
Tootgarook Swamp Australasian Bittern Monitoring Project 2016

***Song Meter Survey, Wildlife Camera, and UAV Survey in
Tootgarook Swamp,
Rosebud West (Capel Sound) and Boneo***
*: to determine the possible breeding and presence of Australasian Bittern
Botaurus poiciloptilus*



Australasian Bittern Botaurus poiciloptilus in study area at Tootgarook Swamp.

Cameron Brown and Jessica Durrant, volunteer citizen scientists.



Australasian Bittern monitoring project 2016

Song Meter survey, wildlife camera, and UAV survey in Tootgarook swamp, Rosebud West (Capel Sound) and Boneo: to determine the possible breeding and presence of Australasian Bittern *Botaurus poiciloptilus*

Save Tootgarook Swamp Inc.

<http://www.savetootgarookswamp.org/>



ABN 791 666 033 45

Draft Report

Prepared for: Birdlife Australia, Boneo Park, Natural Systems Mornington Peninsula Shire, Trust for Nature, Save Tootgarook Swamp Inc, and Wildlife Acoustics.

Period 17th of July to 2nd December 2016

Song Meter survey, Wildlife Camera, and Remotely Piloted Aircraft (UAV) survey in Tootgarook Swamp

Song Meter survey, Wildlife Camera, and Remotely Piloted Aircraft (UAV) survey in Tootgarook Swamp, ROSBUD WEST and Boneo

To determine the possible breeding and presence of
Australasian Bittern *Botaurus poiciloptilus*

April 2017

Document information

Report prepared for use by: Birdlife Australia, Boneo Park, Natural Systems Mornington Peninsula Shire, Trust for Nature, Save Tootgarook Swamp Inc, and Wildlife Acoustics.

Prepared by: Cameron Brown

Citation: *Cameron Brown 2016, draft report: Song Meter survey, wildlife camera, and UAV survey in Tootgarook swamp, Rosebud West (Capel Sound) and Boneo: to determine the possible breeding and presence of Australasian Bittern Botaurus poiciloptilus.*

Document control

Version Reviewed Date issued

Draft 01 April 11th, 2017 Cameron Brown

Final Version 31st May 2017 (Chris Purnell (Birdlife Australia) and Cameron Brown

Acknowledgements

Cameron Brown and Jessica Durrant acknowledges the contribution of the following people in undertaking this study.

The McNaught family from **Boneo Park Equestrian Centre**, for site access and other support.

Matthew Stahmer, Volunteer Coordinator, **Natural Systems Mornington Peninsula Shire**, for Ecological Vegetation information within the Mornington Peninsula.

Gidja Walker for further and greater EVC analysis and description, **Gidja Walker Ecology**.

Chris Purnell (for further additional comments and suggested edits) and Andrew Silcocks, **Birdlife Australia** for donation of a SM3 Song Meter and advice.

Matthew Herring **Bitterns in Rice Project** for advice.

Wildlife Acoustics Inc, at 3 Mill and Main Place, Suite 210, Maynard MA 01754-2657, United States for awarding us a grant for the Kaleidoscope Software for audio analysis.

Assistance from **Malcolm Legg** and **Brandon Gonzalez**

Images

Cover Page Australasian Bittern in study area at Tootgarook Swamp.

All images through-out this report have been photographed at the study site and are Copy-right C. Brown and J Durrant 2016-17, or are screen shots of Wildlife Acoustics Kaleidoscope Software doing analysis.

Or are labeled as to their prospective owner.

Email contact@savetootgarookswamp.org

Executive Summary

The Tootgarook Swamp is the largest remaining shallow freshwater marsh in the Western Port and Port Phillip Bay region and contains the largest intact stands of tall marsh and sedge wetlands on the Mornington Peninsula. The loss and alteration of these habitats in the region has resulted in a reduction in the occurrence of several freshwater wetland obligates including the Australasian Bittern, *Botaurus poiciloptilus*.

The Australasian Bittern has been regularly documented within the Tootgarook Swamp since 1891¹. Recent observations, including breeding calls in spring, lead to the belief that breeding could potentially be occurring in the 650-hectare wetland.

The Australian Bittern is listed federally as Endangered under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and identifying and securing habitat for the species is a priority to its conservation.

Objectives, outcomes and conclusions

Given its cryptic appearance and behavior of the species and the logistical difficulties in conducting biodiversity surveys in preferred wintering habitat (often dense tall vegetation) the project sought to compliment traditional survey methods with remote sensing technology including song meters and wildlife cameras.

From 07/2016 to 12/2016 the monitoring project complimented on-ground physical surveys with deployment of:

- 1) a SM3 Song Meter (donated by Birdlife Australia) within the lowest part of the Tootgarook Swamp wetland
- 2) seven wildlife cameras at locations nearby to where Australasian Bitterns had been flushed in previous years
- 3) An unmanned aerial vehicle (UAV) with mounted camera in other nearby areas

Australasian Bittern was recorded in a combination of all survey techniques.

The new combined survey methods also detected 20 additional species (17 birds, 2 frogs and a bat) to the manual observation survey, with 12 of these species purely recorded by the SM3+ Song Meter. Wildlife cameras and UAV have also been able to record unique behaviours that previously have not been seen before in the swamp, with the animal acting more natural in their environment.

Information gathered from the Song Meter and the Wildlife cameras data indicates that several species of birds were recorded on the cameras that were not picked up by the Song Meter, as well as birds that were not picked up by Song Meter and wildlife cameras that was through manual observation and vice-versa.

Overall it is the authors view that the overall strategic approach to combined observation techniques gave an overarching interpretation of the avian species composition in the area.

These findings confirm the application of remote sensing technology is an effective method for detecting fauna in wetland environments.

¹Natural History Notes. The Bittern. The Australasian Sat 6th June 1891 pg. 25
<http://trove.nla.gov.au/newspaper/article/140705788?>

Passive surveillance is an important facet of capturing images or sounds of wildlife with minimal disturbance by humans as wildlife can sense and/or have an acute awareness of human behaviour. Active surveys can deal completely different results as most wildlife try to avoid humans if possible.

This is something you can witness even just sitting quietly in a car [example 1] at a nature reserve or park, when wildlife may be around but the minute you exit the vehicle the wildlife becomes aware you may be a threat.



Example 1 Superb Fairy-Wren on car windscreen. [Linked]

This really shows the importance of using different methods and equipment when conducting fauna surveys to detect species. Desktop surveys of fauna species should only be used as a guide to potential expected species encounters in the field, thus allowing time for the appropriate preparatory measures to be undertaken prior to survey start.

Recorded data from the song meters has been sent to Birdlife Australia for analysis. The recorded field data was also analysed by the author.

Table of Contents

Project scope.....	7
1.0 Introduction	9
1.1 Target species	10
1.2 Study site.....	13
1.3 Site Conditions	14
1.4 Study period:.....	16
2.0 Methods	18
2.1 Study site selection	19
2.2 Song meter deployment	21
2.3 Wildlife Camera deployment	23
2.4 Data Analysis.....	28
2.5 Limitations.....	28
3.0 Results.....	31
3.1 Equipment data.....	32
SM3 Song Meter	32
Wildlife Cameras.....	33
Remotely Piloted Aircraft (UAV)	34
4.0 Discussion.....	35
4.1 Song Meter deployment at the site.	35
4.2 Wildlife Camera deployment at the site.	41
4.3 UAV deployment at the site. An UAV	45
4.4 Manual Observations at the site.....	46
4.5 Future sites.....	61
5.0 Recommendations	63
6.0 References	65
Maps	66

Project scope

The scope of works for this survey included the following:

- ☒ A review of existing Australasian Bittern information at the site, Tootgarook Swamp on the Mornington Peninsula,
- ☒ deploying a Song Meter to record bird calls,
- ☒ deployment of six UOVision Zero Glow Wildlife Cameras to capture random per chance movements,
- ☒ deploying a UAV for incidental observation of birds in the north of the Song Meter,
- ☒ confirming the presence or absence of the species within the site,
- ☒ write a comprehensive report on the project.

The deployment of song meters helps to determine if certain bird species are present and exhibiting breeding behavior, in this case we were looking for Australasian Bittern behaviour.

This report provides information on:

- ☒ results from Song Meter deployment,
- ☒ results from Wildlife camera deployment,
- ☒ results of UAV deployment,
- ☒ discussion on the results.

Common Long Necked Tortoise *Chelodina longicollis* stumbled across while moving between equipment in the study site at Tootgarook Swamp



1.0 Introduction

Remote detection devices were deployed to compliment 2015 survey efforts to detect the presence and behavior of Australasian Bittern within the Tootgarook Swamp. A Song Meter was deployed within the study area and booming Australasian Bitterns calls recorded and sent to Birdlife Australia. The Booming is considered by Birdlife Australia as an indication of possible breeding. Habitat structure and function found at Tootgarook Swamp are typical of those required by Bitterns to forage roost and breed. Considering the size of the wetland (approx. 650 hectares) it's being the most significant habitat remaining on the peninsula.

Environmental Vegetation Classes (EVCs) [Table 1] that exist in the Tootgarook Swamp are extremely significant within the region of the Mornington Peninsula Shire, as well as the bioregion of the Gippsland Plain. These are to be considered of State conservation significance as described in DELWP's "Standard Criteria for Sites of Biological Significance in Victoria" (December 2004) compiled by Nevil Amos". Birdlife Australia has stated; "As a result, Tootgarook represents regionally significant habitat for several wetland (e.g. Australasian Bittern, Baillon's Crake, Sharp-tailed Sandpiper) and grass/sedgeland species (e.g. Spotted Harrier, Southern Emu-wren, Stubble Quail)"².

Table 1 Courtesy of Mornington Peninsula Shire Council (examples of little remnant EVC's Map 3a-e).

EVC	% of Mornington Peninsula EVC found at Tootgarook Swamp	Bioregional Conservation Status
Aquatic Herbland (653)	71	Endangered
Brackish Wetland (656)	100	Extinct Presumed ³
Sedge Wetland (136)	99.6	Endangered
Gahnia Sedgeland	99.1	Endangered
South Gippsland Plains Grassland (132)	100	Endangered (FFG Listed)
Tall Marsh (821)	94.62	Endangered

² Purnell, C and Herman, K., 2016. **Tootgarook Swamp Bird Monitoring Program – Year 2 Annual Report**. Unpublished report prepared for the Mornington Peninsula Shire Council by BirdLife Australia. Pg. 21

³ Page 3 Appendix 4. **2003 Biodiversity Action Planning, Strategic Overview Gippsland Plain Bioregion Pt3** - Additional Appendices. DSE, Vic Government

1.1 Target species

The **Australasian Bittern** *Botaurus poiciloptilus* [Figure 1] is also known as the Bunyip Bird, or Brown Bittern.

The species is listed as Globally Endangered under *International Union for Conservation of Nature* listings (IUCN), Nationally Endangered (EPBC), as the estimated whole population of mature individuals of the species is low and evidence suggests that the number will continue to deteriorate. The species is also assumed to have undergone a severe reduction in population numbers as a result of the reduction in the species' area of occupancy and the loss of habitat and breeding grounds (TSSC, 2010)⁴.

The Australasian Bittern is similarly listed as threatened under the Victorian Flora and Fauna Guarantee Act 1988 and is also one of 20 birds that the Australian Government has prioritised resource allocation to, to support the species recovery effort.

The Federal Australian Government currently supports funding for seven projects through the National Landcare Programme to help restore Bittern habitat. Recent environmental water flows, including water supplied by the Commonwealth Environmental Water Holder, are resulting in a small population boom for bitterns nesting in the Barmah-Millewa forest. The [Threatened Species Strategy webpage](#) includes information on what is being done to support the species recovery effort.

Distribution & Abundance: A total of approximately 1000-2499⁵ mature individuals remain in Australia, New Zealand and possibly still New Caledonia. The areas with the largest populations are south-eastern Australia and New Zealand, while small numbers persist in south-western Australia, south-eastern QLD and Tasmania.

Size & Weight: With neck stretched, can stand just over 1 meter tall. Body length: 66 –76 cm. Weight: females 571- 1135 g; males 875 –2085 g. Wingspan of 1050–1180 cm.

Identification: The Australasian Bittern is the iconic bird of the southern Australian swamp, and its resonant booming call is said to have been the basis of the Aboriginal and colonialist myth of the Bunyip. It is a large, stocky, thick-necked heron with a cryptic plumage consisting of mottled buff, brown and dark brown streaks. The colour of the plumage varies slightly, particularly on the mantle and nape, from almost black to dark or rufous brown. Sexes are similar (though females are slightly smaller), while immatures are generally paler.

They are mostly seen singly or in pairs, usually within beds of reeds, rushes or sedges in freshwater wetlands, standing motionless among vegetation in the shallows. When flushed, birds rise awkwardly on large broad wings with rounded tips, their legs usually dangling, flying up to 10 metres above the vegetation. After a brief flight, they usually plunge out of sight into dense vegetation.

Call: Males make deep booms during the breeding season, audible for about 2 kms. The deep,

⁴ TSSC (Threatened Species Scientific Committee) (2010). Listing advice for *Botaurus poiciloptilus* (Australasian Bittern).

⁵ **The IUCN Red List of Threatened Species.** Version 2016- 3.
<http://www.iucnredlist.org/details/22697353/0>

booming calls given by males during the breeding season helped give rise to legends of Australia's mythical Bunyip. Various Indigenous groups, and later, European colonists, told tales of a fearsome, elusive creature living in the swamps

Habitat: Vegetated wetlands. Often seen feeding in more open areas in water up to 30 cm deep, but relies on the dense cover of reeds, rushes, sedges, and other water plants such as rice which it will roost and breed in.

