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Mammals on Lutregala Marsh Reserve, Bruny Island

2015 – 2017

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Front Image: Feral cat on Lutrgeala Marsh Reserve in 2017 LUMA 1 – TLC camera trap.

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Summary

In 2015 the Tasmanian Land Conservancy commenced a mammal survey on Lutregala Marsh Reserve to help inform the Bruny Island Cat Management Project. Five camera monitoring traps were installed in May 2015 with an additional three sites added in August 2016 and resampled in November 2017. Trap nights ranged from 210 to 245 nights per year with 438 to 626 species detections recorded per year. Eleven mammal species were identified on Lutregala Marsh Reserve across the three year period. Mean mammal diversity changed from 6.2 species in 2015 to 4.7 species in 2017, which may reflect either seasonal differences and life history stages of some species over the sampling periods or the lower number of sampling sites in 2015. In addition to the expected compliment of wallaby and possum species the most notable mammals detected included eastern quoll, potoroo, ringtail possum, feral cats and fallow deer. Invasive cats and fallow deer are a threat to conservation values of the Reserve and their removal from the Bruny Island landscape is a high priority.

The highest number of cat detections were obtained in 2015 with a decreasing trend in 2016 and 2017. Five to 14 different cats were detected on the Reserve in 2015, 5 to 8 cats in 2016 and 4 to 5 cats in 2017 with at least 9 different cats being detected over the three year period. The range of body sizes from adults to kittens confirmed that cats are breeding at the Main Road end. Two population clusters exist; one associated with Simpsons Bay Road, and the second near the Main Road accessing The Neck coastline and seabird colonies. This reduction in cat detections is most likely a result of the Bruny Island Cat Management Program where approximately 20 cats have been removed from the immediate vicinity. Ongoing monitoring will be continued with a detailed analysis of mammal occupancy and abundance undertaken within five years.

Acknowledgements

TLC gratefully acknowledges the Save The Tasmanian Devil Appeal through the UTAS Foundation that helped fund the purchase of motion sensor cameras. This work is part of the Bruny Island Cat Management Project administered by Kaylene Allan and the Kingborough Council in partnership with the Tasmanian and Commonwealth governments and a range of other government, non-government and private stakeholders overseen by a steering committee. This work also helps inform the TLC's ecological monitoring program on Lutregala Marsh Reserve and a number of TLC staff namely Matthew Taylor, Denna Kingdom, Tim Deveraux, Rowena Hamer and TLC volunteers help undertake this work. Sincere thanks to everyone.

1.0 Introduction

1.1 Lutregala Marsh Reserve

Lutregala Marsh is a 42 hectare saltmarsh and coastal forest reserve at the mouth of Simpsons Creek in Isthmus Bay – the narrow connection joining south and north Bruny Island (Fig 1). It is typically part of a larger low lying saline marsh system supplied by freshwater originating in the South Bruny Range flowing into Lutregala Creek onto Simpsons Creek and into Simpsons Bay. On its eastern boundary the Reserve adjoins the PWS Bruny Island Neck Game Reserve and to the south and west adjoins private properties used for grazing and domestic purposes (Fig 2).

Lutregala Marsh Reserve was listed on the register of the National Estate in 1997 as an intermediate marsh (vegetation above and below the waterline) as it plays an important role in nutrient cycling in Simpsons Bay and adjacent coastal areas (Tasmanian Land Conservancy 2016a). The Reserve contains diverse flora and fauna including threatened sea lavender *Limonium austral*, 15 species of terrestrial amphipods, crustaceans and mollusca and a rich diversity of raptors, waterfowl, seabirds, shorebirds and forest bird species including the endangered swift parrot *Lathamus discolor* and forty-spotted pardalote *Pardalotus quadragintus*. It provides important refugial habitat for terrestrial mammals including eastern quoll *Dasyurus viverrinus* and others that use this pinchpoint as a transitional corridor across The Neck. Feral cats pose a significant threat to the Reserve's natural values and while cat densities prior to this work were unknown, a neighbouring property on Simpsons Bay Road has maintained a large number of pet and stray cats.

Fig 1 Location and landscape contect of Lutregala Marsh Reserve, Bruny Island.

Fig 2 Physical features of Lutregala Marsh Reserve (reserve boundary marked by red line).

1.2 Lutregala Marsh Reserve Management Plan

This mammal survey is in accord with the Lutregala Marsh Reserve Management Plan (Tasmanian Land Conservancy 2016b) which contains the following key actions and targets.

