THREATENED SPECIES OF FAUNA AND FLORA IN THE TAPITALEE AREA, NOWRA. INVENTORY, SPECIES PROFILES AND ASSESSMENT OF THREATS

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CONTENTS

Page

TABLES

FIGURES

EXECUTIVE SUMMARY

The Tapitallee area located in the Shoalhaven Local Government Area has a rich and diverse flora and fauna. The area is considered a 'hot spot' for species listed as threatened with extinction under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Environmental Planning & Assessment Act 1979* (EP&A Act). Currently 32 species of animal (fauna) and one species of plants (flora) have been found in the area that extends from the Cambewarra Range south to the Shoalhaven River and east to North Nowra and west to the Boyd's property of Bundanon.

The reasons for this high biodiversity are associated with the mild climate, variety of rock (soil) types, vegetation and the presence of unlogged (pristine) forest. The documentation of these assets has been undertaken by various people since the 1930's (Elliott notes). This report documents the threatened species in the region and provides a background to their distribution and abundance in the area. Where possible scientific literature (journal publications) is reviewed to provide the reader with accounts on each species. This is combined with unpublished records and grey literature (those not peer reviewed). Where possible I add my experience with each species to give specific personalised information. By combining these sources this report provides an inventory of threatened species, their distribution, life histories, ecological requirements and threats. The objective of this report is to prepare species profiles and a risk assessment of threats for each species so that the community is aware of the natural assets and plan for threat abatement strategies. In this context management actions that enhance the environment, such as weed and feral animal control can be viewed as conservation measures to retain our biodiversity.

The main points from my study of fauna and flora in the Tapitallee area are:

- The area has a diverse assemblage of fauna and flora as consequence of mature forest and biophysical factors such as geology, altitude and rainfall;
- The mature forest along the upper slopes of the Cambewarra Range and along the Shoalhaven River support hollow-bearing trees, hence caters for forest dependant species of animal such as large forest owls and gliders;
- Much of the mid-slope forest along the Cambewarra Range has regrown since the 1950's and now functions as a habitat corridor, especially for migratory birds;
- The sandstone escarpments and associated forests along the Shoalhaven River provide habitat (and corridor) for ecological specialists such as the Brush-tailed Rock Wallaby, Broad-headed Snake and Large-eared Pied Bat;
- The heathland on the top of the Cambewarra Range (historically known as Red Rock) supports populations of Long-nosed Potoroo, Eastern Bristlebird and Giant Burrowing Frog. These populations appear to be isolated from those which occur elsewhere;
- The majority of land in the Tapitallee area has freehold title. The reserve system includes portions of the Cambewarra Range Nature Reserve (a series of isolated areas along the escarpment), Tapitallee NR and Bangalee Reserve;
- Our Landcare group actively removes weeds, baits for Red Fox, revegetates degraded landscapes and provides workshops and literature to inform the local community on the area's biodiversity. This group works in tandem with Shoalhaven City Council;

- Threats to the biodiversity include habitat removal (urban development), predation by feral animals (Red Fox and Cats), competition from feral herbivores (Chital Deer, Rusa Deer and possibly feral Goats) and weed infestation (in particular lantana)

DEFINITION OF TERMS

Within this report the following terms are defined.

- ***Direct impacts*** are those that directly affect the habitat and individuals.
- ***EEC*** Endangered Ecological Community as defined by the Threatened Species Conservation Act, 1995 or the Environmental Protection Biodiversity Act (1999).
- ***EP&A Act*** Environmental Planning and Assessment Act 1979
- ***Exotic*** means species introduced from outside the area, that is from overseas or interstate.
- ***Grazing animals or stock*** means all livestock (including cattle, horses, sheep, goats and alpacas).
- ***Indirect Impacts*** occur when Project-related actions affect species, populations or ecological communities in a manner other than direct loss, usually beyond the footprint of disturbance. Indirect impacts can include loss of individuals through predation by domestic and/or feral animals, deleterious hydrological changes (including increased runoff and raising or lowering of the water table), erosion, weed invasion, pollution, trampling or other impacts due to increased human activity within or directly adjacent to sensitive habitat areas, altered fire regimes, habitat fragmentation and disruption of wildlife movement corridors.
- ***Landholders*** mean the owners and or managers of freehold and public lands.
- ***Local Population*** means the population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area.
- ***Native Vegetation*** means indigenous vegetation as per the *Native Vegetation Act 2003.* This includes indigenous trees, shrubs, groundcover plants and aquatic plants.
- ***Noxious Weeds*** means any plant declared under the *Noxious Weeds Act 1993* within the local government area of the Shoalhaven.
- ***OEH*** Office of Environment and Heritage
- ***Proposal*** is the development, activity or action proposed
- ***Regeneration*** means reproduction from self-sown seeds or by vegetative recovery (sprouting from stumps, lignotubers, rhizomes or roots), which occurs naturally after disturbance.
- ***Rehabilitation*** The treatment or management of land disturbed by the project for the purpose of establishing a safe, stable and non-polluting environment, and includes remediation
- ***Risk of Extinction*** is the likelihood that the local population of the species or local occurrence of the endangered population or ecological community will become extinct either in the short, medium or long-term as a result of direct or indirect impacts on the

viability of that population and includes changes to the ecological function of communities.

- ***Short term*** is within five years of the granting of consent.
- ***Stock*** means all livestock (including cattle, horses, sheep, goats and alpacas).
- ***Subject area*** means the broader area of Tapitallee ranging from the Cambewarra Range (old Red Rock Nature Reserve) in the north to the Shoalhaven River to the south and Bundanon to the west (join partners in this project).
- ***Subject site*** means specific locations as described in this report.

1 INTRODUCTION

1.1 Background

This report was commissioned by *Shoalhaven Landcare Association* on behalf of the Australian Government under a Caring for Country Grant to assess and documents the threatened species of flora and fauna in the Tapitallee area of the Shoalhaven. The report draws together published and unpublished accounts of the species listed under the New South Wales government *Threatened Species Conservation Act 1995* (TSC Act), which are at risk of extinction in the wild. The purpose of the report is to provide the local community a list of the threatened species but also accounts of their state and local distribution, habitat preference, life history and threats to persisting in the wild. One of the threats is the invasion of bushland by weeds. Lantana *Lantana camara* is listed as a weed of national significance (WONS) and a major aim of this project is the removal of this weed and re-establishing of native vegetation. Hence, by removing lantana and revegetating the landscape with local species of plant (and facilitating natural regeneration) we aim to reduce the risk of local extinctions. This report was prepared by Mr Garry Daly and work was carried out under NPWS Scientific Licence S10470 and Animal Ethics Committee approval 05/2371.

1.2 The Project

The main aims of the project are to map and remove infestations of lantana, a nationally listed weed of significance and restore degraded landscapes by either facilitating natural regeneration or by revegetating areas with endemic species of plant. A secondary outcome is to document the threatened species of flora and fauna in the area and provide information on each species to inform the local community of their natural asset.

1.3 Report Objectives

The objectives of the report were to:

- assess the Subject Area for threatened species and endangered ecological communities as listed under State and Commonwealth legislation;
- provide species profiles and threats to threatened species and endangered ecological communities;
- conduct targeted surveys for fauna and flora;
- assess the local and regional significance of select threatened species that were either detected on or adjacent to the site or may utilise the site based on known habitat preference;
- identify habitat of conservation significance;
- provide data from the surveys in an Excel spreadsheet as per requirement under the scientific licence issued by the Office of Environment and Heritage (OEH).

1.4 Description of Area

Location, topography, geology and soils

The Subject Area is situated approximately 15 km north-west of Nowra (Berry 1: 25,000) topographic map, GDA Northing 749220, Easting 6112488, Zone 56 projection in 66 datum, and ranges from 50-400m AHD). For the exercise of this report the Tapitallee area ranges from the Cambewarra Range (old Red Rock Nature Reserve) in the north to the Shoalhaven River to the south, Bundanon to the west (join partners in this project) and Hockey's Lane in the east.

The geology of the area is varied. In the north the sandstone exposed on Cambewarra Range Nature Reserve and environs (Red Rock) is Hawkesbury Sandstone (Paix 1968). This is the southern most remnant of the geologic unit. The sandstone along the Shoalhaven River west to the Hampton bridge in Kangaroo Valley and encompassing most of Bangalee Reserve, Tapitallee Nature Reserve (NR) Riversdale, Bundanon and Bugong National Park, is Nowra sandstone (Hazelton 1993). In between these areas the rolling low hills are on Cambewarra latites and the soils were deep and fertile (Hazelton 1993). The Illawarra Escarpment occurs on the upper steep slopes and has brown podsolic soils and large sandstone floaters that have fallen from the escarpment.

Indigenous vegetation

The general trends in the vegetation is for woodland, shrubland and heath occurs on the shallow soils such as those on Cambewarra Range NR, closed forest is usually located along the eastern or south facing slopes along the escarpment, tall open forest has regenerated along much of the upper slopes below the escarpment and coastal moist forest occur on the relatively flat valley. In areas where there is high soil fertility the majority of the original native forests have been cleared for agriculture. Remnant trees have been the seed source for large areas on the lower slopes to regenerate. In general the native vegetation on poor and/or rocky soils and on very steep slopes were left and those on the more gentle slopes that has soils of higher fertility were cleared for agriculture.

Altitude, soil depth, moisture and climate have a major bearing on the species of plant that grow in an area. A comprehensive account of the indigenous vegetation within the reserves is given by EcoGIS (2004) and this will be covered in more detail in Section 2.

1.5 Previous Studies of fauna in the area

The earliest notes on the fauna in the Tapitallee area come from Aubery Elliott and span the period from roughly 1926-41. Aubery Elliott lived at the end of Flannery Lane (Milburn) and ran a dairy. However, his passion was birding. His unpublished notes on the birds of the area are a fascinating read. They provide an insight to the past abundance and species diversity of the birds primarily on the authors land and adjoining properties but also the subject area. These observations have to be placed in the context that Red Fox had recently colonised the area and the landscape was primarily cleared for agriculture. Since Aubery's time much of the lower slopes of the escarpment has regenerated with native forest and consequently there has been changes in the bird populations. For example the Regent Honeyeater, a species that is now critically endangered was observed in 1926 then again in 1938 when "A party of between one to two dozen stayed for a few minutes about the cow yard this morning as we milked. Most of the time was spent feeding on the blossom of the coral tree." Then in 1939 the species was observed several more times the largest number being 60-100 birds near the

intersection of Flannery lane and Browns Mt Rd (where a tennis court used to exist). Over the last twenty years there have been few sightings of the Regent Honeyeater in the Shoalhaven. The species is edging towards extinction.

Norm Robinson (1987) conducted surveys for native mammals in the Illawarra during the 1970's and eighties. Although he conducted quite a lot of trapping the survey effort and location of his trap sites was not adequately recorded. Norm also showed skins of animals to local people to ascertain if the species was present in an area. Consequently much of the data that he gathered was never recorded and some may have been inaccurate. Norm did detect Brush-tailed Rock Wallabies at Kellets Creek the first person to recognise the existence of this colony. He also recorded the presence of the Grey-headed Flying Fox camp at Budgong, again the first time this had been recorded in the literature.

The author conducted targeted surveys for the Yellow-bellied Glider *Petaurus australis* along the Shoalhaven River escarpment as part of the Species Impact Statement for Bomaderry Creek link Road (QEM 1992). This survey demonstrated the importance of the Grey Gum – Spotted Gum forests in the area from Bomaderry Creek to Bangalee Reserve for this species.

In 1995 that author obtained a grant to conduct fauna surveys in the Tapitallee area from Bangalee Reserve to Bugong NP (then crown land). The surveys were conducted primarily by Michael Murphy with assistance from the author. Subsequently several reports and scientific papers (Murphy and Daly 1996, Daly 2006) documented the region's significance for threatened species of fauna and the data was put on the newly established NPWS wildlife atlas. Their surveys produced many records of the distribution and habitat corridor of the Yellow-bellied Glider, Broad-headed Snake, Giant Burrowing Frog and Brush-tailed Rock Wallaby (Daly and Murphy 1996). During that period I was shown a site at Budgong that supported tadpoles of the Stuttering Frog *Mixophyes balbus.* Unfortunately this species appears to be extinct in southern NSW (Daly 1998, Daly and Craven 2010). Michael trapped a White-footed Dunnart *Sminthopsis leucopus*, which remains the northern known limit in the region. Although the surveys were not systematic this study remains the single most comprehensive account of the regions fauna.

In 1997 the author was awarded a contract to survey fauna using systematic methods as devised for the comprehensive regional assessment (CRA) of forests in NSW as part of the Regional Forestry Agreement. This was the first time surveys were done by a team of experts on all classes of vertebrate fauna in a systematic manner. This included small and medium sized mammal trapping, harp trapping for microbats, diurnal bird surveys, call playback surveys for large forest owls and gliders, reptile and frog surveys. Unfortunately due to the vast area required to survey (including Kosciuszko, Morton and Wadbilliga NP's) only three sites were sampled in the Subject area using the complete methodology. These sites were all within the then Red Rock NR. Some targeted surveys were conducted elsewhere. These surveys confirmed the presence of Eastern Bristlebird, Giant Burrowing Frog and Long-nosed Potoroo at this site.

In addition surveys have been conducted by the author for the eastern gas pipeline 2000 (G. Daly unpub. data). Since that time I have also conducted a series of surveys for various subdivisions and development applications in the area. These surveys used the CRA methodology. The progression of data on the region's fauna has been the collection of opportunistic records held by few people to the use of systematic repeatable survey methods recorded on a state-wide database (wildlife atlas) that has public access.

1.6 Threatened Fauna and Flora in the Locality

Records from the Office of Environment and Heritage's Atlas of NSW Wildlife (accessed June 2012) and the author's records indicate the threatened species listed in **Table 1** have been found within the Tapitallee area.

Table 1
Threatened Terrestrial Fauna and Flora Recorded within or adjacent to the Tapitallee area

Note: EEC = Endangered Ecological Community, E = endangered and V = vulnerable.

Species Common Name/EEC	Species Scientific Name	TSC Schedule	EPBC Act	Most recent record
Tiger Quoll	*Dasyurus maculatus*	2	V	2006
White-footed Dunnart	*Sminthopsis leucopus*	2		1995
Koala	*Phascolarctos cinereus*	2		1950's
Brush-tailed Rock Wallaby	*Petrogale penicillata*	1		2012
Yellow-bellied Glider	*Petaurus australis*	2		2011
Eastern Pygmy Possum	*Cercartetus nanus*	2		2006
Grey-headed Flying Fox	*Pteropus poliocephalus*	2	V	2010
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	2		2007
Golden-tipped Bat	*Kerivoula papuensis*	2		2001
Eastern Freetail Bat	*Mormopterus norfolkensis*	2		2010
Greater Broad-nosed Bat	*Scoteanax rueppellii*	2		2010
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*	2		2010
Large-eared Pied Bat	*Chalinolobus dwyeri*	2		2010
Southern Myotis	*Myotis macropus*	2		2010
Bush Stone Curlew	*Burhinus grallarius*	1		2007
Black Bittern	*Ixobrychus flavicollis*	2		2009
Square-tailed Kite	*Lophoictinia isura*	2		2010
Superb fruit Dove	*Ptilinopus superbus*	2		
Glossy Black Cockatoo	*Calyptorhynchus lathami*	2		2008
Gang-gang Cockatoo	*Callocephalon fimbriatum*	2		2010
Powerful Owl	*Ninox strenua*	2		2006
Barking Owl	*Ninox connivens*	2		
Masked Owl	*Tyto novaehollandiae*	2		1996
Sooty Owl	*Tyto tenebricosa*	2		2004
Regent Honeyeater	*Anthochaera phrygia*	Critically endangered	E	1977
Varied Sitella	*Daphoenositta chrysoptera*	2		2010
Scarlet Robin	*Petroica boodang*	2		1986
Olive Whistler	*Pachycephala olivacea*	2		
Diamond Firetail	*Stagonopleura guttata*	2		
Heath Monitor	*Varanus rosenbergi*	2		
Broad-headed Snake	*Hoplocephalus bungaroides*	1	E	
Giant Burrowing Frog	*Heleioporus australiacus*	2		2009
	Solanum celatum	1		2012
Illawarra Subtropical Rainforest		EEC		

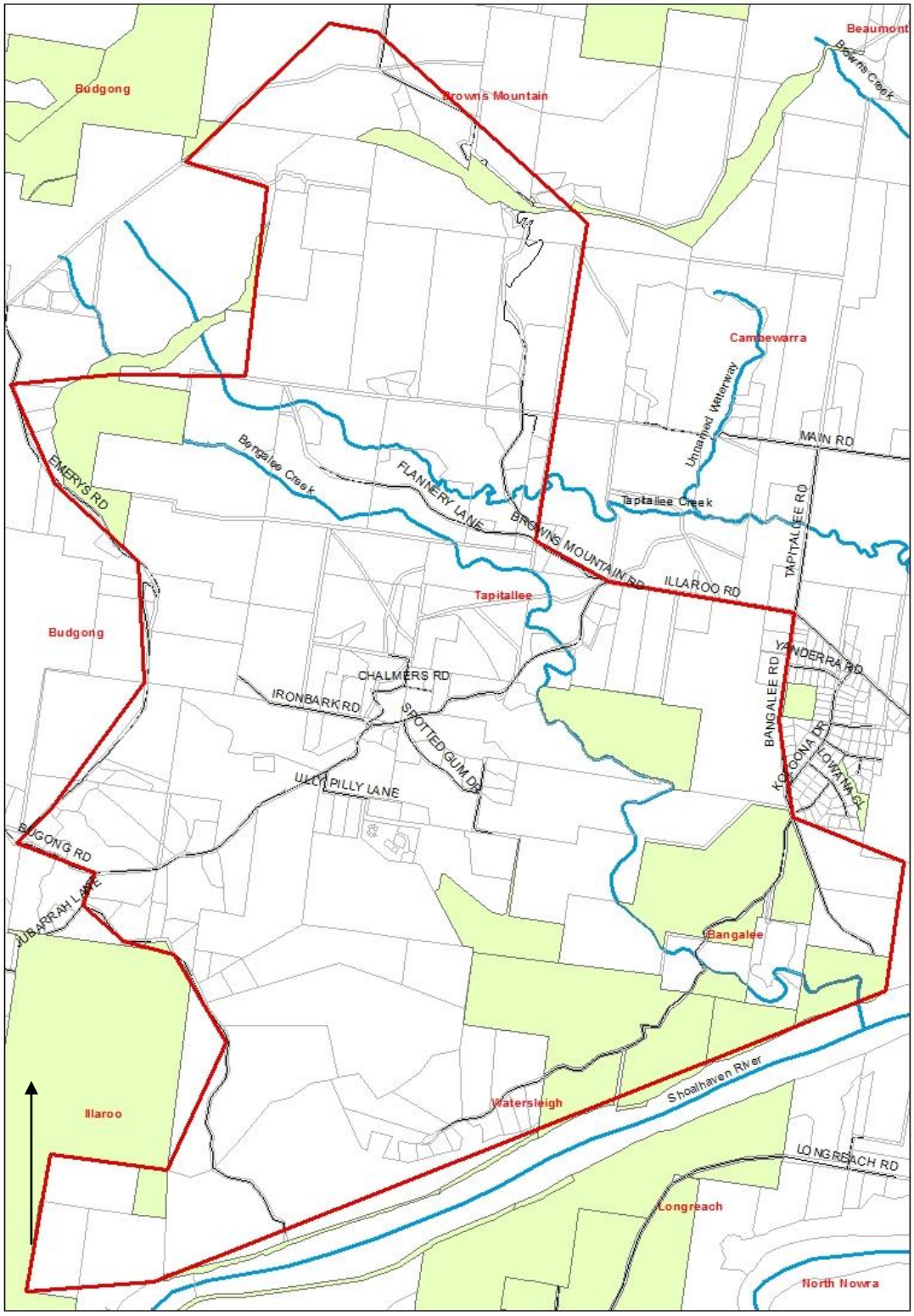

Figure 1
Detail of Tapitallee area showing area where lantana control outlined in red

2 METHODS

The methods utilised during fauna survey work for the preparation of this report were developed as part of the CRA process and adhere to those defined under the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working draft*), prepared by the Department of Environment and Conservation (2004) and the *Draft Guidelines for Threatened Species Assessment* prepared by the (then) Department of Environment and Conservation and Department of Primary Industries (2005).

2.1 Fauna Assessment

2.1.1 Introduction

Surveys for fauna were conducted In Bangalee Reserve (Daly and Murphy 1995), Riversdale (Daly and Leonard 1996), the Anglican Youth Centre (Gaia Research 2008) and freehold land in the headwaters of Bangalee Creek and Tapitallee Creek during the southern Comprehensive Regional Assessment (CRA) of Forests in NSW (Daly unpub. data). Surveys conducted after 1997 used methods developed during the southern CRA. These methods are detailed below.

2.1.2 Elliott and Cage Trapping for small to medium sized mammals

Elliott traps are small aluminium traps that have spring mechanise to close the door when the animal enters the trap. The standard CRA methods consists of ten A size Elliott traps set for three days on the ground at twenty metre intervals and baited with a mixture of peanut butter and rolled oats. The traps are placed under bushes or other vegetation so that they were protected from direct sunlight and were checked during the early morning each day to minimise stress to captured animals from heat/ants. The line of traps is called a transect.

Two cage traps were set along the transect and baited with the above-mentioned mixture plus sardines and set for the same period. These larger traps (55 x 20 x 20 cm) were set at one end and half way along the transect.

2.1.3 Harp Trapping for Microbats

Harp traps are aluminium rectangles that have rows of fishing line strung within the rectangle. Microbats cannot detect the fishing line by their sonar and fly into the taught line and then fall into a calico bag strung under the line. The bats climb up the bag and rest under a sheet of plastic. Harp traps are usually erected within 100 metres of the Elliott trapping transect or nearby flight paths and set for the same period as the Elliott traps. The traps were checked daily in the early morning.

2.1.4 Foot-Based Spotlighting for Arboreal Mammals

The majority of marsupials are nocturnal and surveyors use spotlights to observe arboreal (tree living) mammals. Spotlighting is usually conducted for 30 minutes along and adjacent to Elliott trap and cage trap transect. Some gliders and possums proclaim their territories by

calling. Each species has specific calls that can be identified by an experienced zoologist by their calls and direct observation.

2.1.5 Nocturnal Call Playback

Nocturnal birds and mammals are often detected when they vocalise to proclaim their territory or during social interaction. This behaviour is exploited when surveying by broadcasting pre-recorded calls to elicit a response if that particular species is within the immediate area. The calls of select threatened species are broadcast through a car stereo system. No spotlights are operated during the playback but the immediate area is spotlit after the cessation of the playback.

Call playback is given in the following order.

- Powerful Owl *Ninox strenua.*
- Barking Owl *N. connivens*.
- Masked Owl *Tyto novaehollandiae*.
- Sooty Owl *Tyto taeniolatus.*
- Squirrel Glider *Petaurus norfolcensis.*
- Yellow-Bellied Glider *Petaurus australis*.
- Koala *Phascolarctos cinereus.*
- Bush Stone Curlew *Burhinus grallarius.*

2.1.6 Diurnal Bird Census

Diurnal birds proclaim their territories by calling. Each species has specific calls that can be identified by an experienced ornithologist by their calls and direct observation. Birds are surveyed for a period of 20 minutes within a 2-hectare area of the transect. Birds detected outside the 2-hectare plot were also recorded.

2.1.7 Diurnal Reptile Searches

Reptiles are surveyed during the day, especially during warm sunny conditions. The method used to find reptiles is by observing animals as they bask or forage and /or by lifting habitat such as rocks, decorticating bark and fallen logs. Reptiles are usually surveyed for a period of 60 minutes within the transect.

2.2 Flora

2.2.1 Introduction

Flora surveys within Cambewarra Range Nature Reserve (1023ha) and Tapitallee Nature Reserve (95ha) were conducted by Nick Gillie and staff from the Nowra NPWS (EcoGIS 2004). The survey included 20 plot based (20 x 20m) quadrants plus spot checks and interpretation of aerial photographs to provide vegetation mapping of the reserves. Both

reserves are currently comprised of separate portions, though the two portions of Tapitallee NR are separated by only a few hundred metres. Within the study area Cambewarra Range NR has one portion at the headwaters of Tapitallee Creek and Bengalee Creek and one portion on the top of the escarpment, which includes the Red Rocks plateau (formerly Red Rocks NR)

Within Cambewarra Range NR the largest area has steep slopes, prominent cliffline and a plateau. On the Cambewarra escarpment the main communities were wet heath forest consisting of Budderoo-Morton plateau Open Forest and Cambewarra plateau moist shrub fern forest. The main vegetation communities in the portion of Cambewarra Range NR within the Bengalee Creek headwaters are Warm Temperate Layered Forest and Warm Temperate and Subtropical Rainforest. However, EcoGIS (2004) states that the vegetation off Emery's Rd was difficult to fit into existing forest ecosystems with a dominant canopy *of E. muelleriana* along with *E. paniculata* with Burrawang *Macrozamia communis* in the understorey. Tapitallee NR is primarily Spotted Gum–Red Bloodwood forest with Water Gum *T. laurina* along the creek. The descriptions of the vegetation communities are taken from EcoGIS (2004) but amended to reflect the most up to date summary of vegetation communities in NSW based on catchments provided by OEH (2011 and 2012). Several communities described by EcoGIS (2004) do not fit the OEH/CMA template descriptions.

2.2.2 Vegetation Communities

Lilly Pilly – Sassafras – Stinging Tree Warm Temperate rainforest (SR568 or PM5A 113)
Lilly Pilly – Sassafras – Stinging Tree Warm Temperate rainforest is common in Cambewarra Range Nature Reserves. It is considered part of the Illawarra Subtropical Rainforest by OEH (2012). It occurs in gullies and on protected slopes and has a large number and variety of species. The most common and characteristic are Lilly Pilly *Syzygium smithii*, coachwood *Ceratopetalum apetalum*, sassafras *Doryphora sassafras*, Stinging Tree *Dendrocnide excelsa,* Cabbage Tree Palm *Livistona australis* and Jackwood *Cryptocarya glaucescens*. Other species include Crabapple *Schizomeria ovata,* Sweet Pittosporum *Pittosporum undulatum,* Whalebone tree *Streblus brunonianus,* Native Tamarind *Diploglottis australis, Planchonella australis, Syzygium australe, Citronella moorei, Pennantia cunninghamii, Baloghia inophylla, Brachychiton acerifolius, Toona australis, Alectryon cinereus and* figs *Ficus macrophylla, Ficus superba, Ficus obliqua and Ficus coronata.*

The shrub layer is a sparse cover of Rough Treefern *Cyathea australis,* Native pepper *Tasmannia insipida,* Bastard Rosewood *Synoum glandulosum, Eupomatia laurina, Coprosma quadrifida, Citriobatus pauciflorus, Pittosporum revolutum* and *Breynia oblongifolia* up to 4 metres high. Lianas include *Pandorea pandorana, Marsdenia rostrata*, *Smilax australis, Malaisia scandens, Cissus antarctica, Lagenophora moorei, Marsdenia flavescens, Maclura cochinchinensis, and Piper novae-hollandiae.* Ground cover is a sparse cover of ferns including Gristle Fern *Blechnum cartilagineum, Microsorum scandens, Pyrrosia rupestris, Lastreopsis microsora* and *Pellaea falcata ssp falcata, Arthropteris tenella* and *Doodia aspera*, and herb *Pseuderanthereum variabile.*

OEH states that there are 2,740ha of Sub-tropical Rainforest in the Shoalhaven LGA, the majority occurs around the Cambewarra escarpment but there is a patch near Milton on the Monzonite derived soils.

Grey Myrtle - Lilly Pilly Dry rainforest (SR551 or PM5A 38)
Grey Myrtle – Lilly Pilly Dry Rainforest is a simple low closed forest with a sparse groundcover usually found beside creeks. The rainforest is a low to medium forest up to 10 metres high, dominated by *Backhousia myrtifolia.* Other species present include *Syzygium smithii, Notelaea venosa, Pittosporum undulatum* and Sandpaper Fig *Ficus coronata*. An open tall shrub layer up to 4 metres high, usually contains *Rapanea howittiana, Breynia oblongifolia*, and *Cyathea australis. Doodia aspera* dominates the ground cover, along with *Asplenium flabelliforme, Pellaea falcata ssp falcata*, *Pyrrosia rupestris* and *Lastreopsis accuminata*. Lianas such as *Marsdenia rostrata, Pandorea pandorana*, and *Smilax australis* intertwine in the shrub and tree layer. These are stands of this forest type on the lower slopes of Tapitallee Creek and Bangalee Creek. OEH (2012) states that there is 424ha of the forest type in the Shoalhaven.

Lilly Pilly - Coachwood warm temperate rainforest (SR567)
Lilly Pilly - Coachwood warm temperate rainforest is a simple closed forest found on the upper slopes of the Cambewarra escarpment that is often covered in water vines. The main canopy species are *Syzygium smithii*, *Livistona australis, Doryphora sassafras, Cryptocarya glaucescens* and *Schizomeria ovata.* Characteristic midstorey species include *Synoum glandulosum, Tasmannia insipida, Eupomatia laurina, Cyathea australis, Ficus coronata, Psychotria loniceroides* and the vines *Morinda jasminoides, Smilax australis, Microsorum scandens, Marsdenia rostrata, Palmeria scandens, Pandorea pandorana, Parsonsia straminea, Cissus hypoglauca.* Characteristic groundcover species are the ferns *Lastreopsis microsora, Blechnum cartilagineum, Blechnum patersonii , Asplenium australasicum and Doodia aspera*. OEH (2012) states that there are 10,825 ha of the forest type in the Shoalhaven.

Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies (SR652)
Sydney Blue GumXBangalay - Lilly Pilly moist forest in gullies is widespread in the Tapitallee area and often grades into Turpentine - Red Bloodwood - Sydney Peppermint Open Forest. The community occurs on sheltered slopes in gullies and on escarpments with loamy soils below 400m south from the Illawarra. The main canopy species are *Eucalyptus salignaXbotryoides, Syncarpia glomulifera,* White-topped Box *Eucalyptus quadrangulata,* Lilly Pilly *Syzygium smithii* and Cabbage-tree Palm *Livistona australis.*

The main secondary species are Blackbutt *Eucalyptus pilularis,* Scentless Rosewood *Synoum glandulosum,* Sweet Pittosporum *Pittosporum undulatum* and Jackwood *Cryptocarya glaucescens.* Characteristic mid-canopy species are *Notelaea venosa, Clerodendrum tomentosum, Eupomatia laurina,* Wait-a-while *Smilax australis*, *Pandorea pandorana, Morinda jasminoides, Marsdenia rostrata,* and *Stephania japonica.* Characteristic ground cover species are Rasp Fern *Doodia aspera, Pseuderanthemum variabile, Oplismenus imbecillis, Gymnostachys anceps,* Gristle Fern *Blechnum cartilagineum,* Wombat Berry *Eustrephus latifolius, Tylophora barbata* and *Geitonoplesium cymosum.* OEH (2012) states that there is 9,692ha of the forest type in the Shoalhaven.

Turpentine - Red Bloodwood - Sydney Peppermint Open Forest (SR658 or PM5A 95)
This forest is a dense sclerophyll forest with an open understorey. The community is widespread east of the Morton plateau on coastal lowlands near Conjola and Wandandian and in near Tallowa dam grades into Yalwal Shale-sandstone Transition Forest and in moist sheltered locations may grade into Sydney Blue GumXBangalay - Lilly Pilly moist forest – Sassafras – Stinging Tree Warm Temperate rainforest.

The common canopy species are *Syncarpia glomulifera, Eucalyptus botryoides x saligna* and *Corymbia maculata, C. gummifera,* and *E. piperita, E. paniculata ssp paniculata* and *Eucalyptus scias subsp. callimastha*. Tree orchids, such as *Cymbidium suave,* are found in tree hollows in the tree layer. A moderately dense shrub understorey comprises *Acacia obtusifolia, Zieria aborescens, Tristaniopsis collina, Astrotricha species B, Correa lawrenciana, Dodonaea triquetra* and *Elaeocarpus reticulatus.* The occasionally dense ground cover is dominated by sedges *Lepidosperma urophorum, Lepidosperma laterale, Dianella caerulea var caerulea* and *Lomandra longifolia,* with ferns *Pteridium esculentum* and *Calochlaena dubia.* Vines growing in the ground cover include *Smilax glyciphylla, Billardiera scandens, Cassytha pubescens, and Cissus hypoglauca.* The ground cover sparse and often dominated by *Doodia aspera* but may also include *Microlaena stipoides.* Turpentine Forest occurs in the upper Tapitallee Creek and upper Bengalee Creek occur in areas where the forest has been cleared and remnant Turpentines were left. These remnants were seed trees for the regenerated forest. OEH (2012) states that there are 12,867 ha of the forest type in the Shoalhaven.

Spotted Gum - White Stringybark - Burrawang shrubby open forest (SR643 or very roughly PM5A 95)

Spotted Gum open forest is widespread in the study area and fine stands exist at Bangalee Scout Camp, Bangalee Reserve and Tapitallee NR. Elsewhere in the area stands are regenerating in areas previously cleared for agriculture.

Spotted Gum open forest is a medium to tall forest 25 –30 metres in height, dominated by *Corymbia maculata* with White Stringybark *Eucalyptus globoidea* as dominant canopy species. Other associated species may be Grey Ironbark *Eucalyptus paniculata subsp. paniculata* and Red Bloodwood *Corymbia gummifera, E. punctata* and on better quality soils *E. saligna x botryoides*. The shrub layer can be very sparse in some localities. Shrubs include the cycad *Macrozamia communis* with patches of *Allocasuarina littoralis* regenerating in burnt areas*, Breynia oblongifolia,* and *Persoonia linearis.* The smaller shrub layer contains *Hibbertia aspera, Oxylobium ilicifolium, Playsace lanceolatus, Hardenbergia violacea*, and *Leucopogon lanceolatus.* The ground layer comprises grasses *Entolasia stricta, Imperata cyclindrica,* and *Microlaena stipoides* intermixed with herbs and twiners *Desmodium varians, Dianella caerulea var caerulea, Glycine clandestine* and *Schelhammera undulata* along with sedges *Lepidosperma laterale, Lomandra longifolia* and *Lomandra multiflora ssp multiflora.* OEH (2012) states that there are 3,089 ha of the forest type in the Shoalhaven.

Red Bloodwood - Grey Gum shrubby forest (SR593 or PM5A 246)

The dominant species in this community are *Corymbia gummifera / Syncarpia glomulifera / E. punctata and E. piperita.* It has a diverse dry shrub understorey, including *Persoonia linearis, Banksia spinulosa, Acacia obtusifolia, Tetratheca thymifolia, Leucopogon lanceolatus, Lomatia ilicifolia, Acacia terminalis, Platysace lanceolata, Bossaia obcordata*, *Macrozamia communis* and *Gompholobium latifolium*. The ground cover contains grasses *Entolasia stricta*, and herbs *Patersonia glabrata, Gonocarpus teucriodes.* Wiry Panic *Entolasia stricta, Pomax umbellata, Patersonia sericea, Lepidosperma laterale, Lomandra multiflora, Phyllanthus hirtellus, Dianella revoluta var. revoluta, Dianella caerulea var caerulea*, *Goodenia hederacea, Panicum simile, Lomandra confertifolia subsp. rubiginosa, Glycine clandestina, Hardenbergia violacea*.

Red Bloodwood – Grey Gum shrubby forest also known as Yalwal Shale-Sandstone transition forest occurs on shallow sandy soils on low lying ridges and moderately dry slopes in the

foothills and on ridges and benches on the tops of the northern sandstone plateau areas. OEH (2012) states that there is 31,109ha of the forest type in the Shoalhaven.

Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone (SR594)

Red Bloodwood *Corymbia gummifera*, Hard-leaved Scribbly Gum *Eucalyptus sclerophylla*, Silvertop Ash *Eucalyptus sieberi* are the main canopy species that grown to a height of 15m. Other canopy species may include Sydney Peppermint *Eucalyptus piperita*, Yertchuk *Eucalyptus consideniana*, and Blue-leaved Stringybark *Eucalyptus agglomerata*. The shrublayer is species diverse and includes *Lambertia formosa, Persoonia levis,* Hairpin Banksia *Banksia spinulosa, Petrophile pedunculata, Leptospermum trinervium, Lomatia ilicifolia, Bossiaea heterophylla, Hakea laevipes, Platysace linearifolia, Pimelea linifolia and Tetratheca thymifolia.* This community occurs to the south of Riversdale Rd and grows on soils derived from Shoalhaven Sandstone. OEH (2012) states that there is 47,022ha of the forest type in the Shoalhaven.

Cambewarra Plateau Moist Shrub/Fern Forest (PM5A 141?)

EcoGIS (2004) describe this community as supporting *Eucalyptus sieberi, C. gummifera, and E. piperita. Tristaniopsis collina* with a shrub layer of *Acacia obtusifolia, Banksia serrata, Gahnia sieberiana, Epacris pulchella* and *Amperea xiphoclada.* The ground ferns include *Pteridium esculentum* and *Calochlaena dubia.* This community is not recognised in the current OEH summary of vegetation communities.

Northern South Coast Swamp Heath (PM5A 303?)

Northern South Coast Swamp Heath has a dense shrub canopy and a groundcover of sedges and ferns. It is restricted to Cambewarra Range on shallow soils on Hawkesbury sandstone. The main species present include *Baeckea linifolia, Melaleuca thymifolia, Gymnoschoenum sphaerocephalus, Empodisma minus and Restio complanatus.* This community is not recognised in the current OEH summary of vegetation communities.

River Oak Open Forest (SR606 or PM5A)

River Oak Open Forest occurs on river banks of major rivers or banks of swift flowing streams and rivers. It is found along sections of Tapitallee Creek, mostly outside the study area. The main species present is River Oak *Casuarina cunninghamiana.* Other species common present in the shrublayer and midcanopy are *Hymenanthera dentata, Urtica incisa, Black Wattle Acacia mearnsii, Acacia floribunda, Stephania japonica, Pandorea pandorana.* The ground cover includes *Lomandra longifolia, Oplismenus aemulus,* Kidney Weed *Dichondra repens*. OEH (2012) states that there is 645ha of the forest type in the Shoalhaven.

Water Gum - Coachwood riparian scrub along sandstone streams (SR660)

Water Gum - Coachwood riparian scrub along sandstone streams has a very limited distribution in the Tapitallee area being confined to select areas along Bengalee Creek (Tapitallee Nature Reserve). In this location the presence of Coachwood is doubtful or very minor. Other species present are Grey Myrtle as Dry Rainforest is present in this reserve. OEH (2012) states that there is 3ha of the forest type in the Shoalhaven.

Threatened species of the Tapitallee area, Nowra

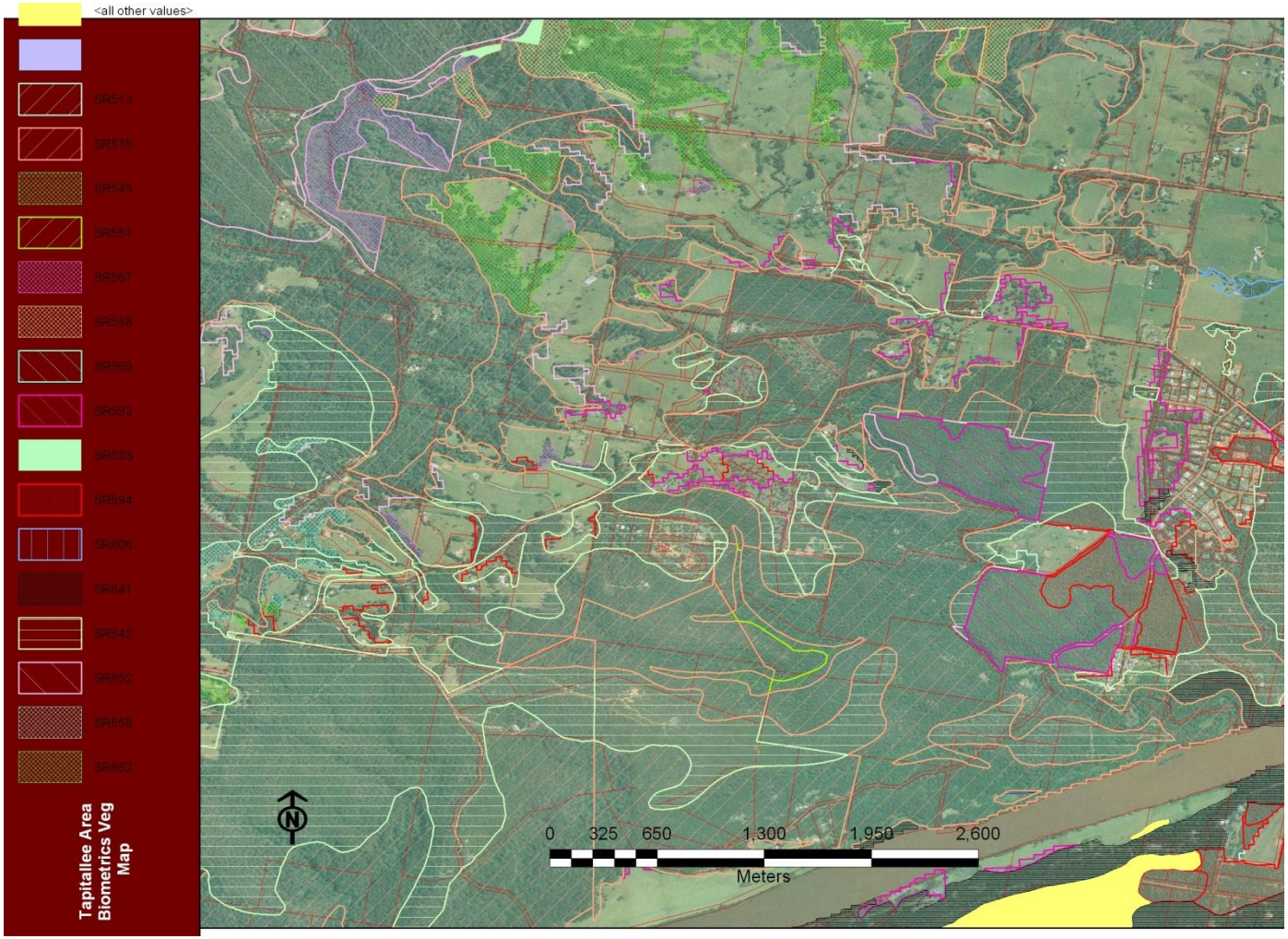

Figure 2
Vegetation of the Tapitallee area from OEH 2012

3 SPECIES PROFILES

The species profiles are divided into three sections being Distribution, Ecology and Threats. The distribution of each species is described for Australia, NSW, the Shoalhaven and specific sites in the Tapitallee area. This provides the reader with a national, state and local context. Specific locations where I have found the Broad-headed Snake are not given as this species is subject to illegal collection by people who keep this species as pets.

The Life history section provides information on the biology of each species such as habitat preference, home range size and number of eggs/young per breeding event (fecundity). The Treats section lists the factors that are putting pressure on the populations of rare plants or animals. Common threats are the loss of habitat (usually from urban development) and predation by introduced animals such as the Red Fox. However, there are a number of indirect impacts such as competition from exotic plants such as Lantana. For example lantana can colonise and hence out compete the endangered Nightshade *Solanum celatum.*

The species profiles do not provide descriptions of plants and animals. It also does not provide images of each species. These can be obtained from other sources such as Van Dyke, S, and Strahan, R. (2008), Wilson and Swan (20010) and Daly et al. (2000),

Compared to animals there are relatively few threatened species of plant and endangered ecological communities in the Tapitallee area. Some species and populations such as the Bomaderry Creek Zieria, the terrestrial orchid *Genoplesium baueri* and the population of Langley's Mallee have highly restricted occurrences (Bomaderry Creek) outside of the study area and will not be considered.

3.1 Tiger Quoll

Distribution

The Tiger, or Spotted-tailed Quoll is the largest extant marsupial carnivore on mainland Australia. The Tiger Quoll has a broad but fragmented range from south-eastern Queensland, through eastern New South Wales to eastern and south-western Victoria and Tasmania in a range of forested habitats (Edgar & Belcher, 1995; Van Dyke and Strahan 2008).

The distribution of the Tiger Quoll has contracted since European settlement and there are no recent records from South Australia or the Murray River (Van Dyke and Strahan 2008). Most of the existing populations are small, occur at low density and are fragmented. Within the Illawarra region Tiger Quoll are most frequently reported from the Barren Grounds – Cambewarra region. There have been very few records from Helensburgh to Wollongong over the last decade (Daly unpub. data).

In the Tapitallee area the species is known from the Cambewarra range through to North Nowra, though records over the last decade indicate a contraction in reporting and probably few animals persist in the area. There are few records of this species in Morton NP.

Ecology

Prey taken by the tiger quoll include, invertebrates, reptiles, birds, mammals and carrion. The species is pre- dominantly a flesh eater and mammalian prey, ranging in size from 500 to

5000g, constitute more than 70% of the diet by biomass (Belcher, 1995). Medium-sized mammals recorded in their diet include Common Ringtail Possum *Pseudocheirus peregrinus,* Greater Glider *Petauroides volans*, Common Brushtail Possum *Trichosurus vulpecula* and Mountain Brushtail Possum *Trichosurus caninus*, Long-nosed Bandicoot *Perameles nasuta,* Red-necked Pademelon *Thylogale thetis,* and European Rabbit *Oryctolagus cuniculus* (Belcher 1995, 2000; Dawson et al. 2007, Jones & Barmuta 1998, Glen and Dickman 2006). Tiger Quoll also eat road killed macropods and Wombats (Belcher *et al.* 2007) and fish (Jarman *et al.* 2007). Invertebrates, reptiles, birds and small mammals are important prey for juveniles (Belcher 1995). The Tiger Quoll is an opportunistic predator, consuming a wide variety of taxa and varying its diet to take advantage of short-term fluctuations in prey abundance (Glen and Dickman 2006).

The Tiger Quoll is usually nocturnal and forages for small mammals, birds and carrion. Juvenile quolls are more dependent on invertebrates, small mammals and birds while adults mostly eat medium sized mammals such as small macropods, possums, gliders, Rabbits and bandicoots. It forages in trees as well as on the ground and will feed on road-killed animals. They have an unfortunate habit of raiding poultry in areas adjacent to the bush and several animals have been shot in the Tapitallee area. They also raid garbage tins and have a liking for cream/dairy products such as cream cheese (pers. obs.).

Females attain adult size at two years and mate during late May to early August (Van Dyke and Strahan 2008). An average of five young are reared in dens between August June and August after a gestation period of 21 days (Van Dyke and Strahan 2008). Males do not help rear the young and juveniles are independent at 18-20 weeks (Van Dyke and Strahan 2008).

The home range of the Tiger Quoll is large with females being territorial and having a home range of between 88-1067 ha (Claridge *et al.* 2005). Males are not territorial and have a home range between 621-5000 ha which overlaps those of other males and females (Belcher 1995; Claridge *et al.* 2005). Animals may move 3-5 kilometres per day and may move up to eight kilometres while forging at night (Van Dyke and Strahan 2008). Gullies, ridges and drainage lines are used more that midslopes when forging (Belcher and Durrant 2006). The Tiger Quoll is a forest-dependent species recorded from a number of forest types, including rainforest, wet and dry sclerophyll forest, and woodland (Mansergh, 1983; Watt, 1993; Edgar & Belcher, 1995; Jones & Rose, 1996).

Quolls use latrines, which are often positioned on the top of rock outcrops and boulders, especially beside streams (G. Daly pers. obs.). Latrines may be used to communicate information on the reproductive status of females (Van Dyke and Strahan 2008).

In the 1990's a male Tiger Quoll was observed foraging on my property during the day and soon after raided my chooks and garbage tin. It denned in the ceiling cavity between the levels of my house, dragging rags and other material into the den. I could hear it make tapping sounds on the timber at dusk before it left the den. On two occasions it ventured into our house and was not phased by the noise from the television. The animal used the concrete pad near the den as a latrine. A few years later this site was used again as a latrine, this time by a female. She too used the same site in the ceiling as a den. During these occasions I could here the calls of the Tiger Quolls from near Tapitallee Creek at night.

Threats

The main threats to the Tiger Quoll are reduction of habitat by the clearing and/or logging of forests, increased collisions with moving vehicles by the construction of more roads and higher vehicular movements, competition with the Red Fox and shooting.

Tiger Quoll, Barren Grounds NR Photograph courtesy N. Jackett

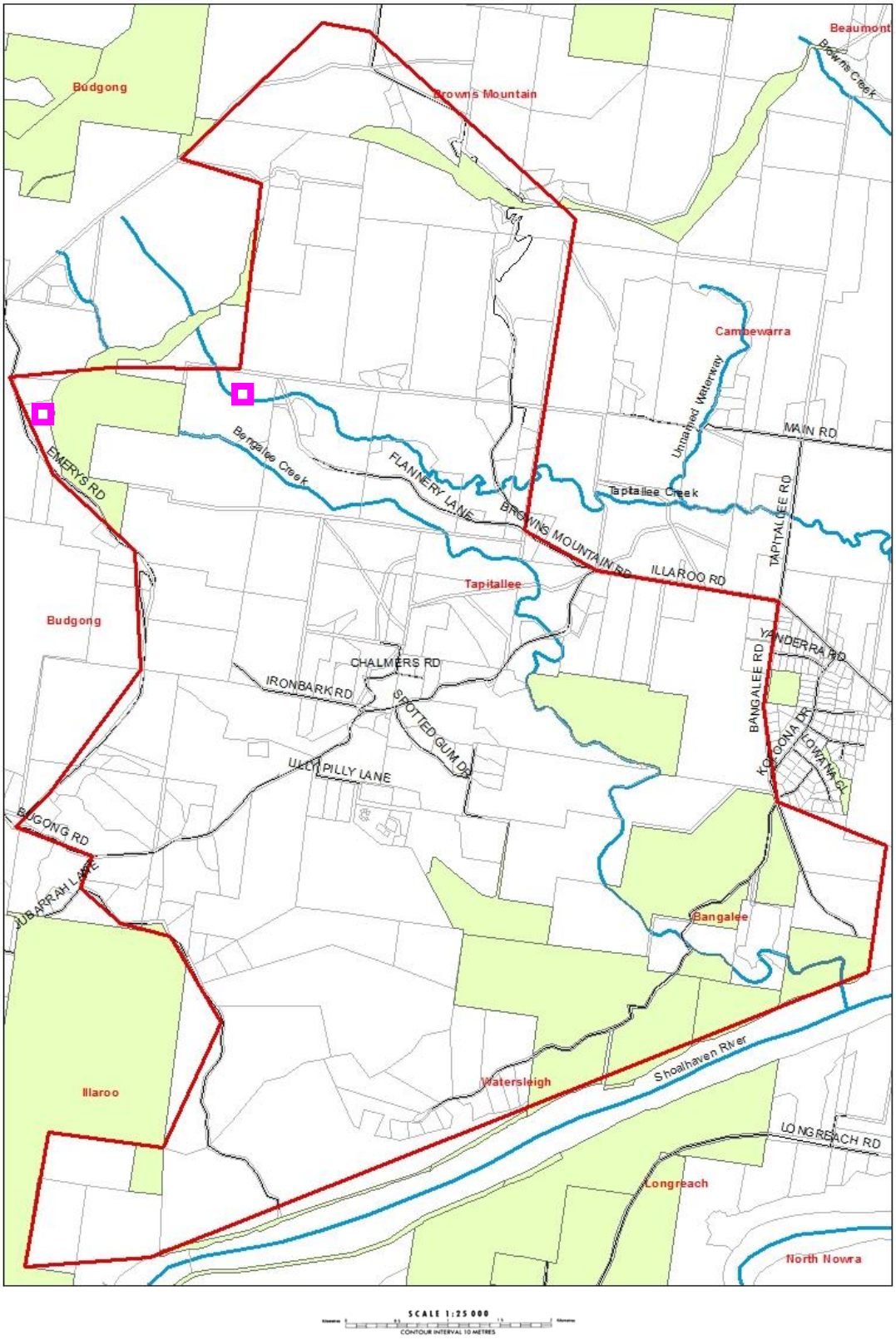

Figure 3
Tapitallee area showing approximate location where Tiger Quoll detected

3.2 White-footed Dunnart

Distribution

The White-footed Dunnart has been trapped in Booderee National Park (King 1980), Budgong (Daly and Murphy 1996), Currambene State Forest (Braithwaite *et al.* 1988), Parma Creek, Kioloa, Conjola National Park (Daly *et al.* 1998), Vincentia (Gaia Research 2001) and Dolphin Point (BES 2006). The specimen trapped near Riversdale (Daly and Murphy 1996) currently represents the definite (museum record) northern limit of the species range in the Illawarra. In a recent survey a Common Dunnart was trapped at Bangalee Scout Camp (NGH 2012). The Common Dunnart and White-footed Dunnart are very similar in appearance being separated morphologically by the latter species have striations on the pads of the feet. The identity of the Bangalee Scout Camp specimens requires clarification.

Ecology

Over it's range the White-footed Dunnart has been detected in a variety of habitat types but in New South Wales it has been found on ridges and mid-slope in open forest, woodland and heath (Klomp and Wise 1997, Lunney *et al.* 1986, Daly and Murphy 1996 and Daly *et al.* 1998, King 1980). One population occurs in far northeast Queensland in highland complex notophyll vine-forest (Van Dyke 1985). There appears to be few consistent patterns for habitat preference for the species. In the Shoalhaven it has been found in heathland and or woodland, which have sandy substrates, or in open forest, which has a sparse ground-cover (Gaia Research 2001). At a site near Vincentia animals were trapping in heath that was six years post burn (Gaia Research 2001) but has not been found there since that time despite annual surveys (Gaia Research 2007).

Radio-tracking studies found considerable overlap in the home range if individual animals, which averaged about one hectare (Laidlaw *et al.* 1996). Although regular movement of about 50 m have been documented (Laidlaw *et al.* 1996), one study found that individuals can move up to 1500 metres per day (Lunney and Leary 1989).

Threats

The main threats to the White-footed Dunnart are reduction of habitat by the clearing of forests for urban development, increased fire frequency and predation by the Red Fox and Cat.

White-footed Dunnart

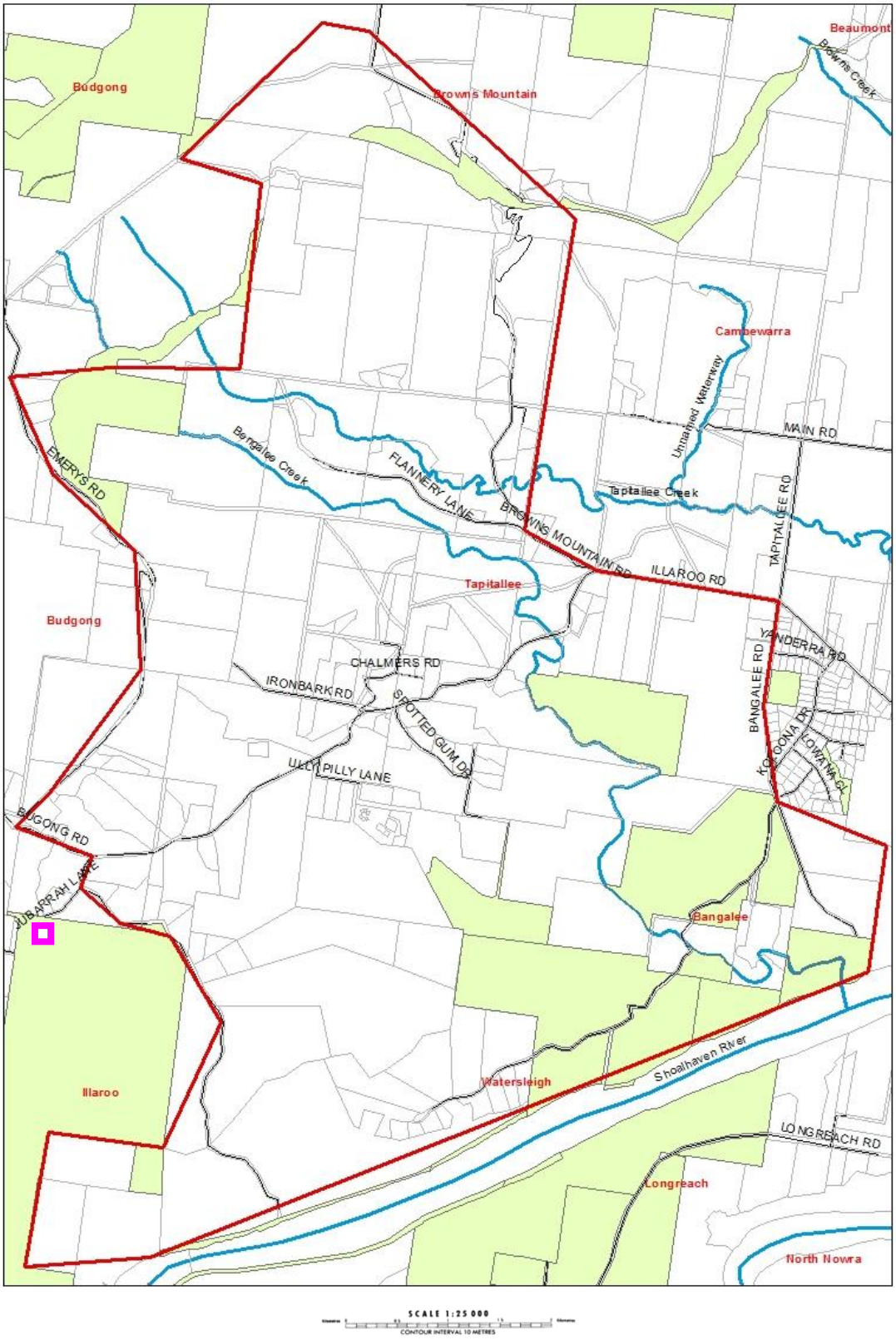

Figure 4
Tapitallee area showing approximate location where White-footed Dunnart detected

3.3 Koala

Distribution

The distribution of Koala is along the wetter portions of Queensland from near Cairns south to South Australia including Kangaroo Island. The distribution has contracted since European settlement and is fragmented. Animals have been translocated to several islands off Victoria. Koalas are concentrated on flat, fertile, low-elevation soils and are not widely found in public forests. In the Shoalhaven the species is rare but widespread. Most records are from the western portion of Morton NP on higher nutrient soils near Sassafras.

Since the 1930s, due in part to protective legislation and cessation of hunting, Koalas have recolonised parts of their former distribution in NSW and Queensland. In Victoria and South Australia the recovery is part of re-introduction programs and the species now occurs in areas where it was not recorded historically (DECC 2008).

Ecology

Koalas live in breeding aggregations, generally comprising a dominant male, a small number of mature females, as well as juveniles of various ages (Phillips 1997). The home range of koalas varies depending on the quality of the habitat and the number of available food trees. The average home range is 10–15 ha (Phillips 1994; Callaghan and Phillips 1998).

Females reach maturity at 2 to 3 years of age (Martin and Handasyde 1990a), males at 3 to 4 years. Mating normally occurs between September and February, A healthy female koala can produce one young each year for about 12 years. Gestation is 35 days Following birth, the young remains in the pouch for approximately six months and on leaving the pouch remains dependent on its mother and is carried on her back. Young reach independence at about 12 months, although they can remain in the mother's home range for a further 2–3 years (Mitchell and Martin 1990).

The koala lives almost entirely on eucalypt leaves. It has firm preferences for particular varieties of eucalypt and these preferences vary from one region to another on the south coast the primary food tree species are Cabbage Gum *E. amplifolia,* Ribbon Gum *E. viminalis* and Forest Red Gum. These species generally grown on more fertile soils and this provides greater availability of nutrients within leaves (Cork *et al.*1990), which Koala prefer. In the Tapitallee are these are stands of Cabbage Gum beside Tapitallee Creek – beside Tapitallee Rd.

Threats

Studies of Koala at coastal areas of NSW (Port Macquarie and Lismore) indicate that the major threats are predation by domestic and feral Dog, Fox and mortality due to wildfire and collisions with vehicles (Lunney, Urquhart and Reed 1988). Loss of habitat from urban development and agriculture has fragmented the remaining Koala populations. In recent years, some colonies have been hard hit by disease, especially chlamydia. A survey of koalas in 1986–87 found that the koala had disappeared from 50–75% of its historic range in NSW (Reed et al. 1990).

