Corella, 1991, 15(5): 143–149

FLUSH BEHAVIOUR, CATCHABILITY AND MORPHOMETRICS OF THE GROUND PARROT *Pezoporus wallicus* IN SOUTH-EASTERN QUEENSLAND

DAVID C. McFARLAND

Queensland National Parks and Wildlife Service, P.O. Box 42, Kenmore, Qld 4069

Received 25 January 1990

The flush behaviour of the Ground Parrot is described, and the success rates of several netting methods are compared. While netting at nests was the most successful, dusk and group netting yielded the highest capture rates among methods that can be used year round. Of the 115 parrots banded, 35 were chicks (9% retrap rate) and 80 were free-flying birds (28% retrap rate). All recaptures were in the same areas as originally banded, indicating a highly sedentary nature of young birds (<3 months old) and subadults/adults (>7 months). Immigration and emigration of young birds (3–7 months) occurred in the autumn. Annual survivorship of birds banded as free-flying individuals was 60 per cent. Four age classes were recognized (chick, juvenile, subadult and adult). Ageing was based on a combination of plumage characters and iris colour. Ground Parrots may be sexed by culmen length but more data are needed. The species exhibits four of the five morphological features correlated with a granivorous existence.

INTRODUCTION

The Ground Parrot is a shy, elusive granivore whose cryptic plumage and dense habitat make direct observation difficult. Often, the first indication of the species' presence is when a bird takes flight just in front of an observer tramping through heathland (Gould 1865). Voluntary flights are made only during the dawn and dusk calling periods (Bevege 1967; Jordan, unpub. data). Only limited information is available on catching Ground Parrots (Jordan 1988) and on their morphology (Ford 1969; Forshaw 1981). This paper examines the Ground Parrots' (a) response to disturbance (flush and flight behaviour), (b) catchability (comparison of four netting methods), and (c) morphology (weight, moult, possible age and sex differences).

STUDY AREA

Ground Parrots were regularly flushed in six sites and occasionally trapped in four sites in Cooloola National Park, Queensland (26°05'S, 153°02'E). The parrots inhabited closed graminoid heathlands dominated by a diversity of shrub and sedge species, e.g. *Banksia oblongifolia*, *B. robur*, *Leptospermum semibaccatum*, *L. liversidgei*, *Xanthorrhoea fulva* and *Caustis recurvata*. The vegetation, climate and location of the study area are fully described in McFarland (1988a).

METHODS

Flush behaviour

Parrots were flushed during the daytime either accidentally while wandering through heathlands or on purpose when walking marked transects in all sites. Transect lengths ranged from 1 900 to 3 600 m and covered both dry and wet microhabitats in each heathland. Further details are provided in McFarland (1988b).

Between January 1986 and February 1987 inclusive, the following data were collected for each bird flushed: time of day, weather conditions (index scores between 0 [low] and 4 [high] for cloud cover, wind, rain and mist), years since site last burnt, distance between bird and observer at time of flush (m), height above ground and distance flown (m), extent of zig-zagging in flight (index score between 0 [none] and 3 [most of flight]), whether or not the bird's flight path curved, and whether the bird called while flying. No data were collected for reflushed birds.

Catchability

Mist-netting was conducted irregularly throughout the study between March 1986 and October 1988 inclusive. During the dusk flying period and when flushing by either a single person or a group, a line of six to 12 mist-nets (18 m, Tetoron 1½") was used. The flushing and dusk netting techniques are described by Jordan (1988). During this study, group size averaged 13 people (range 7–26). For each trapping attempt, records were kept of the total net hours (number nets used × hours nets open), the number of parrots flushed, how many times each bird was flushed, and the number of birds that flew over the nets, rebounded off the nets and escaped, or were caught. Only the number of net hours, rebounds and captures were noted in dusk netting attempts.

