

Floating LiDAR Metocean Data Collection Services

E05 and E06 Bird and Bat Acoustic Analysis and Results Summary

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December 2021

Bird and Bat Acoustic Data Analysis and Results Summary for Data Collection Periods 1–7

This report summarizes bat and bird acoustic data associated with the E05 Hudson North and E06 Hudson South NYSERDA buoys collected from August 2019 through July 2021. Analyses and results are presented as cumulative and thus show all identified species to date.

Bat and bird acoustic sensors were deployed at the E05 Hudson North buoy on 10 Aug 2019 and E06 Hudson South buoy on 03 Sep 2019. To date, bird and bat data collected at the E05 Hudson North buoy have been analyzed and are reported here through data collection period 7 (ending 14 May 2021), and bird and bat data collected at the E06 Hudson South buoy have been analyzed and are reported here through data collection period 7 (ending 15 July 2021) (Table 1).

To date we have recorded 247 avian and bat vocalizations (Table 1) with American Herring Gull accounting for the majority of activity at the E05 Hudson North buoy (n=86, 92%) and at the E06 Hudson South buoy (n=137, 95%) (Table 1).

We matched avian and bat observation times to LiDAR derived wind speed at 98m data that was collected simultaneously from the buoys. Eight percent of avian and bat observations were made when the LiDAR was non-operational resulting in 227 total observations with associated wind speed data. We summarized wind speed to the nearest whole value and generated a distribution to determine the proportion of observations that occurred when wind speeds were less than or equal to 5.0 m/s.

Table 1. Bat and Avian Species and Species-Groups Identified between August 2019 and July 2021

Buoy	Type	Species / Species Group	Vocalization Sequences
E05 Hudson North	Birds	American Herring Gull	86
		American Redstart	1
		Palm Warbler	1
		White-throated Sparrow	2
		Yellow Warbler	2
		Least Bittern	2
	E05 Birds Total		94
	Bats	Silver-haired Bat	6
Silver-haired Bat or Hoary Bat		1	
E05 Bats Total		7	
E05 TOTAL			101
E06 Hudson South	Birds	American Herring Gull	137
		Ring-billed Gull	1
		American Redstart	2
		Wood Thrush	2
		Grey-cheeked Thrush	1
		Green Heron	1
	E06 Birds Total		144
	Bats	Silver-haired Bat	2
E06 Bats Total		2	
E06 TOTAL			146
TOTAL			247

Acoustic Analysis

Bat Acoustic Analysis

Upon receipt, data were backed up for storage and processing. We ran each dataset through bat acoustic identification software SonoBat (Arcata, USA). Generally running files through a scrubber can eliminate WAV files that are algorithmically determined to be noise files and not bats based on features of the sonogram. For example, WAV files with bandwidth ranging from 20 kHz and below can be identified and eliminated as produced by audible insect noises, and files that have pulses of sound above 20 kHz can be kept for further analysis. In the case of the buoy data, it is difficult to pre-filter noise because, unlike insect chatter, noise associated with the other equipment on the buoy such as the LiDAR make pulsing ultrasonic noise that scrubber algorithms will not eliminate. We used the SonoBat automated identification classifier on all recorded WAV files.

We determined the most typical SonoBat output for non-bat high frequency recordings (i.e., noises generated by peripheral buoy sensors) was a constant pulse every ≈ 10 msec with a mean characteristic frequency (f_c) of ≈ 39.75 kHz and a bandwidth of ≈ 4 kHz. The characteristics of these sounds are not like any bat species and thus we were able to eliminate files containing only

those parameters (~90% reduction) in preparation for manual vetting (i.e., human analyst review of files with a non-negligible probability of having ultrasonic bat vocalization signatures).

Between 10 Aug 2019 and 5 Mar 2021, bat acoustic sensors at the E05 Hudson North buoy were operational for 280 days (Figure 1), and between 03 Sep 2019 and 15 Jul 2021 bat acoustics at the E06 Hudson South buoy were operational for 347 days (Figure 2). Interruptions in operation were likely due to storage capacity as power supply was much more consistent during data collection periods 5 and 6 compared to collection periods 1 to 4; a conclusion further supported in that there were no operation interruptions during data period 7.

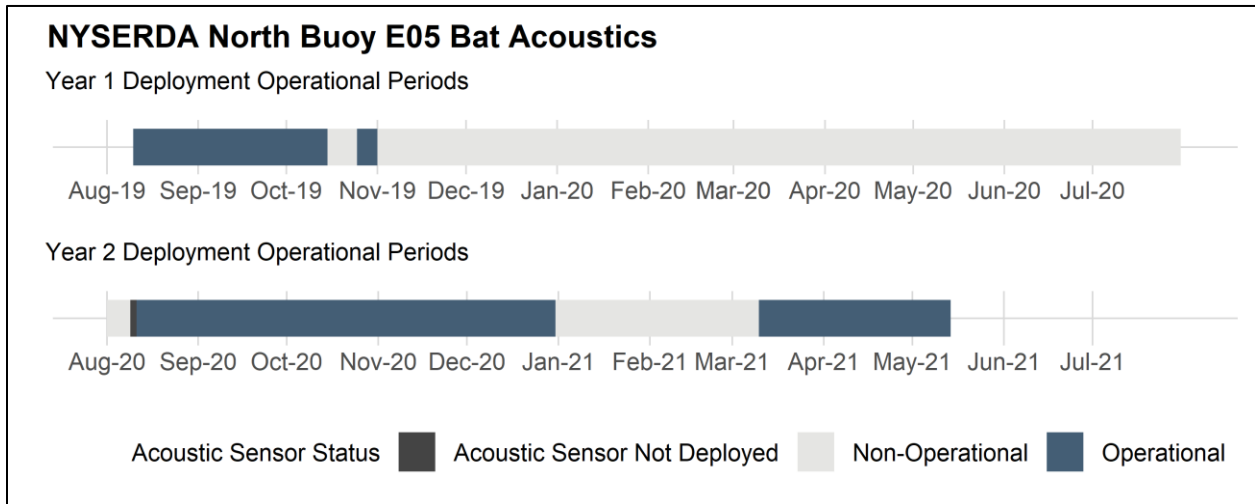


Figure 1. E05 Hudson North bat acoustics operational status in years 1 and 2.

