Distribution of priority woodland birds in the north-eastern Mount Lofty Ranges

DEWNR Technical report 2017/02

Government of South Australia
Department of Environment, Water and Natural Resources

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June, 2017

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ISBN 978-1-925510-61-4

Preferred way to cite this publication

Hobbs TJ, Armstrong DM, Willoughby N, Johnson R & West A (2017). *Distribution of priority woodland birds in the north-eastern Mount Lofty Ranges,* DEWNR Technical report 2017/02, Government of South Australia, Department of Environment, Water and Natural Resources, Adelaide.

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Foreword

The Department of Environment, Water and Natural Resources (DEWNR) is responsible for the management of the State's natural resources, ranging from policy leadership to on-ground delivery in consultation with government, industry and communities.

High-quality science and effective monitoring provides the foundation for the successful management of our environment and natural resources. This is achieved through undertaking appropriate research, investigations, assessments, monitoring and evaluation.

DEWNR's strong partnerships with educational and research institutions, industries, government agencies, Natural Resources Management Boards and the community ensures that there is continual capacity building across the sector, and that the best skills and expertise are used to inform decision making.

Sandy Pitcher
CHIEF EXECUTIVE
DEPARTMENT OF ENVIRONMENT, WATER AND NATURAL RESOURCES

Acknowledgements

The Mount Lofty Ranges Woodland Birds Project is a join initiative of the Government of South Australia's Department of Environment, Water and Natural Resources (DEWNR), Natural Resources Adelaide and Mount Lofty Ranges and DEWNR Science and Information Group (SIG). We greatly appreciate the support of Daniel Rogers, Jason Vanlaarhoven, Danielle Witham, Simon Sherriff, Michelle Bald, Sandy Carruthers, Lisien Loan and Brenton Grear in the development and completion of this work.

We are indebted to many landholders across the Mount Lofty Ranges for allowing our bird survey teams to access and study the woodland birds of the region. Many thanks to our dedicated team of ornithologists (David Armstrong, Graham Armstrong, Brian Blaylock, Phil Northeast) for their keen observational skills during field surveys, and assistance from Grace Hodder, Craig Gillespie and Helen Owens in data entry and management.

We appreciate the contributions of Daniel Rogers, Graham Carpenter and Joel Allan in allowing us to better understand the ecology and drivers of bird distributions in the region, and Stuart Collard and Craig Neumann for their scientific review of this report.

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Summary

Reducing the decline and increasing the resilience of many woodland bird species is a high priority for conservation and natural resource management in the Mount Lofty Ranges region. Several natural resource management agencies across the region are investing in large-scale, long-term habitat restoration and management programs to relieve pressure on their declining woodland birds.

Several high priority bird species known from north-eastern parts of Mount Lofty Ranges (i.e. Brown Treecreeper, Chestnut-rumped Thornbill, Diamond Firetail, Hooded Robin, Jacky Winter, Restless Flycatcher and Southern Whiteface) have been identified as the intended beneficiaries of these management programs.

Historic knowledge on the distribution and environmental drivers of these species, and the locations or landscapes preferred by these species, have been constrained by gaps or biases in bird observations across the region. Biased analyses using poor quality data has the potential to produce misleading information on environments and locations preferred by woodland birds.

In this study we have stratified landscapes and analysed recent bird data to identify environments that are poorly represented by past surveys. With this knowledge we have designed and conducted new surveys in 2016 to fill gaps and reduce biases in bird data, and to facilitate better analyses of species distributions and their responses to environment.

Species distribution modelling software was used to identify environmental variables that have the most influence on individual species distributions, quantify the strength of these relationships and produce maps of their potential distribution (including likelihood of occurrence statistics) across the study area. These potential species distribution maps for seven high priority species can be used to identify locations where management actions are most likely to benefit an individual species, or combined to identify landscapes where management actions can benefit multiple woodland bird species.

These priority landscapes tend to be located west, north and south-east of Monarto, south of Palmer, north-east and south-east of Truro, and include eastward flowing drainage lines/valleys to the east of Springton. They are typically found in rolling hills with low to medium rainfall (~400–450 mm/year) containing local patches of 10 to 25% native vegetation cover within broader landscapes with between 6 and 10% native vegetation cover.

1 Introduction

1.1 Background

Approximately 90% of the original woodlands of the Mount Lofty Ranges (MLR) of South Australia (SA) have been cleared, modified or fragmented. In the last 60 years, these activities have severely impacted on the natural environments of the region, and especially on bird species dependent on native vegetation (Ford and Howe 1980; Paton et al. 1994; Paton et al. 2004; Szabo et al. 2011). Several bird species are declining significantly while some large–bodied generalists are increasing. Of particular interest to the rest of Australia, the MLR is viewed as indicator of change for temperate woodlands (i.e. 'canary landscape', Szabo et al. 2011). Many natural resources management (NRM) agencies across temperate Australia, including the SA Department of Environment, Water and Natural Resource (DEWNR), Natural Resources (NR) Adelaide and Mount Lofty Ranges (AMLR) and NR SA Murray-Darling Basin (MDB) are investing in large-scale, long-term habitat restoration and management programs to relieve pressure on their declining woodland birds.

DEWNR NR AMLR, in conjunction NR SAMDB, are seeking improved confidence in information regarding the presence of declining, ground foraging, grassy woodland bird species in the north-eastern (NE) Mount Lofty Ranges (MLR), an area considered under–surveyed in relation to the central parts of Mount Lofty Ranges. In addition, there is a need to improve knowledge regarding the environmental features that influence the occurrence of declining woodland birds so that investment can be better directed towards particular locations and activities that are more likely to benefit these values. Priority bird species for the region are based on those identified by Rogers (2011), with this study focussing on the seven highest priority species for NR AMLR conservation programs.

1.2 Aims and objectives

This study aims to improve the confidence in the spatial location and environmental features targeted for restoration aimed at maintaining the woodland birds of the north-eastern Mount Lofty Ranges (NE MLR, Figure 1.1). This information will also serve to both improve the recognition of the value of modified landscapes in supporting these declining species; and inform the types of investment/interventions appropriate for maintaining populations of these species in the landscape.

The information provided by this study is intended to assist natural resource managers within government (e.g. DEWNR NR AMLR, NR SAMDB & NR Northern and Yorke; Australian Government), non-governmental agencies (e.g. Eastern Hills and Murray Plains Catchment Management Group, Goolwa to Wellington Local Action Planning Association, Birds SA, Trees for Life, Greening Australia, Nature Conservation Society of SA) and private landholders involved in on-ground works in the region.

Objectives of this study include:

1. Design a bird survey to fill gaps in recent records of woodland birds from the eastern Mount Lofty Ranges
2. Implement surveys in autumn and spring of 2016
3. Reduce spatial and temporal biases in bird records used in analyses of individual species environmental responses and likely distributions
4. Generate individual species models for seven high priority bird species (i.e. Brown Treecreeper, Chestnut-rumped Thornbill, Diamond Firetail, Hooded Robin, Jacky Winter, Restless Flycatcher, Southern Whiteface)
5. Identify landscapes that can be prioritised for restoration activities aimed at maintaining woodland birds

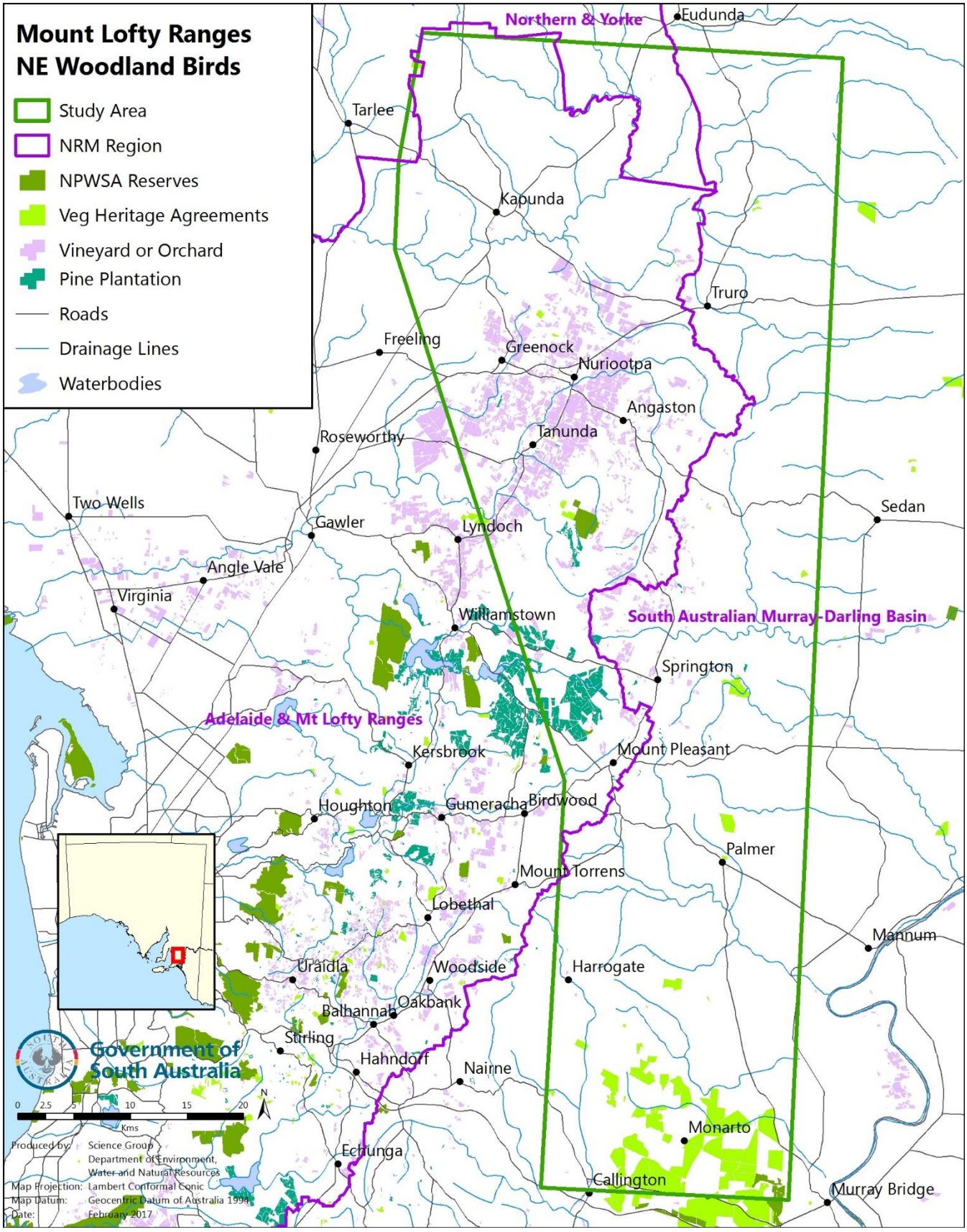


Figure 1.1. Study area for priority bird species in the north-eastern Mount Lofty Ranges

2 Methodology

2.1 Study area

This study considers the natural and modified landscapes (~292,000 ha) of north-eastern Mount Lofty Ranges (NE MLR) (Figure 1.1). The study area intersects three biogeographic regions (i.e. Kanmantoo, Flinders Lofty Block, Murray–Darling Depression; IBRA Version 7, DotE 2012) and includes four IBRA sub–regions (i.e. Fleurieu, Broughton, Mount Lofty Ranges, Murray Mallee). Topography of the region is diverse, dominated by undulating hills, and includes large areas of rolling hills to ranges or gently inclined slopes, with smaller areas of level plains (CSIRO 2015). The region experiences a Mediterranean climate with cool wet winters and warm dry summers. Mean annual rainfall in the study area ranges between 309–768 mm/year, and mean annual temperature between 13.4–16.5 °C (ANUCLIM Version 6.1, 1976 to 2005, Xu & Hutchison 2013). These lands are dominated by livestock grazing and annual cereal cropping production systems, with components of high intensity agriculture (e.g. vines and orchards), conservation areas containing predominately native vegetation communities and smaller areas of pine plantation forestry (Figure 1.1).

2.2 Bird data

In early 2016, bird records from the north-eastern Mount Lofty Ranges (NE MLR) study area were compiled from DEWNR's Biological Databases of South Australia (BDBSA, DEWNR 2016), an extract of all records from the national Bird Atlas (i.e. 1998–2015; Birdlife Australia 2016), and existing records held in DEWNR NR SAMDB's Vertebrate Database (i.e. "Murraylands" dataset). Supplementary records were provided by ornithologist Graham Carpenter from his 2012, 2013 and 2015 observations in the region. Duplicate records were identified and removed from the "Consolidated Dataset" (i.e. "Birds_All") and bird taxonomy (i.e. scientific binomials and common name) standardised across sources.

In mid-2016, DEWNR Science and Information Group's (SIG) 2016 autumn survey data were added to the Consolidated Dataset.

In late-2016, DEWNR SIG's 2016 spring survey data were added to the Consolidated Dataset.

In early 2017, new BDBSA bird data (i.e. 2015–16) records were also added to the Consolidated Dataset. Further supplementary data were added from other surveys/observations conducted in the region (i.e. DEWNR NR AMLR's Paddock Tree Project [Trees for Life] and Monarto Frahn 500 Project [DCP]; Graham Carpenter observations from 1997–99, 2014, 2016).

The final Consolidated Dataset (i.e. "Birds_All") was closely inspected for any errors, duplicate records or transfers between source datasets. All bird records were constrained to the boundaries of the NE MLR study area, except for a few records obtained from DEWNR SIG 2016 opportune surveys located in close proximity to the study area. Bird taxonomy was standardised (i.e. scientific binomials and common name) to conventions used in DEWNR's BDBSA Fauna Taxonomy list published in December 2016 (DEWNR 2016).

2.3 Environmental data

The environmental data selected for this study are a subset used by DEWNR Science and Information Group (SIG) researchers to understand the distribution of ecosystems and associated species in South Australia (e.g. Hobbs *et al.* 2015, Bonifacio *et al.* 2016). Topography, soils, climate, water redistribution and vegetation cover have been shown by these studies to influence the distribution and function of South Australian ecosystems, species, primary productivity and vegetation cover.

2.3.1 Topography and soils

To map environmental features and estimate some ecological functions, the 'Digital Soils and Landscape Grid of Australia' (CSIRO 2015) provides access to topographic and soil spatial datasets that can quantify the distribution of landscape types, vegetation communities, ecological functions and associated fauna. Layers include landforms, soil characteristics and topographic features that influence water redistribution, and primary productivity across landscapes (CSIRO 2015). These spatial layers contain nationally consistent data (90 m resolution) based on digital elevation models (DEM) data collected by NASA Space Shuttle missions NASA (2014).

To assist in landscape stratification for analysis and design of fauna surveys, or provide insight into the likely distribution of fauna species, a subset of this data has been used in this project:

- Slope/relief class - landform classifications (Speight 2009) (landscape stratification and survey design)
- Topographic wetness index - (landscape stratification, survey design and species distribution mapping)
- Soil texture - multi-layer in top 1 m of soil profile (species distribution mapping)
- Soil pH - soil acidity or alkalinity, multi–layer in top 1 m of soil profile (species distribution mapping)

Landforms (slope/relief classes)

The Speight (2009) classification system identifies 38 potential landform classes (10 occurring within the study region, CSIRO 2015). These have been simplified to five classes following Table 2.1.

Table 2.1 Simplification of slope/relief classes used for landscape stratification in this study

Strata ID	General description	Slope/relief class
0	water bodies or lakes	0
1	level plains	11 to 14
2	gently inclined slopes	21 to 24
3	undulating hills	31 to 35
4	rolling hills to ranges	41 to 76

Topographic wetness index (TWI)

TWI is a measure of local water redistribution patterns; lower values represent drier water-shedding areas and higher values represent wetter run–on or flood out areas (CSIRO 2015). The continuous TWI data (range 4.3 to 17.5) have been simplified into in four TWI classes using natural breaks in the distribution within the NE MLR study area (Table 2.2).

Table 2.2 Simplification of topographic wetness index (TWI) values used for landscape stratification in this study

Strata ID	General description	TWI
1	dry	4 to 8
2	mid	8 to 10
3	wet	10 to 21
9	lakes	>21

Soil texture index (STI)

To differentiate functional soil types (e.g. heavy clays through to deep sands) data on the proportion of sand in the 0–15 cm, 15–30 cm, 30–60 cm, 60–100 cm soil profiles (CSIRO 2015) was used to create a continuous soil texture index (rather than many discrete soil group classifications) using the formula:

$$STI_{0–100cm} = Sand_{0–15cm} \times Sand_{15–30cm} \times Sand_{30–60cm} \times Sand_{60–100cm}$$

The index is weighted towards higher proportions of sand in uppermost soil layers which provides an ecological surrogate for increased rainfall absorption and lower runoff values from deeper sandy soils. The continuous STI data ranges between 0.02 for deep clay soils to 0.75 for deep sands in the NE MLR study area.

Soil pH (acidity/alkalinity)

The average pH of soils was calculated from pH data (CSIRO 2015) in the 0–15 cm, 15–30 cm, 30–60 cm, 60-100 cm soil profiles using the formula:

$$pH_{0–100cm} = (pH_{0–15cm} + pH_{15–30cm} + pH_{30–60cm} + pH_{60–100cm}) / 4$$

The index is slightly weighted by the pH values in the uppermost soil layers to reflect its likely influence on plant species and the typically higher proportions of plant roots in upper soil layers. The continuous Soil pH data ranges between 4.8 for acidic soils to 8.2 for alkaline soils in the NE MLR study area.

2.3.2 Climate

While other SA studies have found that several bioclimatic variables can be useful in predicting the likely distribution of ecosystems and species over large geographic areas (e.g. 11 climate variables in rangeland ecosystems, Hobbs *et al.* 2015). At smaller scales (e.g. NE MLR study area) many bioclimatic variables (e.g. Hijmans *et al.* 2005; Xu & Hutchison 2013) become highly auto correlated and redundant when used in spatial analyses. For this study, the available suite of bioclimatic variables were constrained to mean annual rainfall and mean annual temperature as previous studies indicated they often have a strongest influence on species distributions.

Mean annual rainfall (MAR)

Mean annual rainfall in the study area is 489 mm/year with a spatial range of 309–768 mm/year (ANUCLIM Version 6.1, 1976 to 2005, Xu & Hutchison 2013). The continuous mean annual rainfall data have been simplified into in 4 Rainfall classes using natural breaks in the distribution within the NE MLR study area (Table 2.3).

Table 2.3 Simplification of mean annual rainfall (MAR) values used for landscape stratification in this study

Strata ID	General description	MAR (mm/year)
3	low	301 to 400
4	low to medium	401 to 500
5	medium	501 to 600
6	high	601 to 800

Mean annual temperature (MAT)

Mean annual temperature in the study area is 15.0 °C with a spatial range of 13.4–16.5 °C (ANUCLIM Version 6.1, 1976 to 2005, Xu & Hutchison 2013).

2.3.3 Native plant cover

Two measures of native plant cover have been included in the study:

1. **Tree crown cover** based on a single very high resolution satellite image (equivalent to aerial photography)
2. **Woody vegetation cover** based on multi-year Landsat satellite cover estimates (30 m resolution)

The two measures of native plant cover are correlated, however, the woody vegetation cover data has the potential to discriminate variations in primary productivity (i.e. photosynthetic activity) which may influence vegetation community types, vegetation health and resources utilised by different bird species.

Tree crown cover

In 2015, individual native species tree crowns were mapped as polygons (i.e. 'Trees' layer) within the NE MLR study area using very high resolution satellite imagery of the study area (~10–20 cm resolution; A Hay (Flying Ant) 2016, pers. comm., 25 January). The process classified tree crowns based on multiple training points within each 1 km by 1 km image subset, converted classified raster imagery to polygons and stitched the subsets to create a complete coverage of individual trees for the study area. Tree crowns were not mapped for Kaiserstuhl Conservation Park, areas of planted vegetation cover (i.e. DEWNR VEG.PlantedVegetationCover sde) or areas identified with intensive land uses (SA Government 2015).

Within our study, the tree crown cover polygons were converted to 50 cm resolution gridded data and resampled to 5 m and 30 m grids. Gaps in the 30 m gridded Tree crown cover layer (e.g. Kaiserstuhl Conservation Park and planted Monarto Woodlands) were in–filled using locally–recalibrated (i.e. 500 m buffer) Landsat woody vegetation cover data (30 m resolution).

For landscape stratification (and later use in species distribution analyses) the mean Tree crown cover was calculated for the surrounding 4 ha (113 m radius) for each 30 m grid cell. The continuous 4 ha mean Tree cover data have been simplified into six Tree crown cover classes using natural breaks in the distribution within the NE MLR study area (Table 2.3).

Table 2.4 Simplification of tree crown cover values (local 4 ha scale) used for landscape stratification in this study

Strata ID	General description	Tree crown cover (%)
0	treeless	0 to 0.1
1	very sparse	0.1 to 5
2	sparse	5 to 15
3	low	15 to 30
4	moderate	30 to 56
5	high	56 to 100

Woody vegetation cover

Auscover (2016) has created Australia-wide estimates of persistent green cover based on annual dry season Landsat imagery from 2000 to 2010. The resulting product "Woody vegetation cover" (30 m resolution) provides a surrogate for native vegetation mapping but also provides estimates of foliage-projected cover (Auscover 2016, Gill *et al.* 2017) that can provide indicators of primary productivity, vegetation community types, vegetation health and species preferences. For species distribution analyses the mean Woody vegetation cover was calculated for the surrounding 4 ha (113 m radius) for each 30 m grid cell.

2.3.4 Environmental data and derivatives

For continuous environmental data further spatial statistical analyses were conducted to create environmental derivatives that may influence the distribution of priority bird species (e.g. spatial variability in productivity and vegetation cover, patchiness). These derivatives included mean and standard deviation values using 30 m resolution gridded data for continuous environmental variables at different scales (i.e. local 4 ha=113 m radius, landscape=500 m radius).

2.4 Landscape stratification

Each gridded class coverage of Landforms, Rainfall, Topographic wetness and Tree crown cover were converted to polygons and these polygon layers intersected to identify patches of common landscape stratifications across the four classes (total of 265 landscape stratification classes). Areas identified as containing non-native planted cover (e.g. vines, orchards, pines; DEWNR VEG.PlantedVegetationCover sde) or intensive land uses (e.g. irrigated areas, industrial uses; DEWNR LANDSCAPE.LandUse2008 sde, SA Government 2015) were masked from further analyses.

In early 2016, recent bird records (i.e. last 10 years, 2006–15) were extracted from the consolidated bird database and intersected with landscape stratification patches (i.e. polygons). Only the most recent occurrence records were used to represent extant populations and recent survey efforts. Within each individual patch all bird records were simplified to a single occurrence of species by each of the 10 years (i.e. species x year x patch) to reduce survey intensity bias (i.e. repeated visits to the same site, or nearby sites with similar environmental attributes, within 1 year). For each patch these species by year records were summed for the 10 years period as an indicator of local survey intensity. For each unique landscape stratification class (i.e. Landform x Rainfall x Topographic wetness x Tree crown cover) the total area of patches and total number of unique species by year per patch records within each landscape stratification class were calculated. The ratio of *Total number of records : Total area for each landscape stratification class* is an indicator of the degree of equality in representativeness of surveys efforts in the region. Landscape stratification classes with a total patch area of <100 ha were considered to be uncommon combinations of environments and were given the lowest priority for new surveys in this study.

2.5 New site selection

2.5.1 Area-weighted representativeness of survey effort

The total number of species by patch by year records across 2006–15 for each landscape stratification class were simplified to "Survey site–equivalent" based on an approximation of a total of 30 records for a survey site with 2 repeated visits (i.e. 15 records per visit). The Survey site–equivalent values were calculated for each landscape stratification class. Excluding areas and records for non–native woody vegetation or intensive land uses, this equates to a total area of ~271 300 hectares with 370 survey site–equivalents in 2006–15. With the proposed addition of 100 new survey sites in 2016 this equates to a survey site to area (ha) ratio of *1:577*.

For each landscape stratification class the difference between 2006–15 Survey site–equivalents and an optimal post-2016 Survey site equivalent (i.e. balanced area-weighted representation, 1 survey site per 577 ha) was used to identify deficits (i.e. under-surveyed) or excesses in survey efforts (i.e. over-surveyed). The range of over- and under-surveyed site-equivalents was indexed (0–1) to highlight strata requiring new surveys. The proposed 100 new survey sites were proportionally allocated to under–surveyed landscape strata to increase the area–weighted representativeness of bird survey data.

2.5.2 Optimisation of stratified survey site selections

To optimise survey site selection the mean ($\bar{x}$) and standard deviation (SD) values of each strata class within the continuous datasets (i.e. Rainfall, Topographic wetness index, Tree crown cover) were calculated to help identify locations within central range of each individual strata class (i.e. $\bar{x}\pm0.5$ SD). The central range was given an optimal

score of 1 and locations outside of this central range were assigned a score of 0.5. Local scale uniformity in Tree crown cover values were estimated by dividing the 4ha mean Tree crown cover value by standard deviation over the 4 ha area (i.e. lower values represent most locally–uniform cover). Uniformity estimates were converted to optimisation scores (Table 2.5). Each gridded sub–strata priority class coverage of Rainfall, Topographic wetness, Tree crown cover and Uniformity of cover were converted to polygons.

Table 2.5 Classes of uniformity of tree crown cover values used for survey patch selection in this study

Strata ID	General description	Uniformity estimate	Optimisation score
0	very high	0	1.0
1	high	0 to 0.1	0.9
2	medium	0.1 to 0.2	0.8
3	medium–low	0.2 to 0.3	0.7
4	low	0.3 to 0.4	0.6
5	very low	0.4 to 0.5	0.5
6	exclude	>0.5	0

These optimisation polygon layers, plus the landform class polygon, were intersected. The product of optimisation scores for Rainfall, Topographic wetness index, Tree crown cover and Uniformity of cover were calculated for each polygon patch. All patches with an optimal product value of <0.4 (i.e. unsatisfactory for surveys) were excluded.

The potential landscape survey patch layer was intersected by land tenure parcels data (i.e. DEWNR DCDB.PARCEL sde) to identify landscape patches managed by single landholder. The size of each optimal landscape patch within a single land tenure was calculated. Parcel IDs were annotated to each patch to permit later discovery of land holder identity and contact information for site access.

The average point density of all bird species records (2006–15) within 1 km radius (observations/km²) was used to identify geographic areas devoid of recent bird observations (i.e. 90 m gridded density data). An Unsurveyed Index (i.e. 1-(Ln(Point Density+1)/4.61512)) was created to strongly avoid areas with a high number of records and prioritise surveys in lightly–surveyed areas (Figure 3.5).

Targeted optimal locations for new survey sites were identified by filtering the potential landscape survey patch–parcel layer (i.e. potential survey patches by Parcel IDs) for each under-surveyed landscape strata. The Unsurveyed Index value was annotated for each patch–parcel using the patch–parcel centroid. The landscape survey patch optimisation value was multiplied by the Unsurveyed index value to identify the highest priority patches for new surveys. Within each under–surveyed stratum each patch–parcel was ranked according to the product of optimisation scores and largest patch–parcel size.

Potential survey patch–parcels were selected with highest combined rank, and duplicates within a single Parcel ID and stratum were ignored. The priority of each patch–parcel within each stratum was noted, and selections continued until 2x the number of required survey sites per strata (3x for single survey strata) were recorded. If primary sites (i.e. most highly ranked with each stratum) could not be accessed, these alternate secondary sites allowed for substitution of sites. The centre of each potential polygon patch–parcel was located and converted to potential survey point for use in Global Positioning System (GPS) navigation.

2.6 New bird surveys

Potential stratified survey sites were inspected using DEWNR satellite image data and/or online Google Maps (https://www.google.com.au/maps/) to verify site selections, vegetation cover and accessibility. SA Government property title searches (https://www.sailis.sa.gov.au/) and local knowledge was used to identify landholders and to seek permission to access potential survey sites.

Autumn and spring periods of 2016 were identified for surveys of 100 stratified survey sites (i.e. one visit in each season). Bird surveys were conducted by experienced bird observers with local knowledge and experience of birds of the Mount Lofty Ranges. Global Positioning System (GPS) devices were used to accurately locate survey sites. At each site and visit a standard "20 minute/ 2 hectare area search" (i.e. Birdlife Australia, 80 m radius; Loyn 1986) was conducted, the presence of all bird species was recorded (i.e. presence-only data). Supplementary observations of weather conditions and vegetation types were also noted. Opportune observations were also made on approach and departure from each site, and during travel between sites. After preliminary analysis of potential habitats for priority bird species following the autumn 2016 surveys, additional "targeted opportune" sites were visited in spring 2016. Many of these targeted opportune sites were located in the north-eastern corner of the study area in environments with a higher likelihood of containing priority bird species and with few prior bird observations.

All observations were recorded on standardised datasheets prior to data entry into the DEWNR NR SAMDB Vertebrate Database (i.e. Microsoft Access) and then transferred to DEWNR's corporate Biological Databases of South Australia (BDBSA; DEWNR 2016).

2.7 Species distributions

An important characteristic of reliable analyses of species distributions and their responses to environmental variables is to reduce data biases resulting from temporal and spatial variability in sampling intensity. For this study care has been taken to reduce duplicates in time and space and to adopt appropriate analytical methods.

Java-based MaxEnt software (version 3.3.3k; Phillips *et al.* 2006, Phillips 2015) was used to evaluate relationships between each priority bird species and several environmental variables (and their interactions), identify the most efficient (i.e. maximum entropy) model, and produce a spatial map of the likelihood of occurrence for each species. MaxEnt models were run using a consistent set of environmental variables across all species. MaxEnt software includes algorithms to reduce the influence of correlated environmental variables.

Species distribution analyses were conducted on the seven targeted high priority bird species ("level 1") from the region (Table 2.6). Supplementary analyses were also conducted on 14 additional bird species identified by Rogers (2011) as having a priority for conservation management within the broader Mount Lofty Ranges region (i.e. medium priority, "level 2"). Records for these analyses were constrained to all priority species for the period 2000 to 2016, with a locational accuracy of <500m. Earlier bird records were not used for species distribution models as the locational accuracy of bird records prior to 2000 are lower due the lack of Global Positioning System (GPS) devices, and the historic reliance on hard-copy maps, by bird observers of that era. All duplicate individual species by point location records were removed to reduce bias in analyses.

Each MaxEnt logistic models included each individual species' observations plus 10000 randomly-selected background training points. Duplicate presence records within each 90m grid cell were removed by MaxEnt to further reduce model bias. The maximum number of model iterations for algorithm convergence was set at 5000. Measures of variable importance (i.e. percent contribution and permutation importance) were calculated using a jack-knife method (Phillips *et al.* 2006, Phillips 2015). MaxEnt's proportional area under the curve (AUC) statistics were calculated for each model as a measure of model strength (i.e. higher value=better model).

Table 2.6 Priority bird species analysed for potential distribution and responses to environment in the north-eastern Mount Lofty Ranges

High priority (level 1)	Medium priority (level 2)	
Brown Treecreeper	Australian Owlet-nightjar	Rufous Songlark
Chestnut-rumped Thornbill	Black-chinned Honeyeater	Sacred Kingfisher
Diamond Firetail	Brown Songlark	Varied Sittella
Hooded Robin	Crested Shriketit	White-browed Babbler
Jacky Winter	Elegant Parrot	White-winged Chough
Restless Flycatcher	Peaceful Dove	White-winged Triller
Southern Whiteface	Rainbow Bee-eater	Zebra Finch

3 Results

3.1 Stratification of landscapes for bird surveys

The spatial distribution of the four bird survey stratification classes (i.e. of Landforms, Rainfall, Topographic wetness, Tree crown cover) are presented in Figure 3.1 to Figure 3.4. The intersection of the four stratification class layers (and excluding areas containing vines, orchards or pines) resulted in 265 landscape strata. Approximately one-third of the strata represent very small landscape components (i.e. 111 strata, <100 ha in size) of the north-eastern Mount Lofty Ranges region. The largest landscape components (i.e. >10000 ha in size) consist of undulating hills (and a few ranges) with low–medium to medium rainfall and very sparse tree cover or virtually no tree cover.

Analyses of area-weighted representativeness of all bird species data recorded between 2006 and 2015 (Figure 3.5) across Landform, Rainfall and Tree crown cover classes (Table 3.1), and in finer landscape detail (i.e. topographic wetness, Table 3.2), show the allocations of new "stratified survey sites" for under-surveyed landscape strata. These new stratified survey sites were located to avoid landscapes with high densities of existing bird records (i.e. Unsurveyed Index, Figure 3.5). No new sites were allocated to "Treeless" (i.e. <0.1% tree crown cover) strata as they provide few opportunities for priority woodland species. Biases in previous bird records were clearly evident from the 2006 to 2015 dataset (i.e. most records occur with higher rainfall areas with higher tree cover). Most new survey sites (78%) were allocated to landscapes containing undulating hills, with 53% of all sites allocated to the "Very Sparse" tree crown cover class (0.1 to 5% cover) and 43% of all sites allocated to the "Sparse" tree crown cover class (5 to 15% cover).

