Bat and Bird Data Analysis and Results Summary

May 2021 to May 2022

Progress Report #4 (Final)

US Wind Metocean Buoy Campaign

Prepared by:

Normandeau Associates, Inc.
4581 NW 6th Street, Suite H
Gainesville, FL 32609
www.normandeau.com

February 2023

Executive Summary

This report summarizes bat and bird acoustic data collected between 19 May 2021 and 19 May 2022 at the E14 US Wind buoy. Results are presented cumulatively such that findings reported in prior reports are contained in subsequent reports. Bat and bird acoustic sensors were deployed with the E14 US Wind buoy on 19 May 2021 and continue to collect data for the second year at the time of this reporting. Here we present the bat and bird acoustic results associated with the above-water acoustic sensors deployed on the buoy. To date, we have recorded 37 bat and 123 bird detections, representing 17 unique species identified by their vocalization characteristics (Table 1). Bat acoustic detections were produced by three species: eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionycteris noctivagans*). Silver-haired bats accounted for 67.6% (n=25) of bat vocalization sequences. Bird acoustic detections were produced by 14 species (Table 1). Gull species accounted for 83% of all avian vocalization sequences, with most calls produced by herring gulls (n=94).

Table 1. Bat and Bird Species Identified between 19 May 2021 and 19 May 2022

Taxonomic Group	Species / Species Group	Vocalization Sequences
Bats	Eastern Red Bat	9
	Hoary Bat	3
	Silver-haired Bat	25
Bats Total		**37**
Birds	Herring Gull	94
	Great Black-backed Gull	3
	Laughing Gull	5
	Common Loon	1
	Semipalmated Plover	1
	Solitary Sandpiper	2
	Spotted Sandpiper	1
	Brown Pelican	10
	Magnolia Warbler	1
	Chestnut-sided Warbler	1
	Blackpoll Warbler	1
	Wood Thrush	1
	White-throated Sparrow	1
	Northern Waterthrush	1
Birds Total		**123**
TOTAL		**160**

Justification

Bats have been observed offshore for over 100 years (Merriam 1887; Thomas 1921) yet the extent of their presence in the pelagic environment is only recently beginning to be understood.

In the Eastern US, most species found offshore are long-distance migratory species, which include eastern red bats, hoary bats, and silver-haired bats (Sjollema et al. 2014). Short-distance migratory species from the genera *Myotis* and *Perimyotis* have also been detected. Offshore bat activity peaks significantly throughout the autumn migration period of August–early November (Peterson et al. 2014; Lagerveld et al. 2015, 2017, 2020). Bats have experienced significant population declines via turbine collisions at terrestrial wind energy developments; whether a similar collision risk will be experienced at offshore facilities is an open question.

Off the coast of Maryland (USA) the offshore environment provides habitat for waterbird species, including sea ducks, loons, gulls, scoters, terns, alcids, gannets, shearwaters, petrels, and shorebirds. Some passerine species may also use the offshore environment during long-distance seasonal migrations (DeLuca et al. 2015). Understanding the prevalence of certain bird species within the US Wind project area is paramount to evaluating relative exposure and potential risks to species when considering adverse effects such as collision and displacement (Garthe and Hüppop 2004; Furness et al. 2013; Robinson Willmott et al. 2013).

Understanding the prevalence of bats and birds in the offshore environment and under what ambient conditions they occur prior to, during, and after wind farm construction will provide US Wind the capacity to detect changes to species prevalence and support an informed response to any potential species impacts and identification of any mitigation strategies.

Operations and Analysis Summary

The SM4 Bat acoustic detector was operational for 272 days (Figure 1). For the the SM4 Bat acoustic sensor the period where timestamps were not recorded was considered non-operational because the detector was set to record from an hour before sunset to an hour after sunrise, and it was not possible to determine if this is the actual time the detector was operational. This lack of timestamp spans 16 January 2022 to 05 April 2022. Even though we could not be certain of when the SM4 Bat acoustic sensor was operational, we still examined the audio files for calls, and none were found. There was a further non-operational period between 30 December 2021 and 13 January 2022 for the SM4 Bat detector which was likely due to a power supply issue.

The SM4 Bird acoustic sensor was operational or partially operational for 340 days (Figure 2). Partially operational refers to periods where the sensor was collecting data but no accurate timestamps were being recorded. However, the sensor was set to record 24/7 and so we know that false negatives are unlikely and when data were analyzed, bird calls were found. As with the SM4 Bat detector, this timestamp error period occurred between 16 January 2022 and 05 April 2022. Observations without timestamps are reported with species totals but are removed from figures that show detection dates. There were 43 mostly gull vocalization sequences recorded during the clock error period, and we were unable to match the vocalizations to a specific day within the data collection period. As with the SM4 Bat detector, between 19 December 2021 and 13 January 2022, the SM4 Bird acoustic sensor was completely non-operational, which was likely due to a power supply issue.

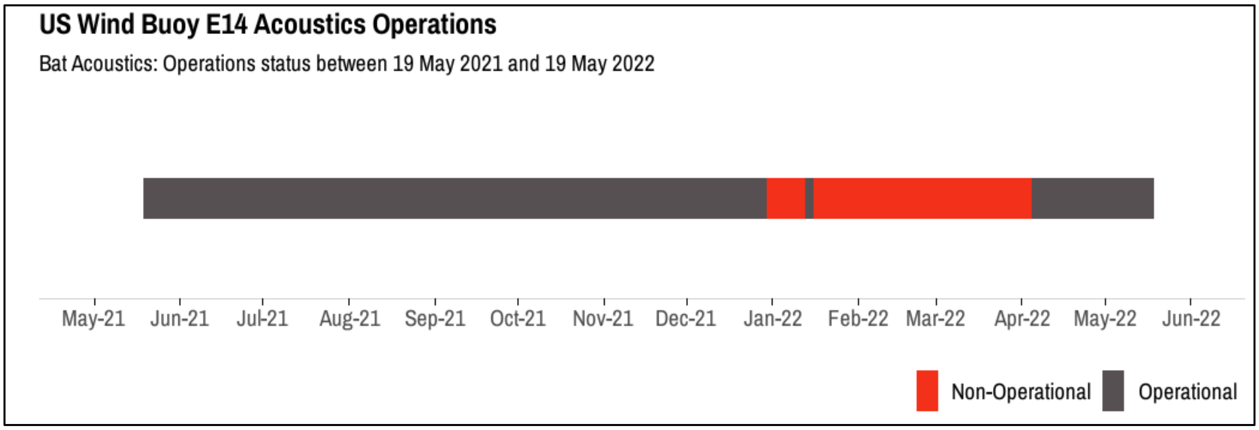

Figure 1. Bat acoustic sensor operations on the E14 US Wind buoy during data collection periods 1–4.

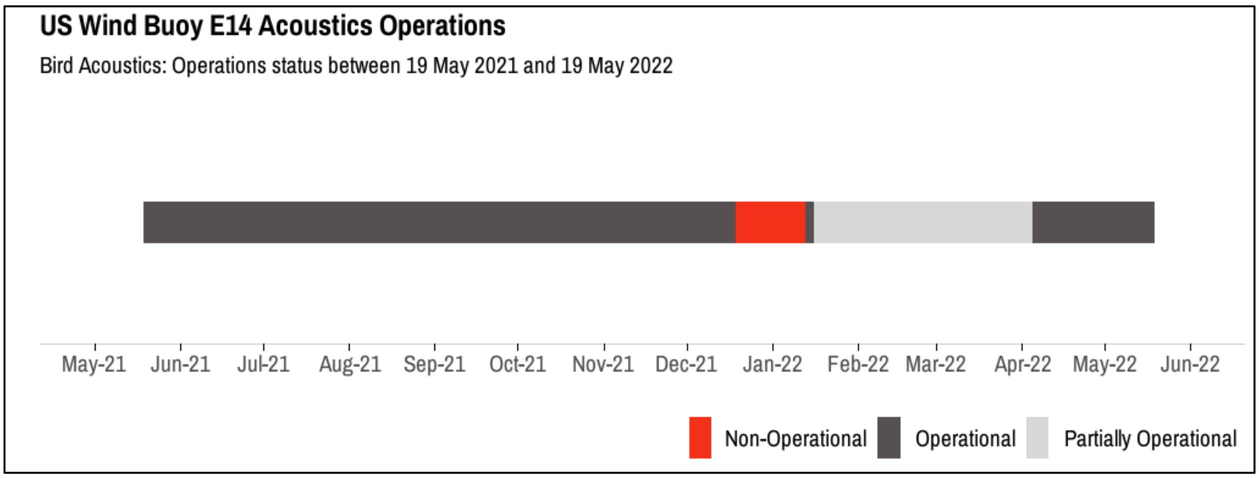

Figure 2. Bird acoustic sensor operations on the E14 US Wind buoy during data collection periods 1–4. Partially operational refers to a time period where data were collected but timestamps were not accurately recorded.

