Monitoring Rufous Scrub-birds in the Barrington Tops and Gloucester Tops IBA in the 2010-2011 Season

Mike Newman and Alan Stuart

Hunter Bird Observers Club Special Report No. 6

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Cover Photo: A female Rufous Scrub-bird *Atrichornis rufescens,* photographed in the Gloucester Tops in 2010 (Photographer: David Stowe). Estimates place the population of the southern sub-species *Atrichornis r. ferrieri* at just 4,000 birds. There have been very few photographs of the southern sub-species and photographs of the female are particularly uncommon.

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SUMMARY

Rufous Scrub-birds are a skulking, cryptically plumaged species which is seldom seen. Fortunately territorial males have loud characteristic calls which were used to locate territories during surveys between August 2010 and January 2011 in the Gloucester Tops area of the Barrington Tops & Gloucester Tops Important Bird Area (IBA).

22 territories were confirmed based on repeat records at least 3 weeks apart during surveys along 20 km of track. A further 5 probable territories were located based on multiple records less than 3 weeks apart. Assuming territories are located within 150m either side of the track the estimated density of breeding pairs is in the range 3.6 to 4.5 territories/km^2. This range is considered to be conservative because there were a number of possible additional territories based on single records.

In 1980/81 Ferrier found 21 territories in 18 km of transects with an implied density of 3.8/km^2. As the surveys in this study covered approximately 80% of the same transects as Ferrier it is concluded that the Rufous Scrub-bird population has not declined during the last 29 years.

In both studies the territories were predominantly in eucalypt forest with dense ground cover, mostly adjacent to beech forest *Nothofagus moreii*.

53 bird species were recorded during 91 Atlas surveys (500m radius). Of the other species nominated to support the IBA listing, the Flame Robin and Australian Logrunner were the only species for which there were multiple records during these surveys, and both species were scarce at the high altitude (>1,150m) involved in this study.

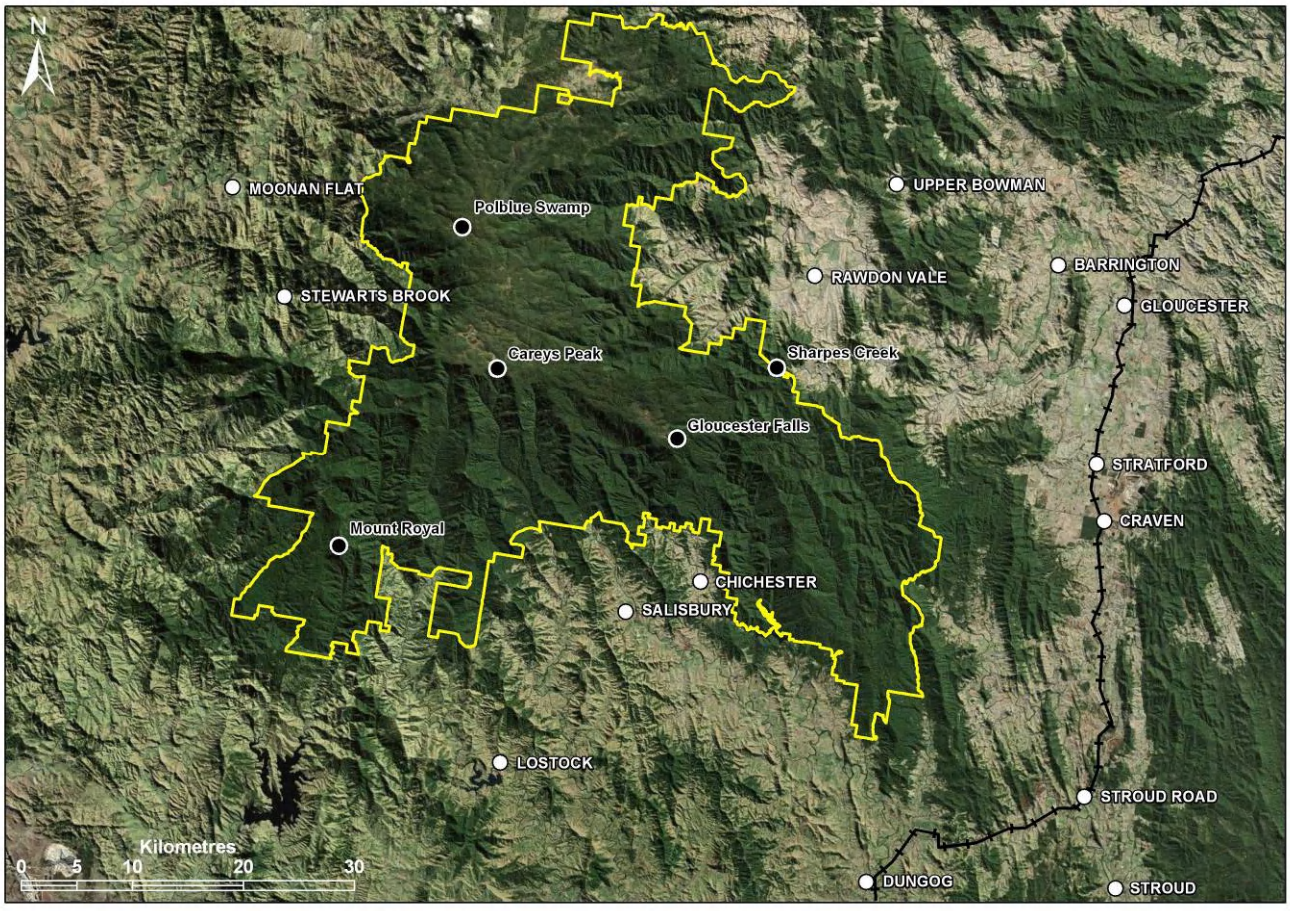
1. INTRODUCTION

The Barrington Tops & Gloucester Tops Important Bird Area (IBA) is one of 66 IBA's in NSW. It encompasses 127,478 ha with boundaries as indicated in Figure 1. Although IBA's have no legal conservation status *per se*, and sometimes may include private property, all of the Barrington Tops & Gloucester Tops IBA lies within National Parks and is protected.

The Rufous Scrub-bird *Atrichornis rufescens* is the trigger species underpinning the nomination of the Barrington Tops & Gloucester Tops IBA. It is a requirement of the IBA nomination that the trigger and other key species (namely, for this IBA, Australian Logrunner *Orthonyx temminckii*, Green Catbird *Ailuroedus crassirostris*, Regent Bowerbird *Sericulus chrysocephalus*, Flame Robin *Petroica phoenicea*, Pale-yellow Robin *Tregellasia capito,* Paradise Riflebird *Ptiloris paradiseus*) are monitored to determine trends in their status.

In this report, we summarise the results of a pilot scheme for sustainably monitoring Rufous Scrub-birds using volunteers, that potentially can be used in all five IBA's for which the Rufous Scrub-bird is the trigger species.

Figure 1 Location of Barrington Tops & Gloucester Tops IBA



2. RUFOUS SCRUB-BIRD SURVEYS

2.1 Introduction

The Rufous Scrub-bird is a cryptically marked skulking species, which is seldom seen. Fortunately male Rufous Scrub-birds have loud penetrating calls which are used to advertise and defend territories, particularly during the breeding season. This attribute has been used in two previous studies of the Rufous Scrub-bird in the Barrington Tops & Gloucester Tops area.

The approach taken by Simon Ferrier in his PhD study in 1980/81 was to conduct surveys along 18 km of transects in the Gloucester Tops area. Transects were established in habitat known from pilot surveys to contain Rufous Scrub-birds. Ferrier made 18 surveys along these transects throughout the year determining the location of calling scrub-birds. Birds heard on multiple occasions spanning a breeding season were assumed to be territorial males. Calling birds were most easily detected between September and December under conditions of high humidity, low wind and low mist. Time of day did not appear to be a critical parameter. Ferrier estimated there to be 20.29 (SD 1.11) singing males within an area 150m either side of his transects at Barrington Tops & Gloucester Tops, which corresponds to a density of 3.8 territories/km^2.

In Ferrier's work in the Gloucester Tops area most Rufous Scrub-bird territories were found in eucalypt forest with dense understorey adjacent to beech forest *Nothofagus moreii.* Territories were on average 1.13 ha in area, often circular in shape, with the male predominantly singing from an area of approximately 50m diameter. On occasions when clusters of calling birds were encountered it was possible to assign territories to individual males.

A more recent study conducted by Birds Australia (BA) using volunteers (Ekert 2002) also involved monitoring calling males during the breeding season. In this case a number of fixed point locations were established which were monitored annually using a standard protocol to determine the presence or absence of calling scrub-birds. The intent was to use annual variations in the reporting rates of scrub-birds to determine trends in their relative abundance. The BA study sampled a larger area of potential habitat, particularly areas at lower altitude than those surveyed by Ferrier, which were above 1,150m.

The possibility of using call playback to stimulate scrub-birds to call was investigated in both of the above studies, but in each case was found to be ineffective and its use was discontinued.

For the present study we elected to use transect surveys similar to those conducted by Ferrier allowing a comparison with his baseline data of scrub-bird territory densities. The choice of method also fitted well with our intent to conduct an intensive set of Atlas surveys for all bird species, including all species listed to support the IBA nomination. For both

aspects of this study the results were broken down and reported against transect segments involving 1km linear length of trail (i.e. taking into account curves and undulations).

The 2010 studies described in this report were viewed as a pilot study to test the suitability of the transect approach using volunteers to identify scrub-bird territories and fine tune the approach. Four other IBAs involving the Rufous Scrub-bird as the trigger species have also been nominated. Ideally similar approaches to monitoring Rufous Scrub-birds should be used across the five IBAs.