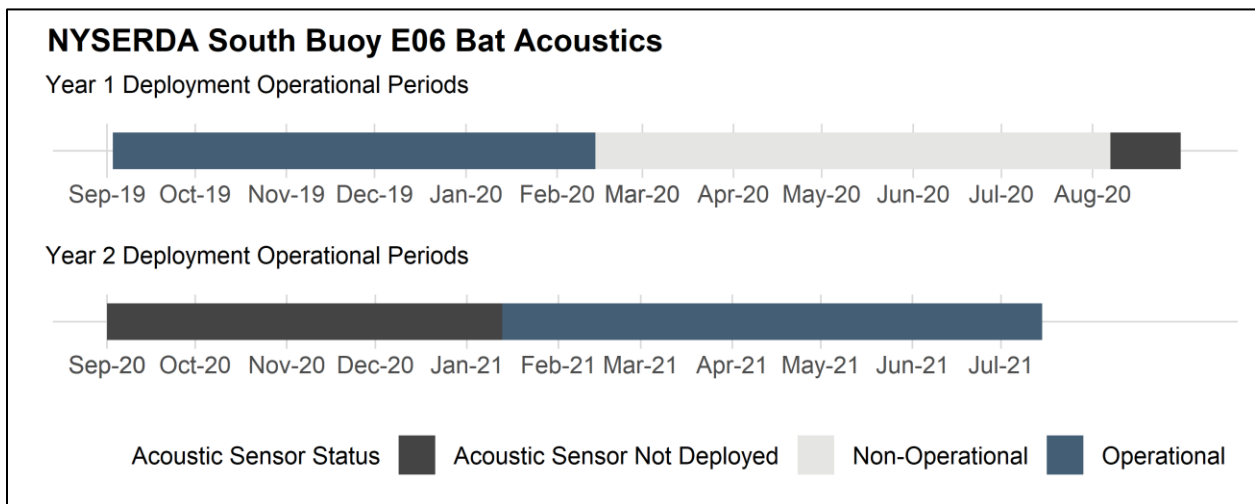


Figure 2. E06 Hudson South bat acoustics operational status in years 1 and 2.

Through seven data collection periods SM4 bat acoustic detectors have collected 304,552 WAV files at E05 Hudson North and 97,812 WAV files at E06 Hudson South (Table 2). The total number of files do not correlate with the total number of observed bat vocalizations but rather

with the number of times the microphone was triggered by an ultrasonic sound that results in the SM4BAT unit making a recording. Unlike SM4BIRD units that record continuously, the SM4BAT units only create recordings when the microphone detects an ultrasonic signal in the environment. Slight differences in the placement of the microphone in relation to peripheral buoy instruments that may give off consistent intermittent ultrasonic pulses can result in differences in the number of recordings created with an SM4BAT unit. That the unit is making thousands of recordings when operational is a good indicator that the units are functioning properly despite an overall paucity of bat acoustic activity around the buoy.

Table 2. Deployment and Operation Information Associated with SM4BAT Acoustic Data Collected at E05 Hudson North and E06 Hudson South NYSERDA Buoys

Buoy	Collection Period	Deployment Period	Detector Operational Periods	Number of WAV Files	Data Status
E05	1	10 Aug 2019– 25 Oct 2020	10 Aug 2019– 15 Oct 2020	NA	Analyzed and reported in this summary
	2–4	25 Oct 2019– 9 Aug 2020	25 Oct 2019– 11 Nov 2019	28,846	Analyzed and reported in this summary
	5–6	11 Aug 2020– 10 Mar 2021	11 Aug 2020– 31 Dec 2020	169,569	Analyzed and reported in this summary
	7	10 Mar 2021– 14 May 2021	10 Mar 2021– 14 May 2021	106,137	Analyzed and reported in this summary
	8	14 May 2021–	14 May 2021–	NA	Data to be analyzed
E05 TOTAL				304,552	
E06	1–4	3 Sep 2019– 7 Aug 2020	3 Sep 2019– 14 Feb 2020	15,803	Analyzed and reported in this summary
	5–6	13 Jan 2021– 26 Feb 2021	13 Jan 2021– 26 Feb 2021	49,822	Analyzed and reported in this summary
	7	26 Feb 2021– 15 Jul 2021	26 Feb 2021– 15 Jul 2021	32,187	Analyzed and reported in this summary
	8	15 Jul 2021–	15 Jul 2021–	NA	Data to be analyzed
E06 TOTAL				97,812	

Bird Acoustic Analysis

Data reviewed from the first retrieval in late 2019 (data collection periods 1–4) was found to be excessively clipped due to high amplitude wind, water, and buoy noise. The data collected during periods 1–4 were used to create an automated WAV file clipping check algorithm in MATLAB (Mathworks, Natick, MA), which was designed to inform all subsequent files as to which files contained the least amount of clipping and thus could be processed further with the Kaleidoscope software (Wildlife Acoustics, Maynard, MA).

