(24) Evaluating helicopter/VTOL bird strike risks

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A recent USDA study of avian wildlife collisions with rotary-wing aircraft showed that such collisions pose significant risks of damage and economic loss, not to mention possible loss of human life. Accordingly, it is becoming increasingly important that we understand the rate at which collisions between birds and helicopters may occur and how these risks vary with time of day and season. Rotary-wing and vertical-take-off-and-landing (VTOL) aircraft differ from fixed-wing operations in speed, altitude, and maneuverability, subjecting them to different bird-strike hazards. In this paper, we explore the feasibility of using avian radar as a tool to measure bird- helicopter/VTOL strike risks. The radar location near the center of the airfield was selected to examine bird movements, including daytime feeding/commuting and nocturnal migration; it also offers the opportunity to track aircraft. Broadly, the intent of this preliminary data analysis is to:

1. Track flight paths of gull-sized and larger birds and to explore variation in temporal (daily and seasonal) and spatial distributions throughout the year.
2. Demonstrate the capability of avian radar to track helicopters and VTOL aircraft on departure and approach.
3. Present data for evidence of near-misses between large birds and helicopters/VOTL (tracks within 150 m of one another), and attempt to describe how the potential for near-misses can vary daily and seasonally.

This analysis is timely and is intended to provide valuable feedback for helicopter and VTOL flight planning in the presence of such bird hazards. Key Words: Helicopter, Vertical-take-off-and-landing, near-miss, military airfield, rotary-winged aircraft, bird strike hazard

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Exploring the Relationship between Near Miss Events and Bird Strike Risk

Presented by Beth Thurber-Duggan and Chris Bowser

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Near Miss Events

- Bird strikes occur infrequently and irregularly
- FAA defines Near Midair Collision as an incident when two flying aircraft are < 500 ft distant (FAA 2014 Aeronautical Information Manual)
- We applied this definition to define a Near Miss Event (NME) between operating aircraft and flying birds
  - NME represents a potential bird strike
- NMEs are identifiable with avian radar

Avian Radar

- X-Band radar detects and tracks small and large targets in 3D
- Detection range that extends beyond the airfield operations area
- Effective at night
- A single radar dataset can be used to differentiate bird targets from aircraft targets
- Formally tested by DoD and FAA

Study Objectives

1. Use avian radar to track flight paths of small and large birds

2. Demonstrate the capability of avian radar to track aircraft on departure and approach at a military airfield

3. Examine radar track data for evidence of Near Miss Events

Site Description: MCAS Cherry Point

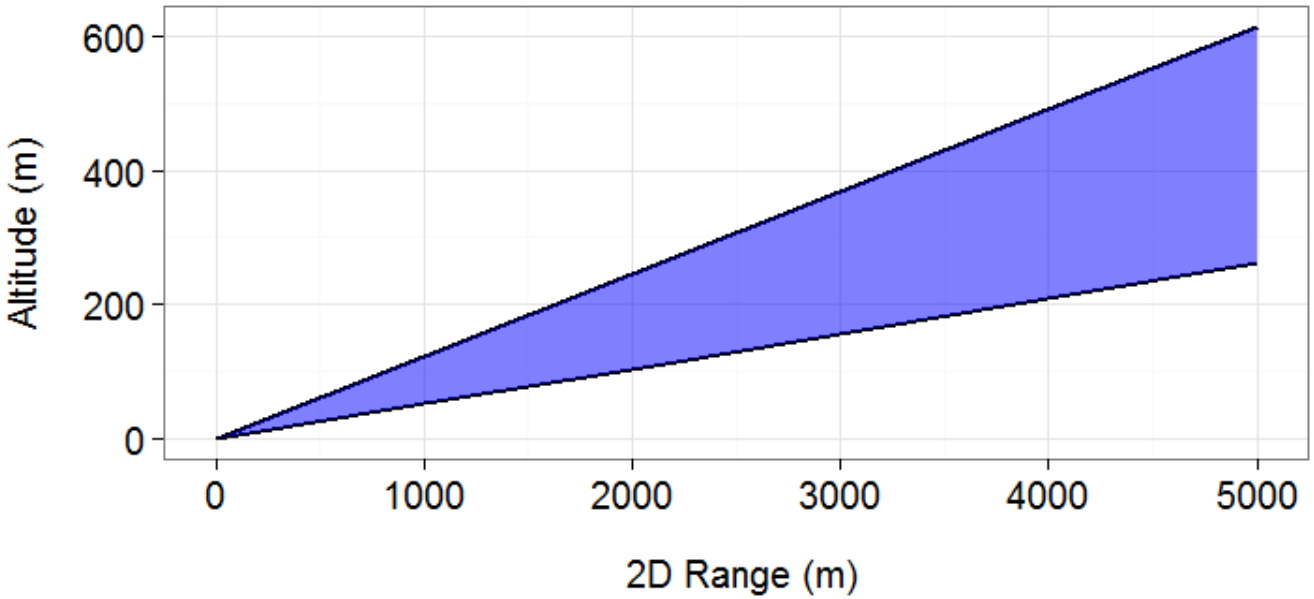
- Base is home to the 2nd Marine Air Wing
  - Covers 13 000 acres
- Active military airfield with 4 runways
  - 2 800 acres
  - Water on three sides: Neuse River (north), Slocum Creek (west), Handcock Creek (east)
- Host a range of aircraft: AV-8B (Harrier), EA-6 (Prowler), KC-130J (Hercules), Unmanned Aircraft Systems, several helicopters, and commercial aircraft

