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# Monitoring the Rufous Scrub-bird *Atrichornis rufescens* in the New England region

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A locally-based monitoring survey of the Rufous Scrub-bird *Atrichornis rufescens* in the New England region was undertaken during three breeding seasons from 2010 to 2013 to establish baseline numbers of territories. Twelve kilometres of transects were established in the Horseshoe Road area in known Scrub-bird habitat and surveyed 10 times. Twelve 'territories' were identified based on male birds calling on three separate occasions from the same site. It required seven surveys to identify the 12 territories and all of them remained occupied at the completion of the survey in 2013. Monitoring of this species is possible due to the conspicuous calling of male Scrub-birds; they were detected on 64 percent of systematic surveys of known territories. The habitat along Horseshoe Road appears to be of high quality for the Rufous Scrub-bird as numbers of territories were similar to surveys undertaken using similar methods in what is considered high quality habitat in the Barrington Tops and Wiangaree areas. A comparison with previous surveys involving different methods in the Horseshoe Road area from 1997 to 2004 indicated that territory numbers are stable (12 now compared with 13 previously) and that 75 percent of current territories are in the same location as previously.

## INTRODUCTION

The decline of biodiversity globally (Butchart *et al*. 2010) and in Australia (Ritchie *et al*. 2013) increasingly necessitates monitoring programs that can identify the declining elements of biodiversity, the severity of the declines and ideally guide management responses to address the declines. Long-term datasets are likely to become an increasingly important resource in monitoring biodiversity (Magurran *et al*. 2010), but designing a cost-effective program that delivers reliable long-term data is a formidable challenge.

A strong-inference (Burton 2012) or question-driven (Lindenmayer and Likens 2010) approach to monitoring emphasises rigorous study design and is at the very least an aspiration for many monitoring programs. With a multitude of monitoring programs needed, however, it is difficult to obtain sufficient resources to cover them all to an exacting standard, and scientific specialists and statisticians are not always available. At the other end of the spectrum, locally-based monitoring (Burton 2012) is typically less expensive and carried out by local personnel. It is also prone to failure for reasons such as lack of focus or a poor design that diminishes confidence in the results. Reid *et al*. (2013) give some Australian examples of unsuccessful locally-based monitoring, while Lindenmayer and Likens (2010) list a host of factors that may derail monitoring programs.

The Rufous Scrub-bird *Atrichornis rufescens* is a relictual Gondwanan species of high elevation wet forests of northeastern New South Wales (NSW) and far southeastern Queensland (QLD). It is an appropriate subject for monitoring because it is: a rare and extraordinary species (Chisholm 1951; Ferrier 1984; Higgins *et al*. 2001, Gole and Newman 2010); considered to be endangered (Garnett *et al*. 2010; BirdLife International 2012); formally listed as a threatened species in NSW, QLD, nationally and internationally; and potentially at risk, as a mountain-top relic, to decline from rising temperatures as a result of climate change. Another important reason for monitoring is that while the species is generally thought to still be declining (Garnett *et al*. 2010; BirdLife International 2012), there is little hard evidence available.

Monitoring is a cornerstone of the Important Bird Area (IBA) program of BirdLife International and BirdLife Australia (Dutson *et al*. 2009; BirdLife International 2013). IBAs are sites of global bird conservation significance and the Rufous Scrub-bird is a key species of five Australian IBAs, including the New England IBA in northeastern NSW. To fulfil the monitoring requirements of the IBA program a monitoring program was established in 2010 for the species in three IBAs; Gloucester Tops, Scenic Rim (Newman *et al*. 2014) and New England.

Monitoring the Rufous Scrub-bird presents a particularly challenging dilemma. Strong inference is most needed for rare and threatened species, but these are precisely the species for which this type of monitoring is extremely difficult to achieve (Pavlacky *et al*. 2012). For example, a previous monitoring program for the species (Ekert 2005b) was discontinued in 2005 following the loss of funding and issues regarding its effectiveness (Cunningham and Welsh 2000; EcoLogical 2009).

