Proposal: Low-cost trail-camera verification of active Little Penguin burrows on Granite Island

John Nicholls
Victor Harbor, South Australia

Abstract

Accurate estimates of Little Penguin (*Eudyptula minor*) population size on Granite Island are limited by the difficulty of confirming burrow occupancy. The October 2026 census identified 23 active burrows, which were taken to represent 46 adult birds. An active burrow was defined by the presence of penguin droppings, a fishy smell and the absence of spider webs at the entrance, criteria consistent with those used in previous studies (Colombelli-Négrel 2015, 2023). However, these signs can also be produced by possums, and occupancy can vary spatially and temporally (Weerheim *et al.* 2003, Whitehead *et al.* 2014, Colombelli-Négrel 2018). This proposal outlines a low-cost, non-cellular trail-camera trial using a single GardePro A5 (or equivalent) camera to verify the presence of one or two adult penguins in each of the 23 burrows. The camera would be rotated through the burrows at 48-hour intervals, with a dedicated 16 GB SD card and a fresh set of eight alkaline AA batteries used for each burrow. The camera has a standard 1/4-inch tripod socket and would be mounted on a small folding tripod so that the burrow entrance remains unobstructed. Motion-triggered stills would be posted on a simple public webpage (Active1, Active2, etc.), clearly labelling burrows containing two adults, one adult or none. The trial could be completed in approximately seven weeks with minimal equipment and disturbance, and would provide a transparent, verifiable adult count. Setup and rotation would be carried out by a volunteer (the author and/or Stephen Hedges if willing). The approach complements existing methods and addresses a recognised limitation of sign-based occupancy estimates for burrow-nesting seabirds (Sutherland & Dann 2012).

Keywords

Little Penguin, *Eudyptula minor*, Granite Island, burrow occupancy, trail camera, GardePro, population estimate, verification, citizen science.

Introduction

Seabirds are the sentinels of the marine ecosystem and the most threatened group of birds (Croxall *et al.* 2002, 2012, Dias *et al.* 2019). Accurate estimations of their population trends are therefore needed (Paleczny *et al.* 2015). Yet obtaining robust estimates can be challenging because many seabirds breed on remote islands or in deep burrows. In addition, the nocturnal and burrowing behaviours of some seabirds can make estimates difficult because they cannot be viewed from a distance and are only active on land at night (Colombelli-Négrel 2023). Population estimates are thus usually obtained by marking as many birds as possible (Sutherland & Dann 2012) or by estimating burrow occupancy (Pearson *et al.* 2013), both methods being labour-intensive.

On Granite Island, the October 2026 census identified 23 active burrows. An active burrow was defined by the presence of penguin droppings outside the entrance, a fishy smell, and the absence of spider webs. These criteria are consistent with those used in previous work, where a nest was recorded as active if it contained eggs, chicks or adults, or there was clear evidence of Little Penguin presence such as fresh droppings, a strong penguin smell or recent excavation, and inactive if cobwebs were present at the entrance (Colombelli-Négrel 2015, 2023). However, these signs are not definitive. Possums are known to occupy or visit burrows, and can leave droppings and remove spider webs. Burrow occupancy can also vary both spatially and temporally (Weerheim *et al.* 2003, Whitehead *et al.* 2014, Colombelli-Négrel 2018). Automated acoustic methods, while useful, estimated only 14–26% of the Granite Island colony in previous work (Colombelli-Négrel 2023). A direct visual confirmation of the number of adult penguins in each burrow would therefore improve the accuracy and transparency of the adult count.

Trail cameras and burrow cameras have been used successfully for Little Penguins at other colonies. Phillip Island Nature Parks has operated a live burrow camera since at least 2013, providing continuous visual records of occupancy, incubation and chick-rearing (Phillip Island Nature Parks 2024). Wildlife camera monitoring is also recommended in the Tasmanian Little Penguin Toolkit for indexing numbers of penguins using runways (NRE Tasmania 2021). Camera traps positioned at burrow entrances have been shown to

reduce uncertainty in occupancy and breeding-status estimates for other burrowing seabirds (Bird *et al.* 2022). These precedents demonstrate that camera-based verification is both feasible and informative for this species.

