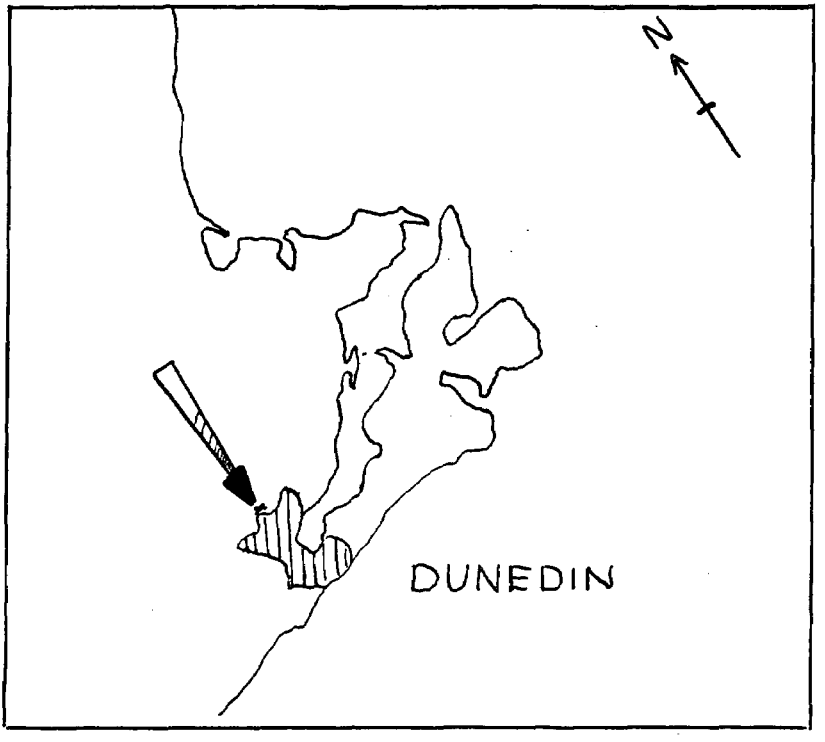
BREEDING BIOLOGY OF RIFLEMAN AT DUNEDIN

By R. S. GRAY

SUMMARY

Nest boxes were used to study the nesting cycle of Rifleman *(Acanthisitta chloris)* in second-growth bush near Dunedin city. During three nesting seasons, two to five territories were studied. It was found that the incubation period was 20-21 days; the nestling period was about 24 days; there was an interval of about 48 hours between successive eggs of a clutch; and clutches known to be complete varied from 2 - 4 eggs.

No pair raised more than two clutches per season, though several pairs built or at least started more than two nests. Losses occurred mostly during the building and egg stages, and were generally due to abandonment for reasons unknown. In only one nest were fledglings lost, and this was due to human interference, which would probably not have occurred if the nest had been in a natural site.



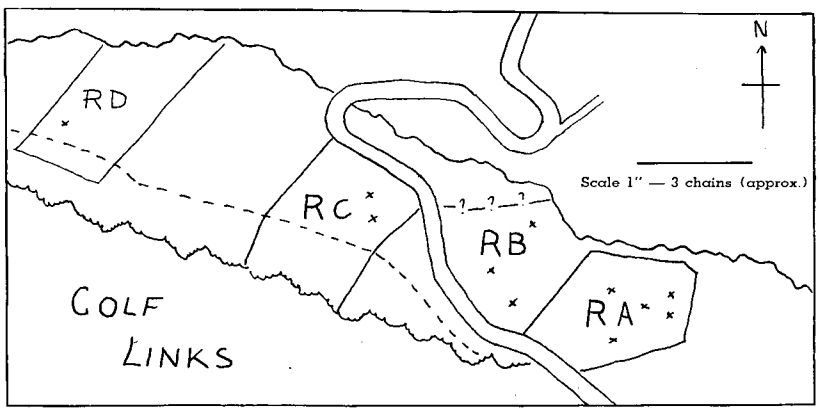
Map 1 — Map of Dunedin showing location of study area.

INTRODUCTION

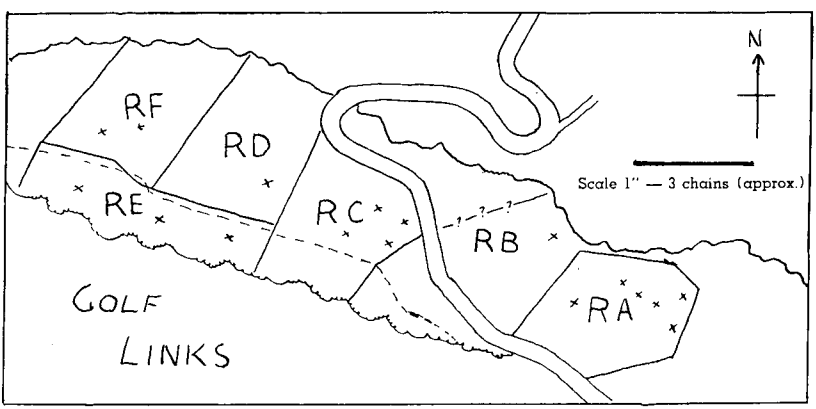
The study area is in a patch of bush near the Ross Creek Reservoir. This Reservoir is on the outskirts of Dunedin and approximately three miles from the centre of the city.

The Rifleman territories under observation are along one side of a small valley and are bounded by the Balmacewen Golf Links at the top and a small tributory of Ross Creek at the bottom. Altogether there were six territories — RA, RB, RC, RD, RE, RF — covering approximately seven to eight acres on ground sloping very steeply to the north.

In 1965, at week-ends, I followed up the birds in RA territory only, and discovered that my six nest boxes there were not quite large enough.



Map 2 — Map of study area 1966-67 season showing territories and positions of nest boxes.



Map 3 — Map of study area 1967-68 season showing territories and position of nest boxes.

