Central Coast Council

Myotis Species Management Plan 2023

Photo credit: Chris Charles

Executive Summary

The Southern Myotis or Large-footed Myotis (*Myotis macropus*) is a moderately sized echolocating bat also known as a 'microbat' that forages along waterways for invertebrates and small fish. The Southern Myotis is threatened with extinction in New South Wales due to loss or disturbance of roosting sites, clearing of native vegetation adjacent to foraging areas, application of pesticides in or adjacent to foraging areas and reduction in stream water quality affecting food resources. As such the Southern Myotis is listed as a Vulnerable Species under Schedule 1 of the *Biodiversity Conservation Act 2016*.

The Southern Myotis has been recorded throughout the Central Coast Local Government Area (LGA). The Central Coast is situated at the centre of a growth corridor between Sydney and Newcastle. Rapidly increasing population and development within the Central Coast LGA is placing increasing development pressure on remaining Southern Myotis habitat. Species distribution modelling indicates that 46% of modelled habitat with a predicted habitat suitability of greater than 70% has the potential to be negatively impacted by development. Whilst 43% of modelled habitat with a predicted habitat suitability of greater than 90% has the potential to be negatively impacted by development.

This Species Management Plan (SMP) outlines the process that proponents of planning proposals and biodiversity certification, development applications and Council works must follow to avoid and minimise impacts to the Southern Myotis.

1. Legislative context

A key requirement of the *Biodiversity Conservation Act 2016* is that proponents of development must first demonstrate avoidance of impacts to biodiversity, then minimisation of impacts to biodiversity, prior to the calculation and retirement of biodiversity credits. Indirect impacts, referred to as Prescribed Impacts must also be adequately considered and avoidance and minimisation of impacts must occur prior to the retirement of offset credits. For the Southern Myotis, impacts to water quality that reduce the abundance of small fish and/ or aquatic invertebrates must be adequately assessed, and developments must incorporate best practice treatment processes for stormwater.

For a development where Southern Myotis habitat is being impacted directly or indirectly and does not automatically trigger the need to prepare a Biodiversity Development Assessment Report (BDAR), i.e., due to clearing limits not being reached or a site not being included on the Biodiversity Values Map, additional assessment criteria are required. This includes a Five Part Test of Significance completion of in accordance with s 7.3 of the BC Act that demonstrates a significant impact on the Southern Myotis is unlikely to occur. If a significant impact is likely to occur, a BDAR or Species Impact Statement (SIS); if the action is being assessed under Part 5 of the EP&A Act must be prepared.

Mitigation measures nominated within this SMP will be included as Conditions of Consent on a Development Consent or as part of nominated mitigation measures within a Review of Environmental Factors for Council's own works. The mitigation measures can be nominated if they relate directly to the development, are for a planning purpose and can reasonably be achieved.

2. The Planning Area

This SMP covers all areas of potential and known Southern Myotis habitat on the Central Coast.

3. Aim of this Species Management Plan

The aim of this SMP is to ensure the appropriate avoidance, minimisation and offsetting of Southern Myotis habitat that occur on the Central Coast, and where possible, Southern Myotis habitats are also enhanced. The aim will be met through the implementation of the recovery actions outlined in Section 7.

4. Species ecology and overview

Echolocating bats differ from Flying Foxes as they use echolocation to locate and capture prey (Jones and Teeling 2006) in the form of insects (Milne et al. 2016). Flying Foxes use sight and smell to locate and feed on a combination of fruits, nectar and pollen (McDonald-Madden et al. 2005). Within Australia there are around 82 known species of microbat and 23 of these species have been recorded on the Central Coast. Microbat species on the Central Coast differ by their roosting habits, with some species using caves or disused mine shafts (Gonsalves et al. 2021), while others roost in tree hollows (Goldingay 2009) or other man-made structures such as old or disused buildings (Sanderson et al. 2010).

The Southern Myotis is a relatively-long lived aquatic habitat specialist (Dwyer 1970) and is unique in being the only trawling bat species in Australia, where the species captures prey with its enlarged hind feet from or beneath the water surface (Campbell 2011). Trawling is a strategy in which individuals fly 5 – 100 cm above the water surface before dipping to make contact with the surface and raking with their large feet (Robson 1984). Using this strategy and being an aquatic specialist, its diet consists of aquatic invertebrates and small fish (Law and Urquhart 2000, Robson 1984). The Southern Myotis roosts in caves, tree hollows, under bridges and in other constructed structures such as culverts (Campbell 2009, Campbell et al. 2010, Gorecki et al. 2020).
The Southern Myotis has a distribution from the western Murray River, across Eastern Australia, including the wet tropics and Cape York, parts of the Northern Territory and Papua New Guinea (Churchill 2008) (Figure 1). In New South Wales, the Southern Myotis is predominantly found across a narrow coastal band but has also been recorded along some of the major inland rivers, reflecting its close association with water (McKean and Hall 1965; Lumsden and Menkhorst 1995). The Southern Myotis tends to be more common on larger streams (Anderson et al. 2006) but also occur in estuaries and coastal lagoons (Clark-wood et al. 2016; Gonsalves and Law 2017).