Diet: Fish, frogs, eels, yabbies', mice, insects.

Breeding: Poorly known. Usually four or five eggs in well-hidden platform nest about 10-30 cm above water level. Incubation approx. 23 days; a further 7 weeks until chicks fledge but leave nest after about two weeks. Appears that only female incubates and raises young. Polygyny (male with multiple females) highly likely, including recent observations (Jan. 2015) of single booming male with three nests/females in single rice paddock near Griffith, NSW.

Movements: Poorly known. Responds to flooding of ephemeral inland wetlands, presumably sometimes from coastal refuges. Movements of Riverina rice crop breeding population not known.

Commonwealth Listing Advice on *Botaurus poiciloptilus* (Australasian Bittern) and approved conservation advice is available from:

<http://www.environment.gov.au/biodiversity/threatened/species/pubs/1001-conservation-advice.pdf>. In effect under the EPBC Act from 03-Mar-2011.

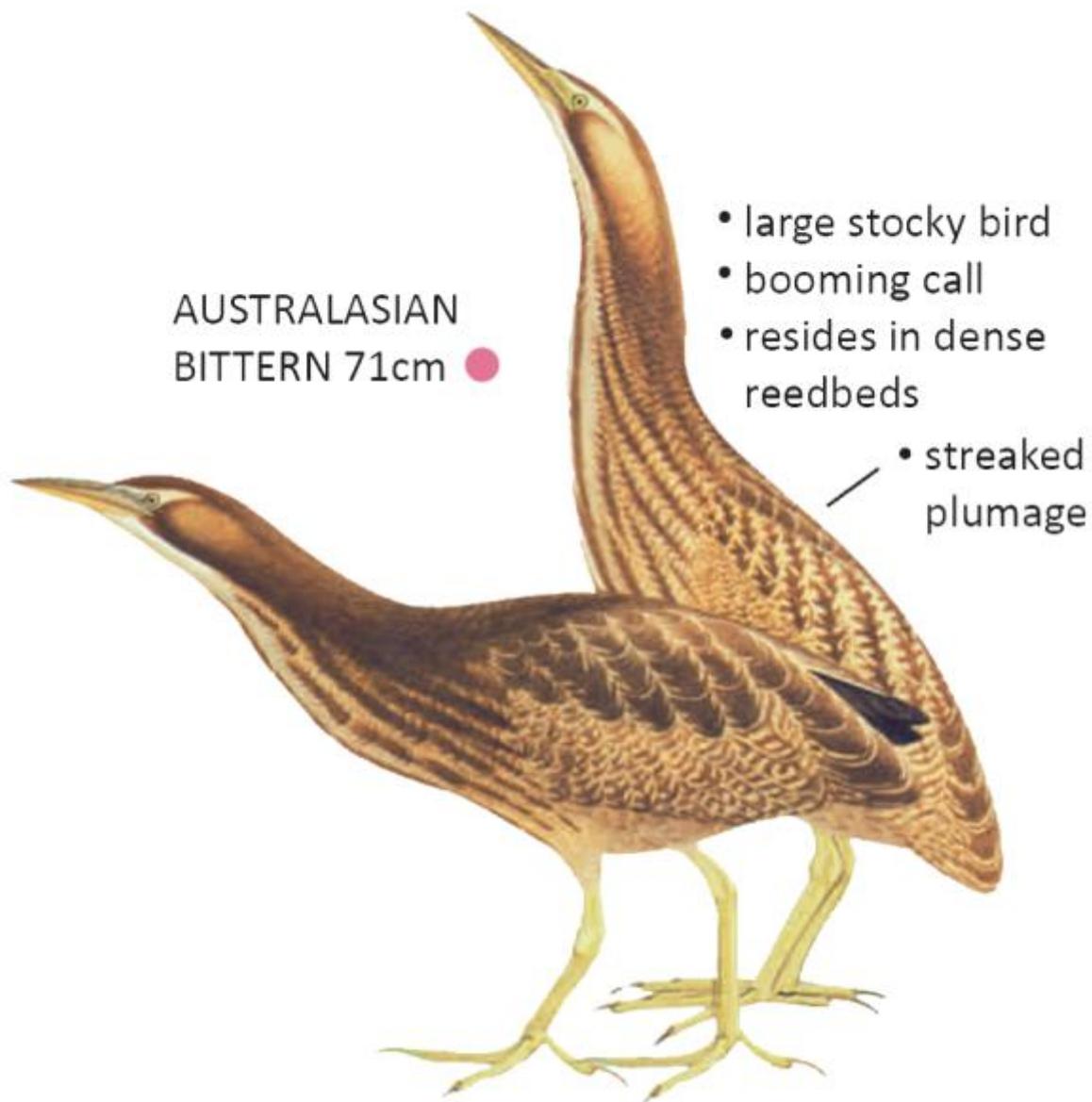


Figure 1 The Australasian Bittern. Image adapted for BirdLife Australia identification sheets. Original artwork by Jeff Davies.

The Australasian Bittern is one of the 20 priority birds to have an improved population trajectory by 2020 announced by the federal government as part of the Australian Government National Threatened Species Strategy. Former federal environment minister, Greg Hunt, set the strategies goal to halt and reverse the decline in our threatened species. It is the view of both authors of this report that all Australians should do their part to protect Australia's Biodiversity, and the monitoring of this species plays a part in which individuals and citizen science can do there bit as set out in the Australia's Biodiversity Strategy 2010-2030⁶ which states;

"We must, as a society and as individuals, acknowledge the threat to our biodiversity and act collectively to reverse the decline. This will require making some difficult decisions and

⁶ Natural Resource Management Ministerial Council 2010, Australia's Biodiversity Conservation Strategy 2010-2030, Australian Government, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

changing how we interact with our environment. We need to consider biodiversity in our everyday actions.

Governments and the private sector will need to put in place frameworks to make biodiversity central to their decision-making processes. Individuals should act to reduce their ecological footprints.”

Threats:

“Reduction in extent and quality of habitat due to the diversion of water away from wetlands (primarily for irrigation as well as groundwater extraction); the drainage of swamps; the loss or alteration of wetland habitats due to clearing for urban and agricultural development; peat mining; predation by introduced vertebrate pests such as foxes (*Vulpes vulpes*) and cats (*Felis catus*); reduced water quality as a result of increasing salinity, siltation and pollution; and overgrazing by livestock and detrimental fire regimes (Marchant and Higgins, 1990; Kingsford and Thomas, 1995; Garnett and Crowley, 2000; Kingsford, 2000; Jaensch, 2004).”⁷

1.2 Study site

The study area [Figure 2] falls within the Gippsland Plain Bioregion and the Mornington Peninsula. It lays within the lowest sections [Figure 3] of the Tootgarook Swamp, making it a crucial part of the wetland, this area being the first natural area (unmodified by man) for ground water to appear above the surface during discharge other than the Boneo Drain (figure)

The site forms part of the greater Tootgarook Wetlands and the majority of the study area and surrounding landscape comprises indigenous vegetation on private covenanted (Boneo Park Equestrian Center), uncovenanted land to the north, with Shire owned reserves of 40 Colchester road and Sanctuary Park to the North East and extremely heavily modified vegetation to the Northwest (former land fill). Diagonally directly across the study site running from North-East to South West is a Public Acquisition Overlay that has been in existence for approximately 50 years, we will label it as the Southern Peninsula Freeway the proposed extension for Peninsula Link. This generally was the location of the equipment.

⁷ <http://www.environment.gov.au/biodiversity/threatened/species/pubs/1001-conservation-advice.pdf>
Australian Government Department of Environment.

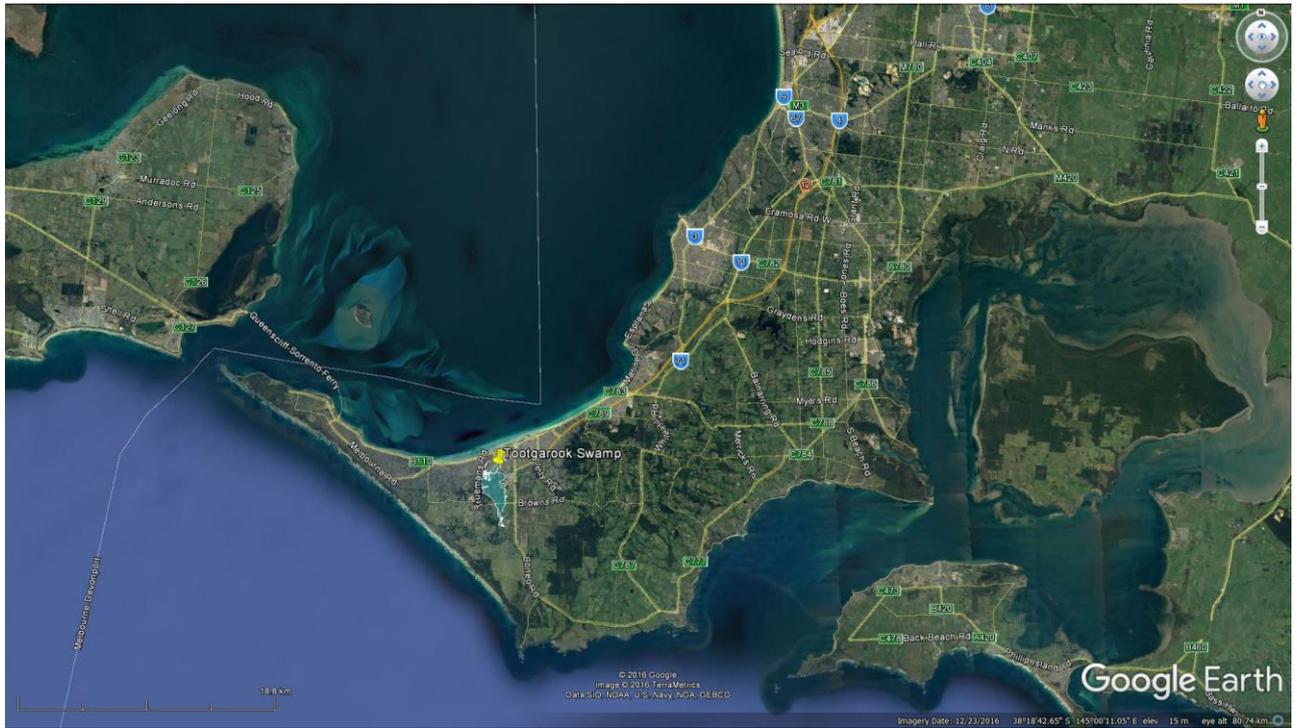


Figure 2 Map Location of the study site within the Mornington Peninsula (courtesy Google Earth).

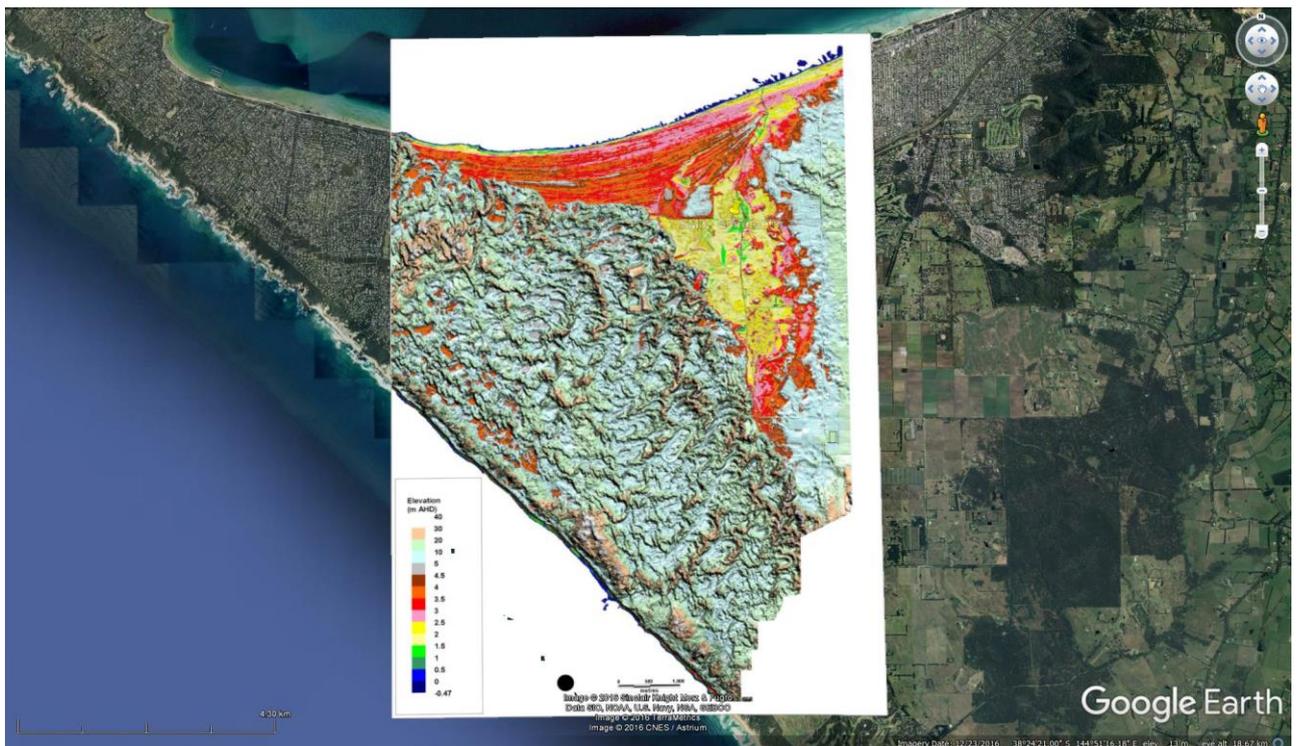


Figure 3 LiDAR Imagery Yellow inland area being Tootgarook Swamp. (courtesy Google Earth and Peter Dahlhaus University of Ballarat 2012).

