5. VERTEBRATE FAUNA

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5.1 Introduction

The history of the Abydos-Woodstock Reserve is outlined by Berry (Chapter 1). Its position as a focus for the important biological work of Burbidge (1943, 1959), Ealey (1967a, 1967b), Ealey and Main (1967) and Suijdendorp (1967) has also led to the area having had considerable attention from naturalists. The opportunistic collections of the fauna made over the past 50 years has resulted in the acquisition of a substantial body of knowledge on the mammals of the Reserve. Birds and reptiles have received little attention and there is no published information.

The objectives of our survey were to-:

Determine the richness and diversity of the vertebrate and selected invertebrate taxa in this zoogeographically important area of the Pilbara.

Evaluate the importance of the major and minor habitats on the Reserve to the vertebrate assemblage.

Describe the annual and seasonal activity patterns of the vertebrate communities and determine the patterns of reproduction and growth in a variety of species.

Examine the genetic diversity of selected species restricted to discrete minor habitats (rockpiles).

Identify any unique communities that are important to the conservation and management values of the Reserve.

5.2 Study area and Methods

Sampling Sites and Climate

This study aimed to record the vertebrate assemblage from as many major and minor landforms and vegetation types as possible in and adjacent to the Reserve. The regional landforms and vegetation of the Abydos-Woodstock Reserve are described by Tinley (Chapters 2, 4). These were taken into account when selecting sampling sites for intensive study. Brief descriptions of these sites appear in Appendix I.

Fires were frequently seen around the Reserve, and small areas on the eastern edge were deliberately burnt in January and February 1989. In January 1990 there were extensive fires, resulting from lightning strikes, over the Reserve that burnt out sampling sites WS2, WS3 and WS4 and parts of the adjacent areas.

The long term climatic averages for the region are presented by Tinley (Chapter 2). Over the three years of this study rainfall showed significant seasonal and annual variation (Table 5.1). There were major episodic rainfall events in March 1988 and

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February 1989 that resulted in the flooding of Coorong Creek and other ephemeral streams (Plate 19).

Table 5.1 Rainfall registered at Woodstock Station each month between January 1987 and October 1990.

Years	1987	1988	1989	1990
J	95.2	61.9	63.4	79.2
F	78.8	10.0	227.0	6.6
M	—	252.2	04	—
A	—	8.0	46.2	—
M	4.8	109.2	9.0	
J	—	0.8	117.9	3.4
J	8.5	—	2.3	
A	—	49.7		—
S	—	—	—	—
O	—	0.4		—
N	—	1.9	4.0	—
D	23.0	72.4	11.2	
TOTAL	210.3	566.5	484.4	

Sampling Surveys

In order to obtain an assessment of the seasonal and annual variation in the faunal assemblages of the Reserve, it was decided to undertake sampling surveys at several times of the year over a three year period. Nine surveys were undertaken to examine the fauna: between 21-31 March 1988, 2-9 May 1988, 22-30 September 1988, 9-17 February 1989, 16-24 April 1989, 16-24 September 1989, 26 February-7 March 1990, 25 July-2 August 1990 and 24 October-1 November 1990.

Regular trapping and traverse data were collected on all surveys except for May 1988 and April 1989. In May 1988 only the fenced pitfall traplines were operated so that an assessment could be made of the impact of the cyclonic rains of late March on the ground fauna. In April 1989 only Elliott traplines distant from the regular sampling sites and on rocky substrates were operated. Extensive searches were made of rockpiles and hills to observe or locate signs of rock-wallabies.

Sampling Methods

Eight lines of fenced pitfall traps were established in a variety of soil and vegetation types to document the terrestrial vertebrate and selected invertebrate taxa. These eight lines (Nos. WS1-6, 8, 10 on Figure 5.1) consisted of 50 m long flyscreen mesh, 30 cm high, that crossed six pitfall traps inserted 600 mm into the substrate. Pitfall traps were generally made of 175 mm diameter PVC pipe 600 mm deep, but at several sites where the soil was less than this depth, piping was replaced with 400 mm deep inverted conical pits.

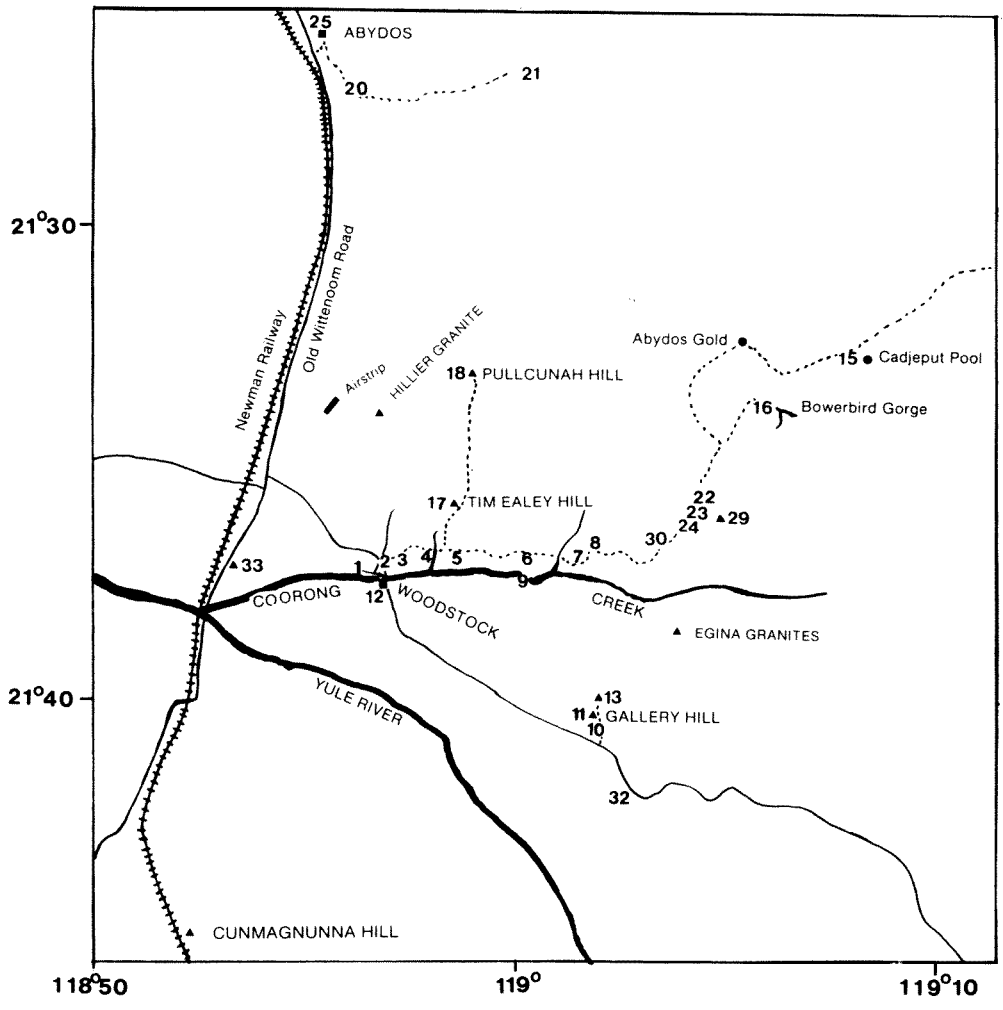

Figure 5.1 Abydos-Woodstock area showing vertebrate sampling sites. Numbers refer to sites described in Appendix 1.

At each of these sampling sites a line of 15 Elliott Type A traps (9cm x 9cm x 32 cm), baited with universal bait, were set 15 metres apart and within 50 metres of the fenced pitfall trapline. In areas where the substrate was either too rocky for fenced pitfall lines (screeslopes, rockpiles) or subject to seasonal inundation (creeks), Elliott traps were set regularly and opportunistic collecting of reptiles undertaken at the same time. During the extremely hot summer months, the Elliott traplines were closed after checking in the early morning and reopened near sunset when marked animals were released and pitfall traplines rechecked.

Mist nets were erected over small semi-permanent pools to catch bats. These were operated on most surveys and were kept operational for 2-3 hours after dark when activity became much reduced or had ceased.

On all surveys extensive searches were made of rockpiles, crevices, bark and litter, to record the vertebrates in these microhabitats. In July 1990 over 20 km of headwater creeks were traversed on foot while searching for signs and burrows of Bilbies. Each sampling site was surveyed for nocturnal species on each sampling survey using a 6 volt headtorch. Two, or generally three, observers surveyed each site for 25-30 minutes at least an hour after sunset on each survey.

All reptile and mammal individuals captured were measured, weighed and marked. Nearly half of all individuals caught were euthanased, using Nembutal, and had liver and occasionally blood removed and frozen in liquid nitrogen before the carcase was fixed in formalin and later preserved in alcohol. These individuals form the basis of the reproductive studies referred to in this paper, and are the subject of ongoing studies into the systematics and genetic variability amongst arid zone vertebrates. There was a very low recapture rate among the released individuals, however, some data were obtained on growth rates of certain species,and these are presented in this paper.

The avifauna was recorded during all travels around the Reserve throughout each survey. In order to make seasonal comparisons in the avifaunal assemblage, an early morning traverse of 23.4 km was undertaken daily between sites WS1 and 8 (Figure 5.1). This involved the recording of all species and numbers whilst travelling between these sampling sites and for the 20-30 minute period spent handling other vertebrates at each site.

The collections and records of the Western Australian Museum were examined for additional records of species collected on the Reserve, and a search was made of the notebooks of naturalists known to have visited the area: particularly, the notebooks of Andrew Chapman who was ranger on the Reserve between September 1980-February 1981 and August 1982-November 1982. This added additional records of the easily identified bird and larger reptile and mammal species.

Fires that burnt much of the Reserve in January 1990 also burnt the area covered by the fenced pitfall lines at sampling sites WS2, WS3 and WS4 and much of the area surrounding these lines. The fenced pitfall lines were opened on each survey following the fire, but the associated Elliott traplines were moved to the nearest unburnt areas;these areas were within 200 metres of their original position but on the opposite side of the track.

Genetic Variation

An electrophoretic evaluation of allozymes was undertaken for several species of small mammal and reptile on the Reserve. These data will be presented in detail elsewhere, but are used in the present report to examine the genetic diversity of species that use discrete minor habitats.

5.3 Amphibians and Reptiles

Introduction

The past five years has seen much collation and integration of most aspects of Australian herpetology in the important reference works of Pianka (1986), Bradshaw (1986), Heatwole and Taylor (1987) and Greer (1989).

There has been an increasing international interest in the herpetofauna of Australia's arid regions as a result of the pioneering work of Pianka (1986). His studies, which have extended over twenty years, have not only expanded our knowledge of arid zone reptiles, but have made a major contribution to the field of community ecology. The area in which Pianka conducted most of his Australian studies was in and adjacent to the Great Victoria Desert of Western Australia; a desert characterised by extensive sanddune and sandridge systems and adjacent to the vast mulga (*Acacia aneura*) country of the Goldfields.

Another recent contribution of major importance to the understanding of Australian herpetology has been the work of Greer (1989). This monograph has a comprehensive collation of the literature on most aspects of Australian lizard biology as well as the extensive unpublished work of Greer himself. This provides many new insights into reptile systematics and biology,and allows a comparison of the findings of our study with those of previous workers.

The focus of our study was on the herpetofauna of a little known and poorly documented region of the arid, northeastern Pilbara region of Western Australia. The composition of the herpetofaunal assemblage was documented and the responses of selected species to seasonal and annual variation was evaluated.

Survey Methods

All lizards collected were examined in the laboratory to determine their sex and reproductive condition. Testes were measured with dial vernier calipers for length and breadth, while in females the maximum length and breadth of yolky follicles in each ovary and eggs in each oviduct were recorded.

An evaluation of the seasonal condition of the more frequently trapped lizard species was undertaken by calculating a body mass index; $CI = 3\sqrt{WT}/SVL \times 100$. Juveniles were excluded from the analysis to avoid variation in growth and hatching times.

Results

Herpetofaunal Assemblage

The herpetofaunal assemblage of the Abydos-Woodstock Reserve consists of 5 species of amphibians in two families, 15 species of snakes in three families,a turtle and 52 species of lizards from five families. Most species known from the Reserve were recorded during the present survey (Table 5.2).

The only species previously known to occur on the Reserve, but not collected during this survey were the legless lizard *Delma nasuta*, and the skink *Ctenotus schomburgkii*. Both these species were collected by Ealey in the late 1950s, while Butler collected an additional specimen of *Delma nasuta* in 1963. During the final survey survey in October

Table 5.2: The herpetofauna of the Abydos-Woodstock Reserve indicating the number of individuals of each species captured at the main sampling sites. Location of other sites of capture are documented on the right. An asterisk indicates a species has been collected previously, and a plus indicates an observational record.

