Light mitigation:
Reducing vessel interactions with seabirds MIT2022-06

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Background

Light is necessary for fishing vessels operating at night, for various reasons.

Attraction, confusion, disorientation = vessel strikes.

Previous iteration of project (Lukies et al. 2021).

Mitigation standards developed 2023 (DOC and MPI).

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 at sea on commercial fishing vessels.

Identify options for mitigating vessel strikes.

Methods – Lighting treatments

Discussions with fishers / industry to characterise lighting in use

Chose lights

- 2 Hella hypalume LED worklights: 19,000 lumens (amber) and 28,000 lumens (white)
- 6 red LED worklights (total 4,800 lumens)

Land-based trials on Stephens Island (Takapourewa)

- 6 treatments (incl. control) 1 min treatment (light on) separated by 5 min dark (light off).
- 3 blocks per night (2200 – 0000), 17 nights' data

At sea trials in Hauraki Gulf

- Charter fishing vessel, same treatments
- 20 min "light on" on dodging / drifting, 10 min "light off" (steam back to start position)
- 2 blocks per night, 3 nights' data

Methods - Stephens Island (Takapourewa)

Top of the Marlborough sounds

1 million + pairs fairy prions

Breeding season

Work carried out pre-fledging

Thermal camera

Count of grounded birds

Figure 1. Rig location on Stephens Island

Figure 2. Pulsar Helion thermal scope

Figure 3. Rig and camera set up

Methods – At sea

Hauraki Gulf

3 nights

Figure 4. At sea trials underway

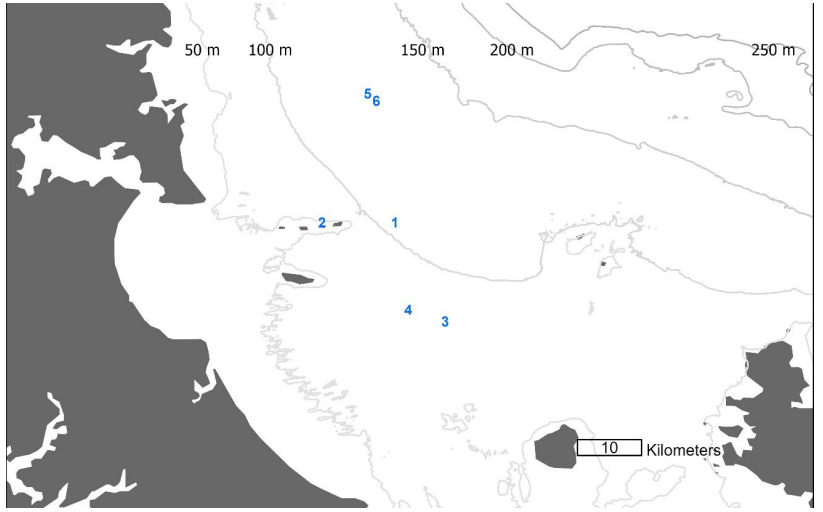

Figure 5. Location of at sea trials

Figure 6. Lights set up on vessel

Video review

Stephens Island (Takapourewa)

Two separate metrics as a proxy of vessel strike risk:

- Snapshot counts at 10 second intervals of “number of birds in the frame”
- Behaviour counts “number of times a bird flew towards camera or turned towards the middle of the frame during the one-minute treatment period”

- Both counts repeated for one-minute dark periods prior to treatment

At sea

Less birds:

- Count of birds flying into frame

Data Analysis - Stephens Island (Takapourewa)

Stephens Island

Generalised linear mixed effects models (Poisson distribution was selected for the general counts and the negative binomial for the behaviour model)

Used counts prior to treatment as an offset

A random effect of treatment blocks nested within nights

For the snapshot counts, multiple measurements per treatment were included by adding treatment to this nested random effect

Fixed effects included treatment, relative humidity, cloud cover, windspeed, the time of night, wind direction, moon illumination, moon brightness (= moon illumination if the moon was visible, otherwise zero).

