APPENDIX R

2018 Bat Survey Report

Prepared for

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TETRA TECH

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FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

BOEM	Bureau of Offshore Energy Management
Empire	Empire Offshore Wind LLC
EW	Empire Wind
ft	foot
GPS	Global Positioning Device
km	kilometer
Lease Area	Designated Renewable Energy Lease Area OCS-A 0512
m	meter
mi	mile
NOAA	National Oceanic and Atmospheric Administration
Project	The offshore wind project for OCS A-0512 proposed by Empire Offshore Wind LLC consisting of Empire Wind 1 (EW 1) and Empire Wind 2 (EW 2).
RV	Research vessel
SGCN	species of greatest conservation need
SSC	Species of Special Concern
Tetra Tech	Tetra Tech, Inc.
USFWS	U.S. Fish and Wildlife Service

R.1 INTRODUCTION

Empire Offshore Wind LLC (Empire) proposes to construct and operate an offshore wind facility (Project) located in the designated Renewable Energy Lease Area OCS-A 0512 (Lease Area) administered by the Bureau of Ocean Energy Management (BOEM). The Lease Area covers approximately 79,350 acres (32,112 hectares) and is located approximately 14 statute miles (mi; 12 nautical miles, 22 kilometers [km]) south of Long Island, New York and 19.5 statute mi (16.9 nautical miles, 31.4 km) east of Long Branch, New Jersey (**Figure R-1**).

Empire contracted Tetra Tech Inc. (Tetra Tech) to evaluate bat activity and species composition within and in the vicinity of the Lease Area. The study was completed in accordance with recommendations provided by Tetra Tech bat biologists and consisted of deploying an acoustic bat detector on a 200-foot (ft; 61-meter [m]) geophysical research vessel (**Attachment R-1**, **Image 1**) operating in the area from May through December 2018. The results from this study supports an environmental baseline on bats that occur within the Lease Area, which will support permitting activities required for the Project.

R.1.1 Bat Species Potentially Occurring in the Lease Area

A total of eight bat species have the potential to occur in the Lease Area (**Table R-1**; Harvey et al. 2011; NJDEP 2010; BCI 2018; NYSDEC 2019a; USFWS 2019a). Three of the species (hoary [*Lasiurus cinereus*], eastern red [*Lasiurus borealis*], and silver-haired bats [*Lasionycteris noctivagans*]) are expected to have a high potential to occur within the Lease Area; whereas, the potential occurrence of the remaining five species (big brown bat [*Eptesicus fuscus],* little brown bat [*Myotis lucifugus*], northern long-eared bat [*Myotis septentrionalis*], tri-colored bat [*Perimyotis subflavus*], and eastern small-footed bat [*Myotis leibeii]*) is uncertain given the limited amount of research in the New York bight offshore marine environment.

Migratory tree bats (hoary bats, eastern red bats, and silver-haired bats) are reported to have a high likelihood of occurring in the Lease Area based upon species range and documented occurrence offshore. These species spend the summer in the northeast United States and Canada and travel as far south as Mexico during the winter (Cryan 2003). Even though roosting opportunities are essentially absent in the Lease Area, hoary, eastern red, and silver-haired bats are likely to occur during migratory periods (spring and late summer/early fall) and have been observed offshore during fall migration (Johnson et al. 2011; Sjollema 2011; Hatch et al. 2013; Peterson et al. 2014; Dowling et al. 2017). Eastern red bats are the most frequently encountered species off the Atlantic seaboard during fall migration and may regularly travel along the outer continental shelf during migration (Hatch et al. 2013; Dowling et al. 2017). Silver-haired bats may migrate along coastlines, and both silver-haired and hoary bats have been recorded off the coast of New Jersey (Cryan 2003; NJDEP 2010).