The main threats to the Southern Myotis are a lack of prey items within stream habitats (this can happen where declines in prey abundance occur as a result of a reduction in water quality), reduction in foraging habitat due to an increase in aquatic weed abundance, an absence or loss of hollow-bearing trees from clearing or lack of hollow recruitment, bridge and culvert replacement/disturbance, chemical pollution and artificial lighting near foraging habitat.

The Southern Myotis is listed as a Vulnerable Species under Schedule 1 of the *Biodiversity Conservation Act 2016*. The species is also listed as a Species Credit Species under the NSW Biodiversity Assessment Method. This means that if during the preparation of a BDAR, the Southern Myotis is detected or assumed to be present on the site, Southern Myotis species credits must be retired and used to protect and enhance Southern Myotis habitat elsewhere in New South Wales.

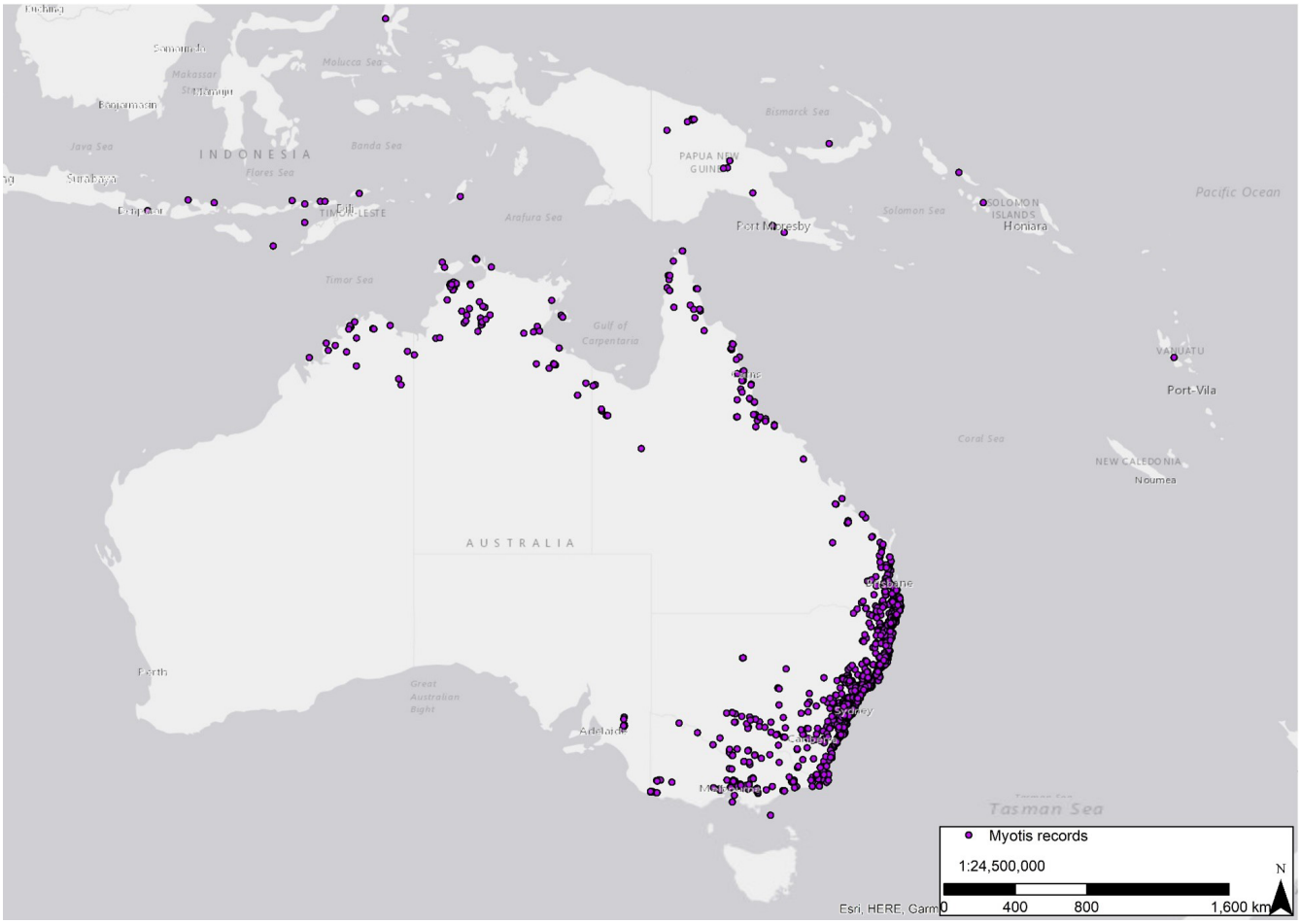

Figure 1. Full extent of known distribution of the Southern Myotis. Data source Atlas of Living Australia.

5. Myotis on the Central Coast

There is a total of 4,242 km of creeks and streams and 19,998 ha of waterbodies that includes estuaries and coastal lagoons representing suitable foraging habitat for the Southern Myotis across the Central Coast (Figure 2). There is 10,230 ha of riparian native vegetation on streambanks across the Central Coast, and of this 6,686 ha is publicly owned and 4,896 ha of riparian areas are not located in conservation zones.

The NSW BioNet database is maintained by the NSW Government and includes records for a range of common and threatened plants and animals in NSW. The database contains 150 Myotis records in the Central Coast LGA since 1982, which occur predominantly along creeks and waterways. These records are shown on Figure 2.

In November and December 2020 Council completed a targeted survey of the Southern Myotis across 43 sites (Figure 3) using ultrasonic detectors (Anabats). The surveys occurred on the edge of Tuggerah Lake, Brisbane Water, Terrigal and Avoca Lagoons as well as creeks, natural wetlands and constructed wetlands. The surveys detected Myotis at 10 sites (Figure 3), with their characteristics summarised in Table 1.

A Species Distribution Model (SDM) was prepared for the Southern Myotis (Figure 4). The NSW Bionet records and the records from the 2019 Green Grid surveys and 2020 targeted surveys were used to develop the model, along with 42 environmental variables (listed in Appendix 1). Despite the apparent low level of habitat occupancy reflecting the limited survey effort across the LGA, the SDM identified 11,192 ha of potential habitat with a predicted suitability of greater than 70%. Of this 4,739 ha (42%) is publicly owned and 5,177 ha (46%) are not located in conservation zones. The SDM also identified 3,121 ha of potential habitat with a predicted suitability of greater than 90%. Of this 1,359 ha (44%) is publicly owned and 1,332 ha (43%) are not located in conservation zones.

