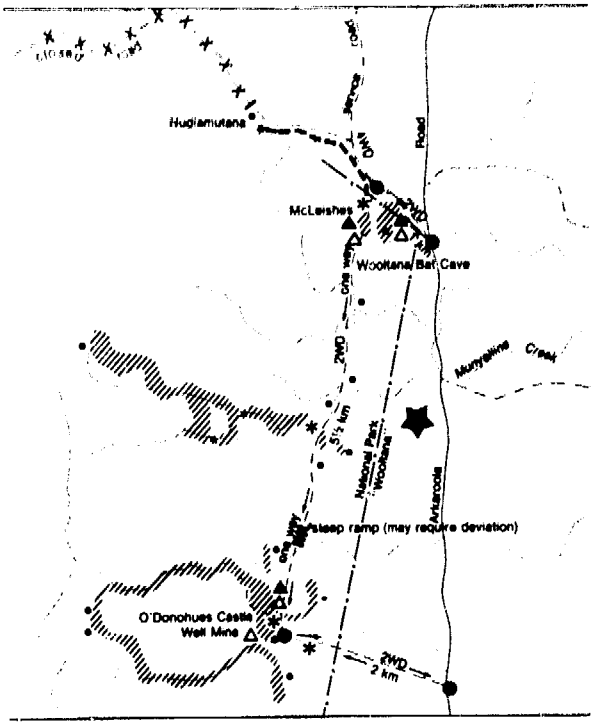
Camping and picnic areas

Parking areas

Figure 18

Access and Proposed Development





- Walking route and scenic areas
- Proposed new campsites
- Proposed graded roads
- Scenic areas
- Parking areas
- Geological interest
- Historical interest
- Fossil area
- Water

- Walking route and scenic areas
- Proposed graded roads
- Landing ground
- Scenic areas
- Parking areas
- Geological interest
- Historical interest
- Water

0 2 4 6 km

Figure 19

Day Use Areas

The walking track through the gorge does not need forming and will generally follow the closed road. Camping will be restricted to the Balcanoona Creek area in the vicinity of the water trough.

McLeashes Copper Prospect/O'Donoghue's Castle Mine Loop
This area of the park offers considerable potential for development as a day-use area for park visitors who wish to experience the character and history of the Gammon Ranges in a relatively accessible part of the park. Development of the area is neither feasible nor necessary in the short or medium-term future. However, access should be upgraded if and when visitor pressures on the park make this necessary. Until this time, the tracks in this area should remain open to public access by four-wheel-drive vehicles. The two major walking areas specified in Figure 19 are in superb walking country.

Balcanoona airfield will be available for the use of light aircraft for people wishing to gain access to the park, and will be maintained in accordance with the Federal Department of Transport conditions, but without responsibility for providing fuel or access from the airfield to park features. Points of access to the park are indicated in Figure 18.

COMMUNICATIONS

Provide an efficient and effective radio communications system for the park, tied into the South Australian National Parks and Wildlife Service State-wide network.

An effective communication system is currently installed and working in the park. Because of the isolation of the area, Service vehicles travelling from Balcanoona base should carry a Single Side Band (SSB) radio which links with the State-wide Service network. As staff are recruited for the park, the numbers of radios will have to be reviewed. All staff must be trained in the effective operation of radios and be given formal clearance to operate them. Lives frequently depend upon this equipment. Systematic maintenance schedules for the radios must be instituted because of the rigorous operational conditions.

VISITOR SERVICES

Walking Routes And Self-Guiding Tracks
Establish walking routes and self-guiding track facilities as a visitor service.

Self-guiding track facilities and designated walking routes are planned for six areas in the park. Three sites, O'Donoghue's Castle Mine, Weetootla Gorge, and the Rampart Range Lookout lend themselves to an open approach, while the other areas; the Bolla Bollana Smelter, Wooltana Cave, and the Mount McTaggart Aboriginal engraving site are suited to a more intensive approach.

The first two to be completed should be Bolla Bollana Smelter and Weetootla Gorge, followed by the Wooltana Cave area, Mount McTaggart Aboriginal engraving site, and finally Rampart Range Lookout and O'Donoghue's Castle Mine.

The first two sites require little on-ground disturbance. The Bolla Bollana route should be marked out with sight-line coloured pegs, and the Weetootla route should follow the old road. The Bolla Bollana brochure could illustrate reconstructions of the original buildings, describe the mining process, and

describe the causes for the failure of the mine. The Weetootla Gorge brochure could describe areas of habitat in the gorge with emphasis on environmental conditions, and the ecology of the Euro and Yellow-footed Rock-wallaby. Field sketches related to specific view points should direct the walk rather than pegs.

The Wooltana Cave lends itself to more intensive treatment. The area is very suitable for the interpretation of the geology of the limestones/dolomites, the cavern, the natural history of the Ghost Bat, and the question of its disappearance. The method of guano extraction and the sheer size of the cavern is fascinating. Probably the best route is to climb the eastern ridge first, cross to the cavern, then follow the mining operations downhill to the mining camp.

Rampart Range Lookout and O'Donoghue's Castle Mine site are suitable for more open development. Track cutting may be necessary to reach the Rampart Range Lookout, but the mine site is fairly open and should allow visitors to explore freely with an annotated map. The Rampart Range Lookout track should be oriented towards explaining natural history and landscape, while the mining area is excellent for its geological interest and demonstration of mining methods.

The more extensive two-day walking circuit from Italowie Gap, together with the walking routes proposed for the north-eastern day-use area (Figure 19), should be mapped and described in the explanatory leaflets covering each area. The walking routes themselves require minimal signposting and marking. The establishment of walking routes and self-guided tracks will require comprehensive survey and design planning.