Feral Animal Control

1. **Minimise the impact of cats on wildlife on the Reserve**
2. **Support eradication of fallow deer on Bruny Island**

A neighbour to the west of Lutregal Marsh Reserve has numerous cats whose movements are not controlled. One way to address this issue is within a broader cat management strategy that was developed and is now being implemented across Bruny Island, in conjunction with Kingborough Council and other partners. This integrated community-based program brings considerable scope for effective control and even potential eradication of feral cats from the island in the future. The TLC is therefore partnering in this cooperative and comprehensive cat management strategy for Bruny Island and Lutregala Marsh Reserve has been identified as an important management site.

There have also been fallow deer *Dama dama* recorded on the property in recent times which were accidently introduced to the island from a restocking program on nearby Sattelite Island in 2012/3. Bruny Island is outside the range of this partly protected species in Tasmania and their eradication from the island should be an urgent priority for government and the community. Fauna monitoring will help collect trend data on this invasive species and contribute to any efforts by PWS or State Government to have them eradicated.

Key Activities

- Continue partnering in a cat management strategy for Bruny Island
- Undertake standard long term ecological vegetation and fauna monitoring
- Install and score baited camera traps for feral and native animals

2.0 Survey Methods

Motion sensor cameras were deployed at the locations shown in Figure 3. Five traps were installed in 2015 and an additional 3 sites in 2016 making 8 sites in total (Appendix A). Traps were installed in May 2015, August 2016 and November 2017 and were in place for at least 21 days. Methodology for the camera deployments, use of attractant and data analysis follows the STDP *Remote camera survey techniques for wildlife: Standard Operating Procedures* (http://www.tassiedevil.com.au/tasdevil.nsf) and TLCs monitoring procedures manual (www.tasland.org.au).

2.1 Camera traps

Scout Guard SG560Z Zero Glow 8m cameras with an 8GB SD camera card were installed with a setting of mode-camera, photo size 5MP, 1 photo per 30 seconds, flash range 15m, and date and time stamp activated.

Camera traps were located in habitat at the sites typical of Fig 4 and Fig 5 with cameras mounted on a tree or post at a height of approximately 1.5 m above the ground and angled in the direction of a runway, track or clearing or habitat feature. Runways, tracks and boundary lines were deliberately targeted as they facilitate mammal movement. Commercially prepared fish oil was used as a scent attractant and dispensed onto a rock, wood surface or directly onto cleared ground approximately 2 to 3 m away from the camera to attract animals to the desired site.

Fig 3 Location of camera traps on Lutregala Marsh (LUMA) Reserve.

Fig. 4 Camera site LUMA6 on edge of marshland and LUMA4 in forest corridor.

2.2 Photo interpretation

Cameras were retrieved and images catalogued according to year and site number. Metadata on deployment, retrival, location, and other relevant information to the survey was recorded. Photos were processed and scored according to TLCs standard protocol (www.tasland.org.au). A sequence of one or more images of the same individual is scored as one detection provided they are no more than 10 minutes apart.

A determination of the number of individual cats detected was undertaken manually. This involved studying every image and assigning a known or unknown status according to the cat's body markings, time sequences and other body characteristics at comparable focal lengths. Cats were assigned an 'unknown' status if body markings were indistinguishable or partly concealed making cross referencing difficult. This assessment process is relatively quick and enables an approximation of the number of known vs unknown individual cats per site to be determined and the calculation of a lower to upper range in cat number.

3.0 Results

3.1 Mammal Diversity

Table 1, Table 2 and Appendix B contain a list of the total species and the diversity recorded on Lutregala Marsh Reserve during each session of trapping in 2015, 2016 and 2017. The most species rich sites were along the *Eucalypt Amygdalina* dry coastal forest track at LUMA3, 4 and 5 near The Neck. The change in mean species diversity and total mammal diversity between 2015 and 2017 is likely to reflect a number of

factors relating to differences in timing of monitoring per year and their associated seasonal differences relating to food supply and breeding cycle.

Table 1. Fauna (all species) captured on Lutregala Marsh Reserve 2015 - 2017.