Sites	1	2	3	4	5	6	7	8	9	10	11	12	14	15	17	18	22	24	25	29	31	Other Sites
No. pitfall trapnights	288	276	330	348	330	318	-	318	-	276	-	-	-									
No. Elliott trapnights	595	605	675	725	675	635	620	635	315	485	180	-	58	174	256	317	294	180	-	132	-	575
Chelidae																						
**Chelodina steindachneri*	+								+													
Hylidae																						
**Cyclorana maini*	39	10	1	1	3	2		3	9	2		3										
**Litoria rubella*	11							3	15			8							1			10 @ 26
Leptodactylidae																						
**Limnodynastes spenceri*	82	3	1	2	3	4			8													
Uperoleia glandulosa	2																					
**U. russelli*	81	12	6					4	13	1		2		5								
Gekkonidae																						
Diplodactylus conspicillatus		4	3	9	3	7				1												
**D. elderi*			1	1		1		2		1												
D. jeanae		1																				
D. stenodactylus	1	6	2	6	1	3		3		2												
Gehyra pilbara	1	2							2			61							1			
**G. punctata*							2	3	12		16	4		6	6						8	1 @ 16
**G. variegata*	4			7			1	2	1			6		1					1			
Heteronotia binoei	6	1	1	1				4		1									1			
**Nephrurus levis pilbarensis*	1		6	2	3					6	2											
Oedura marmorata											1											
Rhynchoedura ornata		1	1	4				4		1					1							
Pygopodidae																						
**Delma nasuta*																						
**D. pax*	1					1		2					1									
D. tincta			1																			
**Lialis burtonis*	2	1	2	2				4	1													

Sites	1	2	3	4	5	6	7	8	9	10	11	12	14	15	17	18	22	24	25	29	31	Other Sites
Agamidae																						
**Ctenophorus caudicinctus*		1					2	5	5	2			2	2	1	1	2		1	1		1 @ 20, 1 @ 27
**C. inermis*		4	8	4	5			1	1	1	1	3							1			1 @ 20
**C. isolepis isolepis*		2	3	9	6	8			1	10	1		1		3							1 @ 23, @ 27
Diporiphora winneckei				1						1										1		
**Gemmatophora longirostris*	4	1			1			2	2			1							1			
Pogona minor		1		3	1					2		1			1							
Scincidae																						
Carlia munda	8												1									
Cryptoblepharus plagiocephalus													1	6								2 @ 16
Ctenotus duricola		1	2	4	10	5				6												
**C. grandis*	1	61	48	37	31	5	8	45	8	14								2	2			
C. helenae	1	9	6	4	2	13		5		7									1			2 @ 30
C. nigrilineatus							2															
**C. pantherinus*	1	1	2	11	7	8				19							1					
**C. saxatilis*	7	3				2	17	27	17	1				2	1	2	3			7	1	1 @ 33
**C. schomburgkii*																						
C. serventyi				3						2												
**Cyclodomorphus branchialis*	1																					
Egernia depressa											1											
**E. formosa*							1						2	1		2				4		1 @ 21
**E. striata*			3	7	6	6				5												
**Eremiascincus richardsonii*												1										
**Lerista bipes*	16	1	11	5	10	7			1													
**L. muelleri*	6	1						3							1							
Menetia greyii	1					2				2												
**Morethia ruficauda*			2	2																		
Notoscincus ornatus	1					1		1										1				
**Proablepharus reginae*						1		3														
**Tiliqua multifasciata*			5	5	2	4	1	1		4												

Sites	1	2	3	4	5	6	7	8	9	10	11	12	14	15	17	18	22	24	25	29	31	Other Sites
Varanidae																						
**Varanus acanthurus*	1	1	1	2		1	4	4		1							6	2				
**V. brevicauda*		2			4	2				9												
V. caudolineatus					1																	
V. eremius			1	1							1											
**V. giganteus*		+							+	+	1						+					
**V. gouldii*		+	1	2	1				+	+								1				
V. panoptes	+			1				1														
**V. pilbarensis*									1						1							
**V. tristis*												3										
Boidae																						
Aspidites melanocephalus										1	+	+										
**Morelia olivacea barroni*									1													
**M. perthensis*																					1	
**M. stimsoni*			1									3										
Typhlopidae																						
Ramphotyphlops diversus	1		3					1														
**R. grypus*					2																	
**R. hamatus*		2																				
Elapidae																						
**Acanthophis pyrrhus*										+	1											+ @ 16
**Demansia psammophis cupreiceps*												3										
**Furina ornata*																					1	
**Pseudechis australis*		+						1		1	2	1					1					
**Pseudonaja modesta*			1																			
**P. nuchalis*		1			1							2										
**Rhinoplocephalus punctatus Vermicella approximans*		1																				
Herpetofauna																						
No. of Species	25	27	27	27	21	20	9	24	17	27	10	15										
Lizards																						
No. of Species	19	21	21	25	17	18		19		23												
No. of Individuals	64	105	110	133	94	77		121		99												

1990 the second records of the elapid snakes *Acanthophis pyrrhus* and *Pseudonaja modesta* were obtained; single specimens of these had previously been collected in 1959 and 1958 respectively, although Chapman (pers. comm.) had seen *A. pyrrhus* in 1981 near the Woodstock homestead and Young (pers.comm.) recorded this species at Woodstock homestead. The only previous specimen of the blind snake *Ramphotyphlops grypus* from Woodstock was collected in 1953.

Examination of Table 5.2 indicates that 27 species of reptile and one frog were recorded on the Reserve for the first time during this survey. This includes the newly discovered, endemic skink, *Ctenotus nigrilineatus*, that was recently described from two specimens collected during this survey from one small area on the Reserve (Storr 1990).

Despite the occurrence of 73 species of herpetofauna on the Reserve, only 27 species were captured at any one sampling site (Table 5.2). There was very little variation in number of species caught at any major sample site, however, there was considerable variation in species composition.

Amphibians were only captured after rain and were most abundant near watercourses. *Litoria rubella* was always present in the cisterns of Woodstock homestead.

The majority of snakes from all three families were captured in numbers that were too low to indicate any habitat preferences for individual species. This also was the case for the larger varanids such as *Varanus giganteus*, *V. gouldii* and *V. panoptes* and several smaller species of lizards. Most species of snakes on the Reserve were nocturnal, although *Pseudonaja* spp. and *Demansia psammophis* were also seen during the day.

Several lizard species showed strong preferences for sites that were principally rocky; these were *Ctenophorous caudicinctus, Gehyra punctata, G.pilbara, Oedura marmorata, Cryptoblepharus plagiocephalus, Ctenotus saxatilis, Egernia formosa, E. depressa, Varanus acanthurus* and *V. pilbarensis*. Species that were generally captured on the extensive sandy loams included *Ctenophorus isolepis, Diplodactylus conspicillatus, D. stenodactylus, Nephrurus levis, Rhynchoedura ornata, Lialis burtonis, Ctenotus duricola, C. grandis, C. helenae, C. pantherinus, C. serventyi, Egernia striata, Lerista bipes, Morethia ruficauda, Varanus brevicauda* and *V. eremius*. The smaller litter frequenting lizards such as *Heteronotia binoei, Carlia munda, Lerista muelleri, Menetia greyii* and *Proablepharus reginae* were captured at sites where litter accumulated adjacent to watercourses or under larger shrubs. The arboreal species *Gemmatophora longirostris, Pogona minor, Gehyra variegata,* and *Varanus tristis* were caught at sites where shrubs or short trees predominated.

Two cases of predation were observed; a *Ctenotus grandis* and a *C. duricola* being eaten by a *Varanus gouldii* and an *Egernia striata*, respectively.

Sex Ratio, Reproduction and Growth

The sex ratio, size of reproductively active female lizards, mean clutch number and the period of female reproductive activity are presented in Table 5.3.

Reproductive activity was recorded in 34 species of lizard representing all five families. The small sample sizes for most taxa make definitive statements on size at sexual

Table 5.3: List of lizards species showing sex ratio of dissected specimens, female size range at sexual maturity, mean clutch size and percentage of reproductivity active females in each of the nine surveys.

Species	♂♀ ♂♀ SVL	Repro-duct-ive range (mm)	Mean clutch size (mm)	Mar 88	May 88	Sep 88	Feb 89	Apr 89	Sep 89	Feb 90	Jul 90	Oct 90
Diplodactylus conspicillatus	7:18	55-69	2(7)				3(100)			4(100)		
Diplodactylus elderi	4:2	40-46	2(2)				1(100)			3(100)		
Diplodactylus stenodactylus	7:16	46-52	2.3(4)	2(100)		1(0)	3(100)					
Diplodactylus jeanae	1:0	32.5							1(100)			
Gehyra pilbara	34:29	46.8-56	1(13)		1(0)	2(100)	5(40)		4(100)	6(0)	7(43)	5(80)
Gehyra punctata	26:28	54-61	1.3(4)	1(0)	4(0)	2(100)		2(0)	2(100)	5(20)		1(100)
Gehyra variegata	11:10	48.2-51	1(4)				3(67)	1(0)		1(100)	1(100)	1(0)
Heteronotia binoei	6:4	44.9-49	1.8(4)				4(100)			1(100)		
Nephrurus levis	7:12	71.5-91	1.8(4)	3(67)		1(100)				2(100)		
Oedura marmorata	1:0	57							1(100)			
Rhynchoedura ornata	4:8	42-54	2(1)			1(100)			1(100)			
Lialis burtonis	3:5	167-210	2(2)		1(0)		2(100)					
Ctenophorus caudicinctus	7:6	67	7(1)							1(100)		
Ctenophorus inermis	17:8	76.6-98	5(2)		1(0)	2(100)	2(0)		3(100)	1(100)	1(0)	2(0)
Ctenophorus isolepis	17:22	64.5-69	2(1)	2(100)	1(0)					4(100)		1(0)
Diporiphora winneckei	2:0	66	6(1)						1(100)			
Gemmatophora longirostris	8:3	84-95	3.7(3)	1(100)			1(100)			2(100)		1(0)
Pogona minor	4:3	117-134	8.3(3)						3(100)			
Carlia munda	4:5	40-42	2(3)		1(100)					2(100)		
Cryptoblepharus plagiocephalus	8:1	35.5-37.5	2(1)	2(50)		2(100)						2(0)
Ctenotus duricola	8:13	55.6-59		2(0)			2(100)			1(0)		1(0)
Ctenotus pantherinus	16:8	84.5-102	6(2)	2(50)	2(0)	1(0)			4(50)	1(100)		2(0)
Ctenotus serventyi	3:1	54-65				2(50)			1(100)			
Lerista bipes	19:26	49-61	2(4)	6(50)		1(100)	7(71)		1(0)	2(100)		
Lerista muelleri	3:5	37.5-40				1(100)				1(100)		
Menetia greyii	4:0	30-32	2(2)	1(100)			1(100)			2(100)		
Morethia ruficauda	1:3	42.5			1(100)							
Notoscincus ornatus	1:3	39.2			1(100)							
Proablepharus reginae	3:2	41	3(1)							1(100)		
Tiliqua multifasciata	6:7	210-250	4.5(2)			1(100)	1(0)					3(100)
Varanus acanthurus	8:10	175	4(1)									1(100)
Varanus brevicauda	4:6	82.2		1(0)			1(0)		1(100)			1(0)
Varanus gouldii	3:3	297	5(1)				1(100)					
Varanus pilbara	1:1	148	6(1)			1(100)						
No. of species with adult ♂♀			11	7	14	16	2	10	20	3		12
No. species showing activity			8	1	12	13	0	9	18	2		4
Percent activity			73	14	86	81	0	90	90	67		33

maturity, mean clutch size and volume and period of maximal reproductive activity equivocal. The female to male ratio of lizards not listed in Table 5.3 were -: *Delma pax* 0/4, *D. tincta* 0/1, *Ctenotus grandis* 37/66, *C. helenae* 11/23, *C. saxatilis* 22/35, *Cyclodomorphus branchialis* 0/1, *Egernia depressa* 0/1, *E. formosa* 3/6, *E. striata* 2/7, *Eremiascincus richardsonii* 0/1, *Varanus eremius* 1/1, *V. giganteus* 0/1, *V. panoptes* 0/1, *V. tristis* 0/3.

Reproductive activity correlated closely with general activity such that during the spring-summer period (September to March) when the greatest number of individuals and species were observed and trapped, the proportion of those reproductively active was highest. There were also some apparent differences between years. In March 1988 73% of the 11 species (for which there were information) were reproductively active, this rose to 81% of 16 species in February 1989 and 90% of 20 species in February 1990. Reproductive activity was high in September 1988 and 1989 (86% of 14 species and 90% of 10 species respectively), but was markedly lower in October 1990 when only 33% of the 12 species showed signs of activity.

During the survey period over 230 individual lizards of 16 species were marked and released at their point of capture. Recapture rates were very low in all species except *Ctenotus grandis*. The data on changes in SVL for the 36 recaptures of 126 individually marked *C. grandis* over the period of study are presented in Figure 5.2, and indicates that an adult body size is attained around two years of age and that adults live for at least three years.

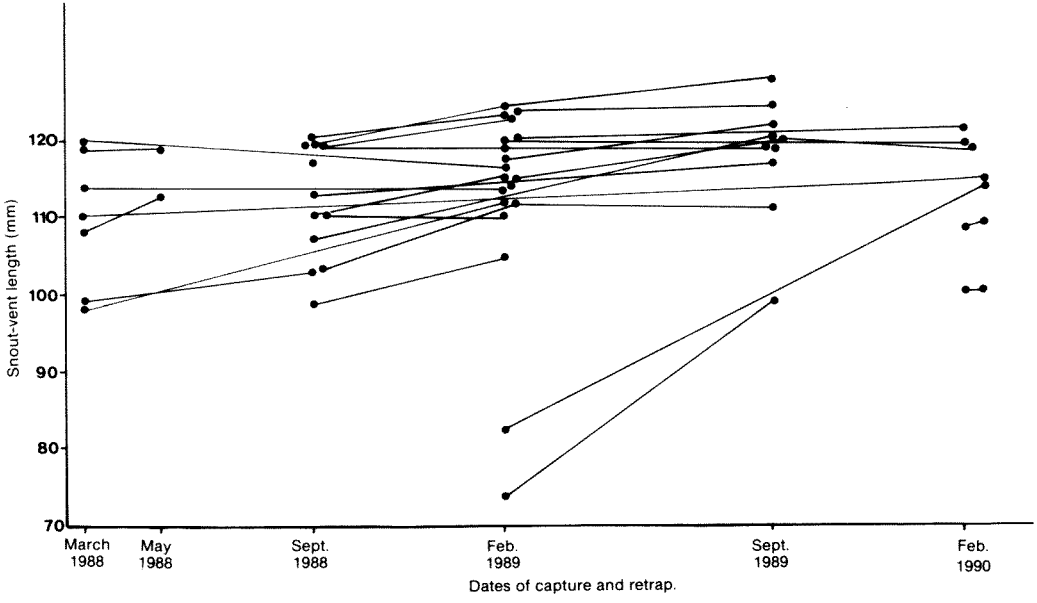

Figure 5.2 Snout-vent length of *Ctenotus grandis* caught and subsequently retrapped at Abydos-Woodstock.

There were two recaptures from each of *Nephrurus levis* (4 released), *Ctenotus helenae* (8 released) and *Egernia striata* (14 released), while three of the 24 *C. saxatilis* and one of the 12 *C. pantherinus* released were recaptured.

Body Mass Indices

The body mass index of four commonly captured lizard species is presented in Table 5.4. For both skinks, *Ctenotus grandis* and *C. saxatilis*, individuals captured in October 1990 were in much poorer condition than in any other survey. In both species there was a spring-summer gain in condition between September 1988 and February 1989, but no gain (a loss in *C. saxatilis*) the following year between September 1989 and February 1990. The saxicoline gecko, *Gehyra punctata*, had body mass indices which changed in a pattern very similar to the saxicoline skink, *C. saxatilis*, with the best condition attained in April 1989 and the worst in September 1990. The gecko *Gehyra pilbara* had a relatively constant body mass index throughout the study; all individuals were collected off the walls of Woodstock homestead.

Table 5.4: Body mass indices (X ± SE (n)) for four commonly captured lizard species on Abydos-Woodstock Reserve.