Proposed methods

A single non-cellular, battery-powered GardePro A5 (or current equivalent such as the E5S) trail camera would be used. The camera is set to take motion-triggered still images (no video) with a short delay between triggers. It has an IP66 weatherproof rating, a standard 1/4-inch tripod socket on the base, and runs on eight AA batteries. No cellular or Wi-Fi connection is required. This approach is consistent with the use of automated recorders in previous Granite Island studies, which were also non-cellular and deployed for fixed periods (Colombelli-Négrel 2023).

The camera would be mounted on a small folding tripod so that the burrow entrance remains completely unobstructed. Metal stakes driven into the ground are not required. The tripod is placed on the surface beside the entrance and weighted if necessary with a rock or sandbag. The camera is aimed at the entrance from a short distance, allowing free movement of birds in and out of the burrow. This non-invasive mounting is consistent with recommendations for nest monitoring that avoid disturbance to the entrance (NestWatch 2025).

A dedicated 16 GB micro-SD card would be used for each of the 23 burrows. Cards would be pre-labelled 1 to 23 with a permanent marker. When the camera is moved to a new burrow, the SD card and the eight AA batteries would be replaced with a fresh card and a fresh set of alkaline batteries. This ensures that each burrow has an independent record and that battery failure does not affect data collection. Alkaline AA batteries are inexpensive and widely available; a 48-pack costs approximately AUD 32 (Big W, 2026). Micro-SD cards (16 GB) are also inexpensive; a single card with adapter costs approximately AUD 17 (Big W, 2026). For a 48-hour deployment, alkaline batteries are more than sufficient. Batteries would be replaced at each move as a precaution. The GardePro A5 (or equivalent) is available in Australia for approximately AUD 150–185 (Pro’s Choice or GardePro Australia).

The camera would be rotated through the 23 burrows at 48-hour intervals. With one camera, all 23 burrows could be monitored in 23 deployments (approximately seven weeks, allowing for weather and access). Each deployment would record whether the burrow contained two adults, one adult, or none. The 48-hour period is long enough to capture nocturnal arrivals and departures, which peak after sunset and before sunrise (Chiaradia & Kerry 1999, Colombelli-Négrel 2023). This sampling window is comparable to the evening recording windows used in the acoustic monitoring study (Colombelli-Négrel 2023). Setup, rotation and card/battery changes would be carried out by a volunteer, possibly the author and/or Stephen Hedges if he is willing to take part.



Figure 1. GardePro A5 (or equivalent) trail camera. The unit has a standard 1/4-inch tripod socket on the base and is IP66 weatherproof.



Figure 2. Battery compartment of the GardePro camera showing eight AA batteries. A fresh set of eight alkaline batteries would be used for each 48-hour deployment.



Figure 3. Example of the GardePro camera mounted on a small folding tripod beside a burrow entrance. The entrance remains completely unobstructed.



Figure 4. Example of a 48-pack of alkaline AA batteries available at Big W for approximately AUD 32. Fresh batteries would be used for each 48-hour deployment.



Figure 5. Example of a 16 GB micro-SD card with adapter, available at Big W for approximately AUD 17. One card would be used for each burrow and labelled with a permanent marker.

Estimated cost of the trial

The total equipment cost for the trial is estimated as follows (prices approximate, AUD, 2026):

Item	Quantity	Unit cost	Total
GardePro A5 (or equivalent) trail camera	1	AUD 160	AUD 160
16 GB micro-SD cards	23	AUD 17	AUD 391
Alkaline AA batteries (8 per burrow)	184	AUD 0.67	AUD 123
Small folding tripod	1	AUD 25	AUD 25
Total			**AUD 699**

The total equipment cost is approximately AUD 700. This covers one camera, one dedicated 16 GB SD card for each of the 23 burrows, a fresh set of eight alkaline AA batteries for each burrow, and a small tripod. No ongoing connectivity or subscription costs are required. Volunteer time for setup and rotation is not costed.