Figure 5
Tapitallee area showing approximate location where Koala detected

3.4 Brush-tailed Rock Wallaby

Distribution

The range of the Brush-tailed Rock-wallaby extends from Nanango in south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit.

The Brush-tailed Rock Wallaby was once abundant and ubiquitous throughout the mountainous country of eastern Australia (Short and Milkovitis 1990). However, the species has had a severe decline during the latter end of the last century and a survey for Rock Wallabies during 1993 confirmed that the only known populations in southern NSW occur in the Shoalhaven (Wong 1993).

Populations exist along the Shoalhaven River escarpment from Tapitallee to Kangaroo Valley (Robinson 1989, Wong 1993, Daly and Murphy 1996, Daly unpub. data). An assessment of the population in the region was compiled in 1992 estimated that a total of about 40 animals persist, mostly on private land (Wong 1993). Recent surveys indicate the Shoalhaven population is still about 40 animals but this includes some new populations being found (M. Norton pers. comm.). Separate colonise exist at Cambewarra, Kellets Creek-Hampton bridge and off Yarramunmun Firetrail. There has been a translocation program undertaken to bolster the Kellets Creek population (M. Norton pers. comm.), which declined to an unsustainable level.

About 1990 I was shown a Sooty Owl roost site west of Bundanon by S. Evison that had rock wallaby scats. The overhang had rocks darkened by the oils from the wallabies feet over many years. This was the Kellets Creek site that Norm Robinson had found many years before. This site has been the subject of intense management and due to the efforts of Melinda Norton the population persists. In 2012 I located scats in Bangalee Reserve. This was exciting as previous surveys failed to locate and fresh scats in the area (Daly and Murphy 1996) and indicates that the Kellets Creek population is expanding.

Ecology

The Brush-tailed Rock Wallaby inhabits rocky escarpments that have sufficient ledges so that animals can rest in north or west facing caves and escape potential predators such as the Dog and Fox. Brush-tailed Rock Wallaby's are nocturnal to crepuscular and spend most of their daylight hours sheltering or sunning themselves on steep rocks sheltered by a cave, overhang or vegetation.

The reliance on refuges means the Brush-tailed Rock Wallaby's lives in small groups or colonies, with overlapping individual home ranges of about 15 hectares each (Archer *et al*. 1985). Short (1980) found that home ranges were roughly rectangular around the cliff line, ranging from 6–30 hectares in size (with an average of 15 hectares in size) and 400–900 metres along the cliff (with an average of 700 metres along the cliff).

Brush-tailed Rock-wallaby are displaced from their refuge caves and ledges by feral Goats. In the Shoalhaven I have located caves where there are old (bleached) rock wallaby scats and

recent Goat scats. The diet of Rock Wallabies in Kangaroo Valley was found to be primarily grasses and forbes but the foliage of shrubs and trees was also significant (Short 1989).

Females give birth to one joey at a time, after a gestation period of approximately 30 days (Close1993). The young remain in the pouch for six months. After the joey first emerges from the pouch, it spends a further 7–20 days in and out of the pouch. As Brush-tailed Rock Wallaby's are crepuscular (that is most active at dawn and dusk), young may be left at dawn, dusk or at night in refuges while the mother moves out to feed. Weaning is believed to occur 86 days after leaving the pouch, when the joey is nine months old (Lee and Ward 1989). Sexual maturation of females occurs at 18months, males at 20–24 months (Lee and Ward 1989, Rob Close pers. comm.). Life expectancy in the wild is 5–10 years or more (Eldridge et al 1988), and can be longer in captivity.

The minimum time between litters is likely to be 210 days (Lee and Ward 1989). The number of joeys born per year is related to dominance. A study by Joblin (1983) found the dominant female of a group produced 1.09 joeys per year, and the subordinate females produced 0.59 per year. Reproductive success appears to be related to both the dominance rank of breeding females and the habitat the breeding female occupies.

Threats

Red Fox eat Rock Wallabies an is considered are a main reason for their decline and their current distribution being restricted to rock outcrops and escarpments which is considered to afford protection from the Fox. Competition for refuge site with feral Goats and possibly Wallaroo is considered a threat for rock-wallabies.

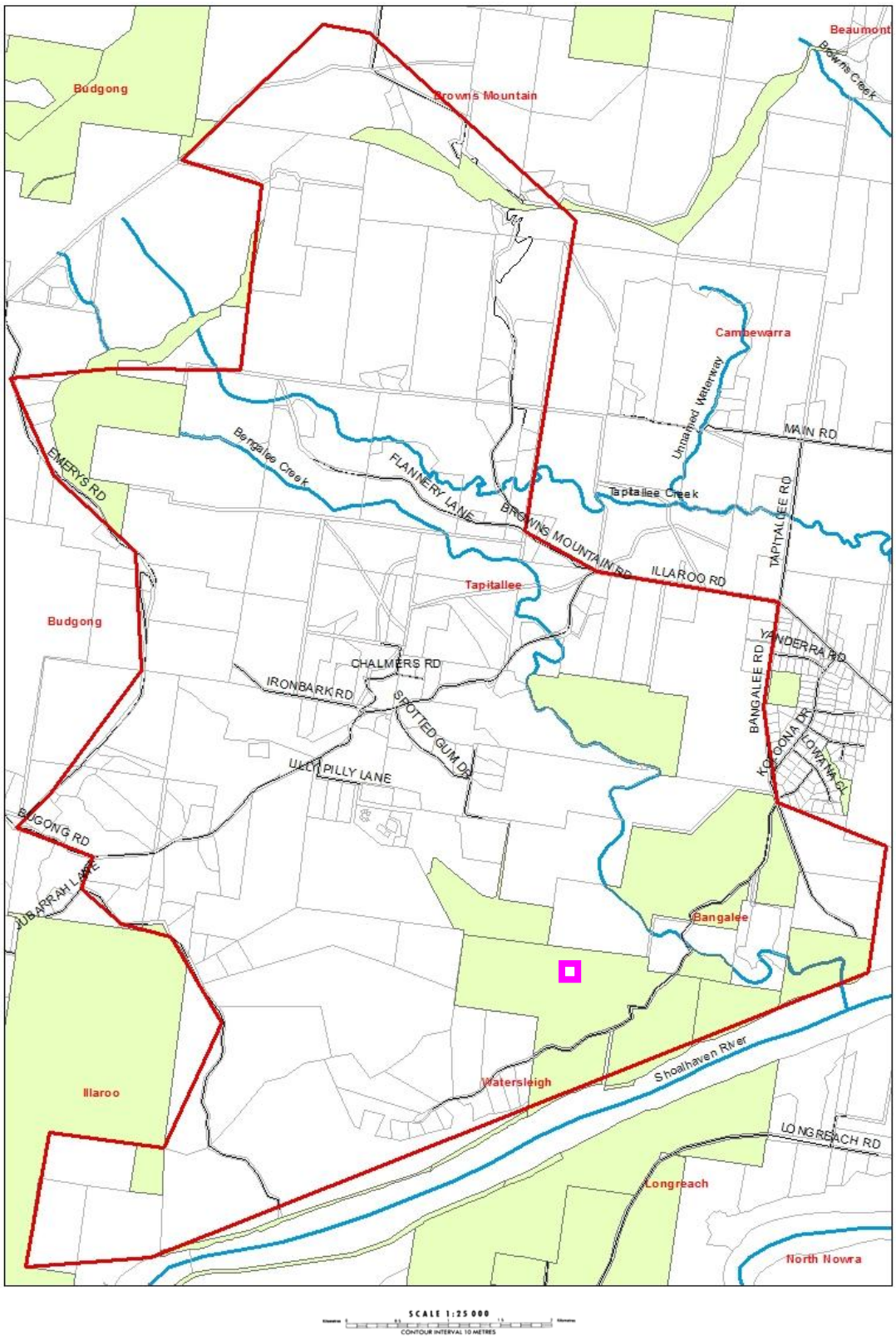

Figure 6
Tapitallee area showing approximate location where Brush-tailed Rock Wallaby detected

3.5 Eastern Pygmy Possum

Distribution

Eastern Pygmy Possums have been found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in the Sydney basin (including the Shoalhaven) most records are from woodlands and heath.

In the Tapitallee area the species is known from the block of land off Illaroo Road south of the Pony Club in Scribbly Gum – Red Bloodwood woodland that has a high species diversity of plants (including *Banksia spinulosa*) in the shrublayer (NGH 2012). The species was also trapped at Bangalee Scout Camp (NGH 2012).

Ecology

Eastern Pygmy-possums appear to be mainly solitary, each individual using several nests, with males having non-exclusive home-ranges of about 0.68 hectares and females about 0.35 hectares. The species feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes (Van Dyke and Strahan 2008). They are an important pollinator of heathland plants such as banksias.

Threats

The clearing of woodland for urban development is the greatest threat to the Eastern Pygmy Possum in the Tapitallee area. Under current zoning the area south of Illaroo Rd is slated for urban development. This is the area that supports the highest density of Eastern Pygmy Possums in the Shoalhaven. Loss of animals by collisions with moving vehicles and predation by domestic cats is another threats to the local population.

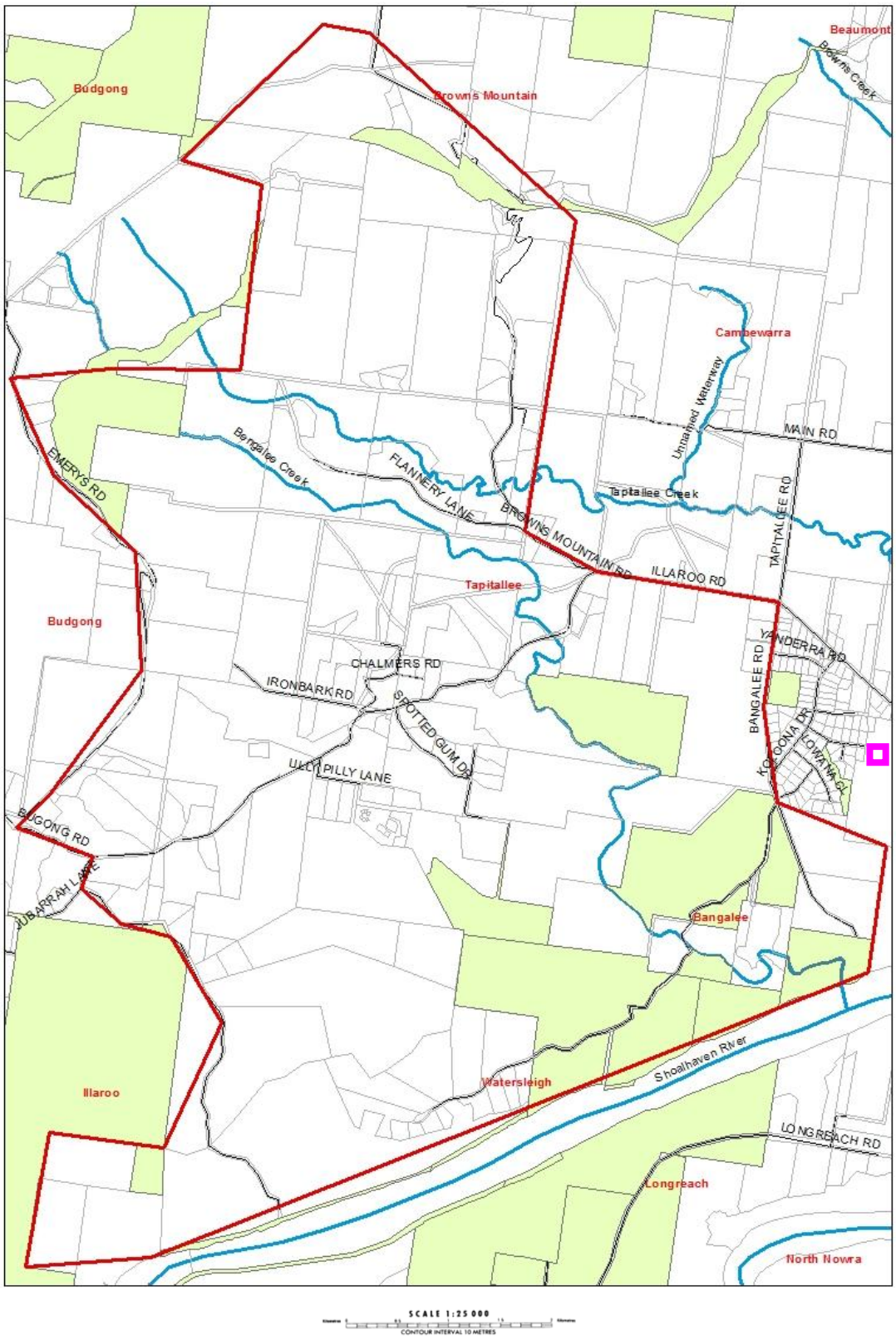

Figure 7
Tapitallee area showing approximate location where Eastern Pygmy Possum detected

3.6 Yellow-bellied Glider

Distribution

The Yellow-bellied Glider occurs along the east coast of Australia from Victoria to about Gladstone in central Queensland (pers. obs.). There are isolated populations in north-east Queensland, south-west Victoria and south-east South Australia (see Strahan 1995). Populations also occur at Carnarvon George, Blackdown Tablelands and west of Ingham, Qld (pers. obs.). These represent isolated populations due to clearing.

The habitat corridor for Yellow-bellied Gliders in the North Nowra-Tapitallee area was initially investigated by the author in 1991 (QEM 1992). Subsequent surveys by Daly and Murphy (1995) indicated that the species occurs in the Grey Gum – Spotted Gum forests in the area from Bomaderry Creek along the Shoalhaven River escarpment to Hampton Bridge, Kangaroo Valley. The have occasionally been recorded north of Illaroo Rd in the Spotted Gum forests along Charmers Road (W. Charmers pers. comm.).

Ecology

The Yellow-bellied Glider occurs in eucalypt forests that range from tall open forest to woodland. They are a forest dependant species and rely on the presence of hollows, which are used as den sites. They feed on sap, honeydew, nectar and manna (Goldingay and Kavanagh 1991).

The Yellow-bellied Glider is nocturnal and usually occurs in family groups, which may number from 2-6 animals, and may live for six years (Goldingay and Kavanagh 1991). They are territorial and frequently call to other members of the group. The size of territories range from 30-65 ha (Goldingay and Kavanagh 1991).

Yellow-bellied Gliders incise a range of ‘gum’ trees to procure sap. However, only a few trees are incised at any one time. In south-eastern Australia the species has been recorded sap feeding from Spotted Gum *C. maculata*, Red Bloodwood, Grey Gum *E. punctata*, Brown Barrel *E. fastigata*, Sydney Blue Gum *E. saligna* and Forest Red Gum *E. tereticornis* (G. Daly pers. obs).

The Yellow-bellied Glider occurs in a range of eucalypt forests that range from tall open forest to woodland. In southern NSW they have been detected from near sea level to 1080 m asl (Daly unpub. data). They are a forest dependant species and rely on the presence of hollows, which are used as den sites. Hollows utilised by Yellow-bellied Gliders occur in mature trees. They feed on arthropods, sap, honeydew, nectar and manna (Goldingay and Kavanagh 1991).

The diet varies spatially and temporally. Food resource availability at a given location is linked strongly to the phenological pattern of tree species within a forest (Kavanagh 1984). The ephemeral nature of food resources also means that Yellow-bellied Glider habitat is characterised by a mosaic of tree species associations which will provide year round food supply (Kavanagh 1987). Hence, the species has a patchy distribution, as many forest associations do not provide sufficient year round food resources. The exception to this is the Mountain Ash *E. regnans* forests in Victoria (Millage *et al.* 1991).

The Yellow-bellied Glider has long protuberant incisors and bites certain gum trees to procure sap. The bite marks may be distinct and are usually V shaped. Yellow-bellied Gliders hang face down and lick the sap as if flows into the sharp point of the V incision. Other species of

possum, such as the Sugar Glider and Feather-tail Glider also utilise the sap from such incisions (pers. obs.).

Within the territory of a troupe of Yellow-bellied Gliders only a select few trees will be incised. Goldingay (1987) suggests that sap feeding is periodic and related to an increased flow rate of the incised tree. Sap trees may be incised for certain periods and then left for several years. Factors such as the availability of other food resources (i.e. phenology) may influence the incidence of sap feeding. Sap trees can be utilised over long periods over several generations of glider and are usually found close to the troupes core area within their home range. A list of tree species incised by Yellow-bellied Gliders for sap in southern NSW is given in Table 6 (Daly unpub. data).

The Yellow-bellied Glider is nocturnal and usually occurs in family groups, which may number 2-6 animals (Goldingay and Kavanagh 1990). Wild animals may live for six years. The Yellow-bellied Glider is territorial and frequently calls to other members of the troupe. Territories range in area from 30-65 ha (Goldingay and Kavanagh 1991). Females usually produce single young per year, but breeding may occur in alternate years (Goldingay and Kavanagh 1990).

Threats

The major threat to the species is clearing associated with forestry, urban development, electricity easements and roadworks. Wildfire is also known to impact on this species by reducing the availability of food such as insects and blossom.

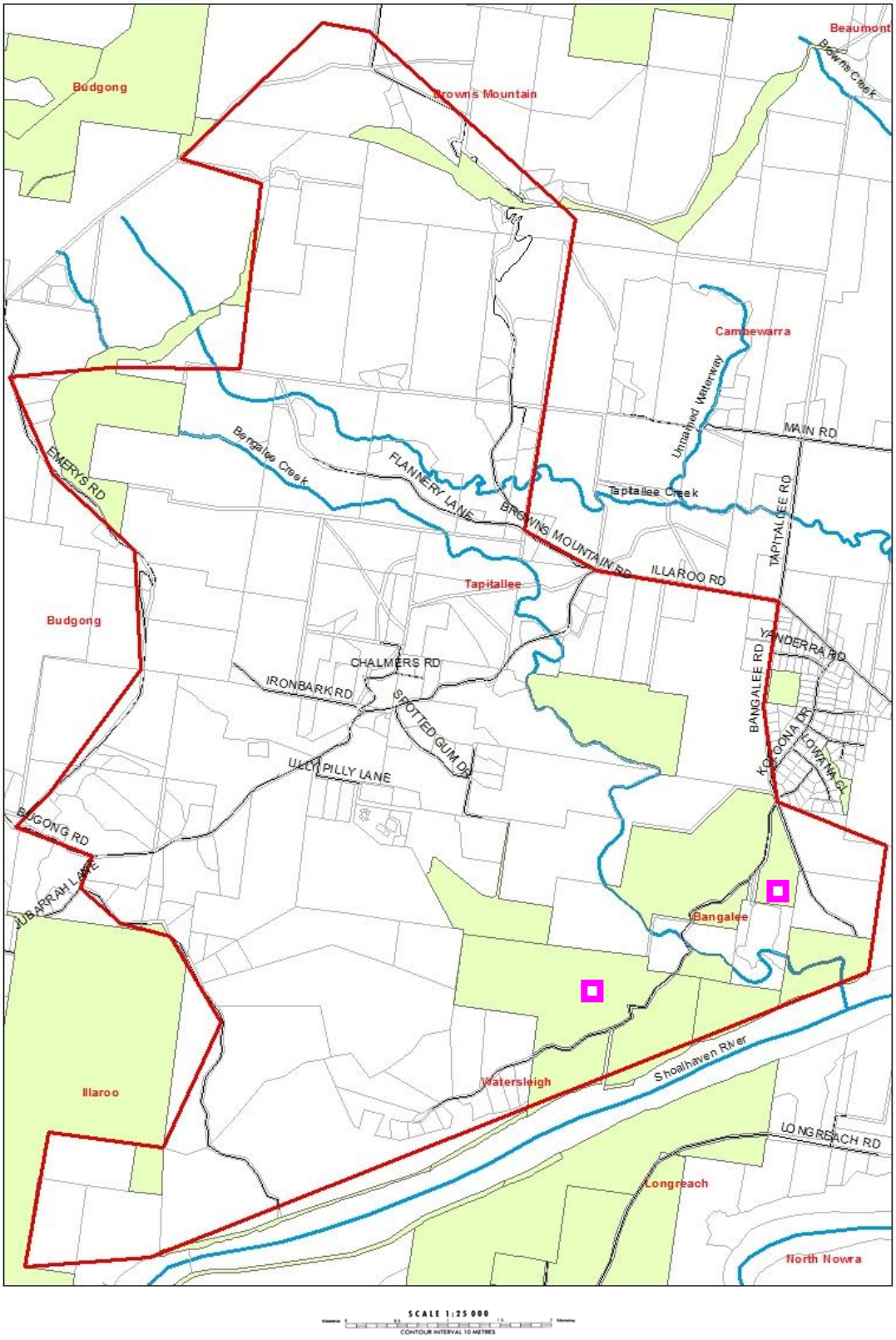

Figure 8
Tapitallee area showing approximate location where Yellow-bellied Glider detected

3.7 Grey-headed Flying Fox

Distribution

The Grey-headed Flying-fox occupies the coastal lowlands and slopes of southeastern Australia from Bundaberg to Geelong and are usually found at altitudes < 200 m (DECCW 2009). Areas of repeated occupation extend inland to the tablelands and western slopes in northern New South Wales and the tablelands in southern Queensland. Sightings in inland areas of southern New South Wales and Victoria are uncommon. There are rare records of individuals or small groups west to Adelaide, north to Gladstone and south to Flinders Island.

In the Shoalhaven there are camps at Bomaderry Creek, Budgong, Comerong Island and Yatta Yatta and South Broomaqn State Forest (Cockwhy Creek) (Gaia Research 2000). All camps are temporary being occupied during the warmer months. The Bomaderry Creek camp established in 1990's and at times can support several thousand bats. The species forages on eucalyptus blossom and the fruit of figs in the Tapitallee area.

Ecology

Grey-headed Flying-foxes feed primarily on blossom and fruit in canopy vegetation and supplement this diet with leaves (Ratcliffe 1931, Parry-Jones and Augee 1991, Eby 1995, 1998, Tidemann 1999, Hall and Richards 2000). The majority of animals feed on nectar and pollen from eucalypts (genera *Eucalyptus, Corymbia* and *Angophora*), melaleucas and banksias. Grey-headed Flying-foxes forage over extensive areas. One-way commutes of approximately 50 km have been recorded between camps and foraging areas (Eby 1991), although commuting distances are more often < 20 km (Tidemann 1999).

Grey-headed Flying-foxes form camps where adults hang during the day. South of Sydney these camps are mostly seasonal and the bats depart during the cooler months of the year. During the summer breeding season young Grey-headed Flying-foxes are left at the camp while the mothers forage at night. Disturbance of camps during this period can lead to young being abandoned or distressed so that they fall from their roost tree. Once on the ground the young are abandoned.

Threats

The main threats to Grey-headed Flying-foxes are the loss of foraging and roosting habitat as a result of clearing for agriculture, urban development and forestry. The Grey-headed Flying-foxes is also threatened from competition from the Black Flying Fox *Pteropus alecto.* The Black Flying Fox has recently expanded its range and now occurs in the Sydney Basin and has been detected in the Shoalhaven.

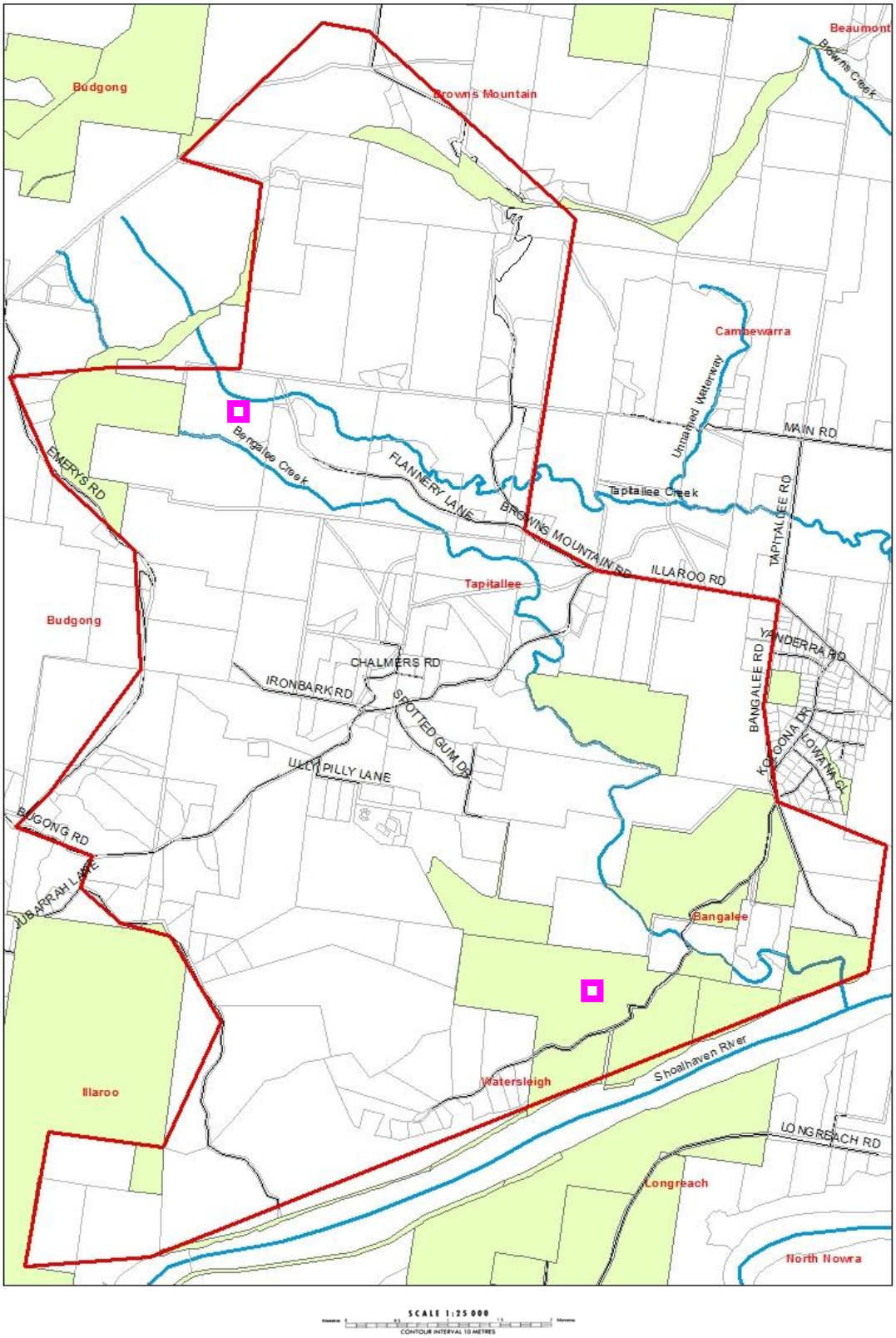

Figure 9
Tapitallee area showing approximate location where Grey-headed Flying Fox detected

3.8 Eastern Bentwing Bat

Distribution

The Eastern Bent-wing Bat occurs along the east coast from Queensland through New South Wales and Victoria. There are other subspecies/populations in north-west West Australia and the Northern Territory and one in the west of Victoria and South Australia (Van Dyck and Strahan 2008). Each population is centred on one or two maternity colonies, and the population range is often determined by watersheds (Dwyer 1966 and 1969). Dwyer (1969) indicates that the Common Bent-wing Bat in the Shoalhaven belong to two populations which have nursery sites at Church Cave, Wee Jasper and The Drum, Bungonia. It has been trapped between the upper reaches of Bengalee and Tapitallee Creeks (G. Daly unpub. data).

Ecology

The Eastern Bentwing Bat species is essentially a cave-roosting species, but is also known to use man-made habitats such as road culverts, storm-water tunnels and other man-made structures. During spring, pregnant females, with some non-pregnant females and juvenile males, congregate at maternity roosts. The females stay in these roosts during summer and depart in February and juveniles depart a month later and both may travel considerable distances to their over wintering roosts (Van Dyck and Strahan 2008). Roost sites outside the breeding period depend on the sex and age of the individuals.

The Eastern Bentwing Bat is known from a variety of habitats along the east coast including rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grasslands (Churchill 1998). In forested areas, it flies above the canopy to hunt, while in riparian rainforest it may fly within a few metres from the ground (G. Daly pers. obs.).

Threats

The direct impacts on this species are the loss of hollow-bearing trees that may be used as roost sites and the loss of bushland that may be used for foraging.

