

Spring bird communities of a high-altitude area of the Gloucester Tops, New South Wales

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Abstract. Annual spring surveys between 2010 and 2016 in a 5000-ha area in the Gloucester Tops in New South Wales recorded 71 bird species. All the study area was at altitudes >1100 m. The monitoring program was carried out with involvement of a team of volunteers, who regularly surveyed 21 1-km transects, for a total of 289 surveys. The study area was within the Barrington Tops and Gloucester Tops Key Biodiversity Area (KBA). The trigger species for the KBA listing was the Rufous Scrub-bird *Atrichornis rufescens*, which was found to have a widespread distribution in the study area, with an average Reporting Rate (RR) of 56.5%. Another species cited in the KBA nomination, the Flame Robin *Petroica phoenicea*, had an average RR of 12.6% but with considerable annual variation. Although the Flame Robin had a widespread distribution, one-third of all records came from just two of the 21 survey transects. Thirty-seven bird species had RRs >4% in the study area and were distributed across many transects. Of these, 20 species were relatively common, with RRs >20%, and they occurred in all or nearly all of the survey transects.

Introduction

A high-altitude part of the Gloucester Tops in New South Wales (centred at 32°05'S, 151°36'E) was surveyed annually in spring over the period 2010–2016. The Gloucester Tops form the eastern part of the Barrington Tops National Park. In 2009, they were included in a newly designated Important Bird Area (IBA), the Barrington Tops and Gloucester Tops IBA, on the basis of the presence of seven species: Rufous Scrub-bird *Atrichornis rufescens*, Green Catbird *Ailuroedus crassirostris*, Regent Bowerbird *Sericulus chrysocephalus*, Australian Logrunner *Orthonyx temminckii*, Paradise Riflebird *Lophorina paradiseus*, Flame Robin *Petroica phoenicea*, and Pale-yellow Robin *Tregellasia capito* (Dutson *et al.* 2009). More recently, IBAs have been redesignated as Key Biodiversity Areas (KBAs) in order to extend the concept to non-avian threatened species (BirdLife Australia 2017). The boundaries and general location of the Barrington Tops and Gloucester Tops KBA are presented in Figure 1, which also shows the area covered in the present study. All of the study area was at altitudes of >1100 m. It should be noted that a considerable part of the KBA is at lower altitudes and, based on pilot surveys conducted contemporaneously with this study, has different bird assemblages.

The main focus was to locate Rufous Scrub-bird territories, and the study area historically was known to contain core habitat for this species (see detailed results in Stuart & Newman 2018). However, all bird species encountered during the surveys were recorded and are presented here. Analysis of results from the 2010–2016 survey has led to insights about the bird population of this high-altitude part of the Gloucester Tops.

Methods

Two main habitat types occur in the study area, characterised by their principal types of vegetation: Antarctic Beech *Lophozonia moorei* rainforest, and open eucalypt forest comprising mainly Messmate *Eucalyptus obliqua* and Brown Barrel *E. fastigata* interspersed with

shrubs such as *Banksia* species (Binns 1995). These two habitats occur as a mosaic throughout the study area, with some sections of Snow Gum *E. pauciflora* open woodland also present (Binns 1995). The Antarctic Beech rainforest is characterised by an open understorey of ferns and Bracken *Pteridium esculentum*, whereas the eucalypt forests have a dense understorey of *Lomandra* species, Bracken, fallen timber and leaf-litter. Mostly, the vegetation within the study area is dense and impenetrable, but there are several roads and walking tracks, which collectively sample all the key aspects of the area (e.g. following water courses, steep slopes and ridges).

Twenty-one 1-km transects were established along existing roads and tracks in the survey area. Figures 1–2 show their general location; individual transects are listed in Table 1. The 1-km segments were measured either by odometer readings where car access was possible, or by measurement on Google maps (<https://maps.google.com.au/>) to determine end-point map coordinates (see Newman *et al.* 2014 for additional detail). Twenty transects were surveyed annually in 2010–2012, with one additional transect (GT3A) added in 2013, and then all received regular survey effort in 2013–2016. In 2015 and 2016, because of resource constraints, the monitoring program was reduced, to focus on 11 of the 21 transects (the five Kerripit Road transects, the five Gloucester Tops Road transects and the first kilometre of the Careys Peak transects).

Each surveyed 1-km transect was visited at least four times each spring, except for the second and third kilometres of the Mount Nelson Track and the final transect of the Careys Peak Track, which were more difficult to access and thus were visited only two–three times each year. All 21 transects contained the two main Gloucester Tops habitat types, Antarctic Beech rainforest and eucalypt open forest, although the ratio of these varied. Transects CP2 and MN2 were predominantly Antarctic Beech rainforest with some pockets of eucalypt open forest. Transect CP3 had only some small pockets of rainforest.

Surveys were carried out by volunteers between September and November annually. The timing coincided

