LIDDELL

GLENCORE

Indirect Offset Plan Outcomes

Report

Table of Contents

1. Overview

1.1 Background

LCO received approval for the extension of Liddell Open Cut Coal Mining Operations under the State Environmental Planning and Assessment Act 1979 (EPA Act) on 1 December 2014 (DA 305-11-01 Modification 5) and approval under the Commonwealth Environment Protection Biodiversity Conservation Act 1999 (EPBC Act) on 24 December 2014 (EPBC Approval 2013/6908). The State and Commonwealth approvals both require the provision of an indirect offset to augment the agreed land-based biodiversity offsets to address the impacts of the project. This indirect offset was agreed to be a financial contribution towards recovery actions for the spotted-tailed quoll (Dasyurus maculatus maculatus) as part of the:

- Final Draft National Recovery Plan for the Spotted-tailed Quoll Dasyurus maculatus (Long and Nelson 2008); and/or
- Management actions identified for the spotted-tailed quoll as part of the NSW Biodiversity Conservation Division (BCD) Saving Our Species Project Species Action Statement.

An Indirect Offset Plan (IOP) was prepared to satisfy the conditions of the State and Commonwealth approvals relating to this financial contribution. The approved IOP specifies how the $243,000 indirect offset (by way of financial contribution) would be used to support recovery actions for the quoll.

Three recovery projects were identified and implemented under the IOP as follows:

1. Develop software to allow identification of individual quolls from camera trap images.
2. Development of standard camera trapping protocol based on project above. Implement cross tenure monitoring program (Royal National Park, Wollemi National Park and Middle Foy Brook Area) integrating live trapping, camera trapping, population viability and genetic analysis.
3. Trap and track (using telemetry collars or camera trapping) 6 female quolls for 3 years. Assess habitat use by female spotted-tailed quolls.

This report documents the outcomes and contribution to spotted-tailed-quoll conservation realised from funding each project.

2. Project Tasks

A brief description of each project is provided in the following sections. Project work and funding was carried out over a 5yr period, nominally FY2016/17, FY2017/18, FY2018/19, FY2019/20 and FY2020/21. A 12-month period has followed with assessment of results and findings ready for publication by end June 2022 in line with approval requirements.

2.1 Task 1 – Development of Individual Recognition Software for Quolls

Task 1 involved the development and sharing of computer software that enables the identification of individual quolls from remote camera data. Further information regarding Task 1 can be sourced in the IOP.

A research agreement was developed and executed on the 23 June 2016 with Invasive Animals Limited (IAL) to undertake the Project. IAL subsequently enlisted the services of Dr Greg Falzon (Delves Falzon Pty Ltd) to develop the software, referred to as the Quoll Identification Toolkit (QIT)..

The intial build was completed 30 June 2017. The software then underwent an extensive user testing and refinement phase. In 2020 it was reported that the QIT was ready for release in a MATLAB™ format, with further work completed in 2021 to a standalone software format to allow distribution as freeware.

The QIT is now ready and available, including a user manual. The software is available for download via the PestSmart resource library operated by Centre for Invasive Species Solutions (CISS) (formerly IAL). The QIT can be accessed at *https://pestsmart.org.au/resources/?title=quoll-identification-software-toolkit* .

Appendix 1 includes the abstract for the scientific paper outlining the development of the QIT. Please note the abstract only is provided such that any future copyright issues are avoided pending choice of journal publication made by the authors. A private copy can be directly requested from the authors at anytime via contact details provided with the abstract.

2.2 Task 2 – Task 2 Surveying/Monitoring STQ Populations

A research agreement was developed and executed on the 4 April 2018 with the University of New England (UNE) to undertake the Project with a PhD candidate selected and appointed to run the project. In short, the project focused on the development of survey and monitoring techniques of Spotted-tailed quoll populations by implementing a draft camera trapping protocol (based on previous research) for testing and refinement. Camera trapping grids were established (lured camera trap stations) at three sites over four years within Middle Foy Brook offset areas, Mt Royal National Park, and Wollemi National Park. The program was integrated with live trapping to gain further population viability and genetic data.

Following completion of field work in 2021, UNE have prepared a report including a series of scientific papers addressing the IOP objective as Appendix 2.

2.3 Task 3 - Assess Habitat Use by Female STQ

As mentioned above, UNE were also engaged to complete this project under research agreement in 2018. Implementation of Task 3 at the Liddell Site was successful capturing, and fitting telemetry tracking collars on 6 female quolls from the Liddell Coal/Middle Foy Brook site. Unfortunately, the GPS/VHF collars proved unreliable, with GPS data only collected for two female quolls. As as a consequence, the camera trapping was expanded as an alternative means to assess habitat use by female quolls.