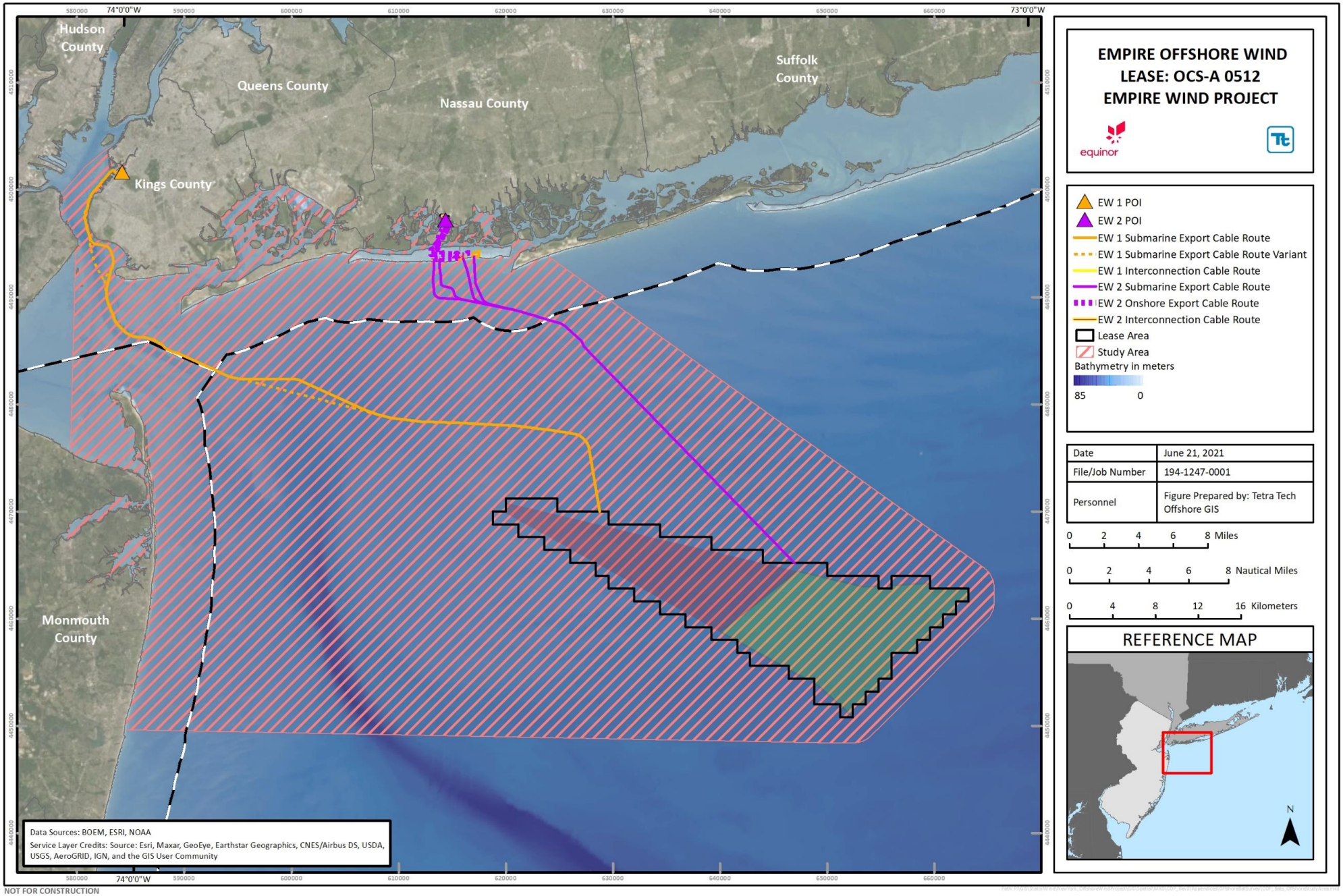


Figure R-1 Project Area

Table R-1 Bat Species Potentially Occurring in the Lease Area

Common Name	Scientific Name	Migratory Status a/	Likelihood of Occurrence	Anticipated Offshore Presence	High or Low Frequency Species	Federal Status b/	New York Status b/
Big brown bat	*Eptesicus fuscus*	Non-migratory	Low	Often found on large islands with suitable habitat up to 5 mi (8 km) offshore such as Nova Scotia, Martha's Vineyard, Assateague Island, and Mount Desert Island.	Low	–	-
Eastern red bat	*Lasiurus borealis*	Long-distance migrant	High	Numerous historical and current accounts in offshore environments up to 200 mi (322 km) offshore. Observed by boats with no land nearby.	High	–	-
Eastern small-footed bat	*Myotis leibeii*	Regional migrant	Low	Has only been observed in coastal environments and islands very close to land such as Mount Desert Island (<0.5 mi [0.8 km]). Unidentified Myotis species have been recorded in offshore environments up to 85 mi (137 km) from mainland. Is not known to occur on Long Island.	High	–	SC
Hoary bat	*Lasiurus cinereus*	Long-distance migrant	High	Numerous historical and current accounts in offshore environments up to 50 mi (80 km) offshore. Observed by boats with no land nearby and some occurrences of non-residents in Bermuda 650 mi (1,046 km) from nearest mainland.	Low	–	-
Little brown bat	*Myotis lucifugus*	Regional migrant	Low	Often found on large islands with suitable habitat up to 5 mi (8 km) offshore such as Nova Scotia, Martha's Vineyard, and Mount Desert Island. Has been observed regionally migrating from Martha's Vineyard to mainland.	High	–	SCGN

Table R-1 Bat Species Potentially Occurring in the Lease Area (continued)

Common Name	Scientific Name	Migratory Status a/	Likelihood of Occurrence	Anticipated Offshore Presence	High or Low Frequency Species	Federal Status b/	New York Status b/
Northern long-eared bat	*Myotis septentrionalis*	Regional migrant	Low	Often found on large islands with suitable habitat up to 5 mi (8 km) offshore such as Nova Scotia, Martha's Vineyard, and Mount Desert Island. Unidentified Myotis species have been recorded in offshore environments up to 85 mi (137 km) from mainland.	High	T	T, SGCN
Silver-haired bat	*Lasionycteris noctivagans*	Long-distance migrant	High	Numerous historical and current accounts in offshore environments up to 130 mi (209 km) offshore. Observed by boats with no land nearby and some occurrences of non-residents in Bermuda 650 mi (1,046 km) from nearest mainland	Low	–	-
Tri-colored bat	*Perimyotis subflavus*	Regional migrant	Low	Often found on large islands with suitable habitat up to 5 mi (8 km) offshore such as Nova Scotia, Martha's Vineyard, and Assateague Island.	High	P	SGCN

Notes:
a/ Sources: Griffin 1940, Zimmerman 1998, Buresch 1999, Broders et al. 2003, Harvey et al. 2011, Sjollema 2011, Johnson and Gates 2008, Pelletier et al. 2013, Dowling et al. 2017, BCI 2018, USFWS 2018
b/ P = Under petition to be listed on the Endangered Species Act (ESA) (USFWS 2017). T= Threatened or E= Endangered under the Endangered Species Act (USFWS 2018). SC = Special Concern, any native species for which a welfare concern or risk of endangerment has been documented in New York State (NYSDEC 2015a); SGCN = Species of Greatest Conservation Need (high priority), species in need of conservation in the next ten years (NYSDEC 2015b).

The evidence supporting potential offshore presence of the other species is less clear. Big brown bats, little brown bats, and northern long-eared bats occur in both Long Island and New Jersey and are associated with coastal islands (Peterson et al. 2014). Little brown bats and big brown bats have been observed traveling from Martha's Vineyard to the mainland in the summer and fall most likely to reach hibernacula on the mainland (Dowling et al. 2017). Although northern long-eared bats are found on Martha's Vineyard in abundance, they have not been observed to be seasonally migrating to the mainland for winter hibernation during nanotag tracking surveys (Dowling et al. 2017). No recorded offshore movement of northern long-eared bats has been confirmed, although unknown *Myotis* species (possibly little brown bats and northern long-eared bat) have frequently been observed on coastal islands and occasionally in offshore environments (Peterson et al. 2014; Sjollema et al. 2014). Tri-colored bats have been observed on large islands in the Gulf of Maine up to 5 mi (8 km) offshore, although they have not been observed in more distant offshore environments (Peterson et al. 2014).

The known ranges of other North American bat species do not extend into Long Island and are not known to occur in the nearest New Jersey county to the Lease Area (Monmouth County; Solari 2018); although the range of the Indiana bat (*Myotis sodalis*) does extend into western Middlesex County, New Jersey, a coastal county adjacent to and west-northwest of Monmouth County (USFWS 2019b).

R.1.2 Protected Bats

R.1.2.1 Federal

Of the 45 species of bats known to occur in the continental United States, five species and two subspecies are currently federally listed as threatened or endangered, and protected under the federal Endangered Species Act (ESA; USFWS 2018): Florida bonneted bat (*Eumops floridanus*), gray bat (*Myotis grisescens*), Indiana bat, Mexican long-nosed bat (*Leptonycteris nivalis*), northern long-eared bat, Ozark big-eared bat (*Corynorhinus townsendii ingens*), and Virginia big-eared bat (*C. t. virginianus*). Of these species, only two federally listed bat species are present in New York and New Jersey: Indiana bat and northern long-eared bat. The northern long-eared bat has been documented in New Jersey, with records in Monmouth, Ocean, and Atlantic counties (USFWS New Jersey Field Office 2017), as well as confirmed maternity roosts in the towns of Brookhaven, East Hampton, Riverhead, Southampton, and Southold on Long Island, New York (C. Herzog, NYSDEC, email communication, November 18, 2019). Historical and current records of the Indiana bat in New Jersey demonstrate its presence only in north and west-central New Jersey (USFWS New Jersey Field Office 2018; Barbour and Davis 1969), and in New York, the species range does not include Long Island, and the species has never been recorded on Long Island. Based on this information, northern long-eared bat is the only federally protected bat species likely to occur in or near the Project Area. The tri-colored bat, which may also occur in the Lease Area, is currently under a status review for listing under the ESA (USFWS 2017).

R.1.2.2 State

Although the Lease Area is located in federal waters, New York state agencies will be required to provide a determination confirming that the federal approvals are consistent with applicable coastal zone management plans and policies, which protect wildlife. Further, presence of species within the Lease Area may be attributed to movement between these terrestrial areas during migration or residency, and export cable landfalls and other aspects of the Project are subject to state approvals.

