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ABUNDANCE, DIET AND ROOSTING DEFECATIONS OF THE TORRESIAN IMPERIAL-PIGEON *Ducula spilorrhoa* IN DARWIN

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Observations on seasonal variation in the presence of the Torresian Imperial-Pigeon in Darwin, Northern Territory, indicate that numbers are highest between September and April. The diet in a suburban environment is dominated by a few plant species, of which the Carpentaria palm is the most important.

INTRODUCTION

The Torresian Imperial-Pigeon *Ducula spilorrhoa* is a common breeding visitor to Darwin in the late dry season to late wet season (Crawford 1972; Blakers *et al.* 1984; Thompson 1987). In most years small numbers of birds remain all year round, with the bulk migrating north (Thompson 1987).

Crome (1975) and Frith (1982) list a considerable variety of fruits of rainforest plants that comprise the diet of the pigeon. Frith (1982) indicates that the range of fruits taken in the Northern Territory is rather restricted. Most of Frith's comments on Northern Territory birds appear to refer to those occurring in patches of natural rainforest and monsoon forest. Little information is available on the diet of the pigeon in urban areas other than Thompson's (1987) comment that in Darwin the diet includes fruit of the Carpentaria palm *Carpentaria accuminata* and Weeping Figs *Ficus benjamina*. My data indicate differences in diet in urban and natural forest habitats.

Observers have recorded large accumulations of seeds below nesting colonies in Queensland (Crome 1975; Frith 1982). The possibility of the pigeon being an important agent for the dispersal of certain seeds remains to be demonstrated.

This paper reports on observations of birds in a suburb of Darwin, Northern Territory, with particular attention to seasonal variations in numbers, diet and roosting behaviour. Data on defecatory patterns at roosts are presented as an indication of the potential significance of the pigeon as an agent of dispersal of seeds from fruiting plants, and their subsequent concentration below roosts.

METHODS

From July 1988 to June 1991 I recorded the number of pigeons seen on a regular route (2 km) through the Darwin suburb of Millner. These counts were conducted during the early morning (beginning about 0630–0645 hrs CST) for a period of approximately 30 minutes on an average of 18 days each month. Millner is characterized by established gardens, including many large palms, native and exotic fruiting and ornamental trees. Sections of the bird-count route also passed alongside mangroves and bushlands bordering a small tidal creek and through a park. Pigeons were only rarely encountered in riparian sites and parkland. Most birds were recorded perched in prominent trees in gardens, on telegraph wires in the street, or in flight.

Information on diet of the pigeons was collected over a ten-year period by casual observations of feeding, and the examination of droppings in December 1990 and September 1991. As little quantitative data on feeding or systematic collection and analysis of droppings was undertaken, this information is provisional.

In early December 1990 several pigeons occasionally used tall trees overhanging the metal roof of my living-room as diurnal and nocturnal roosts. The number of roosting birds was determined by direct observation. The sound of defecations striking the roof were sufficiently loud and distinctive to enable me to keep a record of numbers of defecations and their intervals measured to the nearest minute. I was able to

record defecatory patterns on the evenings of 3 and 5 December 1990 and early on the morning of 29 December 1990 for a total period of 5 hours 40 minutes. More frequent records were not possible, as birds did not use the same roost regularly, and appeared to abandon my garden entirely as a roosting area at the end of December 1990.

To determine the number of seeds contained in defecations I spread a plastic sheet measuring 2.5 × 3.7 m on the ground below a day time roost on 21–23, and 28–29 September 1991. Seeds were also collected for identification from the drop-sheet and adjacent lawn on these dates.

RESULTS AND DISCUSSION

Pigeons were present in Millner in all months except June and July (Table 1). Casual observations in Darwin over the last ten years, however, include records in all months (unpubl. data). Numbers of birds and the months in which they were present vary from year to year (Table 1). Peak numbers were recorded between September and April, but the period of high numbers varied from six months duration (September to February) in the 1988–89 season to eight months (September to April) in the 1990–91 season.

Numbers of the Torresian Imperial-Pigeon in Darwin are low compared with concentrations reported in eastern Cape York and New Guinea. Crome (1975), for example, estimated the population roosting and nesting in mangrove forest covering approximately 5 ha on the Low Isles, north Queensland, at up to 25 000. Birds made daily feeding flights to and from the mainland (see also Frith 1982; Atherton and Greeves 1985; Coates 1985; Thorsborne *et al.* 1988).

In Millner, birds were generally recorded singly or in pairs during morning bird counts, and occasionally in larger groups numbering up to six individuals. At other times in Darwin, I have recorded flocks of up to 20 individuals after breeding had apparently concluded and prior to migration north in the mid to late wet-season.

The Torresian Imperial-Pigeon breeds regularly in Darwin. It has not been reported to nest in colonies as on offshore islands elsewhere in its range (Frith 1982). I have recorded nests in Millner in the late dry-season in October through to November, and juvenile birds in the company of adults in November and December.

