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RADIO TRACKING THE NOISY SCRUB-BIRD:
report on a feasibility study,
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BACKGROUND

The establishment, by translocation, of new colonies of the endangered Noisy Scrub-bird, *Atrichornis clamosus*, is a major part of the management program for the species (Burbidge *et al.* 1986). The translocation process involves the capture of adult birds from the population at Two Peoples Bay Nature Reserve and their eventual release at a pre-selected release site. To date one colony - at Mt Manypeaks - has been successfully established by this process. An attempt to establish the scrub-birds at Nuyts Wilderness in the Walpole-Nornalup National Park has not been successful while a third attempt, at Quarram Nature Reserve, looks promising. Reasons for lack of success are unknown, but an obvious gap in knowledge concerns post-release behaviour.

Noisy Scrub-birds are difficult to observe in the wild being small (males 52 g, females 33 g), cryptically coloured and able to move rapidly through the dense understorey vegetation which is their preferred habitat. Visual observations are usually limited to brief glimpses at close range as the bird moves in and out of view. Vocalisations, particularly the territorial song of the male, are often the only indication of scrub-bird presence. Information on scrub-bird behaviour in the wild, such as movements within and between territories and interaction with conspecific individuals is very difficult to obtain by visual observations.

Monitoring of post-release behaviour of Noisy Scrub-birds has therefore been confined to determining the number and distribution of singing males within the release area. This is usually done within the first few weeks after release and at yearly intervals thereafter. While this approach can determine whether the colony is succeeding or not, it tells little about the movements and interactions of individuals in the initial period after release. Most importantly, it provides no information about the location and behaviour of females and non-singing males.

The aims of the current project were to assess the feasibility of using radio-tracking as a means of monitoring Noisy Scrub-bird movements after release. Both the method of attachment of the transmitter to the bird and the practicality of following and locating scrub-birds fitted with transmitters in dense vegetation and gully/ridge terrain typical of release areas needed to be tested. The development of successful techniques for radio-tracking of Noisy Scrub-birds would allow the collection of specific information in future projects which could help explain failures and improve translocation strategies.

METHODS

Timing

The pilot project was programmed for late July to coincide with the last weeks of the 1990 scrub-bird translocation project. Procedures, facilities, and a field crew were already established and in operation at that time and, most importantly, captive birds were available. After monitoring the bird's acceptance of the transmitter and the attachment procedure they were released in a designated release area thus remaining part of the translocation project and contributing to the establishment of a new colony.

Selection and Location of the Study Site

The site for the radio-tracking study needed to be accessible by vehicle and within easy reach of Two Peoples Bay Nature Reserve to minimise travel time. Given that habitat suitable for Noisy Scrub-birds is likely to be more or less impenetrable the area of suitable habitat needed to be relatively small (commensurate with the range of the transmitters) and the topography such that monitoring could mostly be carried out from outside the area occupied by the bird. It was also important that the birds used in the radio-tracking study become part of a translocated colony of scrub-birds.

Two release areas had been chosen for the 1990 translocation project but only Mt Taylor (200 m, lat. 35°00', long. 118°20'30") in the Gull Rock National Park, 30 km by road to the west of Two Peoples Bay Nature Reserve, was considered suitable for this trial radio-tracking project. Herald Gully, on the south side of Mt Taylor, contains dense scrub with small patches of very densely vegetated swampy areas and some low forest. A small stream runs for most of the year in the eastern arm and in the main section of the gully. On the slopes there are areas of heath, light scrub and thickets of stunted jarrah (*Eucalyptus marginata*).

Since 1988 a male Noisy Scrub-bird had been regularly heard singing territorial song in Herald Gully. The persistence of this bird, which had arrived there by natural dispersal from the Two Peoples Bay population, was a good indication that the habitat was suitable. It is likely that this bird was not accompanied by a female. By the time the radio-tracking work got under way an additional three males and one female had been released in the gully and four males were regularly heard singing territorial song. It is assumed that the original male occupied the central area of the gully system south of the track where the two upper arms join (Fig. 1), since this is where the male was heard most often in two years of monitoring (Danks, unpublished). The other three males must have been the males released during the translocation project in June and July prior to the radio-tracking work. The location of the released female was not known but was assumed to be also in the Herald Gully system.

Capture Methods

The capture method for territorial male Noisy Scrub-birds relies on the use of song play-back to attract the male to a mist net which has been arranged and modified to be effective for terrestrial (non-flying) birds. The locations of scrub-bird territories are known from annual censuses of singing males within the Two Peoples Bay Nature Reserve (Danks, unpublished data).