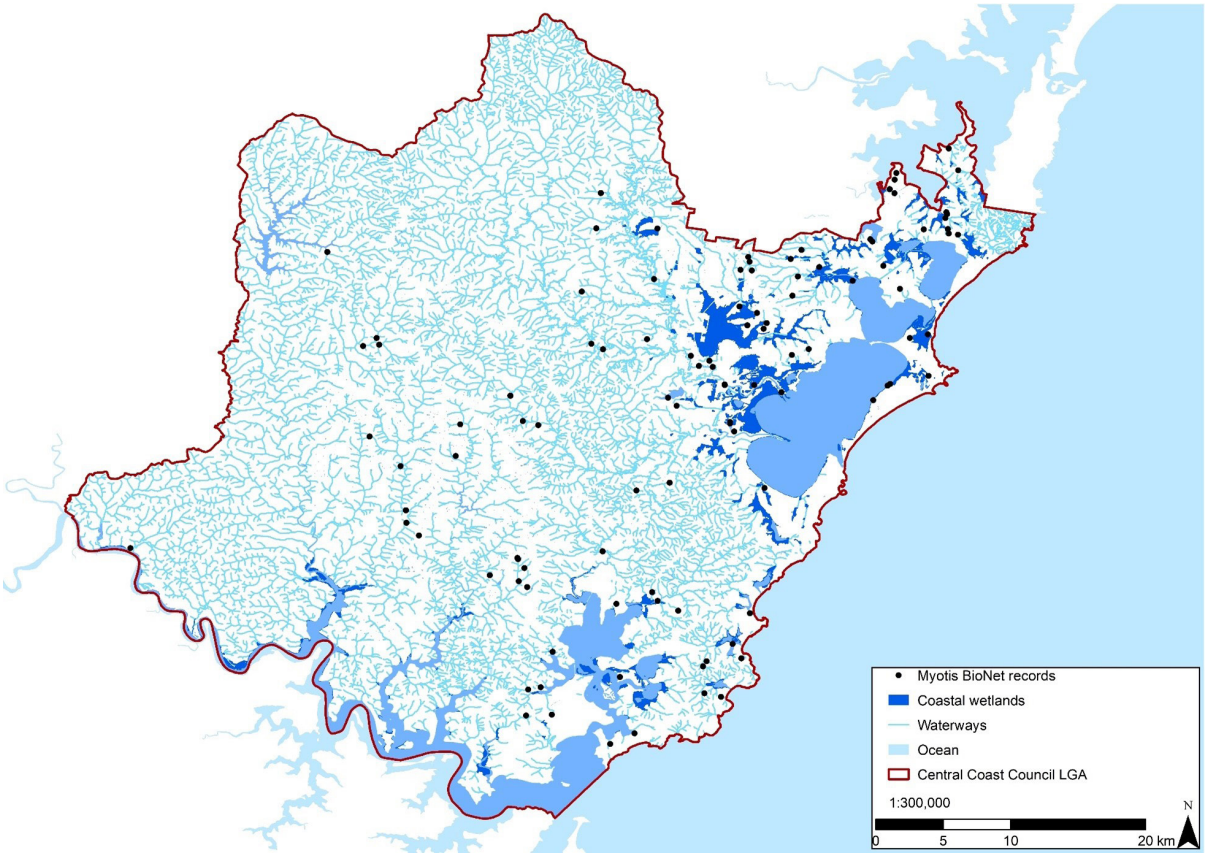

Figure 2. BioNet records of Myotis observations and distribution of creeks and waterways representing suitable fora ging habitat for the Southern Myotis across the Central Coast

