

Monitoring Bird and Bat Interactions with Turbines and Microavoidance Using Remote Sensing Technology (ATOM)

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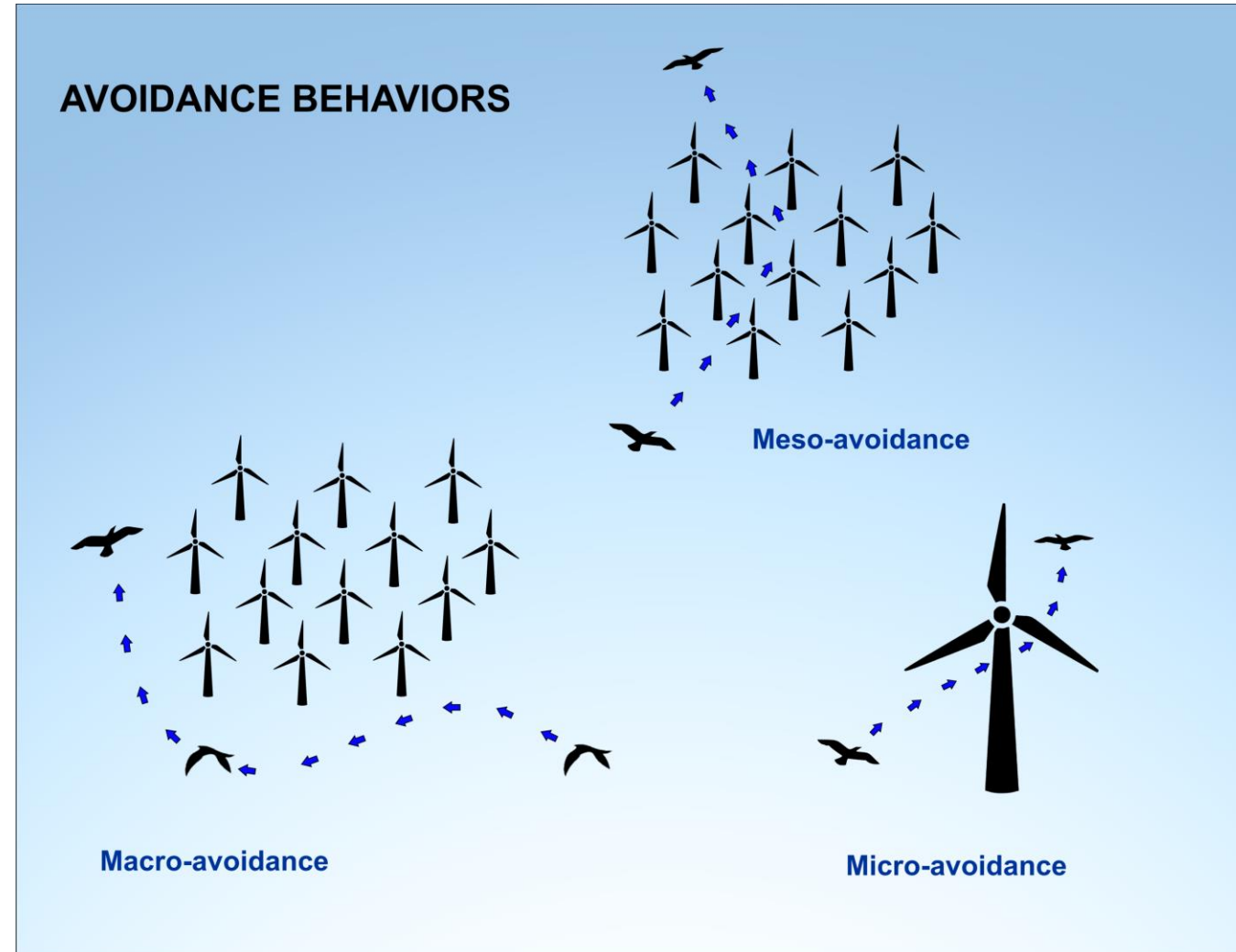
Background

- USA goal of 30 GW deployed offshore wind by 2030 (Map)
- National Environmental Policy Act (NEPA) process
- Endangered Species Act
- Migratory Bird Treaty Act
- Main concerns:
 - Mortality from collisions
 - Indirect impacts on population fitness through displacement or attraction

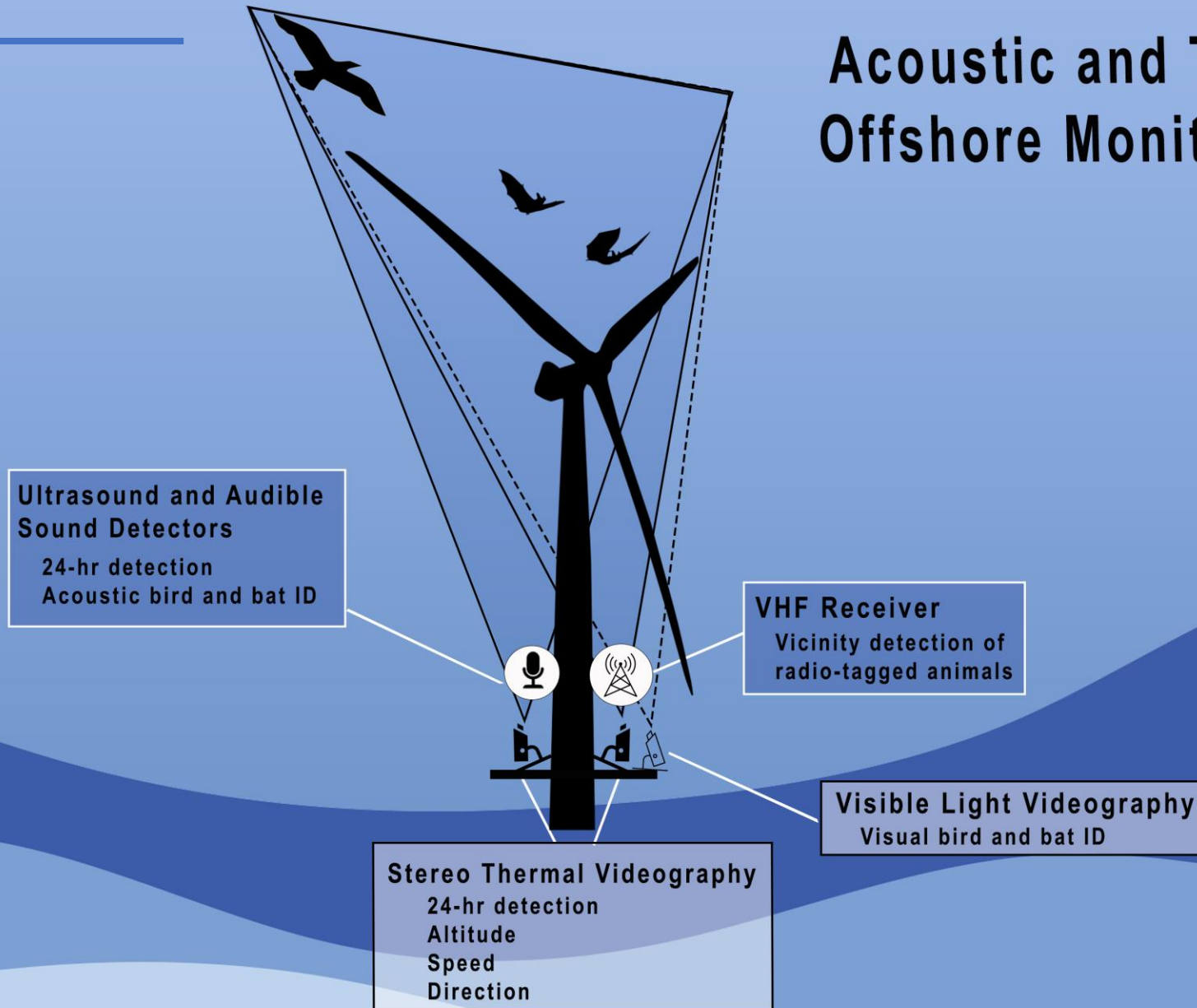


Avoidance

- Avoidance studies of seabirds
Macro/Meso/Micro
 - Macro creates displacement
 - Meso and Micro – reflect collision risk and effects of attraction
- Terrestrial land birds understudied
- Micro-avoidance understudied



Acoustic and Thermographic Offshore Monitoring (ATOM™)