SURVEYS	SPECIES			
	Ctenotus grandis	*Ctenotus saxatilis*	*Gehyra pilbara*	*Gehyra punctata*
Mar. 88	2.857 ± 0.0187 (42)	2.822 ± 0.0306 (24)	2.965 ± 0.0520 (3)	2.840 ± 0.0388 (4)
May 88	2.842 ± 0.0817 (4)	2.891 (2)	3.024 ± 0.0286 (3)	2.817 ± 0.0287 (10)
Sep. 88	2.844 ± 0.0227 (41)	2.793 ± 0.0510 (7)	2.924 ± 0.0844 (5)	2.833 ± 0.0442 (9)
Feb. 89	2.944 ±0.0164 (61)	2.847 ± 0.0687 (12)	3.005 ± 0.0472 (9)	—
Apr. 89	—	2.889 (2)	3.041 (2)	3.022 ± 0.0196 (7)
Set. 89	2.911 ± 0.0199 (33)	2.825 (2)	3.110 ± 0.0436 (11)	2.988 ± 0.0530 (7)
Feb. 90	2.912 ± 0.0159 (42)	2.769 ± 0.0309 (25)	3.003 ± 0.0296 (9)	2.749 ± 0.0278 (14)
Jul. 90	—	—	2.883 ± 0.0458 (10)	—
Oct. 90	2.648 ± 0.0498 (9)	2.663 ± 0.0454 (9)	3.005 ± 0.0302 (11)	2.747 ± 0.0365 (7)

Effects of Fire on Lizards

The number of lizard species and individuals trapped in the pitfall traplines before and after the fires of January 1990 are presented in Table 5.5.

The combined data for sites WS2, WS3 and WS4, before and after the fire, shows that both the number of species and individuals declined markedly in the nine months post fire. In the sites that remained unburnt throughout (WS1, WS5, WS6, WS8, WS10), there was no appreciable decrease in species number, and the decrease in individuals was proportional to the decrease in trapping effort between the two periods.

The species least affected by fire in the short term were those that live in burrows or are primarily fossorial. In the burnt sample sites, 32 of the 37 individuals trapped after the fire, belonged to *Ctenophorous inermis*, *Diplodactylus conspicillatus*, *D. stenodactylus*, *Rhynchoedura ornata*, *Egernia striata* — all of which live in burrows — and *Lerista bipes* — which is fossorial. All of the above species are also nocturnal.

Table 5.5: Number of lizard species and individuals caught by pitfall traps at sites burnt in January 1990 (WS 2, 3, 4) and those that remained unburnt throughout the study (WS 1, 5, 6, 8, 10). Numbers captured before January 1990 are presented first, and those after this month second for both burnt and unburnt sites. The number of pitfall trapnights and the total number of species and individuals are also presented.

Species	Burnt sites 2/3/4	Unburnt sites 1/5/6/8/10
Diplodactylus conspicillatus	5/8	5/6
Diplodactylus elderi	1/1	2/2
Diplodactylus stenodactylus	5/5	6/0
Gehyra variegata	4/0	0/1
Heteronotia binoei	3/0	4/4
Nephrurus levis	6/0	5/3
Rhynchoedura ornata	2/1	3/0
Delma pax	—	1/3
Lialis burtonis	4/0	3/1
Ctenophorus caudicinctus	1/0	—
Ctenophorus inermis	1/11	3/0
Ctenophorus isolepis	4/0	13/5
Gemmatophora longirostris	—	2/1
Pogona minor	3/0	2/0
Carlia munda	—	2/4
Ctenotus duricola	6/0	11/10
Ctenotus grandis	18/0	25/5
Ctenotus helenae	3/0	8/5
Ctenotus pantherinus	12/0	18/12
Ctenotus saxatilis	—	5/3
Ctenotus serventyi	2/1	2/0
Egernia striata	4/5	8/8
Lerista bipes	8/2	23/3
Lerista muelleri	—	3/1
Menetia greyii	—	2/3
Morethia ruficauda	2/0	—
Notoscincus ornatus	—	0/1
Proablepharus reginae	—	1/2
Tiliqua multifasciata	2/2	—
Varanus acanthurus	1/0	0/3
Varanus brevicauda	2/0	7/6
Varanus caudolineatus	—	0/1
Varanus eremius	2/0	—
Varanus gouldii	1/0	—
Varanus panoptes	0/1	—
No. pitfall trapnights	594/360	906/624
No. of species	25/10	25/24
No. of individuals	102/37	164/93

Discussion

The herpetofaunal assemblage of the Abydos-Woodstock Reserve is one of the richest recorded in Australia. It is comparable in number of species to that recorded within the boundaries of Karijini (formerly Hamersley Range) National Park (73) that lies about 200 km to the south but which is four times as large (Johnstone 1983a). The richness in lizard species is exceptional and ranks above the 15-42 species described by Pianka (1986) for his study sites in and adjacent to the Great Victoria Desert, and represents the most diverse assemblage yet recorded in Australia. If consideration is given only to those lizard species known from the eight main sampling sites that lie on the sandy Abydos plain, there are still 43 species recorded.

The diversity of the herpetofauna in the Reserve can be partially explained by the juxtaposition of extensive areas of sandy-loam soils with *Triodia* (that are renowned for supporting rich assemblages), isolated rockpiles (that support a special group of saxicoline reptiles), and the anastamosing drainage lines with their fringing belts of woodland. Pianka (1986) has suggested that the richness of Australia's arid herpetofauna results from the influence of several environmental factors, such as the interdigitating of several habitats, presence of the ubiquitous and unique *Triodia* spp. grasses, a variable and unpredictable rainfall and the replacement of the role of mammalian predators by reptilian taxa. Morton and James (1988) have proposed a multi-causal scheme to explain the diversity and abundance of Australian desert lizards, which invokes climatic, edaphic and a complex of biotic factors that interact. This synthesis has been re-examined by Pianka (1989) using his extensive data base and experience in arid regions worldwide. He evaluated eleven causal factors that make a contribution to the richness of desert lizards, including the role of fire and the biogeographic history of regions, and concluded that many links in Morton and James' causal network were well established, but for some the evidence was weak. Certainly, the role of fire in creating a complex of seral community stages cannot be underestimated in enhancing lizard diversity.

The broad sympatry of 9 species of *Varanus* on the study area is the highest recorded outside the Kimberley (Cogger and Heatwole 1981).

Although the majority of reptiles are well within their known ranges on the Reserve, a few species are at the edge of their ranges, while the records of *Ctenotus serventyi* and *Varanus caudolineatus* represent major extensions of ranges. *Ctenotus nigrilineatus* is known from nowhere else. The only species of herpetofauna listed on Schedule 2 of the Western Australian Wildlife Conservation Act as fauna in need of special protection is the Olive Python, *Morelia olivacea barroni.*

The present examination of lizard reproductive status from the study area adds little to the comprehensive appraisal of this subject in Greer (1989). There were several species where the information was additional, however, the great majority of information on size at sexual maturity and clutch size was within the range presented for the species in Greer's (1989) summary tables.

The majority of species were reproductively active during the spring and summer, however, sample sizes of most species were too small to assess changes in reproductive

success between years. There were strong indications from our data that reproductive activity may be curtailed when environmental conditions have been unfavourable for many months. The number of species that were reproductively active in September 1990 the spring following an extremely dry summer was consistently lower than that recorded in either of the previous two spring seasons (Table 5.3). It is also possible that the lower incidence of reproductive activity seen in March 1988, when compared with later February-March surveys, was a result of the long drought that preceded that survey.

Three species, *Gemmatophora longirostris, Ctenophorus inermis*, and *Gehyra pilbara*, had individual females that had both oviductal eggs and yolky follicles simultaneously. Of the 7 species of *Ctenotus* captured during this survey, only 3 showed signs of reproductive activity, and just one of these, *C. pantherinus*, had gravid females. The three most frequently captured species, *C. grandis*, *C. helenae*, *C. saxatilus*, had no females that showed signs of activity, a fact repeated in collections of *C. robusta* from the Kimberley and *C. fallens* from the southwest of Western Australia (How and Dell unpubl.). This suggests that gravid females in some species of *Ctenotus* are behaviourally different from other females, a fact born out by our examination of the sex ratio of this species. The combined three spring surveys had 5 female *C. grandis* and 41 males, and three of the females were sub-adult in size.

The body mass index of the four most abundantly captured species of lizard from the Reserve showed different patterns (Table 5.4). Both species of *Ctenotus* and *Gehyra punctata* had increasing indices in surveys following the good rains of late March 1988, June 1988 and early February 1989. Peak indices were recorded in February 1989 and decreased to a minimum by September 1990 after a long period of below average rainfall (Table 5.1). *Gehyra pilbara*, which had constant access to the insect food resources around homestead lights, showed little change in indices over the three year period (Table 5.4).

The impact of fire on the lizard fauna of sampling sites was profound. A comparison between burnt and unburnt sites showed that fire reduced both the number of species and individuals on a site. Those species best able to survive the short term effects of fire were the burrowing or fossorial species. It is not known what the longer term response to fire might be as the study concluded 10 months after the fire and during one of the driest periods for 20 years when post fire regeneration of vegetation was minimal. These data are in close agreement with the findings of Caughley (1985), who recorded four burrowing species that forage over open ground as the most abundant species in most recently burnt areas of mallee in western New South Wales. Her data also indicate that there is a continuous replacement of species as the vegetation passes through successional stages after fire, such that the number of species remains relatively constant. Pianka (1989) has reviewed the available data on the impact of fire on desert reptile assemblages and concluded that it played a key role in contributing to the richness of these taxa.

5.4 Birds

Introduction

In a regional context the avifauna of the Pilbara is well summarised by Storr (1984). However, practically nothing is published on the assemblage in different parts of the region and there are no published data on changes between seasons or between years. There have been some site specific surveys for environmental assessment of mining projects but these reports are unpublished. Seasonal changes in the avifauna of arid areas of Australia have been presented by Wyndham (1978) for north-western New South Wales and south-western Queensland, by Brooker *et al.* (1979) for the north-western Nullarbor Plain and Saunders and Curry (1990) for the Murchison region of Western Australia. However none of these authors studied predominantly *Triodia* plains which dominate the vegetation at Abydos-Woodstock.

Birds were recorded opportunistically throughout the Abydos Woodstock Reserve during the sampling surveys listed (see Introduction, 5.2). Census counts made were the basis for the data presented here.

Results

The Assemblage

One hundred and four species of bird are known from the Abydos-Woodstock Reserve and adjacent parts of the Soansville Plateau. These are listed on Table 5.6. Ninety-two species were recorded during the 1988-90 Museum survey. The twelve species previously recorded by A. Chapman or W.H. Butler (pers. comm.) but not sighted during this survey are marked with an asterisk on Table 5.6. The 104 species comprised 61 non-passerine and 43 passerine species and can be compared to the 133 species (74 non-passerine and 59 passerine) known from Karijini National Park, *c.* 110 km south of Abydos-Woodstock Reserve (Johnstone 1983b).

Table 5.6 includes 19 species of non-passerines which are associated with ephemeral streams and pools. These species were infrequently recorded at Abydos-Woodstock and only occur when water is present. Some, such as *Charadrius veredus, Tringa nebularia* and *T. glareola*, are trans-equatorial migrants which only visit Abydos-Woodstock during their migration.

Table 5.6 shows that only half of the total number of bird species were recorded on each of the nine survey periods and the number varied little over the temporal sequence. Although the species composition varied somewhat between seasons and years, the majority of passerines and seed-eating and carnivorous non-passerines remained fairly constant. Species requiring water or those that are associated with the margins of water showed the greatest seasonal and or year difference.

Table 5.7 shows the total number of individuals and the number of sightings for the six daily transects for each of the nine sampling periods. The transect length was 23.4 km (see Introduction, this chapter). Sixty-one species were recorded on the transect compared to 92 species for the area generally. Because of the heterogenity of the area all data collected on the transect are treated together.

Table 5.6: List of birds recorded at Abydos-Woodstock Reserve showing number of days that each species was recorded for first 8 days of each survey. Asterisk represents birds sighted on subsequent days only. Species listed with an asterisk only are those recorded previously by A. Chapman (pers. comm.) or W.H. Butler (pers. comm.)

	Mar 88	May 88	Sep 88	Feb 89	Apr 89	Sep 89	Feb 90	Jul 90	Oct 90
CASUARIIDAE									
Dromaius novaehollandiae Emu	1		1	3	2	*		1	1
PODICIPEDIDAE									
Tachybaptus novaehollandiae Black-throated Grebe	3								
PELECANIDAE									
Pelecanus conspicillatus Australian Pelican						1		1	
PHALACROCORACIDAE									
Phalacrocorax sulcirostris Little Black Cormorant						1			
* *Phalacrocorax melanoleucos* Little Pied Cormorant									
Anhinga melanogaster Darter									1
ARDEIDAE									
Ardea pacifica Pacific Heron			1			2		2	
Ardea novaehollandiae White-faced Heron	2		1	6	1	1		1	
* *Egretta alba* Great Egret									
Nycticorax caledonicus Rufous Night Heron			1						
THRESKORNITHIDAE									
Threskiornis spinicollis Straw-necked Ibis								*	
ANATIDAE									
Anas superciliosa Black Duck		1	2	1		1			2
Anas gibberifrons Grey Teal									1
ACCIPITRIDAE									
Elanus caeruleus Black-shouldered Kite				1	1	1			
* *Milvus migrans* Black Kite									
Accipiter fasciatus Brown Goshawk				1					

Table 5.6 (continued)

	Mar 88	May 88	Sep 88	Feb 89	Sep 89	Feb 89	Jul 90	Oct 90	90
Accipiter cirrocephalus Collared Sparrowhawk				1			1	1	
Aquila morphnoides Little Eagle	1	2	2	1		2	2	4	3
Aquila audax Wedge-tailed Eagle	1	4	3		3	1	2		1
Circus assimilis Spotted Harrier	2	1	*	3	5	1	2		
FALCONIDAE									
Falco longipennis Australian Hobby	4	2		1	1		1	1	1
Falco peregrinus Peregrine Falcon					1				
Falco berigora Brown Falcon	2	3	3	7	5	4	2	4	4
Falco cenchroides Australian Kestrel	4	7		4	7	1	8	8	5
PHASIANIDAE									
Coturnix novaezelandiae Stubble Quail					1				
TURNICIDAE									
Turnix velox Little Button-quail		2	2	8	5	6	3	4	6
RALLIDAE									
* *Fulica atra* Coot									
OTIDIDAE									
Otis australis Australian Bustard			3	5	4	2	2	1	2
CHARADRIIDAE									
Charadrius melanops Black-fronted Plover	5	4	5	6		2		1	1
* *Charadrius veredus* Oriental Plover									
SCOLOPACIDAE									
Tringa nebularia Greenshank	1			1					
* *Tringa hypoleucos* Common Sandpiper									
* *Tringa glareola* Wood Sandpiper									
RECURVIROSTRIDAE									
* *Himantopus himantopus* Black-winged Stilt									

Table 5.6 (continued)