Table 3.1. Landform x Rainfall x Tree crown cover strata in the north-eastern Mount Lofty Ranges, and targeted new survey sites based on area-weighted representativeness of all bird species records during 2006–15

Strata[1]			**Tree crown cover (%) class / New sites**					
Landform class	**Rainfall class (mm/year)**	**Total new sites**	Treeless (0–0.1)	Very Sparse (0.1–5)	Sparse (5–15)	Low (15–30)	Mod-erate (30–56)	High (56–100)
Level plains	Low (301–400)							
	Low–medium (401–500)							
	Medium (501–600)							
	High (601–800)							
Gently inclined slopes	Low (301–400)	***5***		4	1			
	Low–medium (401–500)	***3***		1	2			
	Medium (501–600)	***3***		1	2			
	High (601–800)	***2***			2			
Undulating hills	Low (301–400)	***2***		2				
	Low–medium (401–500)	***11***		11				
	Medium (501–600)	***38***		21	17			
	High (601–800)	***27***		9	12	5	1	
Rolling hills to ranges	Low (301–400)	***1***			1			
	Low–medium (401–500)	***1***		1				
	Medium (501–600)	***3***		1	2			
	High (601–800)	***4***		2	2			
Total		**100**	**0**	**53**	**41**	**5**	**1**	**0**

[1] A finer level of stratification using topographic wetness classes are presented in Table 3.2

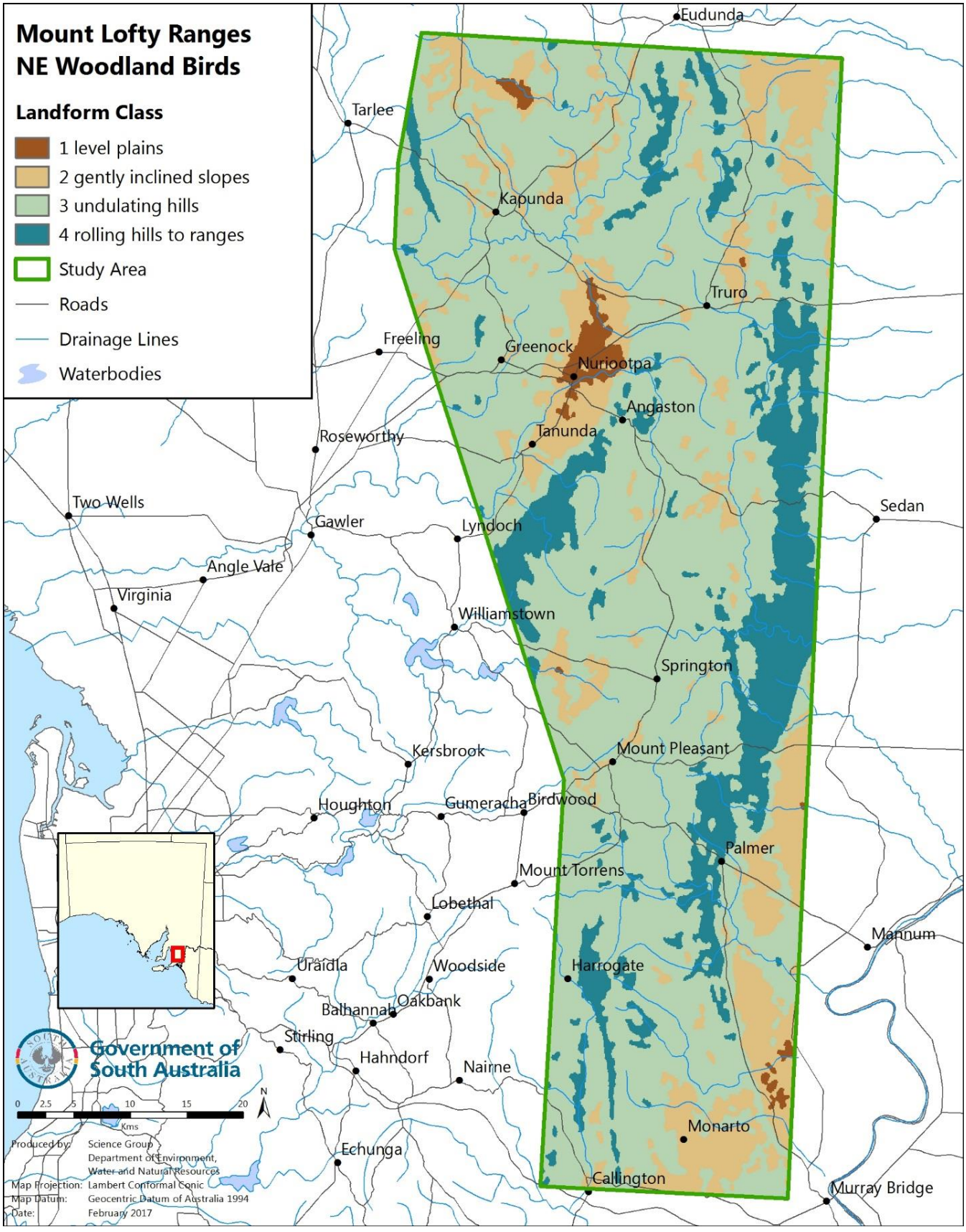
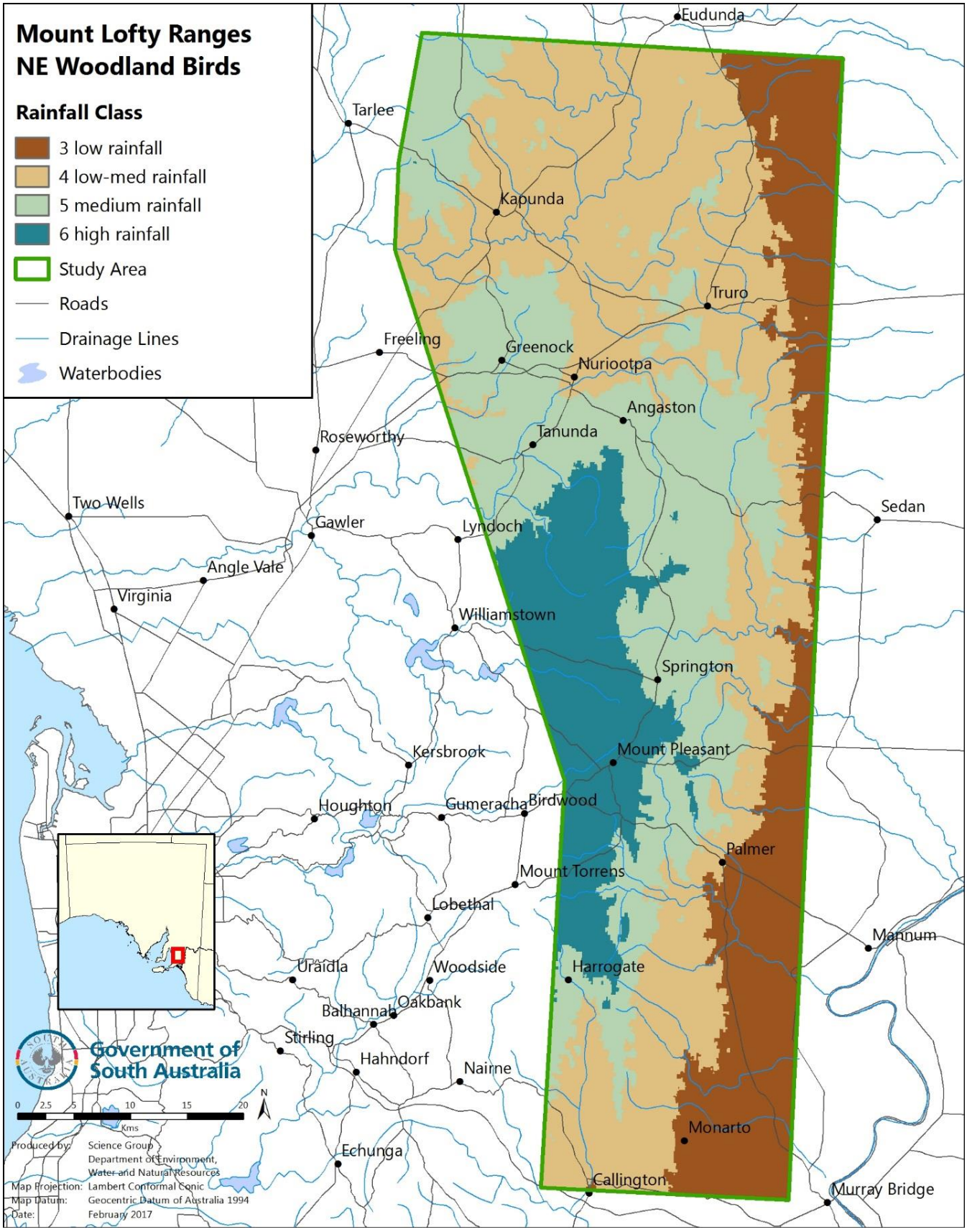
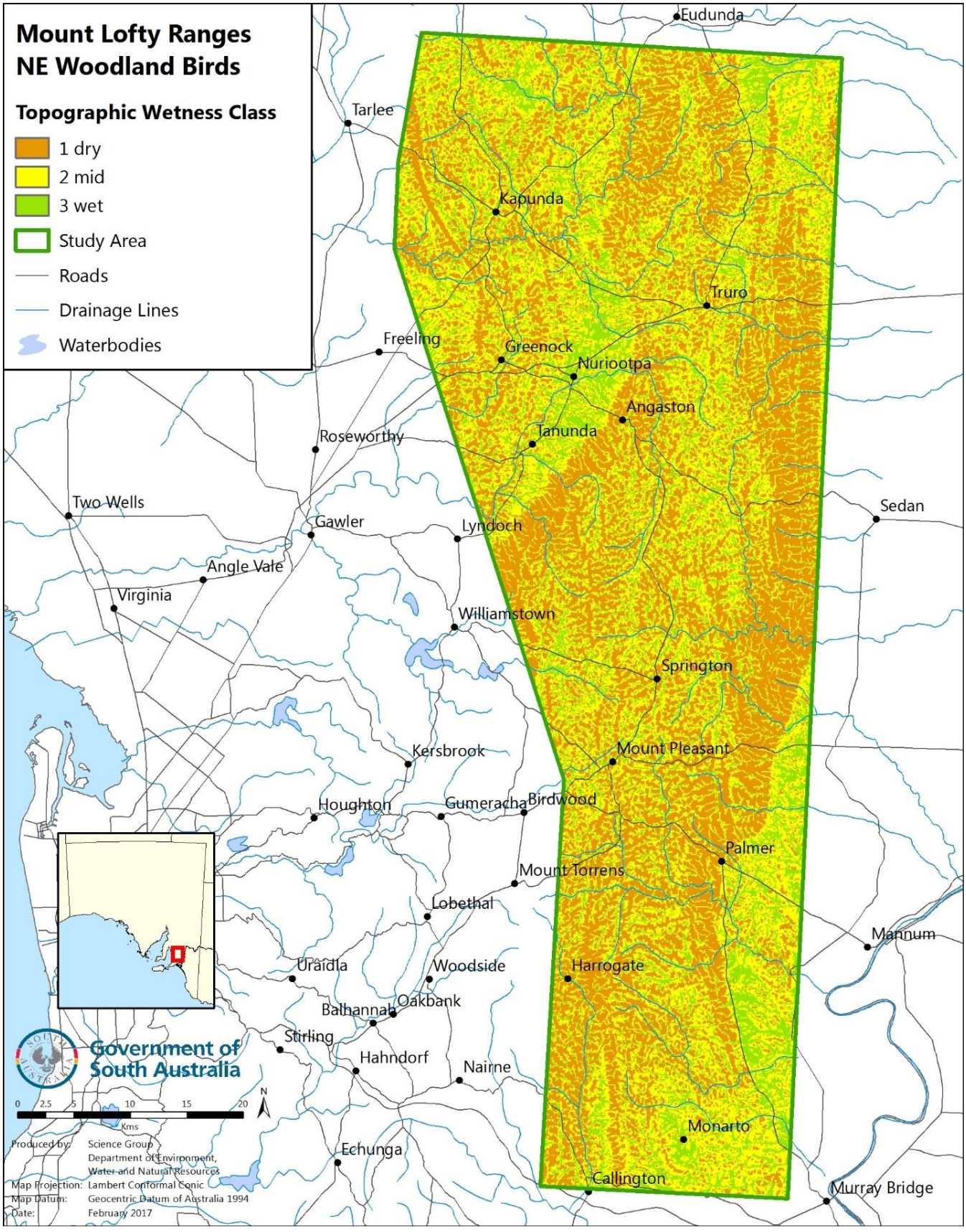


Figure 3.1. Landscape stratification using DEM landform classifications in the north-eastern Mount Lofty Ranges



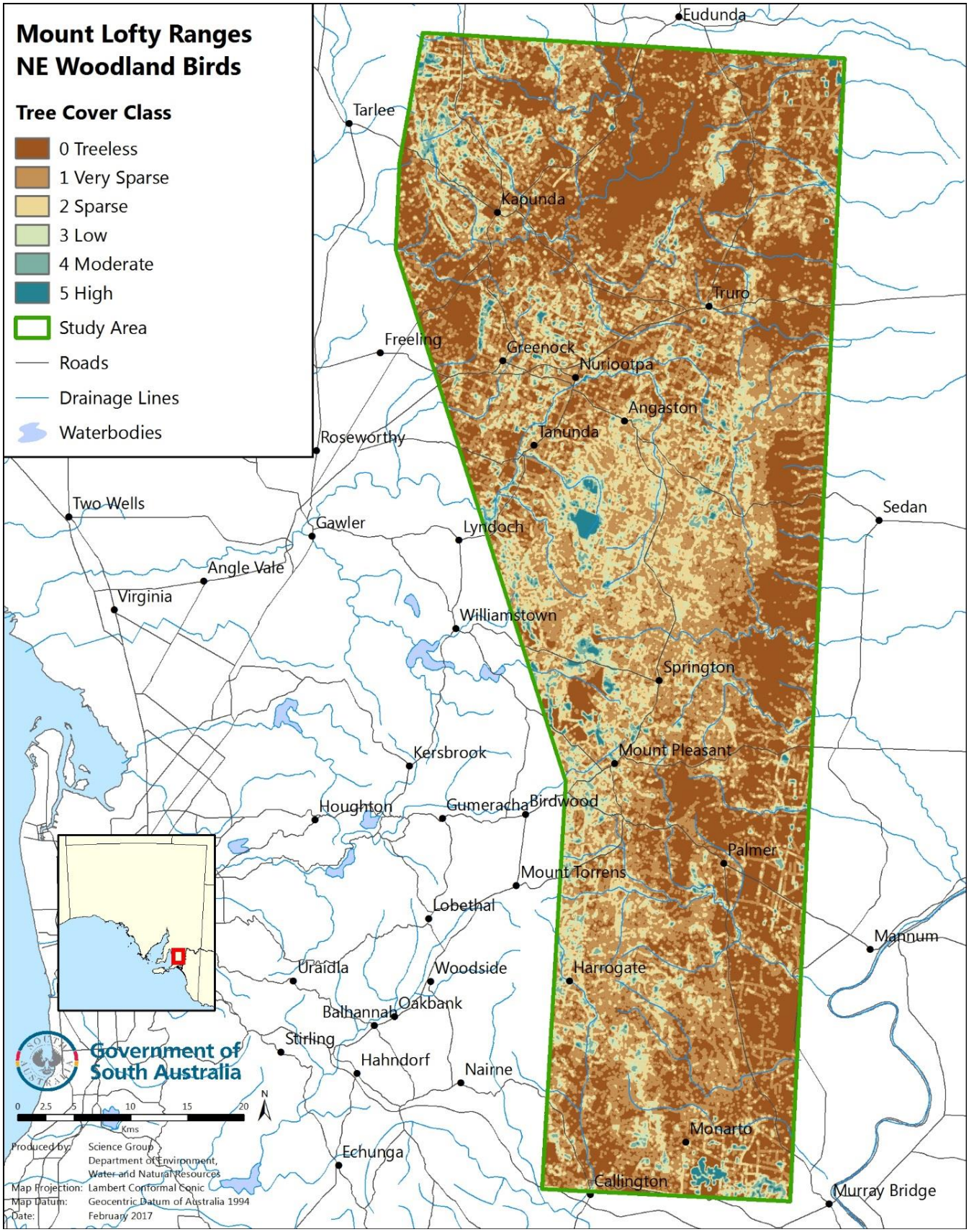
Mean annual rainfall (mm/year): low=301–400; low to medium=401–500; medium=501–600; high=601–800.

Figure 3.2. Landscape stratification using mean annual rainfall in the north-eastern Mount Lofty Ranges



Topographic wetness index: dry=4–8; mid=8–10; wet=10–21; lakes>21.

Figure 3.3. Landscape stratification using DEM topographic wetness index in the north-eastern Mount Lofty Ranges



Mean tree crown cover (%): treeless=0–0.1; very sparse=0.1–5; sparse=5–15; low=15–30; moderate=30–56; high=56–100.

Figure 3.4. Landscape stratification using tree crown cover mapping in the north-eastern Mount Lofty Ranges

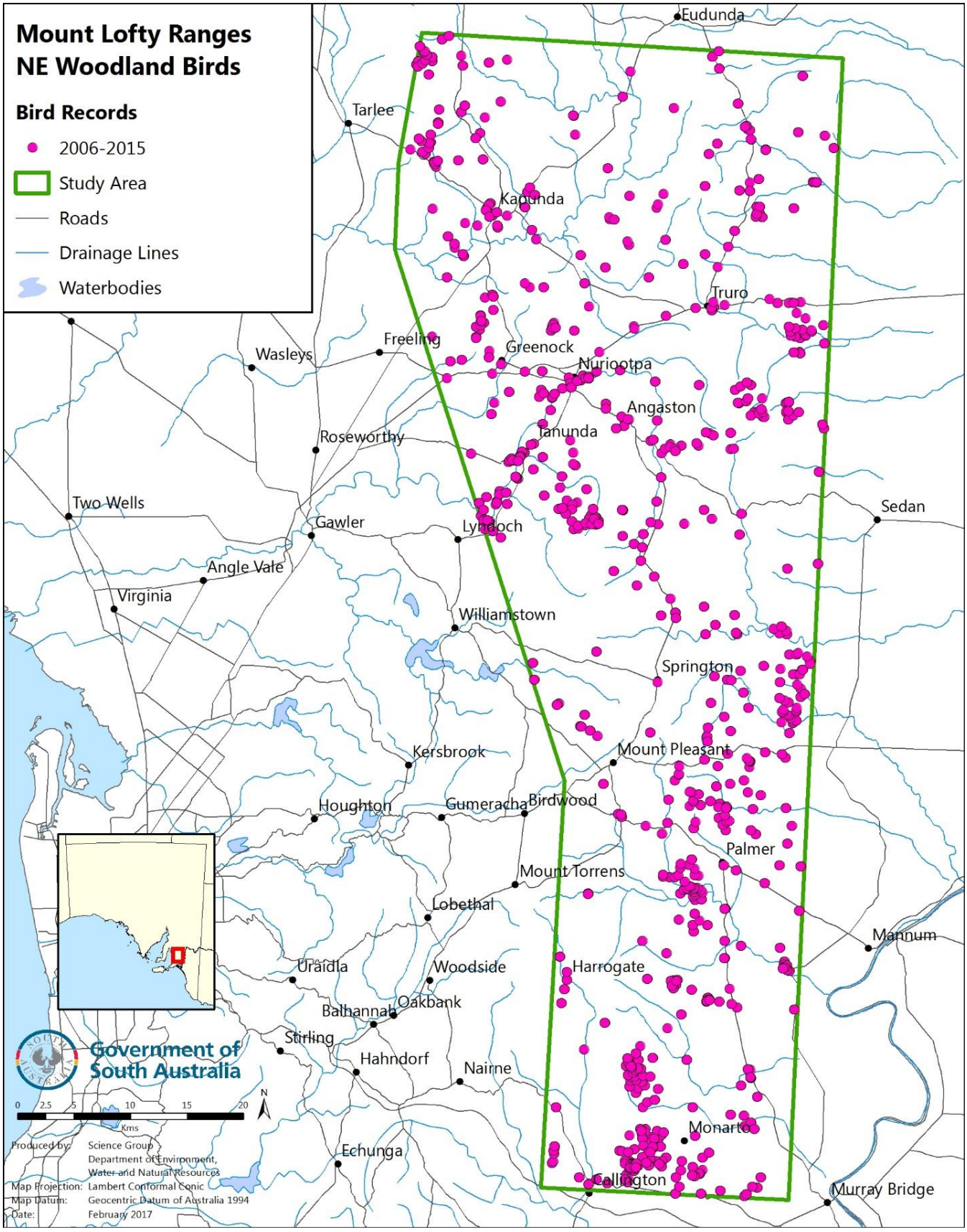


Figure 3.5. Bird record density for the 2006–2015 period in the north-eastern Mount Lofty Ranges

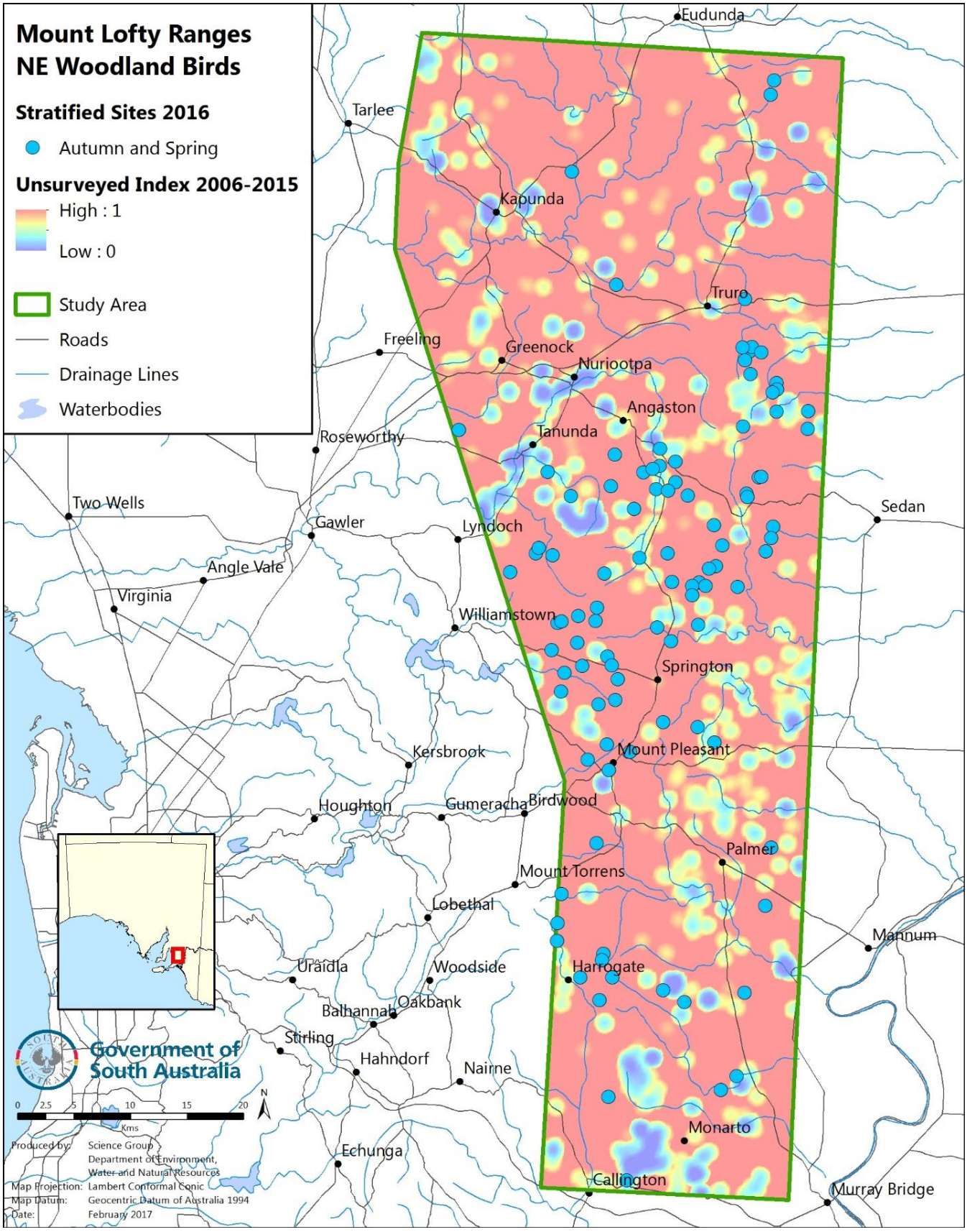


Figure 3.6. Landscapes with few bird records (red areas) from surveys or observations during 2006–2015, and DEWNR SIG 2016 stratified bird survey sites in the north-eastern Mount Lofty Ranges

Table 3.2. Summary of area, patch–by–year (2006–15) bird record density and under–surveyed environmental strata in the north-eastern Mount Lofty Ranges

					Tree crown cover class															
					0 Treeless	1 Very Sparse			2 Sparse			3 Low			4 Moderate			5 High		
Landform class	Rainfall class	Wetness class	Area (ha)	New Sites	Excluded area (ha)	Area (ha)	Under–surveyed	New sites	Area (ha)	Under–surveyed	New sites	Area (ha)	Under–surveyed	New sites	Area (ha)	Under–surveyed	New sites	Area (ha)	Under–surveyed	New sites
1 level plains	3 low	1 dry	4		*4*	<1	0.03													
		2 mid	220		*120*	85	0.47		10	0.25		2	0.11		2	0.12		<1	0.03	
		3 wet	347		*209*	122	0.51		6	0.21		4	0.17		4	0.17		2	0.12	
	4 low–med	1 dry	33		*3*	8	0.23		10	0.25		9	0.24		4	0.16				
		2 mid	580		*155*	136	0.52		142	0.52		100	0.44		42	0.38		5	0.13	
		3 wet	1149		*441*	285	0.58		234	0.57		133	0.48		48	0.41		9	0.24	
	5 medium	2 mid	13		*3*	6	0.21		2	0.12		1	0.09		<1	0.00				
		3 wet	22		*3*	13	0.28		5	0.18		2	0.11		<1	0.01				
	6 high	2 mid	4		*<1*	1	0.07		<1	0.04		1	0.07		2	0.10				
		3 wet	31		*2*	6	0.21		14	0.28		8	0.23		1	0.07				
2 gently inclined slopes	3 low	1 dry	1753		*688*	715	0.69		227	0.57		84	0.45		31	0.36		9	0.08	
		2 mid	11027	**3**	*5095*	4151	0.88	2	1098	0.73	1	392	0.62		212	0.55		80	0.46	
		3 wet	8943	**2**	*4458*	3245	0.85	2	808	0.69		274	0.58		118	0.50		39	0.29	
	4 low–med	1 dry	1395	**1**	*490*	511	0.65		252	0.58	1	107	0.49		32	0.37		3	0.14	
		2 mid	6276	**2**	*2714*	2410	0.82	1	831	0.70	1	242	0.57		73	0.45		6	0.19	
		3 wet	4968		*2004*	1908	0.79		731	0.68		238	0.57		76	0.45		11	0.26	
	5 medium	1 dry	764	**1**	*115*	270	0.59		254	0.58	1	93	0.47		30	0.36		2	0.11	
		2 mid	3120	**2**	*713*	1147	0.74	1	846	0.71	1	304	0.58		100	0.47		10	0.25	
		3 wet	2142		*333*	824	0.70		648	0.67		248	0.57		80	0.46		10	0.25	
	6 high	1 dry	238		*7*	43	0.40		108	0.49		48	0.41		25	0.34		7	0.22	
		2 mid	950	**1**	*31*	224	0.57		376	0.62	1	211	0.56		83	0.47		26	0.35	
		3 wet	746	**1**	*21*	226	0.57		287	0.60	1	156	0.53		45	0.40		12	0.27	
3 undulating hills	3 low	1 dry	7859		*3191*	3184	0.85		1045	0.72		276	0.58		119	0.49		45	0.40	
		2 mid	11439	**1**	*5016*	4502	0.88	1	1269	0.75		379	0.60		206	0.54		68	0.43	
		3 wet	4062	**1**	*1494*	1732	0.78	1	575	0.66		167	0.52		74	0.37		19	0.32	
	4 low–med	1 dry	32189	**3**	*13301*	12361	0.99	3	4467	0.88		1605	0.76		421	0.62		34	0.37	
		2 mid	32028	**7**	*12832*	13203	1.00	7	4327	0.87		1325	0.75		314	0.58		27	0.35	
		3 wet	11039	**1**	*3315*	4837	0.89	1	2049	0.79		664	0.65		163	0.52		11	0.26	
	5 medium	1 dry	28959	**16**	*5416*	12132	0.99	9	7370	0.94	7	2709	0.82		1109	0.72		223	0.56	
		2 mid	26125	**18**	*5003*	11282	0.98	10	6916	0.93	8	2037	0.79		747	0.66		141	0.46	
		3 wet	7977	**4**	*913*	3164	0.85	2	2720	0.83	2	890	0.70		259	0.54		32	0.34	
	6 high	1 dry	13004	**12**	*931*	5104	0.90	5	4179	0.88	5	1698	0.78	1	687	0.69	1	405	0.61	
		2 mid	9783	**11**	*482*	3533	0.86	3	3302	0.85	5	1560	0.77	3	613	0.67		292	0.52	
		3 wet	2983	**4**	*114*	948	0.72	1	1063	0.73	2	585	0.67	1	173	0.53		101	0.40	
4 rolling hills to ranges	3 low	1 dry	4739	**1**	*2529*	1652	0.78		418	0.64	1	103	0.49		30	0.36		7	0.22	
		2 mid	1133		*423*	511	0.65		151	0.53		30	0.32		14	0.28		3	0.16	
		3 wet	404		*61*	177	0.54		133	0.50		24	0.34		8	0.23		<1	0.03	
	4 low–med	1 dry	16108	**1**	*10046*	4623	0.89	1	1005	0.72		329	0.61		92	0.46		14	0.24	
		2 mid	3696		*1718*	1481	0.76		384	0.62		92	0.48		20	0.32		1	0.06	
		3 wet	940		*232*	434	0.64		215	0.53		43	0.40		16	0.30				
	5 medium	1 dry	5524	**3**	*1767*	2049	0.80	1	1084	0.74	2	438	0.64		159	0.49		27	0.32	
		2 mid	1230		*247*	490	0.64		320	0.61		124	0.51		48	0.41		2	0.10	
		3 wet	202		*15*	56	0.42		65	0.44		54	0.38		12	0.27				
	6 high	1 dry	4234	**3**	*303*	1630	0.78	2	1317	0.75	1	573	0.66		311	0.58		100	0.49	
		2 mid	822	**1**	*22*	229	0.57		325	0.61	1	196	0.54		45	0.36		4	0.17	
		3 wet	125		*<1*	22	0.33		48	0.41		46	0.40		7	0.22		1	0.09	
Total			271331	**100**	*86979*	105672		53	51633		41	18608		5	6653		1	1786		0

3.2 DEWNR Science and Information Group (SIG) bird surveys 2016

DEWNR SIG 2016 surveys of 100 new stratified sites and opportunistic sites (Figure 3.7) were conducted in late autumn (5/05/2016–25/06/2016) and spring (26/09/2016–27/10/2016). Over 6000 observations were made (Table 3.3, Table 3.5), including all seven targeted high priority species (level 1, Figure 3.8) and 11 of the 14 medium priority species (level 2, Figure 5.1). One-third of all observations (i.e. 2142 of 6133 records) occurred on stratified survey sites with an autumn to spring ratio of *44:56*. The total number of spring observations (i.e. stratified + opportune) was more than double of those recorded in autumn, this is partially attributed to many targeted opportune surveys being located in more productive landscapes with medium to higher plant cover values in the north–east of the study area.

A total of 137 species were encountered across DEWNR SIG 2016 surveys (Table 3.3, Table 3.5), including 131 native species and 6 non-native species. The total number of high priority species observed on stratified sites during autumn and spring periods were similar (i.e. 36 cf. 37).

Table 3.3. Summary of bird species recorded during DEWNR SIG 2016 bird surveys in the north-eastern Mount Lofty Ranges

	Autumn survey records			**Spring survey records**				
Bird species	Strati-fied	Oppor-tune	*Sub-total*	Strati-fied	Oppor-tune	*Sub-total*	**Total records**	**Total species**
High priority (level 1)	36	55	*91*	37	201	*238*	**329**	**7**
Medium priority (level 2)	8	27	*35*	29	213	242	**277**	**11**
Low priority	872	931	*1803*	1080	2390	3470	**5273**	**113**
Non-native	24	31	*55*	56	143	*199*	**254**	**6**
Total	**940**	**1044**	***1984***	**1202**	**2947**	***4149***	**6133**	**137**

3.3 All bird data

The Consolidated Dataset (i.e. "Birds_All", combination of BDBSA, Bird Atlas, DEWNR NR AMLR & SAMDB projects, Graham Carpenter and DEWNR SIG 2016 data) resulted in over 147000 unique bird records (Table 3.4, Table 5.1) with 87.2% of these records occurring between 2000 and 2016. For the 2000 to 2016 period, 9446 observations (7.4%) were made of high priority species (level 1) and 8104 (6.3%) for medium priority species (level 2) with 103158 (80%) other native species and 7566 (5.9%) non-native species records. The density of these 2000 to 2016 records is not uniform across the MLR NE study area (Figure 3.9) with some localised areas (e.g. west of Monarto) having a very high number of records.