Methodology: Radar Data Collection

- Data collection is continuous, 24 h/day
  - 00:00:00 14 Nov – 23:59:59 21 Nov 2014 EST were included (192 h)

- All periods with precipitation were removed to simplify the analyses (20 h)

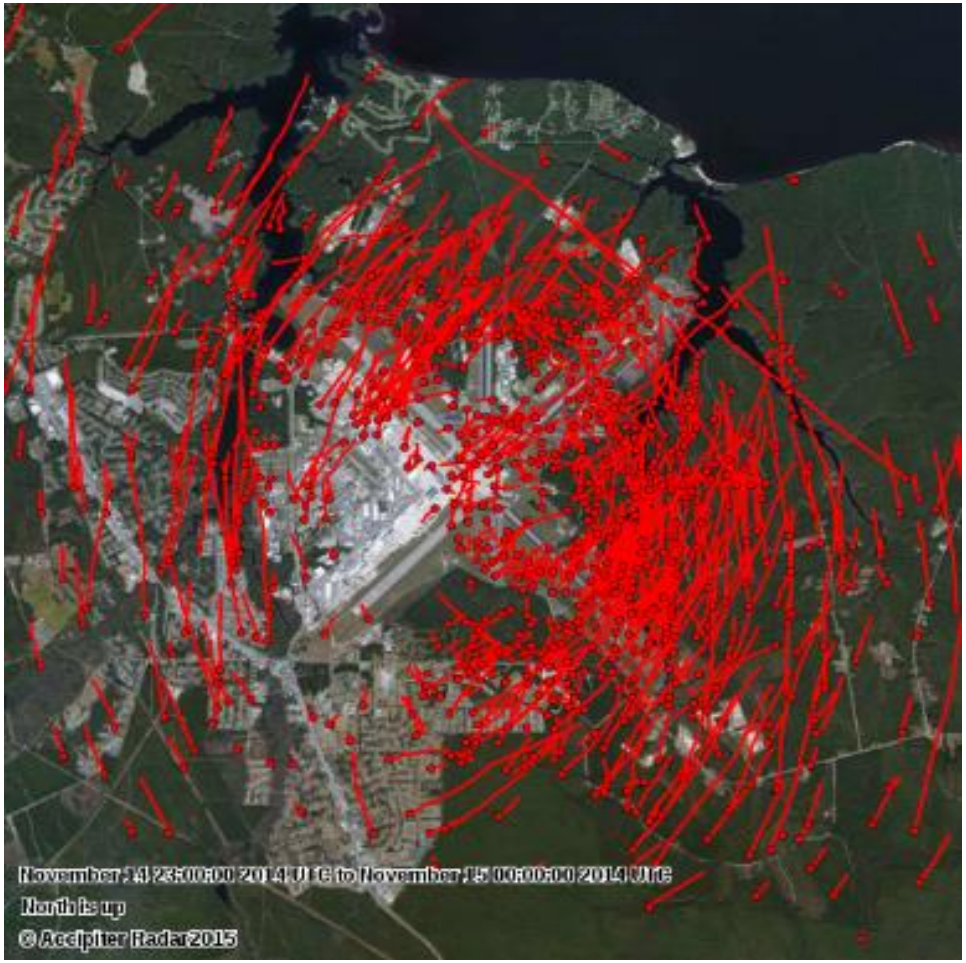
- The dish antenna is tilted to 5°
- 4° beam detects flying targets between 209-491 m AGL at 4 km range



