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THE BIOLOGY OF THE PLAINS-WANDERER *Pedionomus torquatus* ON THE RIVERINE PLAIN OF NEW SOUTH WALES DURING AND AFTER DROUGHT

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One hundred and sixteen male and 66 female Plains-wanderers *Pedionomus torquatus* were captured between April 1981 and February 1985. Body measurements are presented. Twenty-six chicks and immature birds were caught, some several times. These birds, and the discovery of nests, indicate that breeding started in late August in the two years following the 1982 drought, and second clutches were laid in January in one of these years. Wing feather moult was observed during the 1982 drought only. Observations on habitat and behaviour are presented.

INTRODUCTION

The Plains-wanderer *Pedionomus torquatus* has had an unstable taxonomic history with the sexes being described first as two species (Gould 1840, 1842) whilst recently this sole member of the family Pedionomidae has been removed from the order Gruiformes and placed in the Charadriiformes (Olson and Steadman 1981).

The Plains-wanderer is a rare species (Cowling and Davies 1983) that has undergone a marked contraction in distribution (Bennett 1983, Blakers, Davies and Reilly 1984). Bennett (1983) reviewed the biology and distributional records of the Plains-wanderer and concluded that this species was poorly known and probably widespread in small numbers in its remaining strongholds in the Riverina and north-central Victoria. By following up occasional sightings, two of us (GNH and PNM) became conversant with its apparent habitat preferences and discovered Plains-wanderers to be more or less permanently present in some areas. A banding study was initiated to reveal details of morphometrics, moult, residency and breeding of the species. The study began shortly before the drought of 1982 – early 1983 (Figure 1) and continued through two years of higher rainfall, allowing us to make some interesting temporal comparisons. In 1984 DJB-G commenced a full-time study of the Plains-wanderer. This enabled him to make more detailed measurements of some aspects of Plains-wanderer ecology which will be reported in the future.

STUDY AREA AND METHODS

Habitat

This study has been confined to Plains-wanderers occurring on the Riverine Plain between the Murrumbidgee and Edwards Rivers. The Riverine Plain is extremely flat and the soils are generally heavy and of alluvial origin although there are admixtures of aeolian material. The

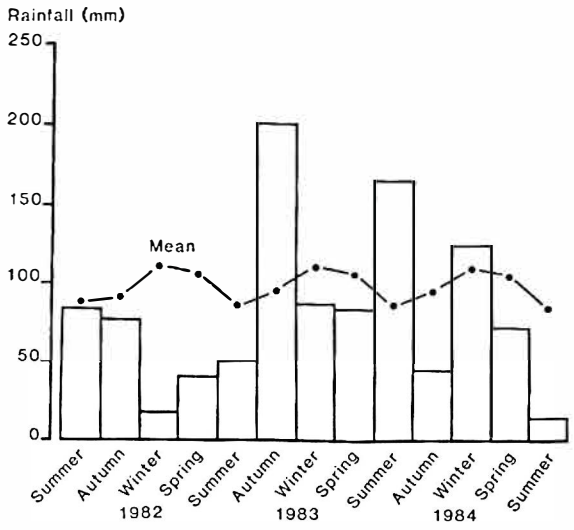

Figure 1. *Seasonal rainfall at Deniliquin during the study period (bar chart) and the 120-year mean (line).*

vegetation has been considerably modified by grazing and clearing. In many areas it is not certain what was the original condition of the vegetation, but six main vegetation types can now be recognized (Table 1). No formal assessment of the relative abundance of Plains-wanderers in these vegetation types was undertaken. The low capture rate per search hour, even in preferred habitat, and the necessity to search at night enforced by Plains-wanderer behaviour, proved to be a considerable stimulus to ascertain their habitat preference. A floristic list is available for each vegetation type but is not presented here as it appeared that the physical structure of vegetation was more influential on Plains-wanderer distribution than the plant species present.