Site No	Trap Nights	No of Detections	Species Diversity*	Mammal Diversity**
May 2015				
LUMA1	49	209	11	7
LUMA2	49	49	9	6
LUMA3	49	146	15	7
LUMA4	49	116	14	7
LUMA5	49	106	9	4
	245	**626**	**22 species**	**Mean 6.2**
Aug 2016				
LUMA1	30	72	7	6
LUMA2	30	32	6	3
LUMA3	30	6	2	2
LUMA4	30	34	5	4
LUMA5	30	31	6	5
LUMA6	30	67	5	4
LUMA7	30	116	6	4
LUMA8	30	86	6	5
	240	**438**	**11 species**	**Mean 4.1**
Nov 2017				
LUMA1	28	66	7	6
LUMA2	14	6	2	2
LUMA3	28	38	10	6
LUMA4	28	64	6	4
LUMA5	28	45	7	6
LUMA6	28	16	4	4
LUMA7	28	122	4	4
LUMA8	28	106	8	6
	210	**463**	**17 species**	**Mean 4.7**

*Includes mammals, birds and reptiles ** does not include detections for cow or no id

A total of 11 mammal species were detected on Lutregala Reserve over the three year period (Table 2). The most abundant and commonly detected mammal species were Bennett's wallaby *Macropus rufogriseus*, Tasmanian pademelon *Thylogale billardierii* and brush-tailed possum *Trichosurus vulpecula*, all of which are widespread on Bruny Island in a range of habitats. The rarest capture was one image of a ringtail possum *Pseudocheirus peregrinus* in 2015 indicating this species has a very low detectability rate on the Reserve which may also reflect its status across the island. In 2015 multiple images of a rat species and of house mouse *Mus musculus* were detected, with neither captured in 2016 but with a small number of detections again in 2017. The rat could have been either black rat *Rattus rattus* or the native long-tailed mouse *Pseudomys higginsii* but did not have the body shape for native swamp rat *Rattus lutreolus*. Eastern quoll *Dasyurus viverrinus* were identified at three sites in 2015, not captured in 2016 and captured at two sites in 2017. It is pleasing to see this species persisiting on the Reserve even in low densities while in association with

cats. Other notable findings were of fallow deer *Dama dama* first appearing in 2016 at 5 of 8 sites and in 2017 at 5 of 8 sites making 6 different sites in total. Two deer were flushed during camera deployment in 2017 and disappeared into the marsh.

Table 2 Detection and occupancy of mammals on Lutregala Marsh Reserve 2015-2017.

No of Detections	Echidna	Bennetts Wallaby	Padem.	Brushtail Possum	Ringtail Possum	Potoroo	Eastern Quoll	Cat	Rat sp	House Mouse	Fallow Deer	Mean Mammal Diversity
2015												
LUMA1	2	34	10	41	0	42	2	18	0	0	0	7 sp
LUMA2	0	10	10	3	0	13	1	2	0	0	0	6 sp
LUMA3	0	1	27	18	0	0	6	8	26	18	0	7 sp
LUMA4	5	6	45	26	1	0	0	1	0	5	0	7 sp
LUMA5	0	1	31	4	0	0	0	2	0	0	0	4 sp
Detections % Occupancy	**7 40%**	**52 100%**	**123 100%**	**92 100%**	**1 20%**	**55 40%**	**9 60%**	**31 100%**	**26 20%**	**23 40%**	**0 0%**	**6.2 species**
2016												
LUMA1	0	11	2	28	0	3	0	4	0	0	1	6 sp
LUMA2	0	4	0	4	0	0	0	6	0	0	0	3 sp
LUMA3	0	2	3	0	0	0	0	0	0	0	0	2 sp
LUMA4	1	0	12	10	0	0	0	0	0	0	2	4 sp
LUMA5	0	1	5	1	0	0	0	2	0	0	7	5 sp
LUMA6	0	19	10	1	0	0	0	2	0	0	0	4 sp
LUMA7	0	3	61	3	0	0	0	0	0	0	7	4 sp
LUMA8	0	12	39	2	0	1	0	0	0	0	2	5 sp
Detections % Occupancy	**1 13%**	**52 88%**	**132 88%**	**49 88%**	**0 0%**	**4 25%**	**0 0%**	**14 50%**	**0 0%**	**0 0%**	**19 63%**	**4.1 species**
2017												
LUMA1	0	4	3	17	0	29	0	4	0	0	8	6 sp
LUMA2	0	2	0	2	0	0	0	0	0	0	0	2 sp
LUMA3	3	6	4	13	0	0	2	1	0	0	0	6 sp
LUMA4	0	7	15	36	0	0	0	1	0	0	0	4 sp
LUMA5	0	3	10	26	0	0	0	1	1	0	1	6 sp
LUMA6	0	8	1	2	0	0	0	0	0	0	5	4 sp
LUMA7	0	16	86	16	0	0	0	0	0	0	4	4 sp
LUMA8	0	16	70	12	0	0	1	0	1	0	3	6 sp
Detections % Occupancy	**2 13%**	**66 100%**	**201 88%**	**156 100%**	**0 0%**	**29 13%**	**4 25%**	**7 50%**	**2 25%**	**0 0**	**24 63%**	**4.7 species**