Methodology: Identifying Near Miss Events

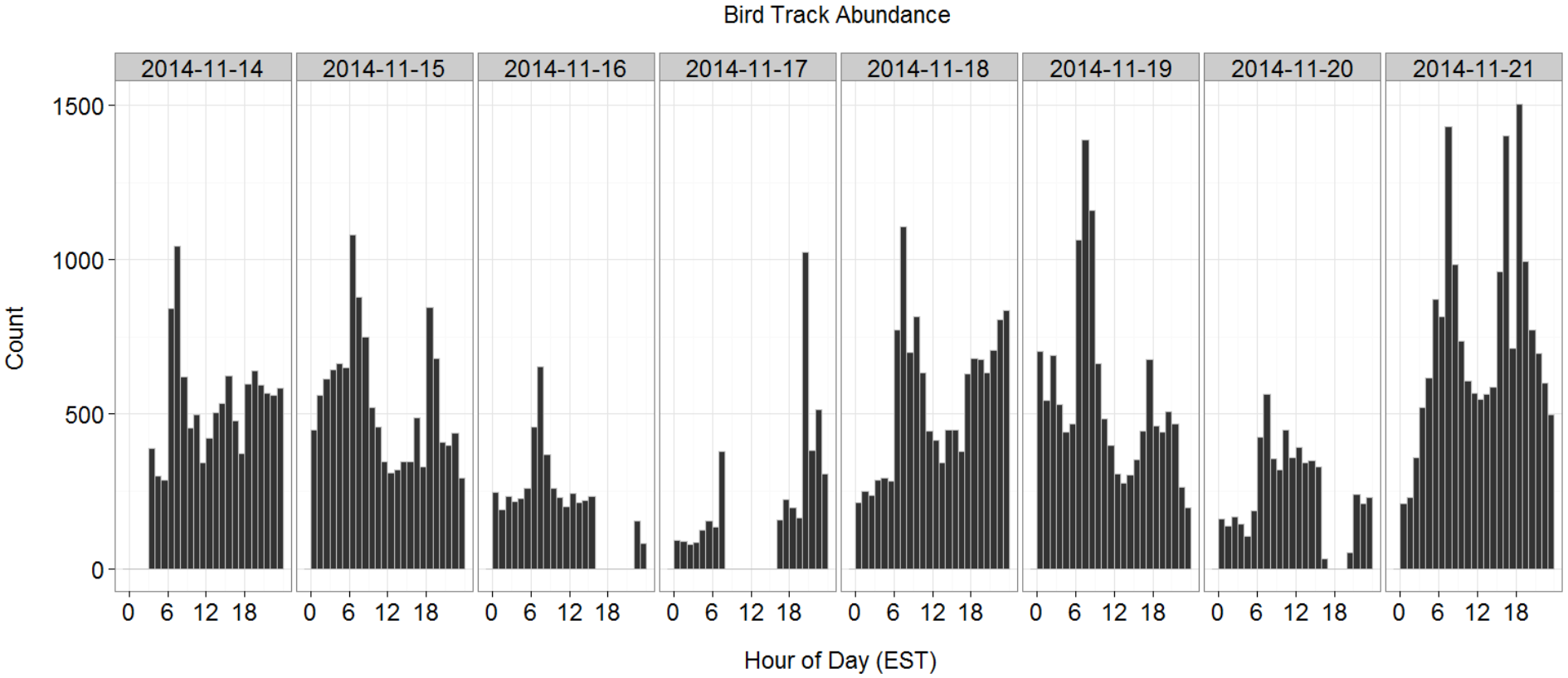
- Instances when aircraft and birds tracks were simultaneously detected ≤ 150 m distant = NMEs
- When NME conditions were satisfied more than once for the same bird and aircraft, only one instance was retained
- Detection range was limited to 4 km
  - Beyond 4 km, the height separation uncertainty is equal to the maximum distance for a NME (i.e. 150 m)

Results: Bird Track Activity



- Bird tracks were detected in every hour
- Counts of bird tracks ranged between 33-1503 tracks/hour
  - Mean = ~480 tracks/hour
- Detected within and beyond the airfield operations area in all cardinal directions