New York State classifies the northern long-eared bat as State Threatened (NYSDEC 2019b)[1]. The eastern small-footed bat is listed as a Species of Special Concern (SSC), which means that the welfare of this species is a concern or at risk of endangerment (NYSDEC 2015a). The State of New York has also identified the northern long-eared bat, little brown bat, and tri-colored bat as high-priority Species of Greatest Conservation Need (SGCN), which asserts a need for conservation action in the next 10 years (NYSDEC 2015b). The New York Department of Environmental Conservation is currently proposing changes to its list of endangered and threatened species, which would include status changes of tri-colored bat to a state threatened species, little brown bat to a SSC, and officially listing the northern-long eared bat as threatened (NYSDEC 2019c).

R.2 METHODS

Tetra Tech conducted acoustic bat monitoring in the Lease Area from May 29 through December 2, 2018, using a single bat detector station mounted near the top of the roving offshore research vessel (**Attachment R-1**, **Image 2**).

R.2.1 Acoustic Detectors

A Wildlife Acoustics Song Meter SM4BAT Monitoring System (bat detector) was utilized to record bat activity in full spectrum format for the duration of the acoustic monitoring survey (for equipment specifications, see **Attachment G-2**). The detector was powered by internal D cell batteries. Each bat detector was programmed to record bat echolocation files using the following settings: trigger window = 2 seconds, sampling rate = 256 kilohertz, gain = 12 decibels, and trigger max = 15 seconds. The bat detectors recorded bat activity from one hour before sunset until one hour after sunrise each day. The incoming echolocation calls were recorded onto high-capacity data storage cards, which were exchanged monthly while the ship was in port by trained technicians and then sent to a Tetra Tech office and backed up on a server. The technicians also checked the functionality of the bat detector during each card exchange visit during the survey period.

The detector was mounted on the highest point of the research vessel (RV) Ocean Researcher (a 200-ft [61-m] long RV), with the omnidirectional microphone located on the top of a railing with an unobstructed view of the sky (**Attachment R-1**, **Image 1 and Image 2**). The detector remained continuously active and in its original location through its deployment, including when the RV Ocean Researcher returned to port (Port Elizbeth, New Jersey, approximately once a month). Onboard global positioning system (GPS) allowed for accurate georeferencing of each bat pass.

R.2.1.1 Acoustic Analysis

Bats emit pulses of high frequency sound to navigate in their environment and search for prey. A single pulse (or call) is generally not helpful for identifying species; however, a series of pulses (also known as an echolocation sequence or bat pass) can more reliably be used to assign a species classification. A bat pass is defined as an echolocation sequence with two or more call pulses separated by two or more seconds (Loeb et al. 2015).

Analysis of bat acoustic data was conducted using a two-phased approach: 1) filter data with a U.S. Fish and Wildlife Service (USFWS)-approved software program (see USFWS 2017) to remove non-bat sounds and assign an initial species or group classification, and 2) manually review and cross-validate a subset of this data using an additional, independent echolocation software program to confirm species presence. The Project acoustic data was filtered and classified using Kaleidoscope Pro (Wildlife Acoustics, Inc.) version 4.2.0, with

[1] The northern long-eared bat was automatically listed as state threatened when it became federally listed under the ESA on April 2, 2015.

the classifier "Bats of North America 4.2.0" for species of bats in New York. Classifiers were further modified to reflect the species with the potential to occur in the Lease Area (**Table R-1**). A sensitivity level of "0 balanced/neutral" was used per Wildlife Acoustics and USFWS (2017) recommendations. For filtering, signals of interest ranged from 16 to 120 kilohertz with a duration of 2 to 500 milliseconds and contained a minimum of two call pulses.

Every bat pass auto-classified as a species or unidentified bat pass was manually reviewed with Kaleidoscope Pro to remove noise and ensure accurate activity rates. After filtering and initial classification of the acoustic data, species presence was cross-validated and manually confirmed for a subset of the data using SonoBat (SonoBat, Inc.) version 4.2.0, with the Northeast regional classifier to confirm presence. SonoBat was used for this step because of its extensive reference library of known echolocation sequences and superior spectrogram platform for reviewing full-spectrum calls. During manual review, a recording was considered as suitable for species level identification if 1) the recording included search phase pulses, 2) the individual call pulses within the bat pass were not oversaturated, and when possible 3) the individual call pulses included the presence of harmonics. Bat passes lacking sufficient detail to be identified at the species level were classified as "unidentified high frequency species" if the characteristic frequency was greater than or equal to 35 kilohertz, and "unidentified low frequency species" if the characteristic frequency was lower than 35 kilohertz. Unidentified high frequency species could include the following: eastern red bat, eastern small-footed bat, little brown bat, northern long-eared bat, tri-colored bat. Unidentified low frequency species bats could include big brown bat, hoary bat, and silver-haired bat. Manual vetting was performed until at least one bat pass per detected species or species group per month was confirmed. Only bat passes recorded within the Lease Area were used in this report.

R.2.1.2 Regression Analysis

Regression analyses were completed for temperature, wind speed, and date to investigate if they correlated with the number of bat passes per night. Weather data was collected from the National Oceanic and Atmospheric Administration's (NOAA) National Data Buoy Center using a buoy at the New York Harbor entrance (Station 44065; NOAA 2018). Wind speed and temperatures were averaged across each night of the survey period. The statistical software R was used to complete the analysis using the functions "corr.test" to examine the Pearson's Product-moment Correlation and "lm" for simple and mixed general liner models (R Core team 2018).

R.3 RESULTS

R.3.1 Bat Acoustic Survey Results

During the 2018 acoustic surveys, 188 nights were sampled within the Lease Area from May 29 to December 2, 2018. The detector station was fully operational during the entire survey period. A total of 584 bat passes were recorded within the Lease Area and identified to the species level or frequency group, with a minimum of zero passes and a maximum of 133 passes recorded in a single night (**Figure R-2**, below).

R.3.1.1 Species Presence and Activity Rates

Bat passes identified at the species level within the Lease Area included three species and two groups. Bat passes were distributed across the Lease Area (**Figure R-2**). Although concentrations of eastern red bat, silver-haired bat, and big brown bat passes appear on the map, they often represent single nights with multiple bat passes and not repeated use of the same area over many nights. No hoary bats were recorded within the Lease Area; however, one confirmed call of the species was documented along the Empire Wind 2 (EW 2) submarine export cable route on June 24, 2018 approximately 8.4 mi (13.5 km) offshore (south of Jones Beach State Park,

Long Island). The total number of bat passes recorded during the survey period within the Lease Area for each species or group is presented in **Table R-2**.

