Review of the conservation ecology and bioacoustics of the Tasmanian masked owl

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This report is an overview of information considered relevant by the authors to the conservation ecology, survey and management of the Tasmanian masked owl *Tyto novaehollandiae castanops* Whilst the authors have used best endeavours to ensure accuracy, they do not warrant that the material is free of error. Consequently, the information is provided on the basis that the authors will not be liable for any error or omission. However, should any error or omission be notified, the authors will use their best endeavours to correct the information.

Front page photograph: (Photo 1) Tasmanian masked owl *Tyto novaehollandiae castanops* (Photo: Joel Evans)

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On the subject of the Tasmania masked owl

The masked owl of Tasmania is not uncommon but rarely seen. Dead birds are frequently picked up after having struck telegraph wires at night or being killed by road traffic. Sometimes it becomes caught in rabbit traps and has been known to lift a trap and carry it attached to its foot for nearly half a mile. This feat was noted with a bird that was eventually forced down in the courtyard of Entally National House, Hadspen

Sharland in '*Tasmanian Birds*' (1958)

Sheaves of oats were stacked in paddocks and in barns. These attracted many rats and mice on which the owl population fed, along with rabbits. A very large masked owl accidentally caught in a rabbit trap had three claws damaged. It was kept in a barn and hand fed rabbits until its foot heeled. Although free to go it stayed and laid two eggs on the sheaves. When the threshing machine was due, Mr Parsons made a wire netting covered frame, placed oats on it, then the eggs and put it in a corner of the barn. The owl hatched and reared two chicks. The parent owls took no notice of the threshing machine working 'close by'. Owls were often caught in rabbit traps. One morning nine had been caught but fortunately no broken legs. They were looked after if claws were damaged. There would be up to three pairs of owls nesting in one barn. Barn owls were the very rare birds and seemed more knock kneed than the masked owls and didn't like the masked owls 'too close to them' in the barn. Both species nested at the same time in the barn – barn owls usually on the top ends of the large poll supports and masked owls on the sheaves. They were very noisy when young were being fed. One pair of barn owls successfully nested on chaff in a draught horse manger. Mr Parsons constructed a partition part way down the manger in order to prevent the owls contaminating the horse's food.

Accounts from Gwen Holtham (nee Parsons) of her father's property at Forthside in northern Tasmania during the 1940's (Joan Elliott pers. comm. 1996; Joan was a member of Birds Tasmania and a keen bird observer; Gwen was Joan's friend). In 'Predicting essential habitat for forest owls in Tasmania' by Phil Bell, Nick Mooney and Jason Wiersma (1996) '*Report to Tasmanian Environment and Heritage Technical Committee, Regional Forest Agreement – Tasmania*.'

Various reference books claim that the species is common. Although I cannot say that I agree with that statement, it is undoubtedly well distributed throughout Tasmania, but usually many miles between pairs, and I have neither seen nor heard of more than one pair in any extensive locality, and would be more inclined to say that perhaps owing to the very characteristic call which at some times of the year is so persistent and loud as to attract attention, together with the striking appearance, and also the fact that it is seen in barns and caught in rabbit traps, the listing as 'common' has arisen.

Les Hill in '*Notes on the habitat and breeding of the Tasmanian masked owl*' Emu 1955.

Review of the conservation ecology and bioacoustics of the Tasmanian masked owl

1. Introduction

Survey and management of Tasmanian masked owls for conservation purposes has been an active area of research, monitoring and policy development over the past few years. Indeed, emerging technologies such as passive acoustic monitoring (PAM) and advances in GPS tracking are creating opportunities for cost effective survey and monitoring of the subspecies and are providing insights into the ecology, behaviour and habitat use of the subspecies at both fine- and landscape-scales.

The Tasmanian masked owl was listed as endangered in Tasmania under the Tasmanian *Threatened Species Protection Act 1995* in 2002 and as vulnerable under the Commonwealth, *Environment Protection and Biodiversity Conservation Act 1999* in 2010. Although considered threatened for more than two decades, little systematic survey or conservation attention has been afforded the subspecies, mainly due to its nocturnal, secretive behaviour and low detectability using traditional survey techniques.

2. Purpose of this document

This document reviews the current information base on acoustic monitoring and ecology of Tasmanian masked owls for conservation purposes. The knowledge base is rapidly expanding with the uptake of emerging technologies such as passive acoustic monitoring and GPS tracking but also because of a recent increased profile of the Tasmanian masked owl. Regular review of the knowledge base will ensure that advances in ecological research and adaptive management of the Tasmanian masked owl can be incorporated into survey guidelines and conservation management decision making in a timely manner.

3. The Natural Values Atlas (NVA)

3.1 Background

The Natural Values Atlas (NVA) is the Tasmanian Government's repository of spatial data on biodiversity and other natural values. The NVA is a key source of data to inform researchers, environmental consultants and development proponents on when and where Tasmanian masked owls have been observed. Records in the NVA often include additional information on the nature of the observations such as 'road killed', 'sighting' or 'audible'. The NVA also includes records of the location of habitat features associated with observations of the subspecies such as 'nest' or 'roost tree'. The interpretation of NVA records is critical in some circumstances to ensure appropriate conservation of the subspecies and protection of important habitat features.

3.2 Tasmanian masked owl records

In July 2025 there were 3547 records of Tasmanian masked owls in the NVA including: 'audible' (n = 2252), 'camera trap' (n = 6), 'carcass' (n = 31), 'kill carcass' (n = 1), 'nest' (n = 46), 'not recorded' (n = 269), 'pellet' (n = 10), 'potential nest hollow' (n = 2), 'radio tracker signal' (n = 1), 'roost site' (n = 13), 'scat' (n = 1) and 'sighting' (n = 915).

The distribution of Tasmanian masked owl records in the NVA is shown in Figure 1.

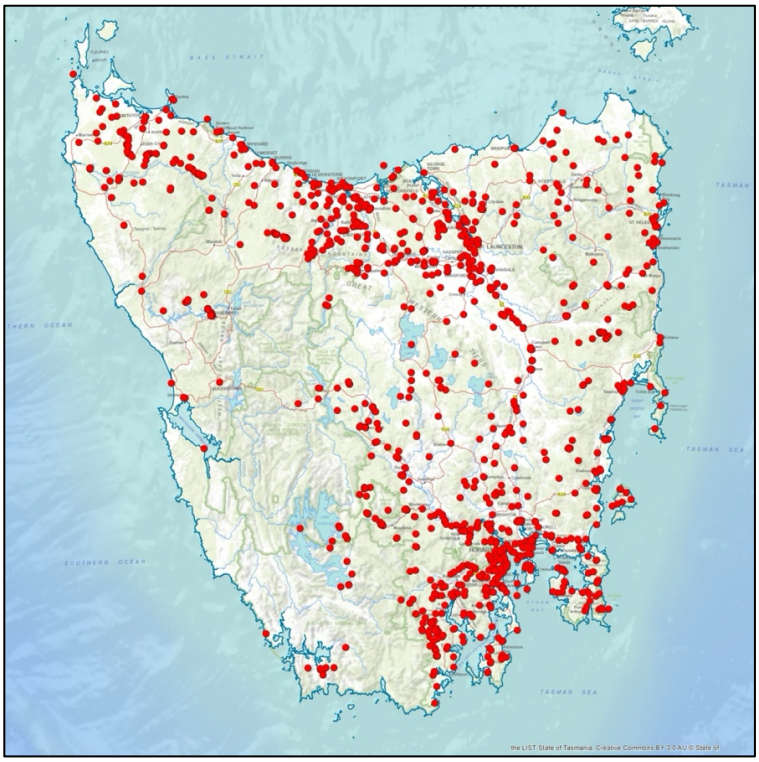


Figure 1. *Distribution of Tasmanian masked owl records (red dots) in the NVA (accessed July 2025)*

3.2.1 Sighting records

There are 915 'sighting' records of Tasmanian masked owl in the NVA. Sighting records include most of the historic records in the NVA (i.e., prior to 2018). Based on the examination of a sample of historic Tasmanian masked owl records, most of the 'sighting' records are 'audible' observations i.e., they are hearing of Tasmanian masked owl call(s) rather than sighting of the subspecies.

3.2.2 Acoustic records

There are 2252 'audible' records of Tasmanian masked owl in the NVA. Audible records are either audible observations such as a hearing at the location of the record, or remote audible detections such as from manual listening to acoustic recordings, examining spectrograms or analysing acoustic data using an automated call detection algorithm. There are some 'camera trap' records of the Tasmanian masked owl in the NVA which are manual detections of Tasmanian masked owl calls from the audio component of camera trap video.

The distribution of Tasmanian masked owl 'sighting' and 'audible' records in the NVA is shown in Figure 2.

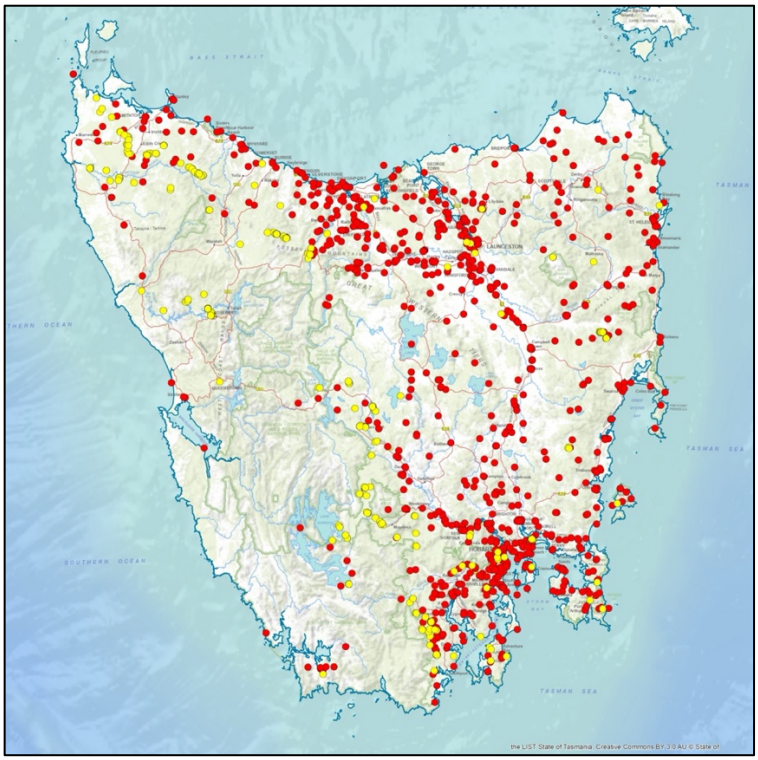


Figure 2. *Distribution of Tasmanian masked owl records in the NVA (accessed July 2025) showing the distribution of 'audible' records (yellow dots) and 'sighting' records (red dots).*

3.2.3 Roost and nest records

There are 13 'roost' records in the NVA though further interrogation of 'roost' records reveals that 9 of these are incorrectly labelled as roosts, reducing the total number of roost records to just a few. Roosts are much under-represented in the NVA, especially long-term roosts in caves and potholes. A roost record is usually a tree hollow roost, native vegetation roost or cave roost, though some are in anthropogenic structures or exotic trees. The very small number of roost records in the NVA adds little information on which to understand the distribution or nature of Tasmanian masked owl roosting habitat.

There are 46 nest records in the NVA. Their distribution is shown in Figure 3. After excluding duplicate locations there are 43 nest records. Sixteen nest records have not been validated and are of unknown veracity, three of which are most likely to be roost records. Twenty-one records were confirmed as a nest though the nest or nest tree has since gone and most of the records are >40 years old. After discounting nests confirmed to have gone (e.g., nest tree has fallen) and those that have not been validated, there remains only six nest records in the NVA that have been validated and are likely to be extant. A summary of the age of records including additional information on record validation and the status of nest records is provided in Table 1.

Table 1. *Summary information on the status of nest records in the NVA.*

Age of record	Not validated as nest	Not validated as nest and likely to be a roost	Nest or nest tree confirmed gone
<20 years (8 records)	5	1	1
20 - 40 years (16 records)	9	2	6
>40 years (19 records)	2	0	14

Many nests which have been validated by recognised experts and are likely to be extant, have not been entered in the NVA because of researcher and/or landowner confidentiality issues. Given the recognised importance of nests and nesting habitat to conservation of the Tasmanian masked owl, researchers, consultants and interested members of the public are encouraged to enter nest locality data on the NVA.

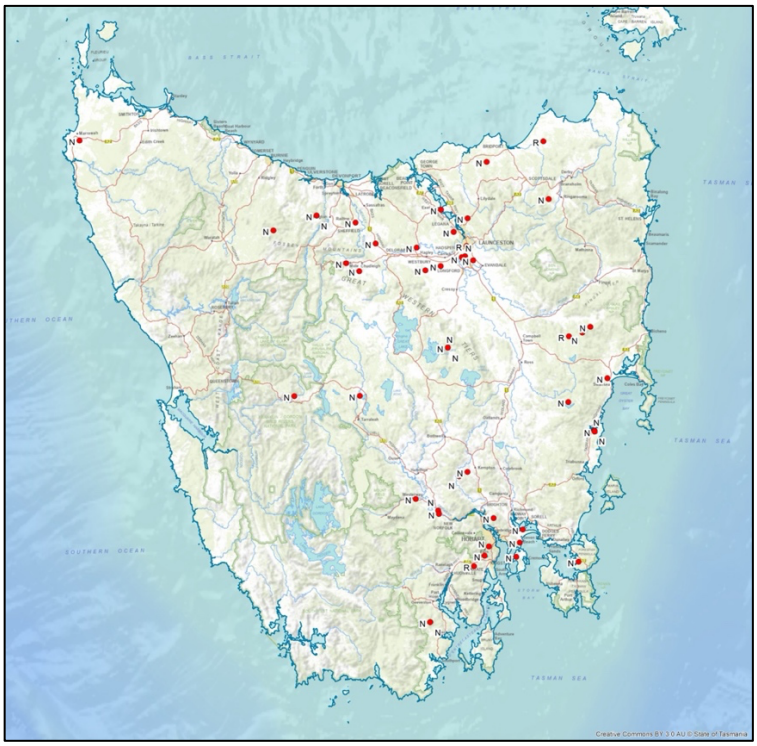


Figure 3*. Distribution of Tasmanian masked owl roost (R) and nest (N) records (red dots) in the NVA (accessed 27 July 2025).*

3.2.4 Carcass records

There are 32 carcass records in the NVA. Most of these records are likely to be road killed birds (Figure 4) although some found dead near roads may have collided with wires or fences.

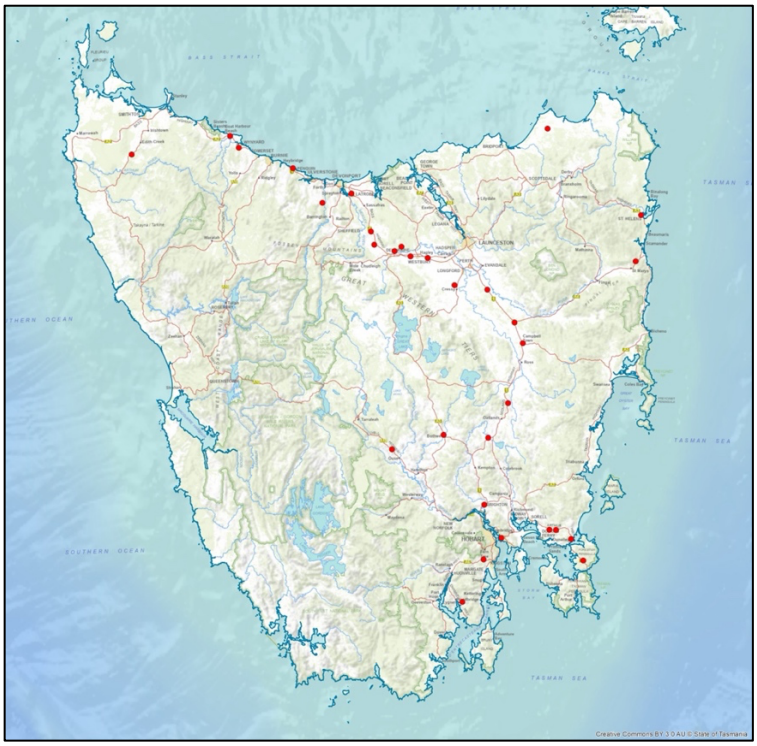


Figure 4. *Distribution of Tasmanian masked owl carcass records in the NVA (records current as at 27 July 2025).*

3.2.5 Other records

There is an assortment of other observation types of Tasmanian masked owl records in the NVA including: not recorded (n = 269), pellet (n = 10), potential nest hollow (n = 20; noting that a potential nest hollow is not an observation of a Tasmanian masked owl), radio tracker signal (n = 1) and scat (n =1; described as a pellet in the notes field).



Tasmanian masked owl, northwest Tasmania (Photo: Adam Hardy)

3.3 Tasmanian masked owl audible records from acoustic monitoring

There are 2170 acoustic records in the NVA (Figure 5) from 69 locations (Figure 6). For the purposes of this document a location is defined as all Tasmanian masked owl detections ≤ 1 km from their nearest neighbour.

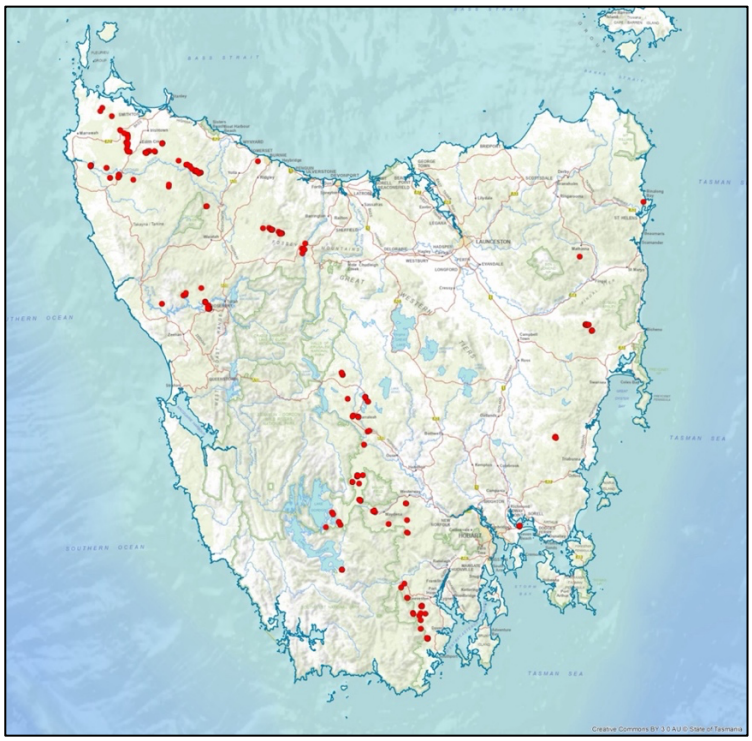


Figure 5. *Distribution of all Tasmanian masked owl 'audible' records detected on audio recordings collected by acoustic recording units (red dots).*

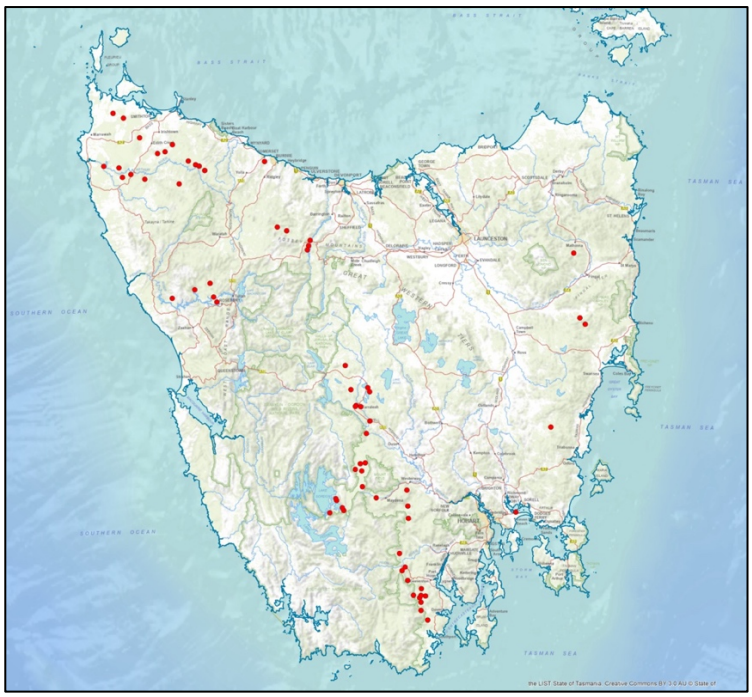


Figure 6. *Locations of all Tasmanian masked owl acoustic records (red dots) where location is a cluster of all records ≤1 km from their nearest neighbour.*



Deployment of an acoustic recorder. The location of an acoustic recorder may have a high level of accuracy, but this does not reveal where the owl was calling from.

3.3.1 Location of acoustic detections

The location of Tasmanian masked owl acoustic records in the NVA is usually the location of the acoustic recorder on which the subspecies' call was detected and not the location of the caller.

3.3.2 Location accuracy of acoustic detections

Information on the detection range of acoustic recorders is not provided with any Tasmanian masked owl acoustic record in the NVA. Therefore, the specific location of the caller is not known and could be close to or some distance away from the location of the acoustic recorder.

3.3.3 Types of acoustic detections

Most Tasmanian masked owl acoustic records in the NVA are assumed to be the screech call and this information is sometimes with the NVA record. However, some observers have noted the chattering call, and this information is sometimes provided with the NVA record. Most available automated call recognisers have been developed to detect screech calls. There are few if any automated call recognisers developed for the detection of chattering calls. Most detections of chattering calls are likely to have been made by visual examination of spectrograms and/or by listening to acoustic recordings. There is often a close temporal association between screech calls and chattering calls and manual examination of spectrograms around the time of screech calls can be rewarding in the detection of chattering calls.

Some observers have provided information on the abundance of Tasmanian masked owls calling with NVA records such as 'multiple birds calling' and such observations are suggestive of the presence of a breeding pair or family group. Some observers have provided information on the calling behaviour with NVA records such as 'high frequency of calls at dusk and dawn' suggesting the potential presence of a roost and/or nest site nearby. Only a few observers have provided information on the age of the birds calling such as 'juvenile birds calling – confirmed by Bill Brown'.

3.3.4 Methods of detections

Very little information is provided with Tasmanian masked owl acoustic records in the NVA on the method of detection such as listening to acoustic recordings, examining spectrograms or using an automated call detection recogniser.

4. Passive acoustic monitoring

4.1 Background

Tasmanian masked owls occur in most terrestrial habitats. However, determining the presence of resident birds is problematic, particularly whether a location is used for nesting and/or roosting and false negatives are a common risk. In the past, the survey technique of broadcasting Tasmanian masked owl calls was used to try and solicit a response from nearby Tasmanian masked owls and hence detect their presence (e.g., Bell et al., 1996; Todd et al., 2018; Cisterne et al., 2020). However, detecting the subspecies by broadcasting calls can be difficult and confidence of absence is a major issue. Using acoustic recorders (i.e., autonomous recording units or ARUs) to detect the calls of Tasmanian masked owls is emerging as an effective technique for initial site-based surveys to detect presence and to monitor the use of habitats by the subspecies at both fine- and landscape-scales.