Results: Bird Track Activity

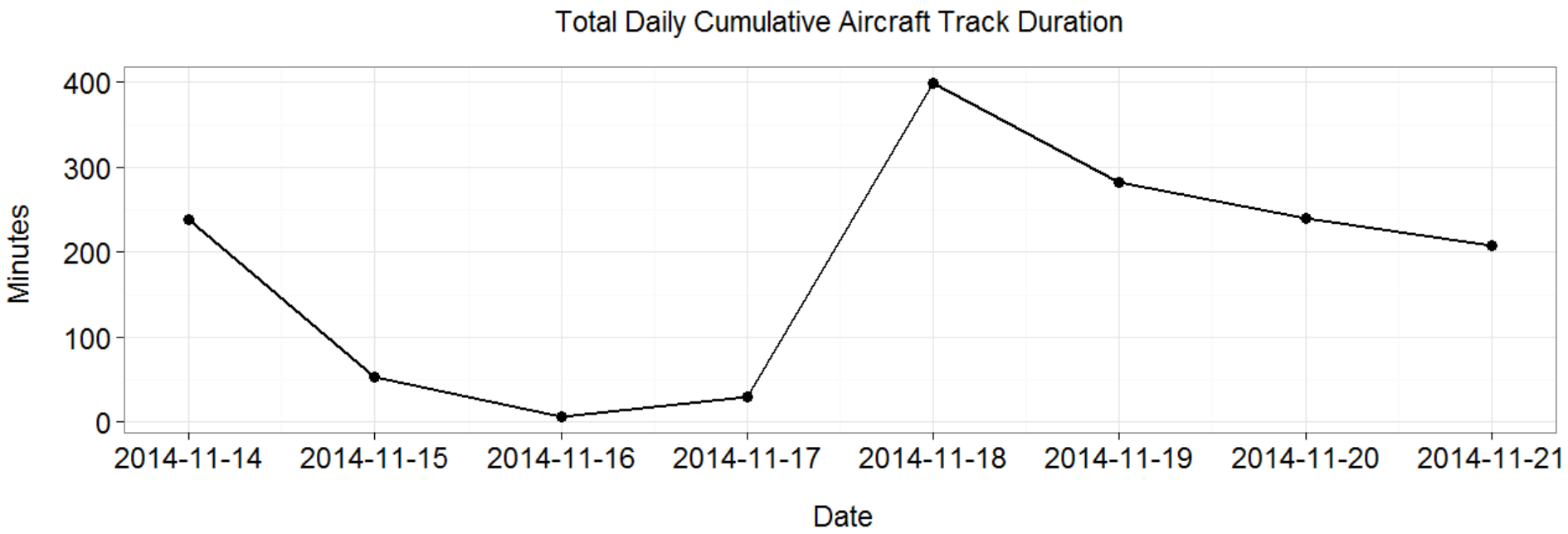


Two peaks in bird track abundance per day: near the timing of sunrise and sunset

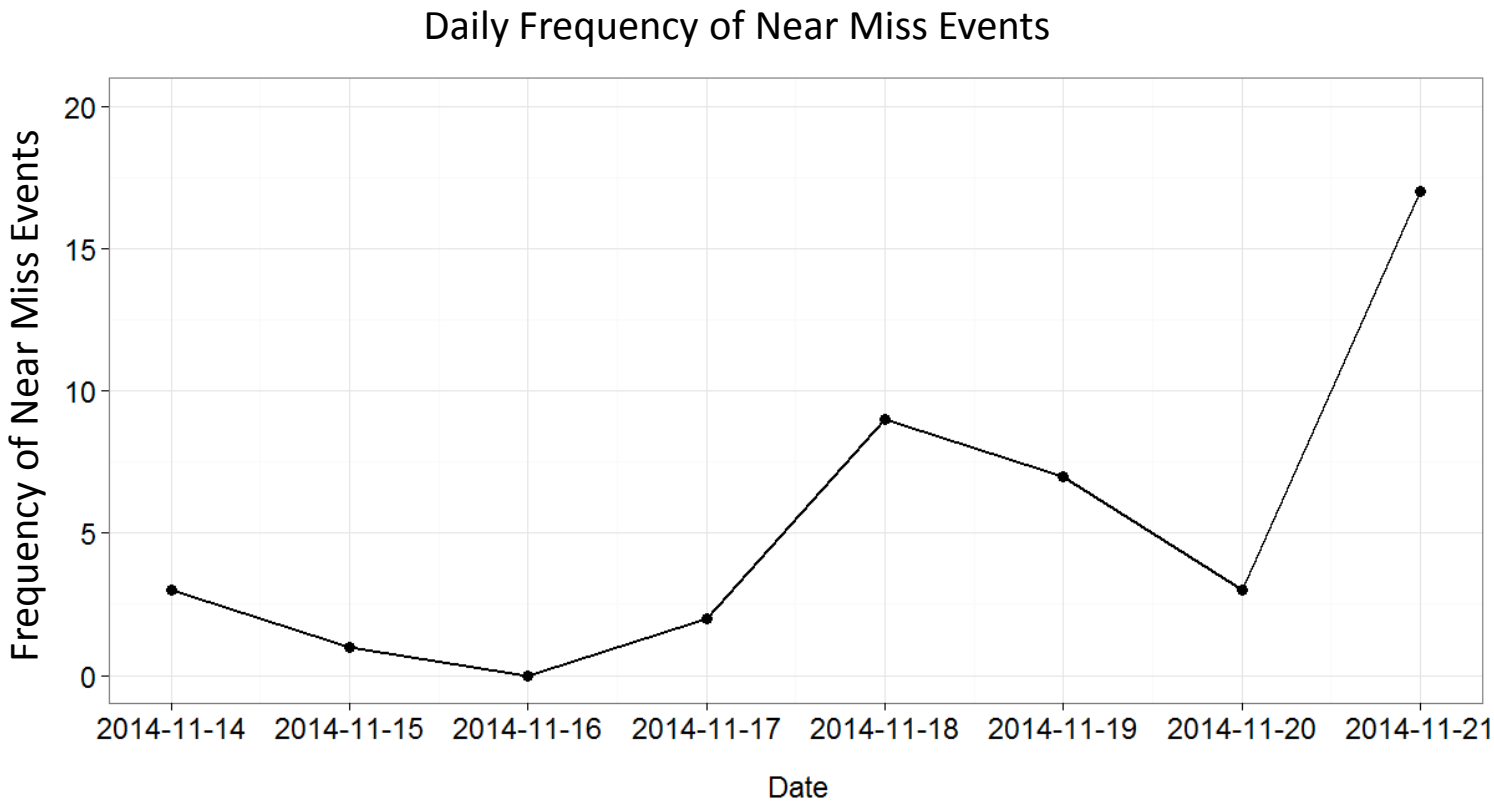
Results: Aircraft Tracking

- Across 8 days, aircraft were detected 8:00-22:00 EST (inclusive)