1.3 Site Conditions

When assessing habitat availability in the study site it is important to consider local weather variation during the study period. Weather for the site can be summed up in the following

images taken from the authors personal weather station **IVICTORI913⁸** [figure 4] in the north of the Tootgarook Swamp. Rain occurred in August and built up and then again in October, this resulted in a nearby construction site running dewatering pumps that created noise interference and/or disturbance for Australasian Bittern calls.

Summary

July 17, 2016 - December 3, 2016

	High	Low	Average		High	Low	Average
Temperature	34 °C	1.4 °C	13.7 °C	Wind Speed	43.6 km/h	--	3.4 km/h
Dew Point	23.3 °C	-0.2 °C	8.7 °C	Wind Gust	76.3 km/h	--	--
Humidity	99%	19%	73.4%	Wind Direction	--	--	WSW
Precipitation	139.4 mm	--	--	Pressure	1033.7 hPa	986 hPa	--

Weather History Graph

July 17, 2016 - December 3, 2016

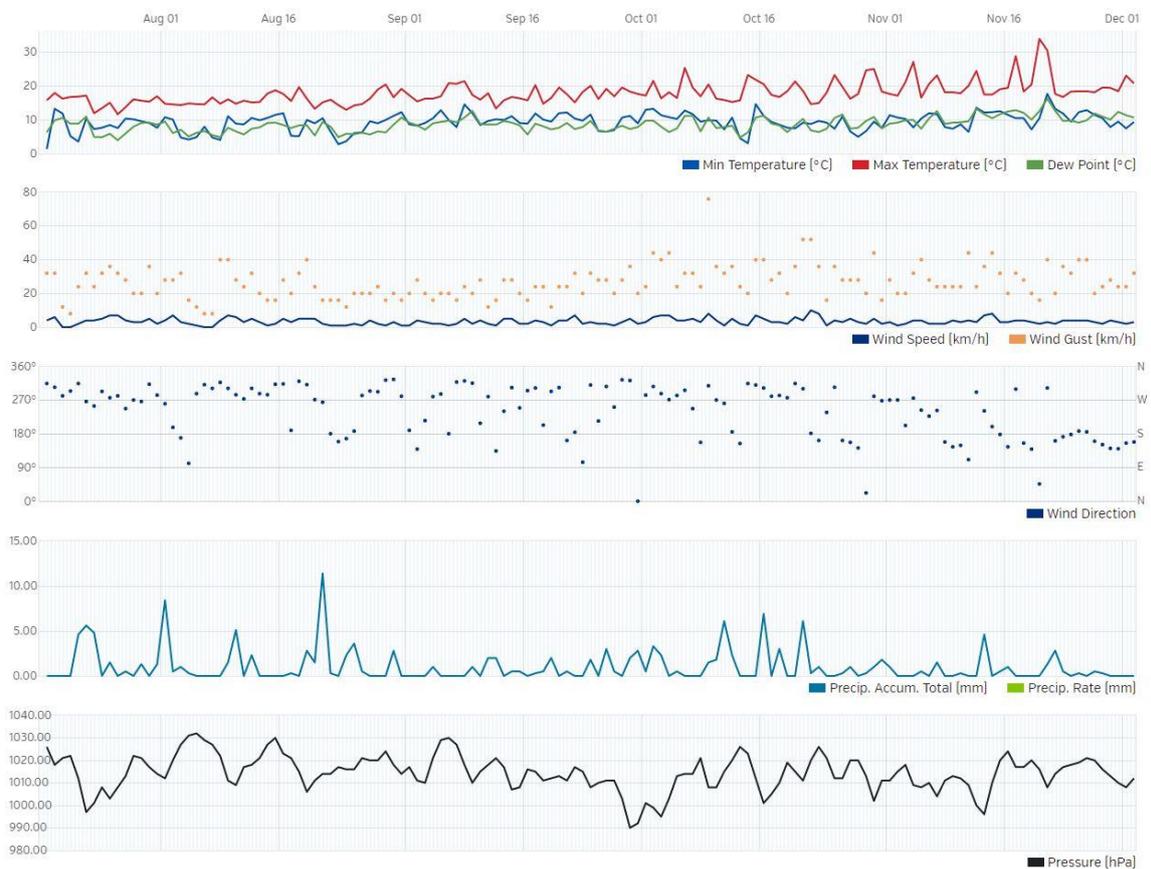


Figure 4 IVICTORI913 data

⁸ Weather Underground <https://www.wunderground.com/personal-weather-station/dashboard?ID=IVICTORI913#history>

1.4 Study period:

The study period was chosen based on the greatest number of sightings of Australasian Bittern that have been observed and mapped, including historical data, as well as site conditions (water depth) and permission for equipment location at Boneo Park in the Tootgarook Swamp.

Our historical data we have recorded shows winter is the best time for Australasian Bittern numbers and the chosen location of the equipment, in previous years we have known five Australasian Bittern to be in the swamp in the nearby surrounding location.

Aurora Bluetail (*Ischnura aurora*)



2.0 Methods

Passive surveillance techniques were used. The Song Meter SM3 acoustic recorder is a multi-role bioacoustics recording device that can simultaneously record any combination of avian, terrestrial and/or marine life at the time of programable recording.

It is programmed by the operator to sleep until programmed recording times awake the song meter when it then commences recording vocal calls until the programmed recording times finish, it then sleeps until the next schedule time. The SM3 can perform a wide variety of recording roles, and remain in the field for extended periods of time, as well as recording in mono or stereo using two microphones in 16-bit .wav or optional .wac lossless compression format.

The recordings are stored within the Song Meter on SD cards which are then analysed by a computer using Kaleidoscope Pro software. (A new learning curve also, as it is a new package compared to the previous Song Scope software, previous recogniser's needed to be converted or retrained to the new software).

A single SM3 Song Meter was deployed within a small section of raised Southern Gippsland Plains grassland⁹ just below 92 Elizabeth Ave, adjacent a complex network of Tall Marsh, Aquatic Herbland, Brackish Wetland and Gahnia Sedgeland within Boneo Park, and was deployed for several months. The location was a high central point within the wetland corresponding to surrounding historical data of Australasian Bittern movements.

The song meters were programmed to record from 1 hour on 1 hour off for the month of August till the 18th of September and then 3 hours dawn and 3 hours at dusk each night over the remaining duration of the survey.

The Song Meter (Figure 1) was fixed to a star picket via a strap thus enabling it to obtain the best vocal recordings possible and could pick up traffic noise from the surrounding area 700 -1500 metres away. SD cards were downloaded once per fortnight during the project time frame and batteries exchanged.

To the south of the Song Meter, in from East to West, an array of UOVision covert Zero-Glow (940nm wavelength) Wildlife Cameras¹⁰ (Figure 2) were setup to attempt to capture random per chance movements of the birds based on the locations of previous flushing of Australasian Bitterns. The overall scheme is laid out in figure 3.

A lightweight Parrot Bebop 2¹¹ was used for remote piloted aircraft surveying during available conditions.

During battery and SD Card exchanges on field equipment, manual observation and documentation took place using a Nikon D5300 camera and Sigma 150-600mm f/5-6.3 DG OS HSM Sports lens, this method provided the least passive surveillance.

⁹ Per. Comm. phone call – **Dr. Steve Sinclair Arthur Rylah Institute DELWP Plant Ecology, Spatial Analysis, Vegetation Mapping**. The grasslands in the Tootgarook Swamp are unique to the Tootgarook Swamp and are different to Southern Gippsland Plains Grassland EVC_132, though this is the closest match and was applied for protection of the grasslands contained within the Tootgarook Swamp.

¹⁰ UOVision Wildlife Cameras UV565 (1), UV565HD with Sound (4), UV595HD with Sound (2)

¹¹ Parrot Bebop 2 <http://global.parrot.com/au/products/bebop2/>

2.1 Study site selection

The site is well known to be critical habitat for the Australasian Bittern as mentioned in per comm. with Chris Purnell, and Birdlife Australia's report.

“Core range and nationally significant, critical habitat for the Australasian Bittern (EN, EPBC) was identified across 5 land parcels in the north of the swamp: 92W, Sanctuary Park Reserve (including VicRoads Freeway. Reserve and 40 Colchester Rd) and the McNaught property (Hiscock's Rd & landfill boundary)”

This had been determined based on our previous sightings, observations and mapping, which has been provided to Birdlife Australia, and this report builds on this previous information.

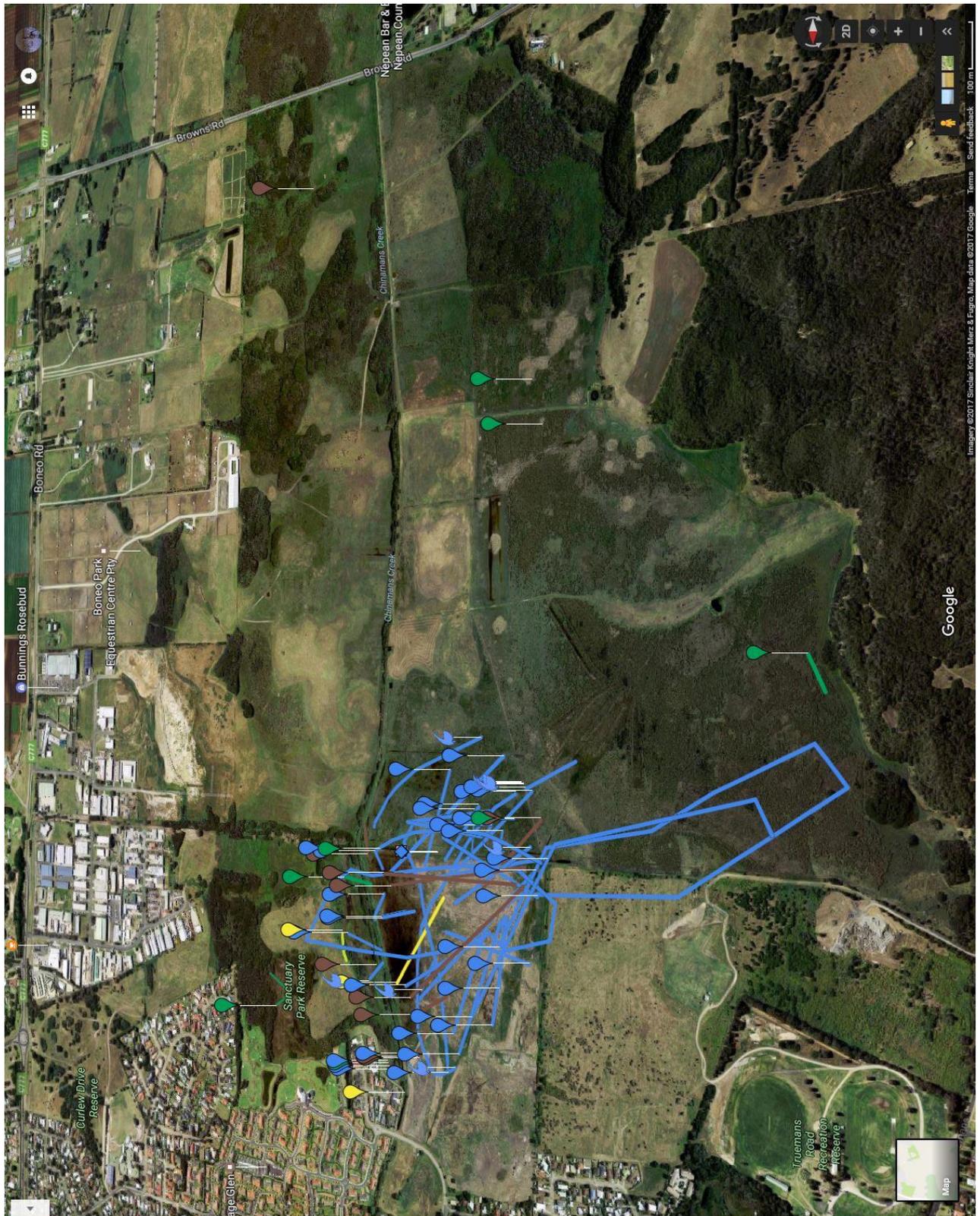
Prior to this survey taking place on the 17th of July 2016, encounters with Australasian Bitterns had occurred on numerous occasions [Table 2], with up to three birds in a single observation. This gave us confidence in the deployment of equipment with a view that results would be expected.

We previously observed Australasian Bitterns in 2016 prior to the study period on the;

Table 2: Date	Count
25 th May 2016	3
1 st June 2016	1
13 th June 2016	1

The site selection was based on the previous year's data which had yielded a recording of Australasian Bittern 'Booming'. It was on a raised grassland within the swamp generally central to previous visual observations and mapping of the bird, and was chosen in discussion with Chris Purnell from Birdlife Australia who had donated the song meter to our organisation.

Historical mapping [Figure 5] and observation of direction of flushed Australasian Bittern has shown to be an extremely valuable resource in regard to planning our chosen sites, with many hundreds of hours spent over the last 5 years gathering this data.



Australasian Bittern Mapping p. X

Brown=Autumn, Blue Winter and Green=Spring
Map also shows location of Feral Animals sighted in the area.