This study did not receive any specific funding and was undertaken with part-time contributions from staff of the NSW Office of Environment and Heritage and local volunteers. It is an example of locally-based monitoring and adhered to the injunction that IBA monitoring "…must be simple, robust and cheap…produce useful data, but avoid unnecessary sophistication…[and] involve the local community in collecting data" (Birdlfe International 2006, p.9).

The aim of the monitoring was to establish baseline data for the distribution of the Rufous Scrub-bird along transects established in the Horseshoe Road area, within or adjacent to the New England IBA. Horseshoe Road was chosen because Scrub-birds were known to occur in the area, it is accessible, and as a comparatively low elevation and isolated occurrence, decline is reasonably likely. Surveys were carried out from 2010 to 2013 and a comparison of the results is made with previous surveys (1997 to 2004) in the same area.

## METHODS

Male Rufous Scrub-birds hold territories from which they call consistently, particularly in the breeding season. Surveys were carried out between September and December, which is the period shown by Ferrier (1984) and Stuart *et al*. (2012) to encompass the peak calling rate. The survey method used was adopted from Ferrier (1984) and Newman and Stuart (2011). All Scrub-birds heard or seen along a predetermined one-kilometre transect were recorded using a GPS and estimate of the perpendicular distance and direction from the transect. Territories were identified by clusters of records obtained from repeated surveys.

Only a small number of observers (either singly or in pairs) who were experienced in the identification of Rufous Scrub-bird calls were used. Surveys were conducted in the morning, starting at dawn or soon after and continued until about 11 am. Transects were walked in 30 minutes. This rate (2 km/hr) was similar to the 2.5 kilometres per hour walked by Ferrier (1984). Each transect was surveyed a total of 10 times. Call playback was not used systematically, based on the experience of Ferrier (1984) and earlier monitoring surveys by the NSW National Parks and Wildlife Service (NPWS). However, playback was used opportunistically outside of the formal survey.

A 'territory' was defined as a site where a Rufous Scrub-bird was heard calling on at least three occasions, with each record at least one month apart. A site was considered to be roughly one hectare based on the area reported by Ferrier (1984) in which a territorial male spends 95 percent of its time (1.13 ha). This definition is similar to that used by Newman and Stuart (2011) in the pilot stage of their Scrub-bird surveys of Gloucester Tops, although they used the less stringent criteria of two records at least three weeks apart. After the first year of their study, they used the more exacting criteria that territories should be occupied in successive years to be considered permanent (Newman *et al*. 2014).

Originally, fourteen transects were established in the Horseshoe Road area (Fig. 1), centred on known Rufous Scrub-bird habitat. They were located along roads in five areas: Boot Hill (1 transect), Bellbucca Road (2 transects), Mt Killiekrankie (3 transects), Kilprotay Road (6 transects) and League Scrub (2 transects). All transects contained habitat that was previously known to support Scrub-birds. However, when Scrub-birds could not be located at League Scrub, the two kilometres of transects at this location were discontinued (thereby leaving 12 km in total).

Rufous Scrub-bird data from the current and previous surveys such as the systematic NPWS surveys of 1999, 2001, 2002 and 2004 were collated and, where necessary, entered into the *Atlas of NSW Wildlife*, as well as a number of opportunistic records.

## RESULTS

It required 22 visits to systematically survey all transects 10 times. Systematic surveys were conducted over three breeding seasons from 4 November 2010 to 12 February 2013. Scrub-birds would call during light rain and light wind, and would continue calling throughout the day unless there was moderately strong wind or bright sunshine (when calling rates would decrease, although not stop completely). On sunny days, surveys ceased by about 11 am. On one occasion, a survey was carried out in the late afternoon. The earliest time in the season that a survey was undertaken was on 4 September and all surveys were completed by 21 December, with the exceptions of two surveys carried out in early February 2013 to complete the study.