2.2 Methods

Transects were established along roads and walking tracks in the Gloucester Tops area of the Barrington Tops & Gloucester Tops IBA as show in Figure 2. One kilometre segments were measured, either by odometer readings where car access was possible, or by measurement on Google maps to determine end point map coordinates. These points were found using GPS units set to WGS84 coordinate system. All transect segments were marked at their extremities using yellow tape. The selected transects corresponded with approximately 80% of the area surveyed by Ferrier and also coincided with a number of the fixed survey sites used in the previous BA study. The impenetrable nature of the bush made it impractical to conduct surveys away from existing tracks.

Most of the survey work was conducted around two camps, each of 3 days duration, held in September and October 2010. Each camp involved nine volunteers, with five people attending on both occasions. The first day of each camp was used to train the survey team. This involved ensuring that all participants could recognise the calls of Rufous Scrub-birds. After playing tapes of scrub-bird calls participants were taken to a known Rufous Scrub-bird territory where the resident male bird called persistently using its chipping song. Volunteers were asked to determine the point on the track nearest to the calling bird and estimate the distance of the calling bird, this being the approach used to identify the location of territories. In-the-field training was very important because the taped calls involved the northern sub-species of the Rufous Scrub-bird, which has a slightly different repertoire of songs and calls to the southern sub-species found at Gloucester Tops.

Five teams were established involving at least one person previously experienced in locating Rufous Scrub-birds and familiar with the survey techniques. Each team was asked to survey between three and five transect segments, each 1 km in length. The following information was recorded:

1. GPS coordinates, side and distance from track of any Rufous Scrub-birds, either heard or seen.

2. Type and duration of calls heard.

3. Information relating to the detectability of scrub-birds (e.g. humidity, wind strength, cloud cover, time of day).

4. Numbers and GPS coordinates of any Flame Robins (listed in the IBA nomination).

5. Conduct a 500m radius Birds Australia Atlas survey for all species observed during the survey, listing the numbers of all species nominated in the IBA nomination (i.e. Australian Logrunner, Pale-yellow Robin, Paradise Riflebird, Green Catbird, Regent Bowerbird).

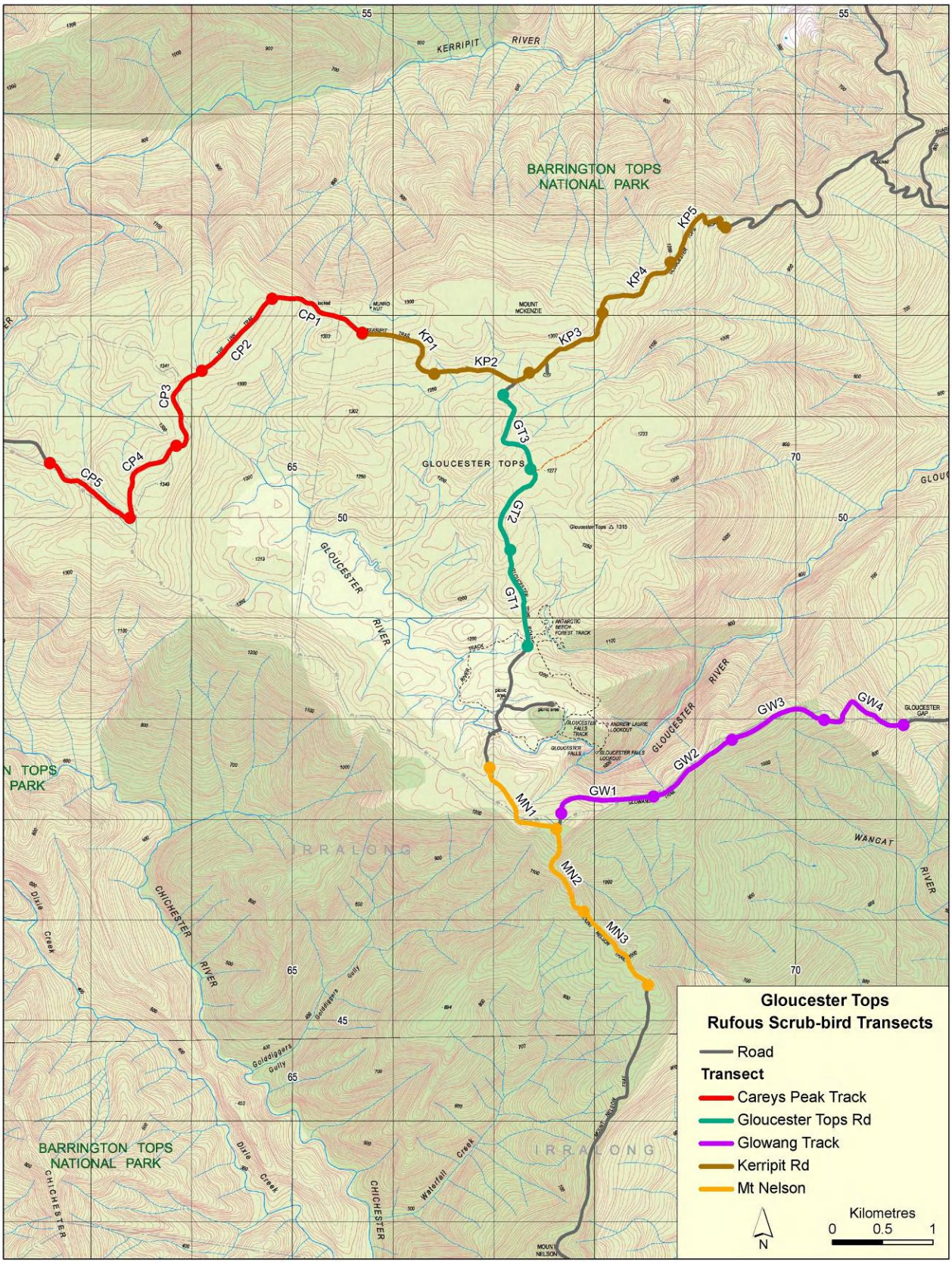
6. An indication of the habitat type (e.g. eucalypt forest with dense understorey or beech forest with bare ground).

Surveys typically commenced about 8.00 am and took between four and six hours to complete. Typically one hour was spent in each one km transect segment, the actual amount of time depending on whether any scrub-birds were located. When scrub-birds were found, up to 10 minutes additional time was spent at the location to determine the types of calls used and the duration of calling. In instances where clusters of calling birds occurred it was necessary to spend extra time, ideally establishing that more than one bird was calling simultaneously. In summary it was considered more important to be certain that scrub-birds had been correctly identified and assigned as precisely as possible to accurately measured territory locations, than to standardise the time spent surveying each transect segment. In instances where observers had to return along a walking track through a set of transect segments they were asked to record all scrub-birds on both the outward and inward walk, because this provided confirmation of records, and additional information on the size of territories and the persistence with which scrub-birds call. Observers were encouraged to spend more time surveying on the outward journey, when the birds were more active and to return more rapidly unless scrub-birds were heard or seen. Observers were discouraged from attempting to attract scrub-birds by call playback or “pishing” and leaving the track to seek out calling birds.

Rufous Scrub-bird observations were deemed to involve a confirmed territory when two records were obtained at the same location separated by an interval of least three weeks. This definition was used to indicate permanent occupation of a Rufous Scrub-bird territory. It is a less stringent criterion than that used by Ferrier which deemed a territory to be confirmed when scrub-birds were recorded before and after the breeding season. The 3 week criterion was necessary to enable interpretation of results from the short term 2010 pilot study.

Additional transect surveys were conducted during day visits to the Gloucester Tops study area targeting areas where the previous survey effort was below average. In addition records provided by casual visitors to the study area were evaluated.

