Australian Field Ornithology 2018, **35**, 107–110
http://dx.doi.org/10.20938/afo35107110

Sizes of some Rufous Scrub-bird singing areas in the Gloucester Tops

Alan Stuart

81 Queens Road, New Lambton NSW 2305, Australia
Email: almarosa@bigpond.com

Abstract. The sizes of the singing areas for three male Rufous Scrub-birds *Atrichornis rufescens* in the Gloucester Tops, New South Wales, were estimated by locating the positions of males in visits to their territories in 2015–2018. The smallest singing area was 0.54 ha and the largest was 1.66 ha. The sizes of the singing areas are similar to those found in the early 1980s.

Introduction

The Rufous Scrub-bird *Atrichornis rufescens* is classified as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the IUCN Red List, and as Vulnerable under the New South Wales *Biodiversity Conservation Act 2017*. It is a cryptic ground-dwelling species occurring in areas of dense vegetation (Ferrier 1984, 1985). The populations of both the northern (*A. r. rufescens*) and southern subspecies (*A. r. ferrieri*) are suspected to be in decline (Garnett *et al.* 2011).

Most studies of Rufous Scrub-birds have focused on monitoring the status of subpopulations (Ekert 2002, 2005; Eco Logical Australia 2009; Newman & Stuart 2011; Williams 2012; Newman *et al*. 2014; Andren 2016; Stuart & Newman 2018). Studies of individual birds may assist development of optimal conservation strategies for this species.

Most of what is known about the behaviour and breeding biology of the Rufous Scrub-bird has come from a study carried out in the early 1980s (Ferrier 1984, 1985). Ferrier's study included the estimation of territory sizes, which he did by first locating the positions of calling Scrub-birds by triangulation from listening points along his survey transects (Ferrier 1984). Experiences over 2010–2017 with calling Scrub-birds in the Gloucester Tops, New South Wales (Stuart & Newman 2018) led to an appreciation that it was often difficult to pinpoint precisely the direction to the bird when it was many tens of metres away from a transect. The present study involved locating the positions of calling males by a hand-held GPS unit in visits to territories in 2015–2018. It was an opportunity to test Ferrier's results by a different, more accurate method and to investigate whether any changes in sizes of singing area had occurred in the more than three decades between the two studies.

Home-ranges, territories and singing areas

The concept that animals restrict their movements to a finite area is well established (e.g. see Burt 1943; Odum & Kuenzler 1955; Kie *et al*. 2010) and the area is usually referred to as the animal's home-range. Bas *et al*. (2005, p. 137) defined home-range as "the area traversed by the individual in its normal activities of food gathering, resting, mating, and caring for young" and similar definitions have been made by others (e.g. Burt 1943). If all or part of the home-range is defended against other individuals of the same species, the guarded area is called a territory. Maher & Lott (1995, Appendix 3, p. 1591) defined a bird's territory as an "exclusive area that is defended". Often an animal's home-range is considerably larger than its territory. For example, the home-range of the Eurasian Blackcap *Sylvia atricapilla* was found to be seven times bigger than its territory (Ferry *et al.* 1981).

The territory size of a cryptic (i.e. secretive) species often is determined from the locations from where it calls (its singing area). Anich *et al*. (2009) in radiotelemetry studies of Swainson's Warbler *Limnothlypis swainsonii* showed that this approach under-estimated the territory and home-range sizes. Thus, although the size of a Rufous Scrub-bird's singing area can be measured, the relationships to the bird's actual territory size and to its home-range are as yet unknown. Ferrier (1984) acknowledged this issue in his earlier study. He assumed that the Rufous Scrub-bird's singing area defined its territory but recognised that this was not necessarily correct; for simplicity, he treated the terms 'territory' and 'home range' as analogous.

Ferrier (1984) used two methods for estimating Rufous Scrub-bird singing areas—minimum complex polygons, adjusted for sample size, and bivariate normal 95% probability ellipses. Both yielded similar relative indices of the territory size (mean areas 0.88 and 0.90 ha, respectively). The latter method was adopted for the present study.

Methods

Territory selection and territory descriptions

A recent study identified the locations for 37 Rufous Scrub-bird territories in the New South Wales Gloucester Tops (Stuart & Newman 2018). Three territories were selected for investigations into the sizes of singing area but, because of the Scrub-bird's threatened species status, their exact locations are confidential. All were at altitudes of 1200–1300 m above sea-level, lying within an area of radius ~1.5 km centred approximately at 32°05′S, 151°37′E. The selection criteria were: (1) the territory had long-term occupancy in 2010–2015 (Stuart & Newman 2018); (2) it did not straddle a road or walking track, whereby human disturbance potentially could affect the bird's behaviour;

and (3) it appeared to be centred within 200 m of a road or walking track (for ease of access by observers).