[Open in My Maps](#)

- Australasian Bittern Pre-2014**
 - Australasian Bittern Sighting Feb 2008
 - Australasian Bittern Sighting July 2008
 - Australasian Bittern Sighting Aug 2008
 - Australasian Bittern Sighting Sep 2008
 - [3 MORE](#)
- Australasian Bittern 2014**
 - Australasian Bittern Sighting 9th Feb 2014
 - ↩ Direction 9th Feb 2014
 - Australasian Bittern Sighting 17th May 2014
 - ↩ Direction May 17th
 - [39 MORE](#)
- Australasian Bittern 2015**
 - Australasian Bittern Sighting 17th May 2015
 - Australasian Bittern Sighting 19th May 2015
 - Australasian Bittern Sighting 20th May 2015
 - ↩ Direction before loosing sight 20th May 2015
 - [28 MORE](#)
- Australasian Bittern 2016**
 - Australasian Bittern Sighting 21st April 2016
 - ↩ Direction before loosing sight 21st April 2016
 - 1st Australasian Bittern Sighting 29th May 2016
 - ↩ Direction before loosing sight 29th May 2016
 - [29 MORE](#)
- Feral Animals**
 - ↩ Apprent direction of Fox Travel
 - Foxes 3rd Aug 2014
 - Fox 9th Aug 2014

Figure 5 Google mapping of the Australasian Bittern Project in the Tootgarook Swamp (courtesy Google Maps).

2.2 Song meter deployment

A song meter is designed to record all audible acoustics that are occurring at the time of recording. It is programmed by the operator to sleep until programmed recording times, awake the song meter when it then commences recording vocal calls until the programmed recording times finish. It then sleeps until the same procedure the following day. This is to save battery life. The recordings are stored within the song meter on SD cards which are then transferred onto the computer and analysed using specialized software called Kaleidoscope from Wildlife Acoustics.

The Song Meter was positioned on what essentially becomes an island of raised damp grassland [Figure 6,7,8 and Table 3] (Southern Gippsland Plains Grassland) surrounded by Tall Marsh, Gahnia Sedgeland, and Spike Sedge Wetland. The Song Meter was deployed for one month from the 17th of July 2016 to the 2nd of December 2016.



Figure 6 Cameron Brown with the Song Meter deployed in Southern Gippsland Plains Grassland. (132) at Boneo Park.



Figure 7 Red circle location of the raised damp grassland in the surrounding wetland. A number of Swans nests can be seen in the foreground of the photo.

The Song meter was programmed to record from 1 hour on 1 hour off for the month of August till the 18th of September and then 3 hours dawn and 3 hours at dusk each night over the remaining duration of the survey. The Song Meter was fixed to a star picket via two straps, with a piece of timber positioned behind, so as to obtain the best vocal recordings possible. SD cards were downloaded once per fortnight during the project time frame.

2.3 Wildlife Camera deployment

Wildlife Cameras were deployed in locations [Figure 7] that were thought to be suitable habitat based around the historical dataset (observations, groundwater height, EVC's and LiDAR) we have been building for the Australasian Bittern, including movements when the birds have been flushed, this means that over time and depending on groundwater height we have a reasonable chance of predicting areas of possible Australasian Bittern encounters within the Tootgarook Swamp. Two wildlife cameras (1 & 2) were deployed to a fence while the other five were firmly attached to garden stakes. Table 3 gives a layout and description of the deployment.



Figure 8 Locations of Song Meter and Wildlife Cameras deployed for this study within the Tootgarook Swamp (courtesy Google Earth).

Table 3: GPS coordinates for the deployed equipment deployed.	GPS Coordinates	EVC deployed in ¹²
SM3 Song Meter	38°22'54.87"S 144°52'18.58"E	Southern Gippsland Plains Grassland. (132)
		
UOvision Wildlife Camera 1 (Facing WSW)	38°23'0.75"S 144°52'9.26"E	Brackish Grassland (934) with Tall Marsh (821) behind.



¹² EVC descriptions courtesy of Gidja Lee Walker Ecology - www.gidjawalker.com.au

UOvision Wildlife Camera 2
(Facing SSE)

38°23'0.88"S
144°52'9.43"E

Brackish Sedgeland (13) & Tall
Marsh (821).



UOvision Wildlife Camera 3
(Facing S)

38°22'59.91"S
144°52'7.11"E

Brackish Grassland (934) /
Gahnia Sedgeland (968)



UOvision Wildlife Camera 4
(Facing SSE)

38°22'58.05"S
144°52'10.68"E

Tall Marsh (821)/Aquatic
Herbland (653)/ Brackish
Grassland (934).



UOvision Wildlife Camera 5
(Facing SE)

38°23'0.06"S
144°52'14.68"E

Gahnia Sedgeland (968) with
inundated Aquatic Sedgeland
(308).



UOvision Wildlife Camera 6
(Facing SE)

38°22'58.14"S
144°52'17.06"E

Spike Sedge wetland (819)
with Gahnia Sedgeland (968).



UOvision Wildlife Camera 7
(Facing S)

38°22'57.04"S
144°52'18.62"E

Spike Sedge wetland (819)
with Gahnia Sedgeland (968).



2.4 Data Analysis

Recorded data from the song meters was sent to Birdlife Australia for analysis. Birdlife Australia has developed a preliminary recogniser for the Australasian Bittern with Museum Victoria. We received this last year and converted it to the new format for Kaleidoscope, we also retrained this with new call information to make its accuracy even better, though did run into some issues, this is discussed later.

Save Tootgarook Swamp was also awarded a grant from Wildlife Acoustics to aid in this project in the form of new Kaleidoscope software. The grant was applied for by Save Tootgarook Swamp with the help of Andrew Silcocks of Birdlife Australia.

The recorded field data was also analyzed by the author, a total of 637 Hours was recorded in the field from the SM3 Song Meter.

2.5 Limitations

There are several limitations associated with the use of Song meters for determining the presence or absence of a certain fauna species at a site. Not all species call frequently, like the Australasian Bittern. Species like the Australasian Bittern are cryptic and elusive and current deployment has only occurred due to site knowledge of the frequency of the Australasian Bittern from regular bird surveys.

The Song Meter and Wildlife Cameras were only deployed for a number months and species such-as the Australasian Bittern could easily have been missed. It was important to ensure the Songmeter was free from contact of moving and rustling vegetation on the microphones at a height that allowed it to pick up sound clearly and undampened, this did not protect against wind interference in the open area, which affected many of the recordings. The batteries on each charge in the unit only lasted approximately 12 days before running flat and being replaced.

Wildlife Cameras too needed to be away from rustling and moving vegetation and placed in optimal locations to avoid glare from the sun.

Weather, Water and Terrain were other factors that made the project a difficult undertaking. Waders were necessary [Figure 9] and backpack for servicing equipment, changeover of batteries, SD cards etc., (Wildlife Cameras were located in inundated water). Additional there was the carrying of a DSLR Camera (3.3kg), this meant nothing could be placed down on the ground. All hours served for the project are volunteer hours. UAV (Remote Piloted Aircraft) Flights were taken when it was possible to find time which did not always necessarily combine with best weather conditions for flying.

It should be said all hours given were volunteer hours - SD Cards, AA, and D Size Batteries were not regularly changed over as needed, with days missed on recordings. Jess was due in September with our first child and servicing and surveying frequently came down to just myself, making it more difficult to observe and do maintenance on equipment.

We also had an eight day VCAT hearing as a party to make submissions and prepare for, had to put down our canine companion of 13 years as well as several other personal issues, including a death in the family prior to undertaking the project.

Not as much time was spent in the field as I would have liked with the number of observers I would have preferred, to cover and study a location of 650 hectares.



Figure 9 18th of September Jess 3 days before giving birth, in in the depth of water in some locations at the study site which is needed to be navigated.



Wildlife Camera number 5 deployed in the Study Area.

3.0 Results

The results of the combined survey are listed in the following [Table 4].

Species	Scientific name	Table 4: Survey Technique			
		SM3	Wildlife Camera	UAV	Manual Observation
Australasian Bittern	<i>Botaurus poiciloptilus</i>	x	x	x	x
Australasian Pipit	<i>Anthus novaeseelandiae</i>				x
Australian Magpie	<i>Cracticus tibicen</i>	x			x
Australian Pelican	<i>Pelecanus conspicillatus</i>				x
Australian Raven	<i>Corvus coronoides</i>	x			
Australian Reed-Warbler	<i>Acrocephalus australis</i>	x	x		x
Australian Spotted Crane	<i>Porzana fluminea</i>	x			
Australian White Ibis	<i>Threskiornis molucca</i>		x	x	x
Black Swan	<i>Cygnus atratus</i>	x		x	x
Black-shouldered Kite	<i>Elanus axillaris</i>		x		x
Common Starling	<i>Sturnus vulgaris</i>		x		
Dusky Moorhen	<i>Gallinula tenebrosa</i>	x			
Eastern Barn Owl	<i>Tyto alba</i>		x		
Eastern Great Egret	<i>Ardea modesta</i>	x			x
Eurasian Skylark	<i>Alauda arvensis</i>		x		
Flame Robin	<i>Petroica phoenicea</i>		x		
Galah	<i>Eolophus roseicapillus</i>				x
Golden Whistler	<i>Pachycephala pectoralis</i>	x			
Golden-headed Cisticola	<i>Cisticola exilis</i>	x	x		x
Great Cormorant	<i>Phalacrocorax carbo</i>				x
Grey Butcherbird	<i>Cracticus torquatus</i>	x			
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	x			
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	x			
Lewin's Rail	<i>Lewinia pectoralis</i>	x			
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>				x
Little Corella	<i>Cacatua sanguinea</i>	x			
Little Grassbird	<i>Megalurus gramineus</i>	x	x		x
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>				x
Little Raven	<i>Corvus meloni</i>	x	x		x
Magpie-lark	<i>Grallina cyanoleuca</i>	x	x		
Masked Lapwing	<i>Vanellus miles</i>	x			
Nankeen Kestrel	<i>Falco cenchroides</i>		x		x
Nankeen Night-Heron	<i>Nycticorax caledonicus</i>		x		
Pacific Black Duck	<i>Anas superciliosa</i>	x	x		x
Purple Swamphen	<i>Porphyrio porphyrio</i>	x	x		x
Silver Gull	<i>Chroicocephalus novaehollandiae</i>	x			x
Spotless Crane	<i>Porzana tabuensis</i>	x			
Straw-necked Ibis	<i>Threskiornis spinicollis</i>		x	x	x
Striated Fieldwren	<i>Calamanthus fuliginosus</i>		x		x
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>				x
Superb Fairy-wren	<i>Malurus cyaneus</i>	x	x		x
Swamp Harrier	<i>Circus approximans</i>	x	x	x	x
Wedge-tailed Eagle	<i>Aquila audax</i>				x
Welcome Swallow	<i>Hirundo neoxena</i>		x		x
White-faced Heron	<i>Egretta novaehollandiae</i>		x		x
Willie Wagtail	<i>Rhipidura leucophrys</i>		x		x
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>				x
Common Froglet	<i>Crinia signifera</i>	x	x		x
Eastern Banjo Frog	<i>Limnodynastes dumerilii insularis</i>	x	x		x
Southern Brown Tree Frog	<i>Litoria ewingii</i>	x	x		x
Verreaux's Tree Frog (Whistling Tree Frog)	<i>Litoria verreauxii</i>	x	x		
Red-Groined Frog	<i>Paracrinia haswelli</i>	x			
Red Fox	<i>Vulpes vulpes</i>		x		x
Unidentified Bat			x		
Common Long Necked Tortoise	<i>Chelodina longicollis</i>				x
	Total out of 55 Species	30	29	5	35

3.1 Equipment data

(N. B images in this section should be clickable document are [Linked] and should link to live online data.)

SM3 Song Meter

☑ A Total of 25 avian species were identified, and 5 Frog Species.

Common Name	Latin Name
Australasian Bittern	Botaurus poiciloptilus
Australian Magpie	Cracticus tibicen
Australian Raven	Corvus coronoides
Australian Reed-Warbler	Acrocephalus australis
Australian Spotted Crake	Porzana fluminea
Black Swan	Cygnus atratus
Dusky Moorhen	Gallinula tenebrosa
Eastern Great Egret	Ardea modesta
Golden Whistler	Pachycephala pectoralis
Golden-headed Cisticola	Cisticola exilis
Grey Butcherbird	Cracticus torquatus
Grey Shrike-thrush	Colluricincla harmonica
Laughing Kookaburra	Dacelo novaeguineae
Lewin's Rail	Lewinia pectoralis
Little Corella	Cacatua sanguinea
Little Grassbird	Megalurus gramineus
Little Raven	Corvus meloni
Magpie-lark	Grallina cyanoleuca
Masked Lapwing	Vanellus miles
Pacific Black Duck	Anas superciliosa
Purple Swamphen	Porphyrio porphyrio
Silver Gull	Chroicocephalus novaehollandiae
Spotless Crake	Porzana tabuensis
Superb Fairy-wren	Malurus cyaneus
Swamp Harrier	Circus approximans
Common Froglet	Crinia signifera
Eastern Banjo Frog	Limnodynastes dumerilii insularis
Southern Brown Tree Frog	Litoria ewingii
Verreaux's Tree Frog (Whistling Tree Frog)	Litoria verreauxii
Red-Groined Frog	Paracrinia haswelli

The Song Meter proved being able to record very high-quality audio recordings from the site without direct human interference on species, cryptic veg dwellers like crakes and rails are more likely to be heard than seen, were recorded by the song meter as well the Australasian Bittern.