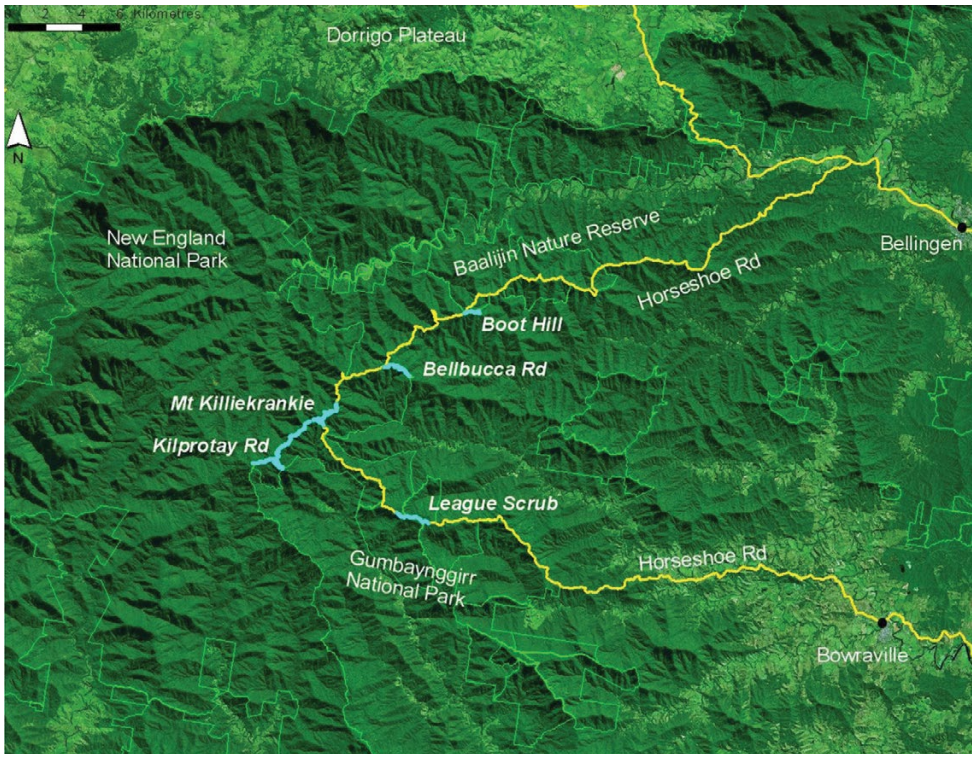


**Figure 1.** *The Horseshoe Road study area showing the location of the transects in blue.*

The two kilometres of isolated transects at League Scrub may no longer contain Rufous Scrub-birds as considerable survey effort was expended in the area (five systematic surveys and many non-systematic visits) without success. League Scrub also had a relatively high incidental visitation rate for this region due to the presence of an old camp site, but no recent sightings have been reported. Systematic surveys were discontinued at League Scrub after five surveys due to the absence of Scrub-birds and the high logistical cost of visiting the area. League Scrub data were subsequently excluded as this study is focussed on areas that are currently occupied by the species.

Call playback was not used in the systematic surveys. However, extensive opportunistic use of playback indicated that birds sometimes respond, occasionally quite vigorously. The use of this technique could be reconsidered in future if it can be conducted without significant disruption to the birds.

Twelve territories were identified (Fig. 2) based on the definition of three records at a site more than one month apart. All territories were occupied in more than one season.

Territories were at least 300 metres apart. Records were tightly clustered at each territory (Fig. 3). They occurred within an area of about one hectare, consistent with the male territory size estimated by Ferrier (1984).

The average estimated distance of the territories from the transects was 40 metres. The most distant territory was estimated at 80 metres and closest at 20 metres. Two of the closest territories included the transect itself (i.e. crossed the road).

Scrub-birds were successfully located on 64 percent of systematic surveys at the 12 territories (Table 1) during systematic surveys (120 surveys; 77 records).

The accumulation rate of Rufous Scrub-bird records and territories with increasing numbers of surveys is displayed graphically in Figure 4.