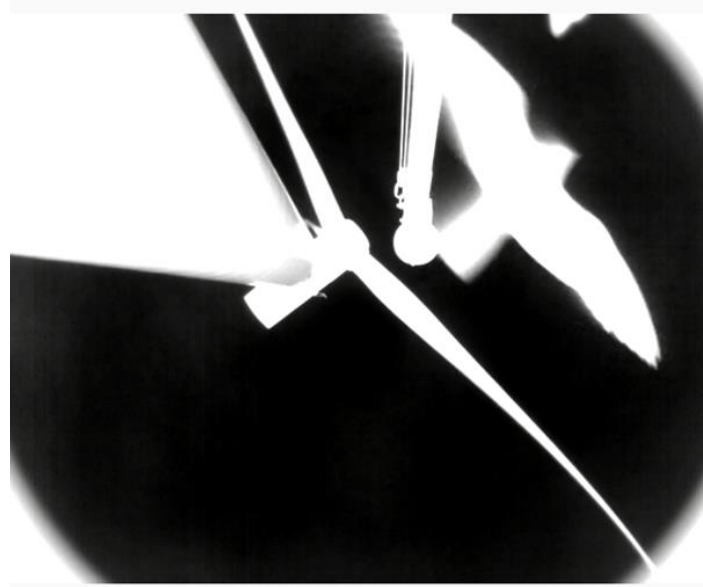


ATOM Sensors



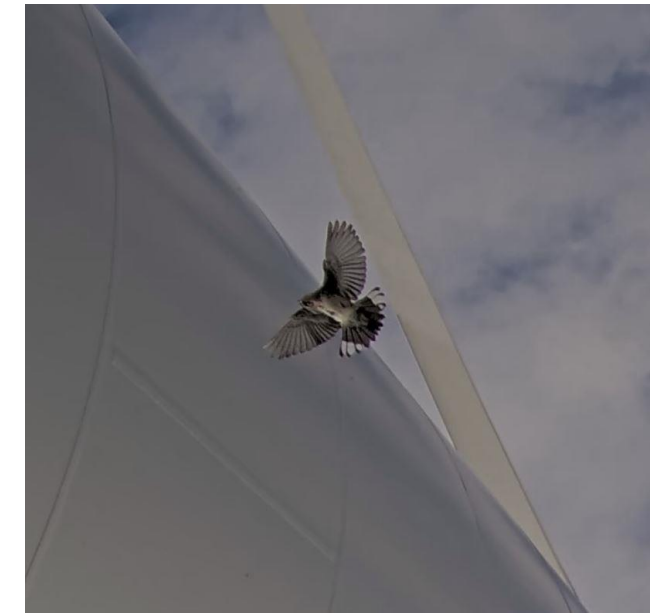
Thermal Cameras

- Two cameras in fixed position
- Operating in Stereo
- Can calculate flight height, speed, and direction
- Detects targets in poor conditions
- Housed inside a weather proof container
- No Species ID*



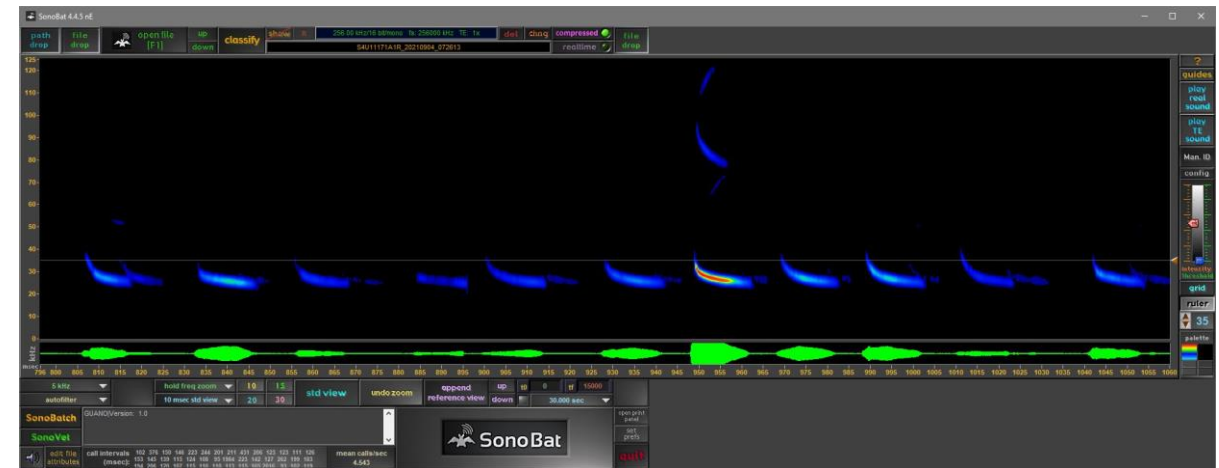
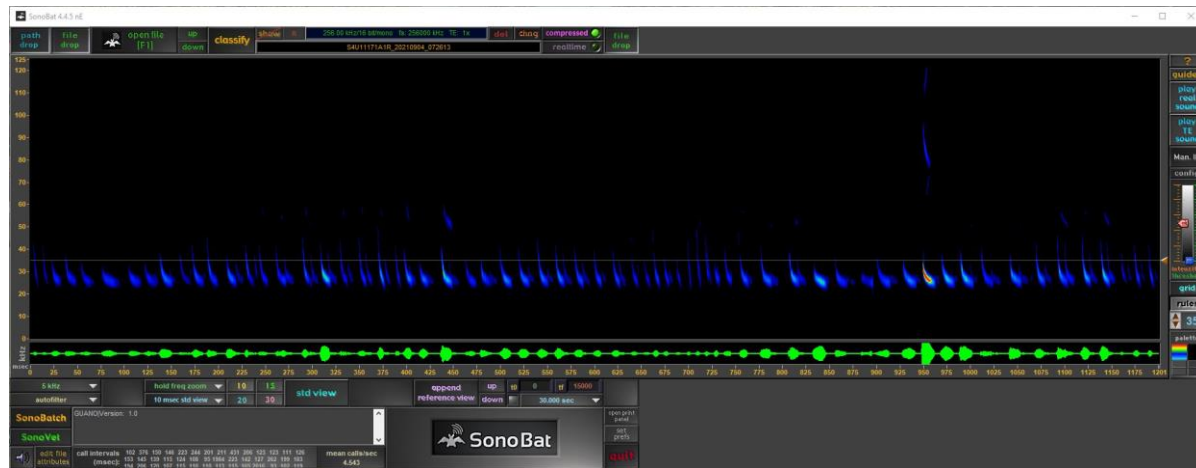
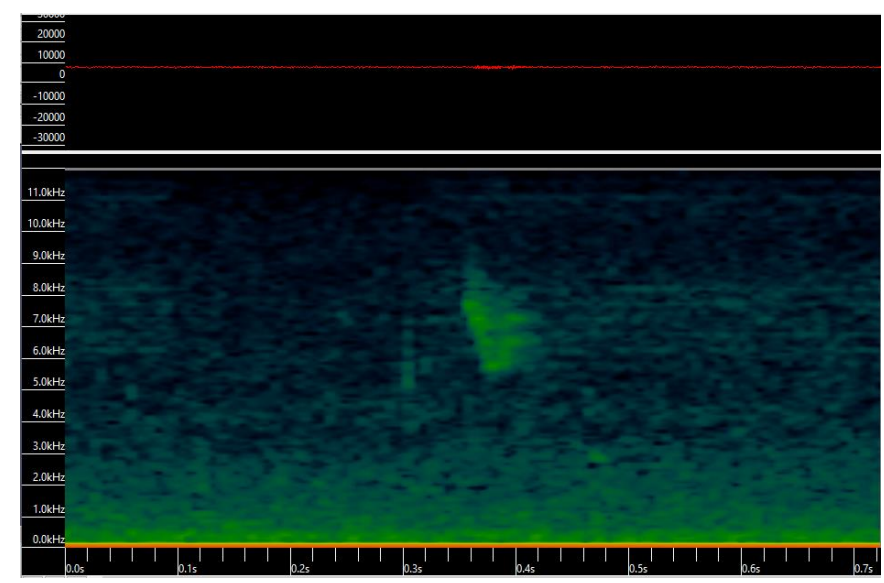
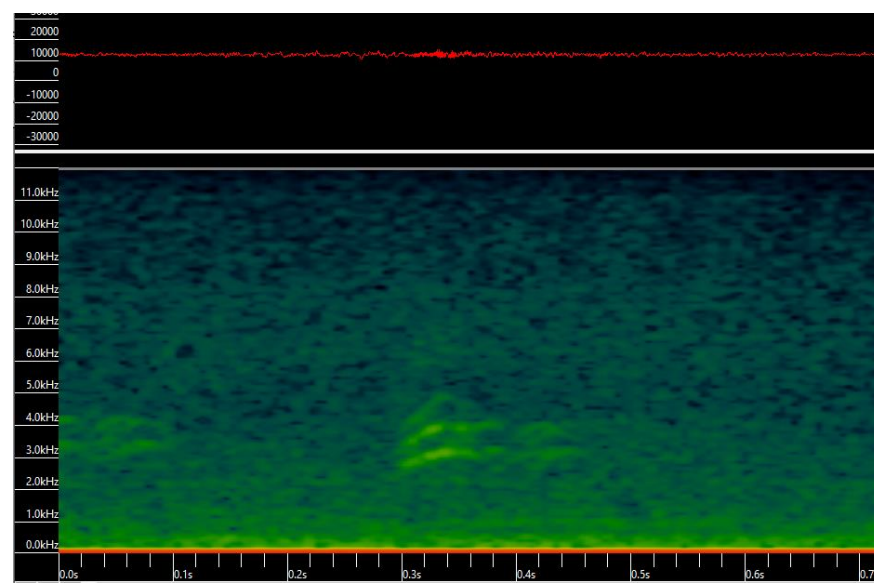
Visible Light Cameras