3.2 Cat Detections

Cats were consistently captured on Lutregala Marsh Reserve over the three sampling periods (Table 2). Cat sightings were confined around three sites near Simpsons Bay Road and three sites along the bush track opposite the the Main Road. The data shows a decreasing trend in the total number of cat detections and total number of cats estimated on the reserve over the three year sampling period (Table 3, Fig 5).

Table 3 Cat detections at comparable sites over the three years

Cat Abundance	Simpsons Bay Road (LUMA 1,2,6)	Main Road (LUMA 3,4,5)	No of Cats Estimated
2015	20 detections	11 detections	5 – 14 cats
2016	12 detections	2 detections	5 – 8 cats
2017	4 detections	3 detections	4 – 5 cats

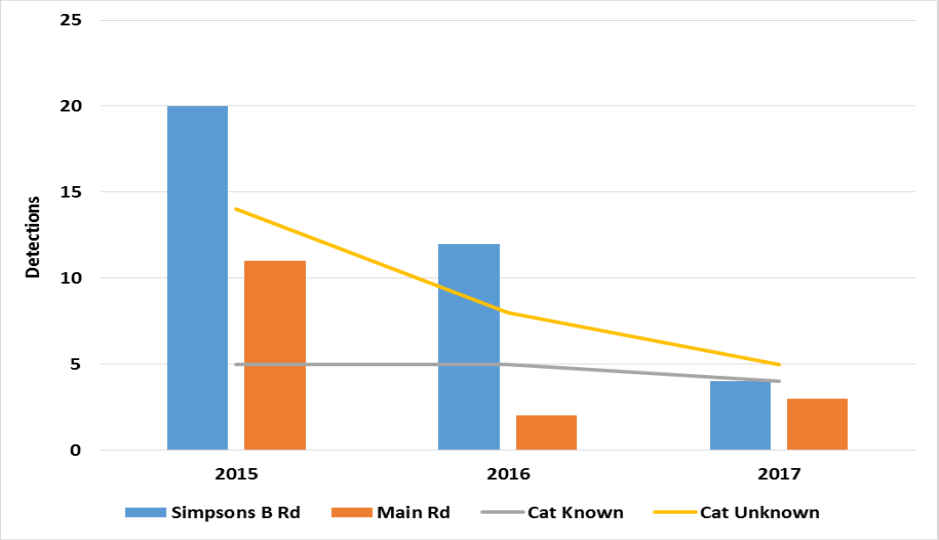

Fig 5 Cat detections and number of cats estimated over three years

This decreasing trend concurs with the fact that a number of domestic and stray cats associated with a Simpsons Bay property have been reduced in number and several feral cats have been removed from the reserve as part of active management by the BI Cat Program during this period. The following information kindly supplied in Jan 2018 by Kaylene Allan, Cat Management Officer with Kingborough Council reported:

- 6 cats have been removed from the Neck area and 3 collared. 1 of these cats was trapped on Lutregala along the Neck Road entry track.
- We know from the collaring data and camera data that some of these cats use Lutregala. We have photos of the dead cats.
- Camera data has shown that many remaining cats are trap shy.
- 15 cats have been removed from the western side of Lutregala Creek through work with the landowner... only 5 cats remain at the house which will eventually be contained.

An assessment of the cat images focusing on body size and coat pattern has enabled an estimate of the number of known and unknown individual cats to be determined (Appendix C). The total number of images assessed and assessment made is shown in Table 3, noting that several images of the same cat can be scored as 'one detection'.

A range of body sizes from adults to kittens confirms that cats are breeding on the Reserve especially at the Main Road end. The second finding was that the cats identified at sites LUMA 1, LUMA 2 and LUMA 6 around Simpsons Bay Road, were not identified on the forest track at LUMA 3, LUMA 4 and LUMA 5 near the Main Road adjacent to The Neck seabird colony. This suggests that two separate clusters of cats occur on the Reserve, one associated with the residences of Simpsons Bay which could comprise domestic and stray cats and the second associated with The Neck area and more likely stray and feral cats using the coastal beaches and shearwater and penguin colonies at The Neck. Images of all the known cats are in Appendix D.