Plate Eastern Bentwing Bat

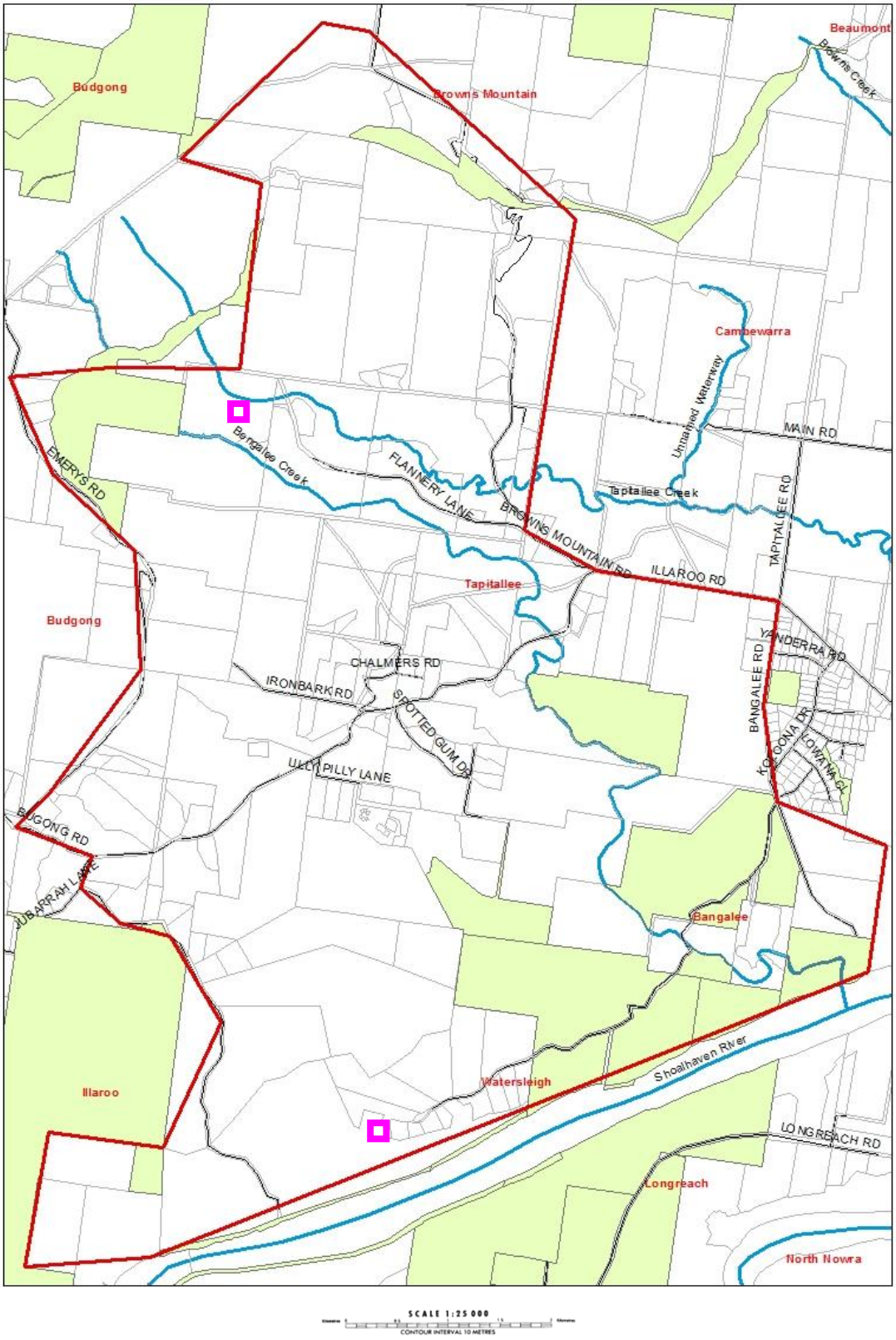

Figure 10
Tapitallee area showing approximate location where Eastern Bent-wing Bat detected

3.9 Yellow-bellied Sheath-tail Bat

Distribution

The Yellow-bellied Sheathtail Bat is a wide-ranging species. With the exception of Tasmania it is found across northern and eastern Australia. In the most southerly part of its range - Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes of NSW. One animal was observed in June 1997 at the author's home in Tapitallee (G. Daly pers. obs.). The animal was observed foraging on top of a hill for two nights.

Ecology

Evidence indicates this species is a spring migrant to the Shoalhaven, with records from southern Australia only taken between January and June (Churchill 1998). The species roosts in tree hollows and tend to be solitary for most of the year but may form small groups of 2-6 in late winter and spring. This species feeds above the canopy and hence is rarely trapped. It roosts in tree hollows. It is usually solitary but maternity colonise of 100 individuals have been recorded. Yellow-bellied Sheath-tail Bats seem to migrate in winter from cooler areas in southern Australia to warmer northern areas.

Threats

The direct impacts on this species are the loss of hollow-bearing trees that may be used as roost sites and the loss of bushland that may be used for foraging.

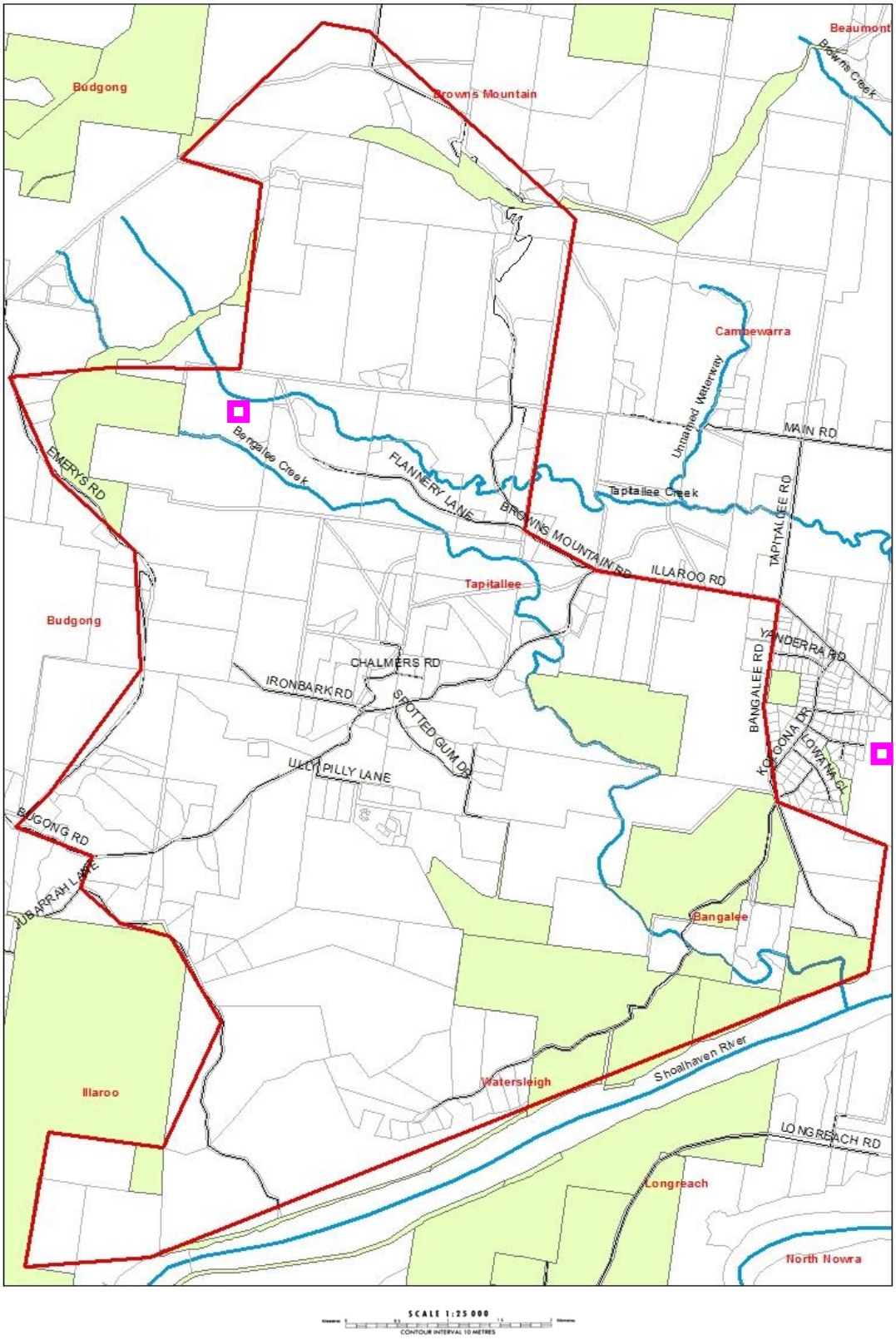

Figure 11
Tapitallee area showing approximate location where Yellow-bellied Sheathtail Bat detected

3.10 Greater Broad-nosed Bat

Distribution

The Greater Broad-nosed Bat occurs from north Queensland along the east coast to the New South Wales Victorian border. In the broader region the author has trapped specimens at Dunmore, Misty Mt Rd west of Batemans Bay, Avon dam area and the Yallah area. This is a rare species rarely tapped in this area. The records of this species in the area come from Anabat recordings.

Ecology

Although inhabiting a variety of habitats from woodland through moist and dry eucalypt forest to rainforest it generally not occur at altitudes above 500 m, except perhaps in the very north of its range (Van Dyck and Strahan 2008). Creeks and small rivers in open forest and favoured corridors where it hawks backwards and forwards for its prey of slow flying insects and smaller microbats.

The Greater Broad-nosed Bat roosts in tree hollows and a single young is born in January. Prior to birth several females will congregate at maternity sites, which are hollow-bearing trees. This species usually forages above the canopy at a height of thirty metres. Subsequently it is rarely caught in harp traps and most records on the wildlife atlas are from Anabat recordings of calls.

Threats

The direct impacts on this species are the loss of hollow-bearing trees that may be used as roost sites and the loss of bushland that may be used for foraging.

Plate xx Greater Broad-nosed Bat

Figure 12
Tapitallee area showing approximate location where Greater Broad-nosed Bat detected

3.11 East-coast Freetail-Bat

Distribution

The East-coast Free-tail Bat occurs along the coast and ranges from the New South Wales from Picton to south-eastern Queensland (http://www.environment.gov.au/biodiversity/threatened/publications/action/bats/39.html). However, we did trap one East-coast Free-tail Bat during the southern Comprehensive Regional Assessment of Forests in the Shoalhaven. Other references such as Van Dyck and Strahan (2008) still present the distribution of the East-coast Free-tail Bat further south but this may be in error due to the recent taxonomic separation of the complex. I have not trapped this species or the undescribed Eastern Freetail Bat in the Tapitallee area. The records of the species occurrence originate from Anabat recordings from other parties.

Ecology

Habitat can be inferred from the few collecting localities, represented by about 12 confirmed records in New South Wales (Parnaby 1995). Such habitats include dry eucalypt forest and coastal woodlands but individuals have been captured in riparian zones in rainforest and wet sclerophyll forest (Allison and Hoye 1995, Daly unpub. data). This species often forages above the forest canopy or at forest edges (Allison 1983). Bats are known to roost in tree hollows but occasionally found in buildings (Gilmore and Parnaby 1994, Allison and Hoye 1995).

Threats

The direct impacts on this species are the loss of hollow-bearing trees that may be used as roost sites and the loss of bushland that may be used for foraging.

Note: The East-coast Free-tail Bat is morphologically similar to the undescribed Eastern Freetail Bat *Mormopterus sp.* The species can be distinguished by forearm length. The East-coast Free-tail Bat forearm being 35-41mm (average 38mm) whereas the Eastern Freetail Bat forearm being 31-35mm (average 33mm).

Plate xx East-coast Freetail Bat

Figure 13
Tapitallee area showing approximate location where Eastern Freetail Bat detected

3.12 Eastern False Pipistrelle

Distribution

The Eastern False Pipistrelle occurs along the east coast from southern Queensland through New South Wales, Victoria, Tasmania and the south-eastern tip of South Australia. In the region this species has been most frequently caught in tall open forest at altitudes about 100m. It has been trapped between the upper reaches of Bengalee and Tapitallee Creeks (G. Daly unpub. data).

Ecology

In southern Australia the species hibernates during winter and roosts in the hollows of living eucalypts. Females fall pregnant during late spring and early summer lactating from December to mid- January. This species often forages below or near the canopy and has a preference for tall open forests at high altitude (Van Dyck and Strahan 2008). Given the relatively large size of this bat it is expected to have a large home range and has been recorded forging over 12 kilometres from its roost.

Threats

The direct impacts on this species are the loss of hollow-bearing trees that may be used as roost sites and the loss of bushland that may be used for foraging.

Plate xx Eastern False Pipistrelle

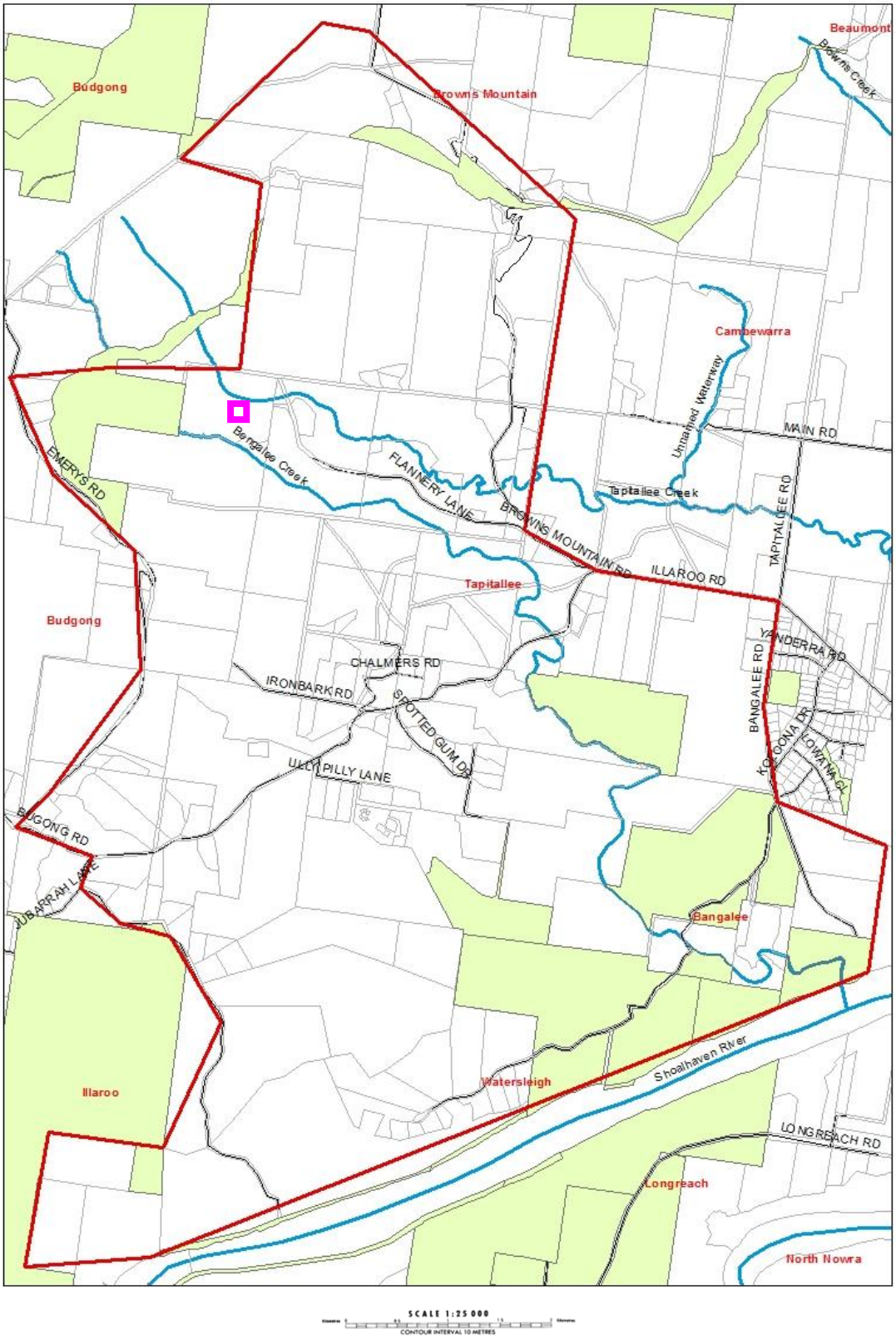

Figure 14
Tapitallee area showing approximate location where Eastern False Pipistrelle detected

3.13 Southern Myotis

Distribution

The Large-footed or Southern Myotis occurs along the coast and ranges from Victoria to north-eastern Western Australia and the Murray River to eastern South Australia (Van Dyck and Strahan 2008).

In the Tapitallee area the Southern Myotis has been detected along Bangalee Creek at the Hockey's Lane Crossing (Parnaby 1996).

Ecology

The Large-footed Myotis forages over fresh and semi-saline water often along creeks for insects and occasionally fish (Robson 1984). They rake the surface of the water with their sharp, curved claws of their feet to capture food. They have been found roosting in caves, mines or tunnels under buildings and bridges, in dense foliage (Dwyer 1970a) and tree hollows adjacent to water. Males tend to be solitary and are strongly attached to a particular site (roost) and defend a territory, excluding other males from his harem of females during the breeding season (Dwyer 1970b). Within the range from central NSW to south-eastern Queensland females give birth to two young each year, one in early October and the other in late January (Van Dyck and Strahan 2008).

Threats

The direct impacts on this species are the loss of hollow-bearing trees that may be used as roost sites and the loss / degradation of riparian areas that may be used for foraging.

Large-footed Myotis

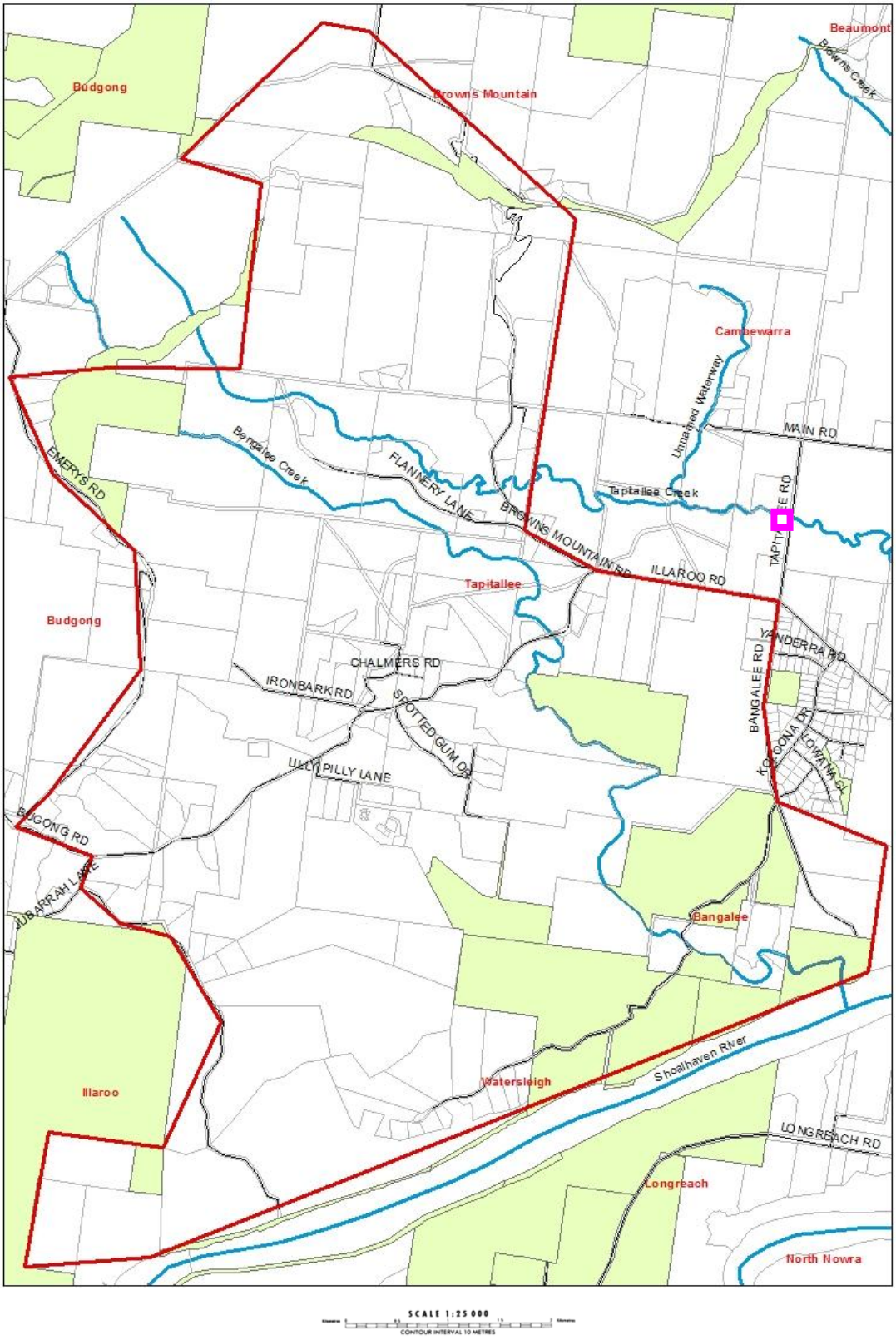

Figure 15
Tapitallee area showing approximate location where Southern Myotis detected

3.14 Large-eared Pied Bat

Distribution

The Large-eared Pied Bat occurs from near Rockhampton Qld (Van Dyck and Strahan 2008) south to Meroo NP, Nowra (G. Daly unpub. data) to the east and west of the Great Dividing Range. One animal was trapped just outside the Subject area just below the escarpment off the road to Bundanon (Daly and Leonard 1996).

Ecology

The Large-eared Pied Bat roosts in caves and the abandoned nests of Fairy Martins *Petrochelidon ariel.* It has been detected in on the edge of closed forest, tall open forest, open sclerophyll forests and woodlands from near sea level to 1500m AHD (Van Dyck and Strahan 2008). In sandstone country in the Sydney basin it usually roosts in the pock holes on vertical cliff walls (Van Dyck and Strahan 2008). Usually fewer than 10 animals huddle together at any site. Females are known to give birth to one or two young in late November and early December and suckle till January (Van Dyck and Strahan 2008). The species hibernates during winter (Van Dyck and Strahan 2008).

Threats

The direct impacts on this species are the loss of roost caves and the loss / degradation of bushland that may be used for foraging.

Large-eared Pied Bat note distinct white fur edging the underside of the body

Figure 16
Tapitallee area showing approximate location where Large-eared Pied Bat detected

3.15 Golden-tipped Bat

Distribution

The Golden-tipped Bat occurs along the coast and ranges from Cape York Peninsula to the NSW/Vic. boarder (Van Dyck and Strahan 2008). One specimen has been trapped in the upper reaches of Tapitallee Creek (G. Daly unpub. data) in an area of riparian rainforest where Yellow-throated Scrubwren and Brown Gerygone exist.

Ecology

The Golden-tipped Bat occurs in moist, closed forest that receives high summer rainfall (Van Dyck and Strahan 2008). It is most frequently caught along small streams where there is an abundance of vines. The species roosts in the abandoned nests of the Yellow-throated Scrubwren *Sericornis citreogulus* and the Brown Gergyone *Gerygone mouki* (Schultz 2000) along creeklines.

The Golden-tipped Bat feeds on web building spiders and most night foraging movements are within 2 km of the roost and can occur in dry sclerophyll forest (Van Dyck and Strahan 2008). Reproduction in temperate areas occurs in spring and summer with females giving birth in late November to December and lactating to late January. Maternity roosts have been located in bird nests and tree hollows, with colony sizes numbering about 10 individuals (Van Dyck and Strahan 2008).

Threats

Logging of lowland riparian areas of tall open forest and rainforest would have been the most significant threat to this specialised forest dependant species. Since clearing in the area probably peaked after the great war (soldier resettlement) much of the foothills vegetation has regrown. Much of the habitat used by Golden-tipped Bat has regenerated, albeit the species is still extremely rare with only one capture in the broader area.

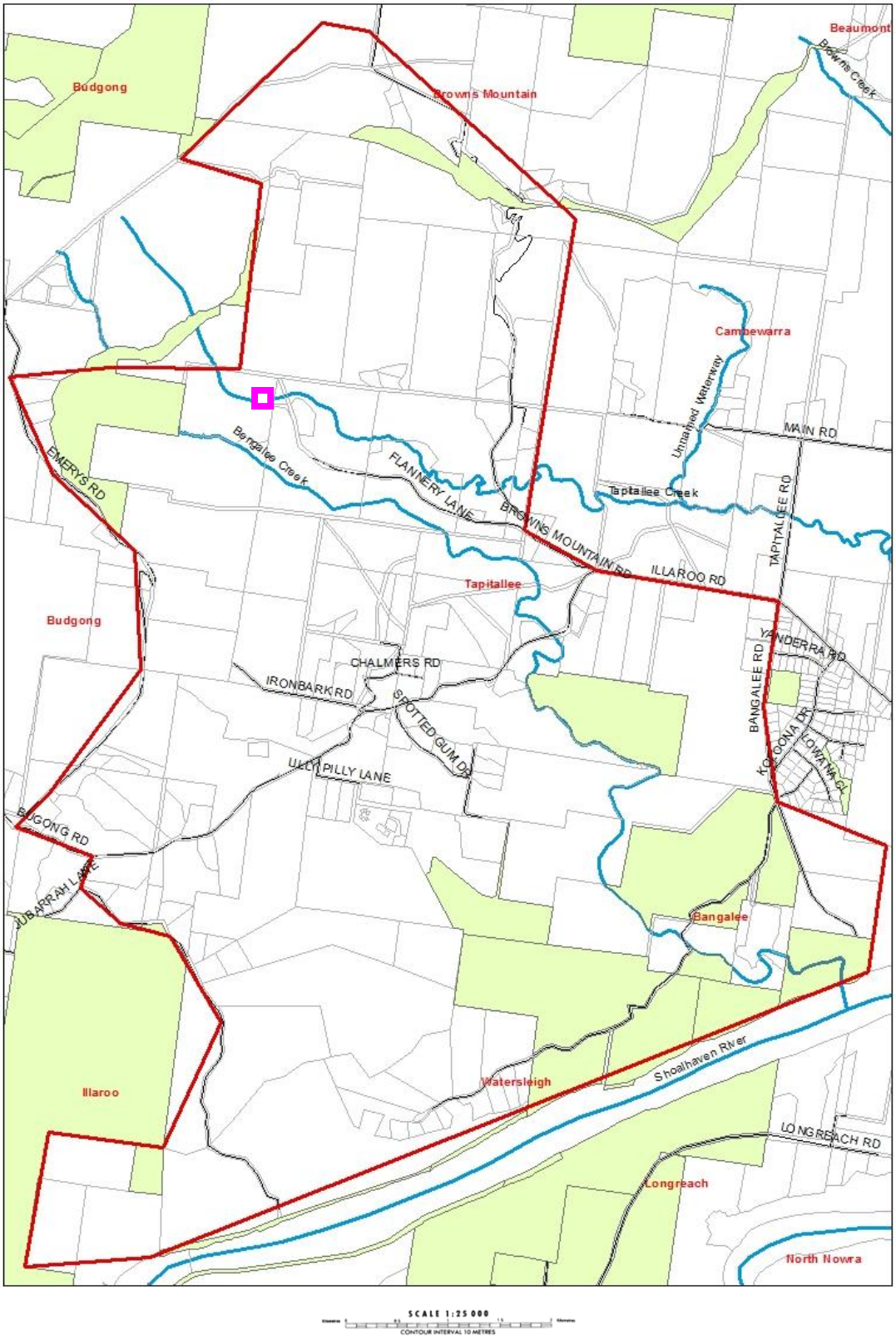

Figure 17
Tapitallee area showing approximate location where Golden-tipped Bat detected

3.16 Bush-stone Curlew

Distribution

The Bush Stone-curlew has a broad distribution, having been recorded from almost all but the most arid areas of mainland Australia and on many offshore islands (Garnett & Crowley 2000; Barrett et al. 2003). The species has had a drastic decline since the introduction of the Red Fox and is now only common in the tropical north of the continent. It is still reasonably common on Kangaroo Island, South Australia, which is free of foxes (Gates and Paton 2005). This species is considered locally extinct but on occasion birds have been detected elsewhere in the Shoalhaven so there is a remote possibility that stray animals may be detected.

The Elliott notes (1932) state "Was originally quite plentiful about Cambewarra but shooting thinned the birds out to a deplorable extent while the fox has completed the work of extermination." The last records from the Cambewarra area were in 1938, a few years after Red Fox invaded the region.

Ecology

Bush Stone-curlews live for approximately 30 years (McGilp 1947) and are believed to hold long-term pair-bonds (Flavell 1992). Breeding probably begins at 2-3 years of age (Marchant and Higgin1993). The Bush Stone-curlew breeding season begins with a noisy courtship around August-September in NSW and has generally finished by March (Marchant and Higgins 1993, Price 2004). A breeding pair will have between one and three clutches within a breeding season (most frequently one or two), with each clutch usually containing two eggs (Andrews 1997, Johnson and Baker-Gabb 1993).

Eggs are laid directly on bare ground, with grass and leaves scraped away (Johnson and Baker-Gabb 1994). The nest site is typically in or near the edge of open grassy woodland or within a cleared paddock where there is good visibility across the surrounding lands (Johnson and Baker-Gabb 1994). Nest sites can be near or beside a fallen log or exposed tree root, and this may provide some camouflage for nesting birds. The same nesting areas may be used in successive years and some have been reported to have been used for almost 30 years (Marchant & Higgins 1993, Johnson and Baker-Gabb 1994). The incubation period is between 22 and 30 days, with both parents participating in the incubation and care of the young (Andrews 1997).

Bush Stone-curlews have a generalist diet, foraging on wide variety of flying and ground-dwelling invertebrates (including locusts and grasshoppers), seeds, small fruit, crustaceans, molluscs, frogs, lizards, snakes and even mice (Marchant & Higgins 1993, Barker and Vestjens 1989).

Resident breeding birds remained with their partner and in their home range year round, and had home ranges of 26-64 hectares (Gates 2001). Mobile breeding Bush Stone-curlews may fly long foraging distances, used communal roost sites and had large home ranges of up to 337 hectares (Gates 2001).

In NSW, Bush Stone-curlews occur in lowland grassy woodland and open forest. In general, habitat occurs in open woodlands with few, if any, shrubs, and short, sparse grasses of less than 15cm in height, with scattered fallen timber, leaf litter and bare ground present. In coastal areas, structurally similar elements of tidal and estuarine communities provide suitable habitat,

for example Bush Stone curlews are recorded within Casuarina woodlands, saltmarsh and mangroves (Price 2004).

Threats

The direct impacts on this species are predation fro Red Fox and cats, trampling of eggs by cattle, clearing woodlands, modifying ground habitat by the removal of fallen logs, increased fires regime and proliferation of exotic pasture grasses. The loss of habitat through urban development is a local threat to this species.