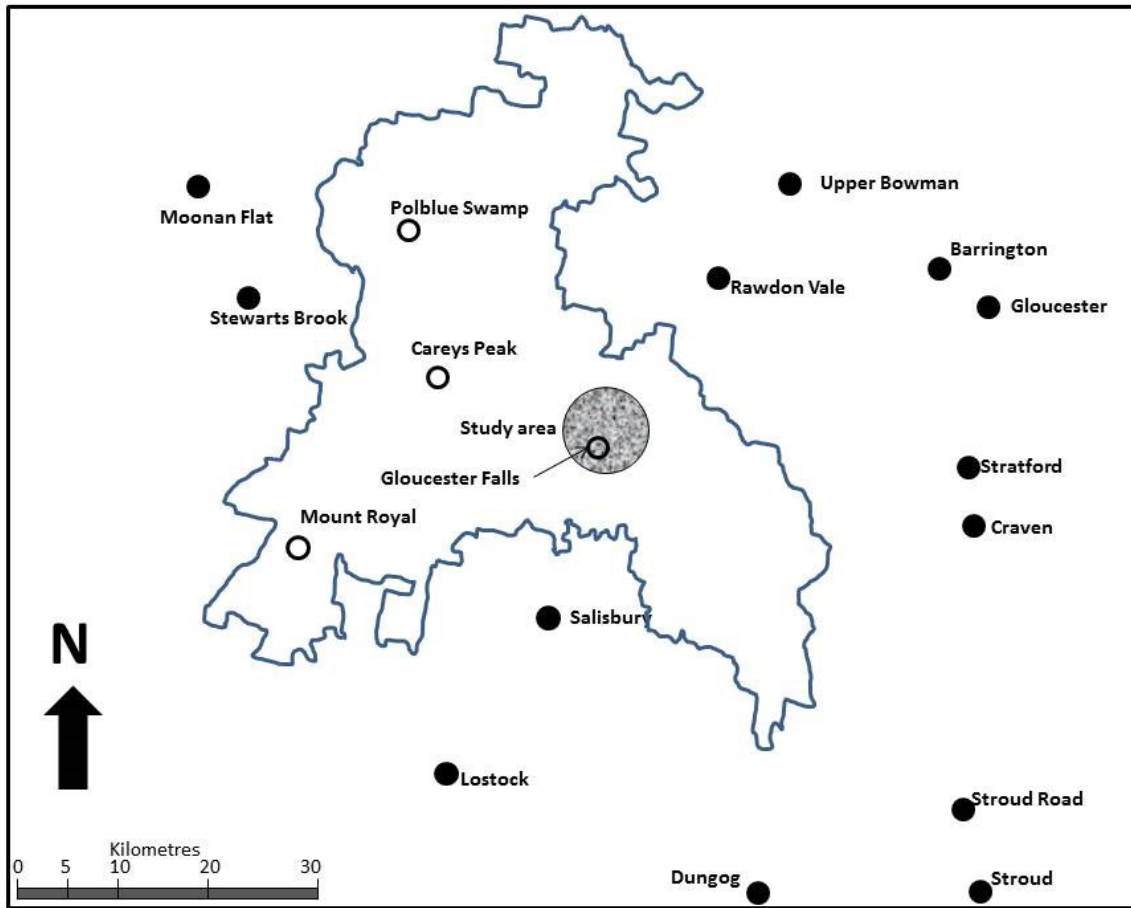


Figure 1. Barrington Tops and Gloucester Tops Key Biodiversity Area and the study area (shaded).

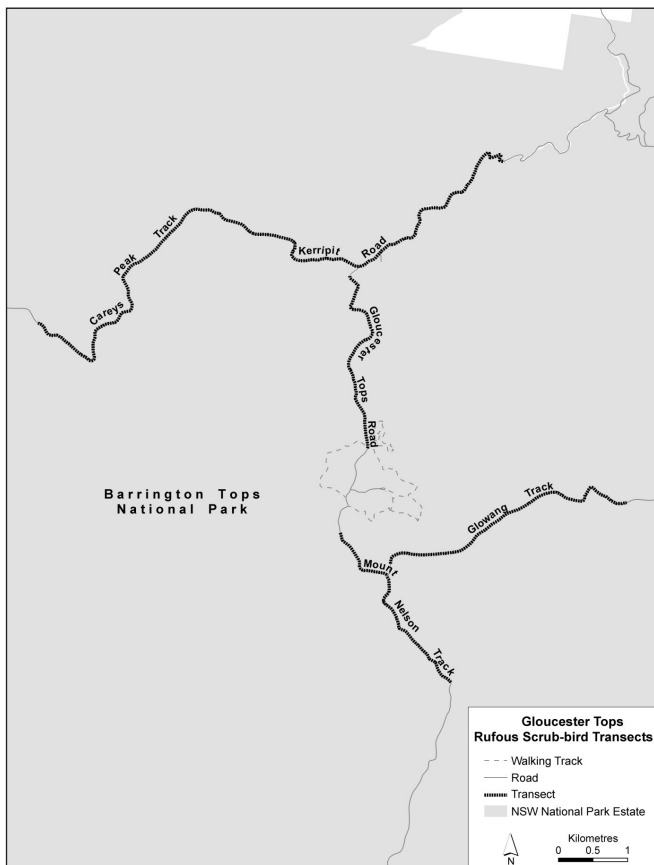


Figure 2. Locations for the transects in the Gloucester Tops study area (from Newman *et al.* 2014).

with the breeding season for Rufous Scrub-birds, when calling males are most reliably detectable (Ferrier 1984). The 1-km transects were surveyed by one–three people (typically two people) with at least one person being experienced in the survey method. Surveys were done only when conditions were favourable (low–medium wind, zero–low rainfall). They commenced c. 0800 h and took 4–6 h to complete. Typically, c. 1 h was spent in each transect; the actual time varied, depending on whether any Scrub-birds were located (because the surveyors were collecting additional specific information in such cases). Transect CP1 received extra coverage because of some visits to train new volunteers in Scrub-bird call recognition and to place and retrieve a Song Meter (Stuart *et al.* 2012).

Surveyors recorded the presence of all bird species seen or heard along each 1-km transect, including any birds flying over (although extensive canopy cover limited the opportunities for the latter). No limit was set for the maximum distance from the track for records; under favourable conditions, a calling Rufous Scrub-bird can be heard 150 m away (Ferrier 1984) but for many other species the transect’s sampling width would have been less than that. For three sets of transects (Careys Peak, Glowang, Mount Nelson) the surveys involved two passes through each 1-km transect, i.e. outbound and then inbound a few hours later. Less time was devoted to surveying during the inbound passage and the total time spent in the transect remained c. 1 h. When surveyors had to return through a transect, they were asked to combine the records for both the outbound and inbound passages. The resulting data

were submitted to the BirdLife Australia Atlas (Birdata) as 500-m-radius area surveys. Reporting Rates (RRs) for each species for each year from 2010 to 2014 inclusive were then calculated, and also for the 5-year period 2010–2014 and the 7-year period 2010–2016. The RR is the number of times the species was recorded divided by the number of surveys conducted (expressed as a percentage).

Results

From 2010 to 2016, a total of 289 surveys was carried out in the 21 1-km transects, recording 71 bird species. The cumulative number of species seen over the 7-year period is presented in Figure 3, and Figure 4 shows the cumulative number of species in relation to survey effort, which varied from year to year as already discussed. Table 1 summarises the results for each of the 21 transects, and Table 2 summarises the annual and overall results.