Worldwide, passive acoustic monitoring is emerging as an alternative to traditional wildlife monitoring surveys and typically involves deploying acoustic recorders to passively record sounds on a set time schedule, followed by off-site analysis of the acoustic data. The passive nature is likely to usurp more active survey techniques such as call-playback which itself can alter subject behaviour. Passive acoustic monitoring can provide a cost-effective and minimally invasive way to sample continuously across multiple locations over extended periods of time. Acoustic data form a permanent record that can be re-analysed to reduce observer bias and can be effective for detecting rare species with low detectability. In avian research, acoustic recorders are used for monitoring population trends, studying behaviour and modelling habitat associations. Integrating traditional survey methods with acoustic monitoring has the potential to be a valuable tool for overcoming the challenges in quantifying habitat use and breeding success for cryptic and highly mobile threatened species like the Tasmanian masked owl (Gros et al., 2026).

The time-consuming nature of manual species identification using acoustic monitoring across extensive spatial areas and typically involving hundreds or thousands of hours of recordings has driven the need for streamlined acoustic data processing and reliable methods to automatically identify species' calls. Several approaches have been proposed worldwide for automatic call detection, including decision trees (Digby et al., 2013), spectrogram cross-correlation (Katz et al., 2016), hidden Markov models (Wildlife Acoustics, Inc., 2021), and most recently, deep learning using neural networks (Nolan et al., 2022).

Recent research on calling behaviour of owls is revealing the types of additional information that can be gleaned from acoustic recordings (e.g., Todd et al., 2017; Dale et al., 2022). Todd et al. (2017) found Tasmanian masked owls produce a deeper (lower frequency) screech than Australian masked owls *Tyto novaehollandiae novaehollandiae*, adult and juvenile Tasmanian masked owls produced different screech calls and paired male and female Tasmanian masked owls produced different chatter calls from each other. Comparison of the chatter calls between individuals suggested that these types of calls may be used to identify individual owls. Dale et al. (2022) developed a technique to determine the sex of Northern spotted owls *Strix occidentalis caurina* to support acoustic monitoring efforts that were restricted to determining species presence rather than breeding status. Distinguishing female from male Northern spotted owl vocalizations can facilitate determination of pair status using passive acoustic methods, greatly enhancing inference derived from non-invasive monitoring data (Dale et al., 2022). Jackett et al. (2025)

examined the relationship between environmental variables (latitude, temperature, elevation) and acoustic characteristics (call duration and mean dominant frequency) of Australian masked owl calls recorded via passive acoustic monitoring. They found that the mean dominant frequency of calls increased at lower latitudes and warmer temperatures and decreased with elevation.

4.2 Detecting Tasmanian masked owl calls

4.2.1 Types of calls

The most heard and/or recorded call of the Australia masked owl *Tyto novaehollandiae novaehollandiae* is the 'screech' call, often described as a much deeper (lower frequency) and louder version of the rasping hiss of the Eastern barn owl *Tyto javanica*. The second most observed call is the 'chatter' call, sometimes described as a cackle. The screech and chatter calls are produced by both sexes, with an extended form of the chatter thought to be used as a courtship call. The masked owl screech call carries over a greater distance than the chatter call, increasing its detectability. There are other calls described for the Australian masked owl which are probably related to communication between a pair and/or offspring in close proximity (Todd et al., 2017).

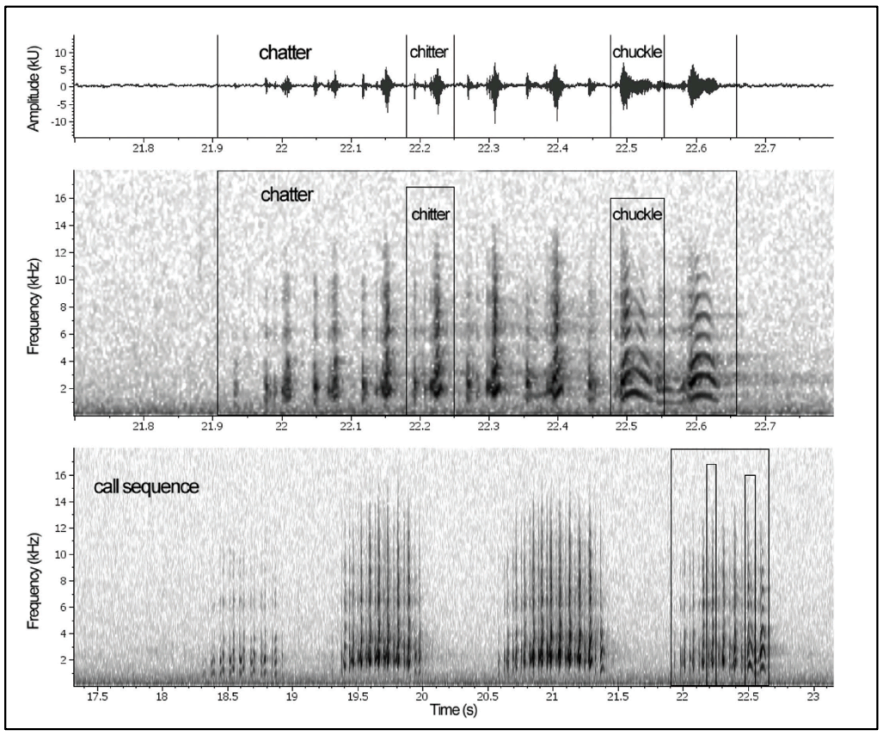


Figure 7. *Typical spectrogram of a chatter call sequence of a Tasmanian masked owl. The call sequence shown in the bottom graph (approximately 4.4 seconds duration) is made up of 4 chatters. The chatter (0.7 seconds duration) shown in detail in the middle graph is made up of 9 notes including 7 chitters and 4 chuckles (Todd et al., 2017)*

To avoid confusion, it is recommended that the terminology and definitions used in Todd et al. (2017) for chatter calling is used for recording and reporting on the results of acoustic monitoring for Tasmanian masked owls (i.e., the chatter call may comprise both chitter calls and/or chuckle calls). Figure 7 shows a typical spectrogram of a chatter call sequence. This recorded call sequence is made up of 4 chatters, and each chatter is made up of notes including chitters and chuckles (Todd et al., 2017). Figures 8 to 11 show typical spectrograms of screech and chatter calls of a Tasmanian masked owl adult (Figure 8 and 9), juvenile (Figure 10) and chick (Figure 11).

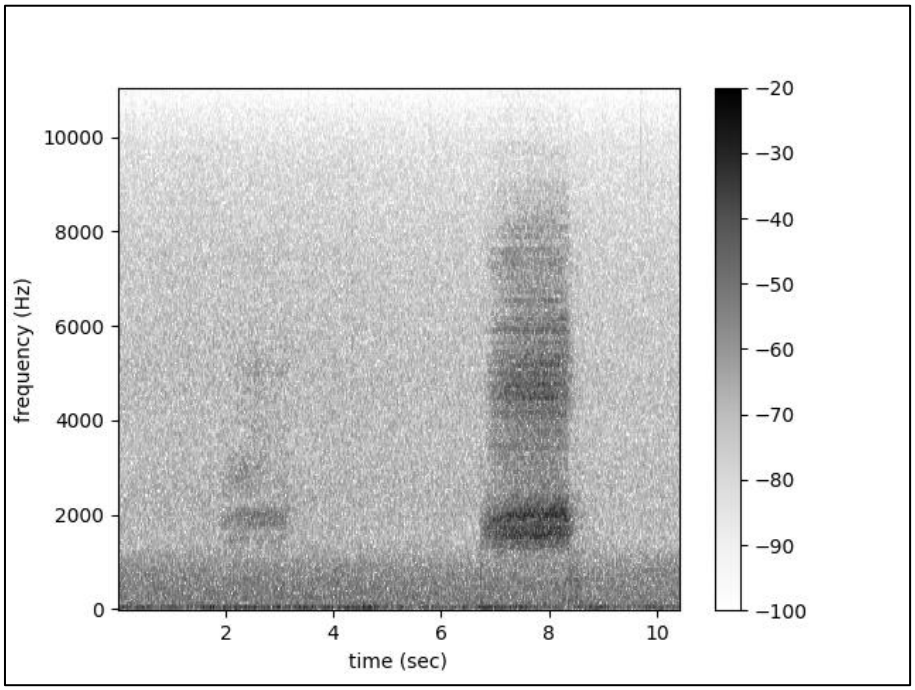


Figure 8. *Spectrogram of adult Tasmania masked owl screech calls, LHS faint call (from an owl some distance away from the acoustic recorder) then a loud response call RHS (from an owl likely to be in the tree above the acoustic recorder).*

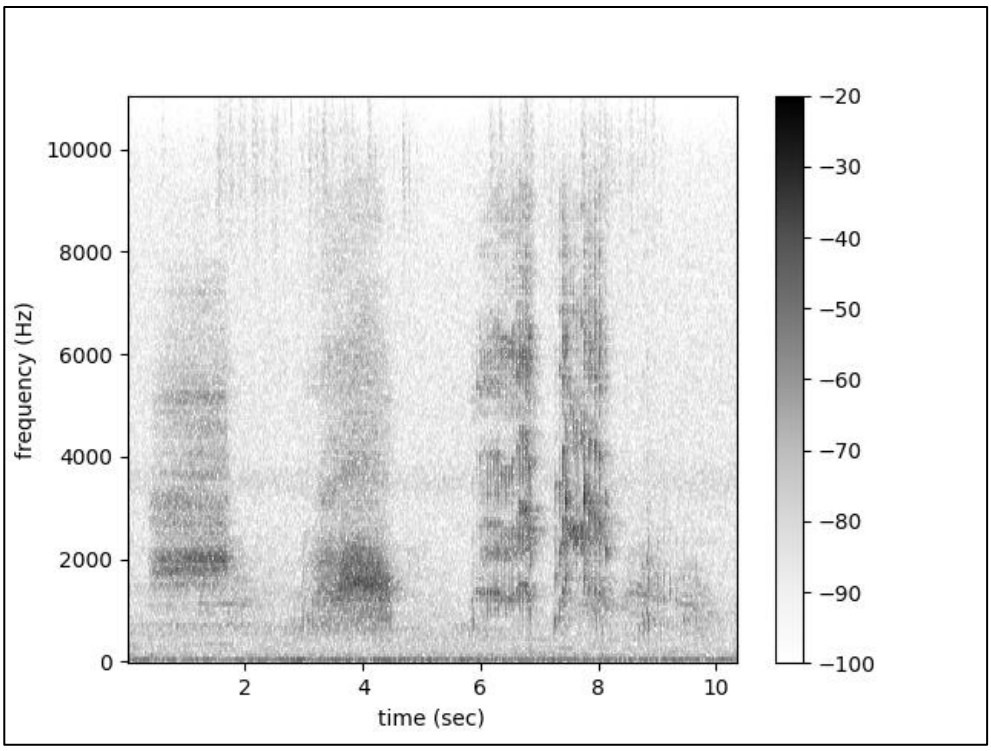


Figure 9. *Spectrogram of an adult Tasmanian masked owl screech call, loud (LHS), then a 'transitional' call between screech and chatter, then a chatter call sequence (RHS). Calls are close to the acoustic recorder.*

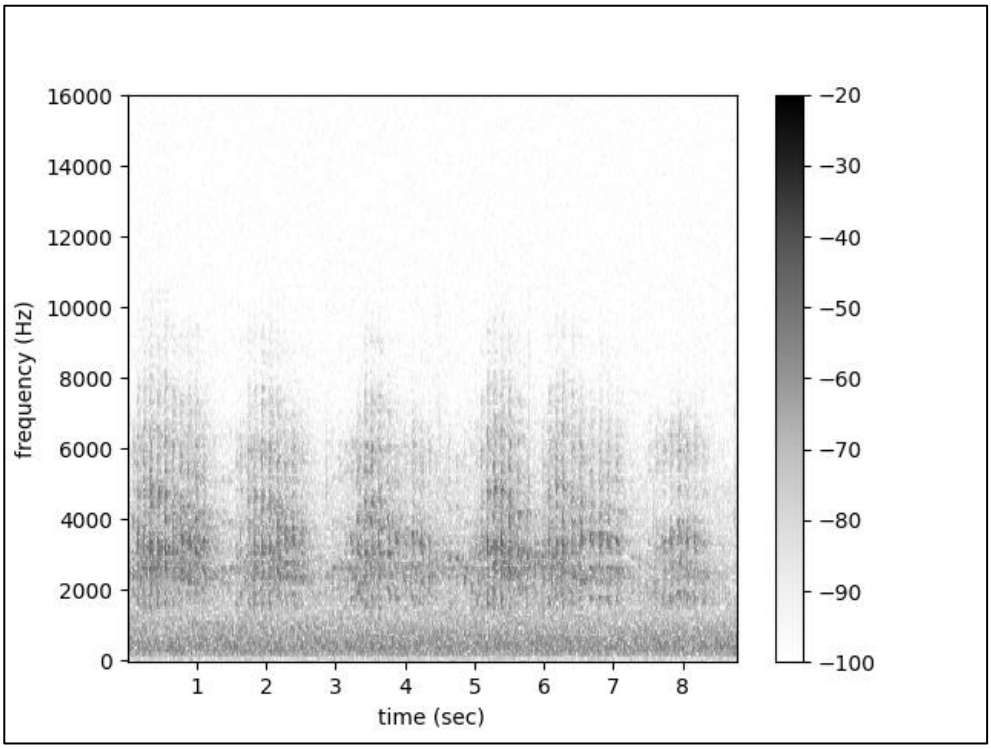


Figure 10. *Spectrogram of a chatter call sequence of a juvenile Tasmanian masked owl (identification made from down still detectable around the facial disc of the observed caller). Calls recorded at a known nest site, central north Tasmania.*

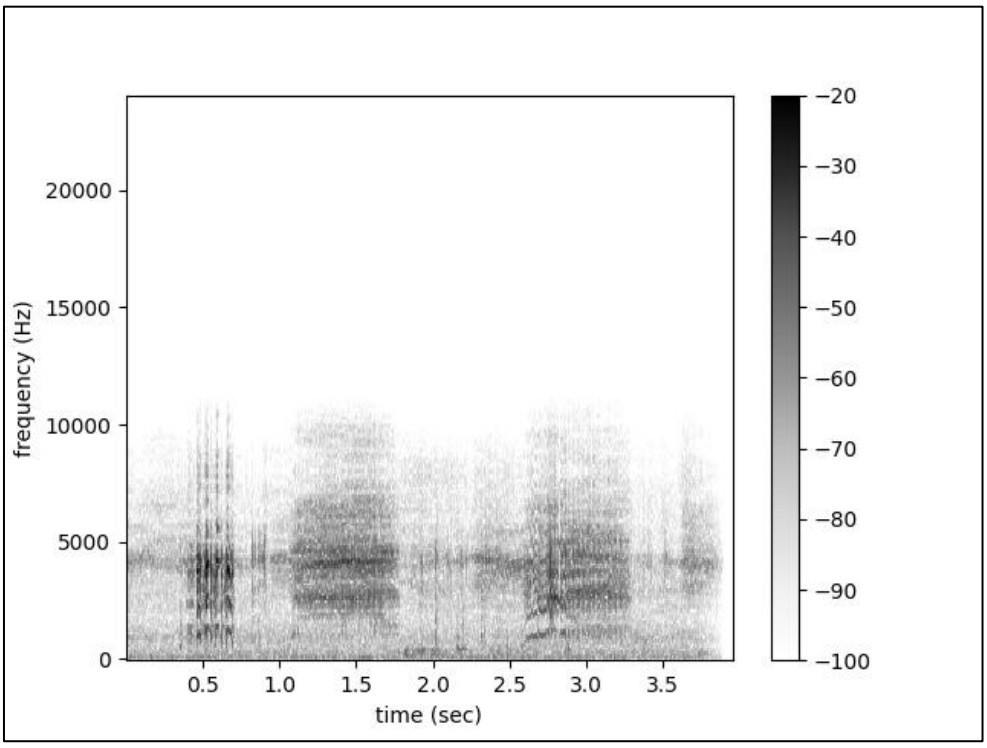


Figure 11. *Spectrogram of a screech and chatter call sequence of an advanced Tasmanian masked owl nestling.*

To date, automated detection recognisers have been developed for the Tasmanian masked owl screech call, but no high-performance recognisers are available for the chatter call or for juvenile or chick calls. Nonetheless, manual examination of spectrograms and/or listening to acoustic recordings can be undertaken to detect these characteristic calls. The development of automated

detection algorithms for the repertoire of adult, juvenile and chick calls of the subspecies (and an understanding of the behavioural context of each call type) will improve our capacity to interpret the functional use of habitat by Tasmanian masked owls using passive acoustic monitoring. Currently, interpretation of acoustic detections via automated detection algorithms is somewhat limited to the frequency and timing of screech calls across the night and across the acoustic recorder deployment period.

Techniques have been developed to use the time difference of arrival of calls at multiple acoustic recorders to locate the source of the calls. However, these are not routinely used in acoustic monitoring of the subspecies. Likewise, the intensity of calls can also be used to indicate the distance of calls from an acoustic recorder and so an acoustic recorder array can be used to give an indication of the location of the source of the calls. The deployment and servicing of acoustic arrays can be time consuming and require additional resources (e.g., multiple acoustic recorders that each require maintenance) however, combined with other techniques, acoustic localisation has potential application in site-based searches for key habitat features such as roost and nest sites.

4.3 A framework for remote detection and monitoring of Tasmanian masked owl calls

4.3.1 Frequency of call detections over the acoustic recorder deployment period

The frequency of call detections on a nightly basis and across the acoustic recorder deployment period provides an indication of Tasmanian masked owl activity within the detection range of the acoustic recorder. Figure 12 shows the number of detections of the subspecies' screech calls per night over a recorder deployment period of three weeks in a dry eucalypt forest site, northeast Tasmania. Note that there were many calls detected over the deployment period (i.e., 106) and many calls detected on some nights (i.e., up to 18). There were clearly two owls calling at the site, one close and one far from the acoustic recorder. An interpretation of these results is that there is frequent Tasmanian masked owl activity within the acoustic recorder's detection range. Note that there were no calls detected on the nights of 11 – 15, 25 and 31 March 2025. If the deployment period was limited to 11 – 15 March 2025 the interpretation of the acoustic data would have been quite different. This acoustic monitoring example demonstrates the relationship between deployment period and the confidence of presence/absence of Tasmanian masked owls and the capacity to interpret the actual calling behaviour of the subspecies. An intensive ground-based search within 200 m of this acoustic recorder identified a Tasmanian masked owl roost tree very close to the acoustic recorder.

Figure 13 shows the number of detections of Tasmanian masked owl screech calls per night over a recorder deployment period of 45 days in a wet eucalypt forest site, central north Tasmania. An interpretation of these results is that there is frequent Tasmanian masked owl activity within the acoustic recorder's detection range. However, note that there were no calls detected on 28 (62%) of 45 nights. Further, if the deployment period was only between 26 March and 9 April 2025 the interpretation of the acoustic data would have been that there is limited Tasmanian masked owl activity within the vicinity of the acoustic recorder.

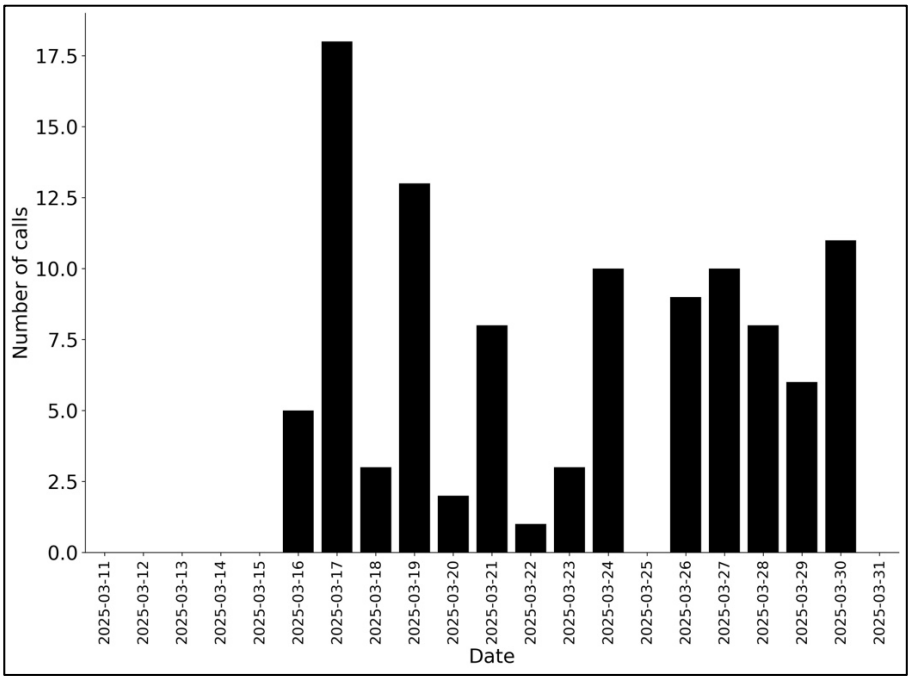


Figure 12. *Frequency of Tasmanian masked owl call detections per night over a 21-day period (11 – 31 March 2025) in a dry eucalypt forest site, northeast Tasmania. The acoustic recorder was scheduled to record from dusk until dawn each night. Note that up to 18 calls were detected over a single night however, no calls were detected on the first 5 nights of deployment of the acoustic recorder, nor on night 15 and 21. The nightly detection rate (i.e., the percentage of recorded nights when at least one call was detected) was 66% (Phil Bell, unpublished data).*

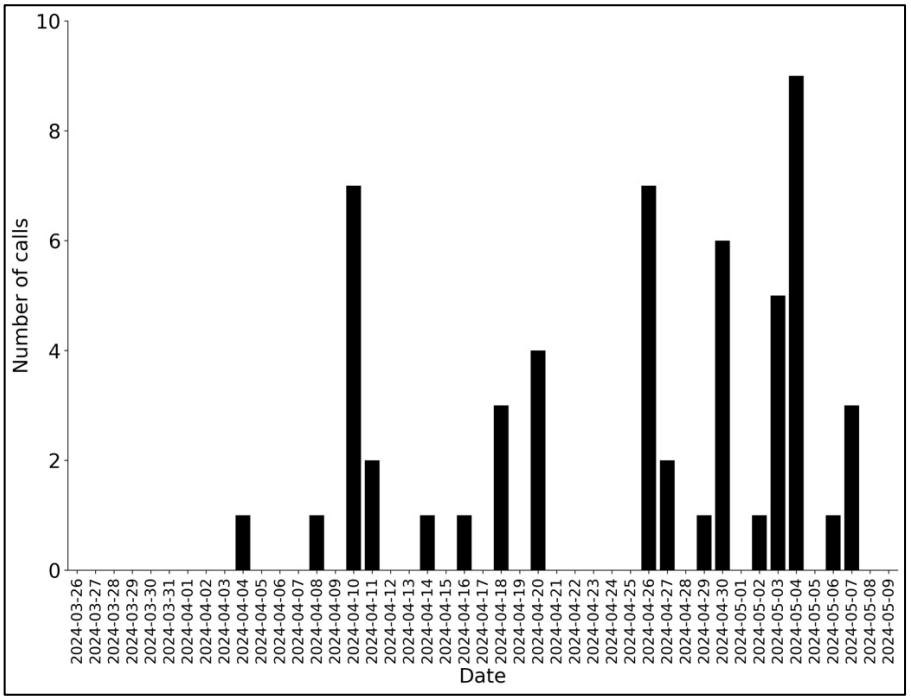


Figure 13. *Frequency of Tasmanian masked owl call detections per night over a 45-day period (26 March – 9 May 2024) in a wet eucalypt forest site, central north Tasmania. The acoustic recorder was scheduled to record from dusk until dawn each night. Note that multiple calls were detected on several nights (up to 9 calls over a single night) though no calls were detected on 28 (62%) of 45 nights. The nightly detection rate (i.e., the percentage of recorded nights when at least one call was detected) was 38%.*

4.3.2 Frequency of call detections over the night

Figure 14 shows the frequency of call detections over the night over a 21-day period in a dry eucalypt forest site, northeast Tasmania. The corresponding frequency of call detections per night for this recording period is shown in Figure 12 (with a nightly detection rate of 66%). The acoustic recorder was scheduled to record from dusk until dawn each night. Note that most call detections were close to dusk and dawn. An interpretation of these results is that a high proportion of the calling at dusk and dawn suggests the likely presence of a roost or nest site within the detection range (on the basis that Tasmanian masked owls tend to call around the time of departure from a roost or nest and around the time of returning to a roost or nest). An intensive ground-based search at this site identified a roost tree near the location of the acoustic recorder.

