

SHORT COMMUNICATIONS

BREEDING OF THE RAINBOWBIRD AT SWAN VALE, NSW

At Swan Vale near Glen Innes, NSW, the Rainbow-bird *Merops ornatus* is a common migrant each spring and autumn, but in some years a few pairs breed in the area. I observed closely two nests in 1956 and one in 1967 and obtained the following data from them.

Nest-site and nest

Tunnels are excavated in low sloping gravel-banks and sometimes in the sides of deep ruts on bush-roads. The gravel-banks, where the observed nests were, had been formed by digging material for road-making, and the gravel itself varied in hardness. Apparently one pair of birds will make several attempts at excavating a tunnel, because in 1956 there were five shallow holes within a distance of one metre and a sixth about four and a half metres away, and one pair of birds was seen working at most of these holes and flying from one to another. At the shallowest holes they could be seen digging at the very hard gravel with their beaks and then scratching out the loosened material with their feet. In holes being actively dug in softer material the evidence for this action is a ridge on the floor of the tunnel separating two grooves in which the feet have worked.

Normally the tunnels are horizontal, thus contrasting with those of the Red-backed Kingfisher *Halcyon pyrrhopygia*, which slope upwards, and end in a spherical nest-chamber. However, the tunnels usually curve to one side so that the contents of the nest cannot be seen with reflected light from the entrance, or perhaps only partially. Luckily one tunnel in 1956 and that of the nest in 1967 were straight so that I could see the contents of the nests. The tunnels in 1956 measured 0.91 and 0.53 m in length, the shorter, which was straight and in which I made my observation, being dug in much harder clayey gravel than the longer.

When the first egg is laid, there is no nesting material or debris in the chamber, but at the end of incubation the floor is built up considerably with castings of insects, as seen in the nest in 1967. Later, this debris is often removed by small ants so that the evidence of occupation of a tunnel is destroyed in a puzzling manner.

Clutch-size and laying

C/5 was observed in two nests, one in 1956 and

one in 1967. Unfortunately the laying routine was not completely established. Observations at the nest in 1956 were as follows:

	4	December	One egg; nest found.
11:00	6	„	Two eggs.
10:00	7	„	Adult on nest; left by 10:30 when three eggs.
10:00	8	„	Adult on nest, left by 10:10, but heavily overcast and too dark to count eggs.
09:00	9	„	Four eggs.
11:30			
08:30	10	„	Adult in nest; would not leave.
	15	„	Five eggs.

Thus the eggs could have been laid at intervals of forty-eight hours, the first on 3 December and the fifth on 11 December. If not, they must have been laid irregularly. Because the eggs may hatch during a period of more than twenty-four hours, incubation probably starts before the clutch is complete. This would account for the bird being on the nest on 8 and 10 December, but would still not prove that eggs were laid at intervals of forty-eight hours. In fact, the third egg was probably laid between 10:00 and 10:30 on 7 December, and it was particularly unfortunate that I could not count the eggs on 8 December when the adult left the nest at about the same time and in similar circumstances as on 7 December and when the fourth egg may have been laid.

In 1967 I found the nest in the afternoon of 3 December and saw that there were eggs in it but could not count them. I checked again that evening when it was almost dark, hoping that then my weak torch would be more effective; but the adult was in the nest and did not leave. Next afternoon there were three eggs and the clutch was later completed to five. This shows that the adult will probably spend the night on the nest before laying is finished.

Incubation

Presumably this starts, at least partially, before the clutch is complete. The period was best determined in one of the nests in 1956, the laying routine in which has already been given in detail. There, the last egg was almost certainly laid on 10 or 11 December, on a reasonable assumption between 09:00

and 11:00. At 07:30 on 4 January the nest contained four young and one egg, and at 14:00 on 5 January five young. The period, then, from laying to hatching of the last egg, was about $24\frac{1}{2}$ or $25\frac{1}{2}$ days \pm about $\frac{1}{2}$ day, or precisely 24 (25) days 13 hours \pm 16 hours.

In the nest in 1967 matters were much more uncertain, partly because the laying was poorly observed and partly because one egg probably did not hatch. The only fact of the laying period was that there were three eggs on the afternoon of 4 December. At 17:00 on 28 December there were two eggs and three young; at noon on 30 December there were one egg and four young. However, assuming that laying is at intervals of forty-eight hours, we can feel confident that the last egg was laid between 09:00 and 11:00 on 7 or 8 December; we may further assume that all eggs would have hatched between 17:00 on 28 December and 16:00 on 30 December. This, then, gives an incubation period of 22 (21) days 7 hours \pm 1 day, which is less than for the other better record.