Seventy-one species were recorded in the spring surveys; the complete list of species is provided in Appendix 1. Thirty-four species had fewer than five records each and, in most of those cases, there were only one–three records. With some exceptions, which will be addressed in relevant sections below, those species can be considered vagrant at high altitude in the Gloucester Tops during spring. The other 37 species all had RRs >4% (Table 3). Fourteen species were recorded in every transect and another six species were present in at least 19 of the 21 transects. Twenty species had RR >20% and were found in at least 19 transects. The Brown Thornbill *Acanthiza pusilla* was the most ubiquitous species, having an RR of 90.5% and being recorded in all transects. Indeed, in most surveys, parties of Brown Thornbills were usually encountered at several locations along the transect. This was also often the case for the Crimson Rosella *Platycercus elegans*, White-throated Treecreeper *Cormobates leucophaea*, White-browed Scrubwren *Sericornis frontalis* and Grey Fantail *Rhipidura fuliginosa*.

No transect had records for all 37 of the species that had an overall RR of >4%; however, 12 transects recorded 32–35 of these species (Table 1). The lowest number of species with overall RR >4% was recorded in transect

CP5, but this transect included all the species with overall RR >20%. This transect was surveyed only nine times.

Annual changes to the RR of regularly occurring species (RR >4%) were analysed using only the first 5 years of data (2010–2014); because the survey effort was scaled down in 2015 and 2016, data from the 2015–2016 surveys were not used. Table 4 shows the RR in each year for 2010–2014 for these 37 species and the Coefficient of Variation (CV; often termed the relative standard deviation).

Discussion

The overall RRs of individual species (Table 3) indicate how often a species was recorded during the surveys. For each species, the magnitude of the overall RR reflects a combination of its abundance, how widely it is distributed (as indicated by the percentage of transects reported in Table 3), its ease of detection (i.e. large or vocal versus small or cryptic) and variations in its annual occurrence (Table 4).

The cumulative number of species recorded increased rapidly to 52 during the first 2 years of the study (Figure 3). During the subsequent 5 years, three–four additional species, mainly in the vagrant category, were added each year. After 7 years of surveying (289 surveys), the cumulative total of species recorded still had not plateaued (Figures 3–4).

One outcome from the study was an insight into the amount of effort required to characterise the birds of an area targeted for surveying. All 37 of the species with RRs >4% in 2010–2016 were recorded within the first season of surveying. However, it was not until 44 surveys had been completed in the first year that every one of the 37 species had been recorded on at least one survey. Furthermore, it was not until after the first 2 years of surveys had been completed (124 surveys) that the RRs for those 37 species approximated the values eventually attained for the complete 2010–2016 study. And, as discussed above, after 7 years of surveying, the cumulative total of species showed no sign of reaching a plateau. This adds to the growing literature on sampling effort and detectability for

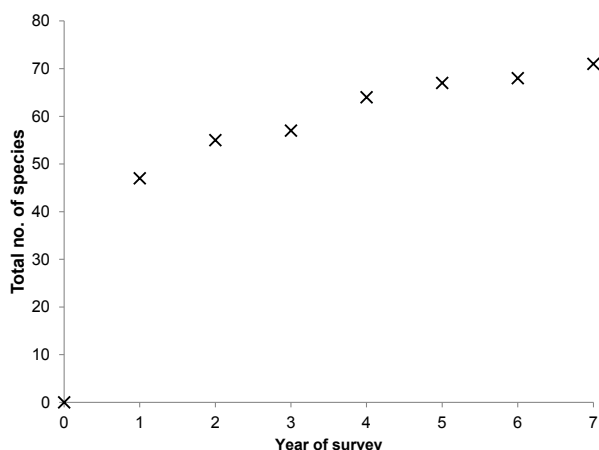


Figure 3. Cumulative increase in total number of bird species recorded at Gloucester Tops, New South Wales, in 2010–2016.

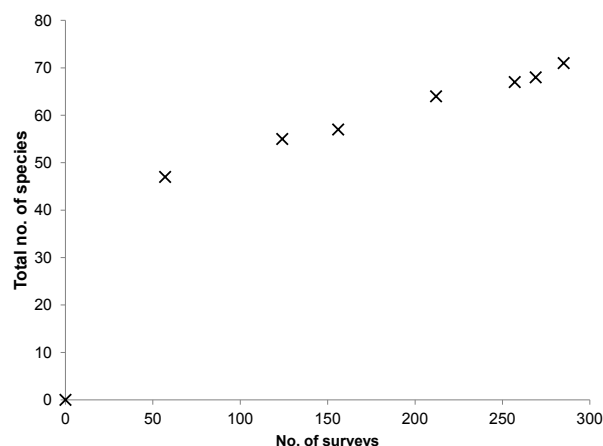


Figure 4. Cumulative increase in total number of bird species recorded relative to survey effort at Gloucester Tops, New South Wales.

Table 1. Results of bird surveys at individual transects in the high-altitude area of the Gloucester Tops, New South Wales, in 2010–2016. RR = Reporting Rate for all transects, all surveys and all years.