Morphometrics

All Ground Parrots caught were banded with bands (size 23 SS) supplied by the Australian Bird and Bat Banding Scheme (ABBBS). The following measurements were taken using the methods described in the Banders' Manual (ABBBS 1989): wing and tail lengths (to nearest millimetre using a ruler), tarsus length (to nearest 0.1 mm using Vernier callipers) and culmen length (tip to posterior edge of cere, to nearest 0.1 mm using Vernier callipers), and body weight (to nearest gram using a Pesola balance). Notes were also kept of the presence or absence of moult and brood patch, and the iris colour. Weight data were collected from eggs and chicks, the latter being weighed soon after dawn before the first feed by an adult. Not all of the above measurements were taken for all birds handled.

Data were also obtained from Ground Parrot specimens collected in Queensland and lodged in the Queensland Museum (n = 8) and with the Queensland National Parks and Wildlife Service (n = 5).

RESULTS AND DISCUSSION

Flush behaviour

When disturbed, Ground Parrots fly low over the heath, alternating bursts of rapid wing beats with glides, before stalling and pitching into the vegetation. The birds make small sharp changes in direction during the wing beat pulses, give no call and generally have a curving flight path (Table 1). The greater the distance flown, the more zig-zagging by the parrot ($r = 0.69$, $df = 154$; $P < 0.01$). For height and distance flown and bird-observer distance there were no significant differences between sites (years since fire), months or time of day (ANOVA; $P > 0.05$ in all cases). Nor were there any significant differences in the bird-observer distance for birds flushed in different microhabitats (dry, ecotone and wet). Stepwise regressions showed that none of the climatic variables, time of day or fire age of site had any significant effect on height and distance flown and bird-observer distance ($P > 0.05$ in all cases). Voluntary flights during the daytime were observed only four times. All were in the morning (0600–0930 h) on overcast days.

TABLE 1

Summary of flush behaviour of Ground Parrots in Cooloola National Park (n = 156 for all features).

	Height flown above heath (m)	Distance flown (m)	Bird-observer distance at flush (m)
Mean	1.1	76.8	12.3
S.E.	0.04	3.3	0.5
Range	0.5–4.0	4–200	2–50

	Call made		Arcing flight		Zig-zag score			
	Yes	No	Yes	No	0	1	2	3
Frequency	1	155	113	43	67	50	34	5
%	0.6	99.4	72	28	43	32	22	3

TABLE 2

Number of times Ground Parrots flushed during netting attempts. Frequency distributions given for single person and group methods.

	Total number of times bird flushed								
Method	1	2	3	4	5	6	7	8	9
Single n	50	26	16	6	0	0	0	0	0
%	51	27	16	6	0	0	0	0	0
Group n	162	95	26	7	3	2	1	0	1
%	55	31	9	2	1	1	0.5	0	0.5

The behaviour outlined above agrees with the qualitative descriptions given elsewhere (Gould 1865; Mattingley 1918; Hindwood 1933; Forshaw 1981; Porter, unpubl. data). Ground Parrots are also considered good climbers and capable of perching (Mattingley 1918; Meredith and Isles 1980; Courtney, pers. comm.). In this study, three birds were observed perching in shrubs. All had landed in taller vegetation after being flushed.

Individual parrots were flushed up to eight times in succession but the majority only flushed once or twice irrespective of the number of observers involved (Table 2). This response seems to be typical of the species (Mattingley 1918; Hindwood 1933; Hunt 1958; Newman 1979), with the level of reflushing dependent on the density of the cover and the intensity of the search. Some birds refused to be flushed and either remained motionless (areas rewalked flushed new birds) or quickly ran away (radio-tracked birds were found to easily outwalk a person moving in both dry and wet micro-habitats).

TABLE 3

Comparison of several techniques used in netting Ground Parrots. Single person method divided into netting (a) away from and (b) around nest sites. Actual numbers given in parentheses.

