12-Month Pre-construction Bat Environmental Impact Assessment (EIA)

For the proposed Merino Wind Energy Facility, Northern Cape, South Africa

ANiMALiA

Compiled by

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PREPARED FOR:

Great Karoo Renewable Energy (Pty) Ltd

By

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Appointment of Specialist

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Appointed by:	Great Karoo Renewable Energy (Pty) Ltd
For:	Bat Environmental Impact Assessment (EIA) Report

Independence

Animalia Consultants (Pty) Ltd has no connection with the developer. Animalia Consultants (Pty) Ltd is not a subsidiary, legally or financially of the developer; remuneration for services by the developer in relation to this Bat Impact Assessment Scoping Report is not linked to approval by decision-making authorities responsible for permitting this proposal and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project.

Applicable Legislation

Legislation dealing with biodiversity applies to bats and includes the following:
NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004; Especially sections 2, 56 & 97).

The Act calls for the management and conservation of all biological diversity within South Africa. Bats constitute an important component of South African biodiversity and therefore all species receive additional attention to those listed as Threatened or Protected.

Contents

Table i. Explanation of abbreviations used in this document.

Abbreviation	Explanation
ACR	African Chiroptera Report
BESS	Battery Energy Storage System
GHA	Green Hydrogen Ammonia
DEA	Department of Environmental Affairs
DMRE	Department of Mineral Resources and Energy
EIA	Environmental Impact Assessment
GHAF	Green Hydrogen & Ammonia Facility
IRP	Integrated Resource Plan
MM	Meteorological ("Met") Mast
PV	Photo-voltaic (facility)
REC	Renewable Energy Complex
REF	Renewable Energy Facility
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SABAA	South African Bat Assessment Association
SEA	Strategic Environmental Assessment
ShM	Short Mast (passive bat detection system)
WEF	Wind Energy Facility
COD	Commercial Operation Date
Bp/h	Bat passes per hour

NEMA Requirements

The content of a specialist report is specified in the EIA Regulations GN R. 982, as amended (4 Dec 2014) Appendix 6. A specialist report prepared in terms of these Regulations must contain:

NEMA Requirement	Section/page in report
Details of the specialist who prepared the report, and the expertise of that specialist to compile a specialist report including a curriculum vitae.	Separate Curriculum Vitae
A declaration that the specialist is independent in a form as may be specified by the competent authority.	Page 3
An indication of the scope of, and the purpose for which, the report was prepared.	Section 1
An indication of the quality and age of the base data used for the specialist report.	Sections 3; 4
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change.	Sections 4; 5
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment.	Section 3
A description of the methodology adopted in preparing the report or carrying out the specialised process, inclusive of equipment and modelling used.	Section 3
Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure.	Section 5
An identification of any areas to be avoided, including buffers.	Section 4.6
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.	Section 4.6
A description of any assumptions made and any uncertainties or gaps in knowledge.	Section 3.5

A description of the findings and potential implications of such findings on the impact of the proposed activity, or activities.	**Sections 4; 5; 7**
Any mitigation measures for inclusion in the EMPr.	**Section 5**
Any conditions for inclusion in the environmental authorisation.	**Sections 5; 6; 7**
Any monitoring requirements for inclusion in the EMPr or environmental authorisation.	**Section 5; 6; 7**
A reasoned opinion whether the proposed activity or portions thereof should be authorised, and regarding the acceptability of the proposed activity or activities. And if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr.	**Sections 5; 6; 7**
A description of any consultation process that was undertaken during the course of preparing the specialist report.	**Sections 3**

1 OBJECTIVES AND TERMS OF REFERENCE FOR THE STUDY

- A description of the baseline characteristics and conditions of the receiving environment (e.g., site and/or surrounding land uses including urban and agricultural areas).
- An identification of possible impacts on bats and a description of the nature and extent of each identified impact.
- Identifying gaps in knowledge with regards to each identified impact on bats.
- Presentation of no-go areas in the form of bat sensitivity mapping.
- Recommendations to avoid negative impacts, as well as feasible and practical mitigation, management and/or monitoring options to reduce negative impacts, that can be included in the Environmental Impact Assessment (EIA).

2 INTRODUCTION

This document is the Bat Environmental Impact Assessment Report for the proposed Merino Wind Farm completed by Animalia Consultants (Pty) Ltd.

2.1 Project description

Great Karoo Renewable Energy (Pty) Ltd is proposing the development of a commercial wind farm and associated infrastructure on a site located approximately 35km south-west of Richmond and 80km south-east of Victoria West, within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province.

A preferred project site with an extent of ~29 909ha and a development area of ~6 463ha within the project site has been identified by Great Karoo Renewable Energy (Pty) Ltd as a technically suitable area for the development of the Merino Wind Farm with a contracted capacity of up to 140MW that can accommodate up to 35 turbines (Figure 2.1). The development area consists of the four (4) affected properties, which include:

- Portion 1 of Farm Rondavel 85
- Portion 0 of Farm Rondavel 85
- Portion 9 of Farm Bult & Rietfontein 96
- Portion 0 of Farm Vogelstruisfontein 84

The Merino Wind Farm project site is proposed to accommodate the following infrastructure, which will enable the wind farm to supply a contracted capacity of up to 140MW:

- Up to 35 wind turbines with a maximum hub height of up to 170m. The tip height of the turbines will be up to 250m. The rotor diameter will be up to 160m, with a blade length of 80m.
- Concrete turbine foundations to support the turbine hardstands.
- Inverters and transformers.
- Temporary laydown areas which will accommodate storage and assembly areas.
- Cabling between the turbines, to be laid underground where practical.
- A temporary concrete batching plant.
- 33/132kV onsite facility substation.
- Underground cabling from the onsite substation to the 132kV collector substation.
- Electrical and auxiliary equipment required at the collector substation that serves that wind energy facility, including switchyard/bay, control building, fences, etc.
- Battery Energy Storage System (BESS).
- Access roads and internal distribution roads.
- Site offices and maintenance buildings, including workshop areas for maintenance and storage.

The wind farm is proposed in response to the identified objectives of the national and provincial government and local and district municipalities to develop renewable energy facilities for power generation purposes. It is the developer's intention to bid the Merino Wind Farm under the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme, with the aim of evacuating the generated power into the national grid. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP) with the Merino Wind Farm set to inject up to 140MW into the national grid.

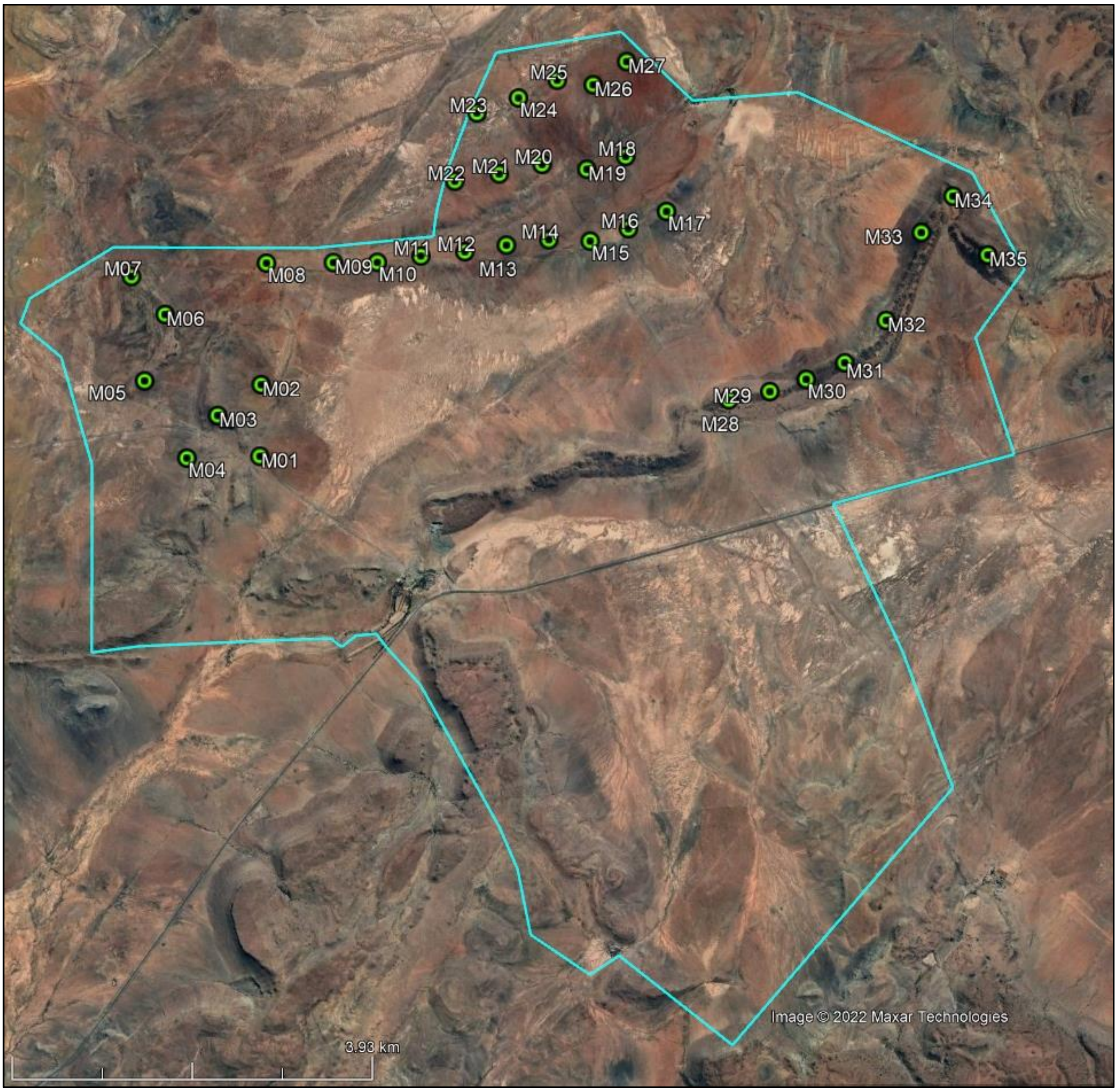

Figure 2.1. Proposed turbine layout of the Merino Wind Farm.

2.2 The Bats of South Africa

Bats form part of the Order Chiroptera and are the second largest group of mammals after rodents. They are the only mammals to have developed true powered flight and have undergone various skeletal changes to accommodate this. The forelimbs are elongated, whereas the hind limbs are compact and light, thereby reducing the total body weight. This unique wing profile allows for the manipulation of wing camber and shape, exploiting functions such as agility and manoeuvrability. This adaption surpasses the static design of the bird wings in function and enables bats to utilise a wide variety of food sources, including, but not limited to, a large diversity of insects (Neuweiler 2000). Species-based facial features may differ considerably as a result of differing lifestyles, particularly in relation to varying feeding and echolocation navigation strategies. Most South African bats are insectivorous and are capable of consuming vast quantities of insects on a nightly basis (Taylor 2000, Tuttle and Hensley 2001) however, they have also been found to feed on amphibians, fruit, nectar and other invertebrates. As a result, insectivorous bats are the predominant predators of nocturnal flying insects in South Africa and contribute greatly to the suppression of these numbers. Their prey also includes agricultural pests such as moths and vectors for diseases such as mosquitoes (Rautenbach 1982, Taylor 2000).

Urban development and agricultural practices have contributed to the deterioration of bat populations on a global scale. Public participation and funding of bat conservation are often hindered by negative public perceptions and unawareness of the ecological importance of bats. Some species choose to roost in domestic residences, causing disturbance and thereby decreasing any esteem that bats may have established. Other species may occur in large communities in buildings, posing as a potential health hazard to residents in addition to their nuisance value. Unfortunately, the negative association with bats obscures their importance as an essential component of ecological systems and their value as natural pest control agents, which actually serves as an advantage to humans.

Many species of bats roost in large communities and congregate in small areas. Therefore, any major disturbances within and around the roosting areas may adversely impact individuals of different communities concurrently (Hester and Grenier 2005). Secondly, nativity rates of bats are much lower than those of most other small mammals. This is because, for the most part, only one or two pups are born per female per annum. Under natural circumstances, a population's numbers may accumulate over long periods of time. This is due to the longevity of up to 30 years (O'Shea *et al*. 2003) and the relatively low predation of bats when compared to other small mammals. However, bat populations are not able to adequately recover after mass mortalities and major roost disturbances.

2.3 Bats and Wind Turbines

Although most bats are highly capable of advanced navigation through the use of echolocation and excellent sight, they are still at risk of physical impact with the blades of wind turbines. The corpses of bats have been found in close proximity to wind turbines and, in a case study conducted by Johnson *et al*. (2003), were found to be directly related to collisions. The incident of bat fatalities for migrating species has been found to be directly related to turbine height, increasing exponentially with altitude, as this disrupts the migratory flight paths (Howe *et al*. 2002, Barclay *et al*. 2007). Although the number of fatalities of migrating species increased with turbine height, this correlation was not found for increased rotor sweep (Howe *et al*. 2002, Barclay *et al*. 2007). In the USA it was hypothesized that migrating bats may navigate without the use of echolocation, rather using vision as their main sense for long distance orientation (Johnson *et al*. 2003, Barclay *et al*. 2007). Despite the high incidence of deaths caused by direct impact with the blades, most bat mortalities have been found to be caused by barotrauma (Baerwald *et al*. 2008). This is a condition where low air pressure found around the moving blades of wind turbines causes the lungs of a bat to collapse, resulting in fatal internal haemorrhaging (Kunz *et al*. 2007). Baerwald *et al*. (2008) found that 90% of bat fatalities around wind turbines involved internal haemorrhaging consistent with barotrauma.

Although bats are predominately found roosting and foraging in areas near trees, rocky outcrops, human dwellings and water; in conditions where valleys are foggy, warmer air is drawn to hilltops through thermal inversion which may result in increased concentrations of insects and consequently bats at hilltops, where wind turbines are often placed (Kunz *et al*. 2007). Some studies (Horn *et al*. 2008) suggest that bats may be attracted to the large turbine structure as roosting spaces or that swarms of insects may get trapped in low pressure air pockets around turbines, also encouraging the presence of bats. The presence of lights on wind turbines has also been identified as a possible cause for increased bat fatalities for non-cave roosting species. This is thought to be due to increased insect activity and subsequent increased foraging activity of bats (Johnson *et al*. 2003). Clearings around wind turbines, in previously forested areas, may also improve conditions for insects, thereby attracting bats to the area. The swishing sound of turbine blades has also been proposed as a possible source for disorientation in bats (Kunz *et al*. 2007). Electromagnetic fields generated by the turbine may additionally affect bats which are sensitive to magnetic fields (Kunz *et al*. 2007). It could also be hypothesized, from personal observations that the echolocation capabilities of bats are designed to locate smaller insect prey or avoid stationary objects, and may not be primarily focused on the detection of unnatural objects moving sideways across the flight path.

South African operational monitoring studies currently point to South African bats being just as vulnerable to mortality from turbines as international studies have previously indicated. The main species of concern are *Neoromicia capensis*, *Tadarida aegyptiaca* and *Miniopterus natalensis,* on this site and in general.

Whatever the reason for bat fatalities in relation to wind turbines, it is clearly a significant ecological problem which requires attention. Most bat species only reproduce once per year, bearing one young per female, therefore their numbers are slow to recover from mass mortalities. It is very difficult to assess the true number of bat deaths in relation to wind turbines, due to carcasses being removed from sites through predation, the rate of which differs from site to site as a result of habitat type, species of predator and their numbers (Howe *et al*. 2002, Johnson *et al*. 2003). Various mitigation measures are being researched and experimented with globally. The implementation of curtailment processes, where the turbine cut-in speed is raised to a higher wind speed, has been proven to be the most effective mitigation measure currently. This relies on the principle that the prey of bats will not be found in areas of strong winds and more energy is required for the bats to fly under these conditions anyways. The impact on bats foraging in the area will be higher when uncurtailed turbine blades are left to turn slowly in low wind speeds; it is a misperception that faster turning blades present a higher mortality risk.

3 METHODOLOGY

3.1 Literature-based and On-site Inspections

The site is evaluated by comparing the amount of surface rock (possible roosting space), topography (influencing surface rock in most cases), vegetation (possible roosting spaces and foraging sites), climate (can influence insect numbers and availability of fruit), and presence of surface water (influences insects and acts as a source of drinking water) to identify bat species that may be impacted by wind turbines. These comparisons are done principally by briefly studying the geographic literature of each site, available satellite imagery and by ground-truthing with site visits. The probability of occurrence based on the above-mentioned factors are estimated for the species both expected and confirmed on site as well as the larger surrounding area.

3.2 Active & Passive Monitoring

Several site visits were made to the Merino WEF between December 2020 and December 2021. Passive data can ground truth bat sensitivity features and habitats delineated in the bat sensitivity constraints map and collect bat activity data for different seasons.

Passive bat detection systems (Figure 3.1) were set up on two meteorological masts with microphones at 10m, 50m and 100m (Met Mast 1) and 7m, 70m and 140m (Met Mast 2). Additionally, one short mast bat detection system was also set up, with a microphone at 7m (referred to as ShM1). These systems were set to gather bat activity data every night for 12 months to form part of the long-term pre-construction monitoring and inform the EIA study.

The data is analysed by classifying (as near to species level as possible) and counting positive bat passes detected by the systems. A bat pass is defined as a sequence of ≥1 echolocation calls where the duration of each pulse is ≥2ms (one echolocation call can consist of numerous pulses). A new bat pass is identified by a >1 000ms period between pulses. These bat passes are summed into hourly intervals which are used to calculate nocturnal distribution patterns over time. Times of sunset and sunrise are automatically adjusted with the time of year.
Nightly bat totals over time are useful for displaying abrupt peaks in activity on specific nights or short time periods, and to visually represent the spread of bat activity over the monitoring period. This may assist in developing mitigation schedules, if required during operation.

