

SOCIAL BEHAVIOUR OF TWO FREE-RANGING CHICKS OF AUSTRALIAN BRUSH-TURKEY *Alectura lathami*

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Received: 2 May 2001

To date, chicks of the Australian Brush-turkey *Alectura lathami* have been believed to live solitarily during the first months of their lives. They hatch asynchronously in incubation mounds of leaf litter and receive no parental care. Upon digging themselves out of the mound, they disperse into dense understorey. This hatching process, their camouflaged plumage, lack of loud calls and large distances between incubation mounds would seem unlikely to facilitate encounters between chicks. Our observations represent the first accounts of social behaviour and time budgets of young Brush-turkey chicks in the wild. One radio-tagged chick, approximately three weeks old, spent 20 per cent of the observation time with another similar-aged wild chick, often separating and meeting again. Occasionally, both roosted on the same tree. They remained within a small area of rainforest, where they fed frequently on freshly fallen fruit, especially Watkins Figs *Ficus watkinsiana*. The chicks engaged in social behaviour, such as wing flap runs or aggressive pecking, and one followed the other when changing feeding sites. When adults were nearby, both the chicks and the adults ignored each other, confirming that megapode chicks form no bonds with adults in the wild. These observations suggest that young Brush-turkey chicks form a loose two-chick group occasionally and that this occurs most likely in areas of a rich food supply.

INTRODUCTION

Chicks of the Australian Brush-turkey *Alectura lathami* and all other megapodes live initially in circumstances that do not appear to facilitate meeting conspecifics. They hatch underground, in burrows or mounds of leaf litter where external heat sources incubate the eggs, and they then dig their own way out to the surface (details in Jones *et al.* 1995). Here, they live completely independently and never join adults (Pycraft 1907; Heinrich 1932; Frith 1956; Nice 1962; Clark 1964). An encounter of two chicks in the wild is unlikely and its time of occurrence unpredictable, for the following reasons. Inside the incubation mounds, eggs are separated by tons of soil and chicks hatch asynchronously. Outside, chicks disperse into dense thickets (Benshemesh 1992; Göth 2001), where they are well camouflaged and lack any loud contact calls (Bergman 1961; Baltin 1969; West *et al.* 1981; Göth *et al.* 1999). In addition, incubation mounds often lie hundreds of metres apart (Jones 1987, 1988a).

So far, we know almost nothing about the behaviour of young Brush-turkey chicks in the wild, mainly due to their secretive behaviour and the difficulties associated with observing them in the dense vegetation they live in (Jones 1999). Whereas adults are known to feed and roost in groups occasionally (Birks 1996; Jones 1987, 1990), the only information on the social behaviour of young megapodes is from Jones (1988b). He suggested that subadults form some sort of groups by about 100 days of age, whereas young chicks appear to remain in dense vegetation and entirely solitary all the time. Recent observations on captive chicks of the Brush-turkey do not support this assumption, as these regularly stayed closely together and engaged in social behaviour (Wong 1999; Göth 2001).

The sparse information available thus evokes the following two questions: (1) Do chicks start to form social bonds only when about 100 days old or also at an earlier age?; and (2) Do the observations on captive Brush-turkeys indicate that young chicks also have social tendencies in the wild, or were these tendencies a result of captivity? In this paper, we present observations which enabled us to address these questions. We radio-tracked more than 100 chicks in the rainforest, but the dense vegetation usually prevented longer observations that might have given insight into the chicks' social behaviour. One radio-tagged individual was, however, exceptionally easy to observe, and we were able to collect information on its movements and social contacts with two other chicks over 25 successive days. Here, we provide information on the nature of these social bonds, as well as detailed descriptions of social behaviour, dispersal, foraging activities, roosting and time budgets in young Brush-turkey chicks in the rainforest. These are the first such results for any of the 22 megapode species (Jones *et al.* 1995).

METHODS

The results presented here are part of a larger radio-tracking study, carried out by A. Göth (Göth 2001); U. Vogel assisted with the fieldwork during the breeding season 1999/2000. The study site was Mary Cairncross Rainforest Park, a 50 hectare patch of subtropical rainforest, 150 kilometres north of Brisbane. We radio-tracked more than 100 Brush-turkey hatchlings to determine survival, habitat choice and ranging behaviour (Göth 2001). Behavioural observations were usually impossible owing to the dense vegetation the chicks lived in. One individual, named chick 532 (after the frequency of its transmitter), however, was attracted by a rich food supply to an area of rainforest with little ground cover, and here, we could observe it over longer periods.