Wildlife Cameras

☑ A Total of 24 avian species were heard (H) or seen (S), and 4 Frog Species were heard (H) or seen (S), and 1 Bat species was seen.

Common Name	Latin Name
Australasian Bittern (S)	Botaurus poiciloptilus
Australian Reed-Warbler (H)	Acrocephalus australis
Australian White Ibis (H+S)	Threskiornis molucca
Black Swan (S+H)	Cygnus atratus
Black-shouldered Kite (S)	Elanus axillaris
Common Starling (S)	Sturnus vulgaris
Eastern Barn Owl (S)	Tyto alba
Eurasian Skylark (H)	Alauda arvensis
Flame Robin (S)	Petroica phoenicea
Golden-headed Cisticola (H)	Cisticola exilis
Little Grassbird (H)	Megalurus gramineus
Little Raven (H)	Corvus meloni
Magpie-lark (H+S)	Grallina cyanoleuca
Nankeen Kestrel (S)	Falco cenchroides
Nankeen Night-Heron (S)	Nycticorax caledonicus
Pacific Black Duck (H+S)	Anas superciliosa
Purple Swamphen (H+S)	Porphyrio porphyrio
Straw-necked Ibis (S+H)	Threskiornis spinicollis
Striated Fieldwren (S)	Calamanthus fuliginosus
Superb Fairy-wren (H+S)	Malurus cyaneus
Swamp Harrier (H+S)	Circus approximans
Welcome Swallow (S)	Hirundo neoxena
White-faced Heron (S)	Egretta novaehollandiae
Willie Wagtail (H)	Rhipidura leucophrys
Common Froglet (H)	Crinia signifera
Eastern Banjo Frog (H+S)	Limnodynastes dumerilii insularis
Southern Brown Tree Frog (H)	Litoria ewingii

Verreaux's Tree Frog (Whistling Tree Frog) (H)	Litoria verreauxii
Red Fox (S)	Vulpes vulpes
Unidentified Bat	

The wildlife camera was able to record sight and sound, though in a fixed position including at night with invisible infra-black flash using 940nm wavelength at up to 12 meters. The Wildlife cameras have an in-built motion-heat PIR (Passive infrared) sensor, again being able to operate without direct human interference allowed fauna to go about its regular activity and behaviour. It allowed for nocturnal species like barn owls to more likely seen, and Australasian Bittern to be observed without flushing the species.

Remotely Piloted Aircraft (UAV)

☑ A Total of 5 avian species were observed, within the limitations of the equipment.

Common Name	Latin Name
Australasian Bittern	Botaurus poiciloptilus
Australian White Ibis	Threskiornis molucca
Black Swan	Cygnus atratus
Straw-necked Ibis	Threskiornis spinicollis
Swamp Harrier	Circus approximans

UAV provided an ability to go to difficult to survey areas, like Tall Marsh where human disturbance to species is caused by rustling and crashing through of vegetation is unavoidable in an area of limited visibility. Getting above the vegetation made it possible to see directly down in open pockets as well as observe numerous nesting Black Swans without opening up areas of Tall Marsh to other predators

4.0 Discussion

The techniques used for surveying as discussed in limitations and results are not necessarily good as or better than physical surveys on their own, just as it is the authors opinion that a manual physical survey is not as good or better on its own.

Rather it seems that the combined methods are extremely useful and possibly superior.

The physical observation only picked up 63.6% of total species recorded in its own right, missing out on roughly 1/3rd of total species count.

The other techniques also proved useful, with the Song Meter picking up 54.5% of species on its own, Wildlife Cameras 52.7% of species on its own and UAV only 9% of species on its own. From these results, it could be stated that only the UAV is simply useful to supplement physical surveys, though its ability to go into difficult areas or to scout for future survey locations make it a valuable timesaving tool. Along with the Song Meter and Wildlife cameras being able to perform tasks and observations that are normally disrupted by human interference, an even greater species count is and understanding of biodiversity within a site is possible.

4.1 Song Meter deployment at the site.

Once again, we managed to record 'Booming' Bitterns as in the previous year's using the mentioned methodology. In total 637 hours of audio was recorded with the SM3 Song Meter.

It was stated in the Birdlife 2016 Project Report for Mornington Peninsula Shire for the previous 2015 year *"records of multiple birds and of "booming" birds (associated with courtship) at Tootgarook Swamp during December are an anomaly and should therefore be considered as evidence of potential breeding at the site. Remote audio recording (Songscope SM3 unit) confirm the presence of at least two males with separate booms heard during August 2015."*¹³

The Australasian Bittern call [Figure 10] 'Boom' appears to be at a very low frequency with the bulk of the call between 50hz-300hz, with the center or strongest part of the call being at approximately 155hz.

¹³ Purnell, C and Herman, K., 2016. **Tootgarook Swamp Bird Monitoring Program – Year 2 Annual Report.** Unpublished report prepared for the Mornington Peninsula Shire Council by BirdLife Australia. **Page 17**

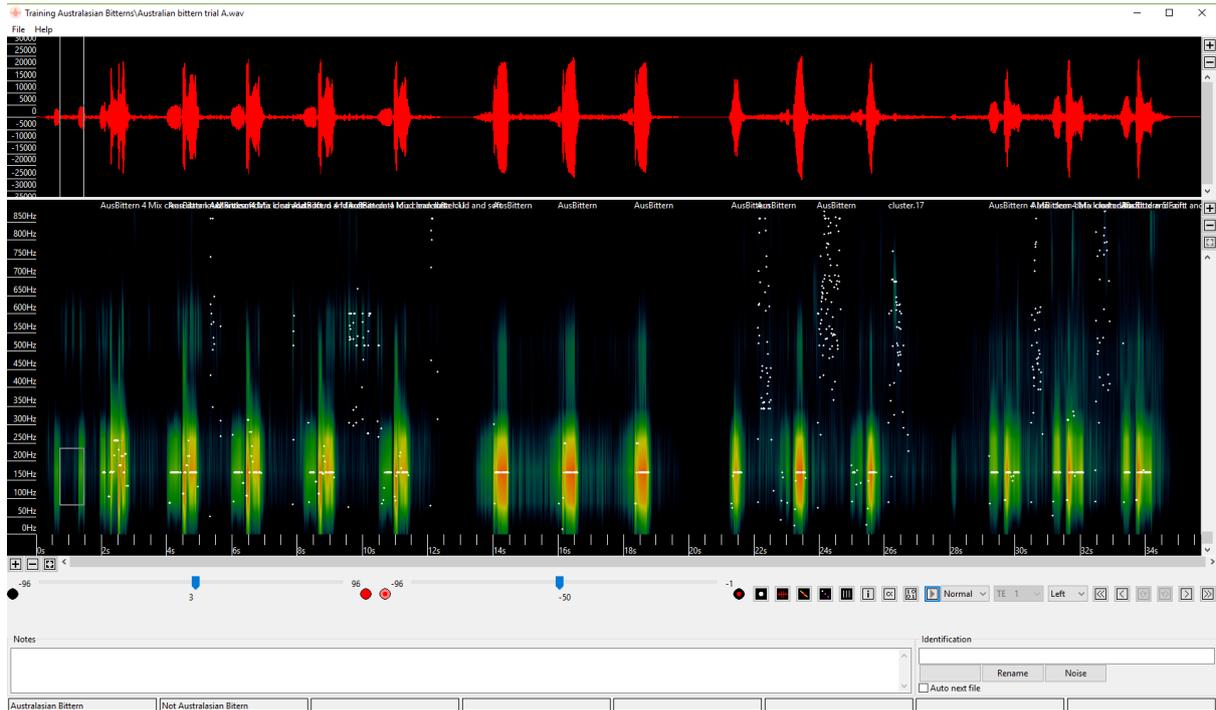


Figure 10 Clean Australasian Bittern Call Courtesy Museum of Victoria and Birdlife Australia. [Linked]

There was a number of Australasian Bittern calls but during the latter half of August calls rapidly drop off, the recordings following the month of August were plagued by a large amount of wind showing and interfering with the audio as well as the sound of vehicles giving false readings.

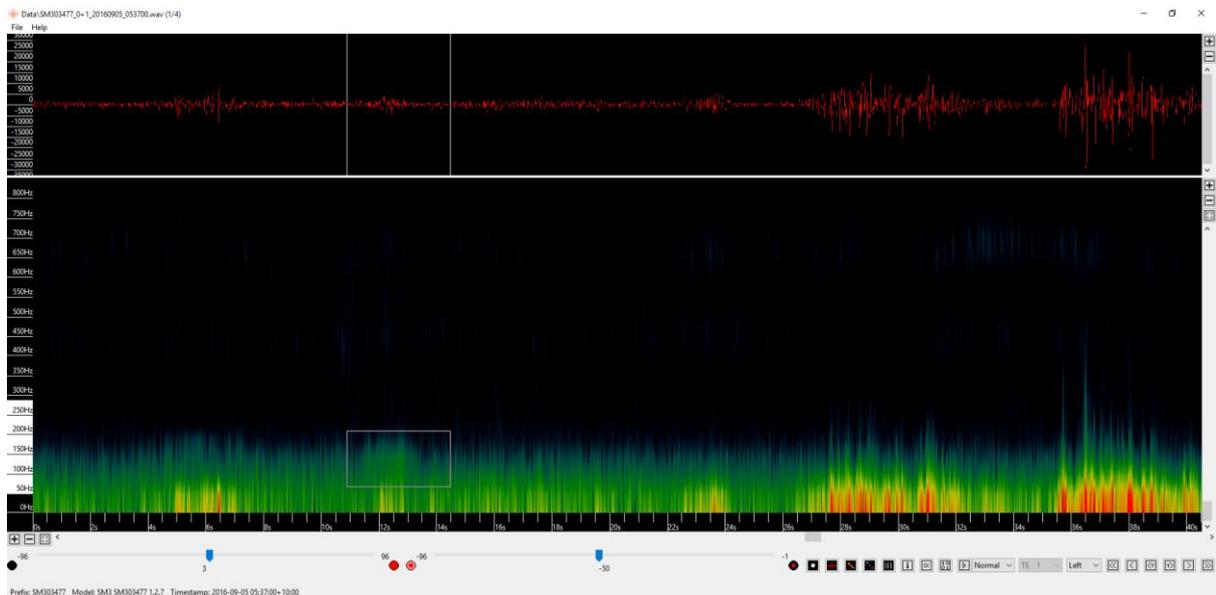


Figure 11 Vehicle in the same frequency range of the Australasian Bittern. [Linked]

There may have been more Australasian Bittern calls masked by wind and manmade mechanical machinery [Figure 11].

Below in figure 12 is a visual example of Australasian Bittern 'Booming' mixed with a light aircraft nearby.

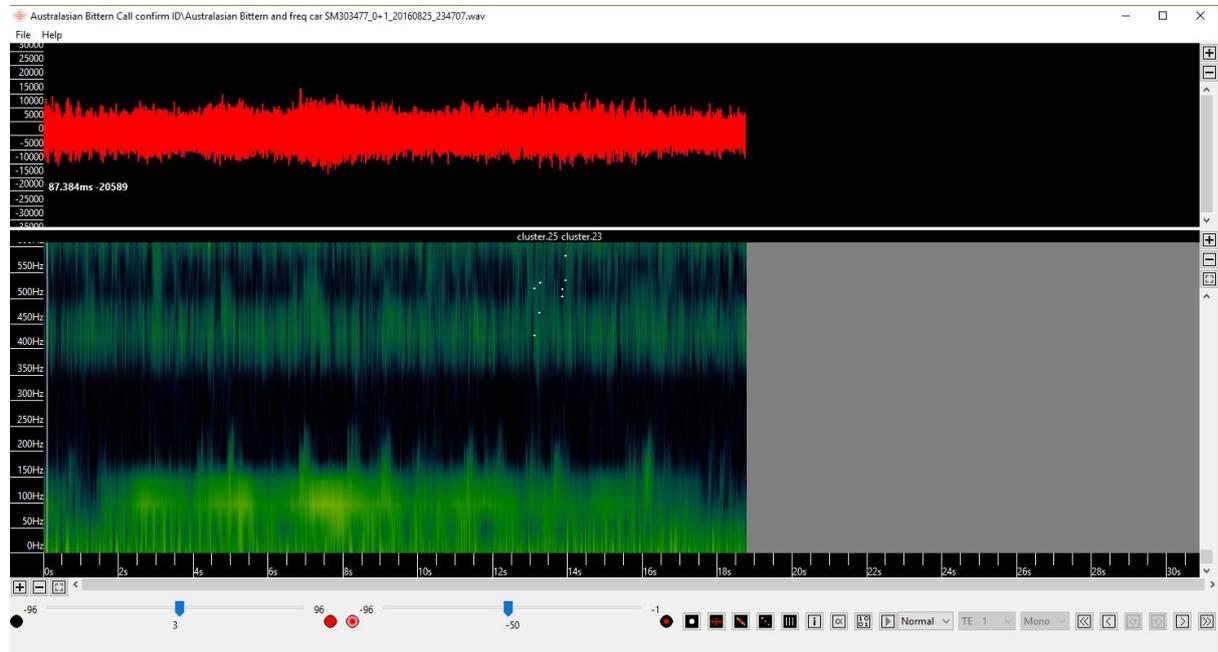


Figure 12 Australasian Bitterns calling with light aircraft noise added to the mix. [Linked]

The wind and nearby mechanical noise made the creation of what is called cluster analysis in the Wildlife Acoustics Kaleidoscope not possible. Creation either ended up with a result table of too many results or too many false positives. Whilst I found my cluster .kcs able to identify Australasian Bittern in recordings, it failed to do so in ones laden with mechanical noise and strong wind, a frequent occurrence during recording.