Following completion of field work in 2021, UNE have prepared a report including a series of scientific papers addressing the IOP objective as Appendix 2.

3. Funding Summary

Over the course of five years (2016-2021), LCO has committed a total of $243,000 to research partners IAL and UNE in acordance with the objectives of the IOP. Table 3-1 summarises the yearly payments.

Payment To	Date	Amount (AU$ excluding GST)	Cumulative commitment ($)
Project 1:			
Invasive Animal Limited	30/06/2016	50,000	50,000
Invasive Animals Limited	16/12/2016	18,000	68,000
Invasive Animals Limited	30/06/2017	12,000	**80,000**
Project 2 and 3:			
University of New England	11/05/2018	61,000	61,000
University of New England	30/06/2019	28,773	89,773
University of New England	30/04/2020	11,050	100,823
University of New England	30/10/2020	25,618	126,441
University of New England	24/9/2021	11,082	137,523
University of New England	Awaiting invoice	26,424	**163,947**
IOP Total Funding			**243,947**

Table 3-1 – IOP Funding summary

4. Change Information

A summary of the current change is provided in *the* table below.

Version	Date	Change Details
1.0	30/06/2022	Initial document

Appendix A - Quoll Identification Toolkit Paper

Quoll Identification Toolkit: semi-automated software for individual animal identification from camera-trap image sequences.

Falzon G*, Lawson C, Johnston B, Shepley A, Meek PD, Desomer B, Fleming PJS

*: Corresponding Author: *greg.falzon@flinders.edu.au* flinders.edu.au/greg.falzon
A link to the online version will be available once published. A copy of this paper is available on request form the corresponding author.

Abstract

The Quoll Identification Toolkit (QIT) was developed to provide a semi-automated software to facilitate the identification of individual quolls from camera trap image sequences. The QIT consists of a graphical user interface supported by an underlying software pipeline incorporating computer vision and machine learning algorithms. The approach proposed provides a mechanism to reduce the workload and uncertainty associated with identification of individual quolls from camera trap image sequences. The QIT pipeline can also be adapted to facilitate identification of other uniquely patterned animal species.

Appendix B - UNE Report - Spotted-tailed Quoll Ecology in the Hunter Valley

Indirect Offset Plan: Final Report

Spotted-tailed Quoll Ecology in the Hunter Valley

Prepared by:

Mr Tim Henderson

Associate Professor Guy Ballard

Dr Bronwyn Fancourt

Dr Rajanathan Rajaratnam

Professor Karl Vernes

Acknowledgements

The research conducted within this report was made possible by Liddell Coal Operations Pty Limited (LCO). We thank the invaluable assistance provided by staff from LCO, the University of New England (UNE), the NSW Department of Primary Industries, and the many volunteers throughout this project. We also thank the private landowners who allowed access to their properties. All work involving animals was conducted with approval of the UNE Animal Ethics Committee.

Executive Summary

The research in this report contributes to the following tasks, as outlined in the Liddell Coal Operations Indirect Offset Plan (IOP):

Task 2: Surveying Spotted-tailed Quoll populations in the Hunter Valley:
This task includes several research articles on spotted-tail quoll camera monitoring and survey design, population viability, interactions with introduced foxes, and genetic connectivity.

Task 3: Spotted-tailed Quoll habitat use in a fragmented landscape:
This task includes a research article on quoll habitat use within the fragmented Middle Foy Brook Offset Areas, with a separate article on female-specific habitat use.

This report is presented as a collection of field-based research outputs on spotted-tailed quoll ecology in the Hunter Valley, New South Wales (NSW). Each chapter has been written as an individual research article on a specific aspect of the ecology of spotted-tailed quolls in fragmented landscapes, and are currently under consideration in peer-reviewed in scientific journals. As such, only the abstracts of each chapter have been included. Full versions of each chapter will be published online, and are available on request to the author.

Research was primarily conducted on quoll populations within Glencore Coal Assets Australia Offset Areas, defined broadly as the Middle Foy Brook Offset Area, and Mt Royal National Park. Additionally, a study site was established in Wollemi National Park (Appendix A). However, this site was established late in the project and recorded very few quolls. Therefore, research at this site has not been included within the research articles.

Additional information on quoll diet composition from scats collected throughout the study is provided in Appendix B.