Three opportunistic visits were conducted outside the preferred calling season (31 March 2013, 8 July 2013 and 18 July 2013). Territories were visited on 26 occasions and birds detected 13 times (i.e. a 50% detection rate). This rate is not directly comparable with the 64 percent detection rate achieved in the breeding season as a significantly longer period of time was spent at territories during the opportunistic surveys (about twice as long). Nine of the 12 known territories were confirmed to be occupied during these surveys.

All the records were based on calls, although the bird was also seen on five occasions. There were no occasions where more than one male was heard calling at a time. On three occasions, contact calls were heard between two birds (one male). Species mimicked included the Superb Lyrebird *Menura novaehollandiae*, Australian King Parrot *Alisterus scapularis*, Australian Logrunner *Orthonyx temminckii*, Eastern Yellow Robin *Eopsaltria australis*, Grey Shrike-thrush *Colluricincla harmonica*, Golden Whistler *Pachycephala pectoralis*, Grey Fantail *Rhipidura albiscapa*, White-browed Scrub-wren *Sericornis frontalis*, Yellow-throated Scrub-wren *Sericornis citreogularis*, White-throated Treecreeper *Cormobates leucophaea*, Lewin's Honeyeater *Meliphaga lewinii* and Green Catbird *Ailuroedus crassirostris*.

A dense rainforest understorey beneath canopy gaps characterised at least part of all the territories (Fig. 5).

A significant number of systematic and non-systematic surveys were previously conducted along the Horseshoe Road from 1997 to 2004, particularly those by Ekert (2000, 2002, 2005a, 2005b) and Seccomb (unpub.). Clearly, with the

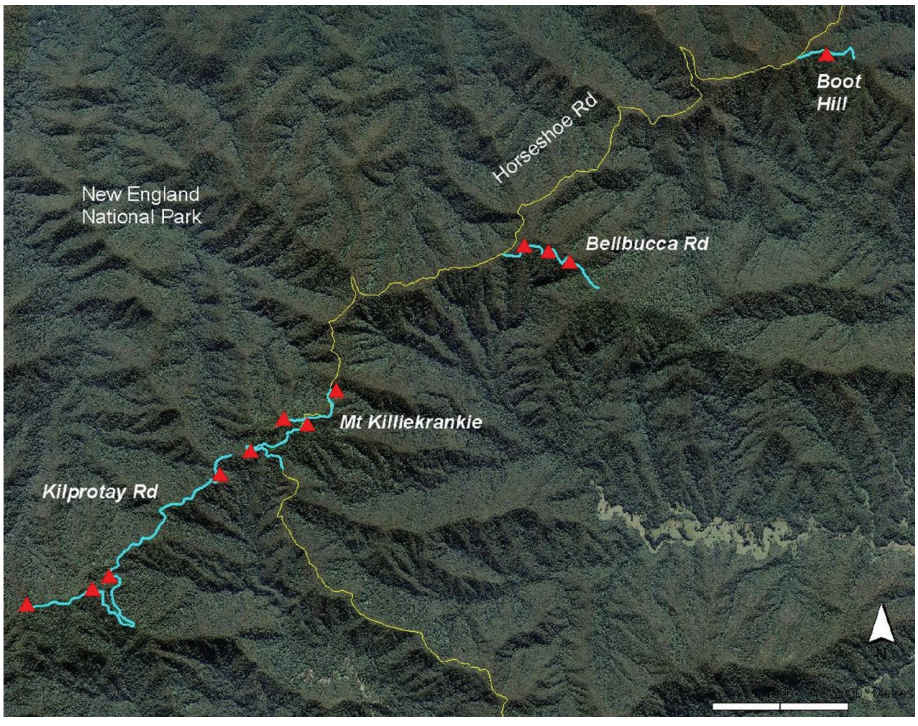


**Figure 2.** *The location of the 12 Rufous Scrub-bird 'territories' found in the systematic surveys (red triangles).*

**Table 1**

Results of the 2010–13 Rufous Scrub-bird systematic surveys. A 'Y' denotes the detection of a Scrub-bird. Killiekrankie transect KK01 and Bellbucca Road transect BB01 both contained two territories. The two transects at League Scrub (LS01 and LS02) were discontinued after five surveys.