| Transect | | No. of surveys | No. of species | No. of species with RR >4% | No. of species with RR >20% | Years surveyed |
|--|------|----------------|----------------|----------------------------|-----------------------------|----------------|
| Group | Code | | | | | |
| Careys Peak Track (double-pass surveys) | CP1 | 24 | 47 | 35 | 20 | 2010–2016 |
| | CP2 | 16 | 35 | 32 | 19 | 2010–2014 |
| | CP3 | 16 | 37 | 35 | 20 | 2010–2014 |
| | CP4 | 14 | 37 | 32 | 20 | 2010–2014 |
| | CP5 | 9 | 24 | 21 | 20 | 2010–2014 |
| Kerripit Road & extension (single-pass surveys) | KP1 | 16 | 33 | 32 | 20 | 2010–2016 |
| | KP2 | 16 | 37 | 35 | 20 | 2010–2016 |
| | KP3 | 12 | 38 | 33 | 20 | 2010–2016 |
| | KP4 | 16 | 40 | 35 | 20 | 2010–2016 |
| | KP5 | 11 | 29 | 28 | 20 | 2010–2016 |
| Gloucester Tops Road (single-pass surveys) | GT1 | 15 | 40 | 34 | 20 | 2010–2016 |
| | GT2 | 19 | 30 | 29 | 19 | 2010–2016 |
| | GT3 | 18 | 35 | 32 | 20 | 2010–2016 |
| | GT3A | 8 | 31 | 29 | 20 | 2013–2016 |
| | GF1 | 17 | 37 | 33 | 20 | 2010–2016 |
| Mount Nelson Track (double-pass surveys) | MN1 | 13 | 35 | 30 | 19 | 2010–2014 |
| | MN2 | 7 | 31 | 29 | 17 | 2010–2014 |
| | MN3 | 7 | 33 | 29 | 20 | 2010–2014 |
| Glowang Track (double-pass surveys) | GW1 | 13 | 38 | 32 | 18 | 2010–2014 |
| | GW2 | 11 | 34 | 31 | 20 | 2010–2014 |
| | GW3 | 11 | 28 | 27 | 18 | 2010–2014 |

bird surveys (e.g. Watson 2003, 2004, 2017; Nalwanga *et al.* 2012).

Annual variation in Reporting Rates

The Coefficient of Variation (CV) provides a measure of the variability of the annual RR of a species. For 12 species, the CV was $\leq 20\%$ (see Table 4). An additional 11 species had CVs of 21–40%, with a tendency for species with lower RR to have a higher CV.

Annual RRs for the Large-billed Scrubwren *Sericornis magnirostra* had a bimodal distribution, resulting in a high

Table 2. Numbers of surveys and bird species recorded per year in spring in 2010–2016, Gloucester Tops, New South Wales.

| Year | No. of surveys | No. of species |
|--------------|----------------|----------------|
| 2010 | 57 | 47 |
| 2011 | 67 | 50 |
| 2012 | 32 | 42 |
| 2013 | 56 | 54 |
| 2014 | 45 | 48 |
| 2015 | 16 | 41 |
| 2016 | 16 | 43 |
| Total | 289 | 71 |

CV of 80%. RRs for this species were high in 2010 and 2014 but low in 2011–2012, and there were no records in 2013 (Table 4). Other examples of the varying annual occurrence of species include the New Holland Honeyeater *Phylidonyris novaehollandiae* with high RRs in 2011–2012, but low RR in 2010 and no records in 2013 or 2014. Similarly, there were no Crested Shrike-tit *Falcunculus frontatus* records in 2012 or 2014 and low RRs in 2010 and 2013, but in 2011 the RR was 9.9% (Table 4). The Red-browed Treecreeper *Climacteris erythrops* was not recorded in 2012 and had RRs of 5.6% in both 2010 and 2011, but in 2013 and 2014 the RRs were 18.5% and 16.7% respectively. The absence of New Holland Honeyeaters in some years is not unexpected for a nomadic species that follows irregular flowering patterns (Higgins *et al.* 2001). However, the absence (or apparent absence) in some years of the other three species (which are usually considered to be sedentary: Higgins *et al.* 2001; Higgins & Peter 2002) was unexpected. This raises the possibility that higher altitudes are a more marginal habitat for these species, suitable in some years, unsuitable in others.

Number of species per transect

Transect CP1 received the most survey effort (24 surveys) and had the greatest number of bird species recorded (47 species) (Table 1, Figure 5). Transect CP5 recorded the fewest species (24 species), and had only nine surveys. These findings suggested there might be a correlation

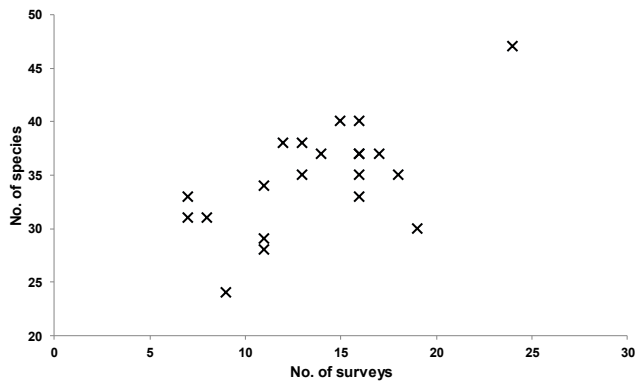


Figure 5. Numbers of bird species recorded in transects compared with the numbers of surveys carried out in the transect, Gloucester Tops, New South Wales.

between the number of species recorded in a transect and the number of surveys, but the correlation was relatively weak ($R^2 = 0.41$). For example, transect GT2 was surveyed 19 times, the second highest number of surveys for any transect, but only 30 species were recorded; in comparison, transects MN2 and MN3 each received only seven surveys but 31–33 species, respectively, were recorded.

Thus, factors other than, or in addition to, the level of survey effort affected the number of species recorded in a transect. Transect KP5 included an area that had been burnt in a fire in 2009 and not many birds were recorded there. Apart from that, there were no obvious major differences in habitat between the transects, other than the qualitative observation that the ratio of the two main habitat types (Antarctic Beech rainforest and eucalypt open forest) varied. A possible future direction for study would be to characterise the habitat within each transect more closely.

Key Biodiversity Area nomination species

The Rufous Scrub-bird was the trigger species for the KBA nomination. It was found to have a widespread distribution in the study area, with an average RR for 2010–2016 of 56.5% and it was recorded in 20 of the 21 transects (Table 3; see also Stuart & Newman 2018).

The Flame Robin (RR 12.6%) was widely distributed, occurring in 18 of the 21 transects, and missing only from transects CP5, KP5 and GT3A, each of which had less survey effort. Flame Robins were associated with open eucalypt forest. The annual RR varied from a low of 5.6% in 2011 to a high of 20.8% in 2014 (Table 4). Although the distribution was widespread, Flame Robins were most often recorded in two adjoining transects, CP1 and KP1. The RRs for the Flame Robin in these transects in 2010–2016 were 29.1% and 31.2% respectively. These two transects together accounted for one-third of all the Flame Robin records in the 7 years of surveys. Although presumably related to habitat, the reason for this is not understood. There were many areas of open eucalypt forest habitat within other transects, where Flame Robins were rarely or never recorded.