TABLE 1

Abundance of Torresian Imperial-Pigeons on daily bird counts. D — number of days birds recorded; C — number of monthly counts.

Year/ month	Daily mean	Standard deviation	Monthly total	D/C	Monthly range
1988					
July	0	0	0	0/10	0
Aug.	0.2	0.49	5	4/25	0–2
Sept.	0.9	0.95	22	14/25	0–3
Oct.	2.0	1.77	43	18/22	0–5
Nov.	1.7	1.49	50	23/30	0–5
Dec.	1.8	1.46	44	19/24	0–6
1989					
Jan.	2.2	1.79	35	16/24	0–7
Feb.	2.0	1.47	30	15/23	0–4
Mar.	0.6	1.14	9	4/15	0–4
Apr.	0.1	0.22	1	1/20	0–1
May	0.1	0.22	2	2/20	0–1
June	0	0	0	0/13	0
July	0	0	0	0/17	0
Aug.	0.3	0.67	6	4/18	0–2
Sept.	0.8	0.79	14	10/18	0–2
Oct.	1.1	0.88	25	15/22	0–4
Nov.	1.2	1.05	25	15/21	0–3
Dec.	1.6	1.07	15	9/11	0–3
1990					
Jan.	—	—	—	0/0	—
Feb.	1.3	0.47	4	3/3	1–2
Mar.	0.6	0.68	11	9/18	0–2
Apr.	2.1	2.16	35	10/17	0–6
May	0.2	0.40	3	3/15	0–1
June	0	0	0	0/18	0
July	0	0	0	0/21	0
Aug.	0.1	0.33	2	2/16	0–1
Sept.	1.6	2.06	27	12/17	0–9
Oct.	1.9	1.93	32	11/17	0–7
Nov.	1.9	1.41	36	16/19	0–6
Dec.	2.4	1.49	33	13/14	0–6
1991					
Jan.	2.9	2.05	47	15/16	0–7
Feb.	2.2	2.28	37	13/17	0–9
Mar.	3.2	2.27	51	13/16	0–7
Apr.	2.1	2.02	38	12/18	0–7
May	0	0	0	0/20	0
June	0	0	0	0/18	0

The Torresian Imperial-Pigeon is heavily dependent upon fruits of cultivated plants in Millner. Sightings of high-flying birds suggest they probably range widely into neighbouring suburbs (where available foods are no doubt similar) and patches of savannah woodland and monsoon forest. Here, I have seen pigeons feeding most frequently on the bright red fruit clusters of *Carpentaria accuminata* palms, and the fruit of the *Schefflera actinophylla* umbrella tree (Table 2). These, and

TABLE 2

Observations of feeding by Torresian Imperial-pigeon in trees of suburban Millner.

Species	Frequency eaten	Cultivation status in Millner area
Carpentaria acuminata Carpentaria Palm	Very frequently	Very commonly planted palm in parks, gardens.
Schefflera actinophylla Umbrella Tree	Frequently	Commonly planted tree in gardens.
Ficus benjamina Weeping Fig	Occasionally	Commonly planted tree in parks, gardens.
Caryota sp. Fish-tailed Palm	Seldom	Commonly planted palm in gardens.
Ficus scobina Sandpaper Fig	Rarely	Occurs irregularly in relatively undisturbed sites, gardens.

some other food plants, are commonly grown in suburban gardens and parks, and fruit heavily in the late dry season (about September to December) over the period when the pigeons breed locally.

My observations suggest that the pigeon is a major dispersal agent of *Carpentaria* palms, and some other plants. The seeds are excreted in quantities at pigeon roosts, and every year a fine crop of *Carpentaria* palm seedlings sprouts under the day time roosts in my garden. These are not selfsown, as there are no mature fruiting palms in the immediate vicinity.

Under the pigeons' nocturnal roosting perch of 3 December an estimated 30 seeds coated with blackish-green excrement were found. Bare earth below a nearby day-time roost occupied by two birds in my garden in early December contained more than 200 seeds. The overwhelming bulk of droppings in both areas contained *Carpentaria* seeds, with a few *Caryota* seeds. Small amounts of unidentified pulpy material were also observed.

TABLE 3

Seeds collected below day-time roost, September 1991.

Species	Number of seeds	%
Arecaceae		
Carpentaria acuminata	58	54.2
Caryota	17	15.9
Chrysobalanaceae		
Maranthes corymbosa	25	23.4
Unidentified	7	6.5

Table 3 lists the numbers and identification of seeds collected below the day-time roost in September 1991. These figures confirm the importance of *Carpentaria* fruit in the diet, although other fruits were probably more frequently eaten in December 1990. At no other time have I encountered *Maranthes* seeds in my garden.

The range of fruits eaten by birds roosting in Millner is much more restricted than fruit of 37 species taken by birds in natural rainforest habitats reported by Crome (1975). There also appears to be no overlap in diet between birds in Millner and in Cape York (Crome 1975; Frith 1982).