Table of Contents

1 Task 2: Surveying Spotted-tailed Quoll populations in the Hunter Valley

Summary

This task focused on the development of robust survey and monitoring techniques for spotted-tailed quoll populations within the Hunter Valley, NSW. Long-term camera trap monitoring sites were established within the Middle Foy Brook Area (and adjacent private property) as well as in Mt Royal National Park. In addition, live-trapping of quolls was conducted to obtain genetic information (Appendix C).

The objective of **Chapter 1** was to implement a robust camera trap survey design for detecting and identifying individual quolls, and to compare quoll density estimates between a fragmented and intact forested site. This chapter provides detailed methodology for surveying quolls and the process for manual individual identification. In addition, this research determined that the fragmented Middle Foy Brook Offset Area supported similar quoll densities to the nearby, intact forested Mt Royal National Park. **Chapter 2** is an extension of camera trap survey design for spotted-tailed quolls, which quantified quoll detectability using targeted quolls surveys, compared to a standardised mammal survey design.

The viability of the Middle Foy Brook quoll population is modelled in **Chapter 3,** using demographic data obtained throughout the project. The population had a low probability of going extinct, but was sensitive to large reductions in carrying capacity, as well as increases in mortality, especially that of juveniles.

The interactions between quolls and the introduced red fox in the fragmented Middle Foy Brook Area, are the focus of **Chapter 4.** This study determined that quolls and foxes appear to co-exist both spatially and temporally, likely due to low fox density at the site. However, this also raises concerns that quolls may not modify their behaviour to avoid foxes, which could explain why quolls are absent in other fragmented landscapes where foxes are more numerous, and highlights the importance of continued fox-control programs locally.

The objective of **Chapter 5** was to obtain genetic material from quolls at the Middle Foy Brook Offset Area and Mt Royal National Park sites, to assess genetic structure and connectivity. Detailed genetic analysis revealed that the genetic structure of the two sites were similar, and are likely part of a larger metapopulation. However, there was very little evidence of recent movement of individuals between the two sites. This may be encouraging for the Middle Foy Brook site, as the population appears to be functioning without direct support for Mt Royal, but there is an inherent risk of it becoming genetically isolated if connectivity is impacted or reduced. It is also likely that Middle Foy Brook population provides a potential source of quoll dispersal to nearby forest fragments within the Hunter Valley, and is in turn support by them as well.

1.1 Chapter 1: Density estimates reveal that fragmented landscapes provide important habitat for conserving an endangered mesopredator, the spotted-tailed quoll.

A link to the online version will be available once published.
A copy of this chapter is also available on request. Email: thender7@myune.edu.au

Abstract

Native predators are being increasingly exposed to habitat loss and fragmentation globally. When developing conservation and management strategies, it is important to determine whether fragmented landscapes can still support similar predator densities to intact areas, and thereby constitute important habitat for these species. The spotted-tailed quoll (*Dasyurus maculatus*) is an endangered Australian mesopredator that is often considered to be forest-dependent. While quolls are known to occur in some fragmented forest landscapes, it is unclear whether these areas represent sub-optimal habitat where quolls merely persist, or whether quolls can still thrive at densities similar to those observed in intact forest landscapes. We used camera traps to detect quolls in both a fragmented and intact forested site, over three years. We used each quoll's unique pelage pattern to identify individual quolls and estimate population density at each site. We were able to assign more than 94% of quoll image sequences across both sites to identify 173 individuals during the study. Density estimates of 0.13-0.66 quolls per km^2 at the fragmented site were comparable to estimates of 0.28-0.48 quolls per km^2 at the intact site. Our results highlight the importance of retaining and protecting forest fragments for the conservation of endangered quoll populations.

1.2 Chapter 2: The importance of species-specific survey designs: prey camera trap surveys significantly underestimate the detectability of endangered spotted-tailed quolls.

The full version is available online: https://doi.org/10.1071/AM21039
A copy of this chapter is also available on request. Email: thender7@myune.edu.au

Abstract

The spotted-tailed quoll (*Dasyurus maculatus*) is an endangered marsupial carnivore that is often surveyed using camera traps. Camera trap surveys targeting quolls typically use meat-based lures and specific camera setups tailored to increase the probability of quoll detection. However, where quolls occur, they can also be incidentally detected as non-target species in camera surveys targeting small to medium-sized herbivorous or omnivorous mammals ('prey' surveys). We investigated whether quoll detectability using traditional 'prey' camera surveys could sufficiently approximate quoll detectability using targeted 'quoll' surveys, potentially enabling quoll data from prey surveys to be used in lieu of undertaking additional quoll-specific surveys. We used 50 Reconyx HC600 cameras to quantify and compare quoll detectability between prey and quoll surveys at each of two different sites. The number of quoll detections, number of individual quolls detected and the probability of quoll detection at both sites were significantly higher in quoll surveys than in prey surveys. Our findings suggest that prey surveys substantially underestimate quoll detectability, resulting in incomplete datasets. We therefore caution against using quoll detection data from prey camera trap surveys for anything other than presence-only data, to avoid misleading survey and management outcomes.