Nestling period

This was quite well established in the nest in 1956, where, as stated above, the last egg hatched between 07:30 on 4 January and 14:00 on 5 January 1967. Young were in the nest at 21:00 on 1 February, but were all flying, about 150 m away, at 14:00 on 2 February. This gives a nestling period of 28 days 5 hours \pm 22 hours.

At the nest in 1967 uncertainty was much greater. Apart from the doubt when the last egg hatched, only one young survived in the nest where it was seen alone regularly from 17 January to 11:00 on 26 January. The nest was empty in the late afternoon of 28 January. The period here was, thus, about $29\frac{1}{2}$ days \pm $1\frac{1}{2}$ days.

General

Information from the second nest found in 1956 was negligible. The hole appeared to be finished on 4 December. On 22 December it certainly had eggs because it was just possible to see one. At 11:15 on 27 January one young bird left the hole when it was inspected. If laying was finished about 5 December, the total incubation and nestling period would agree with what was found in the other nests.

When hatched, the young are naked, blind and pink in colour. After about seven days they are still naked but the remiges have sprouted to about 6 mm in length and the retrices to about 3 mm, and the eyes are narrow slits. By about the ninth day the eyes are open, and by the tenth the young are almost completely covered with tiny light-brown feathers which become green by three days later. By about

the eighteenth day the young are completely feathered and the colours of the adult plumage begin to appear, the birds being merely duller replicas of the adults.

During incubation the adult bird, when flushed, always emerges from the tunnel head-first, but by the time the young are about two weeks old the parent backs out of the hole after feeding them. By that time, too, the floor of the tunnel has become almost completely lined with castings of insects. During incubation, also, the adult sits very closely. If one approaches stealthily and quietly and surprises the incubating bird in the nest, it will not leave, no matter how much noise and demonstration is made outside. If, however, one approaches noisily and slowly, the bird will slip off the nest while the observer is still a good distance away. This is an important point when one wishes to inspect the contents of the nest before hatching.

In many, perhaps most, of the standard books on the birds of countries or regions inhabited by the Meropidae there is very little precise information on the breeding of bee-eaters. Some major works (Baker 1927; Bannerman 1955; Thomson 1964; Witherby *et al.* 1938) merely mention that both sexes incubate, but do not say how long the incubation and nestling periods are. The omissions by Thomson and Witherby *et al.* are specially significant and suggest that there was no acceptable information on these matters on any species of bee-eater when their books were compiled, because both took great trouble to record such details. Other important regional works like those of Bannerman (1933), Chapin (1939) and Praed and Grant (1952–1970) have no detailed information at all. In fact, I have found only two statements published in English regarding the incubation and nestling periods of bee-eaters. One is by McLachlan and Liversidge (1970) who give an incubation period of twenty-eight to twenty-nine days and a nestling period of twenty-nine days for *Melittophagus pusillus*. The other is by Austin (1962) who says for bee-eaters generally that incubation lasts about twenty-two days and that the rearing period is about four weeks. He probably derived his information from Koenig (1951) who bred European Bee-eaters *Merops apiaster* in captivity. She observed that twenty-two days after the start of incubation the first young bird hatched, 'und weiterhin täglich einer', but suggested that the period may have been lengthened because the adults were prevented from incubating once for six hours when their hole collapsed. However, apparently she inferred the dates of laying and start of incubation from the behaviour of the adults, being unwilling to inspect the nest regularly for fear of disturbing the birds. Moreover, though she suspected that laying was at intervals of about forty-eight hours,

she admitted that this was not certain. Her information on the nestling period is less exact, but suggests a period of thirty-five days, no doubt unreliable for wild birds.

It seems, then, that my observations on the breeding details of *M. ornatus* are among the very few such observations that have been made on any species of bee-eater in the field, that they tend to confirm Koenig's suspicion that bee-eaters lay at intervals of forty-eight hours, and that in the wild the incubation period is a few days longer than in captivity. Yet, it may be remarked that the incubation period for *M. pusillus*, a somewhat smaller bird than *M. ornatus*, is apparently even longer than the determinations that I made.

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17 February 1971.

BREEDING OF THE RED-RUMPED KINGFISHER AT SWAN VALE, NSW

The Red-rumped Kingfisher *Halcyon phyrrophygia* appears irregularly at Swan Vale, near Glen Innes, NSW. I found one nest about 1943–44, and in the 1957–58 and 1961–62 seasons, when several pairs nested, I found three nests each season. My data are for these last six nests.

Nest-site

Five nests were in low gravel-banks, 0.6, 1.0 and 1.5 m high, three being in 1.5 m banks, suggesting that taller banks may be preferred. The nest in the 1.0 m bank was 200 mm from the top and two nests in 1.5 m banks were about halfway up the face; the heights of other holes were not recorded. The sixth nest was in the vertical side of a haystack under an open-sided iron-roofed hay-shed, 2.5 m from the ground.

