MIT2019-03: Lighting adjustments to mitigate against deck strikes/ vessel impacts

Proposed methodology for sea-based testing

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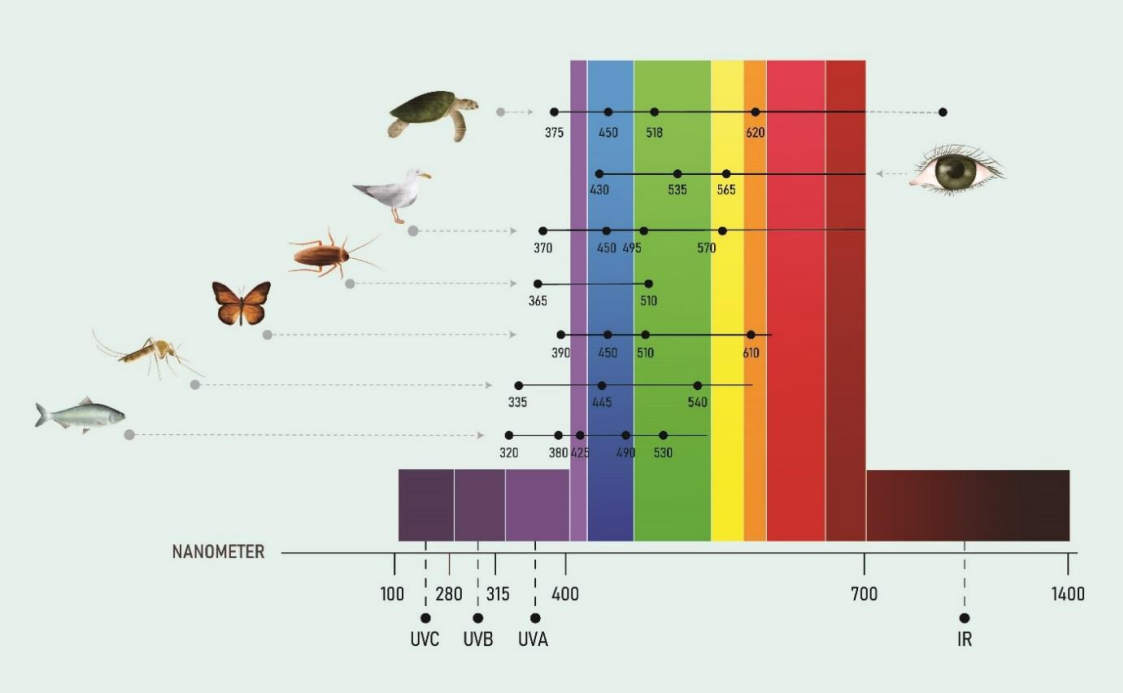

Cover: Fluttering shearwaters in lights on Taranga Hen Island. *Photo: Edin Whitehead*

Figure 1 (this page). Ability to perceive different wavelengths of light in humans and wildlife. Note the common sensitivity to ultraviolet, violet and blue light across many wildlife species, but not humans. *Image: © Pendoley Environmental, adapted from Campos (2017).*

Introduction

Artificial light at night (ALAN) has been shown to impact many taxa and is likely especially impactful on animals that are active at night. Seabirds, many of which are active on colonies or at-sea during the night, have been shown to have disrupted behaviour or collisions as a result of artificial light (Montevecchi, 2006). ALAN seems to disproportionately impact Procellariiformes, a group of largely nocturnally active seabirds that are prevalent throughout New Zealand (Rodríguez et al., 2017a; Warham, 1990). Research also indicates that the most impacted individuals are fledglings (Fontaine et al., 2011; Rodríguez et al., 2017b).

While ALAN from terrestrial locations (cities, lighthouses, street lights) has had deleterious effects on many seabird species (Rodríguez et al., 2017a), light from vessels is also a conservation concern (Black, 2005; Dias et al., 2019; Merkel & Johansen, 2011). Of seabirds that forage in New Zealand waters, common diving petrels (*Pelecanoides urinatrix*) have been especially reported as prone to collisions with vessels at night (deckstrike, Abraham & Berkenbusch, 2019). Anecdotally, many other Procellariiformes are likely also vulnerable to deck strikes. For example, a light-induced collision event that took place in 2018 saw 64 Buller's and flesh-footed shearwaters (rako, *Ardenna bulleri* and toanui, *A. carneipes*) land on a cruise ship in the Hauraki Gulf with many dying, mostly due to attempts to secure the birds after they landed (Morton, 2018).

Lights used on vessels have different wavelengths and wildlife likely have varying sensitivities and behaviours in response to these different lights. As such, we hypothesise that some seabirds will be more at risk of attraction than others, and that this will vary with the wavelengths of the light. By understanding which lights seabirds are most likely to attempt to interact with, we can begin to make recommendations for mitigation against seabird deck strikes. Here, we test lights of differing wavelengths from a vessel around active seabird colonies within the Hauraki Gulf to identify which lights are most and least attractive to seabirds breeding in the area.

Project Objectives

To test the effects of artificial lighting on seabird behaviour at sea based on the refined methodology from the land-based island behavioural trials.

At-sea behavioural experiments - methodology

Behavioural experiments at-sea will take place beginning in October 2020 and March/April 2021 to best test lights when key species will be traveling in the Hauraki Gulf (e.g. diving petrels). Experiments will take place aboard the 11m *El Pescador*, a charter vessel based in Whangarei (Fig. 2). The vessel is able to support 5 people overnight at sea. We will aim to be on the water conducting experiments throughout the entire night for two-three nights each trip, up to ten nights total.