Output and analysis

At least one still image from each burrow would be posted on a simple public webpage. Burrows would be labelled Active1, Active2, etc. Each image would be accompanied by a clear statement of the number of adult penguins visible (two, one or zero). Burrows with two adults, one adult or zero adults would be clearly distinguished. This would provide a transparent, publicly verifiable adult count rather than one inferred solely from signs that can be produced by other species. The total adult count would be the sum of adults confirmed in each burrow. Burrows with no penguins recorded over 48 hours would be noted as unoccupied during the sampling period. The method is low-cost (one camera, 23 SD cards, and alkaline AA batteries), requires no ongoing connectivity, and can be completed with minimal disturbance.

The resulting dataset would also allow a direct comparison between sign-based occupancy (droppings, smell, absence of spider webs) and camera-confirmed occupancy. This comparison would quantify the rate of false positives associated with the current criteria, which is relevant to the interpretation of both the October 2026 census and earlier monitoring reports (Colombelli-Négrel 2017, 2018, 2020).

Discussion

The proposed trial addresses a recognised limitation of burrow-occupancy estimates. While signs such as droppings, smell and the absence of spider webs are useful indicators, they are not definitive, particularly where possums are present. Direct visual confirmation with a trail camera would provide independent verification of the number of adult penguins associated with the 23 burrows identified in October 2026. The method is consistent with the recognition in previous work that burrow occupancy can vary and that multiple lines of evidence improve population estimates (Colombelli-Négrel 2023, Sutherland & Dann 2012). Sutherland & Dann (2012) demonstrated that uncorrected burrow counts can significantly underestimate population size when occupancy varies through the season, and that reference-site data improve accuracy. Camera verification of a known set of active burrows would serve a similar function on Granite Island, providing a calibrated subset against which sign-based estimates can be compared.

The trial is designed to be practical and low-cost. One camera, a set of pre-labelled SD cards, and alkaline batteries are sufficient. Battery and card replacement at each move eliminates the risk of power or storage failure during a 48-hour deployment. A small tripod avoids the need for metal stakes and keeps the burrow entrance clear. The resulting webpage would make the results accessible to the community and to other researchers, and could serve as a model for future monitoring. This approach is complementary to the acoustic monitoring methods already applied on Granite Island (Colombelli-Négrel 2023) and to the night counts conducted by volunteers (Colombelli-Négrel 2020). It does not replace those methods, but provides an independent check on the occupancy of burrows already identified as active. Setup and rotation would be carried out by a volunteer, possibly the author and/or Stephen Hedges if he is willing to take part.

Ethical considerations are minimal. The camera is non-invasive, mounted outside the burrow on a surface tripod, and operated for short periods. The protocol is consistent with the ethics approvals obtained for previous Granite Island work (Flinders University Ethics Committee E388-E449; scientific permit Y26040; Colombelli-Négrel 2023). No handling of birds is required.

Conclusion

A low-cost trail-camera trial offers a practical means of verifying the adult count associated with the 23 active burrows identified on Granite Island in October 2026. By rotating a single GardePro A5 (or equivalent) camera through the burrows at 48-hour intervals, using fresh alkaline batteries and dedicated 16 GB SD cards, and posting the results on a public webpage, the method would provide transparent, visual confirmation of occupancy. The camera would be mounted on a small tripod so that the burrow entrance remains unobstructed. The approach requires minimal equipment (total cost approximately AUD 700), no cellular connectivity, and can be completed in approximately seven weeks. It addresses a recognised limitation of sign-based occupancy estimates and complements existing acoustic and night-count methods. Setup and rotation would be carried out by a volunteer, possibly the author and/or Stephen Hedges if he is willing to take part. I am happy to assist with setup, camera rotation, or website hosting if that would be useful.