There were three records of the Paradise Riflebird (RR 1.1%) and five records of the Australian Logrunner (RR 1.8%). Both species were uncommon at high altitude in 2010–2016. All of the Logrunner records were from

areas of Antarctic Beech rainforest. The Green Catbird and Regent Bowerbird were not recorded during the surveys, and the sole report of a Pale-yellow Robin was an unsubstantiated record of a calling bird. These three species are all known to prefer lower-altitude subtropical rainforests (Higgins & Peter 2002; Higgins *et al.* 2006). Suitable habitat for them occurs elsewhere in the KBA, where they might be more common.

High-altitude specialists

Within the Hunter Region of New South Wales, three bird species have seldom been recorded except at high altitudes: the Rufous Scrub-bird, Crescent Honeyeater *Phylidonyris pyrrhopterus* and Olive Whistler *Pachycephala olivacea* (Stuart 2016). All known Hunter Region records for the Rufous Scrub-bird have been from high-altitude locations within the Barrington Tops and Gloucester Tops KBA (Stuart 2016). This includes another population of Rufous Scrub-birds at The Mountaineer, ~15 km south-east of the present study area (Ekert 2002, 2005). There are also a few historical records from locations in the Barrington Tops (A. Fawcett pers. comm.).

Since 2010, when the surveys in the Gloucester Tops commenced, there have been no records of the Crescent Honeyeater or Olive Whistler in the Hunter Region from outside the Barrington Tops National Park (Stuart 2016). Historically, there have been only three confirmed records for the Crescent Honeyeater from elsewhere within the Hunter Region, all at lower altitudes and involving vagrant birds that were present for only a short time (Raine 2014; Stuart 2015).

The Satin Flycatcher *Myiagra cyanoleuca* is also considered to be a summer breeding migrant to high-altitude areas within the Hunter Region (Stuart 2016). There were only three records during the surveys (RR 1.1%). However, most of the Gloucester Tops records for this species have been for December–January, so it is possible that the spring surveys were conducted before most of the birds had returned to the study area.

Robins

Three *Petroica* robins (Rose *P. rosea*, Flame, and Scarlet Robins *P. multicolor*) were recorded during the surveys. All three species are considered altitudinal migrants in the Hunter Region (Stuart 2016; Stuart & Williams 2016), although the extent to which Scarlet Robins undertake altitudinal movements versus local movements is unclear (Higgins & Peter 2002). As discussed earlier, numbers of Flame Robins in the Gloucester Tops varied from year to year. Although they had a widespread distribution, one-third of all records occurred in two transects. In contrast, Rose Robins were regularly recorded in all transects and at a much higher overall RR (39.6%: Table 3). The RR was consistent from year to year, with a CV of 20% (Table 4). Scarlet Robins were uncommon in the study area, with only four records in 2010–2016 (RR 1.4%).

The Eastern Yellow Robin *Eopsaltria australis* was common in the Gloucester Tops, recorded in all transects, with RR of 50.9%. The CV for the annual RR (for 2010–2014) was 16%. In contrast, the Pale-yellow Robin

Table 3. Common birds of the high-altitude area of the Gloucester Tops, New South Wales, listed by Reporting Rates (RR, %) in 2010–2016.

| Species | RR | % transects with records |
|--|------|--------------------------|
| Brown Thornbill <i>Acanthiza pusilla</i> | 90.5 | 100 |
| White-throated Treecreeper <i>Cormobates leucophaea</i> | 83.2 | 100 |
| Crimson Rosella <i>Platycercus elegans</i> | 80.0 | 100 |
| White-browed Scrubwren <i>Sericornis frontalis</i> | 77.9 | 100 |
| Grey Fantail <i>Rhipidura fuliginosa</i> | 70.2 | 100 |
| Eastern Whipbird <i>Psophodes olivaceus</i> | 64.6 | 100 |
| Golden Whistler <i>Pachycephala pectoralis</i> | 63.9 | 100 |
| Rufous Scrub-bird <i>Atrichornis rufescens</i> | 56.5 | 95 |
| Pied Currawong <i>Strepera graculina</i> | 54.0 | 100 |
| Eastern Yellow Robin <i>Eopsaltria australis</i> | 50.9 | 100 |
| Spotted Pardalote <i>Pardalotus punctatus</i> | 46.7 | 100 |
| Rose Robin <i>Petroica rosea</i> | 39.6 | 100 |
| Striated Thornbill <i>Acanthiza lineata</i> | 37.5 | 100 |
| Crescent Honeyeater <i>Phylidonyris pyrrhopterus</i> | 35.8 | 91 |
| Grey Shrike-thrush <i>Colluricincla harmonica</i> | 35.4 | 100 |
| Eastern Spinebill <i>Acanthorhynchus tenuirostris</i> | 32.6 | 100 |
| Olive Whistler <i>Pachycephala olivacea</i> | 32.3 | 91 |
| Striated Pardalote <i>Pardalotus striatus</i> | 31.9 | 91 |
| Superb Lyrebird <i>Menura novaehollandiae</i> | 29.8 | 95 |
| Fan-tailed Cuckoo <i>Cacomantis flabelliformis</i> | 22.8 | 91 |
| Yellow-faced Honeyeater <i>Caligavis chrysops</i> | 17.2 | 57 |
| Brown Gerygone <i>Gerygone mouki</i> | 14.7 | 76 |
| Satin Bowerbird <i>Ptilonorhynchus violaceus</i> | 14.7 | 76 |
| Flame Robin <i>Petroica phoenicea</i> | 12.6 | 86 |
| Silvereye <i>Zosterops lateralis</i> | 12.3 | 86 |
| Red Wattlebird <i>Anthochaera carunculata</i> | 11.9 | 52 |
| Red-browed Treecreeper <i>Climacteris erythroptus</i> | 11.2 | 76 |
| Yellow-throated Scrubwren <i>Sericornis citreogularis</i> | 10.2 | 76 |
| Australian King-Parrot <i>Alisterus scapularis</i> | 9.8 | 62 |
| Lewin's Honeyeater <i>Meliphaga lewinii</i> | 9.5 | 57 |
| Yellow-tailed Black-Cockatoo <i>Zanda funereus</i> | 8.8 | 76 |
| Black-faced Monarch <i>Monarcha melanopsis</i> | 8.8 | 71 |
| Laughing Kookaburra <i>Dacelo novaeguineae</i> | 8.4 | 76 |
| New Holland Honeyeater <i>Phylidonyris novaehollandiae</i> | 8.1 | 48 |
| Large-billed Scrubwren <i>Sericornis magnirostra</i> | 7.7 | 67 |
| Bassian Thrush <i>Zoothera lunulata</i> | 7.0 | 57 |
| Crested Shrike-tit <i>Falcunculus frontatus</i> | 4.6 | 57 |

was a vagrant in the high-altitude study area, with only one tentative record.