Nest-tunnel

The tunnel always runs steeply upwards and ends in a large spherical chamber so that the contents of the nest cannot be seen from the entrance. The tunnel is about 300 mm long, but was only measured twice, as 255 and 355 mm; one of these was probably not complete. These tunnels are distinguished at once from those of the Rainbowbird *Merops ornatus* which are dug horizontally (see Whitlock 1909, *Emu* 8: 173–194). I enlarged two tunnels slightly in order that I might record the contents of

the nest, but each time the nests were abandoned. Presumably, then, the birds are sensitive to the diameter of the tunnel which normally is just large enough to let them squeeze through. However, I could easily reach the nest in the haystack without upsetting the birds because the hay was flexible and returned to its original position after I withdrew my hand.

Clutch-size

C/5 was determined twice, in the nest in the haystack and in a nest to which I carefully dug an inspection shaft. Both clutches were viewed at least twice at intervals of several days.

Laying

I had no opportunity of finding out whether an egg is laid daily, but kingfishers probably lay each day. I can find no definite reference to this, but equally can find no reference to laying at intervals of forty-eight hours.

Incubation

The period was determined approximately only in the nest in the haystack. It had four eggs at 18:15 on 15 November and five eggs at 18:15 on 18 November. On 6 December at 18:00 there were still five eggs; on 7 December at 14:00 there were two eggs and three young; on 13 December at 15:00 there

were five young. The last egg was therefore laid between 18:15 on 15 November and 18:15 on 18 November; it probably hatched between 14:00 on 7 December and 24:00 on 8 December. This gives an incubation period of 21 days 45 min \pm 2 days 5 hours. However if, as is quite likely, the last egg was laid early on 16 November between 05:00 and 09:00, and hatched, as is again likely, between 14:00 on 7 December and 12:00 on 8 December, the approximation becomes 21 days 18 hours \pm 13 hours. In one other nest, where five eggs were first seen on 20 November and three eggs and two young found at 18:00 on 10 December, the minimum period was almost exactly 20 days.

Incubation during daylight may be by one parent (? female) only, because at one nest where photographs were taken the more dully plumaged bird, with a good deal of brown in the blue of the upper back, alone appeared to do so; in other species of kingfishers both sexes are known to incubate. At the nest in the haystack the incubating bird was invariably absent at 18:00 and I regularly inspected the nest at that time.

The young soon after hatching, as seen in the haystack, do not vary markedly in size; so probably incubation starts only when the clutch is complete and the eggs hatch within about twenty-four hours.

Nestling

The period in the nest in the haystack was 23 days 16½ hours \pm 3 days 11½ hours, because the last young bird left between 20:00 on 2 January and 18:00 on 3 January. However, if it is assumed that the last egg hatched between 14:00 on 7 December and 12:00 on 8 December, this becomes 26 days 6 hours \pm 22 hours. The young are born naked and

pink-coloured, but are capable of vigorous movement. When five to six days old, they are still naked, and their eyes are mere slits which probably could not be opened; in another nest the young at about eight days old had changed colour to a very pale grey and pin-feathers were emerging, while their bills were noticeably lengthening. Both parents feed the young.

Breeding season

The laying date of no clutch was known precisely, but the first egg in the nest in the haystack was probably laid on 12 November 1961. In two other nests the first eggs were laid about 15 November 1957 and probably about 8 December 1957, while a third nest had one egg on 15 November 1961, but no more eggs were laid and the nest was deserted.

Breeding success

Only one nest, that in the haystack, was successful, five young fledging. All the other nests that I found were destroyed in the same way. The tunnel was enlarged to a hole about 300 mm in diameter, exposing the nest-chamber. Four of them must have been destroyed after the young had hatched, either because hatching had been proved or because droppings in the nest indicated this. The fifth was destroyed before hatching, judged by broken eggshells and feathers of the adult in the debris. It is presumed that foxes were the culprits because dingoes are now extinct in the area and goannas are very rare, whereas foxes are very common.

The periods of incubation and rearing for this species found at Swan Vale agree well with those given for the European Kingfisher *Alcedo atthis* by Witherby *et al.* (1938, The Handbook of British Birds).

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19 February 1971.

DISTRIBUTION OF THE BLACK BITTERN IN NEW SOUTH WALES

In New South Wales the Black Bittern *Dupetor flavicollis* is found in coastal areas to a little further south than Sydney (McGill 1960, Handlist of the Birds of New South Wales). Up to now the only two acceptable records south of Sydney are for an immature male collected at Shellharbour in 1909 and a sight-record by Messrs J. D. Gibson and A. R. Sefton on 5 July 1952 at Fairy Creek, 1.6 km north of Wollongong (McGill and Lane 1955, Emu 55: 69).