Method	Total net hr	Number of birds per 100 net hr			
		Flushed	Over top	Rebound	Caught
Single (a)	223	38.1 (85)	2.7 (6)	2.2 (5)	4.9 (11)
(b)	13	107.7 (14)	0 (0)	23.1 (3)	92.3 (12)
Group	761	38.9 (296)	4.1 (31)	4.6 (35)	9.7 (74)
Dusk	136	—	—	19.1 (26)	11.8 (16)

Catchability

Several netting techniques were used to trap Ground Parrots. Capture rates were greatest when netting around nests (single (b) in Table 3), where placement of the nets meant the bird had little chance of escape. This method was only possible during the breeding season. At other times of the year, group flushing and dusk netting were the most successful methods. Jordan (1988) had similar success using these two techniques. While rates of flushing were similar for single (a) and group methods, in the latter, the presence of more people meant a greater capacity to move parrots towards the nets. As a result, there were greater rates of birds in the over the top, rebound and capture categories (Table 3). In single (a) attempts 13 per cent of the birds flushed were caught but in groups 25 per cent were trapped. During the dusk attempts 39 per cent of the birds hitting the nets were captured. This is somewhat less than Jordan's (1988) approximate 50 per cent success rate.

A total of 115 Ground Parrots, comprising 35 chicks and 80 free-flying birds, were banded during the study. Of these, 90 were caught once, 19 twice, 4 three times and 2 four times. Of the birds banded, only 9 per cent of the chicks and 28 per cent of the free-flying individuals were recaptured. No birds were recaptured away from their original banding site. In the regularly netted site, the retrap rate (excluding chicks and juveniles) in spring (54%, 19 of 35 birds caught) was considerably higher than in autumn (11%, 5 of 44 birds caught). Only 38 per cent (n = 8) of the chicks banded on the site were known to be alive two months after fledging, and all were still in the same area as the nest site. No chicks or juveniles were retrapped more than four months after being banded as nestlings. In the same site 60 per cent of the birds banded in 1986 (n = 15) were known to be alive in 1987 and 33 per cent were alive in 1988. (Annual survivorship of Ground Parrots is comparable to other Australian birds [Ford 1985] but more data over a longer time period are needed.)

Young parrots appear to remain in the natal area for at least two to three months after hatching, but by four to five months there has been either high mortality or the young birds have dispersed. An autumn dispersal period, as suggested by Meredith *et al.* (1984) would account for the increased numbers of unbanded birds caught in this season. These are probably first-year birds moving through. Jordan (1987) reported no first-year birds were ever recaptured at the original banding site. Older birds (> 7–12 months) caught in an area, particularly in spring, tend to be more sedentary with some birds residing in an area for at least three years.

The oldest known bird in this study was last caught 2 years 5 months after being banded. Data from the Australian Bird and Bat Banding Scheme show that wild *Psephotus* parrots (of similar weight to Ground Parrots) live for up to eight years. A captive Ground Parrot is still alive after 11 years (Courtney, pers. comm.). Having survived first-year dispersal, a Ground Parrot may be quite long lived (8+ years).

Morphometrics

Comprehensive descriptions of the Ground Parrot's plumage at various ages are given by Forshaw (1981). The results below describe particular attributes of the four age classes recognized in this study, as well as the possible use of culmen length in sexing parrots.

Age classes

1. Chicks. These are birds still in the nest. At hatching the birds have thin dark grey down, an egg tooth and closed eyes. Over the next five days the down thickens, the egg tooth is lost and the young begin to make soft chirping calls. About days five or six the eyes open (oil blue irides) and the female ceases day-time brooding, though she may continue to brood for one or two more nights. Feather shafts begin emerging by day nine, and by day 12 the birds are giving a rasping call when disturbed. The feather sheaths begin breaking by about day 12 and the irides have become dark brown. At this stage the birds are quite mobile within the nest. Wing and body feathering is well developed by day 22, with only remnant down on the head and lower back. The tail is poorly developed and the chicks readily run from the nest and give loud alarm calls. From day 24 onwards the birds may leave the nest permanently. At 28 days after hatching the young are capable of short flights.