	Mar 88	May 88	Sep 88	Feb 89	Apr 89	Sep 89	Feb 90	Jul 90	Oct 90
BURHINIDAE									
Burhinus grallarius Bush Stone-curlew			1			1	1		1
GLAREOLIDAE									
Stiltia isabella Australian Pratincole	1		1	1					
LARIDAE									
* *Sterna hybrida* Whiskered Tern									
COLUMBIDAE									
Geopelia cuneata Diamond Dove	4	6	8	8	8	8	8	4	4
Geopelia striata Peaceful Dove								1	8
Phaps chalcoptera Common Bronzewing			2				1		3
Geophaps plumifera Spinifex Pigeon	6	3	4	8	5	7	8	6	8
Ocyphaps lophotes Crested Pigeon	2	2	5	7	3	6	8	6	8
PSITTACIDAE									
Platycercus zonarius Ring-necked Parrot					1	*			4
Melopsittacus undulatus Budgerigar	6	3	2	5	3		5		
Nymphicus hollandicus Cockatiel	3	4	2	7	5				
Cacatua roseicapilla Galah	3	1	5	4	3	7	3	2	6
Cacatua sanguinea Little Corella	2			8	4	4	8	8	4
CUCULIDAE									
Cuculus pallidus Pallid Cuckoo		6	5	1					
Chrysococcyx osculans Black-eared Cuckoo		3	1	3		1	2		
* *Centropus phasianinus* Pheasant Coucal									
STRIGIDAE									
Ninox connivens Barking Owl								1	
Ninox novaeseelandiae Boobook Owl		1			1	2			

Table 5.6 (continued)

	Mar 88	May 88	Sep 88	Feb 89	Apr 89	Sep 89	Feb 90	Jul 90	Oct 90
Tyto alba Barn Owl						1			
PODARGIDAE									
Podargus strigoides Tawny Frogmouth		1				1			
AEGOTHELIDAE									
Aegotheles cristatus Australian Owlet-nightjar	1	2	1		1	2	1		1
CAPRIMULGIDAE									
Eurostopodus argus Spotted Nightjar	3	3	1	7	5	2	1		5
APODIDAE									
Apus pacificus Fork-tailed Swift					1				
ALCEDINIDAE									
Dacelo leachii Blue-winged Kookaburra	3		2	2		1	1	2	
Halcyon pyrrhopygia Red-backed Kingfisher		2	*	4	5	2	5	1	
Halcyon sancta Sacred Kingfisher				4					**2**
MEROPIDAE									
Merops ornatus Rainbow Bee-eater	3	3	3			5	2	2	**2**
HIRUNDINIDAE									
Hirundo ariel Fairy Martin	2		7	5	*	3	3	1	**3**
Hirundo nigricans Tree Martin									**2**
MOTACILLIDAE									
Anthus novaeseelandiae Richard's Pipit	*	5	7	6	4	4	3	3	**4**
CAMPEPHAGIDAE									
Coracina novaehollandiae Black-faced Cuckoo-shrike	3	5	7	5	5	5	7	2	**4**
* *Coracina maxima* Ground Cuckoo-shrike									
Lalage sueurii White-winged Triller		3	6	1	2				
PACHYCEPHALIDAE									
Petroica goodenovii Red-capped Robin								3	
Colluricincla harmonica Grey Shrike-thrush	1	2	2		4				

Table 5.6 (continued)

	Mar 88	May 88	Sep 88	Feb 89	Apr 89	Sep 89	Feb 90	Jul 90	Oct 90
Oreoica gutturalis Crested Bellbird	5	6	5	6	4	7	7	3	2
MONARCHIDAE									
Rhipidura leucophrys Willie Wagtail	3	4	7	4	8	2	7	8	7
ACANTHIZIDAE									
Gerygone fusca Western Flyeater	1								
Smicrornis brevirostris Weebill							3		
MALURIDAE									
Amytornis striatus Striated Grasswren	1	1	5	3	3	2	7	1	3
Malurus lamberti Variegated Fairy-wren	1	2	1		1	1	3	4	
Malurus leucopterus White-winged Fairy-wren	2	4	5	7	4	6	7	4	6
Stipiturus ruficeps Rufous-crowned Emu-wren				2		1	3		1
SYLVIIDAE									
* *Acrocephalus stentoreus* Clamorous Reed Warbler									
Eremiornis carteri Spinifex-bird			1	1	4	1	1	1	1
Cincloramphus cruralis Brown Songlark	3	6		7	2	2	5	3	
DICAEIDAE									
Dicaeum hirundinaceum Mistletoebird	4	3		1	1		1		
PARDALOTIDAE									
Pardalotus rubricatus Red-browed Pardalote						3		*	3
MELIPHAGIDAE									
Lichmera indistincta Brown Honeyeater		4	6	6	2	8	3	5	2
* *Certhionyx niger* Black Honeyeater									
Certhionyx variegatus Pied Honeyeater	1							5	
Meliphaga virescens Singing Honeyeater	1	7	6	7	3	8	8	8	8
Meliphaga keartlandi Grey-headed Honeyeater			6	3	5	5	5	5	5

Table 5.6 (continued)

	Mar 88	May 88	Sep 88	Feb 89	Apr 89	Sep 89	Feb 90	Jul 90	Oct 90
Meliphaga penicillata White-plumed Honeyeater	3	6	7	6	4	4	8	6	8
Phylidonyris albifrons White-fronted Honeyeater				5	1				
Manorina flavigula Yellow-throated Miner	4	4	8	5	6	5	5	8	7
Acanthagenys rufogularis Spiny-cheeked Honeyeater			1	5	2	1			
Epthianura tricolor Crimson Chat	3	2	1	2	7		6	3	1
PLOCEIDAE									
Emblema pictum Painted Finch	8	6	8	8	8	8	8	1	
Neochmia ruficauda Star Finch									1
Poephila guttata Zebra Finch	7	6	8	8	8	8	8	8	8
GRALLINIDAE									
Grallina cyanoleuca Magpie-lark	4	7	6	6	4	8	6	6	5
ARTAMIDAE									
Artamus personatus Masked Woodswallow	*				1			*	
Artamus cinereus Black-faced Woodswallow	3	5	7	8	8	8	8	8	7
Artamus minor Little Woodswallow	1	1	4		3	1	2	4	2
CRACTICIDAE									
Cracticus nigrogularis Pied Butcherbird	6	6	6	4	6	7	8	7	8
Cracticus tibicen Australian Magpie	1	3	1	1	3	3	2	6	6
PARADISAEIDAE									
Ptilonorhynchus maculatus Spotted Bowerbird					3			1	
CORVIDAE									
Corvus orru Australian Crow	5	7	6	5	7	6	7	7	7
Corvus bennetti Little Crow			1						1
TOTAL SPECIES	49	48	54	56	57	57	48	52	52

Table 5.7: Birds recorded at Abydos-Woodstock Reserve on the regular daily transect. Numbers of sightings and numbers of individuals presented for the first 6 daily transects of each survey.

	Mar 88	May 88	Sep 88	Feb 89	Sep 89	Feb 90	Jul 90	Oct 90
CASUARIIDAE								
Dromaius novaehollandiae Emu	—	—	2/3	—	—	—	—	—
ANATIDAE								
Anas superciliosa Black Duck	—	1/2	—	—	—	—	—	—
ACCIPITRIDAE								
Aquila morphnoides Little Eagle	2/3	2/2	—	—	1/2	—	3/3	—
Aquila audax Wedge-tailed Eagle	—	2/2	2/3	—	1/2	—	—	—
Circus assimilis Spotted Harrier	1/1	—	—	—	1/1	—	—	—
FALCONIDAE								
Falco longipennis Australian Hobby	—	—	—	—	1/1	—	—	—
Falco berigora Brown Falcon	1/1	1/1	3/3	6/11	—	—	1/1	—
Falco cenchroides Australian Kestrel	—	9/9	—	2/2	—	1/1	7/7	1/1
TURNICIDAE								
Turnix velox Little Button-quail	—	1/1	2/2	4/9	3/5	4/4	2/2	2/2
OTIDIDAE								
Otis australis Australian Bustard	—	—	—	4/5	—	1/1	—	—
CHARADRIIDAE								
Charadrius melanops Black-fronted Plover	—	2/2	1/1	2/3	—	—	—	—
COLUMBIDAE								
Geopelia cuneata Diamond Dove	1/12	8/11	26/28	75/136	28/45	15/29	2/9	3/20
Geopelia striata Peaceful Dove	—	—	—	—	—	—	—	6/29
Phaps chalcoptera Common Bronzewing	—	—	—	—	—	1/1	—	—
Geophaps plumifera Spinifex Pigeon	—	2/7	1/3	8/19	13/18	14/28	4/20	12/69
Ocyphaps lophotes Crested Pigeon	2/2	—	1/2	6/9	2/2	3/11	—	15/89

Table 5.7 (continued)

	Mar 88	May 88	Sep 88	Feb 89	Sep 89	Feb 90	Jul 90	Oct 90
PSITTACIDAE								
Platycercus zonarius Ring-necked Parrot			—	—				4/10
Melopsittacus undulatus Budgerigar	10/125	1/12	2/13	5/58		7/52	—	
Nymphicus hollandicus Cockatiel	3/25	2/14	2/13	9/58			—	
Cacatua roseicapilla Galah	2/5	—	—	—	2/3	3/18	—	5/22
Cacatua sanguinea Little Corella	—	—	—	6/150	5/33	11/430	4/600	2/8
CUCULIDAE								
Cuculus pallidus Pallid Cuckoo		5/7	1/1	1/1		—	—	
Chrysococcyx osculans Black-eared Cuckoo		3/3	2/2	5/5		3/3		
CAPRIMULGIDAE								
Eurostopodus argus Spotted Nightjar	2/2	—	—	3/4	—	—	—	1/1
ALCEDINIDAE								
Dacelo leachii Blue-winged Kookaburra	2/3	—	1/1	2/2	—	1/1	—	—
Halcyon pyrrhopygia Red-backed Kingfisher	—	1/1	—	4/4	—	4/4	—	—
Halcyon sancta Sacred Kingfisher	—	—	—	4/4	—	—	—	—
MEROPIDAE								
Merops ornatus Rainbow Bee-eater	—	1/2	1/2	—	3/4	1/1	—	1/1
HIRUNDINIDAE								
Hirundo ariel Fairy Martin	1/2	—	10/21	4/8	1/2	1/2	—	2/2
MOTACILLIDAE								
Anthus novaeseelandiae Richard's Pipit	—	4/5	3/3	4/4	2/3	4/4	—	—
CAMPEPHAGIDAE								
Coracina novaehollandiae Black-faced Cuckoo-shrike	—	5/5	6/9	5/7	4/5	6/11	—	4/5
Lalage sueurii White-winged Triller	—	1/2	5/8	1/1	—	—	—	—
PACHYCEPHALIDAE								
Oreoica gutturalis Crested Bellbird	6/7	9/9	5/5	2/2	11/11	8/8	—	3/3

Table 5.7 (continued)

	Mar 88	May 88	Sep 88	Feb 89	Sep 89	Feb 90	Jul 90	Oct 90
MONARCHIDAE								
Rhipidura leucophrys Willie Wagtail	—	4/6	7/7	4/4	—	6/6	1/1	4/4
ACANTHIZIDAE								
Gerygone fusca Western Flyeater	1/1	—	—	—	—	—	—	—
Smicrornis brevirostris Weebill	—	—	—	3/6	—	—	—	—
MALURIDAE								
Amytornis striatus Striated Grasswren	1/2	1/1	3/3	1/1	1/1	5/7	—	2/2
Malurus lamberti Variegated Fairy-wren	1/2	—	1/4	—	—	—	—	—
Malurus leucopterus White-winged Fairy-wren	1/1	4/6	4/7	5/9	7/8	11/11	—	5/11
Stipiturus ruficeps Rufous-crowned Emu-wren	—	—	—	2/4	—	—	—	1/1
SYLVIIDAE								
Eremiornis carteri Spinifex-bird	—	1/1	—	—	1/1	—	—	1/1
Cincloramphus cruralis Brown Songlark	2/2	7/11	—	5/6	—	4/6	1/1	—
DICAEIDAE								
Dicaeum hirundinaceum Mistletoebird	3/3	2/2	—	—	—	—	—	—
PARDALOTIDAE								
Pardalotus rubricatus Red-browed Pardalote	—	—	—	—	3/5	—	—	4/7
MELIPHAGIDAE								
Lichmera indistincta Brown Honeyeater	—	1/1	5/12	3/4	6/25	3/3	1/1	—
Certhionyx variegatus Pied Honeyeater	1/17	—	—	—	—	—	4/6	—
Meliphaga virescens Singing Honeyeater	1/1	8/8	7/7	11/12	18/25	12/12	2/2	9/10
Meliphaga keartlandi Grey-headed Honeyeater	—	—	6/12	3/4	3/4	2/5	5/9	—
Meliphaga penicillata White-plumed Honeyeater	1/2	4/11	7/9	6/9	5/11	14/37	3/5	8/13
Phylidonyris albifrons White-fronted Honeyeater	—	—	—	10/12	—	—	—	—
Manorina flavigula Yellow-throated Miner	—	2/6	7/17	4/6	2/12	4/24	9/20	6/13

Table 5.7 (continued)

	Mar 88	May 88	Sep 88	Feb 89	Sep 89	Feb 90	Jul 90	Oct 90
Acanthagenys rufogularis Spiny-cheeked Honeyeater	—	—	1/1	6/7	1/1	—	—	—
Epthianura tricolor Crimson Chat	2/13	—	—	1/1	—	—	—	—
PLOCEIDAE								
Emblema pictum Painted Finch	8/37	12/22	51/184	63/176	37/100	20/48	—	—
Poephila guttata Zebra Finch	6/35	11/38	26/130	57/237	56/594	67/189	8/92	29/658
GRALLINIDAE								
Grallina cyanoleuca Magpie-lark	1/1	8/8	4/6	5/6	3/5	7/10	4/8	4/7
ARTAMIDAE								
Artamus cinereus Black-faced Woodswallow	1/1	5/13	6/9	11/21	12/15	17/28	12/65	6/10
Artamus minor Little Woodswallow	—	—	—	—	2/4	—	1/2	—
CRACTICIDAE								
Cracticus nigrogularis Pied Butcherbird	2/2	3/4	9/10	2/5	5/8	4/4	5/8	7/8
Cracticus tibicen Australian Magpie	—	2/3	1/1	—	1/1	1/2	3/4	7/7
CORVIDAE								
Corvus orru Australian Crow	2/5	3/4	6/6	5/5	5/5	17/15	—	8/10

The 61 species are represented by a total of 6141 individuals. Of these, 4922 individuals or 80.14%, comprised the 13 species (21.31% of total species) of granivores. Included as granivores are *Turnix velox, Geopelia cuneata, G. striata, Phaps chalcoptera, Geophaps plumifera, Ocyphaps lophotes, Platycercus zonarius, Melopsittacus undulatus, Nymphicus hollandicus, Cacatua roseicapilla, C. sanguinea, Emblema pictum* and *Poephila guttata.* Figure 5.3 shows that the number of granivore individuals increased dramatically following the good rains of 1988 and remained high for the succeeding two years. In contrast, the non-granivores remained relatively constant during the survey.