Methods of Capture

Attempts were made to flush birds on two occasions in daylight from Type 4 and Type 5 vegetation (see Table 1 for vegetation descriptions) using ropes and chains dragged over the pasture by two vehicles with observers walking immediately behind the rope at approximately 10 m intervals. Stubble Quail *Coturnix pectoralis* were flushed, but not Plains-wanderers. On one occasion three Plains-wanderers were captured on the same night that ropes dragged across an entire Type 5 area during daylight hours had revealed no birds of this species to be present. Subsequent radio-telemetry work (Baker-Gabb, Benshemesh and Maher, unpublished data) revealed that Plains-wanderers do occupy Type 5 areas by both day and night, but that during the day thay avoid detection by running away from approaching intruders, rather than squatting like quail.

Therefore, we used a repeatable nocturnal survey technique in this study. Open plains were quartered by vehicles after dark using headlights on high beam and a roof-mounted or hand-held spotlight. To establish that Plains-wanderers were present in an area often took more than five vehicles hours and 50 km of driving to cover a mere 2 km^2. The majority of the 225 captures were of birds first located on the ground and held in the spotlight beam whilst a second observer approached them on foot and lowered a hand-held fisherman's landing net over the bird. Birds approached in this manner rarely flew although they sometimes walked away. A small number of birds were first seen in flight after they were flushed.

TABLE 1

The main vegetation types on the Riverine Plain.

Type 1.	Open Boree *Acacia pendula* woodland with varying densities in the field layer of sub-shrubs, such as Ruby Saltbush *Enchylaena tomentosa* and Thorny Saltbush *Rhagodia spinescens*, and a variety of ephemeral and perennial herbs.
Type 2.	Bladder Saltbush *Atriplex vesicaria*.
Type 3.	Other sub-shrubs of the family Chenopodiaceae.
Type 4.	Areas dominated by dense Patersons Curse *Echium plantagineum*, Wild Oat *Avena fatua*, White Top *Danthonia caespitosa* and Wimmera Ryegrass *Lolium rigidum* which all grow in winter and spring.
Type 5.	Areas of sparsely growing ephemeral and perennial herbs and grasses.
Type 6.	Bare ground.

Llewellyn (1975) stated that he threw a net over Plains-wanderers from a distance of 4 to 5 m. This is uneccessary in our experience and it is likely that Llewellyn was extrapolating from his knowledge of the behaviour of quail, which were his main targets, rather than Plains-wanderers.

Morphometric data

The wing length was measured using the "flattened wing" method (Svensson 1970), and all other measurements were taken according to Baldwin, Oberholser and Worley (1931). Details of soft parts coloration were noted for all captive birds and all birds were examined for evidence of moult.

Breeding data and determination of sex ratios

Approximate egg-laying dates were calculated be ageing chicks from their plumage (Crome and Rushton 1975) and assuming an incubation period of 23 days (Reader's Digest 1976). Crome and Rushton (1975) recorded that primary feather growth was linear with time and was complete at 7 weeks in males and 8 weeks in females. In females the adult collar and gorget began to appear at 9 weeks of age and the sexes could then be distinguished readily. We found that the underwings of juveniles were not fully feathered for at least a month after this. Thus, so long as juveniles were classified separately, there was little chance of obtaining erroneous sex ratio data among adults.

RESULTS

Habitat

We have not observed Plains-wanderers in the boree woodland (vegetation Type 1) nor in any other fringing woodland such as Black Box *Eucalyptus largiflorens* or Murray Pine *Callitris preissii*. It appears that Plains-wanderers avoid treed habitats even when the field layer is similar to areas which they inhabit. Plains-wanderers have been observed in the other five vegetation types listed in Table 1, but only 5 (2%) of 225 captures occurred in Types 2, 3, 4 and 6. They were overwhelmingly easier to find in Type 5 vegetation. Type 5 vegetation seems to occur in areas of past erosion where the light "A" horizon soil has been eroded by wind to expose a red clay subsoil which does not support dense pasture growth under any seasonal conditions. The more robust plants in Type 5 vegetation are generally spaced 10 to 20 cm apart and rarely exceed 10 cm in height.