On 16 August 1962 at Cuttagee Creek, 8 km south of Bermagui, a Black Bittern flew into a

motor vehicle on a bridge on the Bermagui to Bega road. It was an adult male, and the skin is now in the Australian Museum, Reg. No. 0.40320. Measurement of wing-span was 800 mm and of total length 540 mm, and weight 275 gms.

On 12 April 1967 at 11:00 I disturbed a bittern-like bird from the water's edge of the Wagonga Inlet near Narooma. This is in a shallow estuarine bay, lined with *Casuarinas*; at low tide mudflats, rocks and wooden oyster-slats are exposed. The bird landed on a peg of an oyster-lease at a distance of 27 m, enabling easy identification with 7 × 50 binoculars.

It was under observation for about ten minutes and the following description was obtained: Legs dull greenish grey; bill black on top and paler underneath; throat white; bright yellow plumes on neck and breast (which was brown); head and back dark brown, almost black. From this description the bird was apparently a juvenile. A few days later I confirmed my identification when I examined skins at the Australian Museum.

One hour after that observation as I entered the township of Bermagui 48 km further south, I observed another Black Bittern fly across the road from the harbour and head upstream. I had the opportunity to observe only the dark bill and the yel-

low plumes on the neck and breast, and the general black-brown colour, but it was the same species that I had observed earlier that day.

These three records extend the range some 150 km further south from that given by McGill (*op. cit.*). However, a specimen was reported to be collected at Germantown (now Holbrook) by D. E. D'Ombra (Campbell 1901, Nests and Eggs of Australian Birds: 991), and therefore the statement by North (1913, Nests and Eggs of Birds found breeding in Australia and Tasmania, 4:43-44) that 'it occurs somewhat sparingly throughout the Illawarra District to the southern borders of the State' may well prove to be correct after all.

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29 March 1971.

BREEDING OF THE BLACK SWAN NEAR WERRIBEE, VICTORIA IN 1963 AND 1970

The Black Swan *Cygnus atratus* is found, often in large numbers, in most wetlands in Victoria (Wheeler 1967, A Handlist of the Birds of Victoria). Breeding is related to availability of suitable habitat, the capacity to breed in favourable conditions is retained and breeding is probably influenced both by photoperiodic and nutritional factors (Braithwaite and Frith 1969, CSIRO Wildl. Res. 14: 65-109). This note presents some breeding data gathered in 1963 and 1970 at Lake Borrie, a settling pond in the sewage works of the Metropolitan Board of Works at Werribee, Victoria. The lake is artificial and impounds an area of about eighty hectares in which low banks, dykes and mud islands provide nesting sites. Werribee township has an annual rainfall of 488 mm evenly distributed throughout the year (Bureau of Meteorology 1969, Climatic averages, Australia). However, water-levels in Borrie, and in many of the surrounding ponds, are maintained at a fixed height by controlled inflow and outflow gates.

In 1963 nests were examined from late June to late November, generally at weekly intervals. Each nest was individually marked and records were kept of clutch-size, evidence of hatching and loss of eggs, etc. In 1970 nests were first noted and examined in a small sample-area in August and checked at fortnightly intervals until the last egg disappeared in October. Factors involved in the non-hatching and loss of eggs in 1963 and 1970 were generally not determined. Other nearby ponds of about 600 hectares, in which breeding was also taking place, were also examined between August and December 1970 to determine the minimum number of cygnets

present. Cygnets observed were assigned to five classes of size: very small (recently hatched), small, medium, large and full-grown (apparently fully feathered).

In 1963, eighty-four nests were examined and the timing of completion of 108 first and second clutches in these determined. Though intervals between examinations may have caused the completion of some clutches to be misdated, most first clutches (84.7%) had been completed by late August and most second clutches (87.5%) by mid-October. (These second clutches were of eggs laid in nests which had been previously used.) There was a secondary peak of first clutches noted in September, these clutches perhaps being laid by birds re-nesting after unsuccessful attempts earlier and elsewhere. In 1970, fifteen of thirty-three first clutches laid in the sample-area were completed in August and the last three in October. Second clutches were first noted in mid-September and the last was completed by mid-October.

Table I gives the size of first, second and all clutches found at Lake Borrie in 1963 and for those found in the sample-area in 1970. The table also shows the hatching success of clutches of different sizes, and Table II shows the productivity of the nests. For the 108 clutches examined in 1963, the mean size was 5.13 (\pm S.D. 1.23, range 1-8) eggs while the mean size of eighty-four first clutches was 5.20 (\pm 1.23), and that of twenty-four second clutches 4.88 (\pm 1.23) eggs. There was no significant difference between the mean sizes of the first and second clutches (χ^2 test used here and throughout).