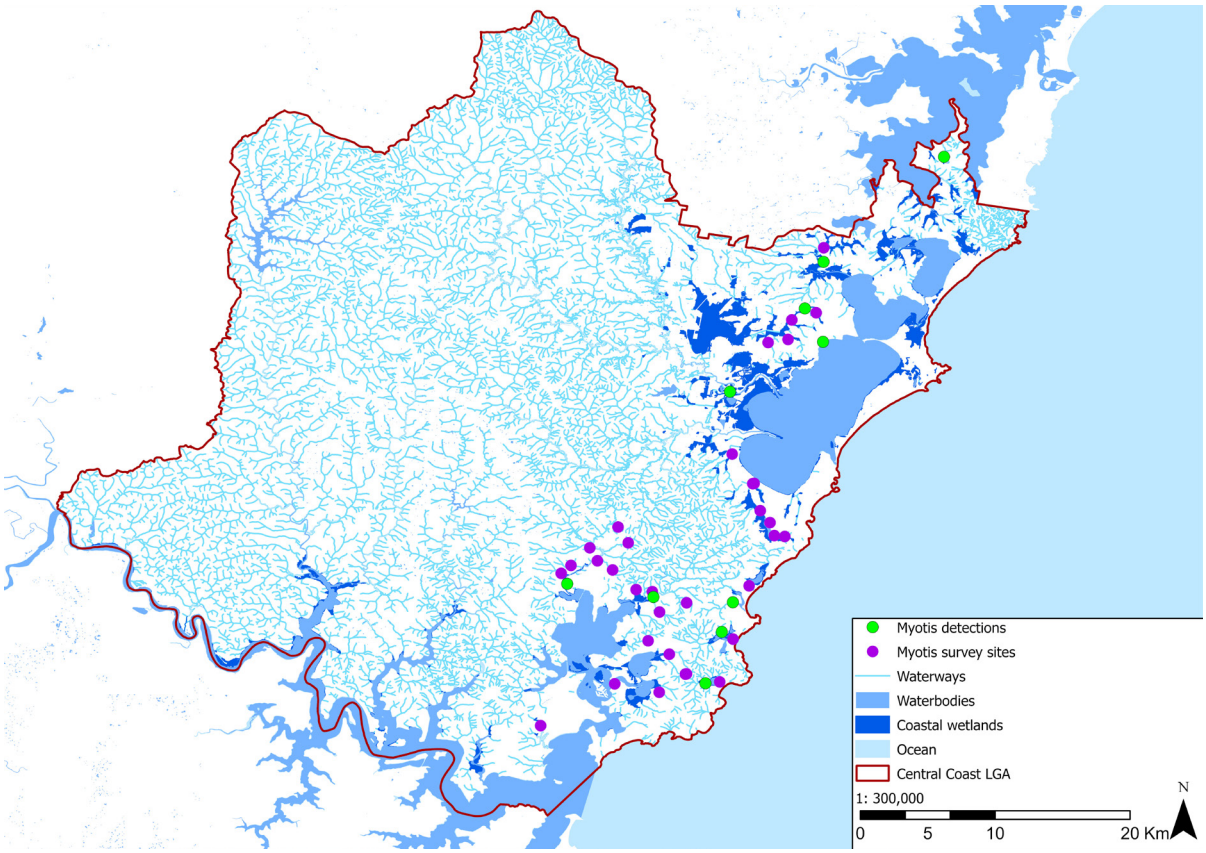

Figure 3. Myotis survey sites (purple dots) and sites where the Myotis was detected (green dots) during targeted surveys.

Photo credit: Jed Field

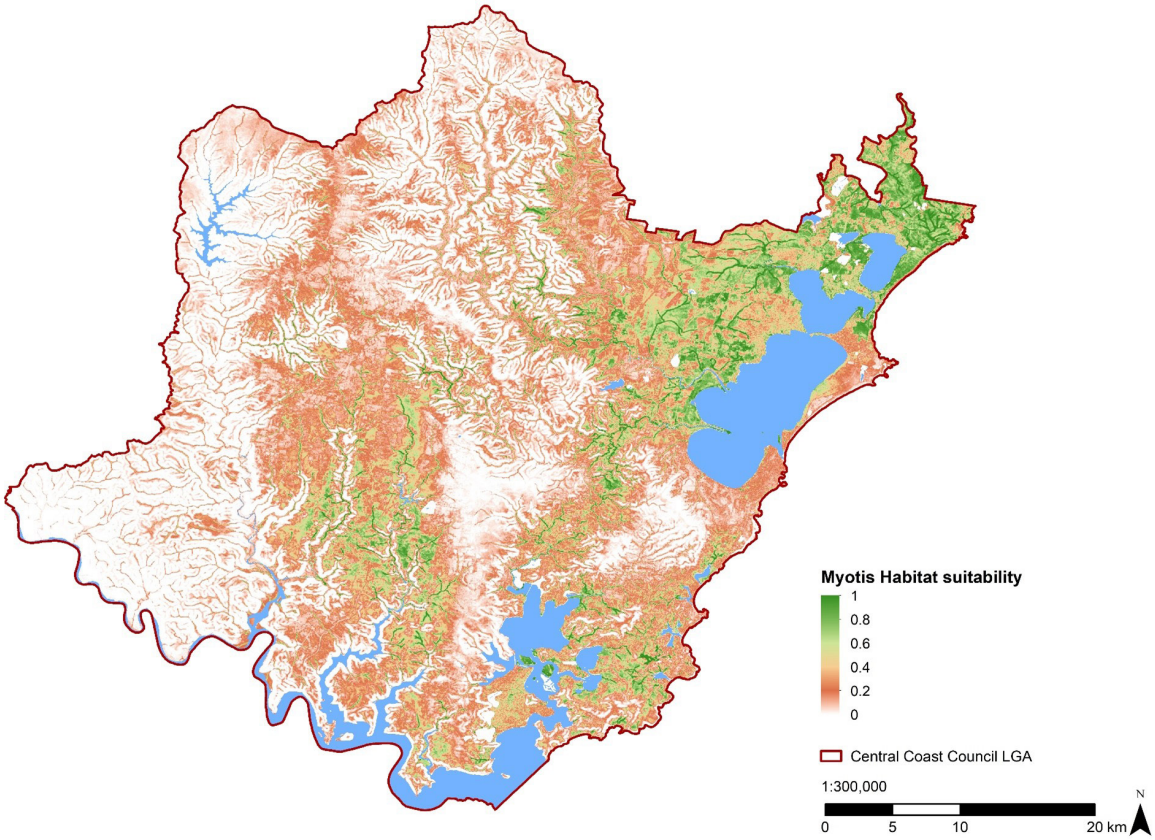

Figure 4. Species distribution model for the Southern Myotis indicating habitat suitability. The darker green areas represent highly optimal habitat.

Table 1.

Summary statistics for targeted Myotis detections including the number and % of sites where Myotis were detected, stream orders and wetland types where observations were recorded and average distance to cleared areas.