Our nocturnal surveys showed that along a vegetation density gradient from bare ground to the densest possible pasture, Plains-wanderers tended to occupy an intermediate position, together with the Banded Lapwing *Vanellus tricolor*. Vegetation favoured by Plains-wanderers was denser than that preferred by the Australian Dotterel *Peltohyas australis* and Australian Pratincole *Stiltia isabella*, but less so than where Brown Songlarks *Cinclorhamphus cruralis* and Stubble Quail *Coturnix pectoralis* were most commonly found. This habitat partitioning was not absolute however. Considerable overlap was observed, particularly in times of drought.

Locomotion

On release after banding, the birds commonly sat or stood for a few minutes and then usually walked away. When running or walking, the birds often stumbled over small objects on the ground and had difficulty in penetrating pasture plants growing close together. This was in marked contrast to Stubble Quail. Although their physical ineptitude could have been the product of handling and/or the spotlight, this seems unlikely because in daylight, captive Plains-wanderers have been observed to experience similar physical difficulty in tracts of dense pasture. Plains-wanderers are direct fliers and their flight could be likened to that of the Eurasian Coot *Fulica atra*. In contrast to Stubble Quail, a flying Plains-wanderer's final 2 m descent to land is slow and fluttering. Usually they landed less than 50 m from where they were flushed and they could than be approached and caught. On a few nights, however, most birds flew, some for long distances. One bird stayed in the air for 20 minutes, and another flew 3.5 km whilst being followed by a vehicle travelling at 40 km per hour before the bird escaped over a fence. The different behavioural patterns tended to be common to most birds on a particular night rather than characteristic of an individual bird. They could not be related to particular weather or seasonal conditions. Immature birds were more likely to fly than adults.

Recaptures

The details of the adult birds which were subsequently recaptured are recorded in Table 2.

TABLE 2

Details of 18 adult Plains-wanderers recaptured in the study area.

Sex	Date of first capture	No. of intermediate captures	Date of last capture	Days between first and last capture
M	11 Dec. 82	0	23 Dec. 82	12
M	16 Dec. 82	1	12 Mar. 83	59
F	27 Jan. 83	0	26 Mar. 83	65
M	5 Jan. 84	1	4 Aug. 84	211
M	10 Feb. 84	0	2 Mar. 84	21
F	10 Feb. 84	0	8 Apr. 84	58
M	1 Mar. 84	1	23 June 84	114
F	2 Mar. 84	0	4 Aug. 84	155
F	16 June 84	1	25 Sept 84	94
F	16 June 84	0	22 June 84	6
M	22 Sept 84	0	1 Nov. 84	40
M	23 Sept 84	1	31 Jan. 85	130
M	23 Sept 84	1	31 Jan. 85	129
M	20 Dec. 84	0	13 Apr. 85	84
M	8 Jan. 85	1	15 May 85	127
F	11 Jan. 85	1	18 May 85	127
M	11 Jan. 85	0	18 May 85	127
M	2 Feb. 85	0	13 Feb. 85	11

No bird has been recorded returning to, or being resident in, the same area for more than 211 days, even though most of the catching activity has been centred on six areas of approximately 150 hectares each. Similarly we have no record of a bird first caught as an immature being present in the subsequent breeding season (Table 3).

All birds recaptured were within 400 m of the original place of capture. Searching areas of adjacent suitable habitat between 2 to 10 km apart has not revealed evidence of local movement.

TABLE 3

Details of 11 juvenile Plains-wanderers recaptured in the study area.

