Floating LiDAR Metocean Data Collection Services

Hudson South 2 E05 Bat and Bird Acoustic Analysis and Results Summary

Prepared for
Ocean Tech Services, LLC
985 Ocean Drive
Cape May, NJ 08204

Prepared by
Normandeau Associates, Inc.
Ocean Tech Services, LLC

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NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Bat and Bird Acoustic Data Analysis and Results Summary for Hudson South 2 E05 Buoy

The Hudson South 2 E05 (HS2 E05) NYSERDA buoy was installed in late Jan 2022. The bat and bird acoustic detectors were operational after the first service trip in Jun 2022. This report summarizes bat and bird acoustic data associated with the HS2 E05 buoy collected from Jun 2022 through Oct 2022. The SM4BAT and SM4 bird-acoustic detectors were retrieved in Feb 2023; however, a fatal clock error and power fluctuations caused SM4BAT detectors to fail early and stop recording on 03 Oct 2022. The SM4 bird-acoustic detectors also experienced these issues but storage cards reached capacity on 04 Oct 2022 before any data were affected. Analyses and results thus show all identified species recorded during this operational period (Table 1).

The bat and bird acoustic sensors at HS2 E05 have recorded 13 bat and 5 bird vocalizations representing two bat species (silver-haired bat and Eastern red bat) and one bird species (herring gull) (Table 1).

We matched bird observation times to LiDAR-derived wind speed at 98 m, which was collected simultaneously from the buoy. Meteo wind data substituted any periods when LiDAR was non-operational. We summarized wind speed to the nearest whole value and generated a distribution to determine the proportion of observations at the recorded wind speed values.

Table 1. Bat and Bird Species/Species Groups Identified Between Jun 2022 and Oct 2022 at HS2 E05

Taxonomic Group	Species / Species Group	Vocalization Sequences
Bats	Eastern Red Bat	4
	Silver-haired Bat	9
Bats Total		**13**
Birds	Herring gull	5
Birds Total		**5**
TOTAL		**18**

Operations and Analysis Summary

Between deployment on 02 Jun 2022 and retrieval on 02 Feb 2023, the SM4BAT acoustic detector was operational for 124 days (Figure 1). A fatal clock error and power fluctuations caused early failure and recording stopped on 03 Oct 2022.

During this operational period, the SM4BAT acoustic detector collected 83,644 WAV files (Table 2). The number of files does 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 resulted in a recording. Unlike SM4 bird-acoustic detectors 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.

Between deployment on 02 Jun 2022 and retrieval on 02 Feb 2023, the SM4 bird-acoustic detector was operational for 125 days (Figure 2). Storage cards reached capacity on 04 Oct 2022 and no recordings were made after this date.

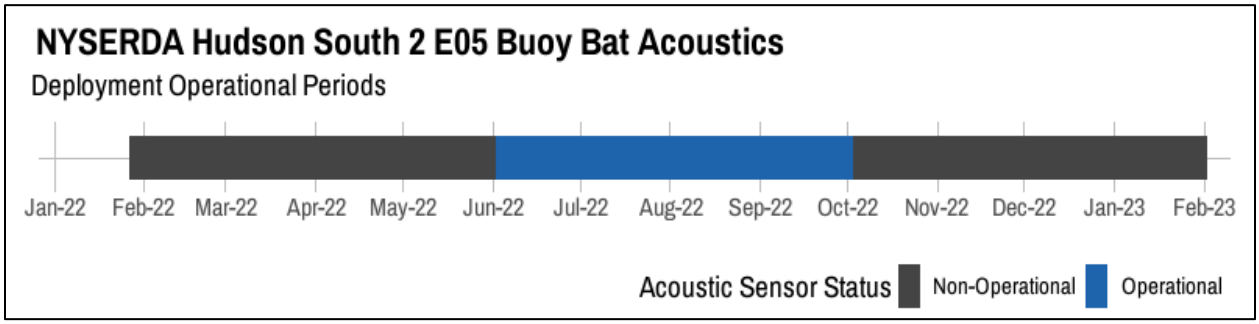

Figure 1. Bat acoustics operational status at HS2 E05.