Table 3.4. Summary of all bird species recorded in the north-eastern Mount Lofty Ranges (consolidated dataset)

	Consolidated dataset records		**Total records**	**Total species**
Bird species	pre-2000	2000–16		
High priority (level 1)	724	9446	10170	7
Medium priority (level 2)	901	8104	9005	14
Low priority	15455	103158	118613	217
Non-native	1770	7566	9336	11
Total	**18850**	**128274**	**147124**	**249**

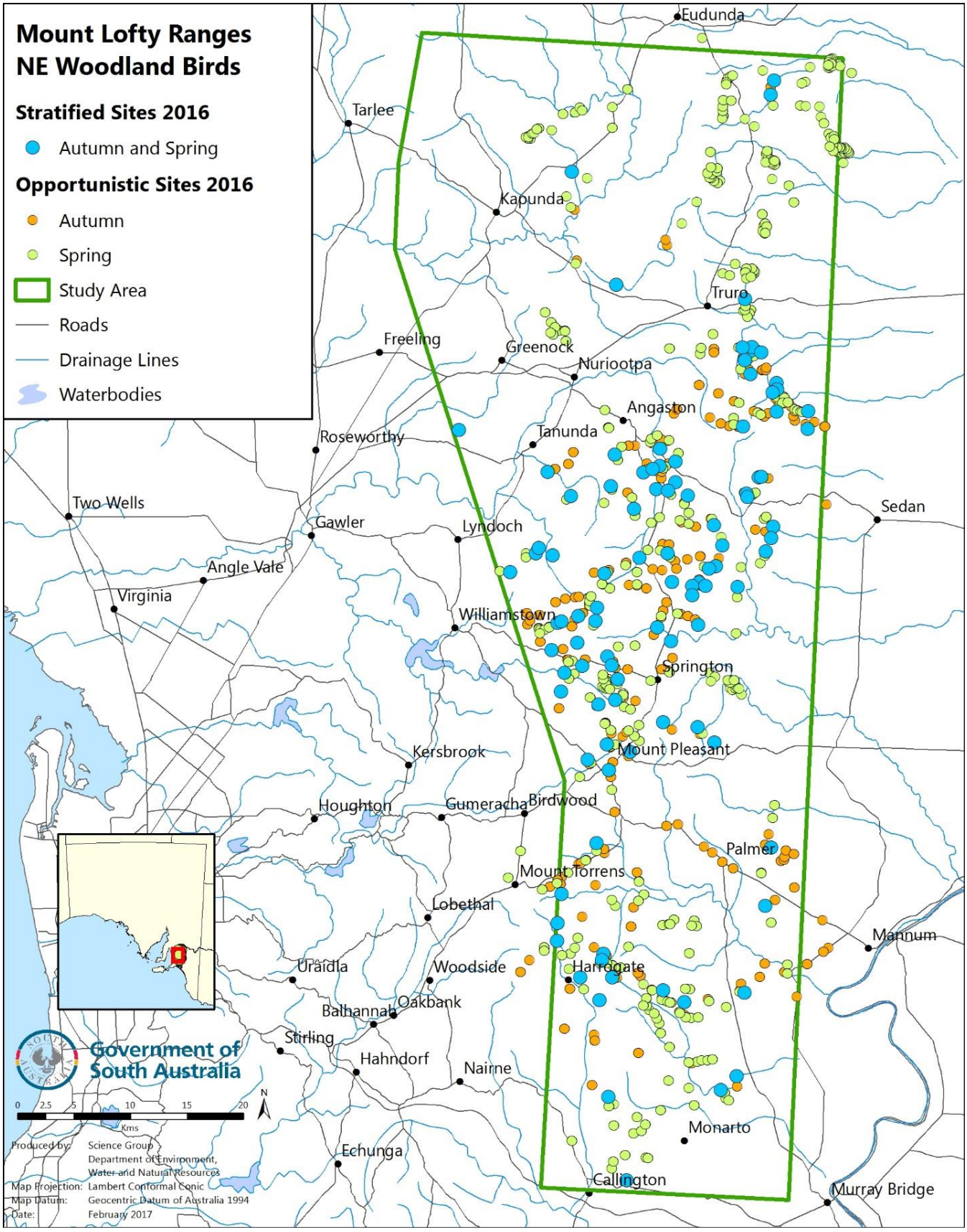


Figure 3.7. DEWNR SIG 2016 bird survey sites in the north-eastern Mount Lofty Ranges

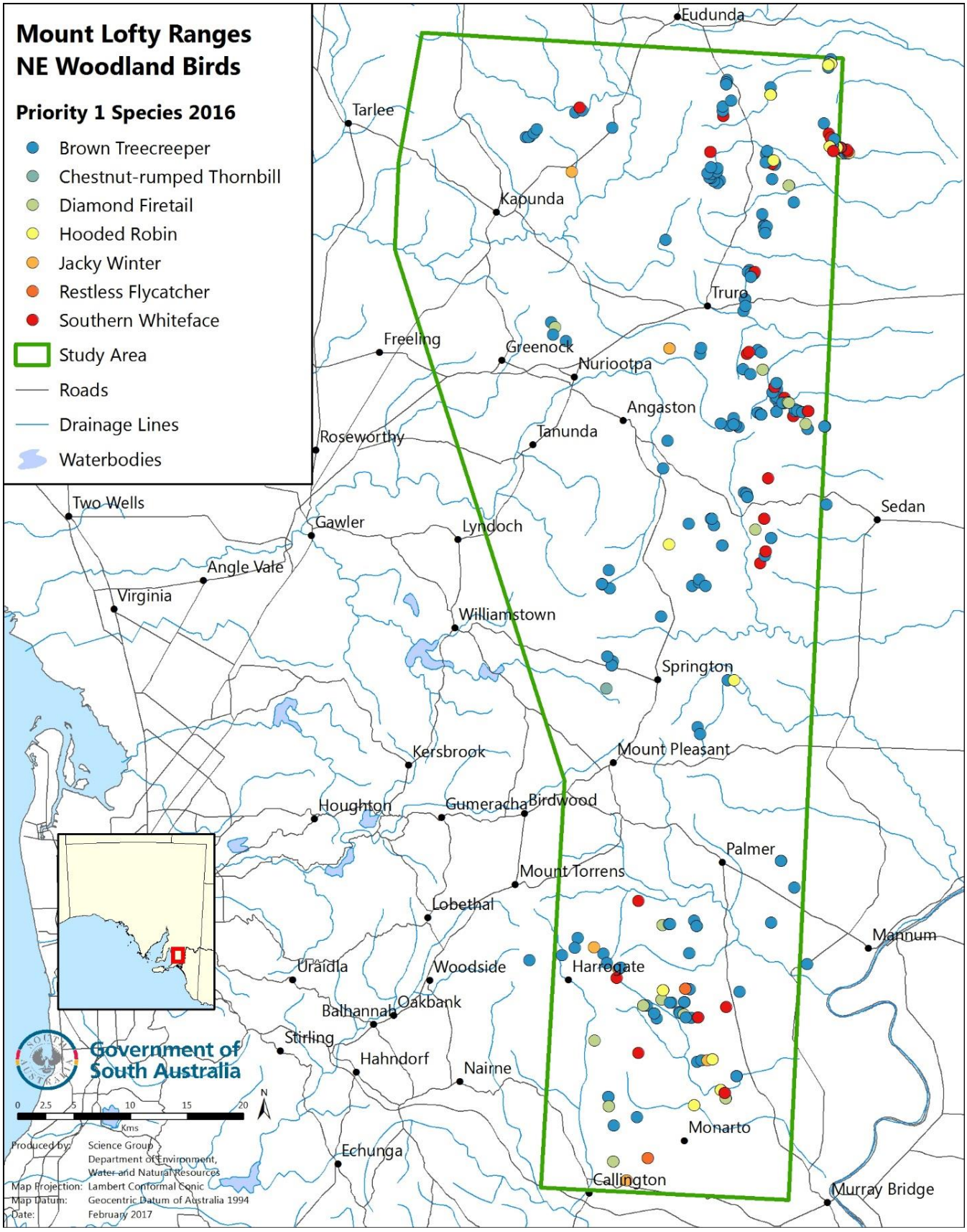


Figure 3.8. High priority species (level 1) observations (DEWNR SIG 2016 surveys) in the north-eastern Mount Lofty Ranges

Table 3.5. Bird species recorded during DEWNR SIG 2016 bird surveys in the north-eastern Mount Lofty Ranges

	Autumn survey records			Spring survey records			
Bird species	Strati-fied	Oppor-tune	*Sub-total*	Strati-fied	Oppor-tune	*Sub-total*	**Total records**
High priority (7 species)	**36**	**55**	***91***	**37**	**201**	***238***	**329**
Brown Treecreeper	20	35	*55*	24	129	*153*	***208***
Chestnut-rumped Thornbill					3	*3*	***3***
Diamond Firetail	3	9	*12*	2	15	*17*	***29***
Hooded Robin	4	2	*6*	4	19	*23*	***29***
Jacky Winter	3	2	*5*	1	4	*5*	***10***
Restless Flycatcher		1	*1*		2	*2*	***3***
Southern Whiteface	6	6	*12*	6	29	*35*	***47***
Other native (124 species)	**880**	**958**	***1838***	**1109**	**2603**	***3712***	**5550**
Australasian Grebe	1	7	*8*	3	6	*9*	***17***
Australasian Shoveler		1	*1*		2	*2*	***3***
Australian Golden Whistler		2	*2*				***2***
Australian Magpie	84	86	*170*	93	151	*244*	***414***
Australian Owlet-nightjar[2]		1	*1*		1	*1*	***2***
Australian Pelican	1		*1*		1	*1*	***2***
Australian Pipit	5	2	*7*	4	23	*27*	***34***
Australian Raven	3	1	*4*	1	3	*4*	***8***
Australian Reed Warbler	1		*1*	11	15	*26*	***27***
Australian Ringneck	2	5	*7*	4	20	*24*	***31***
Australian Shelduck	3	5	*8*	5	10	*15*	***23***
Australian White Ibis				1		*1*	***1***
Banded Lapwing	1		*1*				***1***
Black Kite				1	1	*2*	***2***
Black-faced Cuckooshrike	9	4	*13*	12	41	*53*	***66***
Black-faced Woodswallow	1	3	*4*		1	*1*	***5***
Black-fronted Dotterel	2	1	*3*		1	*1*	***4***
Black-shouldered Kite				2	2	*4*	***4***
Blue-billed Duck		1	*1*		6	*6*	***7***
Brown Falcon	1	5	*6*	2	21	*23*	***29***
Brown Goshawk	2		*2*	5	4	*9*	***11***
Brown Songlark[2]				1	1	*2*	***2***
Brown Thornbill				1	4	*5*	***5***
Brown-headed Honeyeater	7	7	*14*	4	12	*16*	***30***
Buff-rumped Thornbill	5	2	*7*	6	18	*24*	***31***
Chestnut Teal					1	*1*	***1***
Collared Sparrowhawk	1	1	*2*		6	*6*	***8***
Common Bronzewing	5	3	*8*	9	16	*25*	***33***
Crescent Honeyeater	3	8	*11*	2	20	*22*	***33***
Crested Pigeon	11	8	*19*	11	19	*30*	***49***
Crimson Rosella	80	63	*143*	85	181	*266*	***409***
Dusky Moorhen		2	*2*		2	*2*	***4***
Dusky Woodswallow		2	*2*	2	26	*28*	***30***
Eastern Barn Owl					1	*1*	***1***
Eastern Spinebill	3	7	*10*	3	4	*7*	***17***
Elegant Parrot[2]					5	*5*	***5***
Emu	1	3	*4*	2		*2*	***6***
Eurasian Coot	2	12	*14*	2	12	*14*	***28***
Fairy Martin	1		*1*	1		*1*	***2***

Bird species	Autumn survey records			Spring survey records			Total records
	Strati-fied	Oppor-tune	*Sub-total*	Strati-fied	Oppor-tune	*Sub-total*	
Fan-tailed Cuckoo					2	*2*	***2***
Flame Robin	1		*1*				***1***
Galah	63	39	*102*	85	163	*248*	***350***
Great Cormorant					1	*1*	***1***
Grey Butcherbird		1	*1*				***1***
Grey Currawong	3	4	*7*	3	12	*15*	***22***
Grey Fantail	18	22	*40*	6	27	*33*	***73***
Grey Shrikethrush	13	21	*34*	29	110	*139*	***173***
Grey Teal	3	18	*21*	6	12	*18*	***39***
Hardhead		5	*5*				***5***
Hoary-headed Grebe	2	13	*15*		1	*1*	***16***
Horsfield's Bronze Cuckoo	3	5	*8*	3	4	*7*	***15***
Horsfield's Bush Lark				1		*1*	***1***
Laughing Kookaburra	20	13	*33*	25	33	*58*	***91***
Little Black Cormorant					1	*1*	***1***
Little Corella	14	9	*23*	41	39	*80*	***103***
Little Eagle	1		*1*				***1***
Little Pied Cormorant		5	*5*	2	11	*13*	***18***
Little Raven	59	54	*113*	54	83	*137*	***250***
Little Wattlebird		1	*1*		1	*1*	***2***
Long-billed Corella	1	2	*3*	3		*3*	***6***
Magpielark	9	8	*17*	14	27	*41*	***58***
Maned Duck (Australian Wood Duck)	23	41	*64*	27	42	*69*	***133***
Masked Lapwing		5	*5*	4	17	*21*	***26***
Mistletoebird				2	5	*7*	***7***
Musk Duck		1	*1*		1	*1*	***2***
Musk Lorikeet	32	25	*57*	24	29	*53*	***110***
Nankeen Kestrel	4	1	*5*	13	12	*25*	***30***
New Holland Honeyeater	9	17	*26*	9	36	*45*	***71***
Noisy Miner	18	6	*24*	19	31	*50*	***74***
Pacific Black Duck	4	10	*14*	6	9	*15*	***29***
Peaceful Dove[2]	1	3	*4*		12	*12*	***16***
Peregrine Falcon	1		*1*		3	*3*	***4***
Pink-eared Duck		1	*1*				***1***
Purple Swamphen				1		*1*	***1***
Purple-crowned Lorikeet	5	6	*11*	8	39	*47*	***58***
Rainbow Bee-eater[2]				13	52	*65*	***65***
Rainbow Lorikeet		3	*3*		3	*3*	***6***
Red Wattlebird	41	25	*66*	31	61	*92*	***158***
Red-browed Finch	2	1	*3*		1	*1*	***4***
Red-capped Robin	4	2	*6*				***6***
Red-rumped Parrot	18	17	*35*	23	68	*91*	***126***
Rose Robin	1		*1*				***1***
Rufous Songlark[2]				4	8	*12*	***12***
Rufous Whistler	5	1	*6*	7	17	*24*	***30***
Sacred Kingfisher[2]				1	9	*10*	***10***
Scarlet Robin	1		*1*		3	*3*	***4***
Shining Bronze Cuckoo					1	*1*	***1***
Silver Gull		1	*1*				***1***
Silvereye		4	*4*	2	3	*5*	***9***
Singing Honeyeater	11	12	*23*	7	35	*42*	***65***

Bird species	Autumn survey records			Spring survey records			Total records
	Strati-fied	Oppor-tune	*Sub-total*	Strati-fied	Oppor-tune	*Sub-total*	
Spiny-cheeked Honeyeater	1	5	*6*		10	*10*	***16***
Spotted Harrier					2	*2*	***2***
Spotted Pardalote		2	*2*				***2***
Striated Pardalote	36	30	*66*	75	157	*232*	***298***
Striated Thornbill	6	13	*19*	4	11	*15*	***34***
Stubble Quail		1	*1*				***1***
Sulphur-crested Cockatoo	10	16	*26*	20	20	*40*	***66***
Superb Fairywren	22	37	*59*	26	65	*91*	***150***
Tawny Frogmouth	1	1	*2*		2	*2*	***4***
Tree Martin	21	19	*40*	69	130	*199*	***239***
Varied Sittella[2]	2	1	*3*	2	8	*10*	***13***
Variegated Fairywren					4	*4*	***4***
Wedge-tailed Eagle	7	2	*9*	9	10	*19*	***28***
Weebill	6	2	*8*	3	9	*12*	***20***
Welcome Swallow	18	15	*33*	13	18	*31*	***64***
Whistling Kite	1	5	*6*		4	*4*	***10***
White-browed Babbler[2]	2	8	*10*	4	41	*45*	***55***
White-browed Scrubwren		1	*1*		1	*1*	***2***
White-faced Heron		5	*5*	10	17	*27*	***32***
White-fronted Chat		2	*2*	1	2	*3*	***5***
White-fronted Honeyeater	1		*1*				***1***
White-naped Honeyeater				2	3	*5*	***5***
White-plumed Honeyeater	34	42	*76*	46	134	*180*	***256***
White-throated Treecreeper	1		*1*		4	*4*	***5***
White-winged Chough[2]	3	14	*17*	4	75	*79*	***96***
White-winged Triller[2]					1	*1*	***1***
Willie Wagtail	36	37	*73*	24	97	*121*	***194***
Yellow Thornbill		8	*8*		10	*10*	***18***
Yellow-billed Spoonbill		1	*1*				***1***
Yellow-faced Honeyeater	8	5	*13*	12	20	*32*	***45***
Yellow-plumed Honeyeater		1	*1*		4	*4*	***5***
Yellow-rumped Thornbill	39	41	*80*	38	78	*116*	***196***
Yellow-tailed Black Cockatoo					1	*1*	***1***
Yellow-throated Miner				1	4	*5*	***5***
Introduced (6 species)	**24**	**31**	***55***	**56**	**143**	***199***	**254**
Common Blackbird	2	7	*9*	3	20	*23*	**32**
Common Starling	11	16	*27*	45	86	*131*	**158**
Eurasian Skylark					4	*4*	**4**
European Goldfinch	2		*2*		6	*6*	**8**
Feral Pigeon (Rock Dove)	3		*3*	1	3	*4*	**7**
House Sparrow	6	8	*14*	7	24	*31*	**45**
Total (137 species)	**940**	**1044**	***1984***	**1202**	**2947**	***4149***	**6133**

[2] Medium priority species (level 2)

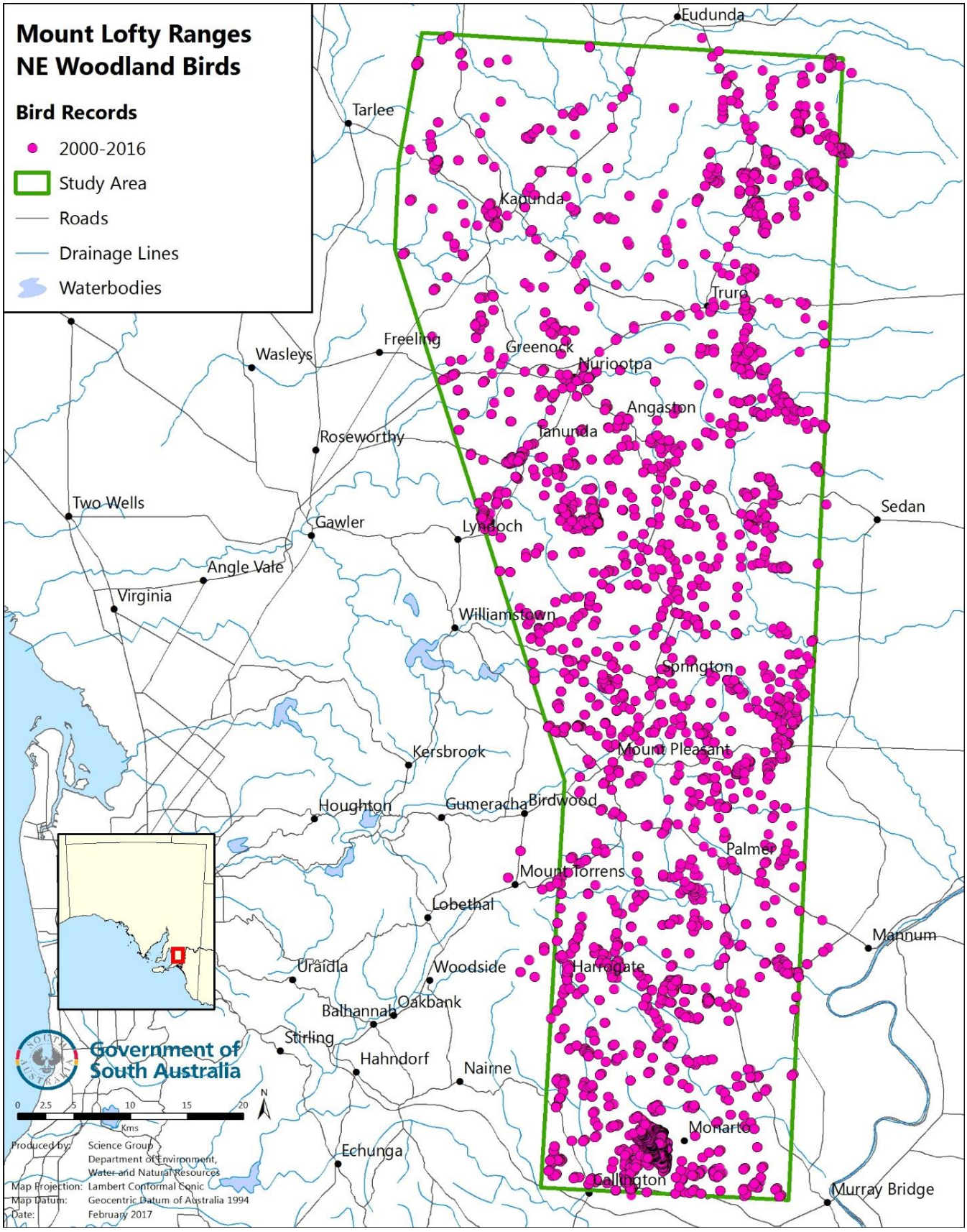


Figure 3.9. Distribution of all 2000–2016 bird records in the north-eastern Mount Lofty Ranges (including opportunistic DEWNR SIG 2016 bird survey records located outside of study area)

3.4 Species distributions

3.4.1 Minimising sampling bias

New DEWNR Science and Information Group (SIG) stratified surveys conducted 2016 (and supplemented by targeted opportune surveys) has provided important gap–filling results for many under–sampled landscape strata and geographic locations. Contrasts between record density maps used in the landscape stratification process at the early stages of this study (Figure 3.5) and those used in species distributions / environmental analyses (Figure 3.10) show considerable improvement in the distribution of bird observations across the study area.

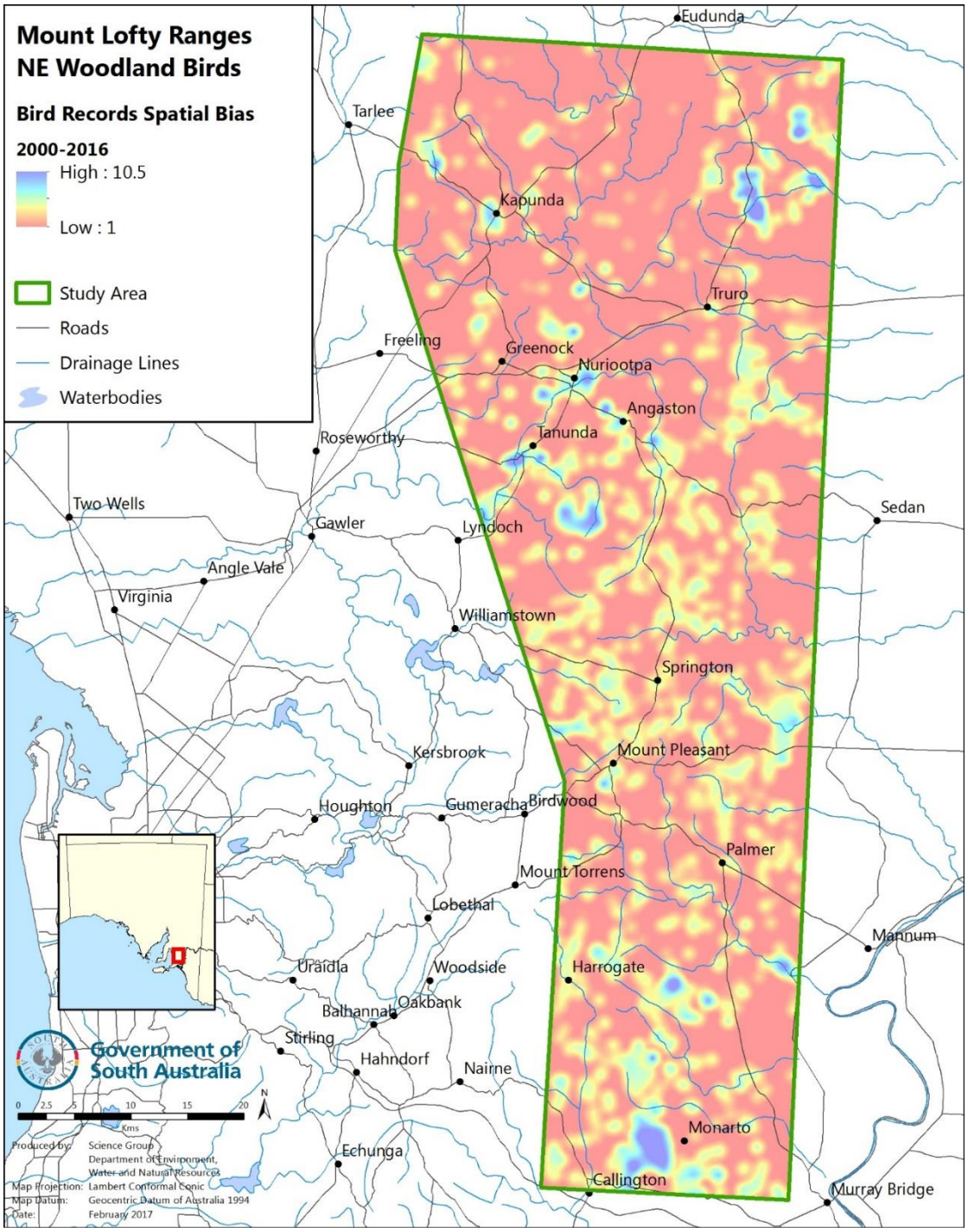


Figure 3.10. Spatial bias in bird observations (blue=high bias) in the north-eastern Mount Lofty Ranges, based on natural logarithm of bird record density (records/km²; consolidated dataset) between 2000 and 2016

3.4.2 Distribution models and responses to environment

Species distribution models (SDM) used in this study are generated from MaxEnt software. These logistic models include spatially-unique observations for each species (i.e. duplicates removed within each 90 m grid cell) plus 10000 background training points (Table 3.6). The model iteratively processes relationships between bird records and single and multiple combinations of environmental variables to identify the optimal combination of variables to estimate the likelihood of occurrence of each species. As continuous environmental data have greater analytical power in model development the Landform classification used in the survey site stratification process was substituted by the highly correlated mean Topographic wetness index at the 500 m radius "landscape" scale.

Preliminary SDM analyses conducted in mid–2016 for priority species used a wide range of environmental variables and their spatial derivatives (i.e. mean and standard deviation at 4 ha [local] and 500 m radius [landscape] scales) to identify variables and spatial scales of data with highest influence on SDMs. Higher standard deviation values for vegetative cover variables represent environments with more fragmented or patchy vegetation cover at local and landscape scales. The most useful set of standard environmental variables across multiple priority species are included in Table 3.7, this table includes summary information on the influence of each of these environmental variables on the final version of SDMs for 21 priority species generated in early 2017 (Table 3.6). MaxEnt SDMs have included a spatial bias file to improve model prediction (Figure 3.10), based on the mean density of all bird records for the 2000 to 2016 period (i.e. bias = 1 + Ln([records/km²] + 1).

Measures of variable importance (i.e. percent contribution and permutation importance) were calculated for each species and environmental variable (Table 3.8 to Table 3.14). The species response tables provide estimates of relative contributions of the environmental variables to the Maxent model (high priority species Table 3.8 to Table 3.14; medium priority species Table 5.2 to Table 5.15). To determine the first estimate (i.e. "percent contribution"), in each iteration of the training algorithm, the increase in regularised gain is added to the contribution of the corresponding variable, or subtracted from it if the change to the absolute value of lambda is negative. For the second estimate (i.e. "permutation importance"), for each environmental variable in turn, the values of that variable on training presence and background data are randomly permuted. The model is re–evaluated on the permuted data and optimised on training AUC (%). Variable contributions should be interpreted with caution when the predictor variables are correlated. MaxEnt's proportional area under the curve (AUC) statistic is a measure of model strength (i.e. higher value=better model).

Response curves show how each environmental variable affects the Maxent prediction. The curves show how the logistic prediction changes as each environmental variable is varied, keeping all other environmental variables at their average sample value (i.e. "single response"). Response curves for high priority species are presented in Table 3.8 to Table 3.14. Supplementary results for medium priority species can be found in the appendices (Table 5.2 to Table 5.15). Note that the curves can be difficult to interpret if some variables are strongly correlated, as the model may depend on the correlations in ways that are not evident in the curves. In other words, the curves show the marginal effect of changing exactly one variable, whereas the model may take advantage of sets of variables changing together (i.e. "combined response").

It is important to note that although Tree crown cover and Woody vegetation cover are highly correlated environmental variables (and may have similar single variable species response curves) that many species are more responsive to the actual greenness/productivity of native vegetation (i.e. Woody vegetation cover values) rather than simply crown area (i.e. Tree crown cover). The automated processing of very high resolution satellite imagery to identify Tree crown cover readily identified Eucalyptus species, but often failed to recognise the crowns of Sheoak (*Allocasuarina verticillata*) trees in the region. Bird species with a preference for Sheoak trees are less likely to respond estimates of Tree crown cover than Woody vegetation cover.

Supplementary species distribution models were also generated for each priority bird species using only abiotic variables (i.e. excluding Tree crown cover, Woody vegetation cover and their derivatives). These identify additional landscapes likely to support priority bird species in the future if optimal restoration activities can create vegetation communities preferred by each species.

Potential species distribution model (SDM) maps and all individual bird records (pre- and post-2000) for high priority species (level 1) are presented in Figure 3.11 to Figure 3.17. Supplementary maps for medium priority species (level 2) can be found in the appendices (Figure 5.2 to Figure 5.15).

Table 3.6. Summary of MaxEnt models for priority bird species in the north-eastern Mount Lofty Ranges

Bird species	Unique records 2000–2016	Model strength (AUC[1])
High priority (level 1)		
Brown Treecreeper	608	0.899
Chestnut-rumped Thornbill	127	0.988
Diamond Firetail	497	0.928
Hooded Robin	305	0.952
Jacky Winter	113	0.982
Restless Flycatcher	92	0.976
Southern Whiteface	378	0.931
Medium priority (level 2)		
Australian Owlet-nightjar	97	0.981
Black-chinned Honeyeater	12	0.978
Brown Songlark	65	0.823
Crested Shriketit	18	0.955
Elegant Parrot	37	0.885
Peaceful Dove	242	0.937
Rainbow Bee-eater	268	0.911
Rufous Songlark	92	0.918
Sacred Kingfisher	73	0.943
Varied Sittella	179	0.957
White-browed Babbler	743	0.935
White-winged Chough	481	0.912
White-winged Triller	78	0.937
Zebra Finch	38	0.905

[1] MaxEnt model strength statistic, proportional area under curve (AUC), maximum of 1

Table 3.7. Environmental attributes used in species distribution models for priority bird species in the north-eastern Mount Lofty Ranges

	Study area				Highest model influence[1]		
Environmental variable	Minimum		Maximum		Value	Rank	**Gridded data name**
Landform (Topographic wetness index, landscape)	ranges	6.2	12.7	floodouts	16.1	2	twi_r500m_mean
Mean annual rainfall (mm/year)	low	309	743	high	84.1	1	sa_rain_r500m_mean
Mean annual temperature (°C)	cool	13.4	16.5	warm	41.6	1	sa_temp_r500m_mean
Topographic wetness index, local	runoff	5.0	15.7	runon	7.2	2	twi_4ha_mean
Soil texture index, landscape	clay	0.03	0.53	sand	24.2	2	sa_snd_index_r500m_mean
Soil pH, landscape	acid	5.0	8.1	alkaline	24.8	1	sa_ph_avg_r500m_mean
Tree crown cover (%), local	low	0.0	100.0	high	41.6	1	trees_4ha_mean
Tree crown cover (%), landscape	low	0.0	78.0	high	42.3	1	trees_r500m_mean
Tree crown cover (% sd), local variability	uniform	0.0	50.0	variable	22.8	1	trees_4ha_std
Tree crown cover (%sd), landscape variability	uniform	0.0	48.6	variable	10.1	3	trees_r500m_std
Woody vegetation cover (%), local	low	0.0	96.6	high	76.2	1	sa_woody_veg_4ha_mean
Woody vegetation cover (%), landscape	low	0.0	80.7	high	17.9	3	sa_woody_veg_r500m_mean
Woody veg. cover (%sd), local variability	uniform	0.0	33.4	variable	7.3	4	sa_woody_veg_4ha_std
Woody veg. cover (%sd), landscape variability	uniform	0.3	33.9	variable	16.1	2	sa_woody_veg_r500m_std

[1] percent contribution or permutation importance value, and variable rank across final SDMs for 21 priority species.