Figure 2 Core survey transects in Gloucester Tops

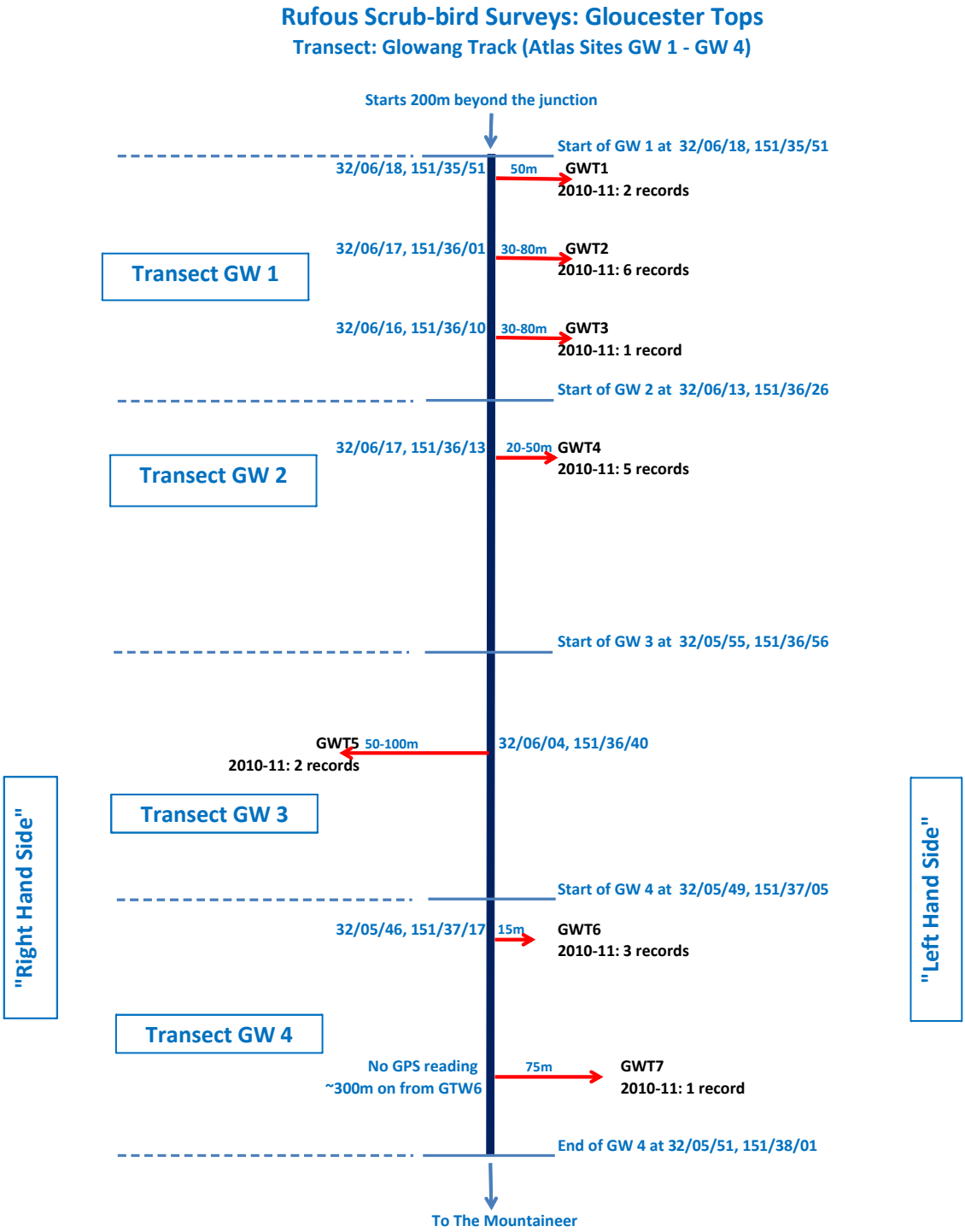


During the first camp in September all of the surveys were repeated on consecutive days by different survey teams. Teams on the second day were unaware of the locations of Rufous Scrub-birds recorded on the previous day. During the second camp in October the primary objective was to confirm as many locations as possible so that they could be assigned "territory status". Survey teams were provided with "mud-maps" identifying the locations of all previous observations to facilitate this objective and were asked to report locations of all scrub-birds on similar sketches. Figure 3 shows an example of a mud-map. This was found to be an effective method of communicating results unambiguously. During follow-up visits we have encouraged members of our core survey team to make opportunistic point surveys at locations where scrub-birds had been reported but not confirmed. Representatives of the Tweed Heads Bird Observers Club attended the September Camp and subsequently adopted a similar approach for monitoring Rufous Scrub-birds in the Scenic Rim IBA (Border Ranges section).

Weather conditions on the Gloucester Tops are unpredictable. An added complication was the need to cross the Gloucester River to reach some of the survey transects. Because of high river levels the Glowang and Mt Nelson Tracks were only surveyed once in October.

The coordinates of transect segments and the number of surveys conducted for each segment are provided in Appendix 1, Table 3.

Figure 3 Example of Mud-map (linear representation of transects)



2.3 Results and Discussion

The area surveyed in this study involves altitudes exceeding 1,150m and was selected because of the existence of baseline data generated by Ferrier. There was an expectation that the high altitude areas would remain core habitat for the Rufous Scrub-bird following any contraction in range as a consequence of climate change. The following discussion deals initially with the results for the Rufous Scrub-bird followed by a discussion of the occurrence of all bird species as indicated by the Atlas surveys.

2.3.1 Rufous Scrub-bird

The ability to reliably recognise calling Rufous Scrub-birds is central to locating their territories. Fortunately, in the breeding season from September to December the probability of detecting males having territories within 150m of a track usually exceeds 50% and can be as high as 80% for an experienced surveyor (Ferrier 1984). This previous study found detectability to peak between October and November. High humidity, low wind and low mist conditions enhanced detection rates.

The main song of the Rufous Scrub-birds has been described as a “chipping” call. It consists of repeated phrases, each involving severable syllables. Males often sing persistently as demonstrated by the bird used for training volunteers. Once heard in the field it is readily recognised, having a resonant metallic quality, easily distinguished from other species by experienced surveyors. Consequently a high reliability was placed on any records by trained surveyors involving scrub-birds persistently using the chipping call.

Rufous Scrub-birds have a wide repertoire of calls and are renowned mimics. Less reliance was placed on records where the “chipping” call was not heard and particularly when only one or two contact calls were reported. Over 95% of the records were based on the detection of calls and the bird was seldom seen.

Rufous Scrub-bird records were assigned to three categories as defined below:

1. Confirmed Territories based on at least one repeat record three weeks or more after the initial record.
2. Calling Sites based on two or more records involving either persistent use of the “chipping” call or a sight observation, but lacking confirmation of continued occupancy over a period of at least three weeks.
3. Tentative Sites involving single records (unless seen) and multiple records, which did not involve the “chipping” call.

The simplest type of Rufous Scrub-bird Territory is approximately one ha in size, 100m in diameter and the bird predominantly calls from a core area of about 50m in diameter in the centre of the territory (Ferrier 1984). The territory used for training purposes fitted this

description. The GPS coordinates describing the position of this, the most measured territory, varied by 2 by 3 seconds of latitude/longitude. Irregularly shaped territories can be lozenge shaped and up to 250m long with more than one node used for calling (Ferrier 1984). This type of territory could result in variations in GPS coordinates as large 5 to 6 minutes if the territory was aligned parallel to the transect. For this type of territory it would be difficult to determine whether clusters of GPS coordinates involved a single or multiple territories in the close proximity. There were few instances where this difficulty arose. Where any ambiguity occurred the conservative position was taken and only one confirmed territory was assigned.

Female Rufous Scrub-birds call infrequently. Ferrier (1984) describes 12 instances of the male and female performing a duet. This possibility must be taken into account when assigning records of calling birds to territories. On several occasions in the present study observers reported the probable presence of two birds based on contact calls. In January 2011 two birds in close proximity (within what has been assigned as a single territory) were performing a song duet. The duetting birds may have been a pair or else an adult and a juvenile male (photographic evidence indicates that second bird was not an adult male).

The summary provided in Table 1 shows the distribution of Rufous Scrub-bird records between the five sets of transects which were surveyed and in some other areas which were visited opportunistically. A more detailed summary of the locations of the records is provided by the sketch maps in Appendix 2 (Figures 4 to 9; includes data for Gloucester Falls sites which had some repeat visits) which cover the 20 km of transects where there was repeat survey effort. For simplicity these maps show linear transects whereas the actual tracks both twist and undulate. Additional details of site coordinates and transect boundaries are provided in Appendix 1, Tables 3 to 5.

Table 1 Summary of Rufous Scrub-bird Survey results

Area	Length (km)	Days Surveyed	Confirmed Territories	Calling Sites	Tentative Sites	Sites all Categories
Careys Peak Track	5	5	8	2	2	12
Kerripit Rd extended	5	5	4	0	5	9
Gloucester Tops Road	3	4	3	0	2	5
Mount Nelson Track	3	3	3	2	1	6
Glowang Track	4	3	4	1	2	7
Total for repeat surveys	20		22	5	12	39
Other areas	3		2	0	1	3
Total plus other areas	23		24	5	13	42

Table 1 shows that Rufous Scrub-birds were distributed fairly evenly throughout the study area. There were records from all but one of the 20 transect segments, but not all of these records were confirmed as territories.

22 territories were confirmed in the 20km of core transects, which equates to a density of 3.6 territories/km^2, assuming that all territories within 150m either side of surveyed transects were detected. This estimate is considered conservative because it is anticipated that more records will be upgraded to confirmed territory status with further survey effort in 2011. For instance, if all the calling sites involving multiple records were upgraded to confirmed status the number of territories would increase to 27 at a density of 4.5/km^2. The density of 3.8 territories/km^2 found by Ferrier in 1981 (Ferrier 1984) lies within the indicative range 3.6 to 4.5 territories/km^2 found in this study. On this basis it can be concluded that in the Gloucester Tops study area Rufous Scrub-bird numbers have remained reasonably stable over a period of 29 years.

18 transect segments primarily involved eucalypt woodland with dense understorey vegetation, usually bordering beech forest. Rufous Scrub-birds were recorded in all of these transect segments. The vegetation varied considerably between the sites at which Rufous Scrub-birds were found. In all instances there was ground cover with extensive leaf litter. There were considerable variations in the extent of mid-storey vegetation which ranged from one to three metres in height. These observations are consistent with Ferrier's (1985) description of the preferred habitat of the Rufous Scrub-bird in the Gloucester Tops area. There was a tendency for Rufous Scrub-bird sites to be located near creeks and in dense gullies, but this was not an exclusive requirement. In some areas there was considerable evidence of the regrowth of beech forest as indicated by the presence many *Nothofagus moreii* saplings. Only two of the 20 transect segments were located in areas dominated by Beech Forest, habitat characterised by a lack of understorey and ground cover vegetation. The absence of Rufous Scrub-bird records from one of those transect segments is consistent with Ferrier's conclusion that, in rainforest, scrub-birds are only found where there is dense ground cover along creek edges and where fallen trees have opened up the forest canopy.

2.3.2 Detection of calling birds

An objective of Ferrier's work (1984) was to establish a single survey method which would provide an absolute measure of Rufous Scrub-bird territory densities. This was achieved by establishing a set of detection factors which could be applied to transect survey results. Ferrier's detection factors varied with humidity, wind strength, day of the year and habitat type. They are available as a look up table for the Gloucester Tops area. Under the most favourable conditions involving high humidity, still conditions and no mist during October and November the probability of detecting a Rufous Scrub-bird calling within 150m either side of a track was found to slightly exceed 80 % for an observer walking at 2.5 km/hr.