Figure 15 shows the frequency of call detections over the night over a 45-day period in a wet eucalypt forest site, central north Tasmania. The corresponding frequency of call detections per night for this recording period is shown in Figure 13 with a nightly detection rate of 38%. The acoustic recorder was scheduled to record from dusk until dawn each night. Note that most call detections were in the middle part of the night. An interpretation of these results is that, although a high frequency of calls were detected on several nights and up to 9 calls in a single night, a high proportion of the calling in the middle part of the night suggests that a roost or nest site is not likely to be present within the detection range. Based on our rudimentary understanding of the calling behaviour of Tasmanian masked owls, this calling behaviour might indicate frequent use of the assessment area though the presence of a roost or nest could not be discounted. An intensive ground-based search failed to find evidence of use of any large hollows or any other evidence of use of this site by the Tasmanian masked owl within 200 m of the location of the acoustic recorder.

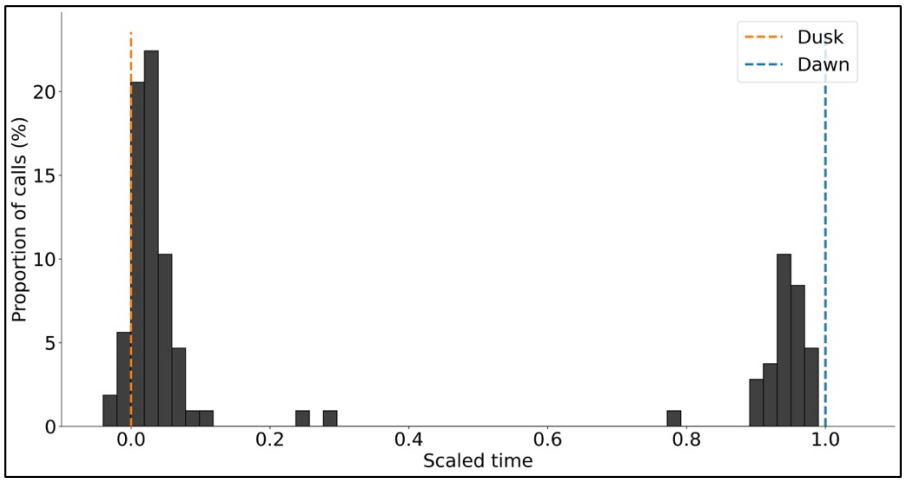


Figure 14. *Frequency of call detections over the night over a 21-day period in a dry eucalypt forest site, northeast Tasmania. The acoustic recorder was scheduled to record from dusk until dawn each night. Note that most call detections were close to dusk and dawn. Intensive ground-based assessment identified a roost tree near the location of the acoustic recorder. The frequency of call detections per night for this recording period is shown in Figure 12 representing a nightly detection rate of 66%.*

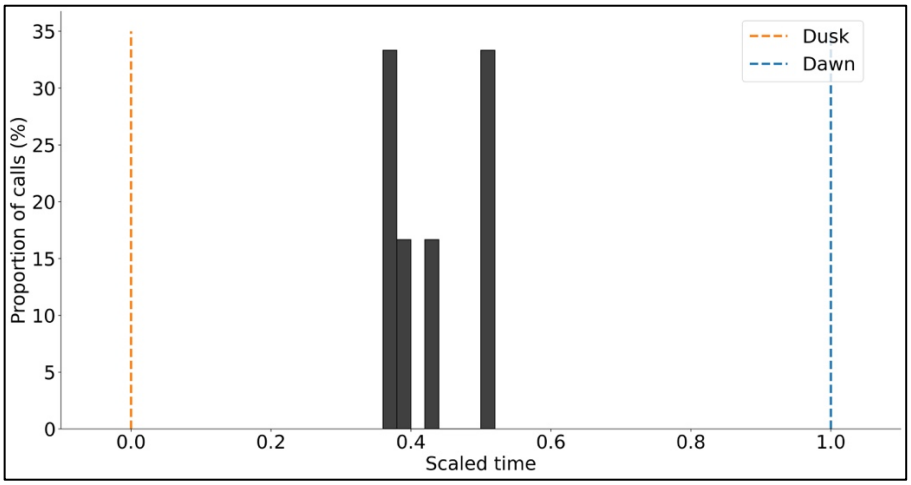


Figure 15. *Frequency of screech call detections across the night over a 45-day period (between 26 March and 9 May 2024) in a wet eucalypt forest site, central north Tasmania. The acoustic recorder was scheduled to record from dusk until dawn each night. Note that most call detections were in the middle part of the night. Intensive ground-based searching failed to find evidence of use of any large hollows by the Tasmanian masked owl within 200 m of the location of the acoustic recorder. The frequency of call detections per night for this recording period is shown in Figure 13.*

4.3.3 Long-term acoustic monitoring of the Tasmanian masked owl

The first published account of long-term acoustic monitoring of Tasmanian masked owl screech calls was undertaken in 2021 in a wet eucalypt forest site, northwest Tasmania (Gros et al., 2023). Figure 16 shows the spatial arrangement of the acoustic recorders used in that study with a 200 m buffer shown as an indicator of the detection range of each acoustic recorder. The overall spatial coverage of the acoustic recorders was about 250 ha with approximately 2 km between the location of the most northern and the most southern acoustic recorder sites.

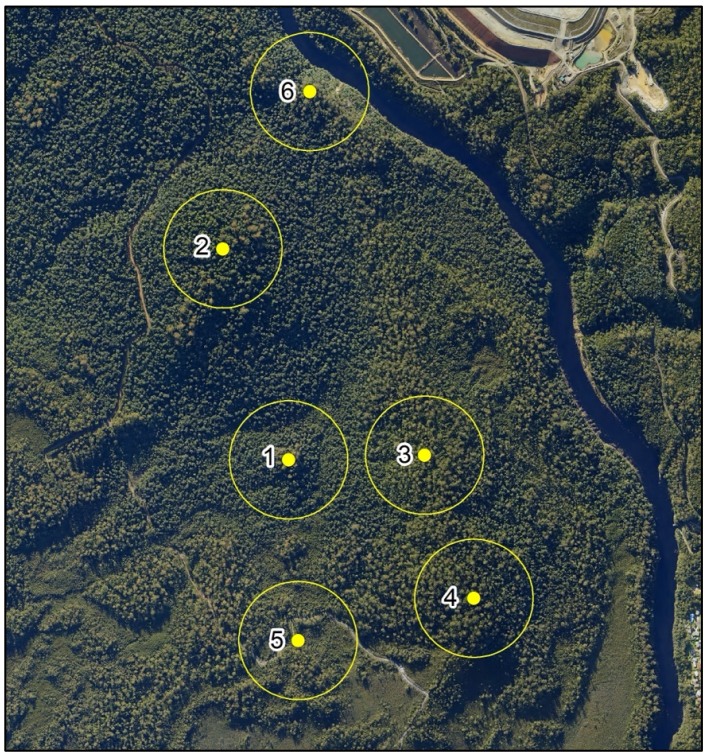


Figure 16. *The spatial arrangement of acoustic recorders from the study by Gros et al. (2023) in northwest Tasmania including a 200 m buffer around each recorder as an indicator of the detection range of the recorders. Note that Gros et al. (2023) detected simultaneous calls between sites 5 and 4, and between sites 5 and 3, suggesting that their detection ranges overlapped.*

Table 2. *Number of detections and the nightly detection rate from Gros et al. (2023). See Figure 16 for locations of acoustic recorders.*

Site	Number of detected calls	Nightly detection rate
1	168	31 over 110 nights (28%)
2	1	1 over 105 nights (1%)
3	15	7 over 32 nights (22%)
4	24	8 over 76 nights (11%)
5	266	36 over 83 nights (43%)
6	3	1 over 66 nights (2%)

Table 3. *Duration of acoustic recorder deployments and number of recording nights (i.e., how many nights were recorded from dusk to dawn on each acoustic recorder, from Gros et al. (2023)). See Figure 16 for locations of acoustic recorders.*

Site	Date start recording	Date end recording	Number of recording nights
1	24 June	22 November	110
2	7 July	8 November	105
3	7 July	18 August	32
4	7 July	8 November	76
5	8 July	22 October	83
6	29 August	12 November	66

Figure 17 shows the number of call detections per night over a 5-month deployment period (i.e., June to October 2021) pooled across the acoustic recorder sites (Gros et al., 2023). Note that, although the duration of the recorder deployment varied across recorder sites (see Table 3) there was an apparent peak in calling frequency in October 2021. Given the documented tendency for seasonal breeding (i.e., spring-summer) this upturn in calling frequency may be related to breeding. The nightly detection rate across the study area over the 5-month deployment period demonstrates consistent use of the area, suggesting it may fall within the 'core territory' of a pair of Tasmanian masked owls. The high frequency of detections around dusk and dawn at sites 1 and 5 (see Figure 18) suggest that a roost or nest site may be close by (Gros et al., 2023).

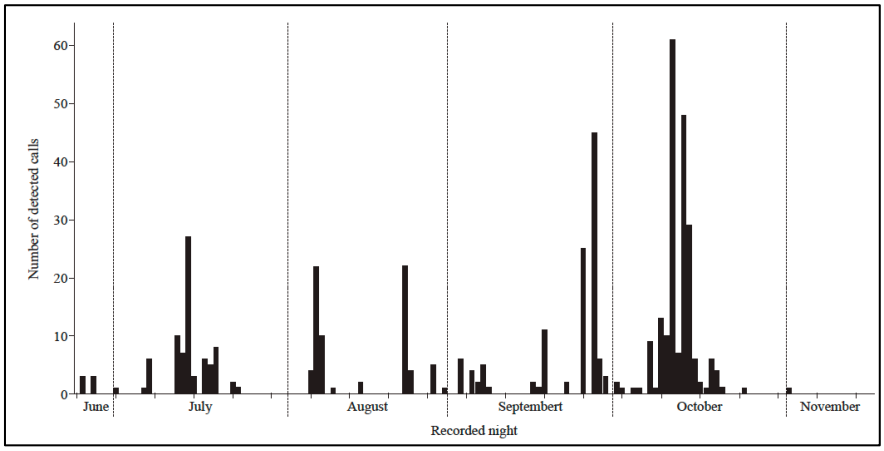


Figure 17. *Number of screech calls detected for each recorded night, pooled across six recorder sites and grouped by month in a wet eucalypt forest site, northwest Tasmania. Note the apparent peak in calling frequency in October (Gros et al., 2023).*

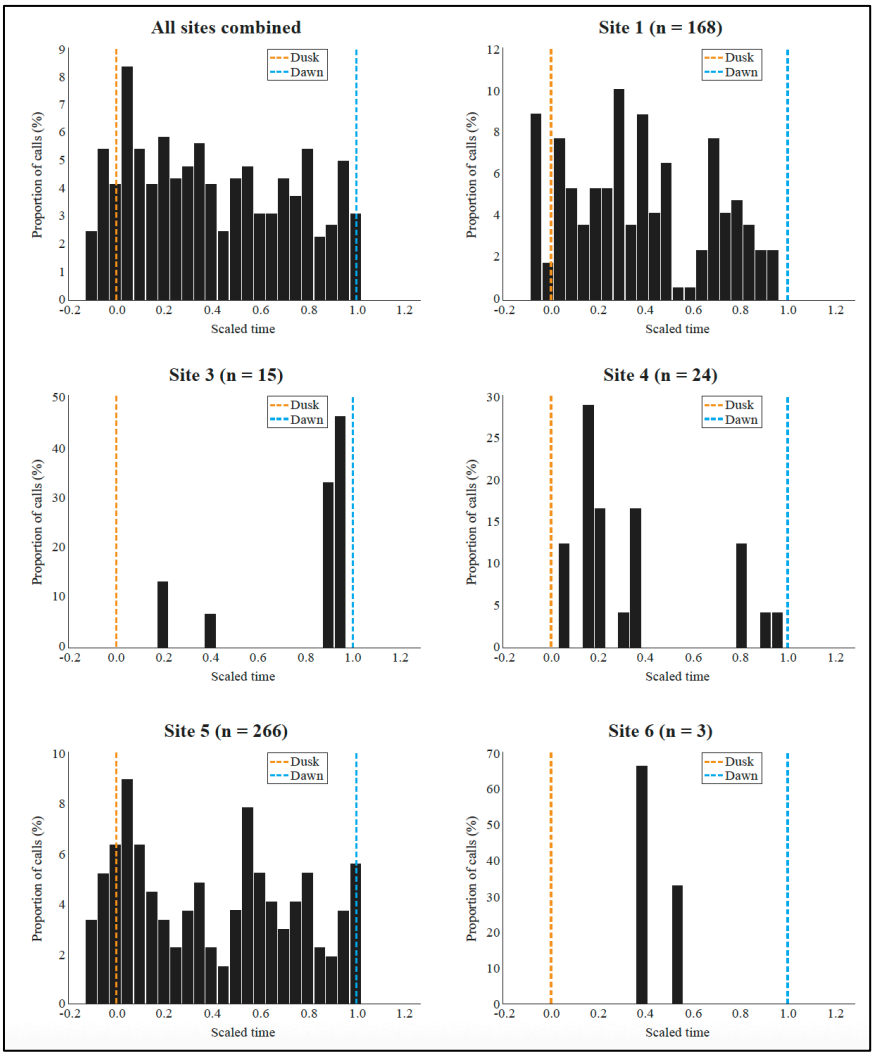


Figure 18. *Frequency of screech call detections across the night at individual sites in a wet forest site, northwest Tasmania (Gros et al., 2023). The acoustic recorder was scheduled to record from dusk until dawn each night. Note that call detections occurred evenly across the night when all acoustic recorder sites were combined and at site 1 and 5 where many calls were detected. Although there was an apparent tendency for dawn calling at site 3, only 15 calls were detected over a 32-day recorder deployment period.*

The study by Gros et al. (2023) demonstrated that the deployment of multiple acoustic recorders across the study area provided an opportunity to make some inferences about habitat use at a fine scale by examining the timing and number of calls detected over the deployment period. However, Gros et al. (2023) also acknowledged the limitations associated with acoustic monitoring and that expert interpretation of acoustic data and understanding the habitat characteristics of the study area are important components of an acoustic monitoring study of Tasmanian masked owls.

Gros et al. (2023) suggests that in surveys for Tasmanian masked owls, acoustic monitoring provides a basis for prioritising areas based on the timing and frequency of detected calls, thereby increasing the efficiency of subsequent ground-based assessments (e.g., searching for roost/nest sites and other evidence of the use of a site by the subspecies) and may complement detailed GPS tracking studies.

Gros et al. (2023) noted that the detection range of acoustic recorders depends on multiple attenuation processes, including geometric, atmospheric (especially wind and rain) and habitat attenuations (e.g., Haupert et al., 2023). Simultaneous calls were recorded between sites 5 and 4, and between sites 5 and 3, suggesting that the sampling areas overlapped (see Figure 16). They recommended that future studies should consider estimating the sampling radius of each acoustic recorder to evaluate the sampling effort of each deployment.

Gros et al. (2023) suggested that differences in the frequency and time of Tasmanian masked owl detections from each acoustic recorder indicated differential use of the study area, from which habitat use could be inferred (e.g., more frequent vocal activity near sites 1 and 5 in the south of the study area compared to sites 2 and 6 in the north of the study area) (see Figure 16). They recommended that future studies could consider using a larger number of acoustic recorders at a larger spatial scale to better understand the functional habitats of a Tasmanian masked owl breeding territory, particularly nesting and roosting habitat. Acoustic recorder arrays combined with ground-based assessments and/or GPS tracking could provide valuable insights into the calling behaviour within different areas (or functional habitats) of a territory or home range (e.g., nesting, roosting, foraging).

Monitoring individual owls using acoustic monitoring may be possible in the future. Documenting the full repertoire of Tasmanian masked owl vocalisations may provide a valuable analytical tool if call types can be linked to occupancy and breeding status. Variation in acoustic properties within call types may provide useful indicators for distinguishing juveniles and adults, or males and females. For example, by using acoustic attributes, Dale et al. (2022) was able to distinguish the sex of Northern spotted owls *Strix occidentalis caurina* and Zhou et al. (2020) was able to distinguish between individual male Ural owls *Strix uralensis*. Todd et al. (2018) showed that juvenile Tasmanian masked owls generally have a shorter screech call than the adult and higher frequency, and that the chattering call from adult females typically has more notes per second with a lower peak frequency than the male. The combination of acoustic recorders and GPS tracking could clarify the function of the subspecies' calls and the behavioural context in which they are used. Identification of individuals could also assist in delineating individual Tasmanian masked owl territories.

The largest dataset from long-term passive acoustic monitoring comes from a known roost site in the Eastern Tiers (Charley Gros, unpublished data). Acoustic recorders were deployed over a 2-year period (Figure 19) and detailed analysis and interpretation of this detection data is in progress (Charley Gros pers. comm.). Nonetheless, based on a cursory examination of the graph in Figure 19, there are some notable characteristics including an apparent upturn in the frequency of call detections between autumn year 1 and summer year 2 which may be related to breeding. Interestingly, this period of high frequency of detections is followed by a period of a month or so in the summer of year 2 with no call detections.

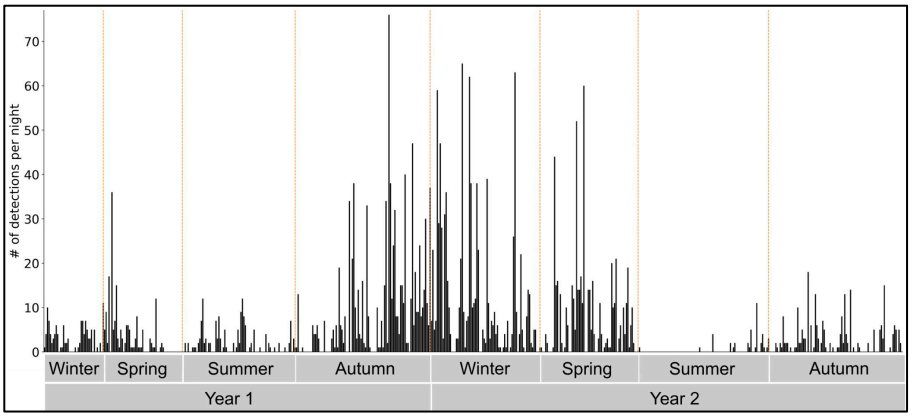


Figure 19. *Frequency of Tasmanian masked owl call detections per night over a 2-year period at a hollow roost site in the Eastern Tiers (Charley Gros, unpublished data). Note the apparent upturn in the frequency of calls between autumn year 1 and spring year 2 of the deployment period. Note also the extended period of no detections in summer year 2 of the deployment period.*

There are now many documented accounts of the nightly detection rate of Tasmanian masked owl calls and sufficient data exist to provide a robust measure of detectability of the subspecies using passive acoustic monitoring. Gros and his associates are currently analysing data from a landscape scale acoustic monitoring study which will likely contribute to addressing knowledge gaps in occupancy and detectability of the subspecies. The results from this research are expected to be published during 2027 (Charley Gros pers. comm.).

A recent study by Jackett et al. (2026) used acoustic recorders to monitor four roost sites (three of which were also nest sites) used by adult pairs of Northern masked owl *Tyto novaehollandiae kimberli*, in riparian habitats of northern Australia. They found (from the analysis of over 10,000 adult screech calls from 987 recording nights) that vocal activity peaked after dusk and before dawn and that seven nights of recording was required to achieve ≥ 95% detection probability for any month. Adult calling rates were found to decline during periods when dependent young were present, indicating reduced detectability during this period. Jackett and his associates (2026) demonstrated that passive acoustic monitoring is an effective method for detecting Northern masked owls around known roost/nest sites and they recommend that future surveys prioritise suitable habitat for roosting/nesting, align recording schedules with crepuscular calling peaks, incorporate a minimum of seven nights of sampling and include juvenile begging calls in post-survey analyses during the subspecies' breeding season (Jackett et al. 2026).

4.4 Acoustic recognisers to automate call detections

There are several acoustic recognisers currently being used to automate detection of Tasmanian masked owl calls. Methods and performance indicators are published for two of these acoustic recognisers i.e., Gros et al. (2026) for Tasmanian masked owl and DPI (2021) for Australian masked owl *Tyto novaehollandiae novaehollandiae*.

Gros et al. (2026) developed an acoustic recogniser for the Tasmanian masked owl using a neural network model. Neural networks typically represent data as 2D spectrograms and frame the problem as an image classification task. Neural networks like BirdNET (e.g., Kahl et al., 2021) are increasingly used in avian research and citizen science projects (e.g., Wood et al., 2023). The strength of neural networks lies in their ability to learn hierarchical representations, enabling them to identify relevant features without relying on predefined settings. Early layers learn basic patterns, while deeper layers capture abstract shapes that are crucial for distinguishing bird species' calls and are robust to variations in spectrograms. However, training neural networks on highly imbalanced datasets, especially for rare or elusive species, remains a key challenge. Gros et al. (2026) developed a passive acoustic monitoring pipeline for Tasmanian masked owl calls from data collected from a broad and representative range of rainforest and native eucalypt forests over

a range of altitudes across Tasmania and automated the identification of target calls in field recordings. The robustness of this method was assessed using an independent, multi-site dataset with a range of vegetation types, seasonal variations and non-target species.

Gros et al. (2026) evaluated various models for detection of Tasmanian masked owl on an independent dataset, separate from the training and validation datasets. The neural network model achieved excellent results, with a sensitivity of 98% and a specificity of 97%. The neural network model outperformed previous approaches, which exhibited higher numbers of false positive and false negative detections. For example, Kaleidoscope Lite showed a sensitivity of 74% and specificity of 84%. The BirdNET model failed to reliably detect the subspecies, detecting only 14% of the calls in the testing dataset.



Song Meter SM4 Acoustic Recorder (Wildlife Acoustics, Maynard, Massachusetts) deployed in potential Tasmanian masked owl roosting/nesting habitat in central north Tasmania.

There are some commonly used metrics in the assessment of performance of acoustic recognisers. A 'true positive' (TP) is where the acoustic recogniser and the expert agree there was a call; 'true negative' (TN) is where the acoustic recogniser and the expert agree there was no call; 'false positive' (FP) is where the acoustic recogniser detects a call, but the expert did not; and a 'false negative' (FN) is where the acoustic recogniser did not detect a call that the expert did detect (Gros et al., 2026; DPI, 2021).

Performance metrics for detection algorithms include 'recall' (equivalent to sensitivity) which is the number of detections correctly labelled as positive divided by the actual number of positive examples plus false negatives. Higher values indicate better performance (i.e., more hits of target species). 'Precision' is also used which is the number of detections correctly labelled as positive divided by the number labelled as positive plus false positives. Higher values indicate better performance (i.e., fewer false positives) (DPI, 2021).