In 1966-67 season I spread eleven larger boxes through territories RA, RB, RC, RD (Map 2). During the 1967-68 season I checked five territories RA, RC, RD, RE, RF) in which I had seventeen boxes (Map 3). As in the previous year, I visited these boxes on every day possible and spent as much time as I could at week-ends and during holidays in the five named Rifleman territories as well as other Rifleman territories outside the study area.

Being a school boy, I could visit nests only after school during the week. Also during each breeding season I spent several weeks away on Christmas holidays: in 1967-68 I was away between 8 December and 9 January; and in 1966-67 between 18 December and 3 January.

VEGETATION

The vegetation consists mainly of an upper canopy of Kanuka *(Leptospermum ericoides)* 40′ - 60′, a middle zone of Whiteywood *(Melicytus ramiflorus)*, and Lemonwood *(Pittosporum eugenioides)*. The lower zone contains young saplings, pepper trees *(Drimys axillaris)*, Red matipo *(Myrsine australis)*, and various Coprosmas. There is often a thick ground layer of the fern *Phymatodes diversifolium.*

In certain areas where the valley is steep, and wet with running creeks, there are areas of Tree Fuchsia *(Fuchsia excorticata)*, in addition to the shrubs and trees already mentioned. These, as I will explain later, are excluded from the study area.

The vegetation in each study area varies a little, and I will proceed now to deal with each in turn.

RA Territory — This supports a complete top canopy of Kanuka, and reasonably thick middle and lower zones of Whiteywood and Red matipo while the ' floor ' is composed of a continuous carpet of fern. This appears to be the ideal territory for Rifleman.

RB Territory — This consists mostly of Tree Fuchsia. For some reason the Riflemen seem to avoid this species of tree.. It may be that the trunks are too smooth for them to grasp and the old bark too frail for them to gain a foothold. In this territory Riflemen did not use the nesting boxes. Moreover, they built only two natural nests, neither of which was successful.

RC Territory — This can be divided into three areas according to its vegetation. The bottom western area consists of a canopy of Kanuka and very dense, damp middle to lower layers and floor zone. On the other hand, the top eastern corner contains practically no ground cover, lower or middle layers. The central zone, like the RA territory, consists of reasonably thick middle and lower layers and floor zone. The Riflemen seemed to favour this central area and to a lesser extent the top area. However, they were only very occasionally seen in the bottom area.

RD, RE, RF Territories — These are almost identical. They consist of a top canopy of Kanuka, a good fern layer and rather patchy middle and lower layers of Red matipo and Whiteywood. This vegetation coverage does not seem to be as suitable as that in the RA territory.

NATURAL NESTS

Unfortunately, I have not been able to look into natural nests Riflemen are in the process of constructing. However, from an examination of the contents of a nest after it had been used, it appears that these nests are constructed in the same way as box nests. The birds may build an extremely large mat, or they may build none at all. It seems that when the floor is too low or uneven, the pair will build it up until it is reasonably flat and then construct the nest on top of this in the same way as in the box nests.

An interesting example of this mat building was when a pair constructed a nest in a hollow fence post. This had a 9" high ridge where the pair decided to build (Fig. 2). The Riflemen stuffed material on either side of this until they had a flat mat some 9½" high in places on which they constructed their nest.

The natural nests in the study area are always located near the ground. This is presumably because the Kanuka and Broadleaf trees are young and the nesting cavities are only large enough at the base of the trees.

The sites where natural nests have been found in the study area and adjoining bush are:—

2 in fence posts
1 in the ground
1 in a Kanuka tree
2 in dead branches on the ground
4 in holes in Broadleaf trees
2 under the eave of a shed (walls of brick, roof of iron).

The ' ground-nest ' was not seen while it was being constructed. When subsequently it was extracted from the cavity, it was obvious the birds had enlarged an area under a large boulder by scraping away the earth with their feet.

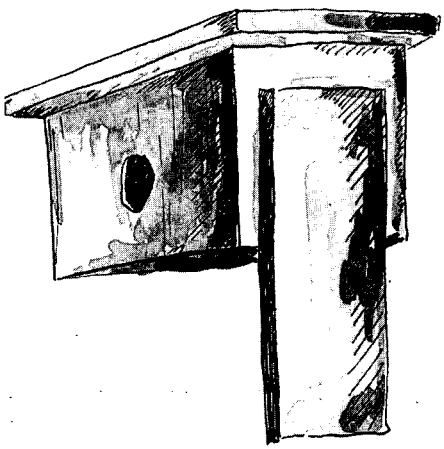


Fig. 1 — External view of nest box.

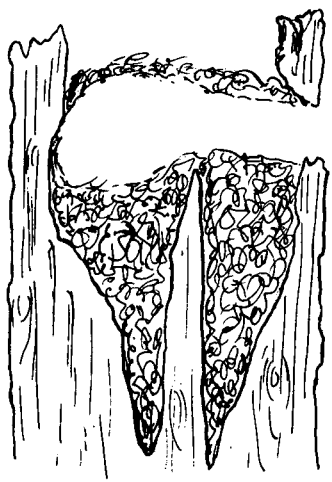


Fig. 2 — Cross section of natural nest (RI1) showing 9½" high mat.

NEST BOXES

The nest boxes are of rectangular shape, with a sloping roof and removable back, made from *Pinus radiata* timber half an inch thick (see Fig. 1).

The most suitable sizes seem to be: width 4.5", length 5.0", height 5.5" at the top end, and 5.0" at the other, so that the roof would slope away from the tree. The entrance hole is 1.5" high by 1.0" wide.

Boxes are stained a very light walnut to match the surrounding trees and to camouflage them from passers-by. A satin varnish is next applied to the boxes to protect them against the weather.

The boxes are nailed on trees about 5.5' from the ground in an area which I think will suit the Riflemen. The necessary conditions seem to be:

(a) Out of sight of passers-by
(b) Below a thick upper canopy
(c) Where the middle and lower layers contain moderately thick Whiteywood, Lemonwood and Red matipo
(d) Where a dense ground layer of fern is present.