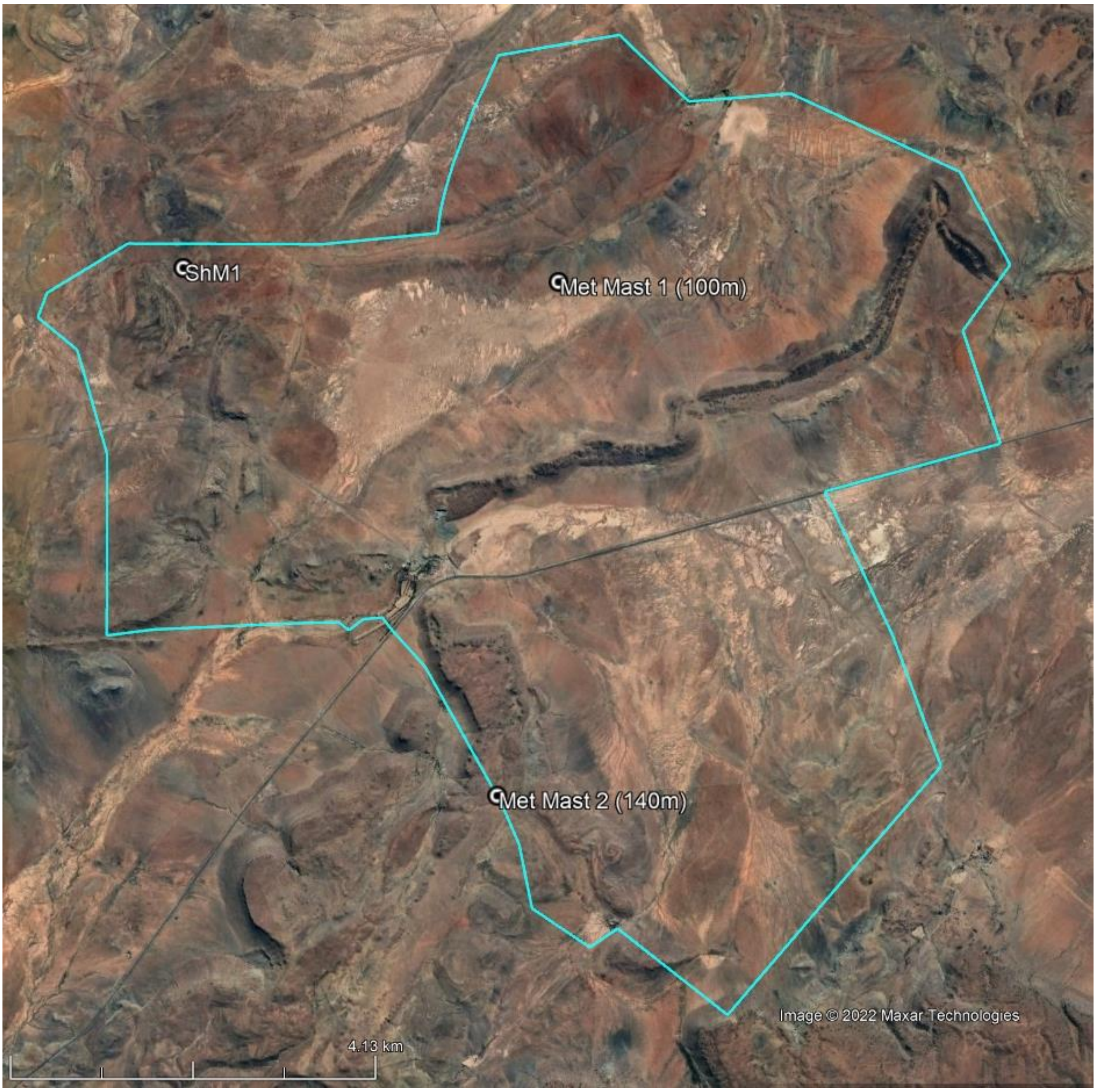

Figure 3.1. Positions of the passive bat detection systems on site.

3.3 Site Visit and Equipment Setup Information

Table 3.1: Equipment setup and site visit information.

Site visit dates		**First visit**	14 – 17 December 2020
		Second visit	12 – 14 April 2021
		Third visit	23 – 25 July 2021
		Fourth visit	20 – 24 Sept 2021
		Fifth visit	16 – 19 December 2021
Met mast passive bat detection systems	**Quantity on site**	2 (Met Mast 1 & Met Mast 2)	
	Microphone heights	Met Mast 1: 7m, 50m, 100m Met Mast 2: 7m, 70m, 140m	
Short mast passive bat detection systems	**Quantity on site**	1 (ShM 1)	
	Microphone height	7m	
Replacements/ Repairs/ Comments		None	
First visit		The passive systems were installed with mounted microphones angled 30° downwards	
Second visit		SD cards were replaced with empty ones, no issues present.	
Third visit		SD cards were replaced with empty ones, no issues present.	
		SD cards were replaced with empty ones, no issues present.	
		SD cards were replaced with empty ones, no issues present.	
Type of passive bat detector		SM3BAT, Real Time Expansion (RTE) type	
Recording schedule		Each detector was set to operate in continuous trigger mode from dusk each evening until dawn (times were automatically adjusted in relation to latitude, longitude and season).	
Trigger threshold		>16KHz, -12dB	
Trigger window (time of recording after trigger ceased)		1 000ms (1 second)	
Microphone gain setting		12dB	
Compression		WAC0	
Single memory card size (each system uses 4 cards)		32GB	
Battery size		17Ah; 12V	
Solar panel output		20 Watts	
Solar charge regulator		6 - 8 Amp with low voltage/deep discharge protection	

Other methods	Terrain was investigated during the day for habitat observations.

3.4 Bat Sensitivity Mapping

Google Earth satellite imagery and verifications during site visits were used to spatially demarcate areas of the site with high and medium sensitivities relating to bat species ecology and habitat preferences. The map considers man-made structures and habitat alterations (such as dams), as well as natural terrain features that are likely to offer roosting and foraging opportunities for bat species found in the broader site area. With regards to hydrology features, distinction has been made between permanent and seasonal water sources. Exposed surface rock on cliffs can also offer roosting space for crevice dwelling bats and have been incorporated into this report.

3.5 Assumptions and Limitations

As with any environmental study, there are certain assumptions and limitations that exist around the current knowledge we possess regarding bats and their behaviour, movements and distribution. Some important points are discussed briefly below:

- Distribution maps of South African bat species still require further refinement, thus the bat species proposed to occur on the site (and not detected in the area yet) should be considered precautionary. If a species has a distribution marginal to the site, it was assumed to occur in the area.

- The migratory paths of bats are largely unknown, thus some uncertainty in this regard will remain until the end of operational monitoring of at least 2 years.

- The sensitivity map is based partially on satellite imagery and from detailed site visits, although given the large extent of the site, there is always the possibility that what has been mapped may differ slightly to what is on the ground.

- Species identification with the use of bat detection and echolocation is less accurate when compared to morphological identification, nevertheless it is a very certain and accurate indication of bat activity and their presence with no harmful effects on bats being surveyed.

- Automated species identification by the Kaleidoscope software may produce a small portion of incorrect identifications or unknown identifications. However, the automated software is very effective at distinguishing bat calls from ultrasonic noise, therefore the number of bat passes are not overestimated.

- It is not possible to determine actual individual bat numbers from acoustic bat activity data from the passive monitoring systems. However, bat passes per night are internationally used and recognized as a comparative unit for indicating levels of bat activity in an area.

- Exact foraging distances from bat roosts or exact commuting pathways cannot be determined by the current methodology. Radio telemetry tracking of tagged bats is required to provide such information if needed.

4 RESULTS AND DISCUSSION

4.1 Land Use, Vegetation, Climate and Topography

The proposed Merino Wind Farm falls within the Nama Karoo Biome, and the vegetation units found on site include **Upper Karoo Hardeveld** and **Eastern Upper Karoo** (Figure 4.1, Mucina & Rutherford 2012). According to Olson *et al.* (2012) the site is located in the Nama Karoo ecoregion.

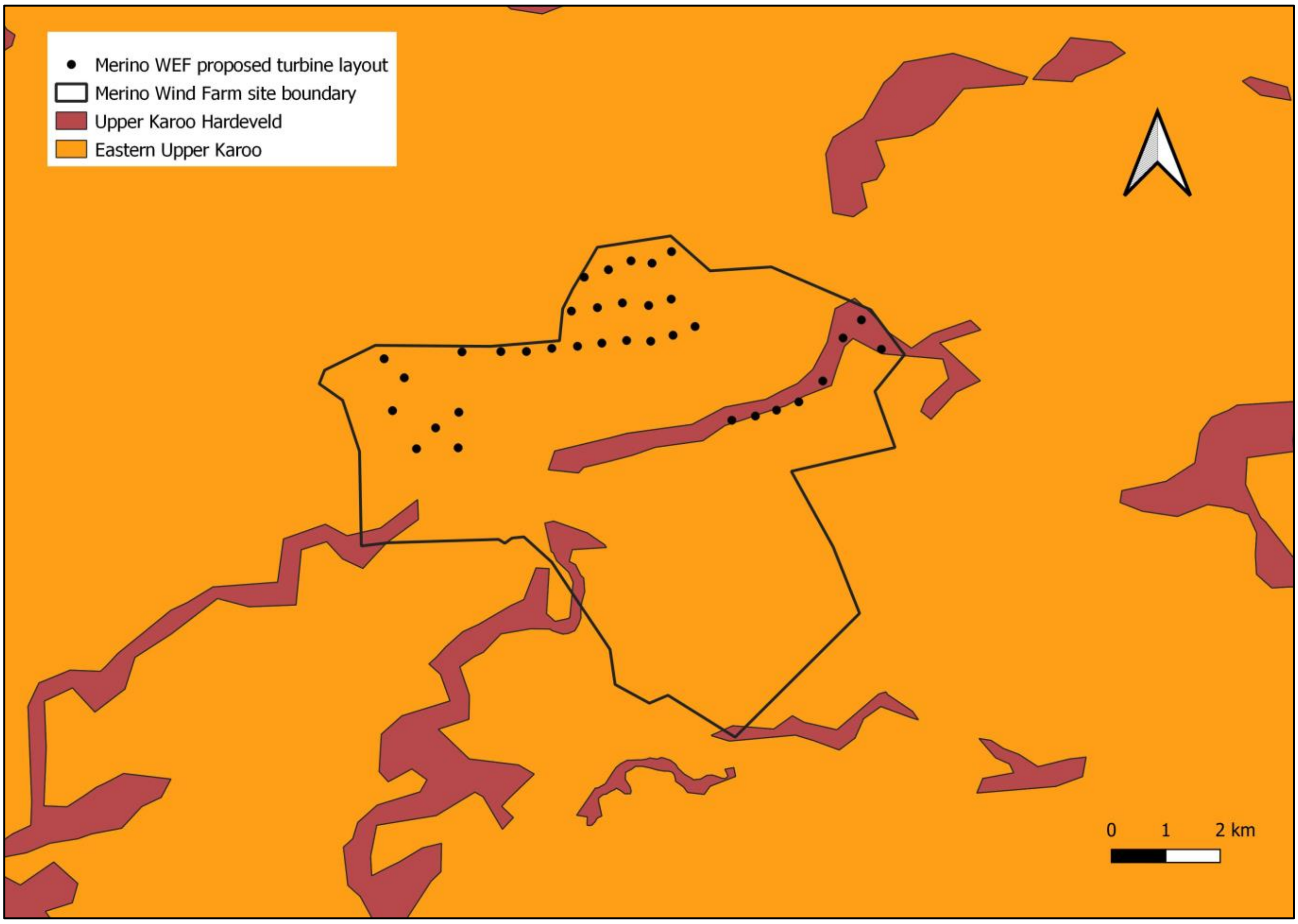

Figure 4.1: Vegetation units present on the proposed Merino Wind Farm, with proposed turbine positions indicated (Mucina & Rutherford 2012).

4.1.1 Upper Karoo Hardeveld

Upper Karoo Hardeveld is typified by steep-sloped koppies, buttes and mesas as part of the Great Escarpment. Large boulders and stones mark the landscape and it supports sparse vegetation such as dwarf Karoo scrub and drought-tolerant grasses (*Aristida*, *Eragrostis* and *Stipagrostis*).

Geologically, this vegetation unit comprises primitive and skeletal soils in a rocky landscape. These soils cover sedimentary rock such as those mudstones and arenites of the Adelaide Subgroup (Karoo Supergroup). Dolerite boulders cover slopes of the mesas and buttes found here.

The Mean Annual Precipitation of this unit ranges from 150 – 350mm per year from north west to east, and frost days are relatively high, although variable (30 – 80 days, depending on altitude).

4.1.2 Eastern Upper Karoo

Flats and gently sloping plains are found within the Eastern Upper Karoo vegetation unit and intersperse with fingers of Karoo Hardeveld on site.

Dwarf microphyllous shrubs dominate this landscape and ‘white’ grasses (*Aristida* and *Eragrostis* species) are prominant after good summer rains. Karoo scrub species of *Pentzia*, *Eriocephalus*, *Rosenia* and *Lycium* are important taxa (Mucina & Rutherford 2012).

Beaufort Group sandstones and mudstones are common in this vegetation unit, and some Jurassic dolerites are also to be found.

Mean annual precipitation ranges from 180 – 430mm per year (west to east), peaking in March, and as for Karoo Upper Hardeveld, frost incidence is high (30 – 80 days per year). Nearby, Victoria West has recorded mean maximum and minimum monthly temperatures of 37°C and -8°C respectively.

Vegetation units and geology are of great importance as these may serve as suitable sites for the roosting of bats and support of their foraging habits (Monadjem *et al.* 2020). Houses and buildings may also serve as suitable roosting spaces (Taylor 2000; Monadjem *et al.* 2020).

4.2 Currently Confirmed, Previously Recorded as well as Literature Based Species Probability of Occurrence

Table 4.1 below indicates the species of bat which have been confirmed to occur on site, those unconfirmed species which may potentially occur on site, as well as those occurring in the broader area of the site based on literature review. For each species, the risk of impact by wind energy infrastructure was assigned by MacEwan *et al*. (2020) based on their distributions, altitudes at which they fly, and foraging ecology.

Table 4.1. Species currently confirmed on site, previously recorded in the area, or potentially occurring. Roosting and foraging habitats in the study area, conservation status and risk of impact are also briefly described per species (Monadjem *et al.* 2020).

Species	**Common name**	**Occurrence in area***	**Conservation status (SANBI & EWT, 2016)**	**Possible roosting habitat in the larger area of the site**	**Possible foraging habitat in the larger area of the site**	**Risk of impact (MacEwan *et al.* 2020 for WEF)**
Tadarida aegyptiaca	Egyptian free-tailed bat	Confirmed on site	Least Concern (2016 Regional Listing)	Roosts in rock crevices, hollows in trees, and behind the bark of dead trees. The species has also taken to roosting in roofs of buildings.	It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types habitats.	High
Laephotis (formerly *Neoromicia*) *capensis*	Cape serotine	Confirmed on site	Least Concern (2016 Regional Listing)	Roosts in the roofs of houses and buildings, and also under the bark of trees.	It appears to tolerate a wide range of environmental conditions from arid semi-desert areas to montane grasslands, forests, and savannahs. But is predominantly a medium height clutter edge forager on site.	Medium - High
Miniopterus natalensis	Natal long-fingered bat	Confirmed on site	Least Concern (2016 Regional Listing)	No known caves in the vicinity of the site. Small groups or individuals may roost in culverts or other hollows.	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium - High
Eptesicus hottentotus	Long-tailed serotine	Confirmed on site	Least Concern (2016 Regional Listing)	It is a crevice dweller roosting in rock crevices, as well as other crevices in buildings. Rock crevices in valleys on site.	It generally seems to prefer woodland habitats, and forages on the clutter edge. But may still forage over open terrain occasionally.	Medium
Sauromys petrophilus	Robert's flat-headed bat	Confirmed on site	Least Concern (2016 Regional Listing)	Roosts mainly in rock crevices.	It forages over a wide range of habitats and may utilise higher air spaces.	High
Epomophorus wahlbergi	Wahlberg's epauletted fruit bat	Literature	Least Concern (2016 Regional Listing)	Roosts in dense foliage of large, leafy trees and may travel several kilometres each night to reach fruiting trees.	Feeds on fruit, nectar, pollen and flowers. If and where available on site.	Medium - High

Nycteris thebaica	Egyptian slit-faced bat	Museum record from greater area	Least Concern (2016 Regional Listing)	Roosts in hollows, aardvark burrows, culverts under roads and the trunks of dead trees.	It appears to occur throughout the savannah and karoo biomes but avoids open grasslands. May possibly occur in the thickets of man-made gardens, and in aardvark burrows.	Low
Cistugo lesueuri	Lesueur's wing-gland bat	Museum record from greater area	Least Concern (2016 Regional Listing)	It is a crevice dweller roosting in rock crevices. Exposed rocky cliffs and rocky koppies.	Areas with available drinking water. Clutter edge forager. May forage in more open terrain during suitable weather.	Medium – High
Rhinolophus darlingi	Darling's horseshoe bat	ACR 2020 record	Least Concern (2016 Regional Listing)	May utilise man made hollows, Aardvark burrows or hollows formed by rocky boulder koppies.	It is associated with a variety of habitats including thickets that may be found in the vegetated drainage areas.	Low
Eidolon helvum	African straw-coloured fruit bat	Literature	Least Concern (2016 Regional Listing) (Globally Near-threatened)	It's a non-breeding migrant with sparse scattered records in the karoo.	Feeds on fruit, nectar, pollen and flowers. If and where available on site.	Medium - High

*Occurrence of species records based on site data collected off passive monitoring systems, ACR 2020 and Monadjem *et al*. 2020

4.3 Ecology of bat species that may be impacted the most by the Merino Wind Farm

There are several bat species in the vicinity of the site that occur commonly in the area. Some of these species are of special importance based on their likelihood of being impacted by the proposed wind farm, due to high abundances and certain behavioural traits. They have also been dominating records of fatalities at wind farms in South Africa. The relevant species are discussed below.

4.3.1 ***Tadarida aegyptiaca***

The Egyptian Free-tailed Bat, *Tadarida aegyptiaca*, is a Least Concern species (IUCN Red List 2016) as it has a wide distribution and high abundance throughout South Africa, and is part of the Free-tailed bat family (Molossidae). It occurs from the Western Cape of South Africa, north through to Namibia and southern Angola; and through Zimbabwe to central and northern Mozambique (Monadjem *et al*. 2020). This species is protected by national legislation in South Africa (ACR 2020).

They roost communally in small (dozens) to medium-sized (hundreds) groups in caves, rock crevices, under exfoliating rocks, in hollow trees and behind the bark of dead trees. *Tadarida aegyptiaca* has also adapted to roosting in buildings, in particular roofs of houses (Monadjem *et al*. 2020). Thus, man-made structures and large trees on the site would be important roosts for this species.