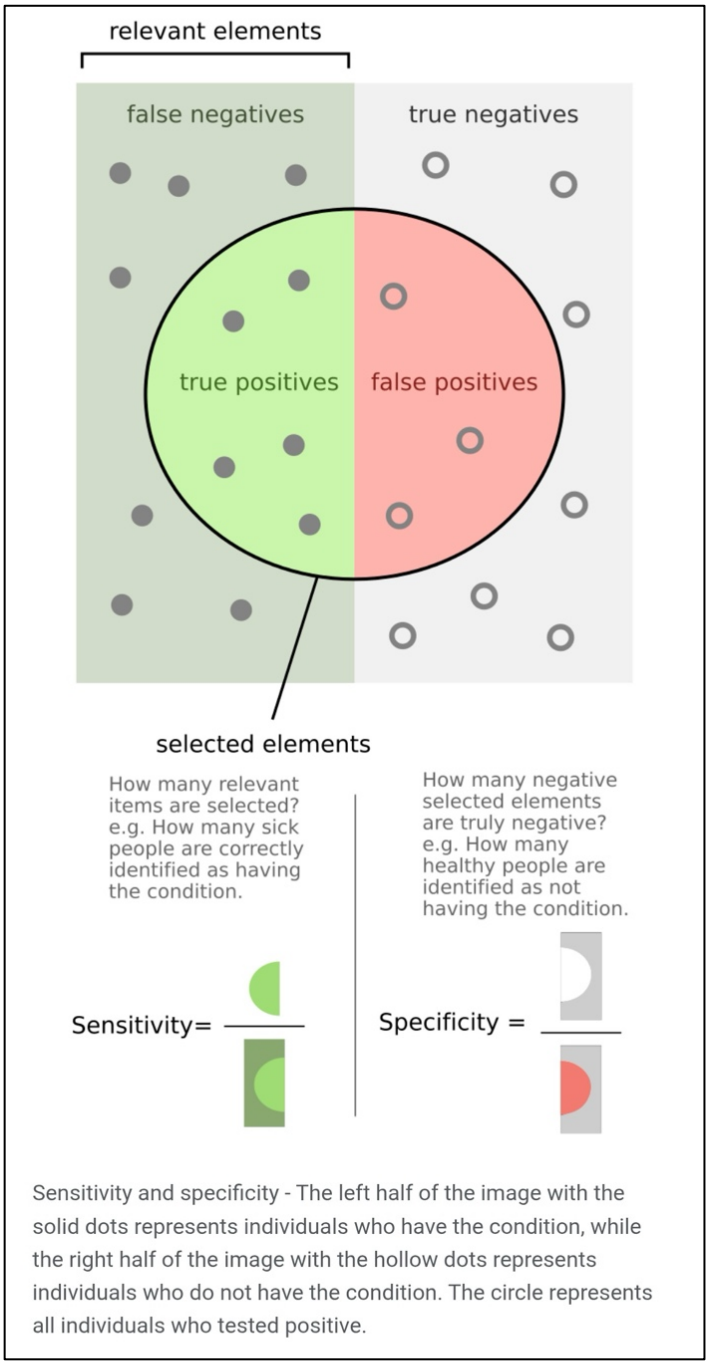


Figure 20. *The diagram above shows a visual definition of the metrics 'sensitivity' (also known as 'recall') and 'specificity' in relation to performance of acoustic recognisers. Precision is also a metric that is used to assess the accuracy of true positives and is the ratio of true positives to the sum of true positives and false positives. High precision means when the recognizer says it found something (e.g., a specific bird call), it is very likely to be correct, with fewer mistaken alerts (false alarms) (DPI, 2021; https://en.wikipedia.org/wiki/Sensitivity_and_specificity).*

Table 4. *Evaluation metrics on the independent testing dataset for Tasmanian masked owl calls from Gros et al. (2026). Sensitivity and specificity were calculated for the outputs of Kaleidoscope Lite and BirdNET, as well as for the Gros et al. (2026) model trained with different numbers of positive samples (n = 1,788 vs. 4,030). The optimal value for both sensitivity and specificity is 100 (Gros et al., 2026).*

Species	Call	Model	Sensitivity	Specificity
Tasmanian masked owl	Screech	Kaleidoscope Lite	74.4	84.2
		BirdNET v2.4	14.0	100.0
		Gros et al. (2026) model, ntrain+=1,788	93.0	77.2
		Gros et al. (2026) model, ntrain+=4,030	97.7	96.5

DPI (2021) developed species recognisers to analyse acoustic data collected in forest monitoring programs and other research programs within NSW. Recognisers were built in open-source software including AviaNZ (Marsland, 2020) and Queensland University of Technology's AnalysisPrograms.exe (Towsey, 2020) and tested in both AviaNZ and Egret (Truskinger, 2020). Testing was also conducted using Kaleidoscope Software (Wildlife Acoustics Inc. 2017) though the performance was found to be a poor relative to the two alternative approaches. The recognisers were tested for recall and precision on three sets of data, 'event-level', 'segment-level' and 'real-world' one-hour recordings. Each recogniser had varying levels of success. Metadata information for the recognisers (both AviaNZ and AnalysisPrograms.exe) to accompany the recogniser was also provided to inform model performance and sounds that will result in potential confusion.

The Australian masked owl *Tyto novaehollandiae* and the sugar glider *Petaurus breviceps* (noted because of the relevance to monitoring sugar glider in Tasmania's forests, particularly in swift parrot *Lathamus discolor* breeding habitat) were included by DPI (2021) amongst 13 target species in the call recogniser project. Fifty-eight Australian masked owl calls were used as training data. These were sourced from different regions and sites including a variety of loud and soft calls and variation in background noise (DPI, 2021).

Table 5. *Test evaluation results from DPI (2021) AviaNZ recognisers (wavelet only), tested in AviaNZ (event and segment-level) and Egret (real-world). Event-level: recogniser performance at level of every event (hit). Segment-level and real-world: recogniser performance at detecting an event anywhere within a 30 -second file.*

Species	Event-level		Segment-level		Real-world	
	Recall	Precision	Recall	Precision	Recall	Precision
Australian masked owl *Tyto novaehollandiae*	71.37%	58.70%	96.00%	65.31%	90.70%	36.79%

Table 6. *Test evaluation results from DPI (2021) QUT's AP recognisers, tested in Egret. Event-level: recogniser performance at level of every event (hit). Segment-level and real-world: recogniser performance at detecting an event anywhere within a 30-second file.*

Species	**Event-level**		**Segment-level**		**Real-world**	
	Recall	Precision	Recall	Precision	Recall	Precision
Australian masked owl *Tyto novaehollandiae*	58.25%	29.56%	93.00%	59.62%	95.35%	15.36%

In general, and in reference to the suite of species for which recognisers were developed, DPI (2021) considered that testing of both their recogniser approaches revealed a high rate of false positives, which limits the routine implementation of their draft recognisers on audio recordings without extensive expert validation. Indeed, they indicated that some human level of validation is a requirement in the foreseeable future with any automated method (DPI, 2021).

DPI (2021) concluded that for large and extensive datasets of recordings, species recognisers with a high precision may be the most efficient to use. For smaller datasets, some precision could be sacrificed as there will be a smaller volume of calls to validate. Species that call repeatedly such as Southern boobook can be adequately scanned by recognisers with a lower recall rate. Typically for rare or threatened species, recognisers with higher recall would be used, which comes at the cost of lower precision (DPI, 2021).

Considering the purpose of the recogniser before building it is useful (DPI 2021). If the purpose is to identify most calls for a particular analysis (e.g., a spatial count), then a high recall is required. Whereas if the aim is to undertake occupancy modelling, a lower recall may be acceptable as a trade-off for fewer false positives, thereby aiming for higher precision. Limiting false positives could also be achieved by avoiding sampling in particular areas (e.g., highways, creeks/dams where insect calling could be high) or to limit sampling to during the peak calling period of the target species (e.g., limiting to a couple of hours a night or avoiding dawn and dusk chorus when diurnal birds may be problematic) (DPI 2021).

4.5 Call detection range of acoustic recorders

The frequent use of acoustic recorders to detect Tasmanian masked owls has increased the need to evaluate how the distance-dependent attenuation of calls, as well as the ambient sound level, impact the acoustic detection distance over diel cycles and across seasons (e.g., Haupert et al. 2023). There is also an increased need to ensure sampling independence to provide relevant indicators of occupancy and abundance. For example, Gros et al. (2023) noted that simultaneous calls were recorded between some adjacent acoustic recorders in their study in northwest Tasmania, suggesting that the sampling areas overlapped. They recommended that future studies consider estimating the sampling radius of the acoustic recorders to evaluate sampling effort. It is interesting to note that Gros et al. (2023) detected simultaneous calls between acoustic recorders, 600 m apart and 750 m apart but not between acoustic recorders, 460 m apart, 500 m apart and 600 m apart. Clearly, there are several factors that are likely to have influenced the detection range of each acoustic recorder used by Gros et al. (2023) however, their results suggest a detection range in the hundreds of meters rather than kilometers. Haupert et al. (2023) identified the sampling area or the 'detection range' as dependent on multiple attenuation processes, including geometric, atmospheric and habitat. They also showed that the detection distance of acoustic recorders mostly depends on the ambient sound which may vary by a factor of up to 5 over the diel cycle and across seasons. They conclude that there is a strong need to account for the variation of the detection distance in acoustic monitoring surveys to provide reliable indicators of occupancy and behaviour (Haupert et al., 2023). Variables most likely to impact the detection

distance of acoustic recorders include vegetation type and density, topographic location and weather conditions, particularly wind and rain, and the sensitivity of the microphones used.

5. Ecology of the Tasmanian masked owl

5.1 Background

Our knowledge of the conservation ecology of the Tasmanian masked owl is limited, particularly our understanding of population size and trend, and the functional habitat requirements of the subspecies. This section provides a summary of the information on the ecology of the Tasmanian masked owl that is deemed relevant to informing survey approaches and conservation management actions.

Prior to the 1990s most of our knowledge of the ecology of the Tasmanian masked owl came from a few key papers, including a study on habitat and breeding by Hill (1955), breeding and diet by Green (1982) and diet by Green and Rainbird (1985).

Mooney (1993) sampled a large number of prey remains from roost/nest sites of Tasmanian masked owls and found that mammals made up most of the items and biomass, and that most of the prey items were introduced species. He compared the diet from pre-European settlement and post-European settlement roost/nest sites and found that native rodents made up most of the pre-European settlement diet but only a very small proportion of the post-European settlement diet, attributing the difference to be largely the result of a shift in the modern diet to introduced rodents and rabbits.

Mooney (1997) studied the habitat and seasonality of nesting of Tasmanian masked owls by examining historically recorded nest trees. He noted that all nests were in old eucalypts, most of which were alive at the time of use. Nests were mainly located in trunk side hollows but also in limb spouts and in trunk chimneys. From observational data on breeding at nest sites and age of chicks found fallen from nests (extrapolating their ages from observations on captive-bred chicks), he concluded that nesting was highly seasonal with most of the clutches likely to have been laid in mid-October to early November. Mooney (1997) also makes the pertinent observation that, although the subspecies is often seen in or flushed from caves, deep ledges or potholes in dry cliffs (usually sandstone), they have only ever been recorded breeding in one cave; and this observation holds true for buildings and other man-made structures.

The first dedicated study on the distribution, abundance and habitat requirements of the Tasmanian masked owl was undertaken in 1996 (Bell and Mooney, 2002; Bell and Mooney, 1997; Bell et al., 1996). This study was funded through the Comprehensive Regional Assessment (CRA) for the Tasmanian Regional Forest Agreement (RFA) with support from the Tasmanian Parks and Wildlife Service and the Australasian Raptor Association of BirdLife Australia. Bell et al. (1996) was the first attempt to collate a comprehensive dataset of Tasmanian masked owl locality records which remains a substantial component of the Tasmanian masked owl dataset in the current Natural Values Atlas (NVA, 2025). Bell et al. (1996) undertook a landscape scale systematic survey of Tasmanian masked owls across broad forest types using call-playback to elicit a response and thereby increase the detectability (by hearing and/or sighting). The results of this rudimentary study of distribution, abundance and habitat requirements (which included a review of the available literature) formed a substantial component of the information base used in the original listing of the subspecies as endangered in 2002 under the Tasmanian, *Threatened Species Protection Act 1995*, and subsequent listing of the subspecies as vulnerable under the Commonwealth, *Environment Protection and Biodiversity conservation Act 1999*.

The original listing of the Tasmanian masked owl as threatened led to its listing as a Priority Species under the Tasmanian RFA and therefore a requirement for the subspecies' protection through the formal reserve system and/or by specific management prescriptions through the

forest practices system. Management prescriptions for forestry activities were subsequently developed by the Forest Practices Authority (FPA) in consultation with the then, Department of Primary Industries, Parks, Water and Environment (DPIPWE), and the agreed management approach was delivered through the FPA's then 'Threatened Fauna Advisor'.

Given the dearth of information on the ecology of the Tasmanian masked owl (at the time of listing), the FPA and DPIPWE facilitated several post-graduate student research projects that targeted the habitat requirements of the subspecies to inform ongoing development and refinement of conservation actions and management prescriptions.

An Honours research project began in 2006 through the University of Tasmania. It was the first radio tracking study of the subspecies. Radio telemetry was used to estimate home range, habitat use and foraging behaviour of two female Tasmanian masked owls in a modified rural agricultural area in southeast Tasmania. The diet of the radio tagged owls was also investigated by collecting and analysing regurgitated pellets and conducting spotlight surveys to quantify prey abundance (Young, 2006; Young et al., 2020; Young et al., 2021).

A PhD research project on the Tasmanian masked owl began in 2007 at the University of Tasmania. The project focused on a broad-scale systematic survey using call playback to investigate distribution and detectability and identify broad habitat preferences of the subspecies. The diet of the Tasmanian masked owl in different habitats was determined using analysis of regurgitated pellets and a synthesis of previously published data. Calling behaviour was also explored using recordings of the subspecies obtained during call playback surveys and by acoustic recorders set at roost sites. A limited radio tracking study was conducted providing additional information on home range size of the subspecies (Todd, 2012; Todd et al., 2017; Todd et al., 2018; Todd et al., 2025).

The Tasmanian masked owl was listed as vulnerable in 2010 under the Commonwealth, *Environment Protection and Biodiversity Conservation Act 1999* which brought additional national attention to the threatened status of the subspecies (Threatened Species Scientific Committee, 2010).

A second PhD research project on the Tasmanian masked owl began in 2018 through the Australian National University. A broad-scale systematic survey of occupancy and detectability using call playback was undertaken in Tasmania's southern forests. Modelling did not reveal any strong relationships between occupancy and habitat and vegetation characteristics, noting that the subspecies was only detected at 18 sites across the study area. However, there was an apparent positive relationship with mean prey abundance and prey diversity, suggesting that prey availability may be an important factor in predicting the occurrence of masked owls. This study also developed genotypes from trace DNA (feathers/pellets) as genetic tags for the Tasmanian masked owl and genetic assessment was used to update population estimates and provide additional support to the endangered status of the subspecies. The study results suggested that the subspecies formed a single genetic conservation unit shaped from isolation by distance, and an effective population size in decline. The results suggested that Tasmanian masked owls do not disperse over long distances, revealed a potential vulnerability of the subspecies to climate change and demonstrated the potentially major negative impact of rodenticides on the subspecies' population growth rates, despite data uncertainty concealing this threat (Cisterne et al., 2020; Cisterne, 2022; Cisterne et al., 2023).

An Honours research project was undertaken in 2022-23 through the University of Tasmania using GPS telemetry to acquire high accuracy data on location, movement and behaviour of Tasmanian masked owls at a fine scale. The project tracked six Tasmanian masked owls to estimate home range size and model functional habitat use by the subspecies. No strong relationships were observed between site exposure, forest patches, solar radiation or wind exposure and roosting locations of tracked owls. Nor was a relationship detected between known nest locations and

distance to watercourse, slope, wind exposure or site exposure. However, there was an apparent negative relationship with solar radiation for nest locations which may require further investigation to confirm (Service, 2023).

Gill et al. (2024) explored the potential of dogs to find owl pellets and thereby increase detectability of the Tasmanian masked owl. Gill and her associates compared the performance of a dog team and an experienced ecologist and subsequently undertook a field study where the dog team searched potential owl habitat in native forests. They found that dogs can find owl pellets with greater sensitivity and efficiency than an experienced ecologist working alone. The results of this work suggest that detection dogs may have application to ecological research on Tasmanian masked owls though their usefulness in routine presence/absence surveys for the subspecies in native forests remains untested.

Advances in conservation research and adaptive management following listing of the Tasmanian masked owl has been severely hindered by the subspecies' low detectability using traditional survey techniques and hard-won data from radio tracking studies. Hence, conservation management of the Tasmanian masked owl has largely focused on the maintenance of mature forest at a landscape scale and the maintenance of potential roosting/nesting habitat (and trees) at a site-based scale.

Recent research is improving the effectiveness of survey techniques for the Tasmanian masked owl, and our understanding of habitat use by the subspecies at both landscape and local scales (e.g., Gros et al., 2023; Gros et al., 2026; Service, 2023). It is likely that a collaboration/combination of acoustic monitoring and GPS tracking research will, over the next few years, provide the information 'break through' needed to inform robust and cost-effective survey techniques and effective conservation management actions for the Tasmanian masked owl.

5.2 Distribution of the Tasmanian masked owl

Mooney (1997) was the first author to suggest that the Tasmanian masked owl was a 'low- to medium-altitude nester' based on all of 18 known historic nest records lying below 640 m in altitude.

Bell et al. (1996) added confidence to this suggestion, predicting the distribution of the subspecies (based on presence only data using a BIOCLIM distribution model) as lowlands (<600 m) with a high mean annual temperature and low mean annual rainfall (Figure 21). This predicted distribution reflects the distribution of dry eucalypt forests and woodlands and cleared land in Tasmania. This was the first attempt at a predictive distribution model for the Tasmanian masked owl. However, it was based on a small incidental, presence only dataset, at a time when there had been virtually no systematic surveys for the subspecies, particularly at higher altitudes and in the western half of Tasmania.

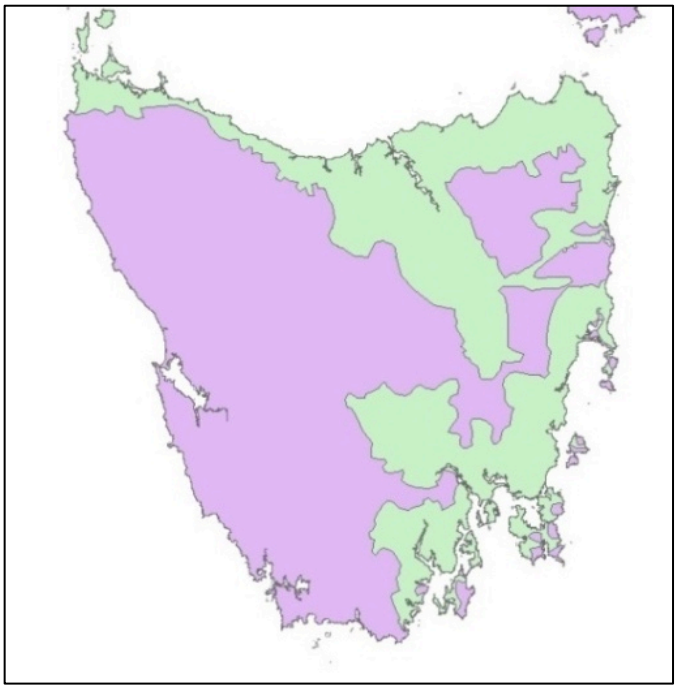


Figure 21. *Simplified BIOCLIM distribution model for Tasmanian masked owl (Bell et al., 1996) (based on presence only data from an incidental dataset of 423 records, including 168 museum specimens from TMAG and QVMAG). The areas shaded green are areas where the probability of the presence of the subspecies is high or moderate and those shaded purple are areas where the probability of the presence of the subspecies is low or extremely low.*

Todd et al. (2018) undertook a broad-scale systematic survey using call playback to investigate distribution and detectability of the Tasmanian masked owl and identify broad habitat preferences. This study showed that the subspecies was most often found in low-elevation mature dry eucalypt forest. Todd et al. (2018) stratified their survey sites based on vegetation type and elevation. All selected sites (n = 211) were at least 2 km from each other and were accessible via road or vehicular track in areas of contiguous forest. Figure 22 shows the locations of survey sites and detections or non-detections from four repeat visits to each site.

Todd et al. (2018) used a zero-inflated binomial model to model the effect of survey-specific variables on detection and site-specific variables on the probability of occupancy. They found that the detection of Tasmanian masked owl was associated with wind (negative effect) and ambient air temperature (positive effect). Elevation appeared to be the most important factor associated with the probability of occupancy by the subspecies, having a negative effect. Other important variables included area of mature forest (positive effect) and area of dry eucalypt forest (positive effect) at 500 m and 1000 m radius scales around survey points. The closest-fitting model at the 500 m radius scale included elevation, mature eucalypt forest and dry eucalypt forest. At the 2000 m radius scale, elevation and high potential hollow abundance were important components and at the 4000 m radius scale elevation and wet eucalypt forest (negative effect) were important components.

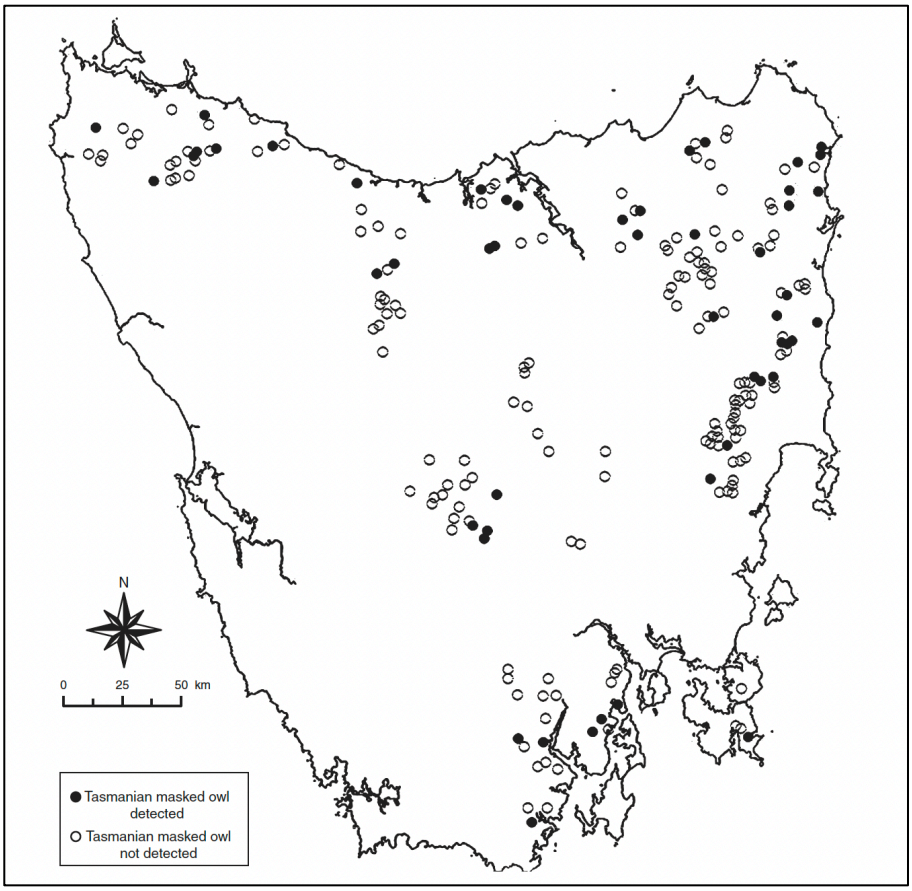


Figure 22. *Location of survey sites where the Tasmanian masked owl was detected and not detected from an intensive systematic survey across Tasmania using call playback, spotlighting and listening techniques. From 844 individual surveys (four visits to each of 211 sites), there were 89 detections of the subspecies (Todd et al., 2018).*

Figure 23 shows a predicted habitat quality map for Tasmanian masked owl based on a habitat occupancy model, noting that the key predictors from the habitat occupancy model include altitude, mature forest and dry eucalypt forest (Todd, 2012). Figure 24 shows a Maxent (Maximum Entropy) distribution model for the subspecies incorporating the environmental variables: average annual rainfall, elevation, mean minimum temperature in coldest month of year, high potential hollow abundance, cleared land (agricultural, urban and exotic), dry eucalypt forest and woodland, wet eucalypt forest and non-eucalypt forest (Todd, 2012). The Maxent model used by Todd et al. (2018) is far more powerful than the BIOCLIM model used by Bell (1996), it used a 46% larger dataset and incorporated additional variables not available in 1996 including high potential hollow abundance, cleared land (agricultural, urban and exotic), dry eucalypt forest and woodland, wet eucalypt forest and non-eucalypt forest, all likely to be strong factors influencing the distribution of the Tasmanian masked owl.