Honeyeaters

The two most common honeyeaters were the Eastern Spinebill *Acanthorhynchus tenuirostris* and Crescent Honeyeater, both with RRs >30% and recorded in all or almost all transects (Table 3). There were frequent records of four other honeyeaters: Yellow-faced Honeyeater *Caligavis chrysops*, Red Wattlebird *Anthochaera carunculata*, Lewin's Honeyeater *Meliphaga lewinii* and New Holland Honeyeater *Phylidonyris novaehollandiae* (Table 3), each of which was recorded in only 10–12 of the 21 1-km transects.

The annual RRs for all six honeyeater species had high CVs, reflecting variability in the occurrence or detection

of these species (Table 4). There were very few records of Lewin's Honeyeater in spring 2014, which was also a relatively poor season for the Red Wattlebird. Conversely, there was an apparent influx of Yellow-faced Honeyeaters in 2013, with the RR rising to 40.0% (Table 4). That year also saw a rise in Crescent Honeyeater records (the RR rose to 56.9%). Eastern Spinebills were more common in spring 2011, with the RR of 59.2% being almost double the average for 2010–2016. New Holland Honeyeaters had small apparent influxes in 2011 and 2012, but there were no records in 2013 or 2014 (Table 4).

Variations in annual RR seem to indicate that these six honeyeater species were nomadic in the Gloucester Tops, with influxes occurring when conditions were favourable. The reason for this, although presumably related to food, is not understood. We visited some transects periodically at other times of the year to monitor Rufous Scrub-birds (Stuart *et al.* 2012) and influxes of honeyeaters (particularly

Table 4. Reporting Rates (RR, %) for common bird species in the high-altitude area of the Gloucester Tops, New South Wales, in spring in 2010–2014 (listed in taxonomic order). CV = Coefficient of Variation (%).

| Species | RR in years specified | | | | | | CV |
|------------------------------|-----------------------|------|------|------|------|------|-----|
| | 5-year 2010–2014 | 2010 | 2011 | 2012 | 2013 | 2014 | |
| Fan-tailed Cuckoo | 23.2 | 22.5 | 28.2 | 28.6 | 30.8 | 6.3 | 43 |
| Laughing Kookaburra | 10.5 | 7.9 | 11.3 | 5.7 | 10.8 | 16.7 | 40 |
| Yellow-tailed Black-Cockatoo | 7.2 | 7.9 | 5.6 | 11.4 | 1.5 | 12.5 | 62 |
| Australian King-Parrot | 8.5 | 4.5 | 8.5 | 2.9 | 13.8 | 12.5 | 56 |
| Crimson Rosella | 78.1 | 79.8 | 83.1 | 57.1 | 84.6 | 70.8 | 15 |
| Superb Lyrebird | 31.7 | 42.7 | 28.2 | 25.7 | 29.2 | 25.0 | 23 |
| Rufous Scrub-bird | 52.9 | 50.6 | 50.7 | 57.1 | 43.1 | 68.8 | 18 |
| Satin Bowerbird | 14.1 | 9.0 | 18.3 | 17.1 | 13.8 | 14.6 | 26 |
| White-throated Treecreeper | 80.7 | 80.9 | 80.3 | 74.3 | 84.6 | 79.2 | 5 |
| Red-browed Treecreeper | 9.2 | 5.6 | 5.6 | 0 | 18.5 | 16.7 | 86 |
| Crescent Honeyeater | 36.6 | 30.3 | 38.0 | 17.1 | 56.9 | 33.3 | 39 |
| New Holland Honeyeater | 7.5 | 2.2 | 11.3 | 14.3 | 0 | 0 | 90 |
| Eastern Spinebill | 33.7 | 22.5 | 59.2 | 28.6 | 36.9 | 18.8 | 48 |
| Lewin's Honeyeater | 10.1 | 10.1 | 15.5 | 8.6 | 9.2 | 2.1 | 47 |
| Red Wattlebird | 12.1 | 7.9 | 15.5 | 14.3 | 16.9 | 6.3 | 39 |
| Yellow-faced Honeyeater | 18.6 | 9.0 | 12.7 | 22.9 | 40.0 | 12.5 | 68 |
| Spotted Pardalote | 47.4 | 40.4 | 57.7 | 48.6 | 47.7 | 41.7 | 14 |
| Striated Pardalote | 32.0 | 28.1 | 35.2 | 40.0 | 41.5 | 14.6 | 34 |
| Brown Gerygone | 13.7 | 15.7 | 12.7 | 22.9 | 10.8 | 8.3 | 41 |
| Yellow-throated Scrubwren | 8.8 | 5.6 | 7.0 | 8.6 | 13.8 | 10.4 | 36 |
| White-browed Scrubwren | 77.8 | 84.3 | 70.4 | 65.7 | 81.5 | 81.3 | 10 |
| Large-billed Scrubwren | 6.5 | 12.4 | 4.2 | 2.9 | 0 | 10.4 | 80 |
| Striated Thornbill | 34.3 | 37.1 | 25.4 | 14.3 | 47.7 | 37.5 | 37 |
| Brown Thornbill | 91.2 | 92.1 | 91.5 | 88.6 | 89.2 | 91.7 | 2 |
| Olive Whistler | 30.1 | 36.0 | 23.9 | 22.9 | 24.6 | 39.6 | 26 |
| Golden Whistler | 63.7 | 65.2 | 52.1 | 62.9 | 70.8 | 66.7 | 11 |
| Grey Shrike-thrush | 36.6 | 36.0 | 38.0 | 45.7 | 43.1 | 20.8 | 27 |
| Crested Shrike-tit | 3.6 | 2.2 | 9.9 | 0 | 1.5 | 0 | 115 |
| Eastern Whipbird | 65.4 | 68.5 | 70.4 | 45.7 | 64.6 | 64.6 | 15 |
| Pied Currawong | 53.9 | 58.4 | 57.7 | 54.3 | 50.8 | 41.7 | 13 |
| Grey Fantail | 70.3 | 64.0 | 57.7 | 71.4 | 81.5 | 70.8 | 13 |
| Black-faced Monarch | 9.8 | 7.9 | 12.7 | 11.4 | 3.1 | 8.3 | 38 |
| Rose Robin | 35.9 | 27.0 | 35.2 | 34.3 | 46.2 | 39.6 | 20 |
| Flame Robin | 13.4 | 13.5 | 5.6 | 8.6 | 18.5 | 20.8 | 48 |
| Eastern Yellow Robin | 50.0 | 59.6 | 47.9 | 54.3 | 43.1 | 39.6 | 16 |
| Silvereye | 9.2 | 3.4 | 9.9 | 14.3 | 9.2 | 14.6 | 50 |
| Bassian Thrush | 6.9 | 2.2 | 7.0 | 17.1 | 9.2 | 4.2 | 84 |