The Mount McTaggart Aboriginal engraving site currently lies just outside the park boundary. However, the Service will seek to add this area to the park and develop the site for public interpretation. The engraving site itself covers a small area which will not require track construction. Sight-line pegs will be sufficient.

Bushwalking Routes And Camps

Foster bushwalking by responsible parties as a desirable use of the park.

Water is available at the points of access to bushwalking areas. Where windmills and wells are the source, these should be regularly maintained. Advice to bushwalkers will be given by the ranger when sought, particularly at the time of permit issue, and walking parties should notify the ranger of their return. The 1:50 000 topographic map series produced by the South Australian Department of Lands are ideal maps for bushwalkers. Camping in the park is permitted under permit by the ranger-in-charge. In issuing camping permits, the ranger must have regard to the expertise and knowledge of the walkers.

Rock-Climbing Activities

Allow rock climbing by responsible parties in designated areas.

Rock climbing will be allowed in designated areas under a permit system. The Service will wait for requests from rock-climbing organisations to climb in the Gammon Ranges National Park. Then, following liaison with these organisations, areas for climbing will be designated. An appropriate permit system will be designed to ensure the safety of other park users and proper consideration being given to wildlife.

Parking Areas

Provide parking areas where they will be used by visitors participating in park acitivities.

Figure 18 shows the locations of proposed parking areas. They should be of standard Service design with barriers to stop vehicles pushing under trees.

Appropriate site planning should be undertaken at Balcanoona Gorge, Italowie Gorge, Weetootla Gorge, Mount McTaggart Aboriginal engraving area, O'Donoghue's Castle Mine, Wooltana Cave, Bolla Bollana, Arcoona Creek, and East Italowie. Information boards should be erected at focal points at the Italowie, Balcanoona, Weetootla, Bolla Bollana, and Wooltana Cave sites. (see Interpretation).

Interpretation Programmes

Prepare a park interpretation plan which will embrace the northern Flinders Ranges region as a whole.

A park interpretation plan should be prepared providing themes which integrate the natural and cultural features of the northern Flinders Ranges and have the Gammon Ranges National Park as the hub of the story. Interpretation themes which are particularly relevant to this park include mountain-building processes, land-shaping processes, colonisation by plants and animals, and colonisation by humans.

Twelve sites of value for visitor interpretation have been identified in the park. These hubs of interpretation are indicated in Figure 20, and facilities which may be appropriate at each hub are suggested below.

Site 1. Ranger information and visitor display in woolshed.
Site 2. Information board, self-guided track, signposting, brochure and map.
Site 3. Information board, self-guided walks, annotated map.
Site 4. Self-guided track on marked route.
Site 5. Self-guided road and track, brochure and map, signposting.
Site 6. Self-guided track, information board.
Site 7. Self-guided track, information board.
Site 8. Sign introducing visitors to the park.
Site 9. Sign introducing visitors to the park.
Site 10. Sign introducing visitors to the park.
Site 11. Sign introducing visitors to the park.
Site 12. Information display introducing visitors to the park and its management.

All signposting, brochures, and maps should be produced in a common letter style and a format which presents a corporate image.

Education Programmes

Prepare resource and methods handbooks for teachers on the northern Flinders Ranges region, with special reference to the Gammon Ranges National Park and encourage the use of such handbooks.

The National Parks and Wildlife Service, through the department's Community Information Service, should consider preparing a resource handbook for teachers. This may be done in consultation with educational authorities using the background information provided in this management plan, together with other information already produced by visiting schools. The presence of such a handbook will encourage school use of the park. (see Education Programmes; Walking Tours and Self-guiding Tracks).

Picnic Areas

Provide picnic area facilities for the day-use areas of the park.

Eight picnic areas have been designated to cater for visitor demands in the foreseeable future.

The proposed picnic area at Bolla Bollana should not be provided until stabilisation of the ruins is completed, and some effective kind of interpretive instruction has been provided which will protect the site from vandalism through ignorance. A pit toilet and fireplaces should be located in this area, and barriers to stop vehicles from entering the historic site should be provided.

Two picnic areas near O'Donoghue's Castle Mine should eventually be developed when access to these areas is improved. One site could be located at the end of the access directly off the Arkaroola road. Locating the area east of the gorge section would allow walking access to the old mine workings and to the Balcanoona road. Water could be supplied from the existing tank to the picnic site. A pit toilet and fireplaces could also be located at this site. The second site, to the north, cannot be developed until the north to south four-wheel-drive road is improved. A pit toilet, water supply, and fireplaces could be provided.

McLeashes Copper Prospect below Nudlamutana Well may ultimately become an important picnic area with many visitor attractions serviced from it: for example, Wooltana Cave and old workings; McLeashes Copper Prospect mine; bushwalks, and vista points. Water could be piped down from Nudlamutana well and tank. Fireplaces and a pit toilet may be required when these areas are developed for visitor use.