In the 1967 season only two boxes out of eighteen in the study area had nothing placed in them by Riflemen.

Stage when nest abandoned	1965	1966	1967
Empty	5	5	2
Odd pieces of material	–	–	3
Mat	–	1	5
Complete nest	–	1	–
Laid Eggs	–	1	5
Hatched eggs	1	–	1
Chicks fledged	–	3	5
Total	6	11	21

Numbers of partial and complete nests

BOX NESTS

I have examined twenty-five completed and partially completed box nests used by pairs of Riflemen and found that these nests followed a common pattern of construction.

First of all a loose woven mat of fern rootlets and dead Kanuka twigs were placed on the floor of the box. Occasionally other material such as small dead leaves, lichen, moss, and bark were also found. The mat was built up to the entrance hole of the box which was cut about an inch above the floor. The mat sloped gently upwards to the back wall of the box where there was a shallow saucer-shaped depression about 1½" in diameter. Fern rootlets and then twigs were woven over the mat to form the tunnel.

The length of the tunnel, which varied widely between pairs, was partly determined by the dimensions of the box. The thickness

of material between the cavity and the back wall of the box varied from 2" to the thickness of one feather. The lengths of tunnels varied from 3" to a narrow but high lip projecting up across the opening of the box (see Fig. 3). Next twigs were placed up the sides of the back half of the box and woven into a strong dome.

It seems to depend on the pair of Riflemen whether the tunnel or the cavity is constructed first. In two nests the cavity was made first, and in one the tunnel. These nests were built by different pairs. The other nests were not seen at this stage of construction.

Once the tunnel and outer shell of the nesting cavity were completed leaf skeletons were tightly woven into the cavity to form a second shell. Finally after several days of rest, depending on the time of the nesting season, a thick lining of feathers was woven into the cavity. These were mainly contour feathers of Blackbird, Thrush and Wood Pigeon and a few flight feathers of small passerines.

Of the nests I analysed the following totals of material were gathered. (RH1 was from a nest box outside the study area and is included because it was an unusually large nest).

Box	Feathers	Twigs	Lichen	Grass	Moss	Leaf skeletons	Fern root	Wood chips	Pine-needles	Approx. total
RC2	300	160	0	75	9	64	84	4	4	700
RC3	450	40	0	7	1	350	50	0	0	900
RF2	90	50	0	0	1	400	60	0	0	600
RH1	360	250	0	80	6	600	0	0	40	1300
RA2 Mat	0	20	1	3	2	12	40	0	0	80
RA5 Mat	0	15	0	0	0	16	30	0	0	60
RA7 Mat	6	10	0	0	0	20	60	0	0	100

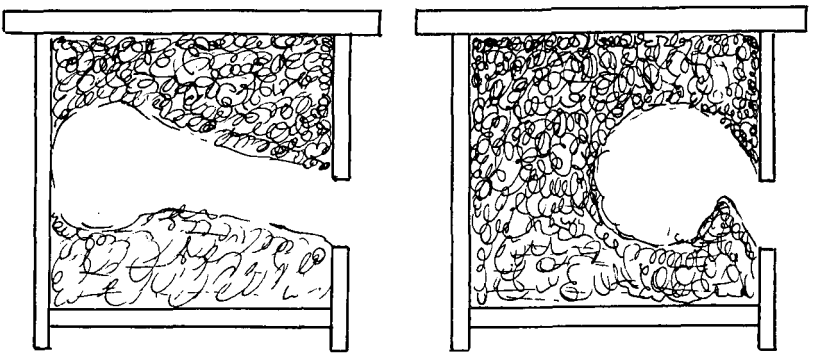
Totals of Material from selected nest boxes, 1967-1968 season

Most of the feathers were between 1.5" and 2.0" long with the exception of Wood Pigeon contour feathers, 3.5" - 4.0" long, and Blackbird primary feathers about 4.5" in length. Twigs ranged from 2.5" - 3.0" long, while leaf skeletons could be 2.0" - 5.0" in length. I have never seen Riflemen bring in more than one piece of material at a time.

Considering RA3 nest, this consisted of 700 pieces of material and was built in twenty-five days. Since both birds built the nest, each bird made approximately 350 trips. The average number of trips per day does not mean much because there were certain days when it appeared that no material was brought, whereas on other days large quantities were added to the nest.

Fig. 3 — Vertical sections of box nests:—

A — RE1 with 3" tunnel B — RD1 with high lip only.



A notable fact was that when the weather was wet for a day or two, a pair would speed up their rate of building. This was particularly noticeable at the stage when a pair was building the tunnel and cavity. For example, in the 1967 season we had three days of drizzle and cold weather. Because the birds had been building very slowly and little change could be expected I did not go down to the bush. When I did go down, I was amazed at the progress. Two nests which had been only ' mats ' three days previously were now complete except for the lining of feathers. Another nesting box which had been empty four days before, now contained a complete nest, except for the feathers (this was RA6). Also in the RA territory, the RA pair besides making a nest had built a ' mat ' in another box about twenty yards away and had placed a couple of pieces of rootlet in another box: all this during three days of wet weather and one day of fine weather.

For some reason Riflemen build a number of incomplete nests: why this is so, and just how many nests they start to build I do not know. In the 1967 - 1968 season, seven boxes were put up in RA territory and all had nests started in them.

(a) *Two* were completed nests, and in them the adults raised chicks;

(b) *Three* had a ' mat ' built up to the entrance;

(c) *One* had a few pieces of rootlet on the floor;

(d) *One* had a mound of rootlets and twigs just inside the entrance.

A solitary male was seen on several occasions near three boxes close to the border of the RA territory, and so it was possible that this bird built three of these incomplete nests. (See above table: nest d, and two of nests b.) It is also interesting to note what happened when one of the ' mats ' was taken from a box. I did this experimentally to see what would happen and one month later RA pair built another mat in the same box.