Bush-stone Curlew

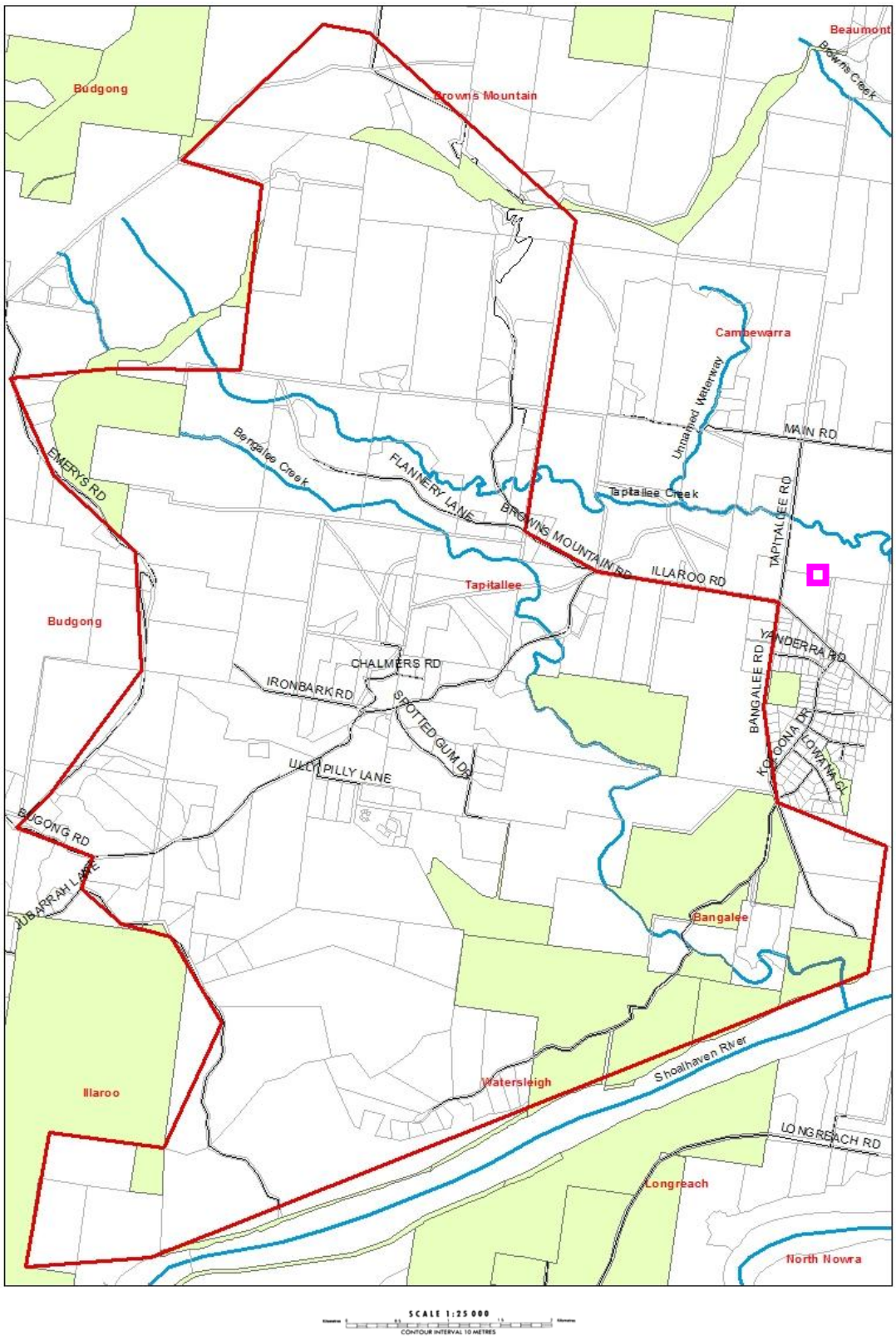

Figure 18
Tapitallee area showing approximate location where Bush Stone Curlew historically detected

3.17 Black Bittern

Distribution

The Black Bittern occurs in Pakistan to south China and south to Australia. Within Australia it ranges from the northern and eastern coasts from Albany in Western Australia to the Shoalhaven. Birds are occasionally observed as far south as Nadgee River but these may be vagrants (Marchant and Higgins 1996).

D. Wright observed one bird at Ryans Swamp (Jervis Bay) on 6 May 1977, near the punt for Comerong Island in April 1984, Nowra Creek December 1984, one bird Nowra Creek January 1985, and one bird at Flat Rock Dam 10 January 1987. A pair of birds was detected by M. Murphy during 1995 along Bomaderry Creek roosting in a willow. These birds frequented this roost for several months. One bird was seen in the mid 1990's along Bengalee Creek and another was seen on the Shoalhaven River at Bangalee Reserve in 2012 (G. Daly pers. comm.).

Ecology

Black Bitterns breed in densely vegetated wetlands in secluded places during summer (Marchant and Higgins 1996). Nests are built in leafy trees, which overhang the water (Marchant and Higgins 1996). Black Bitterns feed on fish and freshwater crustaceans mostly at night (Marchant and Higgins 1996). It has reduced in abundance over the years in eastern Australia, except in north Queensland (Pringle 1985).

Threats

In the Shoalhaven the main threat is habitat removal. Black Bitterns are particularly prone to disturbance. Although they may roost close to areas such as roads they are wary of humans.

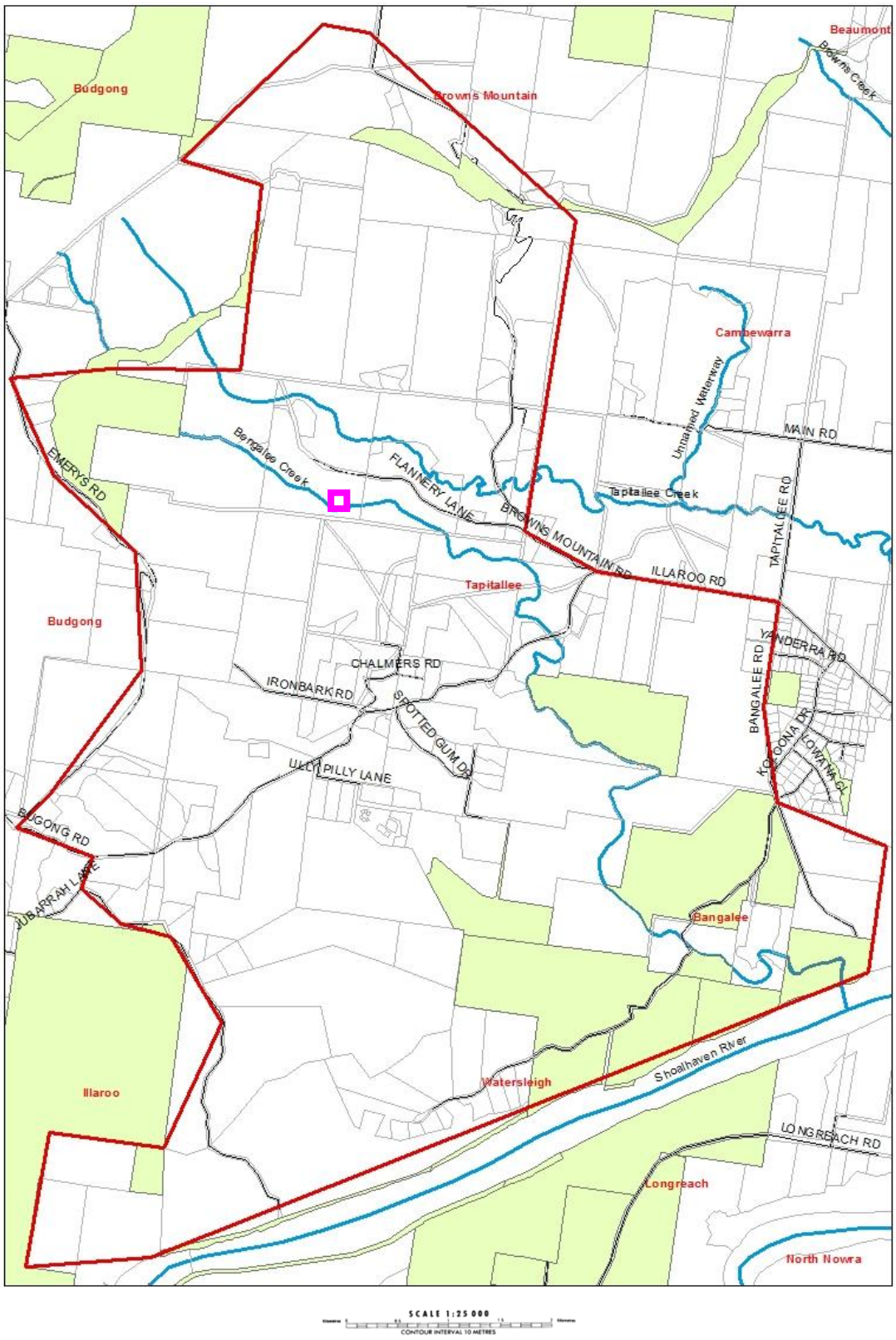

Figure 19
Tapitallee area showing approximate location where Black Bittern detected

3.18 Barking Owl

Distribution

The Barking Owl occurs in Australia, East Indonesia and New Guinea. In Australia, the Barking Owl is found in northern, eastern and south- western Australia from the Pilbara and Kimberley, across the Top End and down through Queensland and the eastern Lake Eyre Basin to southern Victoria, with an isolated population in the south-west corner of WA (Higgins 1999). In NSW, it is widespread on the coastal plain and foothills and the inland slopes and plains.

In the Tapitallee area a pair was heard duetting in the forest below the escarpment near Tapitallee/Bengalee Creeks in 1998. One bird was called up at Budgong near School Creek in 1995. There are no recent records of the species in the region and the Barking Owl is now extremely rare in the Illawarra and south coast of NSW. The species may have been a seasonal visitor to the region.

Ecology

The Barking Owl lives in forests and woodlands of tropical, temperate and semi-arid zones. Its habitat is summarised below from Kavanagh *et al.* (1995), Debus (1997) and Higgins (1999). The habitat is typically dominated by eucalypts, often red gum species and, in the tropics, paperbarks *Melaleuca* species. It usually roosts in or under dense foliage in large trees including rainforest species of streamside gallery forests, River She-oak *Casuarina cunninghamiana*, other *Casuarina* and *Allocasuarina* species, eucalypts, *Angophora* or *Acacia* species.

The Barking Owl hunts opportunistically for terrestrial, arboreal and aerial prey between dusk and dawn and occasionally in daylight (Higgins 1999). The diet is summarised from Kavanagh *et al.* (1995a), Debus (1997), Debus *et al.* (1998, 1999) and Higgins (1999). It eats a variety of birds, mammals and large insects. Rabbits are frequent prey in rabbit-infested areas where there are few other suitably-sized mammals but where possible, the owl appears to prefer native arboreal mammals such as Sugar Gliders (Kavanagh *et al.* 1995, Debus 1997, Debus *et al.* 1998, 1999 and Higgins 1999).

They are strictly seasonal breeders, laying a single small clutch of 1-3 (usually 2) eggs in late winter or spring. The nest site is a large open hollow, often vertical or sloping, in the trunk or sometimes a spout of a eucalypt or *Melaleuca*, usually a live tree though occasionally a dead tree. Nest-hollow entrances are 2-35 m above the ground with a diameter of 20-46 cm and depth of 20-300 cm. In NSW, laying takes place in August-October or in November for replacement clutches if the first clutch fails. The incubation period lasts 36-37 days and the nestling period is 35-36 days.

Threats

Habitat loss and degradation is the major threatening process for the Barking Owl (Garnett and Crowley 2000). The relevant, key threatening processes are clearing of native vegetation, continued net loss of native hollow bearing trees and coarse woody debris due to firewood harvesting practices, removal of dead wood, dead trees and logs and competition for hollows from feral honeybees.

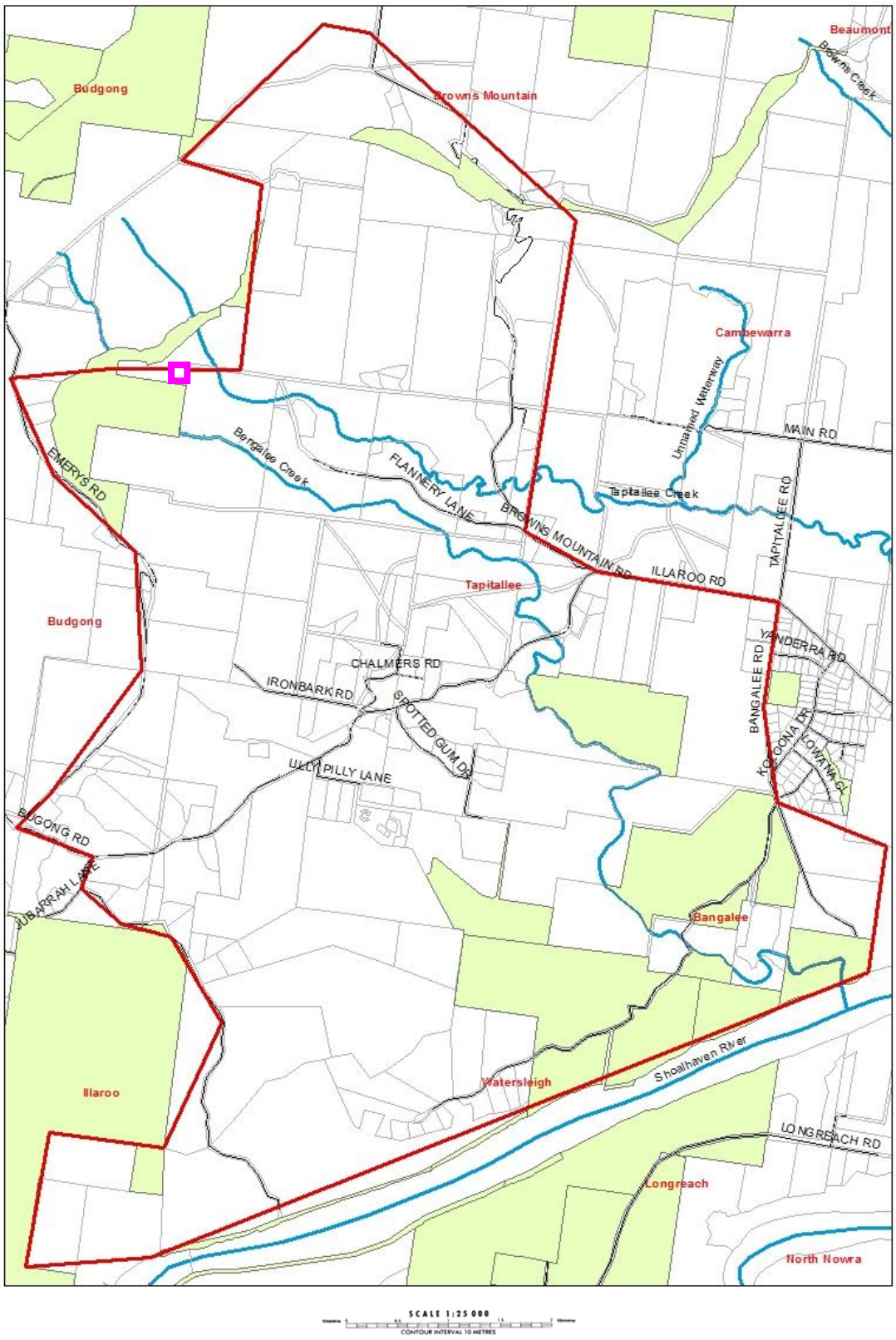

Figure 20
Tapitallee area showing approximate location where Barking Owl detected

3.19 Powerful Owl

Distribution

The Powerful Owl occurs in tall open forest along the coast and ranges from the South Australia Victorian border to the Clarke Range central Queensland (Eyre and Schulz 1996). The Powerful Owl is widely distributed throughout the Shoalhaven (Daly unpub. data). One pair lives in Bangalee Reserve and (presumably) another pair moved into the Tapitallee area in the mid 2000. Since that time birds are occasionally heard calling (and one seen) in the bushland near the upper reaches of Tapitallee and Bangalee Creeks (G. Daly pers. obs.).

Ecology

The Powerful Owl lives as monogamous, life-long pairs sedentary in large permanent home ranges. Home range has been estimated as 300-1500 ha according to habitat productivity; measured as 800 ha for one non-breeding individual and 350 ha for one breeding female closely associated with the nest tree and new fledgling (Kavanagh 1997).

Habitat for this species is primarily tall, moist productive eucalypt forests of the eastern tableland edge and the mosaic of wet and dry sclerophyll forests occurring on undulating, gentle terrain nearer the coast. Optimal habitat includes a tall, shrub layer and abundant hollows supporting high densities of arboreal marsupials.

Tree hollows used by owl prey species form in trees greater than 120 years old; those of a size used by owls for nesting and roosting form in trees greater than 165 and probably greater than 250 years old (Mackowski 1984, Lindenmayer *et al.* 1991, Milledge *et al.* 1991). Nesting occurs in old hollow eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines, with hollows greater than 45 cm wide and greater than 100 cm deep; surrounded by canopy trees and subcanopy or understorey trees or tall shrubs.

Most (84%) pairs nest each year and most of those nesting (93%) produce at least one young (Kavanagh 1997). Laying is strictly seasonal, occurring mainly in June (mid-May to mid-July). The clutch is 1-2 eggs; a single clutch is laid per year although, rarely, a replacement clutch may be laid if the first attempt fails early in the egg stage. The incubation period is 5 weeks.

The Powerful Owl is a specialised predator of arboreal mammals, particularly the Greater Glider *Petauroides volans* and Common Ring-tailed Possum *Pseudocheirus peregrinus* (Debus and Chafer 1994, McNabb 1996 and Kavanagh 1997). These two mammals comprise more than 80% of the diet for this owl in most territories in NSW (DEC 2006). Other mammals eaten include the Grey-headed Flying Fox *Pteropus poliocephalus* and Sugar Glider *Petaurus breviceps*. Powerful Owls may also eat birds such as Pied Currawongs and large parrots (Debus and Chafer 1994, pers. obs.).

Threats

Forest clearing and fragmentation for agriculture and urban developments permanently removes foraging and breeding habitat affecting all age classes of owls. Intensive logging of wood-production forests has the potential for removing nest sites and roost sites for the owls, and den sites for prey species. The species is more than twice as abundant in north-eastern NSW as in south-eastern NSW (Kavanagh and Peake 1993b). It has been estimated that Powerful Owl populations and the area they occupy may have declined by 20-50% since European settlement (Debus and Chafer 1994).

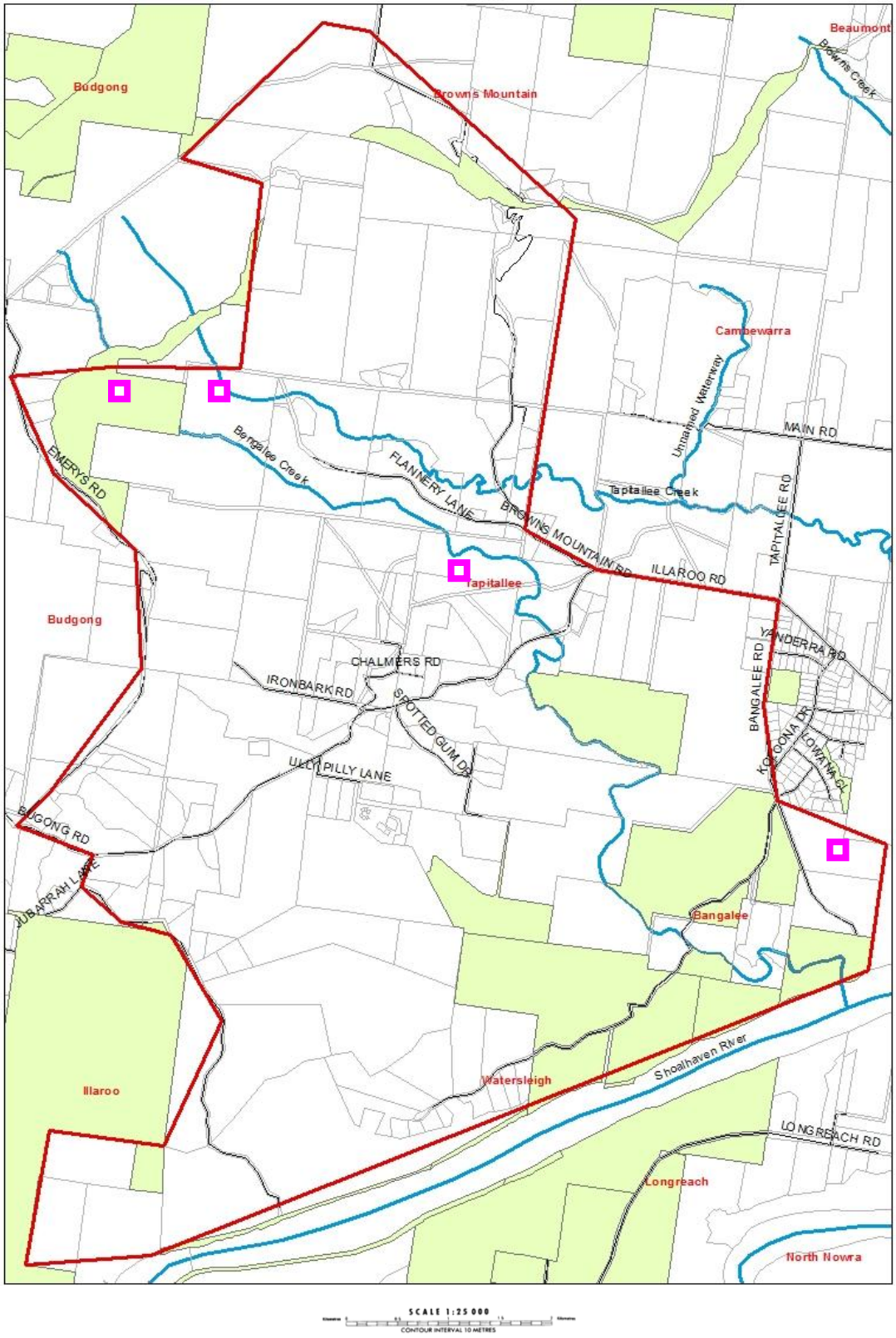

Figure 21
Tapitallee area showing approximate location where Powerful Owl detected

3.20 Masked Owl

Distribution

The Masked Owl was stated as being restricted to the drainages of coastal rivers with no confirmed reports greater than 300 km inland (Schodde and Mason 1980). However, Debus (1993) indicated that the species occurs on the Nullarbor Plain and northern Flinders Range.

The accepted range covers a wide area in Australia mainly around the coast. There are two gaps in the mainland distribution between eastern South Australia and central Victoria and the other between about Broome and the Kimberley region in northern West Australia. The species occurs throughout Tasmania and southern New Guinea. A pair of birds was detected in Bangalee Reserve in the 1990's by S. Evison. The behaviour of the animals indicated that they nested in the reserve at that time.

Ecology

Large forest owls respond to geomorphology, moisture regime, vegetation structure and consequent site productivity rather than specific floristics (NPWS in prep.). Tree hollows used by owl prey species form in trees greater than 120 years; those used by large forest owls for nesting and roosting form in trees greater than 165 or possibly 250 years old (Mackowski 1984, Millage *et al.* 1991). Large forest owls prefer mid to late successional, mixed age or multi-aged forest greater than 60 years old (Davey 1993).

The Masked Owl is found in areas that possess a mosaic of habitats with some open or cleared areas. In non-disturbed habitat they utilise wet-dry forest mosaics, which contain open and dense ground cover (Kavanagh 1977). They utilise ecotonal forests, generally in gently undulating country.

Masked Owls live as monogamous, life-long sedentary pairs in large permanent home ranges (400-1000 hectares) (NPWS in prep.). The social unit is an adult pair and 1-3 dependant young (Debus 1993). Laying is irregular but mostly occurs between May to July. Wild animals lay one to four eggs, which hatch after 5 weeks and the young fledge after approximately two months (NPWS in prep.). Fledglings are dependent on their parents for 1-3 months and then disperse.

Masked Owls nest in hollows of old growth trees (live or dead) in trees of at least 900 mm diameter at breast height (NPWS in prep.) and occasionally in caves (Debus 1993). The nest hollow is greater than 400mm wide, one metre deep and at least 3 m above the ground (NPWS 2000). Nests are usually located in mesic habitats such as gullies.

Masked Owls mainly feed ground dwelling mammals such as Rabbits *Oryctolagus cuniculus,* rats *Rattus* spp. (Debus and Rose 1994) and occasionally Common Ringtail Possums *Pseudocheirus peregrinus* and Sugar Gliders *Petaurus breviceps* (Debus 1993).

Kavanagh (1997) found that the Masked Owl appeared to have a closer association with unlogged or selectively logged forests than the Powerful Owl, particularly in forests that had an open understorey and a sparse ground cover.

Threats

Forest clearing and fragmentation for agriculture and urban developments permanently removes foraging and breeding habitat affecting all age classes of owls.

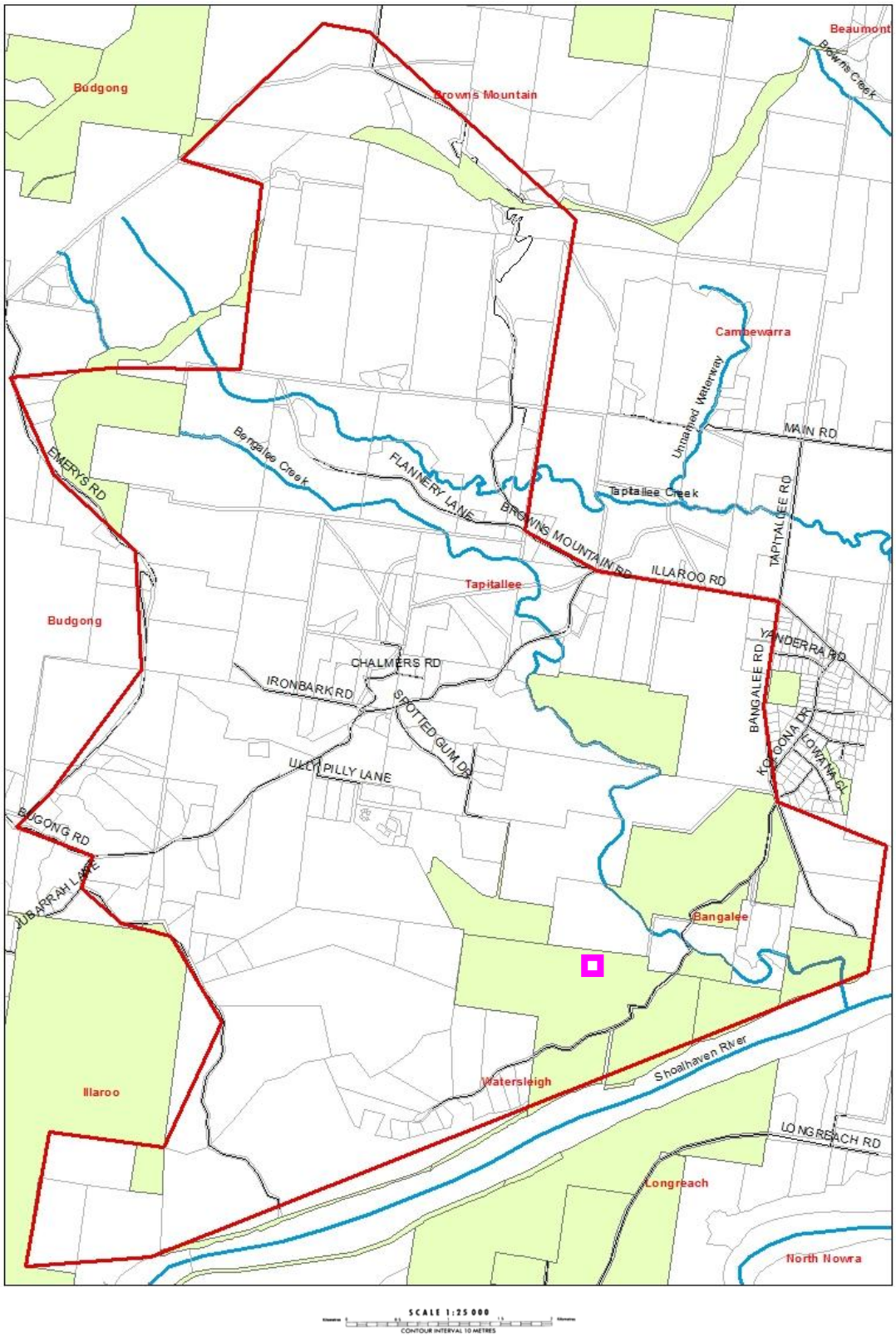

Figure 22
Tapitallee area showing approximate location where Masked Owl detected

3.21 Sooty Owl

Distribution

The Sooty Owl inhabits coastal ranges from central Queensland south to central Victoria (Simpson and Day 1996). The Sooty Owl lives in the tall moist eucalypt forests and rainforests of the coastal, escarpment and eastern tablelands regions of NSW (Kavanagh 2002). There is a gap in the distribution at the lower Hunter valley. In the Shoalhaven the Sooty Owl is widespread along the Cambewarra escarpment and the eastern slopes of Parma Creek and Jerrawangala NR's (Gaia Research 2011) and further south along the escarpments and ranges. The escarpment rainforest and tall open forest between Tapitallee and Bengalee Creeks is within the home range of one pair (G. Daly pers. obs.). This area may be used for breeding.

Ecology

The Sooty Owl roosts in hollows in live or occasionally dead trees, eucalypt or rainforest species, in moist forest; among dense foliage in rainforest gullies; caves, recesses or ledges in cliffs or banks.

Roost sites are in the darkest and most secluded or sheltered positions in the forest. Sooty Owls nest in old hollow trees, eucalypt or rainforest species, usually live but stags are occasionally used, in unlogged, unburnt gullies and lower slopes within 100 m of streams, with hollows greater than 40 cm wide and greater than 100 cm deep; surrounded by canopy trees. Hollow entrances are at least 16 m above ground, in trees of at least 120 cm diameter at breast height. Sooty Owls can also nest in caves (Hollands 1991, Kavanagh 1997, Kavanagh 2002).

The Sooty Owl lives as monogamous, sedentary, life-long pairs in large permanent home ranges. Laying is irregular and unpredictable, occurring in most months with peaks in autumn-winter and early spring. The clutch is 1-2 eggs in the wild; a single clutch is laid per year but sometimes (often?) there is no breeding within a year. The nestling period is reportedly 2.5-3 months, though possibly 2 months the breeding cycle occupies up to 4 months from laying to fledging. The male provides food, while the female provides parental care in the egg and chick stages; both sexes provide food from the late nestling stage to independence of the young.

Juveniles are dependent for 3-5 months post-fledging; thereafter dispersal is unknown. However, one hand-reared immature is known to have dispersed 50km from its point of release in Byron Bay NSW Longevity in the closely related Lesser Sooty Owl is 20+ years in captivity; possibly 15 years in the wild.

Home range has been estimated as 200-800 ha according to habitat productivity; measured as 3000 ha (1000 ha actually used) for one unmated, non-breeding individual in marginal habitat, and 450+ ha for one adult female in continuous habitat of mesic gullies within dry forest (Kavanagh 1997,Kavanagh and Jackson 1997).

The Sooty Owl is a generalist predator taking almost all arboreal, scansorial and small terrestrial mammals occurring within its more specialised habitat. It particularly favours the Common Ringtail Possum, but it also takes large numbers of the Sugar Glider the Bush Rat, Fawn-footed Melomys and the Brown Antechinus. Bandicoots are also commonly taken. Birds and insects are rarely eaten by the Sooty Owl.