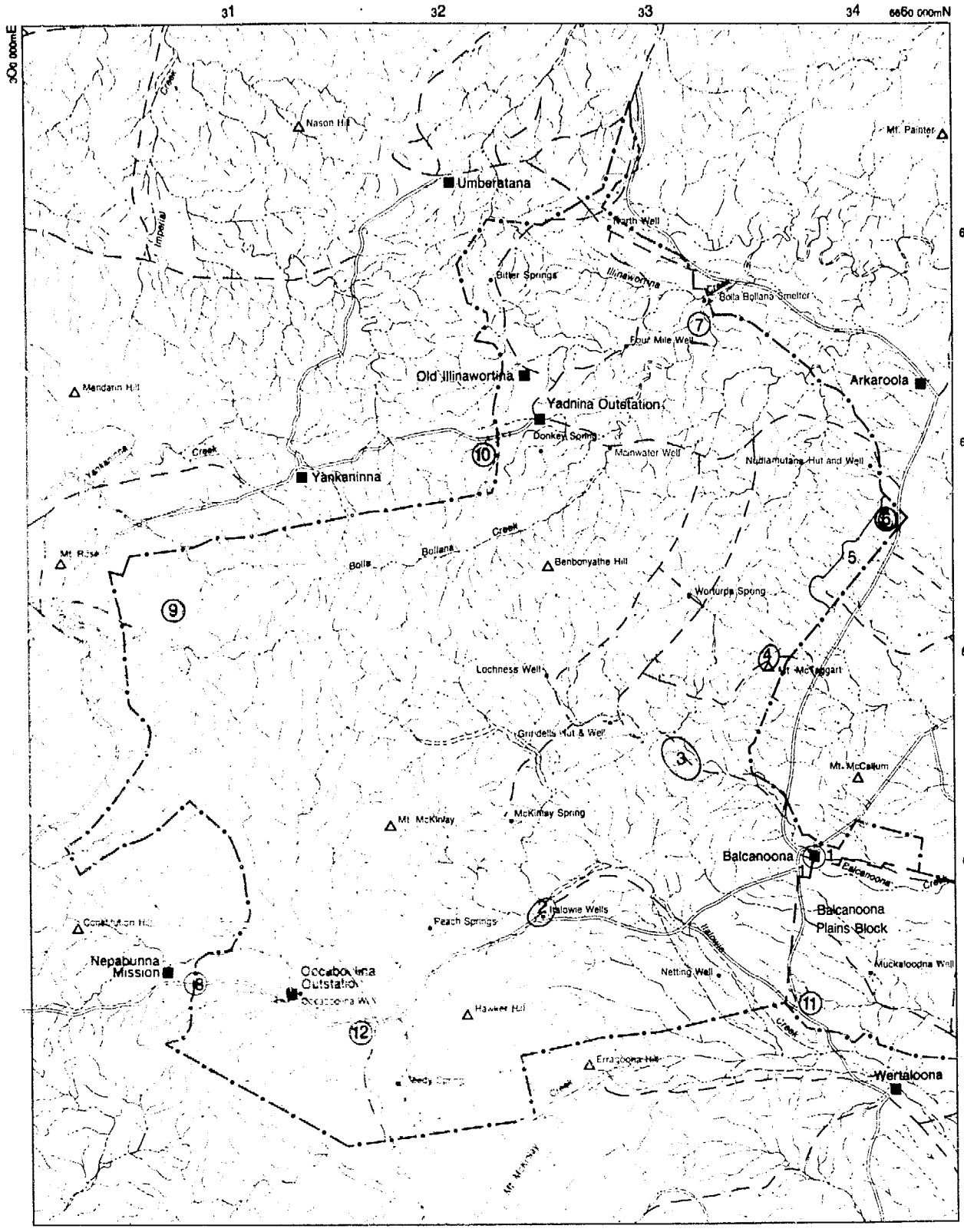
A further picnic area in Weetootla Gorge near Hell's Gate is planned. This site will be accessible only on foot by walkers from the Weetootla Well campsite. Fireplaces should be positioned so as not to disturb the Yellow-footed Rock-wallabies.

Snake Gully Bore is another base from which bushwalkers move into Mainwater Pound. It is not heavily used at present, nor is it likely to be in the near future, but consideration should be given to installing fireplaces in the future if required.

There are a number of pleasant picnic places by the creek among the River Red Gums where the main road from Copley crosses and recrosses McKinlay Creek. At least one site has interesting geological features which are associated with Aboriginal mythology relating to the carpet snake. Water could be provided from a roadside standpipe fed from the Oocaboolina outstation tank. Facilities may not be needed in the foreseeable future but the possibility should be borne in mind.

Grindell's Hut will be a focus for visitors because of its site and history, and fireplaces should be established in the area to cater for the casual four-wheel-drive visitor or walking party. Water is available. A firewood supply may be required.

Garbage cans should be placed at picnic areas which are located on main road routes, but in general, park visitors should be encouraged to remove their own rubbish. Garbage facilities should be proofed against scavenging animals.



Park boundary

Unsealed roads

Tracks

(8) Hubs of interpretation

Figure 20

Interpretation Areas

Camping Areas

Provide camping areas for overnight use of the park.

Italowie Gap

This has been the most commonly used camping area in the ranges since European settlement. This is largely because of the permanent water and shelter provided by the gap, the trees, and the dry country for ten kilometres or more on both sides of the gap. Over such a long period of unplanned use considerable damage to the site has occurred. Because of the natural attributes of the area, its proximity to prime walking country in the Gammon hinterlands, and the Leigh Creek to Balcanoona road, the area should be re-developed as the main camping area for the park (Figures 18 and 19). In planning the development of the area, consideration should be given to providing up to 40 campsites together with appropriate amenities, although this level of development will not be required in the short to medium-term future. The area will be able to accommodate some additional expansion.

Weetootla Gorge

Much damage due to camping has occurred within the gorge, and camping activity needs to be rationalised to a single location between Weetootla Well and the trough.

Up to 15 sites should be provided together with appropriate facilities. Consideration should also be given to establishing additional sites in the longer term, if required.

Arcoona Creek

This is located further from park maintenance resources and needs a simpler layout. Demand is less due to the lower natural beauty of the environment. Management generally will be simplified if more highly developed sites are provided close to the main staff centre, which should draw pressure away from these more isolated sites. Up to five sites should be provided together with basic facilities.

Yadnina/Mainwater Well Area

This is a very pleasant area for autumn, winter, and spring walking. Development of up to five camping sites with basic facilities should be considered if this area becomes popular. Options should be kept open for possible future development of the extensive historic resource at Yadnina.

Snake Gully Bore, Grindell's Hut, and Loch Ness Well

These areas will also be used for some camping, and fireplaces should be provided. An external toilet is required at Grindell's Hut for the growing number of walkers as well as visitors who arrive in four-wheel-drive vehicles. Provision of adequate facilities may also reduce vandalism of the hut itself (see Figure 18).