An assessment of the total number of individual cats captured on the Reserve is:

2015 - 5 known + 9 unknown = 5 to 14 cats detected

2016 - 5 known + 3 unknown = 5 to 8 cats detected

2017 - 4 known + 1 unknown = 4 to 5 cats detected

When analysising the images over the three year period all 'ginger and white' tabbies comprised at least two different individuals (Ginger cat K5 in 2015 could have been K1 in 2017). At least one pure black cat was detected. In 2015, 2016 two grey strongly marked tabbys were different individual cats (Fig 6) and several finely striped tabbies were distinguiishable. In summary, at least nine different cats were present on the Reserve over the sampling period. However, given the large number of unknown cats and that cats can become trap shy, this is likely to be a minimum estimate with many more cats being present.

The nine identifiable cats across three years were:

- 2015 K1 grey bold tabby 1
- 2015 K2 ginger & white tabby
- 2015 K3 adult fine grey tabby
- 2015 K4 kitten fine grey tabby
- 2015 K5 ginger and white heavy tabby
- 2016 K1 pure black
- 2016 K2 strongly marked tabby
- 2016 K4 young tabby white rear socks
- 2017 K 3 finely striped tabby

2015 LUMA1 pic 426 – grey bold tabby 1

2016 LUMA1 pic 75 -adult strongly marked tabby

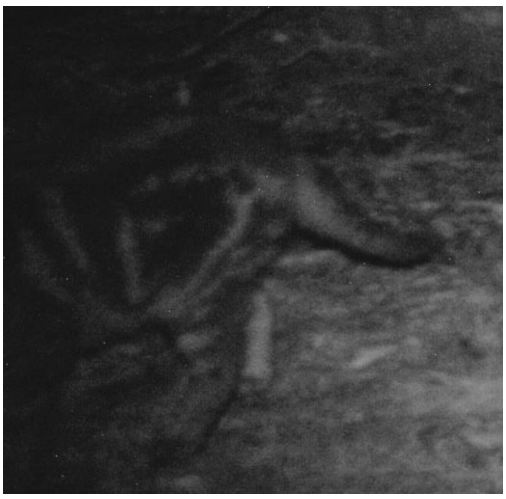

Fig 6 Hind markings on two grey tabby cats showing them as different individuals.

4.0 Discussion

Technological advances in remote sensing camera traps offer less invasive and more ethical and economical ways of gathering information about species presence and distribution (Meek *et al.* 2014). The information collected during this survey has added to the growing body of knowledge on the vertebrate fauna of Bruny Island and has provided insight into the density and distribution of several mammal species on Lutregala Marsh Reserve, especially feral cats. A total of 11 mammals were recorded across the three year survey period, all are known to occur on Bruny Island although fallow deer *Dama dama* are a more recent arrival to the island and not recorded in historic survey reports (Driessen *et al.* 2011; Natural and Cultural Heritage Division 2015). This mammal diversity is typical of what is expected on this small Reserve comprising mainly waterlogged marshland habitat not favoured by many terrestrial mammals. However, it also reflects the rural landscape on Bruny Island where mixed forest corridors, marshland and riparian habitats are interconnected by a network of roads and tracks which facilitate movement and dispersal of browsers, predator and prey species. Hence the small mosaic and structural diversity of habitats of Lutregala Marsh Reserve, affords habitat richness and niche availability for a select number of species though possibly limits the existence of others. The detection of potoroo *Potorous tridactylus*, echidna *Tachyglossus aculeatus*, ringtail possum *Pseudocheirus peregrinus*, and eastern quoll *Dasyurus viverrinus* demonstrates the range of species. The high number of detections and 63% occupancy of fallow deer *Dama dama* in 2016 and 2017 is a major concern to the TLC given the damage this species is known to cause to marshland including newly emergent vegetation and regeneration of wet forest species (Invasive Species Council 2010). Removal of fallow deer from the Reserve and the entire Bruny Island should be a conservation priority for government, the local community and other conservation organisations.

Remote sensing cameras are but one survey tools that should be used in combination with other methods to monitor vertebrate species (Meek *et al*. 2014). A total of 27 native terrestrial mammals have been recorded on Bruny Island (Natural and Cultural Heritage Division 2015) which includes all of Tasmania's eight arboreal species of bat. This study demonstrated that some species may avoid detection either due to shyness, an alternate habitat preference, diet or life history traits and therefore more targeted surveys incorporating a variety of camera heights, settings and lure preferrences may potentially improve species detectability on TLCs reserve in the future. It is uncertain as to whether the low level of rodent detections in this study is due to the species low detectability on camera or rarity in the landscape. There remain some other obvious knowledge gaps for Bruny Island generally, particularly for the smaller to medium weight range terrestrial mammals such as: dusky antechinus *Antechinus swainsonii*, white-footed dunnart *Sminthopsis leucopus*, platypus *Ornithorhynchus anatinus*, Tasmanian bettong *Bettongia gaimardi*, eastern barred *Perameles gunnii* and brown bandicoot *Isoodon obesulus*. We hope to help fill these gaps in the future.