Table 2. Deployment and Operation Information Associated with SM4 Bat Acoustic Data and SM4 Bird Acoustic Data Collected at the E14 US Wind Buoy

Taxonomic Group	Collection Period	Collection Period Date Range	Collection Period (days)	Detector Operational Periods	Detector Operational Period (days)	% Days Operational	Data Status
Bats	1	19 May 2021–30 Aug 2021	103	19 May 2021–30 Aug 2021	103	100.0%	Analyzed and reported in this volume
	2	30 Aug 2021–13 Jan 2022	136	30 Aug 2021–30 Dec 2021	122	89.7%	Analyzed and reported in this volume
	3	13 Jan 2022–5 Apr 2022	82	13 Jan 2022–16 Jan 2022*	4	4.9%	Only analyzed and reported where timestamp data is available
	4	5 Apr 2022–19 May 2022	44	5 Apr 2022–19 May 2022	44	100.0%	Analyzed and reported in this volume
Birds	1	19 May 2021–30 Aug 2021	103	19 May 2021–30 Aug 2021	103	100.0%	Analyzed and reported in this volume
	2	30 Aug 2021–13 Jan 2022	136	30 August 2021–19 Dec 2021	111	81.6%	Analyzed and reported in this volume
	3	13 Jan 2022–5 Apr 2022	82	13 Jan 2022–5 Apr 2022**	82 - Timestamp data unavailable for 78 days	100.0%	Analyzed and reported in this volume
	4	5 Apr 2022–19 May 2022	44	5 Apr 2022–19 May 2022	44	100.0%	Analyzed and reported in this volume

* Acoustic recordings collected but instrument clock failed. No bat calls were found during this period.

** Acoustic recordings collected but instrument clock failed. Data were still analyzed and presented where timestamps were not required.

Bat Acoustic Analysis Summary

Upon data receipt we uploaded the contents of each card to the Normandeau ReMOTe server for storage and processing. We then ran each data set 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 rather than bats, based on features of the sonogram. For example, WAV files with bandwidth below 20 kHz 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. With 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 detectable pulsing ultrasonic noise that scrubber algorithms will not eliminate. We therefore 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 approximately every 10 ms with a mean characteristic frequency of ≈39.75 kHz and a bandwidth of ≈4 kHz. The characteristics of these sounds are not like any bat species, and we determined which calls were more likely bats based on these parameters, effectively scrubbing all the files to a reduced batch for manual vetting (≈90% reduction).

Bat Acoustic Results Summary

To date, we have recorded 37 discrete bat call sequences at the E14 buoy (Figure 3, Table 3). No bat recordings were captured between 16 January 2022 and 4 April 2022 when timestamps were incorrectly recorded. Overall bat activity was low at the buoy with a maximum of five vocalization sequences on one date (19 October 2021) and four sequences per date on only two occasions. One vocalization from an eastern red bat was recorded during the spring 2021 migratory period (Figure 3). The remaining 36 vocalization sequences were recorded during the fall 2021 migratory period (August–October) (Figure 3). Increased activity during the fall migratory period is consistent with the literature. Overall, bat activity was very low throughout the summer months and consistent with the literature and other survey data, which shows that bat activity is higher during fall migration. Bats were recorded at wind speeds ranging between 1.0 ms to 14.0 ms with the median number of detections occurring at 6.6 ms (Figure 4). Bat activity declined sharply when wind speeds were above 8 ms (Figure 4).

Spectrograms collected at the E14 US Wind Buoy for eastern red bat, hoary bat, and silver-haired bat are shown in Figure 5, Figure 6, and Figure 7.

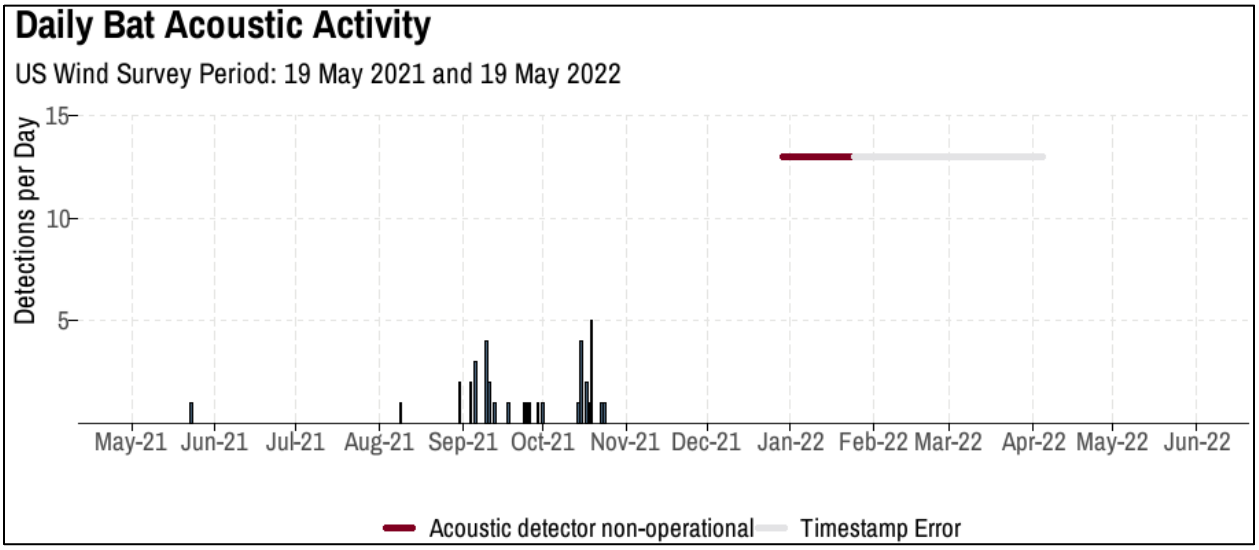

Figure 3. Daily bat occurrences at the E14 US Wind buoy during collection period 19 May 2021–19 May 2022.

Table 3. Bat Occurrences by Date

No bat recordings were captured between 25 Jan 2022 and 05 April 2022 when timestamps were not correctly recorded. Vocalization sequences are counted per date by recording timestamp in UTC-5.

Species	Date	Vocalization Sequences
Eastern red bat	23 May 2021	1
Eastern red bat	09 Aug 2021	1
Eastern red bat	31 Aug 2021	2
Silver-haired bat	04 Sep 2021	2
Eastern red bat	06 Sep 2021	2
Silver-haired bat	06 Sep 2021	1
Silver-haired bat	10 Sep 2021	4
Silver-haired bat	11 Sep 2021	2
Silver-haired bat	13 Sep 2021	1
Eastern red bat	18 Sep 2021	1
Eastern red bat	24 Sep 2021	1
Silver-haired bat	25 Sep 2021	1
Eastern red bat	26 Sep 2021	1
Silver-haired bat	29 Sep 2021	1
Hoary bat	01 Oct 2021	1
Hoary bat	14 Oct 2021	1
Silver-haired bat	15 Oct 2021	4
Silver-haired bat	17 Oct 2021	2
Silver-haired bat	18 Oct 2021	1
Silver-haired bat	19 Oct 2021	5
Hoary bat	23 Oct 2021	1
Silver-haired bat	24 Oct 2021	1

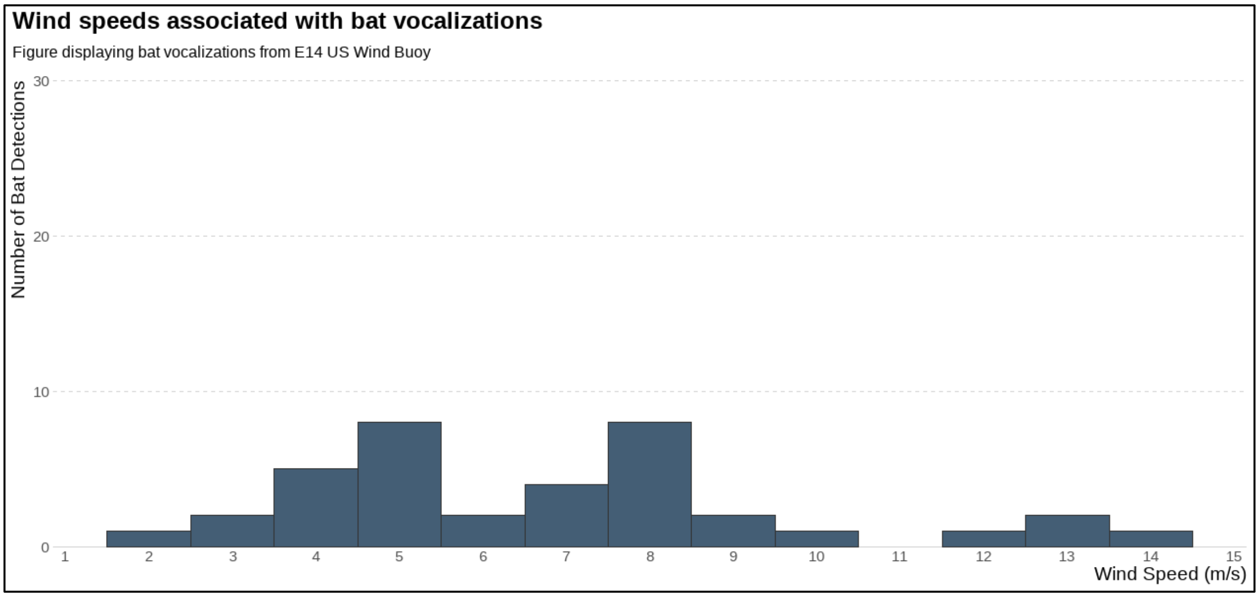

Figure 4. Bat acoustic detections recorded per wind speed (ms) observed at the US Wind Buoy E14.