A 9.5 m x 0.5 m lane was cut through dense vegetation within the target male's territory and the ground cleared of twigs and roots. A 1¼" x 30' mistnet was inverted and set up along one side of the cleared lane with the top shelf spread out on the ground. The 'top' string of this horizontal shelf was tethered to one of the mist net poles. Another string was attached to the opposite end of the horizontal shelf and passed through one of the mist net loops (Fig. 2).

To attract the male to the net two remote horn speakers (Dick Smith, 8 ohm, 15W) were arranged on either side of the mist net. Recordings of Noisy Scrub-bird song were played using a Sony Walkman (WM DC6) cassette player and a small 12 volt amplifier. The technique usually required two operators, one at each end of the net. One person attracted the bird and directed him to the net by means of the cassette player and remote speakers and the other used the long string to pull the horizontal shelf up against the vertical shelf when the bird reached the net.

The birds were weighed within 0.5 hr of capture (between 1400 and 1730 hrs), measured and examined before being kept in a carry box overnight. Next morning the birds were reweighed and this morning weight was later compared with the weight at the time of release to measure weight gain or loss during captivity. The birds were then placed in holding aviaries (3 m x 3 m) densely furnished with brush to provide adequate cover and fed a diet of mealworms, slaters, cockroaches, termites and earthworms. Observations of the birds in the aviaries was possible using hides constructed in front of each aviary. During their time in the holding aviaries the birds were able to settle down after the stress of capture and to become accustomed to the feeding routine, the food items presented and to the presence of people.

The scrub-birds were transported in purpose built, double deck, carry boxes which allowed 8384 cubic centimetres of space for each bird. The boxes were lined with foam inside and out to reduce noise and vibration and prevent injury to the bird. Ventilation was obtained via flywire covered openings. These boxes provided safe, secure means of transporting scrub-birds in vehicles or, strapped to back-pack frames, by foot on a persons back. The birds can be fed safely through a small hatch and examined in transit through the ventilation openings.

Construction and Mounting of the Transmitter Units

A Biotrack SS-1(LR) transmitter measuring approximately 8 x 8 x 5 mm and weighing 1.0 gram was attached to its power source, a button cell mercury battery type MR41 weighing 0.8 gm. Transmitters were constructed and mounted using methods modified from Raim (1978) and Burbidge *et al.* (1989). Because of the likelihood of reducing the performance of the transmitter and battery, and the avoidable gains in weight and dimension of the transmitter unit, connections were not soldered. Instead, the wire lead of the transmitter was spiralled into a small spring-like shape which was then pressed flat onto the terminals of the battery and glued into place using 5 min Araldite (Fig. 3). The transmitter and battery were water-proofed by momentarily dipping into freshly mixed dental acrylic solution and rotated until the unit was covered in a thin even layer. Finally the transmitter aerial was trimmed to a length that would not project beyond the tail feathers of the bird. Field trial showed this procedure to have minimal effect on the transmitted signal. Details of weight, length and frequencies of the transmitter units are presented in Table 1.

The units were attached to the birds by firstly lifting up some of the feathers in the interscapular region and trimming away a small number of the newly exposed feathers. A small piece of gauze was then glued to the feather stubs using Supa Glue and the transmitter unit glued to the gauze. When the glue had dried (20 mins) the feathers which had been lifted away from the trimmed area were lowered to cover the transmitter unit.

Noisy Scrub-birds are strong and determined and easily able to escape the grip of an unwary operator. Two people were required to carry out the above procedure. One person held the bird with its head in a black cloth bag, which reduced its tendency to struggle in the hand. The other person was then able to mount the transmitter unit.

Signal Receiving Equipment

Three receivers were used to monitor the signal from the transmitters attached to the study birds: a modified Yaesu transceiver, a model TRX-24A receiver from Wildlife Materials Inc. (U.S.A.) and a Mariner 67 Biotag receiver from Biotrack. Aerials for these receivers comprised two three-element and one four-element Yagi antennae.

RESULTS

a) Observations on the study birds

Three adult territorial male Noisy Scrub-birds were captured from the Mt Gardner area of Two Peoples Bay Nature Reserve for this study. The birds were in good condition (visual examination) when captured and had body weights within the expected range (Danks, unpublished data). During their time in temporary captivity, which varied from three to fourteen days, all three birds gained weight (Table 2). In the following text, individual birds are referred to by a code consisting of year of capture, sex and sequence number for that sex in that year.

90M6 The first scrub-bird used in the study was initially very quiet in the holding aviary but, after four days sang "short song" (a non-territorial scrub-bird vocalisation, see Smith 1976, Smith and Robinson 1976) which he continued to sing daily until the transmitter was attached on day 9 (21/7). After this operation he was not heard to sing at all. Observations on the bird in the aviary indicated he was rather "shyer" than before and fed less frequently but otherwise showed no sign of distress due to the attached transmitter and aerial. By the following day he had become more confident and, although not singing, was feeding well. The transmitter appeared to be functioning normally and the signal could be detected approximately 280 m from the holding aviary.