In 2015 eastern quoll *Dasyurus viverrnus* were detected 9 times at 3 sites, were not recorded in 2016, but reappeared at two sites in 2017 on Lutregala Marsh Reserve. The sporadic nature of this species movements and population densities validates the need for longterm monitoring where short term fluctuations need a longer time period to be better understood. The availability of pasture, grassland and

forest for food and den resources would suggest Lutregala Marsh is a good location for eastern quoll and that any low population levels could potentially be due to factors such as seasonal variation in food source, stage of breeding cycle and denned young, and displacement by predators or competitors. Parker's (2016) study on Bruny Island recorded a total of 1,054 eastern quoll detections with the majority (n=995) being on north Bruny Island in agricultural and dry forested habitats. Parker obtained 56 detections of quolls on south Bruny Island, 2 being on agricultural land, 10 being in dry forested habitat and 44 detections were in wet forest habitat. Three detections of quolls were recorded at 2 sites at the Neck (coastal scrub habitat).

Parker detected cats and eastern quolls on the same camera at 5 sites compared to this study where eastern quoll and cats were detected on the same camera at 3 sites; two sites were in agricultural land and one in forest habitat. In 2016 Parker found for the entire island a total of 41 cat detections from 27 individual cats recorded over 2,079 trap nights. This finding compares to 14 cat detections from 4 to 6 individual cats (50% occupancy) recorded over 240 trap nights just on Lutregala Marsh in 2016. This is relatively high in comparison given the small size and physical nature of the reserve. In 2015 cat results were even higher at 4 to 6 cats from 31 detections. It is likely this higher cat rate is related to the residences on Simpsons Bay Road and demonstrates the level of impact strays and or domestic cats can have on cat densities where their movements are not controlled.

Parker's detections occurred across 24 sites with wet forest habitat providing the greatest number of detections for any habitat type. There were only three detections of cats in North Bruny with one of these confirmed as a domestic pet. Two detections occurred at the Neck and 19 detections occurred on the south of Bruny Island. In this survey all cat detection sites on Lutregala Marsh Reserve were within 2 km of a house site which suggests the cats can easily access refuge and food waste from neighbouring residences, and were either around Simpsons Bay Road or closer to the Neck. Despite being close in distance the marshland channel of Lutregala Creek presents a physical barrier making crossing and intermixing less attractive.

Lutregala Marsh Reserve contains abundant prey species for cats especially small and young mammals and ground dwelling birds, in particular common bronzewing *Phaps chalcoptera*, painted button quail *Turnix varius* and blackbird *Turdus turdus*. The data obtained for these species provides essential baseline information about the abundance and availability of potential prey species and how these may fluctuate in the future as cat management proceeds. Lutregala also provides a corridor for movement onto surrounding pasture for rabbit, and to beaches for coastal foraging and seabird colonies at The Neck. A detailed analysis of Lutregala monitoring data should be undertaken within five years of commencing this work.

The reduction in cat detections and number of cats estimated on the reserve is most likely as a direct result of the removal of a number of cats from the immediate vicinity by the Bruny Island Cat Management Program. The continuation of this program is essential if we are to halt cat impact and see any reocurrence of small mammals and birds and restoration of Lutregala Marsh ecosystem in the future. This monitoring program will inturn help demonstrate the success of cat removal and the value of community effort.

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Appendix A Trap locations and habitat

Lutregala Marsh Trap Locations

Site No	Easting	Northing	Habitat & TASVEG code
LUMA1	524673	5206917	Edge of small dam FRG / DOV
LUMA2	524668	5205845	Old pasture fenceline FRG / ARS
LUMA3	525399	5206253	Forest track 1 DAC
LUMA4	525302	5206229	Forest track 2 DAC
LUMA5	525072	5206022	Forest track 3 DAC
LUMA6	524726	5205666	Pasture shelterbelt FRG / DOV
LUMA7	525093	5205615	Sedge and forest ARS / DOV
LUMA8	525184	5205611	Sedge and forest ARS / DOV

FRG cleared land, DAC *Eucalyptus amygdalina* dry coastal forest, DOV *Eucalyptus ovata* dry woodland and forest, ARS Saline sedgeland/rushland

Appendix B All species captured and number of detections.