Totals for nests in the other territories (RC, RD, RE, RF) 1967 - 68.

3 were complete nests, and the Riflemen raised chicks.

5 were complete nests but the Riflemen did not raise chicks in them. (2 pairs left because of disturbance by humans — the other 3 left for some unknown reason.)

2 boxes had only a mat. (In one box the mat was made a second time.)

2 boxes were empty.

The pair in territory RC built a mat in one box then deserted. They then constructed a complete nest in another box and raised chicks. After the chicks had fledged they returned to the first box with the mat in it, and completed the nest. They laid four eggs, but after incubating for two days, abandoned the nest. They then constructed a natural nest.

Much the same procedure had taken place the previous year (1966-67) in the same territory. A pair started a box-nest and had almost completed the outer shell of material. This they deserted and then built a 'half nest' in another box about 20 yds. away. Several days later they returned to the first box, completed the nest and raised chicks. By this time I had removed the 'half' nest and broken it up and scattered the pieces around the box to see if the birds would use the box again. The same Riflemen pair, after they had raised their first brood, did return to the box where they had constructed a 'half' nest and found it empty. So they picked up the nesting material I had scattered about the base of the tree, and with additional material, completed the nest. No sooner had they laid two eggs than they deserted it. Why they left and where they went I do not know. Perhaps the location did not quite suit their needs.

In the 1967-68 season the pair in RD territory built a nest in a box and laid three eggs; but due to interference by animals or humans they abandoned the nest after a week of incubation. I removed the contents of the box — eggs and material. Fourteen days later a fresh 'mat' had been constructed but the pair did not complete the nest.

In the same season the pair in RE territory after building a mat in one box, left and built a complete nest in another box There they laid four eggs, which they incubated for two days before deserting it. I removed the nest and eighteen days later found another completed nest in the box. The pair then laid four eggs and hatched chicks.

EGG LAYING

When the nest is finished the eggs are laid. The eggs are not always laid immediately. At the beginning of the breeding season the birds may leave the nest for over three weeks before the first egg is laid; whereas in second brood nests there may be an interval of only two days.

An interval of about 48 hours elapses between laying of each egg. Then once the last egg is laid, usually the fourth, the pair immediately begin incubating. But they do not seem to settle down

very well on the first day of incubation. For example, at RC2 nest (1967-68) after the last egg had been laid I approached the nest at 7.15 a.m. and saw one of the parents fly out. This bird joined its mate and they flew off to feed. Twenty minutes elapsed before the female returned to the nest. She had incubated for five minutes before the male flew down to the nest and called, whereupon the female flew out and both birds went off feeding again. The next day they seemed to be incubating in a more composed and regular manner, one bird incubating while the other fed.

Twenty-one days after the last egg had been laid, the eggs hatch, generally all within twenty-four hours. It appears they all hatch within a few hours of one another, certainly between 5 p.m. and 7 a.m.

I will now describe a number of unusual egg laying cycles of pairs of Riflemen. RF1: The second egg was laid three days after the first, and the third egg two days after the second; the fourth egg was laid two days after the third egg. The pair began incubating the day before the last egg was laid. This was a total of seven days between the laying of the first and last egg instead of the normal six days for a four-egg clutch.

In RD1 (1967-68) nest, the first egg of the second brood was laid on the first of October, the second egg was laid two days later; but the third, in this case the last egg, was not laid until four days after the second egg. Moreover, the pair began incubating when the third egg was laid, that is seven days after the first egg was laid.

Nest RA8 contained only two eggs in the second brood but when these were laid I do not know.

RI1, not in the study area, nested in a fence post and I found only two chicks and no eggs. From previous observations I know that if an egg does not hatch it is left unmolested in the nest.

CHICKS

The chick, when it hatches, is completely featherless. Its eyes are closed and its body is orange in colour. Over the first few days very little change in its appearance is apparent. It is not until four or five days after hatching that the black flecks of feather tracts appear over the body. By the tenth day the chicks have become very active, and their eyes begin to open. When taken from the nest the chicks utter loud squawks which bring both parents around calling furiously. The parents actually dive bombed me, hitting me forcefully with their wings. These attacks vary with different Riflemen pairs. When I was banding the RA6 chicks the adult male flew round and round my legs, frequently hitting them, while the female flew back and forward within inches of my back, calling furiously. When I took out one of the second brood of RF chicks, the female flew on to the branches of a nearby dead Kanuka and dive-bombed me. She returned to the branch and repeated the process several times.

The chick at ten days is covered with black papillae 1 - 2 mm. in length in certain parts of their body (see Plate III (1)). The feather tips appear from the papillae in the next couple of days. The first feathers to appear are on the rump and down the sides of the breast and flank.

As soon as the feather tips appear on the rump the chick's sex can be determined. The male has greenish coloured tips while the female has tips of a dusty ochre colouring. The chick is between twelve and fifteen days old at this stage. As the feathers gradually grow, the bill darkens from yellow to black; and the feet change from pink to a brownish black.

About the 24th or 25th day after hatching the chicks leave the nest. They usually depart in the early morning, for I have visited nests in the late evening and found the chicks in occupation, but by 7 a.m. next morning they have gone. After some difficult stalking the chicks can usually be detected. They are often difficult to find because as soon as the observer approaches the area the parents come around calling furiously and the chicks, huddled together, stop calling. It is almost impossible to detect several small balls of feathers sitting motionless on a branch 60′ up in a Kanuka tree or even higher in the Pine trees or Rimus found in the territories beyond the study area. By the end of the first day the chicks move around a little but usually stay huddled together. After three days they may be scattered about in several trees with one parent feeding them.

The behaviour of parents while their chicks are still in the nest and in the fledgling stage needs more observation; but from my notes it seems that when the chicks hatch both parents attend the young. As the nestlings progress, however, the male appears less frequently around the nest until in the last few days he may only be seen around the nest at odd times. During this time he is away feeding by himself. If the nest is interfered with and the female is calling furiously at the observer, the male may not appear for five minutes or so. Even then he does not become as agitated as the female. This was particularly noticeable with the male from RF2 nest.