The bird was recaptured for release without difficulty on 22/7 and transported to the release site. Bad weather (heavy showers, low temperature) prevented the release operation from being carried out however, and the bird was returned to the aviary. By 25/7 the weather had cleared enough to allow release, however, 90M6 was very reluctant to enter the aviary trap (having already been captured twice in this trap). He required nearly one hour for recapture and needed considerable persuasion. The transmitter was lost during recapture. The bird was released at another site (Quarram) and the transmitter recovered from a shrub in the aviary.

As a result of this experience it was decided that the number of times the bird was recaptured in the aviary should be minimised both to avoid stress to the bird and to reduce the chances of transmitter loss. Subsequent birds were released on the day of attachment without being returned to the aviary. It was also apparent from this experience that transmitters might become detached from the bird due to movement under duress in dense vegetation.

90M7 This bird was captured from a swamp at the bottom of Robinsons Gully at Two Peoples Bay Nature Reserve. He began singing territorial song on the morning of 24/7 - four days after entering the holding aviary. On 25/7 he was removed for attachment of the transmitter and transported to the study area at Mt Taylor. A resident male scrub-bird was singing territorial song about 50 m south of the release point before and after the release of 90M7 who remained quiet and was not, with any certainty, heard to sing during the radio-tracking period.

The signal from the transmitter on 90M7 was monitored almost constantly for the first two hours after release at 1130 hrs (Fig. 1a). During this time the bird made only small movements within 50 m of the release point and the monitoring frequency was reduced with position readings being taken at 15 min intervals. By 1500 hrs the bird had moved 100 m up the western gully away from the territorial male but by 1600 hrs was back at the release point. At 1615 he moved about 200 m upslope to the ridge between the east and west arms of the Herald Gully system and then returned to the release point where he appeared to roost for the evening (1730).

At 0800 the following morning 90M7 was found moving down the eastern gully, about 100 m south east of the release point. There was a territorial male singing to the south of 90M7 and another at the upper end of the western gully. By 1030, 90M7 had moved into the lower portion of the western gully, then up this gully and finally across the intervening ridge toward the eastern gully where a third resident male was singing territorial song. He remained in the eastern gully until 1600 hrs, at which time the signal was lost and could not be regained.

This sudden disappearance of the transmitter signal may have been due to battery failure. It is possible, however, that the bird had simply moved rapidly out of monitoring range. Several searches of the wider area around Mt Taylor were conducted at various times over the next 7 days but no signal from 90M7's transmitter could be detected. No extra singing males were heard during this time.

90M8 During capture this bird responded dramatically to the replay of recorded territorial song and entered the mist net without hesitation. In the aviary next morning he began singing territorial song and by 27/7 (day 2) he had silenced the male in a neighbouring compartment and was singing almost continuously. The transmitter was attached on the morning of 28/7 and the bird was released at the study site at 1200 hrs the same day. None of the resident males of the area were singing at the time and 90M8 began territorial song 10 minutes after release and continued at frequent (approximately 1 minute) intervals. At 1225 there was a commotion in the bush and 90M8 moved rapidly out of the scrub and crossed the track to the northern side where he continued to sing. Another Noisy Scrub-bird, presumably the resident male from south of the track, was singing territorial song from the south side and had apparently chased 90M8 out of his territory.

By 1317 hrs 90M8 had begun to move up the eastern gully (Fig. 1b) and was still singing. A resident male at the top of this gully was also singing. Eventually (1438 hrs) these two birds interacted accompanied by a bout of short song which lasted until 1500 hrs when 90M8 moved away to the west. At this time he was quiet but both the other resident males continued to sing until 1730 hrs. 90M8 crossed into the upper part of the western gully then, at 1600 hrs moved back to the eastern gully returning to within 40 m of the release point, singing only a few times in the eastern gully before roosting.

Next morning (29/7) at 0745 hrs the bird was not at the release point and, after some searching, was eventually located near the top of Mt Taylor north-east of the eastern gully. The signal was not picked up until 1000 hrs. At this time the bird at the top of the eastern gully was singing. For most of the middle part of the day 90M8 moved slowly around a small area at the top of the eastern gully. No song was heard from 90M8. At 1605 hrs he moved rapidly to the west across the ridge north of the gully system. He then travelled around to the west side of the upper western gully where he gave one song and apparently roosted in a patch of stunted *Eucalyptus marginata*.