Table 3.8. Response of Brown Treecreeper to environmental variables in the north-eastern Mount Lofty Ranges

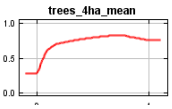
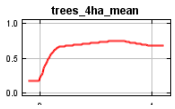
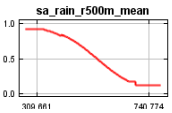
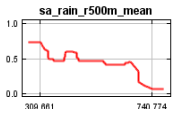
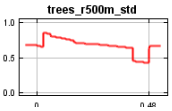
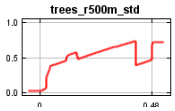
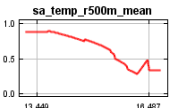
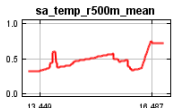
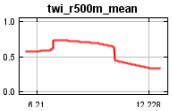
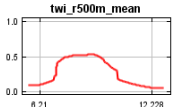
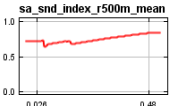
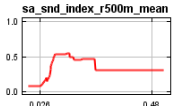
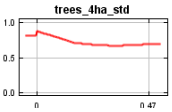
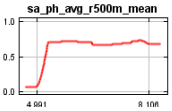
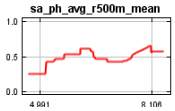
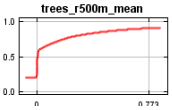
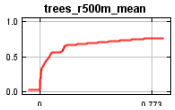
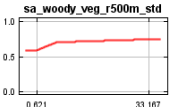
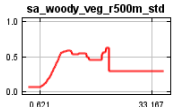
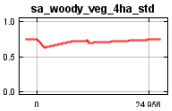
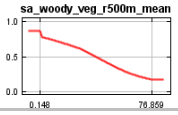
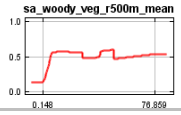
	MaxEnt model (n=608, AUC=0.899)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Tree crown cover, local	41.6	23.2		
Woody vegetation cover, local	19.3	13.3		
Rainfall	15.8	27.1		
Tree crown cover, landscape variability	6.8	2.6		
Temperature	6.1	11.4		
Topographic wetness, landscape	2.3	1.1		
Soil texture, landscape	1.8	1		
Tree crown cover, local variability	1.7	3.1		
Soil pH, landscape	1.4	2.4		
Tree crown cover, landscape	1.3	11.7		
Topographic wetness, local	0.9	0.4		
Woody veg. cover, landscape variability	0.6	0.7		
Woody vegetation cover, local variability	0.2	0.5		
Woody vegetation cover, landscape	0.2	1.6		

Table 3.9. Response of Chestnut-rumped Thornbill to environmental variables in the north-eastern Mount Lofty Ranges

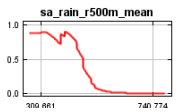
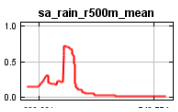
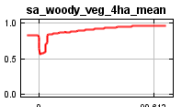
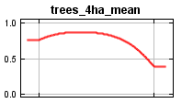
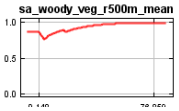
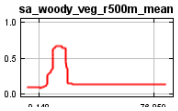
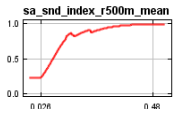
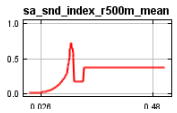
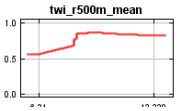
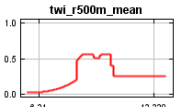
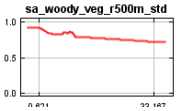
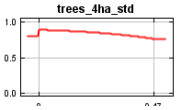
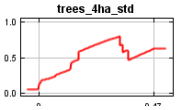
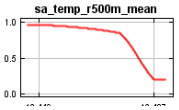
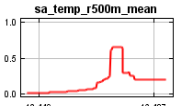
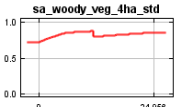
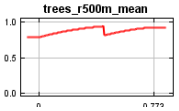
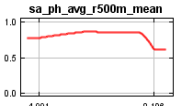
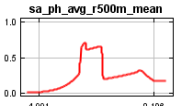
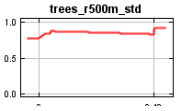
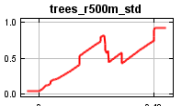
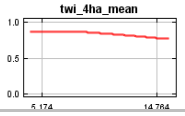
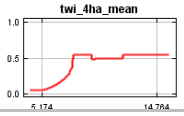
	MaxEnt model (n=127, AUC=0.988)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	50.3	84.1		
Woody vegetation cover, local	21	4.3		
Tree crown cover, local	13.4	0.4		
Woody vegetation cover, landscape	5.5	1.7		
Soil texture, landscape	2.6	4.3		
Topographic wetness, landscape	2.1	1.2		
Woody veg. cover, landscape variability	1.8	0.4		
Tree crown cover, local variability	1.6	0.2		
Temperature	0.7	2.1		
Woody vegetation cover, local variability	0.4	0.1		
Tree crown cover, landscape	0.3	0.5		
Soil pH, landscape	0.2	0.2		
Tree crown cover, landscape variability	0.1	0.3		
Topographic wetness, local	0.1	0.2		

Table 3.10. Response of Diamond Firetail to environmental variables in the north-eastern Mount Lofty Ranges

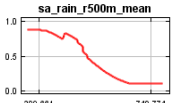
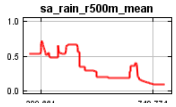
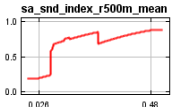
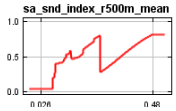
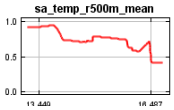
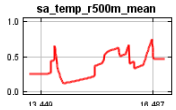
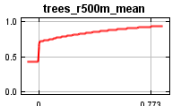
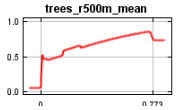
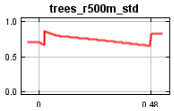
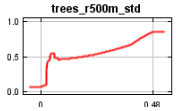
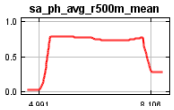
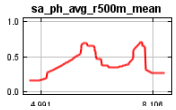
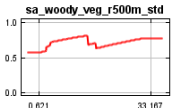
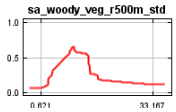
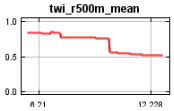
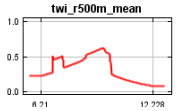
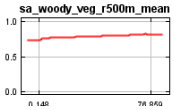
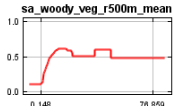
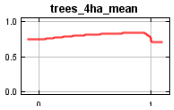
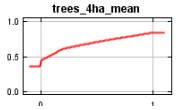
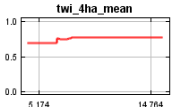
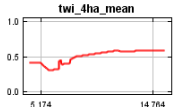
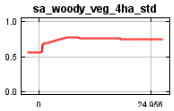
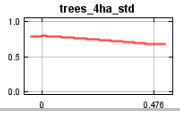
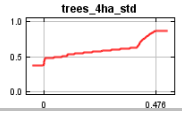
	MaxEnt model (n=497, AUC=0.928)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	35.9	44.4		
Woody vegetation cover, local	34.6	14.9		
Soil texture, landscape	8.2	15.9		
Temperature	7.6	7		
Tree crown cover, landscape	2.9	4.4		
Tree crown cover, landscape variability	2.9	1.6		
Soil pH, landscape	2.4	4.1		
Woody veg. cover, landscape variability	2.4	2.5		
Topographic wetness, landscape	1.6	2.6		
Woody vegetation cover, landscape	0.5	0.2		
Tree crown cover, local	0.4	0.9		
Topographic wetness, local	0.2	0.3		
Woody vegetation cover, local variability	0.2	0.9		
Tree crown cover, local variability	0.1	0.3		

Table 3.11. Response of Hooded Robin to environmental variables in the north-eastern Mount Lofty Ranges

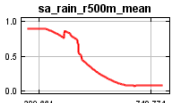
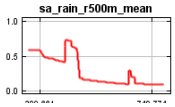
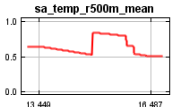
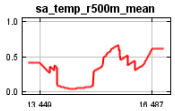
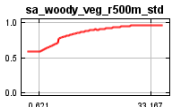
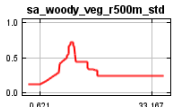
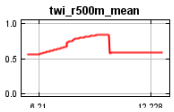
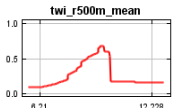
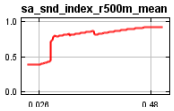
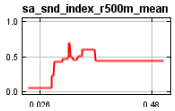
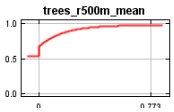
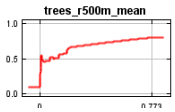
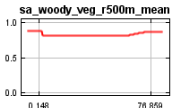
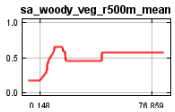
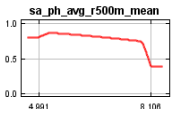
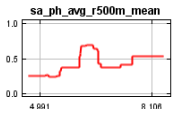
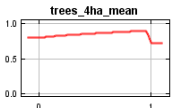
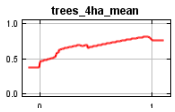
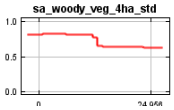
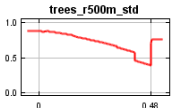
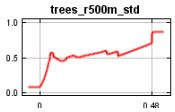
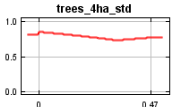
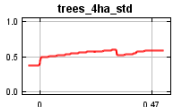
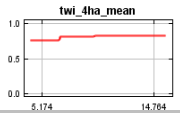
	MaxEnt model (n=305, AUC=0.952)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	40.3	45.9		
Woody vegetation cover, local	24.2	16		
Temperature	11.5	7.1		
Woody veg. cover, landscape variability	7.7	5.9		
Topographic wetness, landscape	4.9	2.1		
Soil texture, landscape	3.5	6.2		
Tree crown cover, landscape	1.8	9.5		
Woody vegetation cover, landscape	1.7	1.7		
Soil pH, landscape	1.4	1.3		
Tree crown cover, local	0.9	0.3		
Woody vegetation cover, local variability	0.8	0.7		
Tree crown cover, landscape variability	0.6	2.4		
Tree crown cover, local variability	0.3	0.7		
Topographic wetness, local	0.3	0.1		

Table 3.12. Response of Jacky Winter to environmental variables in the north-eastern Mount Lofty Ranges

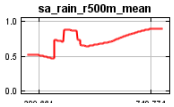
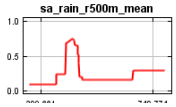
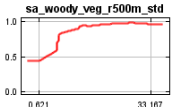
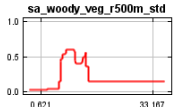
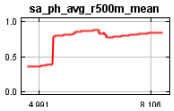
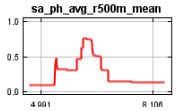
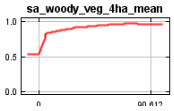
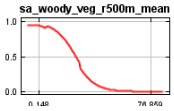
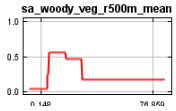
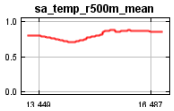
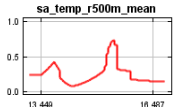
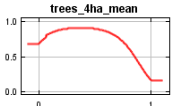
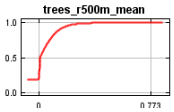
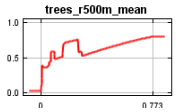
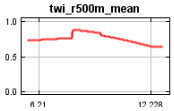
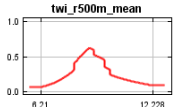
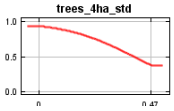
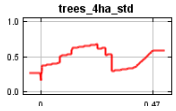
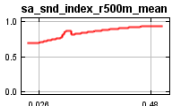
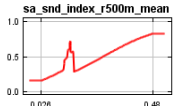
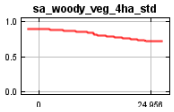
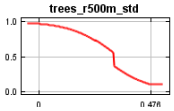
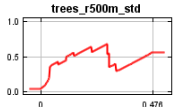
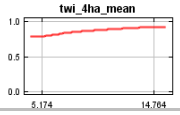
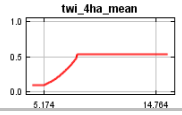
	MaxEnt model (n=113, AUC=0.982)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	35.9	7.6		
Woody veg. cover, landscape variability	15.7	16.1		
Soil pH, landscape	10.9	2.4		
Woody vegetation cover, local	10.8	5.4		
Woody vegetation cover, landscape	7.9	14.4		
Temperature	6.3	1.2		
Tree crown cover, local	3.6	3.2		
Tree crown cover, landscape	2.7	32		
Topographic wetness, landscape	2.4	1.1		
Tree crown cover, local variability	1.1	7.3		
Soil texture, landscape	0.9	1.9		
Woody vegetation cover, local variability	0.7	0.8		
Tree crown cover, landscape variability	0.6	6.5		
Topographic wetness, local	0.4	0.2		

Table 3.13. Response of Restless Flycatcher to environmental variables in the north-eastern Mount Lofty Ranges

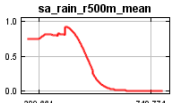
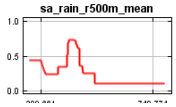
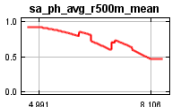
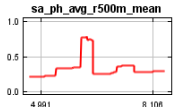
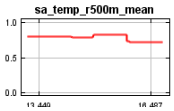
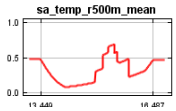
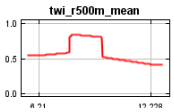
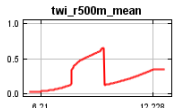
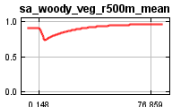
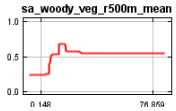
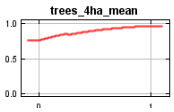
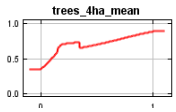
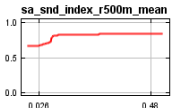
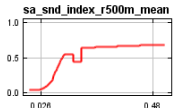
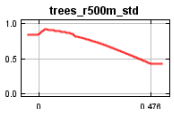
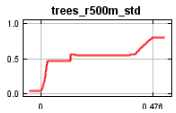
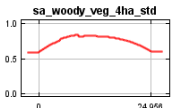
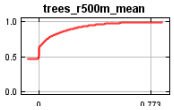
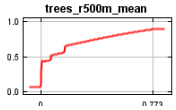
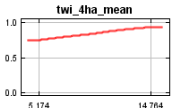
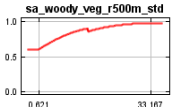
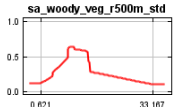
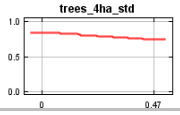
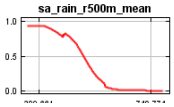
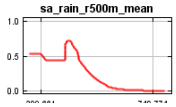
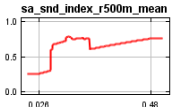
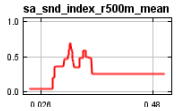
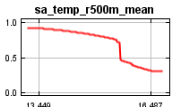
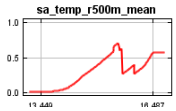
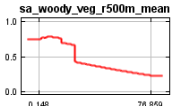
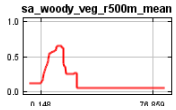
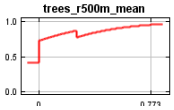
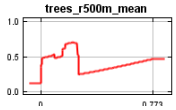
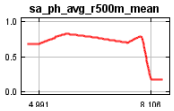
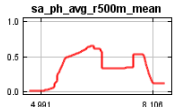
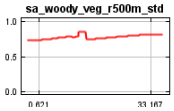
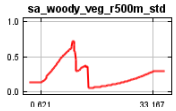
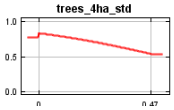
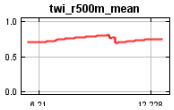
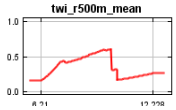
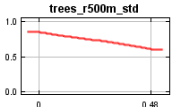
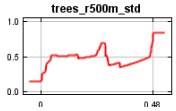
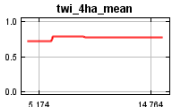
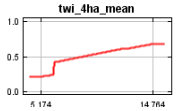
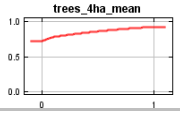
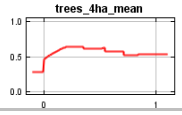
	MaxEnt model (n=92, AUC=0.976)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	33.1	63.1		
Woody vegetation cover, local	21.1	1.8		
Soil pH, landscape	12.4	5.8		
Temperature	10.7	0.2		
Topographic wetness, landscape	10.2	4.5		
Woody vegetation cover, landscape	6.2	3.5		
Tree crown cover, local	1.8	2.4		
Soil texture, landscape	1	0.7		
Tree crown cover, landscape variability	0.8	2.6		
Woody vegetation cover, local variability	0.8	1.9		
Tree crown cover, landscape	0.8	8.1		
Topographic wetness, local	0.5	0.3		
Woody veg. cover, landscape variability	0.4	5		
Tree crown cover, local variability	0.2	0.1		

Table 3.14. Response of Southern Whiteface to environmental variables in the north-eastern Mount Lofty Ranges

	MaxEnt model (n=378, AUC=0.931)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	49	57		
Woody vegetation cover, local	23.5	9		
Soil texture, landscape	10.5	8.1		
Temperature	5.6	10.8		
Woody vegetation cover, landscape	4.5	2.5		
Woody vegetation cover, local variability	2	1.4		
Tree crown cover, landscape	1.3	3.7		
Soil pH, landscape	1.1	2.1		
Woody veg. cover, landscape variability	0.8	0.8		
Tree crown cover, local variability	0.6	1.4		
Topographic wetness, landscape	0.5	0.6		
Tree crown cover, landscape variability	0.2	1.1		
Topographic wetness, local	0.1	0.1		
Tree crown cover, local	0.1	1.1		

3.4.3 Potential distribution maps

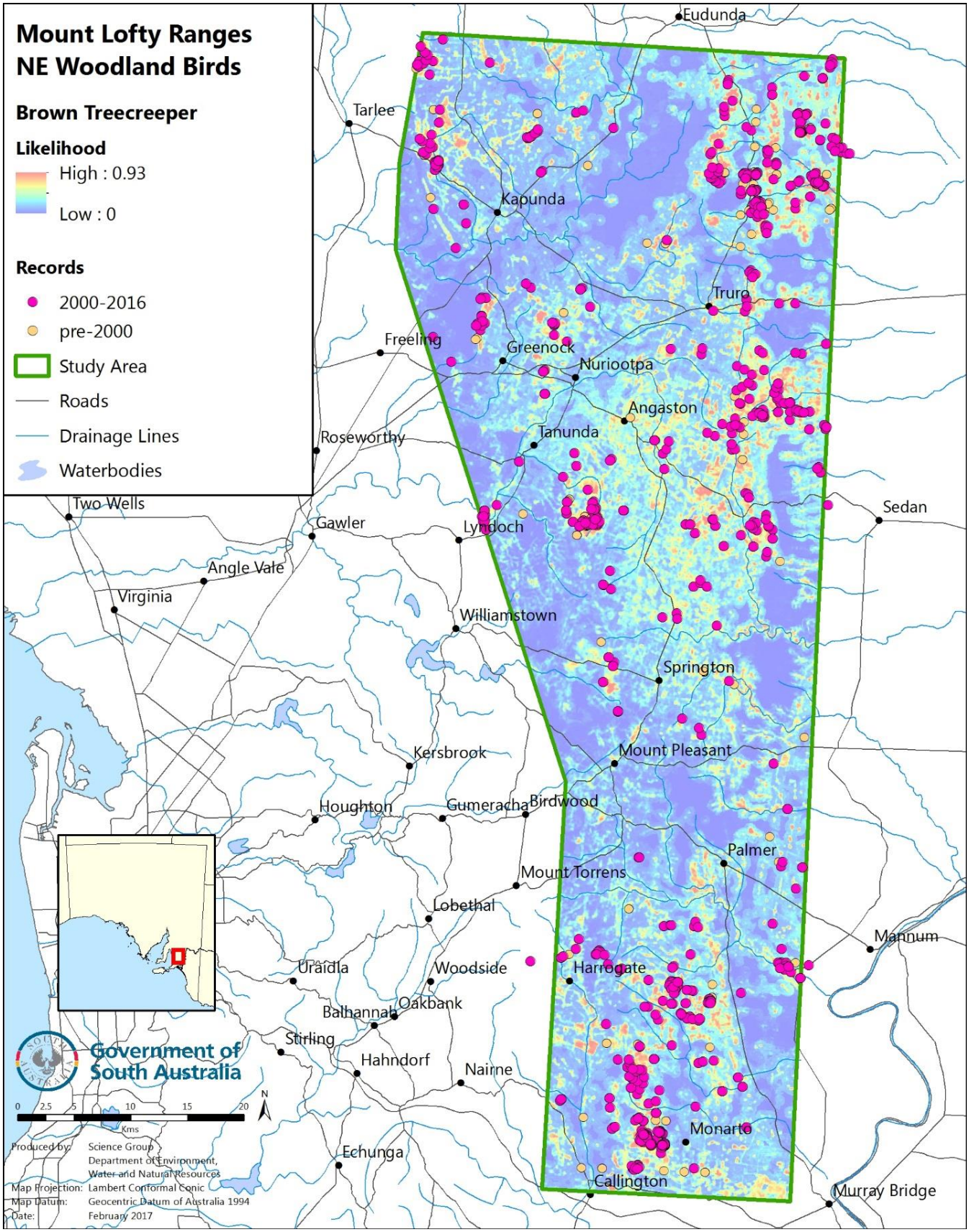


Figure 3.11. Potential distribution of Brown Treecreeper in the north-eastern Mount Lofty Ranges

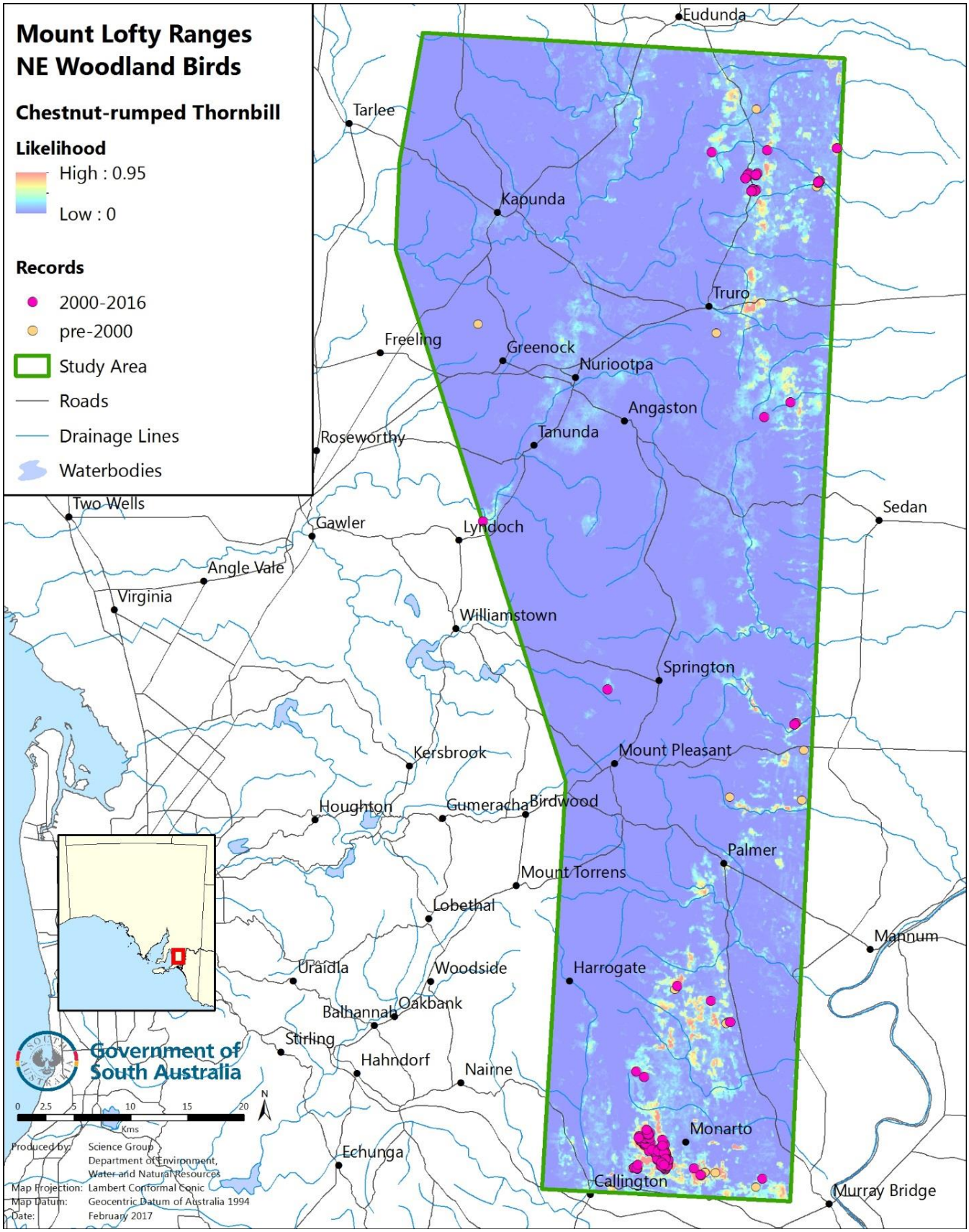


Figure 3.12. Potential distribution of Chestnut-rumped Thornbill in the north-eastern Mount Lofty Ranges

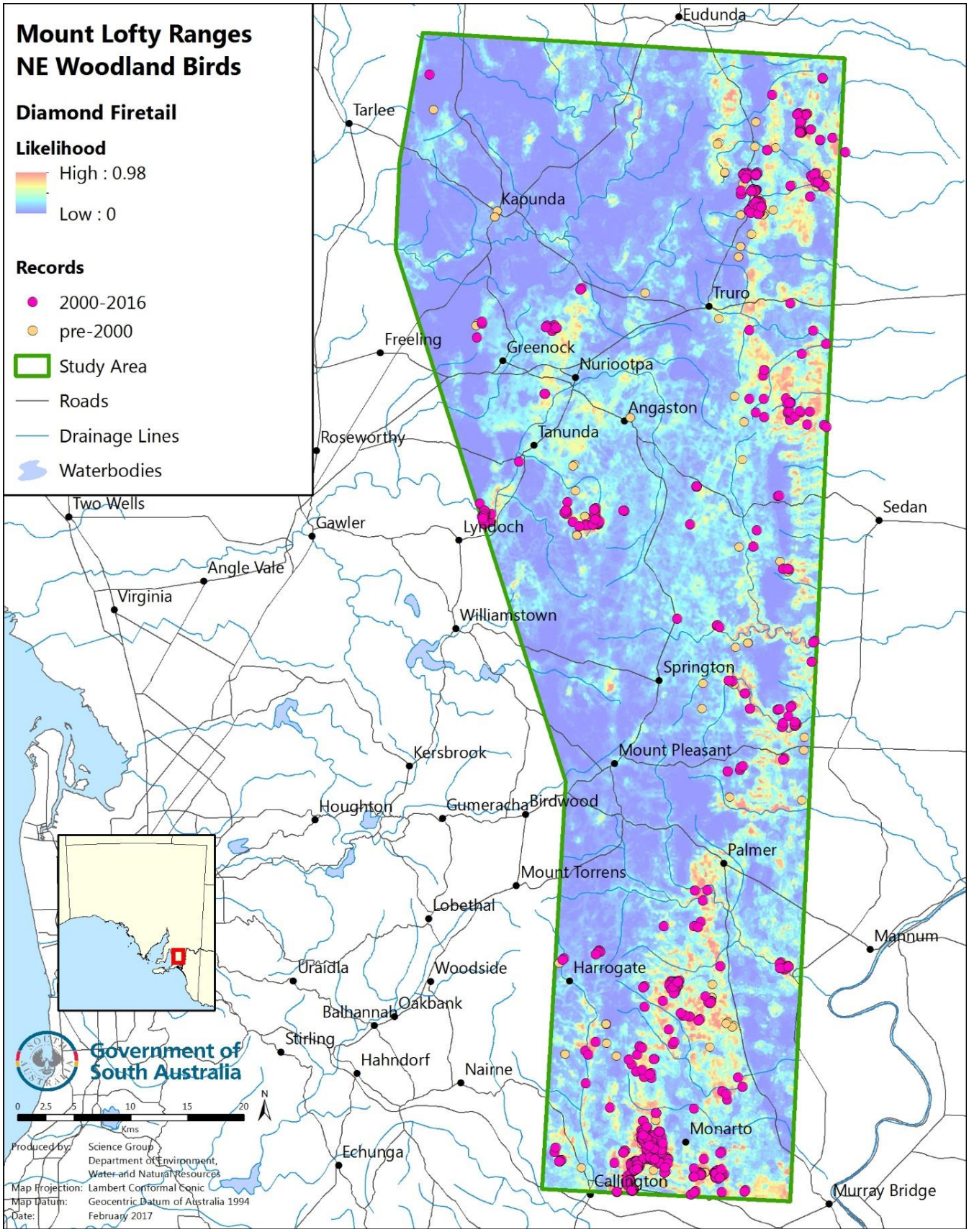


Figure 3.13. Potential distribution of Diamond Firetail in the north-eastern Mount Lofty Ranges

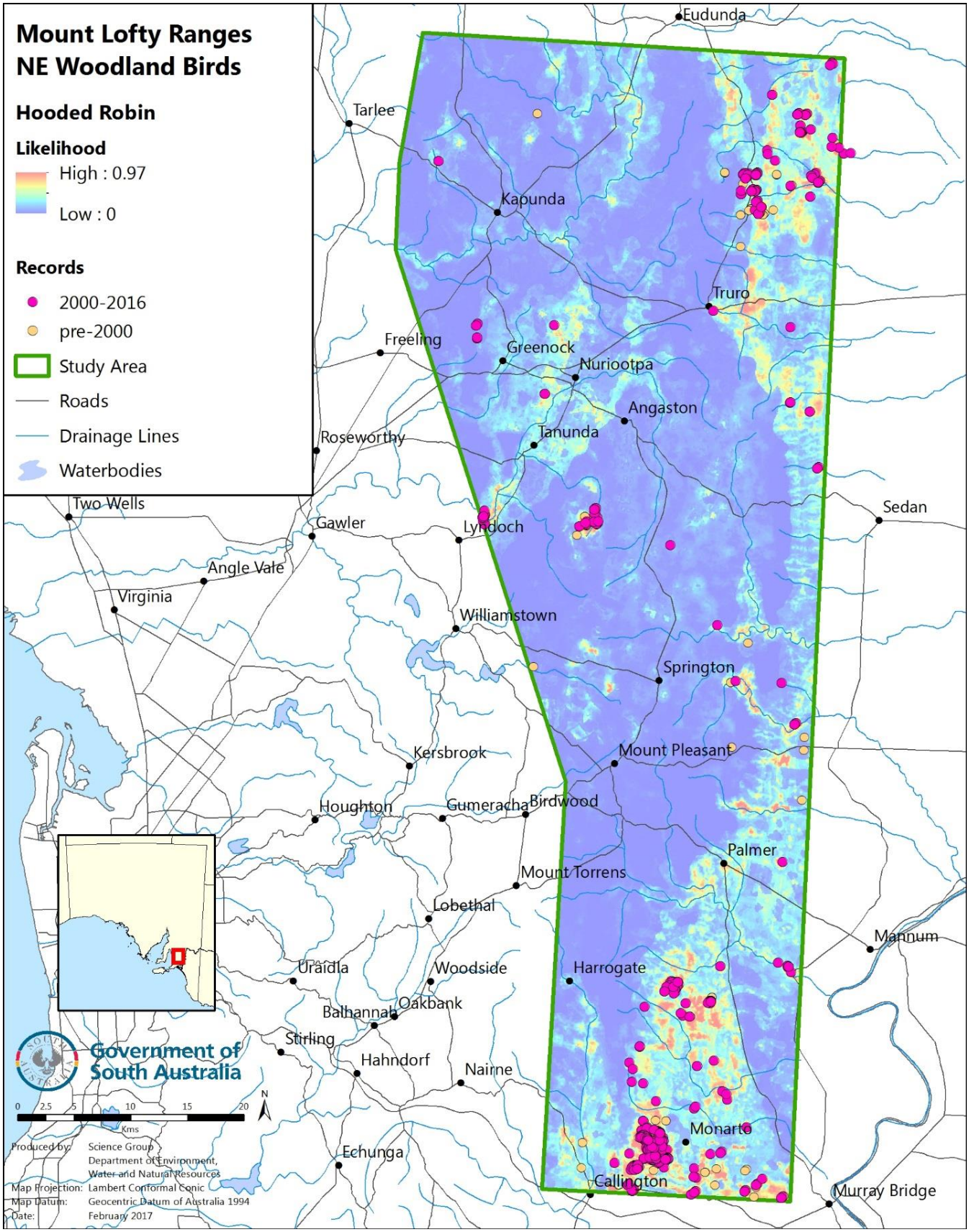


Figure 3.14. Potential distribution of Hooded Robin in the north-eastern Mount Lofty Ranges

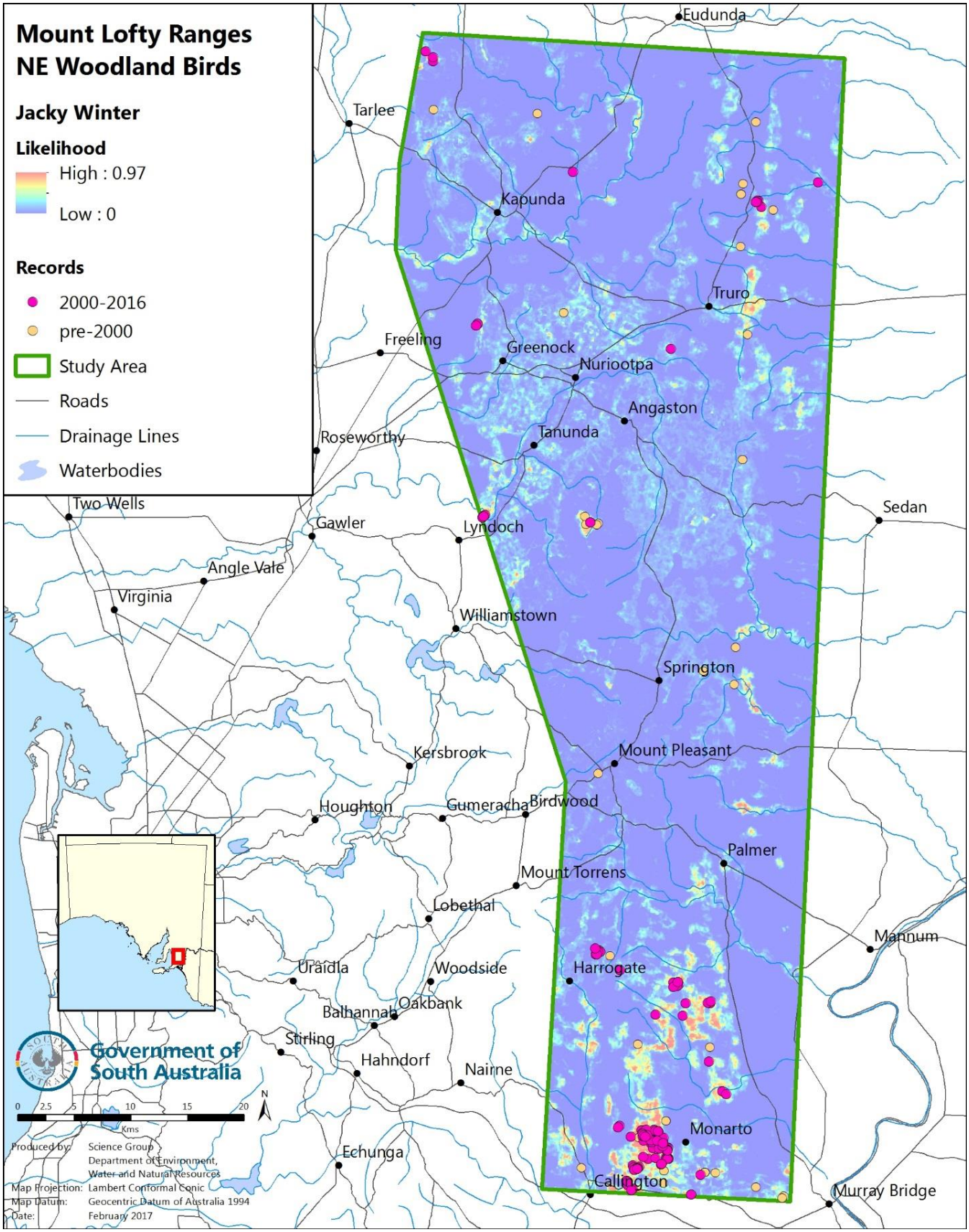


Figure 3.15. Potential distribution of Jacky Winter in the north-eastern Mount Lofty Ranges