1.3 Chapter 3: Modelling the survivability of spotted-tailed quolls in a fragmented landscape.

A link to the online version will be available once published.
A copy of this chapter is also available on request. Email: thender7@myune.edu.au

Abstract

Spotted-tailed quolls are generally considered to be dependent on large, intact forested landscapes. However, they are also known persist in some fragmented landscapes. Quolls in fragmented landscapes are likely susceptible to the associated effects of habitat loss on genetic and demographic stochasticity, as well as increased competition and predation from other predators. We used population viability analysis (PVA) to model the survivability of a hypothetical quoll population in a fragmented landscape under various scenarios of reduced carrying capacity and increased mortality. We found that the quoll population had a low probability of going extinct, unless carrying capacity was reduced by over half. However, the population was particularly susceptible to high levels of juvenile mortality, with a high chance of extinction if mortality exceeded 60%. Conservation and management strategies should seek to reduce the associated impacts of habitat loss and fragmentation on quoll populations in fragmented landscapes, as well as obtain accurate estimates of juvenile mortality to determine the viability of the population.

1.4 Chapter 4: Spatial and temporal interactions between the endangered spotted-tailed quoll and the introduced red fox in a fragmented landscape

The full version is available online: https://doi.org/10.1111/jzo.12919
A copy of this chapter is also available on request. Email: thender7@myune.edu.au

Abstract

Habitat fragmentation can have detrimental impacts on native predators globally through the loss of habitat and associated impacts from introduced predators. The endangered spotted-tailed quoll (*Dasyurus maculatus*) is the largest marsupial carnivore on mainland Australia and is sympatric with an introduced predator, the red fox (*Vulpes vulpes*). Spotted-tailed quolls are considered a forest-dependent species and are often associated with large, intact forested habitats where abundance of prey is high and competition with foxes is low. Spotted-tailed quolls are known to persist in some fragmented habitats in sympatry with foxes, however, the mechanisms facilitating this coexistence are unclear. For 15 months in 2018-19, we used camera traps to investigate whether coexistence between quolls and foxes in a fragmented landscape was facilitated by spatial and/or temporal separation of activity. We found no evidence of spatial separation, with quolls detected on the majority of cameras where foxes were detected. There was considerable temporal overlap between quolls and foxes ($\Delta 1 = 0.71 – 0.81$) and no evidence that fox presence influenced the temporal activity of quolls ($\Delta 1 = 0.76 – 0.80$). Furthermore, there was no evidence of within-night spatiotemporal avoidance between quolls and foxes ($R2 < 0.01$). Our findings suggest that quolls do not offset their spatial and temporal activity to avoid foxes in this fragmented landscape. The spatial and temporal sympatry between quolls and foxes is possibly facilitated by low fox density at this site, suggested by low fox detections. The lack of separation between quoll and fox activity could also explain why quolls become locally extinct in other fragmented landscapes, because quolls may not modify their activity to avoid foxes. Future research should focus on investigating quoll and fox interactions along a gradient of fox densities and assess if higher fox densities influence spatial and temporal coexistence with quolls in fragmented landscapes.

1.5 Chapter 5: Genetic structure and movement between spotted-tailed quoll populations in a fragmented and intact landscape.

A link to the online version will be available once published.

A copy of this chapter is also available on request. Email: thender7@myune.edu.au

Abstract

Species often exist in metapopulations, where spatially discrete populations are connected by the dispersal of individuals between them. In fragmented landscapes, the movement of individuals between populations is important for maintaining genetic diversity and ensuring populations do not become isolated. The spotted-tailed quoll (*Dasyurus maculatus*) is generally associated with intact, forested landscapes. However, a population is known to exist within the Hunter Valley, New South Wales. In this study, we aimed to compare genetic diversity within and between a fragmented and an intact site, to determine if recent movement has occurred between the two sites using population structure analysis, pairwise relatedness and identification of first-generation migrants. We obtained genetic material from 64 individual quolls. We found that the genetic variation for quolls within the fragmented site was comparable to quolls in the intact site. However, the two sites appear to be functioning as separate populations, with little evidence of recent movement between them. Our results suggest that the two populations exist in a larger metapopulation, though the fragmented site is not directly supported by quolls dispersing from the intact site. Furthermore, genetic structure of the two populations suggests that while there is gene flow between them, the lack of direct dispersal to the fragmented site means it is likely supported by quolls in nearby forest fragments. It is therefore essential that conservation and management strategies seek to maintain connectivity within this fragmented landscape so that fragmented populations do not become isolated and risk local extinction.