Between 10 Aug 2019 and 05 Mar 2021, bird acoustic sensors at the E05 Hudson North buoy were operational for 283 days (Figure 3), and between 03 Sep 2019 and 15 Jul 2021 bird acoustics at the E06 Hudson South buoy were operational for 225 days (Figure 4).

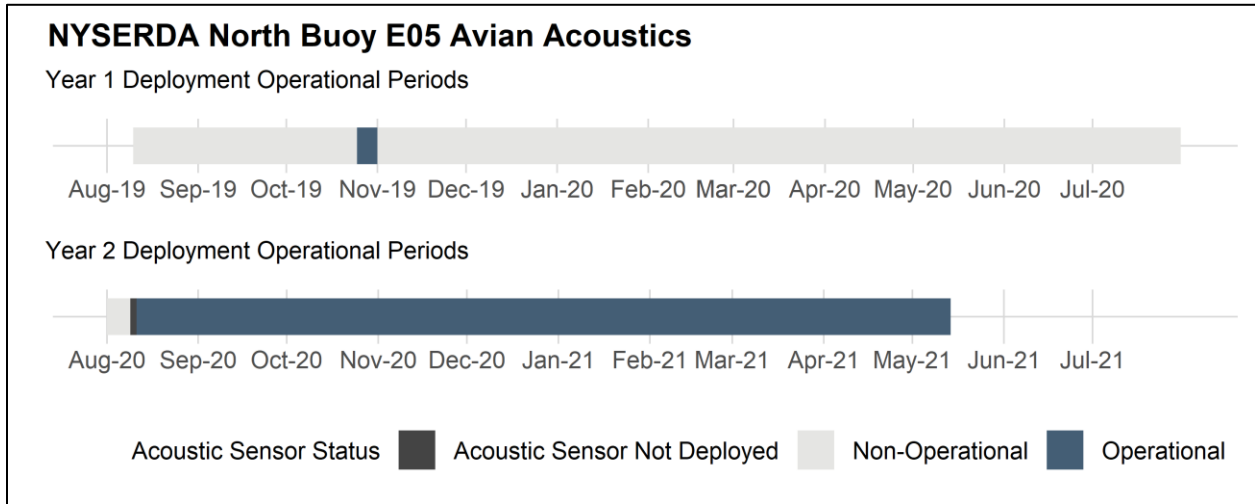


Figure 3. E05 Hudson North bat acoustics operational status in years 1 and 2.

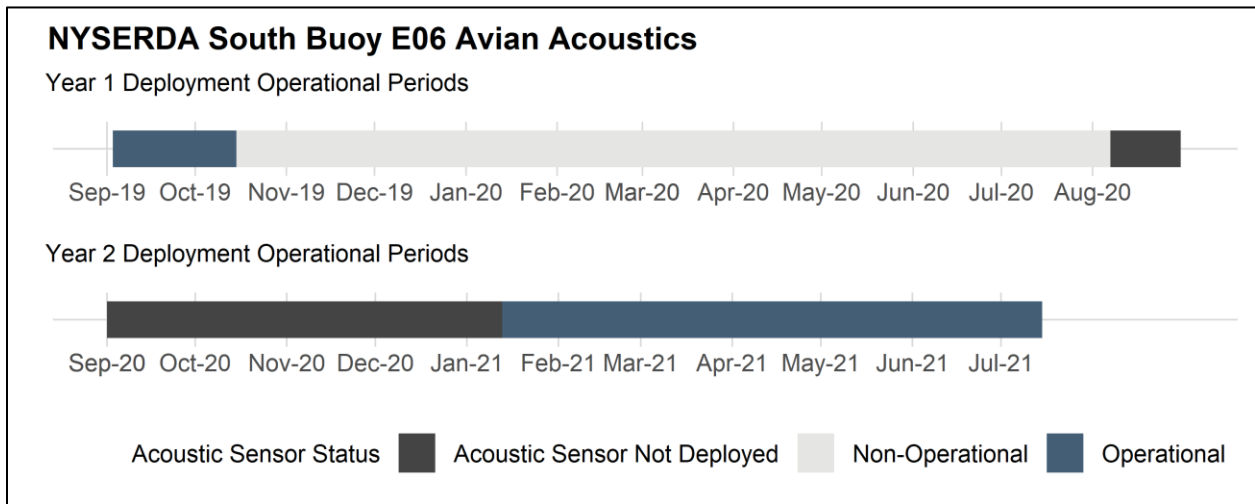


Figure 4. E06 Hudson South bat acoustics operational status in years 1 and 2.

Through seven data collection periods, SM4BIRD acoustic detectors have collected 9,362 hour-long WAV files consisting of 7,575 useable hours of data processed and analyzed (Table 3). After setting adjustments, data collected during periods 5, 6, and 7 had less clipping and much improved overall recording quality than data collected during fall 2019–fall 2020 (data collection periods 1–4).

The usable data from each buoy was processed with Kaleidoscope software using automated detection parameters determined for the flight calls of species listed in Table 4 using data in the Cornell Lab of Ornithology Macaulay Library archives. Additional bird species were confirmed from any detections that did not fall within those listed in Table 4, focusing on but not limited to gulls and terns such as American Herring Gull, Bonaparte’s Gull, Franklin’s Gull, Laughing Gull, Ring-billed Gull, and Roseate Tern (<https://search.macaulaylibrary.org/catalog>). The parameters were chosen to be lenient and allow more false alarms to avoid discarding true positives as much as possible.