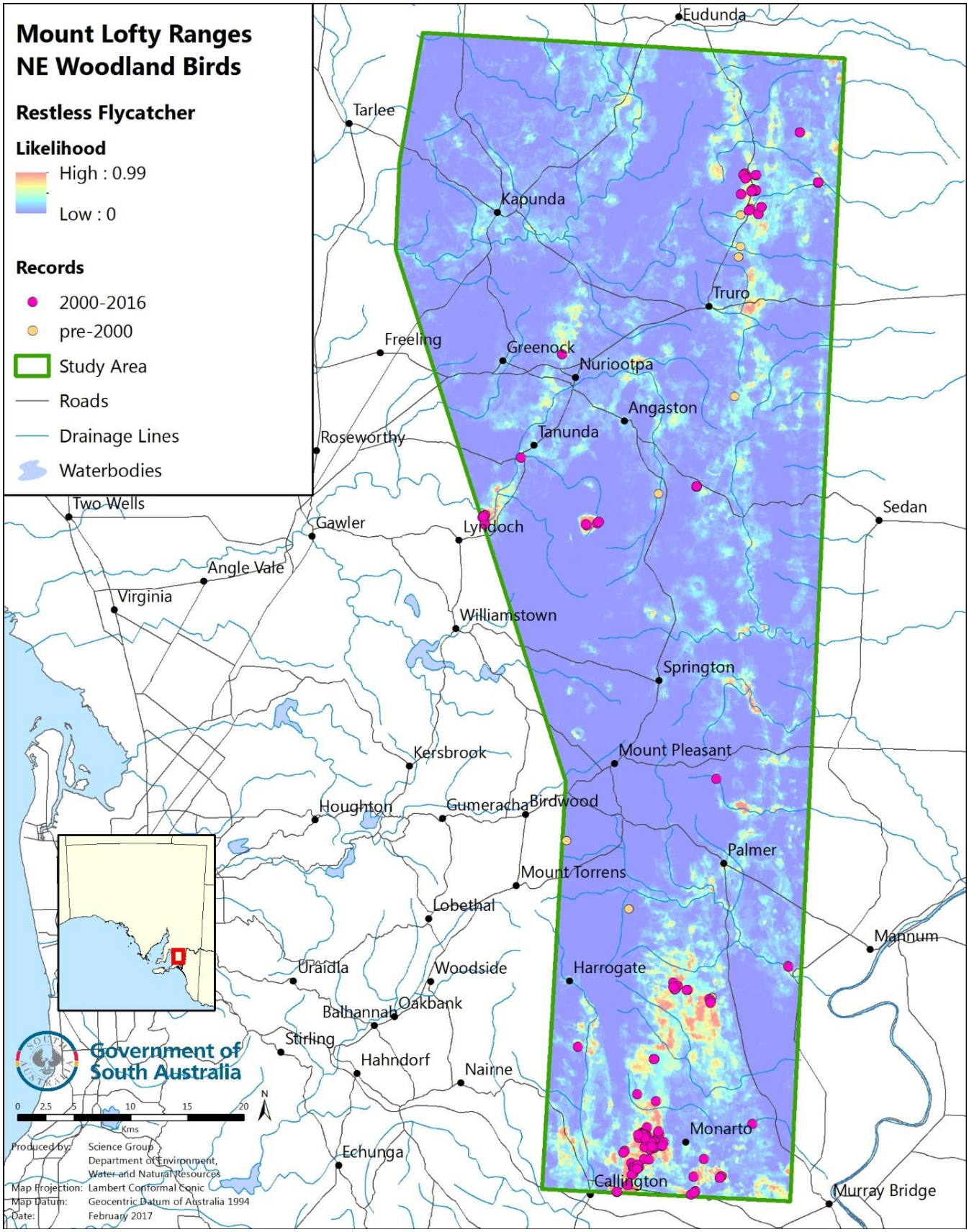


Figure 3.16. Potential distribution of Restless Flycatcher in the north-eastern Mount Lofty Ranges

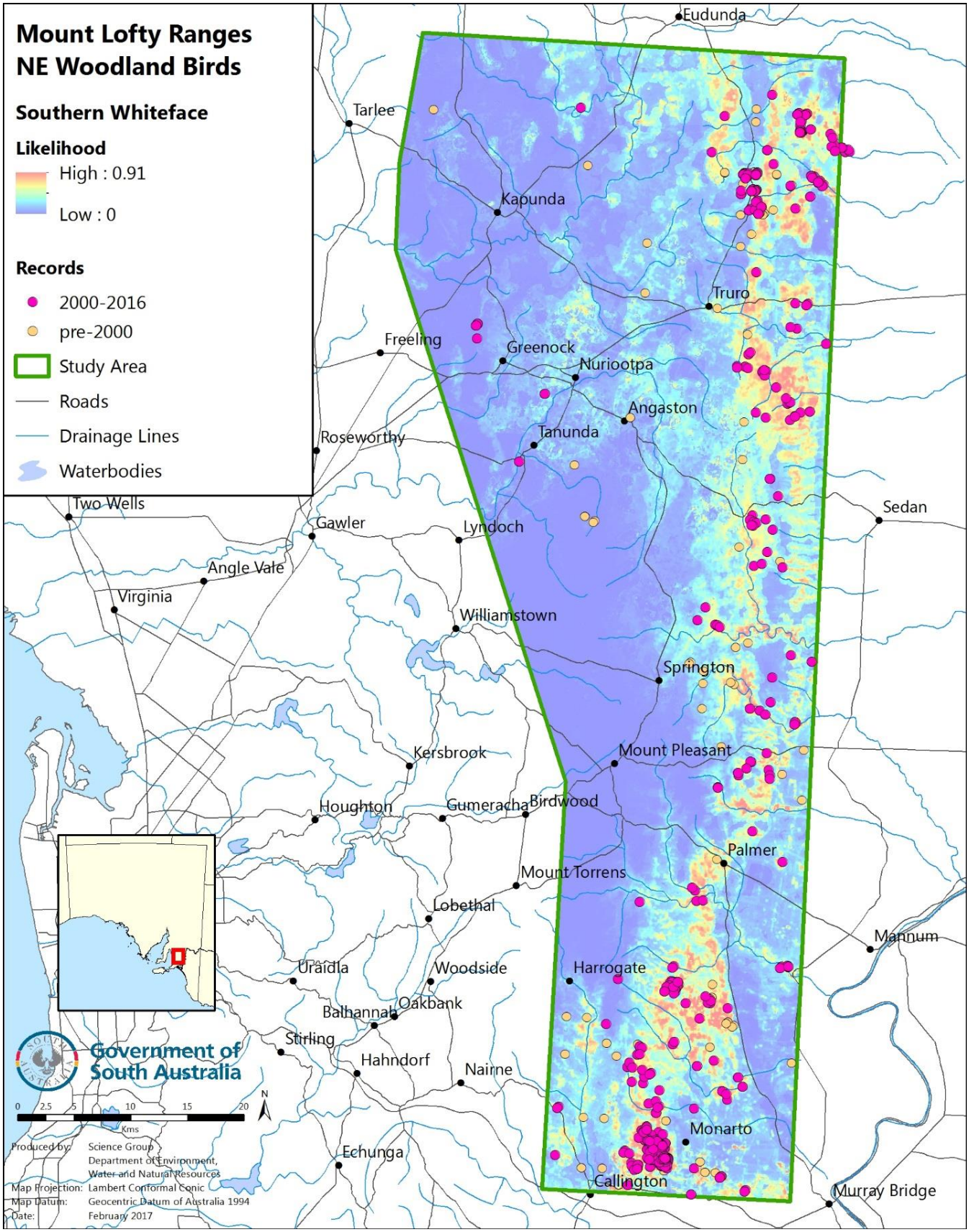


Figure 3.17. Potential distribution of Southern Whiteface in the north-eastern Mount Lofty Ranges

3.5 Priority landscapes

The individual priority species distribution maps represent the most likely landscapes for targeted single–species management in the north-eastern Mount Lofty Ranges (i.e. high priority Figure 3.11 to Figure 3.17, medium priority Figure 5.2 to Figure 5.15). Important environmental variables and species response curves identified in Table 3.8 to Table 3.14 and Table 5.2 to Table 5.15 from MaxEnt modelling can be used to inform targeted management for individual species in the region. Identifying the overlaps in landscapes preferred by multiple priority species can be used to inform regional priority setting and increase effectiveness of management actions.

The mean likelihood statistic across the seven highest priority bird species for each location (range 0 to 0.86) is an indicator of landscapes preferred by multiple high priority species. Mean values were linearly rescaled between 0 and 1 to create a "Landscape Priority Index" for the high priority bird species (level 1) to provide an indicative map of areas for targeted management (Figure 3.18). These priority areas are mainly located west, north and south-east of Monarto, south of Palmer, and north-east and south-east of Truro. Additional priority landscapes include eastwards flowing drainage lines/valleys to the east of Springton.

For locations with a Landscape Priority Index >0.75 a summary of environmental variables assessed for species' responses and distribution models is presented in Table 3.15. Priority landscapes for targeted management are typically located in rolling hills with low to medium rainfall (~400–450 mm/year) containing local patches of 10 to 25% vegetation cover. These patches occur in broader landscapes with between 6 and 10% vegetation cover and have some variability in landscape–scale patchiness of native vegetation.

Table 3.15. Summary of environmental attributes for highest priority landscapes (i.e. landscape priority index >0.75) for high priority (level 1) bird species in the north-eastern Mount Lofty Ranges

	Study area				Highest priority landscapes		
Environmental variable	Minimum		Maximum		-1 SD	Mean	+1 SD
Landform (Topographic wetness index, landscape)	ranges	6.2	12.7	floodouts	8.2	8.7	9.1
Mean annual rainfall (mm/year)	low	309	743	high	401	424	447
Mean annual temperature (°C)	cool	13.4	16.5	warm	15.2	15.4	15.6
Topographic wetness index, local	runoff	5.0	15.7	runon	7.7	8.8	9.9
Soil texture index, landscape	clay	0.03	0.53	sand	0.11	0.15	0.19
Soil pH, landscape	acid	5.0	8.1	alkaline	5.8	6.3	6.8
Tree crown cover (%), local	low	0.0	100.0	high	0.0	16.4	33.8
Tree crown cover (%), landscape	low	0.0	78.0	high	0.0	11.2	22.9
Tree crown cover (% SD), local variability	uniform	0.0	50.0	variable	5.2	13.5	21.8
Tree crown cover (% SD), landscape variability	uniform	0.0	48.6	variable	6.9	15.1	23.4
Woody vegetation cover (%), local	low	0.0	96.6	high	9.2	16.0	22.7
Woody vegetation cover (%), landscape	low	0.0	80.7	high	6.8	11.0	15.1
Woody veg. cover (% SD), local variability	uniform	0.0	33.4	variable	5.9	8.1	10.3
Woody veg. cover (% SD), landscape variability	uniform	0.3	33.9	variable	7.4	9.6	11.8

3.6 Digital data package

The consolidated bird record database, local subsets of environmental raster data (and their derivatives), landscape stratification layers, species distribution models for seven high priority (level 1) plus 14 medium priority (level 2) bird species, and landscape prioritisation layers have been provided in ESRI ArcGIS Version 10.2 File Geodatabases. An ArcGIS Version 10.2 Map Document contains the layers and display schemes used in this report. All new bird survey records (including incidental fauna records) have been loaded into BDBSA.

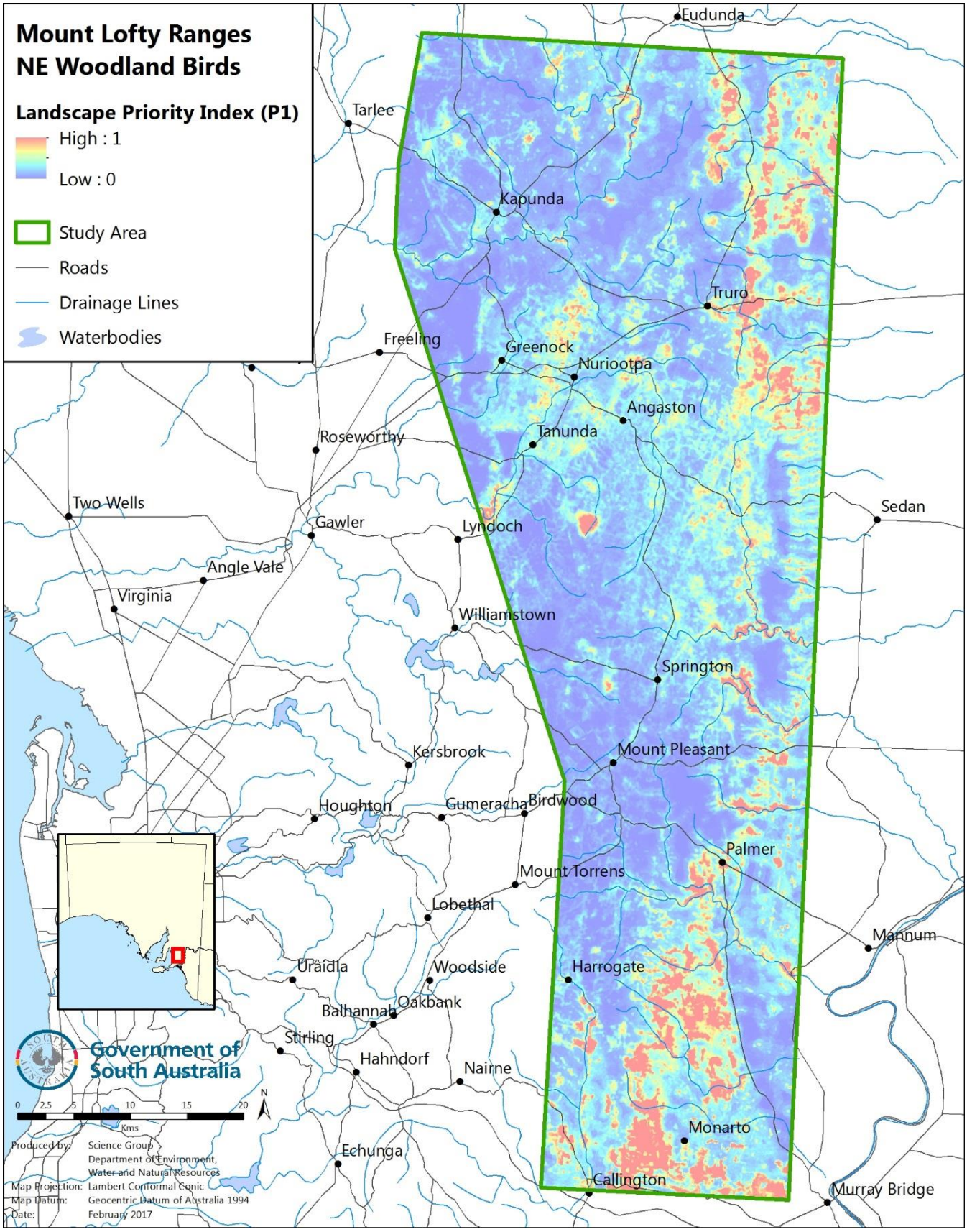


Figure 3.18. Priority landscapes of the north-eastern Mount Lofty Ranges, based on the mean likelihood values of 7 priority bird species (mean values rescaled to an index of 0–1)

4 Conclusions

Reducing the decline, and increasing the resilience, of many woodland bird species is a high priority for conservation and natural resource management in the Mount Lofty Ranges region. Several natural resource management agencies across the region are investing in large-scale, long-term habitat restoration and management programs to relieve pressure on their declining woodland birds.

Several high priority bird species known from north-eastern parts of Mount Lofty Ranges (i.e. Brown Treecreeper, Chestnut-rumped Thornbill, Diamond Firetail, Hooded Robin, Jacky Winter, Restless Flycatcher, Southern Whiteface) have been identified as the intended beneficiaries of these management programs.

Historic knowledge on the distribution and environmental drivers of these species, and the locations or landscapes preferred by these species, have been constrained by gaps or biases in bird observations across the region. If not addressed by appropriate new surveys and analyses these gaps and biases can result in misleading information on the locations and environments that are important to priority bird species, and where investments in land management programs should be prioritised.

4.1 Improvements in bird data

This study has stratified landscapes of the region based on important ecological drivers of faunal distributions (i.e. landforms, rainfall, water redistribution and native vegetation cover) and undertaken analyses using a consolidated database of bird records to identify landscapes that have historically been poorly represented by surveys. Using recent bird record data (2006–15), area-weighted proportional representation calculations and spatial optimisation methods we located 100 new survey sites that would improve the representativeness of new bird surveys in the region.

These new "stratified site" surveys (and supplemented by spatially targeted opportune observation) conducted by DEWNR Science and Information Group (SIG) staff in autumn and springs of 2016 have increased the number of priority bird species records in the region and expanded their known distributions.

4.2 Better species distribution information

Through improved bird data and analytical techniques, the spatial and temporal biases of bird records have been greatly reduced, allowing for the influence of environmental attributes on individual priority bird species distributions to be more clearly identified, and significant improvements on potential species distribution mapping in the region. Species distribution modelling using MaxEnt software has identified and quantified a range topographic, soil, climate and vegetation cover attributes that influence each priority bird species of the region. Individual species distribution models and maps have been created for seven high priority bird species and 14 medium priority bird species of north-eastern Mount Lofty Ranges. Individual species' response curves to environmental variables (both as single and combined variable responses) demonstrate drivers and interactions that influence each species' landscape preferences.

Areas identified by each of these species distribution models with a high likelihood of occurrence, but have not been previously surveyed, should become a focus for future surveys to affirm or refute the existence of priority bird species in those areas. Areas with sub-optimal likelihood of occurrence values should be further evaluated to determine if the currently limiting factor to the occurrence of priority bird relate to vegetation cover or plant species which could be addressed by revegetation or other management activities.

The individual priority species distribution maps produced during this study identify locations, landscapes and spatial extent of landscapes or habitats suitable for each species. The size, patchiness and connectivity of preferred landscapes for each species can be used to inform the planning of management activities or ecological

interventions focussed on single-species management. The efficiency of management activities or interventions within the region can be increased by identifying landscapes where multiple-species benefits are likely be achieved. Information on landscape and environmental preferences of several different priority species (e.g. species distribution maps and likelihood of occurrence statistics) can be integrated and used to prioritise locations for conservation efforts.

In this study, we have presented one possible measure (i.e. Landscape priority index, P1) to prioritise the location of management activities or ecological interventions in north-eastern Mount Lofty Ranges (Figure 3.18). This index uses information based on the mean likelihood statistics across the seven highest priority bird species (level 1) in the region. This simple landscape priority index suggests that most effective generic areas for management activities or ecological interventions are mainly located west, north and south-east of Monarto, south of Palmer, and north-east and south-east of Truro. Additional priority landscapes include eastwards flowing drainage lines/valleys to the east of Springton. These priority areas are typically located in rolling hills with low to medium rainfall (~400-450 mm/year) containing local patches of 10 to 25% native vegetation cover within broader landscapes with between 6 and 10% native vegetation cover.

5 Appendices

A. All bird species recorded in the north-eastern Mount Lofty Ranges

Table 5.1. All bird species recorded in the north-eastern Mount Lofty Ranges (consolidated dataset)

Bird species	Scientific name	NSX code	Priority level	Consolidated dataset records		
				pre–2000	2000–2016	Total records
High priority (7 species)				**9446**	**724**	**10170**
Brown Treecreeper	*Climacteris picumnus*	G04171	1	3385	241	3626
Chestnut-rumped Thornbill	*Acanthiza uropygialis*	S00481	1	280	18	298
Diamond Firetail	*Stagonopleura guttata*	A00652	1	2521	187	2708
Hooded Robin	*Melanodryas cucullata*	S00385	1	1287	88	1375
Jacky Winter	*Microeca fascinans*	S00377	1	179	44	223
Restless Flycatcher	*Myiagra inquieta*	K04173	1	217	25	242
Southern Whiteface	*Aphelocephala leucopsis*	U00466	1	1577	121	1698
Other native (231 species)				**111262**	**16356**	**127618**
Apostlebird	*Struthidea cinerea*	Z00675		8	1	9
Australasian Bittern	*Botaurus poiciloptilus*	K00197		3	2	5
Australasian Darter	*Anhinga novaehollandiae*	K00101		3	2	5
Australasian Grebe	*Tachybaptus novaehollandiae*	C00061		208	46	254
Australasian Shoveler	*Anas rhynchotis*	M04182		318	16	334
Australian Bustard	*Ardeotis australis*	A00176		2	6	8
Australian Crake (Australian Spotted Crake)	*Porzana fluminea*	K00049		5	1	6
Australian Golden Whistler (Golden Whistler)	*Pachycephala pectoralis*	E00398		315	74	389
Australian Hobby	*Falco longipennis*	Z00235		122	20	142
Australian Magpie	*Gymnorhina tibicen*	S00705		6355	874	7229
Australian Masked Owl	*Tyto novaehollandiae*	Q04248			1	1
Australian Owlet-nightjar	*Aegotheles cristatus*	S00317	2	243	33	276
Australian Painted-snipe	*Rostratula australis*	M00170		2		2
Australian Pelican	*Pelecanus conspicillatus*	U00106		38	16	54
Australian Pipit	*Anthus australis*	G00647		532	130	662
Australian Raven	*Corvus coronoides*	A04144		1334	96	1430
Australian Reed Warbler	*Acrocephalus australis*	C04233		189	28	217
Australian Ringneck	*Barnardius zonarius*	M00294		1889	97	1986
Australian Shelduck	*Tadorna tadornoides*	G00207		41	1	42
Australian White Ibis	*Threskiornis moluccus*	A04216		36	9	45
(Australian) Pied Cormorant	*Phalacrocorax varius*	G00099		46	8	54
Baillon's Crake	*Porzana pusilla*	U00050		1		1
Banded Lapwing	*Vanellus tricolor*	G00135		68	10	78
Banded Stilt	*Cladorhynchus leucocephalus*	Z00147		3	2	5
Bassian Thrush	*Zoothera lunulata*	Q04140		9	3	12
Beautiful Firetail	*Stagonopleura bella*	A04056		2		2
Black Falcon	*Falco subniger*	U00238		148	24	172
Black Honeyeater	*Sugomel niger*	S00589		15	20	35
Black Kite	*Milvus migrans*	S00229		229	18	247
Black Swan	*Cygnus atratus*	W00203		247	4	251
Black-chinned Honeyeater	*Melithreptus gularis*	A00580	2	24	14	38

Bird species	Scientific name	NSX code	Priority level	Consolidated dataset records		
				pre–2000	2000–2016	Total records
Black-eared Cuckoo	*Chalcites osculans*	S00341		13	1	14
Black-faced Cuckooshrike	*Coracina novaehollandiae*	Y04120		1106	251	1357
Black-faced Woodswallow	*Artamus cinereus*	Z04115		8	2	10
Black-fronted Dotterel	*Elseyornis melanops*	Y00144		390	32	422
Black-shouldered Kite	*Elanus axillaris*	A04196		325	104	429
Black-tailed Nativehen	*Tribonyx ventralis*	G00055		535	53	588
Blue-billed Duck	*Oxyura australis*	Y00216		118	10	128
Bluebonnet	*Northiella haematogaster*	S00297		26	2	28
Blue-faced Honeyeater	*Entomyzon cyanotis*	Y04200		1		1
Blue-winged Parrot	*Neophema chrysostoma*	M00306		10	4	14
Brown Falcon	*Falco berigora*	W00239		753	114	867
Brown Goshawk	*Accipiter fasciatus*	A04152		445	45	490
Brown Honeyeater	*Lichmera indistincta*	M04166		1		1
Brown Quail	*Coturnix ypsilophora*	G00011		10		10
Brown Songlark	*Cincloramphus cruralis*	Y00508	2	188	61	249
Brown Thornbill	*Acanthiza pusilla*	W00475		43	20	63
Brown-headed Honeyeater	*Melithreptus brevirostris*	G00583		764	138	902
Brush Bronzewing	*Phaps elegans*	U04142		15	3	18
Budgerigar	*Melopsittacus undulatus*	E00310		162	70	232
Buff-banded Rail	*Gallirallus philippensis*	E00046		6	1	7
Buff-rumped Thornbill	*Acanthiza reguloides*	E04170		210	112	322
Bush Stonecurlew	*Burhinus grallarius*	U00174		1		1
Cape Barren Goose	*Cereopsis novaehollandiae*	Y04164		1		1
Caspian Tern	*Hydroprogne caspia*	Q00112		4		4
Chestnut Teal	*Anas castanea*	U00210		33	5	38
Chestnut-backed Quailthrush (Chestnut Quailthrush)	*Cinclosoma castanotum*	K00437			1	1
Chestnut-crowned Babbler	*Pomatostomus ruficeps*	M00446		39		39
Cockatiel	*Nymphicus hollandicus*	E00274		222	93	315
Collared Sparrowhawk	*Accipiter cirrocephalus*	S04125		106	20	126
Common Bronzewing	*Phaps chalcoptera*	U00034		920	112	1032
Common Greenshank	*Tringa nebularia*	U00158		3		3
Common Sandpiper	*Actitis hypoleucos*	S00157		6		6
Crescent Honeyeater	*Phylidonyris pyrrhopterus*	M00630		289	117	406
Crested Bellbird	*Oreoica gutturalis*	G00419		30	7	37
Crested Pigeon	*Ocyphaps lophotes*	W00043		2641	434	3075
Crested Shriketit	*Falcunculus frontatus*	K04181	2	35	36	71
Crimson Chat	*Epthianura tricolor*	S00449		4	10	14
Crimson Rosella	*Platycercus elegans*	E00282		6390	741	7131
Diamond Dove	*Geopelia cuneata*	Z00031		4		4
Dusky Moorhen	*Gallinula tenebrosa*	C04145		336	16	352
Dusky Woodswallow	*Artamus cyanopterus*	W00547		624	106	730
Eastern Barn Owl	*Tyto delicatula*	C00249		77	18	95
Eastern Rosella	*Platycercus eximius*	S04177		32	6	38
Eastern Spinebill	*Acanthorhynchus tenuirostris*	W04143		313	135	448
Elegant Parrot	*Neophema elegans*	Z00307	2	117	12	129
Emu	*Dromaius novaehollandiae*	C00001		46	1	47
Eurasian Coot	*Fulica atra*	Z00059		562	40	602
Fairy Martin	*Petrochelidon ariel*	A00360		102	41	143
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	S04141		59	18	77
Flame Robin	*Petroica phoenicea*	M00382		2	3	5

Bird species	Scientific name	NSX code	Priority level	Consolidated dataset records		
				pre–2000	2000–2016	Total records
Freckled Duck	*Stictonetta naevosa*	E00214		31	6	37
Fuscous Honeyeater	*Ptilotula fusca*	K00613			1	1
Galah	*Eolophus roseicapilla*	C00273		5188	663	5851
Gang-gang Cockatoo	*Callocephalon fimbriatum*	Y00268		1		1
Gilbert's Whistler	*Pachycephala inornata*	Z00403		9	1	10
Great Cormorant	*Phalacrocorax carbo*	A00096		28	6	34
Great Egret	*Ardea alba*	G00187		13	4	17
Greater Crested Tern	*Thalasseus bergii*	W00115		1	2	3
Grey Butcherbird	*Cracticus torquatus*	W04151		279	47	326
Grey Currawong	*Strepera versicolor*	C00697		483	92	575
Grey Falcon	*Falco hypoleucos*	Q00236		1	2	3
Grey Fantail	*Rhipidura albiscapa*	C00361		952	186	1138
Grey Shrikethrush	*Colluricincla harmonica*	A00408		3282	353	3635
Grey Teal	*Anas gracilis*	Y04148		722	68	790
Grey-fronted Honeyeater	*Ptilotula plumula*	Z00623		3	2	5
Ground Cuckooshrike	*Coracina maxima*	W00423		4		4
Hardhead	*Aythya australis*	G00215		415	27	442
Hoary-headed Grebe	*Poliocephalus poliocephalus*	E00062		395	29	424
Horsfield's Bronze Cuckoo	*Chalcites basalis*	U00342		306	102	408
Horsfield's Bush Lark	*Mirafra javanica*	Y00648		148	28	176
Inland Thornbill	*Acanthiza apicalis*	A00476		4	3	7
Intermediate Egret	*Ardea intermedia*	E00186		3		3
Kerguelen Petrel	*Aphrodroma brevirostris*	W00935			1	1
Laughing Kookaburra	*Dacelo novaeguineae*	S04169		1220	311	1531
Lewin's Rail	*Lewinia pectoralis*	Z04203		1		1
Little Black Cormorant	*Phalacrocorax sulcirostris*	C00097		51	8	59
Little Buttonquail	*Turnix velox*	U00018		66	2	68
Little Corella	*Cacatua sanguinea*	W00271		535	91	626
Little Crow	*Corvus bennetti*	Z00691			1	1
Little Eagle	*Hieraaetus morphnoides*	K04077		90	10	100
Little Grassbird	*Megalurus gramineus*	E00522		78	11	89
Little Lorikeet	*Glossopsitta pusilla*	Q00260		3		3
Little Pied Cormorant	*Microcarbo melanoleucos*	C04137		180	64	244
Little Raven	*Corvus mellori*	E00954		2705	499	3204
Little Wattlebird	*Anthochaera chrysoptera*	G04163		114	48	162
Long-billed Corella	*Cacatua tenuirostris*	A00272		122	3	125
Magpielark	*Grallina cyanoleuca*	W00415		1891	450	2341
Major Mitchell's Cockatoo	*Cacatua leadbeateri*	U00270		1		1
Maned Duck (Australian Wood Duck)	*Chenonetta jubata*	U00202		1305	176	1481
Marsh Sandpiper	*Tringa stagnatilis*	W00159		1		1
Masked Lapwing	*Vanellus miles*	G04219		721	78	799
Masked Woodswallow	*Artamus personatus*	Q00544		110	42	152
Mistletoebird	*Dicaeum hirundinaceum*	U04150		471	107	578
Mulga Parrot	*Psephotus varius*	Q00296		14	12	26
Musk Duck	*Biziura lobata*	K00217		35	1	36
Musk Lorikeet	*Glossopsitta concinna*	E00258		1173	184	1357
Nankeen Kestrel	*Falco cenchroides*	C04129		536	180	716
Nankeen Night Heron	*Nycticorax caledonicus*	A00192		118	3	121
New Holland Honeyeater	*Phylidonyris novaehollandiae*	U04126		2534	289	2823
Noisy Friarbird	*Philemon corniculatus*	Y04228		3		3

Bird species	Scientific name	NSX code	Priority level	Consolidated dataset records		
				pre–2000	2000–2016	Total records
Noisy Miner	*Manorina melanocephala*	U00634		836	162	998
Olive-backed Oriole	*Oriolus sagittatus*	G00671		1		1
Oriental Dollarbird	*Eurystomus orientalis*	U00318			3	3
Oriental Plover	*Charadrius veredus*	E00142			1	1
Pacific Black Duck	*Anas superciliosa*	E04146		1229	121	1350
Pacific Swift (Fork-tailed Swift)	*Apus pacificus*	W04179		4		4
Painted Buttonquail	*Turnix varius*	U04178		32	6	38
Pallid Cuckoo	*Cacomantis pallidus*	C00337		72	29	101
Peaceful Dove	*Geopelia placida*	Q04168	2	933	88	1021
Peregrine Falcon	*Falco peregrinus*	S00237		150	9	159
Pied Butcherbird	*Cracticus nigrogularis*	Y00700		20		20
Pied Honeyeater	*Certhionyx variegatus*	E00602		3	8	11
Pink-eared Duck	*Malacorhynchus membranaceus*	C00213		297	20	317
Purple Swamphen	*Porphyrio porphyrio*	M00058		35	8	43
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*	G00259		1390	153	1543
Purple-gaped Honeyeater	*Lichenostomus cratitius*	Y00620		3	8	11
Rainbow Bee-eater	*Merops ornatus*	C00329	2	724	94	818
Rainbow Lorikeet	*Trichoglossus haematodus*	U00254		159	4	163
Red Wattlebird	*Anthochaera carunculata*	W04127		3155	465	3620
Red-backed Kingfisher	*Todiramphus pyrrhopygius*	S00325		18	16	34
Red-browed Finch	*Neochmia temporalis*	G04075		234	127	361
Red-capped Robin	*Petroica goodenovii*	K00381		1069	85	1154
Red-chested Buttonquail	*Turnix pyrrhothorax*	W00019			1	1
Red-kneed Dotterel	*Erythrogonys cinctus*	A00132		137	9	146
Red-necked Avocet	*Recurvirostra novaehollandiae*	Q00148		56	1	57
Red-necked Stint	*Calidris ruficollis*	M00162		3		3
Red-rumped Parrot	*Psephotus haematonotus*	Z00295		3251	422	3673
Redthroat	*Pyrrholaemus brunneus*	K00497			2	2
Regent Parrot	*Polytelis anthopeplus*	U04206			3	3
Rose Robin	*Petroica rosea*	Q00384		2		2
Royal Spoonbill	*Platalea regia*	S00181		4		4
Rufous Songlark	*Cincloramphus mathewsi*	K00509	2	365	35	400
Rufous Whistler	*Pachycephala rufiventris*	K04149		1306	191	1497
Sacred Kingfisher	*Todiramphus sanctus*	U00326	2	148	44	192
Scarlet Robin	*Petroica boodang*	Y00380		134	102	236
Scarlet-chested Parrot	*Neophema splendida*	G00303			1	1
Sharp-tailed Sandpiper	*Calidris acuminata*	Z00163		5		5
Shining Bronze Cuckoo	*Chalcites lucidus*	A00344		11	4	15
Shy Heathwren	*Calamanthus (Hylacola) cautus*	Z00499		3	3	6
Silver Gull	*Chroicocephalus novaehollandiae*	C04065		29	2	31
Silvereye	*Zosterops lateralis*	E00574		527	169	696
Singing Honeyeater	*Gavicalis virescens*	Q00608		3382	271	3653
Southern Boobook	*Ninox boobook*	M00242		205	36	241
Southern Scrub Robin	*Drymodes brunneopygia*	C00441		15	5	20
Spinifex Pigeon	*Geophaps plumifera*	U00042		1		1
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	S04117		961	86	1047
Splendid Fairywren	*Malurus splendens*	Y00532		1		1
Spotless Crake	*Porzana tabuensis*	W00051		2		2
Spotted Harrier	*Circus assimilis*	M00218		160	11	171
Spotted Nightjar	*Eurostopodus argus*	Z00331		7	4	11
Spotted Pardalote	*Pardalotus punctatus*	G04227		230	68	298