References

Bird, J.P., Fuller, R.A., Pascoe, P.P. & Shaw, J.D.S. 2022. Trialling camera traps to determine occupancy and breeding in burrowing seabirds. *Remote Sens. Ecol. Conserv.* doi:10.1002/rse2.235.

Chiaradia, A.F. & Kerry, K.R. 1999. Daily nest attendance and breeding performance in the little penguin *Eudyptula minor* at Phillip Island, Australia. *Mar. Ornithol.* 27: 13–20.

Colombelli-Négrel, D. 2015. Low survival rather than breeding success explains little penguin population decline on Granite Island. *Mar. Freshw. Res.* 66: 1057–1065.

Colombelli-Négrel, D. 2017. *Penguin Monitoring and Conservation Activities in the Gulf St Vincent (July 2016–June 2017)*. Report to the Adelaide and Mt Lofty Natural Resources Management Board, Adelaide.

Colombelli-Négrel, D. 2018. *Penguin Monitoring and Conservation Activities in the Gulf St Vincent (July 2017–June 2018)*. Report to the Adelaide and Mt Lofty Natural Resources Management Board, Adelaide.

Colombelli-Négrel, D. 2020. *Penguin Monitoring and Conservation Activities in the Gulf St Vincent (June 2019–May 2020)*. Report to the Adelaide and Mt Lofty Natural Resources Management Board, Adelaide.

Colombelli-Négrel, D. 2023. Estimating Little Penguin population sizes using automated acoustic monitoring and citizen science. *Ibis* 165: 1423–1431.

Croxall, J.P., Trathan, P. & Murphy, E. 2002. Environmental change and Antarctic seabird populations. *Science* 297: 1510–1514.

Croxall, J.P., Butchart, S.H., Lascelles, B., Stattersfield, A.J., Sullivan, B., Symes, A. & Taylor, P. 2012. Seabird conservation status, threats and priority actions: A global assessment. *Bird Conserv. Int.* 22: 1–34.

Dias, M.P., Martin, R., Pearmain, E.J., Burfield, I.J., Small, C., Phillips, R.A., Yates, O., Lascelles, B., Borboroglu, P.G. & Croxall, J.P. 2019. Threats to seabirds: A global assessment. *Biol. Conserv.* 237: 525–537.

NestWatch. 2025. Using trail cameras to enhance nest monitoring: risks and rewards. Cornell Lab of Ornithology.

NRE Tasmania. 2021. Little Penguin Toolkit. Survey Method 5.5: Wildlife camera monitoring. Department of Natural Resources and Environment Tasmania.

Paleczny, M., Hammill, E., Karpouzi, V. & Pauly, D. 2015. Population trend of the world's monitored seabirds, 1950–2010. *PLoS One* 10: e0129342.

Pearson, S.F., Hodum, P.J., Good, T.P., Schrimpf, M. & Knapp, S.M. 2013. A model approach for estimating colony size, trends, and habitat associations of burrow-nesting seabirds. *Condor* 115: 356–365.

Phillip Island Nature Parks. 2024. Little Penguin Burrow Camera. Phillip Island Nature Parks.

Sutherland, D.R. & Dann, P. 2012. Improving the accuracy of population size estimates for burrow-nesting seabirds. *Ibis* 154: 488–498.

Weerheim, M.S., Klomp, N.I., Brunsting, A.M.H. & Komdeur, J. 2003. Population size, breeding habitat and nest site distribution of little penguins (*Eudyptula minor*) on Montague Island, New South Wales. *Wildl. Res.* 30: 151–157.

Whitehead, A.L., Lyver, P.O.B., Jones, C.J., Bellingham, P.J., MacLeod, C.J., Coleman, M., Karl, B.J., Drew, K., Pairman, D. & Gormley, A.M. 2014. Establishing accurate baseline estimates of breeding populations of a burrowing seabird, the grey-faced petrel (*Pterodroma macroptera gouldi*) in New Zealand. *Biol. Conserv.* 169: 109–116.