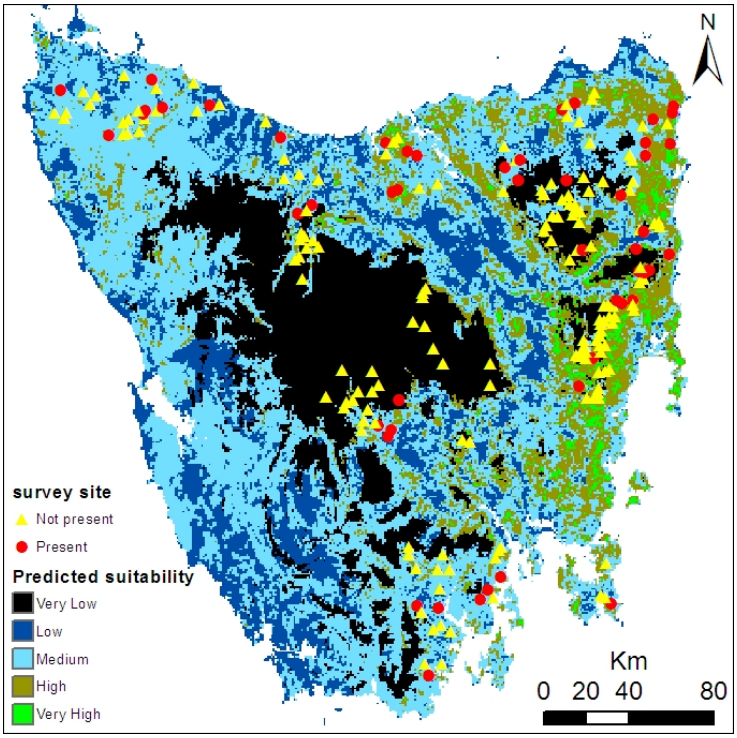


Figure 23. *Predicted habitat quality map for Tasmanian masked owl based on presence/absence data and a statewide systematic survey using call playback. Symbols represent sites where systematic surveys were conducted: yellow triangles = Tasmanian masked owl not detected; red circles = Tasmanian masked owl detected (Todd, 2012).*

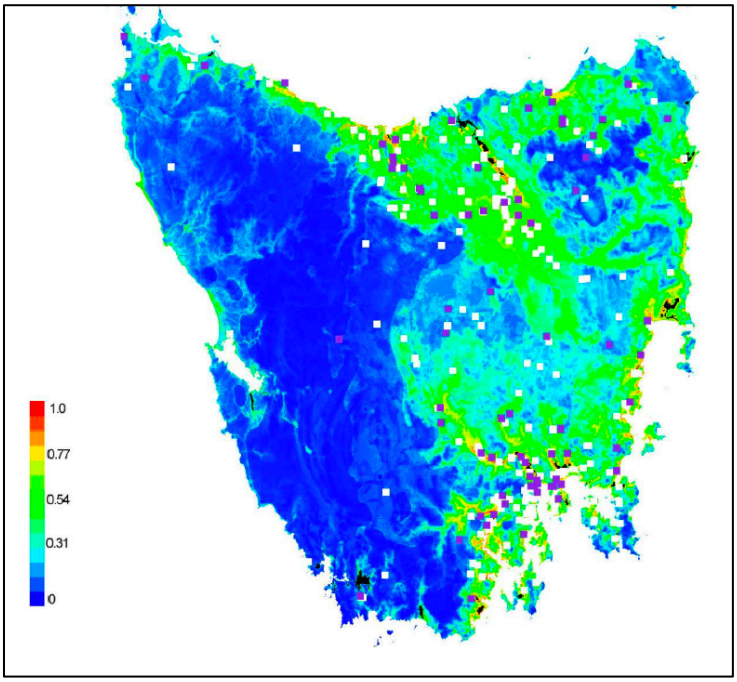


Figure 24. *Maxent distribution model for the Tasmanian masked owl incorporating the environmental variables: average annual rainfall, elevation, mean minimum temperature in coldest month of year, high potential hollow abundance, cleared land (agricultural, urban and exotic), dry eucalypt forest and woodland, wet eucalypt forest and non-eucalypt forest. Warmer colours show areas with higher predicted occurrence (white squares = presence locations used for training; purple squares = test locations) (Todd, 2012).*

Figures 25 and 26 show summary data collected by Todd et al. (2018) and used in the development of habitat models.

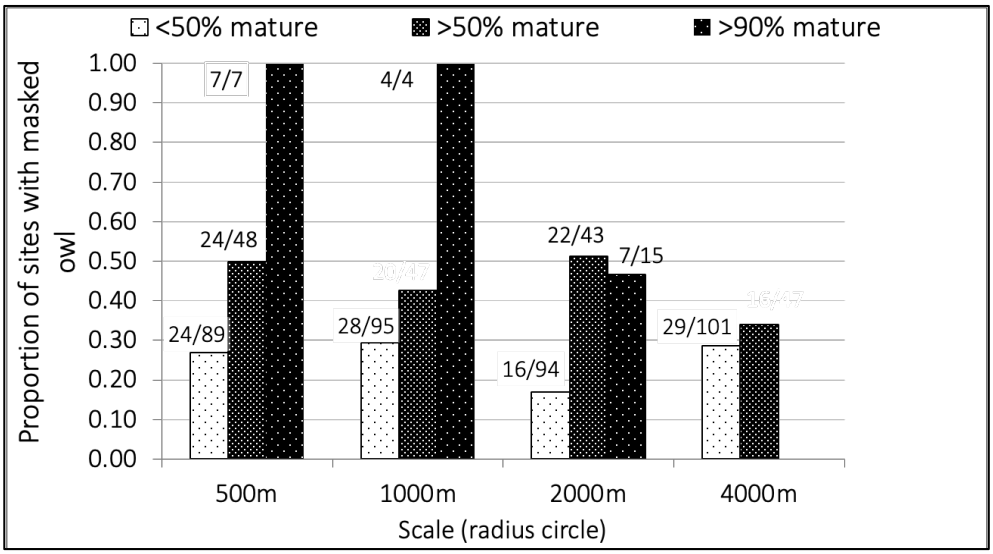


Figure 25. *Summary data on the proportion of Tasmanian masked owl detections/non-detections relative to the proportion of mature forest within increasing scales from 500 m radius to 4000 m radius around survey sites (i.e. approximately 80 ha to 5000 ha) (Todd 2012).*

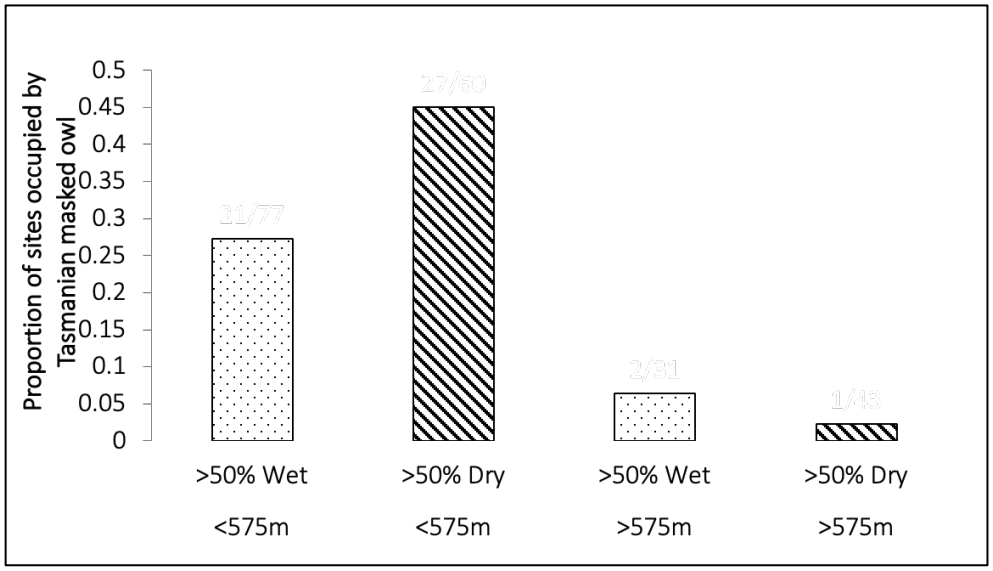


Figure 26. *Summary data on the proportion of Tasmanian masked owl detections in wet eucalypt forest or dry forest at high altitude (i.e., >575m a.s.l.) and low altitude (i.e., <575m a.s.l.) (Todd 2012).*

Todd (2012) found that low elevation sites were more likely to be occupied by Tasmanian masked owls than higher elevation sites, despite the presence of mature eucalypt forest in large areas across the central highlands. He suggested that this could be physiological, related to tree hollow availability (potentially more important in colder climates for shelter reasons) or it could be related to food availability. However, there is no evidence to suggest that suitable tree hollows for roosting/nesting are less abundant in the high elevation forests than in the lower elevation forests in Tasmania.

Todd (2012) also suggested that Tasmanian masked owls may possess a low tolerance of cold conditions for physiological reasons. Barn owls *Tyto alba* have been reported to be one of the most sensitive raptors to winter starvation in cold environments and Todd (2012) thought that this was a conceivable situation for the Tasmanian masked owl and particularly as *Tyto* owls are mostly

tropical in their distribution. Cold temperatures and low prey availability could make high elevation areas marginal habitat for the subspecies causing reduced reproductive success. Todd (2012) recommended research on the abundance of Tasmanian masked owls and their prey at different elevations to assist in understanding the apparent rarity of the subspecies at high elevations.

Todd (2012) noted that mature eucalypt forest has a high density of large trees with hollows suitable for both roosting and nesting purposes for large forest owls (e.g., Kavanagh 2002). However, 'potential tree hollow abundance' was not a factor in the best fitting models of occurrence suggesting that tree hollow abundance per se may not be a strong indicator of Tasmanian masked owl occurrence.

Increased detectability using passive acoustic monitoring will increase confidence in evaluating and modelling environmental drivers of landscape level occupancy and distribution of Tasmanian masked owls. Historic modelling of the distribution and habitat preferences of the subspecies have relied heavily on the incidental records database with obvious bias. For example, Jackett et al., (2020) studied historic records of the Australian masked owl *Tyto novaehollandiae novaehollandiae* in northeastern Queensland where the species is considered rare and in apparent decline. High-veracity records were used to examine habitat associations and develop a spatial model of potential distribution. They concluded that the currently disjointed distribution is probably because of a lack of systematic surveys and that this subspecies might be more widespread than previously thought (Jackett et al., 2020).

5.3 Tasmanian masked owl population

The first published estimates of the size of the Tasmanian masked owl population were between 200 and 665 pairs, though with low confidence (Bell and Mooney, 2002; Bell and Mooney, 1997; Bell et al., 1996).

The most reliable contemporary estimate, though still with low confidence, comes from Todd (2012). Todd (2012) used a predictive habitat map based on a habitat occupancy model to show the potential distribution of habitat categories for the Tasmanian masked owl. The most extensive areas of high and very high habitat potential were in the central, eastern and north-east areas of Tasmania with little high potential habitat in higher elevation areas (see Figure 23 and 24). Using 2000 ha as an average home range, Todd (2012) estimated 62 territories could be supported in very high habitat potential areas and 426 territories in high habitat potential areas giving a total of 488 breeding pairs. Not all areas of high and very high habitat potential were contiguous and so this estimate could be less. Also, many territories occur in less suitable areas where owls may occur at a lower density such as higher altitudes, wet eucalypt forest and agricultural land with large paddock trees. Further, Todd et al. (2012) did not consider unpaired and immature owls. Because of the large number of uncertainties, he considered that it is impossible to arrive at an accurate estimate of population size from the available data but proffered the population size to be around 500 breeding pairs.

Cisterne (2022) developed genotypes from trace DNA (feathers/pellets) as genetic tags for Tasmanian masked owls. He assessed population genetic characteristics over six decades, using museum specimens. The results of his study suggested that the subspecies formed a single genetic conservation unit shaped from isolation by distance, and an effective population size in decline. Cisterne (2022) found no direct evidence of changes in genetic diversity between historical and contemporary samples though the data indicated a declining effective population size, which may indicate a recent decline in population size. The results of the study also suggested that Tasmanian masked owls do not disperse over long distances. The findings overall provided support for the threatened status of the subspecies, the original assessment of a small population (i.e., 400 to 600 pairs) and that the threats from habitat loss are likely to see further declines by isolating subpopulations (Bell and Mooney, 2002; Bell et al., 1997).

Cisterne (2022) suggests that because the Tasmanian masked owl is uncommon above 600 m and dependent on large areas of forest, broad geographical features such as the high-altitude central plateau and deforested midlands may also have had a role in structuring the population. Alternatively, multiple rare dispersal events, as suggested by contemporary geneflow between mainland Australia and Tasmania (Hogan et al., 2013) could contribute to strong latitudinal variation, though this would be expected to be directional. Cisterne (2022) suggests specimens from southwest and central-west Tasmania may provide a clearer picture of the potential role of landscape and/or habitat heterogeneity in structuring the population.

5.4 Home range size of the Tasmanian masked owl

Schodde and Mason (1980) estimated the home range of the Tasmanian masked owl to be 500-1,000 ha based on observations by Hill (1955) of a pair of owls in northern Tasmania.

Some published radio tracking studies have assessed home range size and habitat use for the Australian masked owl *Tyto novaehollandiae novaehollandiae* e.g., in New South Wales (Kavanagh and Murray, 1996) and in Victoria (McNabb et al., 2003). Both these studies report similar home range sizes (and habitat use) for adult female owls in modified habitats of 1,000-1,300 ha. Interestingly, both Kavanagh and Murray (1996) for Australian masked owl and Hill (1955) for Tasmanian masked owl noted that foraging activity occurred mainly towards the centre of the home range area and the probable and known nest site respectively, were located on the edge of the home range.

In a 14-month study of a pair of Australian masked owls *Tyto novaehollandiae novaehollandiae* in a fragmented mosaic of urban bushland and dry open-forest near Newcastle, NSW, Murray and Kavanagh (1996) found high site-fidelity for two autumn-winter breeding seasons. The birds spent long periods of most nights during May-September and March-July in a particular patch of bushland where, by day, they roosted inside the large hollows of old eucalypts. The adult female was radio tagged in September 1994 and tracked for a total of 14 weeks until December 1994. The home range of this bird was estimated as 1017-1178 ha (Kavanagh and Murray, 1996).

Young (2006) was the first radio tracking study of the Tasmanian masked owl. He estimated home range sizes for two radio tracked female Tasmanian masked owls of 1,991 ha and 1,896 ha using the Minimum Convex Polygon method, and 2,507 ha and 2,320 ha, respectively, using the Kernel Estimator method. The 50% isopleth Kernel estimated a core area of 174 ha and 309 ha for each owl respectively. Both female owls used two core areas within their home range reflecting frequent foraging and roosting sites. Noting that only two female owls were tracked in a modified agricultural land/forest landscape, he concluded that the location and configuration of the two home ranges within this landscape, and areas of core use, suggested that the owls were possibly responding to geomorphology, heterogeneity of forest patches, forest structure, and abundance and accessibility of prey (Young, 2006; Young et al., 2020). Both female owls preferentially foraged at forest edges, riparian zones and in small forest patches (Figure 27). Frequently used foraging locations were in open forest with minimal understorey vegetation and a pasture groundcover, which may reflect increased prey abundance, diversity and accessibility in this habitat type (Young, 2006; Young et al., 2021).

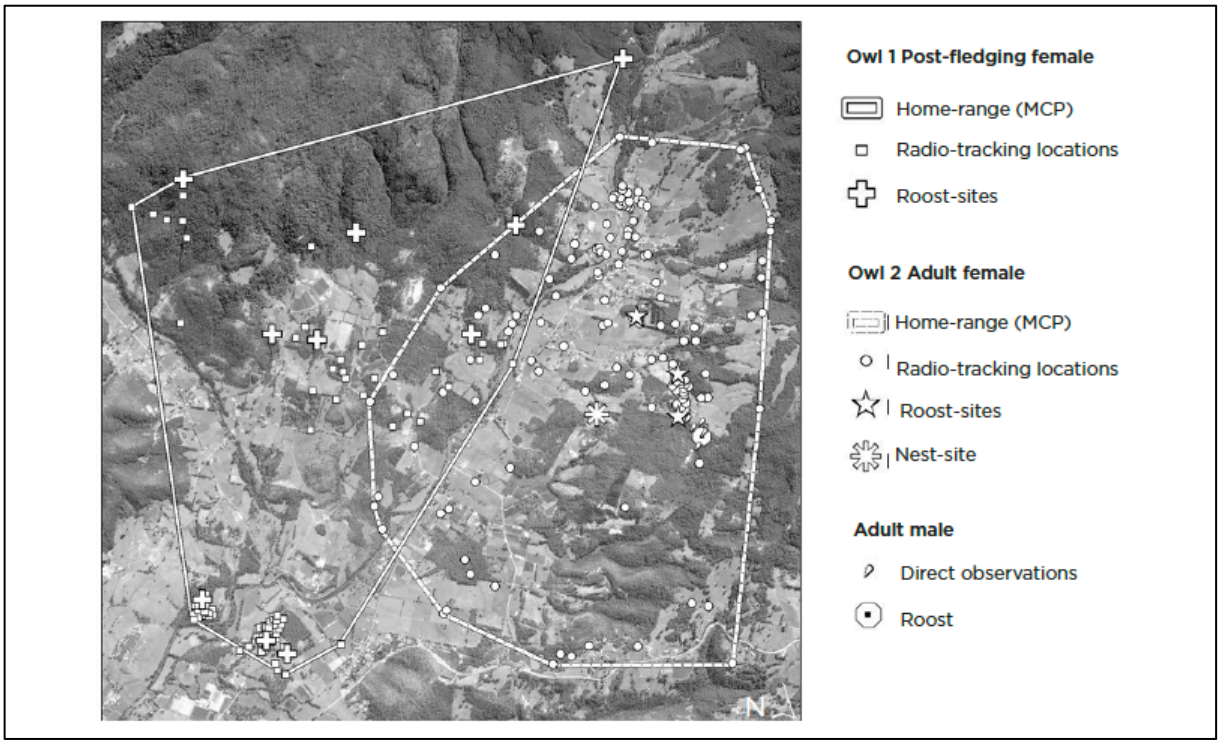


Figure 27. *Home range (Minimum Convex Polygon) and radio tracking locations for a juvenile female and adult female, and direct observations and a roost site of an adult male Tasmanian masked owl (i.e., breeding partner of the adult female) at Crabtree and Mountain River, south-west of Hobart. The area comprises a modified agricultural land and native forest mosaic with patchy dry eucalypt forest and extensive areas of exotic pasture and isolated paddock trees (Young et al., 2020).*

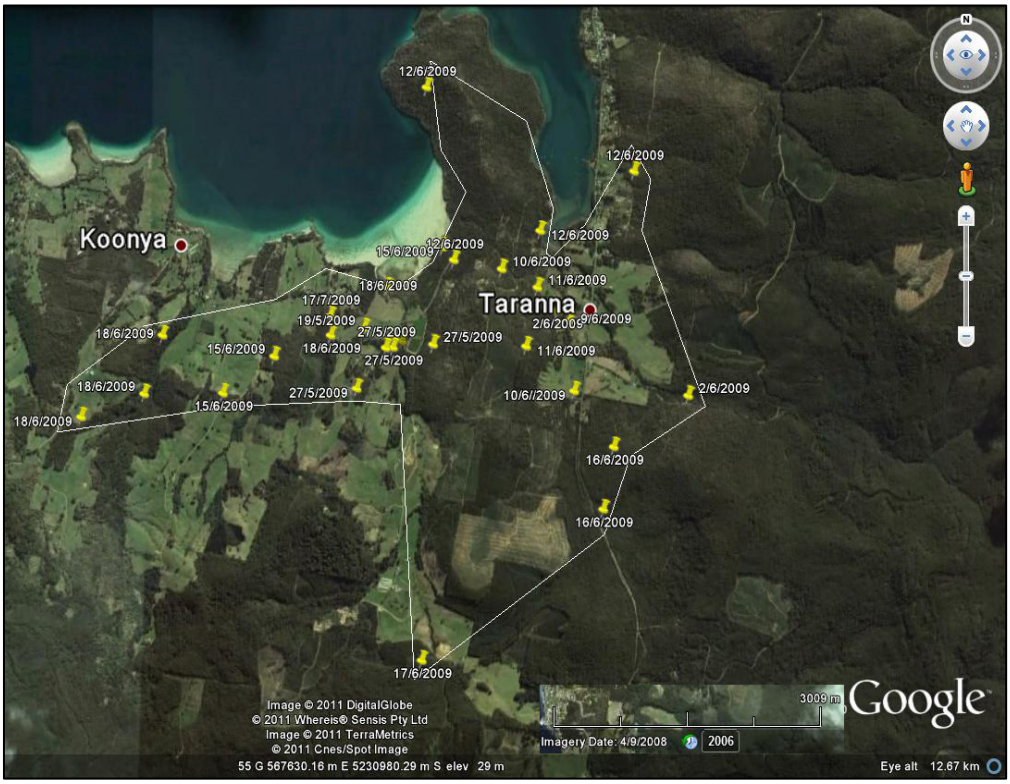


Figure 28*. Home range (Minimum Convex Polygon) of tracked adult male Tasmanian masked owl on the Tasman Peninsula in 2009 (Todd, unpublished data).*

During his PhD study, Todd (2012) radio tracked a male Tasmanian masked owl on the Tasman Peninsula (in the vicinity of Koonya and Taranna) for a 2-month period between May and July 2009. Based on a Minimum Convex Polygon calculation of home range the male owl used an area of approximately 2,000 ha over the tracking period (Figure 28). The home range was comprised of an agricultural land/forest mosaic (Todd, 2012).

Service (2023) tracked six Tasmanian masked owls using GPS telemetry between September 2022 and January 2023, collecting a total of 680 location fixes. The mean home range (Minimum Convex Polygon) for four of the owls (Figure 29) was 2,020 ha ± 1819 ha which was consistent with that found by Young et al. (2020) and Todd (2012) but significantly more variable. He suggested that although a mean home range size of about 2,000 ha might be appropriate, individuals often deviate from this estimate, and the observed variance could be driven by several ecological processes. For example, prey density and availability may drive the amount of habitat an individual requires and owls living in areas with low prey availability may need to travel further afield to encounter enough prey items. Intraspecific competition for territories may also affect an individual's territory size as neighbouring owls may gain or lose habitat depending on how other individuals defend and expand their territories (Service 2023).