- Aircraft were detected in all phases of flight: departure, arrival, in pattern

- Cumulative aircraft track duration = 3.9-108.6 min/hour
  - Median = 19.2 min/hour



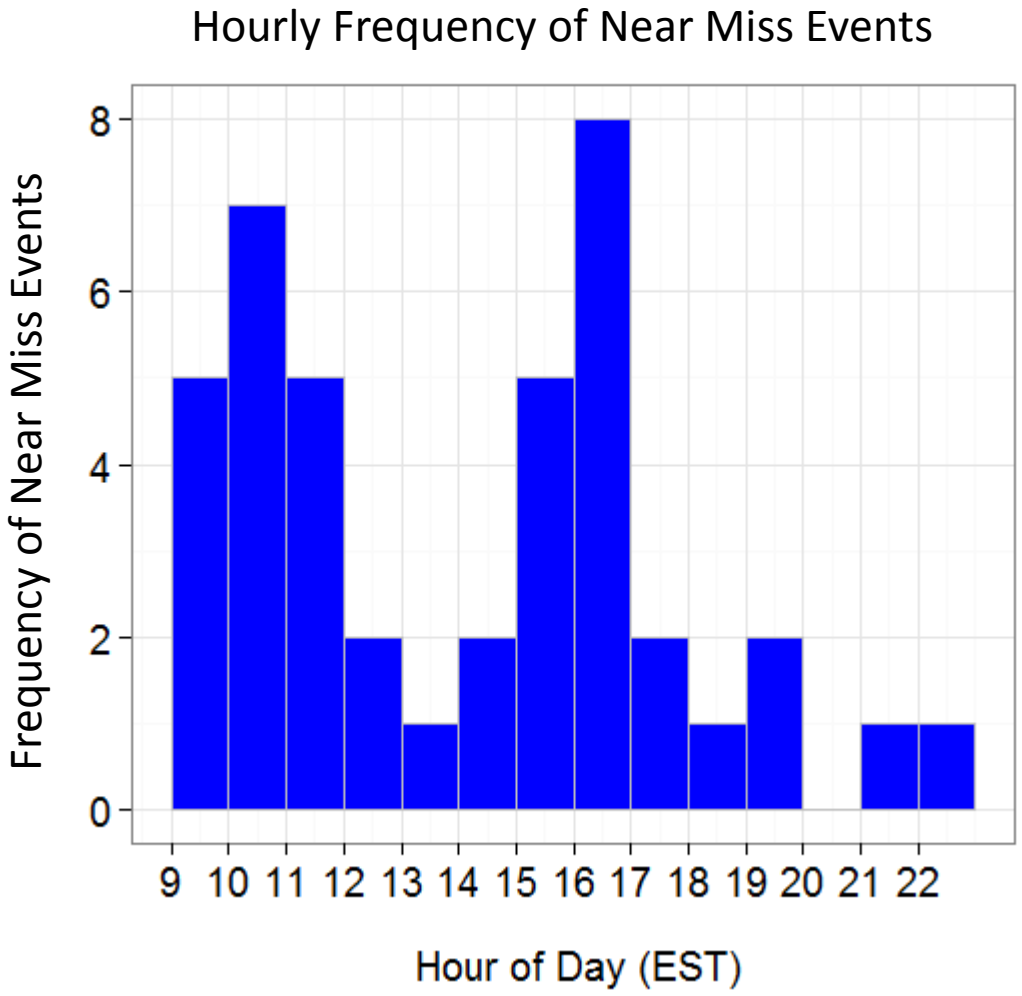
Results: Temporal Pattern of Near Miss Events