Egg weights and changes in chick weight over time are given in Figure 1. Body weights change little up to day six, but after this there is a steady increase up to day 18. Weight levels off in the period when the young fledge at about 10 to 15 g below adult weight (Fig. 1). Six chicks died in nests. Five failed to survive ten days and were, on average, only 38 per cent of their siblings' mean weight when last weighed alive. These birds were assumed to be the last to hatch and, being unable to compete with larger siblings, subsequently starved to death. The sixth chick was 71 per cent of its siblings' weight and died around day 17 from unknown causes. Dead chicks occurred equally in broods of three and four young.

2. Juvenile. These are birds that have left the nest but have not developed the red frons. The first feathers of the frons emerge at three months and it is complete by four months after hatching (Courtney, pers. comm.). Juveniles also have grey-brown to brown irides, pinker legs and beaks, shorter tails, and weigh 5 to 10 g less than subadults and adults (Table 4, Fig. 1).

3. Subadults and 4. Adults. The decision to separate post-juvenile birds into subadults and adults was based on changes in iris colour in retrapped individuals (Table 4) and their apparent level of sexual maturity. Iris changes occurred from the brown of juveniles through to a pale yellow which apears almost white in full sunlight. Birds having either uniform pale yellow or pale yellow with brown fleck irides were considered adults since all known breeding birds (16 birds with brood patches or attending chicks) had

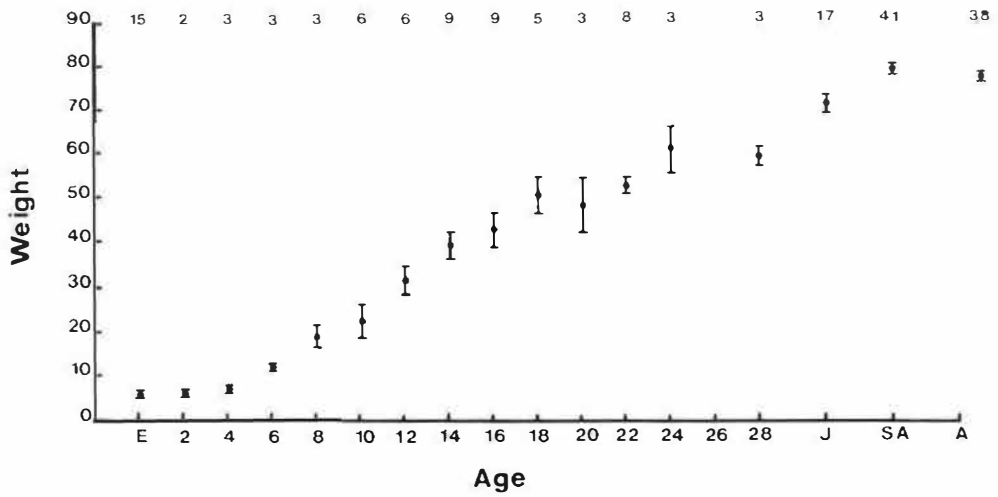

Figure 1. *Changes in weight (g) of Ground Parrots with time (days), from eggs (E) through 28 days as chicks to juveniles (J), subadults (SA) and adults (A). Mean ± S.E. with sample sizes given above points. Chicks weighed prior to first feed of day. Weights of birds that died in nest were excluded.*

TABLE 4

Changes in iris colour in the Ground Parrot.