2015 Species	LUMA 1	LUMA 2	LUMA 3	LUMA 4	LUMA 5	LUMA 6	LUMA 7	LUMA 8	Detections
Bassian Thrush			7		1	NA	NA	NA	8
Bennett's Wallaby	34	10	1	6	1	NA	NA	NA	52
Blackbird			3	1	13	NA	NA	NA	17
Common Bronzewing			24	3	46	NA	NA	NA	73
Brushtail Possum	41	3	18	26	4	NA	NA	NA	92
Painted Buttonquail			6			NA	NA	NA	6
Cat	18	2	4	1	2	NA	NA	NA	27
Cow		2				NA	NA	NA	2
Eastern Quoll	2	1	6			NA	NA	NA	9
Echidna	2			5		NA	NA	NA	7
Fairy Wren		4	2	2		NA	NA	NA	8
Green Rosella	6			1		NA	NA	NA	7
Grey Fantail			1			NA	NA	NA	1
House Mouse			18	5		NA	NA	NA	23
Native Hen	5	1				NA	NA	NA	6
No id	15	5	2	4	1	NA	NA	NA	27
Olive Whistler				3		NA	NA	NA	3
Pademelon	10	10	27	45	31	NA	NA	NA	123
Potoroo	42	13				NA	NA	NA	55
Purple Swamp hen	34					NA	NA	NA	34
Rat sp			26			NA	NA	NA	26
Ringtail Possum				1		NA	NA	NA	1
Tas.Scrubwren			1	13	7	NA	NA	NA	21
Total 22 species									
2016	**LUMA 1**	**LUMA 2**	**LUMA 3**	**LUMA 4**	**LUMA 5**	**LUMA 6**	**LUMA 7**	**LUMA 8**	**Detections**
Bennett's Wallaby	11	4	2		1	19	3	12	52
Blackbird							1		1
Brown Falcon		1							1
Brushtail Possum	28	4		10	1	1	3	2	49
Cat	4	5			1	2			12
Currawong sp		2							2
Echidna				1					1
Fallow Deer	1			2	7		7	2	19
No id	4	2		3	2	7	1	5	24
Pademelon	4		3	12	5	10	61	39	134
Potoroo	1							1	2
Wood Duck							2		2
Total 11 species									
2017	**LUMA 1**	**LUMA 2**	**LUMA 3**	**LUMA 4**	**LUMA 5**	**LUMA 6**	**LUMA 7**	**LUMA 8**	**Detections**
Bassian Thrush			2						2
Bennetts Wallaby	4	2	6	7	3	10	16	18	66
Blackbird			3						3
Brush Bronzewing			2	2	2				6
Brushtail Possum	17	4	18	44	36	2	23	14	158
Cat	4		1	2	1				8
Fallow Deer	9				1	7	4	3	24
Eastern Quoll			3					1	4
Echidna			2						2
Forest Raven			1						1
Native Hen	1								1
Pademelon	3		4	15	11	1	90	77	201
Potoroo	29								29
Raven								1	1
Rat sp.					1			1	2
Fairy Wren								3	3
No id			1	2	1				4
Tiger Snake				1					1
Total 17 species	**67**	**6**	**43**	**73**	**56**	**20**	**133**	**118**	**516**

Total species diversity = does not include data for cow or no id.