Table 3. Deployment and Operation Information Associated with SM4 Avian Acoustic Data Collected at E05 Hudson North and E06 Hudson South NYSERDA Buoys

Buoy	Data Collection Period	Deployment Period	Detector Operational Periods	Number of 1-hr WAV Files	Hours of Usable Data	Data Status	Comment
E05	1–4	10 Aug 2019– 9 Aug 2020	25 Oct 2019– 1 Nov 2019	180	5 (3%)	Analyzed and reported in this summary	Data ‘clipped’ from high amplitude noise
	5–6	11 Aug 2020– 10 Mar 2021	11 Aug 2020– 10 Mar 2021	2,303	2,210 (96%)	Analyzed and reported in this summary	
	7	10 Mar 2021– 14 May 2021	10 Mar 2021– 14 May 2021	1,561	1,537 (98%)	Analyzed and reported in this summary	
	8	14 May 2021–	14 May 2021–	NA	NA	Data to be analyzed	
E05 TOTAL				4,044	3,752		
E06	1–4	3 Sep 2019– 7 Aug 2020	3 Sep 2019– 15 Oct 2019	1,510	127 (8.5%)	Analyzed and reported in this summary	Data ‘clipped’ from high amplitude noise
	5–6	13 Jan 2021– 26 Feb 2021	13 Jan 2021– 26 Feb 2021	474	415 (88%)	Analyzed and reported in this summary	
	7	26 Feb 2021– 15 Jul 2021	26 Feb 2021– 15 Jul 2021	3,334	3,281 (98%)	Analyzed and reported in this summary	
	8	15 Jul 2021–	15 Jul 2021–	NA	NA	Data to be analyzed	
E06 TOTAL				5,318	3,823		
TOTAL				9,362	7,575		

Table 4. Bird Species Whose Flight Calls were used for Automatic Detection Parameter Selection

Cape May Warbler	Northern Parula	Palm Warbler
Ovenbird	American Redstart	Yellow Rumped Warbler
Gray Cheeked Thrush	Black Throated Blue Warbler	Black and White Warbler
Blackpoll Warbler	Common Yellow Throat	Bay-Breasted Warbler
Least Bittern	Green Heron	Veery
Swainson's Thrush	Wood Thrush	Northern Waterthrush
Magnolia Warbler	Blackburnian Warbler	Yellow Warbler
Chestnut-sided Warbler	Yellow-rumped Warbler	Savannah Sparrow
White-throated Sparrow	Blue Grosbeak	Indigo Bunting
	Bobolink	

Results

Bat Acoustic Results

Through seven data collection periods, SM4BAT acoustic detectors have recorded nine bat calls at the NYSERDA Metocean Buoys with all occurrences during the autumn migratory/mating period (Table 5). Though only 9 total occurrence records of bats, wind speeds associated with observations ranged between 2.5 and 17.5 m/s with a median wind speed of 9.1 m/s. Bat acoustic calls were observed in overall much higher wind speeds compared to wind speeds associated with avian acoustic calls (see avian results below), highlighting that while birds are able to sit on water when flight conditions become unfavorable, bats have fewer opportunities for refuge when offshore and therefore must continue to fly as flight conditions worsen.

Table 5. Bat Species Recorded at the E05 Hudson North and E06 Hudson South Buoy

Buoy	Species	Date	Count
E05	Unknown Low Frequency Bat Spp.	09/16/2019	1
	Silver-haired Bat	09/25/2019	3
	Silver-haired Bat	08/26/2020	2
	Silver-haired Bat	10/08/2020	1
E06	Silver-haired Bat	09/26/2019	1
	Silver-haired Bat	10/23/2019	1

A typical silver-haired bat call is shown in Figure 5.

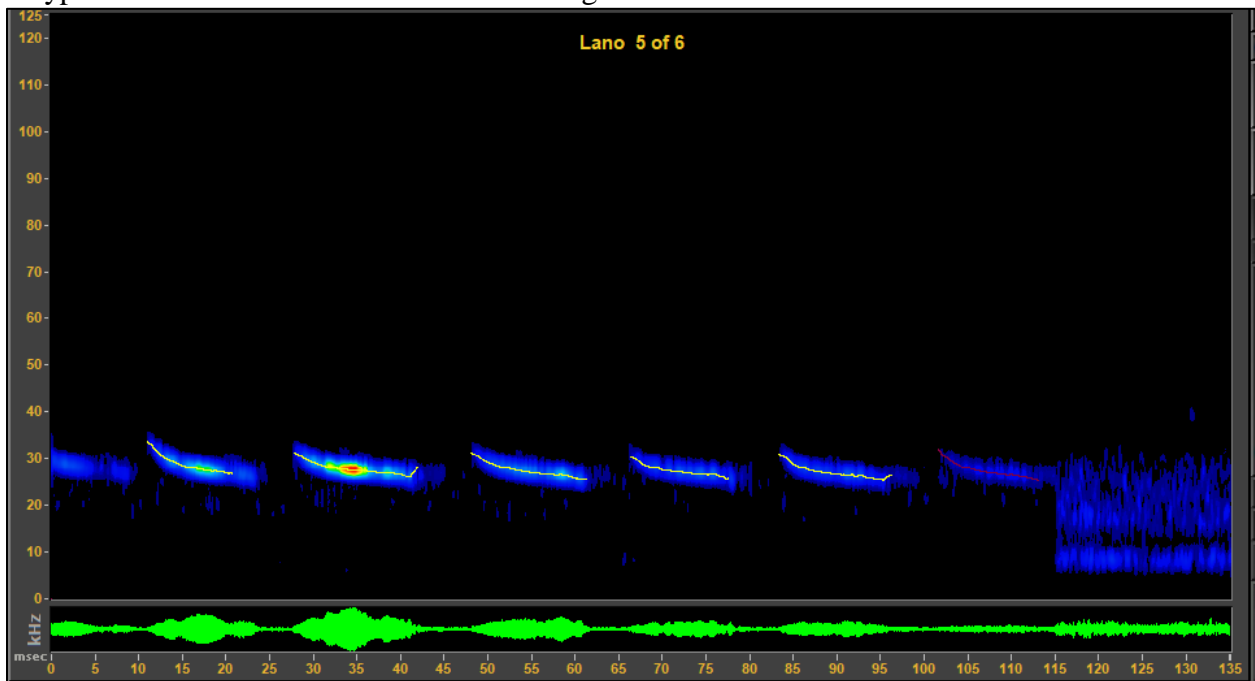


Figure 5. Typical silver-haired bat (*Lasionycteris noctivagans*) recorded from the NYSERDA Metocean Buoys.