Threats

Forest clearing and fragmentation for agriculture and urban developments permanently removes foraging and breeding habitat affecting all age classes of owls.

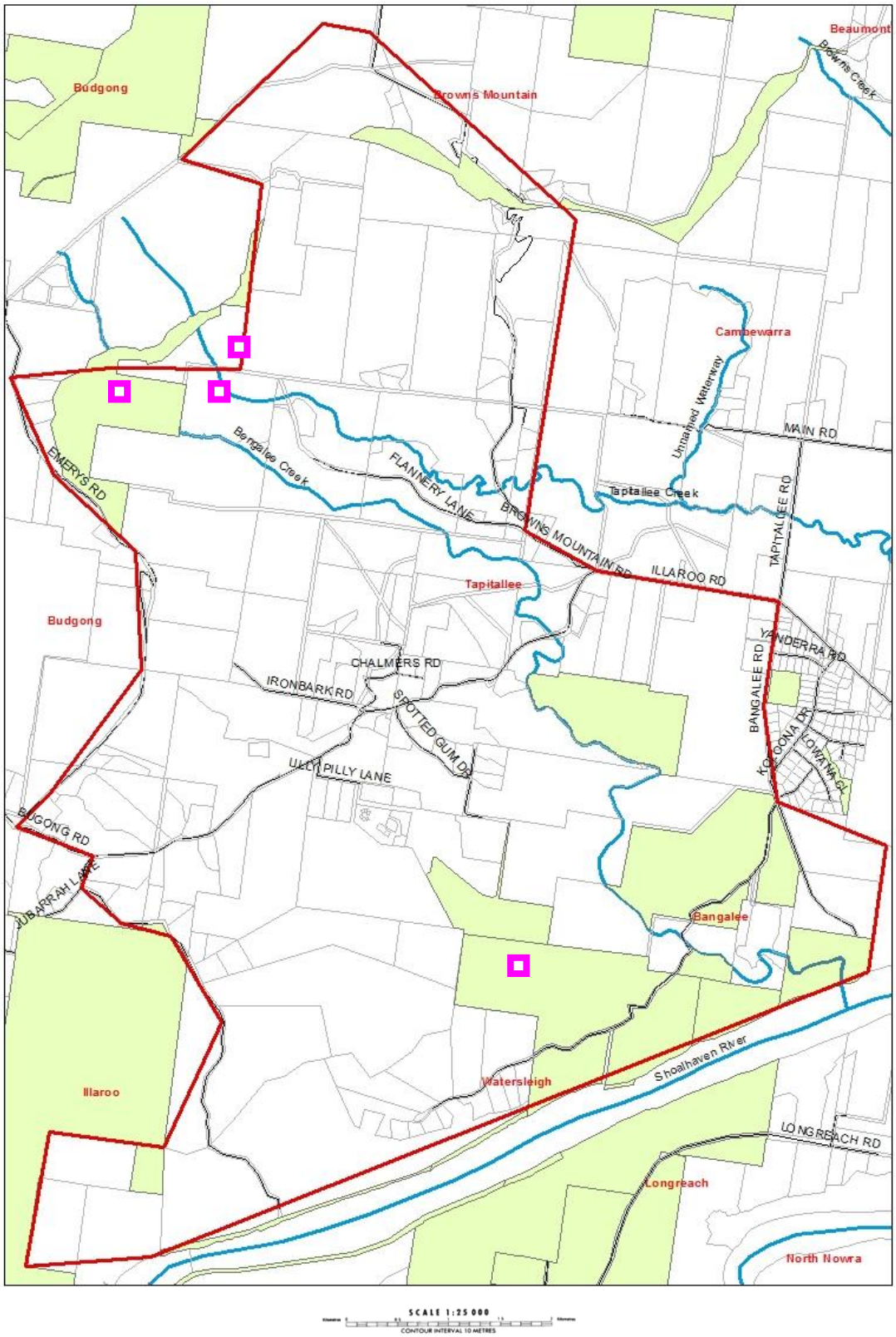

Figure 23
Tapitallee area showing approximate location where Sooty Owl detected

3.22 Superb Fruit Dove

Distribution

The Superb Fruit-dove occurs along the coast and ranges from Cape York, Qld south to the NSW/Qld border (Simpson and Day 1996). Animals occasionally detected further south to Vic and Tas are considered vagrant. In the Shoalhaven this species is a rare vagrant. Only a few specimens recorded, most of which are detected after they have flown into windows. One bird was found in 1997 adjacent to Illaroo Road after it had flown into a window (D. Wright per. comm.). It was subsequently lodged at the Australian Museum.

Ecology

The Superb Fruit-dove is usually found in or on the edge of closed forest where it feeds on rainforest fruits especially laurels (Crome and Shields 1992). It breeds in spring and summer and nests in pockets of eucalypt forest and regrowth next to rainforest (Crome and Shields 1992). One egg is laid per clutch and the chick fledges after five to six days (Crome and Shields 1992).

Threats

Although it is still common in the wet tropics the species probably has been affected by the extensive clearing of coastal closed forest for agriculture.

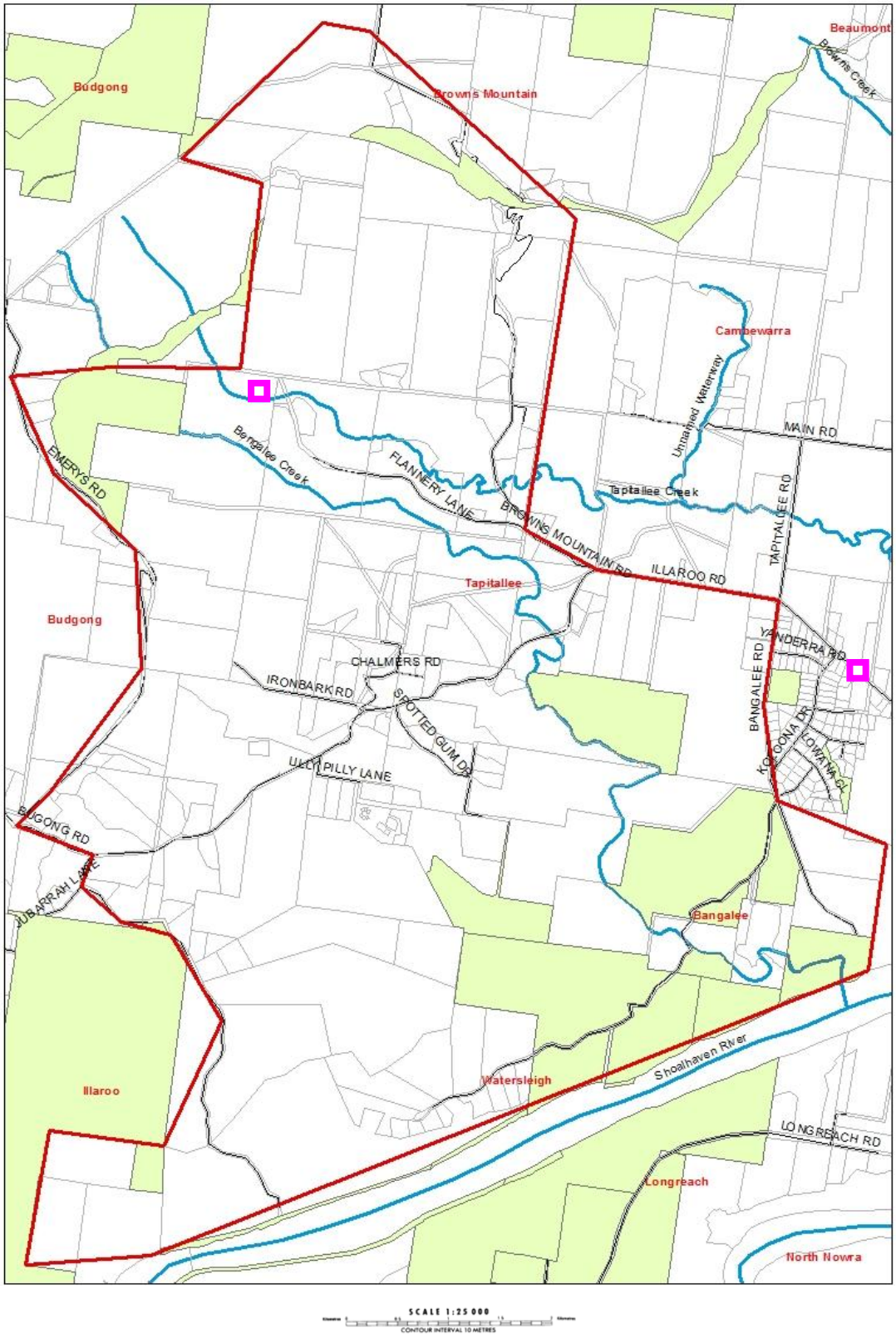

Figure 24
Tapitallee area showing approximate location where Superb Fruit Dove detected

3.23 Gang-gang Cockatoo

Distribution

The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales (NSW) (Shields and Crome 1992). The local population of Gang-gang Cockatoos occurs over the coastal and escarpment forests. However, the birds have very large home ranges and movements are not understood. They are not uncommon in the Tapitallee area and flocks of 20 have been seen. Behaviour of some birds suggests that breeding occurs in the upper Tapitallee catchment.

Ecology

In summer, the Gang-gang Cockatoo occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, the Gang-gang Cockatoo occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas (Shields and Crome 1992). The species undertake nomadic as well as seasonal movements and may occur at apparently random points within their range.

The Gang-gang Cockatoo requires hollows in the trunks or large limbs of large trees in which to breed (Gibbons 1999, Gibbons and Lindenmayer 2000). Breeding usually occurs in tall mature sclerophyll forests that have a dense understorey, and occasionally in coastal forests. Nests are most commonly recorded in eucalypt hollows in live trees close to water (Beruldsen 1980). Breeding usually occurs between October and January (Chambers 1995).

The maximum population of Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas is estimated to be between 18 and 40 pairs. Birds have been observed nesting in hollows in large, old trees, and breeding has been documented at least since 1994. The species shows strong nest site fidelity (Scientific committee determination 23 February 2001).

Threats

Gang-gang Cockatoos were once widespread and numerous in Sydney and surrounding areas, but have been greatly reduced in recent years by loss of habitat. Other threats include competition for nest hollows with other species (Scientific committee determination 23 February 2001).

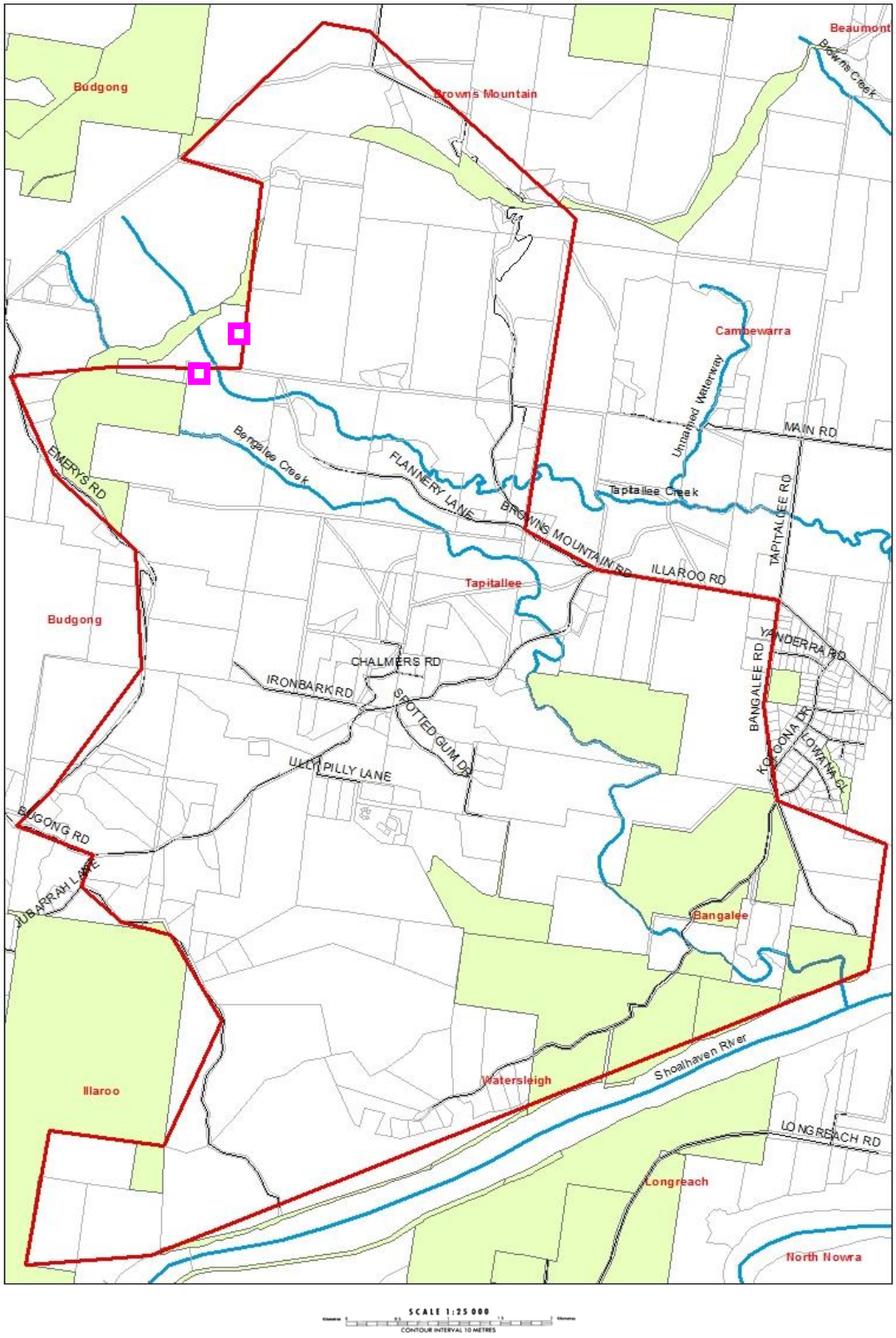

Figure 25
Tapitallee area showing approximate location where Gang Gang Cockatoo detected

3.24 Glossy Black Cockatoo

Distribution

The Glossy Black Cockatoo inhabits woodland and open forest along the east coast and ranges from central Victoria to southern Queensland (Simpson and Day 1996). There is an isolated subpopulation on Kangaroo Island in South Australia. Within its range there are three identified subspecies (Higgins 1999).

The species is widespread in the Shoalhaven and occurs primarily on the coastal plain where stands of the feed tree Black Oak *Allocasuarina littoralis* occur. The species is largely absent from rainforest, tall open forest and heathland. In the Tapitallee area Glossy Black Cockatoos feed on Black Oaks beside Illaroo Rd, Bangalee Reserve and the Budgong area. Nesting has been recorded at Illaroo farm (Ted pers. comm.).

Ecology

Although a number of the breeding locations for this subspecies have been documented (e.g. Blakers *et al*. 1984; Barrett *et al*. 2004), the breeding biology of this subspecies has not been studied in detail (Higgins 1999). Egg laying has been recorded as occurring from April to June with usually one egg being laid (Higgins 1999). The incubation time ranges from 28-33 days in captivity and the female remains on the nest during this time and is fed by the male (Higgins 1999). Hence there is a requirement for an abundance of feed trees within close proximity to the nest tree. Young fledge some 60-105 days and then remain with the parents for another 3-4 months. Pair bonding is strong and appeases to be monogamous (Higgins 1999). There is also a high degree of nest fidelity with previous nest sites being used in subsequent seasons (Garnett *et al.* 1999, Higgins 1999).

The Glossy Black Cockatoo requires old growth trees, which have suitable hollows for nesting and an abundance of She-oak trees for feeding. The diet of the species is very specialised. In the north of their range they frequently eat *Allocasuarina torulosa* but in the southern half of their range their main food is the Black Oak *Allocasuarina littoralis* (pers. obs.). Birds have been recorded to nest within ten kilometres of primary feeding areas (Garnett *et al.* 1999, Higgins 1999).

Threats

The direct impacts on this species are the loss of hollow-bearing trees and feed trees.

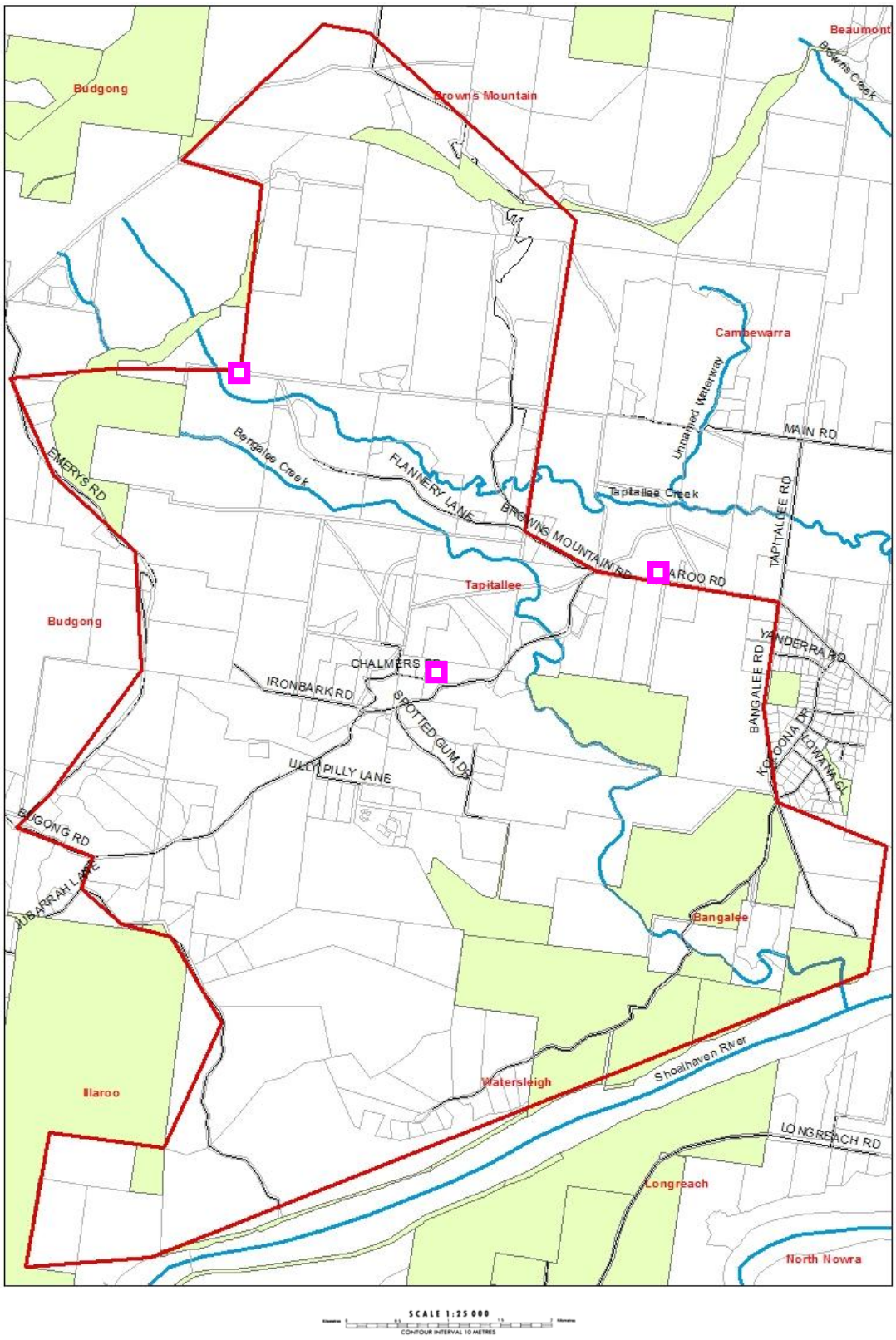

Figure 26
Tapitallee area showing approximate location where Glossy Black Cockatoo detected

3.25 Little Lorikeet

Distribution

The Little Lorikeet is endemic to Australia. It is found from near Cooktown south to the South Australian – Victorian boarder (Higgins 1999, Barrett et al. 2003). In New South Wales Little Lorikeets are distributed in eucalypt forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri (Barrett et al. 2003). In NSW the main areas of observations are from the northern rivers, north-west slopes and the south coast (Higgins 1999).

In the Shoalhaven I have found the Little Lorikeet to be a summer migrant. I have no records of breeding in the area. Birds are highly associated with Scribbly Gum – Grey Gum woodlands and Spotted Gum forests that are flowering. During the 1980's flocks of 20 birds would regularly fly over the Tapitallee area near Flannery lane but did not land (G. Daly pers. obs.). Elliott states that at times this species was very common in 1940 when Spotted Gums were in flower.

Ecology

There is no evidence of regular migration, but Little Lorikeets are generally considered to be nomadic (Higgins 1999), with irregular large or small influxes of individuals occurring at any time of year, apparently related to food availability. However, long term investigation of the breeding population on the north-western slopes indicates, that breeding birds are resident from April to December, and even during their non-resident period, they may return to the nest area for short periods if there is some tree-flowering in the vicinity (Courtney & Debus 2006). In the Shoalhaven the species is regularly detected during late summer when Scribbly Gum flower, although they have been observed feeding on blossom of other species such as Grey Gum and Blackbutt during summer (G. Daly pers. obs.).

The breeding biology of Little Lorikeets is little known, except for long-term observations (43 years) on the north-western slopes by Courtney and Debus (2006). This work, consistent with anecdotal records from around the country, indicates that nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts (Scientific Committee determination 2008). Nest-hollows are used 'traditionally', with the same hollow known to be occupied for at least 29 years (not necessarily by the same individuals) (Courtney & Debus 2006). The breeding season extends from May to September (Higgins 1999) and as long as eucalypt nectar and pollen are available throughout this period, two broods of fledglings can be raised in a season. Clutches are of three to five eggs (Higgins 1999) and broods of three and four young have been recorded, with a single fledgling recorded from one nest (Courtney & Debus 2006). Little Lorikeets in captivity are known to breed at one year of age (G Phipps, pers. comm. 2008, R Webb, pers. comm. 2008 in Scientific Committee determination 2008) and this suggests a minimum age for maturation in the wild of one year. A life span of 10 years in the wild is a reasonable estimate for a parrot of this size (W. Boles, pers. comm. 2008 in Scientific Committee determination 2008). An approximation of generation time based on the age of maturity plus half of the length of the reproductive period of the life cycle (IUCN 2006) produces an estimate of generation time of approximately five years.

Numbers of Little Lorikeets appear to have declined on the south-west slopes and south coast of NSW (R. Allen unpub. data, cited in Courtney & Debus 2006), and on the north-west slopes of NSW (Courtney & Debus 2006). During the mid 1980's and early 1990's they were a

common species in the Budgong area but have since declined (G. Daly pers. obs.). From these data it appears that there has been at least a moderate reduction in population size over the past 15 years or three-generation lengths, a time frame appropriate to the life cycle of the species (Scientific Committee determination 2008).

Threats

The major threats to Little Lorikeets are loss of breeding sites and food resources from ongoing land clearing. Most breeding records come from the western slopes, where there has been extensive loss of the woodland habitat of the species due to historic land clearing. Loss of nest trees from road-side verges, often associated with road works, remains an ongoing threat. Of 50 nest hollows studied by Courtney and Debus (2006), 40% were lost during the 43-year study. Many of these losses were anthropogenic, with five nest trees destroyed by bulldozers, three nest trees burnt and two nest hollows taken over by feral honeybees. New nest hollows are not being recruited at a rate that compensates this loss, because overgrazing by livestock prevents the establishment of eucalypt seedlings and smooth-barked eucalypts are not favoured species in farm revegetation works (Courtney and Debus 2006). Extensive loss of eucalypt woodlands will also have resulted in a large reduction in food availability for this species.

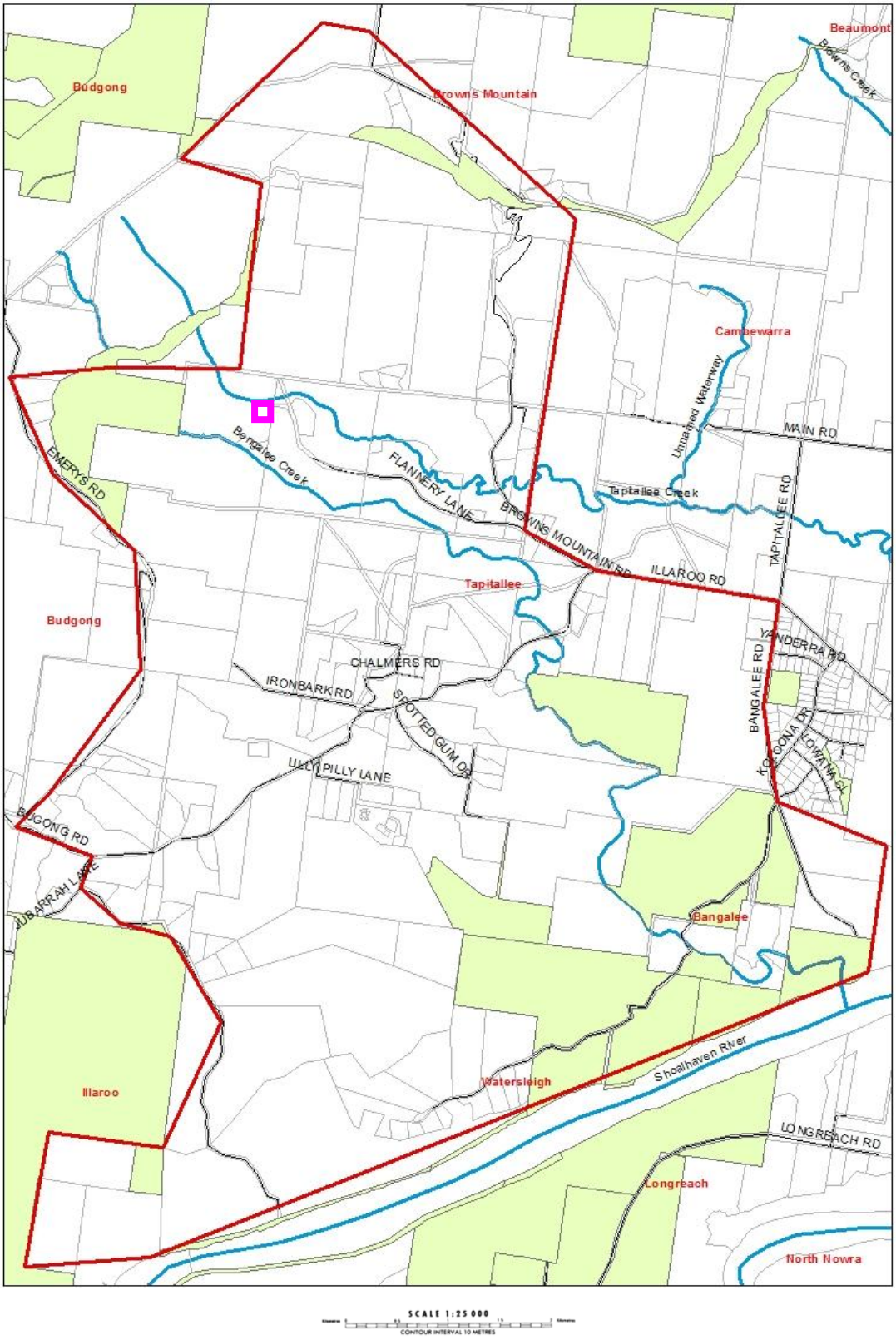

Figure 27
Tapitallee area showing approximate location where Little Lorikeet detected

3.26 Square-tailed Kite

Distribution

The Square-tailed Kite is endemic to Australia and is sparsely distributed throughout the mainland (Marchant and Higgins 1993). The species occurs in coastal and sub-coastal forests, particularly those on fertile soils and with an abundance of passerines (Marchant and Higgins 1993). Square-tailed Kites are seen annually during spring and late summer near North Nowra near the water tower as they make their season migrations. Nesting has been observed at Bangalee Reserve (Daly and Evison 1996). Based on my observations and those of Elliott (1930-40) that species has become more abundant in the area over the last few decades.

Ecology

The Square-tailed Kite is a spring/summer breeding migrant to southern NSW. They feed mostly on small birds and foliage insects but occasionally take small mammals and lizards (Marchant and Higgins 1993).

Square-tailed Kite nest in mature live trees, often near water. The nest is placed in a fork of a large limb, which is usually horizontal (Marchant and Higgins 1993). Breeding in New South Wales occurs from August to early November (Marchant and Higgins 1993). The Square-tailed Kite is threatened by habitat loss through clearing.

Threats

The direct impacts on this species are the loss of trees and hence potential prey species of bird. The indirect impacts on this species include an altered noise and human activity levels near nest sites.