RESEARCH AND MONITORING

Encourage and initiate the monitoring of changes to the physical, biological, ecological, and cultural phenomena of the park.

Encourage and initiate research programmes which explain the condition of physical, biological, ecological, and cultural phenomena of the park, and promote research programmes which measure the perceptions, needs, and impacts of park users.

Research and monitoring of change is an essential part of management. Two important research programmes are already underway in the park and should be continued. The first is that of monitoring changes within exclusion plots in the Arcoona Creek area. This programme has been in operation seven to eight years already and the programme should be extended to include sites which represent each of the major communities in the park.

Experiments of the Vertebrate Pest Control field staff into goat exclusion filters for watering troughs forms the basis of the second research programme. Along with these experiments there should be close monitoring of goat distribution near natural waters. Closure of trough waters may add competitive pressure to Yellow-footed Rock-wallaby populations at natural watering points.

By far the most urgent study to initiate is a programme for monitoring vegetation regeneration in the park. Information gained could be of great value to the pastoral industry in determining appropriate stocking levels. Such studies could be supported by CSIRO, universities and other institutions. In the meantime, an inexpensive system of photopoints and transects should be established using Service resources. A list of problems and possible research/monitoring programmes is presented below.

1. Photopoints and transects to record erosion.

2. Photopoints and transects to record changes in the slopes of Munyi Aboriginal engraving site.

3. Regular records with map references to be kept by the senior park ranger of wildlife sightings.

4. Photopoints and transects to record changes in vegetation communities in the park, especially through the margins of the proposed visitor development areas.

5. A standardised approach to recording, storing, and retrieving data should be developed.

6. A regular monitoring programme to record the population status and distribution of the Yellow-footed Rock-wallaby.

7. A survey of the status and distribution of amphibians.

8. A study of the dynamics of the pond ecosystems of Weetootla Gorge as a baseline study in case degrading developments occur upstream, for example, BHP opening a magnesite mine, or visitor damage or pollution of upstream pond or spring areas.

9. A study of the impact of Gambusia fish on amphibian populations.

10. An assessment of the impact of prescribed burning and wildfire on understorey fauna (for example, reptiles or invertebrates) of the arid/semi-arid environment. These studies should pre-date the first wildfires which are likely to take place from six to ten years after removal of stock.

11. Efforts should be made to locate any endangered or threatened fauna, and to ascertain habitat requirements so as to establish specific management programmes: for example, for the Plains Wanderer, Grey Falcon, Australian Bustard, and Bush Stone-curlew (see also Appendices in Part 1 of this plan).

12. Investigation of the operation of the ecological processes which limit the range of many species which occur in the park.

13. Speleological and palaeontological investigation of the Wooltana Cave and similar sites.

14. Further study of Barn Owl caves to supplement work from Chambers Gorge.

15. A systematic search for the Dasyurid species in the park using varied trapping techniques.

16. Anthropological research into the importance of the park area to the Adnyamathanha people.

17. Further research into Aboriginal place names for the park and creation stories associated with or involving the park.

18. Archaeological research into the location of sites of significance to the Adnyamathanha people.

19. A search for Aboriginal objects of significance to the northern Flinders Ranges which are now in museums or in other collections.

20. A geomorphological study be made of the Munyi site slope instability and visitor control needed. Archaeological and anthropological research centred on Munyi should proceed concurrently with the geomorphological study.

21. A study of the history of land management of Balcanoona.

22. A study of the impact of the location of stock watering points on the populations and distributions of wildlife.

23. A study of the history and archaeology of the Bolla Bollana site before further damage and losses to either the environmental or historic fabric occurs.

24. An assessment of the safety of old mines and caves by a mining specialist leading to recommendations for their management.

25. Assess visitor perceptions and expectations of the park and investigate trends in use.

26. A survey with field tests of local native plant species which may be of value for the rehabilitation of damaged areas.

The National Parks and Wildlife Service should consider distributing a list of research required in the park to universities, colleges of advanced education, and other research organisations. Many organisations are looking for real and useful projects for student and staff research, and the Service should generally encourage work of this kind within the park system.

PROTECTION

Human Safety

Develop rules and regulations, education and interpretation programmes, and works programmes which will ensure a reasonable degree of public and staff safety while visiting, or working in, the Gammon Ranges National Park.

The northern Flinders Ranges is a remote and potentially dangerous region, and a plan of action should be in place to handle the range of emergency situations which can be expected to occur in the park area.

General visitor safety will be aided by the provision of:

- a general visitor information brochure;
- accurate large-scale maps showing features and water for the general park visitor (bushwalkers and specialists will use the existing 1:50 000 Department of Lands topographic map series);
- clear and effective signposting.

In order to ensure safety of old mine sites, mining specialists should be engaged to check the safety of the tunnels and shafts.

If found to be unsafe, barriers should be erected to prevent entry, or mine entrances should be collapsed by the use of explosives. Before any destructive action is taken, the historic value of the site must be first cleared. If a dangerous site is of particular historic significance, the area should be declared a Prohibited Area under the Aboriginal and Historic Relics Preservation Act, 1965, to protect both the site itself as well as the visiting public.

– this will not prevent visitors

Pollution

Develop public relations, and education and management programmes which will minimise pollution of the park.

The importance of the prevention of pollution in this park, and in the arid zone in general, should be stressed in park publicity, information, and interpretation material. In planning and developing camping areas and other visitor facilities, the Service should ensure safe and effective effluent disposal. With regard to magnesite mining activities, ~~strict controls on effluent disposal~~ should be in place. Specific provisions relating to mining activity in the park are set down in the following section.