As with all other hatchlings (Göth 2001), chick 532 hatched in an artificial incubator and was kept warm in a dark foam box for two nights. We then attached a radio transmitter (2 g) to its back with eyelash glue (details about incubation, attachment and radio-tracking

equipment in Göth and Jones 2001) and released the chick on 17 January 2000, when two days old. During the first 15 days, we tracked it daily for periods of 30–60 minutes. Thereafter, we observed it more intensively on three days (4, 6 and 8 February 2000) for 1–3 periods of 70–180 consecutive minutes, with breaks for radio-tracking other chicks. The total observation time was 667 minutes. During this time, we also recorded the behaviour of an unmarked wild chick of approximately 28 days of age, hereafter called chick 2, whenever it stayed in close proximity to chick 532. Since chick 2 carried no transmitter we could not be certain that it was the same bird on all three days, but we assumed this to be the case because of the length of its tail feathers and the obvious absence of other chicks in the area. Its age was estimated as 28 days because of its size and tail feather length (Wong 1999). On 5 and 7 February, and from 9–11 February, chick 532 was observed once a day, and chick 2 could not be seen during the 30 minute observation periods. At 25 days of age, chick 532 lost its transmitter and the observations stopped.

The open structure of the forest made it possible to observe chicks 532 and 2 from a distance of 9–10 metres with binoculars (10 × 40, Swarovski). All observations were recorded using a hand-held cassette recorder. Data recorded consisted of activity, location, distance and line-of-sight (between the two chicks). 'Activity' included scratching (for invertebrates in the leaf litter and swallowing them), pecking (at fruit and swallowing them), resting (sitting motionless), sitting and observing (either sitting or standing while looking into different directions), walking (slow movements), running (fast movements), preening and social behaviour (as described in the Results). 'Location' was estimated as distance from one conspicuous Watkins Fig tree (*Ficus watkinsiana*, see Results). The distance between the chicks was recorded each time one chick moved to a new location, at least 50 centimetres away. 'Line-of-sight' involved the observer deciding whether the two chicks could see one other. The chicks were not disturbed by us in any obvious way, as they continued feeding, resting or preening upon our approach.

RESULTS

Dispersal

After having been released at the age of two days, chick 532 moved 30 metres further into the rainforest within two days. Over the next 12 days it covered distances of 150–200 metres per day and travelled back and forth between two Small-leafed Fig trees *Ficus obliqua* almost daily, where it ate some of the trees' small orange fruit (6 mm in diameter) that had fallen on the ground. On day 13, the chick moved 200 metres into the middle of the Park. In this area, both the orange *Ficus* fruit and fruit of Purple Cherry trees *Syzygium crebrinerve* (1.5 cm in diameter) were plentiful on the ground. Additionally, one large Watkins Fig tree had dropped fleshy fruit (3–4 cm in diameter). Whenever chick 532 was located, during the day and in the evening when it roosted in a tree, it was found within an area of about 30 metres by 20 metres around this Watkins Fig. While feeding, the chick alternated between pecking fruit around the fig tree and moving further away to scratch for invertebrates in the leaf litter.

Social behaviour

During the first 12 days, chick 532 was seen near another chick on only one occasion, on its fourth day post-hatch. The other chick was 12 days older and also carried a transmitter. During the 30 minutes in which we were able to see both birds, we observed no social contact, although they fed no more than 20 metres apart. On the next day, chick 532 had moved much further away while the other one had stayed in the same area.

When chick 532 was between 13 and 20 days old it remained in the vicinity of the Watkins Fig tree. During

this time it was seen with the unmarked chick 2 on four separate days (Feb. 2, 4, 6 and 8) and we observed it for longer periods on three of those days (see Methods; Fig. 1). Chick 532 spent 20 per cent of the total observation time (667 min) with chick 2, e.g. in line of sight, and chick 2 obviously remained in the same area as chick 532, around the Watkins Fig. If both chicks moved away from each other they still met when returning to the fruit under this tree (Fig. 1).