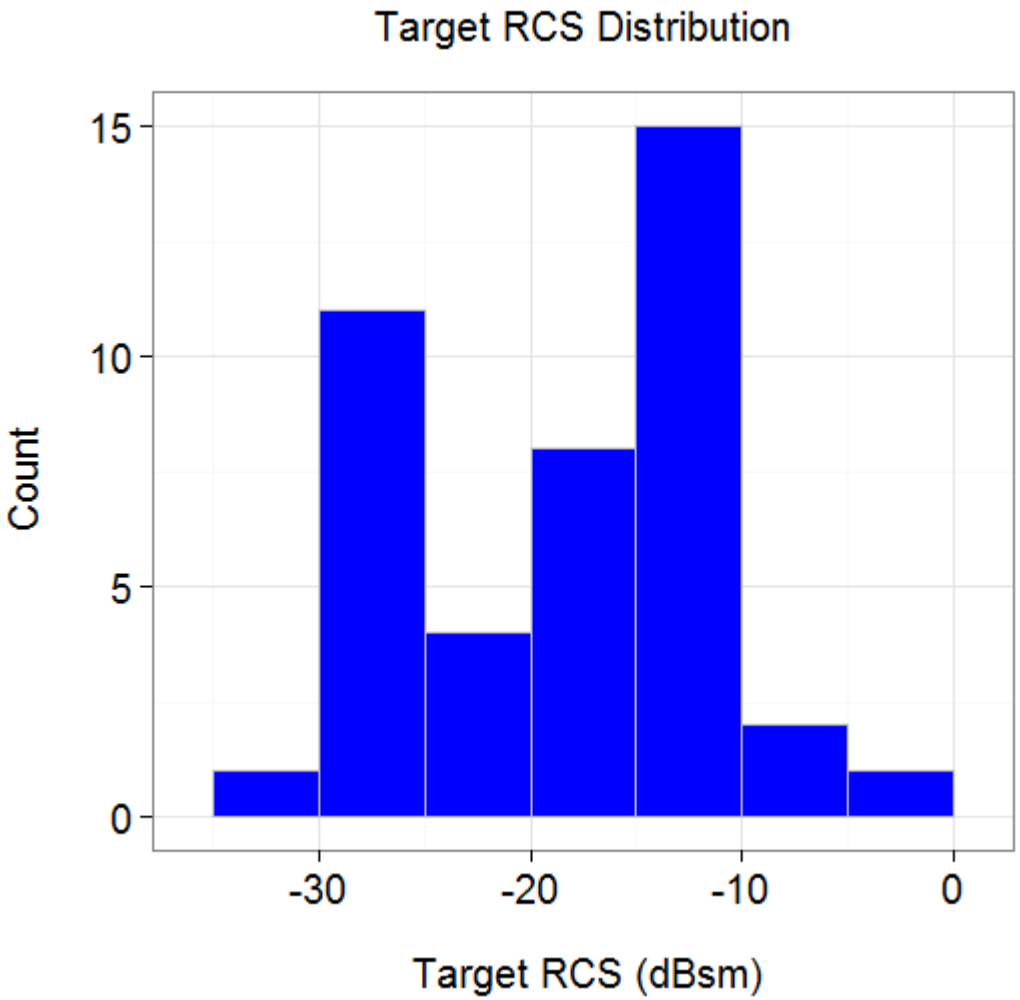
- 42 total NMEs
- ≥ 1 per date, except 16 Nov
- 21 Nov featured the highest daily total (n = 17); 6 in one hour
- 1 reported bird strike: 18 Nov