A summary of the botanical characteristics of the Gloucester Tops is available (Binns 1995), and Ferrier (1984) provided detailed descriptions of the vegetation in the areas supporting Rufous Scrub-birds. All three territories in the present study (referred to as Territories A, B and C) had broadly similar habitat, namely eucalypt open woodland comprising mainly Messmate *Eucalyptus obliqua* and Brown Barrel *E. fastigata* and having a dense understorey of *Lomandra* species, grasses, Common Bracken *Pteridium esculentum*, fallen timber and leaf-litter. All had patches of tree-ferns (*Dicksonia* spp.) and some emergent Antarctic Beech *Lophozonia moorei* saplings from areas of nearby rainforest. Territory A had considerably more fallen trees than the other two territories, and Territory B had more large clumps of tree-ferns.

Locating singing Rufous Scrub-birds

The study spanned September 2015 to March 2018, and involved four–eight visits to the Gloucester Tops each year. The location is remote and access can be problematic because of adverse weather conditions and other factors, e.g. fallen trees, bushfires. Territories were visited in random order and at varying times of day. The procedure involved firstly listening at the edge of a territory for the Scrub-bird to call. In spring, this generally did not take long. At other times of the year, lengthy waits sometimes were required. If the bird had not called within *c*. 30 minutes of the observer arriving at the territory, the attempt was discontinued but when possible the territory was revisited later in the day. If a Scrub-bird was heard, the bird was approached slowly and quietly. When its position could be estimated to ±3 m, approach was halted until the bird moved away. Then, its location at the time of calling was determined using a hand-held GPS unit (Garmin etrex 30x) set to WGS 84 coordinates. In the open woodland habitat, the indicated accuracy of the GPS reading was at least ±8 m and often ±5 m.

If disturbance was thought to have occurred, the attempt at locating the Scrub-bird was abandoned. Evidence of potential disturbance was that the bird ceased its then-current calling pattern and/or rapidly relocated its position. On most days, only one data point was obtained at each territory. If more than one reading was achieved, there were intervals of at least 2 hours between each reading. It was assumed that all records from within a territory were of the same bird but that cannot be proven. The GPS readings were entered into an Excel spreadsheet and converted into east–west and north–south distances (*X* and *Y* distances) in metres from a nominal reference point. A different reference point was used for each territory. The positions of each bird relative to the reference point were plotted in Excel. The relative indices of the singing area sizes were derived by fitting bivariate normal 95% probability ellipses to the data after calculating the determinant of the *X*, *Y* covariance matrix (Ferrier 1984).

Results

Table 1 summarises the data obtained from the three territories. Territories A and B were occupied throughout the study period. During spring, Rufous Scrub-birds at these territories called regularly, more frequently than at other times of the year. Scrub-birds could be located at least once on 22–26 visits. Multiple records were obtained on 6–10 days. Territory C was occupied in 2015–2016, and the final calling location recorded for it was in December 2016. In February 2017, the location of the Scrub-bird in Territory C could not be determined as it did not call for long enough. After that it was never heard again in this territory.

Table 1. Records of Rufous Scrub-birds singing in three territories and the estimated sizes (ha) of the singing areas, Gloucester Tops, New South Wales.

	Territory		
	A	*B*	*C*
Results period	2015–18	2015–18	2015–16
No. of days with records	26	22	14
No. of records	38	35	18
Size of singing area	1.66	0.70	0.54

Figures 1–3 show the positions within the three territories of each Scrub-bird within its singing area when it was first located on any given day.

The bird in Territory A had the largest singing area, 1.66 ha (at 95% confidence probability). The singing areas in Territories B and C were less than half that size (0.54 and 0.78 ha, respectively). The maximum distance between locations in Territory A where the bird was detected was ~130 m (Figure 1), and in Territories B and C was ~80 m and ~60 m, respectively.

Discussion

In the 1980s, Ferrier found that singing areas of territorial Rufous Scrub-birds in the Gloucester Tops ranged in size from 0.49 to 1.33 ha, with a mean of 0.90 ha (Ferrier 1984). Results from the present study are similar. This tentatively suggests that little change in habitat quality or Scrub-bird behaviour has occurred in the intervening decades; however, it must be emphasised that the present study comprised just three territories and relatively few data points.

More than one location data point was sometimes obtained in a territory on the same day, and usually the Scrub-bird had not moved a great distance between the readings. To assess how this might have affected the estimates of the sizes of the singing areas, plots were generated showing only the locations of the Scrub-bird when it was first located each day (Figures 1–3). Territories A and C had an essentially random distribution of locations within the overall singing area (Figures 1, 3). Most of the daily first records from Territory B were also randomly distributed within a small area but on 2 days (22 September and 13 December 2016) the Scrub-bird was at least 30 m to the west of the other records. Without those two records, the estimate for the singing area would have been 0.33 ha.