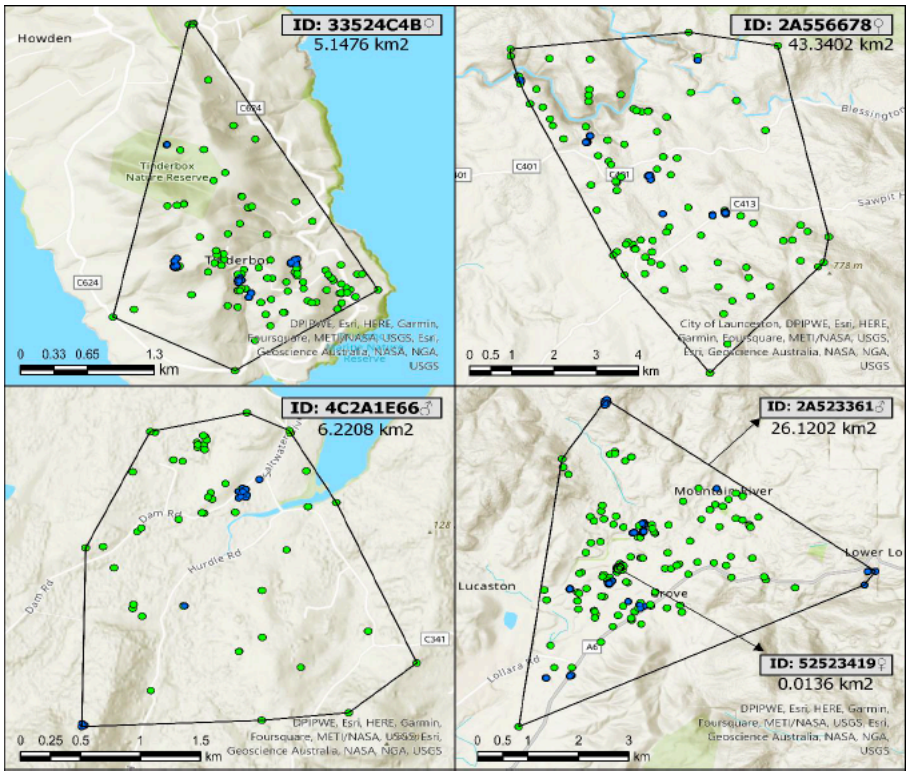


Figure 29. *Home range (Minimum Convex Polygon) for four GPS tracked Tasmanian masked owls. Green dots = active hours fixes; blue dots = roosting fixes (Service, unpublished data).*

5.5 Foraging and diet of the Tasmanian masked owl

Several authors (e.g., Mooney, 1993, Todd, 2012; Young et al., 2020; Cisterne et al., 2020; Service, 2023) have suggested the likely importance of prey abundance and availability in determining the occurrence and home range size of Tasmanian masked owls. Todd (2012) concluded in his PhD study that although the conservation of the Tasmanian masked owl is often discussed in terms of the availability of nesting and roosting sites, the results of his study indicated that the availability (accessibility) of their prey is probably also a critical and sometimes an overlooked factor. The relative importance of the availability of foraging habitat and nesting habitat may vary between areas and would be a valuable avenue for future research.

Prior to the 1990's there were only a few published accounts of the diet of the Tasmanian masked owl (e.g., Hill, 1955; Green, 1982; Green and Rainbird, 1985). Hill (1955) studied a nest near Devonport and observed 5-6 young rabbits brought to the nest each night to be fed to large nestlings, though they were also fed beetles, a large moth, mice and rats. These accounts were cited in Mooney (1993) and Todd et al. (2025), and specific data on diet from these studies were used in the study by Todd et al. (2025).

Mooney (1993) sampled 1093 prey remains from 15 Tasmanian masked owl roost/nest sites and found that mammals made up 74% of items and 94% of the biomass. The prey weight ranged from 2 g invertebrates to 2 kg mammals and about 77% of prey items were introduced species. At individual nests many invertebrates may be eaten (e.g., Hill 1955), prey typically underestimated in studies of macro prey remains. When the diet from prehistoric and historic roost/nest sites was compared Mooney (1993) found that native rodents made up 81% of the pre-European settlement diet but only 9.4% of the post-European settlement diet. The difference was largely the result of a change in availability and shift in the diet to introduced rodents (38%) and rabbits (38%).

Peake et al. (1993) observed, based on all previous diet studies, that the Australian masked owl *Tyto novaehollandiae novaehollandiae* is almost exclusively a predator of mammals, mostly terrestrial mammals. However, since Victoria's small- to medium-sized terrestrial mammal fauna has changed greatly since European settlement, the relevance of the pre-European settlement diet to the current diet had remained unclear. In particular, the degree to which rabbits and introduced rodents replaced native mammals in the diet was unclear. They considered that it is unlikely that introduced species could fully compensate for the decline of native mammals. For example, house mouse is known for its dramatic population fluctuations and given that Australian masked owls are predominantly sedentary, it is unlikely that they would be able to find sufficient mice during population troughs. Further, other introduced rodents are unlikely to be major food source for the subspecies because, outside urban areas, they tend to occur only in small, isolated patches. Rabbit populations have also fluctuated dramatically over time. Peake et al. (1993) suggested that the distribution and habitat requirements of the Australian masked owl in Victoria appeared to be strongly related to its diet and breeding sites. Each of the four main habitat types in Victoria provides what appear to be the two key requirements: access to prey and tree hollows. There are two components to prey accessibility: prey must be sufficiently abundant to support sedentary owls, and the owls must be able to catch it. This division is important because populations of many native mammal species are most dense in areas of dense ground cover, while it has been suggested that Australian masked owls hunt in areas of open understorey (e.g., Schodde and Mason 1980). The occurrence of areas of dense and sparse ground cover in close proximity is a recurring theme in several habitat types. Tree hollow availability is presumably essential for breeding but may also be of importance in the provision of nest sites for arboreal prey. Hollows required by Australian masked owls for roosting and nesting are very large, whereas entrance holes required by their arboreal prey range down to 3-4 cm wide. In the last 150 years, many of the species in the pre-European settlement diet of the Australian masked owl have declined, several to extinction and in general, the availability of tree hollows of sufficient size for nesting has decreased (Peake et al., 1993).

Young et al. (2020) studied the diet of two radio tracked female Tasmanian masked owls in a modified agricultural land/native forest landscape. The diet of one owl (assessed from 58 prey items) comprised mainly native marsupials by number of prey items (42%) and biomass (70%). Introduced eutherian mammals contributed 35% of prey items and 26% of the total biomass. Minor components of the diet included swamp rat *Rattus lutreolus* and birds. Eastern barred bandicoot *Perameles gunnii* and black rat *Rattus rattus* were the most abundant prey items. Tasmanian pademelon *Thylogale billardierii* and rabbit *Oryctolagus cuniculus* were important components of the biomass. The other owl's diet was assessed from only 16 pellets though native marsupials contributed to most prey items recorded by number (53%) and biomass (88%). Introduced rodents (black rat, brown rat *Rattus norvegicus* and house mouse *Mus musculus*) were

also important components of the diet. Swamp rat contributed only a minor part of the diet. Eastern barred bandicoot and house mouse were the most abundant prey items. Although black rat and brown rat were an important component by number in the diet, Tasmanian pademelon contributed most of the biomass (Young et al., 2021; Young, 2006)

Bilney and L'Hotellier (2013) assessed the diet of radio tracked Australian masked owls *Tyto novaehollandiae novaehollandiae* in East Gippsland, Victoria from 44 pellets and identified eight mammal species (seven native, one introduced), of which 6 species and 86% of the diet were species that are predominantly terrestrial in habit.

Todd (2006) documented prey partitioning between sexes in nesting Australian masked owls *Tyto novaehollandiae novaehollandiae* on the central coast of NSW. The female owl was observed to bring bush rats *Rattus fuscipes* and *Petaurus* gliders to the nest while the male owl brought brown antechinus *Antechinus stuartii* and house mouse.

McNabb et al. (2003) radio tracked a female Australian masked owl *Tyto novaehollandiae novaehollandiae* in western Victoria and observed foraging activity focused in dense/medium tree cover. Rabbits comprised 89% of the prey biomass from 277 individual prey items.

Bilney and Bilney (2015) assessed the prey remains from a roost in mountain white gum *Eucalyptus dalrympleana* at about 1,400 m a.s.l. in Alpine National Park, Victoria. The habitat comprised a mosaic of sub-alpine and montane vegetation communities including woodlands, heathlands, grasslands and peatlands. Skeletal remains of 41 prey items were identified and included 23 bush rat, nine broad-toothed rat *Mastacomys fuscus* and nine agile antechinus *Antechinus agilis*. This was the first Australian masked owl dietary study reported from alpine habitat and was similar to other studies in being dominated by terrestrial mammals (e.g., Debus, 1993; Mooney, 1993; McNabb et al., 2003; Todd, 2012; Bilney and L'Hotellier, 2013).

Todd et al. (2025) quantified the diet of the Tasmanian masked owl from regurgitated pellets collected from 17 sites in eastern Tasmania. Mammals dominated the diet at all but one site, with introduced rodents (mostly black rat *Rattus rattus* and house mouse *Mus musculus*) prominent in the diet at all sites. Bandicoots, mostly Eastern barred bandicoot *Perameles gunnii* were an important food item in the diet south of Hobart. They found that the prey species most common in the diet of the subspecies varied across Tasmania with a focus on particular prey species at particular localities. Prey partitioning between the sexes was suggested as the reason for the variation since the subspecies has an extreme (reversed) sexual dimorphism in size for raptors.

The importance of foraging habitat types and the abundance and availability of prey in the occurrence and distribution of the Tasmanian masked owl is likely to be underestimated in survey and conservation management of the subspecies. In areas where the large tree hollow resource is not limited, the available prey base is more likely to be the driver of occurrence and home range size, particularly in locations distant from modified landscapes such as forest interiors, wet forests, western Tasmania and high altitudes. Table 7 provides an example of the reliance on arboreal prey (mainly hollow dependent prey) in a forest interior at 600 m altitude in the eastern highlands (Bell et al., unpublished data). Patterns in the diet of the Tasmanian masked owl across the State were identified by Todd (2012) with that study providing a baseline from which future research into the diet of the subspecies and the influence of dominant vegetation types can be investigated.

A Tasmania wide study of the diet of the Tasmanian masked owl was initiated through the University of Tasmania in 2023. The study aims to better understand variation in the diet of the subspecies across native non-forest vegetation and varying eucalypt forest types and structures. The study is a prelude to further research on the role of prey abundance and availability on the distribution, abundance and home range size of the Tasmanian masked owl. Initial results from the analysis of pellets from nest and roost sites located in wet eucalypt forests, distant from agricultural land, is indicating a much higher diversity of native species and a much higher contribution of arboreal marsupials to the diet (Bell et al., unpublished data). Table 7 shows the

diversity of prey items identified from 407 regurgitated pellets collected over a two-year period from a roost site located in an extensive State Forest block in the eastern tiers. Arboreal marsupials contributed 35% of the total number of prey items and 71% of the total biomass in the diet. In contrast, native and introduced rodents contributed 55% (clearly an important contribution to the total number of prey items) but only 26% of the total biomass in the diet. Unlike the typical diet reported for other studies of the subspecies' diet (including the Australian masked owl), arboreal marsupials are clearly a very important component of the diet at this roost site (i.e., mainly ringtail possum and sugar glider) (Bell et al., unpublished data).

Table 7. *Prey items identified from 407 regurgitated pellets collected over a two-year period from a roost hollow located in an extensive State Forest block in the eastern tiers (Phil Bell, unpublished data). * Prey units are the same as those used by Todd et al. (2025).*

Species	Total number of prey items	% of total number of prey items	Prey units*	Biomass of prey items	% biomass
Sugar glider	44	10.8	6.4	280.3	4.5
Common ringtail possum	81	19.9	49.7	4029.8	65.2
Common brushtail possum	1	0.2	100.0	100.0	1.6
Little pigmy possum	11	2.7	0.4	4.4	0.1
Eastern pigmy possum	6	1.5	1.2	7.2	0.1
House mouse	96	23.6	1.0	96.0	1.6
Black rat	98	24.1	14.0	1372.0	22.2
Swamp rat	31	7.6	5.3	162.8	2.6
Dusky antechinus	2	0.5	2.7	5.3	0.1
Swamp antechinus	11	2.7	3.4	37.3	0.6
White-footed dunnart	4	1.0	1.6	6.4	0.1
Bird	13	3.2	4.0	52.5	0.9
Owlet nightjar	1	0.2	3.3	3.3	0.1
Bat	4	1.0	0.3	1.0	0.0
Insect	3	0.7	0.002	0.006	0.0
Southern brown bandicoot	1	0.2	18.7	18.8	0.3

The following photos provide some guidance on searching for and identifying Tasmanian masked owl pellets. Distinguishing Tasmanian masked owl pellets from those of other raptors (including pellets of the Tasmanian boobook *Ninox leucopsis*, which often contain house mouse) can be difficult. Size of pellets and identity of the prey species from bone and fur/feather remains can be informative. However, identifying the source species of the pellet can be confusing, particularly if there is only a single or a few pellets found. Many roosting cliffs are shared with peregrine falcons *Falco peregrinus* (sometimes within metres) and brown falcons *F. berigora*, and pellets underneath can be mixed. Tasmanian masked owl pellets tend to be relatively large and have very intact bones compared to those of falcons, but there is overlap, especially when pellets degrade. Scavenging mammals can also confuse the identification. At many cliff roosts of Tasmanian masked owls, at least Tasmanian devils *Sarcophilus harrisii* are also present and because of the

long-term nature of the roost (often with prey scraps underneath) the roosts are routinely visited by scavengers. Toes and claws of both brown falcon and Tasmanian masked owl have been identified in devil scats at cliff roost sites suggesting birds literally 'falling off their perches' are also eaten. Tasmanian masked owls have less efficient digestion of bone than do falcons so it can be assumed devils also eat some Tasmanian masked owl pellets (they have been observed to do so in captivity). Raptor and mammal ecologists and museum curators in Tasmania are usually keen to assist in identifications.



Figure 30. *A mixture of Tasmanian masked owl pellets, peregrine falcon pellets and devil scats under a shared roosting cliff at Chauncy Vale (Photo: Nick Mooney).*

Figures 31, 32 and 33 show intact pellets that are less than four weeks old collected from below a roost site. Note the large size of the pellets. Pellets from male and female Tasmanian masked owls tend to be different in size reflecting the typical difference in the size of the prey taken by male and female owls (e.g., very large prey items often taken by female masked owls such as common brushtail possum, common ringtail possum and macropods, and very small prey items often taken by male Tasmanian masked owls such as insects, mice and pygmy possums). Note however, that although pellets from male owls are typically smaller than those of female owls, multiple items can be present in a single pellet. For example, up to three house mouse and three pygmy possum have been found in single pellets from male Tasmanian masked owls. In captivity the pellets of different sexed Tasmanian masked owls overlap in size with about a quarter of them hard to assign by size (Nick Mooney pers. obs.).

Figures 34 and 35 show how Tasmanian masked owl pellets can decompose, particularly following heavy rainfall. The pellets shown in these figures were found below an open vegetation roost at Bridgenorth in northern Tasmania. Although the pellets have somewhat disintegrated, they have not been interfered with by scavengers and clearly show the intact bones of the prey species.

Figure 36 shows pellets and skeletal bone remains collected from a disused Tasmanian masked owl nest in a trunk hollow of mountain white gum *Eucalyptus dalrympleana*, central north Tasmania. The bones were mainly sugar glider *Petaurus notatus*, common ringtail possum *Pseudocheirus peregrinus*, black rat *Rattus rattus*, swamp rat *R. lutreolus* and unidentified birds. Figure 36 also shows a large hollow at the base of a mountain white gum in the eastern tiers. A chimney in the trunk extends from a large cavity roost in the tree canopy to the base of the tree.

Regurgitated pellets fall down the chimney and accumulate at the base of the tree. Prey species were identified from the pellets collected from at the base of this tree monthly over a two-year period. The results of this study are presented in. Table 7.



Figure 31. *LHS Tasmanian masked owl pellet containing mammal prey revealing fur only (note that bones are not always visible without dissection of the pellet); RHS Tasmanian masked owl pellet revealing the lower jawbone (mandible) of a common ringtail possum Pseudocheirus peregrinus (Photos: Phil Bell).*



Figure 32. *LHS Tasmanian masked owl pellet revealing fur and several bones of a swamp rat Rattus lutreolus; RHS Tasmanian masked owl pellet revealing several bones and feather shafts of a common starling Sturnus vulgaris (Photos: Phil Bell).*



Figure 33. *Tasmanian masked owl pellet showing an intact sugar glider skull (Photo: David Cunningham).*



Figure 34. *LHS Tasmanian masked owl partially decomposed pellet containing bones and feather remains of a common starling Sturnus vulgaris; RHS Tasmanian masked owl partially decomposed pellet containing bones and fur remains, including the skull and mandible of a black rat Rattus rattus (Photos: Phil Bell).*



Figure 35. *LHS Tasmanian masked owl partially decomposed pellet containing bones and fur remains, including the skull and mandible of a sugar glider Petaurus notatus; RHS Tasmanian masked owl partially decomposed pellet containing bones and fur remains, including vertebrae, tibia and femur of a black rat Rattus rattus (Photos: Phil Bell).*



Figure 36. *LHS pellets and skeletal bone remains from a disused Tasmanian masked owl nest in a trunk hollow of mountain white gum Eucalyptus dalrympleana, central north Tasmania.; RHS the base of a hollow tree in the eastern tiers where a chimney in the trunk extends from a large cavity roost in the tree canopy to the base of the tree (Photos: Phil Bell).*

Tasmanian masked owls are renowned for their extreme degree of Reversed Sexual Dimorphism (RSD) with females being about 70% heavier than males (Figure 37). This degree of RSD presents

as an obvious difference in general size, power and voice tone. It also has repercussions for wing loading (females being higher and males being more efficient fliers) and therefore maneuverability (females needing wider turning arcs), but also on what hollow entrance sizes are preferred; males can comfortably enter smaller spaces.



Figure 37. *Size difference of sibling Tasmanian masked owls (female on left) in their second year. Note also the difference in 'weight' of the legs (Photo: Nick Mooney).*

Tasmanian masked owls have higher RSD than mainland masked owls. This may reflect less competition in Tasmania; on mainland Australia, masked owls compete to a degree with other large *Tyto* and *Ninox* owls and consequently likely have a narrower niche than the Tasmanian conspecific.

Tasmania is an island with limited resources so having less competition allows a species to expand its niche (in the TMO case by having extreme RSD) to use a wider range of food resources and maintain a higher population than would otherwise be the case. This in turn allows a greater chance of surviving stochastic events and bottlenecks.

Sexual dimorphism in diurnal raptors is associated with the ability to take agile prey especially flying birds. Those that routinely do have very large RSD. It is thought that this is because a small individual, by its engineering more agile, is best able to catch small prey (the usual prey early in breeding) while a large individual is better at conserving heat and producing eggs; hence the male is the small one.

However, nocturnal owls, especially *Tyto* owls have muffled plumage and are famously silent hunters. This makes them slow flyers and their short tails (poor for maneuvering) suggests a surprise hunter and poor at pursuit of fast and/or agile prey. It seems the high RSD allows a huge size range of prey from insects to well grown quolls, small macropods and common brushtail possums (Figure 38) should smaller (safer) prey be of low availability.



Figure 38. *Tasmanian masked owl with a brush-tailed possum almost certainly exceeding the owl in weight. The heavy feet of the owl suggest a female and the color suggests an adult (Photo: unknown).*

It appears that Tasmanian masked owls are opportunistic hunters taking whatever is easily available and worth catching (and transporting should they be breeding), their size and power range allowing a wide choice as a pair (or species). This means that males (taking small to medium sized prey) may have a more critical size/abundance threshold for prey, affecting their survivability in some situations compared to females (taking small to large sized prey). It should be noted that a lack of small/medium sized prey would severely impact breeding since the male does the provisioning early in breeding. Barn owls on the other hand, have very little sexual dimorphism by size and specialise on small mammals, most commonly mice.

Prey availability in post-colonial Tasmania is likely very different in many areas to conditions under which the Tasmanian masked owl evolved. The introduction of the rabbit offered a profoundly different food supply with r selected type hyper-breeding meaning medium sized prey that particularly benefited male Tasmanian masked owls (i.e., rabbit kittens) were highly available for much longer than the prey they replaced (e.g., Eastern barred bandicoot). There are many accounts of breeding Tasmanian masked owls relying (by numbers and biomass) on rabbits with kittens taken by male owls and larger rabbits by female owls.

5.6 Breeding

Aside from the requirement for large hollows, which are almost exclusively in eucalypts, there is scant information on nesting habitat selection by the Tasmanian masked owl.

A GPS tracking study of six Tasmanian masked owls by Service (2023) did not observe a relationship between 'Morphological Protection Index' (i.e., an index of site exposure), forest patches, solar radiation or wind exposure and roosting location. Nor did Service (2023) detect a relationship between known nest locations of the subspecies (n = 16) and the distance to watercourse, slope, wind exposure or Morphological Protection Index. He did, however, observe an apparent negative relationship with solar radiation for nest locations and cited previous research by Ganey (2004) involving Mexican spotted owls *Strix occidentalis lucida* that observed the species' nest sites were considerably cooler than random locations. Ganey (2004) proposed that the owls may be avoiding evaporative water loss in dry climates by selection of habitat with reduced solar radiation. However, Service (2023) also noted that solar radiation is correlated with other environmental variables including topographic aspect and eucalypt community structure,

and that given Tasmanian masked owls nest in large tree hollows with typically stable thermal properties it may be too early to confirm a relationship with solar radiation.

Breeding by Tasmanian masked owl tends to be seasonal (Mooney, 1993) though it may occur at any time of the year (e.g., Bell, 2006).

Mooney (1993) estimated the laying dates from 13 wild broods that were recorded by comparison of the plumage stages with a known-age wild brood from Hill (1955) and captive bred chicks, and assuming an incubation period of 34 days for back-calculation. From Debus (1993), fledging was assumed to be at about 10 weeks after hatching. The back-calculations by Mooney (1993) indicated that clutches were likely laid from mid- to late October and hatching occurred in very late November to early December. Fledging would have taken place in mid- to late February.

Bell (2006) reported on the accidental felling of a Tasmanian masked owl nest tree at Mersylea, near Railton in early May 2006. The nest contained one chick and an egg. The nest was in a white gum *Eucalypt viminalis* paddock tree. Although an isolated paddock tree, it was close to remnant forest and a stream. The tree was 31 m tall with a DBH of 165 cm. The nest was located at a height of about 14 m in a large hollow in the trunk at its first major branch. The hollow entrance was directed slightly upward and so would not have been visible from the ground. The nest cavity was clean of faeces, old, regurgitated material and old prey remains. One small fresh pellet was found, possibly from the owl chick and many intact fresh prey items were present including several black rat and house mouse, and part of a single rabbit. The only other prey remains present were the tails of more than 20 house mouse. The chick was estimated to be about 2 - 3 weeks old and so the eggs were likely laid between mid- and late March 2006. Egg shell and one addled egg was also found in the nest hollow. Whereas this finding suggests that breeding can take place at any time of the year it may not be representative of breeding trends in extensive native forest situations. It is likely that the native forest/farmland mosaic surrounding the nest tree supported a higher abundance and availability of introduced prey species (rats, mice and rabbits) throughout the year compared to more extensive native forest/non forest landscapes (Bell, 2006).

There is a lack of information on why nest hollows stop being used for breeding; sometimes it is obvious but usually not (Nick Mooney pers. comm.). Recent research on the Australian masked owl in the Margaret River Region of Western Australia has identified a tendency for breeding pairs to skip a year between breeding (Boyd Wykes pers. comm.). If this behaviour extends to the Tasmanian masked owl, then it would be an important consideration when surveying for the presence of a nest site.