The male from the RA8 nest, however, was not as indifferent as this; but even he seemed to visit the nest less frequently than did the female during the latter part of the nesting period.

Since the male takes over the feeding of the fledglings, I presume he takes a smaller share in the building and incubating of the second nest than of the first, but I have not been able to show this conclusively.

Once the chicks have left the nest the male assumes the greater portion of the chick feeding duties while the female feeds by herself. For the first few days while the chicks are learning to adapt themselves to the new environment I have seen only the male feeding the chicks. But here again my time for watching a Riflemen family at this stage of breeding has been limited. These observations were not systematic, as I could visit the study area only between 4.30 p.m. and 5.30 p.m. on week days.

At this stage I should comment on the supposedly first brood of chicks which reappear around the nests of second broods. For example, pair RF1 raised their first brood of four chicks, each of which was banded with an aluminium and an orange colour band. At the second nest (RF2) an orange-banded juvenile was observed

first on 31 January, 1968. (The nest was found on 9 January with three eggs in it). However, the juvenile could have been around for some time before I noticed it. It was seen on almost every visit after that but never in or close to the nest, except when joining the parents to call at an observer. The juvenile fed with the male until the chicks of the second brood left the nest. After that the ' first brood ' juvenile accompanied the female, while the male tended the ' second brood ' fledglings. The orange-banded juvenile was never found feeding the chicks, nor did it appear to be attacked by the parents. At this stage two other broods had orange bands but they were several territories away and though it is possible I think it unlikely that the juvenile was any of these birds.

ENEMIES

I have gained the impression that Riflemen and their nests suffer very little from predation. This I think is due firstly to the impregnability of the nesting sites in cavities of tree trunks; and secondly, Riflemen themselves are seen on the ground only very occasionally, usually when they are collecting nesting material. On several occasions, however, I have seen instances of other species of birds attacking Rifleman. I have seen a male Tomtit attack a Rifleman fledgling which had been out of the nest for only a few hours. The Tomtit flew up behind the fledgling which was sitting on a branch and knocked it off. The Tomtit then chivvied the fledgling before it for a short distance. The Tomtit seemed to have hold of the short tail feathers as he did this. But since the incident occurred some 40' up in a tree, it was difficult to note details. While this bullying was going on the adult Riflemen hopped around calling loudly and vibrating their wings.

I have also seen Tomtits chasing adult Riflemen on a number of occasions. I observed, on the other hand, a pair of Riflemen calling at a Tomtit which perched several yards from their nest. They continued to call angrily until the Tomtit moved away.

Brown Creepers also chase Riflemen in much the same way as the Tomtit, but because Brown Creepers prefer the top canopy Riflemen are rarely bothered by them, at least about the nests in my study area.

DISCUSSION

The use of nest boxes in the study area may have affected some of the results obtained. Productivity in terms of eggs laid and of fledglings raised may have been increased or decreased. In the 1967-68 season a total of 33 eggs were laid by five pairs of birds; and 15 chicks fledged out of 19 hatched. The proportion of successful clutches to unsuccessful clutches was 1:1, five nests fledging chicks, four being lost at the egg stage and one by vandalism at the chick stage. The comparative losses between the egg and nestling stages could well have been affected by the nests being in boxes. The dry, secure cavity offered by a box should have increased productivity generally; but the almost neurotic building of partial nests e.g. RA pair in 1967-68, suggests that site selection behaviour may have been affected, even over stimulated. Also there is no doubt that a nest box is more conspicuous than the natural cavities that Riflemen usually use, and this could well have been a factor in abandonment.

Table of Nes

Territory Code Nest No.	Nest Found	State of Nest	Approximate date nest completed	1st egg laid between	2nd egg laid between	3rd egg laid between	4th egg laid between
RA_1	23 Aug	¾" mat	18 Sept	22 Sept 1700 23 Sept 1620	23 Sept 1620 25 Sept 1645	26 Sept 1710 27 Sept 1635	29 Sept 1620 30 Sept 1710
RA_2	10 Nov	complete except for feathers	16 Nov	16 Nov 1700 18 Nov 1700	18 Nov 1700 19 Nov 1340	21 Nov 1720 22 Nov 1715	23 Nov 1630 24 Nov 1645
RC_1	23 Aug	1" mat	16 Sept	25 Sept 1715 26 Sept 1730	28 Sept 1715 29 Sept 1650	30 Sept 1730 1 Oct 1105	2 Oct 1345 3 Oct 1735
RC_2	26 Aug	½" mat	I removed this nest and same pair built their second nest in it.				
RC_3	11 Nov	complete except for feathers	14 Nov	21 Nov 1730 22 Nov 1725	26 Nov 1420 28 Nov 1645		
RD_1	23 Aug	¾" mat and sticks up the walls					