Mining

Ensure that all mining and exploration activity in the park is undertaken in a manner which minimises conflict with the general role and purpose of a national park.

Under the proclamation which constitutes the Gammon Ranges National Park, certain mining and exploration rights may be acquired and exercised subject to the approval of the Minister for Environment and Planning and certain specified conditions and environmental controls. The following conditions, which complement those set down in the proclamation of the park, will apply in order to protect park values where approval has been granted for the undertaking of mining and exploration operations in the park.

- An assessment of the environmental impact of mining and exploration activities, together with proposed amelioration and rehabilitation measures, approved by the Director, shall be carried out before the commencement of operations.
- Disturbance of landforms, soil, vegetation, fauna and heritage items resulting from mining operations and associated activities shall be minimised.
- Monitoring programmes, approved by the Director, covering all aspects of each operations, shall be carried out during all phases of operation.
- Any buildings or structures required in connection with operations shall be designed and located so as to be in sympathy with the park environment.
- Waste products resulting from any mining or exploration operations shall be prevented from entering the natural water systems of the park.
- No plants or animals exotic to the Flinders Ranges region shall be introduced without the written permission of the Director.
- All disturbed sites shall be rehabilitated to standards approved by the Director.
- The disposal methods and placement of waste products, including tailings and waste rock, shall be approved by the Director.

In the light of information that becomes available, the Director may impose additional conditions in the interest of protecting the park. If, in the opinion of the Director, the conditions governing mining and exploration activity in the park are not complied with, operations may be suspended until compliance occurs.

Erosion

Manage park ecosystems, park developments, and patterns of use, in a manner that will minimise damage by soil erosion.

The following elements should be considered in developing and implementing erosion control programmes for the park.

- The establishment of exclusion plots, photopoints and transects to measure the effectiveness of the programme.
- The elimination or control of fauna which damage vegetative cover and cause accelerated erosion, for example, sheep, cattle, horses, donkeys, goats, and rabbits.
- The inclusion of design features in park developments which reduce the risk of accelerating the erosion process.
- The use of local native plant stock where artificial plantings are necessary.

Encouragement will be provided for the maintenance of the Aboriginal feral goat control programme, and continuing assistance to Vertebrate Pest Control research programme aimed at developing methods to effectively control goats and rabbits.

Fire

Investigate the fire history of the park and similar areas in the region, and encourage research which will lead to the establishment of a fire protection plan for the park.

Fire protection planning in this park will be complicated by changes in the structure and density of vegetation which will occur as a result of the exclusion of stock and the control of feral animals. The preparation of an effective fire protection plan for the park will therefore require flexibility as well as the long-term research and monitoring of pre-fire and post-fire conditions (see Research and Monitoring).

The fire protection plan should describe human and mechanical fire fighting resources, actions for protecting public safety, actions designed to protect Service facilities and the property of neighbours, and strategies for protecting species and habitats needing special protection. The plan should be critically evaluated following each fire, and reviewed every five years. In formulating the plan consideration should be given to the fire fighting resources and requirements of neighbouring properties and provision also made for conferences to be held with neighbours during times of fire danger to discuss fire fighting strategies. Close co-operation and communication should also be maintained with the Country Fire Services and park staff should be specifically trained in fire control and suppression techniques.

Management burning may be found to be necessary for specific purposes but this is not likely to be necessary in the short term. Because of its in-accessibility and for ecological reasons, a free burn policy will be necessary for the Wilderness Zone.

Boundary And Extensions

Extend the park where appropriate in order to add to park resources and values.

Fence park boundaries where this is required, in order to restrict the entry of stock in accordance with Service policy.

The Balcanoona plains block, which extends from the margin of the ranges to the shores of Lake Frome, has recently been proclaimed as an addition to the park. The area is biologically significant as it contains a full representation of ecosystems which are marginal to the ranges. This includes Mitchell Grass (Astrebla spp.) grasslands which are not presently represented in the South Australian National Parks and Wildlife Service reserve system, and which are also poorly represented in Australia as a whole. The inclusion of this area adds greatly to the conservation values of the Gammon Ranges National Park.

The Service will ascertain from the lessees of Arkaroola, R. and G. Sprigg, their attitude to the acquisition of Arkaroola. If the lessees are willing to release their control on this area in favour of it becoming part of the park, then action should be commenced to acquire the whole property, with the exception of the tourist development area, for addition to the park. This addition would add very greatly to the scientific, historic, cultural, and scenic values of the park.

The Service is aware of the presence of Aboriginal art sites, including the Mount McTaggart Aboriginal engraving site, at the southern end of Munyallina Valley. The area, which is located on Wooltana station, is also of considerable botanical value. The Service should seek to acquire this area as an addition to the park if the lessees of Wooltana are agreeable.

Boundary fencing provides an important conservation function in restricting the movement of stock into the park from neighbouring properties. Fencing will be erected where necessary in accordance with standard Service specifications and will be regularly checked and maintained.

Feral Animals And Weeds

Eradicate or control noxious weeds and exotic plants and control vermin and exotic or feral animals.

Once established, it is almost impossible to eradicate plant or animal pests from an ecosystem. Nevertheless, management should aim toward this goal unless there are very special reasons for not doing so.

Pest control strategies in the park should include:

- research into the biology and ecology of the pest species to identify characteristics susceptible to control mechanisms;
- the monitoring of the effectiveness of control measures;
- the manipulation of habitat if possible, to make re-establishment more difficult for the plant or animal pests;
- the rehabilitation of areas following control;
- the continued monitoring of pest species.

Clearly the most effective way to reduce the risk of pest establishment is to prevent pest entry into the park.

