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

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Photo: Whitehead 2020

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NORTHERN NZ SEABIRD TRUST

Artificial Light At Night (ALAN)

- Can cause disorientation, exhaustion, injury or mortality from light-induced collisions.
- Petrels and shearwaters are the main seabird group affected by ALAN.
- Mainly fledglings on their first flight.

Image: Whitehead, 2019

Image: Whitehead, 2018

Image: Whitehead, 2020

Project aims

This study aimed to test which light intensities and colours are least attractive to seabirds, to facilitate understanding of how to minimise the impact of light-induced collisions with vessels in the Hauraki Gulf and elsewhere.

Image: Whitehead, 2020

Project aims

The study has four components:

1. Literature review
2. Light analysis and fishery industry survey
3. Land-based behavioural experiments
4. Boat-based behavioural experiments

Image: Whitehead, 2020

1. Literature review - Key findings

- Change in fishing vessel lighting over time. Halogen, fluorescent & LED lights most common. LED's increasing as most energy efficient.
- Petrels and shearwaters most impacted by ALAN.
- Especially juveniles on first flight.
- More seabird fallout on dark and misty/foggy nights.
- Thought that white/blue light (e.g. most LED's) more disorientating to nocturnal seabirds and more yellow/orange light less disorientating.

Image: Whitehead, 2020

2. Light analysis and fishery industry survey - Summary

- Aims
  - Analyse deck strike data from Hauraki Gulf. Survey fisheries for light types used.
  - Characterise the wavelengths and intensity of lights used on boats and model how these are perceived by seabirds.

Image: Whitehead, 2020

2. Light analysis and fishery industry survey - Summary

- Methods
  - Survey sent to fishing vessels.
  - Measured lights using spectrophotometer.
  - Modelled how seabirds would perceive lights based on visual system of wedge-tailed shearwater.

Image: Whitehead, 2020

2. Light analysis and fishery industry survey - Summary

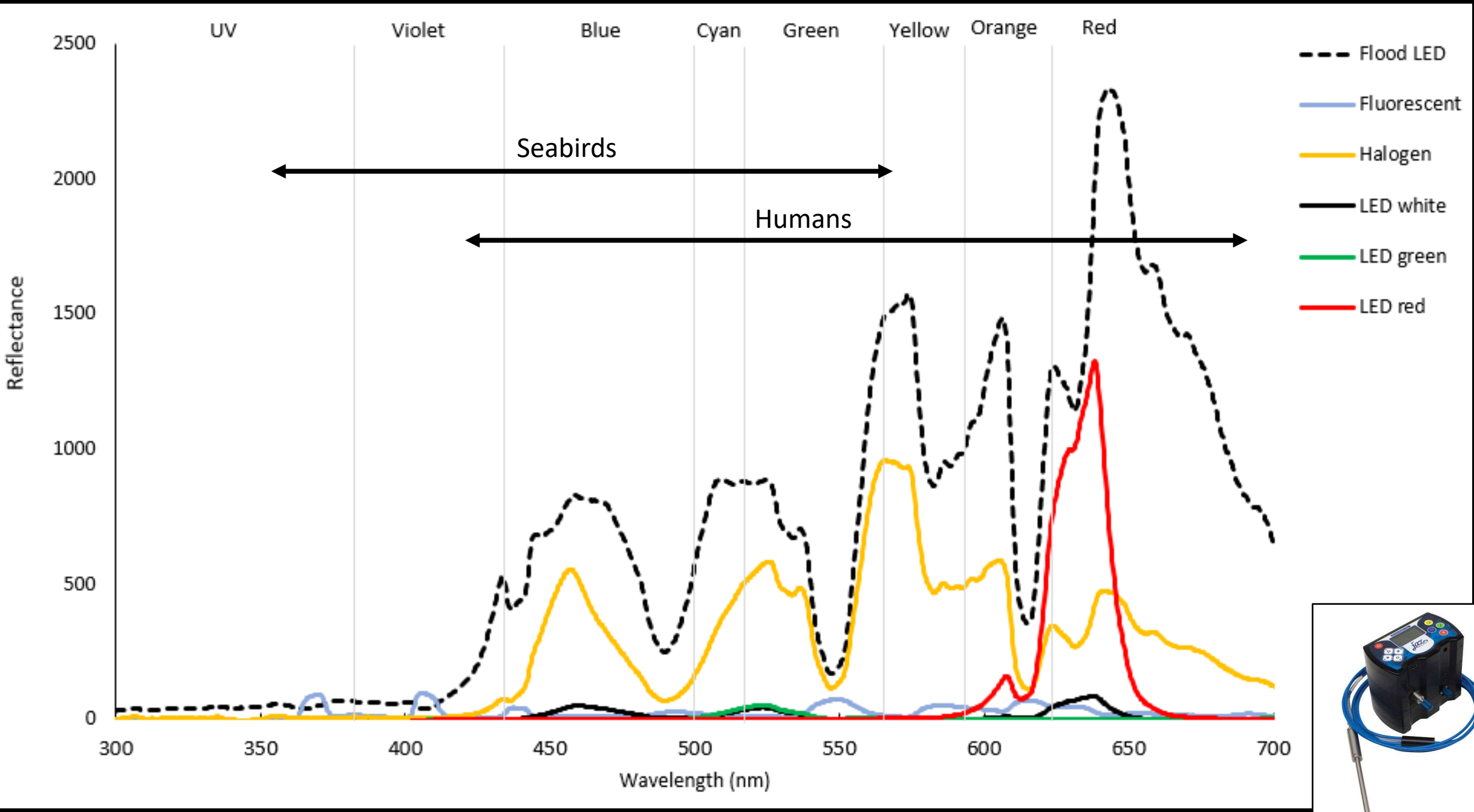
- Results
  - 14 vessels responded to the survey.
    - Lights used: LED (11), fluorescent (7), halogen (5), mercury (1), high-pressure sodium (1).