Screen shot from SonoBat acoustic analysis software (Arcata CA, USA).

Bird Acoustic Results

Between 10 Aug 2019 and 05 Mar 2021, seven bird species and 94 unique bird vocalizations were detected at the E05 Hudson North buoy (Table 6), and between 03 Sep 2019 and 15 Jul 2021 seven bird species and 145 bird vocalizations were detected at the E06 Hudson South buoy (Table 6).

Non-gull species were most prevalent during the autumn migratory period during 2019 and 2020. During the winter, fall, and summer, American Herring Gull comprised the vast majority of detections and were particularly prevalent during the spring when they accounted for all detections at E05 Hudson North (Figure 6) and all but one detection at E06 Hudson South (Figure 7).

Table 6. Confirmed Bird Detections for E05 Hudson North and E06 Hudson South Buoy

Buoy	Species	Date	Vocalizations
E05 Hudson North	American Redstart	10/30/2019	1
	Least Bittern	10/21/2020	2
	Palm Warbler	10/22/2020	1
	White-throated Sparrow	10/23/2020	1
	Yellow Warbler	10/23/2020	2
	White-throated Sparrow	12/19/2020	1
	American Herring Gull	12/20/2020–05/14/2021	86
E05 TOTAL			94
E06 Hudson South	American Redstart	09/15/2019	1
	Wood Thrush	09/15/2019	2
	Green Heron	09/15/2019	1
	American Redstart	09/16/2019	1
	Gray-cheeked Thrush	01/14/2021	2
	Ring-billed Gull	04/04/2021	1
	American Herring Gull	01/14/2021–07/15/2021	137
E06 TOTAL			145

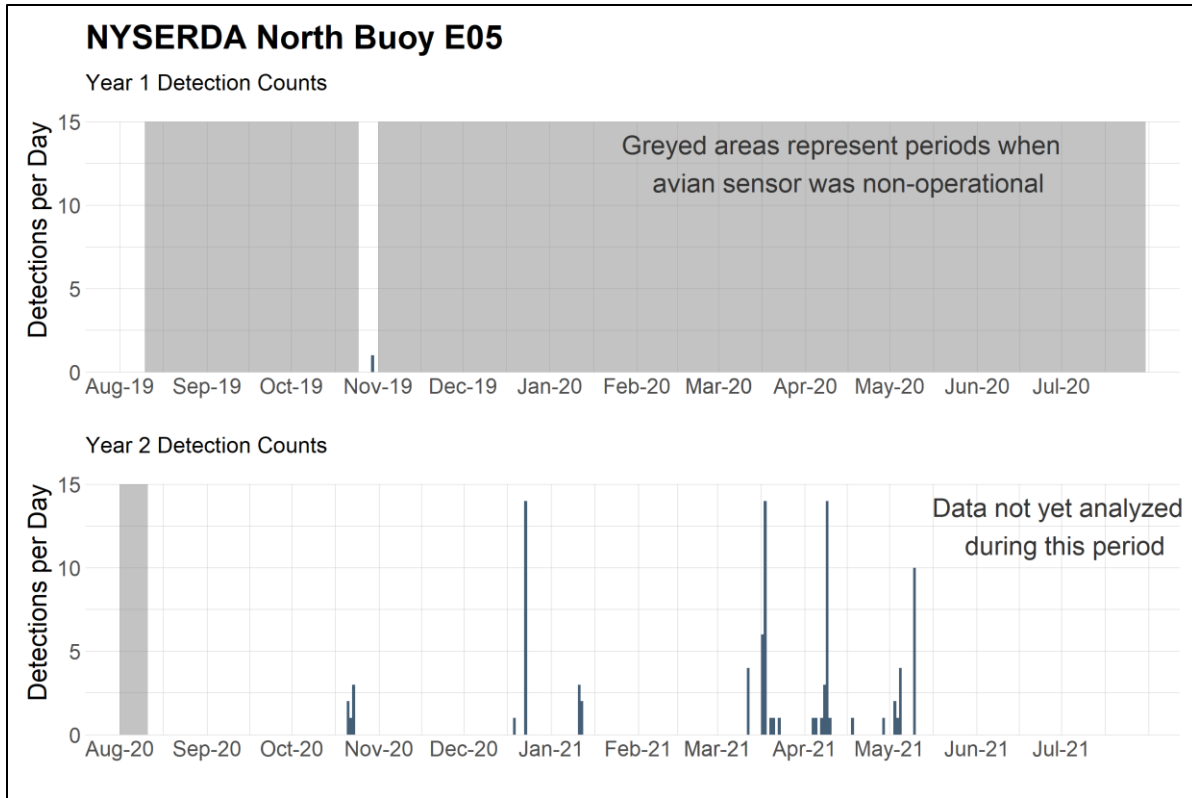


Figure 6. Bird acoustic detections recorded per day at NYSERDA Buoy E05 Hudson North.