The 48 species of non-granivores comprised only 1219 individuals (Table 5.7). The most abundant were the small insectivores *Hirundo ariel, Anthus novaeseelandiae, Oreoica gutturalis, Malurus leucopterus,* and *Artamus cinereus.* Also well represented were the nectarivore/insectivores *Lichmera indistincta, Meliphaga virescens, Meliphaga penicillata* and *Manorina flavigula* which totalled 318 individuals or 26% of the non-granivores.

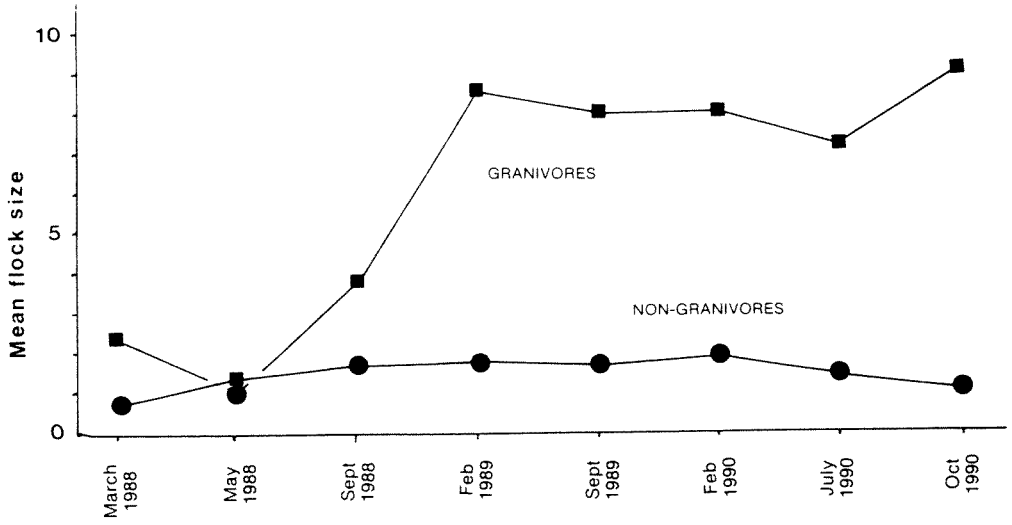

Figure 5.3 Mean flock size of granivore and non-granivore birds on census transects.

Seasonality

Figure 5.4 examines the mean flock size of the 13 granivore species recorded during the transect census. *Turnix velox* was not recorded during the first sampling period but was present on all subsequent surveys. This species was usually recorded as single individuals.

Geopelia cuneata had peak flock size during the drought at the beginning and end of the study. Most sightings on the five sampling surveys after the good rains of 1988 were of one or two birds together. *Geopelia striata* was not recorded until the drought of 1990. *Geophaps plumifera* and *Ocyphaps lophotes* both showed flock size correlated with drought.

Among the parrots, *Platycercus zonarius* was only infrequently recorded during the transect census; *Melopsittacus undulatus* and *Nymphicus hollandicus* had flocks of variable sizes and were not present on the final surveys; *Cacatua roseicapilla* was intermittently recorded; and *Cacatua sanguinea* was sometimes present in large flocks.

The two finches (*Emblema pictum* and *Poephila guttata*) responded differently to the onset of the 1990 drought. *Emblema pictum* declined in flock size and was not recorded on the transect during the final two sampling periods. The only record during July 1990 was a flock of *c.* 150 feeding in a *Triodia* gully at Cunmagnunna Hill just outside our study area. This aggregation was considerably more than those recorded by Blakers *et al.* (1984). *P. guttata* flock sizes increased markedly with the onset of the drought.

Most non-granivorous species were recorded in low numbers and changes attributed to season cannot be determined. *Lalage sueurii* is a known migrant and was not recorded on the last four surveys. *Coracina novaehollandiae* which is considered a passage

migrant and winter visitor by Storr (1984) was recorded on all visits; we did not visit the area during the three months when Storr claims the species is absent.

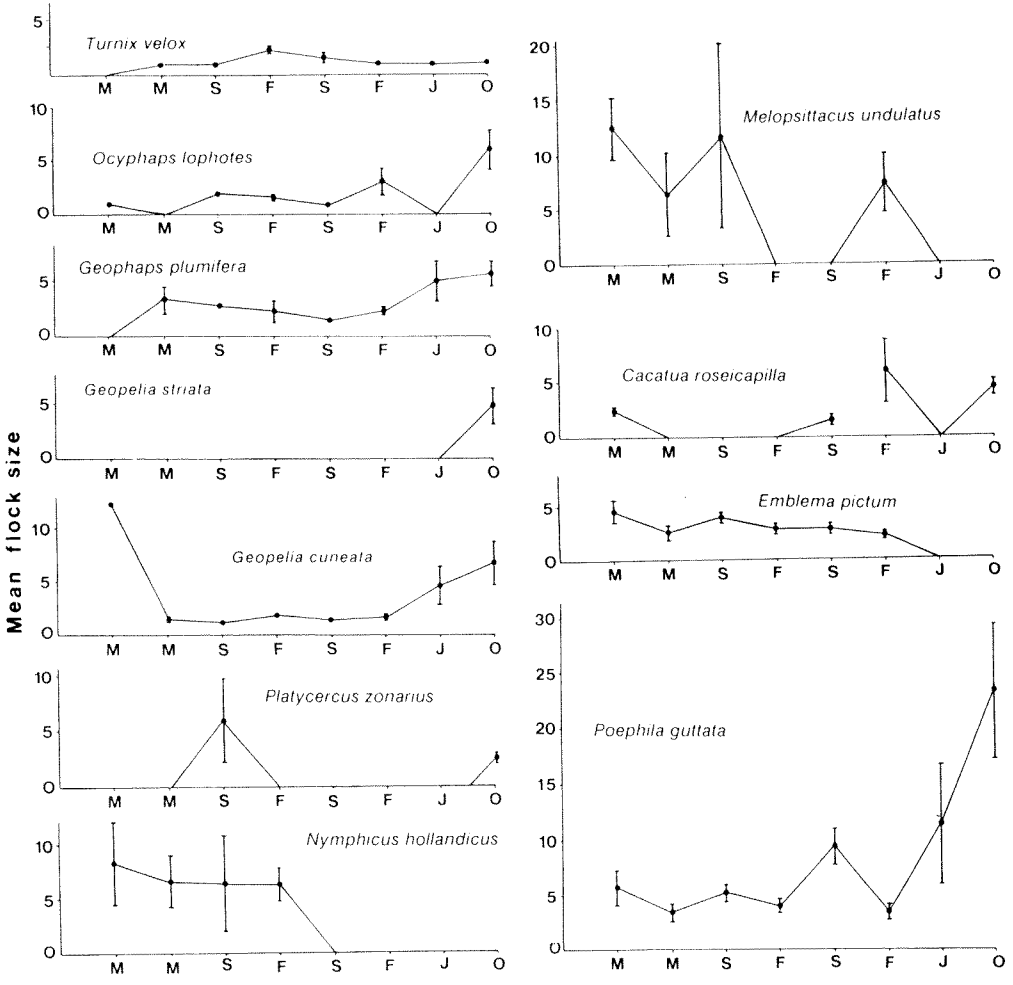

Figure 5.4 Mean flock size of each granivore species during the study period.

Breeding

Breeding data were obtained for 17 species (Table 5.8). Most records were in the 12 months following the heavy rains of 1988 (Figure 5.5). Eleven species including three granivores and eight species of non-granivores were recorded breeding in September 1988. No non-granivores were recorded breeding after September 1989.

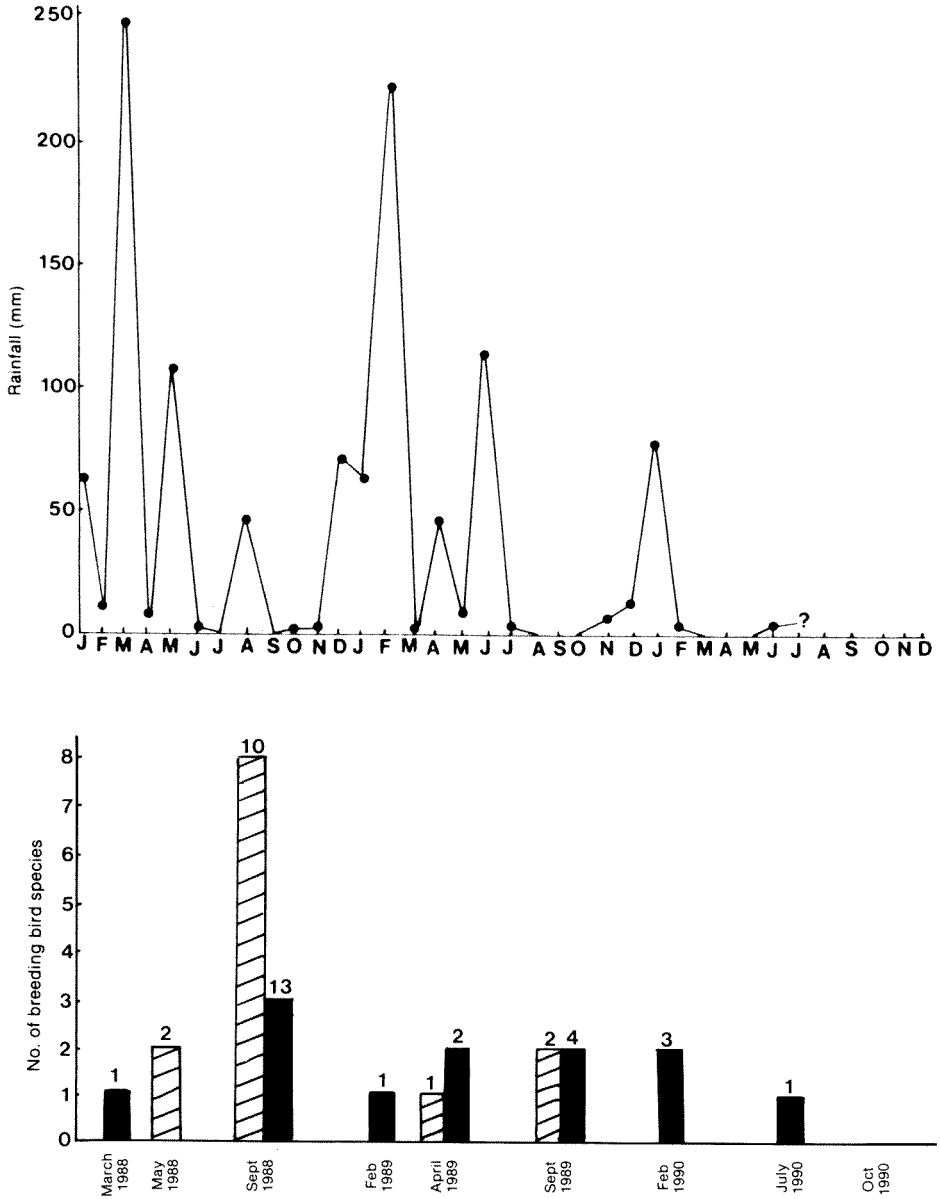

Figure 5.5 Monthly rainfall during 1988-1990 and bird breeding data recorded during survey periods. Hatched bars are insectivorous species and closed bars are granivores. Numbers indicate number of nests.

Table 5.8: List of bird breeding data recorded during the survey of Abydos-Woodstock Reserve.

Ardea pacifica (Pacific Heron). Nest with young at Luke's Pool on 19 November 1980 (A. Chapman, pers. comm.).

Turnix velox (Little Button-quail). Male with 3 chicks near Site WS8 on 12 February 1989; chick near granites on highway on 24 April 1989; male with fledgling at Site WS4 on 18 September 1989.

Geophaps plumifera (Spinifex Pigeon). Nest with 2 young nearly fledged on 21 October 1980 (A. Chapman, pers. comm.).

Geopelia cuneata (Diamond Dove). Nest with 1 fresh egg in *Acacia pyrifolia* at Site WS2 on 23 September 1988 (nest had 2 eggs on 26 September); nest with 2 eggs in *A. pyrifolia* at Site WS2 on 24 September 1988; pair building nest at Site WS5 on 26 September 1988.

Cuculus pallidus (Pallid Cuckoo). Male feeding female and displaying at Site WS1 on 8 May 1988.

Halcyon sancta (Sacred Kingfisher). Adults at nest spout on 27 October 1980 (A. Chapman, pers. comm.).

Hirundo ariel (Fairy Martin). Colonies of old nests are common in the Woodstock area on most larger granite outcrops and metal culverts and bridges along the Newman railway.

Coracina novaehollandiae (Black-faced Cuckoo-shrike). Nest with 3 chicks in *Melaleuca leucadendra* at Site WS1 on 24 September 1988; nest with chicks in *M. leucadendra* at Abydos homestead on 26 September 1988.

Lalage sueurii (White-winged Triller). Nest with chicks in *M.leucadendra* at Site WS 1 on 24 September 1988.

Amytornis striatus (Striated Grasswren). Adult with fledgling near Abydos goldmine on 29 September 1988.

Malurus leucopterus (White-winged Fairy-wren). Nest with 3 eggs and 1 recently hatched chick in *Triodia* near Site WS4 on 3 May 1988.

Eremiornis carteri (Spinifex-bird). Adult giving agitated "mouse-run" at Site WS4 on 16 September 1989.

Pardalotus rubricatus (Red-browed Pardalote). Adults at nest burrows on banks of Coorong at Site WS1 on 19 September 1989.

Meliphaga keartlandi (Grey-headed Honeyeater). Pair feeding 2 fledglings at Site WS7 on 27 September 1988; nest with 2 eggs in *Acacia* sp. at Site WS7 on 22 April 1989.

Manorina flavigula (Yellow-throated Miner). Nest with chicks in *M. leucadendra* at Abydos homestead on 26 September 1988; adults at 2 nests in *M. leucadendra* at Site WS1 on 27 September 1988.

Emblema pictum (Painted Finch). Nest with chicks in *Triodia* at Site WS8 on 26 March 1988; nest with 4 eggs in *Triodia* at Site WS7 on 23 September 1988; adult carrying eggshell at Site WS7 on 23 September 1988; nests being built in *Triodia* at Sites WS7 and WS8 on 25 September 1988; nest with 2 eggs in *Triodia* on Tim Ealey Hill and adult carrying nest material at Abydos homestead on 21 April 1989; nest being built in *Triodia* at Junction Granite on 4 March 1990; nest with 4 eggs in *Triodia* on Junction Granite on 5 March 1990.