Results: Temporal Pattern of Near Miss Events

- NMEs were identified between 9:00-22:00 EST (inclusive)
- Two peaks: 10:00 and 16:00
- 35 h with no NMEs
- 15 h with 1 NME each
- 39.7% of hours with aircraft activity included ≥ 1 NME

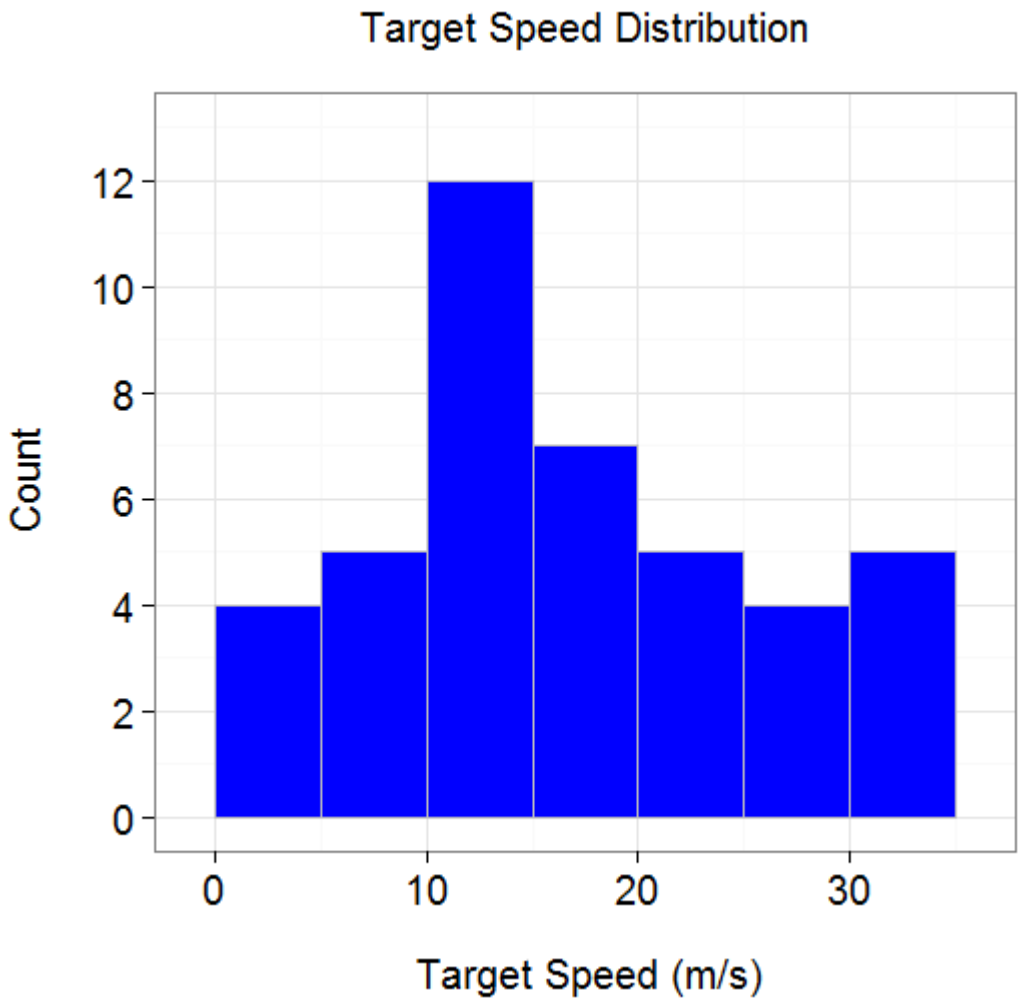


Results: Characteristics of Bird Tracks in NMEs



- Bird tracks involved in NMEs had RCS between -30.1 and -2.0 dBsm
- Median RCS was -16.4 dBsm
  - E.g. American Crow