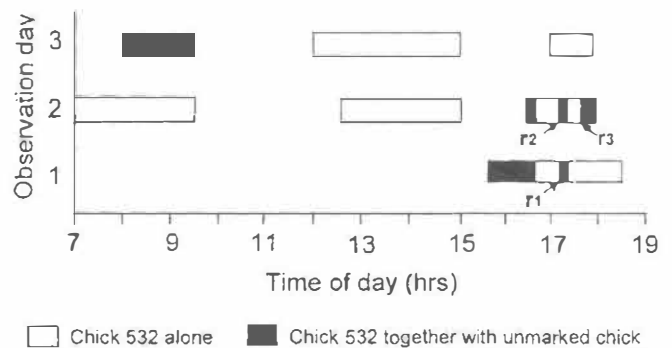


Figure 1. Times when chick 532 and the unmarked chick 2 were observed on three days (February 4, 6 and 8). The rectangles indicate the observation periods on the given day. The white parts within the rectangles show when chick 532 was alone, and the black parts when it was seen with chick 2. r1–r3 indicate 'reunion' events for which the behaviour is described in the text.

When together, the two chicks usually fed, rested or preened themselves close to each other, maintaining a median distance of 2.1 metres (range 1–20 m, $n = 55$ observations after one of the two chicks had changed its position). We often had the impression that one chick deliberately approached or followed the other if it moved further on. Apart from that, we saw more obvious social behaviour inbetween feeding on two occasions. First, when chick 2 walked towards chick 532 and both looked at the other for 10 seconds when 20 centimetres apart. Chick 2 then walked away, out of sight. Second, when chick 2 ran to where chick 532 was scratching in the leaf litter, the latter withdrew 20 centimetres and chick 2 started scratching on the vacated spot. Soon after, chick 2 made a 'wing flap jump' (jumping up while flapping the wings rapidly) over the other chick and ran six metres further, while chick 532 ran after it with its wings flapping too.

We observed the most interactive social behaviour when the two chicks met again after they had been separated. During this first 'reunion event' (r1, Fig. 1), chick 2 appeared suddenly and ran towards chick 532, which was feeding on a Watkins Fig. First it pecked at chick 532 and then both tried to feed on the same fig. Soon after, they looked at each other with their necks extended upwards and their bellies almost touching. Chick 2 then jumped onto chick 532 with both feet, an interaction that resembled fighting in adult males. Both then tried to peck at the same fruit again, and this time chick 532 chased the other away by running towards it with its neck extended horizontally. Following this, both chicks scratched for food while 20 centimetres to 2 metres apart, for another 18 minutes, when chick 2 left the area. On the second day, the 'reunion' (r2, Fig. 1) seemed less aggressive: chick 2 ran towards chick 532, approaching to one metre and then both started

feeding. When meeting again later that day (r3, Fig. 1), chick 532 ran towards chick 2 with a wingflap run and both ran around in a zigzag manner with flapping wings for two minutes.

On the first day, the two chicks spent the night in separate trees, 20 metres apart. On the second day, both went to roost in the tree that chick 2 had stayed in the night before, though on different branches, 6 metres apart and at 6 and 8 metres height respectively. On the third day, chick 532 roosted on the same tree as on day 2, but chick 2 was not seen nearby.

When watching the chicks, we also paid attention to the presence of any calls that might have served a social function. At no time did we hear them utter any of the clucking noises that other chicks sometimes uttered in an outdoor aviary (Göth 2001).

On four occasions, adult Brush-turkeys were seen feeding near the chicks, at distances of two to five metres (they were also attracted by the ripe figs). Usually, neither the chicks nor the adults reacted to each other, both continuing to feed or rest. Only once did an adult approach one of the chicks, to about one metre. The chick stopped scratching, looked at the adult for five seconds, and then continued pecking at food while the adult walked past it and disappeared.

Time budget

Feeding occupied the majority of the chicks' time; both individuals spent more time searching for invertebrates (such as earthworms and collembola) than pecking at fruit, although the floor was covered in figs and other fruit (Table 1). On average, the chicks scratched or pecked at one spot for three minutes (defined as an area not larger than 50 × 50 cm, median, range 1–24 min, n = 56), and they moved 3.8 metres to the next spot for feeding (defined as >50 cm away, median, range 0.2–28 m, n = 56).

DISCUSSION

The results presented here give only a brief insight into the behaviour of chick 532 and its wild counterpart in the rainforest. However, considering the difficulties associated with following and observing the well-camouflaged hatchlings in dense vegetation, they are nevertheless valuable as the first results on the social behaviour and time budget of free-ranging megapode chicks.