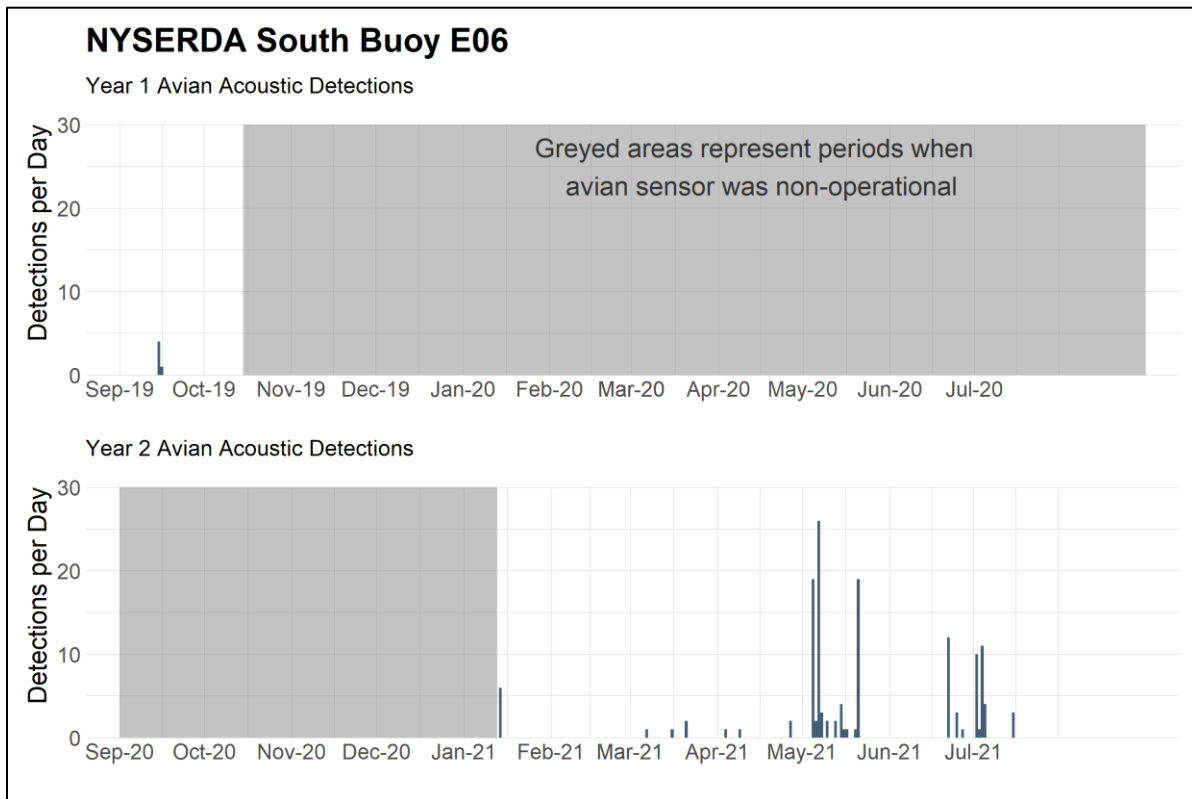


Figure 7. Bird acoustic detections recorded per day at NYSERDA Buoy E06 Hudson South.

Birds were recorded in speeds ranging between 1.0 m/s up to 12.0 m/s with the median number of detections occurring at 3.4 m/s (Figure 8). The majority of avian acoustic observations occurred when wind speeds were less than 5.0 m/s (Figure 8).

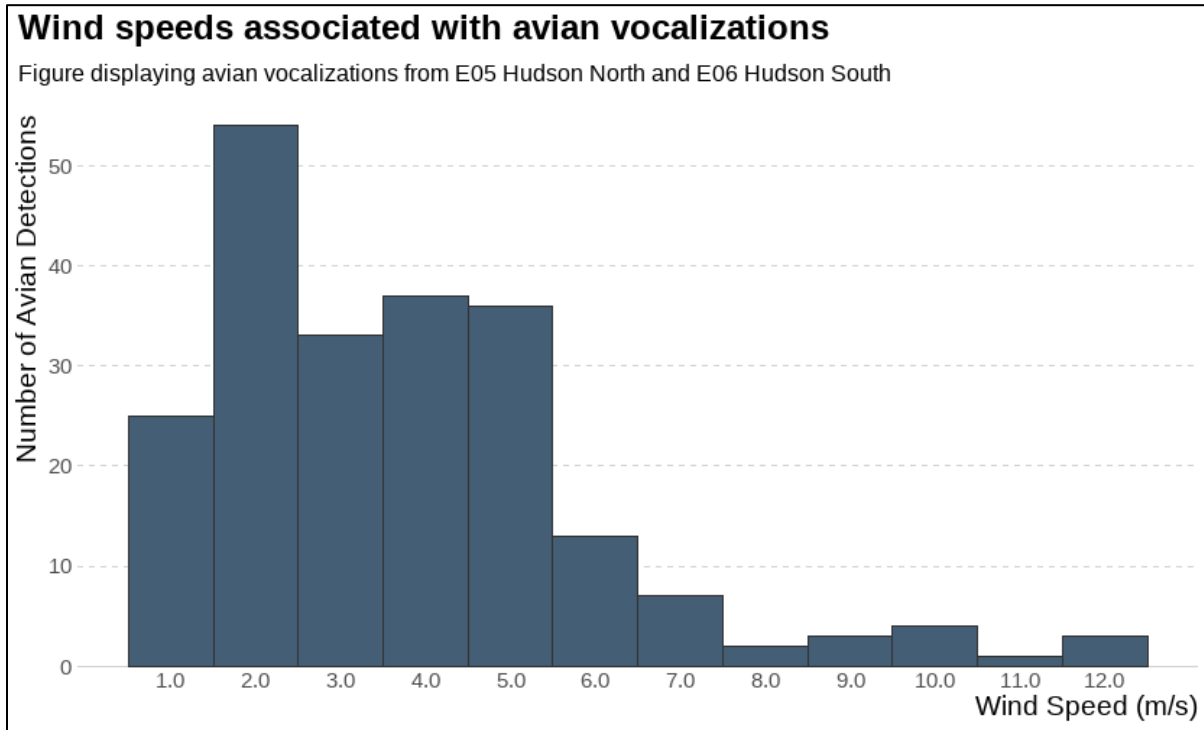


Figure 8. Bird acoustic detections recorded per wind speed (m/s) observed at NYSERDA Buoy E05 Hudson North and Buoy E06 Hudson South.