Table R-2 Total Bat Passes Recorded within the Lease Area for each Species or Group, 2018

Species	Big Brown Bat a/	Eastern Red Bat a/	Silver-Haired Bat b/	Unidentified High Frequency Bat a/	Unidentified Low Frequency Bat	Overall
Total Passes	17	229	184	133	21	584
Percent of Total Passes	2.9%	39.2%	31.5%	22.8%	3.6%	-

Notes:
a/ Hibernating bat
b/ Migratory tree bat

R.3.1.2 Timing of Activity

No bat activity was recorded within the Lease Area prior to June 21, 2018 and very few calls were recorded in July (n = 2). Detection rates were highest in early August through early November consistent with migration periods for migratory tree bats (**Figure R-3**; **Figure R-4**). Migratory tree bats accounted for almost 70 percent of all bat passes (**Figure R-5**). Two spikes in detection rates are evident in the data, with approximately 60 eastern red bat calls/night recorded on two nights in early September and 109 silver-haired bat calls/night recorded on October 8, 2018. The detection rates during these nights were atypically high compared to all other survey nights and may be indicative of higher numbers of migrating bats or of a low number of bats staying in close proximity to the ship for an extended period of time. Several small spikes in detection rates of big brown bats and unidentified high frequency bats were documented in September, October and early November; however, detection rates overall for these groups were notably less than for migratory tree bats, comprising only 25.7 percent of all bat calls identified. Big brown bat calls accounted for 2.9 percent of all identified calls (**Figure R-6**). The detection rates (bat passes per hour during all survey nights) were highest during the early morning hours during both the summer and the fall (**Figure R-7**). During the fall, most bat passes occurred between midnight and 3 a.m. In the summer, most bat passes occurred between 2 a.m. and 5 a.m.

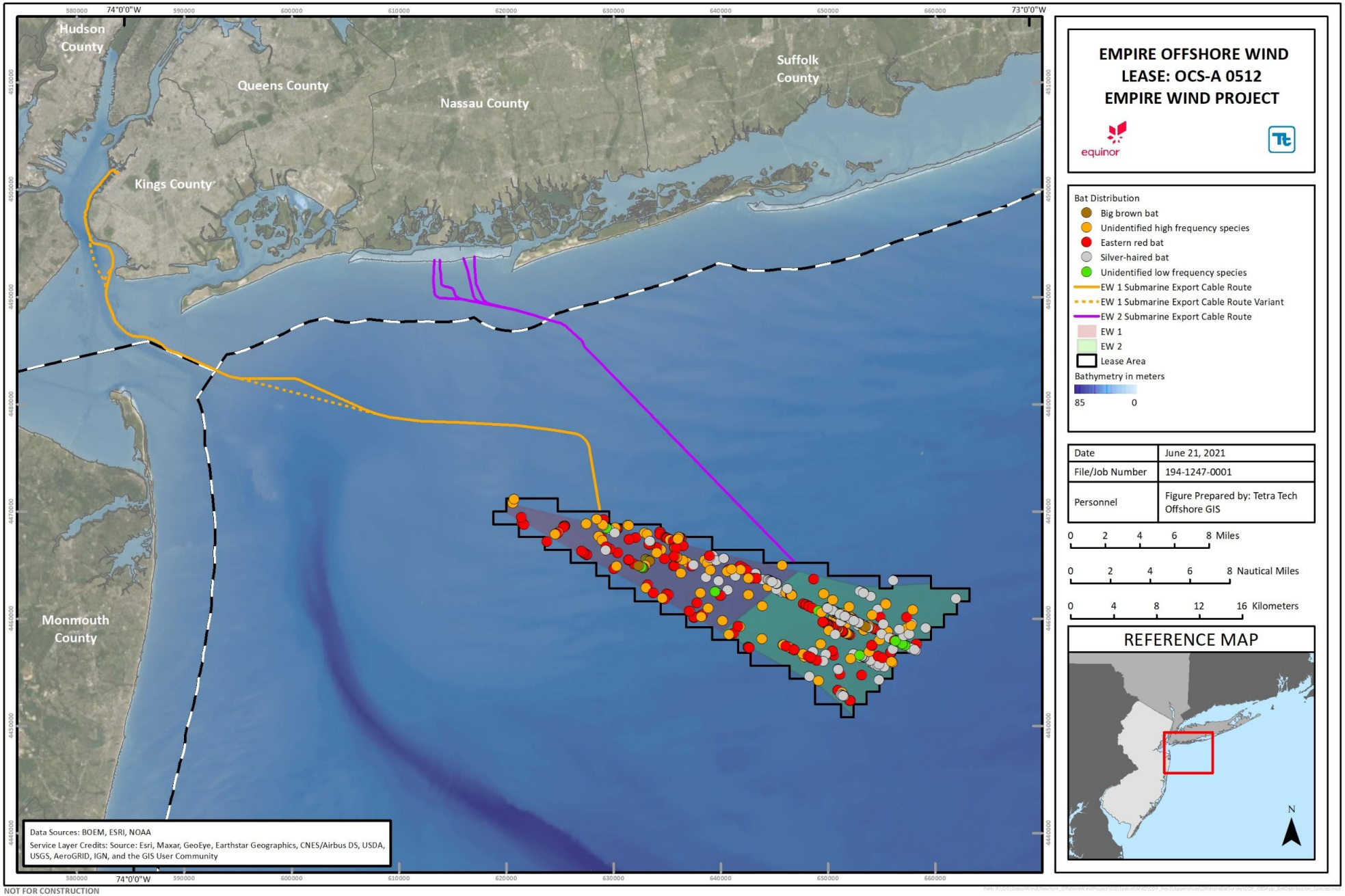


Figure R-2 Bat Passes by Species in the Lease Area

Note: high spatial concentrations of passes may represent activity on a given night and not repeated use of the same area over time.