To date, it has remained unknown whether young megapodes in the wild ever form groups with others. Previous observations of Brush-turkey chicks raised in a

large outdoor aviary indicate that they show most social behaviours from the age of two days onwards, synchronize their feeding and maintain average distances of two to three metres to each other (Göth 2001). However, this social tendency might have been an artefact of captivity. The present study shows that even in the wild, young chicks occasionally form loose bonds with another chick, which means that both stay in the same area and meet there occasionally (here during 20% of the observation time). It nevertheless remains unknown how many chicks form such loose bonds in the wild. While radio-tracking more than 100 chicks during two breeding seasons, it was possible to obtain sightings of one minute or more on 166 occasions. However, in only six per cent of these encounters were the tagged birds seen with another chick (chicks 2 days to 4 weeks old, Göth 2001). This proportion could have been higher in reality because during the usually short encounters, before the chicks escaped into thick vegetation, it was often not possible to exclude that another individual was hidden nearby. On the other hand, some chicks were observed for periods of up to 30 minutes and we could then exclude a group formation for at least this observation period. In summary, associations between two or more young Brush-turkey chicks do not seem to be the rule, but may occur more often than assumed.

In our observations, food obviously played a key role in the habitat choice of the two chicks seen together, as the area they stayed in contained an unusually high number of ripe figs on the floor and both chicks fed on them regularly. This rich food source was obviously the reason why the chicks remained in the area despite the fact that the lack of understorey increased the chance of being detected by predators. Usually, Brush-turkey chicks prefer dense *Lantana* *Lantana camara* and other thickets to live in (Göth 2001). A larger radio-tracking study showed that the chicks often disperse a long way during the first days after hatching, with a high mortality rate and low density in the forest (Göth 2001). These factors, the dense vegetation and their camouflaged plumage do not facilitate meeting other chicks. However, in areas with good food availability, as in this study, the chance of meeting conspecifics increases. Such meetings still remain accidental, and this may explain why only some chicks form bonds.

Calls would be a suitable means for actively finding conspecifics in dense vegetation. During the observations of chick 532 we heard no calls, but chicks of the same age raised in an outdoor aviary often uttered a deep grunt (Göth 2001). However, this single call — the only known for chicks of this species — is rather soft, does not carry

TABLE 1

Time budget for two Brush-turkey chicks in the rainforest. Entries in the table show the percentage of total time the respective behaviour was observed out of the total observation time over three days. The total observation time was 673 minutes for chick 532 and 196 minutes for chick 2.

	Categories of behaviour as described in the Methods.							
	Scratching in leaf litter	Pecking at fruit	Resting	Sitting and observing	Walking	Running	Preening	Social behaviour
Chick 532	59	13	12	3	4	5	3	1
Chick 2	61	15	4	1	6	5	5	3

far and seems unsuitable for contacting other chicks over distances of more than a few metres. In summary, our observations indicate that Brush-turkey chicks meet by chance rather than by an active search for others and that this chance is increased if they congregate in areas with abundant food. They then appear to recognize other chicks as conspecifics, as they engage in social behaviour that is species-specific, such as wing flap runs, fights, sparring (looking at each other breast to breast) and food stealing. The fact that one often followed the other when changing positions suggests that they had some interest in staying together, despite the fact that they separated between feeding bouts and that the availability of food might have been their prime reason for staying in the same area.

In the present radio-tracking study, the high mortality and short retention time of transmitters (Göth 2001) allowed us to look for group formation only in chicks up to four weeks old. No such detailed observations exist on older chicks, juveniles and subadults. However, while radio-tracking Brush-turkey chicks, A. Göth occasionally observed mixed groups of subadults (approximately 3–9 months old) and adults, consisting of two to five birds foraging together. Jones (1988b) also proposed that chicks of approximately 100 days of age form social groups. If this is common in subadults, the occasional 'two-chick-group' of chick 532 and chick 2 could have been a pre-cursor for larger groups formed by subadults. Adults are known to forage in groups outside the breeding season, whereas during the other months, males live solitarily and females form groups occasionally (Birks 1996; Jones 1987, 1990).