Bird species	Scientific name	NSX code	Priority level	Consolidated dataset records		
				pre–2000	2000–2016	Total records
Spotted Quailthrush	*Cinclosoma punctatum*	K04229			1	1
Square-tailed Kite	*Lophoictinia isura*	E00230		17	2	19
Straw-necked Ibis	*Threskiornis spinicollis*	Q00180		40	19	59
Striated Pardalote	*Pardalotus striatus*	Q00976		3959	470	4429
Striated Thornbill	*Acanthiza lineata*	M00470		262	122	384
Striped Honeyeater	*Plectorhyncha lanceolata*	K00585		17	1	18
Stubble Quail	*Coturnix pectoralis*	A04240		175	19	194
Sulphur-crested Cockatoo	*Cacatua galerita*	Q04176		426	103	529
Superb Fairywren	*Malurus cyaneus*	S00529		1081	201	1282
Swamp Harrier	*Circus approximans*	Z00219		17	6	23
Tawny Frogmouth	*Podargus strigoides*	K00313		61	15	76
Tawny-crowned Honeyeater	*Gliciphila melanops*	K00593		15	23	38
Tree Martin	*Petrochelidon nigricans*	A04128		2063	318	2381
Varied Sittella	*Daphoenositta chrysoptera*	C00549	2	493	73	566
Variegated Fairywren	*Malurus lamberti*	Q00536		742	30	772
Wedge-tailed Eagle	*Aquila audax*	G04139		479	78	557
Weebill	*Smicrornis brevirostris*	S00465		1417	147	1564
Welcome Swallow	*Hirundo neoxena*	K00357		1457	329	1786
Western Gerygone	*Gerygone fusca*	Z00463			2	2
Whistling Kite	*Haliastur sphenurus*	Q00228		108	19	127
White-backed Swallow	*Cheramoeca leucosterna*	M00358		5	2	7
White-bellied Sea Eagle	*Haliaeetus leucogaster*	M00226		2		2
White-breasted Woodswallow	*Artamus leucorynchus*	Z00543			1	1
White-browed Babbler	*Pomatostomus superciliosus*	K00445	2	2117	204	2321
White-browed Scrubwren	*Sericornis frontalis*	G04251		18	4	22
White-browed Treecreeper	*Climacteris affinis*	S00561		2	1	3
White-browed Woodswallow	*Artamus superciliosus*	S00545		194	48	242
White-eared Honeyeater	*Nesoptilotis leucotis*	E04218		4	7	11
White-faced Heron	*Egretta novaehollandiae*	G04199		627	110	737
White-fronted Chat	*Epthianura albifrons*	Z04131		180	77	257
White-fronted Honeyeater	*Purnella albifrons*	M00594		124	51	175
White-headed Stilt	*Himantopus leucocephalus*	M00146		119	11	130
White-naped Honeyeater	*Melithreptus lunatus*	S04133		269	119	388
White-necked Heron	*Ardea pacifica*	K00189		44	7	51
White-plumed Honeyeater	*Ptilotula penicillata*	S00625		4516	541	5057
White-throated Needletail	*Hirundapus caudacutus*	Q04184			4	4
White-throated Treecreeper	*Cormobates leucophaea*	Y04172		168	92	260
White-winged Chough	*Corcorax melanorhamphos*	S00693	2	2385	159	2544
White-winged Fairywren	*Malurus leucopterus*	Z00535		5		5
White-winged Tern	*Chlidonias leucopterus*	C00109			24	24
White-winged Triller	*Lalage tricolor*	Z04255	2	232	26	258
Willie Wagtail	*Rhipidura leucophrys*	M04114		4378	562	4940
Yellow Thornbill	*Acanthiza nana*	Z00471		1524	83	1607
Yellow-billed Spoonbill	*Platalea flavipes*	U00182		42	1	43
Yellow-faced Honeyeater	*Caligavis chrysops*	M00614		339	124	463
Yellow-plumed Honeyeater	*Ptilotula ornata*	M00622		117	36	153
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	E00486		2276	383	2659
Yellow-tailed Black Cockatoo	*Calyptorhynchus funereus*	G00267		15		15
Yellow-throated Miner	*Manorina flavigula*	U04118		390	44	434
Zebra Finch	*Taeniopygia guttata*	C00653	2	124	36	160

Bird species	Scientific name	NSX code	Priority level	Consolidated dataset records		
				pre–2000	2000–2016	Total records
Non-native (11 species)				**7566**	**1770**	**9336**
Common Blackbird	*Turdus merula*	W04135		1014	225	1239
Common Starling	*Sturnus vulgaris*	M04130		2804	590	3394
Eurasian Skylark	*Alauda arvensis*	S00993		186	61	247
European (Common) Greenfinch	*Chloris chloris*	Z04175		29	4	33
European Goldfinch	*Carduelis carduelis*	A00996		511	130	641
Feral Pigeon (Rock Dove)	*Columba livia*	K00957		470	139	609
Greylag Goose	*Anser anser*	W04531		19	2	21
House Sparrow	*Passer domesticus*	Q04116		1894	482	2376
Mallard (Northern Mallard)	*Anas platyrhynchos*	Y00948		36	4	40
Muscovy Duck	*Cairina moschata*	C04533		16	2	18
Spotted Dove	*Spilopelia chinensis*	C00989		587	131	718
Total (249 species)				**128274**	**18850**	**147124**

B. Medium priority (level 2) species responses to environment

Table 5.2. Response of Australian Owlet-nightjar to environmental variables in the north-eastern Mount Lofty Ranges

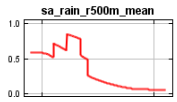
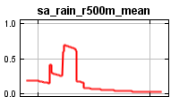
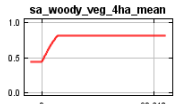
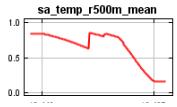
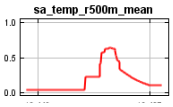
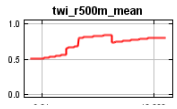
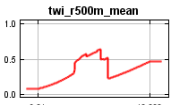
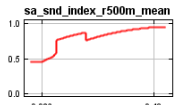
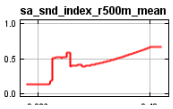
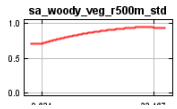
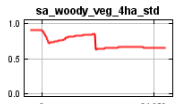
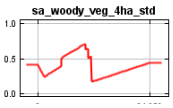
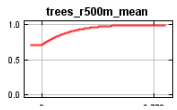
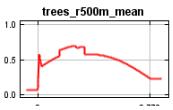
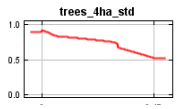
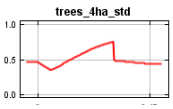
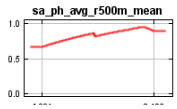
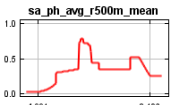
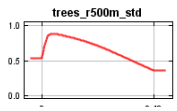
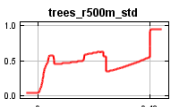
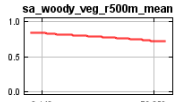
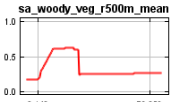
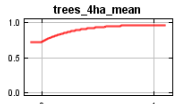
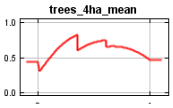
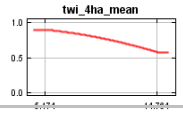
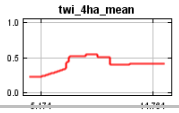
Environmental variable	MaxEnt model (n=97, AUC=0.981)			
	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	50	40.8		
Woody vegetation cover, local	25.2	15		
Temperature	7.7	2.4		
Topographic wetness, landscape	4.2	4.3		
Soil texture, landscape	2.7	6.4		
Woody veg. cover, landscape variability	2.5	2.3		
Woody vegetation cover, local variability	1.6	4		
Tree crown cover, landscape	1.4	7.1		
Tree crown cover, local variability	1.3	3		
Soil pH, landscape	1	2.6		
Tree crown cover, landscape variability	0.8	3.9		
Woody vegetation cover, landscape	0.8	1		
Tree crown cover, local	0.5	6.6		
Topographic wetness, local	0.5	0.5		

Table 5.3. Response of Black-chinned Honeyeater to environmental variables in the north-eastern Mount Lofty Ranges

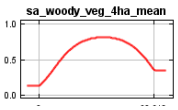
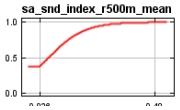
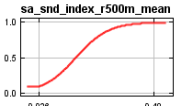
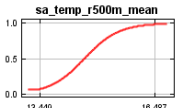
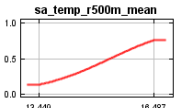
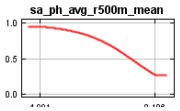
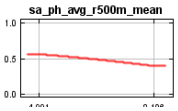
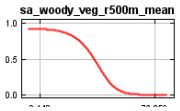
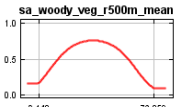
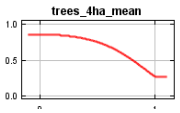
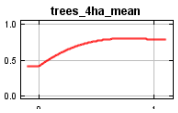
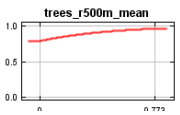
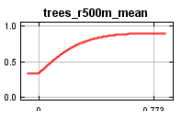
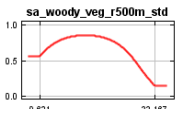
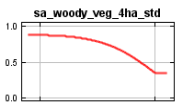
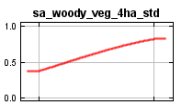
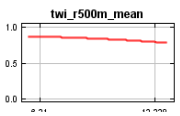
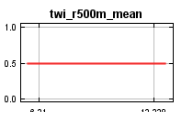
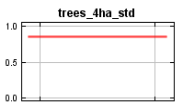
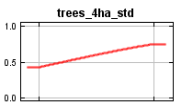
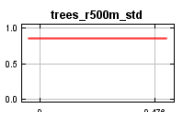
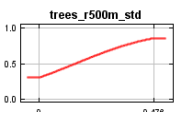
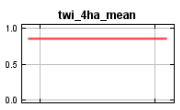
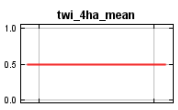
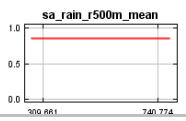
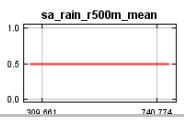
	MaxEnt model (n=12, AUC=0.978)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Woody vegetation cover, local	38.1	51.7		
Soil texture, landscape	24.2	0		
Temperature	22.1	26.4		
Soil pH, landscape	5.8	10.3		
Woody vegetation cover, landscape	4	7		
Tree crown cover, local	1.8	0.1		
Tree crown cover, landscape	1.5	0.7		
Woody veg. cover, landscape variability	1.2	1.8		
Woody vegetation cover, local variability	0.8	1.5		
Topographic wetness, landscape	0.5	0.4		
Tree crown cover, local variability	0	0		
Tree crown cover, landscape variability	0	0		
Topographic wetness, local	0	0		
Rainfall	0	0		

Table 5.4. Response of Brown Songlark to environmental variables in the north-eastern Mount Lofty Ranges

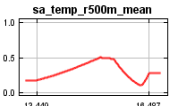
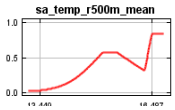
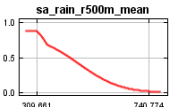
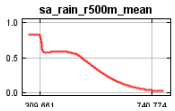
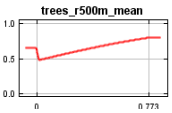
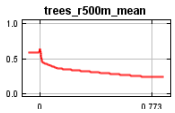
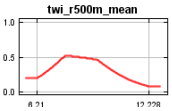
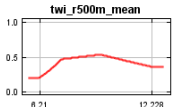
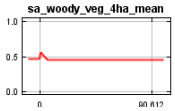
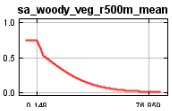
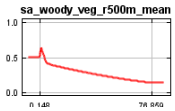
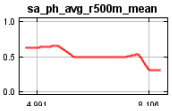
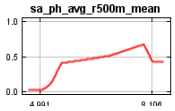
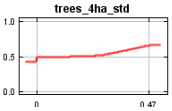
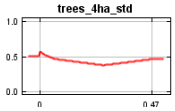
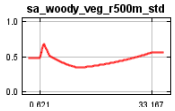
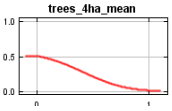
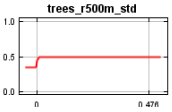
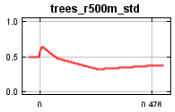
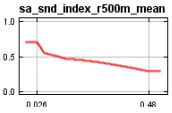
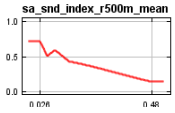
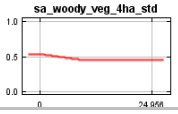
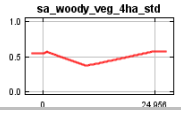
	MaxEnt model (n=65, AUC=0.823)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Temperature	41.6	11.5		
Rainfall	21	28		
Tree crown cover, landscape	10.7	0.7		
Topographic wetness, landscape	6.3	7.8		
Woody vegetation cover, local	5.8	22.7		
Woody vegetation cover, landscape	4.7	13.5		
Soil pH, landscape	4.2	6.4		
Tree crown cover, local variability	1.8	1.3		
Woody veg. cover, landscape variability	1.3	2.2		
Tree crown cover, local	0.9	2		
Topographic wetness, local	0.8	1.5		
Tree crown cover, landscape variability	0.5	0.9		
Soil texture, landscape	0.3	1		
Woody vegetation cover, local variability	0.1	0.6		

Table 5.5. Response of Crested Shriketit to environmental variables in the north-eastern Mount Lofty Ranges

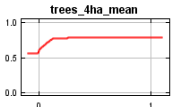
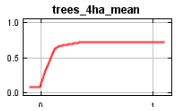
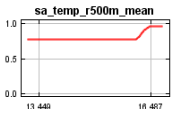
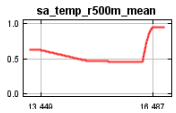
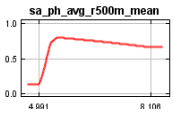
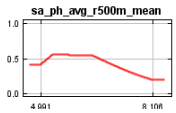
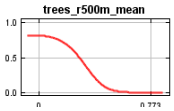
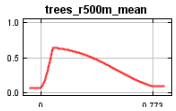
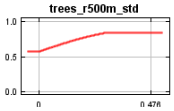
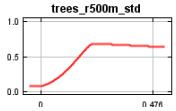
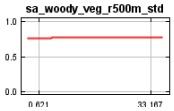
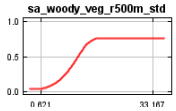
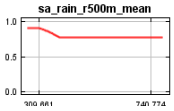
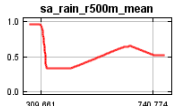
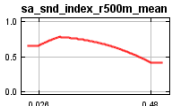
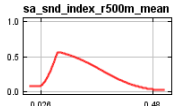
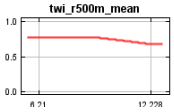
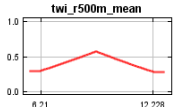
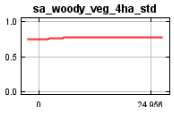
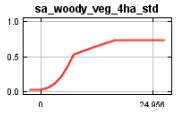
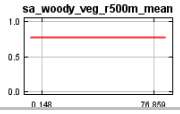
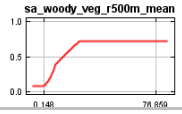
Environmental variable	MaxEnt model (n=18, AUC=0.955)			
	Percent contribution	Permutation importance	Single response curve	Combined response curve
Woody vegetation cover, local	55.9	76.2		
Tree crown cover, local	13.2	0		
Temperature	8.6	4.2		
Tree crown cover, local variability	6	0		
Soil pH, landscape	5.6	6.5		
Tree crown cover, landscape	4.8	4.9		
Topographic wetness, local	4.1	7.2		
Tree crown cover, landscape variability	1.1	0		
Woody veg. cover, landscape variability	0.4	0.2		
Rainfall	0.2	0		
Soil texture, landscape	0.1	0.8		
Topographic wetness, landscape	0	0		
Woody vegetation cover, local variability	0	0		
Woody vegetation cover, landscape	0	0		

Table 5.6. Response of Elegant Parrot to environmental variables in the north-eastern Mount Lofty Ranges

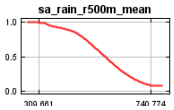
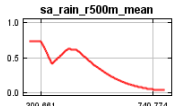
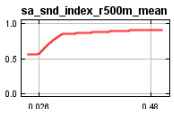
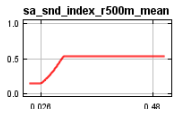
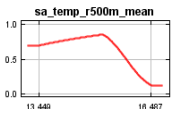
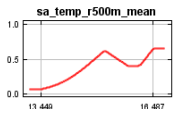
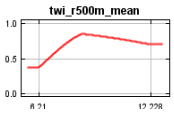
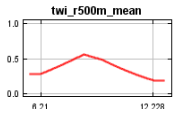
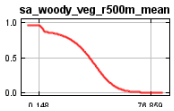
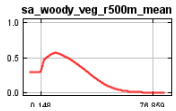
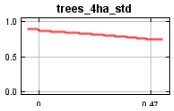
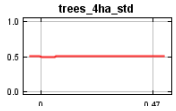
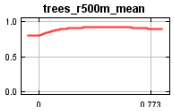
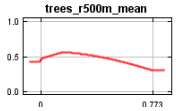
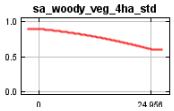
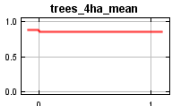
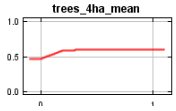
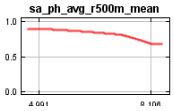
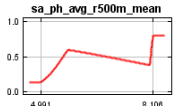
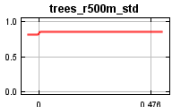
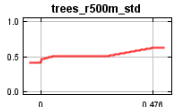
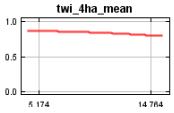
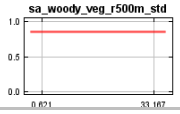
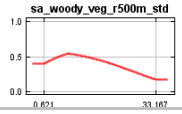
	MaxEnt model (n=37, AUC=0.885)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	43.3	24.1		
Woody vegetation cover, local	28	44		
Soil texture, landscape	8.2	3.4		
Temperature	7.3	7.5		
Topographic wetness, landscape	6.2	4.3		
Woody vegetation cover, landscape	1.6	8.2		
Tree crown cover, local variability	1.5	0.1		
Tree crown cover, landscape	1.3	3.2		
Woody vegetation cover, local variability	1.3	2.6		
Tree crown cover, local	0.6	0.2		
Soil pH, landscape	0.5	1.7		
Tree crown cover, landscape variability	0.1	0.1		
Topographic wetness, local	0.1	0.7		
Woody veg. cover, landscape variability	0	0		

Table 5.7. Response of Peaceful Dove to environmental variables in the north-eastern Mount Lofty Ranges

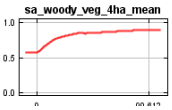
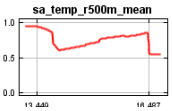
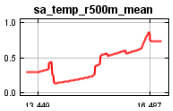
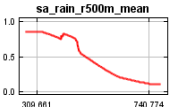
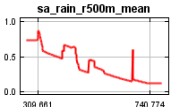
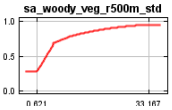
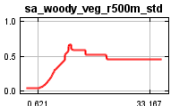
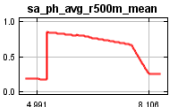
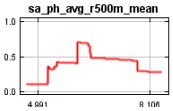
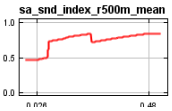
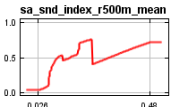
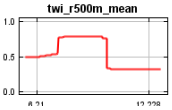
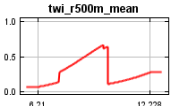
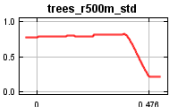
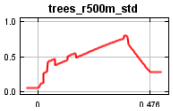
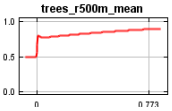
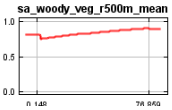
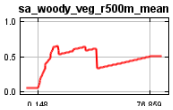
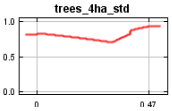
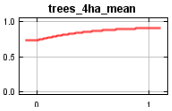
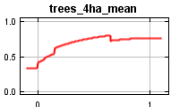
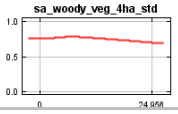
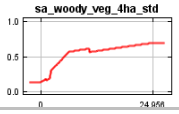
	MaxEnt model (n=242, AUC=0.937)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Woody vegetation cover, local	28.1	9		
Temperature	21	4.2		
Rainfall	15.8	39.5		
Woody veg. cover, landscape variability	12.6	15.1		
Soil pH, landscape	5.2	14.7		
Soil texture, landscape	5	2.1		
Topographic wetness, landscape	5	6.7		
Tree crown cover, landscape variability	2.5	1		
Tree crown cover, landscape	1.9	3.9		
Woody vegetation cover, landscape	1.4	0.9		
Topographic wetness, local	0.7	0.7		
Tree crown cover, local variability	0.6	1		
Tree crown cover, local	0.3	1		
Woody vegetation cover, local variability	0.1	0.3		

Table 5.8. Response of Rainbow Bee-eater to environmental variables in the north-eastern Mount Lofty Ranges

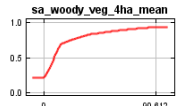
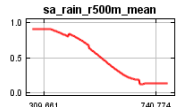
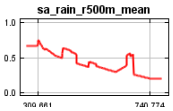
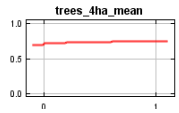
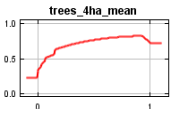
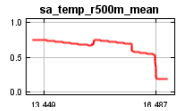
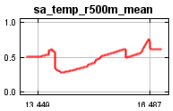
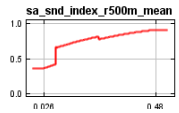
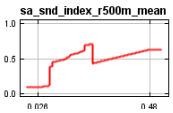
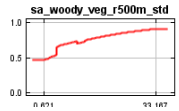
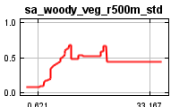
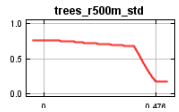
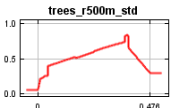
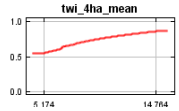
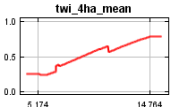
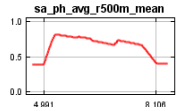
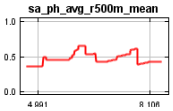
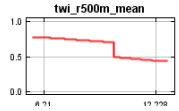
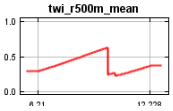
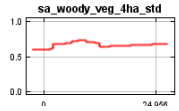
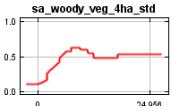
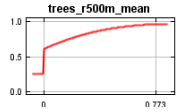
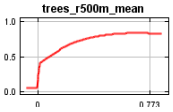
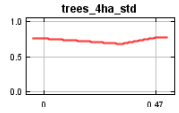
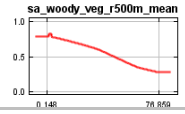
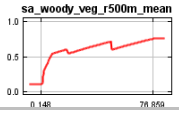
	MaxEnt model (n=268, AUC=0.911)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Woody vegetation cover, local	41.2	34.8		
Rainfall	21.9	29.5		
Tree crown cover, local	8.2	0.3		
Temperature	5.7	1.7		
Soil texture, landscape	5.2	7.3		
Woody veg. cover, landscape variability	3.7	4.5		
Tree crown cover, landscape variability	2.7	1.1		
Topographic wetness, local	2.5	1.5		
Soil pH, landscape	2.3	3.1		
Topographic wetness, landscape	2.1	1.1		
Woody vegetation cover, local variability	1.9	1.3		
Tree crown cover, landscape	1.2	11.4		
Tree crown cover, local variability	1	0.5		
Woody vegetation cover, landscape	0.6	1.8		

Table 5.9. Response of Rufous Songlark to environmental variables in the north-eastern Mount Lofty Ranges

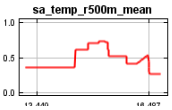
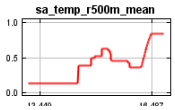
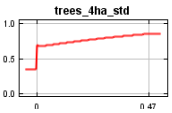
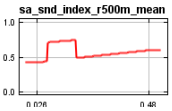
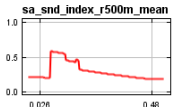
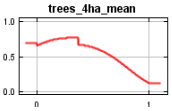
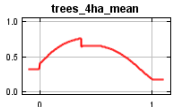
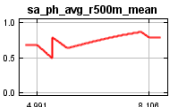
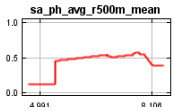
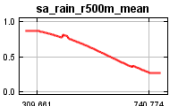
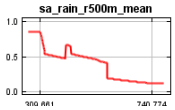
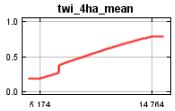
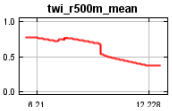
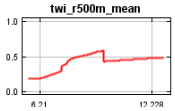
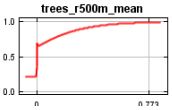
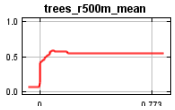
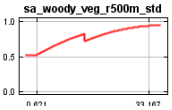
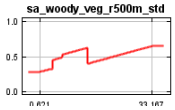
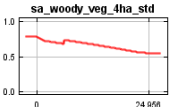
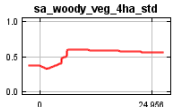
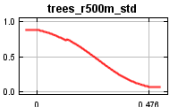
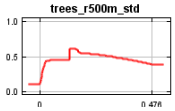
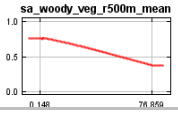
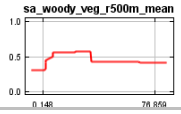
Environmental variable	MaxEnt model (n=92, AUC=0.918)			
	Percent contribution	Permutation importance	Single response curve	Combined response curve
Temperature	32.2	10		
Woody vegetation cover, local	18.5	13.3		
Tree crown cover, local variability	10.6	13.9		
Soil texture, landscape	7.9	5.5		
Tree crown cover, local	6.3	4.7		
Soil pH, landscape	5.3	5.4		
Rainfall	5.3	9.6		
Topographic wetness, local	3.6	1.4		
Topographic wetness, landscape	3.4	3.7		
Tree crown cover, landscape	1.8	8.2		
Woody veg. cover, landscape variability	1.6	10.6		
Woody vegetation cover, local variability	1.6	0.9		
Tree crown cover, landscape variability	1.6	8.7		
Woody vegetation cover, landscape	0.3	4.2		

Table 5.10. Response of Sacred Kingfisher to environmental variables in the north-eastern Mount Lofty Ranges

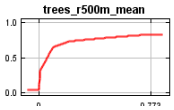
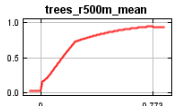
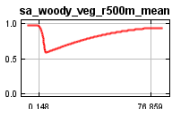
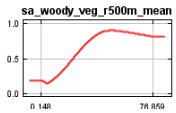
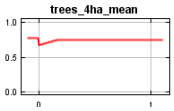
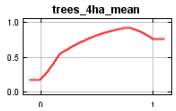
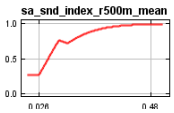
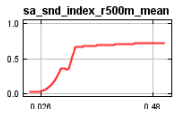
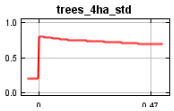
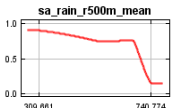
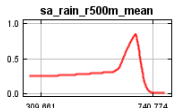
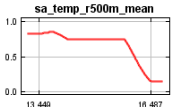
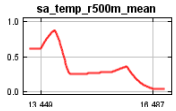
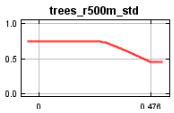
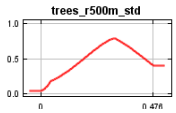
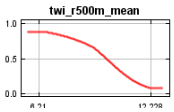
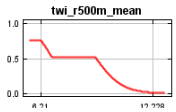
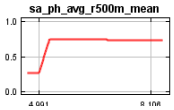
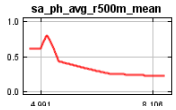
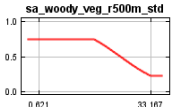
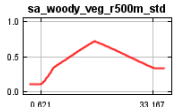
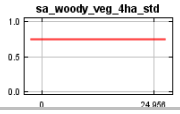
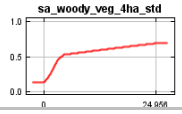
Environmental variable	MaxEnt model (n=73, AUC=0.943)			
	Percent contribution	Permutation importance	Single response curve	Combined response curve
Tree crown cover, landscape	42.3	38.1		
Woody vegetation cover, local	28.8	5.1		
Woody vegetation cover, landscape	6.6	17.9		
Tree crown cover, local	5.2	0.5		
Soil texture, landscape	4.7	5.4		
Tree crown cover, local variability	3.7	22.8		
Rainfall	2.6	3.4		
Temperature	1.8	2		
Tree crown cover, landscape variability	1.6	0.3		
Topographic wetness, landscape	1.1	2.6		
Soil pH, landscape	0.8	1.7		
Topographic wetness, local	0.8	0		
Woody veg. cover, landscape variability	0	0.2		
Woody vegetation cover, local variability	0	0		

Table 5.11. Response of Varied Sittella to environmental variables in the north-eastern Mount Lofty Ranges

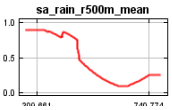
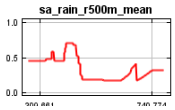
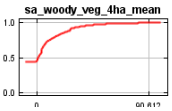
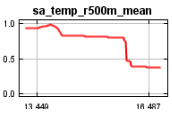
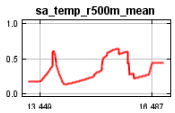
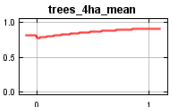
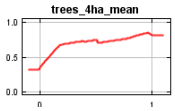
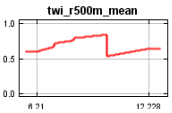
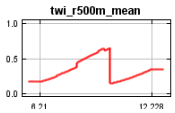
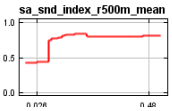
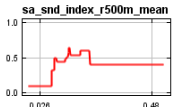
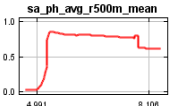
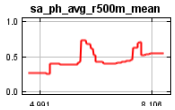
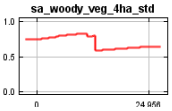
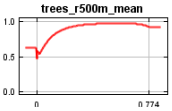
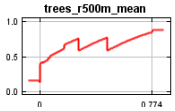
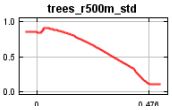
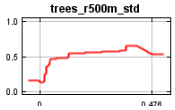
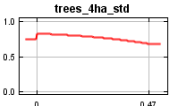
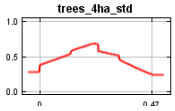
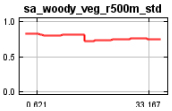
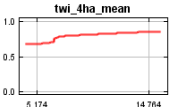
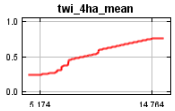
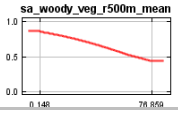
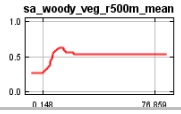
Environmental variable	MaxEnt model (n=179, AUC=0.957)			
	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	38.8	41.1		
Woody vegetation cover, local	30.3	17		
Temperature	7	8		
Tree crown cover, local	4.8	1		
Topographic wetness, landscape	4.4	1.6		
Soil texture, landscape	3.7	5.6		
Soil pH, landscape	3	3.7		
Woody vegetation cover, local variability	1.9	1.3		
Tree crown cover, landscape	1.5	13.5		
Tree crown cover, landscape variability	1.5	5.8		
Tree crown cover, local variability	1.2	0.4		
Woody veg. cover, landscape variability	1.1	0.1		
Topographic wetness, local	0.7	0.1		
Woody vegetation cover, landscape	0.2	0.7		

Table 5.12. Response of White-browed Babbler to environmental variables in the north-eastern Mount Lofty Ranges

