Territorial and Nesting Behavior in Southern Boobook (*Ninox novaeseelandiae*)

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Abstract.—During 1993-1997, three adjacent nesting pairs of the Southern Boobook (*Ninox novaeseelandiae)* were located and observations made on their behavioral interactions, nests, and young in Canberra, Australia. Territory size was close to 100 ha; not the 4 to 10 ha reported in the literature. Males advertized territorial boundaries with the "*boobook*" call and 'duelled' using this and a "*croaking*" call. Neighboring males entered a rival's territory to challenge the resident male, sometimes near the resident's nest. Both sexes fed the young until 2 to 4 weeks after fledging, when females stopped. Males and their young moved to 'camp out' in various parts of their territories earlier defended.

INTRODUCTION

Southern Boobooks (*Ninox novaeseelandiae)* are the smallest of the nine owl species, five *Tyto* and four *Ninox*, that breed in mainland Australia. Observations on the territorial behavior and vocalizations of these owls have been reported by Fleay (1968), Schodde and Mason (1980), Hollands (1991), Olsen (1994), Shields (1994), and Debus (1996) but none of these studies is based on observations of color-marked birds.

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Southern Boobooks (Ninox novaeseelandiae*).*

During our early observations of Southern Boobooks in Canberra (Olsen and Trost, unpubl. data) we saw an interesting sequence of behaviors—individuals sat close to each other giving "*boobook*" calls followed by a more guttural, breathy "*croaking*" call. Then they made physical contact and gave a *"chittering"* call, like they were fighting. To better understand these observations we studied three pairs in Aranda Bushland across the road from our houses.

METHODS

We found the nest sites of three adjacent owl pairs, color-marked the three males and two of their mates (we couldn't catch one female), and radio-tagged one male. The larger of the pair (by weight) had a brood patch and was determined to be the female. Observations were during a 60-90 minute period, beginning a half hour after sunset. Observations for the three pairs were made during the following time-frames: Pair 1, 30 nights between 3 October 1996 and 3 February 1997; Pair 2, 59 nights between 20 September 1994 and 21 February 1995; Pair 3, 25 nights between 6 October 1993 and 6 March 1994. The period of early October to early February covers the egg stage to post-fledging dispersal. We concentrated our observations on the territorial behavior of the radio-tagged male in 1994-1995; the calls and territorial behavior of Pair 3 in 1993-1994, and the calls and territorial behavior of Pair 1 in 1996-1997.

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RESULTS

Territory Size

Schodde and Mason (1980) reported territory sizes for Southern Boobooks of 8 ha, and Olsen (1994) reported territory sizes of 4 to 10 ha. The radio-tagged male defended, through territorial singing ("*boobook*" calls), an area of about 100 ha. When he had nestlings, the radio-tagged male often roosted during the day some distance from his nest in various parts of his territory.

We saw the adjoining male (Pair 1), who was color-banded, over an area of some 50 ha.

VOCALIZATIONS

Southern Boobook calls are described in Schodde and Mason (1980), Hollands (1991), Olsen (1994) and Debus (1996). The following calls are reported to be given by both sexes: "*Boobook*": the 2-note "*boobook*" call.; "*Croak*": the guttural, repeated "*por-por-por*" that is uttered rapidly and softly; "*Bray*": the vibrating purr, similar to the "*mew*" of an Australian Wood Duck (*Chenotta jubata)*; and "*Trill*": the cricket-like call from nestlings and fledglings. Examples of these calls are on the cassette-tape series by Buckingham and Jackson (1990).

"Boobook" Call

We heard one or more of the three males give "*boobook*" calls on most nights we visited the area. The males' call seemed to function as territorial singing, and to communicate with the female, e.g., when he arrived with food. We never confirmed that females give the 2-note "*boobook*" call (table 1), though they did give a single-hoot call.

"Croak" Call

We heard the "*croak*" call a number of times, but never confirmed that females gave it. We saw males using this call in a ritual we called 'duelling' (see below). The resident female was often in view when two unidentified owls gave the call, so we believe the call was only given by males (table 1).

"Bray" Call

We never confirmed that males used the "*bray*" call. The call seemed to be used by females to solicit food or cooperation from males. If males used the "*boobook*" call near the nest, or as they moved away from the nest, females sometimes used the "*bray*" call in response, never the "*boobook*" call.

"Trill" Call

Nestlings and fledglings gave the familiar cricket-like, "*trill*" call described by Fleay (1968). This food-demand call may develop into the adult "*bray*" call. Well after fledging, the young gave this call and we never heard the adults use it, or the fledglings use adult calls. That is, adult females, adult males, and young had three different calls. This contrasts with species like Peregrine Falcons (*Falco peregrinus)* where adult males, females, and young give a 'waik' call that is, or resembles, a food-demand call, and they can all give the familiar "cac-cac" defense call (pers. observ.).