At sea

Generalised linear mixed effects model (negative binomial distribution)

Results - Stephens Island (Takapourewa)

Snapshot counts

Higher counts with:

- less northerly wind
- days closer to full moon
- less moon brightness
- later times

Snapshot counts model

	Chi square	estimate	standard error	p-value
light treatment	26.07			< 0.0001
control		-4.598	1.482	
red		-4.388	1.479	
amber_low		-4.128	1.478	
amber_high		-4.359	1.480	
white_low		-4.154	1.477	
white_high		-4.230	1.478	
relative humidity	3.45	0.006	0.003	0.06
wind speed	0.38	0.002	0.003	0.54
wind eastwards	3.03	-0.091	0.052	0.08
wind northwards	17.11	-0.374	0.090	< 0.0001
cloud cover	1.17	0.001	0.001	0.28
moon illumination	11.22	0.004	0.001	< 0.001
moon brightness	37.60	-0.010	0.002	< 0.0001
time	6.11	0.155	0.063	0.01

Table 1. Model results – snapshot counts

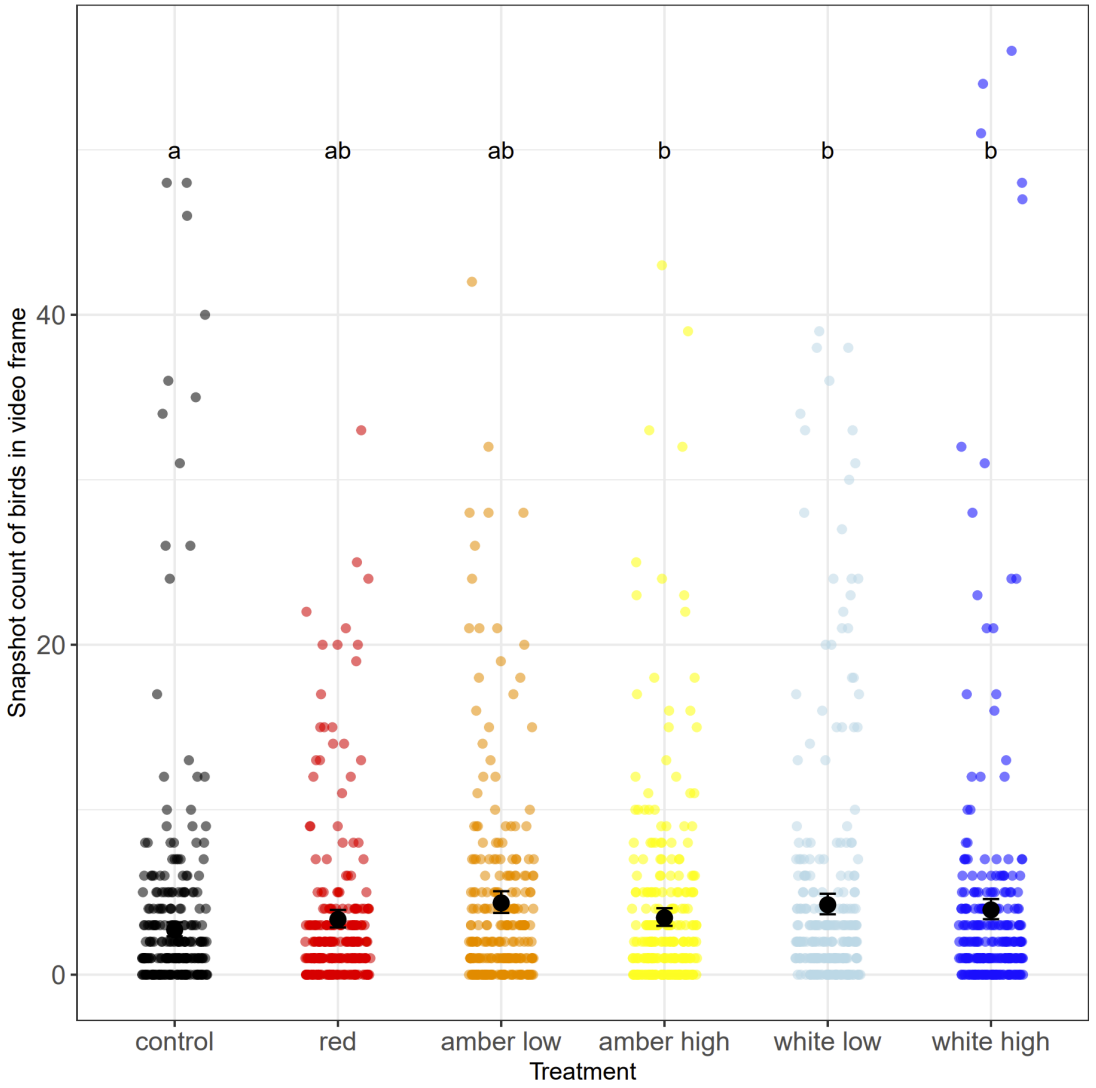

Figure 7. Results from snapshot counts model including raw counts with mean +/- 95% c.i. Letters indicate significant differences between treatments