Table 4 summarises records of defecations on three occasions in December 1990 by either two adults, or two adults and an immature. Birds typically entered nocturnal roosts prior to sunset after late afternoon feeding. The morning records of 29 December also occurred soon after a period of feeding. Each set of records thus relates to birds that presumably had full crops.

Alert birds in the morning defecated with great frequency, at an average rate of once every six minutes per bird. Sleeping birds defecated less frequently, about once every 20 to 25 minutes. No decline in defecation rate with time since ingestion was evident.

Examination of the plastic sheet below the day-time roost in September 1991 indicated that each defecation contained no more than one *Carpentaria* seed. This suggests that each bird had gone to a nocturnal roost in December 1990 with at least nine fruit in its digestive tract. As fruits each weigh 3.95 ± 0.40 (SD) g, this represents a minimum weight of 35 grams of food. The birds' capacity is considerably greater, however; I observed one bird swallow at least 25 *Carpentaria* fruits (weighing about 98 g) in about three

TABLE 4

Timing of Defecations in December 1990.

Date	Recording period	Minutes	No. birds	No. defecations	Mean No. defecations per bird per hour
3/12	1850–2233	223	2	18	2.42
5/12	2130–2253	83	2	8	2.89
29/12	0727–0801	34	3	18	10.58

minutes, causing noticeable distention of the crop, and on two occasions a bird swallowed 14 fruits (about 55 g).

Crome (1975) and Frith (1982) indicate that considerable quantities of excreted fruit seeds accumulate below nesting colonies of the Torresian Imperial-Pigeon on the east coast of Queensland. Crome's description of Low Island's vegetation indicates these seeds do not germinate there.

Despite relatively low numbers in roosts in Darwin, data on defecatory habits suggest that birds are able to drop prodigious quantities of seeds in small areas. These seeds appear to be viable, and as the birds are dispersed rather than nesting or roosting in colonies and change roosting locations frequently, these pigeons are likely to be important agents for the dispersal of seeds.

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BOOK REVIEW

A long-term quantitative and seasonal study of a fluctuating forest-bird community

A Bird Observatory at Moruya, NSW, 1975–84.

S. Marchant, 1992. Occas. Publ. No. 1, Eurobodalla Natural History Society 1992. Available from the author, P.O. Box 123, Moruya, NSW 2537. 246 × 175 mm, 99 pp., no plates. $20.00

This is the most important study yet made of an Australian forest-bird community. Extending over a ten-year period the author documents the precise times of occurrence of the bird species, their relative abundances from year to year, and precise breeding dates. Fifty-five species nested within the study plots, many only in some years. Another 20 appeared regularly or bred only irregularly. Thirteen species visited regularly but did not breed. A further 54 species were aerial birds that flew overhead or were casual or accidental visitors. Documentation of the foregoing is extremely interesting in that it emphasizes that only a proportion of presumed forest 'residents' actually are regular inhabitants of specific areas. The corollory is that a high proportion of our forest birds require very wide living space; something that must be acknowledged in any conservation plan. Why did so many occur for only part of the year? Why did abundances of many vary widely from year to year? Why were some rare and only a minority common? To explain this we need detailed information on the ecological requirements of all the species. That we almost totally lack such information is indeed sobering and disquietening. Notwithstanding this concern, I find Stephen Marchant's graphs of monthly occurrences and abundances of the species, based on numbers of bird days during which they were observed, most interesting and stimulating. It demands that attempts be made to develop equivalent data from other areas.

Marchant's data base on breeding (all records are related back to time of laying of first egg in the clutch) is equally interesting and revealing. We have become accustomed, on the basis of review articles, to believing that the egg-laying season in our forest birds is 4–5 months. This study reveals that, when precise records are gathered for an individual area, the season of all but a couple of species is much shorter. In the following species, for example, it is only about two months: White-throated Tree-creeper, Varied Sittella, Wonga Pigeon, Pied Currawong, Fantailed Cuckoo, Grey Shrike-thrush, Variegated Fairy Wren, Laughing Kookaburra, Black-faced Cuckoo-shrike, Olive-backed Oriole, Sacred Kingfisher.

The Crested Shrike-tit, White-winged Chough, Cicadabird, Brush Cuckoo, and Rufous Fantail, restricted their laying to a single month! Of course, it is possible some of the species bred at Moruya and then went elsewhere to breed a second time but this is surely unlikely. At any event Marchant's data demands that we rethink our ideas on the very protracted nature of Australian bird breeding.

Every ornithologist interested in finer details of the biology of our forest birds should have a copy of Marchant's paper. Its wealth of original data is a joy. It is a delight to see this in the present age, where so much writing (especially book material) is simply a rehash of pre-existent knowledge. Let us hope Stephen Marchant's paper will inspire much more work of this quality in the future.

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