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Wildlife Drone Surveys at Figtree Hill – Ecological Report

REPORT PREPARED FOR LENDLEASE PTY LTD
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"ten" for consistency

"twenty-five" for consistency

Summary

Wild Conservation was engaged by Lendlease Pty Ltd to undertake drone-based wildlife monitoring, with the primary target species being the Koala, across the 480 hectares of the Figtree Hill development site and 290 hectares in reserves (including Beulah Bush, Browns Bush and Noorumba Reserve) for comparison. In total, 25 koalas were detected across the entire survey area. Of these, 10 were detected in Browns Bush on the eastern side of Appin Road, seven were detected in Beulah Bush and three were detected in Noorumba Reserve. One koala was detected within scattered paddock trees in the south of the Figtree Hill development site and a further three were detected to the west of the site along the Nepean River. One Koala was detected along Woodhouse Creek. There was one adult female koala detected with back young.

Detection probability was determined to be high, as the number of Koalas found in each survey section is similar to surveys conducted in 2021 and approximately 25% higher in 2022 overall. We conclude that eight koalas occurred west of Appin Road in 2021 and was the baseline number for comparison in future years. This report addresses the 2022 surveys and found that the number of Koalas increased from eight in 2021 to 14 in and adjacent to the Figtree Hill development site (including the reserve systems). This information is important for monitoring population trajectory and habitat usage in light of development and conservation management for the future.

This increase of Koalas detected in the study area does not necessarily represent an overall increase in Koala numbers in the region, though it should be noted that young animals were found independent of their mothers, which indicates dispersal of new animals that may have been back young during the 2021 surveys. We make recommendations here for the management of this population into the future through fauna monitoring and enhancement of habitat.

Introduction

Wild Conservation was engaged by Lendlease Pty Ltd to undertake drone-based wildlife surveys to locate koalas on the Figtree Hill development site and in adjacent reserves, in order to monitor the population size and density. This work is undertaken to draw comparisons on previous years and is important to monitor the population during the process of development and to determine if conservation and restoration actions are benefiting the population. It is also important to record areas of usage by the koala population and areas that may need enhancement for future survival.

The Koala **(***Phascolarctos cinereus*) has recently (February, 2022) been up listed to 'Endangered' status from 'Vulnerable' a listing that is reflected across Australian federal and state departments for New South Wales, Queensland and the Australian Capital Territory. The current conservation status of the koala is the result of pressure from European settlement in Australia which has resulted in estimated population reductions of more than 50% (Reed and Lunney 1990, Melzer et al. 2000). The remaining koala populations now face both local

and regional extinction in some areas of NSW (Lunney et al. 2002, Lunney et al. 2014) due to both anthropogenic drivers (e.g. habitat loss, dog attack, road injury) and biological drivers (e.g. wildfire, disease) of decline (Lunney et al. 2002, Lunney et al. 2007, McAlpine et al. 2015). These drivers of decline have the capacity to be encouraged or intensified by land clearing and climate change (Lunney et al. 2014, McAlpine et al. 2015). In light of this, it is important for developers to understand the populations of faunae that inhabit proposed sites, so a best practice approach can be delivered during the project.

The koala is an inherently cryptic arboreal marsupial which makes monitoring difficult, and due to this difficulty, many different survey methods have been developed (Melzer et al. 2000, Cristescu et al. 2015). Although we now have reasonably well-developed ideas about koala tree preferences (Phillips and Callaghan 2000, Phillips et al. 2000, Matthews et al. 2007) and koala habitat maps (Lunney et al. 1998, Lunney et al. 2000, Lunney et al. 2009, Callaghan et al. 2011, Law et al. 2017), presence/absence monitoring techniques cannot obtain information on population size and density. With increases in technology and investigations of new ideas, many novel detection techniques of koalas have been discovered, which may lead to new methods of estimating density (Cristescu et al. 2015). This includes the use of passive acoustic monitoring, training dogs to be able to lead surveyors to koala scats and the use of drone technology to fly thermal imaging cameras to detect heat signatures (Cristescu et al. 2015, Law et al. 2018, Corcoran et al. 2019, Beranek et al. 2020).