We will aim to carry out lighting trials at fishing hotspots near seabird islands in the outer Hauraki Gulf to maximize interaction with birds. Specifically, we will aim to carry out trials at the Mokohinau Islands, Te Hauturu-o-Toi/Little Barrier Island, and possibly Taranga/Hen Island and Marotere/Chickens Islands.

Our goal is to identify how seabirds react to light at-sea, so we will move to a different location (or locations) in the case birds are not present in order to maximise our sample sizes and the predictive power of our data. Additionally, we will avoid nights with a full moon as seabird attraction to artificial light is diminished when the moon is bright (Montevecchi, 2006).

Figure 2. The vessel 'El Pescador' where lighting experiments will be carried out. NB: game poles will be removed for the duration of the experiments. *Image retrieved from: http://thefisherman.co.nz/gallery/#gallery_fancybox_123-7*

The light array will be set up across the bow of the vessel, fixed to the railings. Two observers will manually record birds that are attracted to lights, a third person will be operate a thermal imaging camera, and a fourth person will be managing bird safety who will ensure birds do not fly into the

boat or return to sea, if they land on deck, i.e. consistent with DOC protocols for managing birds that land on boats.

Researchers will record behaviour related to attraction, including: # of birds trapped in light beam, # of birds attracted to the area (within ~20 m of beam), # of birds landing on the boat deck, and foraging behaviour.

We will use the same light set up that has already been tested during terrestrial behaviour trials during the 2019-2020 season (Fig. 3, Table 1).

Figure 3. Light array set up on Hauturu – lights from left, halogen, fluorescent, LED flood, and LED (white, green and red), with team members. *Photo: Chris Gaskin*

The lights tested will be the same as were tested on land in December 2019 and January 2020, but will include only one white LED light (our terrestrial trial included white LED lights of two intensities) which is less intense (72W, 5040 lumens) than the original white LED flood (144W, 10080 lumens) to make it more comparable to those used by fishing vessels. A light schedule for all 10 nights on the water will be created randomly (and then repeated throughout the night), in advance of leaving for

the survey. Each light treatment and control treatment with no lights will take place for 15 minutes with a 10-minute dark period in between each light to allow birds to reacclimate to normal night conditions.

During at-sea trials, researchers will have bird boxes on deck and any seabirds attracted to the vessel deck will be captured and safely contained in a box to avoid injury until the light can be turned off and the bird released back into the water. The DOC protocol for managing birds that land on boats is to: switch off lights, if birds do not leave themselves, gently lift and assist them to fly off – but not when predatory birds are present.

Data from at-sea trials will be analysed using multivariate methods to test for statistically significant correlations between light type, behavioural response, and environmental and temporal variables (moon, weather conditions, time of night, date). We expect these results to indicate which light types have the least impact on altering seabird behaviour and attraction and will provide best-practice guidelines for vessels active at night.

Table 1. Light types that will be used during at-sea light experiments.

Light Type
Fluorescent
Halogen
LED green
LED red
LED white flood

Project update – related work re. ALAN

1. We would like to re-visit two aspects of the thermal imaging videos recorded during the island-based experiment last season:

    a. Have at least one other person count the number of birds observed in each video to reduce any potential counting bias,

    b. Assess whether the videos inadvertently filmed at different magnifications can be incorporated into the initial analyses.

2. The land-based lighting experiments will be continued as part of a PhD project (Ariel-Micaiah Heswall, University of Auckland) at various seabird breeding locations around Auckland e.g. Tāwharanui Regional Park/Open Sanctuary, Tiritiri Matangi Island, Te Hauturu-o-Toi/Little Barrier island and possibly Te Henga Bethells Beach.

3. Both New Zealand (Green Bay) and Waiheke Bird Rescue Centres have recently started to using new data recording system that tells them the number and species of seabird that have been brought to them due to light-induced disorientation and collisions, and where they were found. This information will be useful to identify problem areas in Auckland where seabirds are attracted to artificial lights on land.

References

Abraham, E. R., & Berkenbusch, K. (2019). *Preparation of data for protected speciesc apture estimation, updated to 2017–18* Wellington New Zealand

Black, A. (2005). Light induced seabird mortality on vessels operating in the Southern Ocean: incidents and mitigation measures. *Antarctic Science, 17*(1), 67-68.

Dias, M. P., Martin, R., Pearmain, E. J., Burfield, I. J., Small, C., Phillips, R. A., . . . Croxall, J. P. (2019). Threats to seabirds: a global assessment. *Biological Conservation*.

Fontaine, R., Gimenez, O., & Bried, J. (2011). The impact of introduced predators, light-induced mortality of fledglings and poaching on the dynamics of the Cory's shearwater (Calonectris diomedea) population from the Azores, northeastern subtropical Atlantic. *Biological Conservation, 144*(7), 1998-2011.

Merkel, F. R., & Johansen, K. L. (2011). Light-induced bird strikes on vessels in Southwest Greenland. *Marine Pollution Bulletin, 62*(11), 2330-2336.

Montevecchi, W. A. (2006). Influences of artificial light on marine birds. *Ecological consequences of artificial night lighting*, 94-113.

Rodríguez, A., Holmes, N. D., Ryan, P. G., Wilson, K. J., Faulquier, L., Murillo, Y., . . . Rodríguez, B. (2017a). Seabird mortality induced by land-based artificial lights. *Conservation Biology, 31*(5), 986-1001.

Rodríguez, A., Moffett, J., Revoltós, A., Wasiak, P., McIntosh, R. R., Sutherland, D. R., . . . Chiaradia, A. (2017b). Light pollution and seabird fledglings: targeting efforts in rescue programs. *The Journal of Wildlife Management, 81*(4), 734-741.

Warham, J. (1990). *The petrels: their ecology and breeding systems*: A&C Black.