Poephila guttata (Zebra Finch). Nest being built in *Acacia pyrifolia* at Site WS5 on 25 September 1988; nest with 1 fresh egg in *A. pyrifolia* at Site WS4 on 28 September 1988; nest being built in *A. pyrifolia* at site WS4 on 29 September 1988; nest being built in A. *pyrifolia* at Site WS4 on 16 September 1989; nest with 4 eggs in *A. pyrifolia* Site WS24 on 23 September 1989; nest with 5 eggs in *A. ampliceps* at Site WS1 on 27 February 1990; nest with chicks in *Acacia* sp. on Old Wittenoom Road on 1 August 1990.

Grallina cyanoleuca (Magpie-lark). Nest being incubated in *Melaleuca leucadendra* at Site WS1 on 27 September 1988 (several other old nests nearby); old nests in *M. leucadendra* at Abydos homestead in September 1988 and at Lukes Pool in October 1990.

Cracticus nigrogularis (Pied Butcherbird). Recently fledged young being fed by adults at Abydos homestead on 26 September 1988.

Cracticus tibicen (Australian Magpie). Nest being incubated in *Eucalyptus terminalis* near Chinaman Wall on 26 September 1988.

Discussion

The avifaunal assemblage at Abydos-Woodstock is predictably more depauperate than that known from Karijini National Park because of the relative homogeneity of the area and the lack of permanent water. The *Triodia* spp. dominated undulating plains at Abydos-Woodstock Reserve have few trees or shrub thickets. In particular, the Mulga (*Acacia aneura*) shrublands which have rich bird assemblages further south in the Pilbara are entirely absent here.

The Acanthizidae family of small insectivores was almost entirely absent from Abydos-Woodstock Reserve because of the scarcity of shrublands. In contrast four widespread insectivores, (fairywrens of the family Maluridae) which occupy *Triodia* habitats, were recorded.

Other small insectivores that move into the southern Pilbara in winter (Storr 1984) do not normally reach our study area. An exception was our record of *Petroica goodenovii* which is an extension of its known range.

Breeding sites for hollow-nesting species are restricted at Abydos-Woodstock Reserve. *Eucalyptus camaldulensis* along Coorong Creek and the Yule River provide the only possible nest sites for *Cacatua sanguinea* and *C. roseicapilla.* These creek systems would be the main breeding areas for *Melopsittacus undulatus* and *Nymphicus hollandicus.*

Compared to elsewhere in the Pilbara the Abydos-Woodstock Reserve has no major river systems and few permanent pools. Hence most species requiring these habitats are only transient and may be absent for long periods from Abydos-Woodstock Reserve.

Triodia produces vast amounts of seed when conditions are favourable and these seeds remain on the surface until germinated by subsequent heavy rain. Morton and Davies (1983) concluded that a major proportion of plant productivity in *Triodia* communities is allocated to reproduction rather than to growth and maintenance, accordingly seeds constitute one of the most stable and abundant resources. This advantages granivores and explains the high proportion of granivore individuals at Abydos-Woodstock Reserve in comparison to non-granivores.

The two species of finch responded differently to seasonal conditions at Abydos-Woodstock Reserve, although both species eat small grass seeds. *Triodia* spp. (the dominant grass at Abydos Woodstock Reserve) were not recorded as dietary items for *Poephila guttata* by Morton and Davies (1983), whereas *Triodia* is known to be the main food of *Emblema pictum* (Immelmann 1982). Differences in response at Abydos-Woodstock may be due to dietary preferences. Numbers of *E. pictum* dropped dramatically in comparison to *P. guttata* which formed large mobile flocks. It is possible that these flocks were seeking areas of seeding bunch grasses, such as along creeks that respond to small rainfall events. *E. pictum* disappeared from the extensive *Triodia* plains when *Triodia* had failed to seed for several months.

The high proportion of granivorous individuals at Abydos Woodstock Reserve fits the general theory of Wiens and Johnston (1977) who state that the most highly specialised level of granivory evolves when large concentrations of small seeds are available at discrete intervals, usually as a result of episodic heavy rains. During long periods of

drought, water and seed become scarce and isolated, and populations of granivores decline to low levels as was the case at Abydos-Woodstock Reserve in March 1988. The abundant rain and seeding of *Triodia* in 1988 lead to a dramatic increase in number of granivore individuals which then occupied the extensive *Triodia* plains.

Water and seed became isolated during periods of low rainfall and only areas receiving runoff such as creeks and low seepage areas had fresh seeding. During this time many of the flocks of granivores were in transit between food and water resources.

In contrast, food resources of the non-granivores, although sparse, are not concentrated either spatially or temporally to the same extent. Accordingly these species have no advantages in flocking and explains why the mean flock size of non-granivores at Abydos-Woodstock Reserve was only 1.62 compared to 9.55 for granivores.

Some species such as *Lalage sueurii* and *Coracina novaehollandiae* select certain geographic areas for breeding in different years such as occurred in September 1988 but not in September 1989 or October 1990 at Abydos-Woodstock Reserve. This behavioural flexibility to seek out and utilize sites with maximum resources has been explained by Cody (1985).

Certain habitats may be used in certain circumstances (Cody 1985) such as the fire regeneration areas at Abydos-Woodstock Reserve which are discussed in more detail for reptiles and mammals. *Epthianura tricolor* was chiefly recorded in areas regenerating after the fires of 1989 and *Artamus cinereus* was also more abundant in regenerating areas compared to unburnt sites.

Few nectarivore species were recorded at Abydos-Woodstock Reserve. A significant proportion (26%) of the non-granivores (48 species) was represented by four species of insectivore/nectarivores. Blossom seeking nomadic nectarivores were scarce and were recorded only when proteaceaous species such as *Hakea suberea* and *Grevillea wickham* were flowering.

5.5 Mammals

Introduction

The mammal fauna of Abydos-Woodstock Reserve has been well documented over the past 35 years. The detailed studies undertaken by Ealey (1967a, 1967b) and Ealey and Main (1967) on Euros (*Macropus robustus*) and Red Kangaroos (*Macropus rufa*) in the late 1950s was accompanied by collections and records of another 20 species in the area. The Reserve is the best documented location in the Pilbara for its mammal assemblage.

Survey Methods

All mammals collected were measured and examined to determine sex and reproductive condition. Electrophoretic examination of four species was undertaken; *Pseudantechinus macdonnellensis, Pseudantechinus woolleyae, Pseudomys hermannsburgensis* and *Zyzomys argurus*. Allele frequencies were examined at 25, 25, 46, and 47 loci, respectively, and a complete analysis will be presented elsewhere.

Results

The Assemblage

This study documented 31 species of mammal in 13 families on the Abydos-Woodstock Reserve. Five of these species were recorded on the Reserve for the first time, and six were species that have been introduced since European settlement of Australia.

The small dasyurid marsupials and the rodents were documented by the extensive pitfall and Elliott trapping undertaken on the Reserve during all 9 surveys. However, the larger mammals were recorded by observation of individuals, or by their characteristic tracks during daily traverses. Table 5.9 shows the location of mammal captures or signs at the regularly visited sample sites on the Reserve, and Table 5.10 the seasonal occurrence of species on the sampling sites.

Fourteen species of ground mammals were recorded during this study. Eight of these species were recorded from WS8 and seven from WS10. At Pullcunah Hill two species of bats were recorded together with four small ground mammals and two species of macropod. No species were trapped on every survey, although Euros, were recorded every time.

Species Distribution and Abundance

The Echidna, *Tachyglossus aculeatus*, was not observed on any survey, but its characteristic diggings and faeces were recorded at two locations (Table 5.9). All the signs in the Gallery Hill area were at the base of *Drepanotermes* mounds. An Echidna was collected on Woodstock in 1958.

The Northern Quoll, *Dasyurus hallucatus*, was trapped at two sites (Table 5.9); one was an extensive rockpile,the other the steep sides of a gorge. The terminal portion of a tail was found in a sprung Elliott trap at site WS4, suggesting that the species may travel long distances from its favoured rockpile habitats. One female was retrapped on Tim Ealey Hill (WS17) in March 1990 with pouch young. Previous captures were made at the Edgina Granites by Chapman (pers. comm.) in 1981, and a cranium was collected from the Gallery Hill area.

The Mulgara, *Dasycercus cristicauda*, was represented by a single capture of a subadult male that was marked and released. This was the second record of this declared rare and endangered species on the Reserve, having previously been collected by Ealey in 1958 on Abydos airstrip. Our individual had eaten a skink, *Ctenotus pantherinus*, that was in the same pitfall trap.

The Fat-tailed Antechinus, *Pseudantechinus macdonnellensis*, was trapped on rockpiles and sandy plains (Table 5.9), and it was most abundant in July and October 1990. Butler (pers. comm.) and Woolley (pers. comm.) collected this species adjacent to termite (*Nasutitermes* spp.) mounds on the Reserve in 1963 and 1975/76, respectively.

Woolley's Antechinus, *Pseudantechinus woolleyae*, was only collected from rocky habitats. Butler (pers. comm.) also trapped an individual on rocky substrates.

The Little Red Antechinus, *Dasykaluta rosamondae*, was the most widespread and abundant marsupial on the Reserve, which is the type locality for the species (Ride 1964). Peak numbers of this species were recorded in February 1990 (Table 5.10)

The Striped-faced Dunnart, *Sminthopsis macroura*, and Youngson's Dunnart, *S. youngsoni*, were both represented on the Reserve by single specimens caught at widely spaced localities (Table 5.9). These species had not previously been recorded on the Reserve.

The Pilbara Ningaui, *Ningaui timealeyi*, is confined to spinifex habitats and was only trapped in pitfall traps (Tables 5.9, 5.10).

The Common Planigale, *Planigale maculata*, was recorded from the Reserve by a single specimen trapped in dense spinifex adjacent to calcrete hills. This was the first record for the Reserve.

The Bilby, *Macrotis lagotis*, occurred at several sites on the Abydos-Woodstock Reserve. Cranial material in the Museum collections comes from several rockpiles, where, presumably, individuals were taken after capture by foxes or dingoes. Active burrow systems were noted at four disjunct sites on the Reserve during this study after a footsearch of over 20 km of creeks and their banks. All these sites are in, or adjacent to, the small ephemeral headwater creeks of the Yule and Turner Rivers. No animals were sighted during the present study despite extensive periods spent watching active burrow systems at night in September 1989. Twice daily monitoring of an active burrow on the small creek between sites WS4 and WS5 in October 1990 suggests animals emerge several hours after dark each evening. Tracks and diggings were common in the coarse sand in creekbeds where *Cyperus* sp. was growing. Bilbies often excavate around the base of and sometimes completely remove the *Cyperus* plant. It appears that they feed on the tubers, as was reported by Southgate (1990). Chapman (pers. comm.) spent many evenings in 1981 and 1982 watching active burrows in the Egina Granites area but failed to see any animals.

The Spectacled Hare-wallaby, *Lagorchestes conspicillatus*, was known from the Reserve by two skulls collected in 1959 by Ealey, and the sighting of an individual near WS7 and on the airstrip at Abydos Gold by Baker (pers. comm.) in 1986. A population of this species was also known from Pilgangoora mining camp about 70 km north of the Abydos-Woodstock Reserve (Baker pers. comm.). Two road killed specimens and nearly 100 sightings of the species have been made since May 1990 by Baker between the airstrip and Chinnamon Creek on the Mt. York road. Females with young joeys at heel were recorded on May 6, June 8, October 25 and November 7 and 9 1990. Up to seven individuals were seen on a single night, and on October 27, we saw six individuals feeding on the airstrip. Heavy browsing was noted on the plant *Bonamia rosea* that grew abundantly on the disturbed edges of the airstrip.

Rothschild's Rock-wallaby, *Petrogale rothschildi*, occurs on most of the rockpiles and some of the rocky slopes on Abydos-Woodstock Reserve. Sightings were made on five of the rockpiles in the Gallery Hill series, on two in the Egina Granites, and on Tim Ealey Hill, Pullcunah Hill and the steep slopes of the northern edge of the Soansville Plateau. Skulls were removed from fox lairs on several additional rockpiles, and their characteristic faeces were seen on many others. No signs were noticeable on the isolated Gregory's Folly (WS33) rockpile. Spotlighting around rockpiles usually resulted in one

Table 5.9 Number of mammal individuals captured at sampling sites on the Abydos-Woodstock Reserve. Number of captures in pitfall traps is enclosed in brackets, an asterisk indicates a species had been collected previously and observational records are denoted by a plus.

Sites	1	2	3	4	5	6	7	8	9	10	11	15	17	18	22	24	29	32	33	Other Sites
No. pitfall trapnights	288	276	330	348	330	318		318		276										
No. Elliott trapnights	595	605	675	725	675	635	620	635	315	485	180	174	256	317	294	180	132	121	244	268
Tachyglossidae																				
**Tachyglossus aculeatus*											+								+	
Dasyuridae																				
**Dasyurus hallucatus*				+								1	10							
**Dasycercus cristicauda*										1(1)										
**Pseudantechinus macdonnellensis*	1			1						1(1)				1					6	
**Pseudantechinus woolleyae*								1		.				1						
**Dasykaluta rosamondae*	+	2	4(2)	8(8)	10(1)	11	1	1(1)		4(1)	1			1	2	4	1	1		
Sminthopsis macroura					1															
Sminthopsis youngsoni										1(1)										
**Ningaui timealeyi*		3(3)	7(7)	4(4)		4(4)		12(12)		6(6)										
Planigale maculata								1(1)												
Thylacomyidae																				
**Macrotis lagotis*																				Nr 4
Macropodidae																				
**Lagorchestes conspicillatus*							+													
**Petrogale rothschildi*												+	+	+			+		+	+ @ 14
**Macropus robustus*						+	+	+	+		+	+	+	+	+		+		+	
**Macropus rufus*																				Nr 29
Pteropodidae																				
**Pteropus alecto*																				Nr 25
Megadermatidae																				
**Macroderma gigas*														+					+	
Emballonuridae																				
**Taphozous georgianus*												1		3						1 @ 16

Table 5.9 (continued)

Sites	1	2	3	4	5	6	7	8	9	10	11	15	17	18	22	24	29	32	33	Other Sites
Vespertilionidae																				
Scotorepens greyii									3											
**Eptesicus finlaysoni*											1			2						3 @ 16
Muridae																				
**Zyzomys argurus*							10	4			9	1	9	4	1		9		9	2 @ 20, 7 @ 28
Pseudomys delicatulus	1(1)			1(1)				1(1)										1		
**Pseudomys hermannsburgensis*		10	3	13(2)	8	11(2)	2	2(2)		21(13)						10		1		13 @ 23, 4 @ 30
**Pseudomys chapmani*															5			1		
**Mus musculus*	37(2)	24	10	10	5(1)		4	4	5	10		2			5					
Canidae																				
**Canis familiaris*																				
**Vulpes vulpes*																				
Felidae																				
**Felis catus*									+		+									+
Equidae																				
**Equus asinus*		+		+				+	+		+			+						
Camelidae																				
**Camelus dromedarius*				+																
Bovidae																				
**Bos taurus*	+				+			+			+									

Table 5.10: Capture data for small, ground mammal species during each sampling period at Abydos-Woodstock Reserve. Number of captures in Elliotts/ Pitfall traps are presented along with sampling effort.