Tadarida aegyptiaca forages over a wide range of habitats, flying above the vegetation canopy. It appears that the vegetation has little influence on foraging behaviour as the species forages over desert, semi-arid scrub, savannah, grassland and agricultural lands. Its presence is strongly associated with permanent water bodies due to concentrated densities of insect prey (Monadjem *et al*. 2020).

After a gestation of four months, a single pup is born, usually in November or December, when females give birth once a year. In males, spermatogenesis occurs from February to July and mating occurs in August. Maternity colonies are apparently established by females in November.

The Egyptian Free-tailed bat is considered to have a high likelihood of risk of fatality due to wind turbines (MacEwan *et al.* 2020). Due to the high abundance and widespread distribution of this species, high mortality rates due to wind turbines would be a cause for concern as these species have more significant ecological roles than the rarer bat species, and are displaying moderate to high numbers of mortalities at nearby operating wind farms.

4.3.2 Laephotis **(formerly** ***Neoromicia*****)** ***capensis***

Laephotis capensis is commonly called the Cape serotine and has a conservation status of Least Concern (IUCN Red List 2016) as it is found in high numbers and is widespread over much of Sub-Saharan Africa.

High mortality rates of this species due to wind turbines would be a cause for concern as *L. capensis* is abundant and widespread and as such has a more significant role to play within the local ecosystem than the rarer bat species. They do not undertake migrations and thus are considered residents of the site.

It roosts individually or in small groups of two to three bats in a variety of shelters, such as under the bark of trees, at the base of aloe leaves, and under the roofs of houses. They will use most man-made structures as day roosts which can be found throughout the site and surrounding areas (Monadjem *et al*. 2020).

Mating takes place from the end of March until the beginning of April. Spermatozoa are stored in the uterine horns of the female from April until August, when ovulation and fertilisation occur. They give birth to twins during late October and November but single pups, triplets and quadruplets have also been recorded (van der Merwe 1994 and Lynch 1989).
They are tolerant of a wide range of environmental conditions as they survive and prosper across arid and semi-arid areas to montane grasslands, forests, and savannas; indicating that they may occupy several habitat types across the site, and are amenable towards habitat changes. They are however clutter-edge foragers, meaning they prefer to hunt on the edge of vegetation clutter mostly, but can occasionally forage in open spaces. They are thought to have a Medium-High likelihood of risk of fatality due to wind turbines (MacEwan *et al.* 2020) and are currently displaying moderate to high numbers of mortalities at operational wind farms in South Africa.

4.3.3 Miniopterus natalensis

Miniopterus natalensis, commonly referred to as the Natal long-fingered bat, occurs widely across the country but mostly within the southern and eastern regions and is listed as Least Concern (Monadjem *et al*. 2020). This bat is a cave-dependent species and identification of suitable roosting sites may be more important in determining its presence in an area than the presence of surrounding vegetation. It occurs in large numbers when roosting in caves with approximately 260 000 bats observed making seasonal use of the De Hoop Guano Cave in the Western Cape, South Africa. Culverts and mines have also been observed as roosting sites for either single bats or small colonies. Separate roosting sites are used for winter hibernation activities and summer maternity behaviour, with the winter hibernacula generally occurring at higher altitudes in more temperate areas and the summer hibernacula occurring at lower altitudes in warmer areas of the country (Monadjem *et al*. 2020).

Mating and fertilisation usually occur during March and April and is followed by a period of delayed implantation until July/August. Birth of a single pup usually occurs between October and December as the females congregate at maternity roosts (Monadjem *et al.* 2020 & van de Merwe 1979).

The Natal long-fingered bat undertakes short migratory journeys between hibernaculum and maternity roosts. Due to this migratory behaviour, they are considered to be at high risk of fatality from wind turbines if a wind farm is placed within a migratory path (MacEwan *et al.* 2020). The mass movement of bats during migratory periods could result in mass casualties if wind turbines are positioned over a mass migratory route and such turbines are not effectively mitigated. Very little is known about the migratory behaviour and paths of *M. natalensis* in South Africa with migration distances exceeding 150 kilometres. If the site is located within a migratory path the bat detection systems should detect high numbers and activity of the Natal long-fingered bat; this will be examined over the course of the 12-month monitoring survey.

A study by Vincent *et al.* (2011) on the activity and foraging habitats of Miniopteridae found that the individual home ranges of lactating females were significantly larger than that of pregnant females. It was also found that the bats predominately made use of urban areas (54%) followed by open areas (19.8%), woodlands (15.5%) orchards and parks (9.1%) and water bodies (1.5%) when selecting habitats. Foraging areas were also investigated with the majority again occurring in urban areas (46%), however a lot of foraging also occurred in woodland areas (22%), crop and vineyard areas (8%), pastures, meadows and scrubland (4%) and water bodies (4%).

MacEwan *et al.* (2020) advise that *M. natalensis* faces a medium to high risk of fatality due to wind turbines. This evaluation was based on broad ecological features and excluded migratory information. The species is currently displaying low to moderate numbers of mortalities at operational wind farms in South Africa.

4.4 Conservation and protected areas, known sensitivities and caves/roosts within 100km of the site.

There are three protected areas within 100km of Merino WEF, namely the High Karoo Park Protected Environment, Compassberg Protected Environment and Mountain Zebra-Camdeboo Protected Environment (Figure 4.2, DEA 2021). These have no significant bearing on the current site and will not be discussed further. No formal Conservation Areas fall within this radius. No caves or large bat roosts are known within a 100km radius of the site, and no limestone or dolomite are prevalent within this radius. Dolomite and limestone are prone to cave formation.

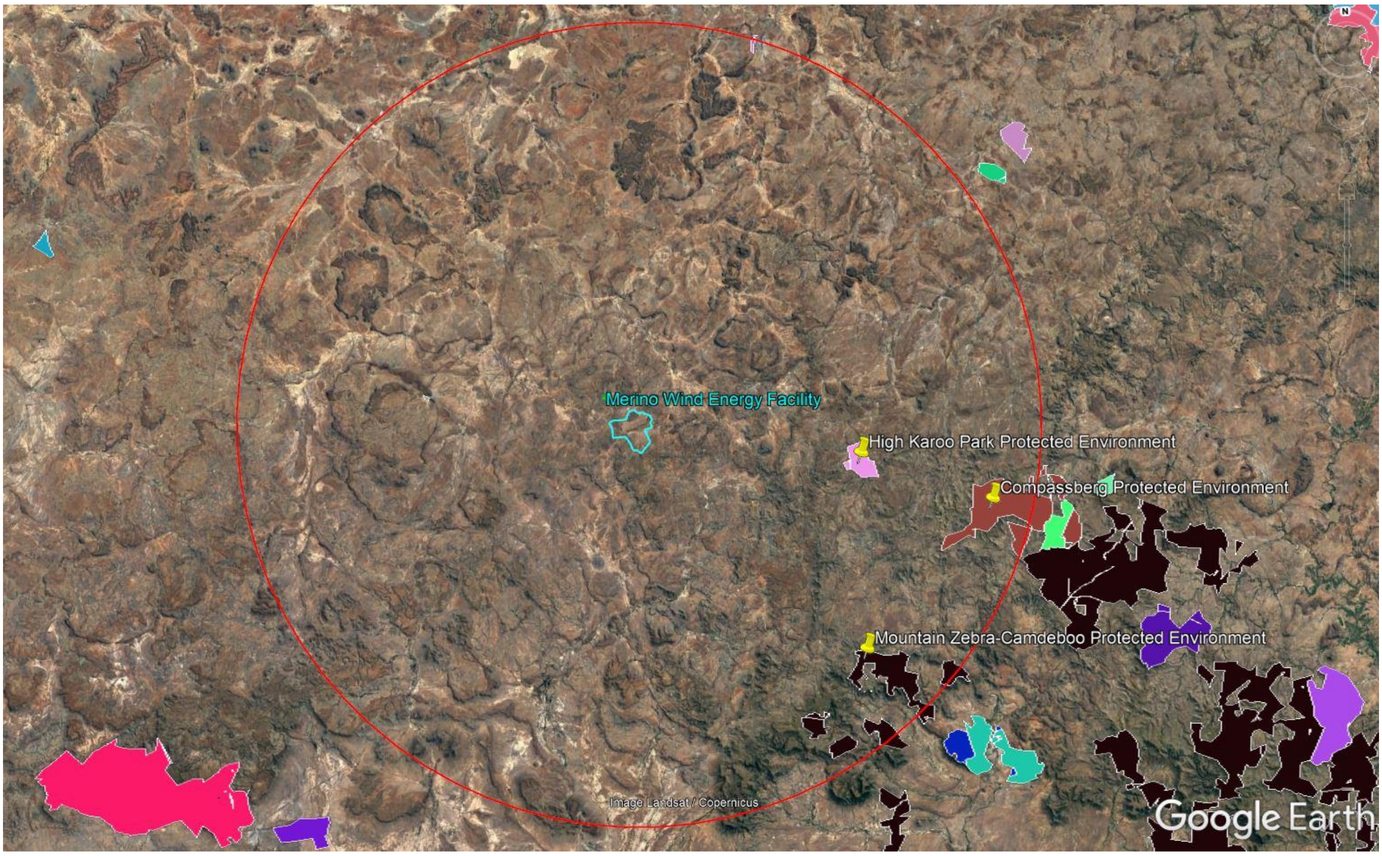

Figure 4.2: Protected areas within a radius of approximately 100km (red line) around the Merino WEF site (DEA, 2021).

4.5 Passive Data

4.5.1 Abundances and Composition of Bat Assemblages

Average hourly bat passes detected per night and total number of bat passes detected over the monitoring period by the systems are displayed in Figures 4.3 – 4.5. Five bat species were detected namely *Eptesicus hottentotus*, *Tadarida aegyptiaca, Laephotis capensis, Miniopterus natalensis* and *Sauromys petrophilus*. Additionally, bat passes were recorded that are classified up to family level and includes Vespertilionidae and Molossidae. Both of these families, includes the species identified and were simply used to group bat passes that were harder to identify.

In general, and overall on all microphones *Tadarida aegyptiaca* was most commonly detected. On Met Mast 1 *T. aegyptiaca* had the highest occurrences at 100m, then 7m and lowest occurrences at 50m. On Met Mast 2 this same species had the highest occurrence at 7m and the lowest at 140m. Overall, *N. capensis* was the second most abundant species. The Met Mast 1 displayed the highest overall bat activity.

Average hourly bat passes per month (Figures 4.6 – 4.12) are useful to indicate overall average high activity months and seasons. Gaps in data are considered in average calculations, whereas total bat numbers are influenced by the completeness of a recording schedule. Met Mast 2 displayed the highest average hourly bat activity in December 2020 at 7m height. The months of November, December and January indicated the highest bat activity overall, with January showing particularly high activity.

The yearly median of average hourly bat passes, at 100m on Met Mast 1 is 0.06 bat passes per hour, and at 140m at Met Mast 2 it's 0.03 bat passes per hour. According to MacEwan *et al.* (2020), for the Nama Karoo ecoregion it's considered to be bat activity levels indicating a low to medium risk of bat mortalities. Therefore, the need for activity mitigation should be determined by the results of the operational mortality monitoring, if the bat mortalities are above sustainable thresholds.

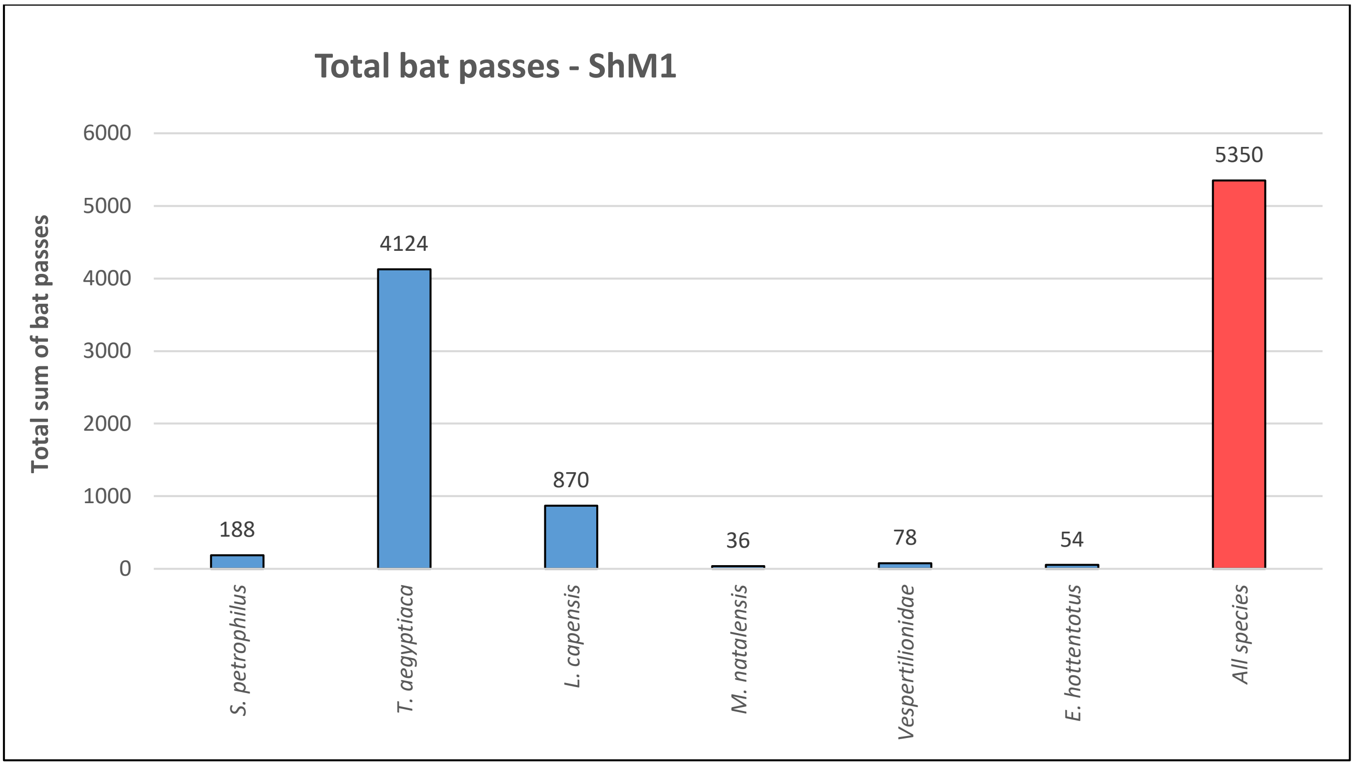

Figure 4.3: Total bat passes recorded over the monitoring period by ShM1.

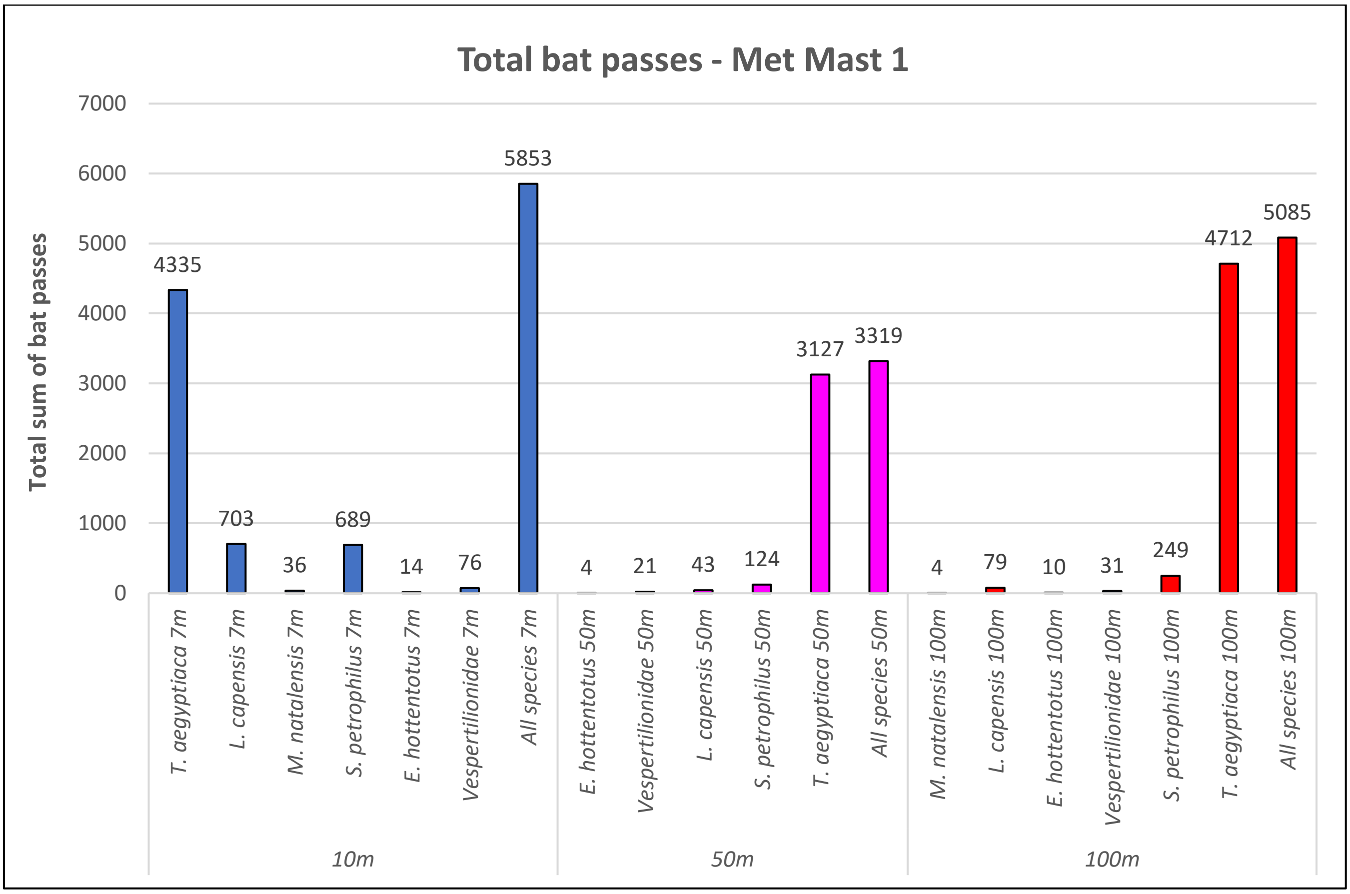

Figure 4.4: Total bat passes recorded over the monitoring period by Met Mast 1.

