Report Date: March 25, 2025

Report Name: Nocturnal Flight Call Project at Gateway Arch National Park – Fall 2024

Report Sponsor: DarkSky Missouri (visit https://www.darkskymissouri.org/nature)

Project Goals: In September 2024, the objective was to collect and analyze the nocturnal calls of migrating birds at *Gateway Arch National Park*. The data were intended to support public outreach efforts, emphasizing the activity of nature during nighttime hours and advocating for responsible lighting practices to preserve the natural nocturnal environment. Whenever possible, spectrographs of bird calls were to be uploaded to *eBird*, contributing to citizen science initiatives.

The project team faced a challenge, having received the *AudioMoth* acoustic loggers only two months before the focus period for Lights Out Heartland. This limited timeframe allowed for minimal familiarity with the equipment, making hands-on experience with its operation a key secondary goal.

Lights Out Heartland, led by DarkSky Missouri, aims to promote adjustments to outdoor lighting during crucial bird migration periods. While the initiative spanned multiple locations, this report centers specifically on data collection at *Gateway Arch National Park*.

* * * See next page ***

Project Setup:

Identifying a suitable recording site at *Gateway Arch National Park* proved challenging due to the need for security and minimal background noise. The *AudioMoth* logger was placed in a bucket to reduce ground noise and placed at the south administration entrance (GPS coordinates 38.624185, -90.18622). This location was plagued by sounds of machinery turning on/off at regular intervals as noted in **Illustration A**.
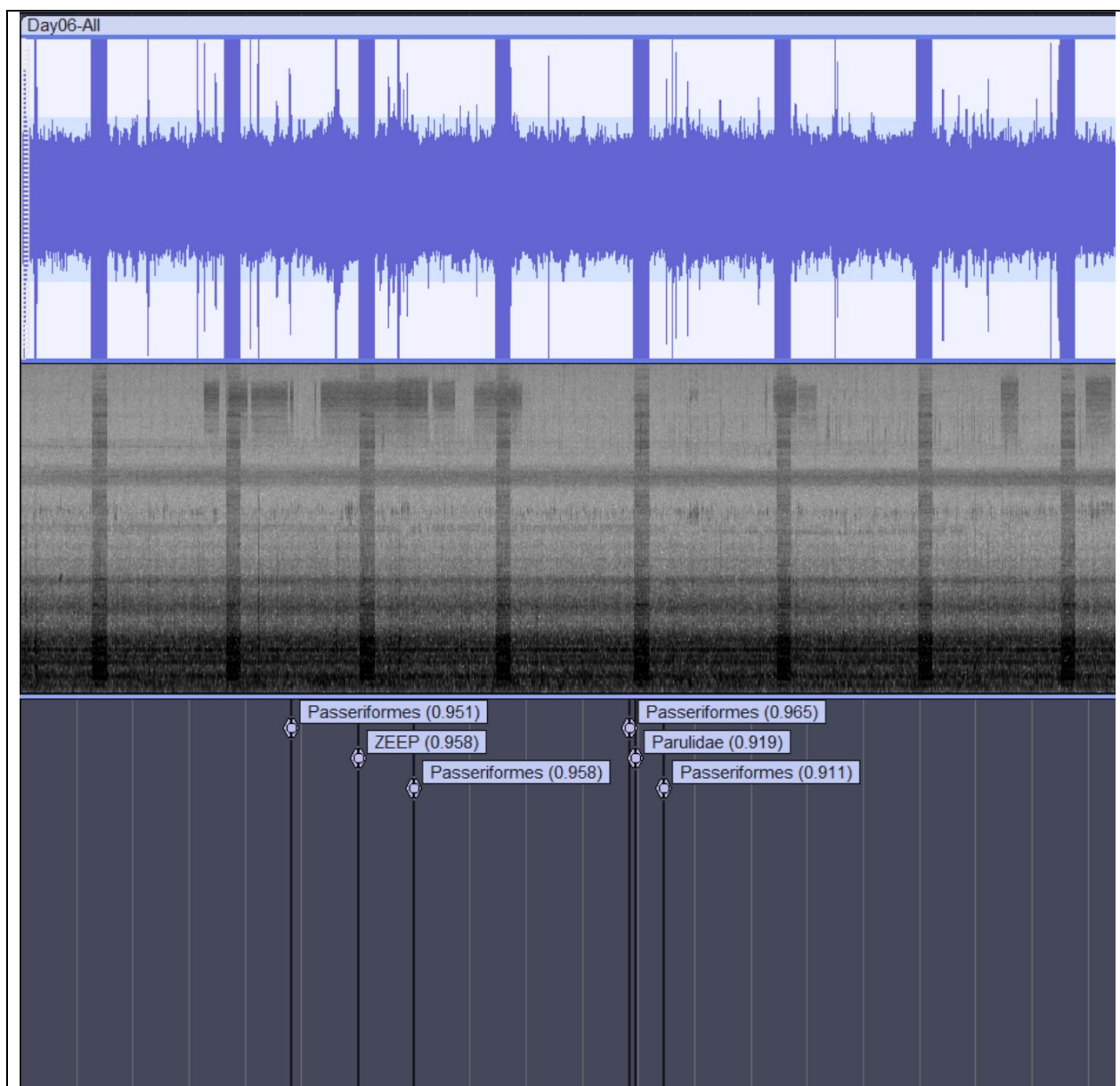
Illustration A – Screen capture of sound file analysis using *Audacity*
The screen capture above utilizes *Audacity* software to analyze sounds recorded between 8:00 PM and 9:30 PM on September 6, 2024. The top section displays a waveform highlighting sound spikes corresponding to machinery operating at regular intervals. The middle section presents a spectrograph of the recorded sounds. The bottom section features a label generated by *Nighthawk AI*, pinpointing the location of a bird call within the sound capture.

