MIT2022-06 Light mitigation: reducing vessel interactions with seabirds

This document accompanies a presentation at a Conservation Services Technical Working Group. The intent is to facilitate discussion around progressing his project in the most productive manner, with a focus on soliciting feedback on and input into the proposed methods.

Project Rationale (ex CSP annual plan)

Artificial light at night from fishing vessels has been identified as a threat to several seabird species, particularly when vessels are operating near seabird colonies in low visibility conditions (e.g., foggy and misty nights). Bright lighting (e.g., spot and flood lights) can lead to species, such as prions, petrels and shearwaters being disorientated, attracted to, and subsequently colliding with vessel structures (i.e., deck strikes). This can result in contamination with onboard chemicals, waterlogging, injury, or death. Therefore, identifying lighting types and set-ups that minimise the attraction that current vessel lights cause is of high conservation interest. However, vessel lighting is essential for the safety of crew and operation of the vessel, so this research must identify light types and set-ups that allow for safe operations, while reducing risks to seabirds.

Introduction / background

Fishing vessels use artificial lights for several reasons:

Trawl

- Illuminate trawl deck – generally open with no shelter deck
- Illuminate trawl net astern when shooting / hauling
- May run lights continuously.
- Most vessels working 24/7

Bottom longline

- Illuminate deck
- Minimal light outside the boat when setting
- Many haul at night – need to illuminate the area beside the hauling station
- Smaller vessels may anchor up overnight – may or may not illuminate deck
- Varying degrees of 'containment' of deck lighting – full or partial shelter deck

Surface longline

- Illuminate deck
- Minimal light outside the boat when setting
- Many haul at night – need to illuminate the area beside the hauling station
- Drift overnight, maybe with lights on to increase visibility
- Varying degrees of 'containment' of deck lighting – full or partial shelter deck

Purse seine

- Generally, work in daylight only but may fish into night occasionally
- May anchor up overnight

All vessels may have searchlights but these will normally only be used briefly for specific tasks such as finding fishing gear and entering / leaving anchorages.

Lighting required depends on the task

300 lux seems like a reasonable figure for general work on deck, brighter and whiter light may be advantageous for delicate tasks.

Lower light levels may be used at high-risk times e.g. setting longlines

More poweful lights may be used for illuminating the sea surface around the vessel.

Searchlights are likely to be the most powerful lights onboard but may be used close to shore.

Light types

Incandescent vs LED – emit light at different wavelengths

'Temperature' generally measured on the Kelvin scale

Red light is commonly used to preserve night vision

Bird vision

- Better than ours
- Can see into UV
- Higher frequency definition – may perceive a strobe effect at higher flicker frequencies than us

- Consequently, metrics such as lux / lumens which use a luminosity function with a peak at 555 nm (green) are not so relevant for birds (but are still useful for describing the light available for humans undertaking tasks).
- Juvenile vs adults – could be different. Fledglings more likely to be attracted to lights. Young juvenile birds returning to colony (+1 or 2 years are more catchable with a spotlight).
- Not much data on luminosity function for seabirds so we don't really know exactly how they perceive light.
- Risky times for deck strike events e.g. poor visibility
- Two key responses to light we are interested in:
    - Attraction
    - Confusion / disorientation

Current recommendations (ex DOC website)

- Minimise marine light use, especially spotlights and floodlights, when you are within 5 km of an offshore island, where most seabird colonies are located.
- Avoid unnecessary movements and activities at night.
- Eliminate unnecessary lights.
- Shield lights to only light areas essential for safe operations.
- Use lights with reduced or filtered blue and violet wavelengths (2200 K or less).
- Use black-out blinds wherever possible
- Follow PSRMP

Previous work

Project MIT2019-03 conducted some initial experimental work, and recommendations included expanding on-land and at-sea trials of different light configurations. This project aims to address the recommendations and to incorporate the lessons learnt.

Project objectives

- Characterise current light set-ups in use on fishing vessels.
- Improve initial trials of different light set-ups both on land at seabird colonies and on commercial fishing vessels.
- Identify options for mitigating seabird deck strikes.

Proposed Methods

Run two separate experiments, one on land and one at sea with pole / mast mounted lights facing downwards and sideways (rather than upwards as per MIT2019-03)

Treatments

- White ('normal' off the shelf LED e.g. 5700K, 25000 lumens)
- Amber (including filter to exclude UV e.g. 2500K, 19000 lumens)
- Intensity variation for amber light?
- Red
- Separate treatments with a dark period

Light metrics

- Spectral composition (to fully measure the type of light emitted)
- Flicker frequency
- Lux / lumens (to understand the amount of light available from a human eye point of view)
- Ambient light during control treatments

Measuring response / behaviour of birds

- Thermal imaging
- Security camera (with or without IR)
- Visual counts
- Photograph of grounded birds / deck strikes (plumage condition may be useable to separate juveniles from adults)
- Potential metrics
    - Max count of birds in view, per minute
    - Bird behaviour e.g. a count of individuals in the dark and then a count moving towards light once it is switched on
    - Count of grounded / deck strike birds, per treatment block
    - Max count of birds 'trapped' in lit area, per minute / treatment block
    - Need to ensure camera has equal ability to detect birds across treatments

Environmental metrics (covariates)

- Wind strength and direction
- Visibility?
- Humidity
- Cloud cover
- Precipitation
- Date, time (moon phase)
- Whether moon is visible

Land based

- Stephens's Island (large fairy prion colony, lay Oct – Nov, Fledge Feb)
- Timing 7th Nov onwards, likely to be dealing with adults only, not fledglings
- Likely to encounter relatively large numbers of birds
- Aim to concentrate effort on higher risk / higher count nights (e.g. poor visibility)
- Aim to concentrate effort at times of maximum bird movement (e.g. time of night, no moon)
- Will trial different treatment durations and count protocols.
- If behavioural response to turning light on looks like the best measure, then we can use short blocks (e.g. 5 min)
- If counts of birds in a defined area, per minute, looks better then longer blocks may be more appropriate

At sea off the NE coast of North Island

- Likely to encounter relatively few birds, likely to be measuring attraction, may take some time
- Possibly two to four repeats per night at sea
- Possibly most bird activity during full moon around dawn / dusk
- Should we chum?
- Gyro stabilised cameras?
- Longer treatment blocks
- Likely to be variation with time of day so need to consider the duration and timing of treatments carefully
- 30 min blocks with 10 min dark periods?
- Drift during each treatment block, then steam back upwind with lights off between blocks

Data analysis

In person review of video footage

Modelling approach looking at counts of birds per minute in each treatment as the response

Not independent samples

Following factors:

- Treatment
- Treatment block (where there are repeat counts within the same block)
- Day
- Breeding stage (Stephens Island)
- Environmental metrics (wind, humidity, etc.)

Next steps

- Design and build lighting rigs
- Source and trial cameras and spectrophotometer
- Finalise protocols and trim to budget (50K)
- Ethics approval
- Stop trigger (e.g. a fixed number of deck strikes per night would stop further work, maybe split by species).