2 Task 3: Spotted-tailed Quoll habitat use in a fragmented landscape

Summary

This objective of Task 3 was to assess habitat use by spotted-tailed quolls in a fragmented landscape using camera traps. Initially, information on habitat use was to be obtained using GPS collaring of female quolls. However, preliminary GPS collaring proved to be logistically challenging and provided inadequate results. Therefore, instead of subjecting individual quolls to further collaring, we approached habitat use assessment using less invasive camera trapping.

Chapter 6 investigated spotted-tailed quoll habitat use within the Middle Foy Brook Area, while **Chapter 7** focused specially on habitat use of known female quolls, as well as the outcomes and challenges of using GPS collaring. Quolls demonstrated flexibility in habitat use, though generally preferred forest fragments and avoided open areas. We were able to obtain GPS data for two female quolls, which provided basic information on their home range, but was insufficient for inferring habitat use or preference.

2.1 Chapter 6: Habitat use by the endangered spotted-tailed quoll *Dasyurus maculatus* in a fragmented landscape.

A link to the online version will be available once published.
A copy of this chapter is also available on request. Email: thender7@myune.edu.au

Abstract

The spotted-tailed quoll (*Dasyurus maculatus*) is an endangered mesopredator endemic to Australia. It is generally considered a forest-dependent species associated with large, intact forested habitats. On Australia's mainland, quoll research has typically been conducted in contiguous forest, and consequently, the species' presumed forest-dependency might reflect sampling bias rather than the species' preferred habitat niche. Recent studies have revealed that quolls also persist in fragmented agricultural landscapes, raising questions about the species' true habitat requirements and preferences. In this study, we investigated quoll habitat use within a fragmented agricultural landscape on mainland Australia. We sought to determine whether quoll habitat preference was similar across four broad vegetation types (open grassland, grassy woodland, dry sclerophyll, and wet sclerophyll forests). From May to December 2020, we deployed 42 lured camera traps across the four vegetation types. We used quoll activity and occupancy to compare habitat use between each vegetation type. Quolls were detected in all vegetation types, and quoll activity indicated a preference for dry sclerophyll forest and grassy woodlands, though this preference varied depending on the time of year. Our results suggest that quoll habitat use on mainland Australia is more flexible than previously assumed, and we recommend further research on factors that may influence habitat preference such as prey availability and seasonal behaviour. Understanding the factors that drive habitat use by quolls outside of contiguous forested landscapes will inform and improve conservation and management strategies to ensure critical habitat for the species is protected and retained in an increasingly fragmented landscape.

2.2 Chapter 7: Habitat requirements of female spotted-tailed quolls, and the challenges of using GPS collaring and camera trapping.

This chapter has not specifically been prepared for scientific publication, but is an extension to Chapter 6, which focuses specifically on female quoll habitat use.
A copy of this chapter is available on request. Email: thender7@myune.edu.au