In the sample-area in 1970 an average of 4.45

TABLE I

Clutch-size and hatching success of Black Swans near Werribee, Victoria, in 1963 and 1970

	CLUTCH-SIZE							
	1	2	3	4	5	6	7	8
1963								
First clutch (84)	1	1	3	18	25	25	10	1
Total eggs hatched (%)	—	—	66.6	50.0	70.4	84.7	71.4	—
Second clutch (24)	1	—	2	3	10	8	—	—
Total eggs hatched (%)	—	—	—	16.7	26.0	31.3	—	—
All clutches (108)	2	1	5	21	35	33	10	1
Total eggs hatched (%)	—	—	40.0	45.2	57.7	71.7	71.4	—
1970								
First clutch (33)	5	1	1	4	12	9	1	—
Total eggs hatched (%)	—	—	100.0	87.5	70.0	64.8	71.5	—
Second clutch (10)	1	—	1	2	3	3	—	—
Total eggs hatched (%)	—	—	—	38.5	100	66.7	—	—
All clutches (43)	6	1	2	6	15	12	1	—
Total eggs hatched (%)	—	—	50.0	70.9	76.0	71.5	71.5	—

(± 1.77) eggs was laid in thirty-three first clutches, and 4.5 (± 1.58) eggs in ten second clutches. For the forty-three clutches examined the average size was 4.47 (± 1.71 , range 1–7). Again, no significant difference between first and second clutches was found, and there was no significant difference between the average clutch-sizes recorded in 1963 and 1970.

The average clutch-size in the 151 clutches examined at Borrie in 1963 and 1970 was 4.9 and resembles figures of 4.46 given by Guiler (1970, Emu 70: 3–8) for southern Tasmania and 4.5 recorded by Lavery (1964, M.Sc. Thesis, Univ. of Qd) in Queensland. However, it is lower than the averages of 5.5 recorded by Frith (1967, Waterfowl in Australia) for the Canberra area and 5.4 found by Miers and Williams (1969, Wildfowl 20: 23–32) in New Zealand.

Of the 554 eggs (in all clutches) laid between June and November 1963, 337 (60.8%) hatched. On average, 70.3 per cent of eggs laid in first clutches hatched, but only 25.6 per cent of eggs in second clutches did so. Of the 192 eggs laid in the sample-area in 1970, 129 (67.2%) produced young; ninety-nine young were hatched from the 147 eggs laid in first clutches and thirty young hatched from forty-five eggs laid in second clutches.

TABLE II

Productivity of Black Swans near Werribee in 1963 and 1970

	CLUTCHES					
	First		Second		All	
	1963	1970	1963	1970	1963	1970
Total number of clutches	84	33	24	10	108	43
Mean clutch-size	5.20	4.45	4.88	4.50	5.13	4.47
Potential hatch	437	147	117	45	554	192
Actual hatch	307	99	30	30	337	129
Mortality in nest	2	1	1	—	3	1
Young produced per clutch	3.63	2.97	1.21	3.0	3.09	2.97

Many eggs disappeared from nests without evidence of hatching or obvious predation, such losses often taking place after other eggs in the clutch had been hatched. Thus, figures of hatching and productivity presented in the Tables are probably underestimated. However, in both seasons predation at the nest-site accounted for few young, and most young were produced from first clutches. Table II shows that, while productivity in first clutches was higher (but not significantly so) than that recorded for second clutches in 1963, in 1970 rates were virtually identical and did not differ significantly. There was no significant difference between productivity in the combined clutches examined in 1963 and 1970, and each nest produced on average approximately three young.

Counts of broods on other ponds round the Borrie study-area in 1970 showed that maximum numbers of young were present between mid-October and late November. Because incubation periods average 36.4 days and range between thirty-two and forty-three days (Miers and Williams *op. cit.*), or forty-five days (Frith *op. cit.*), most hatching occurred between mid-September and mid-October. However, very small cygnets were present in July and nests outside the study area were still producing young in December. The average size of recently hatched broods was 3.4 (range 1–7, $n = 44$), and that of broods just before they could fly was 1.9 (range 1–3, $n = 24$). While some broods may have been counted twice, it is clear that losses before the flying stage were large. From an average clutch-size of 4.47 recorded in 1970, between 2.97 (estimate of productivity, Table II) and 3.4 (counts of broods) young hatch, to result in 1.9 pre-flying young. By comparison Frith (*op. cit.*) stated that from a mean clutch of 5.5 eggs, 4.1 young hatched, of which only 2.1 survived to fledging.