It was found to be more useful going back to visually scan and then manually listen to recordings when noticing what I determined could be a potential call (Boom).

It is unknown as to whether manmade mechanical noise [Figure 15] was interfering with the Australasians Bitterns calling and/or if it just made them more difficult to detect after August, as ground water levels raised with discharging of the surrounding topography, though birds seemed extremely hard to detect after dewatering of a nearby construction site in Capel Sound Industrial Estate started, along with construction noise. It is the authors opinion that dewatering should be banned from adjacent/former infilled development and in the wetland due to the low frequency noise pollution that is creates for immense amounts of time.

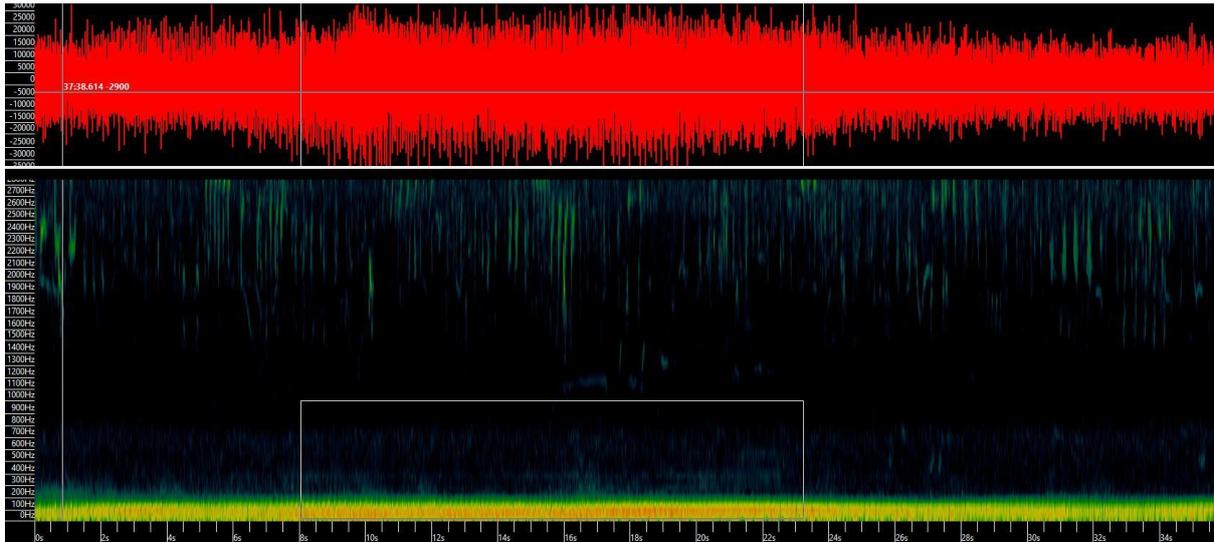


Figure 13 Dewatering pump creating environmental low frequency noise pollution. [Linked]

A single “Boom” was recorded on the 10th of November 2016 which showed that the species was still in the area even though it was not visually seen. The question is, were the birds present in the Tootgarook Swamp between 31st of August and the 10th of November? We are after all searching for an extremely elusive, secretive and cryptic well camouflaged bird, or did high levels of manmade noise cause some type of inference and/or disturbance.

Other information gathered from the data indicates that several species of birds were recorded on the SM3 Song Meter consisting of wetland birds, woodland birds, open country birds and introduced birds.

All song meter vocal call recordings were analyzed by the author and Australasian Bittern calls were recorded, as per the previous year. This was also confirmed by Chris Purnell from Birdlife Australia and Malcolm Legg, expert local fauna ecologist, who verified all recorded calls.

Over the period, what I would consider ideal conditions [Figure 14], a synchronisation of events, occurred only three times providing for optimal recording. That is no wind, no outside interference noise, conditions associated for avian communication occurred, whilst a recording was happening.

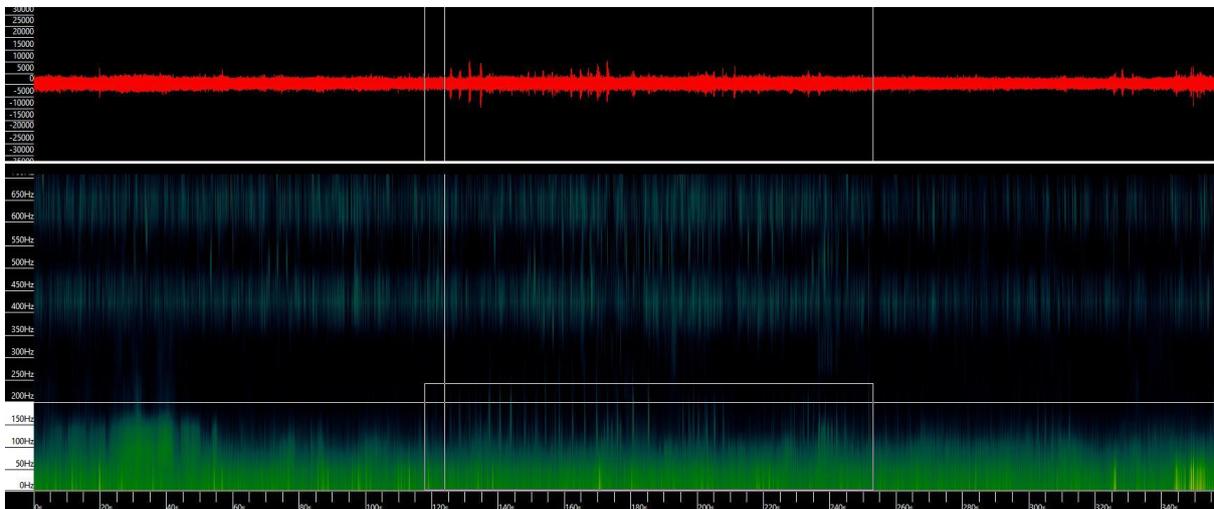


Figure 14 Clean recording with ideal conditions. [Linked]

Examples of other bird calls were recorded over the study period [Figures 15 – 20].

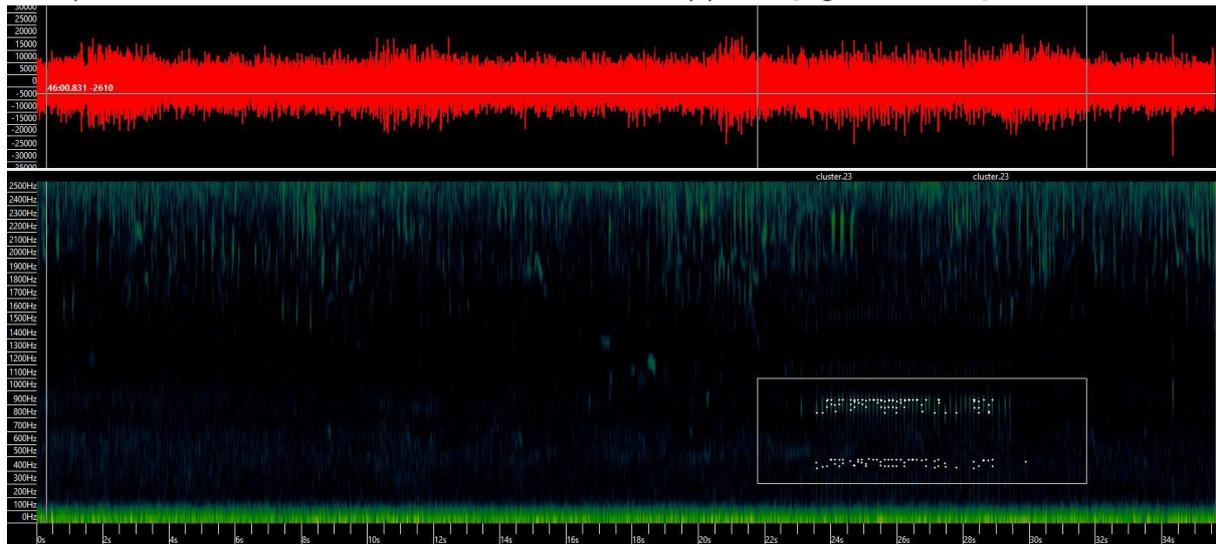


Figure 15 Australian Spotted Crake. [Linked]

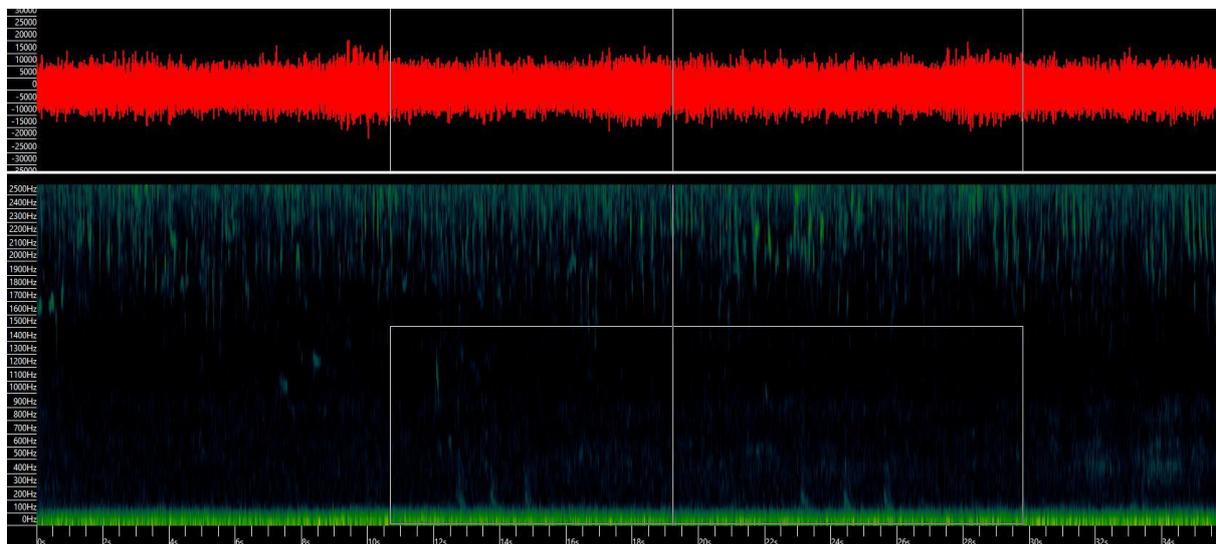


Figure 16 Lewin's Rail. [Linked]

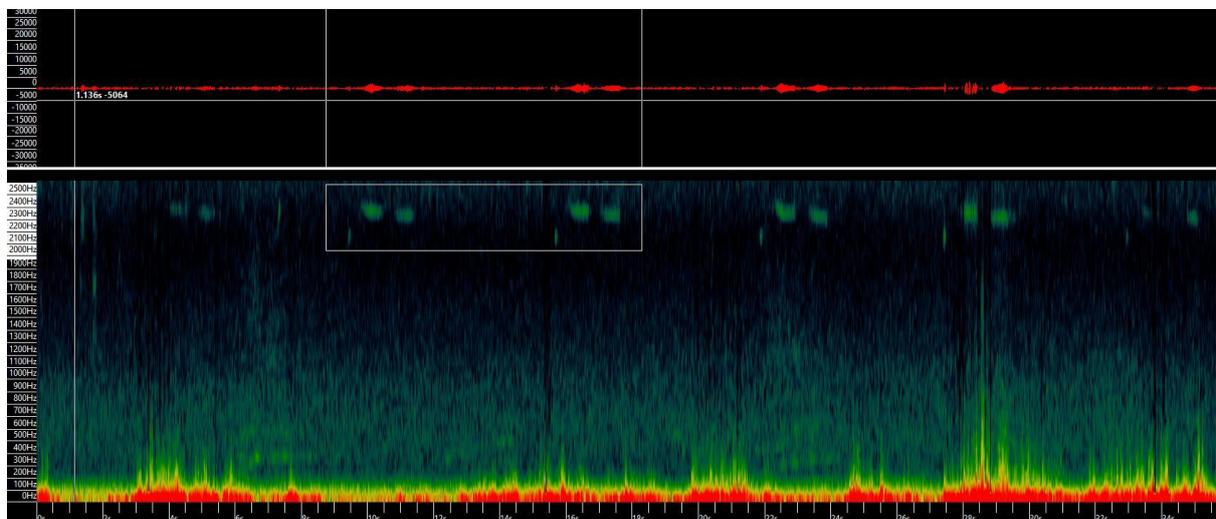


Figure 17 Little Grassbird with bandpass filter enabled. [Linked]