At 0645 the next morning (30/7) the bird was located at the roost position. His first movements were slightly north east into the west gully. He gave territorial song at 0652 hrs and then moved back to the area near his roost site. Apart from one excursion to the top of the west gully (0822 hrs) he spent most of the morning and the middle part of the day moving about a small area west of the upper part of west gully near where he had roosted the previous evening. About 1345 he had moved closer to the west gully and began a series of territorial songs at frequent intervals with the scrub-bird from the gully also singing but less frequently. 90M8 then went back to the area near his roost. At 1410 a male scrub-bird came upslope toward 90M8's position singing territorial song. 90M8 moved away about 150 m to the west until the other scrub-bird retreated to his gully. He then came back to the ridge area (1600) where he sang until 1732 hrs.

On 31/7 at 0632, 90M8 was again located at his roost position. Both he and the bird from West Gully were calling. At 0649, he began to move north-east skirting the woodland associated with the West Gully, reaching the furthermost point from his roost site at approximately 0724. He then returned to within 100 m of his roost site, arriving at 0805. Twice during the rest of the day he made short silent visits well into the western slopes of west gully, before selecting a roost spot within a small tongue of taller eucalypts that protrude from the woodland and not far (perhaps 50-60 m) from the previous two nights positions. Here he began calling at 1711 as did the bird from West Gully. Both birds were still calling when the observer departed at 1732.

The next morning saw 90M8 venturing into a new gully to the west of the Herald Gully system. Departing his roost at 0648, he travelled approximately 300 m to the west, into the woodland of the new gully. At 0723 he began returning to the vicinity of his roost site, arriving at 0733. Between 0910 and 1500, the bird was not observed. At 1520 he again made a short venture into the west gully of the Herald Gully system, returning at 1540. The signal strength of the transmitter deteriorated during this days observation, to the point where the maximum range detectable was approximately 80 m.

On the morning of 2/8 the signal from 90M8's transmitter could not be picked up and after some searching in the area the radio-tracking of this bird was abandoned. It was thought that the lack of signal was probably due to battery failure.

DISCUSSION

Behaviour of Radio-tracked Noisy Scrub-birds

The two scrub-birds which were radio-tracked in this study behaved differently from each other during the capture operation, the period in captivity, and after release. 90M8 for instance was much more vocal and showed more dominant behaviour. This variation between individual Noisy Scrub-bird is commonly observed during capture and in captivity and may be one of the reasons for the occasional failure of the song play-back capture technique which relies heavily on the responsiveness of a territorial male to a simulated challenge (Danks, unpublished data).

The birds also differed in their behaviour after release. 90M7 did not sing territorial song (at least was not heard to sing) and monitoring his presence and movements after release was only possible through radio-tracking. By not singing he did not challenge the resident territorial males and was able to remain in an area encompassing two territories for at least two days without being involved in any detectable interaction with the resident males. His behaviour was therefore like that of the sub-dominant male scrub-birds observed within territories defended by a territorial male at Two Peoples Bay Nature Reserve (Danks and Smith unpubl.). Unfortunately, tracking of this bird ceased rather earlier than expected. It would have been very useful to know how long the bird remained within the resident males' territories and whether (and where) he eventually established his own territory.

By contrast 90M8 announced his presence by singing territorial song shortly after release. All three resident territorial males in the upper part of the Herald Gully system successfully defended their territories against 90M8 who was forced from one encounter to another as he moved through the established territories. Within two days of release he had established a base in what appeared to be marginal habitat, on the outskirts of one of these established territories. From here he was later able to sing without challenge.

Both birds displayed an initial attachment to their respective release points using them as bases for the first two days and as roost sites on the first night after release. For most of the day movements were restricted to small areas (presumably indicating foraging activity) with two periods of high mobility, first in the early morning (about 0650 - 0930) and then late in each day (about 1600 - 1730). These periods of travel involved total movements of up to 800 m and often ended in close proximity to the start point. By 1730 hrs the birds had apparently selected their roost for the night.

Despite the existence of apparently suitable habitat within a few hundred metres of the Herald Gully system and of vegetation providing cover for Noisy Scrub-bird movements, the radio-tracked birds did not move far from the established territories during the study period. Monitoring of singing males in the release area over the months following the releases showed that two males (at least one would be one of the radio-tracked birds) had

established territories in neighbouring gullies 100 m away from Herald Gully.

Observations on the Monitoring Technique

During radio-tracking of the birds, emphasis was placed on the development of appropriate techniques and the following observations were made:

1. Signal strength variation with distance: Loudness of the signal could not be used to approximate the distance between the bird and the observer. Unless the bird was very close (0-80 m) signal strength varied dramatically and was probably more dependent on the orientation of the transmitter unit.