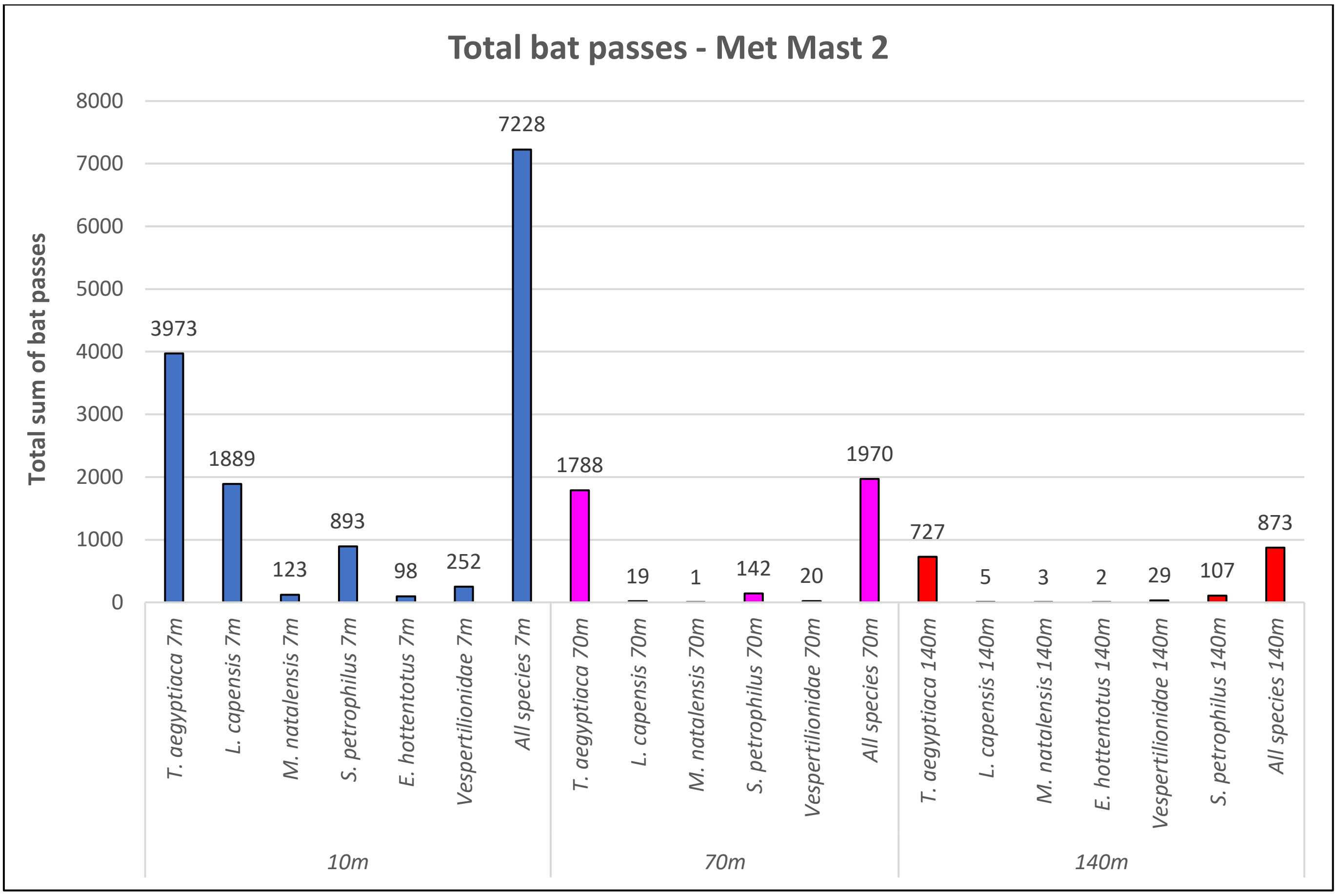

Figure 4.5: Total bat passes recorded over the monitoring period by Met Mast 2.

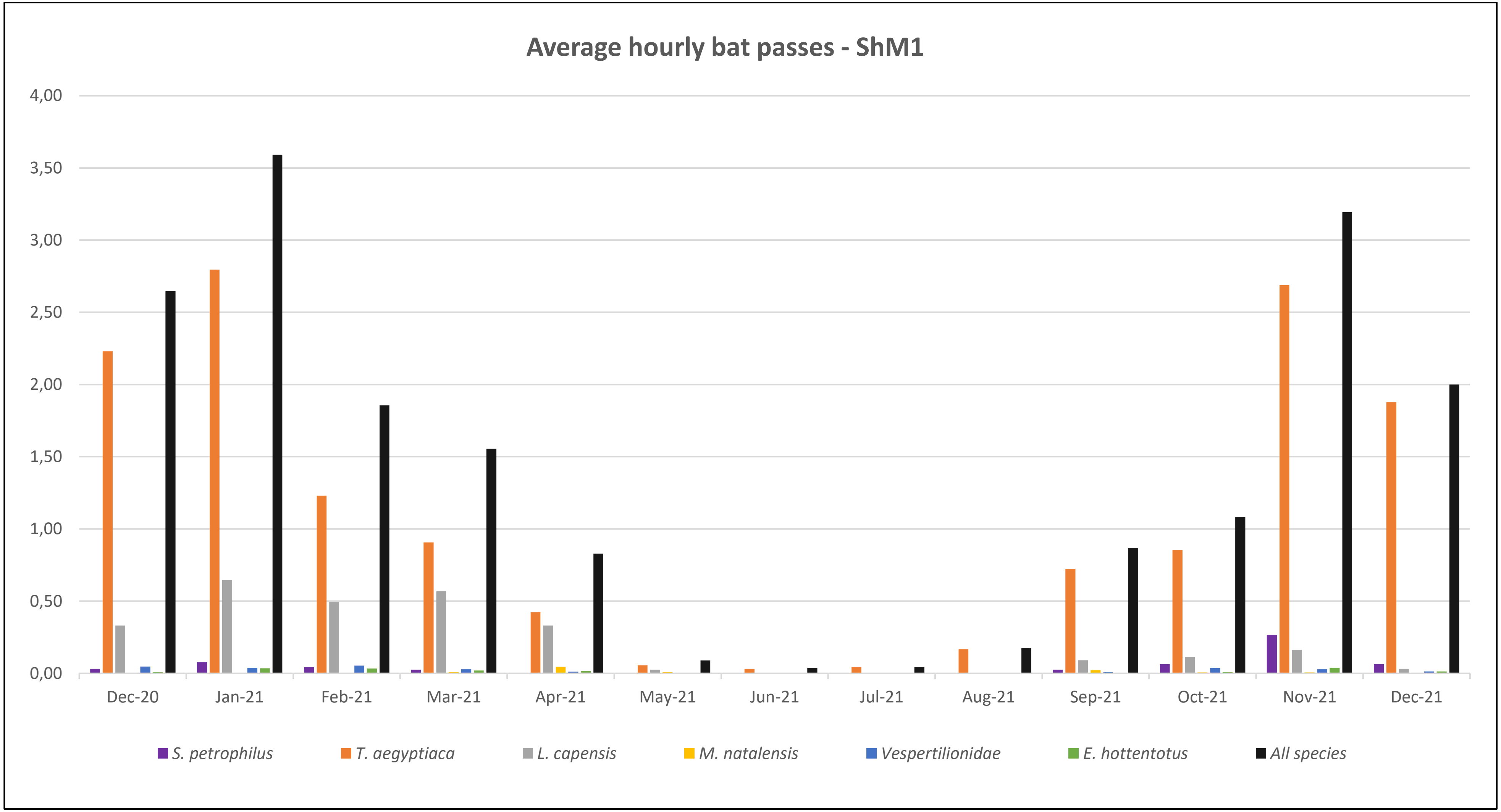

Figure 4.6: Average hourly bat passes per month recorded over the monitoring period by ShM1.

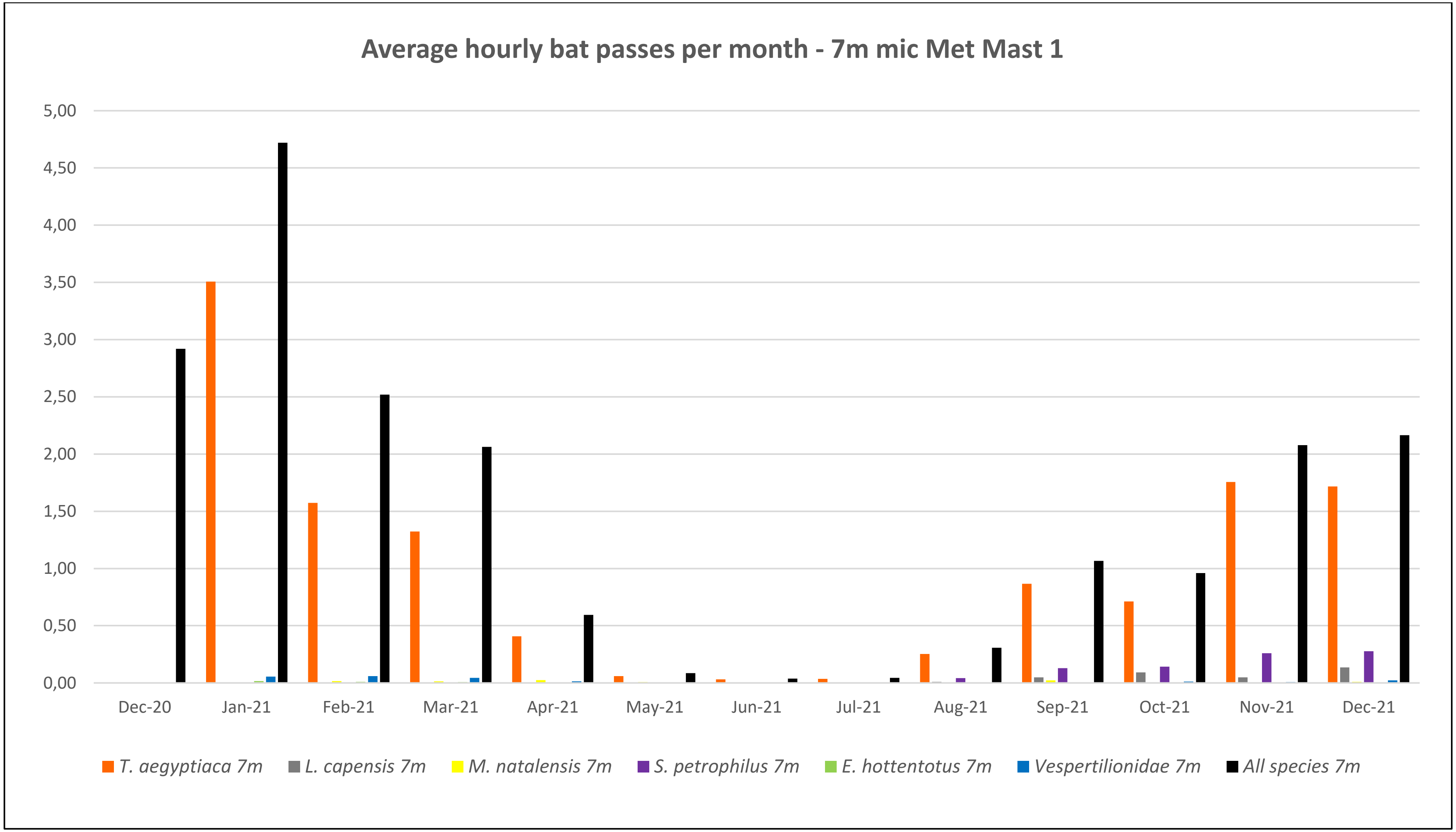

Figure 4.7: Average hourly bat passes per month recorded over the monitoring period by the 7m microphone on Met Mast 1.

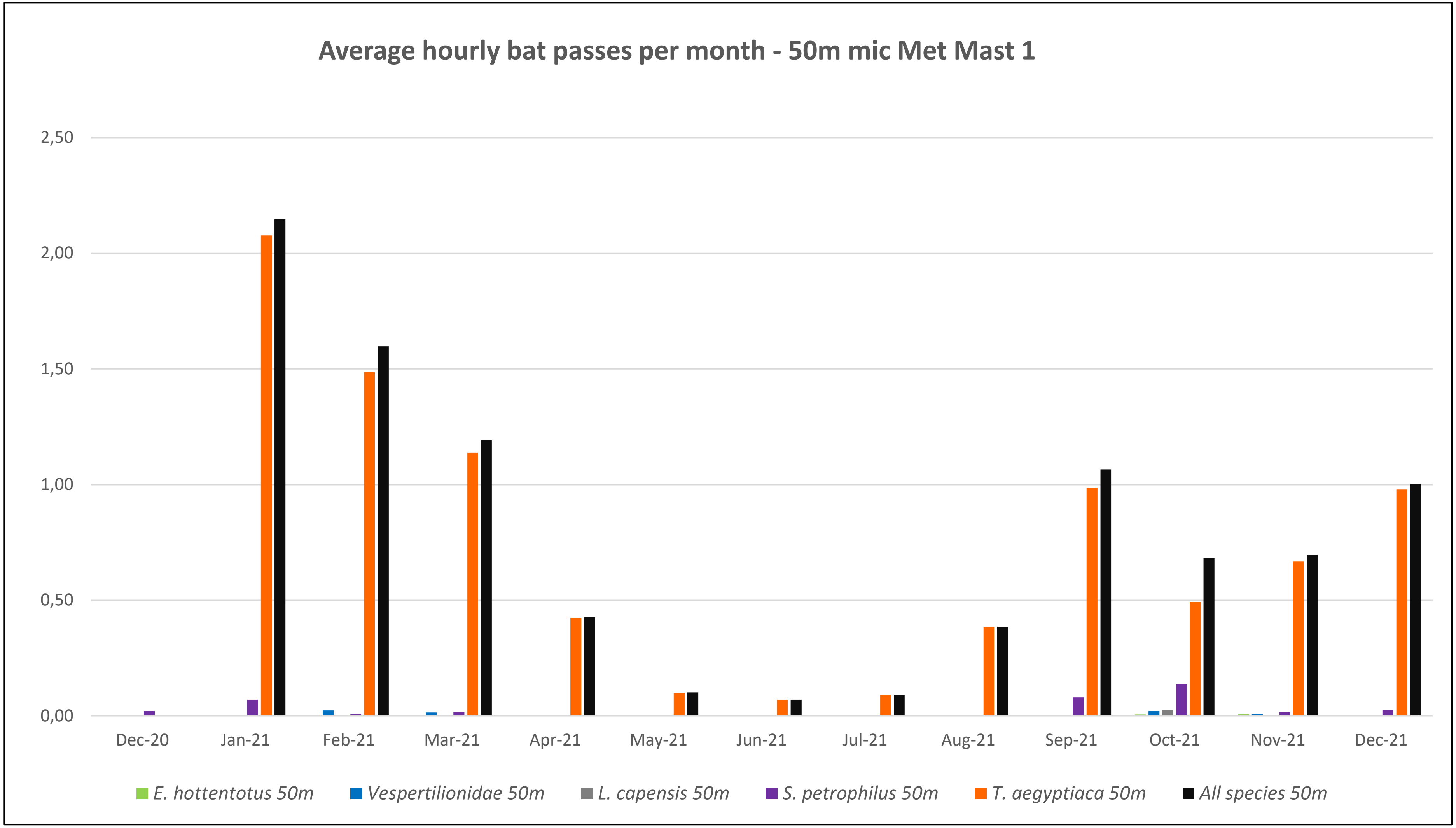

Figure 4.8: Average hourly bat passes per month recorded over the monitoring period by the 50m microphone on Met Mast 1.

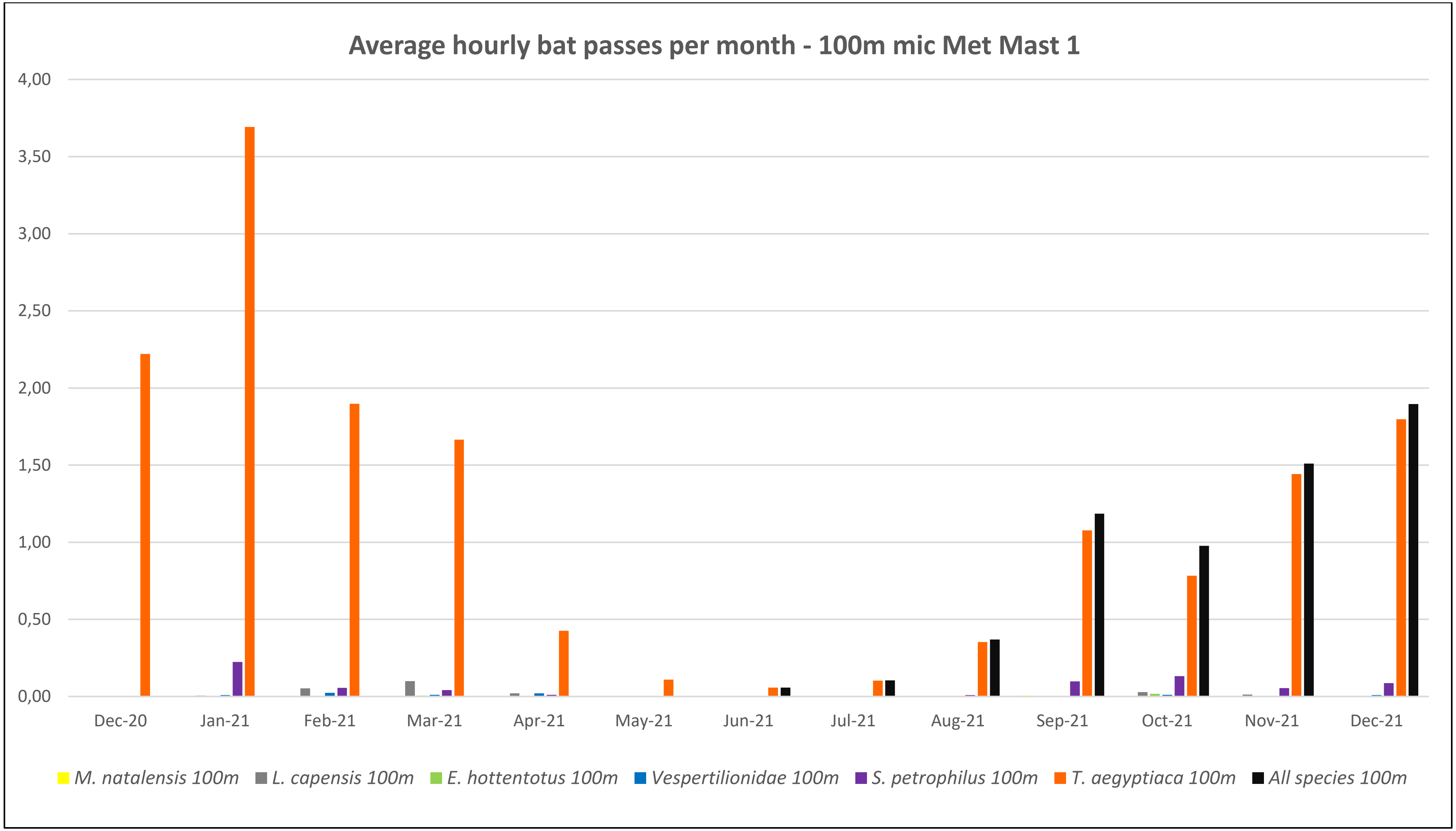

Figure 4.9: Average hourly bat passes per month recorded over the monitoring period by the 100m microphone on Met Mast 1.