  - Seabirds could distinguish between the colour and brightness of the six lights tested: flood LED, white LED, red LED, Green LED, halogen, fluorescent.

Image: Whitehead, 2020

2. Light analysis and fishery industry survey - Summary

- Conclusion
  - Lights tested suitable for use in experiments.


UV
Violet
Blue
Cyan
Green
Yellow
Orange
Red
Seabirds
Humans
Flood LED
Fluorescent
Halogen
LED white
LED green
LED red
Reflectance
2500
2000
1500
1000
500
0
300
350
400
450
500
550
600
650
700
Wavelength (nm)

3. Land-based behavioural experiments - Summary

- Aims
  - Carry out land-based behavioural experiments to test seabird responses to artificial lights and alternative options such as different colours/filters.

Image: Gaskin, 2019

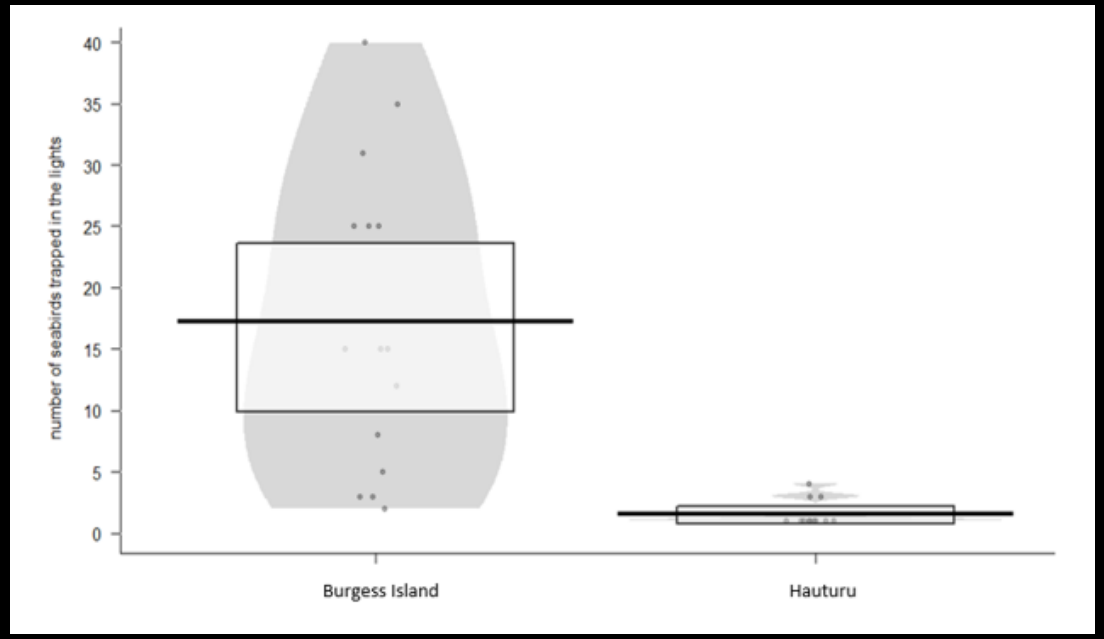
3. Land-based behavioural experiments - Summary