Territory C was selected for the study because of its long-term occupancy. It was occupied every year in the 2010–2016 spring surveys (Stuart & Newman 2018) and there were regular records of it in other months over that

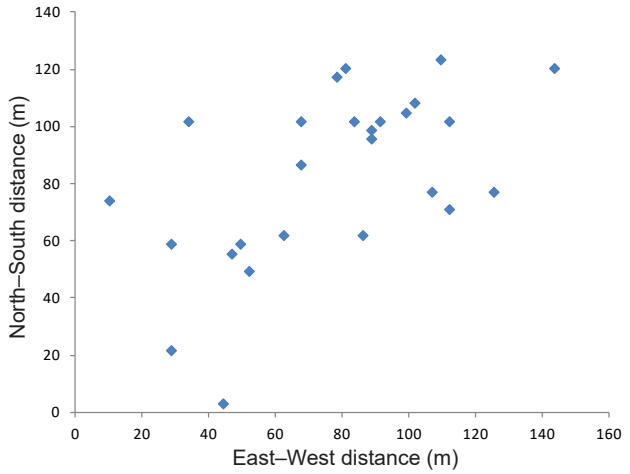

Figure 1. The first location identified each day of the Rufous Scrub-bird in Territory A, relative to a nominal reference point, Gloucester Tops, New South Wales.

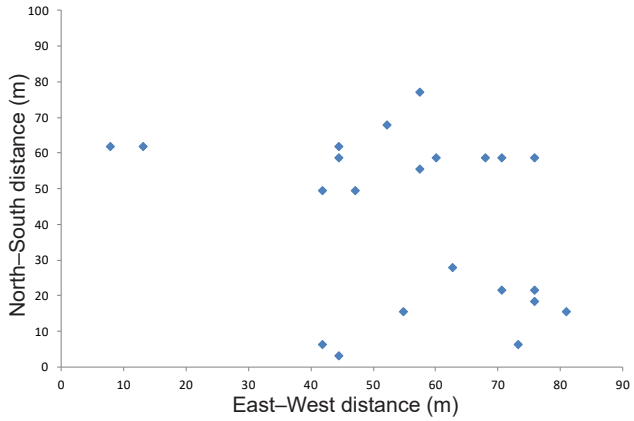

Figure 2. The first location identified each day of the Rufous Scrub-bird in Territory B, relative to a nominal reference point, Gloucester Tops, New South Wales.

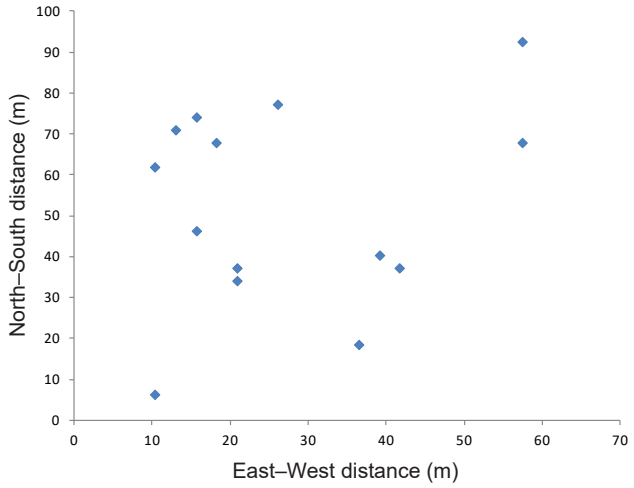

Figure 3. The first location identified each day of the Rufous Scrub-bird in Territory C, relative to a nominal reference point, Gloucester Tops, New South Wales.

period (AS pers. obs.). The bird's absence after February 2016 has been confirmed from investigations using an automated recording unit installed in the territory for several periods of 5–7 days (Stuart & O'Leary unpubl. data). It seems that territory C is no longer occupied by a Rufous Scrub-bird.

The reason why the singing area in Territory A was much larger than those in the other two territories was unclear. It was ~25% larger than the largest singing area found by Ferrier (1984) for Rufous Scrub-birds in the Gloucester Tops (1.66 ha vs 1.33 ha). Although, as previously noted, some differences in habitat were apparent in Territory A, they did not appear to be substantial. A possible explanation for the larger singing area in Territory A was that the Scrub-bird might have altered its singing area over time. However, when the data were examined on an annual basis, there was no indication that any such change had occurred. Future investigations may shed more light.