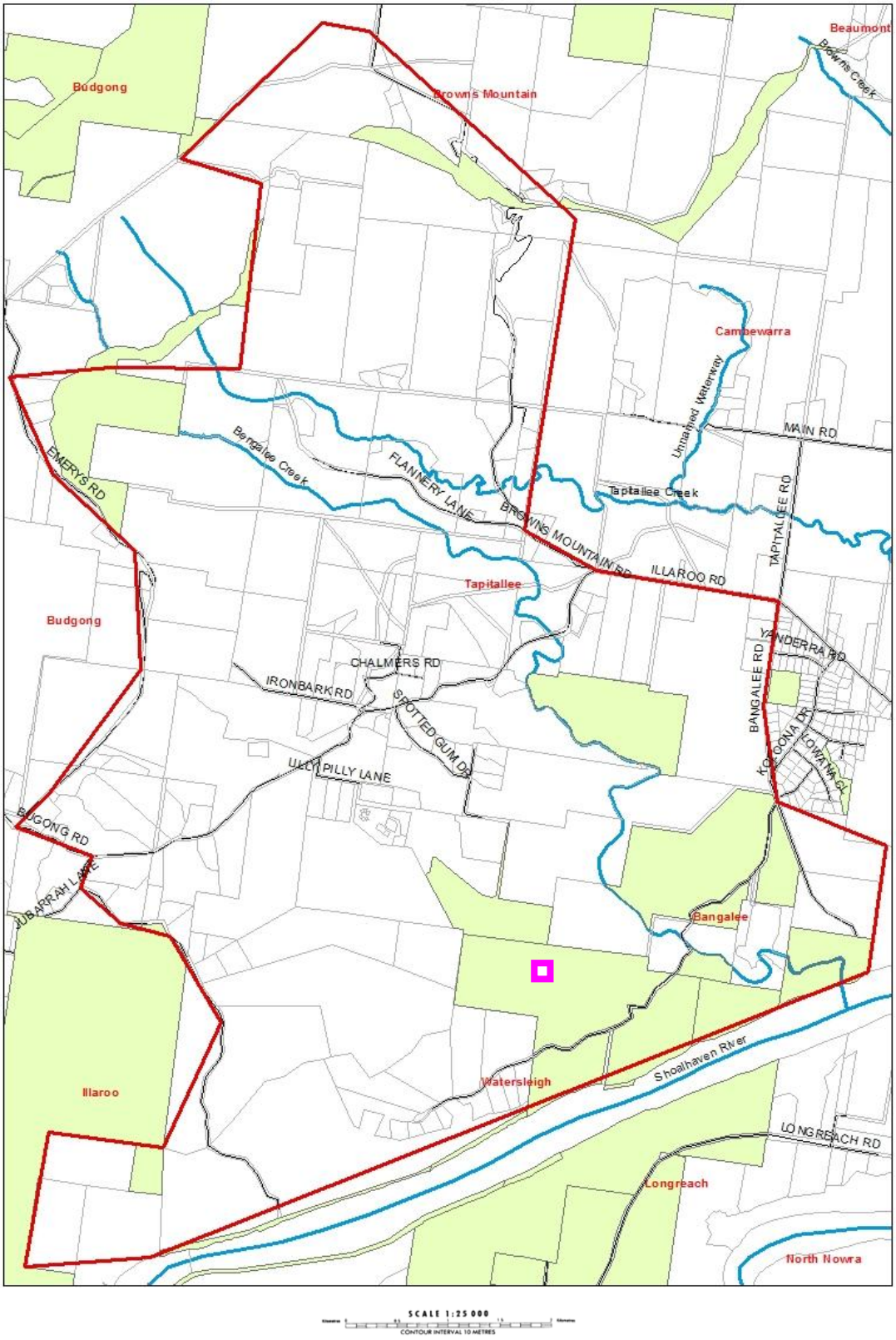

Figure 28
Tapitallee area showing approximate location where Square-tailed Kite detected

3.27 Scarlet Robin

Distribution

The Scarlet Robin is found in south-eastern Australia (extreme south-east Queensland to Tasmania, western Victoria and south-east South Australia) and south-west Western Australia. In the Shoalhaven the Scarlet Robin is widespread and at times not uncommon along the escarpment of the Cambewarra range. Elliott reports that it is common in this district where it breeds on top of the Cambewarra Range (Barren Mountain) and elsewhere. Five specimens from Cambewarra have found their way into the Australian Museum one being brought off Yardley in March 1886 (1024) while four were collected by Grant on October 1887 (01383-6).

Ecology

In NSW it occupies open forests and woodlands from the coast to the inland slopes (Higgins and Peter 2002). Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. During this period it is frequently detected along the northern Shoalhaven escarpment (G. Daly pers. obs.). Audrey Elliott recorded birds in the Tapitallee area mostly between April to October.

The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. The Scarlet Robin builds an open cup nest of plant fibres and cobwebs, sited in the fork of tree (often a dead branch in a live tree, or in a dead tree or shrub), which is usually more than 2 m above the ground (Higgins and Peter 2002; Debus 2006a,b).

Threats

The Scarlet Robin is sensitive to habitat degradation (Watson *et al.* 2001, 2003; Radford *et al.* 2005; Radford and Bennett 2007), and overgrazing (Olsen *et al.* 2005). For instance, its occurrence (presence/absence) is positively associated with patch size and components of habitat complexity including increasing tree canopy cover, shrub cover, ground cover, logs, fallen branches and litter (Watson *et al.* 2003). The direct impacts on this species are the loss of trees i.e. foraging habitat. The indirect impacts on this species include an altered noise and human activity levels around the dwelling.

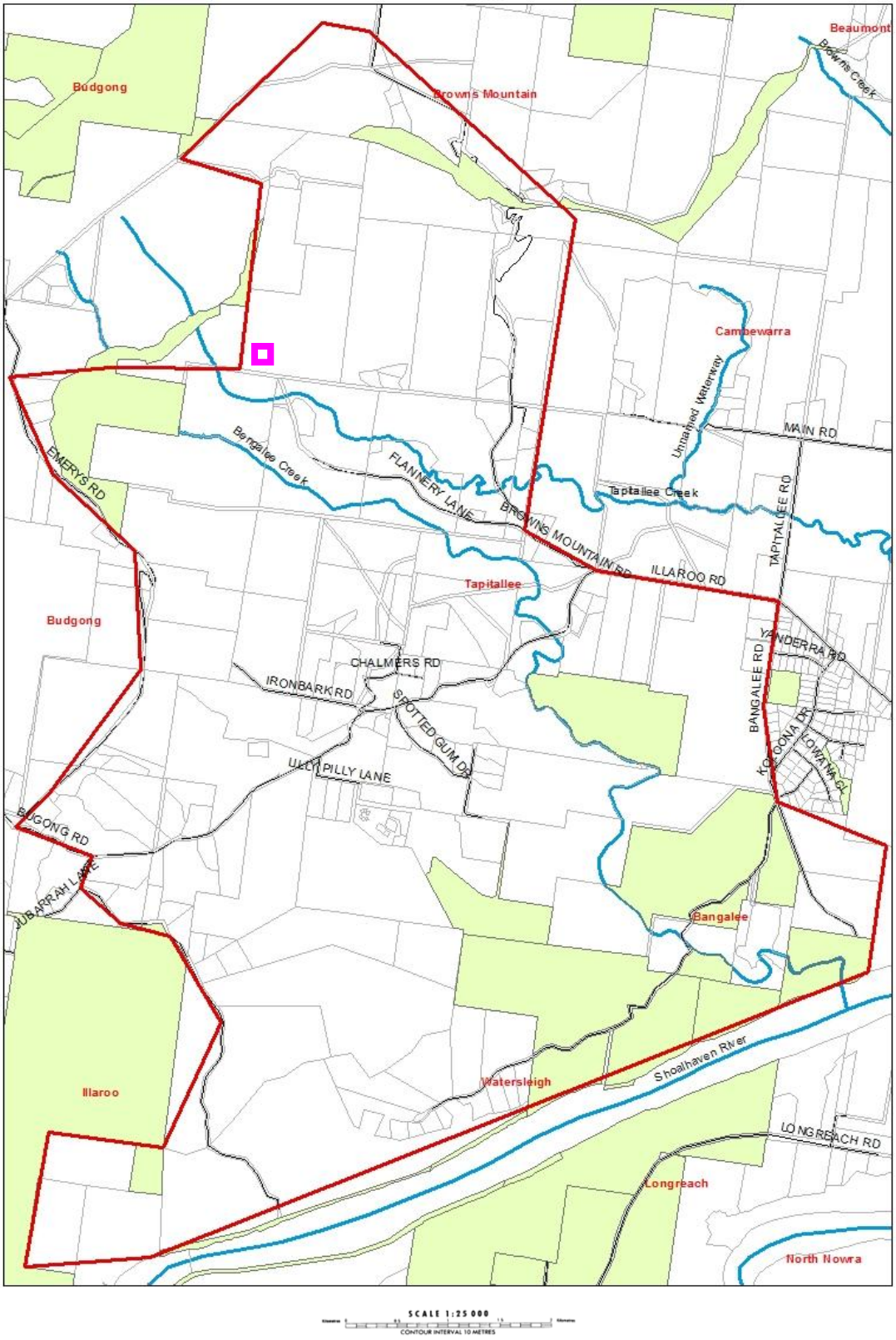

Figure 29
Tapitallee area showing approximate location where Scarlet Robin detected

3.28 Varied Sitella

Distribution

The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west (Higgins and Peter 2002; Barrett et al. 2003). In the Shoalhaven this species is most frequently detected in Scribbly Gum - Red Bloodwood woodlands on the coastal plain. In the Tapitallee area is found in the woodlands and open forest along the Shoalhaven River, such as Bangalee Reserve.

Ecology

The Varied Sittella inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years. Generation length is estimated as 5 years (Debus and Soderquist 2008).

Threats

The apparent decline has been attributed to declining habitat cover and quality (e.g. Watson et al. 2003). The sedentary nature of the Varied Sittella makes cleared agricultural land a potential barrier to movement. Survival and population viability are sensitive to habitat isolation, reduced patch size and habitat simplification, including reductions in tree species diversity, tree canopy cover, shrub cover, ground cover, logs, fallen branches and litter (Watson et al. 2001; Seddon et al. 2003). The Varied Sittella is also adversely affected by the dominance of Noisy Miners *Manorina melanocephala* in woodland patches (Olsen et al. 2005). Current threats include habitat degradation through small-scale clearing for fencelines and road verges, rural tree decline, loss of paddock trees and connectivity, 'tidying up' on farms, and firewood collection. 'Clearing of native vegetation', 'Loss of hollow-bearing trees', and 'Removal of dead wood and dead trees' are listed as Key Threatening Processes in NSW under the Threatened Species Conservation Act 1995.

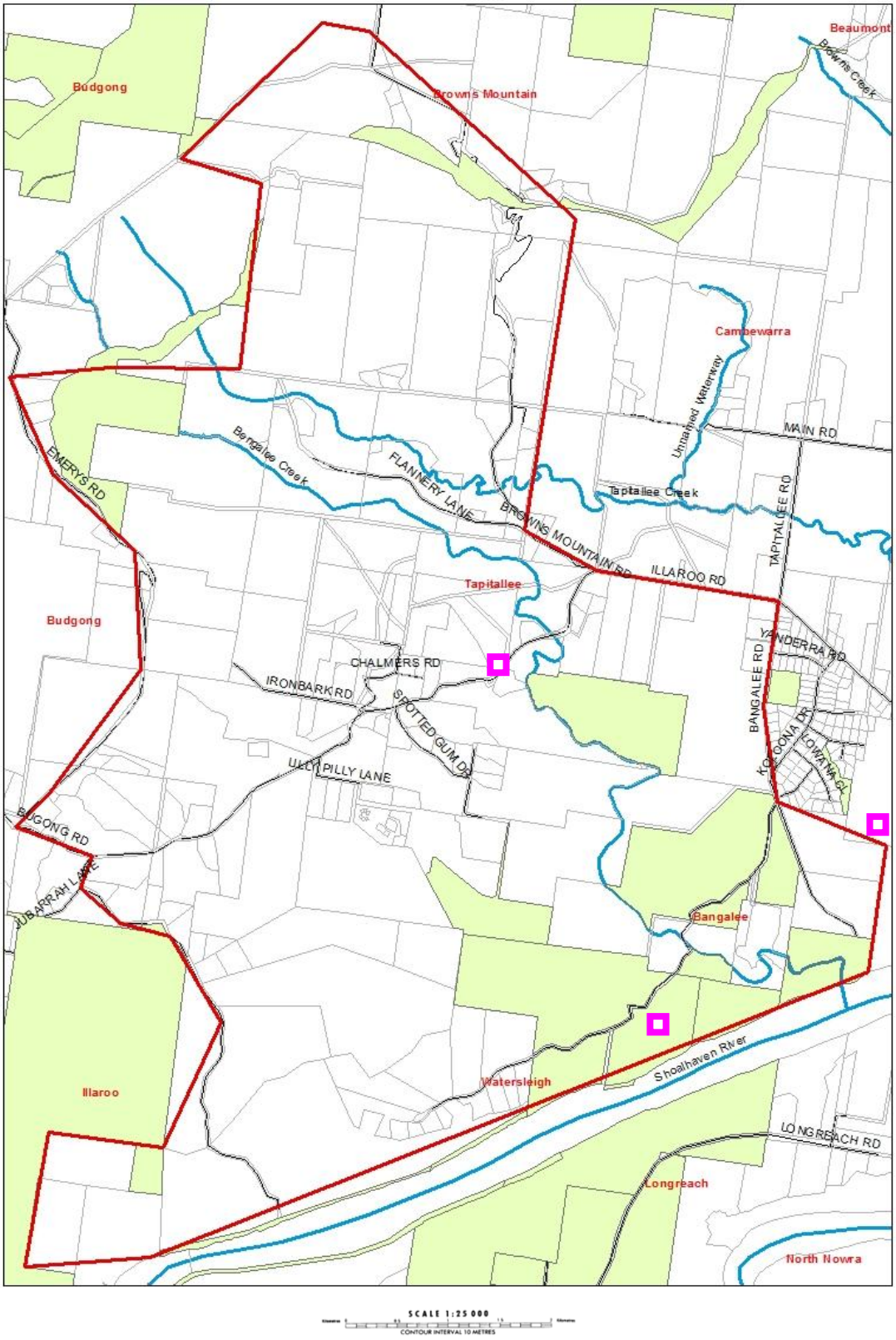

Figure 30
Tapitallee area showing approximate location where Varied Sitella detected

3.29 Regent Honeyeater

Distribution

The Regent Honeyeater is a medium-sized honeyeater drier open-forests and woodlands in south-eastern Australia. Regent Honeyeaters occur mainly in box-ironbark open-forests and riparian stands of Casuarina on the inland slopes of the Great Dividing Range. Although patterns of seasonal movement are poorly understood, a degree of regularity occurs at some sites.

In the Shoalhaven the Regent Honeyeater is rarely detected and the species is highly associated with flowering eucalypts. In the Tapitallee area the species was last seen in the late 1930's by the Aubrey Elliott at the intersection of Browns Mt Rd and Flannery Lane. Elliott states that on 8 April 1939 "There are so many about the corner (the Milk stand corner was the Flannery lane – Browns Mt Rd intersection) now that my previous estimate of 20 birds no longer applies and there must be near 50 birds if not a good deal more but it is impossible to calculate anything like accurately as they are widespread and ceaselessly moving about." On 22 April 1939 he comments "While we were at tennis today many were feed in the trees about the court (located near the Flannery lane – Browns Mt Rd intersection) and at one stage they formed a compact flock and performed some manoeuvres about as if unable to decide whether to fly eastwards or remain; eventually they remained. I should certainly think there would be anything from 60-100 birds in this flock and I doubt then if all birds about the vicinity were included in it."

Ecology

The annual cycle of the Regent Honeyeater at the three main areas of occurrence (Bundarra-Barraba and Capertee Valley in NSW and the Chiltern and Lurg districts in Victoria) includes some common elements: arrival in the area in autumn or early winter and occurrence in loose flocks, often including communal roosting (Oliver 1998); subsequent breeding through spring and early summer, often as aggregations of pairs; and disappearance in mid- to late-summer after young have fledged.

In the Bundarra district of NSW breeding occurs between mid August and January (Ley and Williams 1994) and in the Capertee Valley, NSW, egg laying has been recorded in September and October (Geering and French 1998). Nests are constructed from strips of eucalypt bark, often from Stringybark species, dry Casuarina branchlets, dry grass, twigs and spider web. They are placed in an upright fork between 3 and 30 m above ground and 2-3 eggs are laid.

The oldest retraps of banded Regent Honeyeaters indicate longevity of at least six years seven months and a breeding life of at least 4 years (Menkhorst unpublished data). The total population may be close to or greater than the upper limit of 1500 (Menkhorst et al. 1999). They mainly feed on the nectar of flowering eucalypts, mistletoe (on River She-oak), insects including lerps.

Threats

The main threats to the Regent Honeyeater are significant loss of habitat both in area and quality, which has led to a marked population decline.

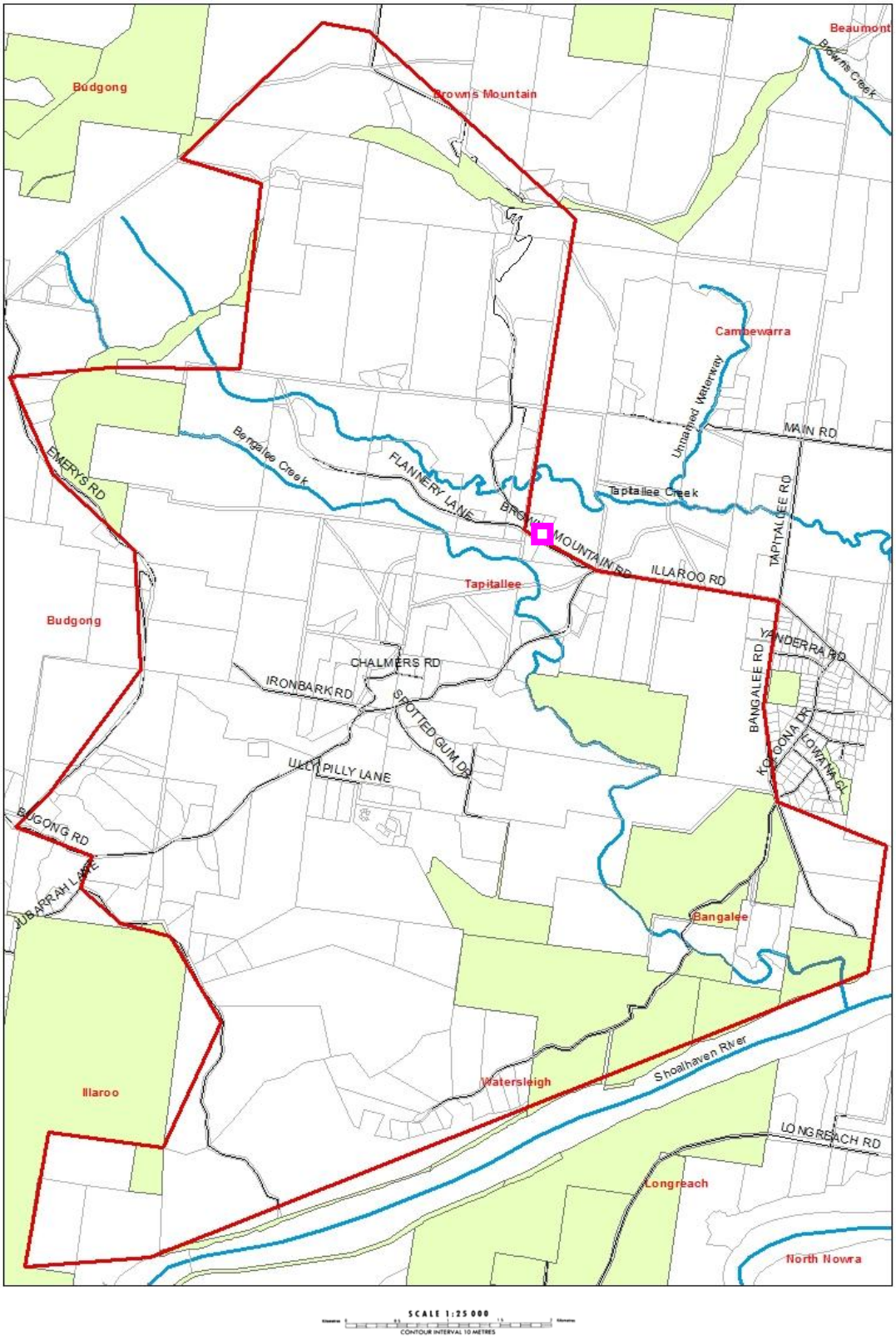

Figure 31
Tapitallee area showing approximate location where Regent Honeyeater detected

Note: these are historic records from the 1930's – see text

3.30 Eastern Bristlebird

Distribution

The Eastern Bristlebird is endemic to Australia and occurs in three geographically separate regional populations in south-eastern Australia. The first, a northern population, occurs in south-eastern Queensland and north-eastern NSW, and consists of extant local populations at Conondale Range National Park, Main Range National Park, Mount Barney National Park, Lamington National Park, Border Ranges National Park, Grady's Creek and Gibraltar Range National Park (Barrett et al. 2003; Holmes 1989, 1997; Stewart 1997, 1998, 2001, 2006; Stewart et al. 2004). The second, a central population, occurs on the central coast of NSW, and consists of extant local populations at Budderoo National Park and adjoining Barren Grounds Nature Reserve, in the Morton National Park-Red Rocks Nature Reserve area, and at Jervis Bay (Baker 1998; Barrett et al. 2003). The third, a southern population, occurs in south-eastern NSW and eastern Victoria, and consists of one extant local population in Nadgee Nature Reserve and another in adjoining Croajingalong National Park (Baker 1998; Barrett et al. 2003; Clarke & Bramwell 1998; Gosper & Baker 1997). Within these three populations there are separate sub-populations. In the central populations there are several subpopulations, these are the Barren Grounds-Budderoo population, Red Rock NR population, Morton populations (may comprise a northern and southern group though low population densities) and the Jervis Bay population (G. Daly unpub. data). The Jervis Bay population is centred at Vincentia-Jervis Bay NP and Booderee NP though animals have been translocated to the northern side of the bay to Beecroft Peninsula Weapons Range.

The translocation to Beecroft Peninsula Weapons Range, a Department of Defence controlled area, involved the movement of 45 individuals from Bherwerre Peninsula (Bain 2003, 2003a; DEC 2006). Radio-tracking of the individuals indicated a colony was successfully established (Bain 2003, 2003a). In a second translocation program, 50 birds were released to the Woronora Plateau in 2008 (Department of Sustainability, Environment, Water, Population and Communities 2011).

The population at Cambewarra Range is centred on the heathland near the power easement that interrupts a portion of Cambewarra Range NP. However, so called ‘floater birds’ have been detected elsewhere along the range from Bundewallah (C. Jacket pers. comm.) to near Devils Glenn.

Elliott states Thorpe collected a female, now in the USA Museum of Natural History at Cambewarra in Nov. 18881 (Specimen No. 11192) for the Australian Museum (based on habitat specimen collected from Red Rock NR ed.) while Grant collected two birds here in October 1887 (Specimen Nos 013555-6, the formed going to the Adelaide Museum). There is little doubt that that these were all procured on top of the range (Barren Mt), as there appears to have been no other suitable haunt for the species in the locality.

The website Atlas of Living Australia shows the Thorpe specimen as taken from the village of Cambewarra. I concur with Aubrey Elliott that the specimen would have been taken from Red Rock, now part of Cambewarra Range NR. The locations of the Eastern Bristlebird are taken from the Elliott notes dated 13 January 1929 “ I saw one about dusk running and hopping briskly over stones etc in the creek bed above Goodger's boundary and below old home. My attention was drawn to it by its uttering short, sharp notes. It was again seen the following evening this time by Arthur also, in "The Bush" below the dairy when we satisfied ourselves that it was of this species. It may be explained that this was a very dry time and bush fires had

apparently driven the bird from what must be considered its normal haunts...the top of the Barren Mountain (Cambewarra Range)."

Ecology

The Eastern Bristlebird inhabits low dense vegetation in a broad range of habitat types including sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest (Baker 1997, 2000; Chapman 1999; Holmes 1989, 1998; Miles 2004; Smith 1977, 1987). It occurs near the coast, on tablelands and in ranges (Blakers et al. 1984; Holmes 1989). The Eastern Bristlebird is found in habitats with a variety of species compositions, but are defined by a similar structure of low, dense, ground or understorey vegetation such as *Allocasuarina paludosa*, *Banksia ericifolia*, *Hakea teretifolia* and *Sprengelia incarnata* or grass-trees (*Xanthorrhoea* sp.), (Baker 2000; Chapman 1999; Clarke & Bramwell 1998; Lamb et al. 1993).

Breeding records indicate that Eastern Bristlebird pairs probably rear only one brood per season, and that usually only one young is fledged per successful breeding attempt. This low fecundity limits the ability of Eastern Bristlebird populations to persist and recover if confronted by a threatening process (Baker 1998; Holmes 1989, 1998).

Threats

The Eastern Bristlebird would be impacted by habitat removal, predation by Fox and Cat and inappropriate fire regimes (i.e. too frequent burning).

Eastern Bristlebird

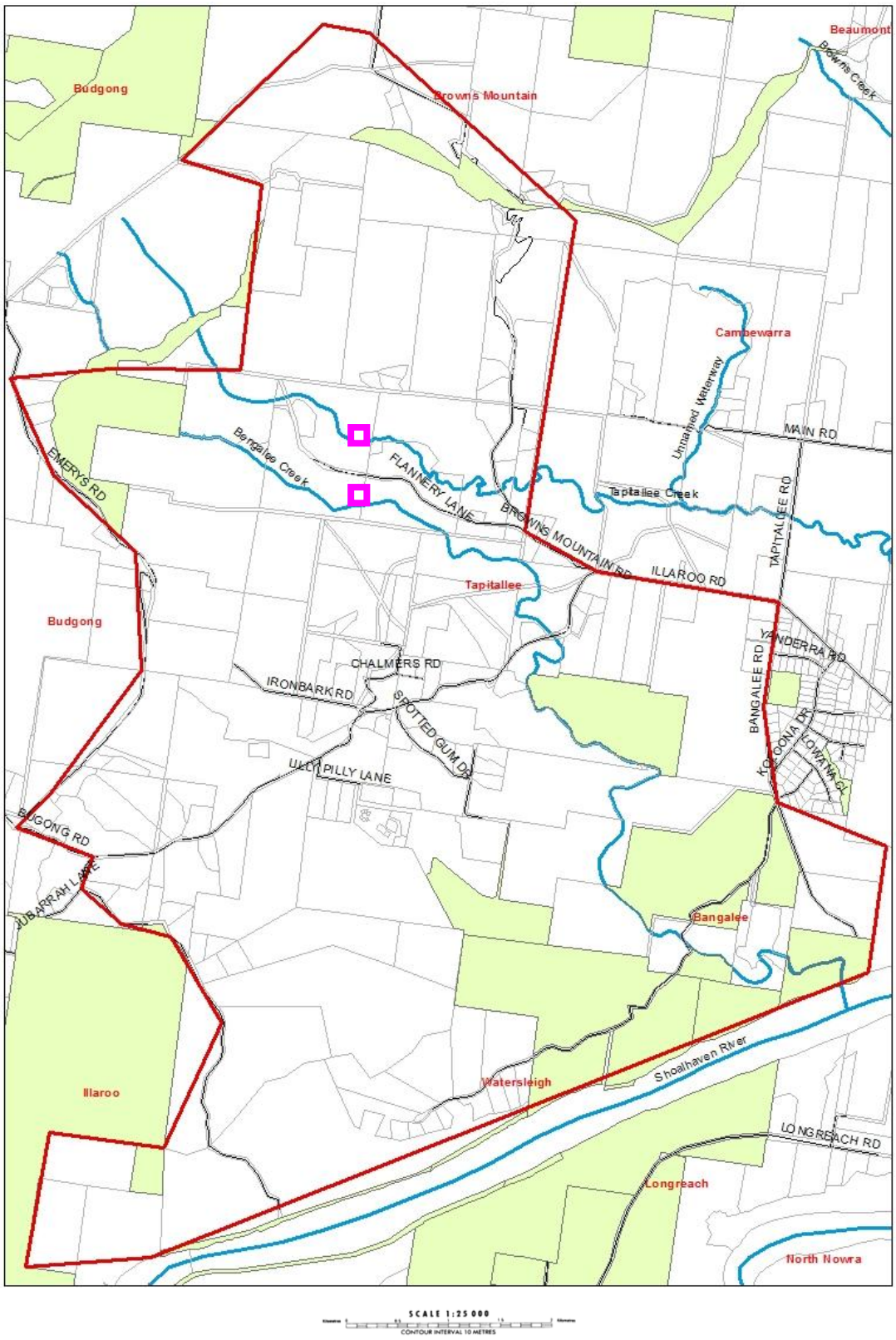

Figure 32
Tapitallee area showing approximate location where Eastern Bristlebird detected in 1929 after wildfire in Red Rock aka Cambewarra Range NR

3.31 Diamond Firetail

Distribution

In New South Wales, the Diamond Firetail occurs predominantly west of the Great Dividing Range, although populations are known from drier coastal areas (Blakers *et al.* 1984, Schodde and Mason 1999). In the Shoalhaven I have only detected this species foraging in grassland in Kangaroo valley (near Chakola). In contrast Elliott states, "It is a common bird around Cambewarra and in some seasons many nests are found on so small a property as Milburn but in other years it appears to be quite scarce. A review of nesting records at Milburn (end of Flannery Lane) from 1934 - 1940 season shows the number of nests located as 1934-5 = 0, 1935-6 = 4, 1936-37 = 4, 1937-38 = 17, 1938-9 = 7, 1939-40 = 9." No Diamond Firetail have been detected in the Tapitallee area during the period 1985 – 2012 indicating a real decline in this species abundance and distribution. It is now considered locally extinct but considered here as the species is highly mobile and may recolonise the area.

Ecology

The Diamond Firetail is a brightly coloured finch that occupies eucalypt woodlands, forests and mallee where there is a grassy understorey. They forage on the ground, largely for grass seeds and other plant material, but also for insects (Blakers *et al.* 1984, Read 1994).

The Diamond Firetail is threatened by clearance and fragmentation of habitat. Isolation and reductions in remnant area inhibit dispersal and increase their vulnerability to local extinction via stochastic events (fires and droughts etc). Small, isolated populations also lose their long-term genetic viability (Barrett *et al.* 1994). Further, Diamond Firetail populations appear unable to persist in areas, which lack remnants of native vegetation larger than 200ha (in Scientific Committee determination).

Threats

Habitat degradation, particularly overgrazing of the grass understorey, threatens the granivorous Diamond Firetail. In addition, an increased abundance of predators such as Pied Currawongs and Australian Ravens may increase nest predation in fragmented woodland remnants (Major *et al.* 1996).