From these data, it appears that the Black Swan breeds seasonally at and near Lake Borrie, and that most laying occurs between late August and October. Apparently recruitment in 1963 depended mainly on

a successful hatching of first clutches and size of local population perhaps increases when conditions, including better supply of food, allow more successful incubation of second clutches, as occurred in 1970.

Records were made in 1963 by Mr W. F. Barrett, while Mr M. C. Downes was Superintendent of the Game Management Section. Mr J. McKenzie helped to collect data in 1970.

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31 March 1971

THE RED-CHESTED QUAIL IN NEW SOUTH WALES

The range of the Red-chested Quail *Turnix pyrrhonorax* is given in standard reference works as inland northern and eastern Australia. In New South Wales it occurs on grassy tablelands and plains of north-western inland districts and McGill (1960, *The Birds of New South Wales*) gives its status as 'rare' and 'irregular in movements'. Recently, Slater (1970, *Field Guide to Australian Birds*) provided a distribution map for this species, showing its range by three black dots, which roughly coincide with Canberra, Deniliquin and Tamworth, indicating that it is rare. Because I became quite familiar with Red-chested Quail during 1968-70 while helping with research into the Stubble Quail *Coturnix pectoralis*, I think that it is worth summarizing recent observations by myself and others, and reviewing its distribution in New South Wales.

It is claimed that it is difficult to identify small quail. However, Red-chested Quail, because they are small and prefer a special habitat, can only be confused with the more common Little Quail *T. velox*. I have found that a useful mark for field identification is that the rump of the Little Quail, when flying away, appears creamy white dissected by a reddish brown streak, which is the tail. The flanks of the Red-chested Quail are an orange colour, and so the rump in flight appears orange divided by a brown tail.

From my own experience I have found the birds only in pastures of native grasses virtually without standing timber and in lucerne and wheat-stubble with a good cover of grasses and weeds. In contrast, Mr J. N. Hobbs (pers. comm.) has observed Red-chested Quail only in lightly timbered to medium-timbered country with a good cover of long grass. The types of pasture in the areas where Red-chested Quail are known to occur are 'Mitchell-Flinders Grass' round Moree-Narrabri, and 'Moist temperate perennial grass' at Richmond; the other localities are 'Temperate short grass' areas. These definitions of pastures are after CSIRO (1960, *The Australian Environment*, 3rd edition).

The only references to the occurrence of Red-chested Quail in New South Wales that I have been able to find in the literature and all my own observations are set out below. Localities are shown on Figure 1. Only three records of the species in New South Wales, two of which are unsubstantiated (see below), have been published in the EMU since its inception. In contrast there are fourteen records published in the EMU of observations of Red-chested Quail in northern Australia (Queensland and Northern Territory).

1864. A nest found by Dr Ramsay at 'Manar', Bungendore (North 1913, *Nests and Eggs of Birds found breeding in Australia and Tasmania*, 4: 194). 'Manar' is midway between Bungendore and Braidwood, and some authors have attributed this record to Braidwood, the larger town of the two.
1865. Gould (1865, *Handbook of Australian Birds* 2: 187) states: 'It first came under my notice when traversing the flats near Aberdeen on the Upper Hunter, where I obtained a single example of the female; since then, however, Mr. Coxen has kindly sent me examples of the opposite sex and I have seen others in collections from the east coast'. Mr Coxen (Gould's brother-in-law) lived at 'Yarrundi', near Belltree, Scone, on the Upper Hunter.
1904. On 15 February a male was collected at Bathurst and on the following day a female was collected at the same place. Dr G. H. Hurst presented these specimens to the Australian Museum, Reg. Nos. 0.21355 ♂ and 0.21356 ♀.
1920. On 5 May a male was collected at Bombala by Mr C. H. Garrick and lodged in the Australian Museum, Reg. No. 0.26376.
1922. On 4 January three specimens were collected by F. C. Morse at Moree and these were lodged in the Australian Museum, Reg. Nos. 0.26633, 0.26635 ♂♂ and 0.026634 ♀. Morse (1922, *Emu* 22: 25) recorded that Red-chested Quail were numerous on the open plains at the time the specimens were collected.
1928. Mr Le Warren (1929, *Emu* 29: 14) tentatively identified some quail he observed in the Upper Macleay Valley, near Bellbrook, as this species; however the observation needs confirming.
1943. On 28 November Mr K. Kirkby ('Koiwon', nineteen km west of Bellata, a town fifty km south of