Colours recorded	Minimum age*	Number of retrapped birds**
Oil Blue	4–6 days†	12
Dark brown	12 days	9
Grey brown	1–2 months	3
Brown	4 months	1
Pale red-brown	7–12 months	4
Fleck	24–36 months	8
Pale yellow	25–27 months	3

*minimum. age (time since hatching) of birds showing iris colour.
**numbers of retrapped birds whose change in iris colour or absence of change were used to estimate timing of changes.
†eyes open between four and six days after hatching.

only these colours. Parrots with flecked or pale yellow irides were caught in months outside the breeding season. No birds with brown, reddish brown or pale brown irides were ever found breeding. These birds were considered subadults. If iris colour is an indication of sexual maturity, then, based on the retrap data, Ground Parrots are capable of breeding when two or three years old (Table 4). This is similar to the related *Psephotus* parrots that usually start breeding when two years old (Forshaw 1981; Sindel, pers. comm.). Courtney (pers. comm.) observed that captive Ground Parrots did not begin courtship displays until three years old.

In terms of other body characteristics measured there were no significant differences between subadults and adults (Table 5, t-tests; $P > 0.05$ in all cases). The results from this study fall within the range of measurements given by Ford (1969) and Forshaw (1981). The only differences are that Queensland parrots appear to have shorter beaks and longer tarsi than more southern birds (Ford 1969).

Ground Parrot weights vary during the year, being greatest in autumn and spring (Table 6). These seasons coincide with peaks in number of seeding plant species. The low weight in October is attributed to breeding birds experiencing the increased energetic demands of incubation and rearing chicks. Moulting occurs between January and June (Table 6), but the severe February moult, as reported by Hinsby (1948) for Tasmanian parrots, was never observed.

TABLE 5

Body measurements and weights of subadult and adult Ground Parrots (mean ± S.E., n = sample size).

Body measure	Subadult			Adult			Combined		
	Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.	n
Wing (mm)	125	0.8	16	131	2.8	18	128	1.7	34
Tail (mm)	173	2.6	15	175	2.2	16	174	1.6	31
Tarsus (mm)	25.9	0.3	16	26.0	0.2	17	26.0	0.2	33
Culmen (mm)	14.8	0.1	33	14.6	0.1	40	14.7	0.1	73
Weight (g)	79	0.9	41	77	1.1	38	78	0.8	79

TABLE 6

Seasonal changes in body weight (g) and moult (% birds examined) of Ground Parrots. Moult results given as (a) % all birds showing moult, and (b) % birds showing tail and wing feather replacement. Adults and subadults combined, mean and S.E. of weights given, n = number of birds examined. — indicates no data for those months.

	Months											
Characters	J	F	M	A	M	J	J	A	S	O	N	D
Weight x̄	76.2	—	75.3	76.1	79.9	80.3	—	77.1	80.0	76.8	81.3	81
S.E.	3.4	—	4.4	1.4	1.3	1.5	—	1.9	1.7	1.7	2.6	—
n	5	—	4	15	19	10	—	10	13	13	4	1
Moult (a)	80	—	75	89	33	30	—	0	5	0	0	0
(b)	80	—	75	33	28	0	—	0	0	0	0	0
n	5	—	4	9	18	10	—	10	12	13	3	1

Sex differences

Forshaw (1981) detected no sexual dimorphism in Ground Parrots based on either plumage or body measurements. However, the geographical dispersion of the sexed specimens he used was not given. In Ford's (1969) analysis, specimens were grouped on a state basis. These results indicated no consistent difference between males and females in wing, tail and tarsus lengths, but for culmen length, males were larger than females. Ground Parrots in this study followed a similar pattern with the only significant sexual difference being in culmen length (Table 7). The bimodal distribution in culmen length among sexed individuals (Fig. 2) supports the suggestion that parrots may be sexed by this measurement. Only birds with culmen lengths of 14.6 to 15.0 mm are unlikely to be accurately sexed. If all adult and subadult birds with culmen lengths less than 14.6 mm are female and those greater than 15.0 mm are male then the sex ratio of the Ground Parrot population in Cooloola is approximately 1:1 (28 males:32 females).