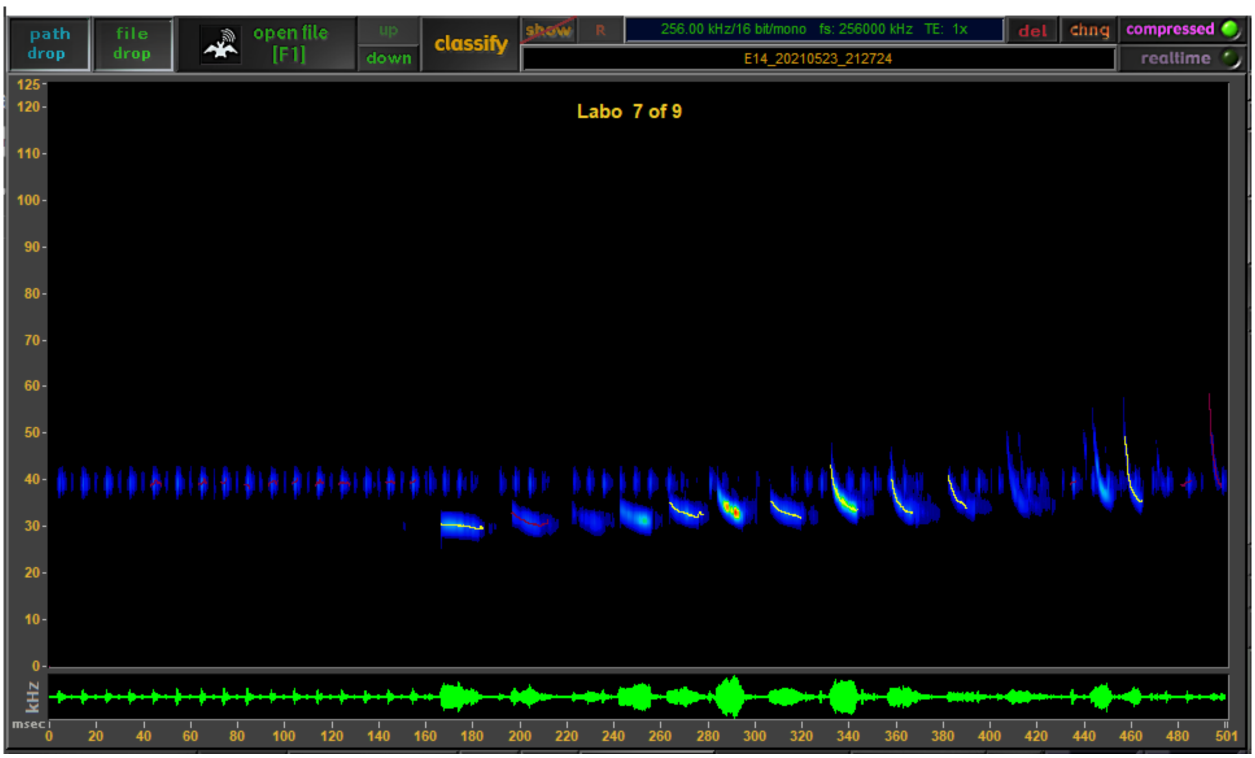

Figure 5. Spectrogram of eastern red bat collected at the E14 US Wind buoy.

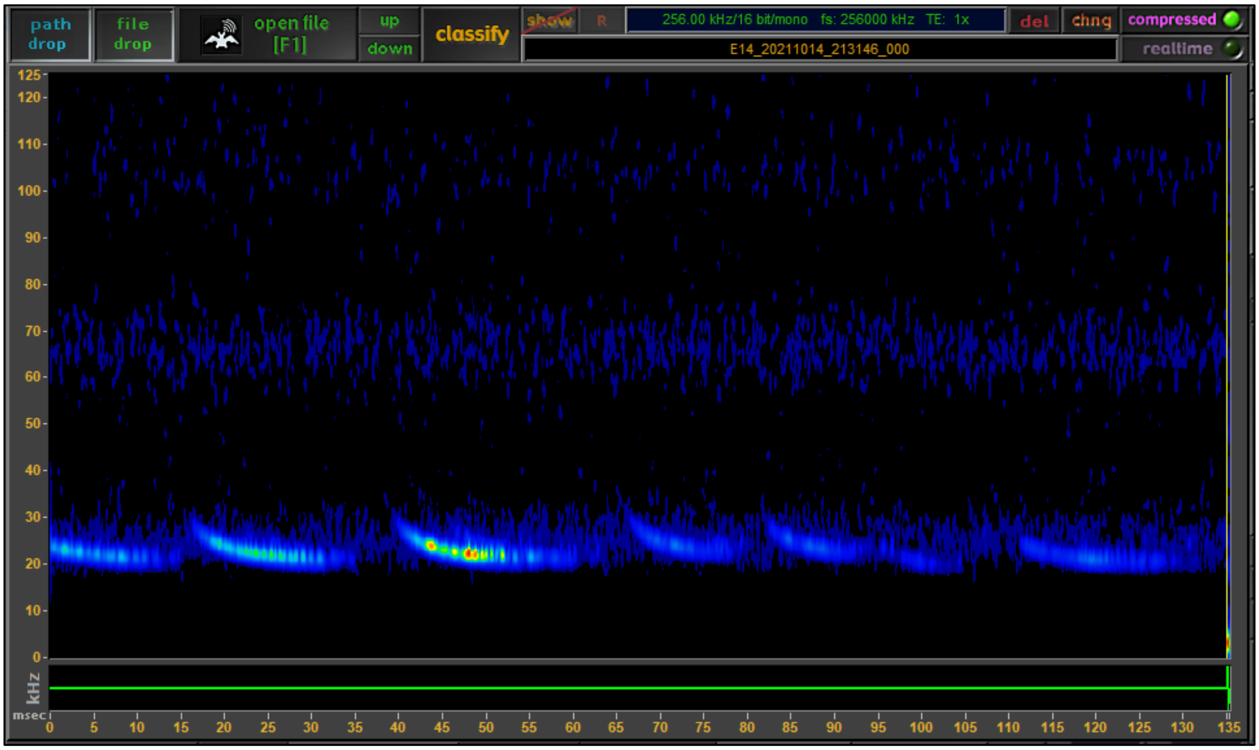

Figure 6. Spectrogram of hoary bat collected at the E14 US Wind buoy.

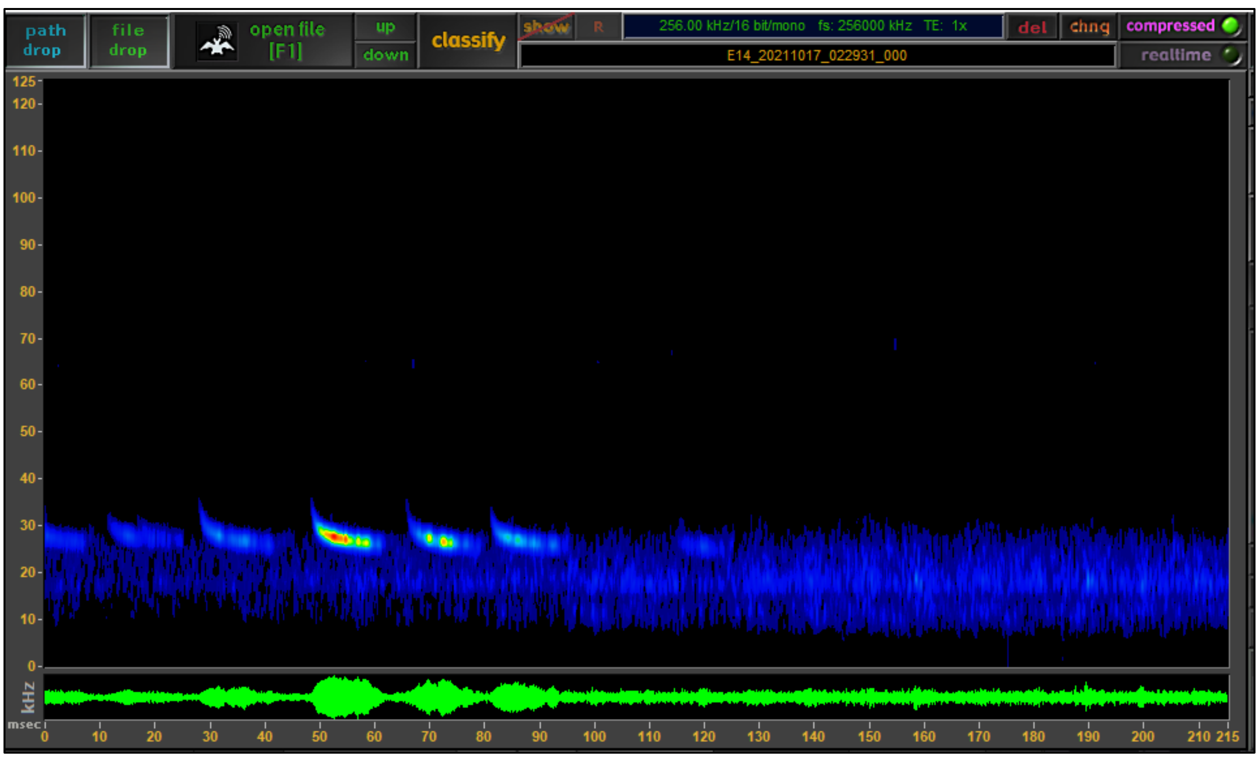

Figure 7. Spectrogram of silver-haired bat collected at the E14 US Wind buoy.