- Single Camera
- Weatherproof
- Permits Species ID



Acoustics

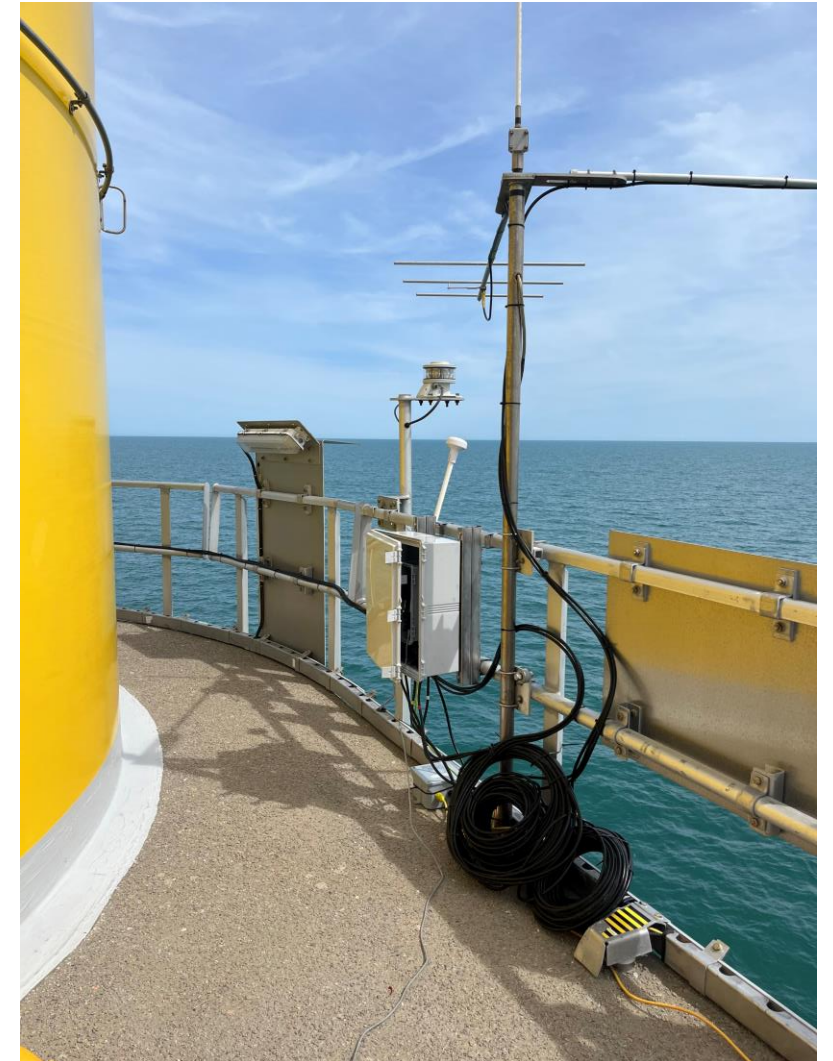
- 2x Bird Detectors
- 2x Bat Detectors
- Weatherproof
- Permits Species ID



Motus

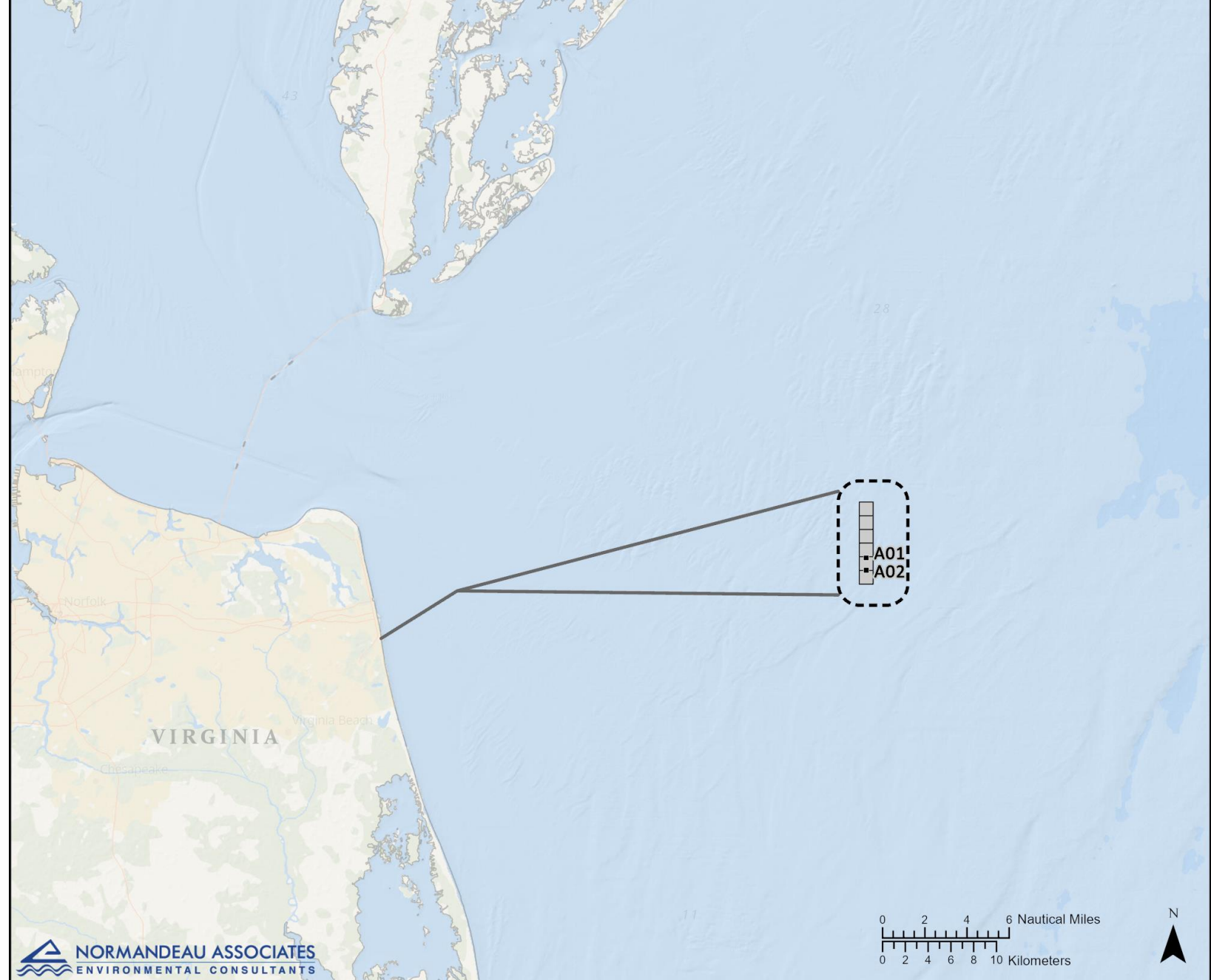
- 1x Dual Band CTT Receiver
- 4x Yagi Antennas (split mast)
- 2x Omni antennas
- 2 Configurations
 - Yagi (166Mhz), Omni (434Mhz)
 - Yagi (434Mhz), Omni (166Mhz)

Turbine	Detection Date	Species	Tag
A01	9/24/2021	Semipalmated Sandpiper	55948
A02	9/24/2021	Semipalmated Sandpiper	55948
A01	8/12/2022	Purple Martin	60790
A01	8/14/2022	Purple Martin	60790
A01	8/15/2022	Purple Martin	60790
A01	8/25/2022	Purple Martin	66283
A01	9/7/2022	Purple Martin	61221
A01	9/9/2022	Purple Martin	61221
A01	9/15/2022	American Kestrel	67435



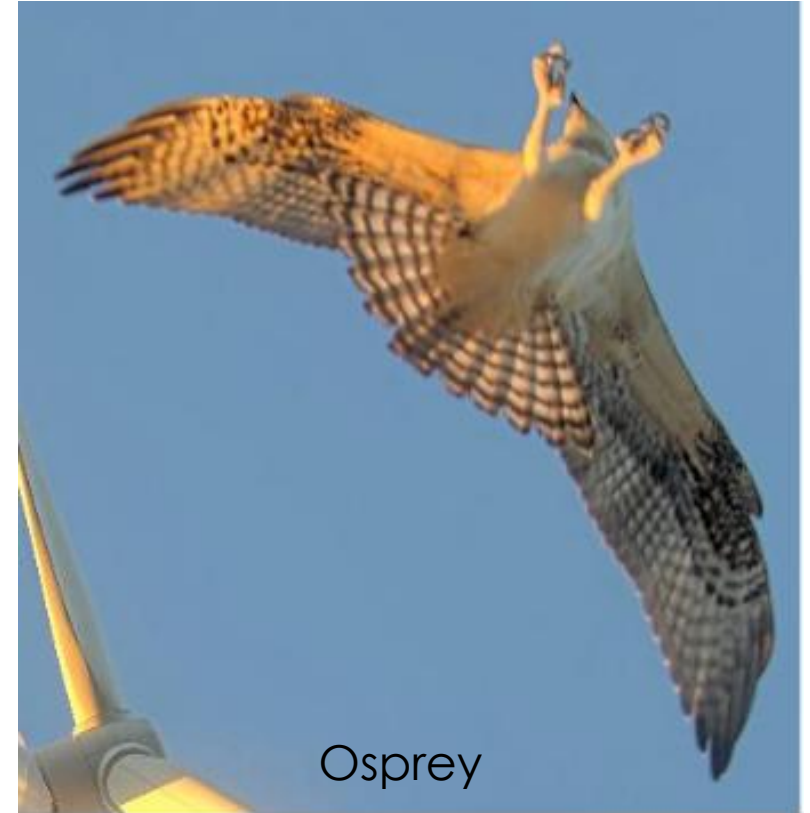
Study Area

- Two ATOM™ systems deployed on wind turbines 23 nautical miles off the coast of Virginia, USA
- Monitored RSZ during day and night
 - 1 April to 15 June 2021
 - 15 August to 31 October 2021
 - 15 January to 15 March 2022