Sampling Trips Elliott/Pitfall traps	Mar/88 1560/324	May/88 —/282	Sep/88 1240/312	Feb/89 900/318	Apr/89 448/24	Sep/89 1017/240	Feb/90 1167/432	Jul/90 782/216	Oct/90 1017/336
Dasyuridae									
Dasycercus cristicauda							—/1		
Dasyurus hallucatus					4/—	3/—	3/—		1/—
Dasykaluta rosamondae	1/2		5/4	1/—	—	3/5	18/1	1/1	9/—
Ningaui timealeyi	—/4	—/5	—/4	—/4	—	—/12	—/3	—/1	—/3
Planigale maculata	—/1								
Pseudantechinus macdonnellensis					1/—			5/1	3/—
Pseudantechinus woolleyae								1/—	1/—
Sminthopsis macroura			1/—						
Sminthopsis youngsoni							—/1		
Muridae									
Mus musculus	3/—		14/—	6/—	2/—	75/3	8/—	2/—	4/—
Pseudomys chapmani						4/—	1/—	1/—	
Pseudomys delicatulus			—/2	—/1					
Pseudomys hermannsburgensis	2/2		1/—	2/4		40/3	6/2	14/7	15/1
Zyzomys argurus	10/—		7/—		1/—	9/—	19/—	10/—	11/—

or two sightings, but up to four were seen in the Gallery Hill area, where tracks indicated regular movement between these rockpiles.

The Euro, *Macropus robustus*, was the most frequently observed macropod on the Reserve, being sighted on all surveys, and generally in the vicinity of rockpiles or screeslopes. Usually single individuals were recorded amongst the 22 sightings, but up to four have been seen on some rockpiles. Characteristic droppings of this species have been noted on nearly every sampling site, attesting to a wide distribution despite low abundance. Chapman (pers. comm.) recorded 17 sightings over a 7 month period in groups of up to three. Skeletal remains are evident in many rock shelter,s probably the result of the poisoning campaign in the 1960s.

The Red Kangaroo, *Macropus rufus*, was very uncommon on the Reserve, with only three sightings over the three year study period. The record of an adult in July 1990 and a female with young at heel and three adults in October 1990 were all in areas regenerating after the fires of January 1990. In July 1990 an examination was made of 21 freshly killed specimens on the new Wittenoom-Port Hedland road, of which only two were of *M. rufus*, the others were all *M. robustus*. Red Kangaroos were more abundant in 1980-1982 with 16 sightings of groups with up to five individuals (Chapman pers. comm.).

The Black Flying Fox, *Pteropus alecto*, was not recorded during this survey, but 12-15 had been recorded in the Date Palms at Abydos homestead in 1982 by Chapman (pers. comm.). Fires in February 1988 had severely burnt the palms.

The Ghost Bat, *Macroderma gigas*, was seen at two sites (Table 5.9). At both locations two individuals were flushed from deep recesses in rockpiles and appeared to fly to other roosting crevices in the same rockpiles. Patterson (pers. comm.) has seen *M. gigas* on only two occasions during his 8 years as ranger on the Reserve, on Coorong Creek near the homestead, and on Coonarrie Creek adjacent to the scarp. Chapman (pers. comm.) saw two individuals in the Gallery Hill area in October 1982.

The Common Sheath-tailed Bat, *Taphozous georgianus*, was trapped in mist nets at Cadjeput Rockhole and Bowerbird Gorge, and caught by hand in a crevice at Pullcunah Hill. The colony on Pullcunah Hill numbered about five and was located in a deep fissure some 20 m under the top of the Hill. This species was also sighted in the Gallery Hill area in 1982 by Chapman.

The Little Broad-nosed Bat, *Scotorepens greyii*, was recorded for the first time on the Reserve, when three individuals were mist netted over stagnant pools in Coorong Creek.

Finlayson's Eptesicus, *Eptesicus finlaysoni*, was caught in mist nets set over small pools in Bowerbird Gorge, where about 20 observations were made over an hour period in October 1990. A small breeding colony consisting of three adults and seven young was examined in the Gallery Hill area, and a colony of about 20 individuals was observed on Pullcunah Hill.

The Common Rock-rat, *Zyzomys argurus*, was abundant at sites where rocks dominated the substrate. Captures were made on most of the rockpiles trapped.

The Delicate Mouse, *Pseudomys delicatulus*, was recorded for the first time on the Reserve. Only four captures were made during the study, most were in pitfall traps (Table 5.9) and at widely spaced sampling sites.

The Sandy Inland Mouse, *Pseudomys hermannsburgensis*, was widespread and abundant, being trapped on nearly all surveys and at most sites. The species was particularly abundant at sites WS4 and WS10 where the *Triodia* was dense and the sandy loam deep. No captures were made in rockpiles (Table 5.9). Large numbers were caught in September 1989 (Table 5.10).

Pebble-mound Mouse, *Pseudomys chapmani*, were trapped at two widely spaced sites, the rocky slopes of the Soansville Plateau escarpment and adjacent to a pebble mound (WS32) east of Gallery Hill (Figure 5.1). Numerous active and abandoned pebble mounds were recorded at locations where soils were skeletal with surface pebbles. Mounds became very visible in areas recently burnt.

House Mouse, *Mus musculus*, was common at sites adjacent to watercourses and on the deeper sandy soils. It was never trapped in rockpiles and infrequently in areas with rocky substrates and shallow soils (Table 5.9). The species was most abundant in September 1989, after the good rains of the previous two summers and winter of 1989, when 79 individuals were captured.

A dead Dingo, *Canis familiaris*, was seen in a creekbed near site WS4 in September 1988. No tracks or faeces were recorded during our surveys. The Museum collection has a skull collected in 1962 on Abydos, and Chapman (pers. comm.) saw Dingos near the homestead, Gallery Hill, Egina Granites and feeding on the carcass of a donkey on the plains in December 1980.

Foxes, *Vulpes vulpes*, were present on the Reserve, and judging from remains of species removed from their lairs, they are an important predator on both the Rock Wallaby and the Bilby. Tracks and faeces were noted around several granite rockpiles, and a 1080 baiting programme was instigated in these areas to attempt to reduce their impact. Numerous fresh pads in the Gallery Hill area suggested foxes frequently moved between the rockpiles.

Cats, *Felis catus*, were seen at three sites, one was startled from a Bilby burrow at Bilby Creek (Table 5.9), and tracks were noted along most creeks traversed. A cat skull, collected from Hilliers Granite in 1959, is in the Museum collection.

The nine sightings of Donkeys, *Equus asinus*, were usually in ones or twos, but up to seven have been recorded. Footprints suggest this species ranges over the entire Reserve. Chapman (pers.comm.) made 53 sightings of groups of up to 20 animals [5.8±4.6]

Camels, *Camelus dromedarius*, also ranged over most of the Reserve, and their tracks were particularly common along certain creek banks that appeared to be used as thoroughfares. Three sightings were of three individuals and one was of five. Chapman recorded 16 groups ranging up to 13 individuals [5.2±3.8].

Cattle, *Bos taurus*, ranged freely over the Reserve. Sightings were frequent with up to 21 individuals in a herd. Their tracks were far more abundant along the major watercourses such as Coorong Creek and the Yule River, where introduced bunch grass, *Cenchrus ciliaris*, and pools provided abundant feed and water. An aerial muster in 1989 resulted in about 140 animals being removed from the Reserve.

Table 5.11: Reproductive pattern in Abydos-Woodstock small mammals. Dasyuridae sequential numbers refer to: number of adult females/number pregnant/number parous. Muridae sequential numbers refer to: number of adult females/number with blastocysts/number parous or with pouch young (litter size in brackets).

Sampling Trips	Mar/88	May/88	Sep/88	Feb/89	Apr/89	Sep/89	Feb/90	Jul/90	Oct/90
Dasyuridae									
Dasyurus hallucatus					3/-/1	2/-/2 (7,5)	1*/-/1 (6)		
Dasykaluta rosamondae			1/1/-			1 oestrus	1/-/1	8/8/—	
Ningaui timealeyi	1/-/1 (5)	2/-/2					1/-/1 (5)		
Pseudantechinus macdonnellensis					1/-/1				3/-/3 (6,5,4)
Pseudantechinus woolleyae									1/-/1
Muridae									
Mus musculus	1/1/-		X	2/1/1	1/1/-	32/10/20	2/-/1	1/1/—	4/1/2
Pseudomys chapmani						2/2/-			
Pseudomys delicatulus			1/-/1						
Pseudomys hermannsburgensis	2/-/2		1/-/1	1/-/1		14/6/6	3/1/1	6/-/4	4/-/-
Zyzomys argurus	6/1/5		2/2/-			5/4/-	7/1/5	3/-/2	7/-/2

* = Retrap from September 1989 when female dropped her pouch young.
X = Specimens not located.

Reproductive Biology

The broad reproductive patterns of the dasyurid marsupials and the murid rodents trapped on the Reserve during our study are presented in Table 5.11.

Two female *Dasyurus hallucatus* were carrying pouch young in September 1989, when the crown-rump-length (C.R.L.) of the young averaged 13.7 and 17.1 mm; one female dropped its young at time of capture and when retrapped in February 1990 was also carrying pouch young averaging 8 mm C.R.L. The females trapped in April 1989 were either parous with regressed teats or had undeveloped pouches.

A female *Dasykaluta rosamondae* collected in September 1989 was in oestrus, eight females collected in October 1990 were pregnant with blastocysts, and three were in their second breeding season. One female collected in late September 1988 had blastocysts and a female trapped in February 1990 was parous. Fourteen juveniles (7 females, 7 males) were marked and released in February 1990. These juveniles had an average body weight of 18.9 g compared with adult females which had an average weight of 29 g at the same season.

The three female *Pseudantechinus macdonnellensis* collected in October-November 1990 were all carrying pouch young, while the female trapped in April 1989 was parous. Males were trapped only in July 1990.

A parous female *P. woolleyae* was trapped in late October 1990, and a male in late July.

An adult male *Sminthopsis macroura* with adult testes size but an immature prostate gland was collected in September 1989. The *S. youngsoni* and *Dasycercus cristicauda* were both juvenile males.

Female *Ningaui timealeyi* with 5 pouch young were trapped in March 1988 and February 1990. The mean C.R.L. for each litter was 8.6 mm. Adults were caught on each survey (except July 1989 when no pitfall traps were open) and juveniles were caught on all surveys except July 1989 and September 1988.

Pregnant *Pseudomys hermannsburgensis* were trapped in February 1989, September 1989 and February 1990. Parous females were trapped on all other surveys except for October 1990 when adult females were neither pregnant nor parous. Two pregnant *P. chapmani* were caught in September 1989. The only female *P. delicatulus* was parous in September 1988.

Female *Zyzomys argurus* were pregnant on each September and March survey. Pregnant *Mus musculus* were caught on almost all surveys between February 1989 and February 1990. Large numbers of this species, including over 30 juveniles were captured in September 1989.

The two female *Taphazous georgianus* captured in October 1990 were both pregnant, and the female *Eptesicus finlaysoni* caught in February 1990 had two young attached (C.R.L. 31 & 26mm). Other juveniles were present in the rock crevice.

Genetic variation

The two species of *Pseudantechinus* had fixed differences at 12 of the 25 loci examined.

Very limited genetic variation was found amongst the 47 loci examined in *Zyzomys argurus*. Owing to the small sample sizes available for all but two of the sites, interpretation of this result is difficult, however it would be consistent with periodic bottlenecking or extinction of the population. Certainly there is no evidence for long term genetic isolation amongst rockpile populations.

The wide ranging *Pseudomys hermannsburgensis* showed greater genetic variation among the 46 loci examined. A detailed examination of the morphological and genetic variation in this species at Abydos-Woodstock is in preparation.

Effects of fire

The fires of January 1990 eliminated the small mammal assemblage from burnt sites (Table 5.12). Nothing was caught in the pitfall traps on the burnt sites after this date, while frequent captures were made on sites that remained unburnt throughout. As mentioned earlier, the extended drought severely hindered the rate of regeneration of the vegetation and presumably slowed recolonisation of burnt areas. Comparisons of captures in Elliott traps after the fire are complex as the traps were moved to adjacent unburnt *Triodia* to give them protection. However, it does show that *Pseudantechinus macdonnellensis*, *Mus musculus* and, particularly, *Pseudomys hermannsburgensis* were present in unburnt *Triodia* but not in adjacent burnt areas.

The only sightings of Red Kangaroos by us were in areas burnt by the fires of January 1990, although Chapman (pers. comm.) recorded them in many different habitats.

Table 5.12: Number of mammal species and individuals caught in major sampling sites (WS2, WS3, WS4) before and after they were burnt in late January 1990, and in other major sampling sites (WS1, WS5, WS6, WS8, WS10) that remained unburnt throughout. Data are presented for pitfall trapline data alone, and all trapping data.

Species	Pitfall Traplines		Elliott + Pitfall Traplines	
	Burnt Sites Pre '90/Post'90	Unburnt Sites Pre '90/Post'90	Burnt Sites Pre '90/Post'90	Unburnt Sites Pre '90/Post'90
Dasyuridae				
Dasycercus cristicauda	0/0	0/1	0/0	0/1
Dasykaluta rosamondae	10/0	1/2	14/0	6/20
Ningaui timealeyi	14/0	14/7	14/0	14/7
Planigale maculata	0/0	1/0	0/0	1/0
Pseudantechinus macdonnellensis	0/0	0/1	0/2	0/1
Pseudantechinus woolleyae	0/0	0/0	0/0	0/1
Sminthopsis macroura	0/0	0/0	0/0	1/0
Sminthopsis youngsoni	0/0	0/1	0/0	0/1
Muridae				
Mus musculus	0/0	3/0	41/3	45/11
Pseudomys delicatulus	1/0	2/0	1/0	2/0
Pseudomys hermannsburgensis	2/0	7/10	9/17	24/16
Zyzomys argurus				
No. of species	4/0	6/6	5/3	7/8
No. of individuals	27/0	28/22	79/22	93/58

Discussion

Prior to this study the mammal fauna on the Abydos-Woodstock Reserve was the best recorded and researched of any in the Pilbara as a result of the earlier work of Ealey in the late 1950's. The first specimens of *Dasykaluta rosamondae* (Ride 1964), *Ningaui timealyi* (Archer 1975) and *Pseudomys chapmani* (Kitchener 1980) were all collected on the Reserve, and it is the type locality for *D. rosamondae*.