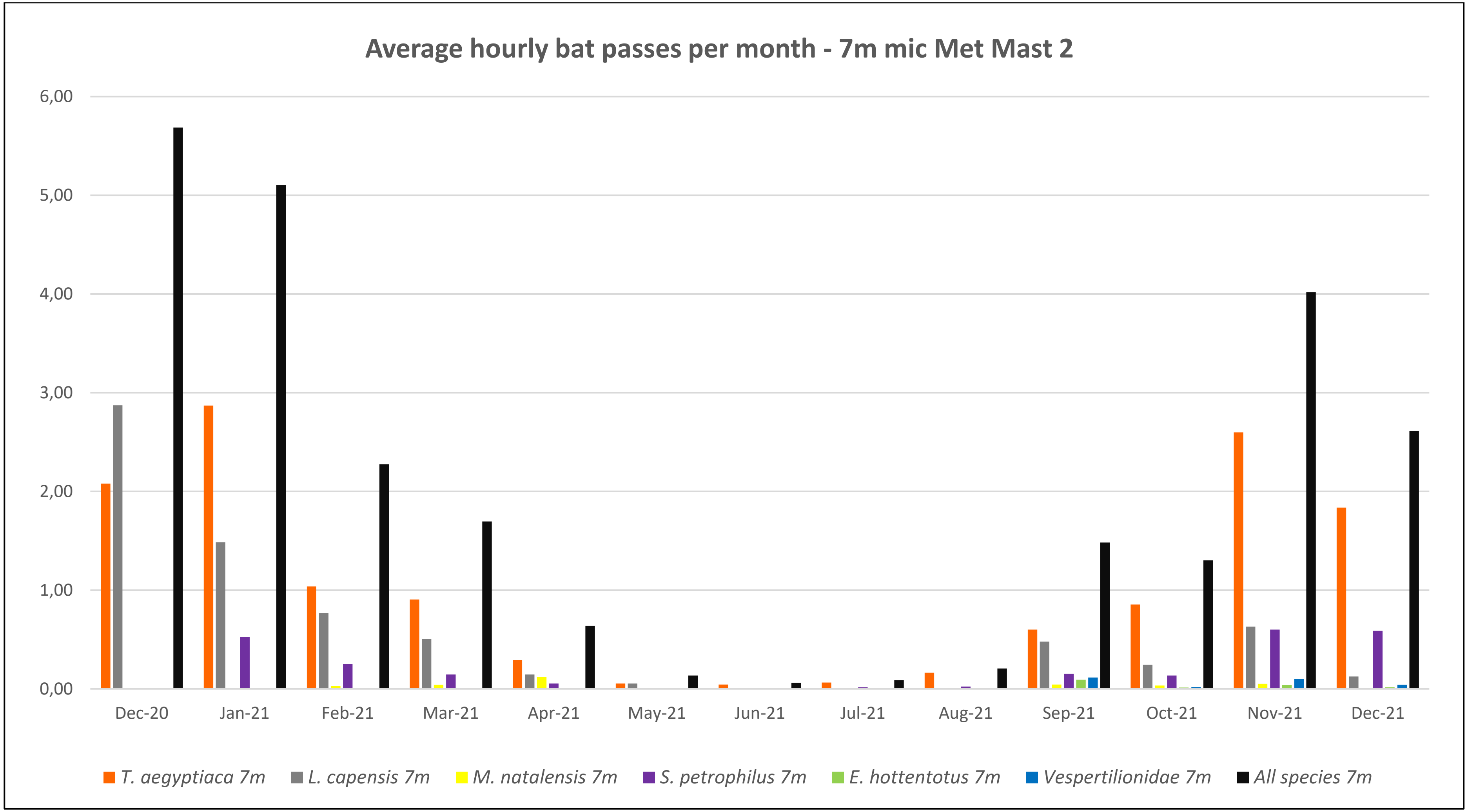

Figure 4.10: Average hourly bat passes per month recorded over the monitoring period by the 7m microphone on Met Mast 2.

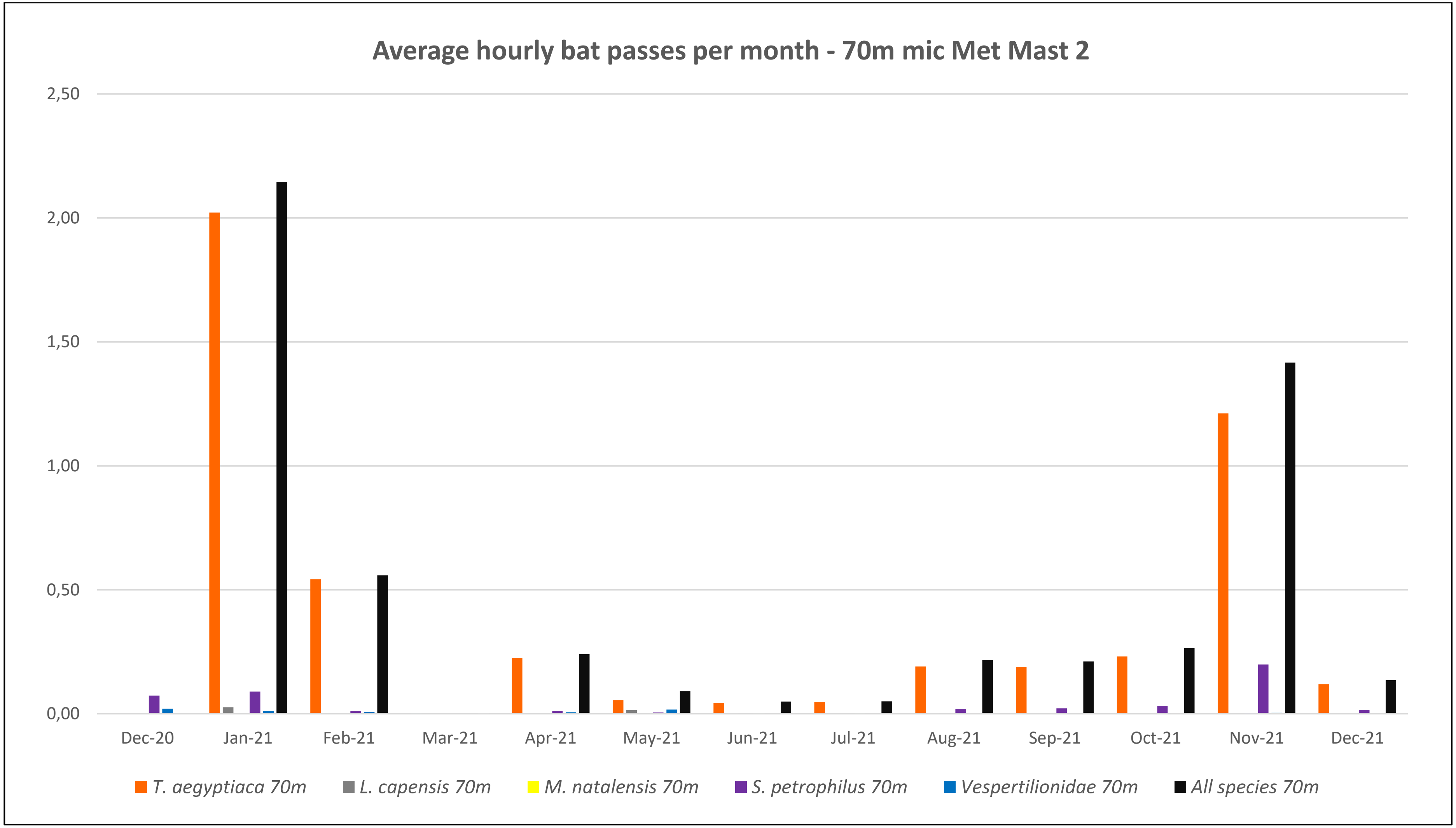

Figure 4.11: Average hourly bat passes per month recorded over the monitoring period by the 70m microphone on Met Mast 2.

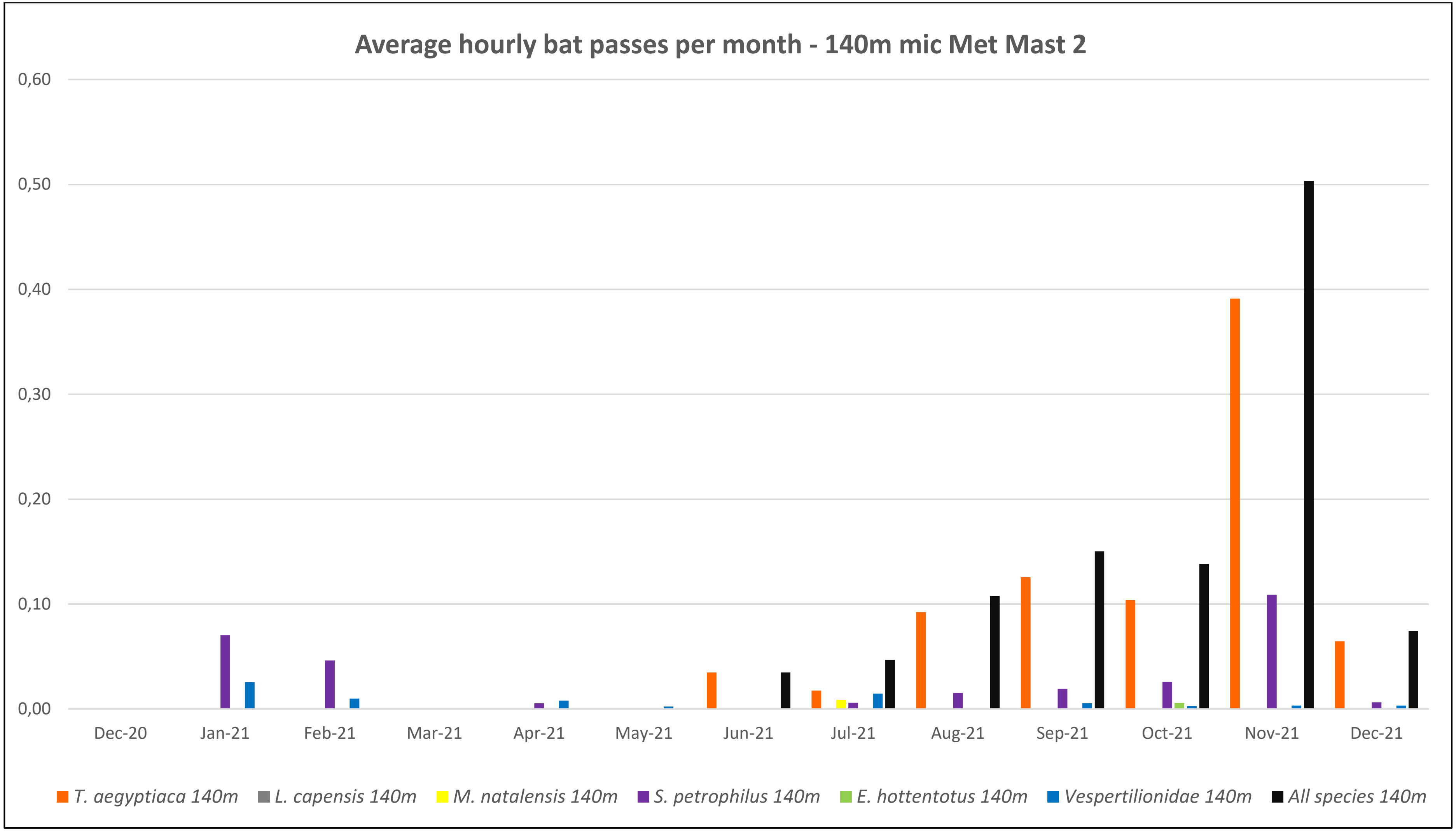

Figure 4.12: Average hourly bat passes per month recorded over the monitoring period by the 140m microphone on Met Mast 2.

4.5.2 Temporal Distribution

Nightly bat totals over time are useful for displaying abrupt peaks in activity on specific nights or short time periods, and to visually represent the spread of bat activity over the monitoring period (Figures 4.13– 4.19). This may assist in developing mitigation schedules, if required. On Met Mast 1, prominent peaks of activity were present between 12 - 26 January 2021 and 5 – 12 December 2021 for *T. aegyptiaca*. On Met Mast 2, prominent peaks were present on 5 and 13 January 2021 for *T. aegyptiaca* at 7m, and approximately the same dates for the 70m and 140m microphone for this species. On mid-November 2021 to mid-December 2021 the 7m microphone on Met Mast 2 had elevated activity, with this peak moving later into December 2021 for the 70m and 140m microphones. At ShM1 *T. aegyptiaca* activity peaked late December 2021 and especially on 13 January 2021, which coincides with the activity peaks on Met Mast 1 and 2.

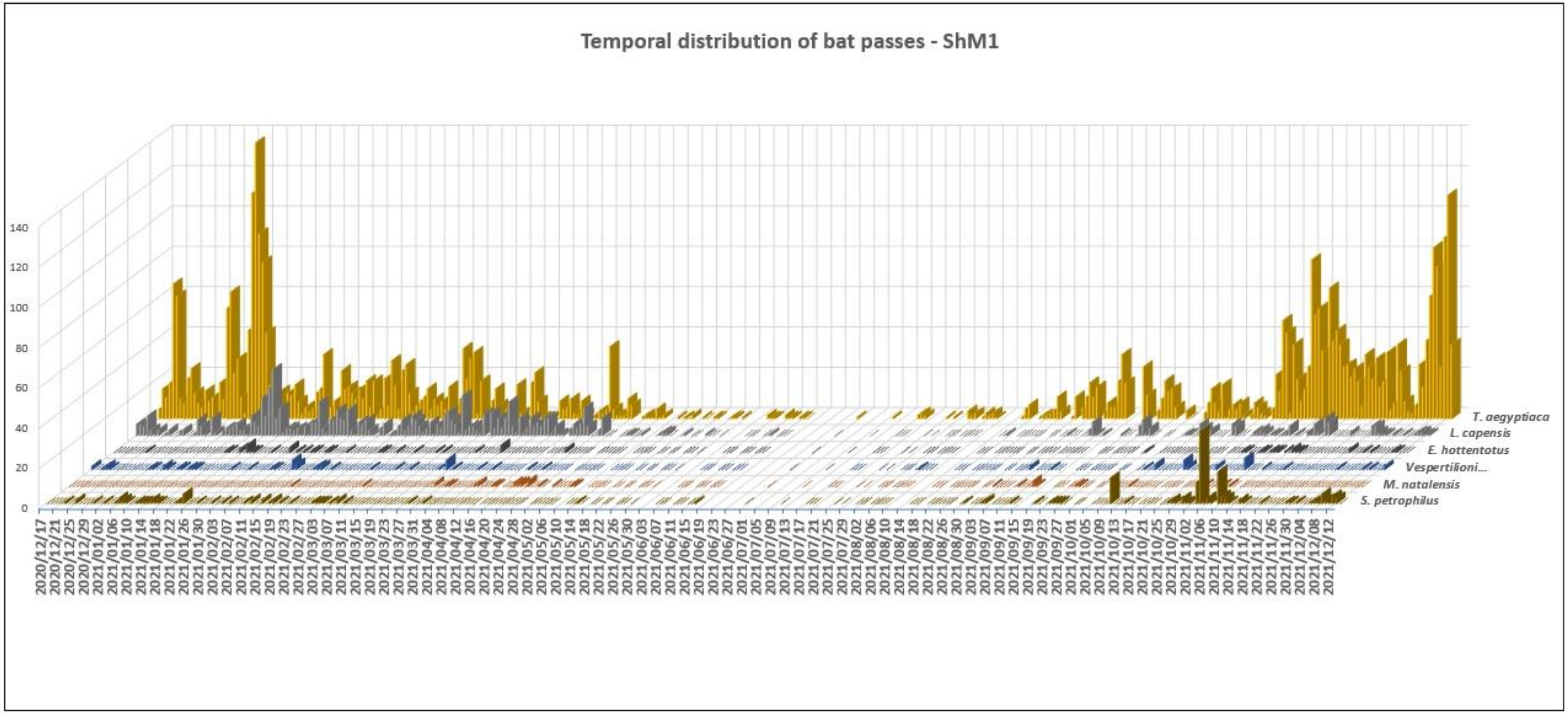

Figure 4.13: Temporal distribution of bat passes detected by ShM1.