Table of Nes

Territory Code Nest No.	Nest Found	State of Nest	Approximate date nest completed	1st egg laid between	2nd egg laid between	3rd egg laid between	4th egg laid between
RA_1	19 Aug	3 pieces of fern rootlet					
RA_2	23 Aug	mat on floor					
RA_3	27 Aug	bits of fern-root					
RA_4	27 Aug	2 pieces of fernroot					
RA_5	27 Aug	thin mat					
RA_6	27 Aug	completed except for feathers		2 Oct 1620 3 Oct 1630	4 Oct 1645 5 Oct 1630	6 Oct 1625 7 Oct 1145	8 Oct 1320 9 Oct 1710
RA_7	2 Nov	fernroot					
RA_8	29 Nov	complete except for feathers	30 Nov 5 Dec	30 Nov 1615 5 Dec 1630	5 Dec 1630 7 Dec 1415		
RC_1	21 Aug	floor covered with twigs and grass					
RC_2	22 Aug	some rootlets and twigs just inside entrance	17 Sept	24 Sept 0830 25 Sept 1630	26 Sept 1630 27 Sept 0700	28 Sept 1645 29 Sept 0730	30 Sept 1115 1 Oct 0715
RC_3	9 Nov	partly lined with feathers	12 Nov	11 Nov 1615 13 Nov 1620	14 Nov 1635 15 Nov 1630	16 Nov 1640 18 Nov 1435	18 Nov 1435 19 Nov 1500
RD_1	27 Aug	few small twigs on floor of box		30 Sept 1000 1 Oct 0730	2 Oct 1630 3 Oct 1645	6 Oct 1630 7 Oct 1145	
RE_1	17 Aug	few rootlets					
RE_2	18 Aug	few rootlets stuffed in entrance	12 Sept	23 Sept 0800 24 Sept 0815			
RE_3	21 Aug	½" mat	20 Sept	29 Sept 0700 1 Oct 0715	1 Oct 0715 2 Oct 1645	3 Oct 1645 4 Oct 1650	5 Oct 1640 6 Oct 1625
RE_4	26 Oct	complete except for feather lining		26 Oct 1700 31 Oct 1645	1 Nov 1630 2 Nov 1615	3 Nov 1630 4 Nov 1215	5 Nov 1 6 Nov 1
RF_1	12 Oct	½" mat	18 Oct	20 Oct 1650 21 Oct 0930	23 Oct 1145 24 Oct 1645	25 Oct 1700 26 Oct 1640	27 Oct 28 Oct
RF_2	9 Jan	complete nest with 3 eggs					

Histories, 1966-67

Incubation known to be in progress	Chicks hatched between	No. chicks No. addled eggs	No. chicks fledged	Chicks left nest	Nest abandoned	State of nest
29 Sept	18 Oct 1635 19 Oct 1630	2 chicks 2 addled eggs	2	12 Nov 1930		
23 Nov	12 Dec 1000 13 Dec 1215	2 chicks 2 addled eggs	2			
3 Oct	22 Oct 0945 23 Oct 0720	4 chicks 0 addled eggs	4	disturbed flew out 14 Nov 1730		
					2 Sept	partial nest
					28 Nov	2 eggs in nest
					29 Aug	outer structure almost complete

Histories, 1967-68

Incubation known to be in progress	Chicks hatched between	No. chicks No. addled eggs	No. Chicks fledged	Chicks left nest between	Nest abandoned	State of nest
					23 Aug	mat and tunnel started
					23 Aug	mat only
					2 Nov	thick mat
					27 Aug	2 pieces fern-root
					27 Aug	thin mat
9 Oct	26 Oct 1635 29 Oct 0830	3 chicks 1 addled egg	3	20 Nov 0930 20 Nov 1300		
					2 Nov	1" mat
		2 chicks	2	24 Jan 1700 25 Jan 1030		
					22 Aug	few fern root-lets added
1 Oct	20 Oct 1630 21 Oct 0900	4 chicks	4	13 Nov 1620 14 Nov 1630		
19 Nov					19 Nov 1500 20 Nov 1335	4 eggs in nests
7 Oct					10 Oct 1700 12 Oct 1730	complete nest with 3 eggs
					28 Aug	¾" mat
					24 - 26 Sept	complete with one egg
6 Oct					7 Oct 1215 8 Oct 1415	4 eggs in nest
6 Nov	24 Nov 1630 25 Nov 1130; 4th egg by 1215 26 Nov.	4 chicks			5 Dec	4 chicks
27 Oct	15 Nov 1640 16 Nov 1630	4 chicks	4	still in on 7 Dec 1500		
	22 Jan 1645 25 Jan 1130	1 addled egg 2 chicks	2	14 Feb 1700 16 Feb 1645		

It seems highly improbable that incubation and nestling periods were affected by the use of nest boxes, though there is just a possibility that egg laying intervals were. The total absence of an interval of 24 hours, the usual passerine interval, does suggest that this interval is more than 24 hours and *probably* 48 - 72 hours in natural nests.

Logically the stage most affected by the use of nest boxes should have been the nest construction stage, especially the length of time taken to build the nest. However, judging by the natural nests found the amount of material normally collected must vary enormously. Also judging by the way in which building operations sped up during wet weather and ceased entirely on other occasions for no apparent reason, it seems likely that the period from the start of building to the laying of the first egg is only minimally affected by the size of the nest cavity. Consider the disparity between RC2 and RF1 in 1967-68. The RC2 nest was discovered with a few twigs on the floor on 22 August and the first egg was not laid until 24 September. The RF1 nest was discovered with a half-inch mat on 12 October and the first egg was laid by 20 October.

Code No.	*Clutch No.*	*Incubation Started*	*No. of Eggs*
RC2	1st	1 Oct.	4
RE3	1st	6 Oct.	4
RA1	1st	7 Oct.	3
RA6	1st	9 Oct.	4
RH1	1st	16 Oct. approx.	4
RF1	1st	27 Oct.	4
RE4	2nd	6 Nov.	4
RC3	2nd	19 Nov.	4
RA3	2nd	7 Dec. approx.	2
RH2	2nd	10 Dec. approx.	3
RI1	2nd	24 Dec. approx.	2
RF2	2nd	1 Jan. approx.	3

Table of Clutch Sizes in and around the study area, 1967-68

There is some indication from the small sample of nests so far obtained that clutch size is largest early in the season and declines towards the end. It is just possible that the nest boxes are in some way reducing the females' fertility for the second clutch, perhaps by a temperature affect. On the other hand the smaller clutches may be an adaptation to a smaller food supply later in the season after the first Spring flush of insect hatchings.