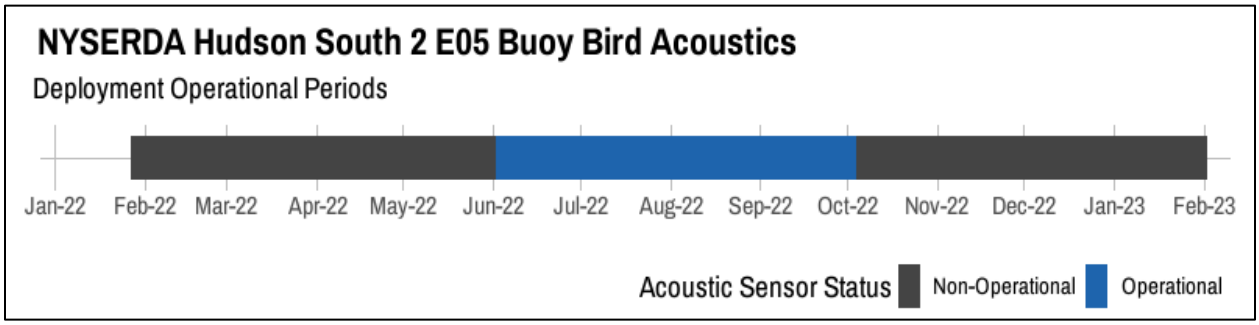

Figure 2. Bird acoustics operational status at H2S E05.

Table 2. Deployment and Operation Information Associated with SM4BAT Acoustic Data and SM4 Bird Acoustic Data Collected at the HS2 E05 Buoy

Taxonomic Group	Deployment Period	Detector Operational Periods	Number of WAV Files	Data Status
Bats	02 Jun 2022– 02 Feb 2023	02 Jun 2022– 03 Oct 2022	83,644	Analyzed/reported herein
Birds	02 Jun 2022– 02 Feb 2023	02 Jun 2022– 04 Oct 2022	2,964	Analyzed/reported herein

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 based on features of the sonogram. For example, WAV files with a 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 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 ms 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 we eliminated files containing only those parameters (≈90% reduction) before manual vetting (i.e., human analyst review of files with a non-negligible probability of having ultrasonic bat vocalization signatures).

Bat Acoustic Results

SM4BAT acoustic detectors recorded 13 bat calls with all occurrences during the autumn migratory/mating period (Table 3 and Figure 3). Wind speeds ranged between 6 and 11 ms with a median wind speed of 8 ms (Figure 4). Overall, bat calls were recorded in much higher wind speeds than those associated with bird acoustics (see bird results below). This difference highlights that while birds can sit on water when flight conditions become unfavorable, bats have fewer opportunities for refuge when offshore and must continue to fly as flight conditions worsen.

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

Table 3. Bat Species Recorded at HS2 E05 Buoy

Buoy	Year-Month	Species	Count
HS2 E05	2022-08	Eastern red bat	1
		Silver-haired bat	1
	2022-09	Eastern red bat	3
		Silver-haired bat	8