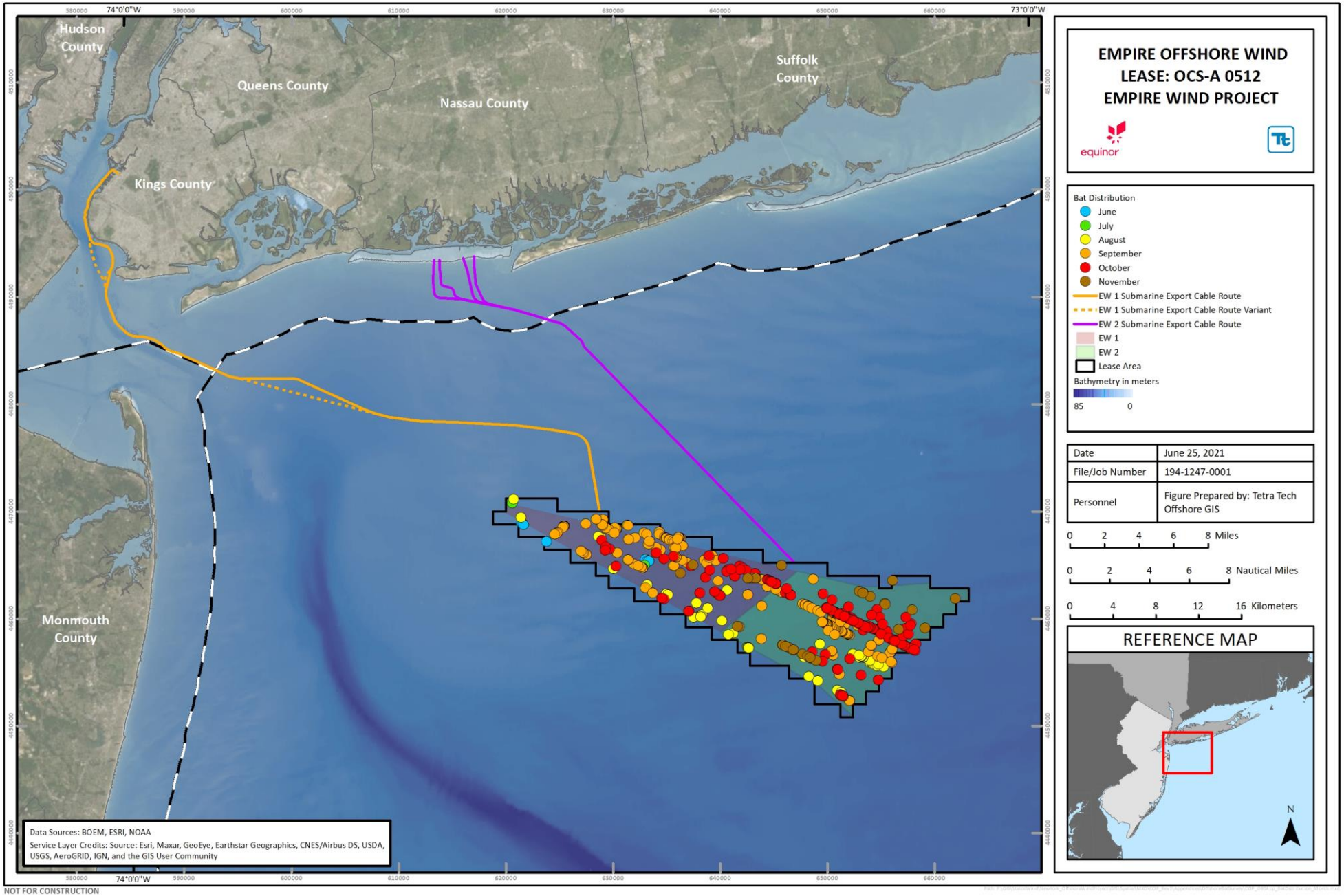


Figure R-3 Bat Passes by Month in the Lease Area

Note: Spatial concentrations of passes may represent activity on a given night and not repeated use of the same area over time.