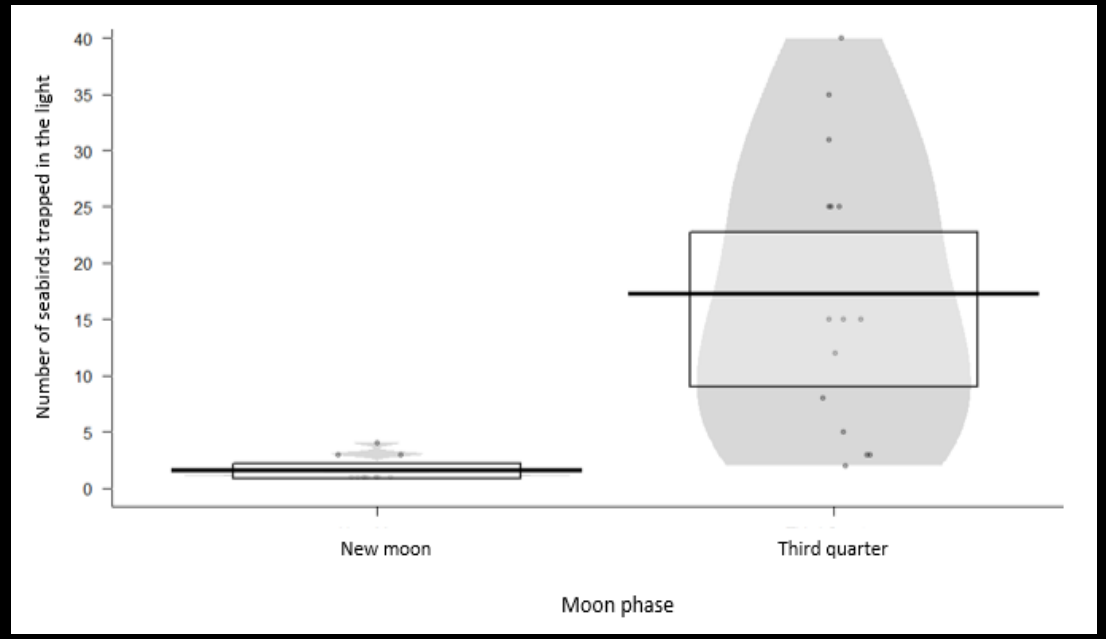
- Methods
  - Two islands in the Hauraki Gulf: Burgess Island and Little Barrier.
  - Lights attached to wooden beam pointing skyward.
  - Starting 30min after sunset, each light shone for 10 min, followed by 10 min darkness.
  - Birds counted and recorded with thermal imaging.

Image: Gaskin, 2019

3. Land-based behavioural experiments - Summary

- Results
  - Difference between islands.
  - Difference between moon phase.
  - No difference in seabirds observed for all light treatments.





3. Land-based behavioural experiments - Summary

- Results continued
  - No difference in seabirds observed for all light treatments.
    - Likely due to small sample sizes.