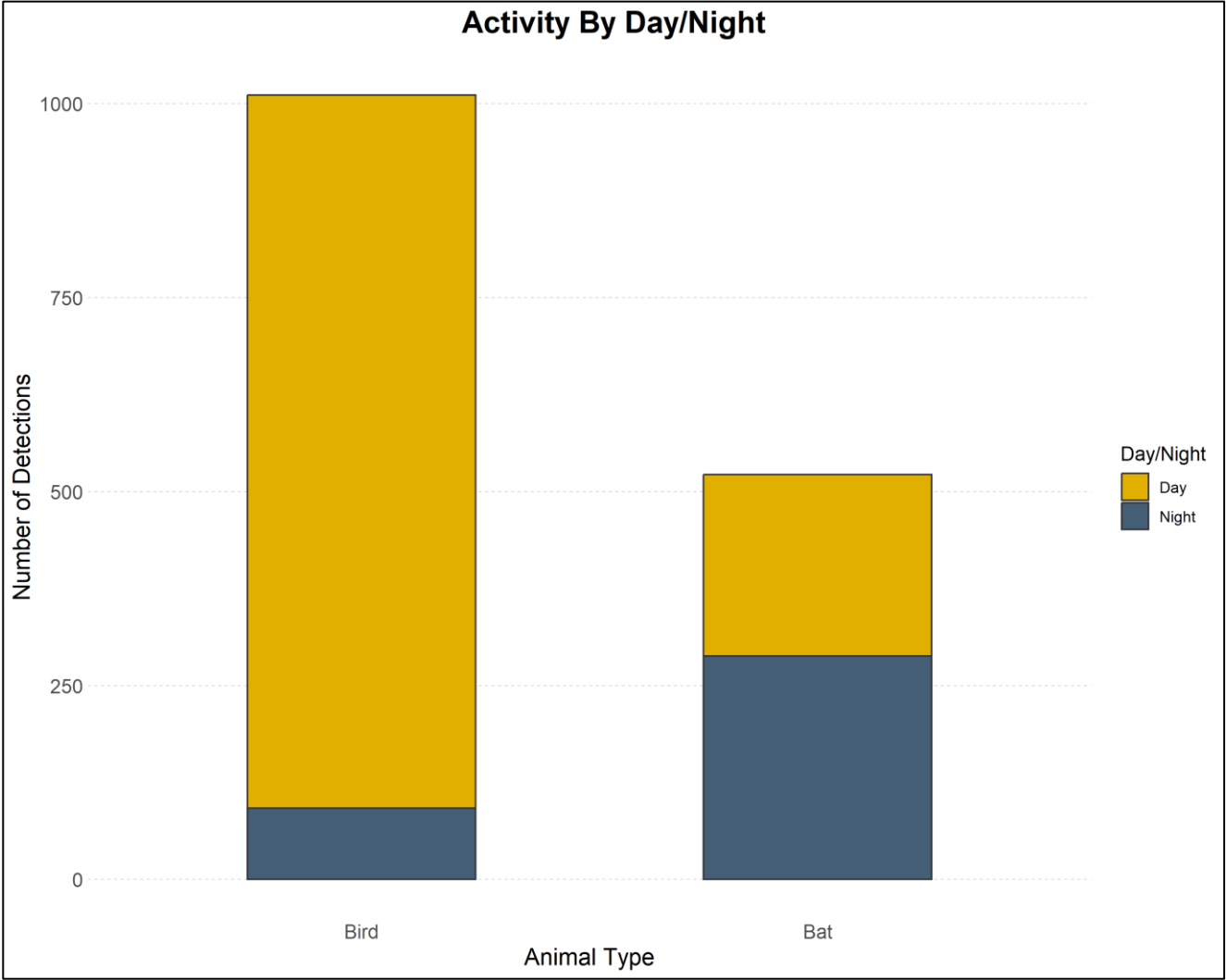


Results

- 1,581 detections (1,011 birds and 521 bats)
- 99% occurred in the fall
- Most detections were birds, including
 - 4 shorebird species
 - 3 gull species
 - 1 tern species
 - 3 raptor species
 - 1 woodpecker species
 - 18 migrant passerine species
 - Skuas, corvids, and swallows also observed



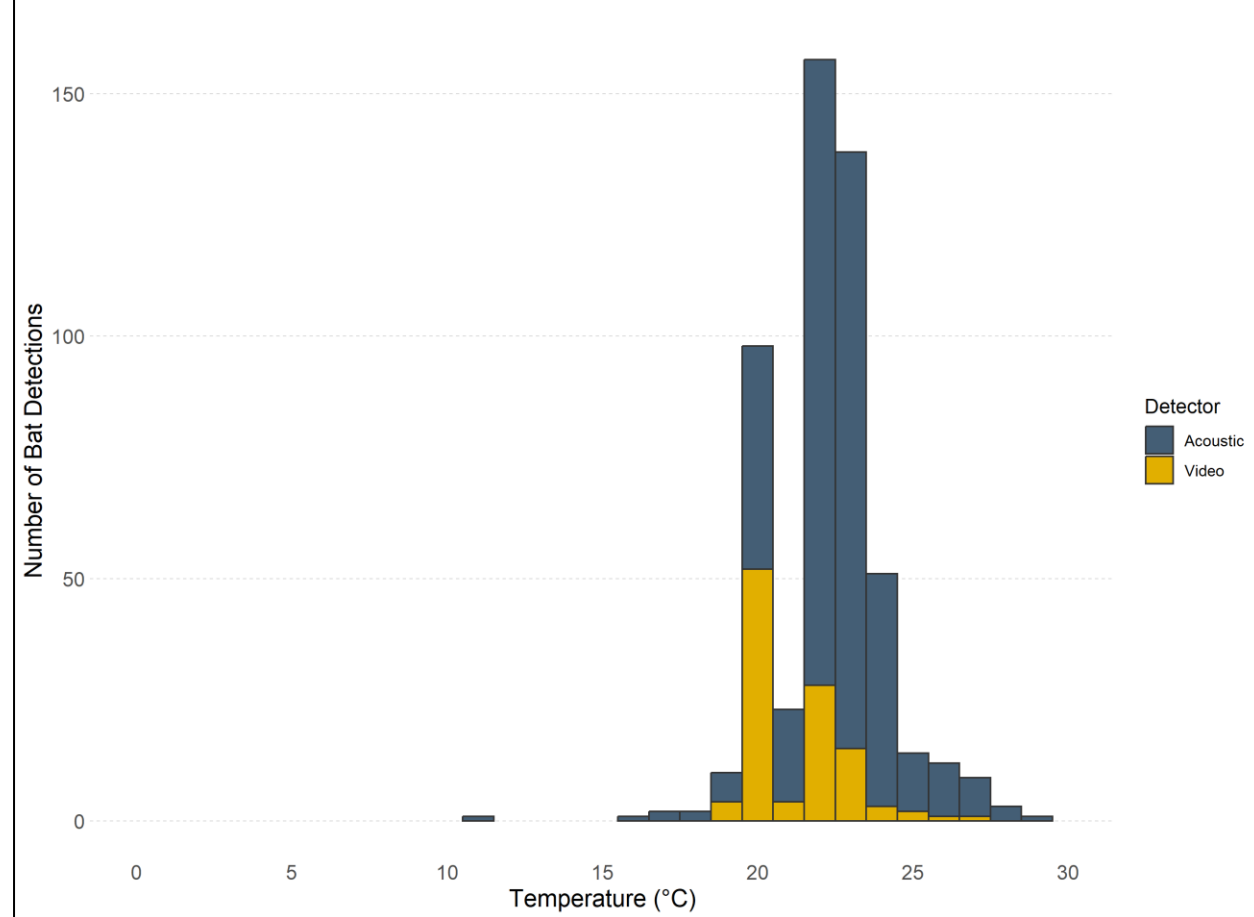
Day/Night Activity



Temperature

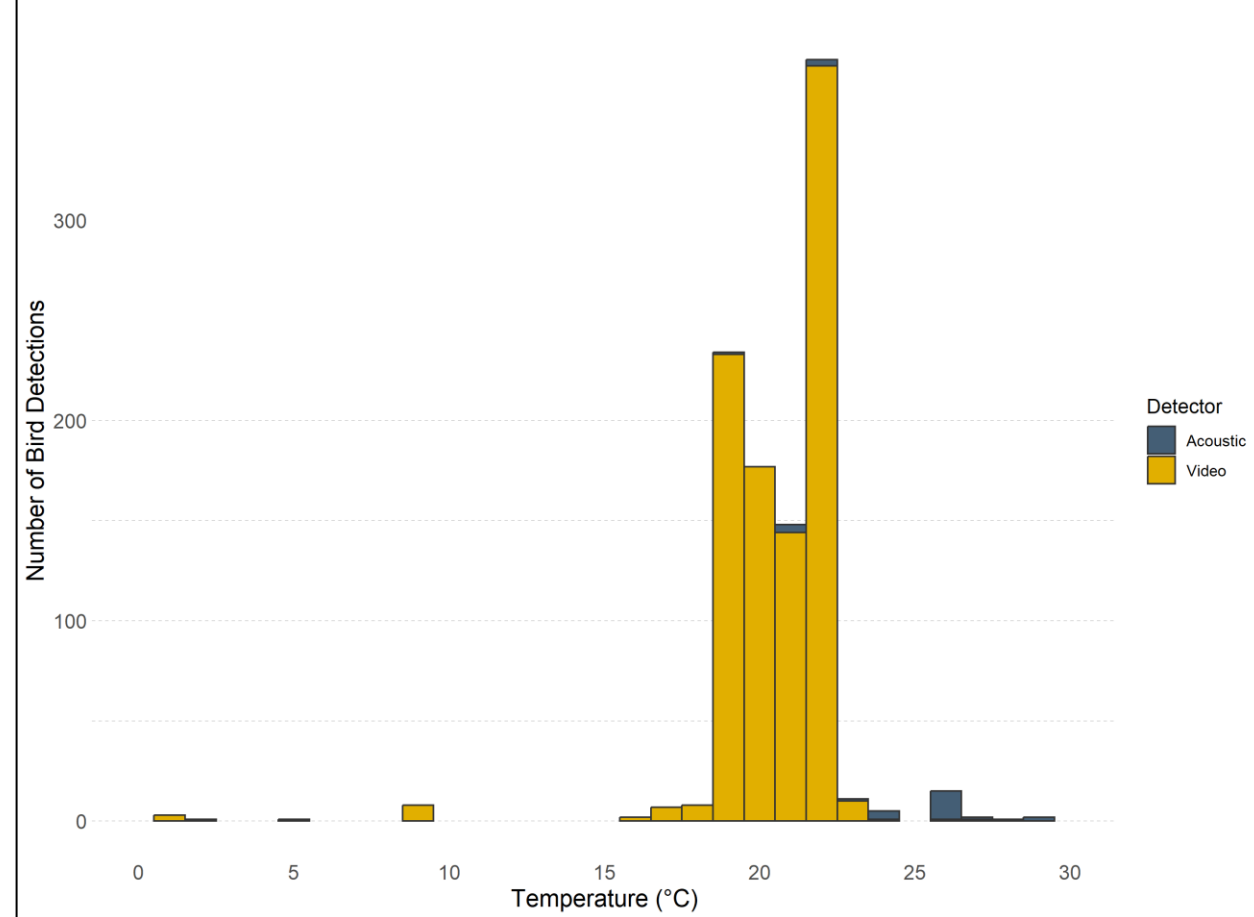
Air Temperature Associated With Bat Detection