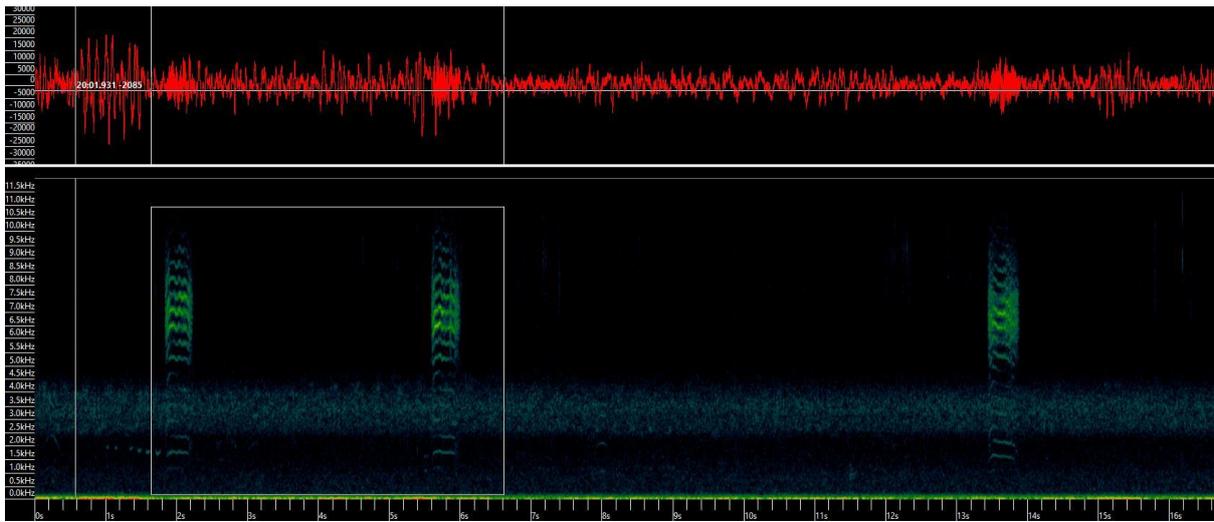


Figure 18 Golden Cisticola. [Linked]

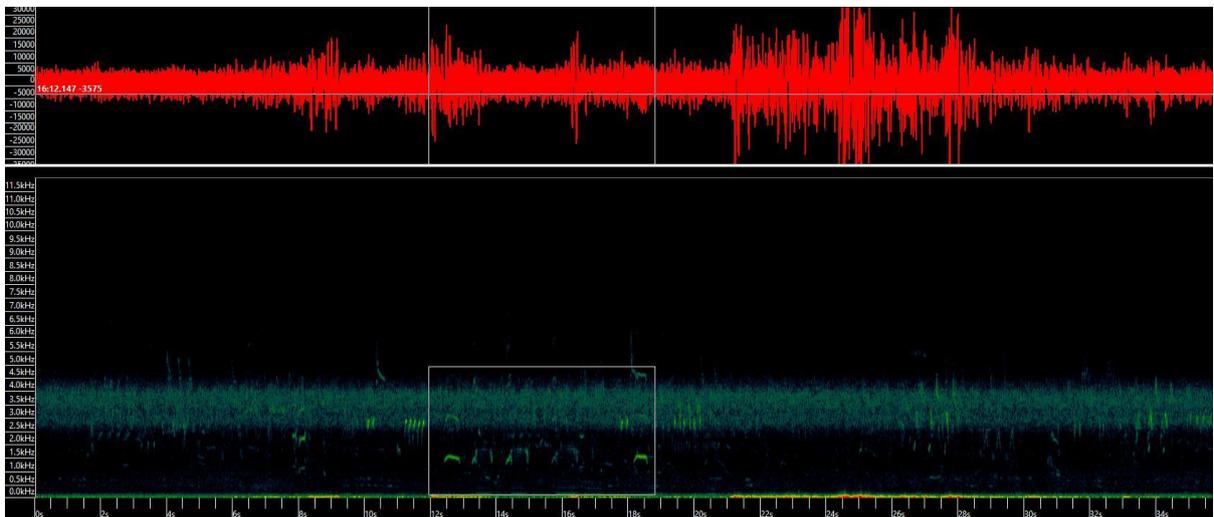


Figure 19 Black Swan. [Linked]

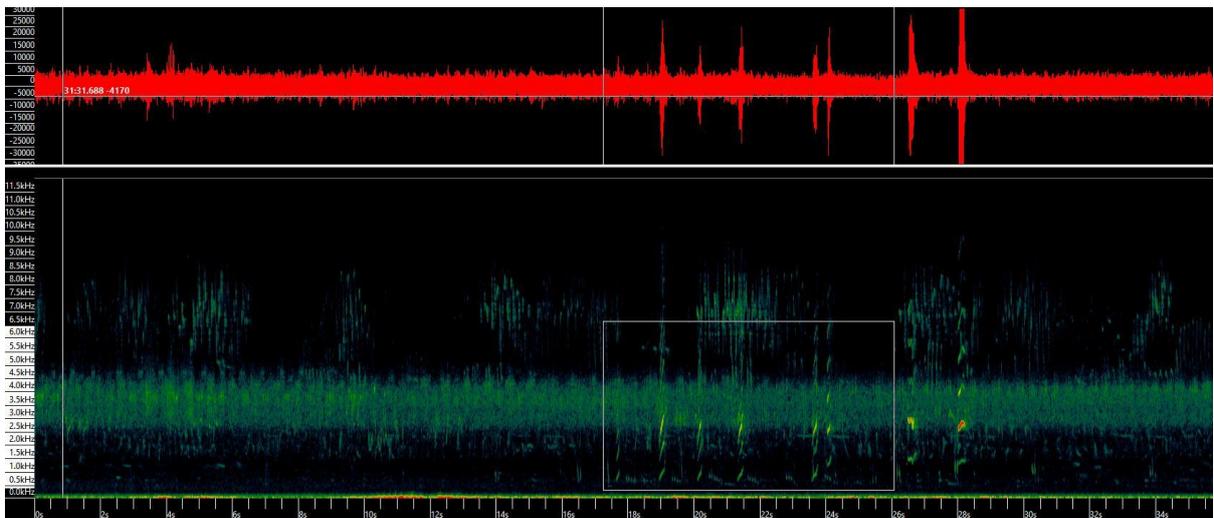


Figure 20 Swamp Harrier. [Linked]

4.2 Wildlife Camera deployment at the site.

Wildlife cameras were deployed to locations nearby where Australasian Bitterns appeared to have been flushed from during previous observations over the last few years. Some fine tuning has occurred as we have flushed birds nearby wildlife cameras before, though the Australasian Bitterns have not set them off.

Not all cameras were successful at capturing per chance movements of Australasian Bittern, though we do have one location that has successfully achieved footage for the last 3 years. This location is in fact a fixed fencepost, a question is, are the birds intelligent enough to notice something new stuck on a garden stake and avoid it?

Not only have we been able to capture footage of the elusive Australasian Bittern we have also captured footage [Figures 21 – 27] of some amazing other fauna including Ibis gorging on frogs, Nankeen Kestrels with prey, Nankeen Night Herons and an Eastern Barn Owl hunting at night plus a lot of activity with Swamp Harriers, the swamps most common raptor species. As well as having a Flame Robin (Near Threatened (NT) on the IUCN Red List¹⁴) land next to one of the cameras by chance looking down fence wire.



Figure 21 Australian White Ibis gorging themselves on frogs. [Linked]

¹⁴ <http://www.iucnredlist.org/details/22704819/0>



Figure 22 An ICUN Near Threatened Flame Robin lands on fencing wire, this fence came in handy for monitoring small birds. [Linked]



Figure 23 An Eastern Barn Owl hunting over the wetland at night, a good example for the use of 940nm night vision. [Linked]



Figure 24 Nankeen Kestrel has snatched up a small skink for a meal. [Linked]



Figure 25 Nankeen Night Heron foraging at the edge of the camera frame, shows why the wildlife camera only picks up per chance movements, if the bird had been to the left a little more no record of events would have occurred. [Linked]



Figure 26 A Swamp Harrier comes in to land for a tabled meal. [Linked]

Foxes [Figure 29] were observed by the Wildlife Cameras coming into the study site 89 times, these foxes were observed entering from outside the property from the adjacent former landfill site at all hours of the day, and a joint program is needed to be able to control this feral species.



Figure 27 Example of a Fox, captured by Camera 3. [Linked]

4.3 UAV deployment at the site.

An UAV (under 2kg) was deployed [Figure 28] to the northern areas of Hiscocks road, searching over Tall Marsh in hopes of finding an Australasian Bittern nest, which is essentially like looking for a needle in a hay stack.

The UAV did successfully detect Australasian Bittern seen on an occasion directly after a bird had been flushed through manual observation. An UAV was deployed approx. 10 mins afterwards with hopes of picking up the bird on the camera.

The drone did also record a large number of Black Swans *Cygnus atratus* [Figure 29] nests, numbering over 20 nests in total, in this particular location only (the authors estimate of over 60 nests in the entire study area), as well as flocks of Ibis feeding and in flight.

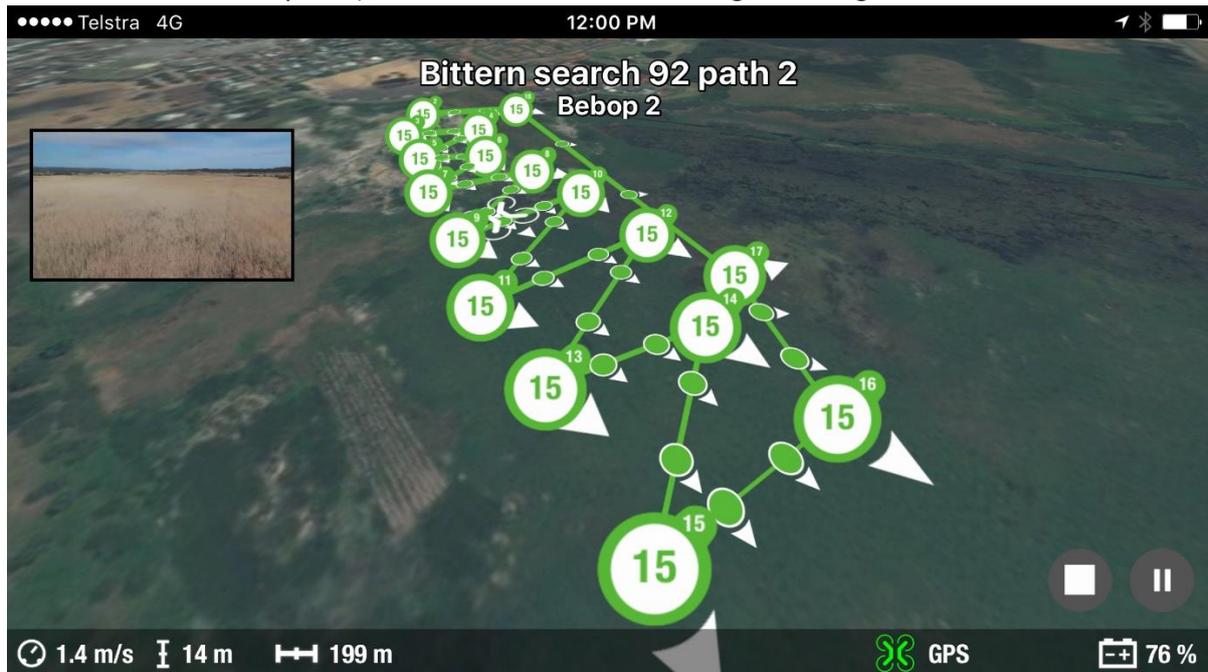


Figure 28 One of the Flight Plans deployed for regular and consistent surveying. [Linked]



Figure 29 Black Swan on nest.

4.4 Manual Observations at the site

Manual observations occurred whilst servicing the equipment, which was at approximately a fortnightly timing, though going longer September- December 2016. Before entering the site I would always give a quick scan with the Nikon D5300 and 600mm lens. The lens provides the ability to clearly identify bird species of least 30cm at up to approx 800 meters distance with the naked eye. The site is difficult to access without the proper equipment and site knowledge of terrain, water depth and locations of geographical features. We believe it is these features that keep feral [Figure 31] animals at bay as they limit their movement to particular pathways. This in our opinion is the prime time (peak groundwater level) for maximum effect of feral animal control works. Weather can play an extremely interesting part at the site, on very windy days you can assume that birds are not visible at the site as they are hiding deeper in the coverage of vegetation. Included are a number of photos here just to show a sample of the biodiversity of this area which is still not fully understood.



Figure 30 A Swamp Harrier out of reach of the Wildlife Cameras, though spotted before entering the site.



Figure 31 A fox on higher ground (at the study site, not fazed by the authors appearance).



Figure 32 A nest in extremely dense and almost impenetrable Tall marsh (821), this site was not suitable for a Black Swan.



Figure 33 Female Superb Fairy-Wren make a beautiful contrast in Tall Marsh (821).



Figure 34 Finding Australasian Bitterns is not easy and when you do they don't always provide the best photo opportunity, it's hard focus and lighting isn't even an option sometimes.



Figure 35 A used nest at the site that was passed, nothing was ever seen on it though evidence of use was there.



Figure 36 Another group of Black Swans with Cygnets, an estimate of over 60 nests in the study area.



Figure 37 An Eastern Great Egret; on one occasion I forgot the camera, a pair of binoculars and an iPhone will do.



Figure 38 A White-faced Herons blue-grey colouring blends in well with the brooding sky coloured winter waters.



Figure 39 Ibis seen frequently in mixed flocks, as well as numerous groups overhead that can be in the hundreds.



Figure 40 Pacific Black Ducks are the only duck species thought to be permanent residents.



Figure 41 A Great Cormorant dries itself off after diving for a meal.



Figure 42 A Little Pied Cormorant dries off; an old disused fence post provides habitat opportunities.



Figure 43 An Australian Reed-Warbler sneakely forages in Aquatic Herbland (653).



Figure 44 Silver Gulls fly extremely low over the Swamp only during the late months of Winter and very early Spring as to why is a mystery?



Figure 45 Australasian Pipits; a bird that blends in well to the grass



Figure 46 Golden Cisticola, the small bird with a harsh loud voice.



Figure 47 Striated Fieldwren are a species that hides well in the Gahnia, it's taken several years to get a photo of one on a fence out in the open.