ACKNOWLEDGMENTS

We thank the Dr. Otto Röhm Gedächtnisstiftung, the Australian Geographic Society, J. and Ch. Haas, U. Wehrhahn and the World Pheasant Association, including WPA Germany, for financial assistance. E. Curio, through his Bird Research and Conservation Foundation, helped with the financial administration. D. Dow, D. Jones, S. Wong and one anonymous referee considerably improved earlier drafts of this paper. The Caloundra City Council allowed us to conduct this study in Mary Cairncross Rainforest Park. Impco International donated eyelash-glue for transmitter-attachment. This study was undertaken with a Scientific Purposes Permit from the Queensland Department of Environment and approval from the Griffith University Ethics Committee for Animal Experimentation. A. Göth was supported by an Overseas Postgraduate Research Award from the Australian Government, a Griffith University Postgraduate Research Scholarship and a research allowance from the Australian School of Environmental Studies, Griffith University.

REFERENCES

- Baltin, S. (1969). Zur Biologie und Ethologie des Talegalla-Huhnes (*Alectura lathami* Gray) unter besonderer Berücksichtigung des Verhaltens während der Brutperiode. *Z. Tierpsychol.* **26**: 524–572.
- Benshemesh, J. (1992). 'The conservation ecology of Malleefowl, with particular regard to fire.' (Unpublished PhD thesis, Monash University: Clayton, Australia.)
- Bergman, S. (1961). Mein Vater, der Kannibale. (F. A. Brockhaus: Wiesbaden, Germany.)
- Birks, S. M. (1996). 'Reproductive behavior and paternity in the Australian Brush-turkey, *Alectura lathami*.' (Unpublished PhD thesis, Cornell University: Ithaca, New York.)
- Clark, G. A. (1964). Life history and the evolution of megapodes. *The Living Bird*, Ithaca **3**: 149–167.
- Göth, A. (2001). 'Survival, habitat selectivity and behavioural development of Australian Brush-turkey *Alectura lathami* chicks.' (Unpublished PhD thesis, Griffith University: Brisbane, Australia.)
- Göth, A. and Jones, D. N. (2001). Transmitter attachment and effects on Australian brush-turkey chicks. *Aust. Wildl. Res.* **28**: 1–6.
- Göth, A., Vogel, U. and Curio, E. (1999). The acoustic communication of the Polynesian Megapode. In 'Proceedings of the Third International Megapode Symposium, Nhill, Australia'. (Eds. R. W. R. J. Dekker, D. N. Jones and J. Benshemesh). *Zoologische Verhandlungen, Leiden* **327**: 37–51.
- Heinrich, G. (1932). 'Der Vogel Schnarch'. (Reimer and Vohsen: Berlin.)
- Frith, H. J. (1956). Breeding habits in the family of Megapodiidae. *Ibis* **98**: 620–640.
- Jones, D. N. (1987). 'Behavioural ecology of reproduction in the Australian Brush-turkey *Alectura lathami*.' (Unpublished PhD thesis, Griffith University: Brisbane, Australia.)
- Jones, D. N. (1988a). Construction and maintenance of the incubation mounds of the Australian Brush-turkey *Alectura lathami*. *Emu* **88**: 210–218.
- Jones, D. N. (1988b). Hatching success of the Australian Brush-turkey *Alectura lathami* in South-East Queensland. *Emu* **88**: 260–263.
- Jones, D. N. (1990). Social organization and sexual interactions in Australian Brush-turkeys *Alectura lathami*: Implications of promiscuity in a mound-building megapode. *Ethology* **84**: 89–104.
- Jones, D. N. (1999). What we don't know about megapodes. In 'Proceedings of the Third International Megapode Symposium, Nhill, Australia, December 1997.' (Eds. R. W. R. J. Dekker, D. N. Jones and J. Benshemesh). Pp. 159–168 (Zoologische Verhandlungen: Leiden.)
- Jones, D. N., Dekker, R. W. R. J. and Roselaar, C. S. (1995). 'The Megapodes'. (Oxford University Press: Oxford.)
- Nice, M. M. (1962). Development of behaviour in precocial birds. *Trans. Linnean Soc. New York* **8**: 1–211.
- Pycraft, W. P. (1907). On the origin of differences between nestling birds. *Proc. IVth Int. Ornithol. Congress*: 454–459.
- West, J., Madinah, M. and Hasan, M. (1981). Artificial incubation of the Moluccan Scrub Hen *Eulipoa wallacei*. *Int. Zoo Yrbk.* **21**: 115–118.
- Wong, S. (1999). 'Development and behaviour of hatchlings of the Australian Brush-turkey *Alectura lathami*.' (Unpublished Ph.D. Thesis, Griffith University: Brisbane, Australia.)