2. Signal strength variation with topography: Topographic position of both the bird and the observer had a strong influence on signal strength, with line of site reception being the strongest. In one instance, while positioned at a line of site vantage point, a bird was detected approximately 400 m away. On moving toward this bird, reception was lost immediately the line of site vantage point was left and the signal was not regained until the observer was within about 100 m of the bird. Similar experiences occurred throughout the monitoring period. For this reason, whenever the signal was lost the observer moved to a high vantage point to regain reception.

3. Manoeuvrability of the observer: Because of the relatively dense vegetation which is the preferred habitat of the Noisy Scrub-bird, manoeuvring of the observer in pursuit of the bird while carrying the Yagi antenna proved very difficult. This was especially so during the periods in which the birds displayed high mobility. On several occasions this resulted in loss of reception. Continued movement by the observer in the direction of the last signal usually resulted in its relocation. If not, then a high vantage point had to be found.

4. Battery failure: Calculations made prior to this study suggested that the batteries used should have given the transmitters a life of approximately 14 days. However, transmitter units 1 and 3 proved to have a life significantly shorter than this. Possible causes for this reduced life include the unknown shelf life of the batteries prior to purchase for this study, and the unknown effect of transmitter construction methods on battery life.

CONCLUSIONS

This pilot study successfully tested procedures for radio-tracking Noisy Scrub-birds. The techniques of construction and mounting of the transmitter units produced a unit which was well within the acceptable weight range for male scrub-birds and would probably also be acceptable for females. The birds showed no apparent signs of stress due to the mounting or presence of the transmitter units and the units remained attached to the birds under field conditions.

Tracking was possible in the release area for 2-5 days and it is confidently expected that this period can be extended with improved battery quality. To understand more of what happens after release of Noisy Scrub-bird we certainly need to be able to track them for longer periods.

Although sometimes difficult to follow through dense vegetation, particularly when moving rapidly, the use of two observers and the possibility of predicting periods of high mobility usually helped in relocating the signal.

Valuable, previously unobtainable information on the behaviour of Noisy Scrub-birds after release was obtained from this study. This kind of information will improve our understanding of the translocation process and may allow improvements to be made in the strategies presently used. The birds in this study were released into areas already occupied by other Noisy Scrub-birds. What we need to know is what happens when a male is released into an unoccupied area, how females behave when released into areas occupied (or unoccupied) by males and what effect females have on males in the release area. Future radio-tracking work with Noisy Scrub-birds should address these questions.

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Table 1 Characteristics of the three transmitter units constructed during the pilot study.

UNIT	WEIGHT (gm)	LENGTH (cm)	FREQUENCY (MHz)
1	1.9	17.6	151.135
2	2.0	16.3	151.175
3	2.0	16.8	151.125

Table 2 Weights and dates of the study birds on capture and release.
* weight of the bird on the morning after capture.
- this bird was no longer carrying the transmitter unit when released.

CODE	CAPTURE		RELEASE		TRANSMITTER UNIT
	DATE	WEIGHT (gm)	DATE	WEIGHT (gm)	
90M6	12/7	49.4*	26/7	54.3+	1
90M7	20/7	44.7*	25/7	47.8	2
90M8	25/7	44.3*	28/7	49.0	3