Bird Acoustic Analysis Summary

Bird acoustic data were processed with Wildlife Acoustics Kaleidoscope Pro software using automated detection parameters determined for the flight calls of species in Table 4 using flight call audio data in the Cornell Lab of Ornithology Macaulay Library archives (https://search.macaulaylibrary.org/catalog). These 30 species were chosen based on sightings noted in ebird.org for the Eastern US region and cross-referenced with the Migratory Bird Treaty Act. Note that detection parameters for the species listed do not necessarily exclude other species or non-bird sounds so manual auditory (headphones) and visual (spectrogram) review of the detections is necessary to confirm any bird call within or outside the list and to exclude false positives. Additional bird species were confirmed from detections that did not fall within those listed in Table 4, focusing on but not limited to gulls, terns, and sandpipers. This species list is not to be taken as exhaustive as the Kaleidoscope settings can also detect species outside this list.

Manual auditory and visual review was conducted on every detection in the first 200 detections within each cluster generated by the Kaleidoscope Pro software auto-detection cluster analysis. Any clusters with fewer than 200 detections had every detection reviewed. Any detections that were not birds were confirmed to be water, wind, buoy noise, or some combination of those, and are not listed. For this analysis, one call corresponds to at least one confirmed detection within any one-minute span. Two calls from the same species within the same one-minute period are counted as one occurrence.

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

Herring gull	Bonaparte's gull	Great black-backed gull
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 yellowthroat	Bay-breasted warbler
Least bittern	Green heron	Veery
Magnolia warbler	Chestnut-sided warbler	White-throated sparrow
Blackburnian warbler	Bobolink	Blue grosbeak
Yellow warbler	Savannah sparrow	Indigo bunting
Swainson's thrush	Wood thrush	Northern waterthrush

Bird Acoustic Results Summary

We have detected 14 species across 123 vocalization sequences during the first year with most calls occurring during the late spring/early summer and late summer/early fall (Figure 8). Overall, bird activity at the buoy was consistently low during the summer months. Gull species accounted for 102 (83%) of the 123 bird vocalization sequences (Table 5). The most commonly occurring species was herring gull (n=94). We observed four vocalization sequences attributed to warbler species: chestnut-sided warbler, blackpoll warbler, magnolia warbler, and northern waterthrush (Table 5). Birds were recorded in speeds ranging between 0.0 ms up to 17.0 ms with the median number of detections occurring at 3.7 ms (Figure 9). Bird activity declined sharply when wind speeds were above 6.0 ms (Figure 9). Representative acoustic bird calls from each species detected at the buoy are pictured in Figure 10 through Figure 20.

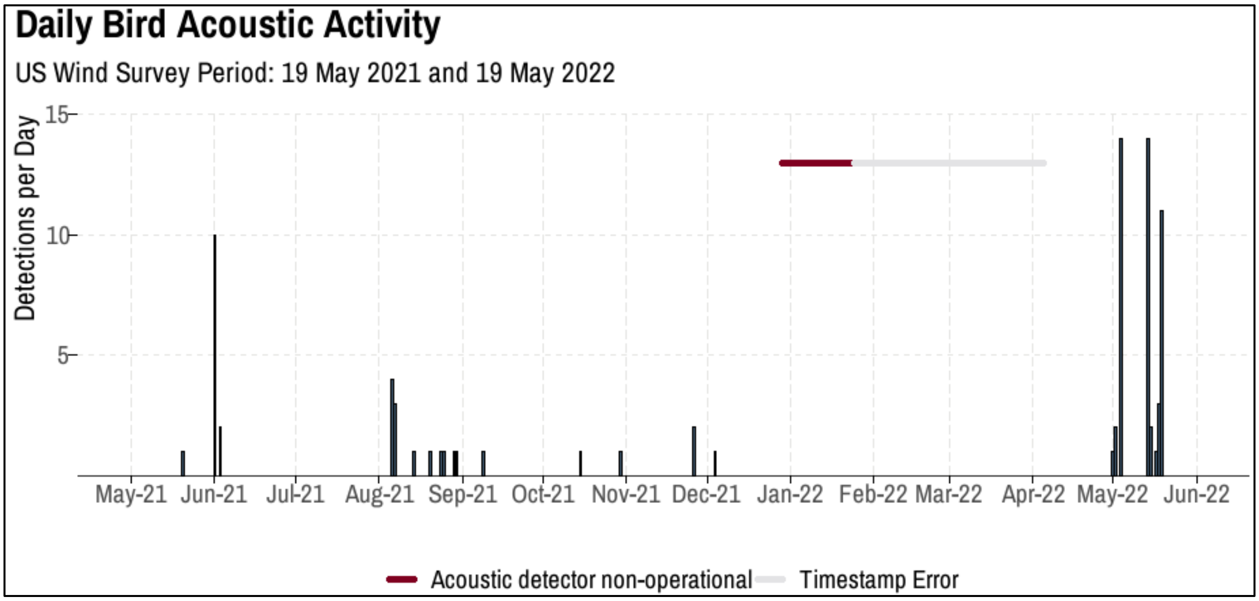

Figure 8. Daily bird occurrences at the E14 US Wind buoy during collection period 19 May 2021–05 April 2022 (n = 80). This figure does not include the 43 birds recorded during the period when accurate timestamps were missing.

Table 5. Bird Occurrences by Date or Data Period for Individuals Recorded when Instrument had a Clock Error

Species	Date	Vocalization Sequences
Chestnut-sided warbler	20 May 21	1
Herring gull	01 Jun 21	10
Herring gull	03 Jun 21	2
Herring gull	06 Aug 21	4
Herring gull	07 Aug 21	2
Spotted sandpiper	07 Aug 21	1
Herring gull	14 Aug 21	1
Herring gull	20 Aug 21	1
Wood thrush	24 Aug 21	1
Solitary sandpiper	25 Aug 21	1
Semipalmated plover	29 Aug 21	1
Solitary sandpiper	30 Aug 21	1
White-throated sparrow	9 Sep 21	1
Northern waterthrush	15 Oct 21	1
Laughing gull	30 Oct 21	1
Herring gull	26 Nov 21	1
Blackpoll warbler	26 Nov 21	1
Common loon	4 Dec 21	1
Herring gull	1 May 22	1

Species	Date	Vocalization Sequences
Herring gull	2 May 22	1
Laughing gull	2 May 22	1
Brown pelican	4 May 22	2
Herring gull	4 May 22	10
Laughing gull	4 May 22	2
Brown pelican	14 May 22	7
Herring gull	14 May 22	7
Herring gull	15 May 22	2
Herring gull	17 May 22	1
Herring gull	18 May 22	3
Brown pelican	19 May 22	1
Herring gull	19 May 22	10
Herring gull	25 Jan–5 Apr 22	38
Great black-backed gull	25 Jan–5 Apr 22	3
Laughing gull	25 Jan–5 Apr 22	1
Magnolia warbler	25 Jan–5 Apr 22	1

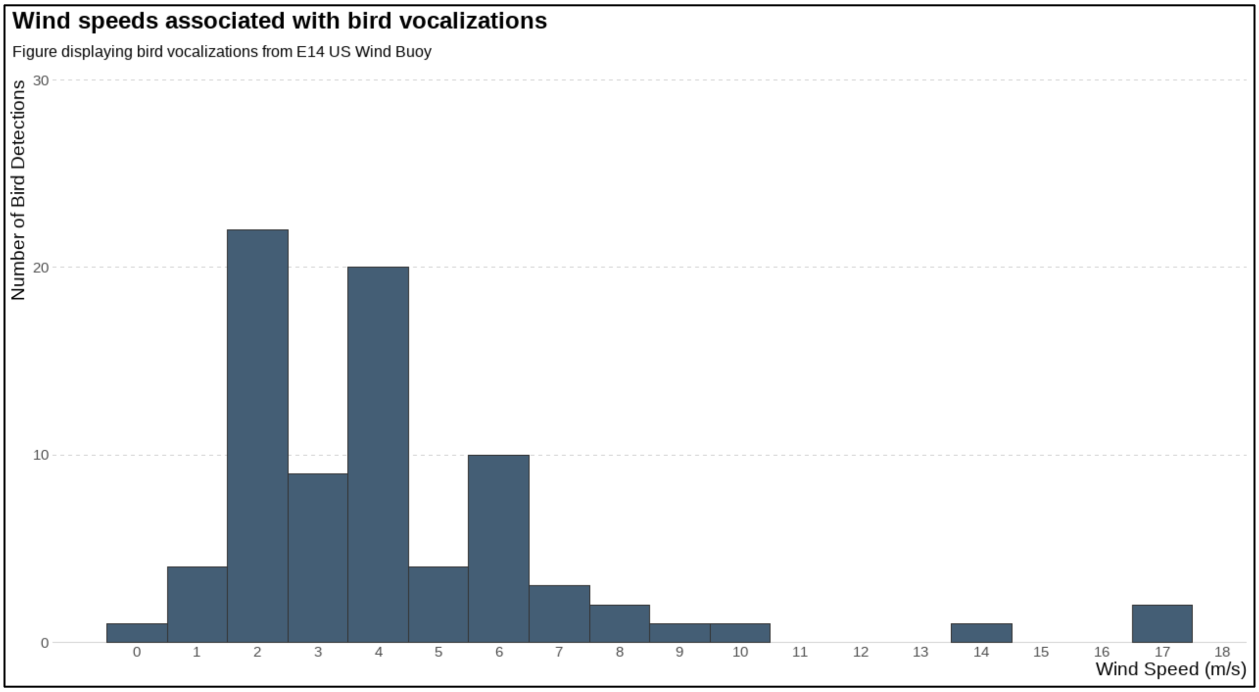

Figure 9. Bird acoustic detections recorded per wind speed (ms) at the US Wind Buoy E14 (n = 80). This figure does not include the 43 birds recorded during the period when accurate timestamps were missing.