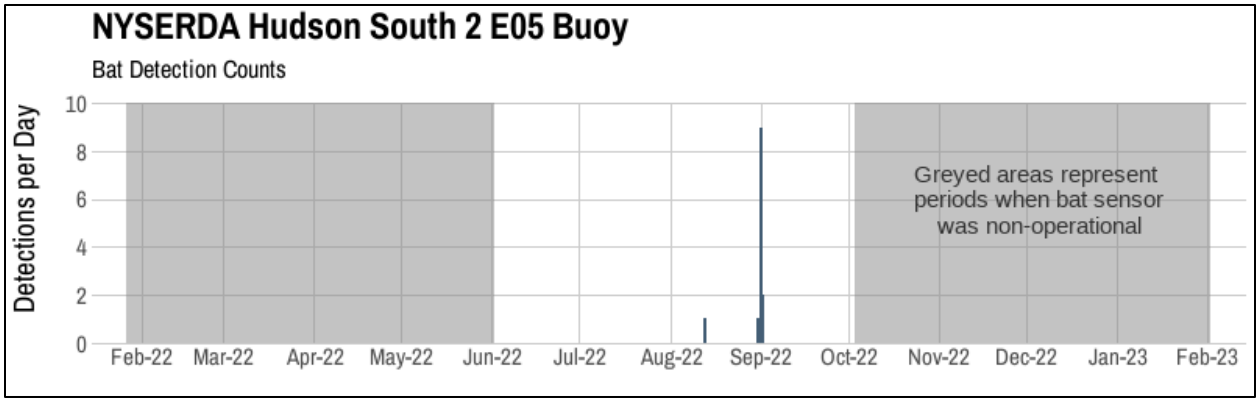

Figure 3. Bat acoustic detections recorded per day at HS2 E05.

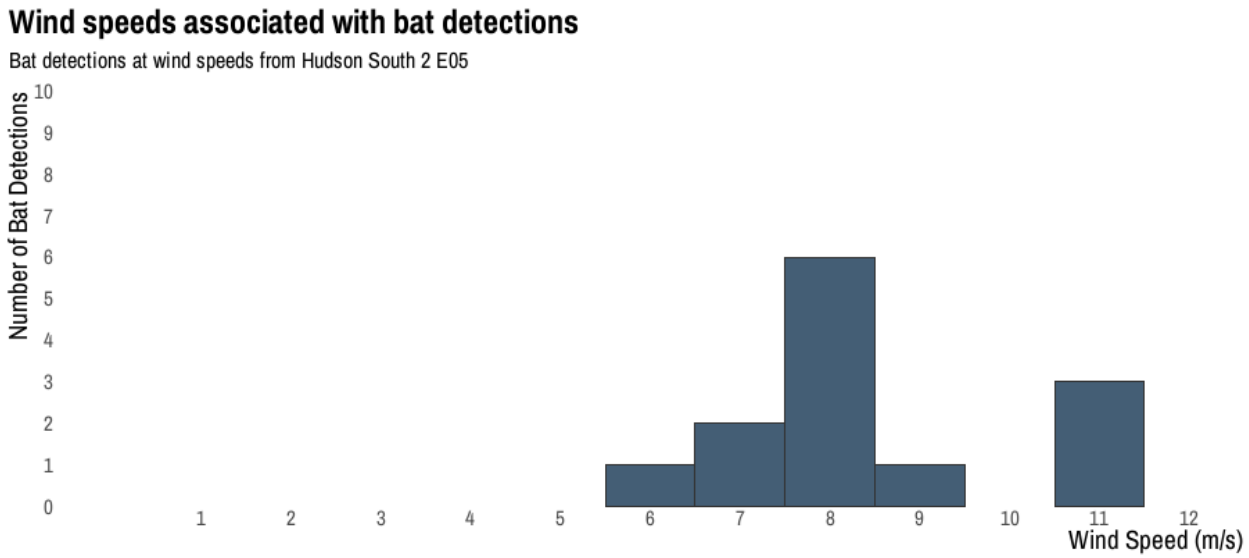

Figure 4. Bat acoustic detections recorded per wind speed (ms) observed at HS2 E05.