Preliminary attempts to validate Ferrier's detection factors against our 2010 transect surveys were unsuccessful. For instance, when the number of scrub-birds recorded by observers during our surveys for one transect of 5km length was compared with the total number of birds found throughout 2010 (Table 1) for that transect the numbers detected were lower than predicted by the model. The discrepancy may be associated with difficulties in measuring humidity and small transect length of 5 km used in the evaluation (Ferrier sampled 18 km/day). Other factors could contribute to this situation, including differences in the field experience of personnel with detecting calling scrub-birds and a lack of prior knowledge of the location of their territories.

In both Ferrier's study and this work a number of scrub-birds were heard on a single occasion or for a short period of time and should not be assigned territorial status. Possible explanations for these records include birds which do not have established territories and are roaming in search of a mate. In addition scrub-birds with territories spanning or bordering the 150m detection zone would only be heard under the most favourable conditions.

An intriguing possibility is that Rufous Scrub-bird breeding behaviour may vary with climatic conditions and that the spring of 2010 may have been anomalous as it involved above average rainfall associated with La Nina conditions. Ferrier's studies were conducted during a period of "normal" rainfall and he suggested that climatic conditions could impact on the vocal behaviour of scrub-birds (e.g. by determining the timing of the breeding season when calling peaks).

Ferrier's goal of achieving a single survey technique which generates reliable estimates of Rufous Scrub-bird territory densities is compelling and attempts to validate his model will continue in 2011.

2.3.3 Variations of individual birds in seasonal calling patterns

Ferrier showed that the frequency at which a group of 19 territorial males called increased during the breeding season, which is thought to be between September and December, peaking in October and November. However, it is possible that individual birds show short term departures from the group behaviour. For instance, Jackson (1920) indicated that the male called less when the female was incubating. This is consistent with Ferrier's findings provided that the timing of breeding is not highly synchronised across all the transects.

During the present surveys the scrub-bird bird used for training purposes was heard on every occasion up to October 12, after which it was mainly silent on several visits. It was subsequently heard calling on several occasions in December and January 2011. These observations are consistent with the hypothesis that it may have bred in October and called less consistently at that time as claimed by Jackson.

Unfortunately very little detail is known about the breeding behaviour of individual Rufous Scrub-birds and its impact on song and their detection.

During the less comprehensive survey effort in November under difficult conditions (e.g. high wind, showers and the noise of cicadas) Rufous Scrub-birds were calling less frequently than expected.

2.4. Future Directions

The pilot studies conducted in 2010 successfully established an indicative range for the density of scrub-bird territories for comparison against baseline levels 29 years previously. However, as discussed previously, there are a number of sites of uncertain status. It is recommended that monitoring effort in 2011 continues to concentrate on a core area involving transects established in 2010 with some minor adjustments in approach as indicated below.

1. Continue to survey the transect segments established in 2010 using the existing approach with the aim of identifying all territories within 150m of transects. Because of the difficulty with crossing the Gloucester River and the steep terrain of one transect it is recommended that the Mt. Nelson and Glowang track transects are combined. The revised transect will involve the first km of the Mt. Nelson track and four km of transect segments along the Glowang track, which is a ridge. Data collected in 2011 will allow the territories to be confirmed on the basis of a longer period of continuity of occupation than the 21 day criteria used for the 2010 analysis.

2. Place emphasis on determining whether the territories confirmed in 2010 continue to be occupied in 2011. The continuity of maintenance of territories between seasons is an important measure of the stability of the Rufous Scrub-bird population.

3. Continue to work on the validation of Ferrier's detection factors and to determine the efficacy of their use in conjunction with single transect surveys for estimating Rufous Scrub-bird territory densities.

The present approach concentrates on what is thought to be core habitat of the Rufous Scrub-bird in the Barrington Tops & Gloucester Tops IBA. It is the area where the species is expected to be present at its highest density and to be most secure in the short term. Indeed in the event of climate change and global warming impacting on the species it has been suggested that the species range would contract to areas adjacent to remnant rain forest at high altitude like the Gloucester Tops. Hence evidence of a long term decline in the Rufous Scrub-bird in core habitat like the Gloucester Tops would be of serious concern and involve an entrenched decline which would be difficult to reverse. Ideally monitoring should also occur in areas where the species is more sensitive to the impact of natural environmental factors. For instance, the concept of rain forest retreat in response to global warming would be expected to impact initially at the edge of the current range of the Rufous Scrub-bird at lower altitude. This is addressed by the fourth initiative.

4. Conduct survey work at lower altitude in areas where Rufous Scrub-birds were found in the BA studies five to ten years ago. In addition to conducting transect surveys, known sites should be visited during the breeding season. Because volunteer

availability may limit the effort that can be committed to this phase of the monitoring the best approach may be to establish an inventory of territories and determine changes in their annual occupancy. If initiative 3 successfully validates Ferrier's detection factors and model for interpreting singe transect survey results (Initiative 3) it would become a valuable approach.

As discussed previously there is very little detailed knowledge of the breeding biology of the Rufous Scrub-bird and the manner it uses song. A Song Meter has recently been acquired which could be used to investigate the following initiatives.

5. To quantify the extent to which individual birds call at different periods of the year. For example determining the extent to which birds which may temporarily cease calling during the breeding season and to investigate the use of song during the non-breeding season when birds are known to call, but detection factors are much lower than in the breeding season (Ferrier 1984).

6. To determine whether there are differences in the song repertoires of individual birds which can used to identify and monitor the annual survival of individual birds. This is an exciting possibility because it is a non-invasive approach to identifying and determining the longevity of individual birds.

Finally it is pointed out that during this study a large number of territories have been identified which are in the area investigated by Ferrier nearly 30 years ago. The territories are in regrowth eucalypt forest and from a management perspective it would instructive to characterise the vegetative structure of these territories and compare the results with those obtained by Ferrier.

7. Characterise the vegetation structure in Rufous Scrub-bird territories and determine whether there have been significant changes during the last thirty years.

Initiatives 5, 6, and 7 involve research aspects which add value to the ongoing monitoring effort. They require specialist skills, particularly initiative 7 and may be best progressed in partnership with other groups.

3. ALL SPECIES RECORDED IN ATLAS SURVEYS

Whilst surveying for Rufous Scrub-birds, the survey teams were asked to also note all of the bird species present in each of the approximately 1km transects. The resulting data were entered into the Birds Australia Birdata database as 500m radius Area Surveys ("Atlas surveys"). In all, 91 Atlas surveys were carried out between August and December 2010. 21 of the 22 transects were surveyed more than once and those 21 transects were registered as Atlas sites (site identification numbers 20147-20168, details are in Table 3, Appendix 1). The Atlas surveys typically took one hour to complete and mainly involved either one, or more often, two observers. The altitudes at the mid-points of all transects exceeded 1,150m.

Birds were scarce and difficult to observe in the areas surveyed because of the dense nature of the vegetation and the secretive nature of species like the Rufous Scrub-bird. Hence emphasis was placed on the identification of calling birds. Weather conditions, frequently involving strong wind, mist and rain, exacerbated the difficulty of conducting surveys, particularly on the Glowang (GW) and Mt. Nelson (MN) tracks which are accessed by fording the Gloucester River. Consequently, these areas received less survey effort than the more accessible Kerripit Road (KP), Careys Peak Track (CP) and Gloucester Tops Road (GT) transect sets.

53 species were recorded in the Atlas surveys and the results are summarised in Table 2. The Table indicates the number of times that each of the 53 species was recorded, and the number of transects in which they were recorded. The distribution of species across the 22 transects is indicated. Species recorded in 76 to 99% and 50 to 75% of transects were described as occurring in "most transects" and "most areas" respectively. For the other species transects where the birds were recorded is specifically indicated in the Table.

Also presented in Table 2 is the reporting rate, which is the frequency each species was recorded during the 91 surveys. The reporting rate for the Rufous Scrub-bird was 54%, a high value reflecting importance of the Gloucester Tops area to the species. Other species listed in the IBA nomination were either scarce (Flame Robin, Australian Logrunner and Pale-yellow Robin) or absent (Paradise Riflebird, Regent Bowerbird and Green Catbird, which are present at lower altitudes).

Four species, Crimson Rosella, White-throated Treecreeper, Brown Thornbill and Grey Fantail were recorded in all transects. Not surprisingly all these species had high reporting rates, ranging from 91% for the Brown Thornbill to 65% for the Grey Fantail. The White-browed Scrubwren, present in 95% of transects, was also regularly recorded with a reporting rate of 80%.

Rufous Scrub-birds were found in 20 of the 22 transects at a reporting rate of 54%. These high numbers reflect the selection of transects located in areas historically known to be core

habitat for this scarce species. The results confirm that the study area remains core habitat, supporting a viable Rufous Scrub-bird population, nearly 30 years after the first systematic surveys were made. In comparison, the similarly vocal Superb Lyrebird was recorded in 15 transects at a reporting rate of 54%. The wider distribution of the Rufous Scrub-bird is attributed to its preference for habitat in woodland adjacent to Beech Forest, where there is dense ground cover and understorey. In contrast the Superb Lyrebirds prefer areas of Beech Forest with minimal understorey, where they can forage on bare ground.

The Olive Whistler has a restricted distribution in NSW being found only in islands of high altitude habitat like the Gloucester Tops. It was widespread, occurring in 17 transects at a reporting rate of 34%. The Golden Whistler was more numerous, occurring in 19 transects at a reporting rate of 63%. In contrast, there was only one record of the Rufous Whistler, a summer visitor, which apparently does not favour high altitude habitat.

All the summer visitors were scarce, Black-faced Monarchs, present in six transects at a reporting rate of 9%, were the most frequently recorded migratory species. It was surprising that both the Leaden and the Satin Flycatchers were only recorded once, particularly as the Gloucester Tops has historically been considered a stronghold for the latter species.