Plant Pests

The areas most likely to be affected by exotic plants are those lowland and lower slope areas usually associated with a deeper soil mantle, and which were favoured by domestic stock, more heavily damaged, and subsequently more liable to plant invasion. Two exotic plant species are widely spread across these lower lands, Salvation Jane (Echium plantagineum), and Wild Hops (Rumex vesicarius). Both are so widespread that control is not practical at present, although Salvation Jane may eventually be controlled biologically. After rain, outwash areas should be monitored regularly for outbreaks of weeds.

Exotic plants which occur around the Balcanoona homestead area and outstations are a special problem. It has been suggested elsewhere in this plan that the Balcanoona homestead area should be maintained as an example of a sheep station homestead complex. The trees, lawns, and orchard are an integral part of this cultural scene and therefore should not be disturbed or replaced.

The outstations however, pose a different problem. During drought periods, most exotic plantings suffer severe stress. Only the Oleander (Nerium oleander) appears to maintain vigour, and apparently achieves this by driving roots under foundations of buildings and tanks. These exotics should be removed and replaced with native trees and shrubs. Oleanders have also become established in Balcanoona Creek adjacent to, and immediately downstream from, the homestead. These plants give every indication of having the capacity to spread further downstream and therefore should also be removed.

Unless new infestations of weeds develop, Service staff will be able to control weeds as part of routine management.

Animal Pests

Animal pests can be divided into three groups. First, the major herbivorous pests including rabbits, feral goats and feral donkeys. Second, the major carnivorous pests, feral cats and foxes. Lastly, minor pests such as straying stock and dogs.

Liaison with the Vertebrate Pest Control researchers will continue and recommended control measures should be maintained. Control measures may include gassing and warren ripping, and the use of narrow spectrum, non-persistent poisoning strategies. Co-operation with the Vertebrate Pest Control researchers into goat-trapping techniques should also continue. The main thrust of the goat control programme will remain with the live trapping programme undertaken by the Nepabunna community. Encouragement and guidance should be given to extending the programme onto neighbouring lands in order to ensure a long-term low-level population in the park.

There is ample evidence in Australia and North America to show that donkeys cause very severe damage in semi-arid and arid environments. A strategy to reduce donkey numbers should be developed in close liaison with Vertebrate Pest Control researchers. There is also evidence that foxes may place significant predator pressure on the Yellow-footed Rock-wallaby. Night shooting using whistle and spotlight appears to be an effective control method. Straying stock will be dealt with in accordance with Service field management policy.

Dingoes are not considered to be an alien pest species as they comprised a part of the native environment prior to the arrival of European man. Because of this, no specific control actions are necessary for conservation management purposes. However, as the park lies within a proclaimed area, the Service is obliged under the Vertebrate Pest Control Act to destroy dingoes on the park. Routine control programmes will be conducted as required.

Grazing By Domestic Stock

Prohibit grazing by domestic stock in the park unless the practice is designed to achieve a desired management objective.

Aboriginal Culture And Sites Of Significance

Recognise the deep and continuing relationship between the national park landscape, its biota, and the Adnyamathanha people, stimulate this relationship, and protect park values and sites of significance to the culture of the Aboriginal people.

The Service has already begun programmes aimed at fulfilling the above objectives. They are ongoing and include:

- the development of a direct and positive ranger relationship with the Nepabunna community;
- involvement in education programmes with the school at Nepabunna;
- discussions with senior members of the Adnyamathanha people concerning management issues;
- the development of an Aboriginal Ranger Training Programme;
- encouragement of the highly successful feral goat harvesting programme.

Research work into Aboriginal relationship with the landscape is presently lacking. Work of this ki[illegible]hich could be undertaken includes:

- a systematic site survey and recording programme in association with the Heritage Unit;

- recording the mythology of the people, perhaps in association with the Aboriginal Ranger Training Programme;
- restricted stories should be recorded in association with the Heritage Unit;
- recording the history and prehistory of the Adnyamathanha people with the possible assistance of universities and schools.

Management actions concerning the Munyi Aboriginal engraving area, as described below, are presented as an example of the recommended approach to protecting sites of Aboriginal significance in the park.

A geomorphological study of the slope instability of the site, together with an analysis of possible problems associated with visitor use should be undertaken as a high priority by a competent arid zone geomorphologist. A management programme for stabilisation and interpretive use of the site also needs to be undertaken. This should be a co-operative project undertaken by a geomorphologist, archaeologist, and interpreter, and combined with specialist soil conservation advice. No more development work should be undertaken beyond a single, drained and stabilised track, and open access to the site should not be allowed. All works should be planned and executed with the agreement of the Adnyamathanha people from initiation of the project.

Historic Sites And Relics

Survey and study the historic relics and related stories of the park, stabilise and protect the remaining historic fabric, and prepare interpretive and educational materials so that visitors may appreciate the history of the park.

The deterioration of many historic sites in the park is rapid. However, apart from protective supervision and some temporary stabilisation of the Bolla Bollana round house, little restorative work has been undertaken. Fossicking and collecting by unknowing and unthinking visitors is also causing permanent loss to the park's historic resource. The homestead site, (the residence of the ranger-in-charge and the park headquarters), has been very fully stabilised and renovated. It is now time to turn to the historic resource of the park at large. The following restoration programme is related to the development of visitor services as discussed in this management plan.

1. A survey of the park historic resource.
2. An architectural and engineering survey of buildings and mines leading to a priority listing of stabilisation and conservation work.
3. The stabilisation and conservation of listed projects.
4. The establishment of a museum of relics needing protection in the Balcanoona woolshed.
5. The development of an educational/interpretive programme to support the day-use visitor services of roads, tracks, and viewing points.

Enforcement

Ensure that the public understands the policies and actions needed to protect and manage the Gammon Ranges National Park.

Ensure that the public understands the restrictions placed on the use of the park resources and the responsibility of the Service in enforcing these constraints.

Be able to interpret, and enforce, the laws associated with the management of national parks and reserves.