Appendix C Estimate of Known and Unknown Cats 2015–2017

Table 3 Estimate of number of cats on Lutregala Marsh Reserve

2015	Image no	Date	Time	Description	Known	Unknown
LUMA1	248	28/05/2015	20:11	grey tabby - unknown		U1 tabby
LUMA1	328-329	4/06/2015	23:03	ginger and white tabby	K2	
LUMA1	335	5/06/2015	15:04	no id light coat - possibly ginger 2		U2 ginger
LUMA1	378	11/06/2015	4:04	no id light coat - possibly ginger 2		U3 ginger
LUMA1	379	11/06/2015	4:06	no id light coat - possibly ginger 2		U3 ginger
LUMA1	381-388	11/06/2015	18:45	ginger and white heavy build tabby	K5	
LUMA1	412	14/06/2015	3:31	no id light coat - possibly ginger		U4 ginger
LUMA1	414	14/06/2015	3:33	no id light coat - possibly ginger		U4 ginger
LUMA1	425-426	16/06/2015	17:36	grey bold tabby 1	K1	
LUMA1	429	16/06/2015	21:35	ginger and white tabby 1 (2 images)	K2	
LUMA1	440	18/06/2015	16:57	ginger and white tabby unknown		U5 ginger
LUMA1	464-465	21/06/2015	2:22	no id light coat - possibly ginger		U6 ginger
LUMA1	471	21/06/2015	7:22	no id - possibly grey tabby 1		U7 tabby
LUMA1	506	25/06/2015	1:41	no id light coat - possibly ginger		U8 ginger
LUMA1	514-515	25/06/2015	16:08	ginger and white tabby	K2	
LUMA1	521	26/06/2015	9:49	no id light coat looks the same as 465		U6 ginger
LUMA1	525	27/06/2015	2:40	no id light coat looks the same as 465		U6 ginger
LUMA1	536	28/06/2015	16:06	ginger and white tabby	K2	
LUMA1	641	10/07/2015	0:07	ginger and white tabby	K2	
LUMA1	642	10/07/2015	0:22	ginger and white tabby	K2	
LUMA2	79	2/06/2015	10:46	grey or tabby head only		U9 tabby
LUMA2	97	7/06/2015	16:42	grey bold tabby 1	K1	
LUMA3	66	8/06/2015	18:16	adult fine grey tabby	K3	
LUMA3	78	11/06/2015	21:17	adult fine grey tabby	K3	
LUMA3	186-189	24/06/2015	4:01	kitten fine grey tabby	K4	
LUMA3	229-230	3/07/2015	20:11	kitten fine grey tabby	K4	
LUMA4	159	21/06/2015	0:37	adult fine grey tabby	K3	
LUMA5	84-85	24/05/2015	2:15	kitten fine grey tabby	K4	
LUMA5	31-32	5/06/2015	18:54	adult fine grey tabby	K3	
					5 Known	**9 Unkn**
2016	**Image no**	**Date**	**Time**	**Description**	**Individual**	**Unknown**
LUMA1	20	26/08/2016	18:15	adult, possibly grey tabby		U1 tabby
LUMA1	56	7/09/2016	17:20	adult pure black	K1	
LUMA1	75	14/09/2016	18:56	adult strongly marked tabby	K2	
LUMA1	76	14/09/2016	22:21	adult dark possibly pure black		U2 black
LUMA2	24	24/08/2016	20:59	adult - pale, possibly white to ginger	K3	
LUMA2	46	27/08/2016	22:17	adult fine tabby	K5	
LUMA2	212-213	3/09/2016	12:12	adult pure black	K1	

LUMA2	377	6/09/2016	16:49	adult pure black	K1	
LUMA2	790	20/09/2016	17:52	adult pure black	K1	
LUMA5	9	24/08/2016	7:22	dark unknown		U3 dark
LUMA5	10	24/08/2016	13:48	young black tabby white rear socks	K4	
LUMA6	48	3/09/2016	16:38	adult pure black	K1	
LUMA6	55	6/09/2016	17:04	adult pure black	K1	
					5 Known	**3 Unkn**
2017	**Image no**	**Date**	**Time**	**Description**	**Known**	**Unknown**
LUMA1	83_84	13/11/2017	10:54	adult - ginger stripy	K1	
LUMA1	237_238	23/11/2017	20:23	adult – grey tabby	K2	
LUMA1	259	26/11/2017	20:47	same as previous, in same position	K2	
LUMA1	331_332	3/12/2017	23:40	fine striped tabby	K3	
LUMA3	2122_2124	1/12/2017	0:10	? lean tabby unsure		U1
LUMA4	2681_2682	30/11/2017	0.94	Bold tabby side pattern	K4	
LUMA5	0184_0186	1/12/2017	0:57	Bold tabby same side pattern	K4	
					4 known	**1 Unkn**

Appendix D Cats known on Lutregala Marsh Reserve in each year.

2015 K2 Ginger and white tabby

2015 K1 Grey bold tabby 1

2015 K3 Adult fine grey tabby

2015 K4 Kitten fine grey tabby

2015 K5 Ginger and white heavy build tabby

2016 K1 Pure black

2016 K2 Adult strongly marked tabby

2016 K3 Adult white ginger

2016 K4 Young tabby white rear socks

2016 K5 Adult fine tabby

2017 K1 adult ginger

2017 K2 Adult grey tabby

2017 K3 fine striped tabby

2017 K4 bold tabby