The Crescent Honeyeater, like the Olive Whistler, is restricted to high altitude habitat within the Hunter Region. It was well distributed occurring in 15 transects at a reporting rate of 29%. However, it favoured more open areas of woodland, particularly where banksias were present. There were only two records of New Holland Honeyeaters, another species which prefers banksia woodland. The Yellow-faced Honeyeater and Lewin's Honeyeater, both usually plentiful in the Hunter Region, were scarce with reporting rates of 9 and 10% respectively. There was one record of the Fuscous Honeyeater.

The Flame Robin, a species with a locally restricted range in the Hunter Region, supports the nomination of the Barrington Tops & Gloucester Tops IBA. It was only found at 5 transects, mainly along Kerripit Road and at the start of the Careys Peak trail. The reporting rate was low at 12% and the species was less frequently observed after September.

Other species supporting the IBA nomination were either scarce or absent at high altitude. There were only four records of the Australian Logrunner and a single vocal record of the Pale-yellow Robin. The Paradise Riflebird was not recorded in the surveys, but was present at lower altitudes nearer the Sharpes Creek camping ground, as was the Green Catbird.

Several species, which are wet forest specialists were surprisingly scarce, the Yellow-throated Scrubwren, Large-billed Scrubwren and Brown Gerygone having reporting rates of 5, 13 and 14% respectively. These species, particularly the Brown Gerygone may prefer lower altitude habitat. For instance, Brown Gerygones were plentiful near the Sharpes Creek camping ground, as were the Superb Fairy-wren *Malurus cyaneus* and Red-browed Finch *Neochmia temporalis*, common species not recorded during the higher altitude surveys.

Table 2 Gloucester Tops Atlas Surveys 2010

Species	Scientific Name	Number of Records	Reporting Rate (%)	Number of Transects	Transects Present(%)	Where Present
Australian Brush-turkey	Alectura lathami	1	1	1	5	MN2
Brown Cuckoo-Dove	Macropygia amboinensis	2	2	2	9	MN3;KP5
Wonga Pigeon	Leucosarcia melanoleuca	1	1	1	5	MN1
Topknot Pigeon	Lopholaimus antarcticus	1	1	1	5	MN1
Yellow-tailed Black-Cockatoo	Calyptorhynchus funereus	5	5	5	23	KP1;GW3;GT3;CP3;CP4
Australian King-Parrot	Alisterus scapularis	4	4	4	18	MN2;MN3;CP2;CP3
Crimson Rosella	Platycercus elegans	74	81	22	100	All transects
Shining Bronze-Cuckoo	Chalcites lucidus	3	3	2	9	KP3;KP4
Fan-tailed Cuckoo	Cacomantis flabelliformis	20	22	12	55	Mainly KP and CP transects
Laughing Kookaburra	Dacelo novaeguineae	7	8	4	18	KP1;CP1;GT1;GF
Superb Lyrebird	Menura novaehollandiae	34	37	15	68	Most transects
Rufous Scrub-bird	Atrichornis rufescens	49	54	20	91	Most transects
White-throated Treecreeper	Cormobates leucophaea	76	84	22	100	All transects
Red-browed Treecreeper	Climacteris erythrops	8	9	7	32	KP1;KP2;KP3;CP1;CP2;GT1;GB
Satin Bowerbird	Ptilonorhynchus violaceus	7	8	5	23	KP3;CP2;MN1;MN3;GF1
Yellow-throated Scrubwren	Sericornis citreogularis	5	5	4	18	KP3;KP4;KP5;MN3
White-browed Scrubwren	Sericornis frontalis	73	80	21	95	Most transects
Large-billed Scrubwren	Sericornis magnirostra	12	13	9	41	Mainly KP3 to 5 and CP3 to 5
Brown Gerygone	Gerygone mouki	13	14	8	36	Mainly MN and KP3 to 5
Striated Thornbill	Acanthiza lineata	34	37	19	86	Most transects
Brown Thornbill	Acanthiza pusilla	83	91	22	100	All transects
Spotted Pardalote	Pardalotus punctatus	37	41	17	77	Most transects
Striated Pardalote	Pardalotus striatus	23	25	13	59	Most areas
Eastern Spinebill	Acanthorhynchus tenuirostris	20	22	15	68	Most areas
Lewin's Honeyeater	Meliphaga lewinii	9	10	6	27	KP2;KP4;KP5;GW1;GW2;GW3
Yellow-faced Honeyeater	Lichenostomus chrysops	8	9	5	23	KP2;KP3;CP1;CP3;CP4
Fuscous Honeyeater	Lichenostomus fuscus	1	1	1	5	MN2

Red Wattlebird	Anthochaera carunculata	8	9	6	27	KP1;CP1;CP2;CP3;GT1;GW1
Crescent Honeyeater	Phylidonyris pyrrhopterus	26	29	15	68	Most areas
New Holland Honeyeater	Phylidonyris novaehollandiae	2	2	2	9	KP2;GW1
Australian Logrunner	Orthonyx temminckii	4	4	4	18	KP5;CP2;CP3;KP5
Eastern Whipbird	Psophodes olivaceus	60	66	19	86	Most transects
Black-faced Cuckoo-shrike	Coracina novaehollandiae	1	1	1	5	CP1
Cicadabird	Coracina tenuirostris	1	1	1	5	CP1
Crested Shrike-tit	Falcunculus frontatus	2	2	2	9	KP4;CP2
Olive Whistler	Pachycephala olivacea	31	34	17	77	Most Transects
Golden Whistler	Pachycephala pectoralis	57	63	19	86	Most transects
Rufous Whistler	Pachycephala rufiventris	1	1	1	5	GF1
Grey Shrike-thrush	Colluricincla harmonica	33	36	19	86	Most transects
Pied Currawong	Strepera graculina	50	55	18	82	Most transects
Rufous Fantail	Rhipidura rufifrons	3	3	3	14	KP2;CP5;GF1
Grey Fantail	Rhipidura albiscapa	59	65	22	100	All transects
Leaden Flycatcher	Myiagra rubecula	1	1	1	5	KP1
Satin Flycatcher	Myiagra cyanoleuca	1	1	1	5	CP1
Black-faced Monarch	Monarcha melanopsis	8	9	6	27	KP1;KP2;KP3;KP5;GF1;GFB
Flame Robin	Petroica phoenicea	11	12	5	23	KP1;KP2;CP1;GW1;GW3
Rose Robin	Petroica rosea	25	27	15	68	Most areas
Pale-yellow Robin	Tregellasia capito	1	1	1	5	MN2
Eastern Yellow Robin	Eopsaltria australis	55	60	20	91	Most transects
Silvereye	Zosterops lateralis	3	3	3	14	CP1;CP3;GW2
Bassian Thrush	Zoothera lunulata	2	2	2	9	KP3;CP1
Russet-tailed Thrush	Zoothera heinei	1	1	1	5	CP2
Mistletoebird	Dicaeum hirundinaceum	2	2	2	9	CP1;MN1

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5 ACKNOWLEDGEMENTS

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The estimated value of the in-kind contributions from volunteers is $21, 502 with an additional $6,059 of support (comprising equipment and in-kind) from DECCW and HBOC (total estimated value of the survey effort therefore being $27,561 – see Appendix 3 for more details).

Appendix 1 Details of Rufous Scrub-bird records and locations

Table 3 Inventory of Transects Barrington Tops & Gloucester Tops IBA

Transect Code	BA Atlas ID	Description	Midpoint	Coordinates[1]	Altitude (m)	No. of Surveys
CP1	20147	1st km of Carey's Peak Track	32/03/35	151/34/22		7
CP2	20148	2nd km of Careys Peak Track	32/03/47	151/32/43	1367	6
CP3	20149	3rd km of Careys Peak Track	32/04/17	151/33/30	1342	5
CP4	20150	4th km of Careys Peak Track	32/04/36	151/33/10	1341	5
CP5	20166	5th km of Careys Peak Track	32/04/33	151/32/57		2
KP1	20151	1 st km of Kerripit Road	32/03/45	151/34/58	1307	7
KP2	20152	2nd km of Kerripit Road	32/03/55	151/35/21	1280	7
KP3	20153	3rd km of Kerripit Road	32/03/48	151/35/56	1282	6
KP4	20154	4th km of Kerripit Road	32/03/31	151/36/24	1292	5
KP5	20155	5th km of Kerripit Road	32/03/08	151/36/46	1198	5
GT1	20156	1st km of Gloucester Tops Road	32/05/08	151/35/37	1271	4
GT2	20157	2nd km of Gloucester Tops Road	32/04/38	151/35/31	1286	4
GT3	20158	3rd km of Gloucester Tops Road	32/04/16	151/35/31	1293	4
GW1	20159	1st km of Glowang Track	32/06/17	151/35/55	1242	3
GW2	20160	2nd km of Glowang Track	32/06/12	151/36/31	1170	3
GW3	20161	3rd km of Glowang Track	32/05/55	151/36/54	1173	3
MN1	20162	1st km of Mt Nelson Track	32/06/07	151/35/25	1225	3
MN2	20163	2nd km of Mt Nelson Track	32/06/34	151/35/47	1174	3
MN3	20164	3rd km of Mt Nelson Track	32/06/58	151/36/07	1037	3
BW1	20165	1st km of Beech Forest Walk	32/05/22	151/35/41	1270	2
GF1	20168	Ist km clockwise Gloucester Falls	32/05/47	151/35/48		3
GFB		Gloucester Falls to Beech walk				1
					Total	**91**

[1] Coordinates are in WGS84 format

Table 4 Confirmed Rufous Scrub-bird Territories *(multiple records at least 21 days apart)*

