Improving techniques for monitoring burrowing petrels: final report to Antarctic Science Ltd

Jeremy Bird[1,2]

[1] Centre for Biodiversity & Conservation Science, The University of Queensland, St Lucia, QLD 4072, Australia.

[2] Jez.Bird@uq.edu.au

Acknowledgement

I would first like to express my gratitude to Antarctic Science Ltd. for supporting me with an international bursary. The bursary provided invaluable support, without which my field project could not have been completed. It has allowed me to develop my career during my current PhD studies by building collaborations with researchers at the Australian Antarctic Division and Tasmania Parks and Wildlife Service, as well as at my home institution, the University of Queensland.

Study purpose

Burrowing seabirds are a major component of marine food webs. In the Southern Oceans they are second only to penguins in terms of avian biomass and prey consumed (Catry et al., 2003). However, more than any other group burrowing seabird populations have been impacted by the introduction of invasive species to islands (Dias et al., 2019). The species concerned, petrels, are particularly difficult to monitor because they are seasonal at colonies, they nest discontinuously, in often rugged terrain, in underground burrows, and are only active at colonies at night (Warham, 1996).

A key challenge is determining burrow occupancy from which breeding populations, their status and breeding success can be inferred via repeat visits. Traditional approaches to determine burrow occupancy are invasive which can compromise study burrows and undermine the data collected, as well as potentially breaking current ethical standards (Carey, 2009).

Through the support of my bursary I was able to deploy remote camera traps outside the burrows of Grey Petrels *Procellaria cinerea* and Blue Petrels *Halobaena cerulea* on Australia's Macquarie Island, a site where petrel populations are now recovering following invasive species eradication (Brothers and Bone, 2008; Springer, 2016). Through this study we have tested the suitability of remote cameras to overcome long-present challenges in burrowing seabird monitoring: determining occupancy, breeding status, breeding success and phenology.

Methods

Twelve cameras were deployed outside burrows of winter-breeding Grey Petrels from April to November, and 29 outside Blue Petrel burrows from August to February. Camera batteries and SD cards were changed regularly through the season. For Grey Petrels four manual burrow-checks were performed with a burrow-scope throughout the season to gain corroboratory evidence on burrow breeding status for comparison with camera data.

All images were inspected manually and tagged with species and behaviours apparent in the image. Images with birds present were grouped into 'events'. The number of events was plotted against date through the season to examine activity patterns.

Results

During the season >500,000 camera trap images were captured and subsequently tagged. Target species were readily identified in photographs and cameras were able to detect small species (Blue Petrel) as well as larger species (Figures 1 and 2).