DUELLING

Though Fleay (1968), Schodde and Mason (1980), and Shields (1994) state that Southern Boobooks are not highly territorial, the owls in Aranda Bushland were highly territorial. They frequently sang, using the "*boobook*" call, from

Table 1.—*Number of times we heard (a)* "boobook" *calls by the male or an owl other than the female; (b)* "boobook" *calls by the female; (c)* "bray" *calls by the male; (d)* "bray" *calls by the female; and (e) bouts of* "croaking" *calls:* ***Pair # 1*** *1996-1997 - 30 nights x 1 hour of observation between 3 October 1996 and 3 February 1997 (fledgling period only);* ***Pair # 3*** *1993-1994 - 25 nights x 1.0 hours of observation between 6 October 1993 and 6 March 1994 (nestling and fledgling period)*

Pair	(a)	(b)	(c)	(d)	(e)
#1	37	0	0	1	2
#3	26	0	0	47	6

high perches and, occasionally, participated in 'duelling'.

A typical 'duelling' encounter started when a male called (we believe this was limited to males) and was answered by another. A quiet period followed, then the distant male called again, this time from closer. As the duel progressed, both males gave the "*boobook*" call while 50 m apart on their territorial border. Eventually the two males perched in the same tree, and continued to "*boobook*". This changed to a low, throaty, "*croak*" call. Sometimes there was physical contact, accompanied by a loud "chittering" from one or both participants. What we found strange about this behavior was that the neighboring male crossed over into his rival's territory and challenged him close to its nest with the resident's mate nearby. The female was sometimes silent, or would give "*bray*" calls.

Because this behavior often occurred in the vicinity of a nest site, we can see how some observers might have interpreted it as a 'duet' between a resident male and female. Some of the behavior described by Debus (1996) in mid-October in Jervis Bay National Park was similar to what we observed; he may have heard 'duelling' instead of 'duetting' and copulation.

EXTRA ADULTS

We never saw extra females helping at the nest as suggested by Olsen (1994) but did find an extra adult male apparently foraging and sitting with the fledged nestlings and adult male of Pair 2 two days after the young fledged. The adults of Pair 2 gave no defensive response to this male. When a baited trap was placed under the family group, both adult males came down. The new male was measured (he was smaller than the resident male) and banded, but we did not see him again. Its relationship to the residents was unknown.

We saw another adult male during daylight in the roost tree normally used by Pair 1 and their fledged young, about 50 m from their nest. The residents were not found on that day. The new male was trapped, measured and marked but was not seen again. He was also smaller than the resident male.

ROOSTING

Adults and young roosted in native cherry (*Exocarpos cupressiformis)*, the tops of eucalyptus, and often in hollows. A radio-tagged male (Pair 2) almost always used hollows. While its mate brooded nestlings its most frequently used roost was hollow on the southern border of its territory; a considerable distance and out of view from its own nest at the eastern border of his territory. This roost was within view of the nest of Pair 3 which had eggs. We thought for some time, because it roosted so far from its own nest, that it may have had another mate and family. However, the only interactions we saw or heard were the 'Duels' it apparently had with Male 3. It could easily engage Male 3 in 'Duels' at dusk from this 'favorite' day roost.

POST-FLEDGING DISPERSAL

Young fledged at about 6 weeks old as stated by Fleay (1968) and Schodde and Mason (1980) although Hollands (1991) considered that 6 weeks was too long. Just-fledged young were fed by both parents near the nest and roosted in the nest hollow. After about a week the young could fly well enough to follow the adults further from the nest and 'camp out' with them in various trees for the day. At night, while they followed the adults around from tree to tree, they were defended mainly by the female

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Southern BooBook Owl nest tree.

who would sometimes give a single *"hoot"* or *"yeo"* call and swoop past our heads (males also used these calls but less often). After 2 to 4 weeks, the females at all three territories seemed to 'lose interest' in defending the young and stopped feeding them, although two females still roosted with the family group (table 2). At about this time the young started to follow the males further and further from the nest but the females did not follow. Adult males assumed total responsibility for feeding and defending the fledged young (table 2). Sometimes they gave a single *"hoot"* if we walked too close to the fledglings. Males roosted with fledglings further and further from the nest and 'camped out' in various parts of the territory. After the young and males left, females remained near the nest until we lost contact with them.

One evening, the fledglings from Pair 2 moved into trees near the nest of Pair 3, which contained one nestling, but Male 2 didn't follow. The resident, Pair 3, did not attack or feed the food-demanding fledglings. The Pair 2 fledglings eventually moved back into Male 2's territory.