Myotis detection (number of sites)	Myotis detection (% of sites)	Stream orders					Constructed waterbodies	Natural wetlands	Average distance to cleared area (km)
		1	2	3	4	5			
10	23	1	1	0	1	2	1	4	82.67

6. Consideration of Myotis during land use planning and development assessment

6.1. Required surveys

During the ecological assessment phase of a project proposal, an assessment must be made to determine if potential Myotis habitat occurs on the site. This may include:

- Farm dams and other constructed water bodies.
- Natural wetlands, coastal lagoons, estuaries and saltmarshes.
- Permanent and ephemeral streams that support aquatic invertebrates.

Where a proposal area occurs within 50 metres of potential Myotis habitat with a predicted suitability of greater than 70% and the site is proposed to have a significant land use change, for example through the removal of hollow-bearing trees, direct modification of Myotis habitat or increased nutrient input, targeted Myotis surveys must occur. The targeted surveys must consist of no less than eight detector nights up to a maximum of 20 detector nights per hectare. Surveys must occur over a minimum of four nights with fine weather and where minimum temperature does not fall below 15 degrees celsius between October to March. Where a proposal involves replacement, removal or modification to bridges, tunnels, culverts or other structures identified as potential Myotis breeding habitat, roost searches must also be undertaken. Thorough roost searches must involve a minimum of 30 minute searches (may include use of thermal imaging cameras if available) per structure in accordance with 'Species credit' threatened bats and their habitats - NSW survey guide for the Biodiversity Assessment Method.

6.2. Assessment of impacts on Myotis

6.2.1. Consideration of Myotis during planning proposals

All streams must have adequate riparian buffers applied during the Planning Proposal stage. At a minimum these must be no less than those prescribed under the *Water Management Act 2000*. However, where surveys have detected Myotis using a particular stream, additional field surveys must occur to determine the location of hollow-bearing trees within 50 metres of the top of bank on each side of the stream. This data is to be used to determine if the riparian protections conserve sufficient numbers of hollow-bearing trees for use by resident Myotis populations. Where standard protections fail to conserve sufficient hollow-bearing trees, additional protected land will be required.

The removal of wetlands, including constructed farm dams that contain emergent aquatic vegetation is not supported if these areas are shown to be used by Myotis. Where removal is unavoidable (and appropriate avoidance has been demonstrated), compensatory constructed wetland habitat must be provided elsewhere on site, or if this is not possible, alternative measures to improve habitat for Myotis in the local landscape must be proposed, including through a Planning Agreement if relevant.

Due to the majority of Myotis stream and natural wetland habitat already being protected through either the *Water Management Act 2000* or the Coastal State Environmental Planning Policy, it is intended that all matters relating to Myotis are adequately addressed at the planning proposal stage, where there is no need to consider the retirement of Myotis Species Credits at the development application stage for recently rezoned land.

6.2.2. Consideration of Myotis during Council's own operations

Hollow-bearing trees within 50 metres of Myotis habitat, must only be removed as a last resort. Where a hollow-bearing tree requires removal where Southern Myotis is present, activities should not occur that will disturb roosting habitat during the breeding period from October to April, or where modification/ upgrades to bridges, culverts or other Myotis-roosting habitat is required compensatory Myotis habitat in the form of a nesting box mounted underneath a bridge or artificially created hollows suitable for Southern Myotis following the methodology of Rueegger (2017) must be provided, installed and monitored annually for a minimum of 5 years. Where proposed works may affect aquatic health, compensatory measures must occur through the completion of bushland regeneration activities, as informed by a Vegetation Management Plan and/or water quality/ aquatic invertebrate monitoring where required.

6.2.3. Consideration of Myotis on industrial, commercial and residential zoned land during development assessment

A genuine attempt at avoiding areas shown to be used by Myotis must be shown within the Flora and Fauna Assessment or BDAR. Where avoidance cannot occur, effective on or offsite restoration of other Myotis habitat in the local landscape must be demonstrated, including how the restoration will occur and how it will be monitored to determine its effectiveness. Assessment of additional impacts on Myotis such as lighting near waterways must also be minimised. Alternative lighting must be used near waterways such as red lights or motion activated lighting to reduce impacts on Myotis foraging behaviour.

Where avoidance is not being demonstrated, alternate measures such as improving baseline water quality from the proposed development must occur.

6.2.4. Consideration of Myotis on Conservation zoned land during development assessment

The assessment of impacts on Myotis and Myotis habitat proposed for industrial, commercial and residential zoned land must be followed, however the level of acceptable impact on Conservation zoned land is lower. Where farm dams and other constructed water bodies are proposed for removal, and these habitats are found to be used by Myotis, Council will require detailed mitigation measures to maintain Myotis habitat in the local landscape. Mitigation measures in the form of bushland regeneration along any streams located on the site must occur, as informed through a Vegetation Management Plan.