The small ground mammal assemblage has been expanded to 14 species as a result of this survey with the addition of *Planigale maculata*, *Sminthopsis macroura*, *S. youngsoni* and *Pseudomys delicatulus*. The bat fauna is still depauperate with only five species in four families. The mammal fauna of Karijini (Hamersley Range) National Park (Dunlop & Sawle 1980) is richer in small mammals because of a much richer bat fauna associated with large Mulga and Cadjeput trees, although the ground mammal fauna of the Park is comparable, despite the fact that the Park is four times larger than Abydos-Woodstock Reserve.

Two species that might occur on the Reserve but whose status is uncertain, are the Rabbit, *Oryctolagus cuniculus*, and the Horse, *Equus caballus*. Butler (pers. comm.) recorded the rabbit at the Woodstock homestead in 1963, but Chapman (pers. comm.) determined after numerous discussions with long time residents and former workers on the Reserve that the species was only present in exceptionally good years. Suijdendorp (pers. comm.) in over 30 years association with Abydos-Woodstock never saw any, and only had one report, from Bonney Downs about 150 km southeast. These findings accord well with that of King (1990), who noted that the Rabbit rarely became established in the northeastern Pilbara due to the shallow soils and preponderance of *Triodia* spp. grasses; the former being unsuitable for burrow systems and the latter unsuitable as forage. Horses were seen by Chapman just outside the Reserve in 1981-82 and it seems highly likely that a few feral animals may persist on it. The Reserve had been grazed by sheep over a long period of time (Ealey 1967a),but has not been used for that purpose for over 30 years (see Chapter 1).

There has been a dramatic change in abundance of large kangaroos on the Abydos-Woodstock Reserve since European settlement. The reasons for this are elucidated by Berry (Chapter 1). During two months of intensive field traverses in March and April 1988, Tinley (1988) recorded only three sightings of each of the two large macropods. There has also been noticeable short-term variation in abundance in recent times as evidenced by the greater frequency of sightings of Red Kangaroos by Chapman in 1980-1982 after several years of above average rainfall, than during the present survey. Camels and Donkeys have probably increased since grazing became less intensive in the late 1960s.

Four species of mammal that are on Schedule I of the Western Australian Rare and Endangered species list occur on the Reserve. These species, *Dasycercus cristicauda, Macrotis lagotis, Lagorchestes conspicillatus* and *Pseudomys chapmani* all exist on the Reserve in small numbers, although numerous pebble mounds of the latter species were seen on stony hills and scarps. Two other species, *Petrogale rothschildi* and *Macroderma gigas*, were uncommon and restricted to the isolated rockpiles.

The importance of the rockpiles to the mammal fauna can be gauged by the number of species that are restricted to, or dependent on them; such saxicoline species include *Dasyurus hallucatus, Pseudantechinus woolleyae, Macropus robustus, Zyzomys argurus* and the three species of bats. Species of small mammal that occupy the sandy soils of the Abydos Plain and its associated vegetation types *(Dasykaluta rosamondae, Ningaui timealeyi* and *Pseudomys hermannsburgensis)*, were generally recorded in reasonable numbers. The introduced *Mus musculus* was caught on most sampling sites that did not have rocky or hard substrates and was particularly common along watercourses.

Extensive trapping around two pebble mounds (WS32) on several surveys indicated that all three species of *Pseudomys* may occur sympatrically, although the only *P. delicatulus* caught around the mound was a subadult male that may have been dispersing. Both species of *Pseudantechinus* were trapped at Pullcunah Hill (WS18), while at WS10 five species of dasyurid marsupial co-occured with probably a sixth, the wide-ranging *Dasyurus hallucatus.*

In general the distribution and inferred habitat preferences of the mammal fauna at the Abydos-Woodstock Reserve are in accord with the comprehensive species' profiles in Strahan (1983). Morton (1990) has drawn attention to the importance of the rabbit as a competitor with native species and its probable role in the extinction of many of them in the arid zone. He particularly drew attention to the persistence of *Lagorchestes conspicillatus* in areas where the rabbit is absent. Such a circumstance occurs at Abydos-Woodstock Reserve.

The reproductive pattern of small mammals on the Reserve is similar to that reported in the literature for the species. *Dasyurus hallucatus* had pouch young from around late August to early September, which concurs with King (1989) for this species in the Fortescue, but is marginally later than the season recorded in the Kimberley (Schmitt *et al.* 1989). There was also the case of a female having small pouch young in February 1990 after previously (September 1989) having lost a litter. The reproductive pattern of *Dasykaluta rosamondae* described by Woolley (1991b) was determined largely from individuals caught during this study, with pregnant females in late October, juveniles present from January, and a male die-off in mid October. The latter finding was verified by the capture by hand of a badly lacerated and poorly conditioned male during the afternoon near Pullcunah Hill.

On the limited information we have available it appears that *Pseudantechinus woolleyae* breeds earlier than its congener. The female *P. woolleyae* caught on 14 October 1963 had pouch young measuring 29 mm C.R.L., while the *P. macdonnellensis* caught on 31 October 1990 had pouch young measuring on average 14 mm C.R.L. However, the highly variable rates of capture of these species during the course of this study necessitates caution in making comparisons between the species based on different years. Woolley (1991a) describes the reproductive pattern of *P. macdonnellensis* and records both males and females as breeding in more than one season. No data on the reproductive pattern were available for either species of *Sminthopsis, Planigale maculata* or *Dasycercus cristicauda*, but the information available for *Ningaui timealyi*

verifies the findings of earlier studies (Dunlop and Sawle 1982, Kitchener and Cooper 1986) indicating a breeding peak between September and March and the presence of adult males in the population at all times.

Species of dasyurid marsupials on the Abydos-Woodstock Reserve exhibit nearly all of the reproductive strategies outlined for this family by Lee *et al.* (1982) and Lee and Cockburn (1986). The occurrence of monoestrus females and male die-off in *Dasykaluta rosamondae* (Strategy I) has been confirmed by the data collected in this study (Woolley 1991b). Species having Strategy II pattern include: *Pseudantechinus macdonnellensis* and possibly *P. woolleyae. Dasyurus hallucatus* was believed to have a type II strategy by Schmitt *et al.* (1989), but our findings suggest it is polyoestrous and therefore Strategy III. *Dasycercus cristicauda* and *Sminthopsis macroura* have Strategy III. There is no literature on the reproductive pattern of *S. youngsoni*, but *Ningaui timealyi* has a Strategy V pattern. It is probable that the wide variety of patterns exhibited by the dasyurids of the Reserve reflects the variety of habitats occupied and resources utilised by this diverse guild.

Reproductive activity amongst murids on the Reserve shows different patterns. House Mice, *Mus musculus* built up to large numbers in September 1989 after the good seasons of 1988 and early 1989, during which time most females were reproductively active. A similar pattern was present in *P. hermannsburgensis*, indicating that populations of these murids respond quickly to favourable seasons following good summer rains. Although numbers were low in *Pseudomys chapmani* it was breeding in September 1989. Dunlop and Sawle (1982) recorded the birth of 4 young to a female of this species in June. Breed (1982) examined the collections of *P. hermannsburgensis* in museums and found that females with embryos were present in nearly all months of the year, indicating that there was no breeding seasonality and that the species had the potential to breed at any time when resources were favourable. Reproduction in *Zyzomys argurus* had not previously been examined in Pilbara populations, but had been determined for both the Kimberley (Bradley *et al.* 1988) and Arnhem Land (Begg 1981) in the seasonally wet/dry tropics. In the Kimberley, reproductive activity was greatest at the end of the wet season in April; it was also the period when individuals were most stressed (Bradley *et al.* 1988). In our study females were pregnant or parous in nearly all months. Juveniles or subadults were caught on each survey (when rockpiles were trapped). Trappability of *Z. argurus* dropped dramatically in April; Begg (1981) found that trappability dropped to almost zero around March/April and Bradley (1988) found there was a 3 to 4 fold decrease in population size by April.

The limited data presented here on the genetic variation of small mammals on the Reserve, shows that both *Zyzomys argurus* and *Pseudomys hermannsburgensis* have panmictic populations, despite the restriction of the former species to widely separated and isolated rockpiles.

The role of fire in structuring small mammal assemblages has been the subject of considerable study in temperate southeastern Australia (Newsome *et al.* 1975, Fox 1983). Common to most of these studies is the fact that *Mus musculus* is the first species to recolonise an area after fire. Species of *Pseudomys* appear after *Mus* and are followed

by mid successional species such as *Antechinus* spp. and *Sminthopsis* spp. (G. Friend pers. comm). Our data from the arid zone show that recolonisation is very slow with no occupancy of sites burnt 10 months previously. However, site WS30 was burnt in February 1989 and captures of *P. hermannsburgensis* in February 1990 and October 1990 showed that recolonisation may occur around 12 months after fire if seasons provide adequate resources and regeneration takes place.

5.6 Discussion

The predominance of *Triodia* grasslands on the Abydos-Woodstock Reserve has shaped both the structure and composition of the vertebrate fauna and determined the focus of much of the previous research undertaken (Burbidge 1943, Ealey 1967a,b, Suijdendorp 1967).

Our study has illustrated that the Reserve and the adjacent areas have a diverse community of vertebrates. The recording of 5 species of frog, 68 species of reptile, 31 species of mammal and 104 species of bird, makes this area comparable to the much larger Karijini (Hamersley Range) National Park in its richness of vertebrate species (Muir 1983). The latter survey only extended over three weeks but incorporated all literature records and data from WA Museum collections.

The Reserve is the only known locality of the endemic skink, *Ctenotus nigrilineatus* (Storr 1990). Its richness in reptile species, particularly lizards, is one of the highest recorded in arid areas (c.f. Pianka 1986). Although the herpetofauna is diverse and there is a rich assemblage of small ground mammals, the birds are characteristically poor in number, because, as we have pointed out, the northeast Pilbara does not have the extensive Mulga plains that provide a diversity of habitats for the avifauna as is the case in the southern Pilbara and northern Goldfields.

Four species of mammal and one snake that are currently legislated as rare or in need of special protection occur on the Reserve: *Dasycercus cristicauda, Macrotis lagotis, Lagorchestes conspicillatus, Pseudomys chapmani* and *Morelia olivacea barroni*, respectively. Numerous other species that have restricted distributions or are very uncommon elsewhere occur on Abydos-Woodstock Reserve.

The extensive rocky slopes, ridges and plateaux, coupled with the ubiquitous rockpiles of the Abydos Plain, provide ideal habitat for many saxiphilous reptile and mammal species that form a major part of the vertebrate assemblage. Our examination of the genetic variation of the saxicoline murid rodent, *Zyzomys argurus*, has indicated that, despite the disjunct nature of the favoured rockpiles to which it is restricted, the species has a panmictic population on the Reserve. The sandplain-inhabiting *Pseudomys hermannsburgensis* shows far greater genetic variation on the Reserve. Our collections of reptiles from Abydos Woodstock and their subsequent genetic evaluation indicates that there is a higher degree of endemicity amongst Pilbara reptiles than previously expected (Aplin pers. comm.). Both the gecko, *Gehyra punctata*, and the blind snake, *Ramphotyphlops hamatus*, seem to be different taxa from those presently referred to as these species at more southern latitudes.

Reproductive activity within the vertebrate assemblage over the three years of study has indicated a complexity of responses. Generally reproductive activity is focused in the spring and summer periods in the arid as has been documented elsewhere (Breed 1982, Schodde 1982, Davies 1977, Pianka 1986). The exceptional rainfall during the early phases of our study promoted rapid growth and seeding in *Triodia* spp. and other grasses, while numerous shrubs and trees began to coppice and flower. The impact of this was to provide visibly improved resources for vertebrates compared with those apparent at the beginning and the end of our study period. Amphibians responded almost immediately to the March 1988 deluge and the breeding chorus was extensive over the Reserve. Birds responded more quickly to the favourable resource conditions than either reptiles or mammals, and breeding peaked in September 1988 in both granivores and non-granivores. By the spring and summer surveys in 1988 and 1989 many species of lizard and small mammal were reproductively active. Further, above average rains in early 1989 protracted the good seasons such that by the spring of 1989 reproductive activity was at a peak in these latter groups. There is support in our data for the prediction of Nix (1976) that insectivorous birds breed before granivores in response to favourable circumstances as their insect prey become abundant before plant seeds are available for granivorous species.

Poor summer rains in 1990 led to a marked decrease in reproductive activity in all vertebrate groups, and there were no breeding records for birds by September 1990. The decreased level of reproduction among reptiles in spring 1990 was accompanied by a decrease in body mass indices of three lizard species examined, *Gehyra punctata, Ctenotus saxatilis* and *C. grandis*, suggesting there was a lower condition among lizards at the end of the study which correlated with the poor preceding seasons. A species with access to constant and abundant resources, *Gehyra pilbara*, maintained a constant body mass index.

Fire has played a major part in structuring arid zone vertebrate assemblages (Pianka 1989), and at the Abydos-Woodstock Reserve fire has previously been the focus of considerable research (Suijdendorp 1967). It was not possible to accurately ascertain the time since last fire of the major sampling sites in our study. However, with a knowledge of the regeneration rate in areas burnt in January 1989 and January 1990, it was apparent that at least 10 years had elapsed since the sampled areas were previously burnt. An area burnt in January 1989 (WS30) was trapped in both February and October 1990, with the finding that *Pseudomys hermannsburgensis* was present on both occasions. This suggests that *Pseudomys hermannsburgensis* is the first mammal to recolonise burnt areas in the Pilbara. *Mus musculus* is invariably the first species to recolonise burnt areas in temperate Australia (Newsome *et al.* 1975, Fox 1983, Friend pers. comm.) and, even though the species was present in large numbers on the Reserve in late 1989, it was not subsequently trapped in sites burnt in January 1990. Trapping in these sites lend support to this view as *P. hermannsburgensis* was present in large numbers in *Triodia* immediately adjacent to the burnt areas, while *Mus* were in low numbers. No systematic recording of reptiles was undertaken at WS30, although *Ctenophorous isolepis* and *Ctenotus helenae* were seen on several occasions. At the main sampling sites burnt in

January 1990, the species that were least affected by the fire were the burrow inhabiting species, *Ctenophorus inermis, Diplodactylus conspicillatus* and *Egernia striata.* Other studies of the impact of fire on arid zone reptiles (Caughley 1985, Fyfe 1980) have relied on examining the assemblages in areas burnt at various earlier times. In our study the same area was monitored both before and after the fire, but regrettably the duration of the monitoring period post-fire was too short to evaluate the true successional stages in recolonisation.