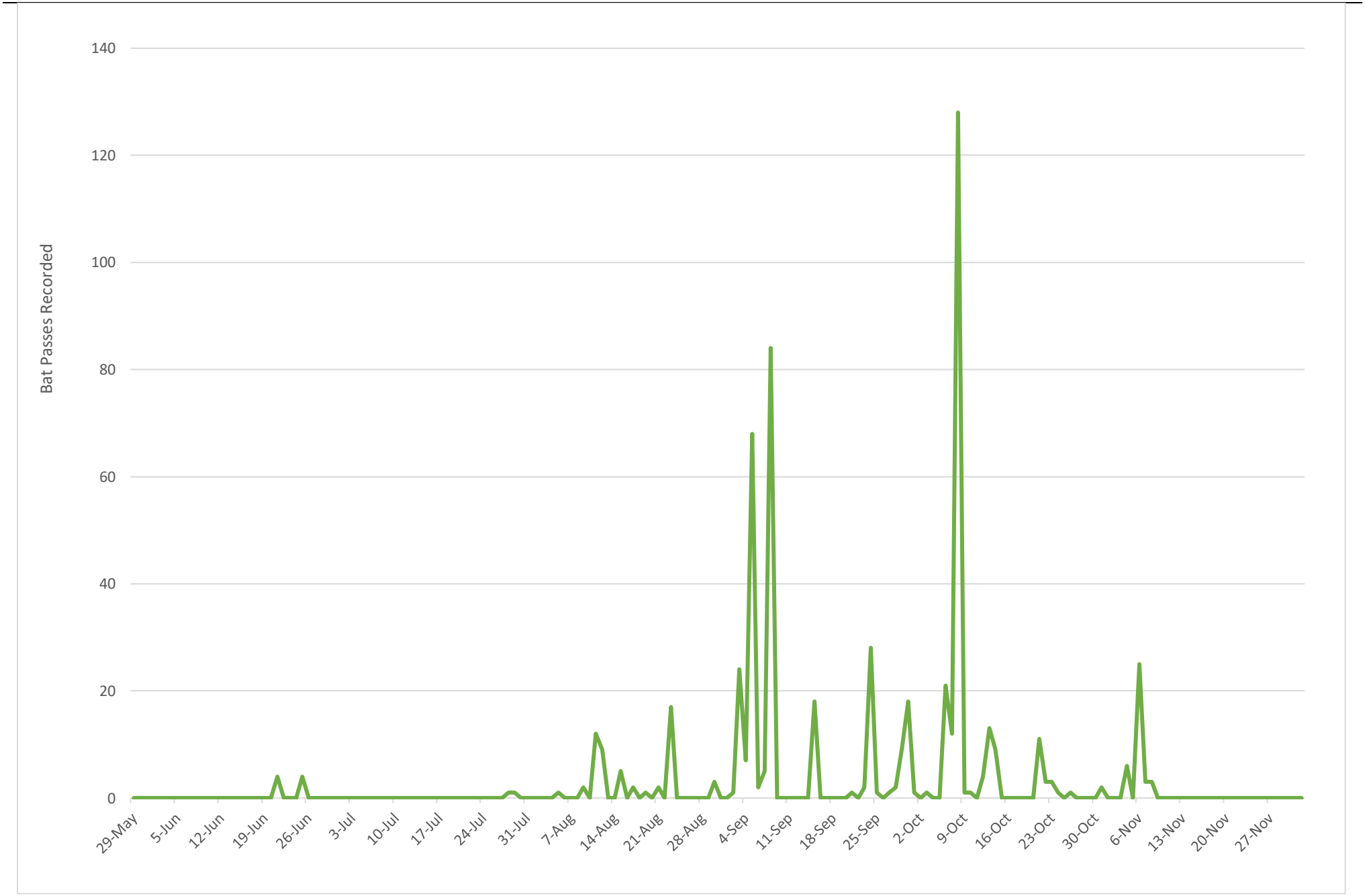


Figure R-4 Total Bat Passes Recorded by Date in the Lease Area

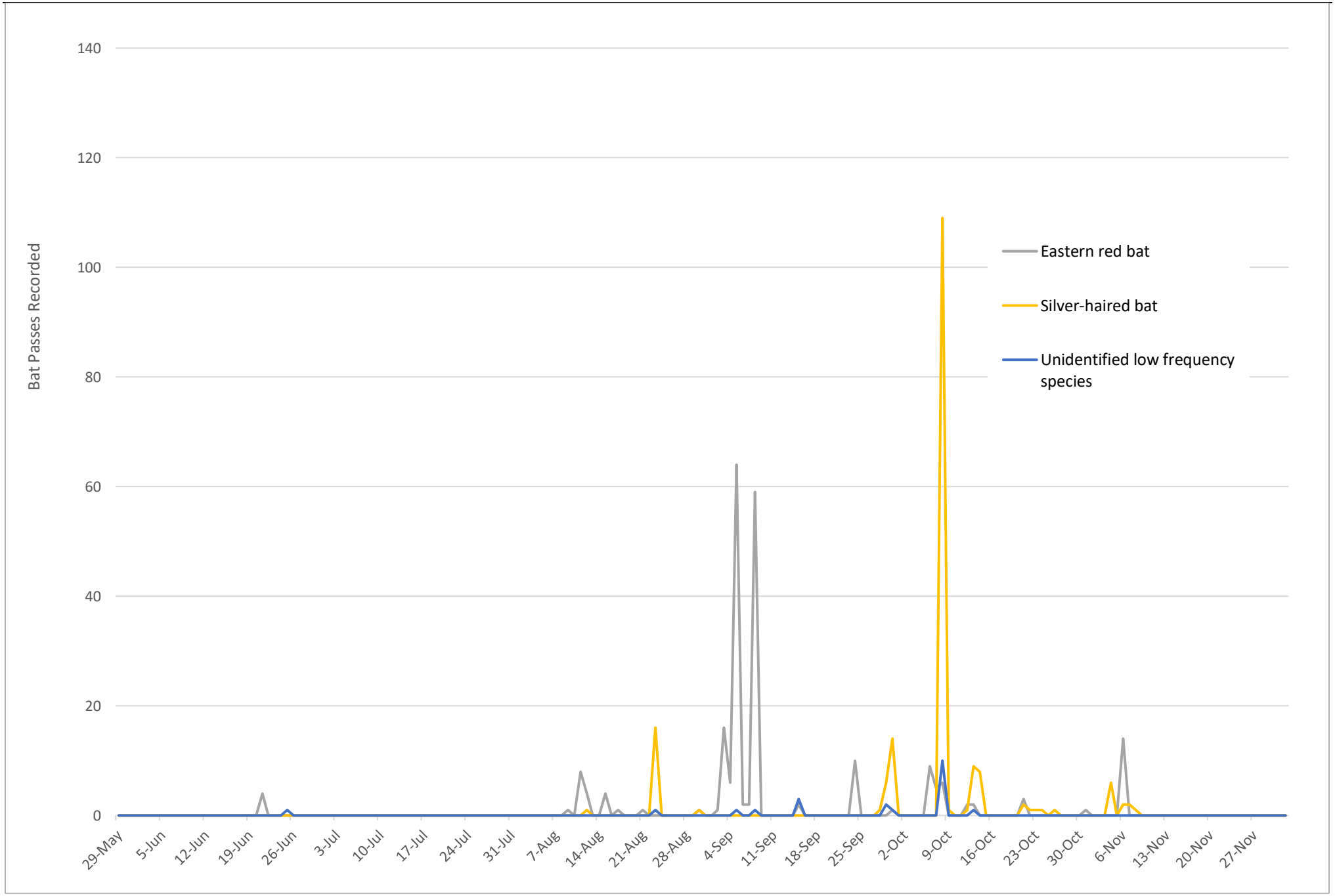


Figure R-5 Total Migratory Tree Bat Passes Recorded by Date in the Lease Area

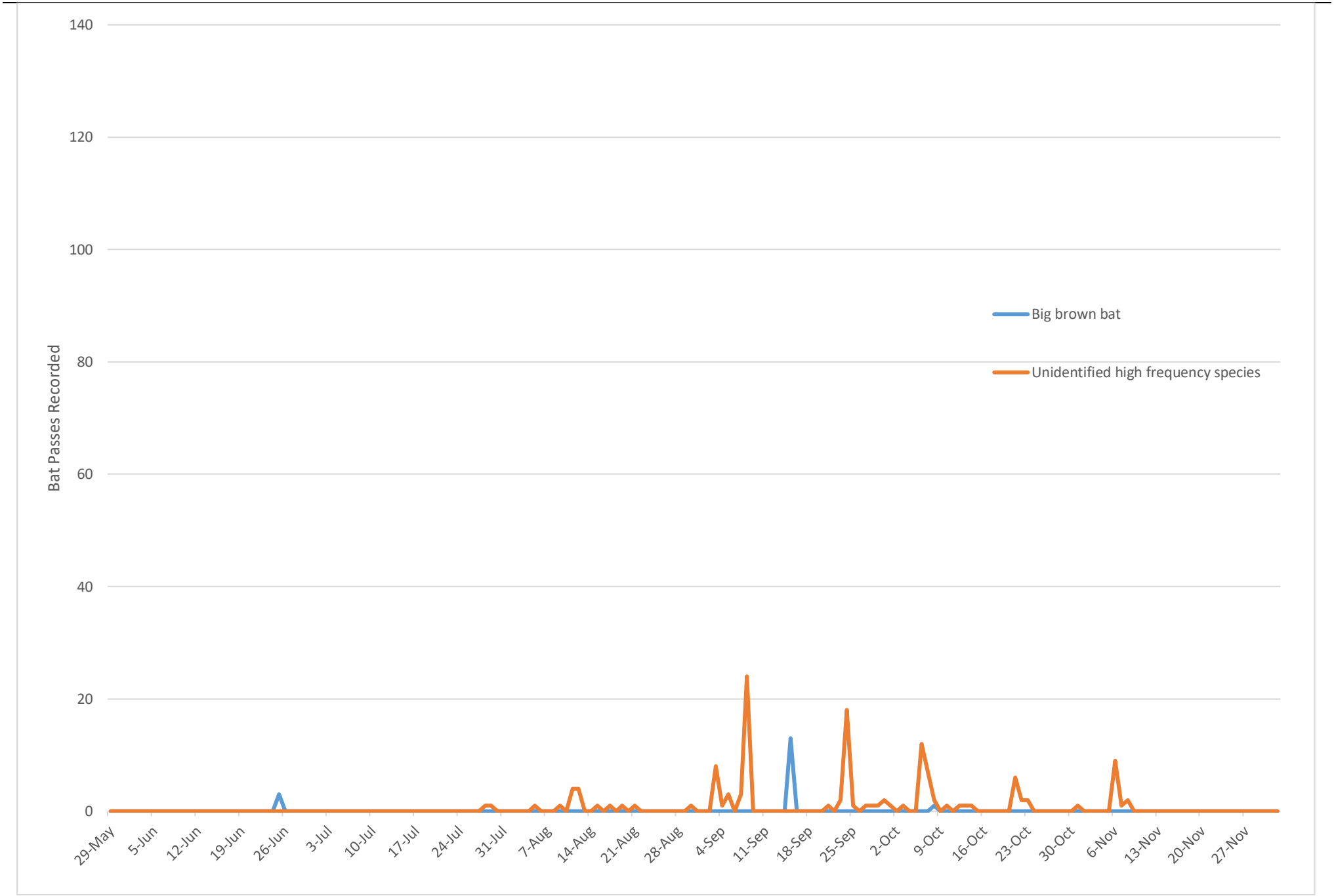


Figure R-6 Total Nonmigratory or Regionally Migratory Bat Passes Recorded by Date in the Lease Area