A type of trap referred to as a harp trap which is used to catch Southern Myotis

7. Recovery Actions

Action	Intended recovery response	Who is responsible
Ensure the largest hollow bearing trees in riparian zones are given highest priority for retention and are avoided during ecological assessments.	Increased roosting and breeding opportunities for Myotis	Relevant Council staff (internal projects) Private developers Development Assessment staff
Ensure adequate riparian corridors are conserved during Planning Proposals and Development Applications, including retention of the highest quality Myotis habitat on site.	Improved connectivity of protected Myotis habitat throughout the Central Coast.	Relevant Council staff (internal projects) Private developers Development Assessment staff
Improve the aquatic health of Myotis habitat through completing bushland regeneration activities as informed by Vegetation Management Plans.	Increased density of aquatic invertebrates and small fish and reduction of exotic species.	Relevant Council staff (internal projects) Private developers Development Assessment staff
Increase availability of natural and artificial hollows, including structures in bridges adjacent to waterways.	Increased availability and choice of Myotis denning habitat throughout the Central Coast.	Relevant Council staff (internal projects) Private developers Development Assessment staff
Incorporate large water bodies with fringing vegetation into water quality structures at the development application stage.	Increased foraging opportunities for Myotis across the Central Coast.	Council Drainage Engineers Private developers Development Assessment staff
Ensure riparian restoration occurs during development of adjacent lands.	Improved quality of Myotis habitat throughout the Central Coast.	Relevant Council staff (internal projects) Private developers Development Assessment staff
Ensure the retirement of Myotis Species Credits when Myotis habitat is impacted during development approved under Part 4 of the EP&A Act.	Protection of Myotis habitat elsewhere in NSW	Council ecological staff and development planners
Increased awareness of Myotis among Landcare and Bushcare groups	Increased community awareness of Myotis	Landcare staff and volunteers

8. Monitoring, Evaluation and Reporting

Every two years Council will undertake an ultrasonic bat survey across the 43 sites to determine detection probability and Myotis persistence in the LGA. The results of the survey will
be included in a review and update of this plan every four years, commencing in 2025.

References

Anderson, J., Law, B. and Tidemann, C., 2006. Stream use by the large-footed myotis Myotis macropus in relation to environmental variables in northern New South Wales. Australian Mammalogy, 28(1),15-26.

Clarke-Wood, B.K., Jenkins, K.M., Law, B.S. and Blakey, R.V., 2016. The ecological response of insectivorous bats to coastal lagoon degradation. Biological Conservation, 202,10-19.

Gonsalves, L. and Law, B., 2017. Distribution and key foraging habitat of the large-footed myotis Myotis macropus in the highly modified Port Jackson estuary, Sydney, Australia: an overlooked, but vulnerable bat. Australian Zoologist, 38(4),629-642.

Jones, G., & Teeling, E. C. (2006). The evolution of echolocation in bats. *Trends in Ecology & Evolution, 21*(3), 149-156.

Lumsden, L.F. and Menkhorst, P., 1995. Large-footed myotis *Myotis adversus*. Pp. 182-183 in Mammals of Victoria. Distribution, Ecology and Conservation, edited by P.W. Menkhorst, Oxford University Press in association with Dept. of Conservation and Natural Resources, Melbourne.

McDonald-Madden, E., Schreiber, E.S.G., Forsyth, D.M., Choquenot, D. and Clancy, T.F., 2005. Factors affecting Grey-headed Flying-fox (Pteropus poliocephalus: Pteropodidae) foraging in the Melbourne metropolitan area, Australia. *Austral Ecology, 30*(5), 600-608.

McKean, J.L., and Hall, L.S. 1965. Distribution of the Largefooted Myotis, Myotis adversus. *Victorian Naturalist* 82: 164-168.

Milne, D.J., Burwell, C.J. and Pavey, C.R., 2016. Dietary composition of insectivorous bats of the Top End of Australia. *Australian Mammalogy, 38*(2), 213-220.

Robson, S.K. 1984. Myotis adversus (Chiroptera: Vespertilionidae): Australia's fish-eating bat. *Australian Mammalogy* 7: 51-52.

Rueegger, N., 2017. Artificial tree hollow creation for cavity-using wildlife–Trialling an alternative method to that of nest boxes. *Forest Ecology and Management, 405*, 404-412.