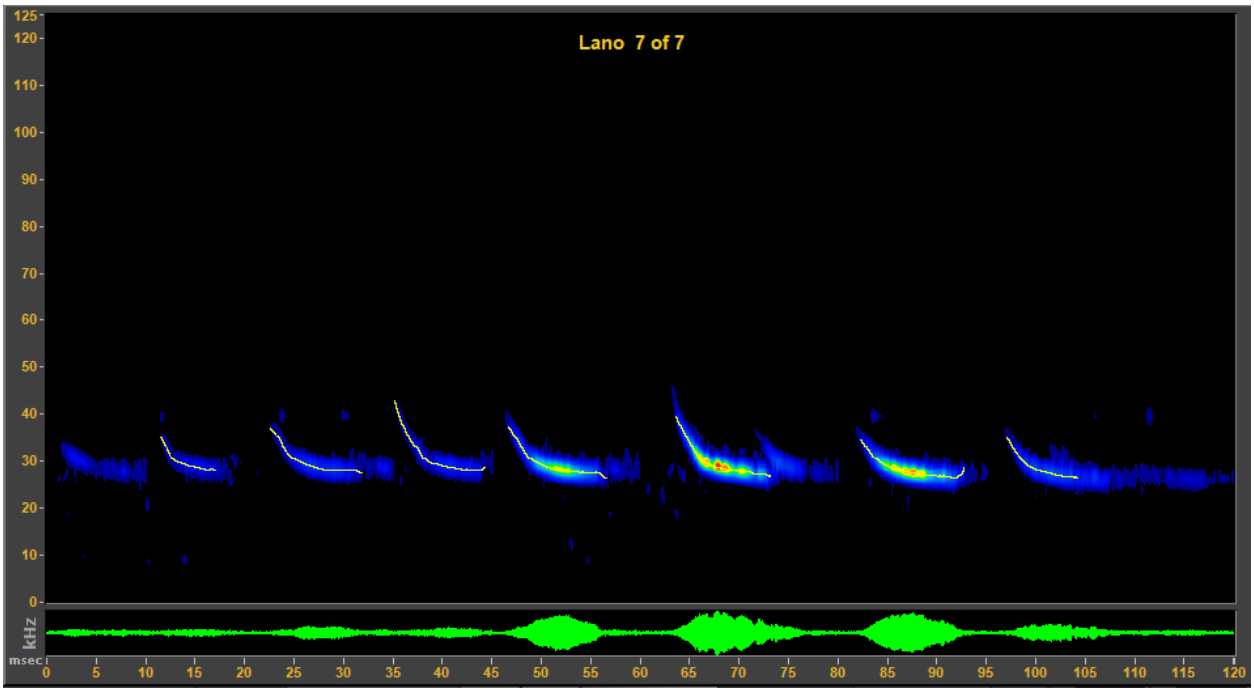

Figure 5. Typical Silver-haired bat (*Lasionycteris noctivagans*) call sequence recorded at HS2 E05 buoy on 02 Sep 2022.

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

Bird Acoustic Analysis

The usable WAV files were processed with the Kaleidoscope software using automated detection parameters selected for capturing a wide variety of avian flight calls of species listed in Table 4 (Cornell Lab of Ornithology Macaulay Library archives; https://search.macaulaylibrary.org/catalog). Additional bird species were confirmed from detections that are not listed in **Error! Reference source not found.**, focusing on but not limited t o gulls and terns such as herring gull, Bonaparte's gull, Franklin's gull, laughing gull, ring-billed gull, and roseate tern. The parameters were chosen to be lenient and allow more false alarms to avoid discarding true positives as much as possible.

Table 4. Bird Species' Flight Calls Used for Automatic Detection Parameter Selection

Cape may warbler	Northern parula	Bobolink
Ovenbird	American redstart	Palm warbler
Gray-cheeked thrush	Black-throated blue warbler	Black-and-white warbler
Blackpoll warbler	Common yellowthroat	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

Bird Acoustic Results

Kaleidoscope processing of the SM4 bird-acoustic data produced 45,031 detections, of which only five were confirmed to be birds. Any detections that were not birds were confirmed to be water, wind, or buoy noise or some combination of those. The five bird calls were identified as herring gulls (Table 5) and occurred in June and late August (Figure 6).