Sex	Date of first capture	No. of intermediate captures	Date of last capture	Days between first and last capture
M	2 Mar. 84	0	8 Apr. 84	37
F	3 Mar. 84	2	31 Mar. 84	28
F	23 Mar. 84	0	31 Mar. 84	8
F	31 Mar. 84	0	10 Apr. 84	11
F	31 Mar. 84	1	16 June 84	78
M	10 Jan. 85	0	31 Jan. 85	21
M	11 Jan. 85	0	16 Jan. 85	5
M	11 Jan. 85	0	22 Feb. 85	42
M	31 Jan. 85	0	22 Feb. 85	23
M	1 Feb. 85	0	5 July 85	155
M	22 Feb. 85	3	26 July 85	154

Morphometric data

There was considerable overlap between the measurements of males and females but the means of all measurements were larger for females (Table 4). The measurement with the lowest proportional overlap between the sexes was total head length (7%). The body weight and wing lengths were notable for their wide ranges. Abrasion of wing feathers in this ground-dwelling bird may account for the large range in wing length measurements. Mass changed seasonally, being lowest in summer and autumn. Some recaptured individuals differed by as much as 10 g (males) to 15 g (females) from one season to the next.

Colour of soft parts

The soft parts of immature birds were always a low intensity pale yellow or cream. Non-breeding adults were of similar intensity but showed a ten-

TABLE 4

Morphometrics of Plains-wanderers.

	Male			Female			
	n	Mean	Range	n	Mean	Range	Overlap
Wing (mm)	86	88.9±4.3	79.0-104.0	52	96.5± 6.1	89.0-109.0	89.0-104.0
Mass (g)	108	54.0±7.0	39.0- 78.0	64	72.4±10.3	57.0- 95.0	57.0- 78.0
Total head length (mm)	35	36.0±0.9	34.5- 39.0	27	37.8± 1.1	36.4- 40.8	36.4- 39.0
Exposed culmen (mm)	35	12.3±1.1	10.8- 13.9	30	12.8-± 1.0	10.6- 14.9	10.6- 13.9
Mid-toe and claw (mm)	32	23.5±1.2	20.5- 25.7	29	24.1± 1.8	19.1- 26.3	19.1- 25.7
Tarsus (mm)	50	25.1±2.1	22.7- 28.4	36	25.9± 1.7	22.9- 30.8	22.9- 28.4

± = Standard deviation

dency to increase in intensity from June onwards, becoming bright yellow to orange when breeding during September to January. Thereafter the colour intensity of soft parts declined. However, the proportion of first year birds at this time was unknown.

Moult

Moult of body feathers was recorded in all years (1982-1985) during October to May. Moult of wing feathers was recorded in only 6 of 182 adults examined in 24 different months over a 4 year period. Moult of primary and secondary feathers was only recorded during the 1982 drought. One male was completing its primary moult in May and a female was half-way through its primary moult in October. In December one male was recorded as having begun and another nearly completed their respective primary moults, whilst another male and a female were half-way through theirs. These observations show that Plains-wanderers moult their primary feathers sequentially. This highlights an anomaly in these data; it would be expected that adult birds would moult their primary feathers at the completion of the breeding period. We have not observed this, nor have we captured any banded parents during the maturation period of the juveniles. Yet as Table 2 demonstrates, some adult birds do appear to be resident during the period when moulting might be expected. As there is no evidence for a well defined moulting period it must be concluded that the birds were more secretive when moulting, that their moult is irregular, or that they normally moult away from the breeding area.

Sex ratio

Of the adult birds caught, 116 were males and 66 were females. This 2:1 ratio was a constant trend and does not appear to have any seasonal variation. It is not certain whether this is due to lower density of females or because they behave more secretively than males. We suspect the former is true because females we observed at night seemed neither more nor less secretive than males. Juveniles have been observed in the ratio of 8 probable males to 11 definite females and so it seems unlikely that females are hatched in lower numbers than males.

Aggregations and breeding

Plains-wanderers are usually solitary outside the breeding season. During the 1982 drought and the dry summer of 1984-1985, three or four birds were occasionally observed within 10 m of each other. The members of a breeding pair were found less than 2 m apart on several occasions in late winter and spring, but less often in summer. Other aggregations consisted of a male and his small chicks, or groups of presumed siblings.

During the severe drought of 1982 there was no evidence of breeding by Plains-wanderers on the Riverine Plain. Successful breeding occurred in spring of 1983 and 1984. Plains-wanderers were first found in distinct pairs in July, and females were then heard calling. Two clutches of four eggs and one clutch of three eggs were found. From these clutches, and additional broods of downy young located, clutches were calculated to have been laid in late August (n=1), September (n=2), October (n=4) and November (n=2).