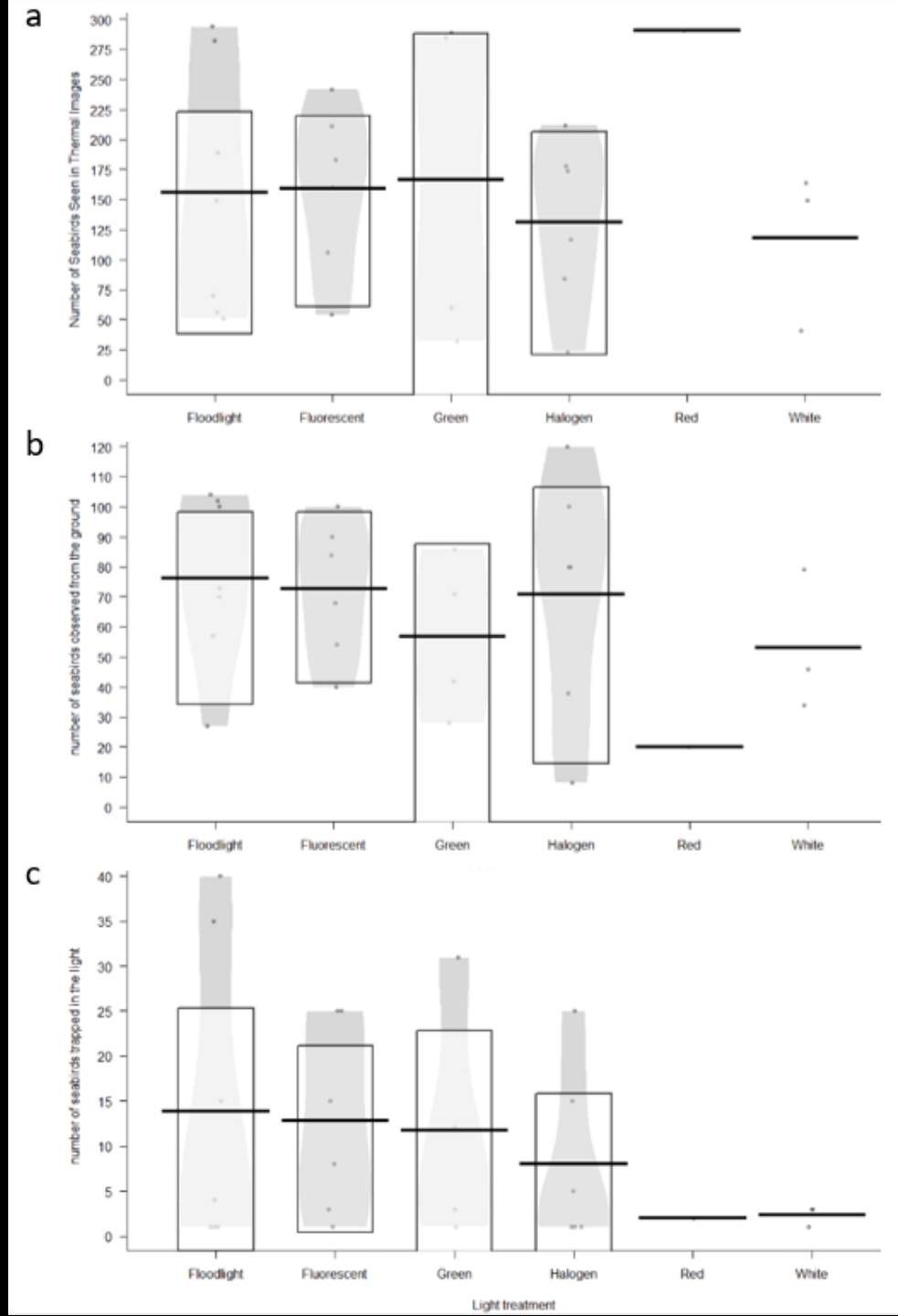


Image: Whitehead, 2020

3. Land-based behavioural experiments - Summary

- Conclusion
  - Insight into the visual system of a nocturnal burrow-nesting seabird like those in the Hauraki Gulf.
  - Larger sample sizes required.
  - PhD student Ariel Heswall has continued land-based lighting experiments as part of her PhD project.
  - Refined methodology for boat-based experiments.

4. Boat-based behavioural experiments - Aims

- To test the effects of artificial lighting on seabird behaviour at sea based on the refined methodology from the land-based behavioural experiments.
- To test the effectiveness of using a fishing vessel as a platform for the boat-based behavioural experiments.

Image: Gaskin, 2021

4. Boat-based behavioural experiments - Methods

- Three locations at sea: near Mokohinau Islands and eastern Coromandel (Mercury and Aldermen Islands).
- Two vessels used: El Pescador (Mokohinaus) and Southern Cross (eastern Coromandel).
- Lighting set up same as land-based experiments, but lights shone horizontally.
- Swapped two white LED's for one.
- Bucket of chum open on deck of El Pescador to smell more like fishing vessel.

Images: Lukies, 2020 & Gaskin, 2021

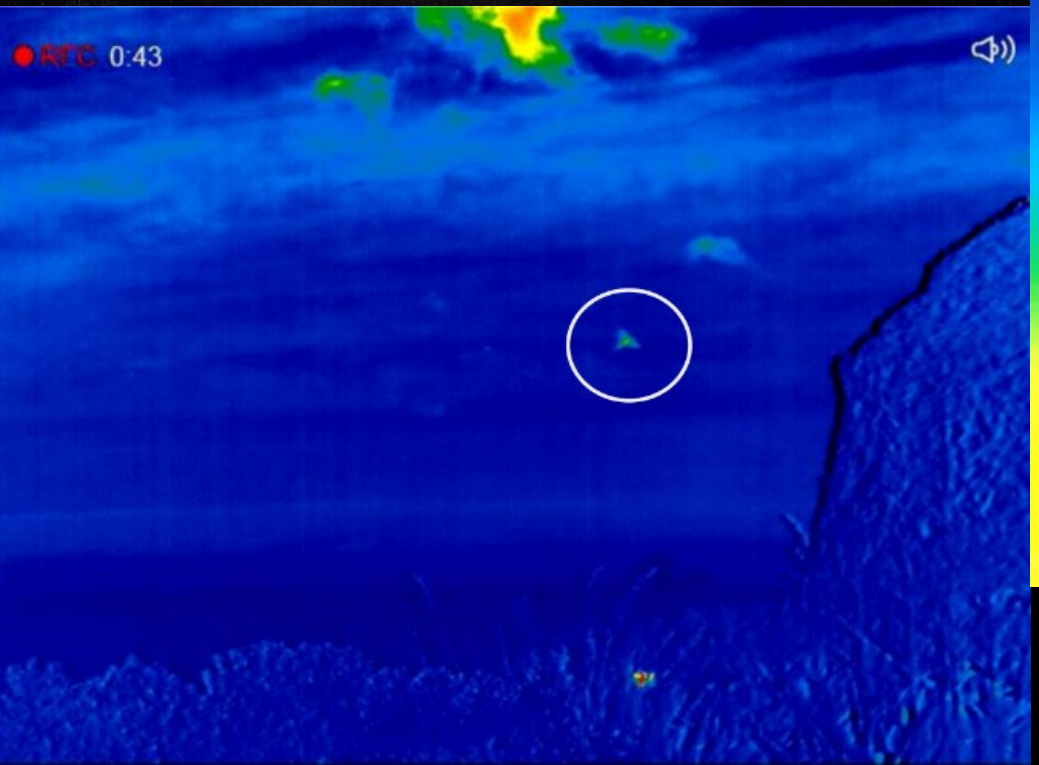
4. Boat-based behavioural experiments - Methods