Table 5. Bird Species Recorded at HS2 E05 Buoy

Buoy	Year-Month	Species	Count
HS2 E05	2022-06	Herring gull	4
	2022-08	Herring gull	1

Birds were recorded at wind speeds ranging between 2.6 ms and 5.7 ms with the median number of detections occurring at 3.7 ms. Figure 7 summarizes the number of detections occurring at wind speeds to the nearest whole value.

A representative herring gull sonogram is shown in Figure 8.

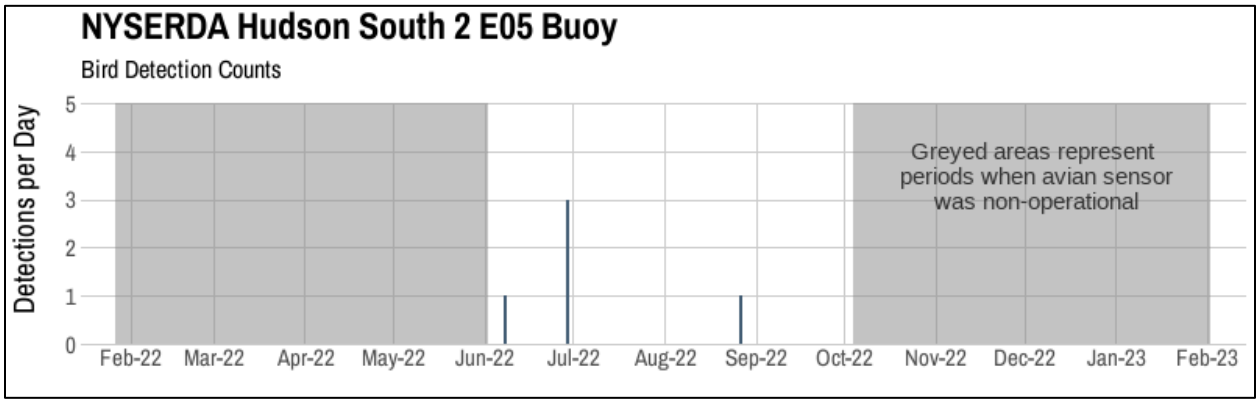

Figure 6. Bird acoustic detections recorded per day at HS2 E05.