The 1983-1984 summer was unusually wet (Figure 1) and further successful breeding was recorded in the form of chicks from five clutches calculated to have been laid in January. The summer of 1984-1985 was very dry and despite intensive searches no breeding was recorded. A minimum of 14 breeding events were recorded from the study area in 1983 and 1984.

Nest descriptions

Four nests were found in vegetation Type 5 and one in rather sparse vegetation Type 4, the latter dominated by Wimmera Ryegrass *Lolium rigidum*. Each nest consisted of a scrape some 6 cm wide and 2 cm deep with a lining of grasses. The nests in vegetation Type 5 had no cover immediately overhead, but all were surrounded by grasses or were shaded from the west. The nest in vegetation Type 4 had overhead grasses pulled together to form a concealing cone.

DISCUSSION

Habitat

Plains-wanderers have been located in old stubble, sparse wheat crops during harvesting and grazed uncultivated pasture, which between them contain a wide variety of native and introduced grasses and herbaceous plants (Llewellyn 1975, Bennett 1983). The uncultivated grazed paddocks in which we caught Plains-wanderers contained

most of the plant species listed by Llewellyn (1975). However, we hypothesise that vegetation structure and the percentage of bare ground have more influence than floristics on the local distribution of Plains-wanderers; this is being tested at present. An open sward allows Plains-wanderers to forage with ease (Baker-Gabb, in press) and to run away from predators undetected (Keartland 1901, Baker-Gabb, Benshemesh and Maher, unpublished data). Plains-wanderers are reluctant to fly during the day. Whilst Plains-wanderers are strong direct fliers, their apparent lack of manoeuvreability in the air and particularly their final slow, fluttering descent to the ground would render them vulnerable to being preyed on by diurnal raptors. The apparent avoidance of sparse grasslands with trees by Plains-wanderers may also be influenced by the behaviour of both diurnal and nocturnal aerial predators that hunt from and rest on elevated perches in the scattered remnant woodlands.

Breeding

Bennett (1983) reviewed 18 breeding records and reported no seasonal trend, with egg-laying occurring in every month except March and April. Additionally, on the Diamantina alluvial plain in western Queensland, chicks have been found recently which were probably hatched in June 1983 (G. Porter, *in litt.*), and March 1984 (pers. obs.). Heavy rain fell about one month prior to both of these breeding events (P. McNeven, pers. comm.). These and Bennett's (1983) records at first appear to contrast with the more restricted breeding season we recorded on the Riverine Plain. However, reanalysis of Bennett's (1983) records shows that 13 (72%) of the clutches from New South Wales, Victoria and South Australia were laid during late winter and spring. As in our study, a minority (22%) of clutches were recorded in summer and only one was from outside these periods. In mid-western Queensland there appears to be a tendency towards autumn and early winter breeding. These few records are similar to the pattern of seasonal breeding of the Budgerigar *Melopsittacus undulatus*, which follows patterns of seasonal growth of pasture plants, (Wyndham 1982). Several authors (Keast and Marshall 1954, Serventy and Marshall 1957, Frith and Davies 1961) have shown that in Australia the breeding seasons of most birds are in general linked with seasonal rainfall or its after effects. In the south breeding is mainly in spring, but breeding in summer and autumn in response to unpredictable heavy rainfall can occur in some species, notably the endemic inland shorebirds that do not migrate out of Australia (Serventy and Marshall 1957, Lane 1987). It seems that the Plains-wanderer conforms to this pattern. On the Riverine Plain, the Plains-wanderer may be prevented from breeding (as in the 1982 drought), or it may extend its breeding from spring into summer (as in 1983), whereas 1 200 km to the north its breeding follows more reliable autumn rainfall.