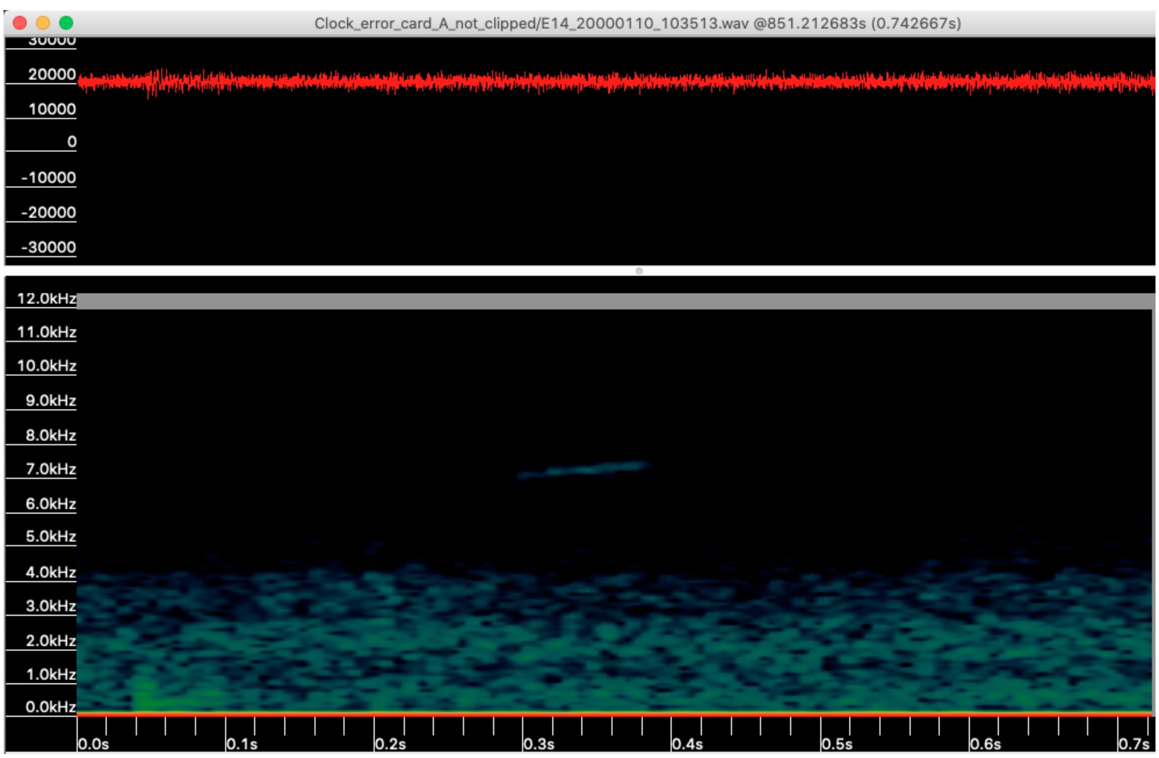

Figure 10. Spectrogram of magnolia warbler call collected at the E14 US Wind Buoy.

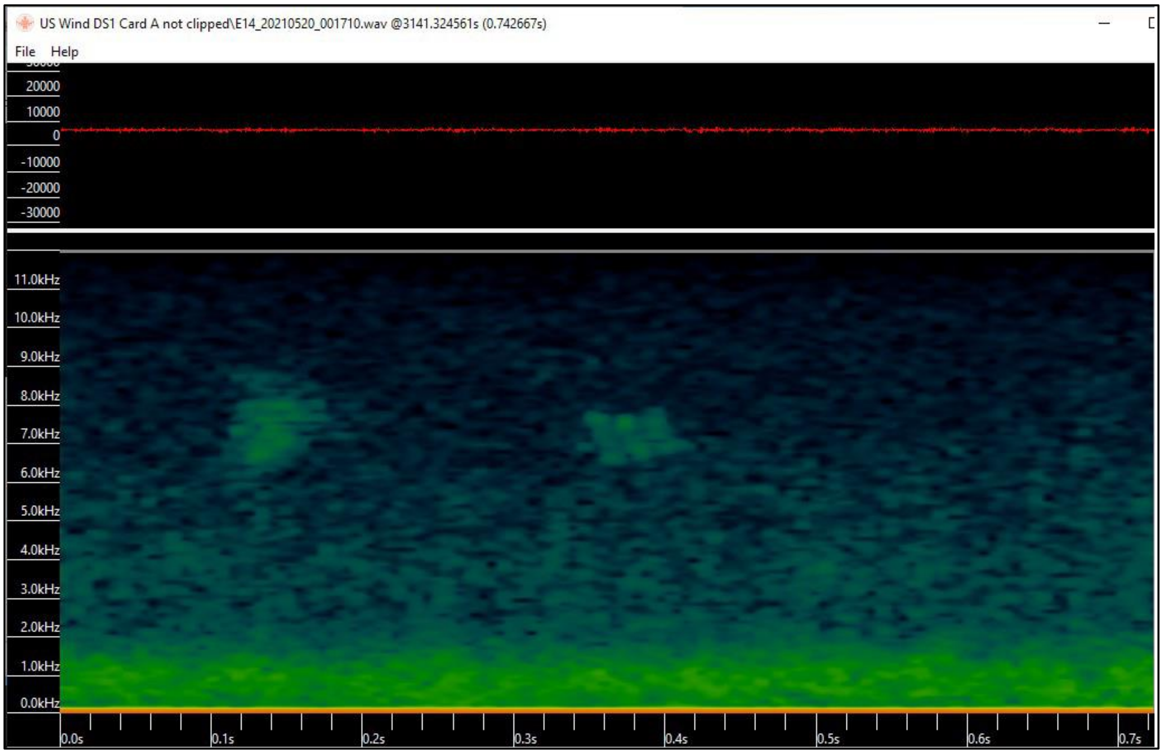

Figure 11. Spectrogram of chestnut-sided warbler call collected at the E14 US Wind Buoy.

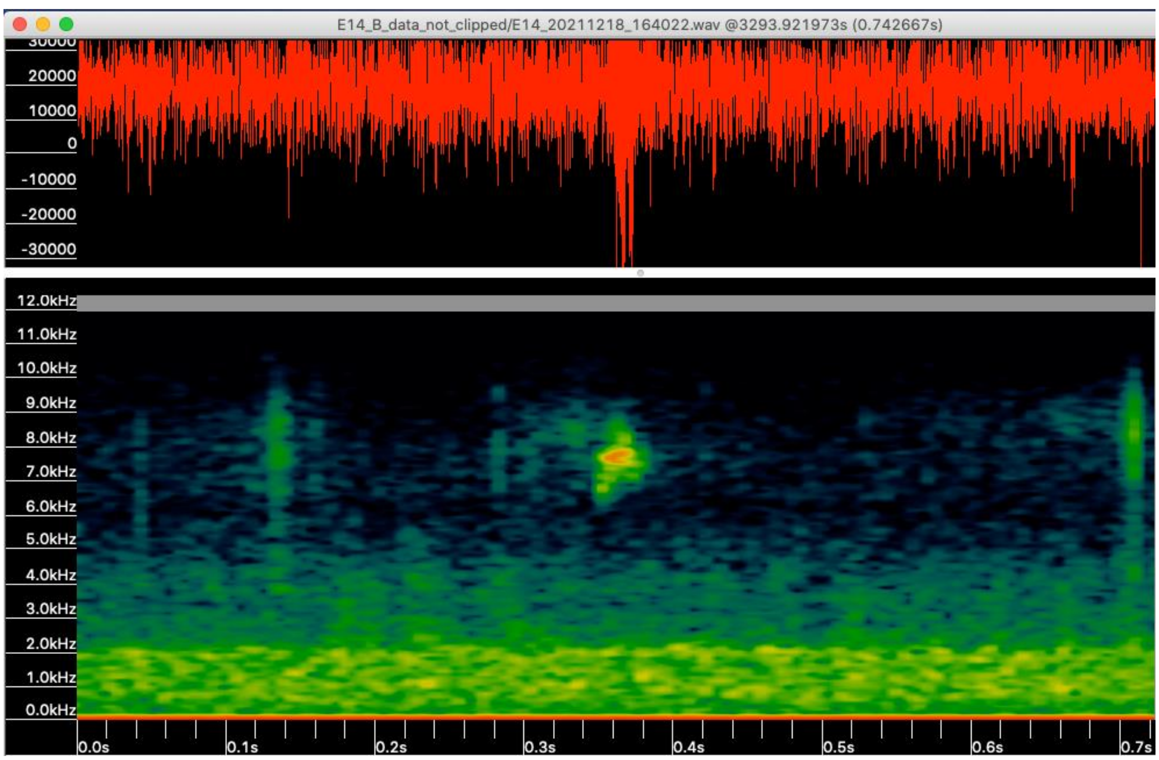

Figure 12. Spectrogram of blackpoll warbler call collected at the E14 US Wind Buoy.