Abstract

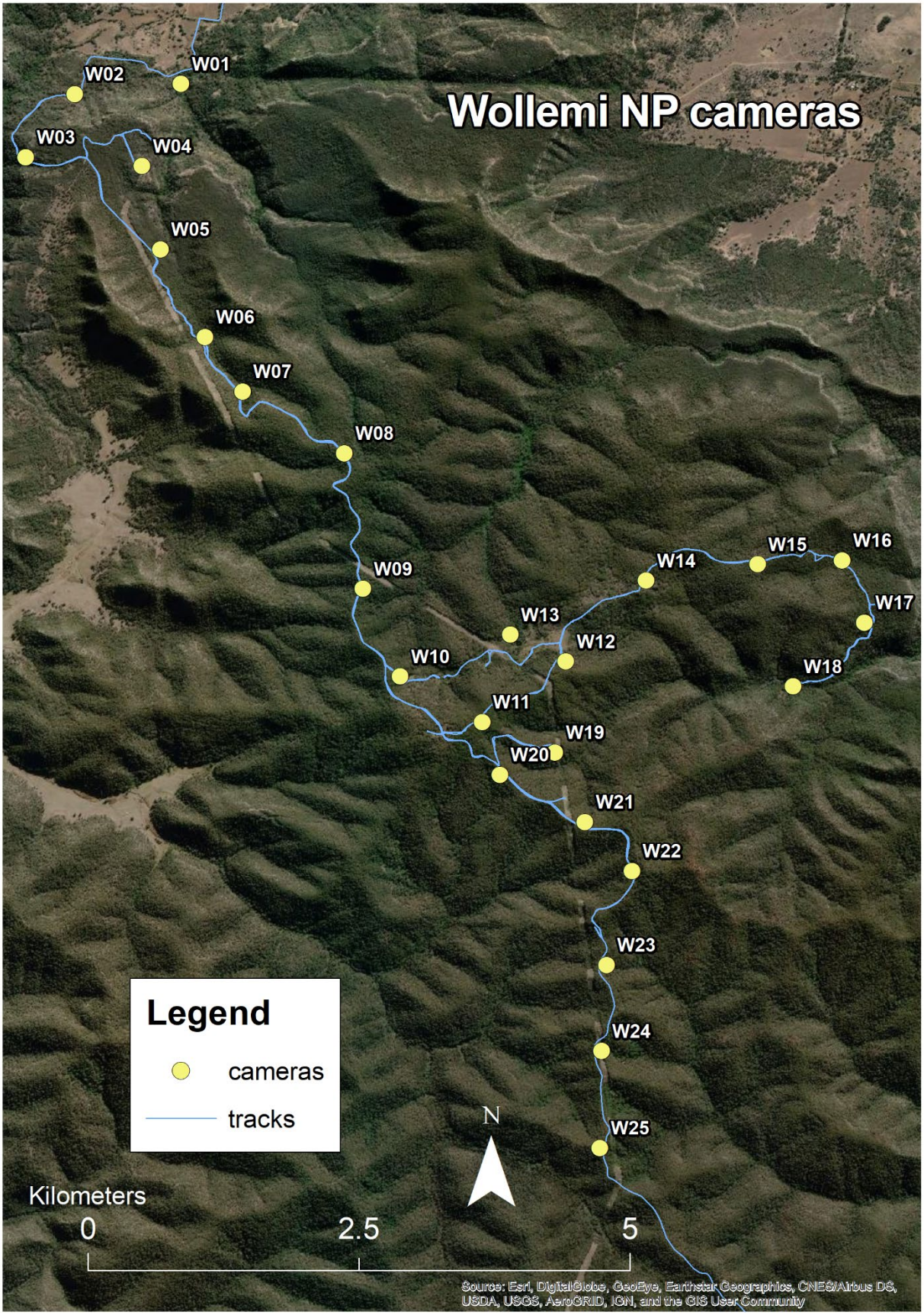
Population density of carnivore species such as the spotted-tailed quoll (*Dasyurus maculatus*) is often limited by female philopatry. Female quoll space use and fitness is likely impacted by habitat fragmentation. Therefore, it is important to understand the habitat requirements of female quolls in fragmented landscapes, to aid conservation and management. We investigated female quoll habitat use in a fragmented landscape within the Hunter Valley, and present the outcomes and challenges of using GPS collaring to investigate quoll habitat requirements. We collared eight female quolls, but only obtained GPS data for two individuals. Ranging area for the two female quolls was 425 ha and 270 ha, respectively, which is comparable to what has previously been recorded elsewhere in Australia. However, this GPS collaring was overall unsuccessful due to various collar malfunctions and issues retrieving the collars. Camera detections revealed that female quolls preferred dry sclerophyll forests and grassy woodlands, though this varied depending on the time of year. These results were similar to Chapter 5, which indicate that forest fragments are important habitat for female quolls within this fragmented landscape. However, this study also highlights the challenges of obtaining detailed information on female quoll habitat use within this fragmented landscape.

3 Synthesis

Research within this report provides important information on spotted-tailed quoll ecology in the Hunter Valley, with an overall contribution to quoll conservation in Australia. Our findings indicate that quolls not only persist within a fragmented landscape in the Hunter Valley, but thrive here at similar densities to the nearby, intact Mt Royal National Park. Genetic monitoring suggests that the two sites are also structurally similar and are part of a metapopulation, but the lack of recent movement from Mt Royal implies that the Middle Foy Brook population is functioning as its' own population. PVA modelling also revealed that the population is likely viable its current state, but its survivability is sensitive to increases in mortality, especially in juveniles. The population co-exists with foxes, though the presence of foxes does not appear to impact quoll activity or overall persistence. This is likely due to low fox density, reinforcing the importance of managing invasive predators. Habitat use by quolls was flexible, potentially reflecting a preferred broad niche, though habitat preference was for forest fragments with an avoidance of open grasslands.