Representative avian sonograms are shown in (Figure 9–Figure 14).

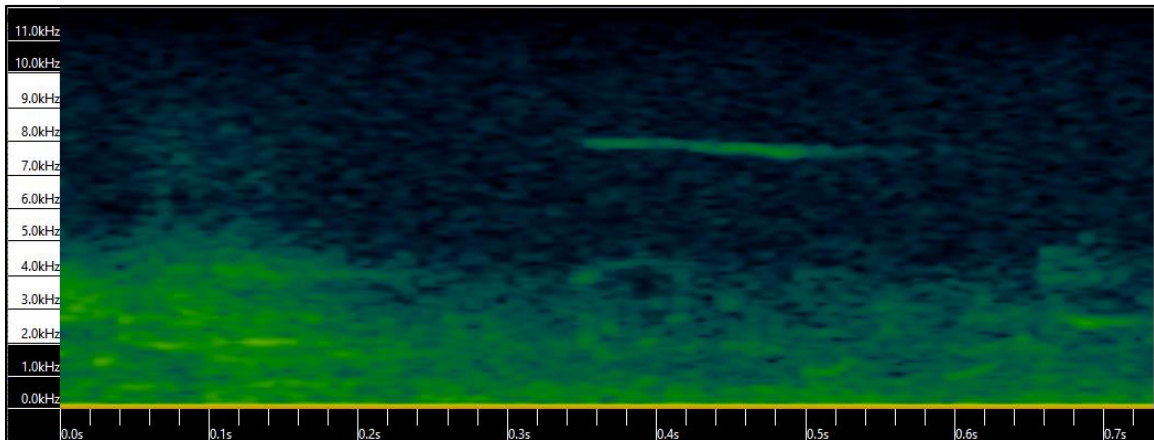


Figure 9. White-throated Sparrow detection on 19 Dec 2020 at 08:57:18.

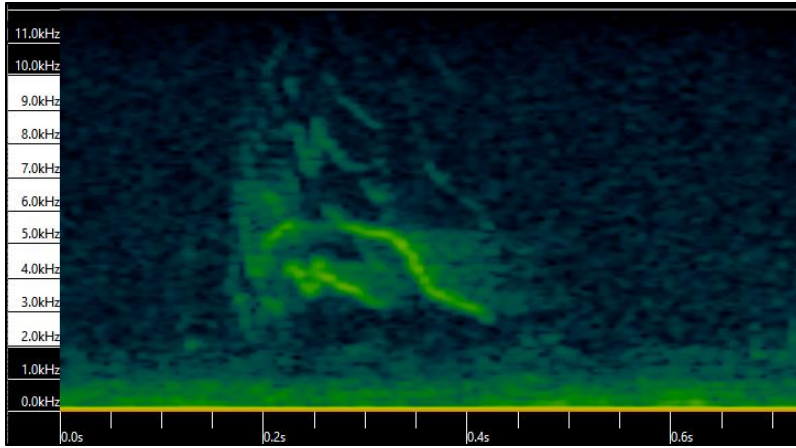


Figure 10. Yellow Warbler detection on 23 Oct 2020 at 12:17:37.

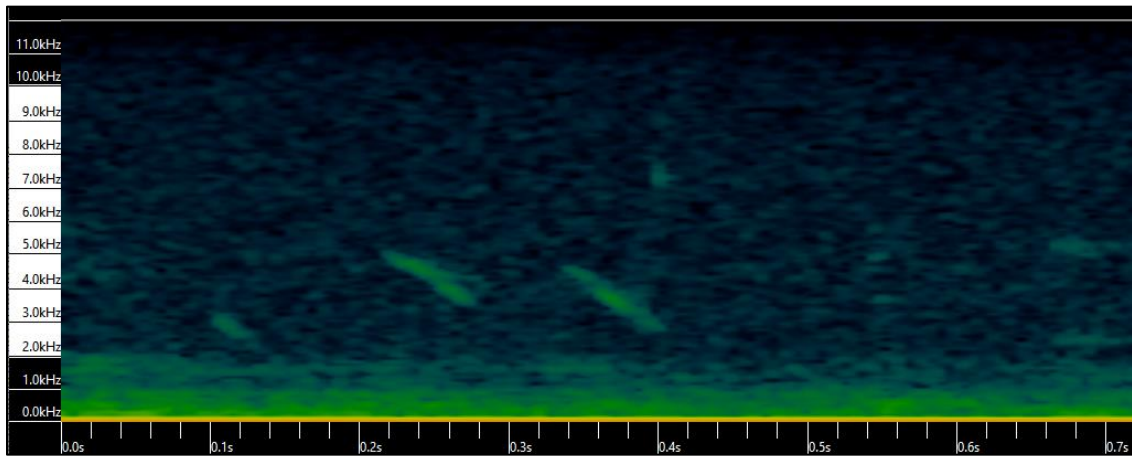


Figure 11. Palm Warbler detection on 22 Oct 2020 at 11:20:57.