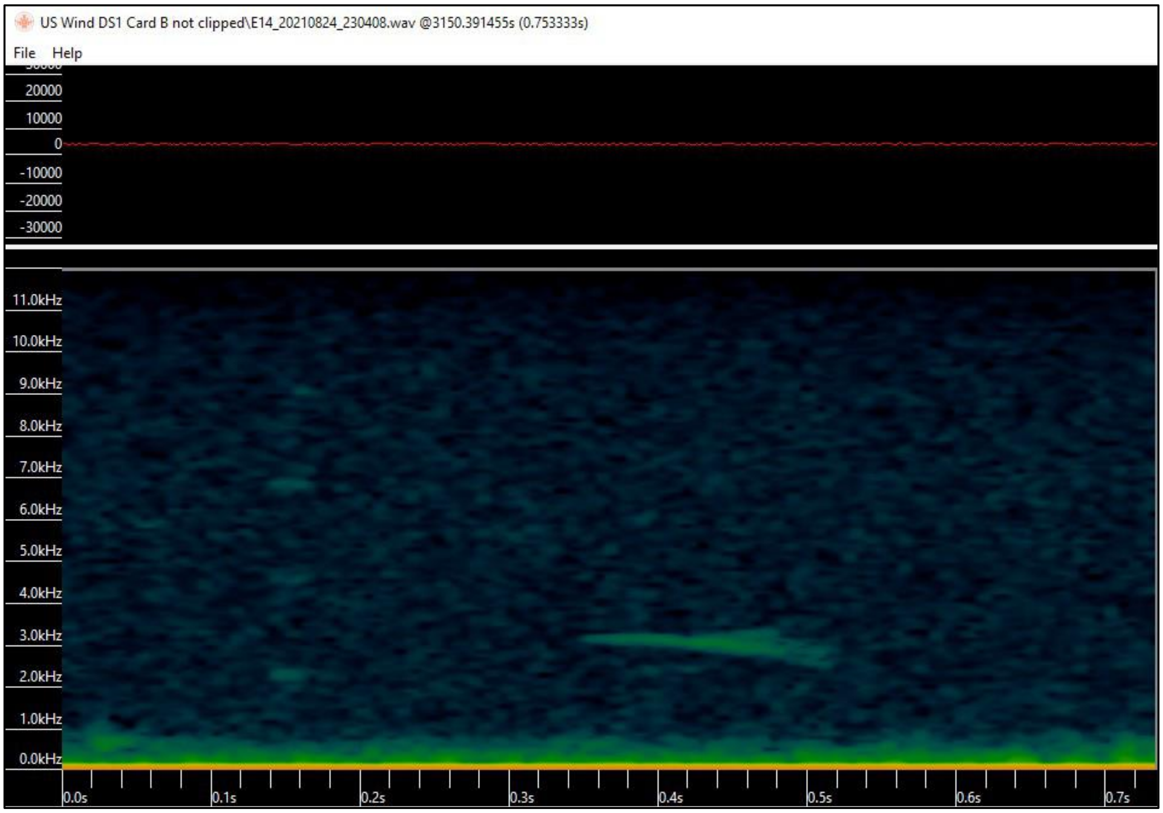

Figure 13. Spectrogram of wood thrush call collected at the E14 US Wind Buoy.

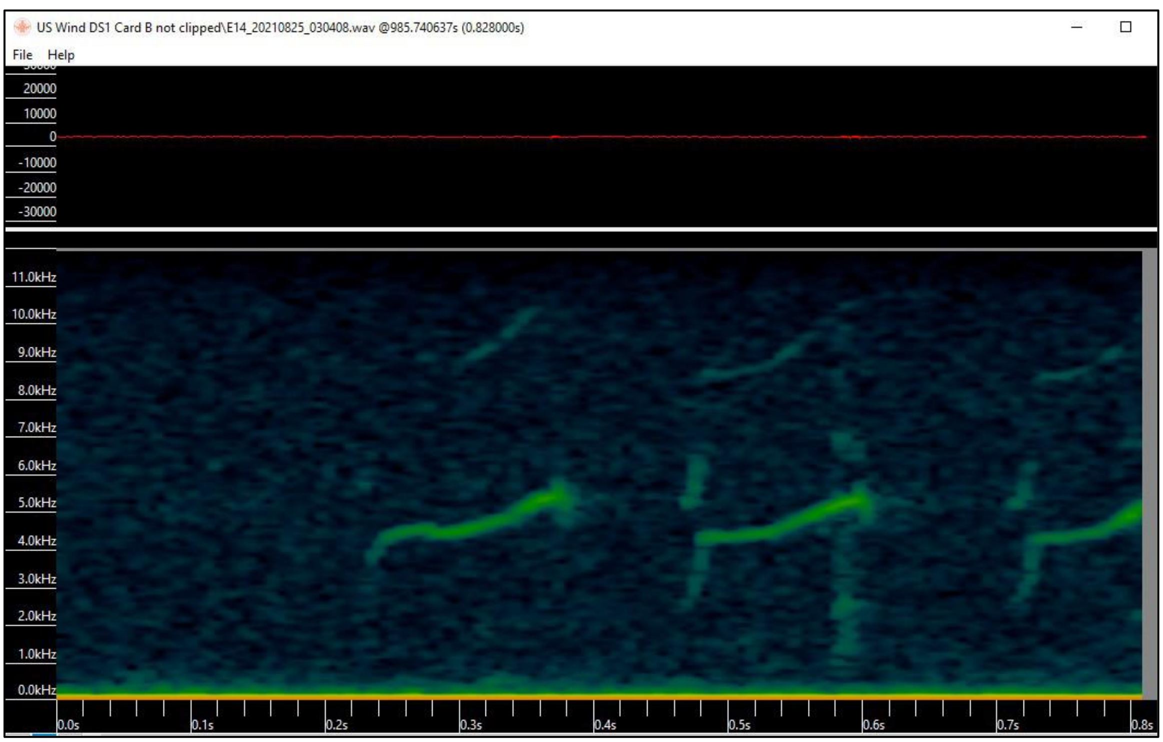

Figure 14. Spectrogram of solitary sandpiper call collected at the E14 US Wind Buoy.

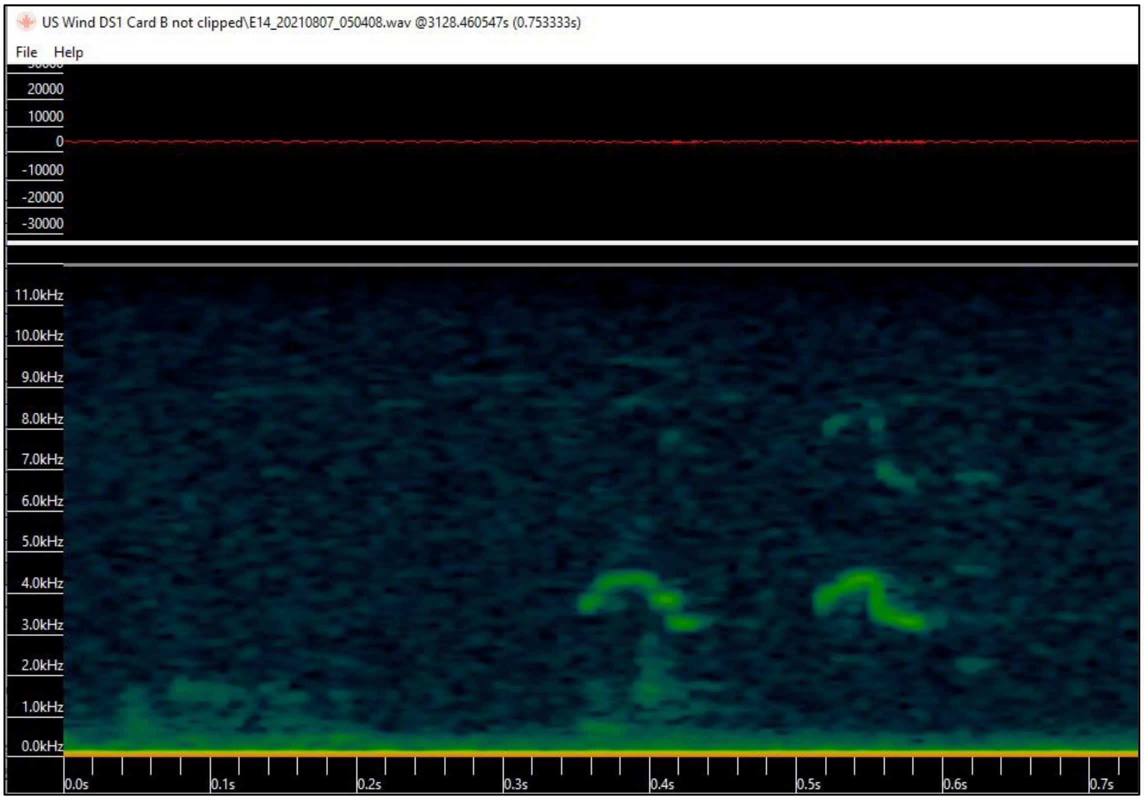

Figure 15. Spectrogram of spotted sandpiper call collected at the E14 US Wind Buoy.