Sanderson, K. J., Napier, G., & Johnston, G. R. (2010). Observations of a large colony of bats roosting in a church. *Australian Mammalogy, 32*(2), 161-163.

Appendix 1.

Description of 42 environmental variables used to develop the Species Distribution Model.

Layer Name	Layer Type	Units	Layer Description
oeh_pct	Plant Community Type mapping	Ha	Office of Environment and Heritage Plant Community Type mapping
precipann	Climate/Water	mm	Annual Precipitation (bio12)
precipcq	Climate/Water	mm	Precipitation of Coldest Quarter (bio19)
precipdp	Climate/Water	mm	Precipitation of Driest Period (bio14)
precipdq	Climate/Water	mm	Precipitation of Driest Quarter (bio17)
precipseas	Climate/Water	CV	Precipitation of Seasonality: Coefficient of Variation (bio15)
precipwetq	Climate/Water	mm	Precipitation of Wettest Quarter (bio16)
precipwp	Climate/Water	mm	Precipitation of Wettest Period (bio13)
precipwq	Climate/Water	mm	Precipitation of Warmest Quarter (bio18)
rain_sumwinr	Climate/Water	mm	Average Rainfall - Summer Winter Ratio
rain1mm	Climate/Water	mm	Average Number of days with rainfall greater than 1mm Annual
rainspr	Climate/Water	mm	Average Rainfall - Spring
rainsum	Climate/Water	mm	Average Rainfall - Summer
rainwin	Climate/Water	mm	Average Rainfall - Winter
rough0100	Landform	index	Neighbourhood topographical roughness based on the standard deviation of elevation in a circular 100 m neighbourhood. Derived from DEM-S
rough0500	Landform	index	Neighbourhood topographical roughness based on the standard deviation of elevation in a circular 500 m neighbourhood. Derived from DEM-S
rough1000	Landform	index	Neighbourhood topographical roughness based on the standard deviation of elevation in a circular 1000 m neighbourhood. Derived from DEM-S
eucdist_ waterobs	Remote sensing	m	Euclidean distance to water observations
rs_fpc	Remote sensing	%	Foliage projective cover or the percentage of ground cover occupied by the vertical projection of foliage. Predicted using a time series of SPOT images between 2008-2011
soil_fert	Soil	Index	Soil fertility
strmdstall	Drainage	m	Euclidean distance to all streams (i.e., all orders: 1 to 9)

Layer Name	Layer Type	Units	Layer Description
strmdstge2	Drainage	m	Euclidean distance to 2nd order streams and above
strmdstge4	Drainage	m	Euclidean distance to 4th order streams and above
strmdstge6	Drainage	m	Euclidean distance to 6th order streams and above
temp_ maxann	Climate/Temperature	oC	Average daily max temperature - Annual
temp_ maxsum	Climate/Temperature	oC	Average daily max temperature - Summer
temp_maxwin	Climate/Temperature	oC	Average daily max temperature - Winter
temp_minann	Climate/Temperature	oC	Average daily min temperature - Annual
temp_ minsum	Climate/Temperature	oC	Average daily min temperature - Summer
temp_minwin	Climate/Temperature	oC	Average daily max temperature - Winter
tempann	Climate/Temperature	oC	Annual Mean Temperature (bio1)
tempannrnge	Climate/Temperature	oC	Temperature Annual Range: difference between bio5 and bio6 (bio7)
tempcq	Climate/Temperature	oC	Mean Temperature of Coldest Quarter (bio11)
tempdiurn	Climate/Temperature	oC	Mean Diurnal Range (Mean period max-min)) (bio2)
tempdq	Climate/Temperature	oC	Mean Temperature of Driest Quarter (bio9)
tempmtcp	Climate/Temperature	oC	Min Temperature of Coldest Period (bio6)
tempmtwp	Climate/Temperature	oC	Max Temperature of Warmest Period (bio5)
tempseas	Climate/Temperature	CV	Temperature Seasonality: Coefficient of Variation (bio4)
tempwarmq	Climate/Temperature	oC	Mean Temperature of Warmest Quarter (bio10)
tempwetq	Climate/Temperature	oC	Mean Temperature of Wettest Quarter (bio8)
treeheight	Remote sensing	m	Tree height
waterobs	Remote sensing	m	Euclidean distance to water observations

Photo credit: Andrew Scott

Central Coast Council

CentralCoastCouncil @CCoastCouncil @centralcoastcouncil

Council Office 2 Hely St Wyong | 8.30am - 5pm, Monday to Friday

P 02 4306 7900 | **W** centralcoast.nsw.gov.au