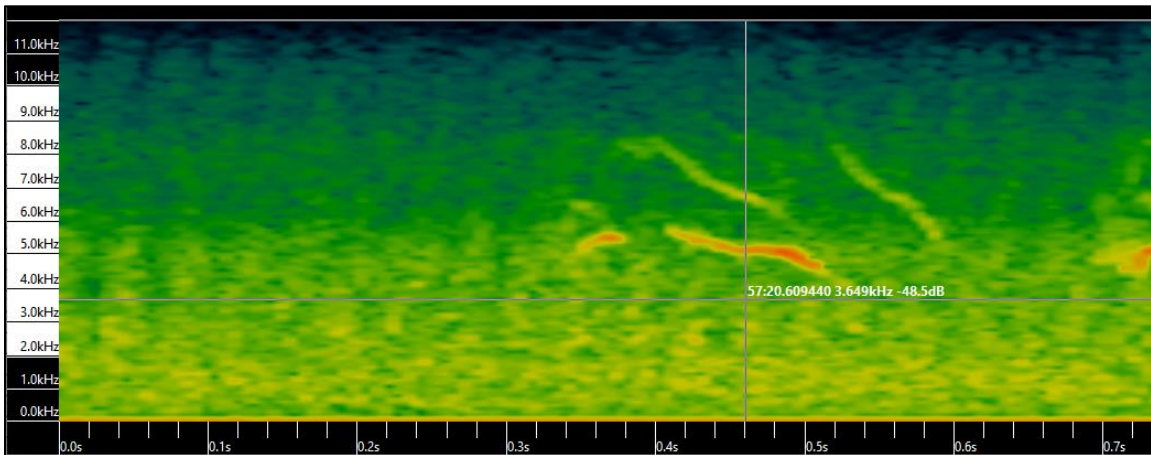


Figure 12. White-throated Sparrow detection on 23 Oct 2020 at 16:07:22.

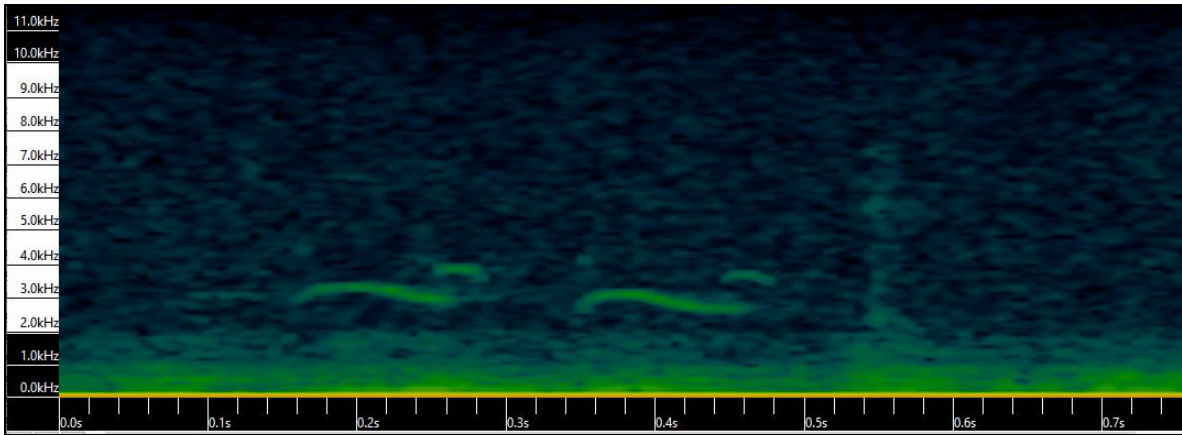


Figure 13. Least Bittern detection on 21 Oct 2020 at 08:33:47.

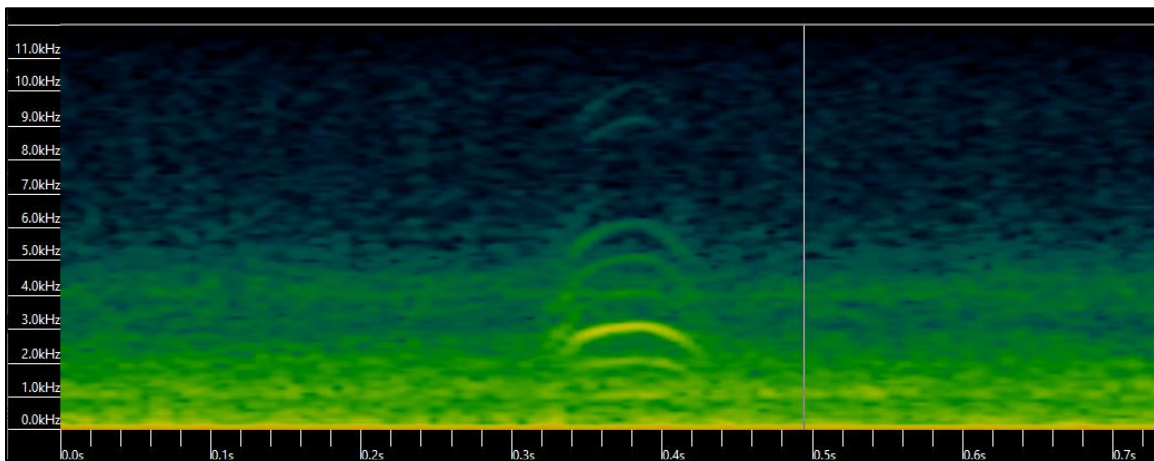


Figure 14. Gray-cheeked Thrush detection on 14 Jan 2021 at 08:35:50.