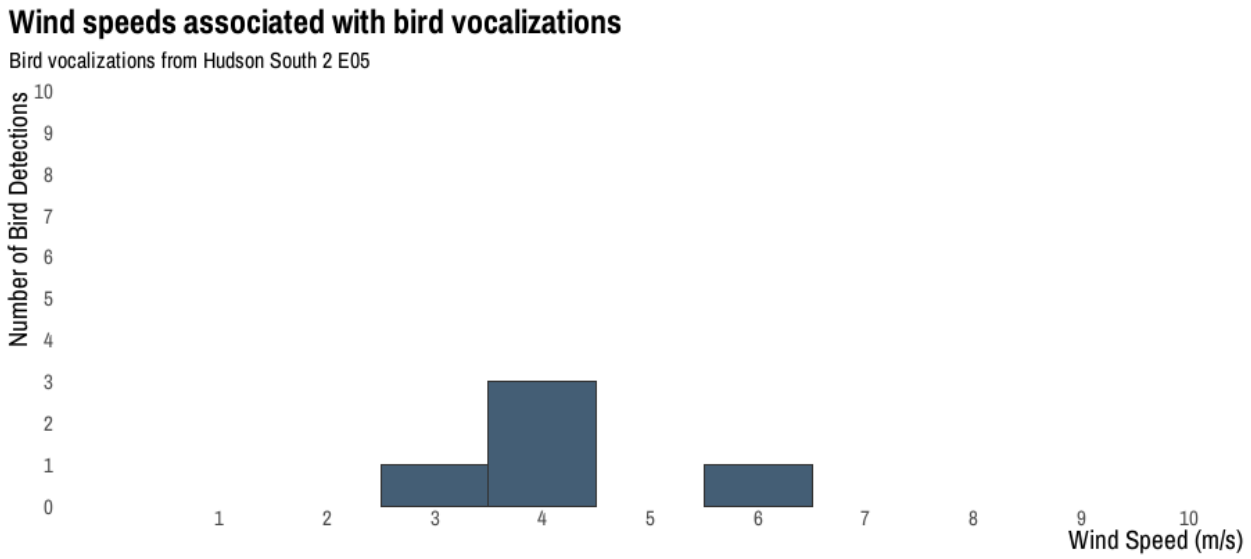

Figure 7. Bird acoustic detections recorded per wind speed (ms) observed at HS2 E05.

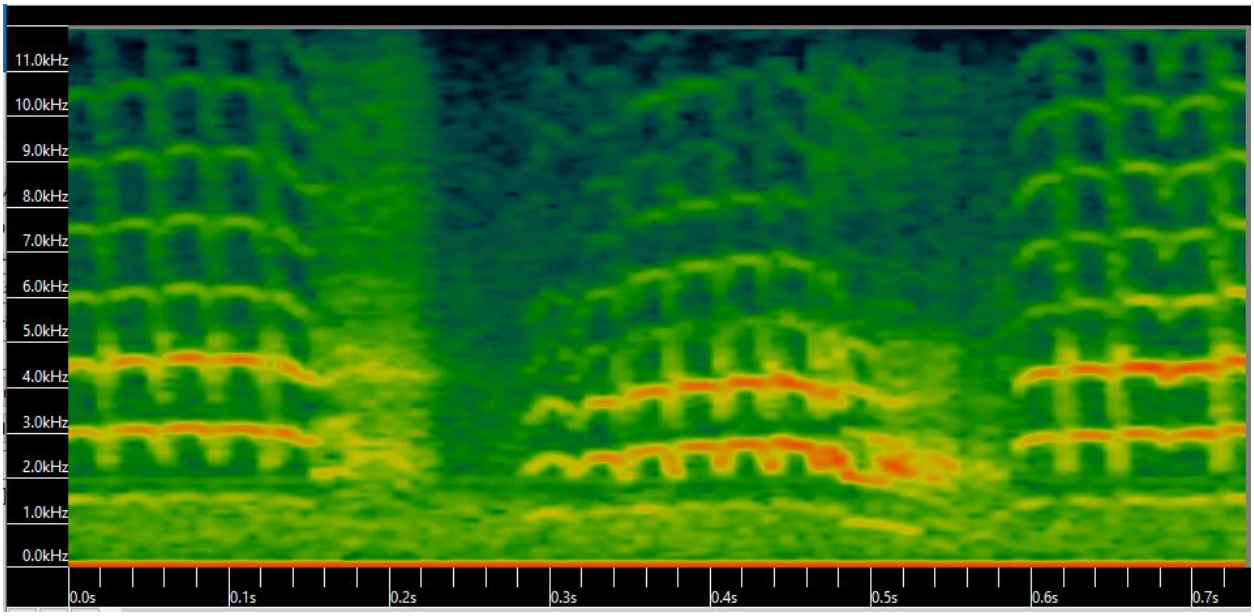

Figure 8. Herring gull detection from Jun 2022 at HS2 E05 buoy.

Motus Detections

No tagged species were detected by the Motus receiver at HS2 E05 (E-05 CTT SensorStation ID# 8390). There were three occurrences of a test tag Ocean Tech Services used for a calibration study which are listed in Table 6.

Table 6. Motus Tag Detections from HS2 E05 Buoy (E-05 CTT SensorStation ID# 8390)

Tag	Species	Date
AOWP#07784C34:5 M.55078	NA (test)	19 Aug 2022
AOWP#07784C34:5 M.55078	NA (test)	04 Sep 2022

Tag	Species	Date
AOWP#07784C34:5 M.55078	NA (test)	05 Sep 2022