Importantly, we do not understand the role the Middle Foy Brook offset areas has for the overall health of the metapopulation, and if it simply exists as a 'sink' population, or itself provides a 'source' to potential, smaller 'sinks' in forest fragments within the Hunter Valley. Further research is needed to determine the role this site and similar fragmented landscapes have for the conservation of this endangered species.

Appendix A – Wollemi National Park camera trap layout



Appendix B – Spotted-tailed quoll scat analysis

	Liddell (n= 69)		Mt Royal (n = 95)	
		Frequency		Frequency
Species	*n*	(%)	*n*	(%)
Small mammals				
Antechinus stuartii, brown antechinus			1	1.1
Mastacomys fuscus, broad-toothed rat	1	1.4		
Mus musculus, house mouse	5	7.2		
Rattus fuscipes, bush rat			6	6.3
Rattus lutreolus, swamp rat			4	4.2
Rattus rattus, black rat	14	20.3	4	4.2
Unknown rodent	2	2.9	1	1.1
Medium-sized mammals				
Isoodon macrourus, northern brown bandicoot	9	13.0		
Lepus europaeus, European hare	2	2.9		
Macropus parma, parma wallaby	1	1.4	2	2.1
Perameles nasuta, long-nosed bandicoot	3	4.3		
Petaurus norfolcensis, squirrel glider	1	1.4	3	3.2
Pseudocheirus peregrinus, ringtail possum	1	1.4	7	7.4
Pteropus poliocephalus, grey-headed flying-fox	3	4.3	1	1.1
Tachyglossus aculeatus, short-beaked echinda			2	2.1
Thylogale stigmatica, red-legged pademelon			20	21.1
Thylogale thetis, red-necked pademelon	1	1.4	6	6.3
Trichosurus caninus, short-eared brushtail possum	3	4.3	4	4.2
Trichosurus vulpecula, common brushtail possum	3	4.3	1	1.1
Large mammals				
Macropus rufogriseus, red-necked wallaby	1	1.4		
Vombatus ursinus, common wombat			1	1.1
Wallabia bicolor, swamp wallaby	5	7.2	8	8.4
Unknown macropod	2	2.9	9	9.5
Bird	4	5.8	9	9.5
Reptile	3	4.3	2	2.1
Amphibian			2	2.1
Insect	5	7.2	2	2.1

Appendix C – Spotted-tailed quoll captures

Table 1. Summary of spotted-tailed quolls caught at the Middle Foy Brook Area, for which genetic material (ear biopsy) was obtained and used for analysis.

Quoll ID	Name	Sex (M/F)	Est. Age	Weight (kg)	Date Collected	y_coords	x_coords
19L001	Ace	M	2nd	3.73	12/06/2019	6421829.647	312992.2921
19L002	Vanilla	F	2nd	1.86	12/06/2019	6421660.844	313184.2462
19L003	Peanut	M	2nd	2.72	12/06/2019	6421557.437	313649.785
19L004	Quinn	F	1st	1.76	13/06/2019	6420543.415	312911.3474
19L005	Kenobi	M	1st	2.05	13/06/2019	6420898.816	312972.6456
19L006	Dustin	M	2nd	3.3	13/06/2019	6421829.647	312992.2921
19L007	Bond	M	1st	2.325	14/06/2019	6422439.619	313318.2489
19L008	Snickers	M	1st	2.45	14/06/2019	6423983.494	313819.4391
19L009	Shaggy	M	2nd	2.65	15/06/2019	6421660.844	313184.2462
19L010	Zero	M	1st	2.275	15/06/2019	6423983.494	313819.4391
19L011	Charlie	M	2nd	3.125	2/07/2019	6420006.874	314300.0027
19L012	Ronan	M	1st	1.575	2/07/2019	6422216.762	312235.4265
19L013	Daisy	F	1st	2	3/07/2019	6420006.874	314300.0027
19L014	Leia	F	1st	1.5	3/07/2019	6422388.183	312548.5022
19L015	Biscuit	F	2nd	1.875	3/07/2019	6423931.236	313596.2153
19L016	Nessa	F	2nd	2.125	4/07/2019	6422383.92	312539.9166
19L017	Crumpet	F	1st	1.775	11/09/2019	6421660.844	313184.2462
19L018	Chomper	M	2nd	3.425	20/11/2019	6420086.06	314077.0778
19L019	Ogre	M	2nd	2.8	17/12/2019	6420006.874	314300.0027
20L020	Aqua	F	2nd	1.5	24/11/2020	6424334.38	315750.5568
20L021	Cupcake	F	2nd	2.15	25/11/2020	6422946.725	315542.8826
21L022	Ariel	F	1st	1.5	13/04/2021	6424443.009	315783.4272
21L023	Oscar	M	2nd	3.25	14/04/2021	6422946.099	315545.0603
21L024	Peggy	F	1st	1.425	15/04/2021	6424325.736	315744.8743
21L025	Worm	M	1st	1.775	24/06/2021	6424477.963	315814.723
21L026	Mavis	F	1st	1.725	24/06/2021	6422219.114	312242.6347
21L027	Spike	M	2nd	3.175	19/07/2021	6424149.06	315636.0058