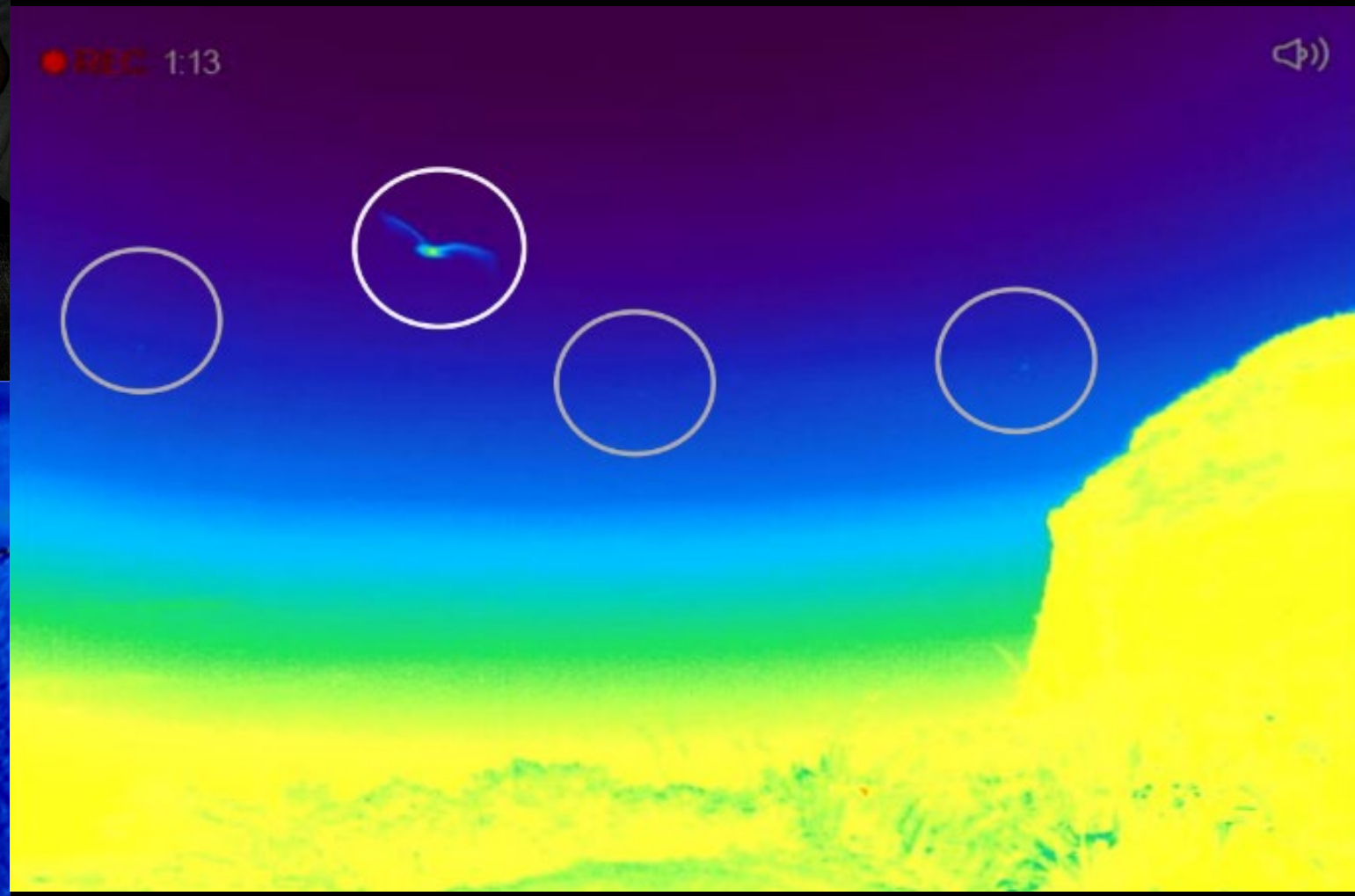
- Started 60 min after sunset, 10 min light followed by 10 min darkness.
- Deck observations
  - the number of birds attracted to the area;
  - the number of birds trapped in the light beam;
  - the number of birds landing on the water;
  - the number of birds striking/landing on the vessel.
- Thermal imaging.
- Vessel-based attraction experiments were analysed using general linear mixed models.