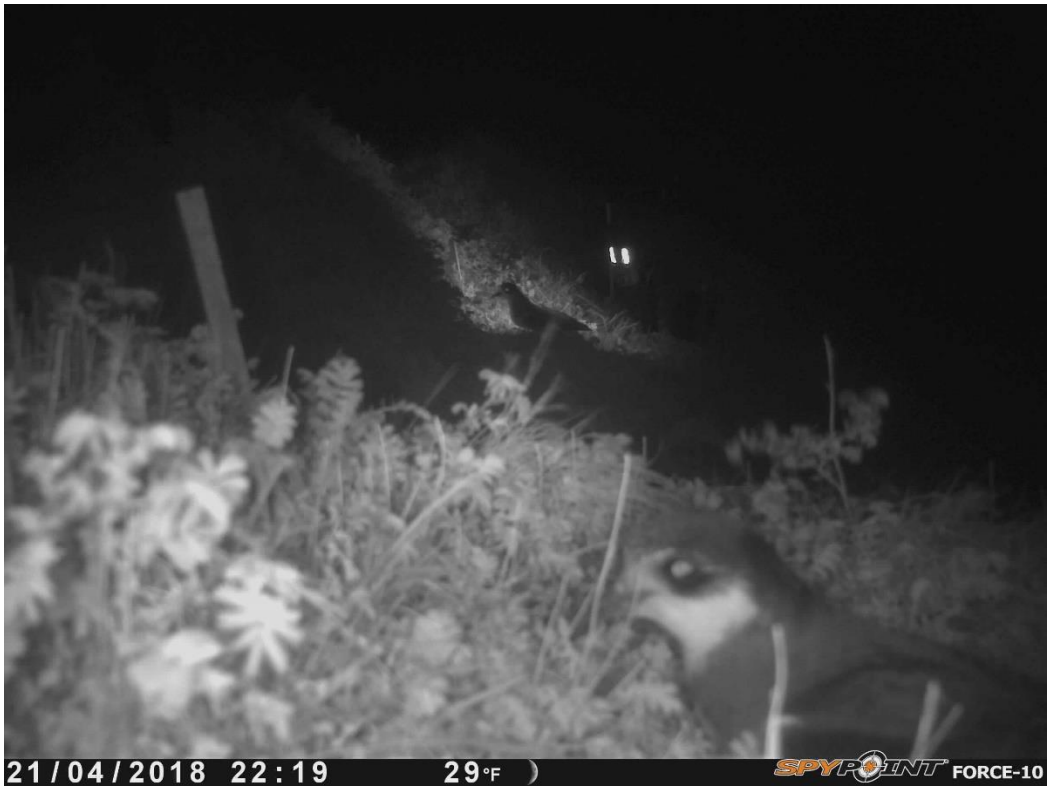

Figure 1: A Blue Petrel returning to its burrow while a second bird is triggering the camera outside its burrow, elsewhere in the colony.

Figure 2: Rarely Grey Petrels emerge from their burrows during daylight.

Plotted through the season we have found activity patterns indicative of burrow breeding status and have been able to infer the timing of key phenological events such as fledging dates (Figures 3 and 4). We are now modelling the burrow breeding status as a function of activity and preparing the results for publication.

Discussion

We found that activities recorded by cameras stationed outside petrel burrows correspond to breeding status of the burrow and can be used to reliably determine breeding success. Seabirds are well insulated and cameras do not trigger every time a bird is present (Fischer et al., 2017). While this is a problem for some studies we found that the season-long activity pattern was important for determining burrow-status. The inherent detection error of individual cameras did not mask the overall patterns. For example, Grey Petrel burrows 8 and 12 (Figure 3) show high activity spikes with wide spacing – their signature differs from most other burrows. By corroborating with our manual burrow checks we identified these two burrows and non-breeding burrows, further evidenced by the lack of chick activity late in the season. We also recorded chicks fledging between late September and late October, able to define precise dates for individual burrows. Similarly, our activity plots highlight the pre-breeding exodus made by Blue Petrels when females grow their eggs between mating and laying. In several burrows this lull in activity was bordered by activity spikes, when birds spent considerable time tidying their burrow entrances. We infer this activity corresponds to breeding burrows, and that those burrows from which it was lacking e.g. burrow 07 (Figure 4) were non-breeding burrows.

We are excited by these findings as we are able to demonstrate that remote cameras can improve on traditional assessments of burrow occupancy and breeding success. Occupancy estimates provide a one-time check – inferring breeding-status from this requires adopting un-tested assumptions, e.g. is an occupied burrow occupied by a breeding pair? Repeat burrow-checks through a season can reduce uncertainty around the assumptions associated with occupancy checks, but uncertainty still remains about the outcome of breeding attempts. By following activity throughout the season using remote cameras we can reliably infer breeding status and breeding success – two key metrics for monitoring the status of burrowing-petrel populations and measuring responses to major conservation interventions.

References

Brothers, N., Bone, C., 2008. The response of burrow-nesting petrels and other vulnerable bird species to vertebrate pest management and climate change on sub-Antarctic Macquarie Island, in: Papers and Proceedings of the Royal Society of Tasmania. pp. 123–148.

Carey, M.J., 2009. The effects of investigator disturbance on procellariiform seabirds: a review. N. Z. J. Zool. 36, 367–377.

Catry, P., Campos, A., Segurado, P., Silva, M., Strange, I., 2003. Population census and nesting habitat selection of thin-billed prion Pachyptila belcheri on New Island, Falkland Islands. Polar Biol. 26, 202–207.

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. https://doi.org/10.1016/j.biocon.2019.06.033

Fischer, J., Debski, I., Taylor, G., Wittmer, H., 2017. Assessing the suitability of non-invasive methods to monitor interspecific interactions and breeding biology of the South Georgian diving petrel (Pelecanoides georgicus). Notornis 64, 13–20.

Springer, K., 2016. Methodology and challenges of a complex multi-species eradication in the sub-Antarctic and immediate effects of invasive species removal. N. Z. J. Ecol. 40, 273.

Warham, J., 1996. The behaviour, population biology and physiology of the petrels. Academic Press.