Results - Stephens Island (Takapourewa)

Behaviour counts

Higher counts with:

- higher humidity
- lower wind speed
- less moon brightness
- later times

Behaviour counts model

	Chi square	estimate	standard error	p-value
treatment	199.26			< 0.0001
control		-6.65	1.73	
red		-6.44	1.73	
amber_low		-5.76	1.73	
amber_high		-5.58	1.73	
white_low		-5.50	1.73	
white_high		-5.41	1.73	
relative humidity	21.26	0.02	0.004	< 0.0001
wind speed	4.07	-0.01	0.004	0.04
wind eastwards	0.15	0.03	0.07	0.70
wind northwards	0.11	-0.04	0.11	0.74
cloud cover	2.76	0.002	0.001	0.10
moon illumination	1.70	-0.002	0.001	0.19
moon brightness	12.58	-0.006	0.002	<0.001
time	9.90	0.23	0.07	0.002

Table 2. Model results – behaviour counts

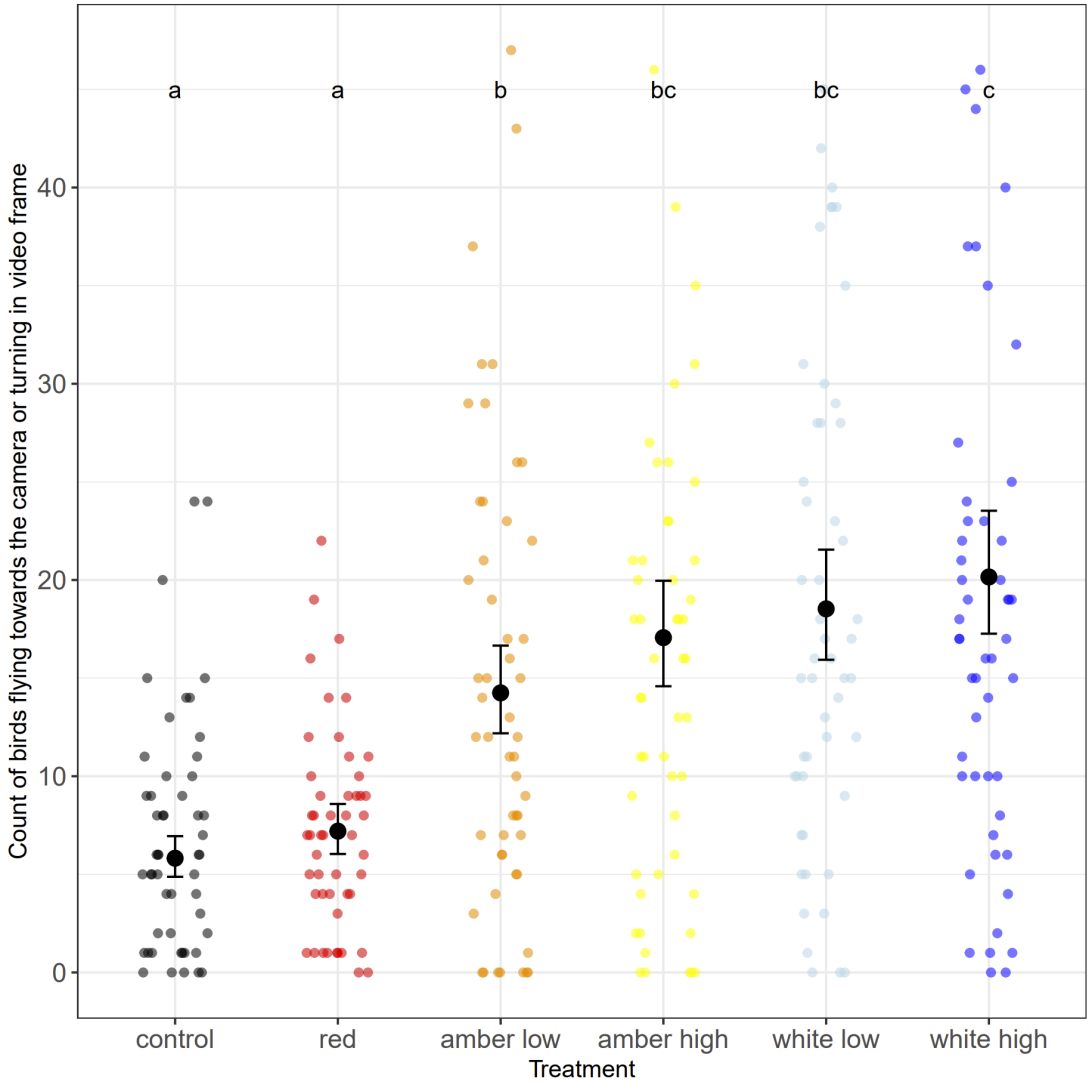

Figure 8. Results from behaviour model including raw counts with mean +/- 95% c.i.
Letters indicate significant differences between treatments

Results - Stephens Island (Takapourewa)