Image: Gaskin, 2021

Thermal imagery

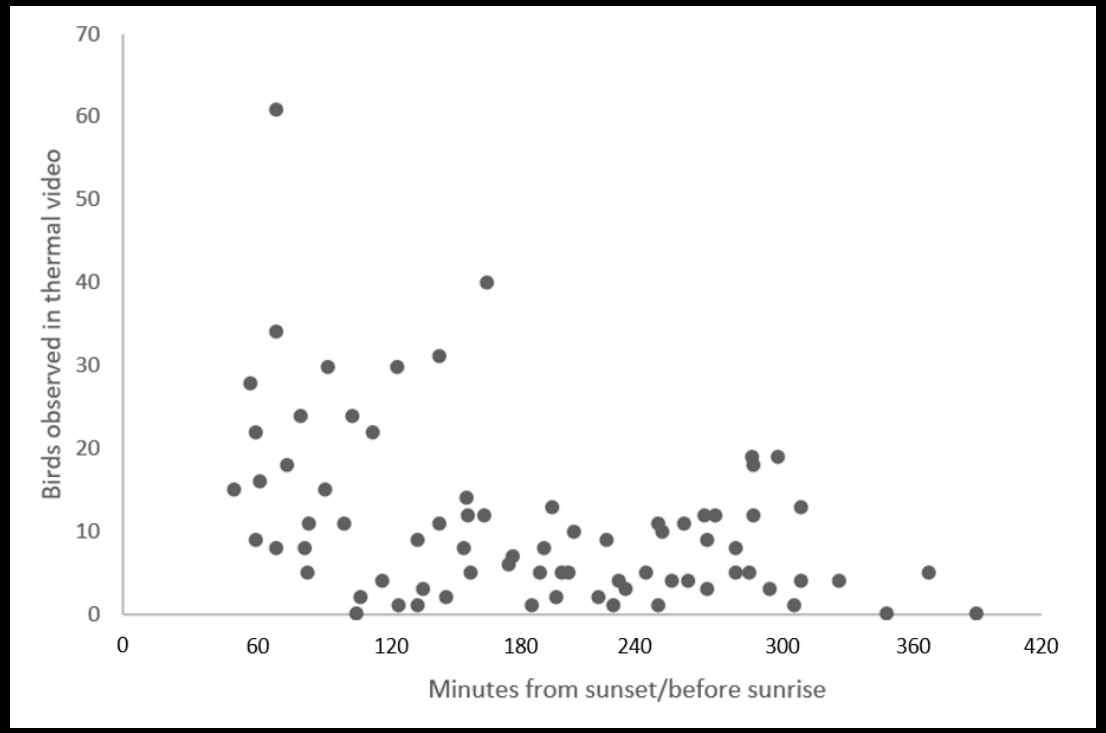
Image: Whitehead, 2020

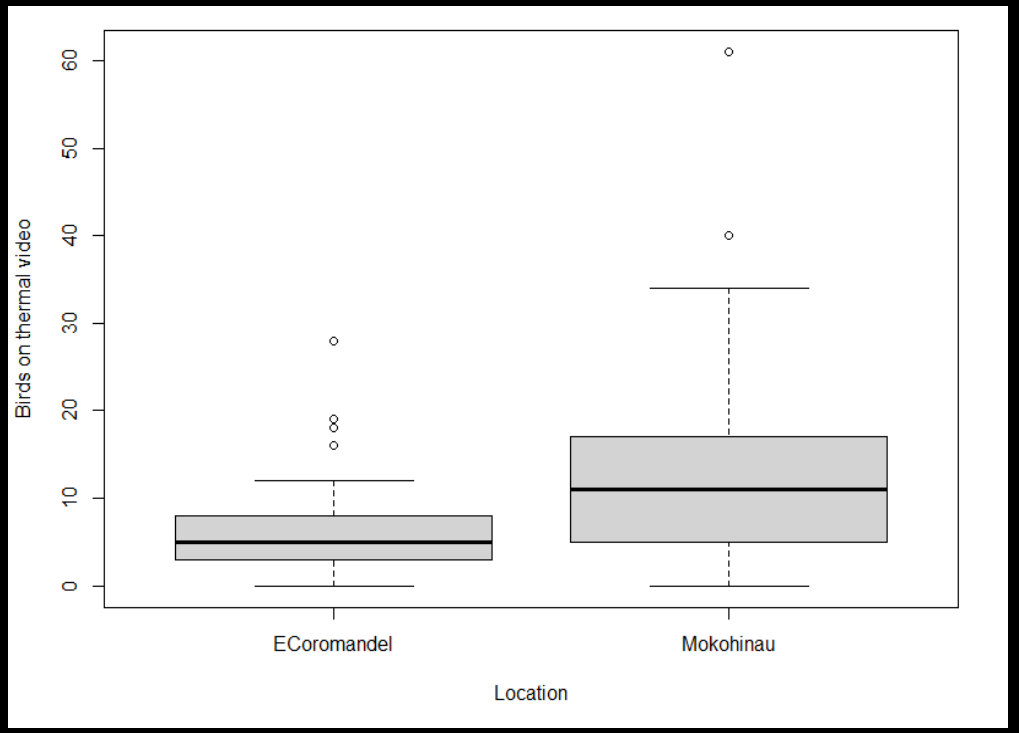




4. Boat-based behavioural experiments - Results

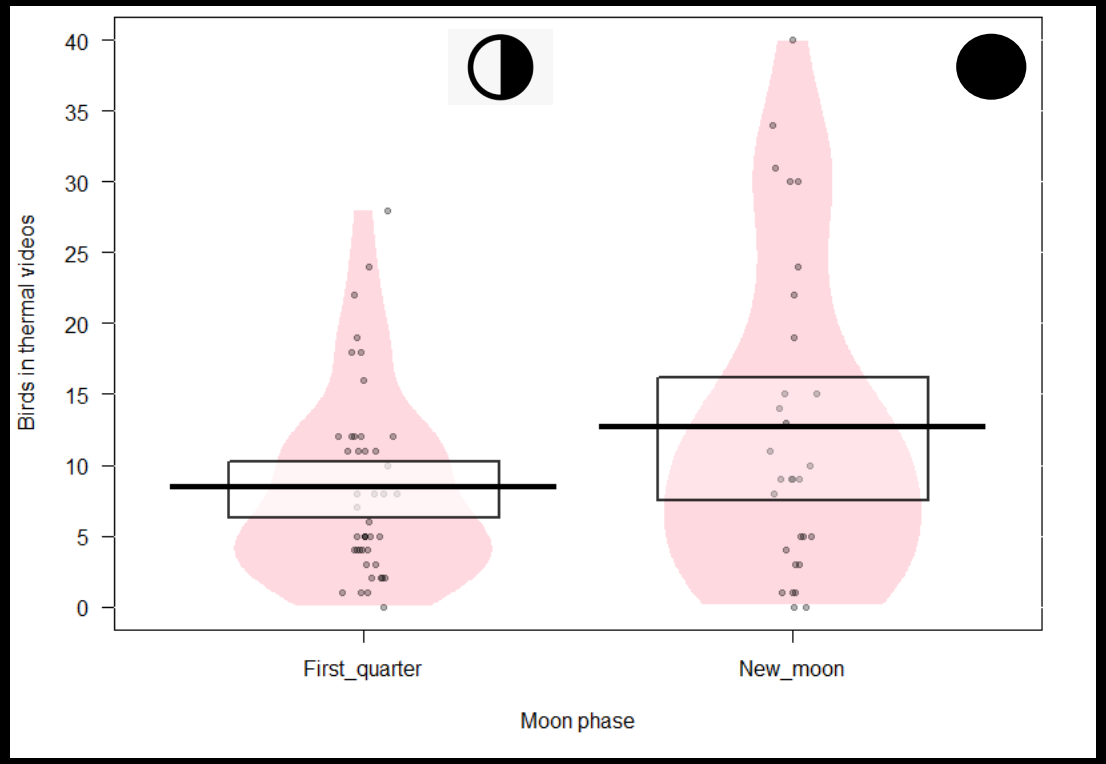
- Statistically significant differences in the number of birds observed:
  - Time of night.
  - Between locations.