NCF Project Flight Calls vs *BirdCast* Detections

Despite the presence of machinery sounds and background noise, *Nighthawk AI* successfully identified 598 potential bird calls, with 64 detections surpassing an 80% probability threshold and 10 species documented. **Exhibit B** provides a report of species detections by date and time.

Although not intended to be a scientific study, daily detections, as shown in **Illustration B**, closely mirrored migration patterns reported by *BirdCast.com*. *BirdCast*, a project by Cornell Labs, offers forecasts, maps, and alerts for nocturnal bird migration across North America.
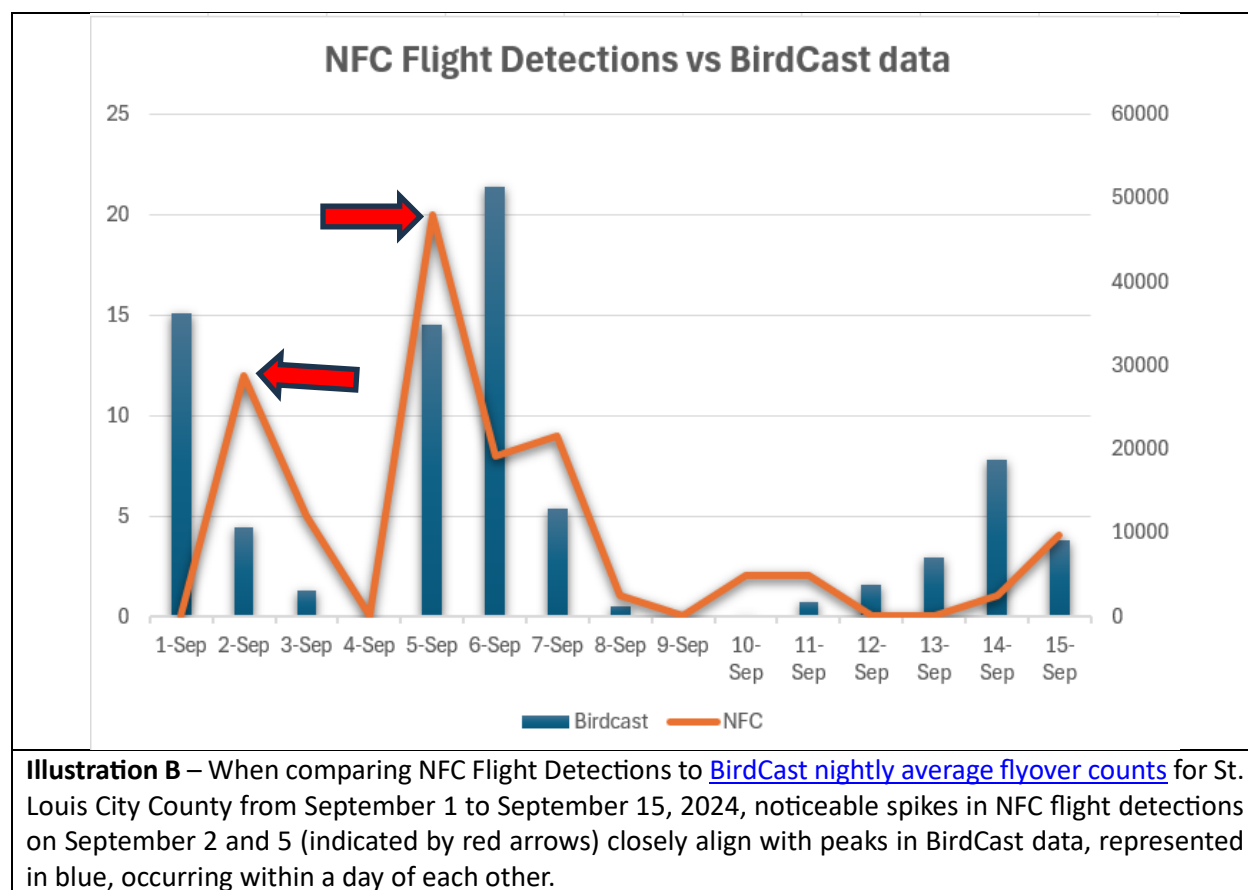
Illustration B – When comparing NFC Flight Detections to BirdCast nightly average flyover counts for St. Louis City County from September 1 to September 15, 2024, noticeable spikes in NFC flight detections on September 2 and 5 (indicated by red arrows) closely align with peaks in BirdCast data, represented in blue, occurring within a day of each other.

Next Steps

The migrating bird species identified by *Nighthawk AI* provided encouragement and interesting talking points for use in public outreach. Due to lack of experience using *Audacity* software to analyze sounds, the project team had limited success uploading spectrographs of birds call to *eBird* for use in citizen science. The project team is refining data collection and analysis methods to build upon and improve this initiative for 2025.

Exhibit A – Data Collection and Analysis

Data Collection and Analysis Details

- Collection Location: *Gateway Arch National Park* (38.624182, -90.186227)
- Collection Period: September 1, 2024 – September 15, 2024
- Collection Time: 8pm – 3am daily

Technology Used

- Hardware:
  - *AudioMoth* Acoustics Recorder (https://www.openacousticdevices.info/)
  - SanDisk Extreme 64G SD U3 MicroSDXC card (provided on loan from DarkSky Missouri)
  - SD Card Reader (if not included in your computer)
  - A USA-A to Micro USB cable (to connect the AudioMoth to your computer)
  - Computer (a newer model that can run the software programs)
- Software (all free):
  - Time App (required), used to set the time on the AudioMoth
  - Configuration App (required), used to program the AudioMoth
- Analysis Software (all free):
  - Audacity (free audio editor software)
  - Python, necessary to run NightHawk AI programs (see important note below)
  - Anaconda Prompt for Python to run simple code and execute Nighthawk
  - Nighthawk, the program to process audio files

Exhibit B – Report

Nocturnal Flight Call Project: Gateway Arch
Recording period of September 1 - 15, 2024