Figure 48 A flock of Yellow Black-tail Cockatoos fly over the Swamp.



Figure 49 A Nankeen Kestrel eats an FFG listed Swamp Skink in mid-flight.



Figure 50 A juvenile Black-Shouldered Kite surveys for food.



Figure 51 A Wedge-Tailed Eagle soars overhead, we recently found a nest used by the Eagles at the edge of the Moonah Woodland and Tootgarook Swamp (March 2017).



Figure 52 An unidentified Mayflies on a Gahnia Flower.



Figure 53 A Day-flying moth *Cruria synopla*.



Figure 54 Damselflies were quite abundant during the later months of the survey, Slender Ringtail *Austrolestes analis*.



*Figure 55 Damselflies come in many different varieties in the Tootgarook Swamp this one thought to be a Pygmy Wisp Teneral *Agriocnemis pygmaea*.*



Figure 56 Gahnia Sedgeland, with a view towards Arthurs Seat unhampered by the built form.



Figure 57 Bolboschoenus caldwellii known as Marsh or Salt-club sedge in flower, the nut is edible .and can be ground into flour and baked into bread.



¹⁵ Chris Purnell - Birdlife Australia comments on this document

Figure 58 Matt Herring and Andrew Silcocks in the Tootgarook Swamp

A key moment during the study was having Andrew Silcocks from Birdlife Australia and Matt Herring from the Bitterns in Rice Project come to visit the Tootgarook Swamp after we had earlier identified Coly-Lion. Coly-Lion is an Australasian Bittern part of the Bitterns in Rice Project whose transmitter had stopped working and they thought it was fantastic to see him alive and well, 395 km from his Coleambally rice crop.

This really highlights the importance of the site for the national population “...records of this bird’s seasonal movements highlight the significance of southern, near coastal wetlands to the conservation of national population.”¹⁵

4.5 Future sites for expansive surveys in order to determine the population densities in the greater area.

A further longer study is required to determine whether Australasian Bittern are breeding within the Tootgarook Swamp and the population numbers and extended over the habitat range within the 650-hectare wetland.

Australasian Bittern 'Booming' was once again detected within the Tootgarook Swamp and it is possible that breeding could be occurring somewhere within the 650-hectare wetland.

☐ A larger more expansive study area within Tootgarook Wetlands. Based on hydrology (LiDAR modeling) two locations would seem logical locations to the west and another to the south, based on observed movements and preferred habitat that the species seems to prefer. These locations have habitat the same as the current known locations being that of Tall Marsh (821), Gahnia Sedgeland (968), Aquatic Herbland (653), Brackish Wetland (656), Sedge Wetland (136), and South Gippsland Plains Grassland (132) in a mosaic complex.

An observation from data in the mapping project is that the Australasian Bittern has a wider dispersal in the spring season than the winter.

Further vegetation information on the Mornington Peninsula may be critical to understanding any route that the species may be using to travel, so that surveying could possibly take place i.e. private property, and other wetland reserves.

Black Swan and Swamp Harrier in the expansive Tootgarook Swamp.



5.0 Recommendations

☒ Continuation of Australasian Bittern surveys to determine possible breeding in the Tootgarook Swamp. Expanding the survey to additional sites in the wetland that have similar habitat to determine population numbers is needed, though help is required to do so.

Local fauna ecologists and likeminded volunteers with the assistance of Birdlife Australia and Mornington Peninsula Shire is needed.

☒ A recommendation that has already been broached by Birdlife Australia, in the Tootgarook Swamp Bird Monitoring Program – Year 2 Annual Report. -

Strong recommendation is made for transfer of that part of 92W, observed to support presence of threatened species, to public ownership associated with ongoing and integrated longitudinal threatened species monitoring and conservation management across land tenure.

☒ Removal of the Public Acquisition Overlay from the Tootgarook Swamp as it threatens destruction of habitat for EPBC listed Australasian Bittern and many other species. The overlay passes through and dissects the lowest reaches of the swamp, the first and last large open area to contain ground water.

A long standing threat to this wetland is dangerously close to becoming a reality. A four lane, estimated 10km freeway extension – proposed on and off for decades. This fragment of freeway remains from a plan called the Rye Bypass drafted in 1965, back when land clearing and filling in wetlands were the norm.

Extensive and excessive amounts of dewatering would be required affecting the entire groundwater system and biodiversity it supports. It is also known that the wetland is suppressing pollution at the former landfill of Flinders Shire on Truemans road, which could be destabilised by such works.

The area is also an important nesting site for Black Swans on the Mornington Peninsula and may contain the largest breeding colony within. Decline of many species by a war of attrition would result from any said construction, which may very well affect Biodiversity beyond the Tootgarook Wetland, as the Freeway would bring more visitors and more pressure to the biodiversity of the Southern Peninsula, an example would be Hooded Plovers in the Mornington Peninsula National Park.

☒ Rezoning of private land in the north of the urban growth boundary, to Rural Conservation Zone (RCZ), and Shire land to Public Conservation and Resource Zone (PCRZ)

☒ Noise monitoring and control at the Capel Sound industrial estate.

☒ Combined and synchronised feral animal control program between Shire and private land owners within and around the Tootgarook Swamp in collaboration with Landcare.

Maximum water height seems to play an important part of fox trails, foxes seem to prefer the higher ground rather than inundated areas. Observations noted foxes will enter the water but the water makes noise and warns potential prey.



An Australasian Bittern takes flight after being flushed.

6.0 References

Purnell, C and Herman, K., 2016. Tootgarook Swamp Bird Monitoring Program – Year 2 Annual Report. Unpublished report prepared for the Mornington Peninsula Shire Council by BirdLife Australia.

Purnell, C and Wilson, C., 2015. Tootgarook Swamp Bird Monitoring Program – Year 1 Annual Report. Unpublished report for the Mornington Peninsula Shire Council by Birdlife Australia.

M. Legg 2014. **Fauna survey of MPS &MW managed reserves at Tootgarook Wetlands.**

Brown, C. Et al, 2014. Swamp Management Guidelines for the Greater Tootgarook Swamp. Prepared for Save Tootgarook Swamp Inc.

Brown, C. Australasian Bittern Mapping project Tootgarook Swamp, Google Maps. 2014-2016

Matt Herring (MH), July 2016 Bitterns in Rice the Story so far 2012-2016

<http://www.bitternsinrice.com.au/wp-content/uploads/2016/08/Bitterns-in-Rice-Project-2012-2016-summary-booklet.pdf>

Australian Dragonfly Identification Key <http://rnr.id.au/cgi-bin/species/odonata>

Maps

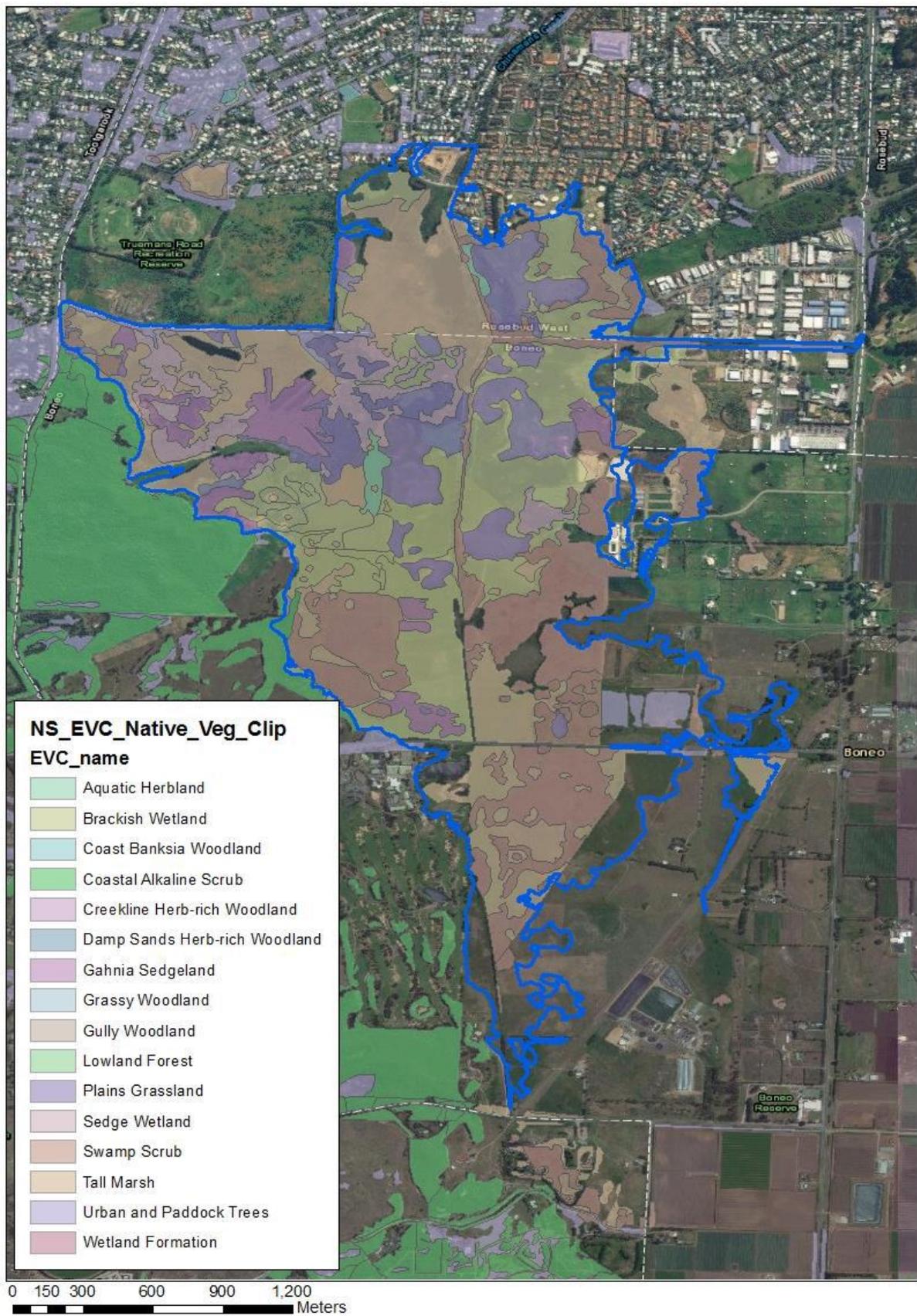


Figure 59Map 3a



Figure 60 Map3b



Figure 61 Map 3c



Figure 62 Map 3d

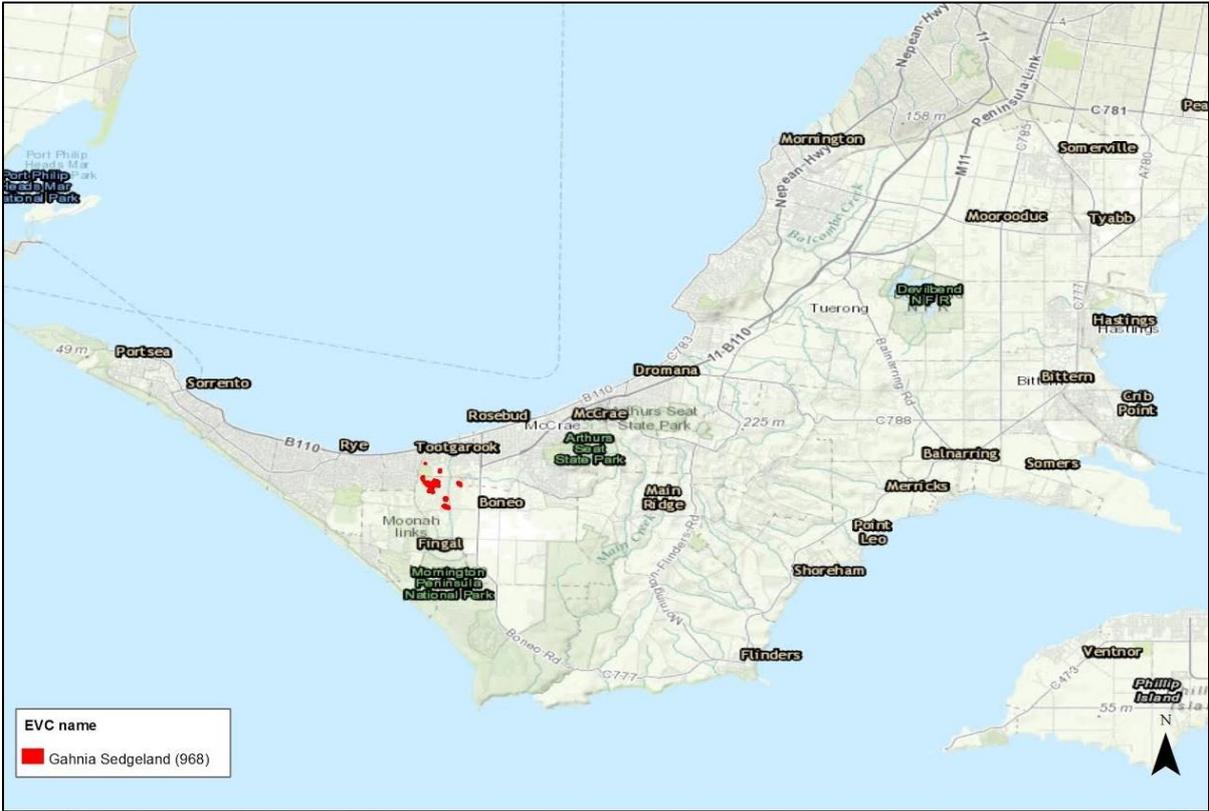


Figure 63 Map 3e