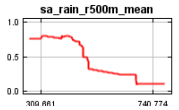
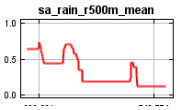
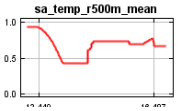
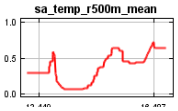
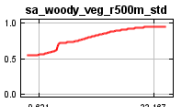
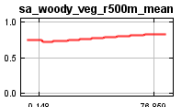
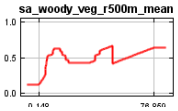
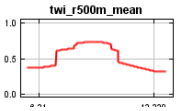
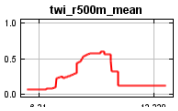
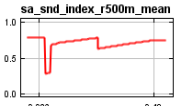
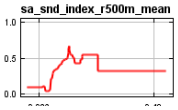
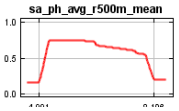
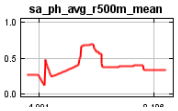
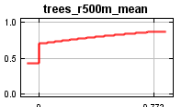
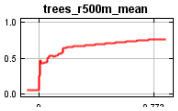
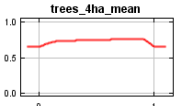
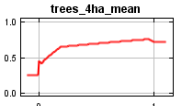
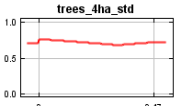
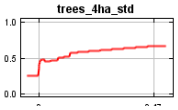
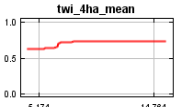
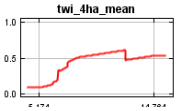
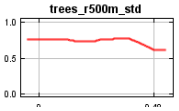
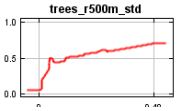
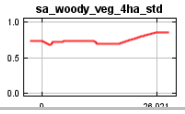
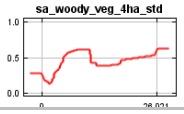
Environmental variable	MaxEnt model (n=743, AUC=0.935)			
	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	39.5	48.5		
Woody vegetation cover, local	24.3	11.7		
Temperature	8.4	7.5		
Woody veg. cover, landscape variability	7.8	5.6		
Woody vegetation cover, landscape	4.7	0.5		
Topographic wetness, landscape	4.1	3.9		
Soil texture, landscape	3.5	9.4		
Soil pH, landscape	2.7	4.8		
Tree crown cover, landscape	2.2	5.4		
Tree crown cover, local	1.4	1		
Tree crown cover, local variability	0.6	0.9		
Topographic wetness, local	0.4	0.1		
Tree crown cover, landscape variability	0.3	0.4		
Woody vegetation cover, local variability	0.1	0.4		

Table 5.13. Response of White-winged Chough to environmental variables in the north-eastern Mount Lofty Ranges

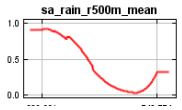
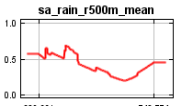
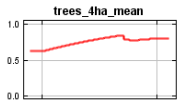
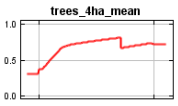
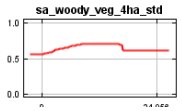
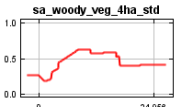
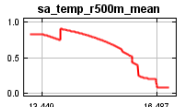
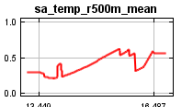
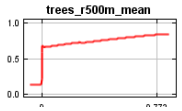
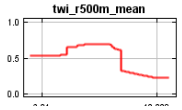
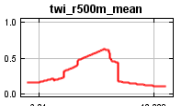
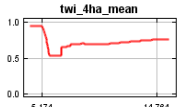
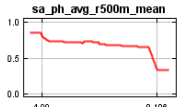
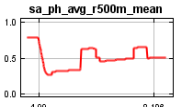
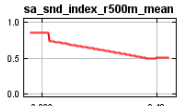
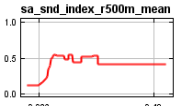
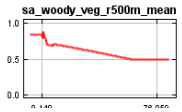
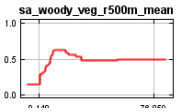
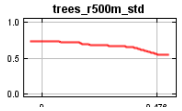
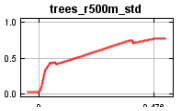
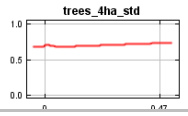
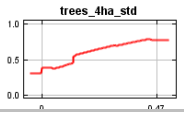
	MaxEnt model (n=481, AUC=0.912)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	32.1	49.4		
Woody vegetation cover, local	29	13.3		
Tree crown cover, local	13	1.7		
Woody vegetation cover, local variability	7.3	2		
Temperature	4.8	9.5		
Tree crown cover, landscape	3.2	6.7		
Topographic wetness, landscape	3	2.6		
Topographic wetness, local	2.4	0.9		
Soil pH, landscape	1.3	1.1		
Woody veg. cover, landscape variability	1.3	7.7		
Soil texture, landscape	0.9	0.5		
Woody vegetation cover, landscape	0.8	3.4		
Tree crown cover, landscape variability	0.5	0.3		
Tree crown cover, local variability	0.4	0.8		

Table 5.14. Response of White-winged Triller to environmental variables in the north-eastern Mount Lofty Ranges

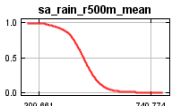
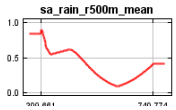
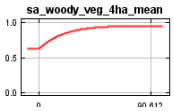
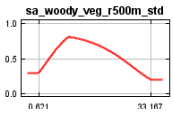
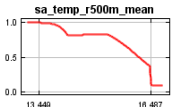
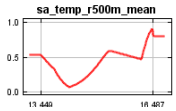
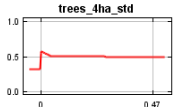
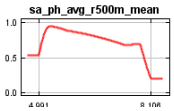
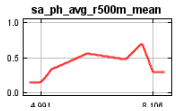
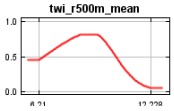
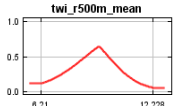
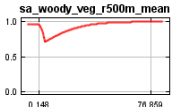
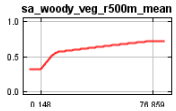
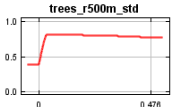
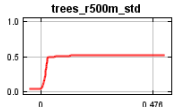
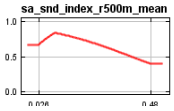
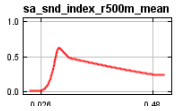
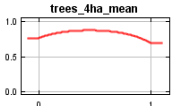
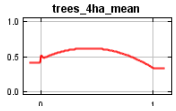
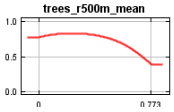
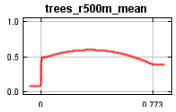
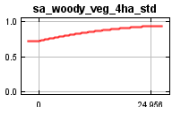
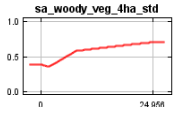
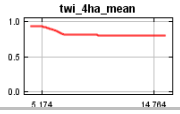
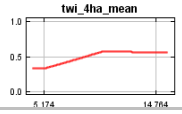
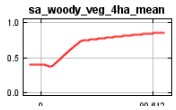
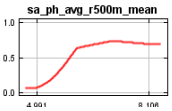
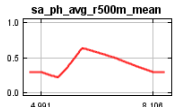
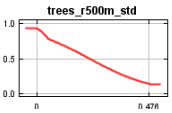
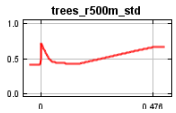
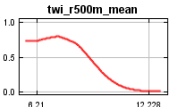
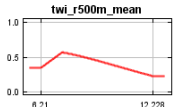
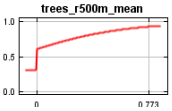
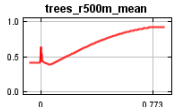
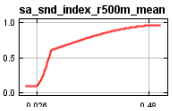
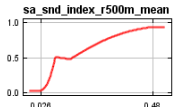
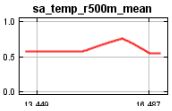
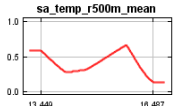
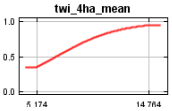
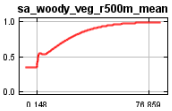
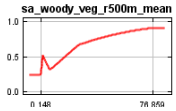
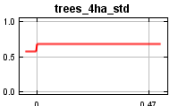
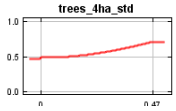
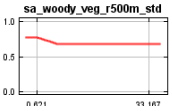
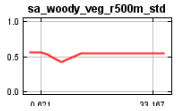
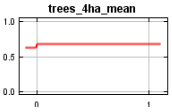
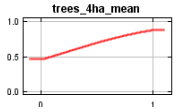
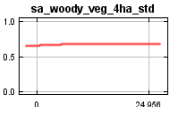
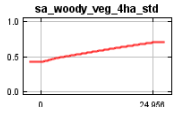
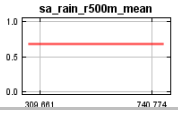
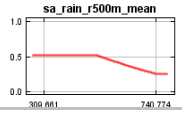
	MaxEnt model (n=78, AUC=0.937)			
Environmental variable	Percent contribution	Permutation importance	Single response curve	Combined response curve
Rainfall	37	56.4		
Woody vegetation cover, local	22	6		
Woody veg. cover, landscape variability	9.1	6.4		
Temperature	8.8	6.8		
Tree crown cover, local variability	5.2	2.8		
Soil pH, landscape	4.9	6.3		
Topographic wetness, landscape	4.1	1.7		
Woody vegetation cover, landscape	3.3	6.5		
Tree crown cover, landscape variability	2.2	3.9		
Soil texture, landscape	1.6	0		
Tree crown cover, local	1	1.7		
Tree crown cover, landscape	0.4	0.1		
Woody vegetation cover, local variability	0.3	1		
Topographic wetness, local	0.1	0.3		

Table 5.15. Response of Zebra Finch to environmental variables in the north-eastern Mount Lofty Ranges

Environmental variable	MaxEnt model (n=38, AUC=0.905)			
	Percent contribution	Permutation importance	Single response curve	Combined response curve
Woody vegetation cover, local	29	12.1		
Soil pH, landscape	22.7	24.8		
Tree crown cover, landscape variability	10.1	7.1		
Topographic wetness, landscape	9	16.1		
Tree crown cover, landscape	8.6	6		
Soil texture, landscape	7.3	10.5		
Temperature	4.9	2.7		
Topographic wetness, local	3.7	5.6		
Woody vegetation cover, landscape	2.7	12.5		
Tree crown cover, local variability	1.2	1.6		
Woody veg. cover, landscape variability	0.8	0		
Tree crown cover, local	0.1	0.2		
Woody vegetation cover, local variability	0	0.8		
Rainfall	0	0		

C. Medium priority (level 2) species distributions

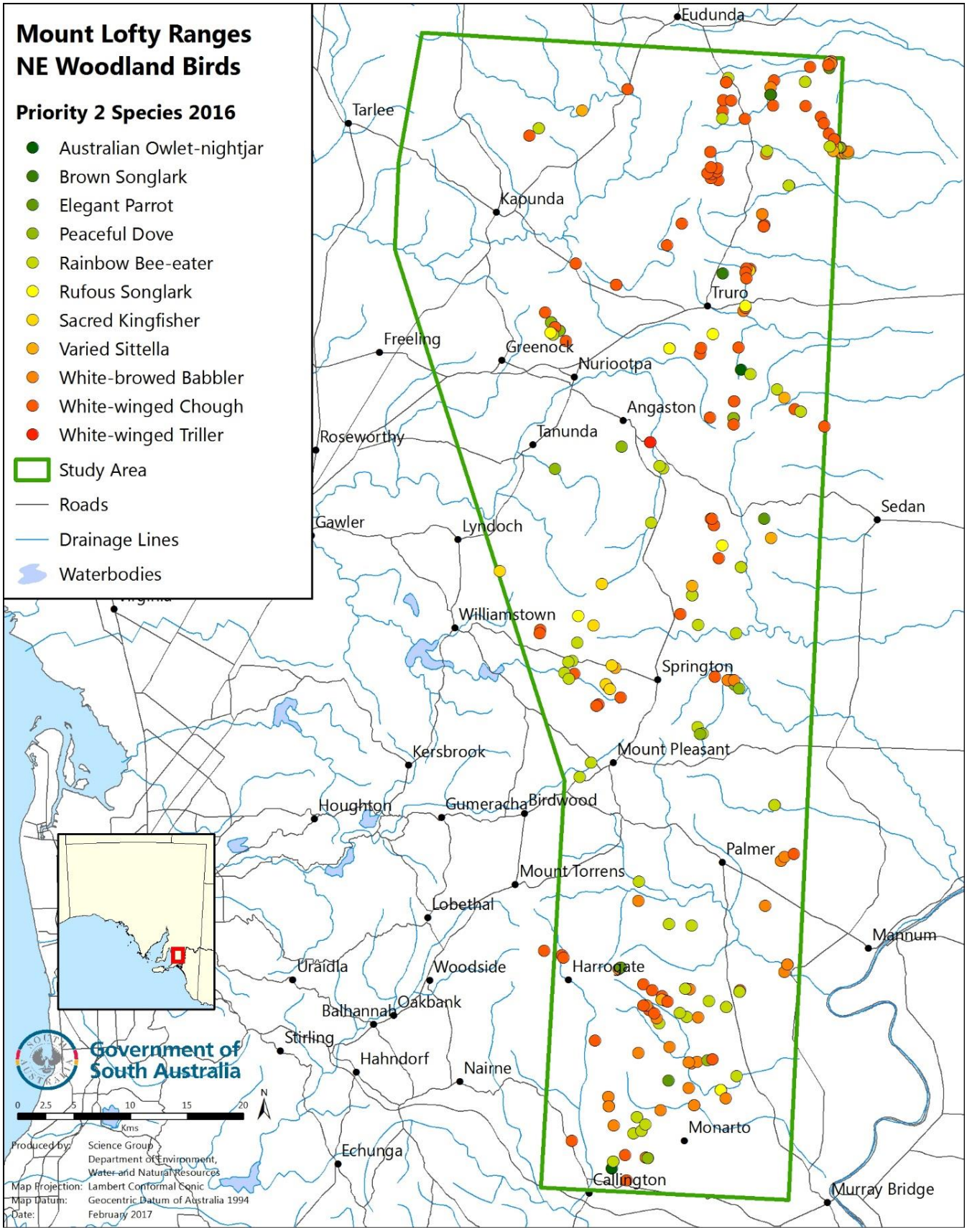


Figure 5.1. Medium priority (level 2) species observations from DEWNR SIG 2016 surveys in the north-eastern Mount Lofty Ranges

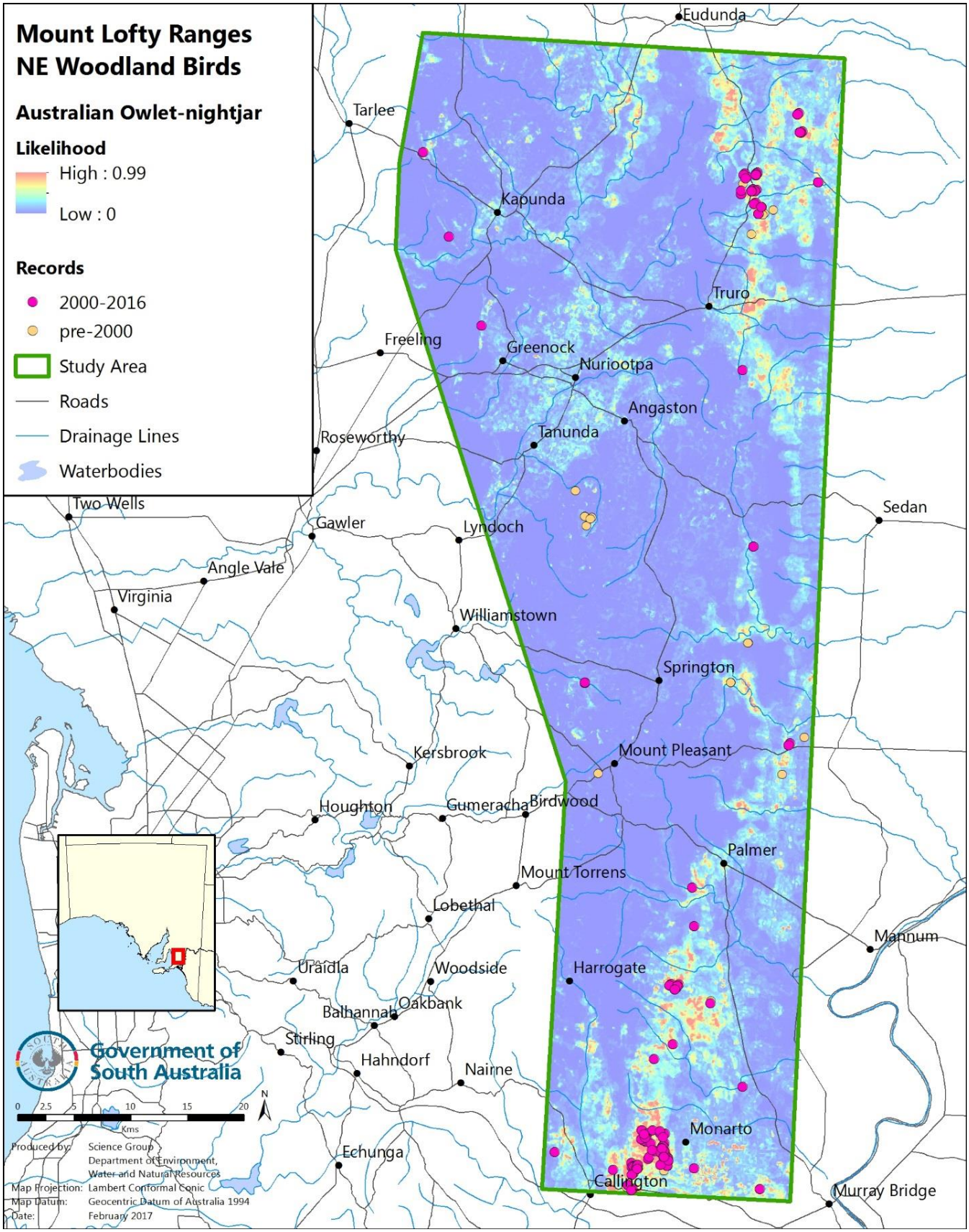


Figure 5.2. Potential distribution of Australian Owlet-nightjar in the north-eastern Mount Lofty Ranges

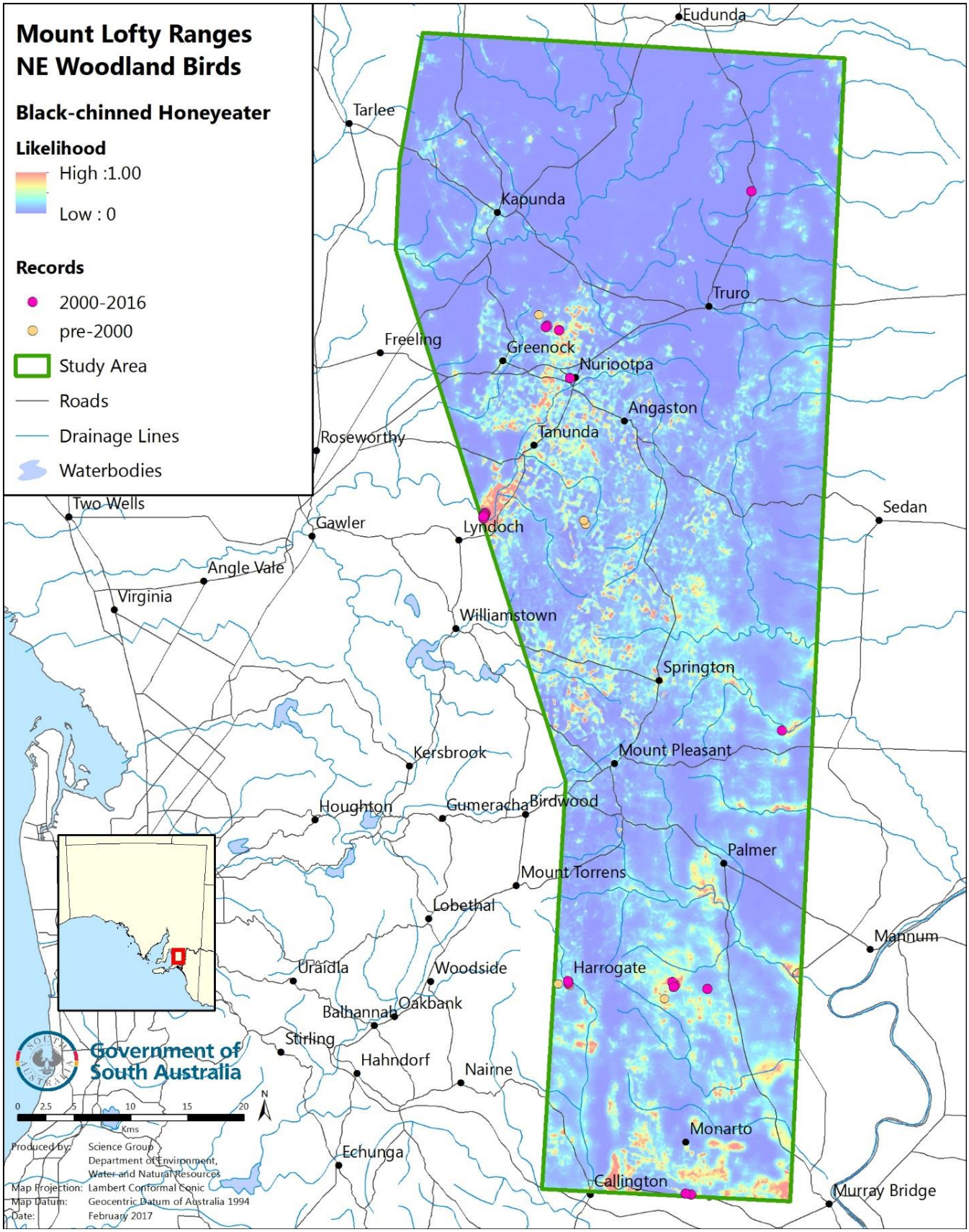


Figure 5.3. Potential distribution of Black-chinned Honeyeater in the north-eastern Mount Lofty Ranges

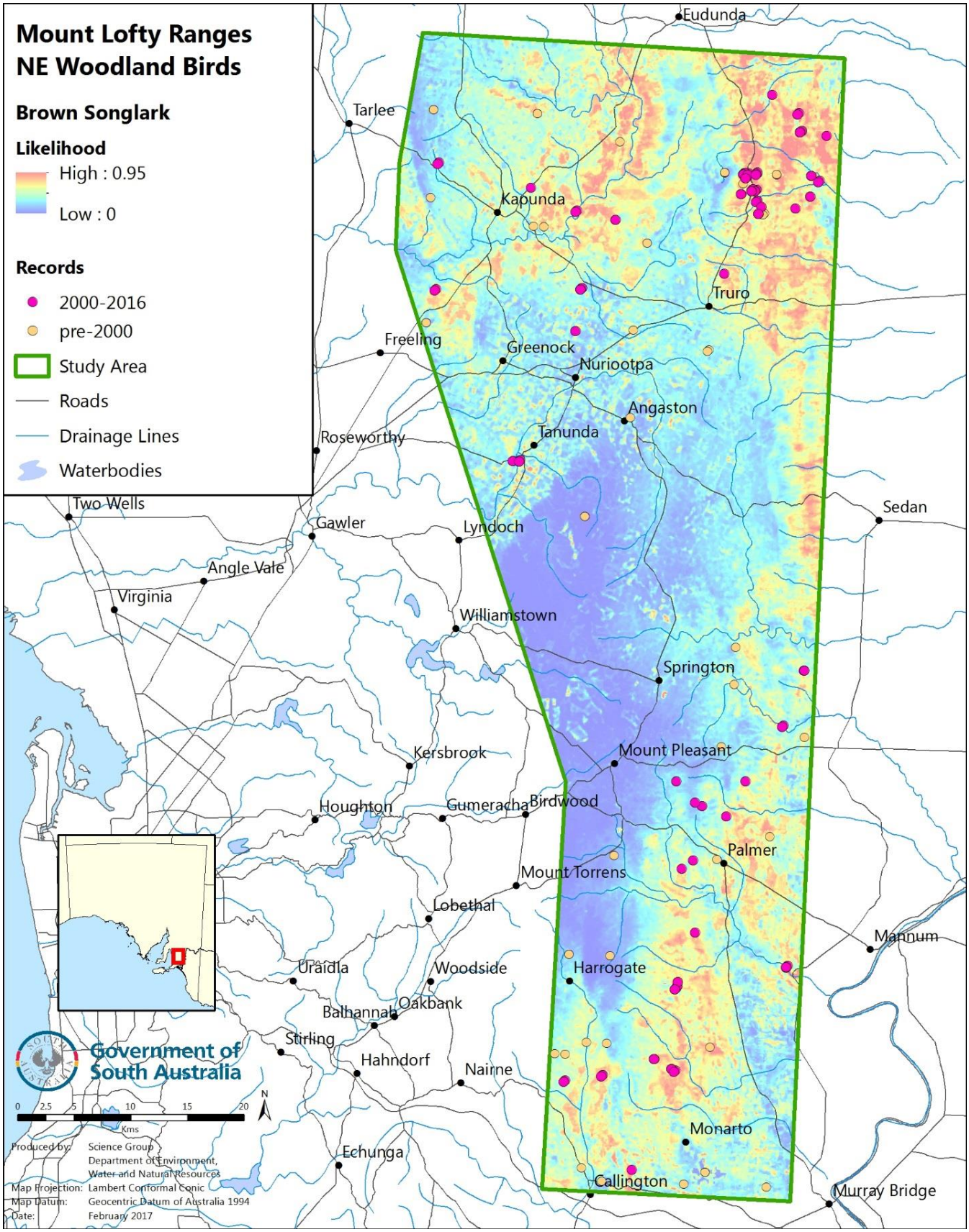


Figure 5.4. Potential distribution of Brown Songlark in the north-eastern Mount Lofty Ranges

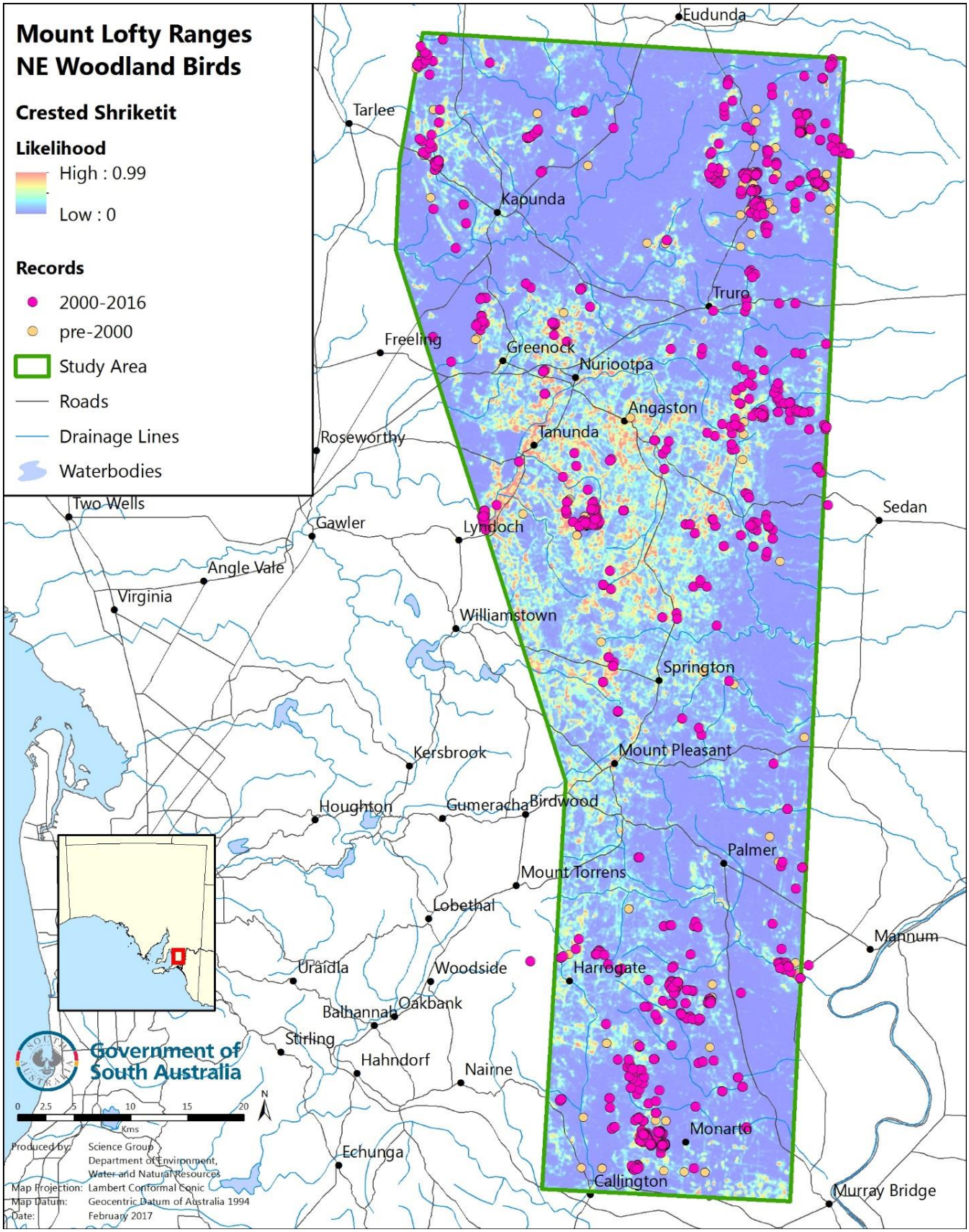


Figure 5.5. Potential distribution of Crested Shriketit in the north-eastern Mount Lofty Ranges

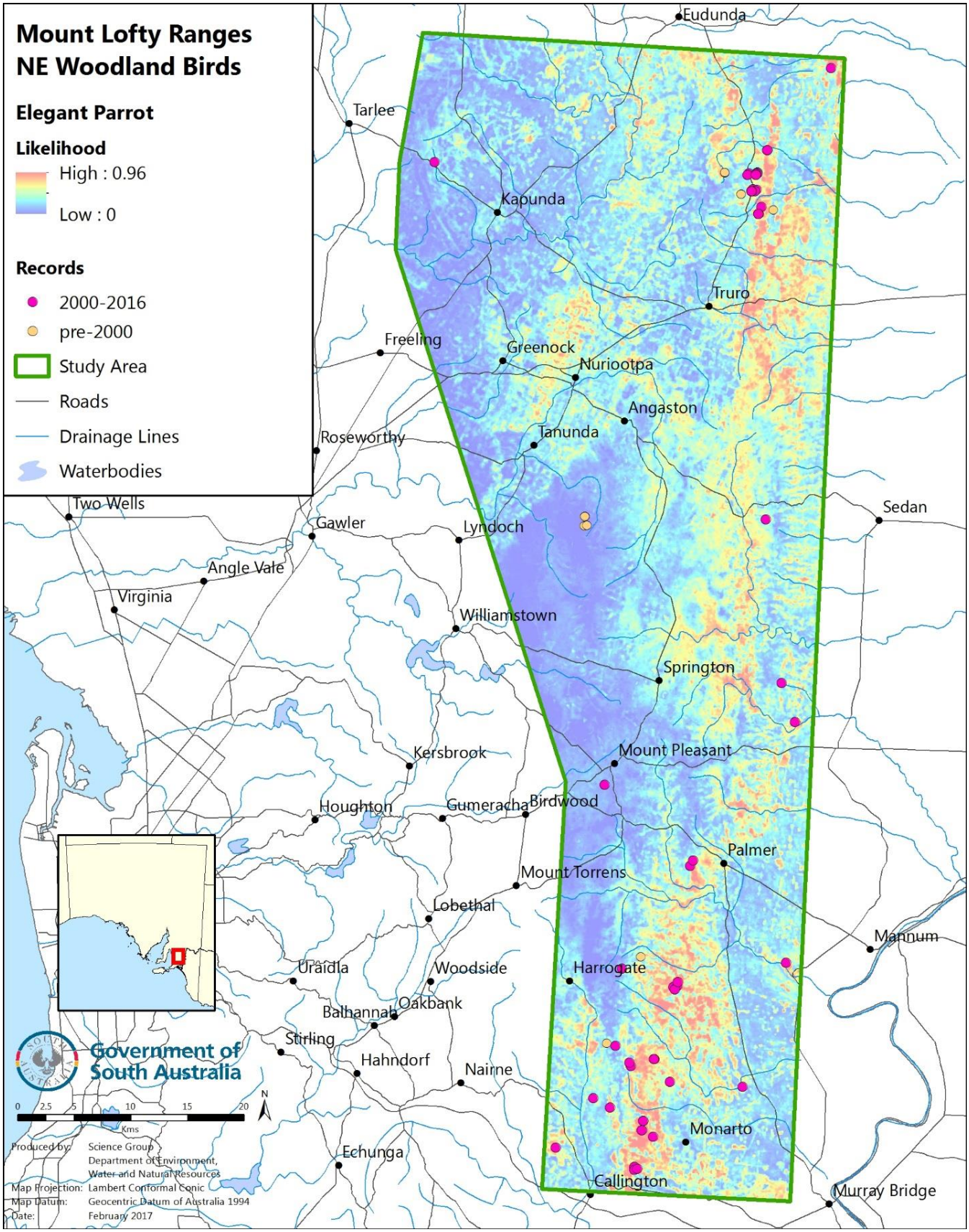


Figure 5.6. Potential distribution of Elegant Parrot in the north-eastern Mount Lofty Ranges