The provision of information and the fostering of a meaningful experience for park visitors are the two essential components in developing public understanding of the park and the reserve system as a whole. Much of what the public perceive and understand about the national park concept reaches it opportunistically through the various media and through issues-oriented information. In order to create a positive public attitude toward the park and its management it is important that:

- the park should reflect a high standard of maintenance and care by staff;
- the park staff should develop a positive, helpful and friendly relationship with the public aimed at gaining public co-operation;
- park literature and interpretive/educational programmes should emphasise conservative uses of the park resource;
- the park staff should encourage co-operative relationships with neighbours which will be mutually protective of both properties;
- positive signposting should be used to inform the public of specific restrictions on their activities;
- park staff should be prepared to take decisive enforcement action where necessary;
- consistent, prompt and effective backup for the actions of park staff should be given by the National Parks and Wildlife Service District and Central Headquarters offices.

Garbage And Litter

Maintain the park in a clean and tidy condition.

Animal-proof bins should be provided at overnight camp and caravan areas. Through personal contact with the ranger and/or with publications and singposting, park visitors should be requested to deposit litter in these animal-proof bins. It is impracticable to expect visitors to take litter home. Park staff will regularly collect garbage and bury it in a landfill trench cut along the contour in the area previously used by Balcanoona to dispose of rubbish. Sufficient soil cover should be used to discourage foraging animals.

WILDLIFE MANAGEMENT

Manage the park ecosystem to ensure that there is no further loss of native species, and ensure that threatened species recover.

Ensure the conservation of the Yellow-footed Rock-wallaby.

A wildlife management programme for the Gammon Ranges National Park should:

- ensure the protection and conservation of endemic, rare, or otherwise significant flora and fauna;
- ensure the co-ordination of public relations, interpretation, visitor services, feral animal, enforcement, and wildlife management programmes;

- conduct a continuous monitoring programme which focuses on change in habitat (see Research and Monitoring);

- monitor Red Kangaroo population dynamics on the Balcanoona plains block and areas adjacent to Yancaninna near Yadnina;

- minimise disturbance to Yellow-footed Rock-wallaby populations by removing road traffic from Weetootla Gorge and camping from the immediate vicinity of Italowie Gap (see Visitor Services);

- continue to provide assistance and encouragement to the Nepabunna community's goat catching programme (see Protection; Feral Animals; Weeds);

- encourage Aborigines to assist with general wildlife survey and observations in the park and to maintain a register of observations;

- develop a public relations and visitor interpretation programme concerning the rehabilitation and regeneration of the habitats and wildlife of the park;

- emphasise the processes at work with specific plants and animals and provide dramatic examples, for example, the exclusion plots.

In summary, the five major purposes of management should be to monitor vegetation regeneration in the park; to protect significant plant and animal species; to buffer the Yellow-footed Rock-wallaby from the impact of visitors and feral animals; to reduce the impact of feral herbivores and carnivores; and to expand the wildlife data base.

ADMINISTRATION

Staffing

Provide adequate staff to implement this management plan and maintain the programme of development, conservation, and protection.

Because of the status of the park, the complexity of its management problems, and the expected future levels of visitor interest and usage, it is currently administered as a National Parks and Wildlife Service District in its own right. To effectively administer the park on this basis, and in order to implement the provisions of this management plan, the following park staff will be required.

District Ranger (ranger-in-charge). The role of this officer will be to liaise with neighbouring pastoralists and other members of the community, co-ordinate the park operations programme, and administer the Aboriginal Ranger Training Programme which is based at Balcanoona. He will also be required to establish and maintain a positive relationship with the Nepabunna community.

A Ranger Grade II (second-in-charge) and three further ranger positions will be needed as development activity and visitor usage increases in the park. These staff should be resident within the park. Their main work involvement will be with the park management and development programmes, and communication with and guidance of, the public. It is proposed that additional ranger staff will ultimately be stationed at Oocaboolina and Yadnina, two strategic locations within the park. A full-time maintenance worker located either on the park or nearby is also required. This position should ideally be filled by a member of the Adnyamathanha community.

Headquarters
Provide a local administrative headquarters for the park.

The manager of the old Balcanoona pastoral lease had many years to consider the most effective location of the main station and outstation buildings. Location was selected to optimise water supply, transport, and resource control. The intensively managed area of the Gammon Ranges National Park is this same area of land and those location criteria are of no less relevance today.

The buildings at the homestead site are satisfactory as park headquarters and have already been accepted as such. The headquarters will ultimately provide the District Ranger's residence, District office, a workshop and stores, a simple visitor centre display area, and an Aboriginal Ranger Training Centre in park management.

Staff Accommodation
Provide accommodation for park staff.

There are four outstation buildings which may be suitable as structures for occupation following some renovation of the buildings, water, and power supplies:

- Yadnina - Some renovation is needed to walls and wet areas, and water pipes need renewing. However, this is a key controlling location for the northern and north-western park areas, for supervision of the four-wheel-drive access road, and the Bolla Bollana ruins.

- Oocaboolina - The building is in need of renovation, but it is strategically placed to control the south-eastern segment of the park, and the road access from Leigh Creek.

- Grindell's Hut - The modern building is in excellent condition as is the water supply.

- Nudlamutana Hut - The building is in need of timber replacement.

Training
Provide special special programmes which encourage Aborigines to play a significant role in park management.

A training programme utilising an Aboriginal Training Officer provided by the Australian National Parks and Wildlife Service and facilities at Balcanoona began in 1983. The programme requires Aboriginal trainees in park management to be resident, and to participate in a balance of theoretical and practical sessions for a period of twelve months. The programme involves the use of park staff, visiting specialists, and senior members of the Aboriginal community.

Workshops And Equipment
Provide park staff with the equipment needed to allow efficient and safe employment.