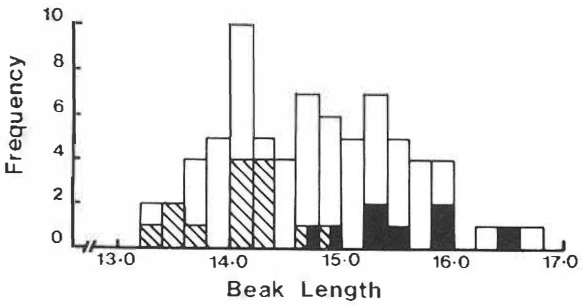

Figure 2. *Frequency distribution of culmen lengths (mm) of Ground Parrots in Queensland. Lengths grouped in two millimetre increments. Hatched areas represent known females; black areas are known males (total n = 73 birds).*

Adaptive Correlates of granivory

Wiens and Johnston (1977) list several structural attributes correlated with granivorous diet. These features include a large relatively short beak that is deep at the base; some structural modification of the digestive tract; a specific leg structure; a specific mode of locomotion; and sexual dimorphism in plumage but not in body measurements. Four of the five features are present in Ground Parrots. The short broad beak is obvious, while the distensible crop is usually conspicuous only in young birds and in adults fully laden with seed. The long tarsi, toes and claws, combined with the parrot's ability to walk and run, are typical of cursorial granivores. Such morphological characters are particularly useful in clambering over the thick tussock vegetation in the wet microhabitats. The Ground Parrot departs from the predicted attributes of granivores in the absence of plumage dimorphism. There are, however, probable structural differences between the sexes. Among the four genera considered closely related to the Ground Parrot, 10 of the 14 species have some plumage dimorphism, but all are more mobile and conspicuous (Pizzey 1980; Forshaw 1981). The ground-dwelling existence and restricted flying activity of the Ground Parrots could mean that visual contact between birds is limited and hence obvious plumage dimorphism is of low value.

TABLE 7

Body measurements of adult and subadult Ground Parrots of known sex (mean ± S.E., n = sample size). Sexed birds from collected specimens or on basis of brood patch (♀) and attendance on chicks (♂).

Body measure	Male			Female			t-test significance
	Mean	S.E.	n	Mean	S.E.	n	
Wing (mm)	127	2.3	7	126	1.5	7	N.S.
Tail (mm)	175	2.8	6	175	3.2	6	N.S.
Tarsus (mm)	26.1	0.3	7	25.8	0.4	7	N.S.
Culmen (mm)	15.5	0.2	8	14.0	0.1	14	$P < 0.001$
Weight (g)	78	2.1	8	79	1.6	14	N.S.

N.S. = non-significant.

ACKNOWLEDGMENTS

I am grateful to Greg Gordon and Peter Ogilvie for their helpful comments on this paper. Special thanks go to the numerous volunteers who gave their time and legs in the pursuit of parrots, to John Courtney for his valuable observations, and to the Australian Bird and Bat Banding Scheme for the longevity data. Logistical and financial support was provided by the Queensland and Australian National Parks and Wildlife Services, respectively.

REFERENCES

ABBBS (1989). 'The Australian Bird Bander's Manual.' (ANPWS: Canberra.)

Bevege, C. (1967). Calling of the Ground Parrot. *Emu* **67**: 209–210.

Ford, H. A. (1985). A synthesis of the foraging ecology and behaviour of birds in eucalypt forests and woodlands. In 'Birds of Eucalypt Forests and Woodlands: Ecology, Conservation, Management.' (Eds A. Keast, H. F. Recher, H. Ford and D. Saunders) pp. 249–254 (Surrey Beatty & Sons: Chipping Norton.)

Ford, J. (1969). Distribution and taxonomic notes on some parrots from Western Australia. *S. Aust. Ornithol.* **25**: 102–104.

Forshaw, J. M. (1981). 'Australian Parrots.' (Lansdowne Press: Melbourne.)

Gould, J. (1865). 'Handbook to the Birds of Australia.' 2. (Author: London.)