Out of the promising emerging techniques for surveying koala populations, drones with mounted thermal cameras appears to be the most flexible, cost effective and promising (Corcoran et al. 2019, Beranek et al. 2020, Witt et al. 2020, Howell et al. 2021). This technology has been used to locate koalas for studies that require capture, for pre-logging operations and for situations where accurate information on density and population size are needed. It is important to couple thermal drone detections with an on-ground team to verify sightings, should data not be biased towards one species or another. Large possums and even roosting birds can appear to be koalas to a drone pilot, so it is necessary to mitigate this margin of error with a follow up real time sighting.

Koalas are known to occur in the general region of Campbelltown, but specifics of population size and use of the habitat within Figtree Hill are notional, although baseline data was gathered during surveys of 2021. Here we report the results of drone surveys targeting Koalas carried out in June and July of 2022. We also report other species detected alongside the drone surveys via spotlighting during detection validation.

Methods

Study site

The Figtree Hill development site is located in the suburb of Gilead, which lies between Wedderburn and Menangle, NSW and is bounded to the east by Appin Road and to the west by the Nepean River (GPS of the site: -34.130542, 150.774482). Much of the site is composed of cleared paddocks and is currently used for livestock agriculture. The clearing dates back to the 1800s and more recently the 1960s. The site is divided east to west by a

heritage-listed canal. There are remnant stands of native Cumberland Plain Woodland and Cumberland Plain Transitional Woodland that lie along Woodhouse Creek, Menangle Creek and the Nepean River. There are larger intact stands of native remnant vegetation within Noorumba Reserve (located to the north east of the site), Beulah Bush (located to the south east of the site) and Browns Bush (located to the east on the opposite side of Appin Road). The reserve systems were also of interest for surveys to determine the population size in the surrounding areas of the Figtree Hill property.

The area was broken up into 10 units, with each comprising of one night of drone surveys (see Table 1 and Figure 1). One of the sites was surveyed twice to gain inference on the detection probability of koalas via drone in differing conditions. One site was split between two nights due to weather interference.

Table 1. Details of drone missions. n = number of repeat surveys.

Site	Description	n	Dates surveyed	Surface area (ha)
F1	Woodhouse Creek North	1	26/06/2022	61
F2	Nepean River North	1	27/06/2022	41
F3	Nepean River South	1	28/06/2022	71
F4	Nepean Creek	1	29/06/2022	99
F5	Woodhouse Creek South	1	06/07/2022	98
F6	Beulah Reserve	1	10/07/2022, 11/07/2022	66
F7	Noorumba Reserve	2	07/07/2022, 26/07/2022	56
F8	Menangle Creek and Biobanks	1	27/07/2022	110
F9	Browns Bush - South	1	12/07/2021	73
F10	Browns Bush - North	1	13/07/2021	95
			Total:	770

Figure 1. *Map of the drone flight paths as plotted on Google Earth.*

Drone surveys

The drone survey protocol followed the method described in (Beranek et al. 2020). We deployed a DJI drone; the Mavic 2 Enterprise Advance. Flights were mapped to follow a single line grid path with 20% overlap and were constructed as kml files on Google Earth Pro. Each flight path was uploaded onto a DJI smart controller. Flights were nominally 65m above ground level (AGL) to account for tree height and visual detection distances but varied due to terrain. The thermal imager (13 mm lens) was set to high gain (-25° to 135℃) and colour and thermal video (MP4) video recordings were simultaneous. Each flight lasted around 23 – 25 minutes until the battery needed to be changed, where each mission required 6 – 8 full charged batteries. Flights were suspended if wind resistance exceeded 10 m/s and at no time did the altitude exceed 120 m. Flight speed for most flights was 5 m/s to minimise motion blur and provide maximum coverage.

The Australian Civil Aviation Safety Authority requires remote pilots to maintain a visual line of sight (VLOS) at all times and to be able to orient the aircraft. Therefore, the drone was fitted with a high intensity strobe navigation light that has a range of over 5.5 km at night and at least 2 km in daylight. However, maintaining VLOS when flying above the forest canopy can be problematic as nearby foliage can obscure the aircraft. To mitigate this, a vehicle-based platform was fitted to the roof of the site vehicle and used to elevate the pilot to an appropriate angle to maintain VLOS.

CASA Certified Pilots Kane Durrant and Rachael Durrant (the Authors) flew the Unmanned Vehicle during the survey period. Both pilots are experienced fauna spotter catchers and NPWS licensed wildlife handlers with experience in koala ecology and survey methods.