A series of workshops, stores, repair ramps, and sheds are located in the headquarters complex of the old Balcanoona homestead area. These will be adequate for park requirements for many years. However, much of the station equipment was sold by auction before acquisition by the Government, and there are now deficiences in the equipment of the workshop. These deficiences should be progressively redressed.

Part 5

Summary of Management Actions

As a guide to the orderly application of the provisions of this plan, the actions required to implement the most important of the management proposals outlined in the previous section are summarised and ranked. This ranking indicates the relative priority of projects and whether they are of a short-term or continuing nature. Those projects of a continuing nature will extend into the term of subsequent management plans for the park.

PROJECT	PRIORITY	DURATION	PAGE
RESEARCH AND MONITORING			
Undertake a study of the Munyi Aboriginal art site	High	Short	143,174
Research and survey the Bolla Bollana Smelter site	High	Short	144,175
Complete a priority listing of historic relics requiring conservation and stabilisation	High	Short	144,175
Undertake a study of the freshwater ecosystem of Weetootla Gorge	High	Short	174
Monitor the status and distribution of the Yellow-footed Rock-wallaby	Moderate	Continuing	145,174
Identify and monitor the status of rare and endangered species in the park	Moderate	Continuing	175
Establish and maintain a wildlife sightings records system	Moderate	Continuing	175
Initiate studies into fire/ ecosystem relationships	Moderate	Continuing	175
Establish and maintain exclusion plots of representative vegetation types	Moderate	Continuing	175
Establish photopoints and transects at strategic and representative locations to record vegetation changes and rates of erosion	Moderate	Continuing	174
Research and survey the park's historic resource	Moderate	Short	174,181
Initiate research programme into the relationships between the park area and the Adnyamathanha people	Moderate	Medium	175,180
Identify the location of sites of significance to the Adnyamathanha people	Moderate	Medium	175,180

PROJECT	PRIORITY	DURATION	PAGE
Monitor visitor perceptions, expectations, and patterns of use in the park	Moderate	Continuing	175
Undertake a safety survey of old mines and caves in the park	Moderate	Short	175
Undertake a survey of amphibians in the park	Low	Short	174
Undertake speleological and palaeontological studies on the Wooltana Cave	Low	Medium	175
Research the impact of stock watering points on the distribution of wildlife	Low	Medium	175
VISITOR SERVICES			
Develop proposed principal visitor campsite at Italowie Gap	High	Medium	162
Establish and develop parking facilities, self-guided track, and interpretive materials for the Bolla Bollana Smelter site	High	Short	162
Rationalise camping, carry out rehabilitation works and develop camping site in Weetootla Gorge and provide for vehicle parking and picnicking	High	Short	162
Establish self-guided walks and provide interpretive material for the Weetootla Gorge area	High	Short	167
Erect park information display at site near Oocaboolina outstation	High	Short	169
Erect signs introducing visitors to the park at designated locations	High	Short	169
Close and rehabilitate the existing campsite at Italowie Gorge	Moderate	Short	162
Establish walking routes and self-guided tracks, and provide visitor interpretation material in the Italowie development area	Moderate	Short	167
Provide picnic facilities at Bolla Bollana Smelter site	Moderate	Short	161,167

PROJECT	PRIORITY	DURATION	PAGE
Provide picnic facilities at the park information display site near Oocaboolina outstation	Moderate	Short	169
Establish self-guided tracks, walking routes, and provide interpretive materials for the O'Donoghue's Castle Mine area	Low	Medium	162,167
Establish self-guided walk and visitor interpretation material for the Wooltana Cave site	Low	Short	168
Establish self-guided walk and provide visitor interpretation material at the Mount McTaggart Aboriginal engraving site	Low	Short	162,167
Provide for camping and vehicle parking at Arcoona Creek	Low	Short	169
Provide for camping at Grindell's Hut	Low	Short	170
Establish a display of historic relics needing protection in the Balcanoona woolshed	Low	Short	181
ACCESS			
Institute proposed vehicle track closures	High	Short	161
Close proposed Service access tracks to the public	High	Short	162
Upgrade access to proposed Weetootla camping area	Moderate	Short	162
Maintain public four-wheel-drive and Service access tracks in a safe condition	Moderate	Continuing	162
Provide two-wheel-drive access and parking facilities at Mount McTaggart Aboriginal engraving site	Low	Short	162
Upgrade access and provide parking facilities in the proposed north-eastern day-use area	Low	Medium	161

PROJECT	PRIORITY	DURATION	PAGE
PARK PROTECTION			
Encourage the maintenance of feral goat control programmes	High	Continuing	180
Undertake pest animal and plant eradication programmes as necessary	High	Continuing	179
Prepare a fire protection plan	Moderate	Continuing	178
Prepare an emergency and disaster plan	Moderate	Short	176
Maintain and replace boundary fencing where necessary	Moderate	Continuing	178
Commence and maintain conservation and stabilisation work on listed historic relics	Moderate	Medium	174,181
Undertake management actions to ensure the conservation of the Munyi Aboriginal art site	Moderate	Short	143,174
ADMINISTRATION			
Develop and maintain a close relationship with the Adnyamathanha people	High	Continuing	180
Seek to actively involve the Adnyamathanha people in the management of the park	High	Continuing	180
Appoint required ranger and maintenance staff	Moderate	Medium	183
Maintain the Aboriginal Ranger Training Programme	Moderate	Continuing	184
Review the adequacy of workshop facilities and remedy deficiencies	Moderate	Medium	184
Investigate the feasibility of locating staff at appropriate outstation buildings	Low	Medium	184

PROJECT	PRIORITY	DURATION	PAGE
ADDITIONAL LAND			
Investigate the possibility of acquiring the Arkaroola lands, less the tourist development area	Moderate	Short	178
Investigate the possibility of acquiring the southern end of the Munyallina Valley	Moderate	Short	178