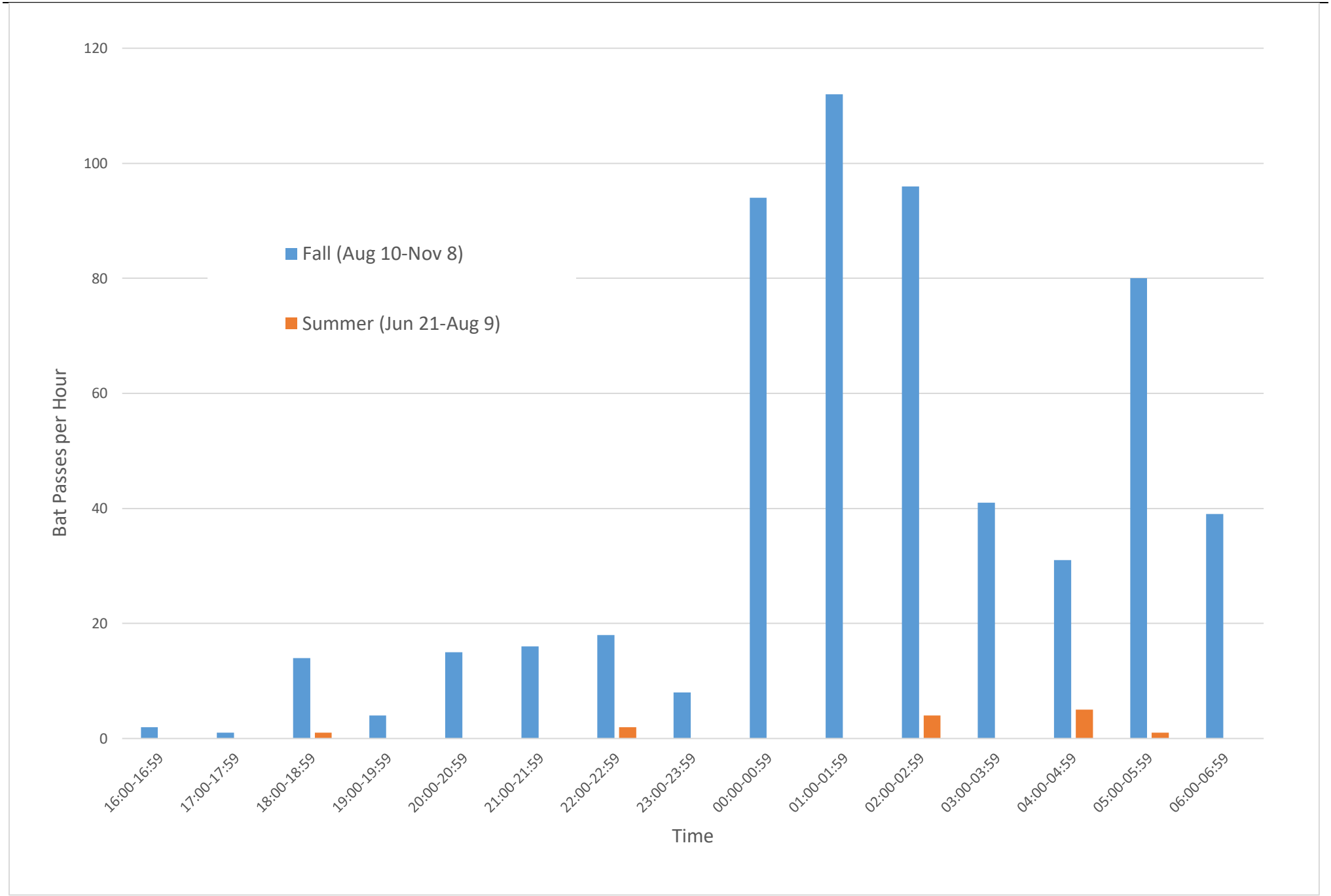


Figure R-7 Bat Pass Distribution Across Hours of the Night for Summer and Fall in the Lease Area

R.3.1.3 Regression Analysis

Multiple regression analysis was used to test if weather (wind and temperature) and time of year (survey date) were significant predictors of the number of bat passes recorded (bat activity). The results of the regression indicated that three predicted models accounted for only seven percent of the variance (R^2= 0.07, F (3,176) =5.3, $p<0.01$). Both wind speed (β= -3.1, $p<0.01$) and survey date (β= 3.2, $p<0.01$) predicted the number of bat passes. When examined as simple linear models, there was a nonsignificant positive correlation of temperature with number of bat passes per night (r=0.69, p=0.49; **Figure R-8**). There was a significant negative correlation of wind speed and number of bat passes per night (r=-2.28, p = 0.02; **Figure R-9**). Seventy-seven percent of all bat passes in the Lease Area were detected at average nightly windspeeds below eight meters per second. Date was positively correlated with bat passes per night, but not significantly (r=0.2, p = 0.09; **Figure R-10**).

R.4 DISCUSSION

R.4.1 Protected Bats

There is little evidence that the federally and state-listed northern long-eared bat forages or travels far offshore. Our findings were consistent with this, as this species was not confirmed within the Lease Area. No myotis species (which includes northern long-eared bat, eastern small-footed bat, and little brown bat) were confirmed acoustically during the survey. It is possible that myotis species were included in the unidentified high frequency bat group, but these calls did not contain characteristics that allow species-level classification even with manual review and were likely approach phase call types (or feeding buzzes) made by eastern red bat. Publicly available information support these findings, as the likelihood of occurrence of federal and state-listed northern long-eared bat or eastern small-footed and little brown bat in the Lease Area is low. In addition, these species are closely associated with forests and rarely travel more than 1,000 ft (305 m) from forested habitats during summer (USFWS 2011).

R.4.2 Other Bat Species

The three bat species with confirmed presence in the Lease Area (big brown bat, eastern red bat, and silver-haired bat), and the hoary bat identified closer to shore along the EW 2 submarine export cable route, are not identified as SSC or SGCN by the State of New York.

Migration patterns, which vary based on species' life history characteristics, can be grouped into three basic categories: non-migratory (e.g., big brown bat), regional migrants (e.g., *Myotis* species), and long-distance migrants (e.g., silver-haired bat, eastern red bat, and hoary bat; Fleming and Eby 2003). This survey indicates that the Lease Area is used by a non-migratory bat species (big brown bat) at low levels mostly in the late summer and fall, as well as long-distance migrants (eastern red and silver-haired bat) at low levels in the spring and summer, and higher levels during fall (84 percent, September through November). Migratory tree bats composed 70 percent of the total bat activity, consisting of 39 percent eastern red bat calls and 31 percent silver haired bat calls, and the detections were spread across the Lease Area. Although the understanding of offshore bat activity and behavior is limited; migratory tree bats have been the most common species observed offshore, which is consistent with the results of this study.