Acoustics and Video



Air Temperature Associated With Bird Detection

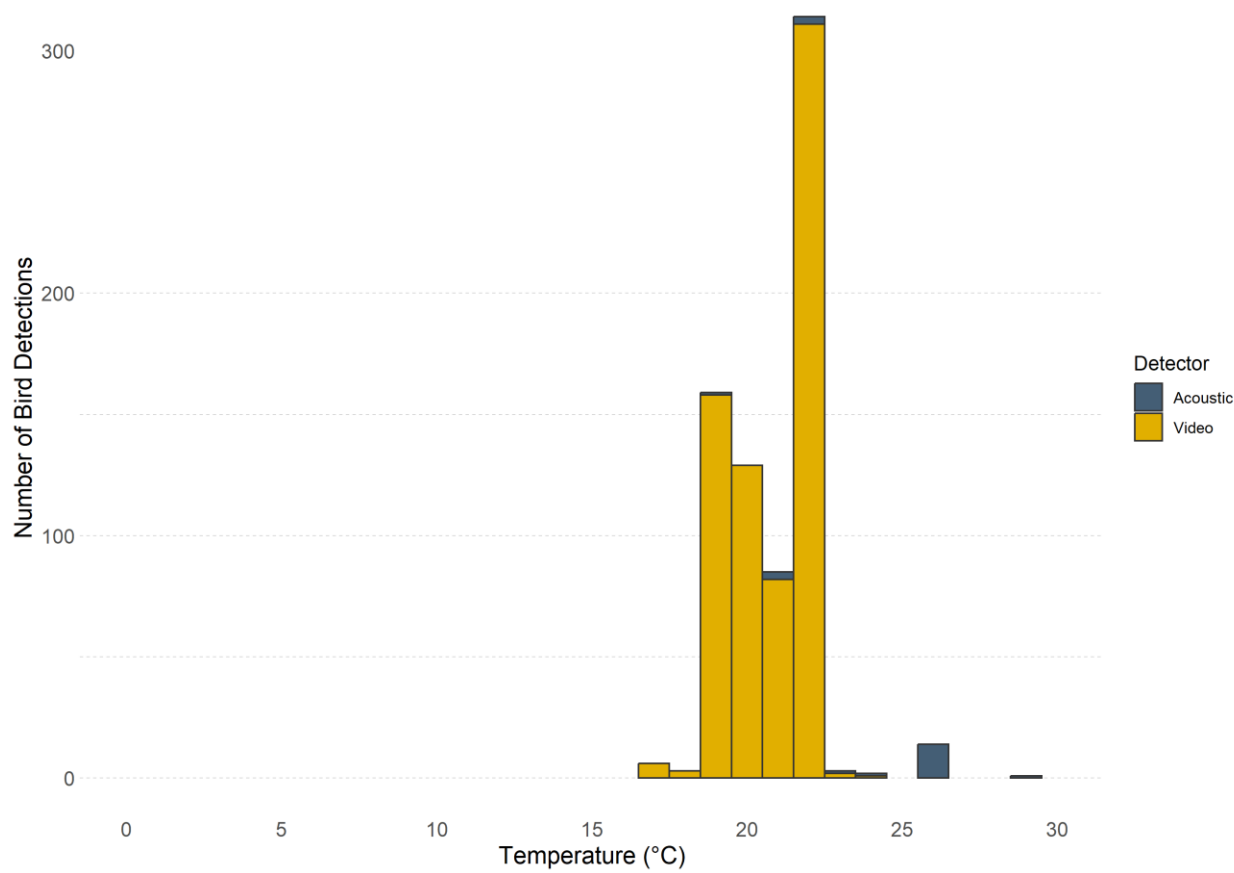
Acoustics and Video



Temperature

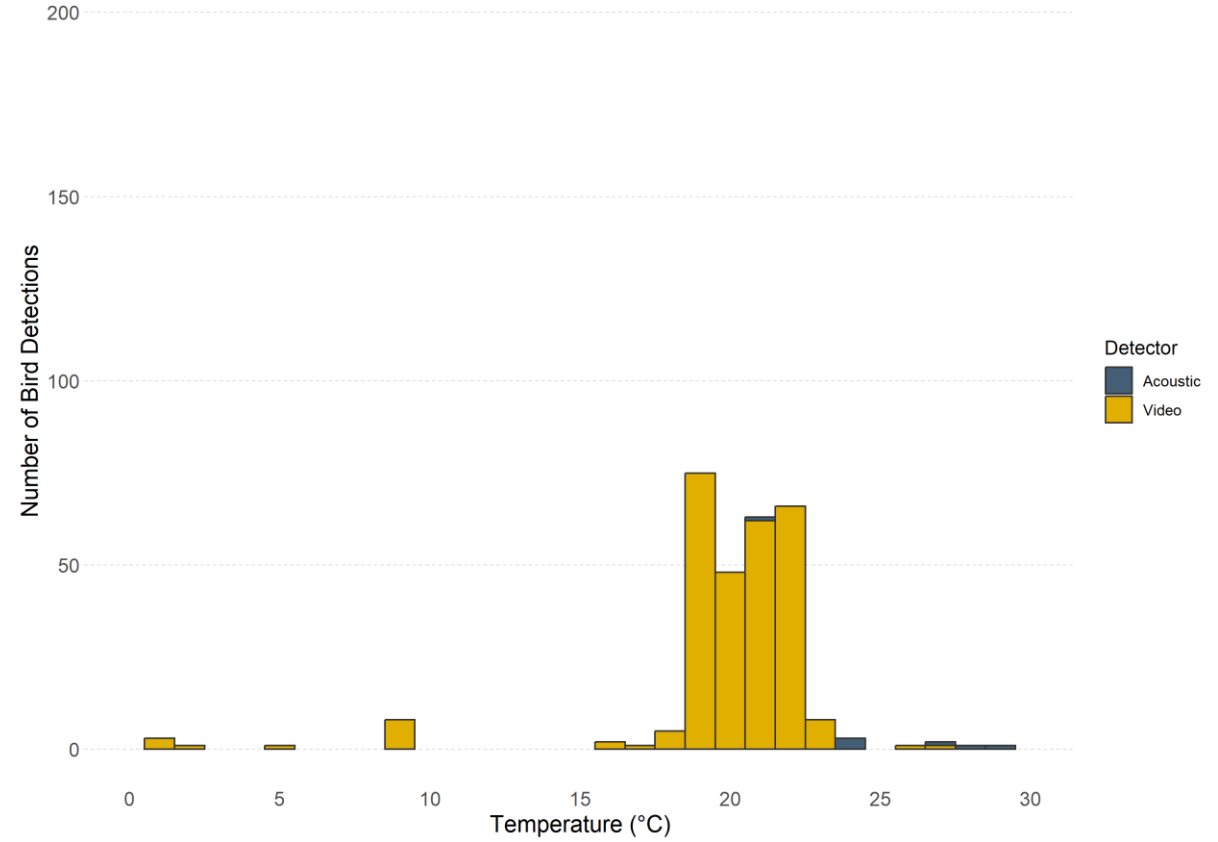
Air Temperature Associated With Bird Detections