Results: Characteristics of Bird Tracks in NMEs



- Bird tracks involved in NMEs were tracked with speeds 2.6-32.9 m/s at the time of the NME
- Mean track speed was 15.4 m/s
  - E.g. Red-tailed Hawk in flapping flight

Results: NME versus Flight Phase

Flight Phase	# Aircraft tracks in NMEs
Approach	19
Departure	2
In pattern	21

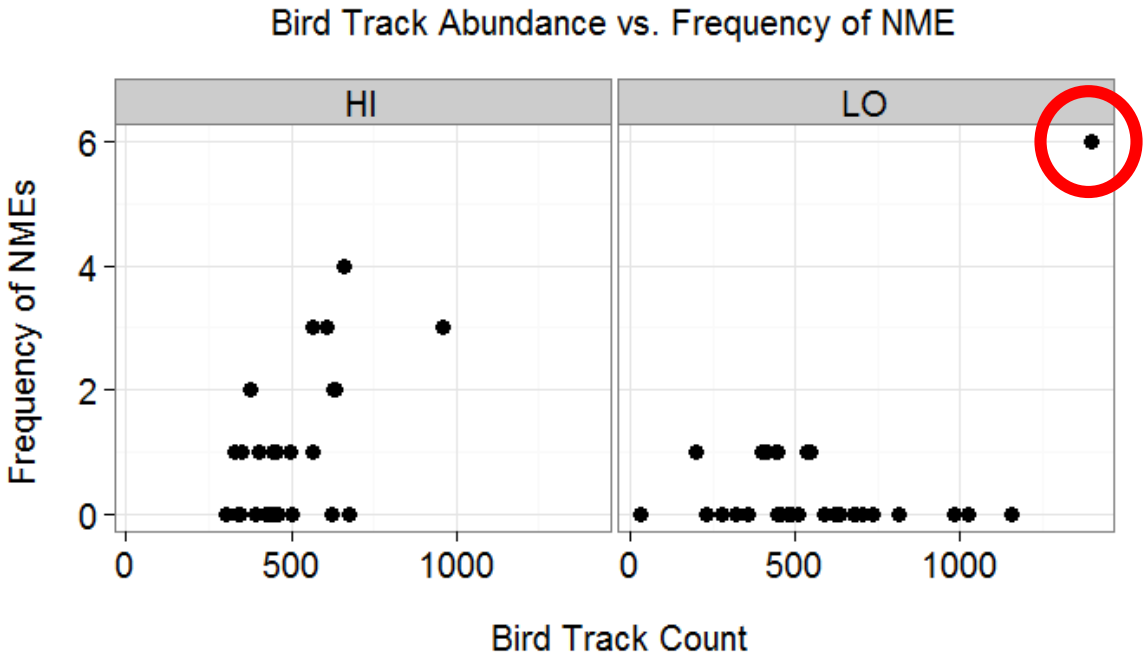
Results: NME versus Aircraft Activity

Aircraft activity	Total hours	# hours when NME ≥ 1	% hours when NME ≥ 1
LO = < 19.2 min/hour	29	8	27.6
HI = ≥ 19.2 min/hour	29	15	51.7

*19.2 min/hour = median cumulative hourly aircraft track duration

Results: NME versus Bird Track Abundance

- Strong positive relationship between frequency of NMEs and counts of bird tracks on high aircraft traffic hours
  - PMC: r = 0.58, $p < 0.05$
- Potential interaction between effects of aircraft activity and bird track abundance on frequency of NME?
- Outlier in one low traffic hour
  - 21 Nov 16:00-17:00 EST



Example: 6 NMEs in a Single Hour

21 Nov 16:00-17:00:

- 6 NME involving just 3 aircraft tracks
- 9.1 min/hour cumulative aircraft flight duration
  - Low flight activity hour
- 1400 bird tracks

Aircraft tracks in yellow
Bird tracks in blue

Summary

- This a preliminary, opportunistic study of potential interactions between bird and aircraft tracks:
  - 42 NMEs in ~1 week of radar data collection
  - One reported bird strike
  - More NMEs with aircraft on approach or in pattern

- Factors not yet considered:
  - Longer term temporal variation: seasonal, annual
  - Geographic variation
  - Weather
  - Flight phase
  - Aircraft type
  - Bird species
  - Bird behaviour

Broader Implications

- The ratio of NME:bird strike was 42:1
- If this relationship remains constant as sample sizes increase, modelling the variation in frequency of NMEs could be used to predict when the likelihood of potential bird strike frequency will be high
- A potentially valuable tool for mitigating bird strike risks



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