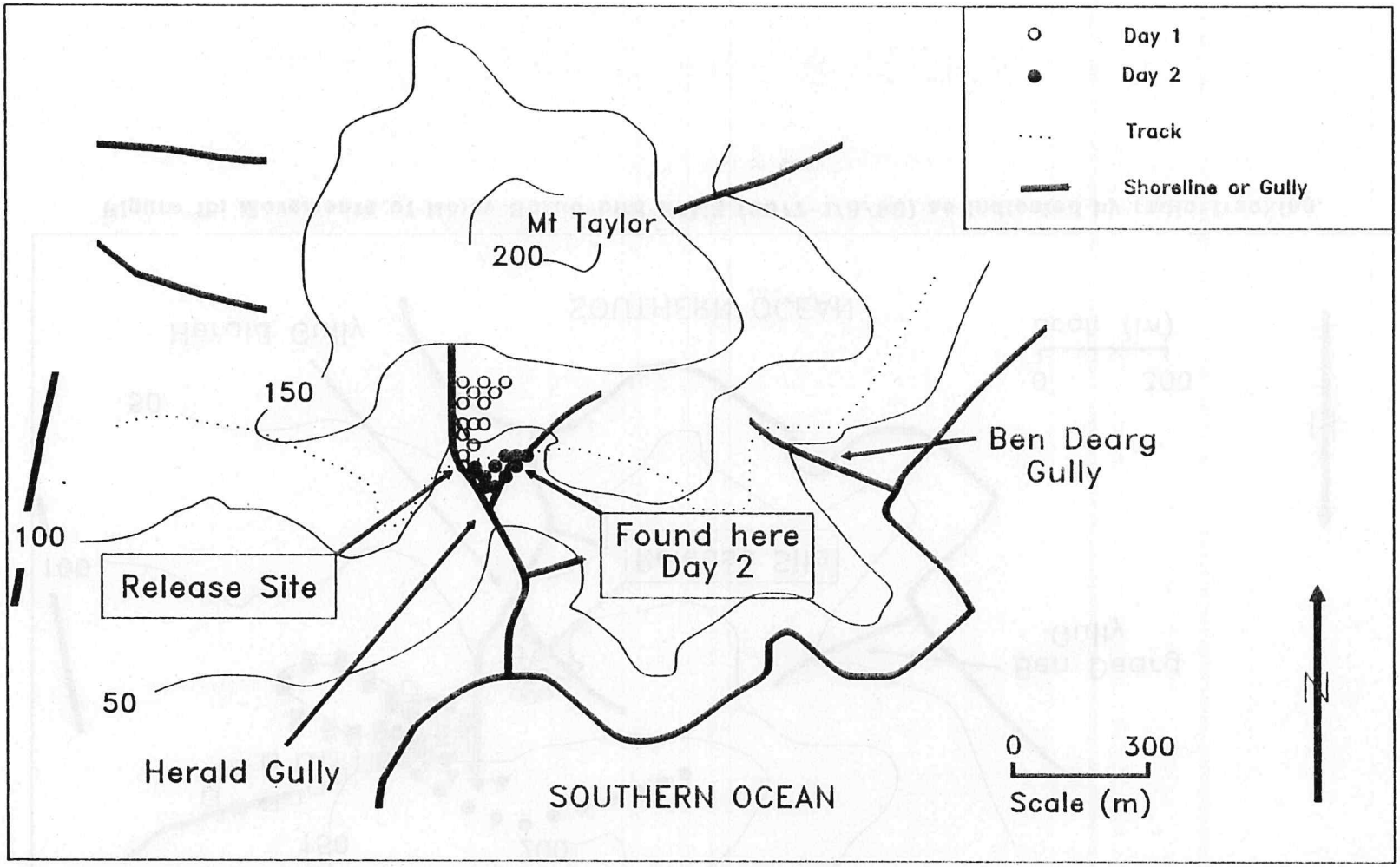

Figure 1a: Movements of Noisy Scrub-bird 90M7 (27/7-28/7/90) as indicated by radio-tracking.