Eastern Spinebills and New Holland Honeyeaters) were noted sometimes in autumn (AS pers. obs.; MN pers. obs.), apparently associated with the prolific flowering in autumn of *Banksia* species. No exceptional blossom events were noted in any of the spring surveys.

Other species

Both White-throated Treecreepers and Red-browed Treecreepers were often encountered in the surveys. The former were very common, recorded in every transect with an overall RR of 80.7% and very low CV of 5% (Tables 3–4). Often they were recorded on multiple occasions within individual transects. In contrast, the RR for the Red-browed Treecreeper was just 11.2%, with a high CV (80.6%). Despite the relatively low RR, they were widely distributed through the study area, being recorded in 16 of the 21 transects, although four of the transects with

no records received below-average survey effort (KP5, MN2, GW2, GW3). There were no records of Red-browed Treecreepers from KP4 despite there being 16 surveys of that transect.

Only two species of thornbill were recorded: Brown Thornbill and Striated Thornbill *Acanthiza lineata*. Brown Thornbills were very common; they were recorded in every transect, as pairs or small parties, with an overall RR of 90.5% and very low CV of 2% (Tables 3–4). Often they were recorded on multiple occasions within individual transects. Striated Thornbills also were encountered very frequently; they were recorded in all transects in pairs or small parties and had an overall RR of 37.5%. The CV was 37%, which mainly reflected an unusually low RR (14.3%) in 2012. It appeared that 2012 was a poor year for Striated Thornbills, for unknown reasons, although the low spring rainfall that year might have been a contributing factor.

White-browed Scrubwrens *Sericornis frontalis* were very common. They were recorded in every transect, as pairs or small parties, with an overall RR of 77.9% and low CV of 10% (Tables 3–4). Often they were recorded on multiple occasions within individual transects. In contrast, Yellow-throated Scrubwrens *S. citreogularis* and Large-billed Scrubwrens had much lower RRs (10.2% and 7.7% respectively), higher CVs, and were recorded in fewer (14–16) transects.

The Bassian Thrush *Zoothera lunulata* had a RR of 7.0%, but 30% of the records were from just one transect, where a pair had a territory close to the track and the birds were often seen foraging on the track. This inflated the detection rate for an otherwise cryptic species. There were three records of Lewin's Rail *Lewinia pectoralis*, another cryptic species, which was detected only when calling. The RR of 1.1% for Lewin's Rail was almost double that for the overall Hunter Region for this species (Stuart 2016).

There were very few records for raptors, although Wedge-tailed Eagle *Aquila audax*, Grey Goshawk *Accipiter novaehollandiae*, Brown Goshawk *A. fasciatus* and Collared Sparrowhawk *A. cirrocephalus* were occasionally recorded in the spring surveys and were sometimes seen in the area at other times of the year.

Conclusions

Seventy-one bird species were recorded in 7 years of spring surveys in a high-altitude area of the Gloucester Tops. Of these, 37 species had RRs of >4%, including 20 species with RRs >20% and records from all or most transects and which therefore could be considered to be common and widespread in the study area. Two of the species mentioned in the 2009 KBA nomination, the Rufous Scrub-bird and the Flame Robin, were regularly present in the study area in spring.

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References

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

BirdLife Australia (2017). IBA-KBA FAQs. Available online: www.birdlife.org.au/projects/KBA/iba-kba-faqs (retrieved 11 August 2017).

Dutson, G., Garnett, S. & Gole, C. (2009). *Australia's Important Bird Areas: Key Sites for Conservation*. BirdLife Australia, Melbourne.

Ekert, P.A. (2002). Monitoring of Rufous Scrub-bird (*Atrichornis rufescens*) in North-East NSW. Report by Ekerlogic Consulting Services for New South Wales 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.

Higgins, P.J. & Peter, J.M. (Eds) (2002). *Handbook of Australian, New Zealand & Antarctic Birds, Volume 6: Pardalotes to Shrike-thrushes*. Oxford University Press, Melbourne.

Higgins, P.J., Peter, J.M. & Cowling, S.J. (Eds) (2006). *Handbook of Australian, New Zealand & Antarctic Birds, Volume 7: Boatbill to Starlings*. Oxford University Press, Melbourne.

Higgins, P.J., Peter, J.M. & Steele, W.K. (Eds) (2001). *Handbook of Australian, New Zealand & Antarctic Birds, Volume 5: Tyrant-flycatchers to Chats*. Oxford University Press, Melbourne.

Nalwanga, D., Pomeroy, D., Vickery, J. & Atkinson, P.W. (2012). A comparison of two survey methods for assessing bird species richness and abundance in tropical farmlands. *Bird Study* **59**, 83–95.