Grounded birds

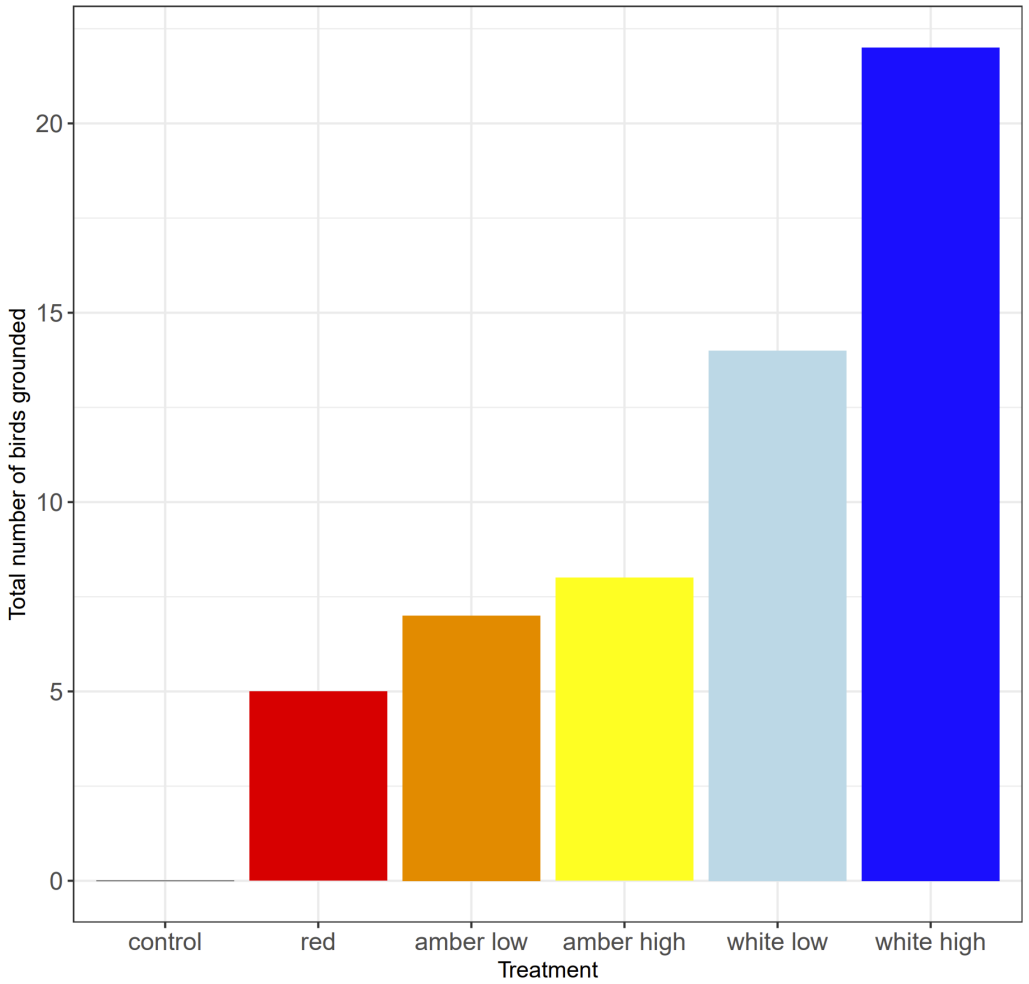

Figure 9. Number of birds grounded per treatment

Results – At sea data

Very few birds, low counts

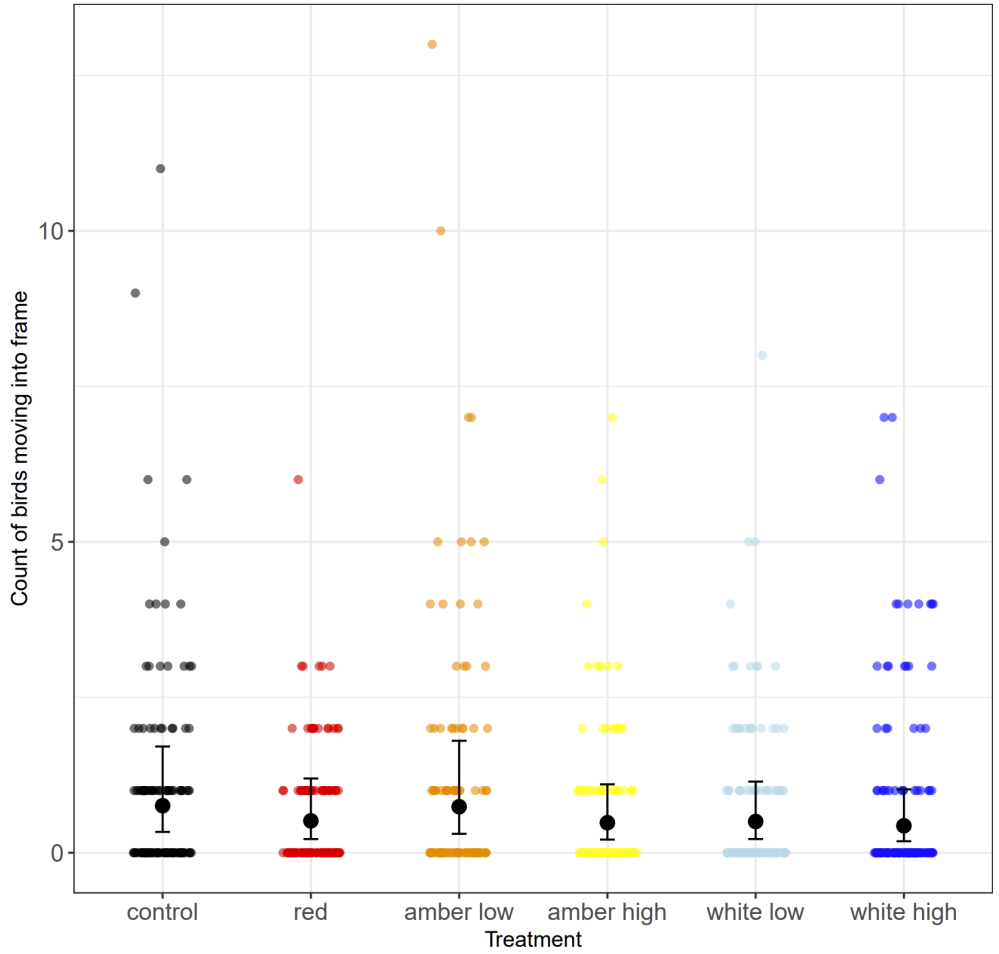

Figure 10. Results from at sea data including raw counts and model-derived mean +/- 95% c.i.

Conclusions

Results support the mitigation standards:

- Brighter and whiter lights produced higher counts

Several environmental variables influencing counts

Behaviour counts produced larger differences between treatments, but more subjective

Hard to get enough numbers at sea, especially without ‘extra’ attractants

Scope was adequate but wider angle lens would be better

Recommendations

Support fishers to implement mitigation standards

Trial warmer-coloured lights under fishing conditions – are they useable?

Further at sea trials

- Wider angle camera
- Less treatments / more repeats
- Find more birds
- Use fish oil as an attractant?

Further land-based trials

- Different species

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