Transect ID	Date of First Record	Degrees South[(1)]	Minutes	Seconds	Degrees East[(1)]	Minutes	Seconds	Distance (m)	Side of Track	Days Between Records	Number of Records
CP1	15/09/2010	32	3	40	151	34	34	75	LHS	130	5
CP1	28/08/2010	32	3	38	151	34	32	50	RHS	147	14
CP1	17/09/2010	32	3	34	151	34	21	60	LHS	91	3
CP3	16/09/2010	32	4	4	151	33	26	40	RHS	41	6
CP3	17/09/2010	32	4	18	151	33	29	80	RHS	26	3
CP4	12/10/2010	32	4	26	151	33	20	90	LHS	66	6
CP4	12/10/2010	32	4	24	151	33	11	70	RHS	66	4
CP5	16/09/2010	32	4	33	151	32	56	70	RHS	26	3
KP2	16/09/2010	32	3	55	151	35	8	85	LHS	72	7
KP2	16/09/2010	32	3	55	151	35	24	100	LHS	41	2
KP3	17/09/2010	32	3	53	151	35	46	15	LHS	44	2
KP4	30/09/2010	32	3	24	151	36	31	10	RHS	53	2
GT1	17/09/2010	32	5	17	151	35	38	90	RHS	40	3
GT1	15/09/2010	32	5	2	151	35	34	30	RHS	68	4
GT2	17/09/2010	32	4	27	151	35	41	55	RHS	26	2
GW1	16/09/2010	32	6	17	151	36	2	50	LHS	26	6
GW2	16/09/2010	32	6	17	151	36	12	35	LHS	26	5
GW3	17/09/2010	32	6	4	151	36	40	75	RHS	25	2
GW4	17/09/2010	32	5	46	151	37	17	15	LHS	25	3
MN1	16/09/2010	32	6	19	151	35	34	100	RHS	26	3
MN1	16/09/2010	32	6	21	151	35	44	50	LHS	26	4
MN3	17/09/2010	32	6	58	151	36	7	60	RHS	25	3
GF	24/10/2010	32	5	49	151	36	5	20	RHS	29	3
GF	1/10/2010	32	5	46	151	35	52	40		31	5

[1] Coordinates are in WGS84 format

Table 5 Rufous Scrub-bird Calling Sites *(multiple records, less than 21 days apart)*

Transect ID	Date of First Record	Degrees South[(1)]	Minutes	Seconds	Degrees East[(1)]	Minutes	Seconds	Distance (m)	Side of Track	Days Between Records	Number of Records
CP3	28/08/2010	32	3	58	151	33	30	30	LHS	19	2
CP3	27/10/2010	32	4	10	151	33	28	50	RHS	0	2
GW1	12/10/2010	32	6	18	151	35	51	50	LHS	0	2
MN1	16/09/2010	32	6	20	151	35	43	50	RHS	1	2
MN3	16/09/2010	32	6	46	151	35	55	20	LHS	1	2