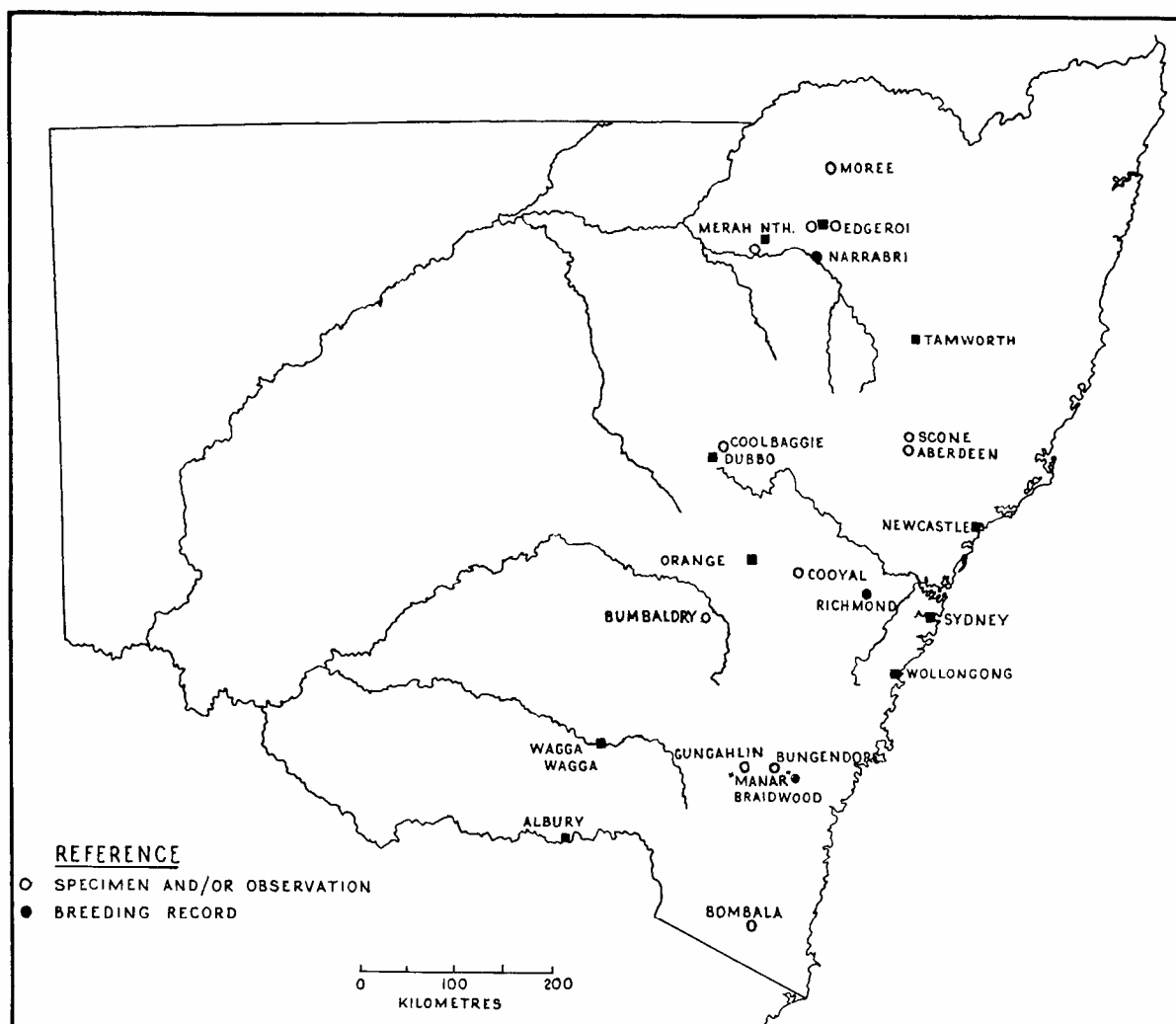


Figure 1. Localities in NSW where Red-chested Quail have been recorded.

Moree) believes he identified these quail on his property. Though Mr Kirkby's identification needs confirmation, the locality would appear to be suitable (McGill 1944, *Emu* 44: 51).

1968. On 28 September a bird was caught at Gungahlin, ACT, and on 14 November an adult female was collected at Bungendore (Canberra Bird Notes 2: 11).

1969. During January and February several pairs were observed in grassy paddocks and a crop of maize near Bakers Lagoon, Richmond, and a nest with 4 eggs was found. Messrs K. A. Hindwood and N. J. Favalaro examined and confirmed the identity of the eggs. This is the first breeding record for the Red-chested Quail in the County of Cumberland.

On 24 March I observed and collected Red-chested Quail on 'Forest Lodge' and another property in the district of Merah North. The birds

were in wheat-stubble and paddocks of native grass.

On 14 May at Coolbaggie Creek, near Eumungerie, Mr J. N. Hobbs (pers. comm.) observed three coveys, totalling twenty-one birds, in a sandy area covered with long grass and open regrowth of pines. He recorded that they were reluctant to fly and did so for very short distances, soon landing and running under the shelter of a pine or bush.