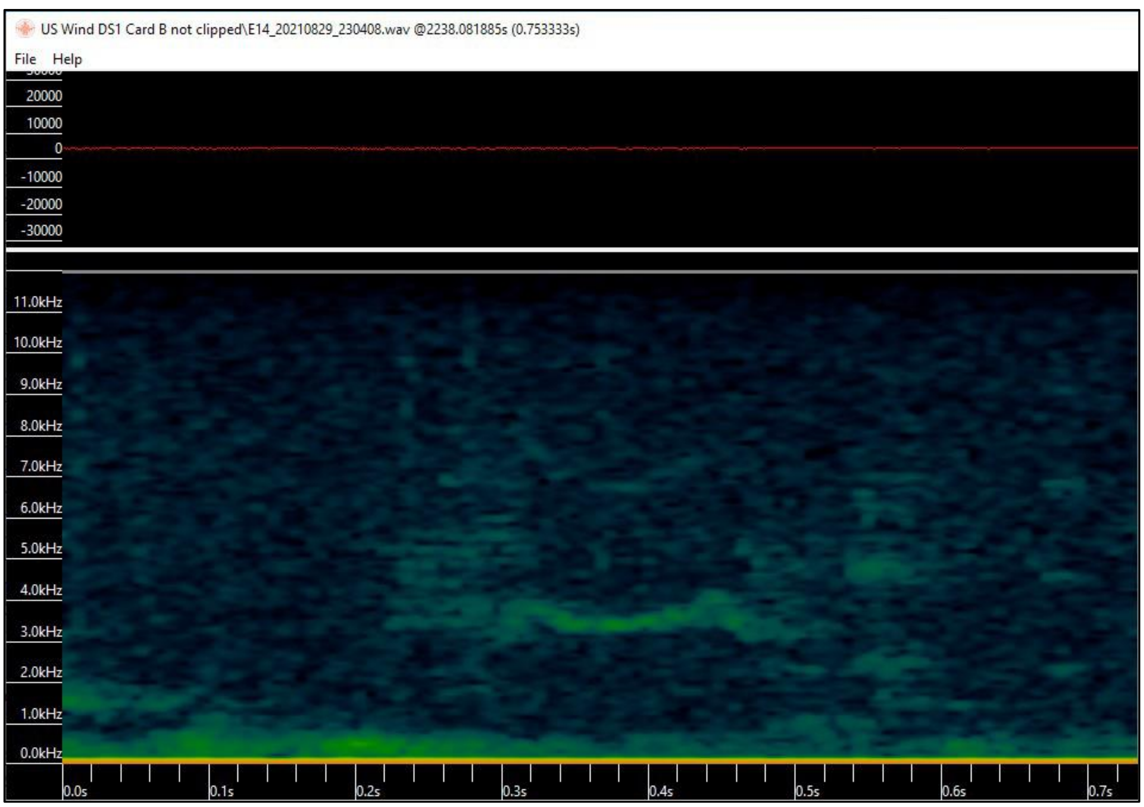

Figure 16. Spectrogram of semipalmated plover call collected at the E14 US Wind Buoy.

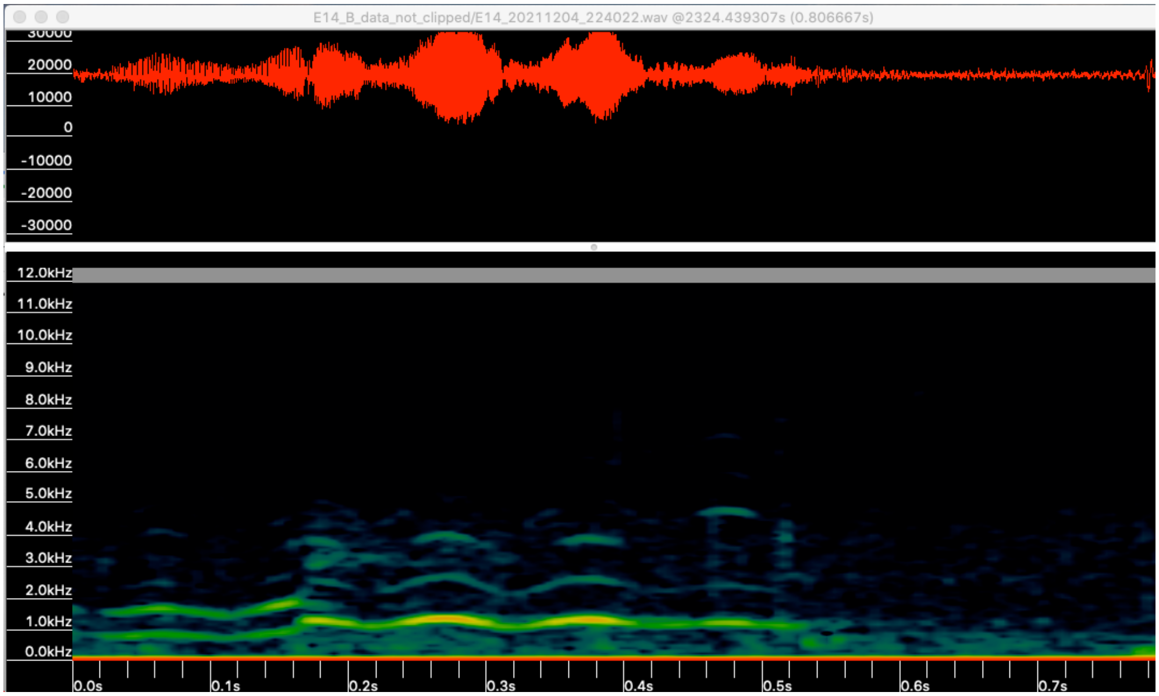

Figure 17. Spectrogram of common loon call collected at the E14 US Wind Buoy.

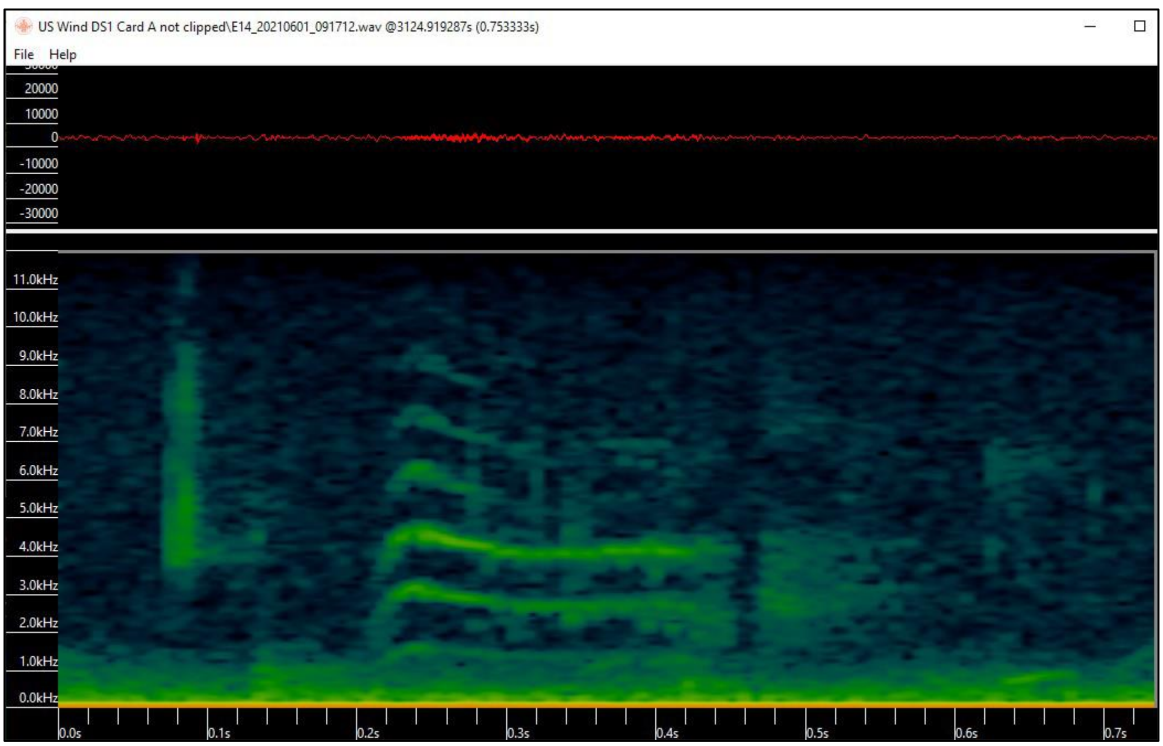

Figure 18. Spectrogram of herring gull call collected at the E14 US Wind Buoy.