[1] Coordinates are in WGS84 format

Appendix 2 Mudmaps of Rufous Scrub-bird Locations

Figure 4 Gloucester Tops Road Transect

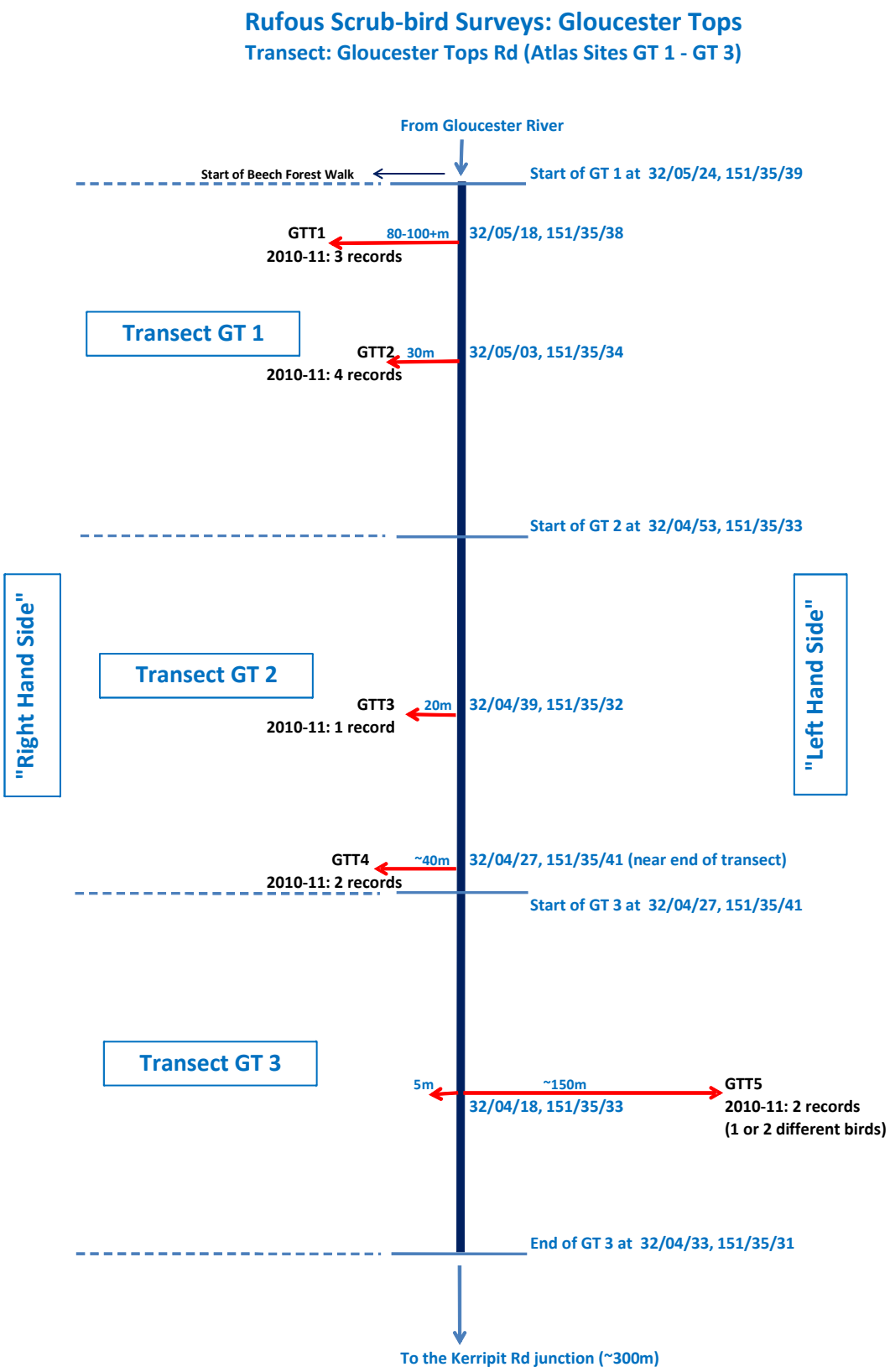


Figure 5 Kerripit Road Transect

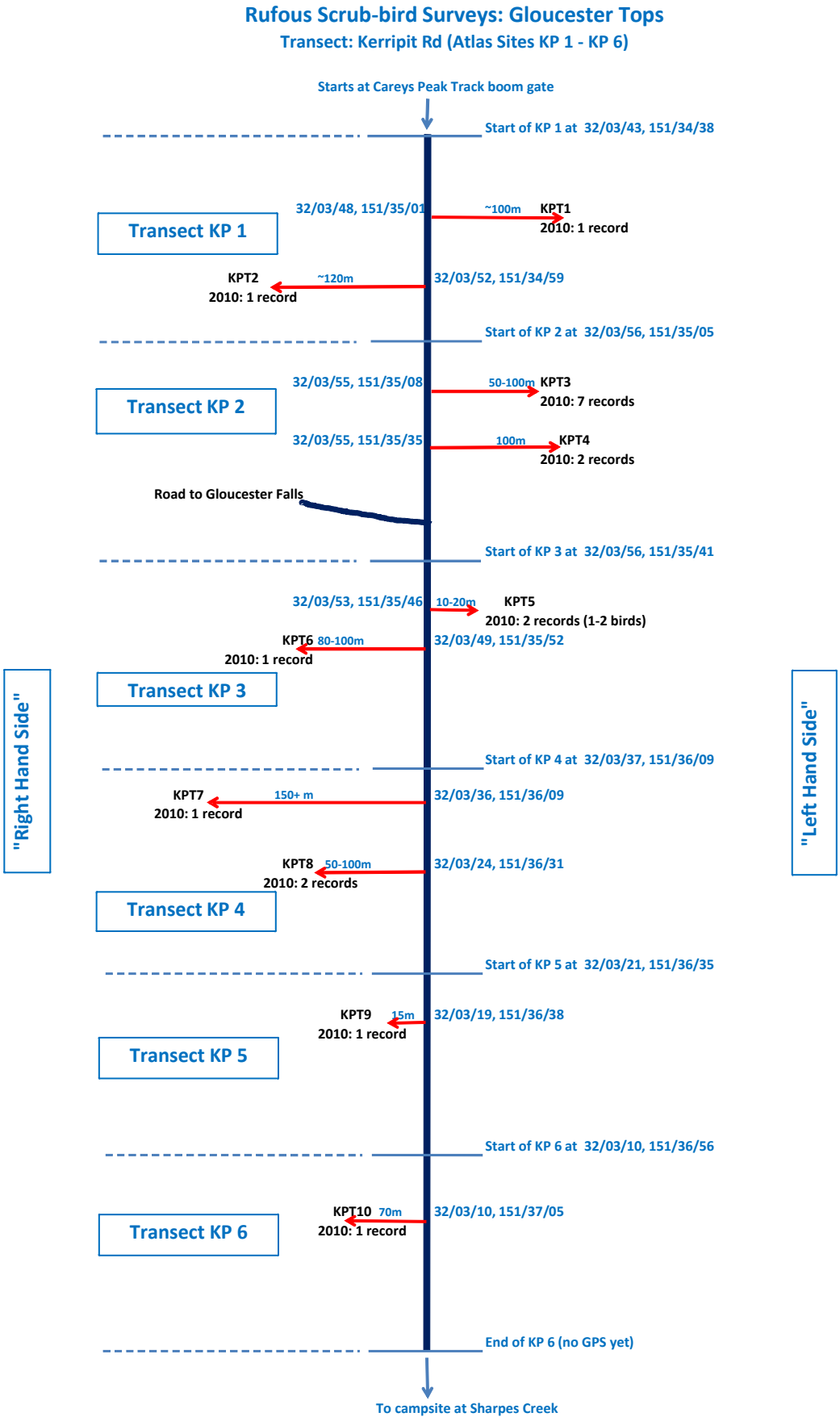


Figure 6 Careys Peak Track Transect

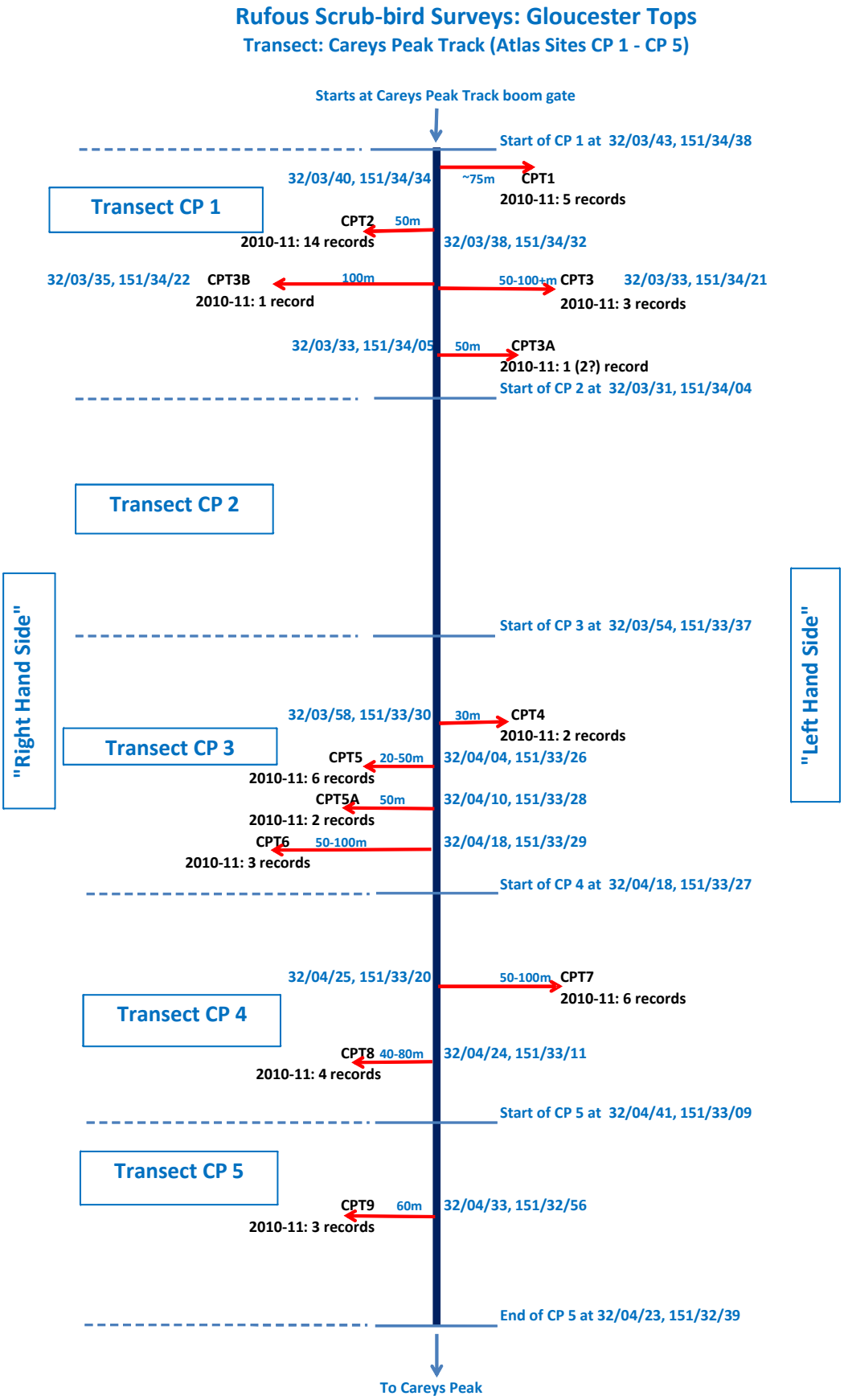


Figure 7 Mount Nelson Track Transect

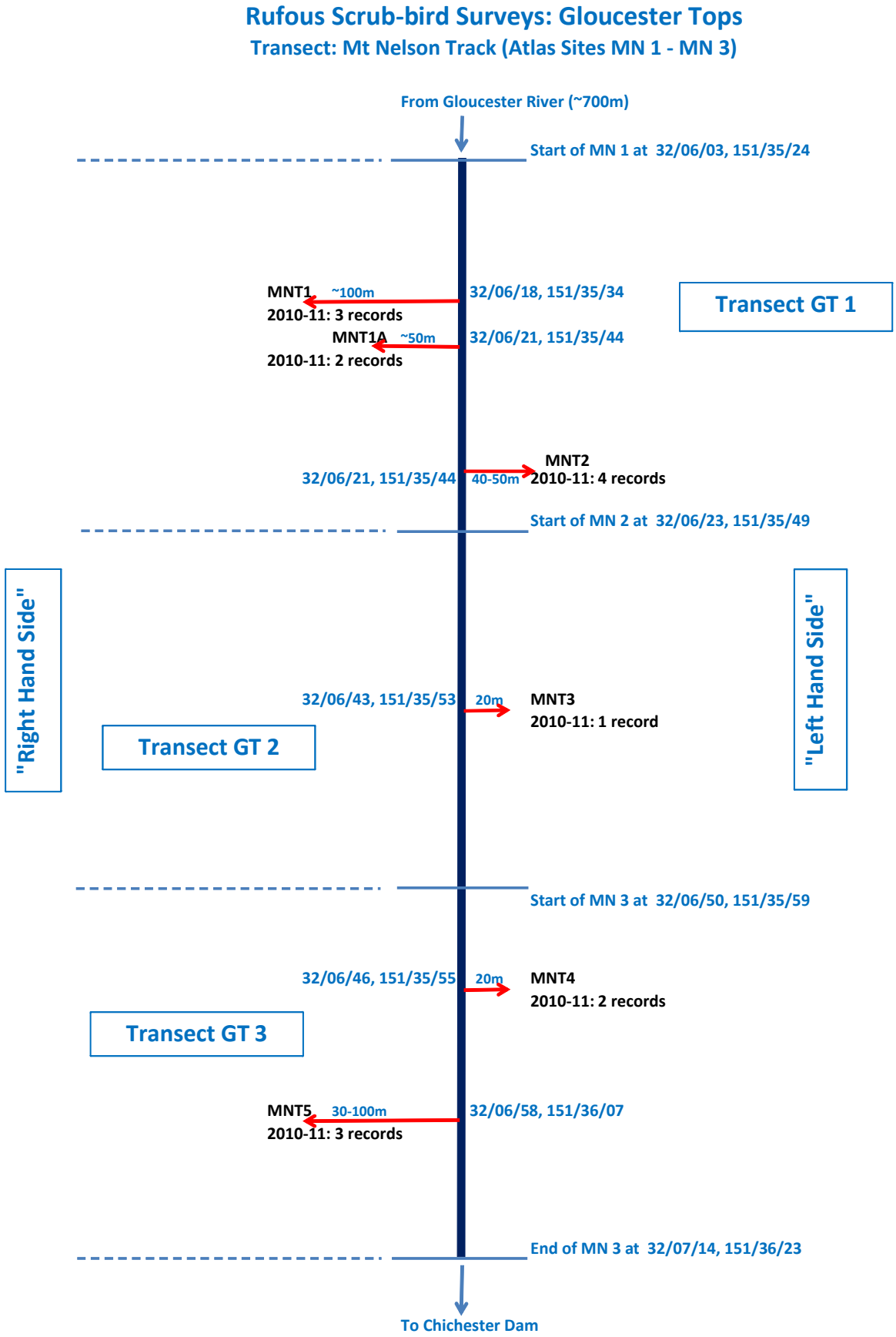


Figure 8 Glowang Track Transect

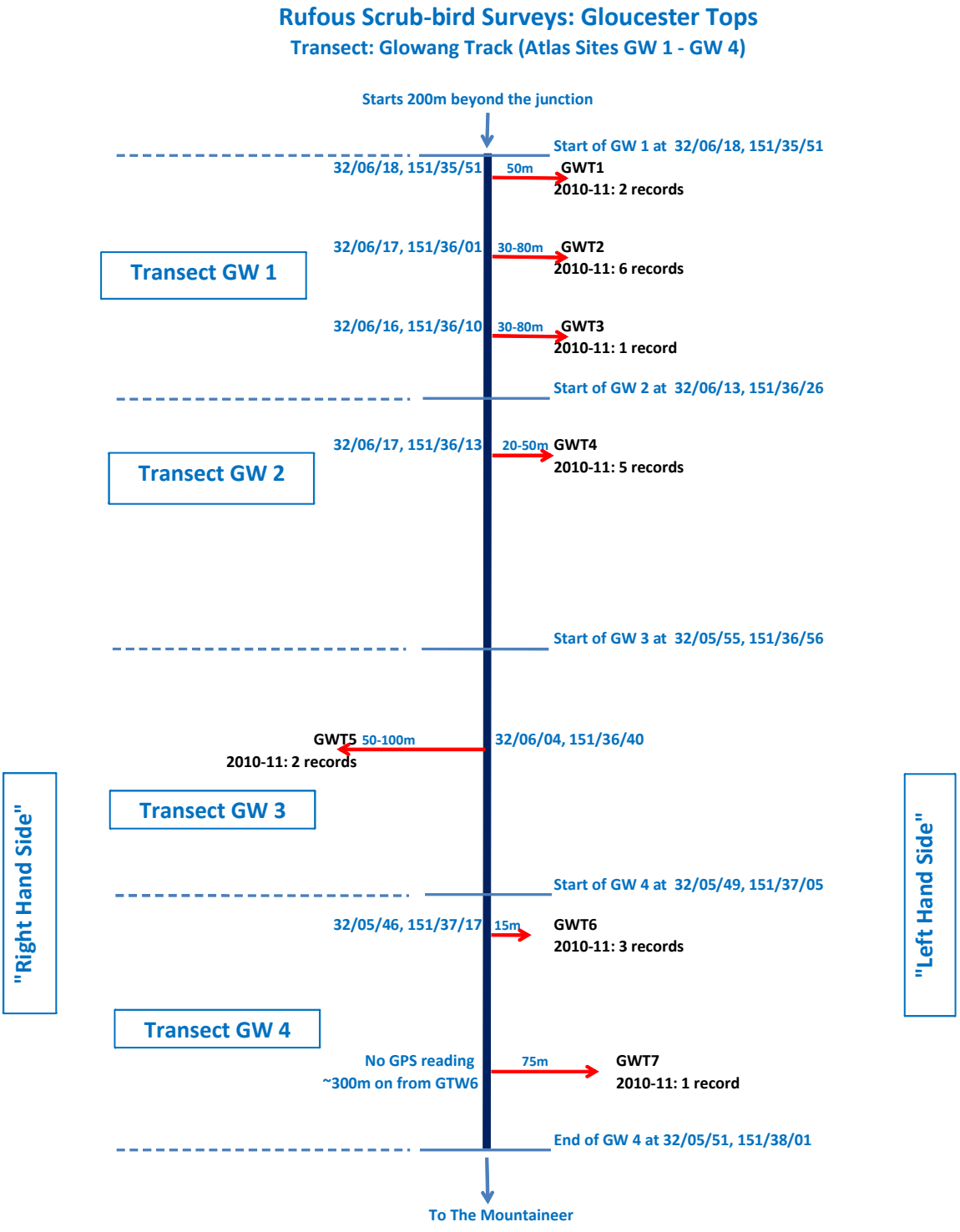
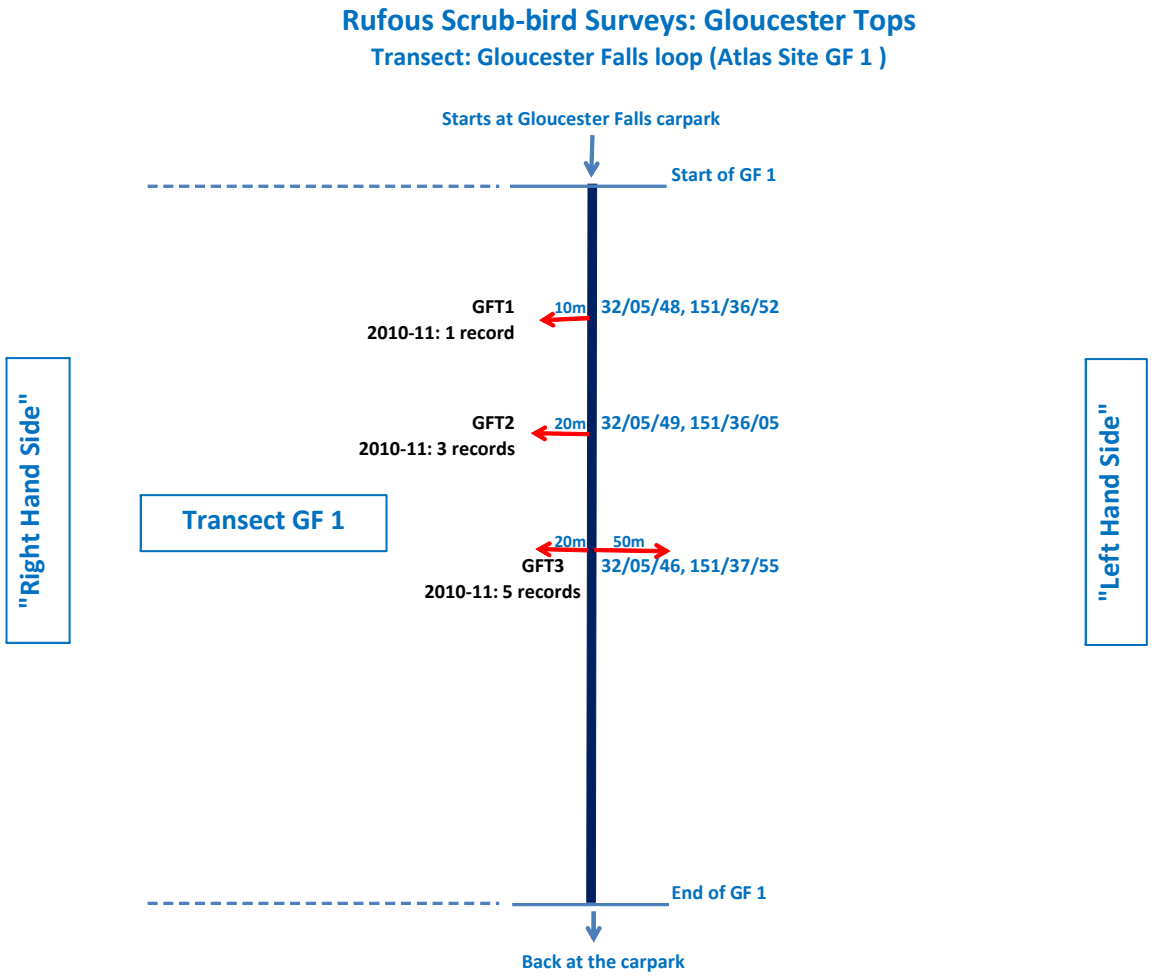


Figure 9 Gloucester Falls Loop Track Transect



Appendix 3 Valuing the Survey Effort

The 2010/2011 survey effort over September 2010 – January 2011 was supported by 16 volunteers, who contributed their personal time and travel costs. Overall, this amounted to a substantial commitment by the volunteers, at an estimated value of $20,960. Additionally, there was an estimated $6,059 contribution by HBOC and DECCW. Thus, the total commitment by volunteers and organisations for the 2010/2011 survey effort is estimated to have been $27,019.

The in-kind voluntary contributions are analysed below in three categories: Planning and preparations for surveys; Carrying out surveys; Analysing data and reporting. A cost basis of $40/hour was used for valuing the volunteer labour (this corresponds to a value used by HBOC to measure in-kind contributions for skilled labour applied to rehabilitation projects). Travel costs were assigned at $0.74/km (this corresponds to the ATO allowance for claims for the use of a 1.6 – 2.6L engine vehicle for business purposes); Newcastle-Gloucester Tops is a 300km round trip, so most surveyors travelled 250-300km each time they participated in a survey. Two surveyors travelled approximately 1500 km to participate in the September 2010 survey.