Thermal detection verification

An in-field validation protocol was followed since error can occur when trying to identify species from thermal signatures (Corcoran et al. 2019). Manual verification was achieved by an on ground team that navigated to the location of each detection with head-torches and a handheld high luminosity spotlight. A photo was taken for all detections and confirmed Koalas are attached in the appendix of this report. Photos were not possible for some detections due to logistical issues.

Results

Overall, eleven species of fauna were detected, which comprised of three species of birds and eight mammals (see Table 1). In total, there were 25 individual koalas detected. Of these, 15 were found within the area surveyed to the west of Appin Road (including F6 - Beulah Reserve and F7 - Noorumba Reserve). Of the koalas west of Appin Road, majority were found within the reserve systems (F6 - Beulah Reserve = seven and F7 - Noorumba Reserve = three), while one was found in scattered paddock trees within the south-east portion of F4. Unlike 2021 surveys, koalas were detected in 2022 to the west of the Heritage Canal with one detected in F2 and two in F3. A further 10 koalas were found on the eastern side of Appin Road in Browns Bush across F9 and F10.

Noorumba Reserve was surveyed twice due to the first night producing no detections. The second survey (F7 S2) of Noorumba Reserve produced a total of two koala detections with one koala being a female with back young for a total of three koalas located in Noorumba Reserve.

Two threatened species were detected during surveys; Koala and Grey headed flying fox. These species were found across the survey area and comprised an approximate third of overall faunal biomass detected by drone. One invasive species was detected by drone, the European red fox. This invasive predator was found in three zones of the survey area and were actively mobile throughout the night.

Table 1. Species list. * Indicates that a female with a back young/pouch young was detected during the survey. Total indicates the maximum abundance across site, i.e. the maximum of repeat surveys as a site are used.

Common Name	Species name	F1	F2	F3	F4	F5	F6	F7 S1	F7 S2	F8	F9	F10	Total
Roosting birds	Aves	1	0	0	2	2	1	1	2	2	0	1	12
Sugar glider/Squirrel glider	*Petaurus sp.*	0	0	0	0	0	0	0	1	0	0	0	1
Koala	*Phascolarctos cinereus*	0	1	2	1	1	7	0	3*	0	7	3	25
Ring-tailed possum	*Pseudocheirus peregrinus*	1	0	1	0	1	0	0	0	0	0	0	3
Grey-headed flying fox	*Pteropus policocephalus*	0	1	0	0	3	0	0	2	0	0	0	6
Brush-tailed possum	*Trichosurus vulpecula*	4	4	1	2	0	5	0	0	0	3	0	19
European red fox	*Vulpes vulpes*	0	0	2	0	0	0	0	1	2	0	0	5
Swamp wallaby	*Wallabia bicolor*	3	2	7	0	0	5	0	3	0	6	5	31
Common wombat	*Vombatus ursinus*	2	0	0	0	0	0	0	0	0	0	0	2

There were four tree species that the koalas were found using based off 25 koala detections. Most were observed in either grey gum (*Eucalyptus punctata*, 12) or grey box (*Eucalyptus moluccana*, 6), however some were detected in ironbark Eucalypts (either *E. fibrosa* or *E. crebra*, 4) and spotted gum (*Corymbia maculata*, 1). The discrepancy in tree use numbers is explained by two koalas being in the same tree at F3 and two koalas being mother and joey at F7. See figure 2.