Based on published accounts of breeding by the Australian masked owl *Tyto novaehollandiae novaehollandiae* and Tasmanian masked owl (e.g., Higgins, 1999), the incubation period for the Tasmania masked owl is 33-35 days and the period to fledging is 2-3 months, with a dependency period of 1-3 months.

Breeding habitat for the Tasmanian masked owl is a concept which refers to a core area within a home range where the nest is located and may also support other features such as roosting hollows and a higher abundance and/or diversity of available prey species (i.e., higher quality foraging habitat) than elsewhere within the home range. There is no empirical evidence to support the concept of breeding habitat except for anecdotal observations of clustering of nest and roost trees and increased prey abundance and availability.

Breeding by the Tasmanian masked owl can be close to residential housing although it is often not clear if the owls simply persisted when the housing was established or took up the nest hollow after the housing was established (Nick Mooney, pers. comm.).



Figure 39. *Tasmanian masked owl dependent fledgling perched at night on a garden gate (Photo: David Jamrozik).*

5.7 Roosting

Diurnal roosting by the Tasmanian masked owl often occurs in tree hollows, but also outside of hollows, usually in trees with dense foliage such as native cherry *Exocarpos cupressiformis*, silver banksia *Banksia marginata* and silver wattle *Acacia dealbata* in dry eucalypt forests, and blackwood *A. melanoxylon*, silver wattle and dogwood *Pomaderris apetala* in wet eucalypt forest. The subspecies is also known to roost in exotic trees such as pines, and in urban areas in buildings and other structures. They also roost in caves and potholes and deep ledges in cliffs, usually with adjacent forest. Some of these cliff roosts can have droppings deposits exceeding 50 cm deep and would appear to be very long-term (Figure 40). Note that a roost hollow of sufficient size and structure is also a potential nest hollow. Tasmanian masked owls apparently rarely move from their roosting sites during the day unless disturbed (Bell and Mooney, 2002). Those that do move are usually mobbed, sometimes aggressively by dangerous birds (e.g., raptors, Australian magpie, laughing kookaburra). Indeed, flushing before being detected may account for sightings in seemingly inappropriate locations (e.g., high in an exposed eucalypt). Such observations can make diurnal observations unreliable (a typical feature of a flushed owl is that both feet are used for perching – a relaxed owl at roost typically stands on one leg, the other leg being dropped as anxiety increases).

Young et al. (2021) described roost sites and roosting behaviour for a juvenile female, an adult female and an adult male Tasmanian masked owl in a mosaic landscape of forest and farmland.

The two female owls were radio tracked and frequently used roost sites in a core area which were typically associated with small watercourses, on the edges of large contiguous forest patches. The juvenile Tasmanian masked owl used several vegetation roost sites after dispersing from its presumed natal territory. The adult female used two vegetation roosts and one tree hollow, and the adult male owl used only one tree hollow roost. The primary tree hollow roost sites of the male and female owls were <400 m apart and were both <1200 m from a suspected nest tree suggesting that the proximity of nest and roost sites may be important to territorial, foraging and reproductive behaviours of breeding pairs.

Bilney and L'Hotellier (2013) gathered information from opportunistic observations and radio tracking of Australian masked owls *Tyto novaehollandiae novaehollandiae* in coastal forest in East Gippsland, Victoria. Twelve roosting/nesting sites were located; 11 were within eucalypt tree hollows (of which 10 trees were either dead or partially dead, with significant structural damage), and one was a vegetation roost.

A 14-month study by Kavanagh and Murray (1996) of a pair of Australian masked owls *Tyto novaehollandiae novaehollandiae* in a fragmented mosaic of urban bushland (dry open forest) near Newcastle, NSW found high site fidelity for two autumn-winter breeding seasons. The birds spent long periods of most nights in a particular patch of bushland where, by day, they roosted inside the large hollows of old eucalypts. During the non-breeding season, the female owl roosted among the dense foliage of several introduced trees occurring on residential properties.

Figures 41 to 44 provide some guidance on identifying roost hollows and vegetation roost sites. Note that it is not typical for a hollow roost to have evidence of use (e.g., pellets, whitewash, prey remains, feathers) directly below the roost hollow or at the base of the tree. However, often such evidence can be found below a vegetation roost and at a traditional vegetation roost site, large quantities of whitewash and pellets may be found. Clearly, the longer a vegetation roost has been used, the greater the potential to find evidence of use on the ground below the perch site.



Figure 40. *Tasmanian masked owl cliff roost at Chauncy Vale showing huge droppings deposit (Photo: Nick Mooney).*



Figure 41. *LHS: Tasmanian masked owl in roost hollow in stringybark Eucalyptus obliqua, southeast Tasmania (Photo: Erin Harris); RHS: Tasmanian masked owl in roost hollow in stringybark Eucalyptus obliqua, northwest Tasmania (Photo: Adam Hardy).*



Figure 42. *LHS: Tasmanian masked owl roost hollow in mountain white gum Eucalyptus dalrympleana, eastern tiers (Photo: Phil Bell); RHS: Tasmanian masked owl at vegetation roost in soft treefern Dicksonia antarctica, southeast Tasmania (Photo: Mick Todd).*



Figure 43. *LHS: Tasmanian masked owl cave roost, southeast Tasmania; RHS Tasmanian masked owl vegetation roost in exotic conifer on peri urban residential property, southeast Tasmania (Photos: Mick Todd).*



Figure 44. *Tasmanian masked owl roosting in a pavement flowering gum in Macquarie Street, Hobart near TMAG (Photo: Mick Brown).*

5.8 Nesting

Nest trees of the Tasmanian masked owl are in a range of forest and woodland types, and even in isolated paddock trees. Nests of the subspecies are typically in very old eucalypts (both alive and dead) (Mooney, 1997). There may also be some potential for the subspecies to nest outside of tree hollows such as in cliff potholes (Nick Mooney pers. comm.).

Searching for potential nest hollows can be difficult from ground-based observations, and it is generally not possible to determine if a hollow has dimensions suitable for use by Tasmanian masked owls unless a detailed examination can be made of the hollow entrance and the internal cavity. Hollows are more likely to be found in large old trees, so tree diameter is a useful surrogate for hollow availability and trees less than 100 cm DBH are less likely to contain hollows suitable for the subspecies (Koch, 2008; Koch et al., 2008).

Not all large trees will contain hollows suitable for use by Tasmanian masked owls, so the likelihood of a suitable hollow occurring in an area increases with both tree age/size and the number of large trees. Therefore, areas with the largest trees and areas with the greatest densities of large trees constitute higher quality habitat than areas with fewer or smaller trees (Koch et al., 2008). Not all trees over 100 cm DBH are old or senescent enough to contain hollows suitable for use by Tasmanian masked owls (e.g., large regrowth poles), and some areas of very large trees at low densities may also provide roosting/nesting habitat for the subspecies (e.g., scattered large old trees in a regrowth dominated forest) (FPA, 2014).

A planning tool used within the Tasmanian forest practices system and commonly used by environmental consultants, forest planners and researchers to identify potential habitat for Tasmanian masked owls is the FPA's 'Mature Habitat Availability Map'. This map identifies areas as high, medium, low or negligible mature habitat availability, based on aerial photograph interpretation of mature crown density and senescence. Higher map categories on average have a greater likelihood of containing hollow-bearing trees and so are more likely to contain hollows suitable for use by Tasmanian masked owls. The caveat here is that some forests of low-density mature trees can provide breeding habitat for the subspecies (FPA, 2014).

Like any landscape scale map based on photographic interpretation, the Mature Habitat Availability Map is indicative only; there are inaccuracies and the map dates with time since aerial interpretation. Therefore, such spatial information is best used for landscape scale assessments of habitat availability rather than assessments at the site scale. At a fine-scale the availability and distribution of hollow- bearing trees is best determined from a ground-based assessment as the actual distribution and quality of habitat at this scale may be different to that indicated by the Mature Habitat Availability Map (FPA, 2014). Where available, the Mature Habitat Availability Map can be supplemented by recent LiDAR and/or high-resolution aerial photography.

Figures 45 to 50 provide some guidance on searching for and identifying nest trees and nest hollows of the Tasmanian masked owl. Note that it can be difficult to identify a hollow as being used by the subspecies, and distinguishing use of a hollow for nesting and/or roosting. It is not typical for a nest to have evidence of use (e.g., pellets, whitewash, prey remains, feathers) directly below the nest hollow or at the base of the tree (note that evidence of young at fledging age is more common as they come and go at the edge of the hollow and move around adjacent branches). However, other observations can assist in confirming use of a hollow for nesting.



Figure 45. *LHS: Tasmanian masked owl nest hollow entrance in mountain white gum, Eucalyptus dalrympleana, central north Tasmania (Photo: Phil Bell); RHS: detail of the same nest hollow entrance (Photo: Dave James).*



Figure 46. *LHS: lower lip of Tasmanian masked owl nest hollow entrance in mountain white gum, Eucalyptus dalrympleana, central north Tasmania showing talon marks from frequent landing and perching; RHS: prey remains, pellets, feathers and eggs shell at base of the nest cavity of same tree (Photos: Dave James).*



Figure 47. *Tasmanian masked owl nest tree in white gum, Eucalyptus viminalis (located at far RHS of photo) adjacent to a highway and overhanging the Derwent River, southeast Tasmania (Photo: Phil Bell).*



Figure 48. *LHS: Tasmanian masked owl nest tree in white gum Eucalyptus viminalis, accidentally felled, central north Tasmania. Nest hollow located at first major branch of the trunk, where people are standing; RHS: nest cavity showing cached rodents and addled egg [note that this photo is taken on the fallen tree and the contents of the nest cavity would have been displaced when the tree fell] (Photos: Phil Bell).*



Figure 49. *Tasmanian masked owl nest tree in white gum Eucalyptus viminalis, accidentally felled, central north Tasmania. LHS: Contents of the nest hollow including black rat, house mouse, feathers and addled egg displayed on the trunk; RHS: another tree cavity approximately 2 m from the nest cavity supporting a trapped common brushtail possum (Photos: Phil Bell).*



Figure 50. *LHS: Tasmanian masked owl nest tree in white gum Eucalyptus viminalis in paddock, southeast Tasmania. RHS: Tasmanian masked owl nest tree in white gum E. viminalis in dry eucalypt forest, eastern Tasmania (Photos: Phil Bell).*

6. Conservation status of the Tasmanian masked owl

6.1 Conservation status of the Tasmanian masked owl

The Tasmanian masked owl *Tyto novaehollandiae castanops* was first listed under the *Threatened Species Protection Act 1995* in 2002. The listing was on Schedule 3.1 (Endangered) under Criterion C2(b) i.e., 'small population in decline' (TSSAC, 2002).

The subspecies was listed under the Commonwealth, *Environment Protection and Biodiversity Conservation Act 1999* in 2010. The listing was made under Criterion C4 as vulnerable on the basis 'The estimated total number of individuals is extremely low, very low or low.' i.e., 'Low – a number of population estimates have been made for the subspecies, ranging from 520 to 1330 breeding individuals (Bell and Mooney, 1997; Bell et al., 1997; Garnett and Crowley, 2000; Bell and Mooney, 2002). 'The Committee considers that this represents a low number of mature individuals for the purpose of this criterion.' (Threatened Species Scientific Committee, 2010).

In the Action Plan for Australian Birds 2020 (APAB) (Cisterne et al., 2021), the Tasmanian masked owl was assessed as meeting the criteria for endangered under IUCN C2a(ii) i.e., 'population 250-2500 mature individuals, a single population and probably a continuing decline'.

6.2 Current known threats to the Tasmanian masked owl

6.2.1 Loss of nest trees (and roost trees) and old-growth forest

The forest and non-forest habitat of the Tasmanian masked owl particularly in the eastern and northern coastal areas of Tasmania has been extensively cleared since European settlement (Bell et al., 1996). Between 1996 and 2009, approximately 142,000 ha of native forest in Tasmania was converted to monoculture plantation or agriculture (FPA, 2009). This has resulted in the loss of nesting habitat (large tree hollows) and the degradation and alteration of foraging habitat for the subspecies (DPIPWE, 2009). Native forest harvesting continues at large scales across Tasmania, mainly without preliminary on-ground assessment, resulting in continuing habitat loss and degradation.

The clearing of large hollow bearing paddock trees and forest remnants for pivot irrigation systems on farms is removing nesting habitat from large areas of the agricultural landscape in Tasmania, where there is also little to no recruitment of younger trees (DPIPWE, 2009).

Residential development, particularly along the east and north coasts of Tasmania has resulted in the loss of roosting/nesting trees and the degradation of foraging habitat for the subspecies (DPIPWE, 2009).

6.2.2 Loss of recruitment trees for nesting (and roosting)

The retention of potential recruitment trees for roosting/nesting by Tasmanian masked owls (and for hollow dependent fauna more generally) currently receives little consideration in environmental regulation of land use activities such as forestry, agriculture and residential housing development in Tasmania (DPIPWE, 2009).

The loss of trees in all age classes from dieback is resulting in a continuing loss of nesting habitat for the Tasmanian masked owl. Most nest trees used by the subspecies in Tasmania are estimated to be more than 150 years old (Mooney, 1997). In recent decades, the rate of loss of these trees through natural attrition and dieback has been very high, with little recruitment of young trees. It is unlikely that any of the nest trees which die, either through natural attrition or dieback, are retained for habitat (DPIPWE, 2009). Silvicultural practices of harvesting rotations being shorter that the time to develop hollows will increasingly erode the availability of tree hollows for the Tasmanian masked owl in the short and long term.

6.2.3 Death from collisions with vehicles on roads and collisions with powerlines and fences, and electrocutions

Despite their obvious nature, little is known of the magnitude of the threat from collisions with moving vehicles, powerlines and fences, and electrocutions, to the Tasmanian masked owl population. However, masked owls are over-represented in roadkill in Australia (DEECA, 2023). The Tasmanian masked owl tends to hunt terrestrial prey along ecotones such as many roads, making the subspecies highly vulnerable to vehicle collisions (Figure 51).



Figure 51. *Roadkilled Tasmanian masked owl (Photo: Nick Mooney).*



Figure 52. *Characteristic presentation in foot of electrocuted Tasmanian masked owl while perched on a power pole (Photo: Nick Mooney).*

A survey of road killed vertebrate fauna in north-eastern New South Wales found that barn owl, Australian masked owl and Southern boobook were the most frequently recorded raptors (Clancy,

2004). Hobday and Minnstrell (2008) recorded Tasmanian masked owl in surveys of the distribution and abundance of roadkill on Tasmanian highways. The subspecies has also been reported on the Tasmanian Roadkill Reporter app, twice in 2023 and twice in 2024.

The Tasmanian raptor rehabilitation program has two records of Tasmanian masked owls being electrocuted, both on perches (Figure 52). Private efforts are made to compensate for anthropogenic mortality and the statewide raptor rehabilitation program deals with about 8-10 Tasmanian masked owls per year with 2-3 being released (Nick Mooney, unpublished data).



Figure 53. *Tasmanian masked owl under rehabilitation following injury from collision with a motor vehicle (Photo: Natasha Kripova).*

6.2.4 Secondary poisoning from rodenticides

Secondary poisoning from rodenticides is a significant concern for the Australian masked owl in all range States and Territories and is a long-known potential threat to the Tasmanian masked owl. However, little is known of the magnitude of this threat at the population level in Tasmania. A rodenticide community awareness program has been underway for several years led by Landcare Tasmania (Landcare Tasmania 2021) and recent studies have explored the nature of the issue and the levels of exposure of the subspecies (e.g., Clarke *et al.* 2025; Cisterne, et al., 2023; Mooney, 2017). Mooney (2017) assessed the Tasmanian masked owl and Tasmanian boobook to be at the highest risk to rodenticides among the Tasmanian raptor fauna. He postulated that nearly 100 Tasmanian masked owls might be killed by rodenticides each year, which could represent the highest anthropogenic mortality factor for the species. Cisterne et al. (2023) used population models to explore the potential effects of rodenticides, though they found that model predictive power was hampered by limited information on juvenile mortality and toxicity, and exposure levels for the subspecies' population. Clarke et al. (2025) measured exposure levels of the subspecies to a suite of anticoagulant rodenticides available in Australia and detected second-generation anticoagulant rodenticides residues in 16 livers from 17 owls dying of varied causes.



Figure 54. Tasmanian masked owl showing classic symptoms of poisoning from anti-coagulant rodenticides – perched inappropriately in the day, drooling saliva and blood, and low situation awareness (Photo: Peter McKay).

6.3 Unassessed potential threats to Tasmanian masked owl

6.3.1 Planned fire and wildfire

There is no information on the threat to the Tasmanian masked owl of planned (e.g., hazard reduction burns and forestry regeneration burns) and/or wildfires in Tasmania. The large scale of the Tasmanian fire hazard reduction program and wildfires across the State are likely to have a negative impact on the availability of nesting habitat and a largely unknown impact on the availability and abundance of prey species for the Tasmanian masked owl. For example, more than 50% of the likely habitat for the Australian masked owl *Tyto novaehollandiae novaehollandiae* across Victoria falls within the extent of the 2019-20 bushfires and 26% was estimated to have been severely burnt. These areas comprised the best habitat and encompassed most of the recent records of the Australian masked owl in Victoria (DELP 2021). In Tasmania, large old eucalypts and dead stags are at enhanced risk of being destroyed by fire (often by 'chimneying') during hazard reduction or other burning (Phil Bell, unpublished data). Assessment of the potential threat of fire to the Tasmanian masked owl and studies targeting the survival rate of potential roosting/nesting trees in hazard reduction burning and forestry regeneration burns in coupes with retained old trees is recommended (see also 6.3.4 Climate change).

6.3.2 Changes in the abundance and availability of prey

Many authors have suggested that the abundance and availability of prey is a key driver of Tasmanian masked owl distribution, home range size and trend in population size (e.g., Mooney, 1993; Bell et al., 1997; Todd, 2012; Young et al., 2020; Cisterne, 2020; Service, 2023). This is not a new idea, and the role of abundance and availability of prey has been associated with both decreases and increases in the abundance of the Australian masked owl *Tyto novaehollandiae novaehollandiae*. Fauna monitoring on State Forest in NSW following the 2019/20 wildfires has suggested an increase in Australian masked owl occupancy which may have resulted from an increase in the abundance and availability of prey species through changes to the understorey within burned forest. However, further monitoring is required to confirm this suggestion (Rohan Bilney per. comm.). Further research on the potential threat of changes in prey abundance and availability on the Tasmanian masked owl and research on the past and current influence of prey abundance and availability on population size and trend of the subspecies is recommended.

Over the past 30 years, several authors (e.g., Peake et al., 1993; Mooney, 1993; Bell and Mooney, 1997; Todd, 2012) have mooted the idea that the decline in masked owls (Australian masked owl and Tasmanian masked owl) and anecdotal historical fluctuations in abundance since European settlement may have been related to the abundance and availability of native and introduced prey species, particularly rabbits. Peake et al. (1993) emphasise the unstable population dynamics of the house mouse, black rat and rabbit in southeastern Australia as a potential threat to the Australian masked owl. However, although it is likely that small to medium sized ground dwelling mammals are the main food resource for the Australian masked owl, the Tasmanian masked owl appears to be more flexible in its prey (possibly as a result of the lack of competition from other large forest owls and also by the nature of its extreme reversed sexual dimorphism by size) hence can exhibit a different diet in different parts of the State and in different forest types (e.g., western Tasmania compared to eastern Tasmania, wet eucalypt forest compared to dry eucalypt forest).

If the Tasmanian masked owl is naturally a rare species (its low breeding rate suggests a high trophic level and therefore natural rarity), then, it raises the question of how it managed to survive, at a low population size, over approximately 12,000 years i.e., the time since Tasmania has been separated from mainland Australia (Todd, 2012). Several potential explanations were proposed by Todd (2012) on how naturally rare species can persist through evolutionary time. McKinney (1997) reviewed the paleontological literature and concluded that species that had a wide geographical range but were locally sparse (as is the case for the Tasmanian masked owl) were relatively resistant to extinction. Todd (2012) suggested another possible explanation is that the subspecies was more numerous in the past and has declined since European settlement which could have been due to a decline in range with the reduction in forest cover through the Midlands and in northern Tasmania, or through an increase in territory size resulting in a lower carrying capacity across the range, or possibly both. A potential cause of an increased territory size could have been a reduction in prey abundance and availability. Evidence for a range decline is implied by the existence of former cliff roost sites where owls no longer occur (e.g., Nick Mooney, 1993) suggesting that they may have occurred at a higher density in the past (Todd, 2012).

There is anecdotal evidence that Tasmanian masked owl numbers were exceptionally high in Tasmania during the rabbit plagues of the mid 1900s (indeed they were regarded by trappers as a nuisance for ruining skins of trapped rabbits) and many reportedly died during the consequent widespread strychnine poisoning and local populations likely suffered from food collapse from effective biological control of rabbits. It is possible that elevated rabbit populations temporarily elevated masked owl populations.

6.3.3 Disturbance at roost/nest sites

Excessive noise and vibration are likely to be disturbing to roosting/nesting Tasmanian masked owls and may damage hollow trees making them unsuitable to the owls (many hollow trees are

old and fragile). Open roosts (outside tree hollows) may suffer more disturbance from noise and vibration (and human activities) simply because of the level of visual exposure of the owls.

The structural integrity of a nest or roost tree is a key factor in the likelihood of physical damage from vibration. The use of heavy machinery and explosives that cause significant vibrations are risk factors for nesting Tasmanian masked owls, occupancy of roost sites, and the integrity of nest and roost trees, most being old.

Nests and roosts inside trees are insulated to some extent from disturbance during the day, though bright lighting at night may impact on the behaviour of active Tasmanian masked owls, particularly near nest and roost sites.

Vegetation clearance has the potential to disturb Tasmanian masked owls using open roosts. Roosts outside of hollows are usually in dense understorey vegetation or forest/scrub with a high foliage cover. Vegetation clearance activities near open roosts may cause individual owls to abandon traditional roost sites and they may be at risk from mobbing birds during that process.

The removal of vegetation and trees has the potential to damage or destroy Tasmanian masked owl nests and both hollow and vegetation roosts. Rock climbers occasionally report flushing Tasmanian masked owls from cliff roosts and there is an unconfirmed report of a nestling found in a cliff pothole (Nick Mooney pers. comm.). Many Tasmanian cliff roosts of Tasmanian masked owls were incidentally located during intensive research on peregrine falcons in the 1970s and 1980s.

6.3.4 Climate change

In Victoria where the Australian masked owl is listed as 'Critically Endangered', climate change is a recognised threat to the subspecies i.e., drying and warming of the environment, including droughts, may trigger habitat changes and reduce prey availability, reducing recruitment and leading to elevated mortality rates (Department of Energy, Environment and Climate Action, 2023). A hotter, drier climate may increase the likelihood, frequency, and/or intensity of fire impacting habitat, with the potential to reduce habitat extent and/or condition. Fire may reduce the availability of hollows for roosting and nesting through hazardous tree removal or the direct impacts of fire. Fire may also reduce abundance of ground dwelling prey and mid-storey prey. Impacts depend on size and scale of fire, with nests in dry forest types more vulnerable to intense fire.

6.3.5 Competition for hollows

The impact of competitors for nest and roost hollows is an unassessed threat to Tasmanian masked owls. In recent decades there have been large increases in the numbers of white cockatoos (i.e., sulphur-crested cockatoo *Cacatua galerita*, little corella *C. sanguinea* and long-billed corella *C. tenuirostris*) and the former have been strongly implicated in the abandonment of one long-term nest of Tasmanian masked owls (Figures 55 and 56). Common brushtail possum is also a strong competitor for nests and roosts in hollow trees and at least one regular tree roost has been abandoned because of feral honeybee *Apis mellifera* colonisation. Kookaburras (introduced to Tasmania) may also be a credible competitor. Ongoing forest harvesting including firewood cutting, land clearing, and agricultural and urban development continues to erode the large hollow resource and may increase competition with other native hollow dependent species.