Hindwood, K. A. (1933). The Ground Parrot. *Emu* **32**: 241–246.

Hinsby, K. B. (1948). Notes on the Ground Parrot. *Emu* **47**: 313–314.

Hunt, A. C. (1958). Ground Parrot 'pocket'. *Emu* **58**: 411.

Jordan, R. (1987). The Ground Parrot in Barren Grounds Nature Reserve. In 'Barren Grounds Bird Observatory Report 1984–86.' (Eds R. Jordan and P. Jordan) pp. 19–23. RAOU Report No. 27.

Jordan, R. (1988). The use of mist nets and radiotelemetry in the study of the Ground Parrot *Pezoporus wallicus* in Barren Grounds Nature Reserve, New South Wales. *Corella* **12**: 18–21.

Mattingley, A. H. E. (1918). The Ground Parrot *(Pezoporus formosus). Emu* **17**: 216–218.

McFarland, D. C. (1988a). Fire and the vegetation composition and structure of subtropical heathlands in south-eastern Queensland. *Aust. J. Bot.* **36**: 533–546.

McFarland, D. C. (1988b). The composition, microhabitat use and response to fire of the avifauna of subtropical heathlands in Cooloola National Park, Queensland. *Emu* **88**: 249–257.

Meredith, C. W., Gilmore, A. M. and Isles, A. C. (1984). The ground parrot (*Pezoporus wallicus* Kerr) in south-eastern Australia: a fire-adapted species? *Aust. J. Ecol.* **9**: 367–380.

Meredith, C. W. and Isles, A. C. (1980). A study of the Ground Parrot *(Pezoporus wallicus)* in Victoria. Publication No. 304. Environmental Studies Division, Ministry for Conservation, Victoria.

Newman, O. M. G. (1979). The Ground Parrot — census, calls, nest and movement. *Tas. Bird Report* **8**: 4–7.

Pizzey, G. (1980). 'A Field Guide to the Birds of Australia.' (Collins: Sydney.)

Wiens, J. A. and Johnston, R. F. (1977). Adaptive correlates of granivory in birds. In 'Granivorous Birds in Ecosystems.' (Eds J. Pinowski and S. G. Kendeigh) pp. 301–340 (Cambridge University Press: Cambridge.)

BOOK REVIEW

Portrait of a Peninsula: The wildlife of Torndirrup.
Vic Smith, 1991. Published by the author.
120 pp., 34 colour photographs, 37 line drawings, 210 × 140 mm, rrp. $12.50.

Vic Smith retired to live and study the fauna on a peninsula, south of Albany in southern Western Australia, where lies the Torndirrup National Park. He describes in Part 1 of this small book the discovery of the region by Europeans, settlement and current attractions. In Part 2 is described the geology, climate, vegetation and flora, and fauna. The most extensive sections are those of vertebrates. There is also a short discussion on the Torndirrup ecosystem, and the ocean to the south with a history of whaling. Throughout the text are attractive line illustrations, mainly of fauna, all but two of which have been drawn by Michael Bamford.

Torndirrup National Park is an interesting place with magnificent coastal scenery. The floral canopy of its low vegetation is remarkable and beautiful, and the sequential blossoms supply food not only to insects and birds but also to honey possums. Beneath the canopy live other small marsupials including dipplers.

It is to be expected in such a small book that discussions are selective and brief but for ornithologists there is a checklist with notes on time of presence, abundance and breeding. The section on marsupials contains much information on their biology.

The book is easy to read and quickly the reader gets a 'feel' for the region, and herein lies its value. Anyone planning to visit the region should read this book and take the copy with them so they can quickly reread it when there. For those who become 'hooked', the bibliography and checklists in Part 3 will guide them into the next stage of enthusiasm. The book may be obtained from the author at 1 Karrakatta Road, Goode Beach, Western Australia 6330.

M. D. Murray
Pymble, NSW