CONCLUSION

Whilst Plains-wanderers have declined markedly, particularly in former strongholds such as southern Victoria, southern South Australia and eastern New South Wales (Bennett 1983), our interim conclusion is that suitable habitat remains widespread in the Riverina of New South Wales. To census all possibly suitable habitat for Plains-wanderers in southern and central Australia at different times of year would require a prodigious effort. It seems unlikely that an accurate estimate of the total population of Plains-wanderers will ever be made. Nevertheless, there is a need for more information on where Plains-wanderers occur in Australia in order to clearly define what constitutes suitable habitat and the expected density of Plains-wanderers within that habitat. Our ability to locate Plains-wanderers repeatedly in the same 100-200 ha areas of paddocks comprising a few thousand hectares has profound management implications in view of Bennett's (1983) conclusion that reserves may not be an option for Plains-wanderers because thay would need to be very large and their acquisition would be prohibitively expensive. Our results show that reserve acquisitions may be a viable option. At our study sites, Plains-wanderers bred successfully and maintained an apparently robust population despite the common occurrence of Feral Cats *Felis catus*, Foxes *Vulpes vulpes* and birds of prey and grazing by sheep *Ovis aries*.

To some extent the situation is anomalous. Plains-wanderers appear to favour areas previously degraded by overgrazing. However in droughts, grazing sheep can render such areas so bare that they are unsuitable for Plains-

wanderers, but what the birds do at such times is not yet established. They may move to vegetation that is normally too dense for them. Our data suggests that there may be increased movement in reponse to drought. Such enforced movement may increase mortality, possibly to a serious extent.

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REFERENCES

Baker-Gabb, D. J. (in press). The diet and foraging behaviour of the Plains-wanderer *Pedionomus torquatus*. *Emu in press*.

Baldwin, S. P., Oberholser, H. C. and Worley L. G. (1931). Measurements of birds. *Sci. Publ. Cleveland Mus. Nat. Hist.* **2**: 1-65.

Bennett, S. (1983). A review of distribution, status and biology of the Plains-wanderer *Pedionomus torquatus*, Gould. *Emu* **83**: 1-11.

Blakers, M., Davies, S. J. J. F. and Reilly, P. N. (1984). The Atlas of Australian Birds. Melbourne University Press, Melbourne.

Cowling, S. J. and Davies, S. J. J. F. (1983). Status of Australian birds with special reference to captive breeding. Victoria Department of Conservation, Forests and Lands Tech. Rep. No. 1.

Crome, F. H. J. and Rushton, D. K. (1975). Development of plumage in the Plains-wanderer. *Emu* **75**: 181-184

Frith, H. J. and Davies, S. J. J. F. (1961). Breeding seasons of birds in subcoastal Northern Territory. *Emu* **61**: 97-111.

Gould, J. (1840). *Pedionomus*. *Proc. Zool. Soc. Lond.* **1840**: 114-115.

Gould, J. (1842). *Pedionomus microurus*. *Proc. Zool. Soc. Lond.* **1842**: 20-21.

Keartland, G. A. (1901). Notes on the Plain Wanderer. *Vic. Nat.* **17**: 167-168.

Keast, J. A. and Marshall, A. J. (1954). The influence of drought and rainfall on reproduction in Australian desert birds. *Proc. Zool. Soc. Lond.* **124**: 493-499.

Lane, B. A. (1987). Shorebirds in Australia. Nelson, Melbourne.

Llewellyn, L. C. (1975). Recent observations on the Plains-wanderer with a review of its past and present status. *Emu* **75**: 137-142.

Olson, S. L. and Steadman, D. W. (1981). The relationships of the Pedionomidae (Aves: Charadriiformes). *Smithsonian Contributions to Zoology*. 337.

Reader's Digest (1976). Complete Book of Australian Birds. Reader's Digest Services Pty Ltd, Sydney.

Serventy, D. L. and Marshall, A. J. (1957). Breeding periodicity in Western Australian birds; with an account of unseasonal nestings in 1953 and 1955. *Emu* **57**: 99-126.

Svensson, L. (1970). Identification Guide to European Passerines. Naturhistoriska Riksmuseet, Stockholm.

Wyndham, E. (1982). Movements and breeding seasons of the Budgerigar. *Emu* **82**: 276-282.