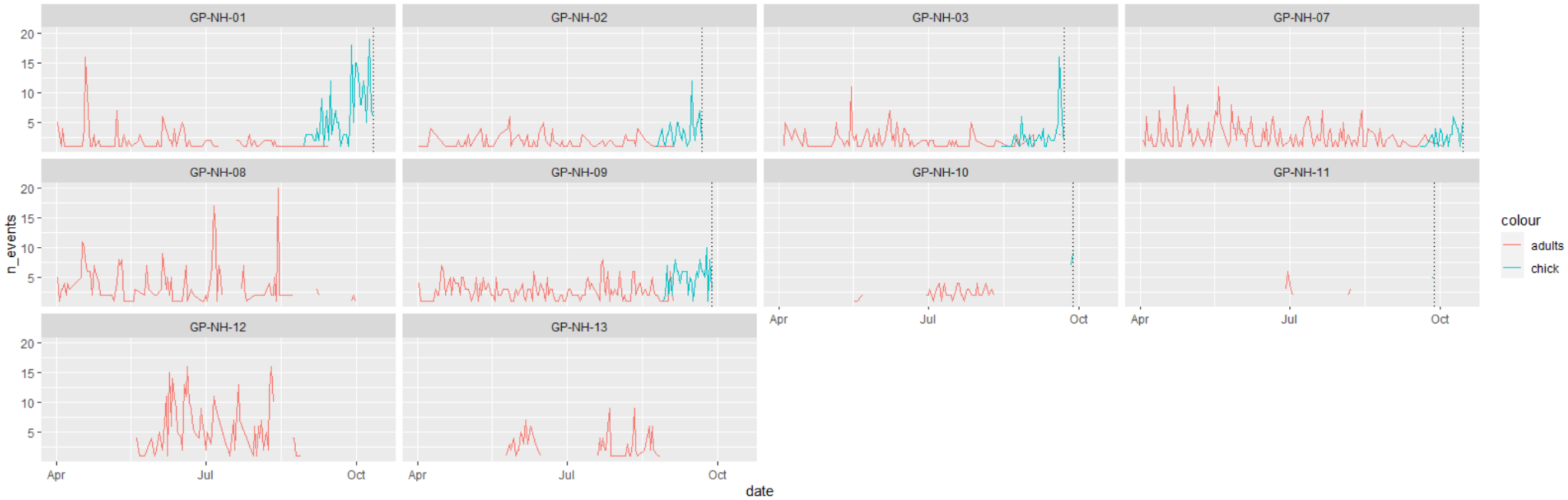

Figure 3: Season-long burrow activity at Grey Petrel burrows. Red lines are adult activity, blue are chicks.

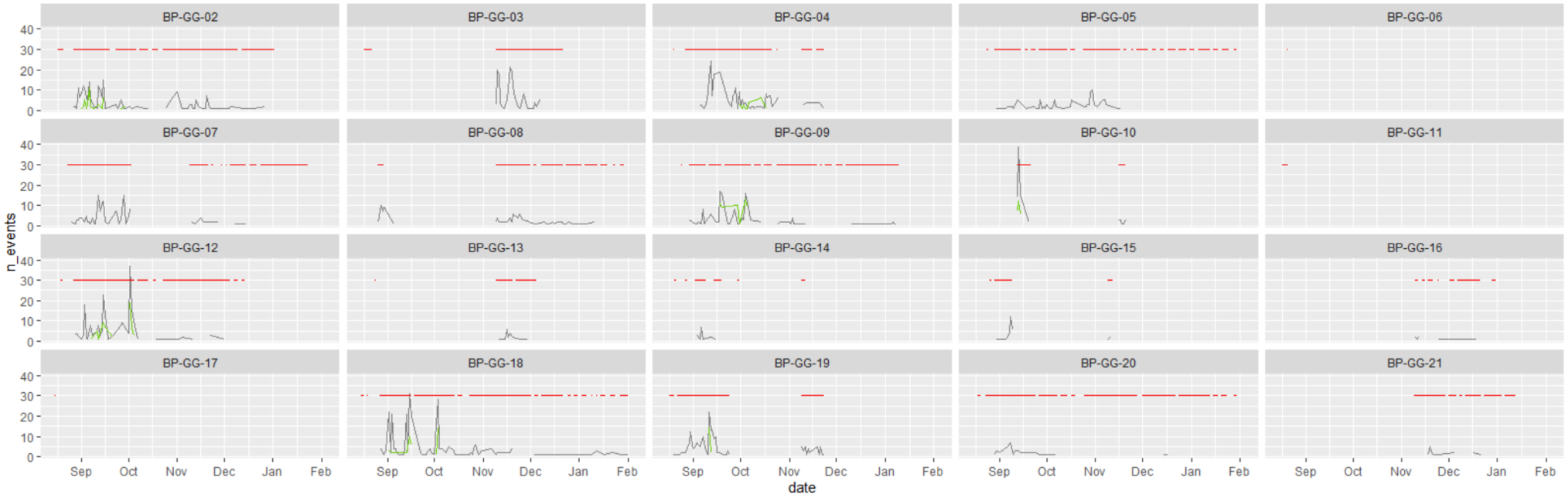

Figure 4: Season-long burrow activity at Blue Petrel burrows. Red lines indicate days on which images were captured, i.e. a proxy for camera functioning, black lines plot all entries and exits, and green lines plot characteristic tidying behaviour