| Transect Number | Territory Number | Survey Number 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | % Recorded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH01 | Boot Hill-1 | Y | Y | Y | Y | – | Y | – | Y | – | – | 60 |
| BB01 | Bellbucca Rd -1 | Y | – | Y | – | Y | Y | Y | Y | Y | Y | 80 |
| BB01 | Bellbucca Rd -2 | Y | – | – | – | Y | Y | Y | Y | Y | – | 60 |
| BB02 | Bellbucca Rd-3 | Y | Y | – | – | Y | Y | – | Y | – | – | 50 |
| KK01 | Killiekrankie-1 | – | Y | Y | Y | Y | Y | Y | Y | Y | – | 80 |
| KK01 | Killiekrankie-2 | – | – | – | – | Y | Y | Y | Y | – | – | 40 |
| KK02 | Killiekrankie-3 | – | – | Y | – | Y | Y | Y | Y | Y | – | 60 |
| KK03 | Killiekrankie-4 | – | – | – | – | Y | Y | Y | Y | Y | Y | 60 |
| KP01 | Kilprotay Rd-1 | Y | Y | Y | Y | – | Y | Y | – | Y | Y | 80 |
| KP02 | | – | – | – | – | – | – | – | – | – | – | 0 |
| KP03 | | – | – | – | – | – | – | – | – | – | – | 0 |
| KP04 | Kilprotay Rd-2 | Y | Y | Y | Y | Y | – | – | – | Y | – | 60 |
| KP05 | Kilprotay Rd-3 | Y | – | Y | Y | Y | – | – | Y | Y | – | 60 |
| KP06 | Kilprotay Rd-4 | – | Y | Y | – | Y | Y | Y | Y | Y | Y | 80 |
| LS01 | | – | – | – | – | – | | | | | | 0 |
| LS02 | | – | – | – | – | – | | | | | | 0 |
| **Mean %:** | | | | | | | | | | | | **64** |

**Figure 3.** *Detail of the three territories identified at Bellbucca Road, illustrating the typical tight clustering of the 2010–2013 survey records. These territories are about 350 metres apart, with two of them crossing the road. The image also shows the common occurrence of territories in wet gullies.*

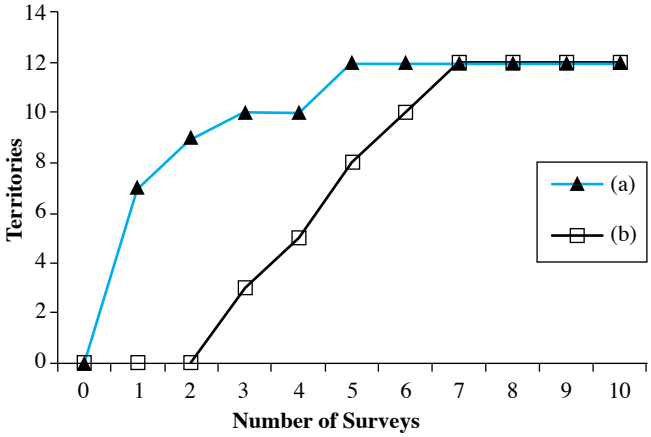


**Figure 4.** *The number of surveys taken to detect Rufous Scrub-birds at territories: (a) first detection of a territory, (b) third detection of a territory. No new territories were found after five surveys. Seven surveys were sufficient to define territories for the purposes of this study (i.e. obtain three records at a site).*



**Figure 5.** *Dense understorey typical of Rufous Scrub-bird territories: (a) territory KP04 and (b) territory KK04 in New England National Park.*