The relationship between singing area and territory for Rufous Scrub-birds is uncertain. When a Scrub-bird is not calling, it is very difficult to know its whereabouts. A future direction for research would be to fit a transmitter onto a Scrub-bird and track where it goes when it is not calling.

Conclusions

The sizes of singing areas of Rufous Scrub-birds in the Gloucester Tops are in the order of 0.5–1.7 ha. This is probably also a measure of the territory size. The findings are in general agreement with those from a study conducted in the early 1980s.

References

Andren, M. (2016). Monitoring the Rufous Scrub-bird *Atrichornis rufescens* in the New England region. *Corella* **40**, 53–60.

Anich, N.M., Benson, T.J. & Bednarz, J.C. (2009). Estimating territory and home-range sizes: Do singing locations alone provide an accurate estimate of space use? *Auk* **126**, 626–634.

Bas, J.M., Pons, P. & Gomez, C. (2005). Home range and territory of the Sardinian Warbler *Sylvia melanocephala* in Mediterranean shrubland. *Bird Study* **52**, 137–144.

Binns, D. (1995). *Flora Survey, Gloucester and Chichester Management Areas*. Forestry Resources Series 34. State Forests of New South Wales, Sydney.

Burt, W.H. (1943). Territoriality and home range concepts as applied to mammals. *Journal of Mammalogy* **24**, 346–352.

Eco Logical Australia (2009). Gondwana Rainforests of Australia Monitoring Strategy Analysis, Evaluation and Review of Rufous Scrub-bird Monitoring. Final Report (ELA project No. 0072-019) by Eco Logical Australia to New South Wales Department of Environment & Climate Change. Eco Logical Australia, Coffs Harbour, NSW.

Ekert, P.A. (2002). Monitoring of Rufous Scrub-bird (*Atrichornis rufescens*) in North-east NSW. Report by Ekerlogic Consulting Services to NSW National Parks & Wildlife Service. Ekerlogic Consulting Services, Wallsend, NSW.

Ekert, P.A. (2005). Monitoring the Rufous Scrub-bird (*Atrichornis rufescens*) in the Central Eastern Rainforest Reserves of Australia. Final Report 2005. Ekerlogic Consulting Services, Wallsend, NSW.

Ferrier, S. (1984). The Status of the Rufous Scrub-bird *Atrichornis rufescens*: Habitat, Geographical Variation and Abundance. PhD thesis. University of New England, Armidale, NSW.

Ferrier, S. (1985). Habitat requirements of a rare species, the Rufous Scrub-bird. In: Keast, A., Recher, H.F., Ford, H. & Saunders, D. (Eds). *Birds of Eucalypt Forests and Woodlands: Ecology, Conservation and Management*, pp. 241–248. Surrey Beatty & Sons, Sydney.

Ferry, C., Frochot, B. & Leruth, Y. (1981). Territory and home range of the Blackcap (*Sylvia atricapilla*) and some other passerines, assessed and compared by mapping and capture-recapture. *Studies in Avian Biology* **6**, 119–120.

Garnett, S.T., Szabo, J.K. & Dutson, G. (2011). *The Action Plan for Australian Birds 2010*. CSIRO Publishing, Melbourne.

Kie, J.G., Matthiopoulos, J., Fiberg, J., Powell, R.A., Cagnacci, F., Mitchell, M.S., Gaillard, J.-M. & Moorcroft, P.R. (2010). The home-range concept: Are traditional estimators still relevant with modern telemetry technology? *Philosophical Transactions of the Royal Society B: Biological Sciences* **365**, 2221–2231.

Maher, C.R. & Lott, D.F. (1995). Definitions of territoriality used in the study of variation in vertebrate spacing systems. *Animal Behaviour* **49**, 1581–1597.

Newman, M. & Stuart, A. (2011). Monitoring the Rufous Scrub-bird in the Barrington Tops and Gloucester Tops IBA – a pilot study. *Whistler* **5**, 19–27.

Newman, M., Stuart, A. & Hill, F. (2014). Rufous Scrub-bird *Atrichornis rufescens* monitoring at the extremities of the species' range in New South Wales (2010–2012). *Australian Field Ornithology* **31**, 77–98.

Odum, E.P. & Kuenzler, E.J. (1955). Measurement of territory and home range size in birds. *Auk* **72**, 128–137.

Stuart, A. & Newman, M. (2018). Rufous Scrub-birds *Atrichornis rufescens* in the Gloucester Tops of New South Wales: Findings from surveys in 2010–2016. *Australian Field Ornithology* **35**, 13–20.

Williams, L. (2012). Trends in the Local Abundance and Geographic Distribution of the Rufous Scrub-bird. BSc (Hons) thesis. Macquarie University, Sydney.

Received 22 March 2018, accepted 2 July 2018, published online 26 September 2018