Table 2. Summary of spotted-tailed quolls caught at Mt Royal National Park, for which genetic material (ear biopsy) was obtained and used for analysis.

Quoll ID	Name	Sex (M/F)	Est. Age	Weight (kg)	Date Collected	y_coords	x_coords
20M001	Zuko	M	1st	1.4	30/06/2020	6436111.791	340426.6434
20M002	Bolin	M	2nd	2.6	2/07/2020	6440320.191	340770.352
20M003	Toph	F	1st	1.15	3/07/2020	6435776.188	340002.5428
20M004	Iroh	M	3rd	3.2	3/07/2020	6439119.813	341459.9842
20M005	Suki	F	1st	1.15	4/07/2020	6438286.593	341178.6677
20M006	Roku	M	1st	1.2	4/07/2020	6438567.559	341190.3943
20M007	Bumi	M	3rd	3.5	6/07/2020	6439119.813	341459.9842
20M008	Cabbages	M	3rd or >	3.6	6/07/2020	6440392.182	341125.4131
20M009	Mako	M	2nd	3.1	6/07/2020	6440320.191	340770.352
20M010	Tenzin	M	3rd	3.1	7/07/2020	6440392.182	341125.4131
20M011	Korra	F	2nd	1.75	9/07/2020	6439532.326	341594.1701
20M012	Katara	F	1st	1.475	8/07/2020	6440144.116	340609.4561
20M013	Kyoshi	F	2nd	1.75	10/07/2020	6438660.383	338452.772
20M014	Asami	F	2nd	2	12/08/2020	6439929.146	340140.636
20M015	Appa	M	2nd	2.6	12/08/2020	6438416.859	338167.7691
20M016	Jinora	F	2nd	1.725	12/08/2020	6439929.146	340140.636
20M017	Aang	M	1st	2.225	13/08/2020	6434902.285	339964.21
20M018	Opal	F	2nd	2.1	14/08/2020	6434853.964	336330.1727
20M019	Ikki	F	1st	1.55	15/08/2020	6434902.285	339964.21
20M020	Meelo	M	1st	1.6	15/08/2020	6436856.479	340760.0446
20M021	Azula	F	1st	1.725	15/08/2020	6436324.421	336375.8137
20M022	Ozai	M	3rd or >	3.85	16/08/2020	6434353.545	334919.8531
21M023	Kya	F	1st	1.6	5/05/2021	6437725.576	340966.1216
21M024	Sokka	M	2nd	2.4	5/05/2021	6439492.15	341613.3788
21M025	Oogi	M	3rd or >	2.7	6/05/2021	6434910.026	339962.862
21M026	Naga	F	3rd	2.35	6/05/2021	6436852.043	340760.0201
21M027	Pepper	F	1st	1.6	6/05/2021	6440348.693	341230.5169
21M028	Bosco	M	2nd	3.1	6/05/2021	6440245.368	340659.2747
21M029	Ty Lee	F	1st	1.725	6/05/2021	6438242.636	337855.0755
21M030	Izumi	F	1st	1.4	26/05/2021	6437317.537	340856.3436
21M031	Pakku	M	1st	1.875	26/05/2021	6439652.561	339605.744
21M032	Sozin	M	3rd	4.175	28/05/2021	6439492.15	341613.3788
21M033	Badgermole	M	1st	2.35	29/05/2021	6437317.537	340856.3436
21M034	Pema	F	3rd	2.4	29/05/2021	6439408.485	339157.7062
21M035	Flopsie	M	3rd	3.35	30/05/2021	6440057.022	340359.9135
21M036	Fang	M	1st	2.075	4/08/2021	6431629.57	338528.4025

GLENCORE