**Table 2**

An approximate comparison of Rufous Scrub-bird territories from 1997–2004 with those from 2010–2013, within 150 metres of the 2010-2013 transects. All territories were defined by containing three records at a site (about 1 ha), obtained at least one month apart. The elevation of each territory was taken from a point approximately in the centre of each minimum convex polygon. There were 75 records of Scrub-birds in the 1997–2004 dataset and 105 in the 2010–2013 dataset.

| 1997-2004 Territories (13 in total) | 2010-2013 Territories (12 in total) | Territories in common | Approx. elevation (m) |
|---|---|---|---|
| Boot Hill A | Boot Hill 1 | 1 | 750 |
| Bellbucca A | Bellbucca 1 | 1 | 800 |
| Bellbucca B | | | 775 |
| Bellbucca C | Bellbucca 2 | 1 | 800 |
| | Bellbucca 3 | | 775 |
| Killiekrankie A | Killiekrankie 1 | 1 | 775 |
| Killiekrankie B | Killiekrankie 2 | 1 | 950 |
| | Killiekrankie 3 | | 850 |
| Killiekrankie C | | | 825 |
| Killiekrankie D | Killiekrankie 4 | 1 | 775 |
| Kilprotay A | Kilprotay 1 | 1 | 750 |
| Kilprotay B | | | 750 |
| Kilprotay C | Kilprotay 2 | 1 | 875 |
| Kilprotay D | | | 875 |
| | Kilprotay 3 | | 950 |
| Kilprotay E | Kilprotay 4 | 1 | 925 |
| | | **Total: 9** | **Average: 825** |

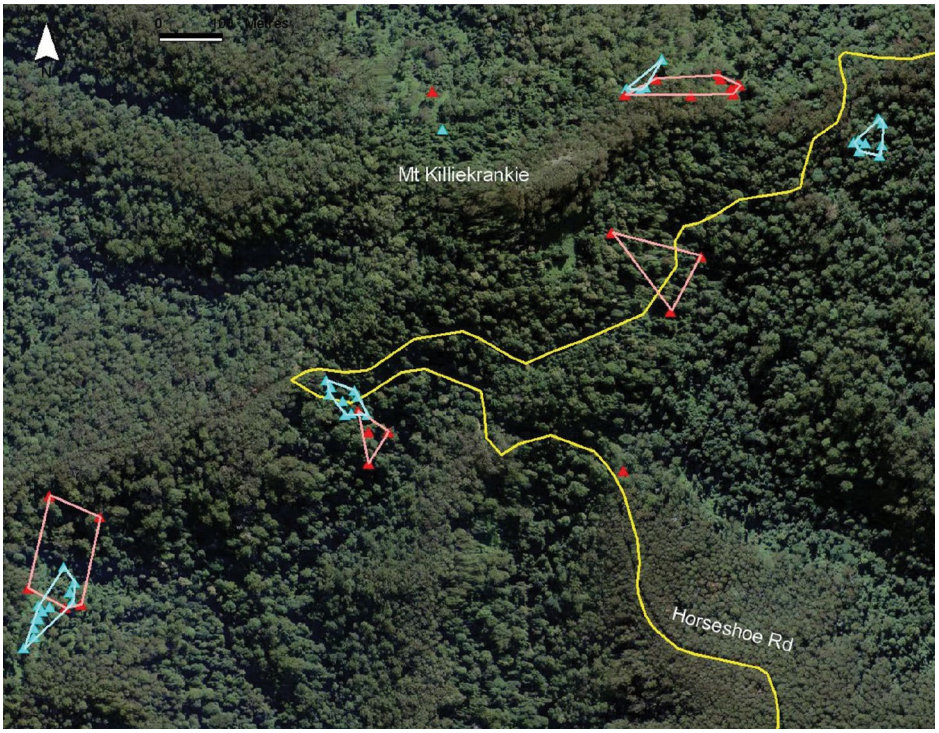


**Figure 6.** *An example of how the 2010–2013 territories (blue minimum convex polygons bounding blue records) were compared with 1997–2004 territories (red minimum convex polygons bounding red records). This detail from the Mt Killiekrankie area shows three territories considered not to have changed (overlapping polygons), one old territory no longer occupied (isolated red polygon) and one current territory not previously occupied (isolated blue polygon).*