1968–1970. On two properties west of Edgeroi ('Greenbah' and 'Boggy Creek') and three properties east of Edgeroi, when hunting for Stubble Quail with a pointer, I regularly observed Red-chested Quail in pairs or small coveys of four or five birds, in paddocks of grass and lucerne, and in wheat-stubble, the last occasion being on 26 August 1970 when a pair were flushed in lucerne. A number of specimens was collected at Edgeroi.

On a property eleven km north of Narrabri and the properties 'Pineview', 'The Pines' and 'Yarran Vale' east of Narrabri, I observed and collected Red-chested Quail in grassy paddocks and wheat-stubble. The most favoured habitat appeared to be wheat-stubble with a good growth of grass, weeds or lucerne. Two males were banded with bands supplied by the Australian Bird Banding Scheme on 'Yarran Vale' on 26 January 1969. Young chicks were observed in a grassy paddock on 'Pineview' during December 1968 and January 1969.

In the Cooyal district, nineteen km east of Mudgee, I saw the greatest number of Red-chested Quail. In early 1969 they were more plentiful than Little Quail and Stubble Quail, and in May of that year during a visit of three days I saw more than one hundred in pairs and small groups of three to five birds. During 1968 and 1969 I had occasion to visit the area every month and Red-chested Quail were sighted, and often collected or banded, on each occasion. Numbers declined during 1970 and only ten were observed on four occasions on three properties during that year. The quail inhabited similar places at Cooyal to those at Narrabri. Chicks were observed in December and January of 1967, 1968 and 1969, and the largest brood was four. All the broods were noted in wheat-stubble, but the eggs may have been laid before the wheat was harvested. No nests were found.

Details of four males and nine females that I collected at Cooyal, now in the Australian Museum, are set out in Table I.

TABLE I

Details of thirteen Red-chested Quail collected at Cooyal

Sex	Reg. No.	Date Collected	Length mm	Wing-span mm	Weight gm
♂	0.43073	22 Feb. 1968	143	275	66
♂	0.43339	24 Apr. 1969	153	276	41
♂	0.43286	27 May 1969	129	258	27
♂	0.43287	27 May 1969	138	273	31
♂	0.43288	27 May 1969	147	257	31
♂	0.43289	27 May 1969	151	279	35
♂	0.43361	26 June 1969	154	275	48
♂	0.43362	26 July 1969	143	262	37
♂	0.43376	26 July 1969	162	—	59
♂	0.43416	27 Aug. 1969	153	267	51
♂	0.43417	27 Aug. 1969	153	272	83
♂	0.43583	21 Feb. 1970	154	284	42
♂	0.43584	21 Mar. 1970	131	255	35

From 16 to 22 January 1970 I banded thirty-three Red-chested Quail in the Cooyal district; two birds have been re-trapped at the banding site, both two days after banding (Morris 1970, Australian Bird

Bander 7: 35). Apart from these, no other Red-chested Quail has been banded in New South Wales.

1971. On 3 March 1971 at Bumbaldry, midway between Cowra and Grenfell, Mr J. N. Hobbs (pers. comm.) observed a pair in very open ironbark-country covered with long dry grass, close to a farm dam.

To summarize, it would appear that before 1900 nothing much was known of the distribution of Red-chested Quail in New South Wales; so, one cannot assess the situation. But North and Gould do not seem to have had a great deal of general information on this bird; it may never have occurred commonly. This is not so for Queensland, because Gilbert regularly recorded it on his travels to as far north as the Burdekin River, stating that both Red-chested and Little Quail were exceptionally abundant. (See Chisholm 1944, *Emu* 44: 144.) From 1900 to 1920 lack of records suggests it remained rare. Possibly it was more common about 1920 and 1922, but certainly it seems that during 1968–71 the species has been more common in New South Wales than it has ever been, at least during this century. This could be accounted for by the greater number of observers and greater attention to the species recently, but if it had been common in any other period since 1900 one would expect more references in the literature. It is significant that despite the few places where the bird has been found, Bungendore occurs on several occasions, and records from the Moree–Merah North–Edgeroi–Narrabri area predominate. It could be that the open grassy plains of Bungendore and the Moree–Narrabri area are the preferred habitat of the species in this State, and the population is always low but increases greatly on occasions. The difficulty of locating the Red-chested Quail and the ease of confusion with the Little Quail could be another reason for lack of recorded observations. Recent abundance could, however, indicate an irruption from the north and possibly such irruptions occur periodically. It is remarkable that no birds have been observed or collected in the drier regions of New South Wales because in South Australia they have been observed in what was formerly semi-arid mallee (Condon 1969, *Handlist of the Birds of South Australia*).

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