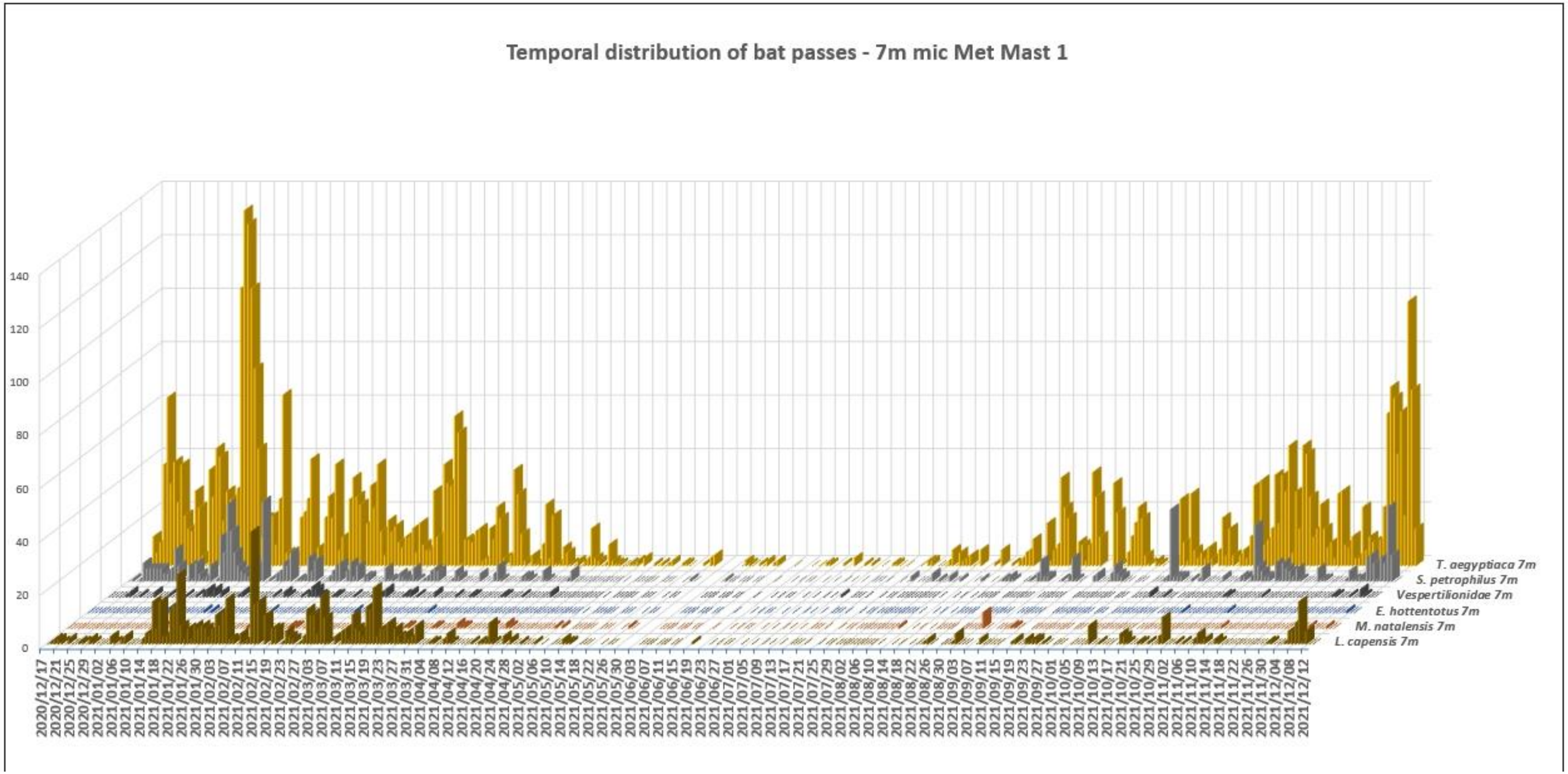

Figure 4.14: Temporal distribution of bat passes detected at 7m by Met Mast 1.

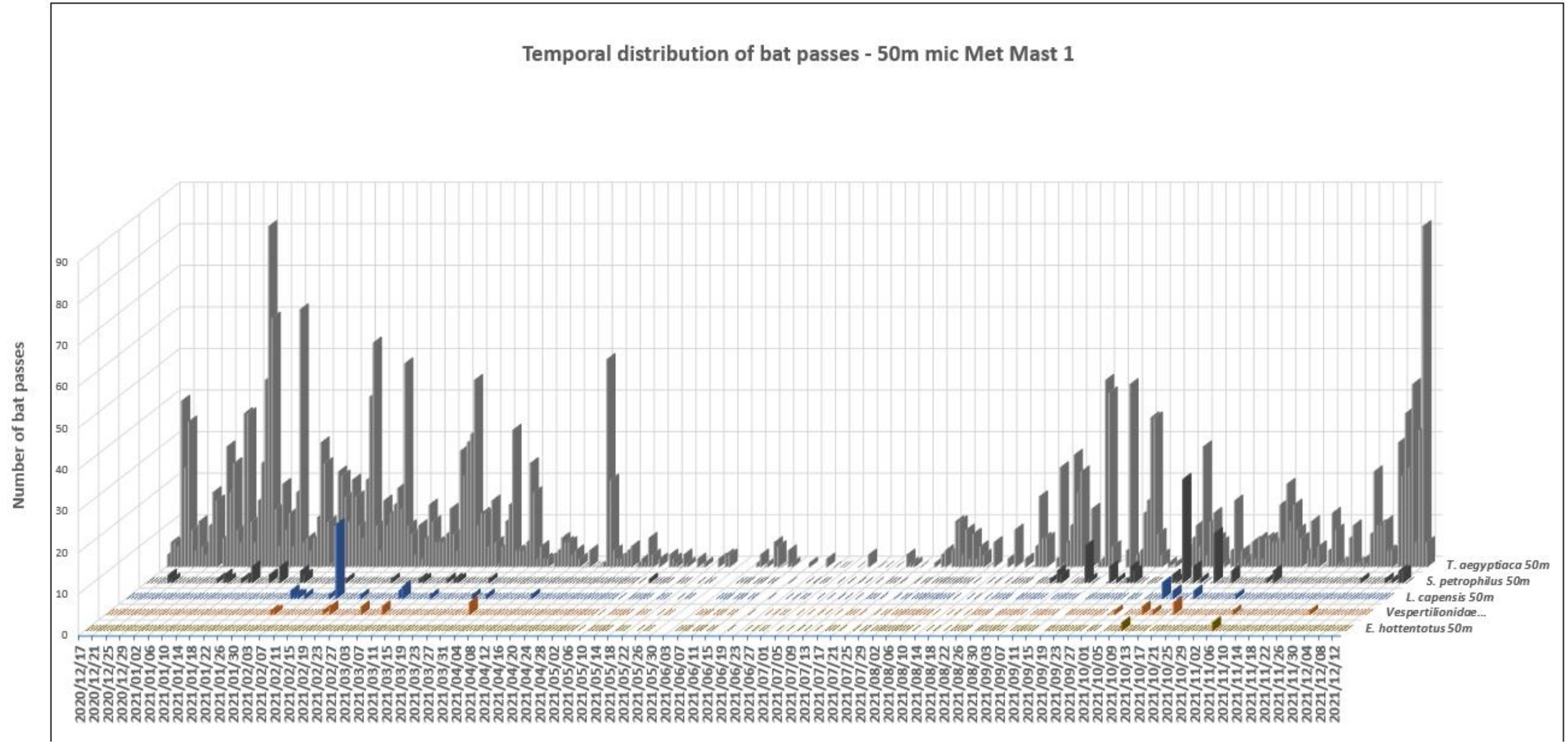

Figure 4.15: Temporal distribution of bat passes detected at 50m by Met Mast 1.

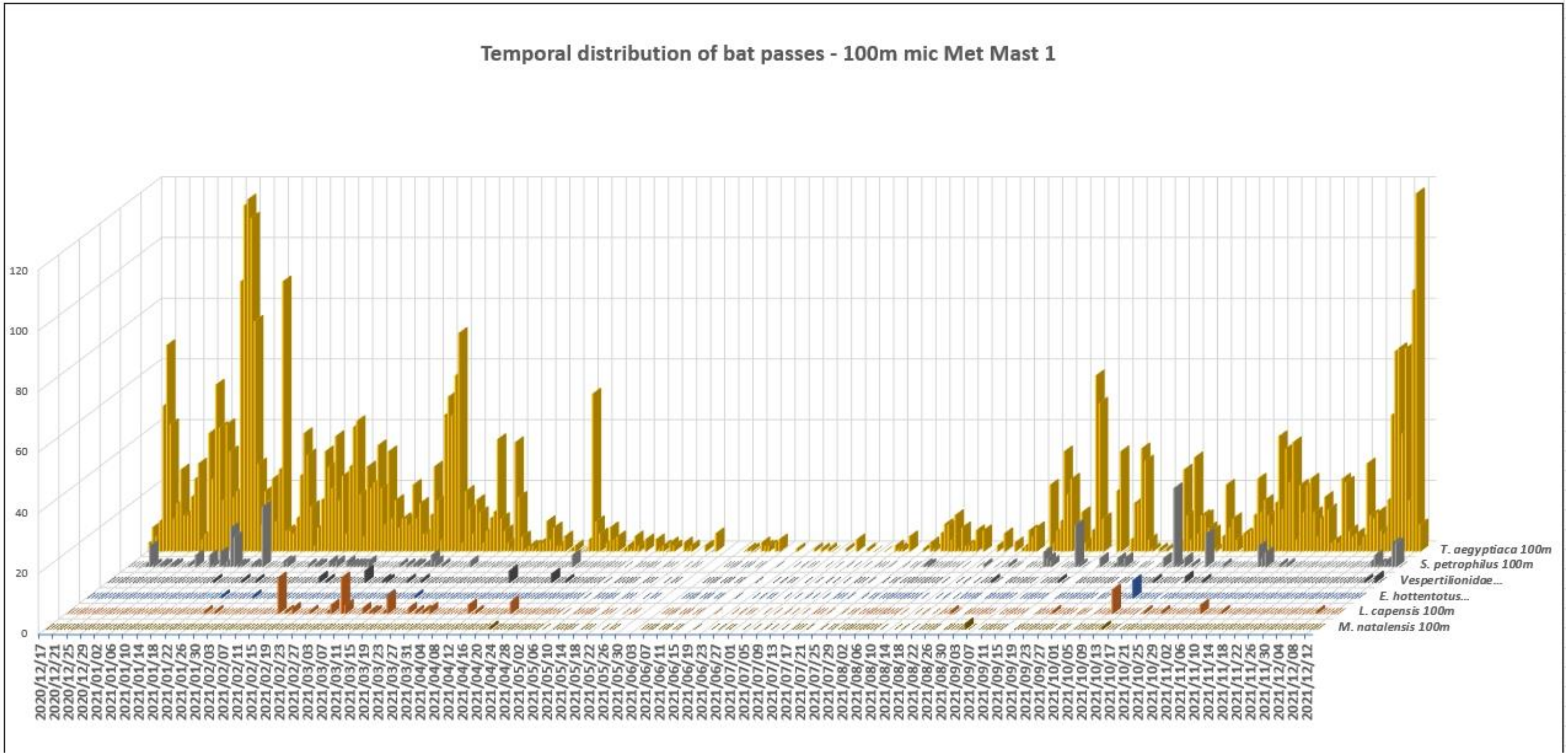

Figure 4.16: Temporal distribution of bat passes detected at 100m by Met Mast 1.

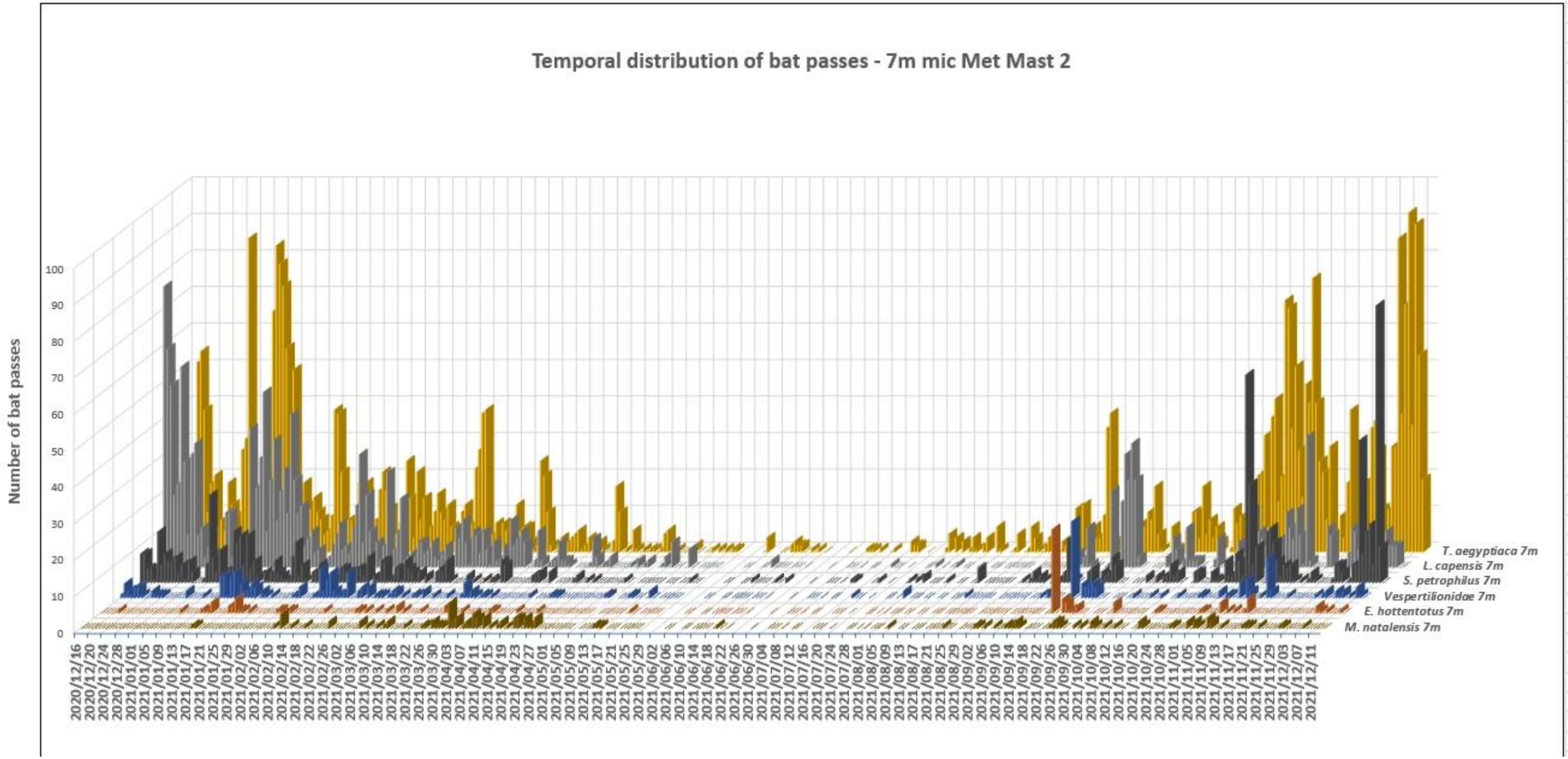

Figure 4.17: Temporal distribution of bat passes detected at 7m by Met Mast 2.

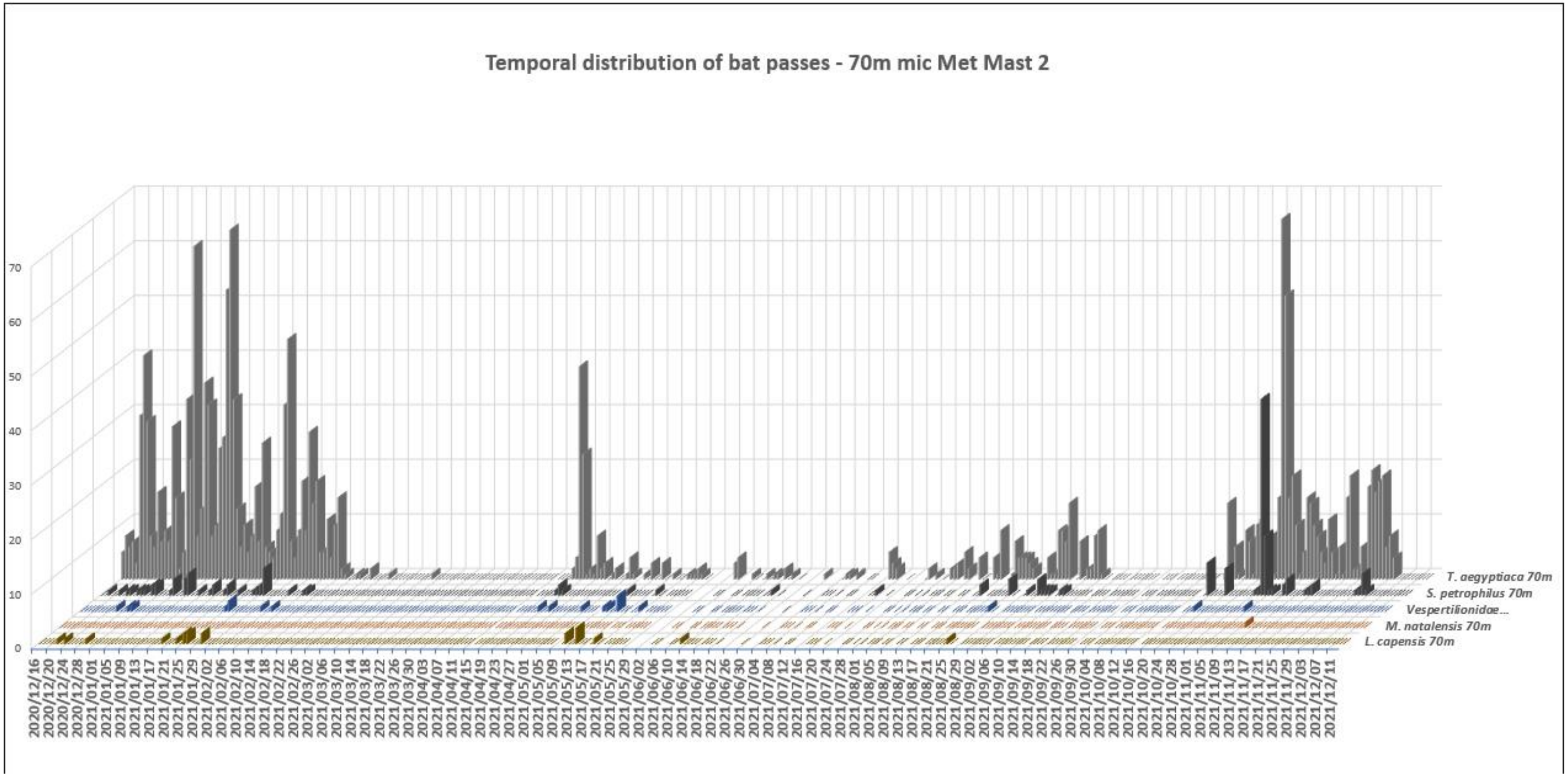

Figure 4.18: Temporal distribution of bat passes detected at 70m by Met Mast 2.