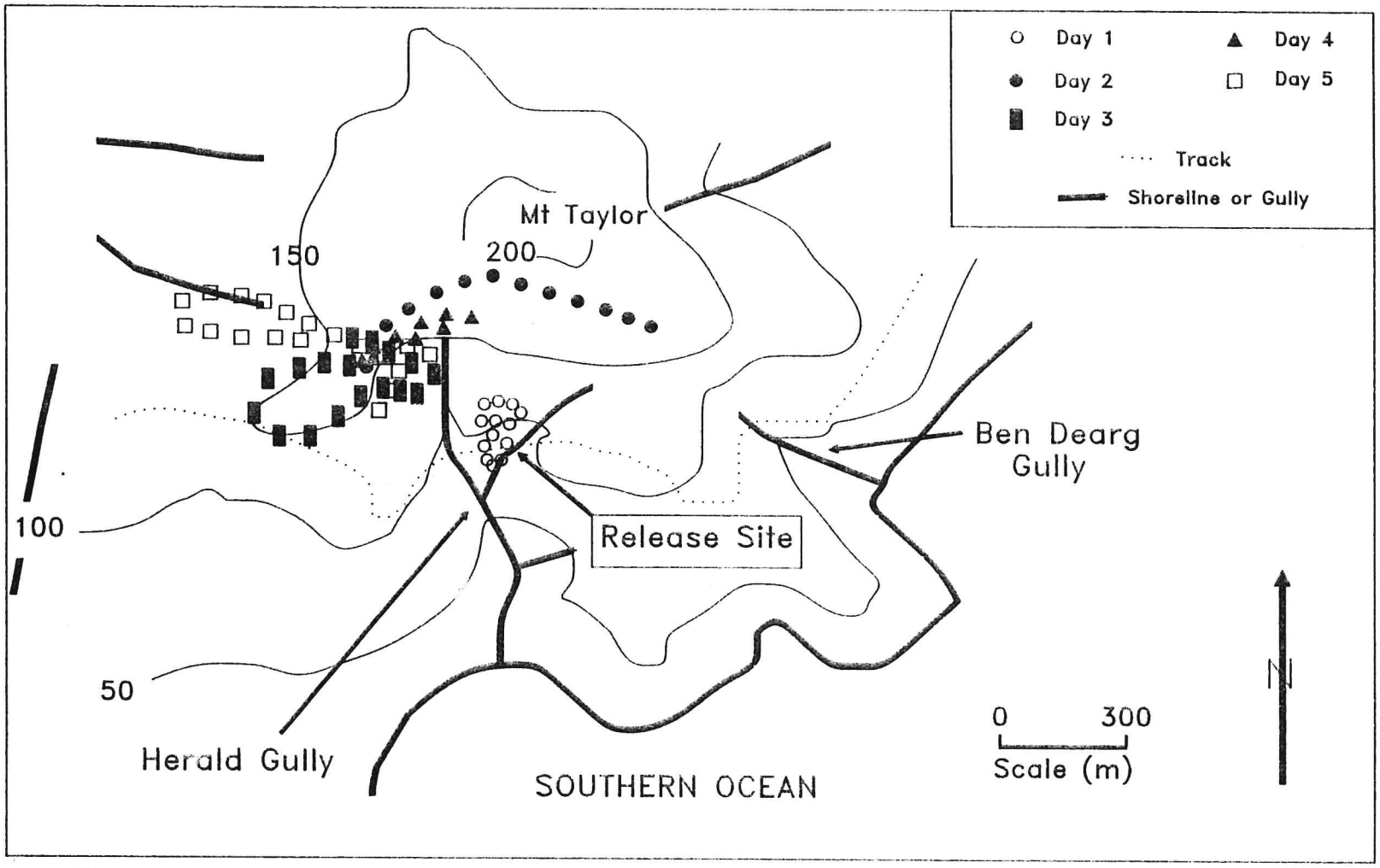

Figure 1b: Movements of Noisy Scrub-bird 90M8 (28/7-1/8/90) as indicated by radio-tracking.