Species/ Detection Time	Number of Detections	Month: September														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Detections: Birds Identified																
1. American Redstart																
8pm - 9pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9pm - 10pm	1	-	-	-		-	-	1	-	-	-	-	-	-	-	-
10pm-11pm	4		1					2							1	
11pm-12am	4		1	-			2	1								
12am - 1am	1							1								
1am - 2am	1			1												
2am - 3am	1		1				-									
Total detections	**12**	-	3	1	-	-	2	5	-	-	-	-	-	-	1	-
Avg probability	**89.15%**															
2. Cape May Warbler																
8pm - 9pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9pm - 10pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10pm-11pm	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
11pm-12am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12am - 1am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1am - 2am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2am - 3am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total detections	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Avg probability	99.99%															
3. Chestnut-sided Warbler																
8pm - 9pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9pm - 10pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10pm-11pm	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
11pm-12am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12am - 1am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1am - 2am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2am - 3am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Nocturnal Flight Call Project: Gateway Arch
Recording period of September 1 - 15, 2024

Species/ Detection Time	Number of Detections	Month: September														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total detections	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Avg probability	96.90%															
4. Chipping Sparrow																
8pm - 9pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9pm - 10pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10pm-11pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11pm-12am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12am - 1am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1am - 2am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2am - 3am	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total detections	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg probability	85.68%															
5. Gray-cheeked Thrush																
8pm - 9pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9pm - 10pm	3	-	1	1	-	-	-	-	-	-	-	-	-	-	-	1
10pm-11pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11pm-12am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12am - 1am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1am - 2am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2am - 3am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total detections	3	-	1	1	-	-	-	-	-	-	-	-	-	-	-	1
Avg probability	99.94%															
6. Least Sandpiper																
8pm - 9pm	18	-	7	1	-	7	-	-	1	-	2	-	-	-	-	-
9pm - 10pm	3	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-
10pm-11pm	3	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-
11pm-12am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12am - 1am	14	-	-	-	-	8	6	-	-	-	-	-	-	-	-	-
1am - 2am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2am - 3am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Nocturnal Flight Call Project: Gateway Arch
Recording period of September 1 - 15, 2024

Species/ Detection Time	Number of Detections	Month: September														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total detections	38	-	7	2	-	20	6	-	1	-	2	-	-	-	-	-
Avg probability	99.93%															
7. Ovenbird																
8pm - 9pm	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
9pm - 10pm	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
10pm-11pm	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
11pm-12am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12am - 1am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1am - 2am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2am - 3am	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Total detections	4	-	-	1	-	-	-	2	-	-	-	1	-	-	-	-
Avg probability	95.38%															
8. Rose-breasted Grosbeak																
8pm - 9pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9pm - 10pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10pm-11pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11pm-12am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12am - 1am	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
1am - 2am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2am - 3am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total detections	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Avg probability	99.02%															
9. Swainson's Thrush																
8pm - 9pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9pm - 10pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10pm-11pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11pm-12am	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
12am - 1am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1am - 2am	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
2am - 3am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Nocturnal Flight Call Project: Gateway Arch
Recording period of September 1 - 15, 2024

Species/ Detection Time	Number of Detections	Month: September														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total detections	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Avg probability	85.88%															
10. White-throated Sparrow																
8pm - 9pm	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
9pm - 10pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10pm-11pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11pm-12am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12am - 1am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1am - 2am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2am - 3am	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total detections	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Avg probability	95.51%															
SUMMARY																
Detections: Birds Identified																
8pm - 9pm	20	-	7	1	-	7	-	1	1	-	2	1	-	-	-	-
9pm - 10pm	8	-	1	1	-	3	-	2	-	-	-	-	-	-	-	1
10pm-11pm	10	-	1	2	-	2	-	3	-	-	-	1	-	-	1	-
11pm-12am	5	-	1	-	-	-	2	1	-	-	-	-	-	-	-	1
12am - 1am	16	-	-	-	-	8	6	1	-	-	-	-	-	-	-	1
1am - 2am	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
2am - 3am	3	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-
Total	64	-	12	5	-	20	8	9	1	-	2	2	-	-	1	4
Avg probability	96.78%															
Detections: No Birds Identified																
Total	534															
Grand Total All Detections																
Total	598															