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.

Raine, D. (2014). The birds of Wirumbirra, Laguna. *Whistler* **8**, 1–9.

Stuart, A. (2015). Bird surveys in Saltwater National Park. *Whistler* **9**, 56–60.

Stuart, A. (Ed.) (2016). *Hunter Region Annual Bird Report Number 23 (2015)*. Hunter Bird Observers Club Inc., New Lambton, NSW.

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.

Stuart, A. & Williams, D. (2016). Rose Robins in the Hunter Region. *Whistler* **10**, 19–23.

Stuart, A., Newman, M., Struik, P. & Martin, I. (2012). Development of a non-intrusive method for investigating the calling patterns of Rufous Scrub-birds. *Whistler* **6**, 24–34.

Watson, D. (2003). The 'standardized' search: An improved way to conduct bird surveys. *Austral Ecology* **28**, 515–525.

Watson, D. (2004). Comparative evaluation of new approaches to survey birds. *Wildlife Research* **31**, 1–11.

Watson, D. (2017). Sampling effort determination in bird surveys: Do current norms meet best-practice recommendations? *Wildlife Research* **44**, 183–193.

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Appendix 1. All bird species recorded in the Gloucester Tops study area, New South Wales, in 2010–2016.

| | |
|--|---|
| Australian Brush-turkey <i>Alectura lathami</i> | Spotted Pardalote <i>Pardalotus punctatus</i> |
| Brown Cuckoo-Dove <i>Macropygia phasianella</i> | Striated Pardalote <i>Pardalotus striatus</i> |
| Wonga Pigeon <i>Leucosarcia melanoleuca</i> | Brown Gerygone <i>Gerygone mouki</i> |
| Topknot Pigeon <i>Lopholaimus antarcticus</i> | Yellow-throated Scrubwren <i>Sericornis citreogularis</i> |
| Shining Bronze-Cuckoo <i>Chalcites lucidus</i> | White-browed Scrubwren <i>Sericornis frontalis</i> |
| Fan-tailed Cuckoo <i>Cacomantis flabelliformis</i> | Large-billed Scrubwren <i>Sericornis magnirostra</i> |
| White-throated Needle-tail <i>Hirundapus caudacutus</i> | Striated Thornbill <i>Acanthiza lineata</i> |
| Lewin's Rail <i>Lewinia pectoralis</i> | Brown Thornbill <i>Acanthiza pusilla</i> |
| Grey Goshawk <i>Accipiter novaehollandiae</i> | Australian Logrunner <i>Orthonyx temminckii</i> |
| Brown Goshawk <i>Accipiter fasciatus</i> | Varied Sittella <i>Daphoenositta chrysoptera</i> |
| Collared Sparrowhawk <i>Accipiter cirrocephalus</i> | Black-faced Cuckoo-shrike <i>Coracina novaehollandiae</i> |
| Laughing Kookaburra <i>Dacelo novaeguineae</i> | Cicadabird <i>Edolisoma tenuirostris</i> |
| Australian Hobby <i>Falco longipennis</i> | Olive Whistler <i>Pachycephala olivacea</i> |
| Yellow-tailed Black-Cockatoo <i>Zanda funereus</i> | Rufous Whistler <i>Pachycephala rufiventris</i> |
| Sulphur-crested Cockatoo <i>Cacatua galerita</i> | Golden Whistler <i>Pachycephala pectoralis</i> |
| Australian King-Parrot <i>Alisterus scapularis</i> | Grey Shrike-thrush <i>Colluricincla harmonica</i> |
| Crimson Rosella <i>Platycercus elegans</i> | Crested Shrike-tit <i>Falcunculus frontatus</i> |
| Superb Lyrebird <i>Menura novaehollandiae</i> | Eastern Whipbird <i>Psophodes olivaceus</i> |
| Rufous Scrub-bird <i>Atrichornis rufescens</i> | Pied Currawong <i>Strepera graculina</i> |
| Green Catbird <i>Ailuroedus crassirostris</i> | Rufous Fantail <i>Rhipidura rufifrons</i> |
| Satin Bowerbird <i>Ptilonorhynchus violaceus</i> | Grey Fantail <i>Rhipidura fuliginosa</i> |
| White-throated Treecreeper <i>Cormobates leucophaea</i> | Leaden Flycatcher <i>Myiagra rubecula</i> |
| Red-browed Treecreeper <i>Climacteris erythrops</i> | Satin Flycatcher <i>Myiagra cyanoleuca</i> |
| Superb Fairy-wren <i>Malurus cyaneus</i> | Black-faced Monarch <i>Monarcha melanopsis</i> |
| Scarlet Honeyeater <i>Myzomela sanguinolenta</i> | Paradise Riflebird <i>Lophorina paradiseus</i> |
| Noisy Friarbird <i>Philemon corniculatus</i> | Rose Robin <i>Petroica rosea</i> |
| Crescent Honeyeater <i>Phylidonyris pyrrhopterus</i> | Flame Robin <i>Petroica phoenicea</i> |
| New Holland Honeyeater <i>Phylidonyris novaehollandiae</i> | Scarlet Robin <i>Petroica multicolor</i> |
| White-cheeked Honeyeater <i>Phylidonyris niger</i> | Eastern Yellow Robin <i>Eopsaltria australis</i> |
| White-naped Honeyeater <i>Melithreptus lunatus</i> | Pale-yellow Robin <i>Tregellasia capito</i> |
| Eastern Spinebill <i>Acanthorhynchus tenuirostris</i> | Mistletoebird <i>Dicaeum hirundinaceum</i> |
| Lewin's Honeyeater <i>Meliphaga lewinii</i> | Red-browed Finch <i>Neochmia temporalis</i> |
| Red Wattlebird <i>Anthochaera carunculata</i> | Tree Martin <i>Petrochelidon nigricans</i> |
| Fuscous Honeyeater <i>Ptilotula fusca</i> | Silvereye <i>Zosterops lateralis</i> |
| Yellow-faced Honeyeater <i>Caligavis chrysops</i> | Bassian Thrush <i>Zoothera lunulata</i> |
| Bell Miner <i>Manorina melanophrys</i> | |