Male 2's nest was near the eastern border of his territory and he and his fledglings moved away from it, foraged small areas for insects each night, and 'camped out' in a native cherry or eucalypt for the day. Over subsequent nights they continued to move to various locations until they reached the western border of Male 2's territory, about 1.5 kilometers from their nest. The young eventually dispersed from there (table 2).

Table 2.—*Number of days after young fledged that (a) female stopped feeding young, (b) female dispersed, (c) young became independent, (d) young were fed solely by the male:* ***Pair # 1*** *1996-1997 30 nights x 1 hour of observation between 3 October 1996 and 3 February 1997, two young;* ***Pair # 2*** *1994-1995 59 nights x 1.5 hrs of observation between 20 September 1994 and 21 February 1995, three young;* ***Pair # 3*** *1993-1994 25 nights x 1.0 hours of observation between 6 October 1993 and 6 March 1994, one young.*

Pair	(a)	(b)	(c)	(d)
#1	23	34	48	25
#2	25	25	42	17
#3	14	30	43	29

In summary, Male 2 appeared to defend a 100 ha area (through singing and 'duelling') before his young fledged, then lead his fledged nestlings to the eastern, northern, southern, then western border of his territory without their mother. Although they were not radio-tagged, we followed Pairs 1 and 3 each night by listening for the calls of begging young. The adult females of these pairs also stopped feeding their young (table 2) and the adult males also appeared to lead fledglings away from their nest until the young became independent.

DISCUSSION

Territory Size

Reported estimates of territory size are too low because the males in Aranda Bushland defended larger areas.

VOCALIZATIONS

"Boobook" and *"Bray"* Calls

It is not clear why we never observed females giving the "*boobook*" call or males giving the "*bray*" call. It may be a characteristic of the three pairs we watched. The "*boobook*" call may be mainly territorial in function with females calling only when they are alone in a territory without a male. The "*bray*" call may be a food-demand call seldom used by males. Also, most of our observations of these owls each year were from around egg-laying to when young dispersed and pairs may engage in 'duets' using the "*boobook*" call earlier (Fleay 1968) or later in the breeding cycle. It is worth noting that, whatever turns out to be typical, these males, females, and young tended to use three quite separate calls as their main vocalizations.

Duelling vs. Duetting

It appears that some of the behaviors interpreted as 'duetting' between mated pairs actually were males 'duelling' with each other, probably over territorial boundaries. More

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Forest habitat of the Southern Boobook Owl.

studies are needed with color-banded birds to determine the nature of 'duetting' in this species, if they duet at all. Duetting could be the male giving a "*boobook*" or "*croak*" call answered by the female's "*bray*" call. Given the difficulties of observing at night, observers could mis-identify individuals, behaviors, and sexes of owls.

'Duelling' was, to us, strange behavior—a neighboring adult male enters its rival's territory and calls, sometimes close to the rival's nest. The behavior probably was antagonistic. But we often wondered if there was some other purpose for the behavior that helped both family groups, a form of communication that established or maintained alliances or status (see below). At least one territorial boundary (between Pairs 1 & 3) changed over the 3 years and it changed near the point where a number of 'duels' took place.

EXTRA MALES

Communication between males was complex. Much of what we saw can be explained by assuming a long-term investment in a territory, where the resident male later led his fledged young. But this does not explain the two adult males seen after the young fledged that were apparently tolerated by both adults. In some birds, like Pied Wagtails (*Motacilla alba)*, the male sometimes shares his territory with a 'satellite', usually a first-winter juvenile or a female from the flock. The cost to the owner is depleted food on the territory but the benefit is that the 'satellite' helps with defense (Davies and Houston 1981). We saw 'extra' males on territories only after the young owls had fledged, so, there was no risk to the territory owner of cuckoldry.

FEMALE MIGRATION

After females stopped feeding the fledglings and left all parental duties to the males, it was not clear how long they remained in the area. It is possible that females fed their young later in the night and we did not see it. But females eventually dispersed, as in other owls, e.g., female Eastern Screech-Owls (*Otus asio)* migrate from their breeding territories during winter (Gehlbach 1994). In other parts of Canberra, we saw pairs of Southern Boobooks roosting together in winter. They could have been mated pairs (females may move to another area to finish their molt, then return) but perhaps they could have been resident males with satellites. If the Aranda Bushland females did not all migrate, and we suspect that some of them did not, their behavior is particularly interesting given Trivers' (1972) theories on parental investment in young.

CONCLUSIONS

These observations differ from previous accounts of the behavior of Southern Boobook and other *Ninox*. Further studies with color-bands and radio-telemetry will show if the behaviors we saw were typical.

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