confounding methods, it is not possible to rigorously compare the results of these surveys with the current survey. However, to enable an approximate comparison, the same rules were applied to the records from the older surveys to identify 'territories' (i.e. three records at a site at least one month apart) within 150 metres of the 2010–2013 transects (Fig. 6). The results are listed in Table 2, which also shows the approximate elevation of each of the territories.

## DISCUSSION

I believe that the Rufous Scrub-bird surveys carried out in New England are a successful example of locally-based wildlife monitoring that has produced reliable baseline data on the distribution of male territories. The approach does not require major resources, develops and retains local expertise and is simple and repeatable. However, the approach is not without its shortcomings.

A particularly significant issue is that the location of the transects were not randomly selected. Instead, known Rufous Scrub-bird habitat was deliberately targeted where it occurred along roads. Most habitat in the area is not occupied by Scrub-birds and there were insufficient resources to survey randomly-selected sites (most of which are likely to be unoccupied), particularly sites that occurred off-road in the typically steep and impenetrable terrain. The upshot is that the results cannot be extrapolated from the transects surveyed to the wider region.

An element of random site selection was included in a previous Rufous Scrub-bird monitoring project (1999 to 2004) across the range of the species to enable broad predictions to be made regarding population changes (Ekert 2000, 2002, 2005a, 2005b). That study highlighted the difficulties faced in implementing a strong-inference approach to monitoring this species. Logistical and methodological issues (Cunningham and Welsh 2000; EcoLogical 2009) and the failure to secure ongoing annual funding led to the discontinuation of the project.

The current program was designed with the benefit of hindsight from that experience within the constraint of limited resources. It is much more restricted in geographic scope, will not be repeated annually, uses only a small number of highly competent volunteers, is not designed to be extrapolated to other very diverse and complex environments and the low implementation costs increase the likelihood of sustainability. It is possible to produce useful data on a low budget in the tradition of some other successful bird monitoring projects (e.g. Recher and Serventy 1991).

The Rufous Scrub-bird is a conspicuous species, particularly in the breeding season, due to the consistent calling of male birds. The method used here required walking one kilometre in 30 minutes. Consequently a calling bird would have been audible for about 15 minutes, since calls can be heard up to 250 metres away (Ferrier 1984; pers. obs.). Despite this relatively short duration, birds were recorded on 64 percent of systematic surveys of territories. This demonstrates the consistent male calling behaviour without which the species would be impossible to monitor.

From the three opportunistic surveys conducted outside the breeding season, it was apparent that under suitable conditions birds continue to call quite consistently. However, it was subjectively observed that the frequency and duration of calling was diminished at these times of the year (pers. obs.). This observation is in accordance with the findings of Ferrier (1984) and Stuart *et al*. (2012) and further justifies the focus on the breeding season as the best time to survey for Rufous Scrub-birds.

Ferrier (1984) warned that comparisons based on the use of relative measures (from survey data) can be derailed by the exceptionally complex and variable issues of detectability. He analysed aspects of detectability in great detail, demonstrating the difficulties faced in trying to resolve this notoriously challenging problem. Examples of the issues that affect detectability in the Horseshoe Road area include the complex topography (steep falls and rises from the road, saddles, crests and valleys), variation in vegetation (rainforest, open forest, vine thickets, cleared gaps), variable weather conditions, variation in observer ability and the large variation in the calling behaviour of individual birds. It is well beyond the resources and scope of this study to tackle all of these issues in an explicit way, although the method takes some of them into account (such as only surveying under suitable weather conditions and only using experienced observers). However, I believe that the territories have been identified with a sufficient level of confidence that will enable substantial changes to be detected in future, for the following reasons:

(i) The study included opportunistic visits to territories in addition to the systematic surveys and the additional data gained greatly increased the confidence in the validity of the territories identified. The definition used for a territory of three records at a site at least one month apart would, at a minimum, require only three surveys over two months. In practice, however, the average number of records at each territory was in fact eight (a maximum of 11 and minimum of four).