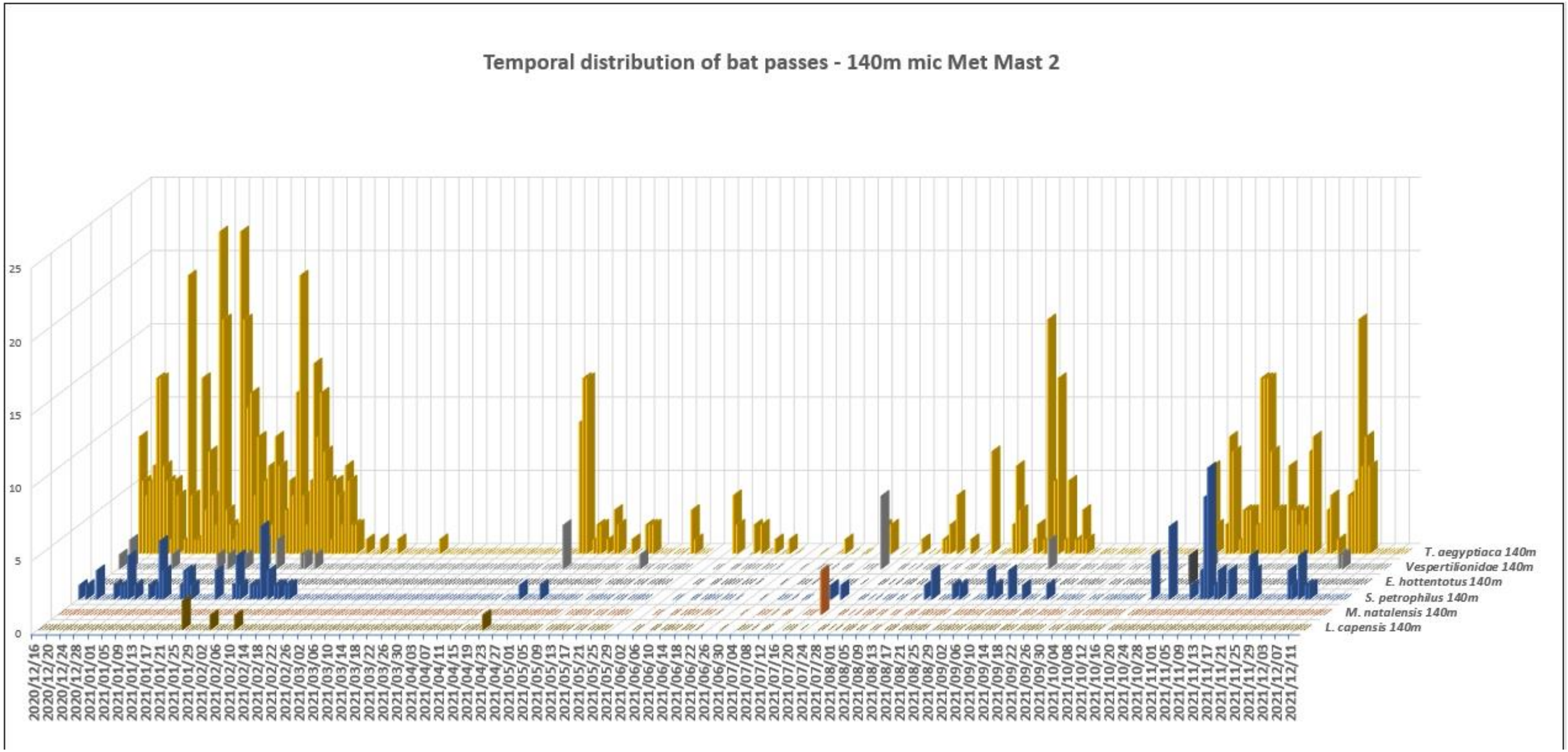

Figure 4.19: Temporal distribution of bat passes detected at 140m by Met Mast 2.

4.5.3 Relation between Bat Activity and Weather Conditions

Several sources of literature describe how numerous bat species are influenced by weather conditions (O'Farrell *et al.* 1967, Rachwald 1992, Arnett *et al*. 2010). Weather may influence bats in terms of lowering activity, changing time of emergence and flight time. It is also important to note that the environmental factors are never isolated and therefore a combination of the environmental factors can have synergistic or otherwise contradictory influences on bat activity. For example, a combination of high temperatures and low wind speeds will be more favourable to bat activity than low temperatures and low wind speed, whereas low temperature and high wind speed will be the least favourable for bats. Below are short descriptions of how wind speed, temperature and barometric pressure influence bat activity.

If it is found during operation that the wind farm is causing unsustainable numbers of bat fatalities, an analysis can be performed to determine the wind speed and temperature range within which 80% of bat passes were detected. The results of such an analysis may be used, if necessary, to inform mitigation measures for turbines based on conserving 80% of detected bat passes. This is keeping in mind the synergistic or otherwise contradictory effects that the combination of wind speeds and temperatures can have on bat activity.

Wind speed

Some bat species show reduced activity in windy conditions. Strong winds have been found to suppress flight activity in bats by making flight difficult (O'Farrell *et al.* 1967). Several studies at proposed and operating wind facilities in the United States have documented discernibly lower bat activity during 'high' wind speeds (Arnett *et al*. 2010).

Wind speed and direction also affect availability of insect prey, as insects on the wing often accumulate on the lee side of wind breaks such as tree lines (Peng *et al.* 1992). At edges exposed to wind, flight activity of insects, and therefore bats, may be suppressed while at edges to the lee side of wind, bat activity may be greater.

Temperature

Flight activity of bats generally increases with temperature. Flights are of shorter duration on cooler nights and extended on warmer nights. Rachwald (1992) noted that distinct peaks of activity disappeared in warm weather such that activity was mostly continuous through the night. During nights of low temperatures bats intensified foraging shortly after sunset (Corbet and Harris 1991).

Peng (1991) found that many families of aerial dipteran (flies) insects preferred warm conditions for flight. A preference among insects for warm conditions has been reported by many authors suggesting that temperature is an important regulator of bat activity, through its effects on insect prey availability.

4.6 Sensitivity Mapping

4.6.1 DFFE Screening tool

The Department of Forestry, Fisheries & the Environmental (DFFE) Screening Tool (accessed 13/04/2022) was consulted for the "Bat" theme, to determine the environmental sensitivity ranking assigned to the site area and surrounds.

For wind energy generation, the tool denotes areas of the site as "High sensitivity" with regards to being within 500m of a river and within 500m of a wetland; a "Medium sensitivity" is also denoted with regards to the presence of croplands (see Figure 4.20).

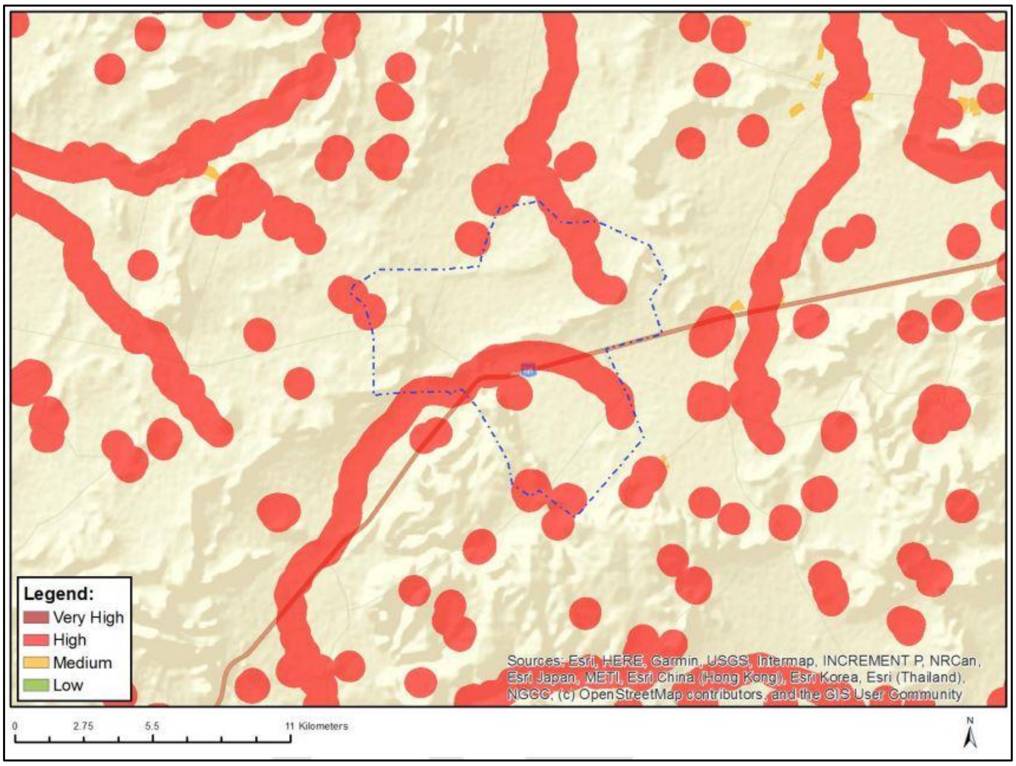

Figure 4.20. DFFE Screening Tool for the "Bat" and "Wind" theme. The Merino WEF boundary is shown in a blue outline, with red and orange areas depicting high and moderate sensitivities in the area, respectively (DFFE Screening Tool 13/04/2022).

4.6.2 Specialist Sensitivity Mapping

Due to the extrapolated nature of the national screening tool, further Google Earth satellite imagery and verifications during site visits were used to spatially demarcate areas of the site with high and medium sensitivities relating to bat species ecology and habitat preferences, where high sensitivities and their buffers are no-go zones for turbines and turbine blade overhang (Table 4.2). In other words, no turbine blades may intrude into high sensitivity buffers. Medium sensitivities indicate areas of probable increased risk due to seasonal fluctuations in bat activity, but turbines are allowed to be constructed in medium sensitivity areas. Figure 4.21 depicts the sensitive areas of the site, based on features identified to be important for foraging and roosting of the species that are most likely to occur on site.

Considering the current proposed layout for the Merino WEF, no turbines are intruding onto the high bat sensitivities and respects the bat sensitivity map. When applying an 80m blade length.

Table 4.2**:** Description of parameters used in the development of the sensitivity map.

Last revision	October 2021
High sensitivities and 200m buffers	Valley bottom wetlands.
	Pans and depressions.
	Dams.
	Rocky boulder koppies (tors).
	Exposed rocky cliff edges.
	Drainage lines capable of supporting riparian vegetation.
	Other water bodies and other sensitivities such as manmade structures, buildings, houses, barns and sheds.
Medium sensitivities and 150m buffers	Alluvial plains and washes.
	Seasonal drainage lines.

Table 4.3. The significance of sensitivity map categories for each infrastructure component for the proposed Merino WEF.

Sensitivity	Turbines	Roads and cables	Internal overhead transmission lines	Buildings (including substation, battery storage facility and construction camp/yards)
High Sensitivity	These areas are 'no-go' zones and turbines may not be placed in these areas. Turbine blades (blade overhang) **may not** intrude into these areas.	Preferably keep to a minimum within these areas where practically feasible.	Allowed inside these areas.	Avoid these areas.
High Sensitivity buffer	These areas are 'no-go' zones and turbines may not be placed in these areas. Turbine blades (blade overhang) **may not** intrude into these areas.	Allowed inside these areas.	Allowed inside these areas.	Preferably keep to a minimum within these areas where practically feasible.
Medium Sensitivity	Turbines within these areas may require priority (not excluding all other turbines) during post-construction studies, and in some instances, there is a higher likelihood that mitigation measures may need to be applied to them.	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.
Medium Sensitivity buffer	Turbines within these areas may require priority (not excluding all other turbines) during post-construction studies, and in some instances, there is a higher likelihood that mitigation measures may need to be applied to them.	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.

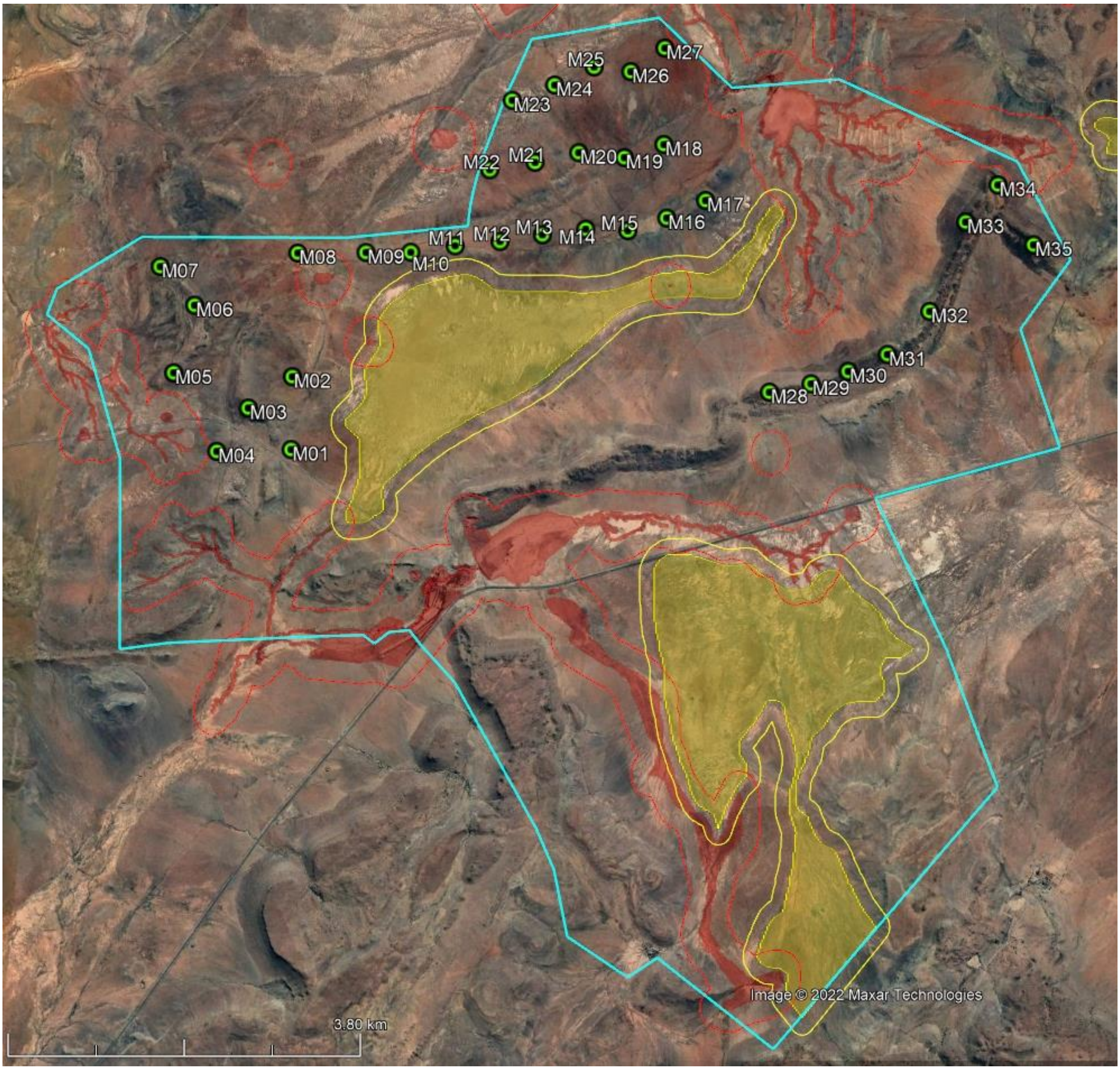

Figure 4.21: The bat sensitivity areas of the proposed Merino WEF. Red shaded = High bat sensitivity; Red line = High bat sensitivity 200m buffer; Yellow shaded = Medium bat sensitivity; Yellow line = Medium sensitivity 150m buffer. The bat sensitivity areas are supplied as a separate .kml file with this report.

5 IMPACT ASSESSMENT & EMP

Tables 5.1 – 5.4 below indicates the assessed impacts associated with the proposed Merino Wind Farm during the construction and operational phases. No significant impacts are identified for the decommissioning phase.

5.1 Construction phase

Table 5.1: Description of impact: foraging habitat destruction.

Nature: Loss of bat foraging habitat.			
Impact description: **Bat foraging habitat will be destroyed due to vegetation clearing during construction.**			
	Rating	Motivation	Significance
Prior to Mitigation			
Duration	**Short-term (1)**	**The construction period will last for less than one year.**	Medium Negative (30)
Extent	**Local (1)**	**Only limited to the construction areas.**	
Magnitude	**Low (4)**	**A relatively small area will be disturbed by construction.**	
Probability	**Definite (5)**	**If the windfarm is approved, the construction activities will destroy vegetation.**	
Mitigation/Enhancement Measures			
Mitigation: • Adhere to the bat sensitivity map. • Rehabilitate areas disturbed during construction, such as temporary construction camps and laydown yards.			
Post Mitigation/Enhancement Measures			
Duration	**Short-term (1)**	**The construction period will last for less than one year.**	Low Negative (20)
Extent	**Local (1)**	**Only limited to the construction areas.**	
Magnitude	**Minor (2)**	**A relatively small area will be disturbed by construction, and less**	

		critical vegetation if the mitigation measures are adhered to.	
Probability	**Definite (5)**	**If the windfarm is approved, the construction activities will destroy vegetation, but less critical vegetation if the mitigation measures are adhered to.**	
Residual Risks: **The residual risk is very low since the site will still offer sufficient foraging areas for bats.**			

Table 5.2: Description of impact: Bat roost disturbance/destruction.

Nature: Bat roost destruction/disturbance.			
Impact description: **Bat roosts may be destroyed or disturbed by earthworks during construction.**			
	Rating	Motivation	Significance
Prior to Mitigation			
Duration	**Short-term (1)**	**The construction period will last for less than one year.**	Medium Negative (30)
Extent	**Local (1)**	**Only limited to the construction areas.**	
Magnitude	**High (8)**	**A relatively small area will be disturbed by construction.**	
Probability	**Probable (3)**	**If the windfarm is approved, the construction activities will destroy vegetation.**	
Mitigation/Enhancement Measures			
Mitigation: • Adhere to the bat sensitivity map.			
Post Mitigation/Enhancement Measures			
Duration	**Short-term (1)**	**The construction period will last for less than one year.**	Low Negative (20)

Extent	**Local (1)**	**Only limited to the construction areas.**	
Magnitude	**High (8)**	**A relatively small area will be disturbed by construction, and less critical vegetation if the mitigation measures are adhered to.**	
Probability	**Improbable (2)**	**If the windfarm is approved, the construction activities will destroy vegetation, but less critical vegetation if the mitigation measures are adhered to.**	
Residual Risks: **The residual risk is very low if the sensitivity map is adhered to.**			

5.2 Operational phase

Table 5.3: Description of impact: Increased bat mortality due to light pollution.