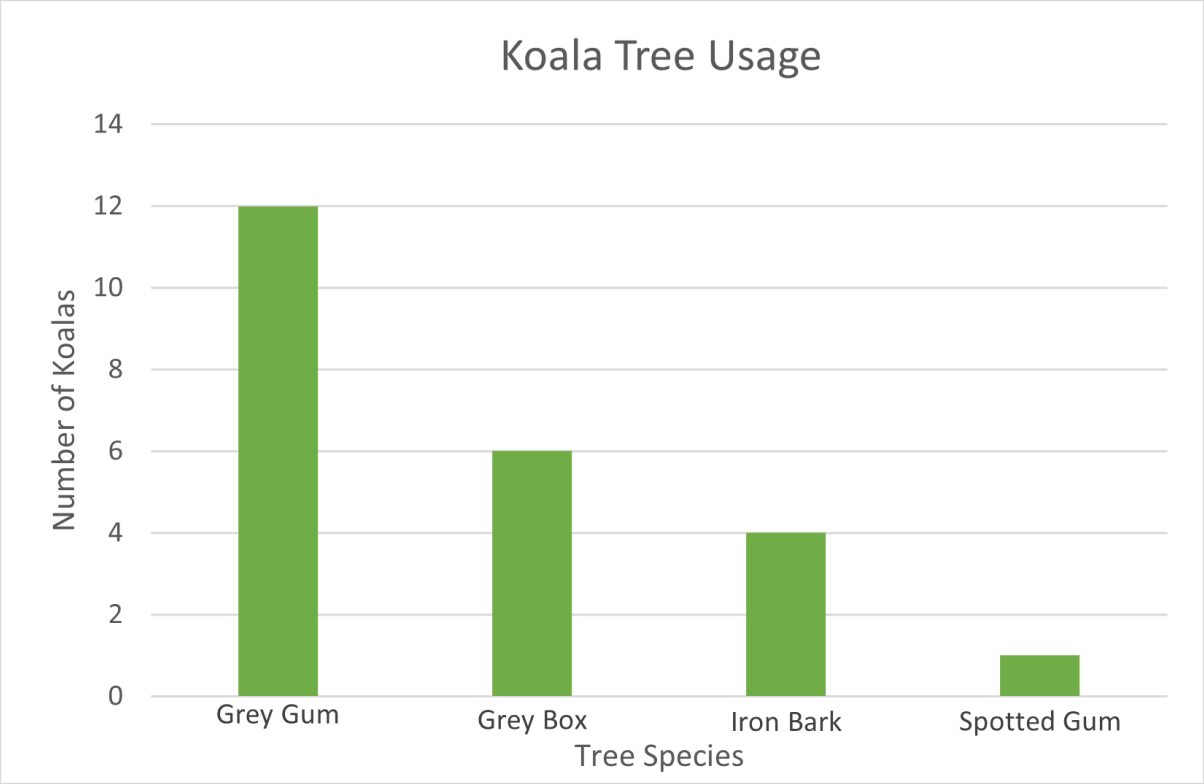

Figure 2. *Tree species use overview of koalas detected via drone.*

Figure 3. *Map of total Koala detections.*

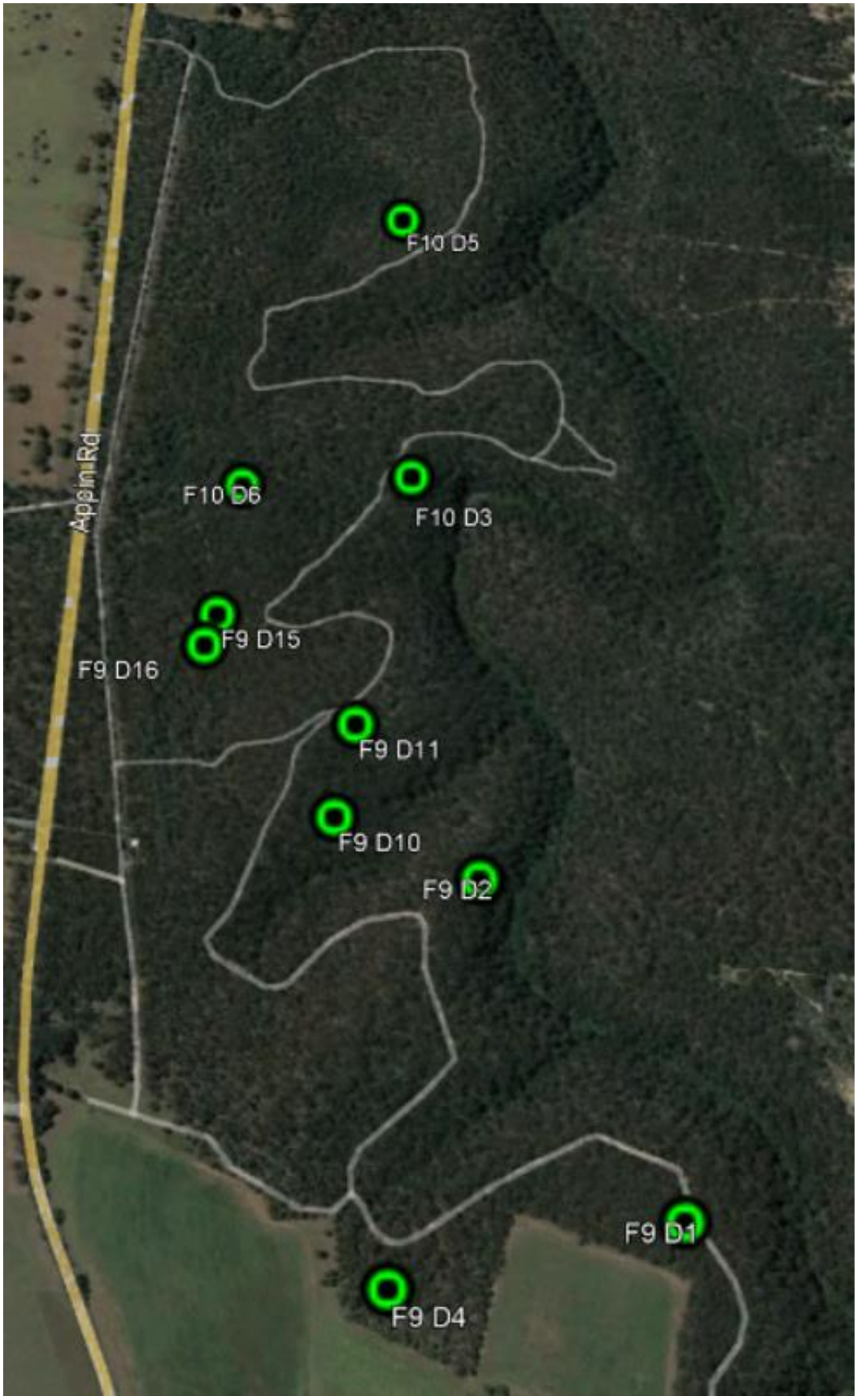

Figure 4. *Browns Bush Koala Detections. Total = 10*

Figure 5. *Beulah Reserve Koala Detections. Total = 7*

Figure 6. *Noorumba Reserve Koala Detections. F7 S2 D1 denotes a female with back young. Total = 3*

Figure 7. *Figtree Hill Koala Detections. F3 D3 denotes two Koalas found in one tree (See Figure 8). Total = 5*

Figure 8. *Two young koalas were found roosting in the same small tree. These rare insights are possible only through hours spent on field surveys.*

Discussion

The 2022 Koala Surveys utilising thermal drone technology detected a greater number of koalas than the same surveys undertaken in 2021. It was demonstrated that 14 koalas were present to the West of Appin Road during the surveyed period of 2022. One of these 14 detected koalas bore a Joey on her back (F7 S2 D1) taking the number of koalas on the west of Appin Road to 15. A further ten koalas were found to the east of Appin Road in Browns Bush (Figure 4).

During our surveys, one koala was detected in Woodhouse Creek (F5 D4), apart from those in Beulah Reserve. A further three koalas were detected to the west of the heritage canal (Figure 7) which was previously thought to be a potential barrier to koala migration from east to west across the site. Woodhouse Creek still appears to be the most suitable route for koalas travelling from east to west due to the Water NSW fence that prevents access through Menangle Creek in the north. However, the koalas present in this western portion of the site could have travelled along the Nepean River and not come from the east at all.