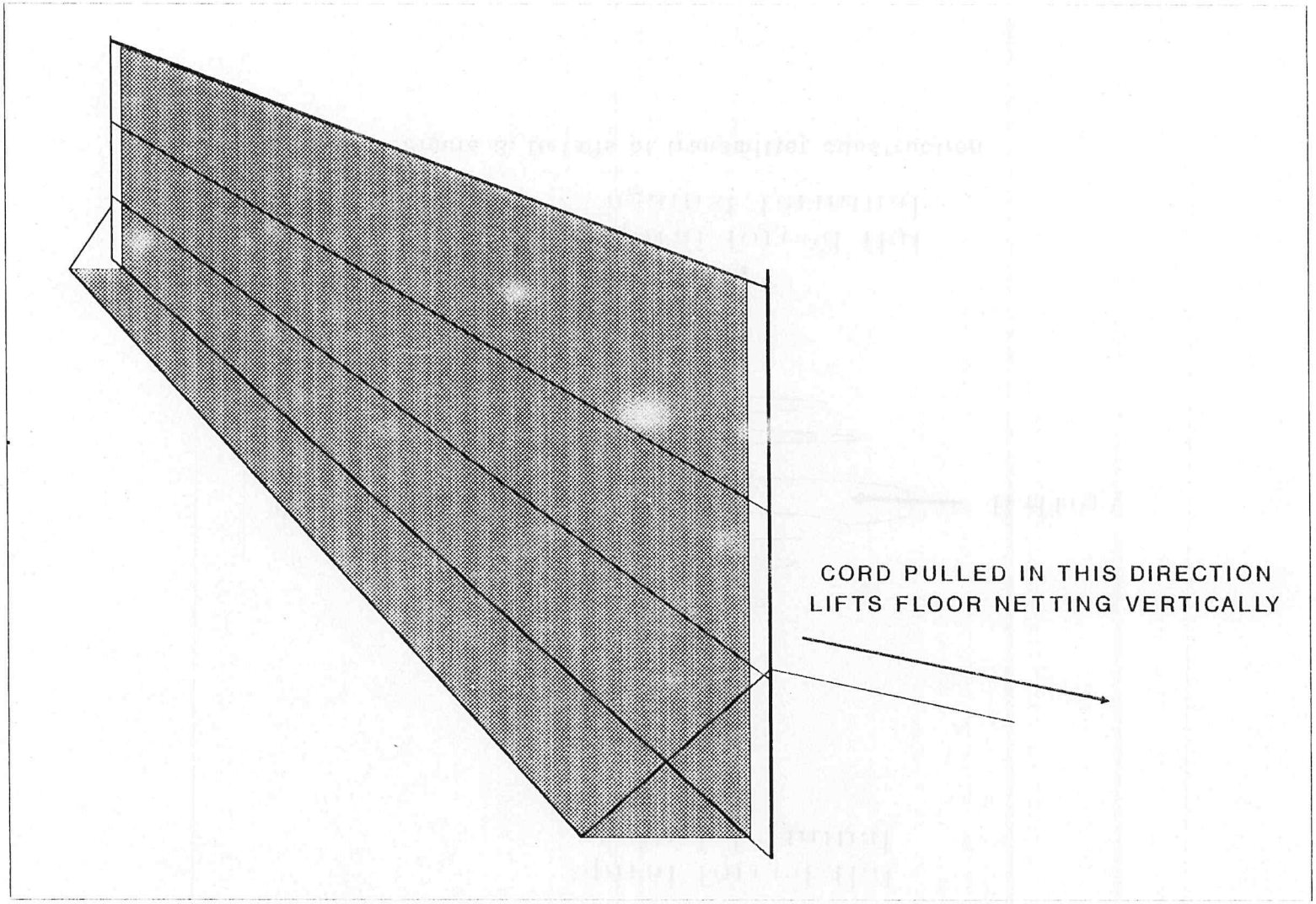

Figure 2: Net design for the capture of Noisy Scrub-birds

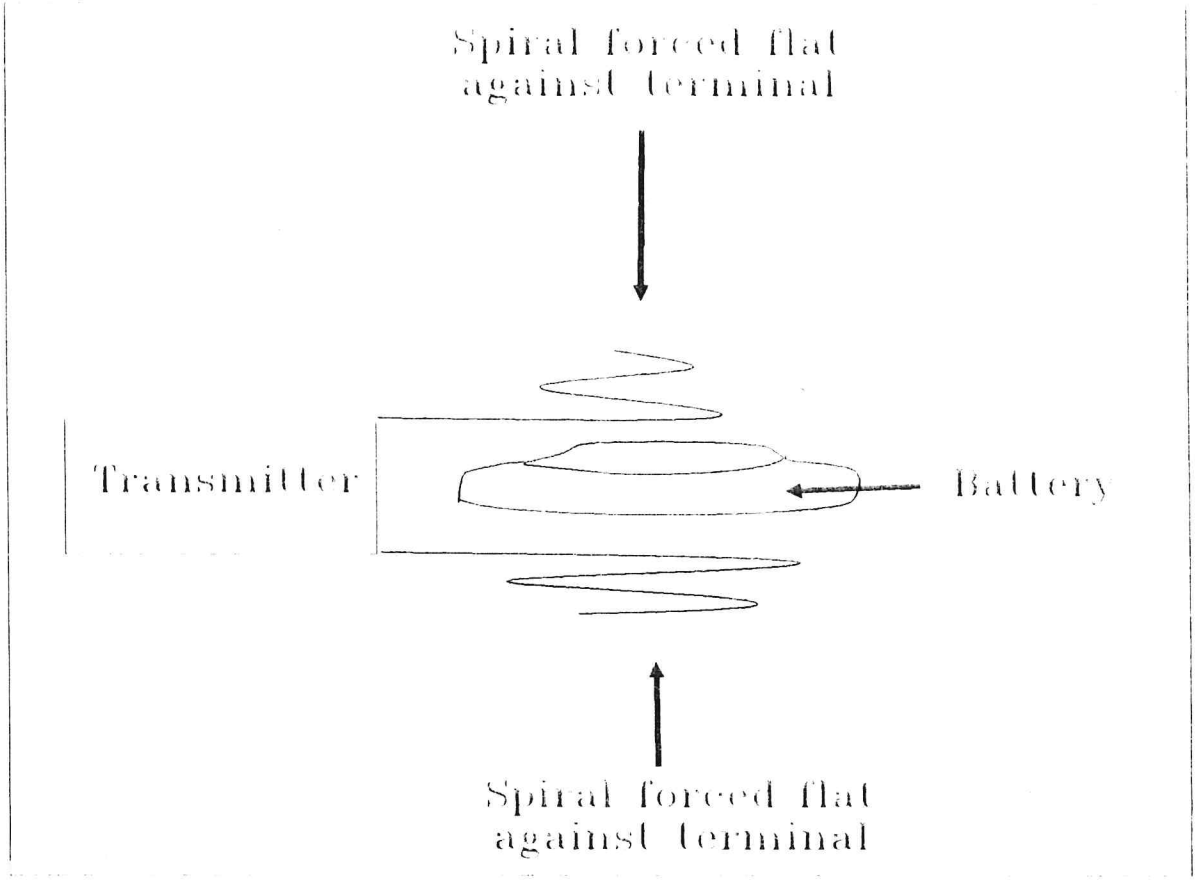

Figure 3: Details of transmitter construction.