Acoustics and Video - Passerines Only



Air Temperature Associated With Bird Detections

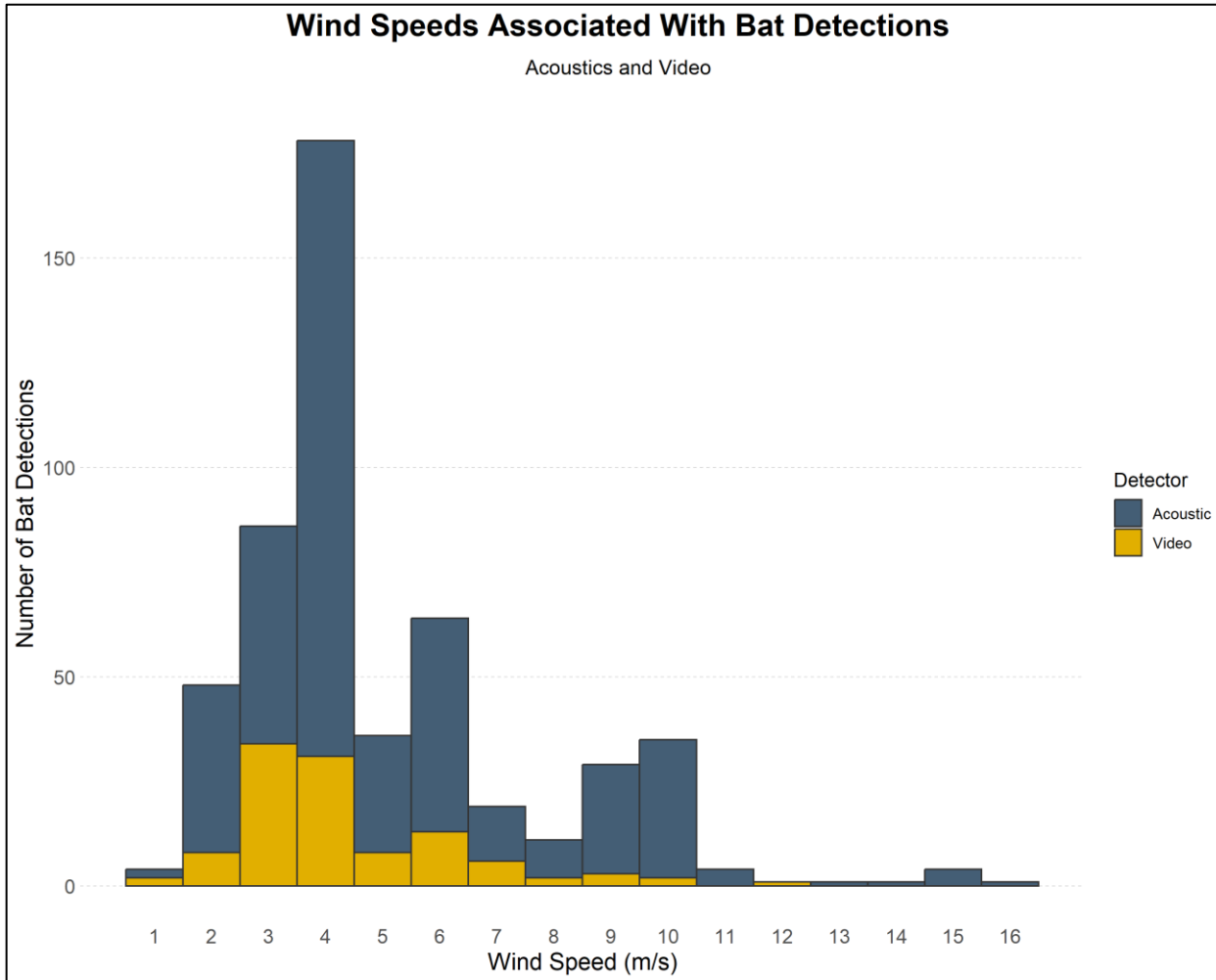
Acoustics and Video - Non-passerines Only



Wind Speeds

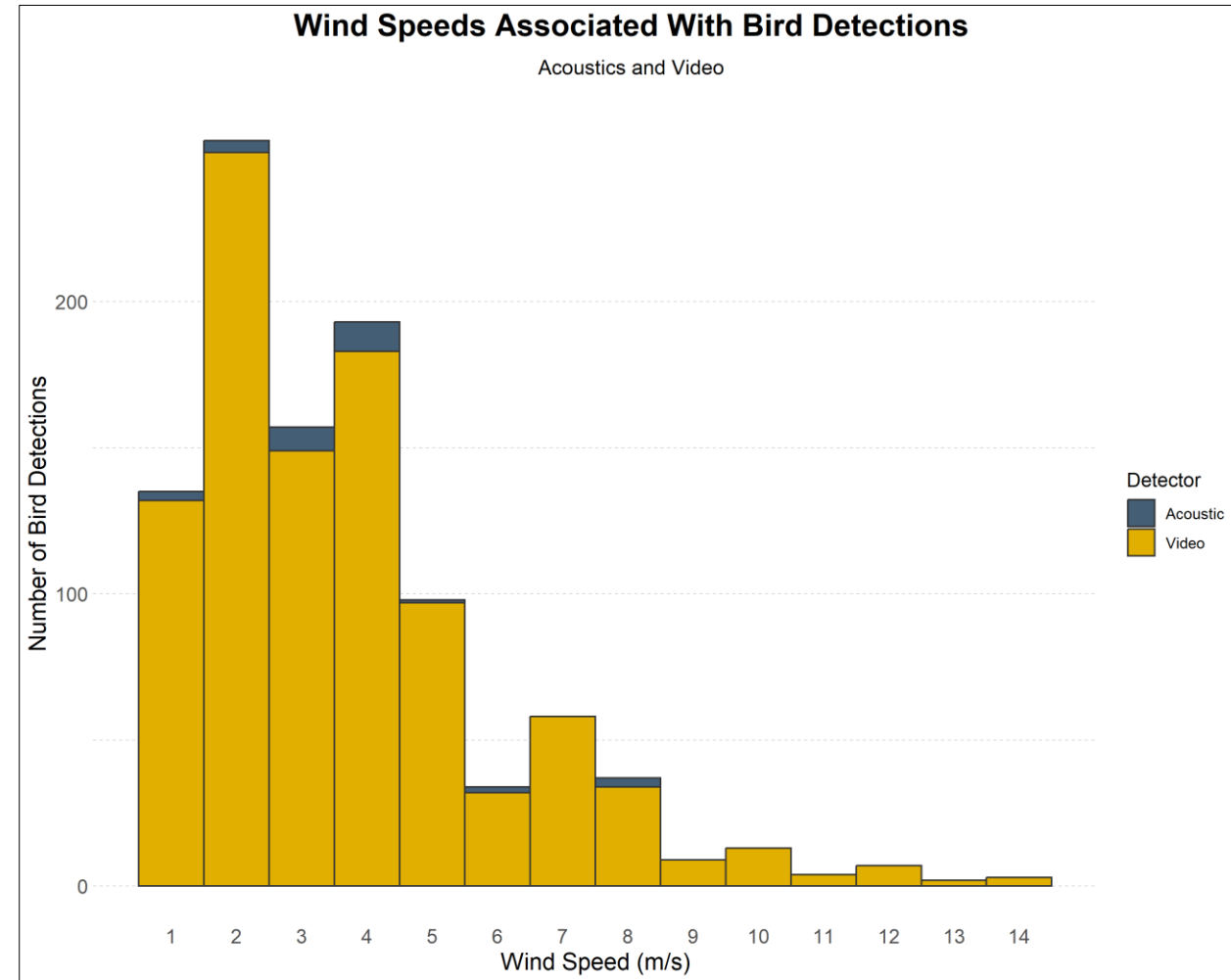
Wind Speeds Associated With Bat Detection