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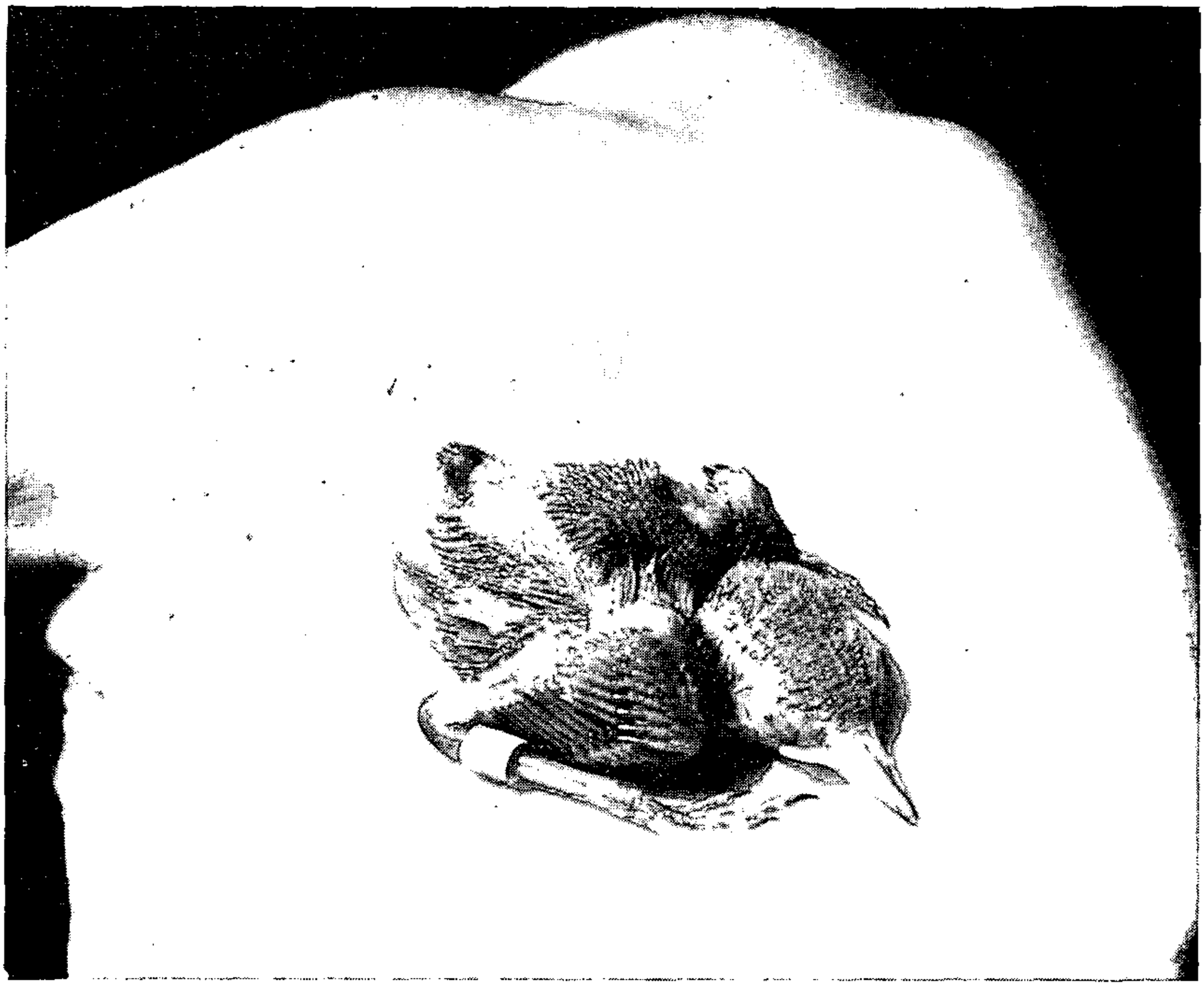

[R. F. Gledhill

Plate III (1) — Ten-day old chick of South Island Rifleman.