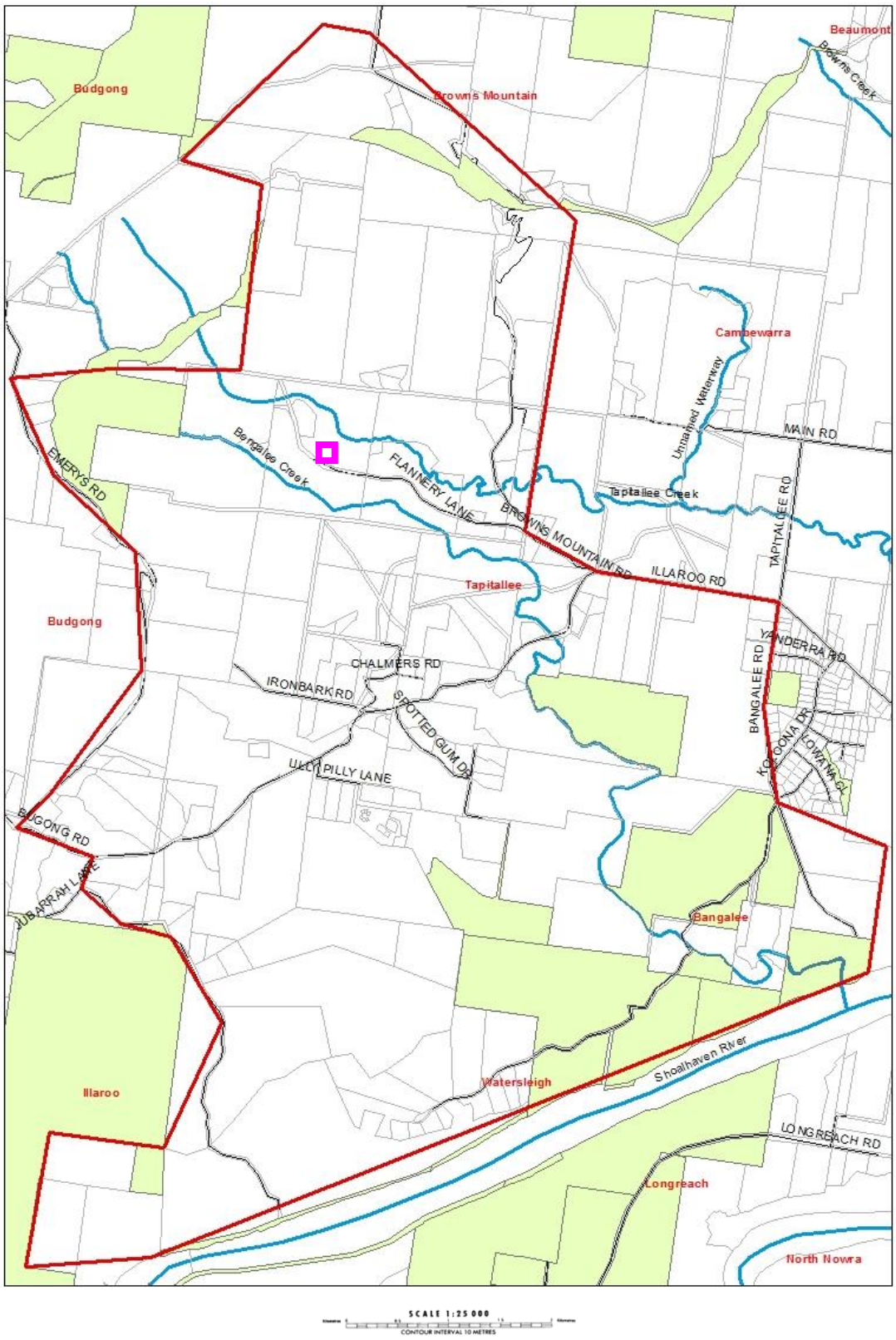

Figure 33
Tapitallee area showing approximate location where Diamond Firetail detected

3.32 Rosenberg's Goanna

Distribution

Rosenberg's Goanna occur in the sandy soils of southern WA, SA (including Kangaroo Island) and western Victoria and in the Snowy Mountains and mid-coast regions of NSW (OEH 2012; Swan *et al.* 2004; Wilson and Swan 2008).

Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River.

In the southern Shoalhaven Local Government Area the species has rarely been detected. A road-killed specimen found in Morton National Park near the Nerriga River in 1995 (G. Daly pers. obs.) and another near Tianjara Falls in 1997 (H. Achurch pers. comm.) and near Coolendel, one was trapped near Sassafras during the Comprehensive Regional Assessment. On the northern side of the Shoalhaven River the species was observed at Riversdale (G. Daly pers. obs.), Budgong (V. Corrigan pers. comm.) and trapped near Tallowa Dam during Comprehensive Regional Assessment (G. Daly unpub. data.). Three additional records were obtained by Sass (2008).

Ecology

The Heath Monitor inhabits coastal heaths and woodland and sclerophyll forests. Mating occurs in spring (Vincent and Wilson 1999) and egg laying occurs in summer (King and Green 1999) with an average of 14 eggs in termite mounds, which incubate over winter and hatch in early spring, about eight months after they are laid (Ehmann et al. 1991, King and Green 1999). The young hatch and stay within the termite mound for several weeks before digging their escape. The home range of the species varies from 4-43 hectares (mean 19, N = 13) (King and Green 1999). The species feeds primarily on insect (65% of volume) but also includes reptiles, mammals and birds (King and Green 1999). In the Sydney region wild animals eat Jacky Dragons, Copper-tailed Skinks and crickets (G. Daly unpub. data).

Threats

The removal of habitat and in particular termite mounds in heath and/or woodland is the main threats to this species. The species if often recorded dead on roads, a result of collisions with moving vehicles. Roads and vehicles are a threat.

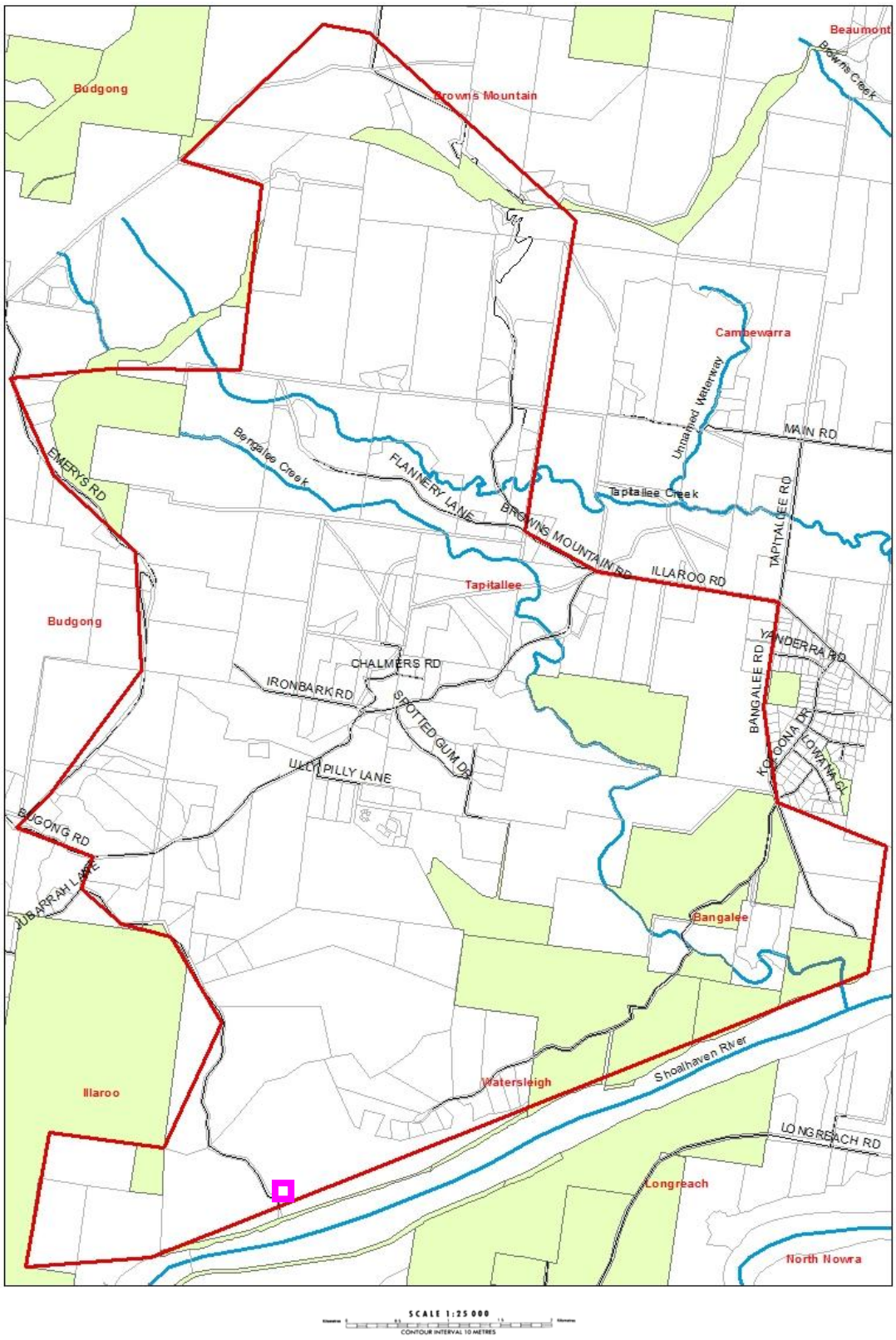

Figure 34
Tapitallee area showing approximate location where Rosenberg's Goanna detected

3.33 Broad-headed Snake

Distribution

The Broad-headed Snake is largely confined to Triassic and Permian sandstones, from Wollemi National Park in the north, the Clyde River catchment in ranges south-west of Nowra in the south, east to the Royal National Park and near Illawarra, and west to the upper Blue Mountains at Blackheath and Newnes. Major populations occur in the Blue Mountains, southern Sydney, an area north-west of the Cumberland Plain, and the Nowra hinterland (DECC 2008). The southern limit of the species is within the Shoalhaven LGA at The Castle. The Broad-headed Snake has been found on Nowra sandstone along the Shoalhaven River escarpment (Daly 2006).

Ecology

The Broad-headed Snake is often found in rocky outcrops and adjacent sclerophyll forest and woodland (Cogger et al. 1993; DECC 2008, Daly 2005). The most suitable sites occur in sandstone ridgetops (Cogger et al. 1993). Near Bathurst snakes occur in forest growing on shale or conglomerate slopes and bluffs (Cogger et al. 1993). Common canopy species include Yellow Bloodwood *Corymbia eximia*, *C. gummifera*, Silvertop Ash *Eucalyptus sieberi, E. punctata* and Sydney Peppermint *E. piperita*. Snakes prefer sites with a west to north-west aspect (DECC 2008). Although most Broad-headed Snakes are found under tightly fitting loose sandstone rocks positioned on north-west facing sandstone ridgelines the species is arboreal, that is lives in trees for periods during the year.

The BHS is nocturnal to crepuscular (active at dusk) and is considered an 'ambush predator', preying predominantly on lizards, particularly Lesueur's Velvet Geckos *Oedura lesueurii* and several skink species including White's Skink *Egernia whitii*, Copper-tailed Skink *Ctenotus taeniolatus*, Weasel Skink *Saproscincus mustelina* and Red-throated Skink *Acritoscincus platynotum* and Eastern Water Skink *Eulamprus quoyii* (Wells 1981; Webb and Shine 1994, Daly unpub. data).

The species gives birth to 4-12 live young (Shine and Fitzgerald 1989). Neonates take 4-6 years to reach maturity. Animals in captive can live for about 20 years (M. Anstis pers. comm.).

Threats

Known threats to the BHS include bushrock removal and disturbance, residential and infrastructure development, illegal collection, altered fire regimes and predation by feral animals.

Broad-headed Snake

Figure 35
Tapitallee area showing approximate location where Broad-headed Snake detected

3.34 *Solanum celatum*

Distribution

Solanum celatum is endemic to New South Wales and has been recorded from a restricted area from Wollongong to just south of Nowra, and west to Bungonia. The Scientific Committee (2003) states that the majority of records are prior to 1960 and a recent survey of six sites found only a single plant within Macquarie Pass National Park, SW of Wollongong, although the species may be present in the soil seed bank at this and other sites. The species has been located along Flannery Lane and on rainforest edge at several sites in the Tapitallee area including Bangalee reserve (G. Daly pers. obs.).

Ecology

It flowers in late winter/spring and fruits in summer. The seed is most likely dispersed by birds (Lewins Honeyeater). This species has been observed to grow after lantana has been removed from a site indicating a seed bank exists in the soil.

Threats

Much of the habitat of *Solanum celatum* has been cleared or grossly altered, and any uncleared areas are often swathed in dense patches of *Lantana camara*. The species is threatened by habitat destruction through clearing for agricultural or urban development and is also threatened by habitat degradation, primarily by invasion of *Lantana camara*. *Solanum celatum* is a fire sensitive obligate seeder, which may be threatened by inappropriate fire regimes (NSW Scientific Committee final determination 2003).

Solanum celestrum

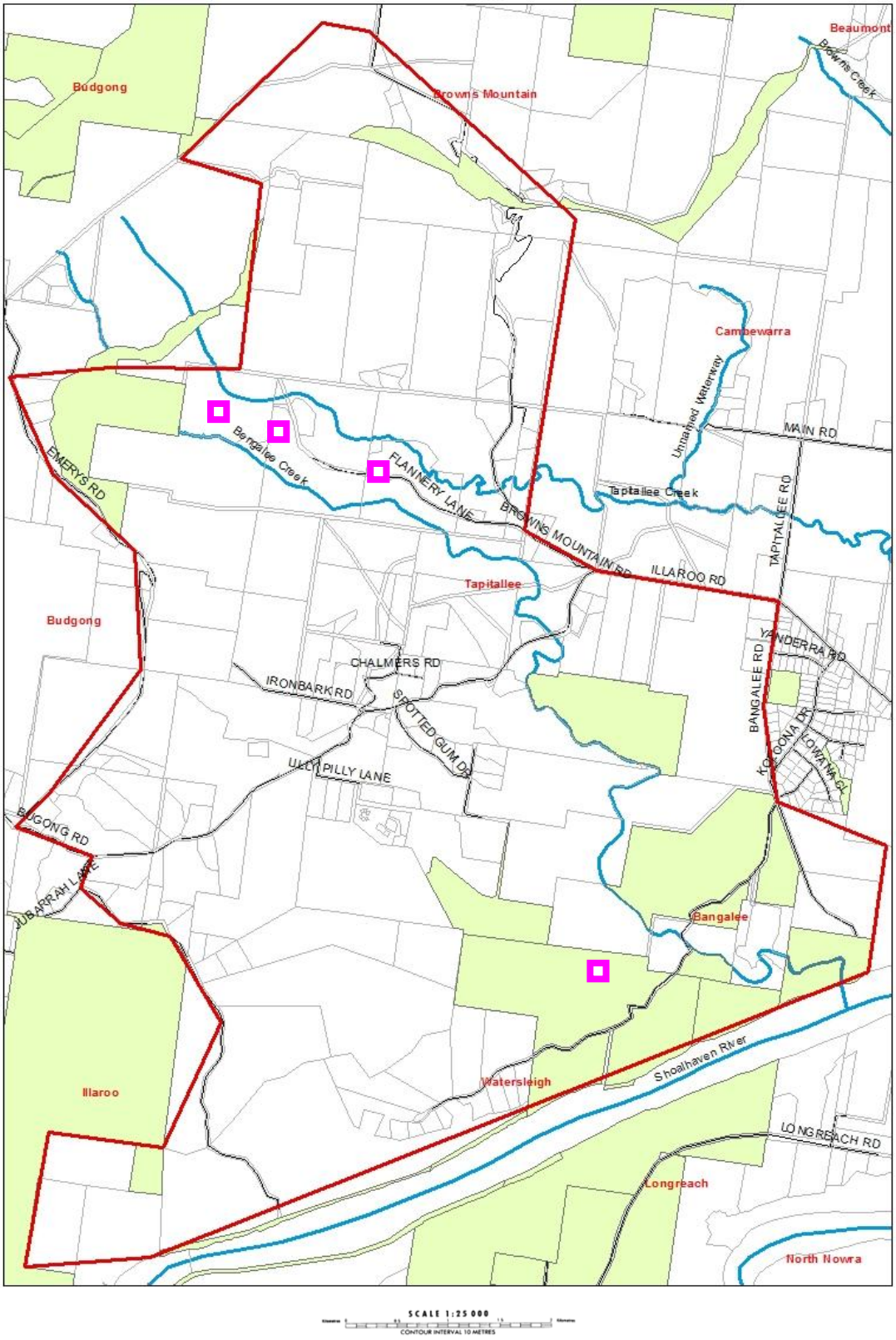

Figure 36
Tapitallee area showing approximate location where *Solanum celatum* located

3.35 Illawarra Subtropical Rainforest

Distribution

The Illawarra subtropical rainforest has been recorded from the local government areas of Wollongong south to the Shoalhaven. Illawarra Subtropical Rainforest occurred mainly on the coastal Permian volcanics, but can occur on a range of geological substrates, mainly between Albion Park and Gerringong (termed the Illawarra Brush by Mills and Jakeman 1995) and north of Lake Illawarra on the Berkeley Hills (termed the Berkeley Brush by Mills & Jakeman 1995). The Illawarra Brush and Berkeley Brush originally covered about 13 600 ha and made up about 60% of the rainforest of the Illawarra area. Outlying occurrences of Illawarra Subtropical Rainforest also occur south to the Shoalhaven River and westwards into Kangaroo Valley, where areas of Permian volcanic soils occur. The community generally occurs on the coastal plain and escarpment foothills, rarely extending onto the upper escarpment slopes. In the Tapitallee area it occurs along the Cambewarra escarpment at altitudes that range from 50-150m asl.

Characteristic trees

Characteristic tree species in the Illawarra Subtropical Rainforest are *Baloghia inophylla, Brachychiton acerifolius, Dendrocnide excelsa, Diploglottis australis, Ficus* spp., *Pennantia cunninghamii* and *Toona ciliata.* Stands may have species of *Eucalyptus*, *Syncarpia* and *Acacia* as emergents or incorporated into the dense canopy.

Threats

Large areas of Illawarra Subtropical Rainforest have been cleared for agriculture. Only about 3400 ha remains (Mills & Jakeman 1995). Since the Regional Forestry Agreement a number of Crown Land areas on the Cambewarra Range that support Illawarra Subtropical Rainforest have come into the reservation system (L. Mitchell pers. comm.). Illawarra Subtropical Rainforest occurs mainly on private land and is still inadequately protected.

Remnants are small and fragmented and their long-term viability is threatened. Weed invasion is a major threat and invasive exotic species include *Lantana camara, Araujia sericiflera, Ageratina riparia, Ageratina adenophora, Delairea odorata, Senna pendula var glabra, Senna septemtrionalis, Tradescantia fluminensis, Cinnamomum camphora, Olea europea subsp. africana, Hedychium gardnerianum, Ligustrum lucidum, Ligustrum sinense, Passiflora subpeltata* and *Solanum mauritianum*. Other threats include further clearing, quarrying, grazing, inappropriate fire regimes, rubbish dumping and hobby farm developments.

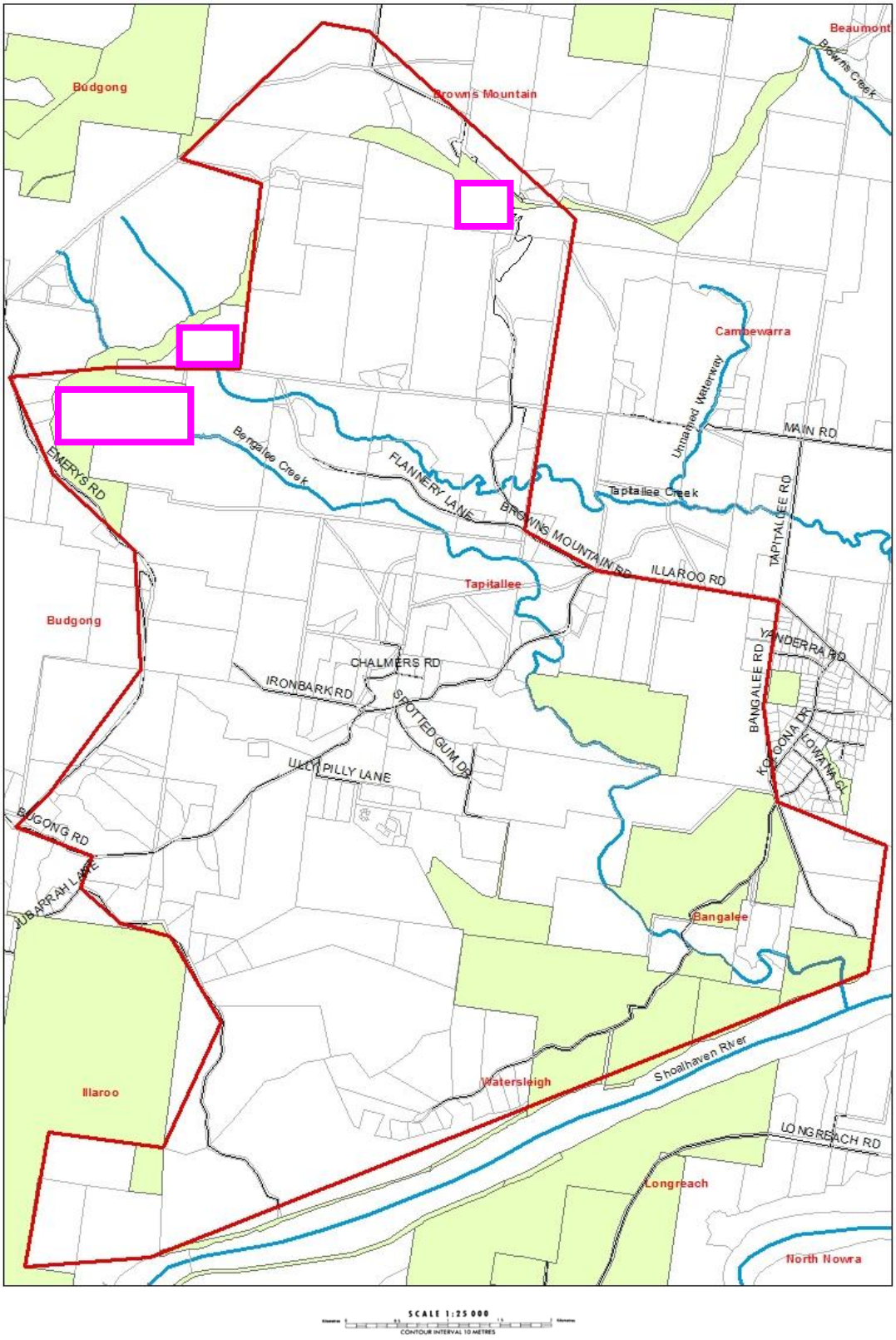

Figure 37
Tapitallee area showing approximate location where Illawarra Rainforest located

4 DISCUSSION

4.1 Conservation Actions

The main conservation actions in the Tapitallee area are the gazettal of land to the reservation system, voluntary conservation agreements, revegetation programs, removal of weeds such as lantana, culling or sterilisation of Chital Deer and fox baiting programs.

Gazettal of land to the reservation system

The CRA process has led to a number of parcels of Crown Land to come within the reservation system in 2001. This includes land on Cambewarra Mountain, land known as Barclay Reserve (now a portion of Cambewarra Range NP), Tapitallee NR, Bangalee Reserve and a parcel of land south of Illaroo Rd. I consider this a wonderful achievement and thank Michael Murphy for the hundreds of hours of surveys and Les Mitchell who supported our work and who worked for NPWS at that time and facilitated the process.

Voluntary conservation agreements

Voluntary conservation agreements (VCA) are agreements between landowners and the NSW Government to protect land from clearing. The agreements are binding, in perpetuity and on the title of the land. The economic benefits to the landowner is that that rates are reduced proportionally, the land can be used for carbon trading and there are special grants for VCA owners to access for weed control and other conservation works. So far in the Tapitallee area only a portion of the owners property (26ha) has a VCA.

Revegetation programs

There have been several revegetation programs in the Tapitallee area. One along Tapitallee Creek revegetated approximately 6 km of creekline with endemic species, filled in some ditches that has been constructed to drain ephemeral wetlands and installed rock as erosion control devices. Other revegetation programs include those in the upper catchments of Bengalee Creek and Tapitallee Creek. There has also been a farm forestry program in the Tapitallee Creek catchment. This work is ongoing and this project has revegetation as part of the project.

In 2011 the Smut Fungus *Entyloma ageratinae* was released to control mistflower and which appears to have been very successful, thus reducing one of the threats to rainforest.

Feral Animal Control Programs

There are several species of mammal that pose a threat to the biodiversity of the area. These include the Yabbie *Cherax destructor,* feral Cat, Red Fox, Rusa Deer and Chital Deer.

The Yabbie *C. destructor* naturally occurs west of the Great Dividing Range but is used in aquiculture to stock in dams. The species has been implicated in declines in stream breeding frogs and other aquatic species (Daly and Craven 2007, Coughran and Daly in press). Yabbies disperse from the dams where they have been released into adjacent catchments and can affect a much wider area outside of the site where they have been released.

Feral cats colonised most of the continent by 1890 (Van Dyck and Strahan 2008). They predate small mammals and rarely seen. They are trap shy. The density of wild cats in the bush is difficult to ascertain but mean home range of free-living cats is 284 ha for males and 151 ha for females, with extensive overlapping between individuals (Van Dyck and Strahan

2008) are the only vector of *Toxoplasmosis,* a disease that has been identified in Brush-tailed Rock Wallabies (M. Norton pers. comm.).

The Fox was deliberately introduced into Australia in the 1860's and 1870's (Van Dyck and Strahan 2008) and reached the Tapitallee area in about 1907 (Elliott notes). The Fox is known to eat small mammals within what is considered the critical weight range and is attributed to the decline and local extinction of ground nesting birds such as the Bush Stone Curlew and small mammals such as the Parma Wallaby and Red-necked Pademelon, Eastern Quoll. Fox baiting is undertaken in the Tapitallee area and has been also done at Budgong to reduce threats to the Brush-tailed Rock Wallaby.

Rusa Deer in the Shoalhaven originated from the population in Royal NP. The species continued to disperse along the coast. Chital Deer in the Tapitallee area originated from a local deer farm. Deer browse small plants and can ringbark small plants by rubbing the felt from their antlers. Culling of deer has occurred in the area at various intensities. There are few Rusa Deer in the area (mostly dispersing animals) and the population of Chital Deer is centred between Ironbark Rd, Illaroo Rd and Emery's Rd.

4.2 Locally Extinct Species

The Tapitallee area has lost several species of animal due to loss of habitat, predation by Fox/Cat, hunting and weed invasion. There is a possibility that species such as the Wompoo Pigeon, capable of flight may recolonise the area. There is also the possibility that species such as the Red-necked Pademelon and Parma Wallaby may be reintroduced in areas where annual Fox baiting occurs.

Table 2
Locally Extinct Fauna and Flora Previously Recorded in the Area

Common Name	Species	Comment
Eastern Quoll	*Dasyurus viverrinus*	Robinson (1987) recorded this species at Cambewarra Mountain in 1970 and J. Selby (pers. comm.) gave an accurate description of an animal shot during the 1960's near the headwaters of School Creek. The Eastern Quoll is listed on Schedule 1 of the TSC Act. None have been detected on mainland Australia for over 30 years.
Eastern Bettong	*Bettongia gaimardi*	This species occurred in open forest and grasslands in coastal south-eastern mainland Australia, but now only exists in Tasmania (Strahan 1995). Listed as extinct in NSW on the TSC Act.
Red-necked Pademelon	*Thylogale thetis*	Robinson (1987) detected this species on the edge of rainforests and 'hanging swamps' where sedges grow amongst scattered eucalypts in Kangaroo Valley and Barren Grounds Nature Reserve and was common around Budgong during the early 1900's (Robinson 1988). There are specimens in the Australian Museum secured by Yardley (B.10242) and Thorpe (B.4594) from Cambewarra.

Parma Wallaby	*Macropus parma*	This species historically recorded from the broader region but eaten by Foxes. Persists on the north coast of NSW at Chaelundi State Forest (pers. obs.) and is listed on the TSC Act Schedule 2.
Emu	*Dromaius novaehollandiae*	Prior to European settlement the Emu occurred in most habitat types, except rainforest (Lindsay 1992) but was never recorded in the Illawarra, which suggests that it was probably rare and removed early on during European settlement of the area.
Wompoo Pigeon	*Ptilinopus magnificus*	This species had its southern limit in the Shoalhaven (Elliot notes). Habitat destruction and shooting has caused it to become locally extinct. Gibson (1989) states that the species has not been recorded in the region since 1920 and it is currently listed on the TSC Act.
Diamond Firetail		Last recorded in the late 1930's by Aubrey Elliott. Highly likely to be locally extinct. Last seen in Kangaroo Valley.
Southern Barred Frog	*Mixophyes balbus*	Last population at Budgong was recorded in 1996. Now extinct from Northern Victoria to south of Sydney (Daly and Craven 2010).

5 CONCLUSIONS

Currently 32 threatened species of fauna one species of flora occur and one endangered ecological community have been found in the Tapitallee area. The area is significant as is the end of the Illawarra escarpment and the southern limit is several species associated with rainforests including the Flame Tree *Brachychiton acerifolius*, Morton Bay Fig, Southern Logrunner and Noisy Pitta. The area also incorporates part of the sandstone escarpment of the Shoalhaven River, which has been recognised as a habitat corridor for plants and animals associated with sandy soil (Daly and Murphy 1996).

Lantana is recognised as a threat to the native plants and animals in the area as it competes with native vegetation. However, the species does have merit. It provides more cover that pasture (that it often replaces) the fruit is eaten by birds (especially Lewins Honeyeater) and the flowers provide nectar for insects and other animals (especially Eastern Spinebill). Lantana also protects the soil from erosion and the leaves provide humus. The removal of lantana by mechanical means may lead to the soil being disturbed and the possibility of erosion. Remediation by the scattering of seed and replanting is effective and natural regeneration from damaged roots can promote the growth of stands of Hairy Clerodendrum and Brown Kurrajong *Commersonia fraseri.* The use of chemicals to control lantana has also been effective but dependant on the seedbank in the area. On the edge of rainforest in the Tapitallee area the main regrowth species have been Stinging Tree, Red Cedar and Pencil Cedar.

6 RECOMMENDATIONS

To promote biodiversity and rehabilitation of native vegetation the following recommendations are provided:

- Through the local Landcare group residents should be encouraged to review work undertaken as part of the program to gauge the effectiveness of the program and discuss the work as part of the rehabilitation strategy for their land.
- The work undertaken as part of this project should be reviewed annually by the Shoalhaven Landcare Committee and evaluated. Additional work may be required;
- People should be advised that outside access roads, asset protection zones and farmland there should be no removal or disturbance of indigenous vegetation. This includes no disturbance to canopy trees, understorey and groundcover plants;
- Feral animal control should continue to reduce the impact of Fox but also to reduce the risk of Fallow Deer spreading and other species such as Rusa Deer establishing;
- People should be advised not to but yabbies *Cherax destructor* or Plague Minnow in farm dams as this species has an impact on frogs and native fish.

Acknowledgements

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