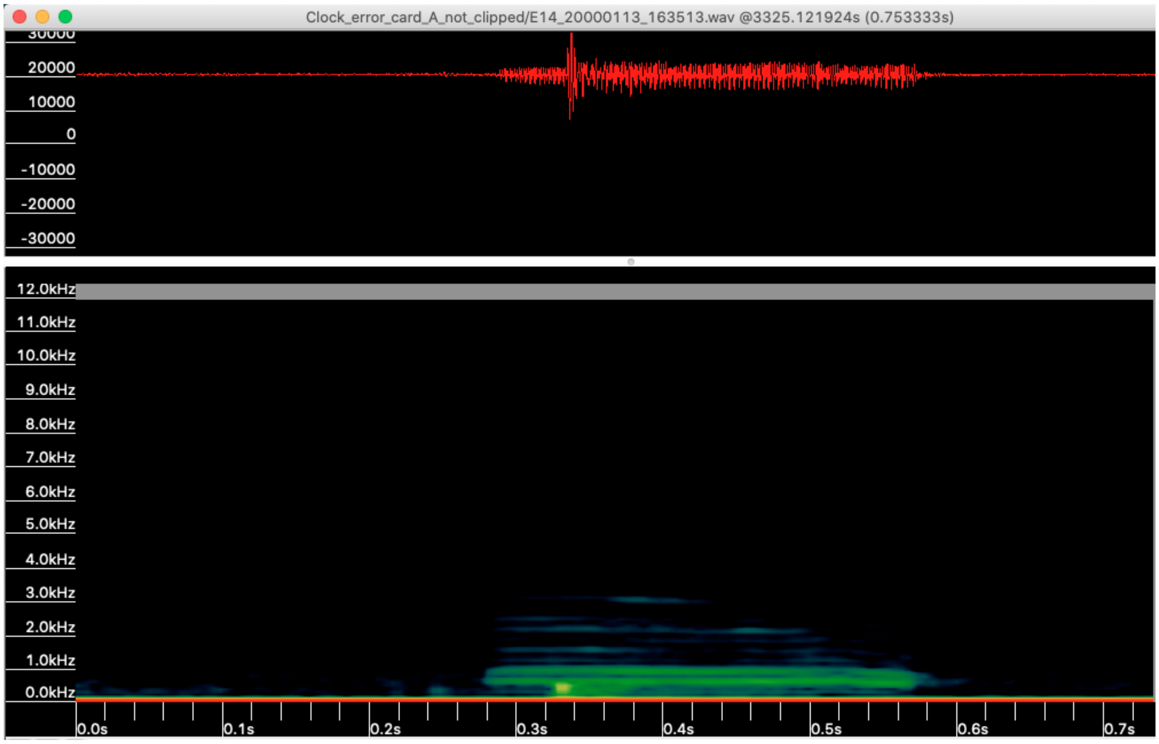

Figure 19. Spectrogram of laughing gull call collected at the E14 US Wind Buoy.

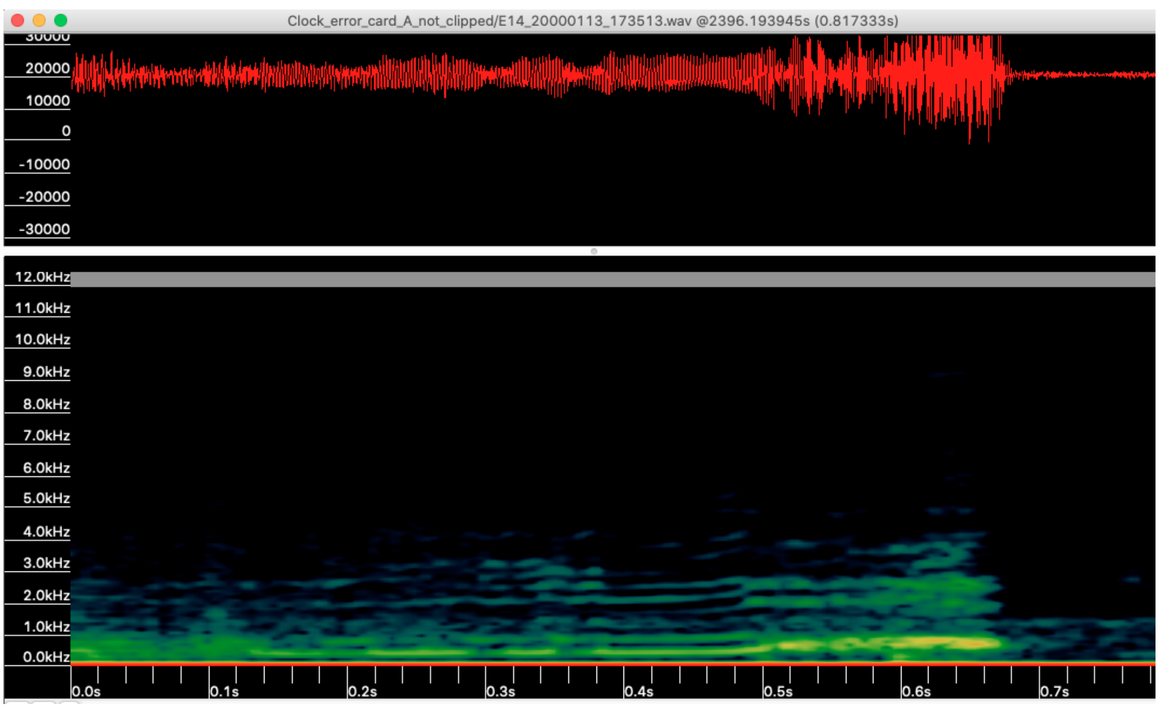

Figure 20. Spectrogram of great black-backed gull call collected at the E14 US Wind Buoy.

Motus Detections

Only one tag was detected during the first year by the Motus receiver: tag number 57814 recorded on 8/31/21. No species identification was provided for this tag.

Table 6. Motus detections from the receiver at the US Wind Buoy E14 during the first year.

Tag	Species	Date Time (UTC)	Receiver Deployment
NDOW#3:3.1 M.57814	NA	31 Aug 2021 15:00	20 May 2021 - 10 Jan 2023

Discussion

Relationships between birds and bats with wind speed differed between the two taxa. Bat activity was more uniform across the wind speed range with some activity drop off above 8 ms (Figure 4). In contrast, bird activity declined sharply above 6 ms (Figure 9). This difference in wind speed preferences may be due to migration tendencies of birds and bats with birds often preferring low wind speeds (Richardson 1990, Ramenofsky et al. 2012), while bats preferring higher wind speeds. This tendency is particularly important in adverse weather as bats try to minimize energy expenditure (Dechmann et al. 2017). Pettit and O’Keefe (2017) also found bats to prefer higher wind speeds in the fall, which is when nearly all detections in this study were found. Additional data collection for the second year will provide further insight into relationships with weather and bird/bat activity and whether the relationships observed during the first year will continue into the second year.

Literature Cited

Dechmann DKN, Wikelski M, Ellis-Soto D, Safi K, O'Mara MT. 2017 Determinants of spring migration departure decision in a bat. Biology Letters. 13: 20170395. http://dx.doi.org/10.1098/rsbl.2017.0395

DeLuca WV, Woodworth BK, Rimmer CC, Marra PP, Taylor PD, McFarland KP, Mackenzie SA, Norris DR. 2015. Transoceanic migration by a 12 g songbird. Biology Letters 11, 20141045.

Furness RW, Wade HM, Masden E. 2013. Assessing vulnerability of marine bird populations to offshore wind farms. Journal of Environmental Management 119:56–66.

Garthe S, Hüppop O. 2004. Scaling possible adverse effects of marine wind farms on seabirds: Developing and applying a vulnerability index. Journal of Applied Ecology 41:724–734.

Lagerveld S, Poerink BJ, de Vries P. 2015. Monitoring bat activity at the Dutch EEZ in 2014. Report no. C094/15. Wageningen (UR): IMARES.

Lagerveld S, Gerla D, van der Wal J, de Vries P, Brabant R, Stienen E, Deneudt K, Manshanden J, Scholl M. 2017. Spatial and temporal occurrence of bats in the southern North Sea area. Report no. Wageningen University & Research Report C090/17). Wageningen (UR): Wageningen University & Research Centre.

Lagerveld S, Noort CA, Meesters L, Bach L, Bach P, Geelhoed S. 2020. Assessing fatality risk of bats at offshore wind turbines. Report no. C025/20. Wageningen (UR): Wageningen Marine Research. https://doi.org/10.18174/518591

Merriam CH. 1887. Do any Canadian bats migrate? Evidence in the affirmative. Transactions of the Royal Society of Canada 4:85–87.

Peterson TS, Pelletier SK, Boyden SA, Watrous KS. 2014. Offshore acoustic monitoring of bats in the Gulf of Maine. Northeastern Naturalist 21(1):86–107.

Pettit, JL, and JM O'Keefe. 2017. Day of year, temperature, wind, and precipitation predict timing of bat migration. Journal of Mammalogy 98:1236–1248.

Ramenofsky M, Cornelius JM, Helm B. 2012 Physiological and behavioral responses of migrants to environmental cues. J. Ornithol. 153, S181–S191. (doi:10.1007/s10336-012-0817-3)

Richardson W. 1990 Timing of bird migration in relation to weather: updated review. In Bird migration (ed. E. Gwinner), pp. 78 –101. Berlin, Germany: Springer.

Robinson Willmott J, Forcey G, Kent A. 2013. The relative vulnerability of migratory bird species to offshore wind energy projects on the Atlantic Outer Continental Shelf: An assessment method and database. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2013-207. pp. 275. Available from www.data.boem.gov/PI/PDFImages/ESPIS/5/5319.pdf

Sjollema AL, Gates JE, Hilderbrand RH, Sherwell J. 2014. Offshore activity of bats along the Mid-Atlantic Coast. Northeastern Naturalist 21(2):154–163.

Thomas O. 1921. Bats on migration. Journal of Mammalogy 2:167.