The habitat in the reserve areas of Beulah, Noorumba and Browns Bush is of higher quality and more in line with naturally occurring bush than the disturbed pockets in the west of the site that are somewhat overrun with lantana, privet, and other weed species. Which accounts for the higher numbers of koalas in these reserve areas. Future regeneration of the western corridors will enhance habitat and increase usable space for the koala population that exists here.

One koala was detected in sparsely spaced paddock trees (F4 D7) (See Figure 7), where one koala had been detected less than 50m away during 2021 surveys. This koala could not be found on repeat surveys of this area the following day, which highlights the importance of ongoing monitoring in this area (See Recommendations).

Our results here support the necessity of utilising a team of spotters to confirm the identity of the thermal detection (Beranek et al. 2020). Brush-tailed possums (*Trichosurus vulpecula*) have been a common find during surveys of this site which have thermal signatures that are similar to the thermal signature of a koala (Corcoran et al. 2019), which makes discerning them from one another on screen difficult. Identifying thermal signatures without in-field validation is likely to lead to inaccurate results, which may further lead to inaccurate recommendations for the management of koala populations.

Repeat surveys of Beulah and Noorumba Reserves were carried out in 2021 and resulted in similar finds each time. These repeat surveys were abandoned for 2022 but Noorumba Reserve was determined to need a repeat survey after no detections were found during the first night due to rain and floodwater interfering with the thermal signatures detected.