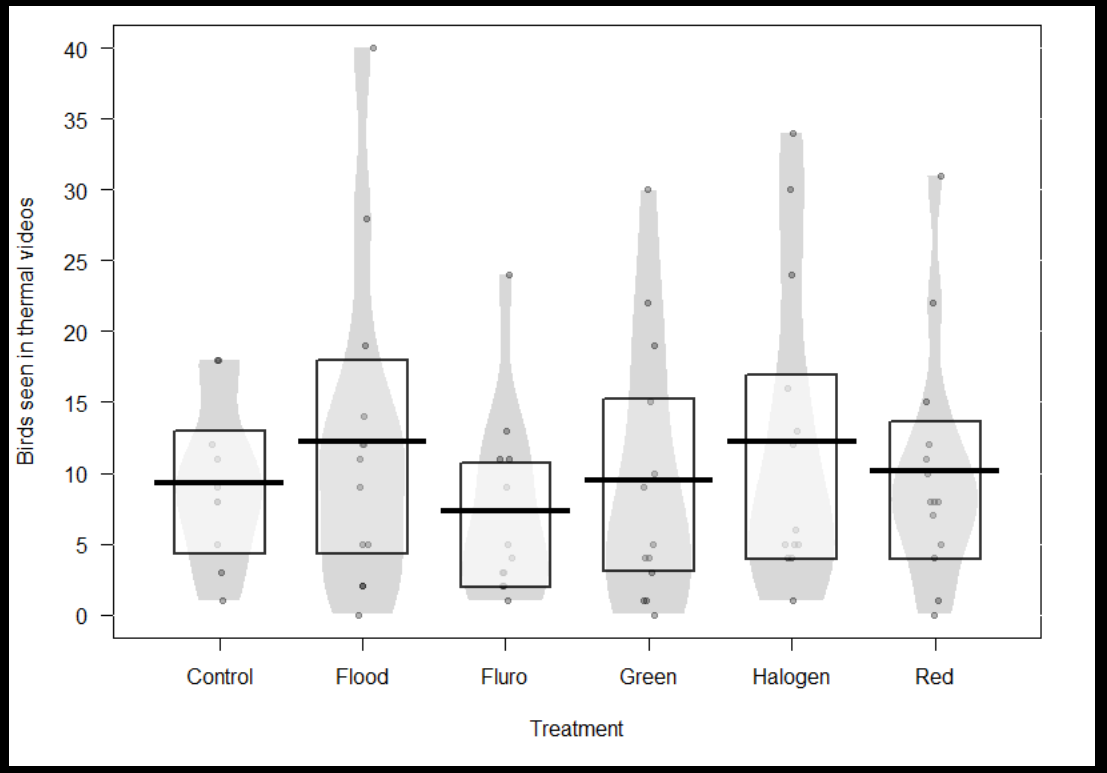




4. Boat-based behavioural experiments - Results

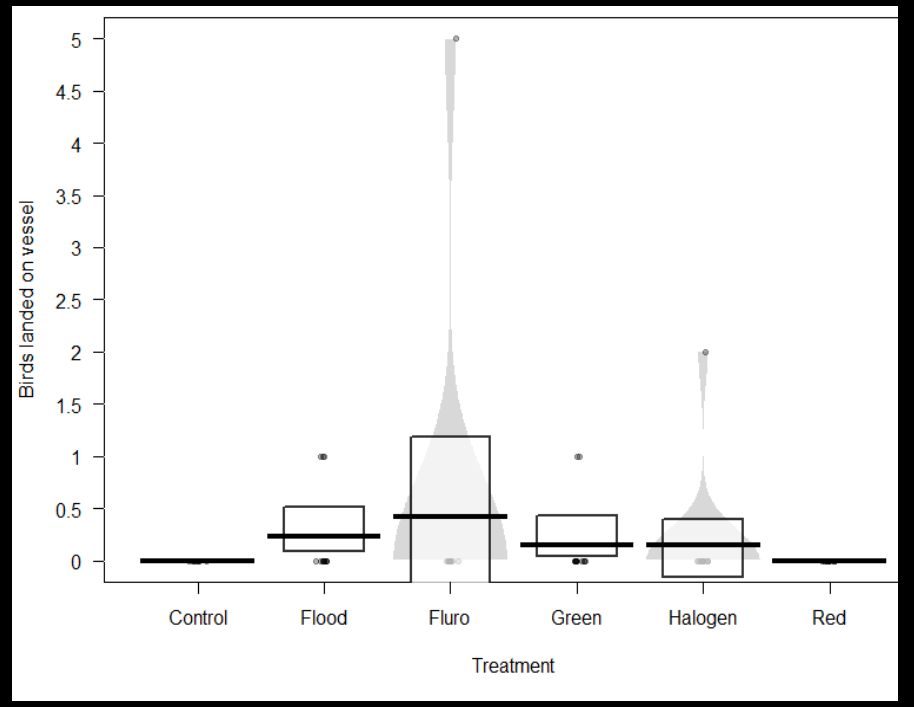
- No statistically significant differences in the number of birds observed:
  - Between moon phases.
  - Among lighting treatments.





4. Boat-based behavioural experiments - Results

- 117 birds trapped in light beam, most during flood LED treatment, least during red LED treatment.
- 17 birds contacted the vessel as deck strikes. Most during fluorescent treatment, least during red LED treatment.
  - No birds were harmed!
- 55 landed on the water near the vessel. Most during fluorescent treatment, least during red LED treatment.
- Not statistically significant results.



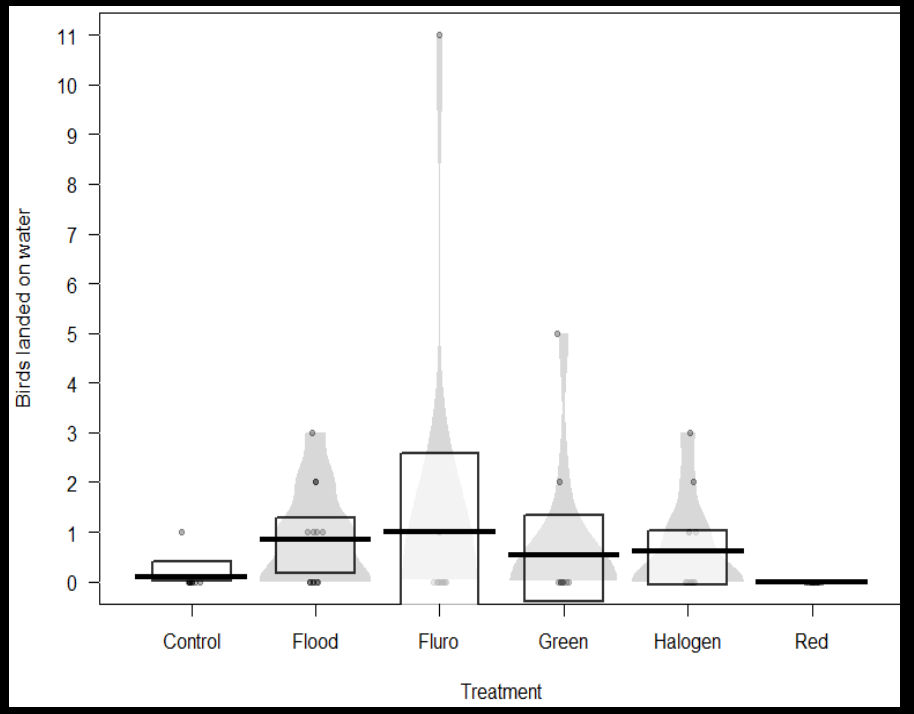


Image: Whitehead, 2020

4. Boat-based behavioural experiments - Limitations

- Small sample sizes.
- Different times of year and different locations.
- Inclement weather = difficult conditions.
- Lights used during experiments not reflective of the intensity of lighting used of commercial fishing vessels.

Image: Whitehead, 2020

4. Boat-based behavioural experiments - Conclusions

- Some locations, times of night and times of year (moon phase) where birds more likely to be attracted to ALAN.
- Larger sample sizes required.
- Further research required to address the issue of seabird attraction to ALAN in the Hauraki Gulf.

Image: Whitehead, 2020

4. Recommendations for further vessel-based behavioural experiments

- Use fishing vessel at platform for experiments.
- Attempt to target specific seabird species such as common diving petrel.
- Time experiments with a greater range of weather conditions and moon phases.
- Reduce confounding factors such as different vessels and locations.

Image: Whitehead, 2020

4. Recommendations for further vessel-based behavioural experiments continued

- Consistency with deck lighting used on vessels.
- Automation of detection to reduce the labour involved in manually detecting birds in thermal videos.
- Switch red LED for phosphor converted amber LED.
- Test strobing light.

Acknowledgements

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DOC rangers on Hauturu Little Barrier Island

DOC Conservation Services Programme team

Maritime NZ

Image: Whitehead, 2020