Subtle changes in protective vegetation at roosts and adjacent to nest hollows may also reduce protection from mobbing or dangerous birds. Rock climbers may also be a disturbing influence at some cliff roosts.

The recovery of peregrine falcons over the past 50 years and consequent reoccupation of some cliffs has seemingly reduced the proportion of cliffs routinely used for roosts by Tasmanian masked owls (Nick Mooney pers. comm.).



Figure 55. *Tasmanian masked owl in roost hollow in white gum Eucalyptus viminalis in southeast Tasmania (Photo: David Jamrozik).*



Figure 56. *Tasmanian masked owl in a hollow (same hollow as shown in Figure 55) being harassed by sulphur-crested cockatoo Cacatua galerita (Photo: David Jamrozik).*

7. Surveying for Tasmanian masked owl roosts and nests in practice

The following photos and captions provide some guidance, by examples, on searching for and identifying Tasmanian masked owl roost and nest hollows and vegetation roost sites. Guidelines and protocols for survey of Tasmanian masked owls are useful and for some techniques and methods, mandatory. In practice, a range of methods may need to be used to identify critical habitat features for the subspecies, or in some cases, no specific methods are required. As with most wildlife surveys, knowledge of the species' ecology, survey experience and careful observation are the most useful tools for Tasmanian masked owl roost and nest surveys.



Figure 57.

LHS: Large amount of whitewash on bracken fern below a known Tasmanian masked owl roost site. Whitewash refers to the chalky, white, paint-like faeces of masked owls. It is composed primarily of uric acid, which appears white. It is an indicator that an owl may be roosting or nesting above (Photo: Phil Bell).

RHS: Tasmanian masked owl partially decomposed pellet. A pellet or collection of pellets may suggest roosting or nesting above. Confirm that the pellet(s) is from a Tasmanian masked owl as they can be easily confused with pellets from other raptors (Photo: Phil Bell).



Figure 58.

LHS: Large entrance to large potential hollow in Eucalyptus amygdalina observed from the ground that may be suitable for roosting or nesting by Tasmanian masked owls. Located in wet Eucalyptus delegatensis-E. amygdalina forest, central north Tasmania (Photo: Phil Bell).

RHS: Large entrance to large potential hollow in Eucalyptus obliqua located in dry Eucalyptus obliqua-E. amygdalina forest, central north Tasmania (Photo: Phil Bell).



Figure 59.

LHS: Common ringtail possum hanging in understorey dogwood Pomaderris apetala about 30 m below the entrance to a large potential hollow in Eucalyptus dalrympleana, southeast Tasmania. Located in Eucalyptus dalrympleana-E. delegatensis wet forest where an acoustic recorder detected many loud dawn and dusk Tasmanian masked owl screech calls (Photo: Phil Bell).

RHS: Common ringtail possum skull in remains of a disintegrated Tasmanian masked owl pellet below a regular vegetation roost in Eucalyptus amygdalina. Located in Eucalyptus amygdalina-E. obliqua dry forest, northern Tasmania (Photo: Phil Bell).



Figure 60.

LHS: Tasmanian masked owl pellet containing skull and other intact bones of black rat below entrance to large hollow in Eucalyptus obliqua, northeast Tasmania (Photo: Phil Bell).

RHS: Entrance to large hollow at approximately 3 m in Eucalyptus obliqua. Located in E. obliqua dry forest, northeast Tasmania (Photo: Phil Bell)

The following photos (i.e., Figures 61 and 62) show a range of large potential hollows as determined from the ground, that were subsequently inspected using a drone. In this scenario in a wet Eucalyptus obliqua-E. delegatensis-E. dalrympleana forest over rainforest in western Tasmania, almost 90% of >40 trees supporting large potential hollows (that from the ground were considered to be potentially suitable for use by the Tasmanian masked owl) were discounted by drone inspection as not currently used or unsuitable for use by the subspecies for roosting or nesting.

From the ground, identification of a eucalypt as supporting large potential hollows is usually based on the size of the tree and its senescent characteristics and/or by observations of large potential hollows using binoculars with good optical and low-light performance.

Assessing large potential hollows from drone inspection is based on a range of possible features (e.g., size of the hollow entrance, depth of hollow, general exposure of hollow, signs of dampness, constraints on access to the hollow entrance). The base of tree hollows cannot always be viewed by drone inspection, usually because the cavity is too deep. A high angle of observation and increased exposure of the drone photo image can illuminate internal features and the base of the hollow, that would otherwise not be possible with ambient light (Photos in Figures 61 and 62 were taken by Jayden Taylor, Michael Crawford, David James and Phil Bell).



Figure 61. *Large potential hollows inspected by drone and discounted as not being used by Tasmanian masked owl.*

Top, Middle, Bottom: LHS: Drone image of large potential hollow in Eucalyptus obliqua, western Tasmania. Located in wet E. obliqua forest over rainforest. RHS: Close up drone image.



Figure 62. *Large potential hollows inspected by drone and discounted as not being used by Tasmanian masked owl.*

Top, Middle, Bottom: LHS: Drone image of large potential hollow in Eucalyptus obliqua, western Tasmania. Located in wet E. obliqua forest over rainforest. RHS: Close up drone image.

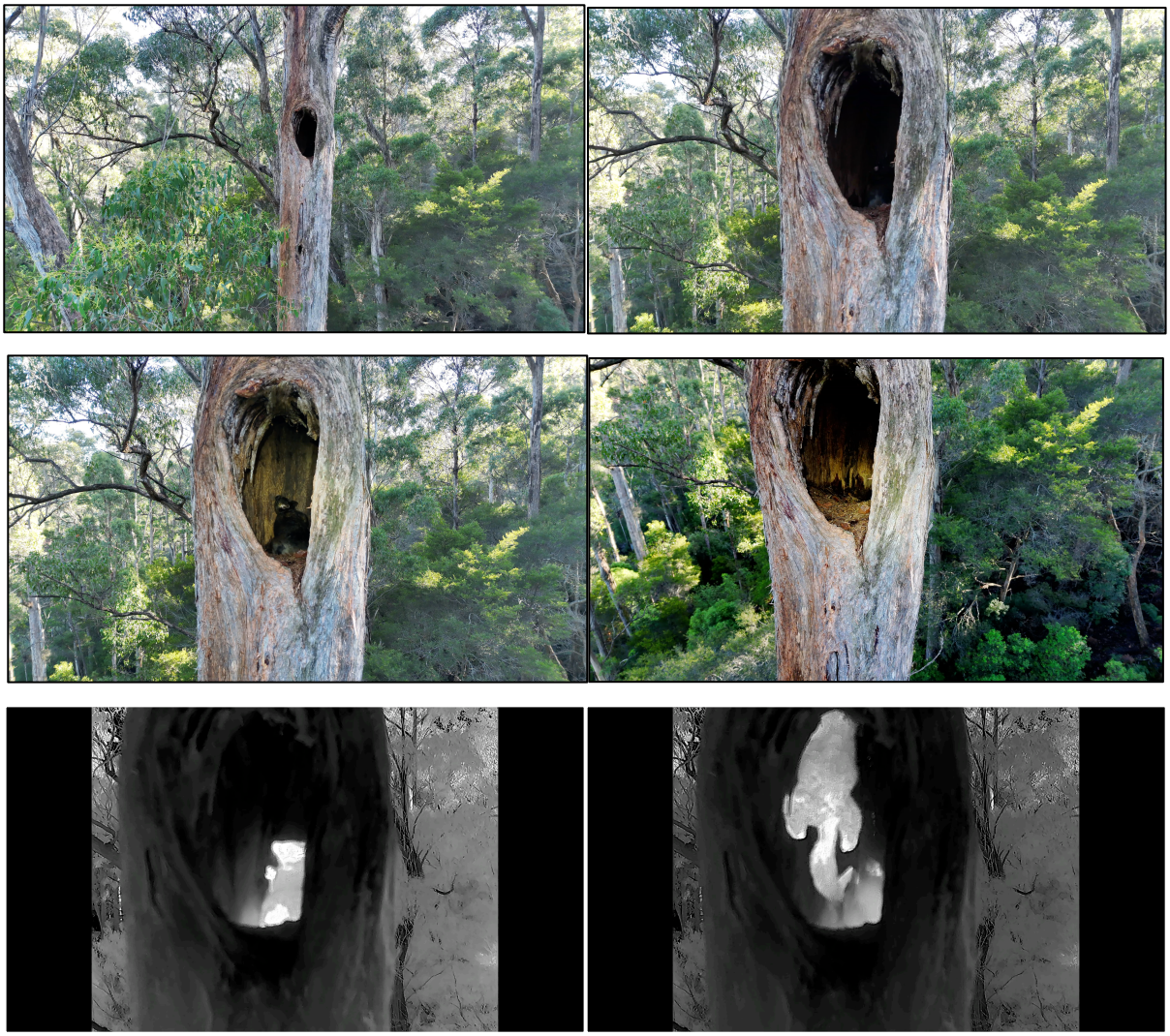


Figure 63. *Drone images of a large potential hollow in Eucalyptus obliqua, northern Tasmania (Drone video images: Jason Wiersma).*

Top: LHS: Approximately 10 m from hollow entrance. RHS: Approximately 3 m from hollow entrance.

Middle: LHS: Approximately 3 m from hollow entrance with drone spotlight on. RHS: Approximately 3 m from hollow entrance after brush-tailed possum climbs out of view.

Bottom: LHS: Approximately 3 m from hollow entrance using the drone's thermal camera while brush-tailed possum remains at the base of the hollow. RHS: Approximately 3 m from hollow entrance while the brush-tailed possum climbs out of view.

It is recommended that inspecting large potential hollows for use by Tasmanian masked owls, using a drone, is undertaken by suitably qualified drone pilots with experience in the ecology of arboreal fauna, particularly in hollow use by the Tasmanian masked owl.



Figure 64. *Images from trail camera video at entrance to Tasmanian masked owl nest, southeast Tasmania (Camera images courtesy of Jack Service, Jason Wiersma and David James)*

Top: LHS: Two young downy chicks. RHS: One downy chick and more advanced chick.

Middle: LHS: Recent fledgling and advanced chick. RHS: Adult on lip of hollow entrance.

Bottom: LHS: Adult on lip of hollow entrance. RHS: Adult delivering an Eastern barred bandicoot to the nest hollow.



Figure 65. *Preparing for tree climbing to inspect large potential hollows*

Top: Establishing a rope access prior to climbing and inspection of a large potential tree hollow at approximately 35 m height in a 4 m dbh eucalypt stag, central north Tasmania (Photo: Phil Bell). It is recommended that tree climbing to inspect large potential hollows for use by Tasmanian masked owls, or other arboreal fauna, is undertaken by suitably qualified tree climbers with experience in the ecology of arboreal fauna, particularly in hollow use by the Tasmanian masked owl.

Bottom: Equipment that may be useful for inspecting large potential hollows includes: a burrow scope or remote controlled camera that can be lowered into a tree hollow, a camera to record external hollow entrance features and internal cavity dimensions, a torch to illuminate the cavity, bags for collecting evidence of use such as feathers, pellets, scats and bones from the cavity, measuring tape to assist in assessment of the cavity and hollow entrance dimension.



Figure 66. *Inspection of 'high priority' large potential hollows by tree climbing at survey sites where prior passive acoustic monitoring has suggested frequent use of the assessment area by the Tasmanian masked owl, or potential use of the assessment area for roosting or nesting by the subspecies.*

LHS: Large trunk hollow in Eucalyptus delegatensis in wet E. dalrympleana-E. delegatensis forest, central north Tasmania;

RHS Large trunk hollow in Eucalyptus amygdalina in dry E. obliqua-E. amygdalina forest, central north Tasmania.

'High priority' large potential hollows in this situation refers to large potential hollows that have been determined from ground-based assessment as most likely to be suitable for use by Tasmanian masked owl and have not been discounted through additional assessment techniques such as inspection by drone. It is recommended that tree climbing to inspect large potential hollows for use by Tasmanian masked owls, or other arboreal fauna is undertaken by suitably qualified tree climbers with experience in the ecology of arboreal fauna, particularly in hollow use by the Tasmanian masked owl (Photos: Phil Bell).



***Figure 67**. Inspection of 'high priority' large potential hollows by tree climbing at survey sites where prior passive acoustic monitoring has suggested frequent use of the assessment area by the Tasmanian masked owl, or potential use of the assessment area for roosting or nesting by the subspecies.*

LHS: Large hollow in Eucalyptus amygdalina in dry E. amygdalina-E. obliqua forest, northeast Tasmania. Hollow containing a clutch of Australian wood duck Chenonetta jubata eggs (Photo: David James)

RHS: Large hollow in Eucalyptus obliqua, southeast Tasmania. Hollow has been used by Tasmanian masked owl for breeding and retains considerable evidence of use such as down from chicks, faecal material, pellets and intact bones from prey species (Photo: David James).



Figure 68. *Tasmanian masked owl nest in large cavity in Eucalyptus obliqua, southeast Tasmania. (Photos courtesy of Jack Service, Jason Wiersma and David James)*

LHS: Base of hollow with clutch of three Tasmanian masked owl eggs and Eastern barred bandicoot carcass (Photo: David James)

RHS: Hollow entrance (Photo: David James).



Figure 69. *Inspection of large potential hollow by tree climbing in Eucalyptus dalrympleana (E. dalrympleana-E. delegatensis wet forest), western Tasmania*

LHS: Base of large hollow with clutch of green rosella eggs (Photo: David James)

RHS: Hollow entrance (Photo: David James).



Figure 70. *Inspection of large potential hollows by tree climbing.*

Top: LHS: Hollow entrance in Eucalyptus obliqua approximately 40 m height with evidence of cockatoo chewing on lip. RHS: Internal cavity with some dampness and very large fungus (Photos: David James).

Bottom: LHS: Hollow entrance in Eucalyptus obliqua (4.5 m dbh) approximately 35 m height. RHS: Internal cavity revealing pool of water in base and cobwebs (Photos: David James).



Figure 71. *Inspection of potential nest tree using a drone*

Top: LHS: Eucalyptus viminalis paddock tree, northern Tasmania. RHS: Close up view of hollow entrance (Photos: Phil Bell).

Bottom: Inspection of internal cavity using a drone with spotlight. Visible are the remains of a dead Tasmanian masked owl including a talon and wing, and possible skeleton and skull of an owl chick (Photo: Jason Wiersma).



Figure 72. *Searching for and inspecting large potential hollows using a helicopter (Photos: Sean Boucher, Sustainable Timbers Tasmania)*

Top: Emergent Eucalyptus regnans supporting large potential hollows in wet eucalypt forest, southern Tasmania.

Bottom: Opportunistic detection of a Tasmanian masked owl at the entrance of a very large hollow in Eucalyptus regnans.

Survey for large potential hollows by helicopter, in combination with eagle nest searching, is currently being trialed with promising results.

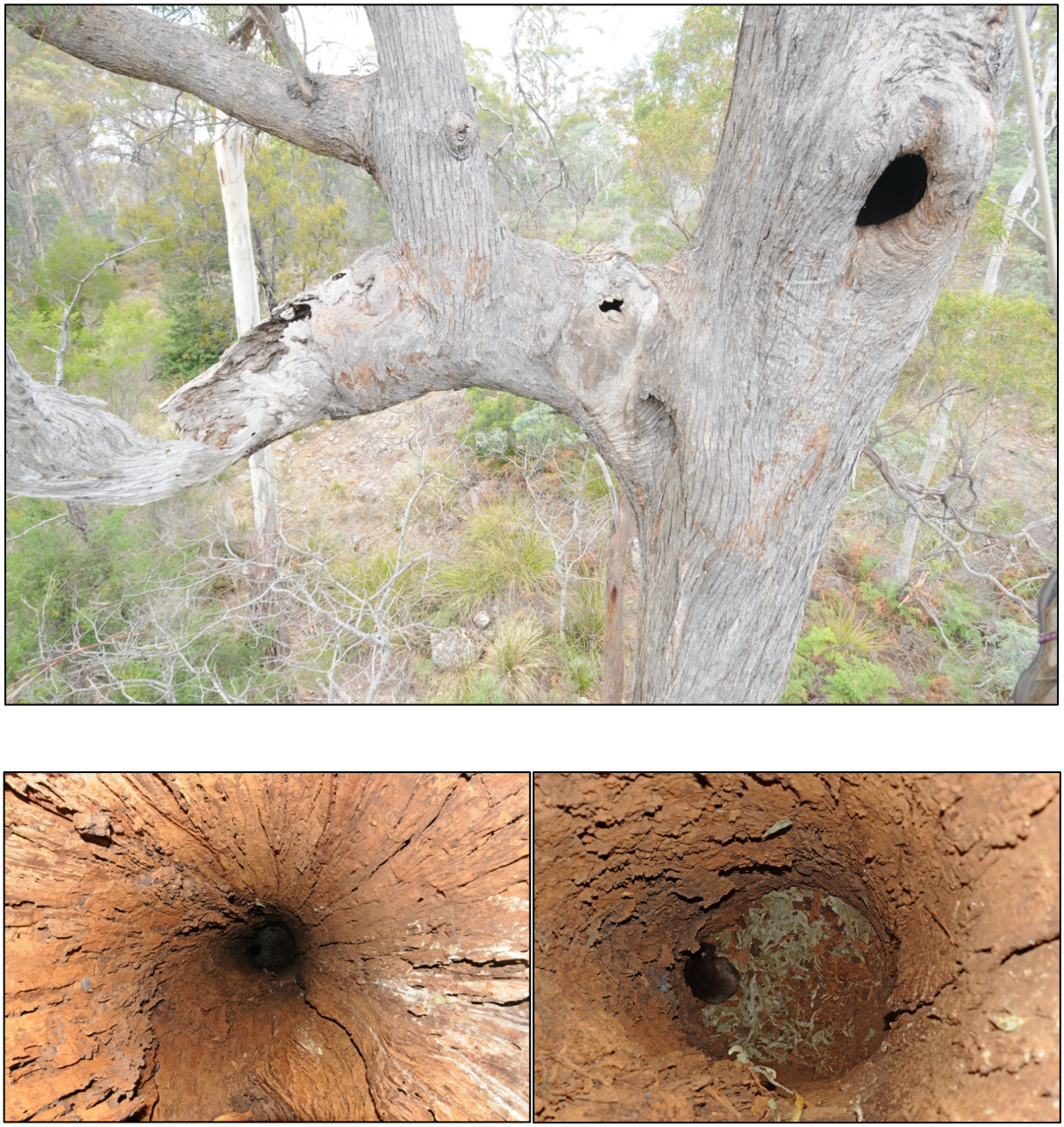


Figure 73. *Monitoring the use of roost and nest sites by tree climbing and hollow inspection.*

Top: Hollow in Eucalyptus amygdalina (E. amygdalina-E. obliqua dry forest), northern Tasmania thought to support a Tasmanian masked owl roost or nest, evidenced by the presence of a pellet below the hollow entrance in major limb. The tree hollow was inspected sometime later by tree climbing and found to be used at that time by brush-tailed possum.

Bottom: LHS: Very deep hollow to base. Small feather, possibly from Southern boobook, and avian faeces on side of chimney. RHS: further examination and illumination revealing brush-tailed possum in the base of the hollow and no evidence of use by Tasmanian masked owl.

8. Recommendations

Recording observations and associated information

- Encourage more detailed documentation of Tasmanian masked owl observations, including a description of the habitat surrounding observations.
- Encourage observers to lodge Tasmanian masked owls found dead with a museum, preferably the Tasmanian Museum and Art Gallery (TMAG) or the Queen Victoria Museum and Art Gallery (QVMAG). Such material is valuable for investigation of the exposure to ecotoxins, particularly anticoagulant rodenticides, and conservation genetics.
- Since non-detection data is often as important as detection data for Tasmanian masked owls, submit non-detection data to the NVA. Be aware that non-detection of the subspecies does not confirm absence.
- Time at detection may be an important indicator of functional habitat use by Tasmanian masked owls, and this information should be submitted to the NVA.
- Acoustic observations of Tasmanian masked owls (from passive acoustic monitoring) submitted to the NVA should include the date and time of the call detection, the duration of the deployment of the acoustic recorder, recording schedule (e.g., sunset to sunrise) and call identification (e.g., screech, chatter).
- Environmental consultants and researchers should enter data on the location of Tasmanian masked owl nests and roosts in the NVA in a timely manner. The location of nests and roosts may need to be considered as sensitive data to protect these sites and breeding Tasmanian masked owls from disturbance by the public

Passive acoustic monitoring.

- Evaluate the detection range of Tasmanian masked owl calls using commonly used acoustic recorders under various environmental conditions.
- Assess presence/absence and potential use of an area by the Tasmanian masked owl by scheduling acoustic recorders to record for the entire night (i.e., from sunset until sunrise). Note also that the subspecies may call before sunset and after sunrise in some circumstances.
- Ensure confidence in detectability of Tasmanian masked owl calling by deploying acoustic recorders for a sufficient period and at a time of the year that is relevant to the likely probability of detection of the subspecies.
- When reporting results from passive acoustic monitoring, provide detail on how the acoustic data was analysed and validated (e.g., type of recogniser used, who reviewed the detections and how much of the dataset was reviewed).
- Use experienced ecologists to undertake validation of calls and training of acoustic recognisers for Tasmanian masked owls.
- Continue the training of acoustic recognisers for Tasmanian masked owls and develop additional recognisers for other call types (e.g., chattering calls and chick, fledgling, juvenile and adult calls).
- Continue to collect and study acoustic datasets from across Tasmania, across seasons and across vegetation types to improve our understanding of Tasmanian masked owl calling behaviour.

- Although breeding appears to be seasonal, Tasmanian masked owls may nest at any time of the year and further research is required to understand breeding seasonality of the subspecies.
- Design acoustic recorder arrays in accordance with the size and configuration of the study area and the concomitant distribution of the potential large hollow resource.

Specific survey techniques

- Monitor research outputs related to the use and efficacy of dogs in the detection of Tasmanian masked owl pellets and the potential application of dogs in routine surveys for the subspecies.
- Use call playback of Tasmanian masked owl calls to assist in ground-based investigations of habitat use, particularly where evidence of the presence of the subspecies has already been established by other techniques such as acoustic monitoring.
- Use acoustic surveys as a minimally invasive method to assess presence/absence and explore functional habitat use by the Tasmanian masked owl.

Conservation research priorities

- Encourage and facilitate ongoing research using GPS and radio tracking of Tasmanian masked owls. These methods are effective for investigating site-based habitat use and to locate roost and nest sites of the subspecies.
- Undertake a statewide occupancy monitoring program using passive acoustic monitoring to improve assessment of population parameters and inform a review of the conservation status of the Tasmanian masked owl.
- Undertake research on the diet of the Tasmanian masked owl and associated prey abundance and availability across forest types to understand the influence of these variables on home range size and configuration.
- Undertake research on the abundance of Tasmanian masked owls and prey at different elevations to assist in understanding the apparent rarity of the subspecies at higher elevations.
- Undertake research on factors influencing roost and nest site selection of the Tasmanian masked owl to assist in survey and conservation management.
- Assess the magnitude and relative priority of threats to the Tasmanian masked owl, particularly those that have been identified as key threats such the loss of nesting/roosting hollows.
- Evaluate the potential threat of fire to the Tasmanian masked owl including studies targeting the survival rate of potential roosting/nesting trees in hazard reduction burning.
- Undertake research on the unassessed threat of competition for nesting and roosting hollows including the effects of ongoing forest harvesting, land clearing, and agricultural and urban development on competition with other native and introduced hollow dependent species.



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[Note that references that relate specifically to Tasmanian masked owl are shown with an "*"]

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