While drone surveys have a higher detection rate than traditional techniques for koalas (Witt et al. 2020), the detection rate is not 100% and there are factors that may influence the probability of detection of an individual (Corcoran et al. 2021). Repeated surveys allows the possibility of modelling the detection probability and accounting this into density/population estimates which can lead to more accurate and precise results and

allows the calculation of confidence intervals (Royle and Nichols 2003). Disregarding the use of modelling approaches and repeated surveys allows for the potential to detect animals that may have been missed in previous surveys.

Recommendations

To further strengthen our findings and make informed decisions regarding the management of this population into the future, we recommend adopting a tracking program for the koalas of this site. This is particularly necessary due to the transient nature of the koalas and their somewhat broad home range and temporal usage of habitat. Of the koalas detected to the west of Appin Road, only two could be reacquired the next day, indicating a movement of more than 100 metres in any available direction. With radio/scent tracking or identifying tags, we could gain a better understanding of how the koalas are using the habitat and avoid false detections on koalas already counted in previous nights that have moved into new survey areas. This project should be coupled with existing or emerging research that could also utilise the data collected for a broader impact in koala conservation.

WILD Conservation also recommends more regular monitoring of the proposed clearing areas for future development to gain a better understanding of koala usage in these areas. Koala detection F4 D7 represents the second koala found in this area in consecutive years though being only a window in time as far as habitat usage goes. In order to gain further insight, we recommend monthly surveying of this zone for koala usage and ongoing camera traps that will inform fauna presence for a best practice approach to manage these areas and populations for the future.

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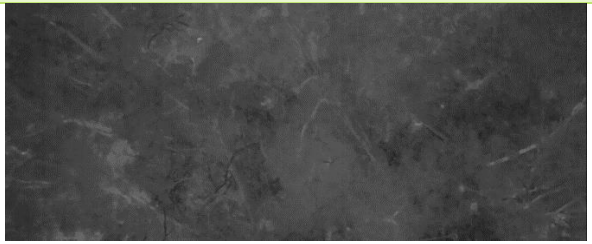
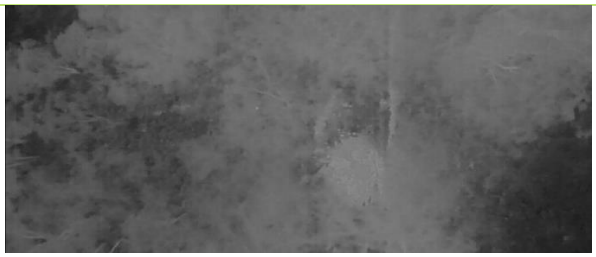
Appendix 1

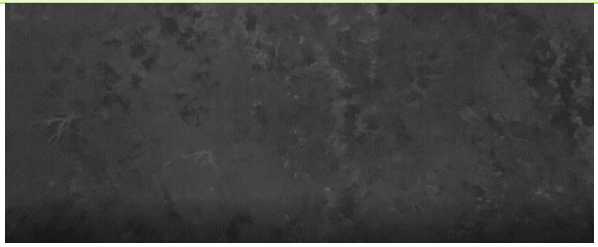
Detection ID	Location	Thermal Detection	Detection Photo
F2 D2	-34.130005, 150.755652		
F3 D3	-34.142688, 150.756400		
F4 D7	-34.144483, 150.766234		

F5 D4	-34.134966, 150.781147		
F6 D8	-34.142081, 150.783791		
F6 D10	-34.141221, 150.782408		

F6 D14	-34.139978, 150.784990		
F6 D15	-34.138526, 150.779895		
F6 D16	-34.137611, 150.780974		

F6 D17	-34.137131, 150.779704		
F6 D18	-34.137236, 150.779577		
F7 S2 D1	-34.117037, 150.787340		

F7 S2 D2	-34.113545, 150.790401		
F9 D1	-34.148461, 150.799712		
F9 D2	-34.144250, 150.797021		

F9 D4	-34.149224, 150.795607		
F9 D10	-34.143421, 150.794892		
F9 D11	-34.142156, 150.795214		

F9 D15	-34.140595, 150.793085		
F9 D16	-34.141037, 150.792901		
F10 D3	-34.138542, 150.796123		

F10 D5	-34.134375, 150.796052		
F10 D6	-34.138669, 150.793441