Planning and preparations for surveys

Review prior literature, devise survey methodology, prepare participant instructions	40 h	$1,600
Meeting at DECCW Newcastle (3 people x 2 h)	6 h	$240
Site visit (3 people x 10 h)	30 h	$1,200
Site visit	300 km	$222
Meeting at Gloucester NPWS office (3 people x 1.5 h)	4.5 h	$180
Meeting at Gloucester NPWS office	300 km	$222
		$3,664

Carrying out surveys

September 15-17 (9 surveyors x 8 h)	72 h	$2,880
September 15-17 (2 x 300 km, 2 x 250 km, 1 x 2000 km)	3100 km	$1,924
October 11-13 (9 surveyors x 8 h)	72 h	$2,880
October 11-13 (2 x 300 km, 4 x 250 km)	1600 km	$1,184
October 27 (2 surveyors x 6 h)	12 h	$480
October 27 (1 x 60 km)	60 km	$44
November 22 (2 surveyors x 8 h)	16 h	$640
November 22 (1 x 300 km)	300 km	$222
December 17 (1 surveyor x 12 h)	12 h	$480
December 17 (1 x 300 km)	300 km	$222
December 22 (1 surveyor x 12 h)	12 h	$480
December 22 (1 x 250 km)	250 km	$185
Jan 21-22 (1 surveyor x 16 h)	16 h	$640
Jan 21-22 (1 x 250 km)	250 km	$185
Printing of survey forms, maps, briefing notes, etc		$50
		$12,496

Analysing data and reporting

September data analysis (2 days)	16 h	$640
October data analysis (2 days)	16 h	$640
November-December data analysis (1 day)	8 h	$320
January data analysis (2 days)	16 h	$640
Prepare final report (8 days)	64 h	$2,560
		$4,800

Contributions by Organisations

DECCW	
Meetings and general assistance	$1,000
Waived camping fees September 15-17	$180
Waived camping fees October 11-13	$180
20 x CDs of Rufous Scrub-bird calls	$150
Preparation of maps	$500
Printing of maps	$150
	$2,160
HBOC	
2 x Walkie-talkie sets & car-chargers	$1,251
Storage box	$70
Temperature/humidity sensors	$88
Miscellaneous stationery	$40
Song Meter, software & accessories	$2,450
	$3,899