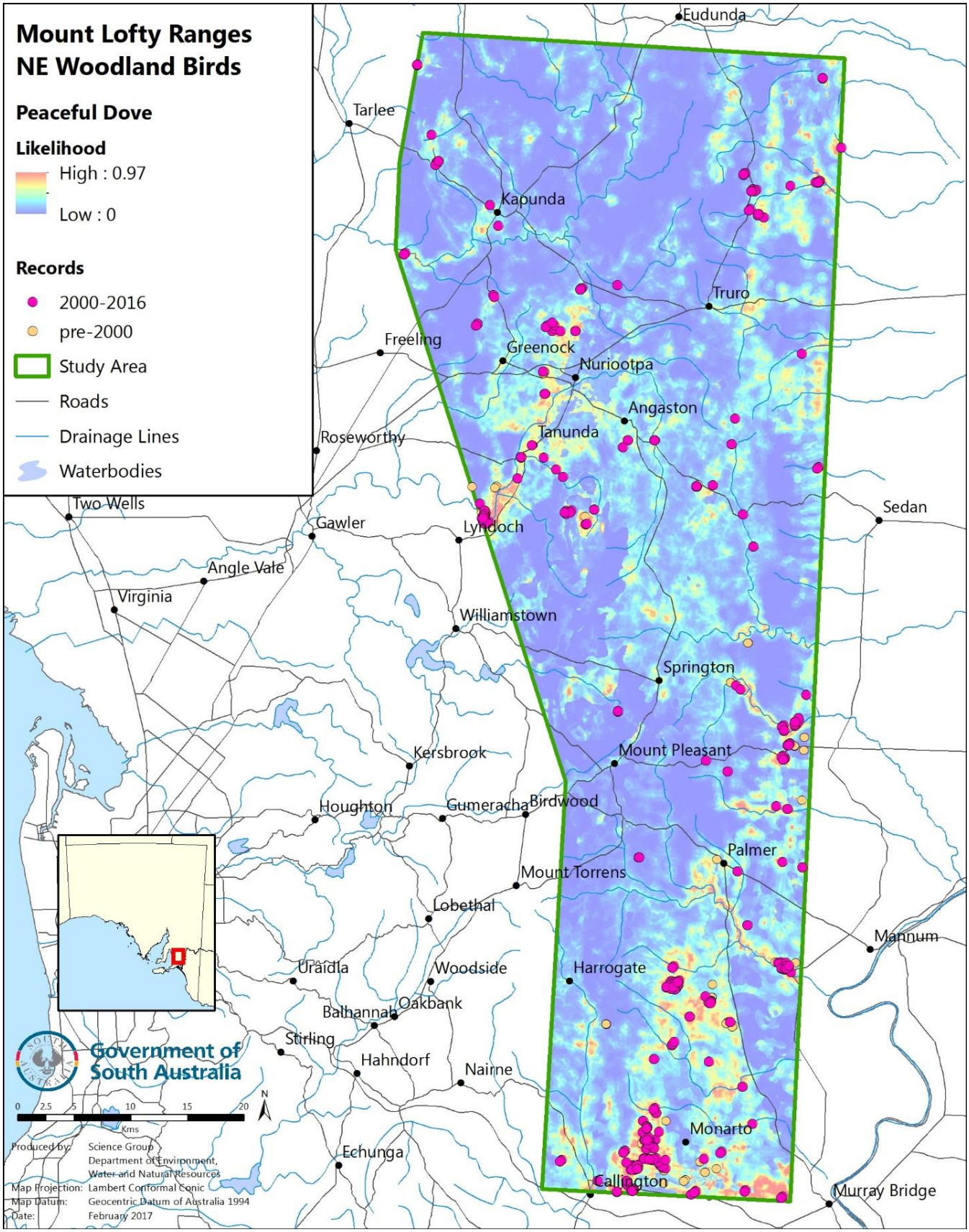


Figure 5.7. Potential distribution of Peaceful Dove in the north-eastern Mount Lofty Ranges

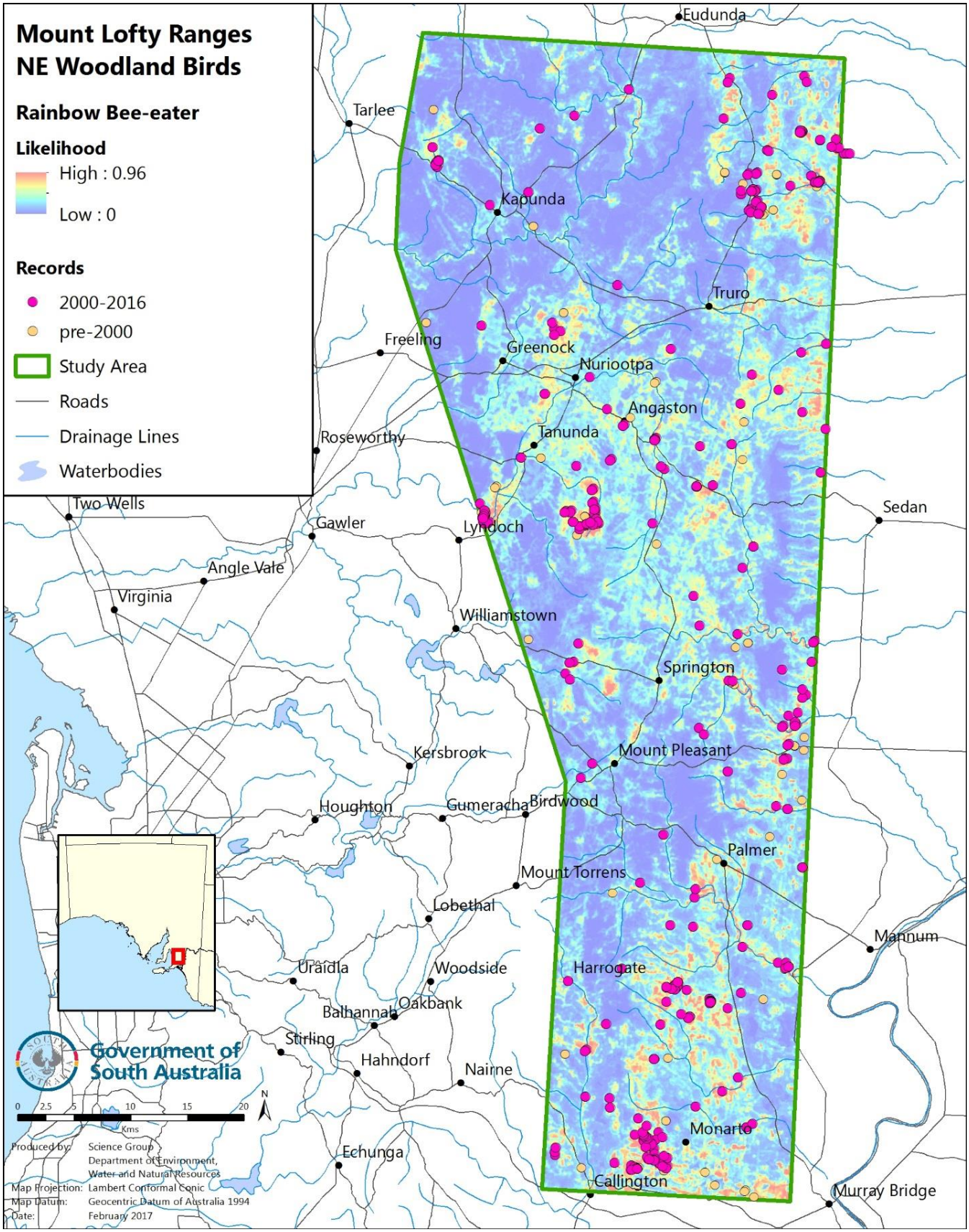


Figure 5.8. Potential distribution of Rainbow Bee-eater in the north-eastern Mount Lofty Ranges

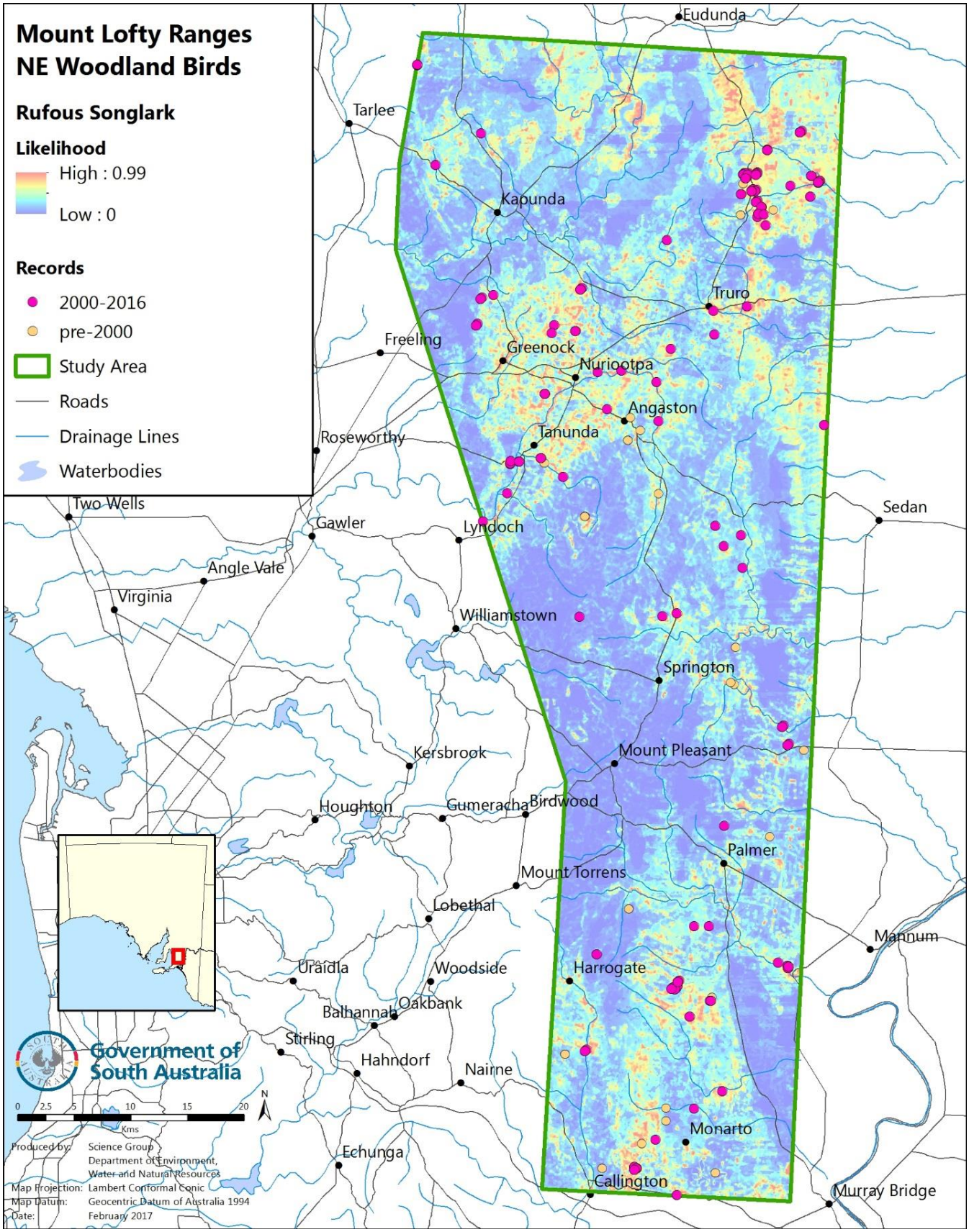


Figure 5.9. Potential distribution of Rufous Songlark in the north-eastern Mount Lofty Ranges

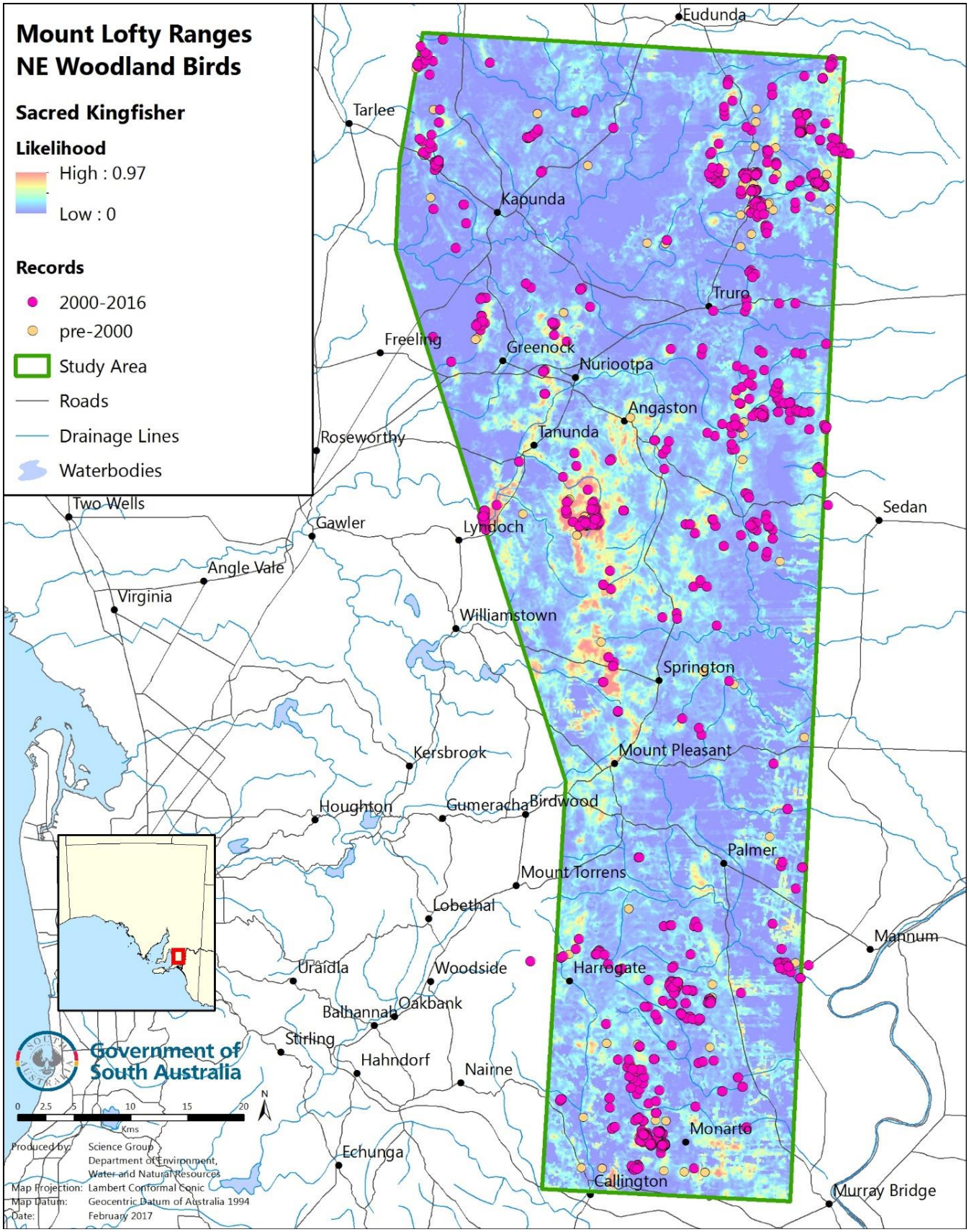


Figure 5.10. Potential distribution of Sacred Kingfisher in the north-eastern Mount Lofty Ranges

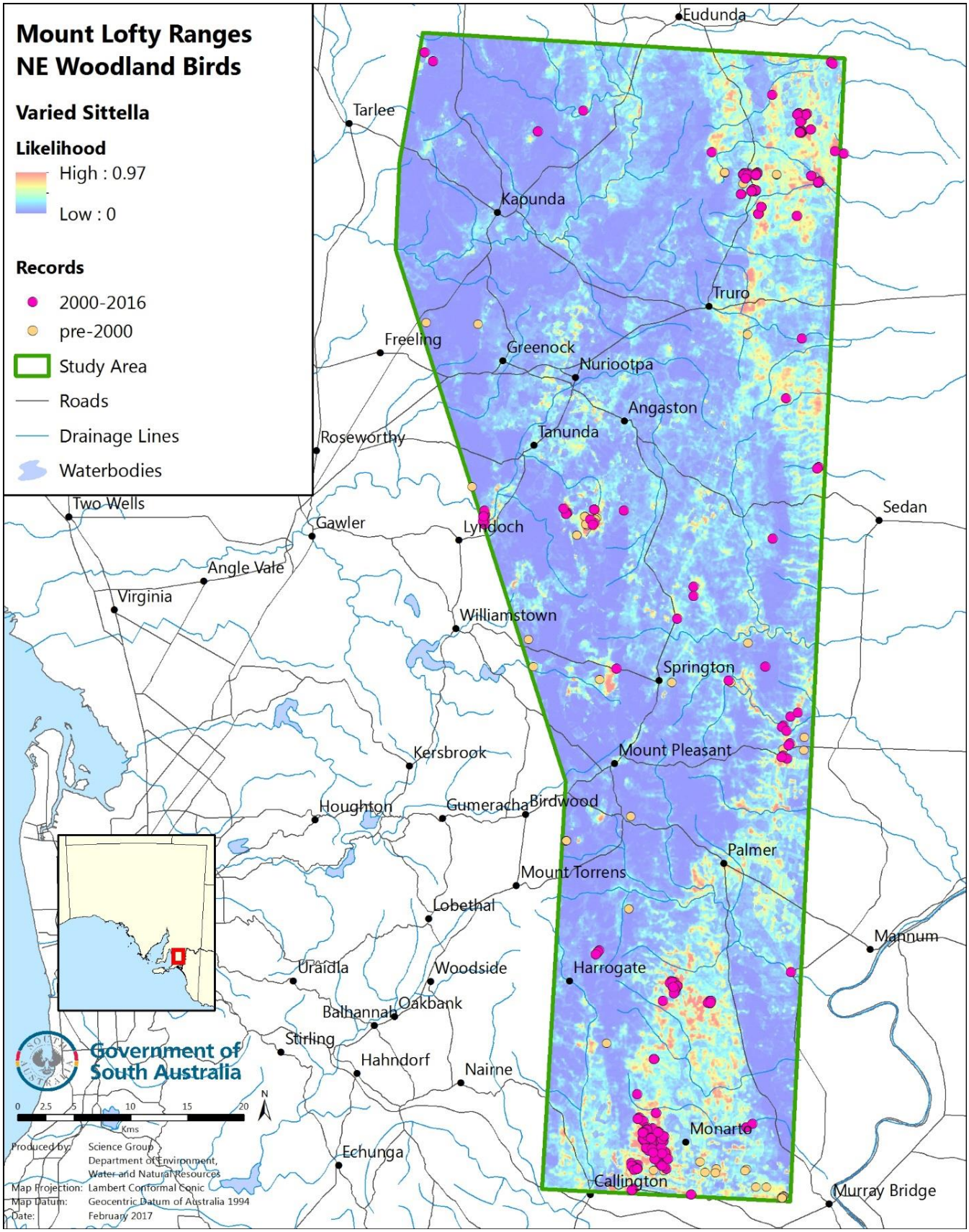


Figure 5.11. Potential distribution of Varied Sittella in the north-eastern Mount Lofty Ranges

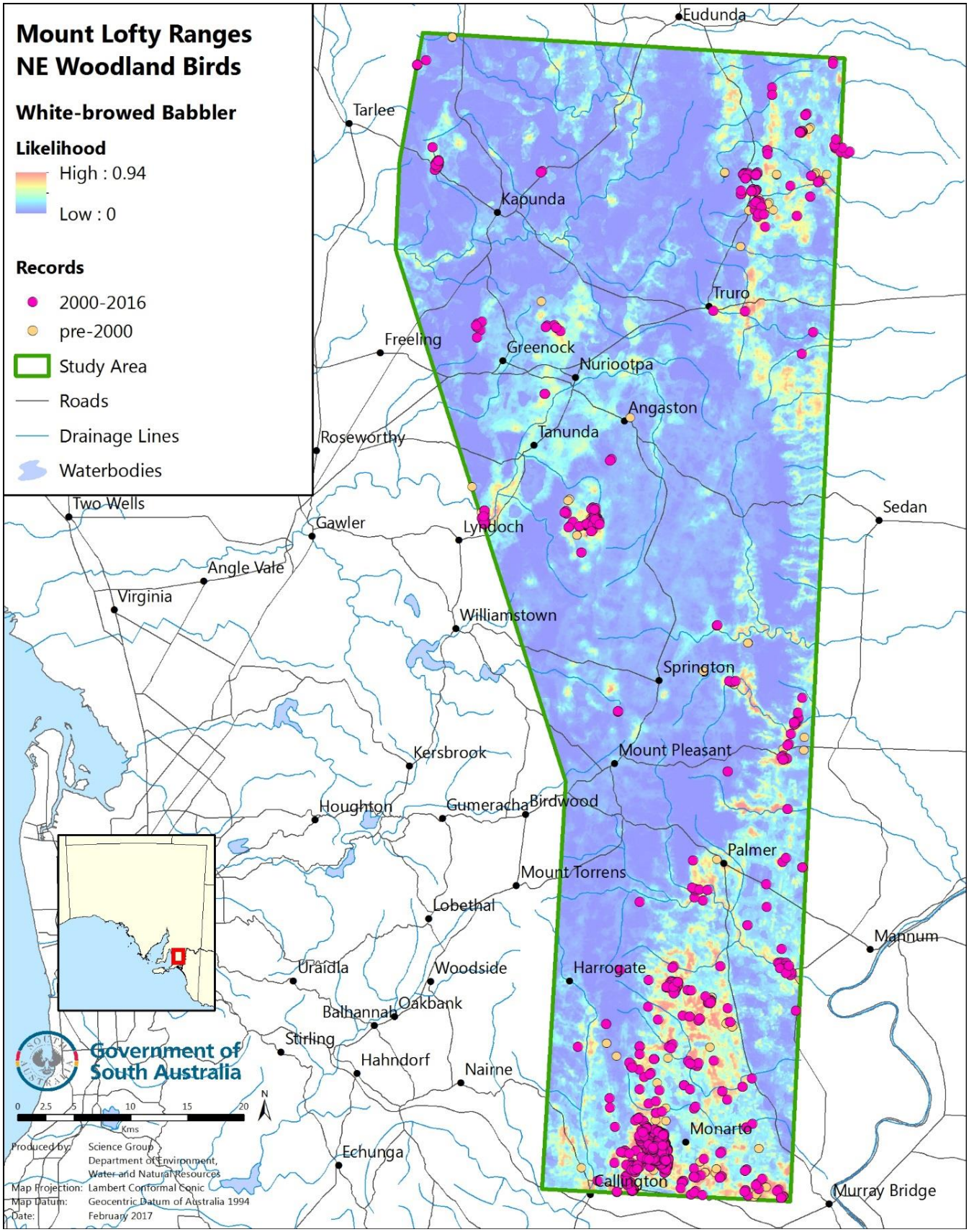


Figure 5.12. Potential distribution of White-browed Babbler in the north-eastern Mount Lofty Ranges

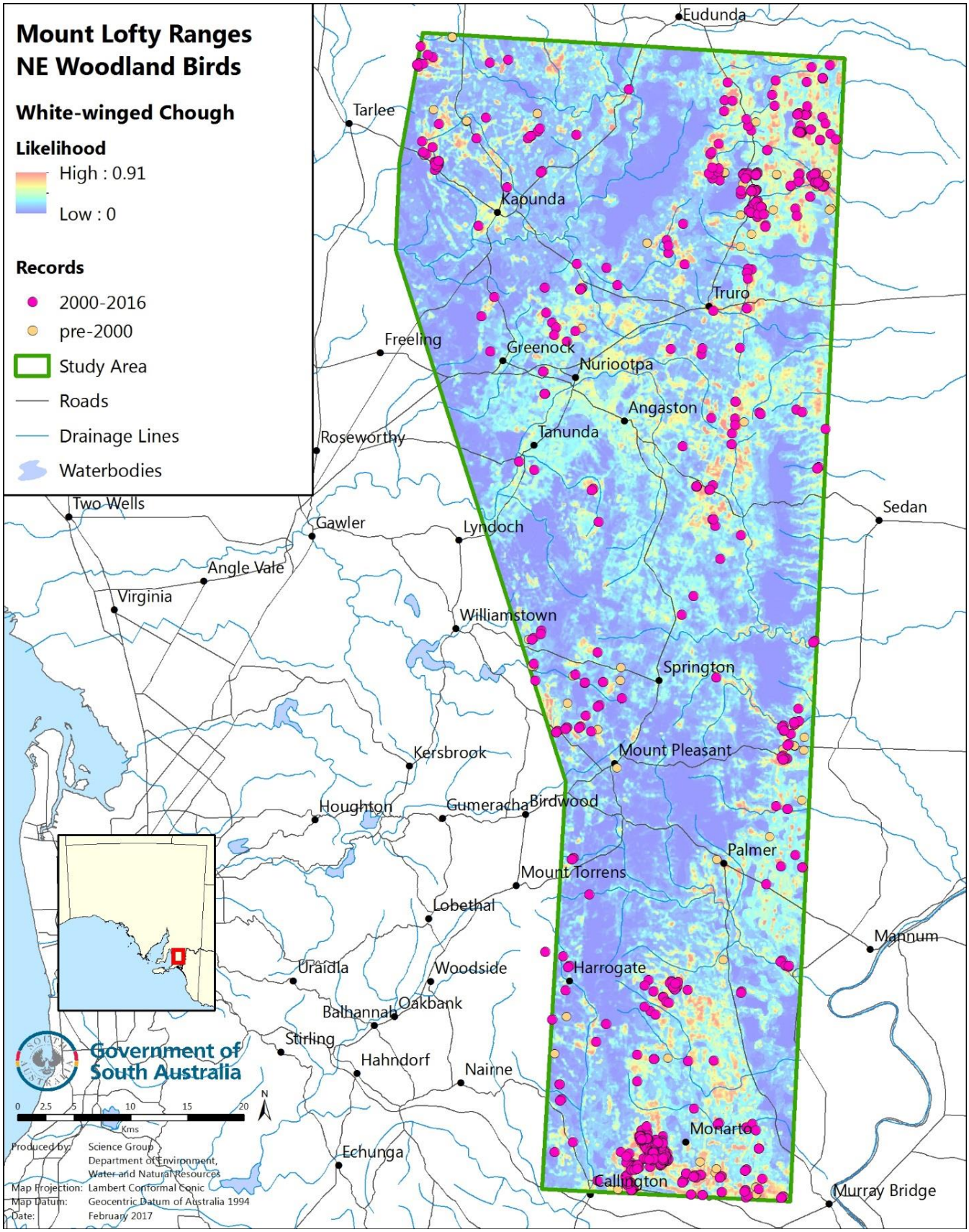


Figure 5.13. Potential distribution of White-winged Chough in the north-eastern Mount Lofty Ranges

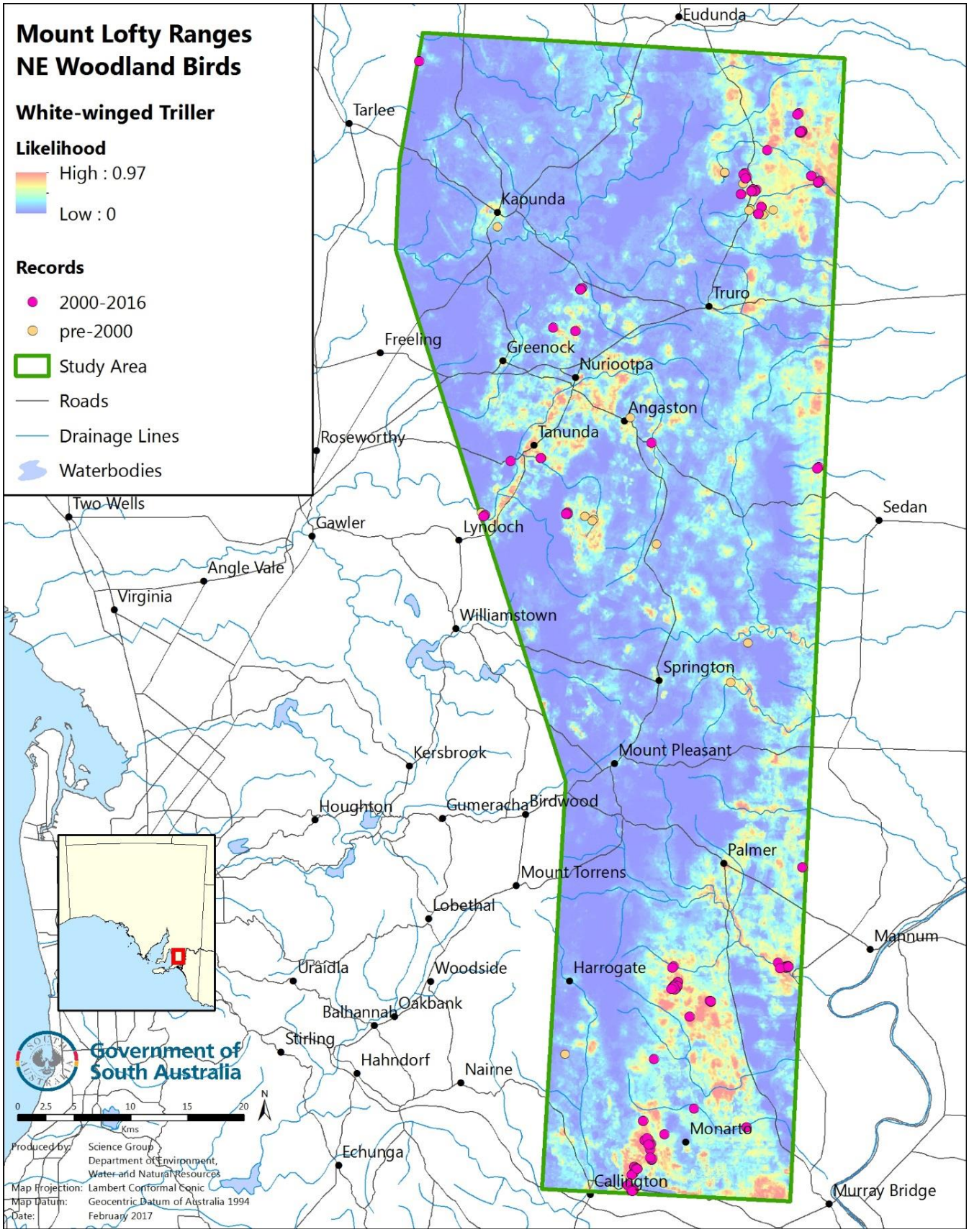


Figure 5.14. Potential distribution of White-winged Triller in the north-eastern Mount Lofty Ranges

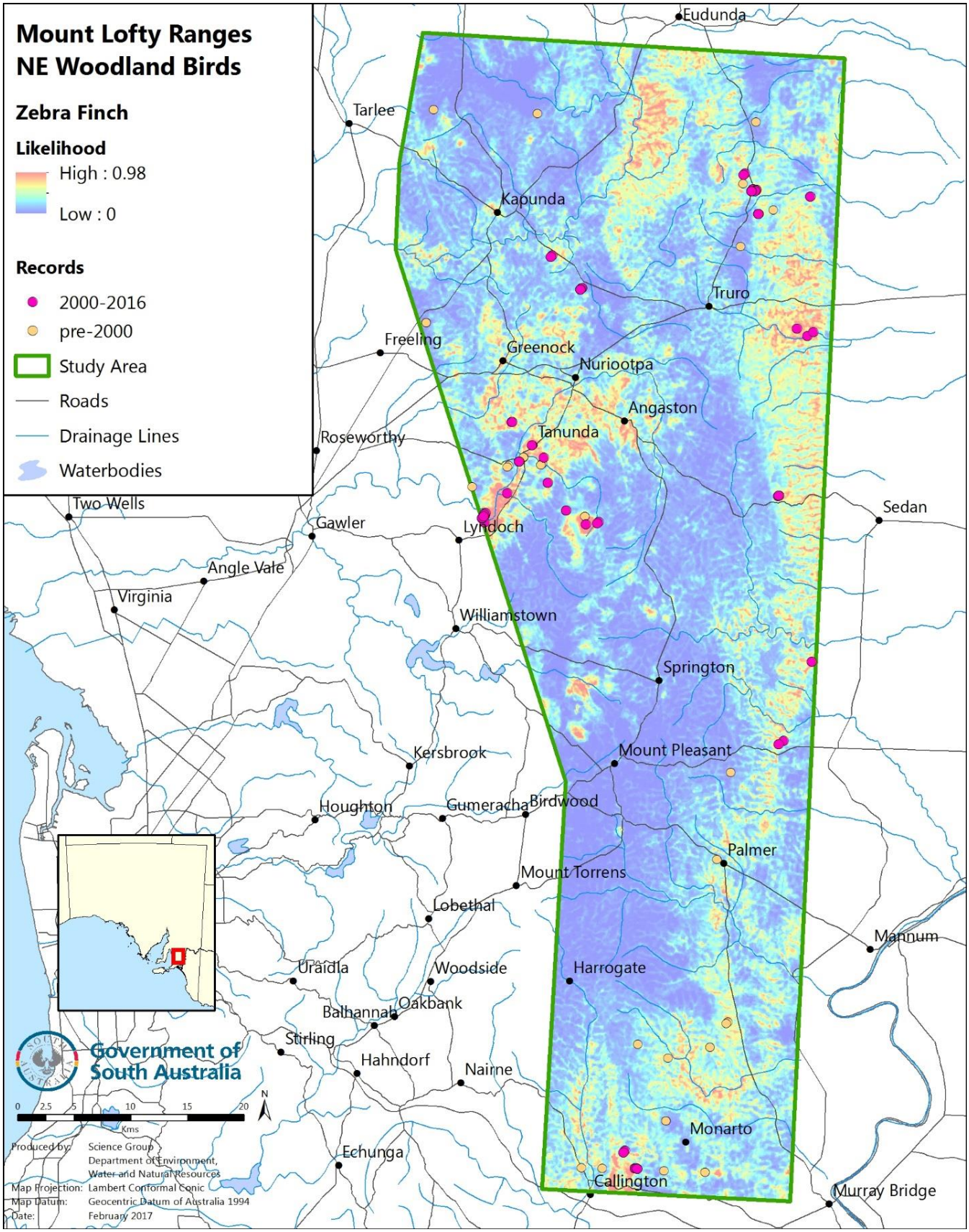


Figure 5.15. Potential distribution of Zebra Finch in the north-eastern Mount Lofty Ranges

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