Acoustics and Video



Wind Speeds Associated With Bird Detection

Acoustics and Video

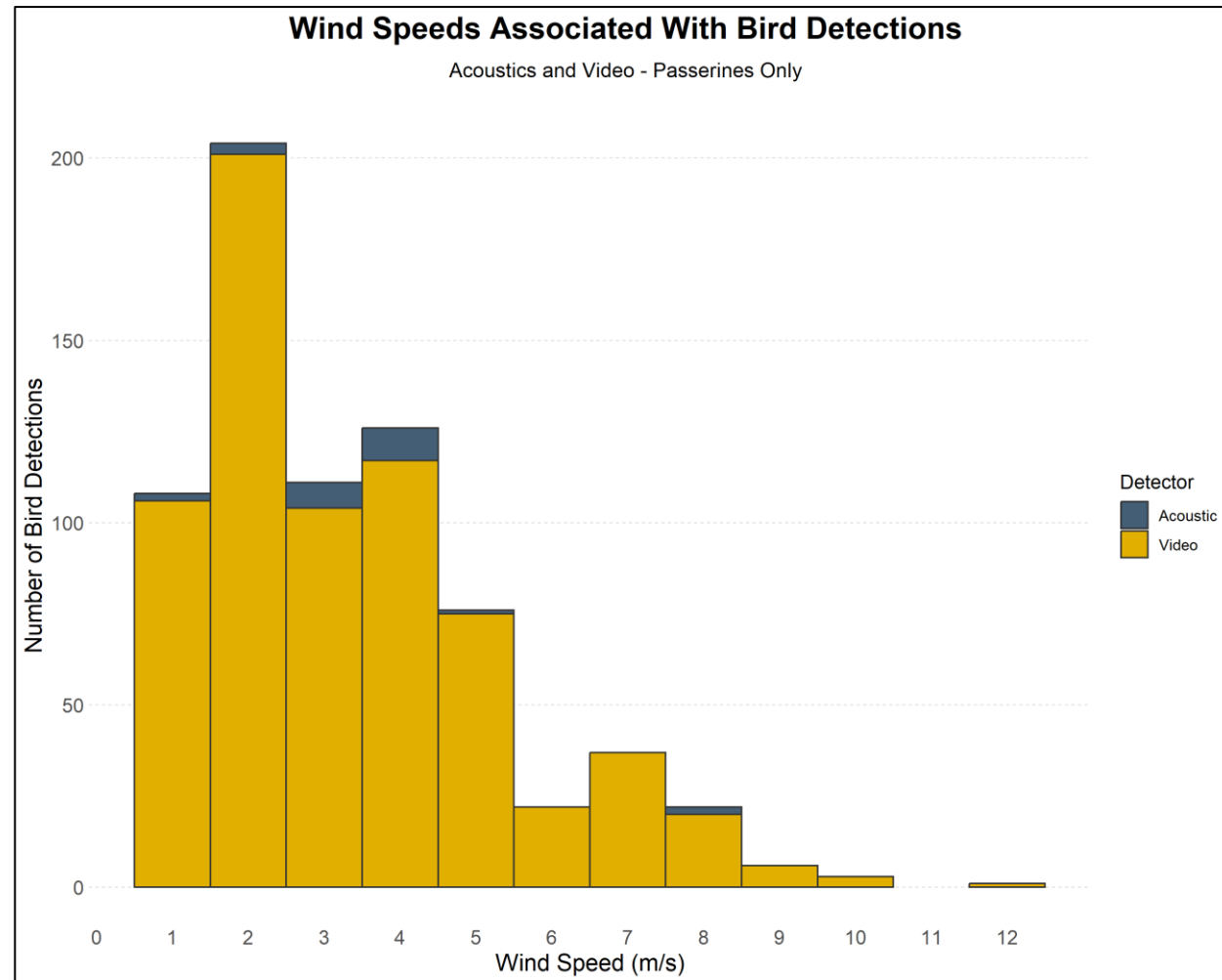


Wind Speeds

Turbine cut-in speed between 3 m/s and 5 m/s

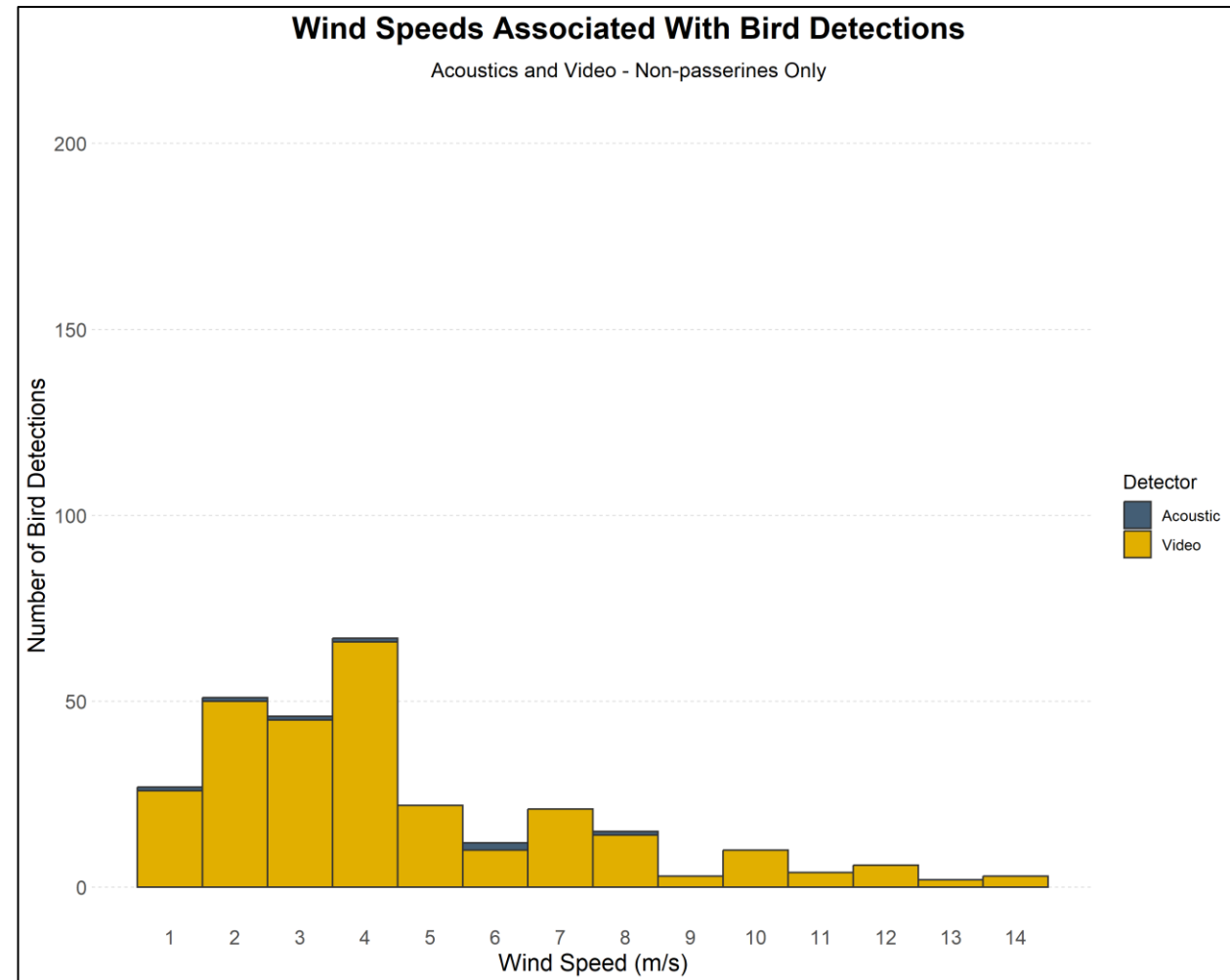
Wind Speeds Associated With Bird Detections

Acoustics and Video - Passerines Only



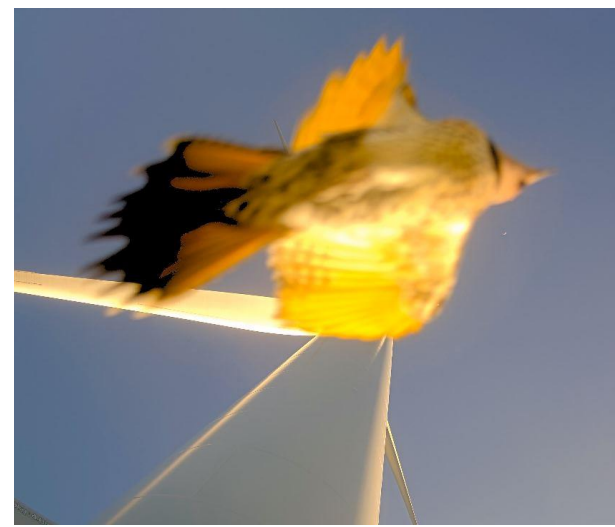
Wind Speeds Associated With Bird Detections

Acoustics and Video - Non-passerines Only

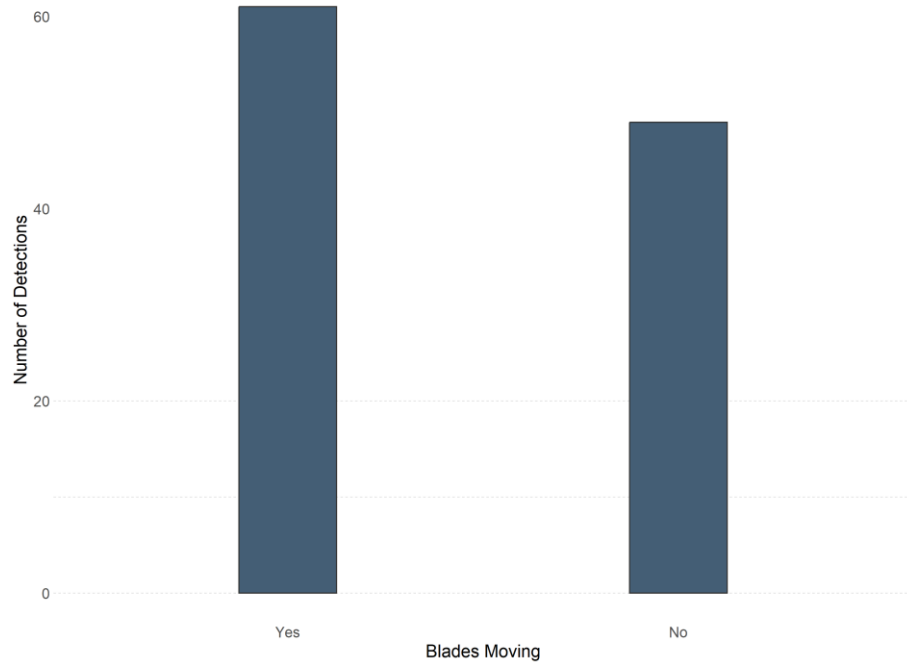


Blade Activity

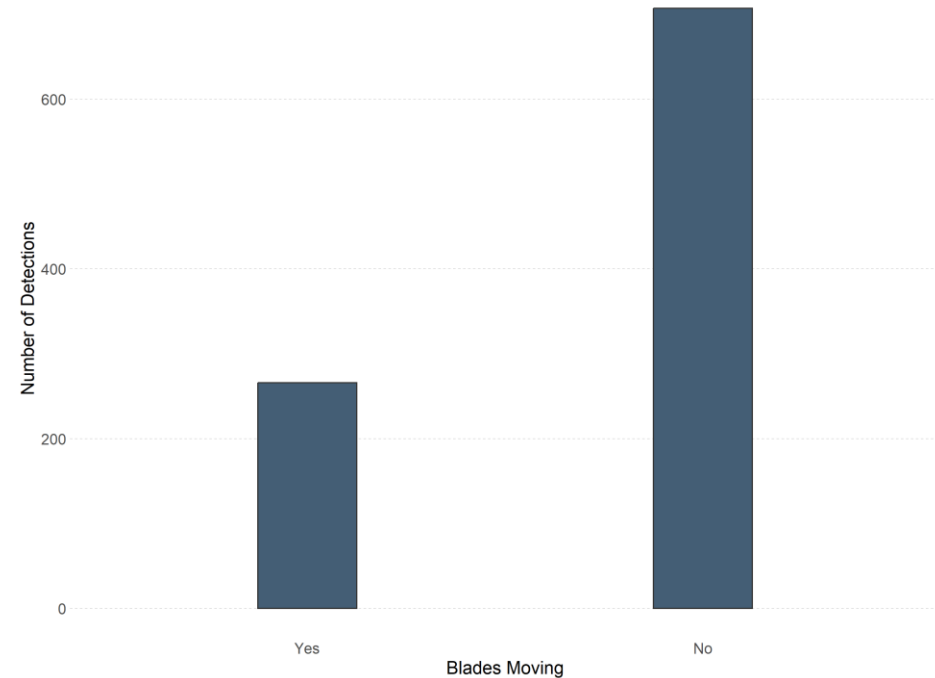
- 72% of bird activity occurred when blades NOT moving
- 55% of bat activity occurred when blades were moving
- Blades were moving 81% of the time