Nature: Increased bat mortality due to light pollution.			
Impact description: **The probability of bat mortalities caused by moving turbine blades may be significantly increased by artificial lighting attracting insects and thereby attracting insect eating bats. Particularly if such lights are placed in close proximity of wind turbines. This applies to insect eating bats that readily forage around lights. Cave dwelling species tend to avoid lights.**			
	Rating	Motivation	Significance
Prior to Mitigation			
Duration	**Long term (4)**	**The impact is applicable for the lifetime of the facility.**	Medium Negative (56)
Extent	**Site and adjacent areas (2)**	**Light pollution can affect adjacent areas.**	
Magnitude	**High (8)**	**Increased bat activity near turbines, due to lights, can significantly increase the probability of bat mortalities.**	

Probability	**Highly probable (4)**	**If not mitigated, the possibility of this impact is high.**	
Mitigation/Enhancement Measures			
Mitigation: • Adhere to the bat sensitivity map. • Use lights with passive motion sensors that only switch on when a person/vehicle is nearby, if possible, for safety and security reasons. • All floodlights must be down-hooded to minimise light pollution. • If possible, do not place outside lights near turbines.			
Post Mitigation/Enhancement Measures			
Duration	**Long term (4)**	**The impact is applicable for the lifetime of the facility.**	Low Negative (28)
Extent	**Site and adjacent areas (2)**	**Light pollution can affect adjacent areas.**	
Magnitude	**High (8)**	**Increased bat activity near turbines, due to lights, can significantly increase the probability of bat mortalities.**	
Probability	**Improbable (2)**	**If mitigated, the possibility of this impact is low.**	
Residual Risks: **Some outside lighting will always be present and poses a low to medium risk for the lifetime of the facility.**			

Table 5.4: Description of impact: Bat mortality due to moving turbine blades.

Nature: Bat mortality due to moving turbine blades.			
Impact description: **Moving turbine blades can kill bats by direct impact or barotrauma.**			
	Rating	Motivation	Significance
Prior to Mitigation			
Duration	**Long term (4)**	**The impact is applicable for the lifetime of the facility.**	Medium Negative (60)

Extent	**Larger area (3)**	**Bats moving between the site and adjacent areas will be impacted.**	
Magnitude	**High (8)**	**Bat mortalities at turbines can impact bat populations significantly over a long period.**	
Probability	**Highly probable (4)**	**If not mitigated, the possibility of this impact is high.**	
Mitigation/Enhancement Measures			
Mitigation: • Adhere to the bat sensitivity map. • If bat mortalities are found to be unsustainably high during the operational study, a curtailment mitigation schedule may need to be implemented. • Refer to Section 6.			
Post Mitigation/Enhancement Measures			
Duration	**Long term (4)**	**The impact is applicable for the lifetime of the facility.**	Medium Negative (45)
Extent	**Larger area (3)**	**Bats moving between the site and adjacent areas will be impacted.**	
Magnitude	**High (8)**	**Bat mortalities at turbines can impact bat populations significantly over a long period.**	
Probability	**Probable (3)**	**If not mitigated, the possibility of this impact is moderate.**	
Residual Risks: **Even with mitigation some bats will be killed during operation, this is unavoidable but should be minimised as much as possible.**			

5.3 Cumulative impact

There are several other renewable energy facilities within a 30km radius of Merino WEF that have received Environmental Authorisation approval as depicted in Table 5.5 and Figure and shown in Figure 5.1 below. Table 5.6 below assesses only the impact of bat mortalities by moving turbine blades, since the approved facilities indicated in Figure 5.1 below are too far from the Merino site to have a cumulative effect on the other identified impacts.

Table 5.5. Approved renewable energy developments within 30km of the Merino WEF.

Project Name	Project Status
Brakpoort Solar PV Facility	Authorised
Umsinde Emoyeni Wind Energy Facility	Authorised
Aurora Solar PV Facility	Authorised
Mainstream Renewable Energy Cluster	Authorised
Ishwati Emoyeni Wind Energy Facility	Authorised
Trouberg Wind Energy Facility	Authorised
Modderfontein Wind Energy Facility	Authorised
Nobelsfontein Wind Energy Facility	Authorised
Bietjiesfontein Solar Energy Facility	Authorised
Karoo Renewable Energy Facility	Authorised

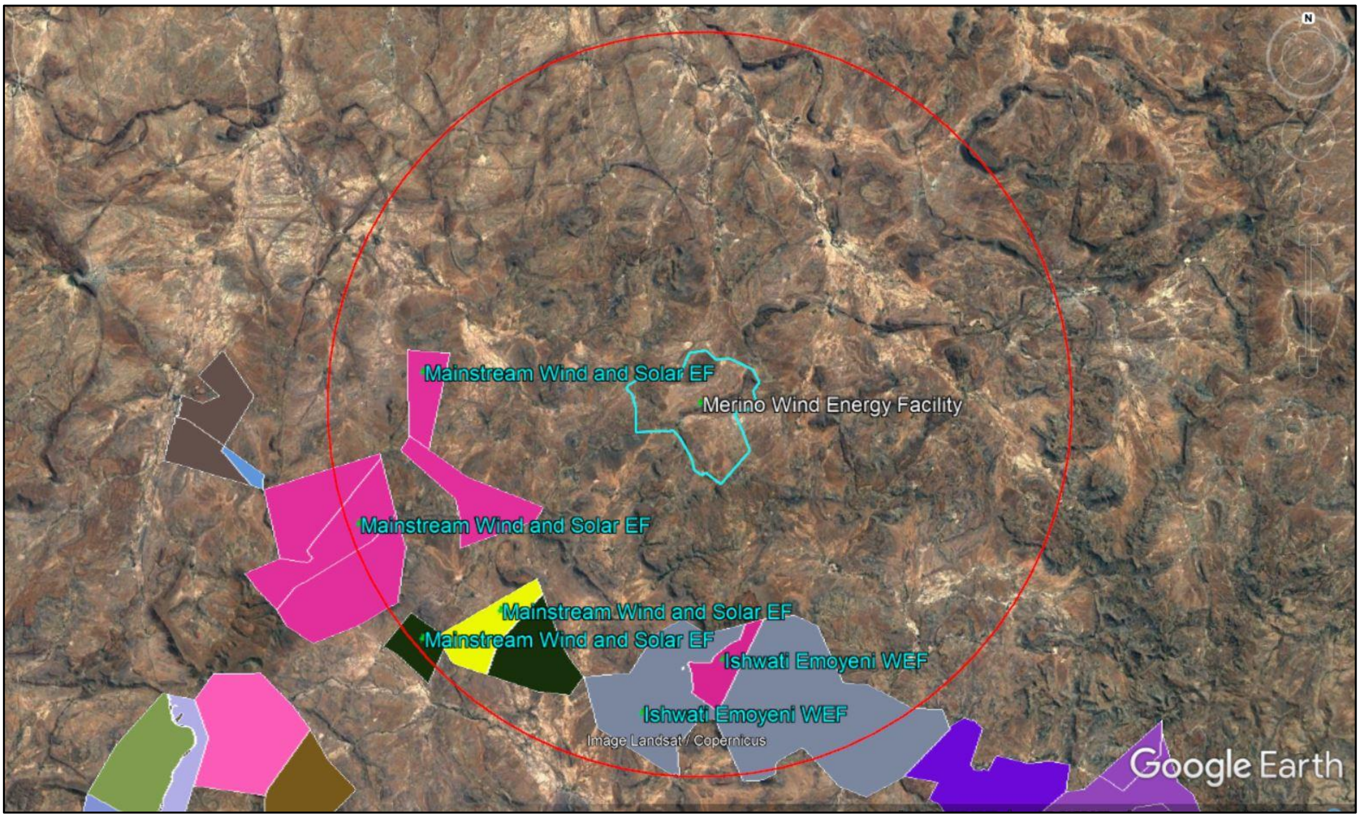

Figure 5.1: Approved Wind Energy Facilities within a radius of approximately 30km (red line) around the Merino WEF site (DEA, 2021).

Table 5.6: Assessment of cumulative impacts.

Nature: **Moving turbine blades can kill bats by direct impact or barotrauma.**		
	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area
Extent	**Long term (4)**	**Long term (4)**
Duration	**Larger area (3)**	**Larger area (3)**
Magnitude	**High (8)**	**High (8)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	Medium (60)	Medium (45)
Status (positive or negative)	**Negative**	**Negative**
Reversibility	**Low**	**Low**

Irreplaceable loss of resources?	**Yes**	**Yes**
Can impacts be mitigated?	**Yes**	**Yes**
Confidence in findings: **High.**		
Mitigation: • Each facility should adhere to its respective bat sensitivity map. • If bat mortalities are found to be unsustainably high during the operational study, a curtailment mitigation schedule may need to be implemented. Each facility is responsible for this condition. • Refer to **Section 6**.		

5.4 Environmental Management Plan (EMP)

Table 5.7: Measurements for inclusion into the Environmental Management Plan for the impacts of foraging habitat and roost disturbance/destruction.

Project component/s	**Earthworks and vegetation clearing during construction.**
Potential Impact	**Bat roosts may be destroyed and bat foraging habitat will be destroyed.**
Activity/risk source	**Earthworks and vegetation clearing during construction.**
Mitigation: Target/Objective	**To minimise the destruction of bat roosts and bat foraging habitat.**

Mitigation: Action/control	Responsibility	Timeframe
Bat sensitivity map needs to be adhered to.	**Site planning team and ECO on site during construction.**	**From planning to end of construction.**

Performance Indicator	» **No disturbance outside of designated work areas.** » **Minimised clearing of existing/natural vegetation and habitats for bats.** » **Limited impacts on bat species, especially those of conservation concern.**
Monitoring	» **Observation of vegetation clearing activities by the EO throughout construction phase.** » **Supervision of all clearing and earthworks by the EO.**

Table 5.8: Measurements for inclusion into the Environmental Management Plan for the impact of increased bat mortality due to light pollution.

Project component/s	**Lighting on the wind farm site.**
Potential Impact	**The probability of bat mortalities caused by moving turbine blades may be significantly increased by artificial lighting attracting insects and thereby attracting insect eating bats. Particularly if such lights are placed in close proximity of wind turbines. This applies to insect eating bats that readily forage around lights. Cave dwelling species tend to avoid lights.**
Activity/risk source	**Artificial lights that are placed near operational turbines.**
Mitigation: Target/Objective	**To minimise bat mortalities due to lighting on site.**

Mitigation: Action/control	Responsibility	Timeframe
• Adhere to the bat sensitivity map. • Use lights with passive motion sensors that only switch on when a person/vehicle is nearby, if possible, for safety and security reasons. • All floodlights must be down-hooded to minimise light pollution. • If possible, do not place outside lights near turbines.	**Site planning team, and wind farm operations manager.**	**From planning, throughout the lifetime of the facility**

Performance Indicator	**Minimal to no bat mortalities due to artificial lighting on site.**
Monitoring	**Observations should be made at night on an annual basis to determine if the outside lights are fitted with passive motion sensors that functions correctly, and if all floodlights are down-hooded. After any maintenance/replacements done on outside lights, this observation must be done.**

Table 5.9: Measurements for inclusion into the Environmental Management Plan for the impact of bat mortalities by moving turbine blades.

Project component/s	**Moving turbine blades.**
Potential Impact	**Moving turbine blades can kill bats by direct impact or barotrauma.**
Activity/risk source	**Moving turbine blades.**

Mitigation: Target/Objective	**Minimal bat mortalities, and adequate monitoring of bat mortalities.**

Mitigation: Action/control	Responsibility	Timeframe
• Adhere to the bat sensitivity map. • If bat mortalities are found to be unsustainably high during the operational study, a curtailment mitigation schedule may need to be implemented. • Refer to Section 6. .	**Site planning team, and wind farm operations manager. Bat specialist doing the operational bat mortality assessment.**	**From planning, throughout the lifetime of the facility**

Performance Indicator	**Minimal bat carcasses recorded on site, considering factors of searcher efficiency and carcass removal by scavengers.**
Monitoring	**The operational bat mortality monitoring assessment can determine the number of bat mortalities. Devices are available on the market to automatically and accurately count bat and bird carcasses, excluding the need to compensate for searcher efficiency and scavenger removal rates.**

6 RECOMMENDED MITIGATION MEASURES

The most effective and required method of mitigation can be determined from preconstruction acoustic bat activity data, climatic data and the results from the operational bat mortality monitoring. The operational bat mortality monitoring will determine the need for mitigation, and if it is required, the specific turbines to be mitigated, in combination with the data from the preconstruction and operational studies, will enable a detailed mitigation schedule to be implemented as needed.

Additional to mitigation by location of turbines (adhering to a bat sensitivity map), other options that may be utilised, when necessary, include curtailment and acoustic deterrents. These options are discussed in more detail below:

Curtailment that increases cut-in speed:

The activity levels of South African bats generally decrease in weather conditions with increased wind speeds. But, in scenarios where significant numbers of bats are being killed, and these bats fly in wind speeds above the turbine manufacturer's cut-in speed, the turbine's computer control system (referred to as the Supervisory Control and Data Acquisitions or SCADA system) can be programmed to a cut-in speed higher than the manufacturer's set speed. The new cut-in speed will then be referred to as the mitigation cut-in speed, and can be determined from studying the relation of long term (12-month) bat activity patterns with wind speed.

In such a case, the turbines are curtailed by means of blade feathering, to render the blades motionless in wind speeds below the mitigation cut-in speed.

Curtailment to prevent freewheeling:

Free-wheeling occurs when the blades are rotating in wind speeds below the generator cut-in speed (also called the manufacturer's cut-in speed), thus no electricity is being produced and only some blade momentum is maintained.

Since bat activity tends to be negatively correlated with wind speed, it means that high numbers of bats are likely to be flying and impacted on in low wind speeds where freewheeling will be occurring. If turbine blades are feathered below the generator cut-in speed, to prevent free-wheeling, it can result in a very significant reduction of bat mortalities with minimal energy production loss.

Acoustic bat deterrents:

This technology is being experimented with on wind farms in South Africa, and thus far yielded positive results that may indicate effectiveness of the devices in the correct scenarios.

However, current data on the SA trials is still limited to a small sample set, and the technology will not necessarily be effective in all mitigation scenarios and on all species. Therefore, it should be considered and tested on a case specific basis, and the effect on reducing bat mortalities must be adequately monitored to determine the level of effectiveness.

Minimizing light pollution on site:

All lights on turbines and at substation and/or Operations and Management (O&M) buildings (excluding aviation lights), should be down-hooded and connected to motion sensors (where safe to do so), to minimise light pollution. Light pollution can attract bats that readily forage on insects attracted to light sources, significantly increasing the likelihood of collisions with turbines.

7 CONCLUSION

This Bat Environmental Impact Assessment Report considered information gathered from five site visits, 12 months of passive recordings, literature, and satellite imagery. The passive data indicates that the three bat species most likely to be impacted on by the proposed wind farm are *Laephotis* (formerly *Neoromicia*) *capensis, Miniopterus natalensis* and *Tadarida aegyptiaca*. These more abundant species are of a large value to the local ecosystems as they provide a greater contribution to most ecological services than the rarer species, due to their higher numbers.

A sensitivity map was drawn up indicating potential roosting and foraging areas. The high bat sensitivities and their buffers are no-go zones for turbines and turbine blade overhang (Table 4.2). In other words, no turbine blades may intrude into high sensitivity buffers. Medium sensitivities indicate areas of probable increased risk due to seasonal fluctuations in bat activity, but turbines are allowed to be constructed in medium sensitivity areas. Figure 4.21 depicts the sensitive areas of the site, based on features identified to be important for foraging and roosting of the species that are most likely to occur on site.

Considering the current proposed layout for the Merino WEF, no turbines are intruding onto the high bat sensitivities and respects the bat sensitivity mapwhen applying an 80m blade length.

There are three protected areas within 100km of Merino WEF, namely the High Karoo Park Protected Environment, Compassberg Protected Environment and Mountain Zebra-Camdeboo Protected Environment (Figure 4.2, DEA 2021). These have no significant bearing on the current site and will not be discussed further. No formal Conservation Areas fall within this radius. No caves or large bat roosts are known within a 100km radius of the site, and no limestone or dolomite are prevalent within this radius. Dolomite and limestone are prone to cave formation.

In general, and overall on all microphones, *Tadarida aegyptiaca* was most commonly detected. On Met Mast 1 T, *aegyptiaca* had the highest occurrences at 100m, then 7m and lowest occurrences at 50m. On Met Mast 2, this same species had the highest occurrence at 7m and the lowest at 140m. Overall, N. capensis was the second most abundant species. The Met Mast 1 displayed the highest overall bat activity.

Average hourly bat passes per month (Figures 4.6 – 4.12) are useful to indicate overall average high activity months and seasons. Gaps in data are considered in average calculations, whereas total bat numbers are influenced by the completeness of a recording schedule. Met Mast 2 displayed the highest average hourly bat activity in December 2020 at 7m height. The months of November, December and January indicated the highest bat activity overall, with January showing particularly high activity.

The yearly median of average hourly bat passes, at 100m on Met Mast 1 is 0.06 bat passes per hour, and at 140m at Met Mast 2 it's 0.03 bat passes per hour. According to MacEwan *et al.* (2020), for the Nama Karoo ecoregion it's considered to be bat activity levels indicating a low to medium risk of bat mortalities. Therefore, the need for activity mitigation should be determined by the results of the operational mortality monitoring, if the bat mortalities are above sustainable thresholds.

The pre-construction bat monitoring has now been completed and informs the EIA phase; passive bat activity data has been gathered, which provides comparative bat activity and species assemblages across all seasons as well as various habitats, terrain and/or areas of the site. If the proposed Merino WEF is approved, a minimum of 2 years of operational bat mortality monitoring must be conducted from the start of the operation of the facility.

Thus far, from a bat impact perspective, no reasons have been identified for the Merino WEF development not to proceed to the approval phase.

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