(ii) Confidence in the identification of territories was also gained from the tight clustering of records, and the very low number of incidental records where territories were not confirmed (four only, all distant from the transect).

(iii) All territories were occupied for more than one season and in the final season of the study, all 12 were still occupied. It is highly likely that sites consistently occupied over this length of time are in fact occupied territories.

(iv) Rufous Scrub-birds can be effectively surveyed within about 150 metres of a transect (Ferrier 1984). The territories identified in this project were close to the transect, on average 40 metres away (not dissimilar to the average distances estimated by Ferrier at Barrington Tops of 48 m and Wiangaree of 57 m). Territories close to roads are much easier to access, identify and verify than distant territories.

(v) No new territories were identified in the last three of the 10 systematic surveys conducted. While there is no guarantee that every territory was detected, it is unlikely that territories close to the transect were missed.

In the Barrington Tops area, Newman and Stuart (2011) identified 1.1 Rufous Scrub-bird territories per kilometre (22 territories in 20 km of transect) and in the same area Ferrier (1984) found 1.2 territories per kilometre (22 territories in 18

km). Ferrier also identified 1.3 territories per kilometre (23 territories in 18 km) at Wiangaree. This study found 1.0 territory per kilometre (12 territories in 12 km). Strict comparisons of different areas is not valid owing to the dramatic differences that can occur in the patchy spatial arrangement of habitat and differences between studies in methods, particularly those of site selection. However, the similarity in these results in areas considered to be high quality Scrub-bird habitat at least gives an indication that there are currently reasonably strong numbers along the Horseshoe Road transects.

The comparison with previous surveys (1997–2004) indicates that at least 16 territories are likely to have been used over the period from 1997 to 2013. The number of occupied territories appears reasonably stable with 12 now occupied compared with 13 in 1997–2004. Nine of them do not appear to have changed. Three territories are now occupied that may have been unoccupied previously, while birds are now absent from four territories that were previously occupied. Elsewhere, more dramatic fluctuations in territory occupation have been observed; in Gloucester Tops, perhaps in response to drought (Newman *et al*. 2014) and in Werrikimbe in response to fire (P. Redpath pers. comm.).

Seven of the territories identified in this study are located in a section of New England National Park that was created in 1997, four are located in Gumbaynggirr National Park (created in 1999) and one adjacent to Baalijin Nature Reserve and protected from logging from about 1999. Many of the territories are located in old logging gaps containing dense post-logging regrowth, such as vine thickets. With all territories now reserved from logging, in the long term these regrowth gaps may return to mature forest and some of the sites may become less suitable habitat. Conversely, other sites may become more suitable as leaf litter, log debris and ground-level humidity all increase.

The average elevation of the Rufous Scrub-bird territories is 825 metres, which represents relatively low elevation habitat for the New England region and elsewhere. A species of cool, high altitude, fragmented habitat may be susceptible to climate change through rising temperatures, with range contraction beginning at the lower, hotter elevations. There is some anecdotal evidence of a general altitudinal retreat (Ferrier 1984), including in the Horseshoe Road area at League Scrub where birds were last recorded in 2002 and could not be re-located after five systematic surveys and numerous opportunistic visits. Range contraction to higher elevation has also occurred due to clearing or disturbance of low elevation habitat in far northeastern New South Wales.

The effects of drought, fire, logging and climate change on Rufous Scrub-bird habitat are highly complex (Ferrier 1985 discusses some of these). The concomitant successional changes in vegetation add further layers of complexity. Therefore, despite the apparent stability of Scrub-bird territories observed in this study, more volatile patterns of habitat occupancy could easily occur in future.

## ACKNOWLEDGEMENTS

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