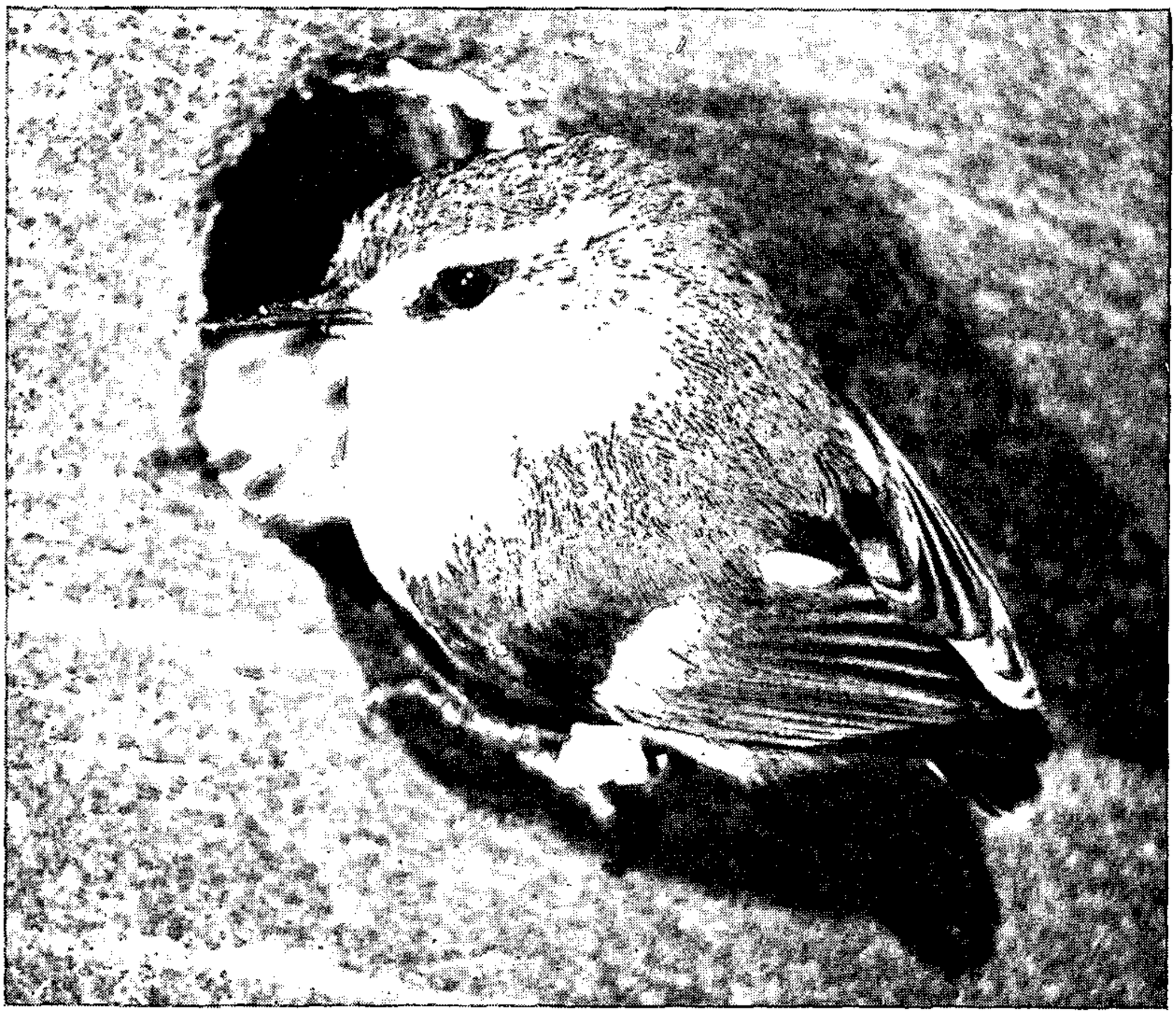

Plate IV (2) — Male Rifleman about to leave nest. [R. F. Gledhill

[R. F. Gledhill

Plate V (3) — Male Rifleman arriving with green caterpillar.

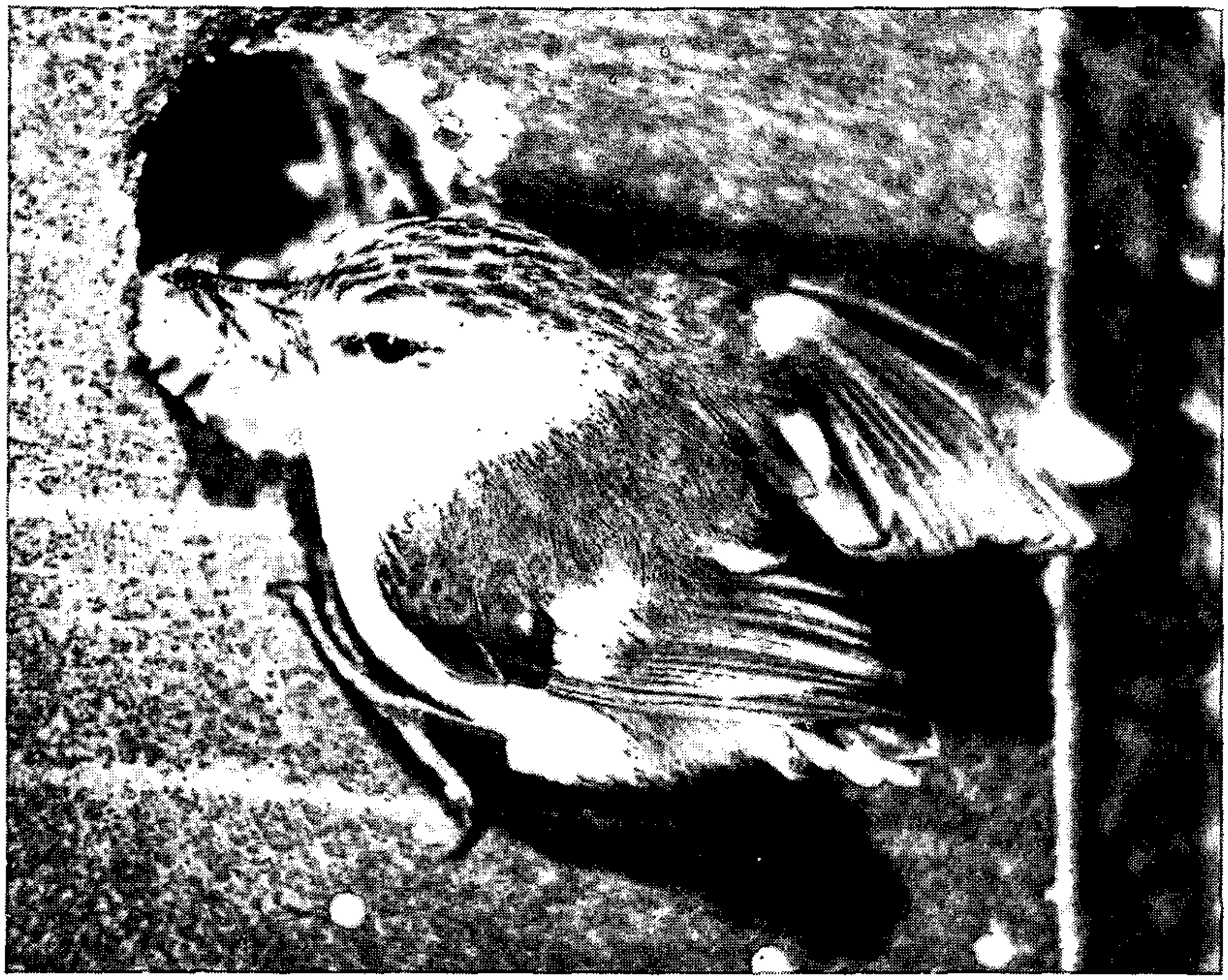

Plate VI (4) — Female Rifleman arriving with a small moth. [R. F. Gledhill

Plate VII (5) — Young female Rifleman being banded. [R. F. Gledhill

[R. F. Gledhill

Plate VIII (6) — Male Rifleman leaving nest with faecal sac.