Bat Activity and Blade Activity



Bird Activity and Blade Activity



Foraging and Avoidance

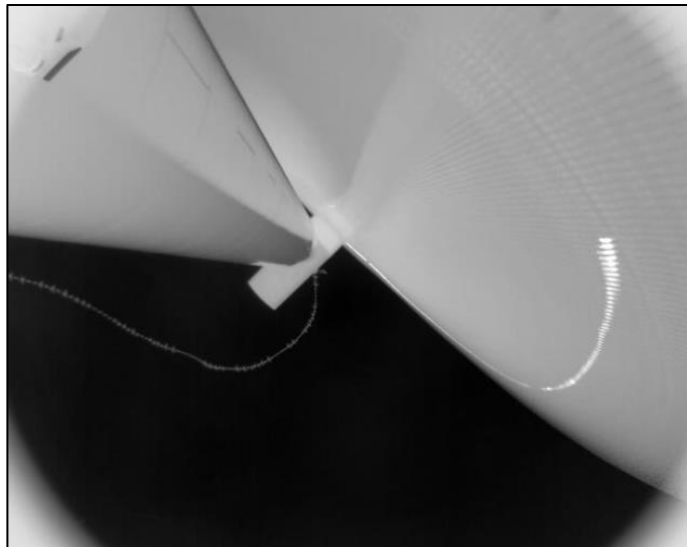
- 596 detections of foraging behaviours around the blades by 21 bird and 2 bat species/group.
 - Aerial foraging
 - Hawking
 - Monopole gleaning
- All except Peregrine associated with insects.



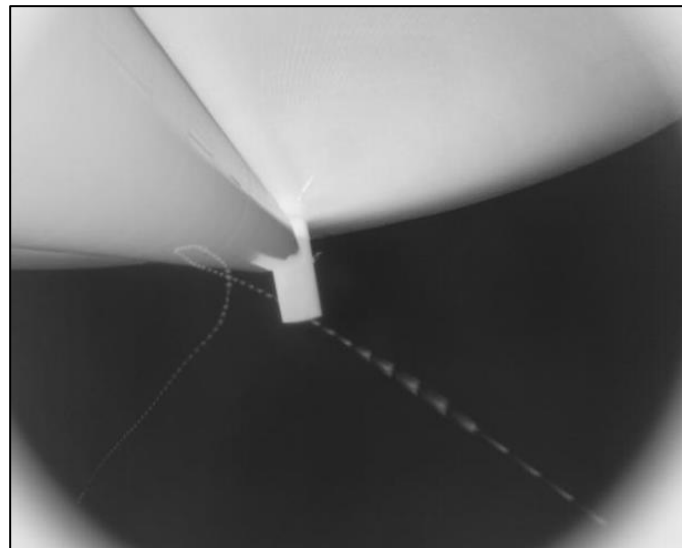
Foraging and Avoidance

- 70 observations of microavoidance from 18 species or species groups (moving blade interaction)
- 2 air displacements (1 bird, 1 bat)
- NO COLLISIONS

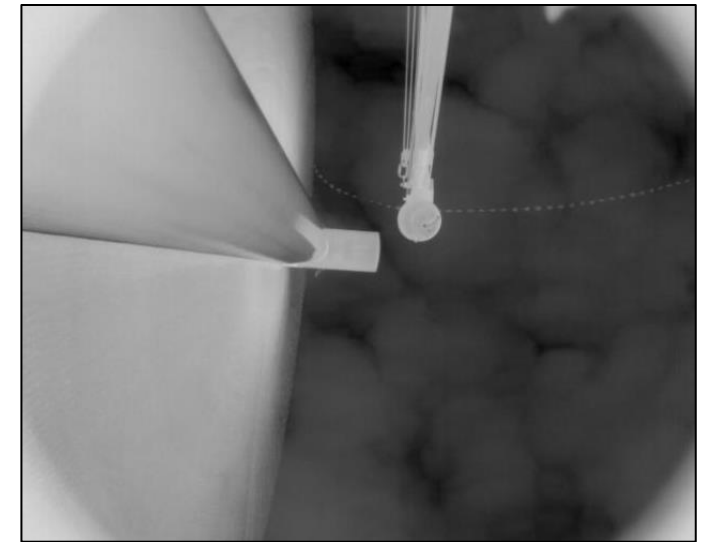
Direction



Speed



No Adjustment



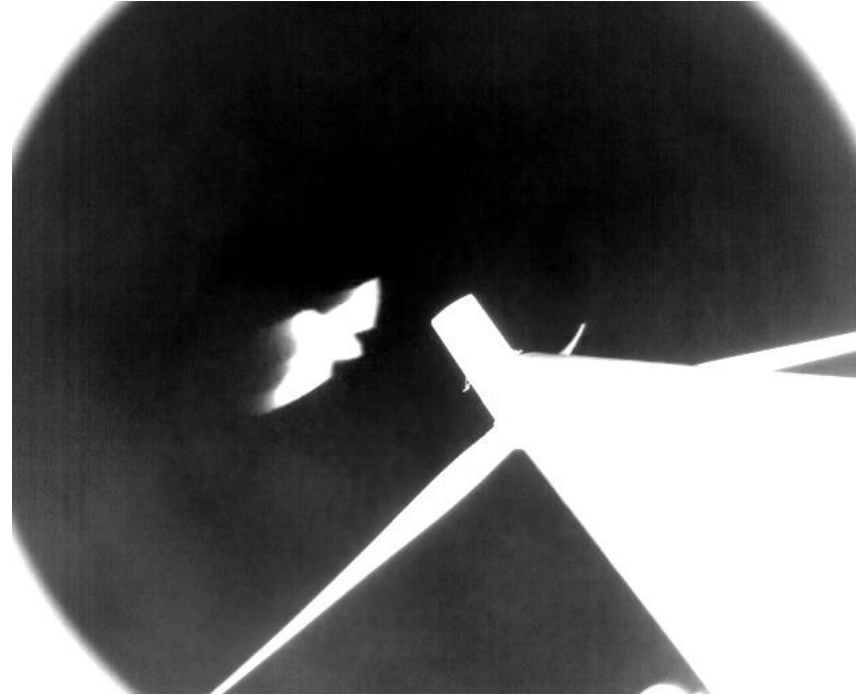
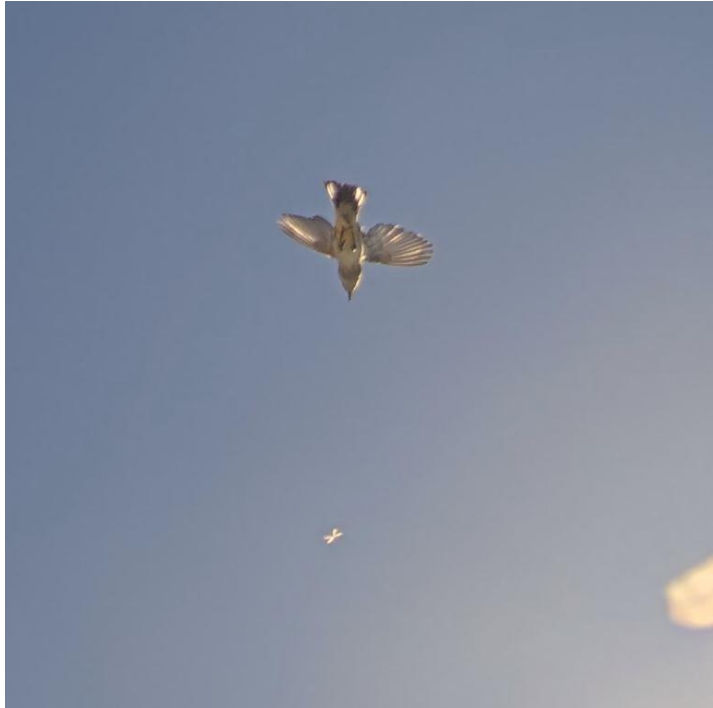
Applications

- Inform collision risk models
- Inform curtailment regimes
- Prioritize species of future research
- Guide minimization and mitigation strategies



Next Phase Research Trials

- 360-degree coverage of the turbine RSZ
- Increase detection range with nacelle-mounted equipment
- Smart Curtailment Integration



Acknowledgements and Thank You!

Dominion Energy team and the CVOW project for their continuing support of this research

SGRE for coordinating site visits

Fast Ferry who so expertly and safely get our team to the turbines for these deployments and retrievals

BOEM for supporting the initial development of the first ATOM system



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