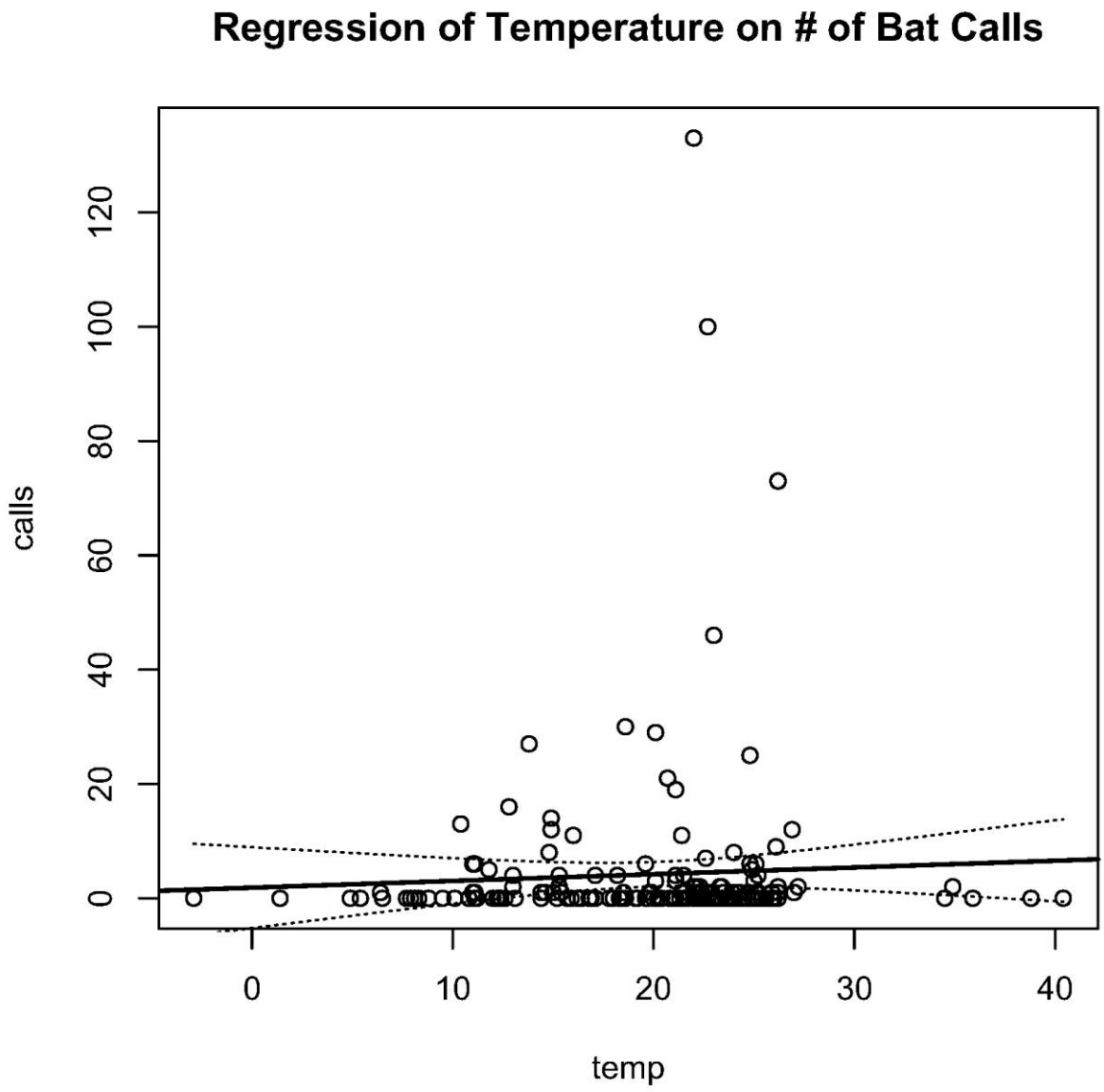


Figure R-8 Linear Regression Illustrating Non-Significant Positive Correlation Between Bat Passes (calls) per Night and Average Nightly Temperature (C) (r =0.69, p = 0.49)

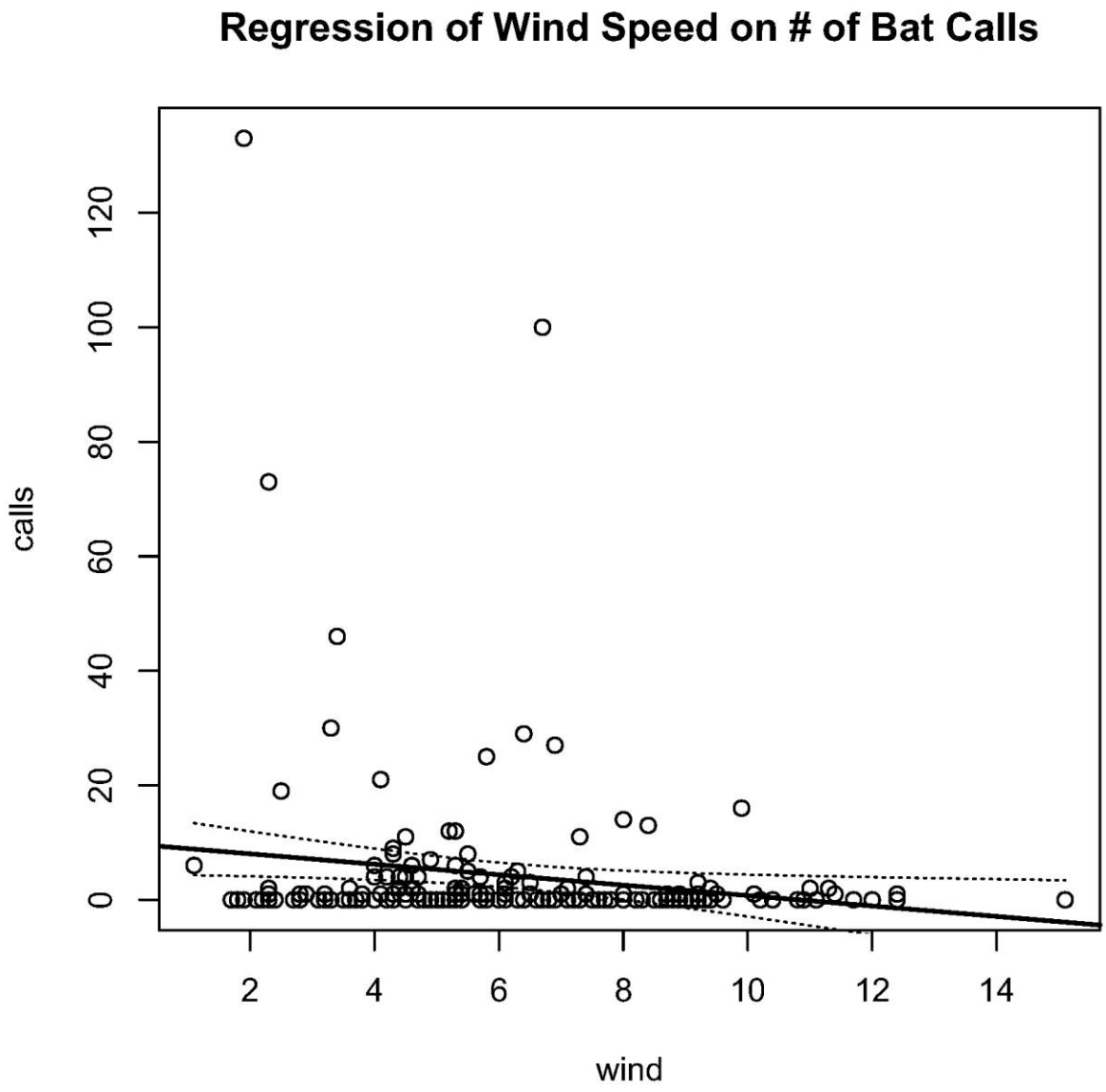


Figure R-9 Linear Regression Illustrating a Significant Negative Correlation Between Bat Passes (calls) per Night and Average Nightly Wind Speed (m/s) (r = -2.28, p = 0.02)

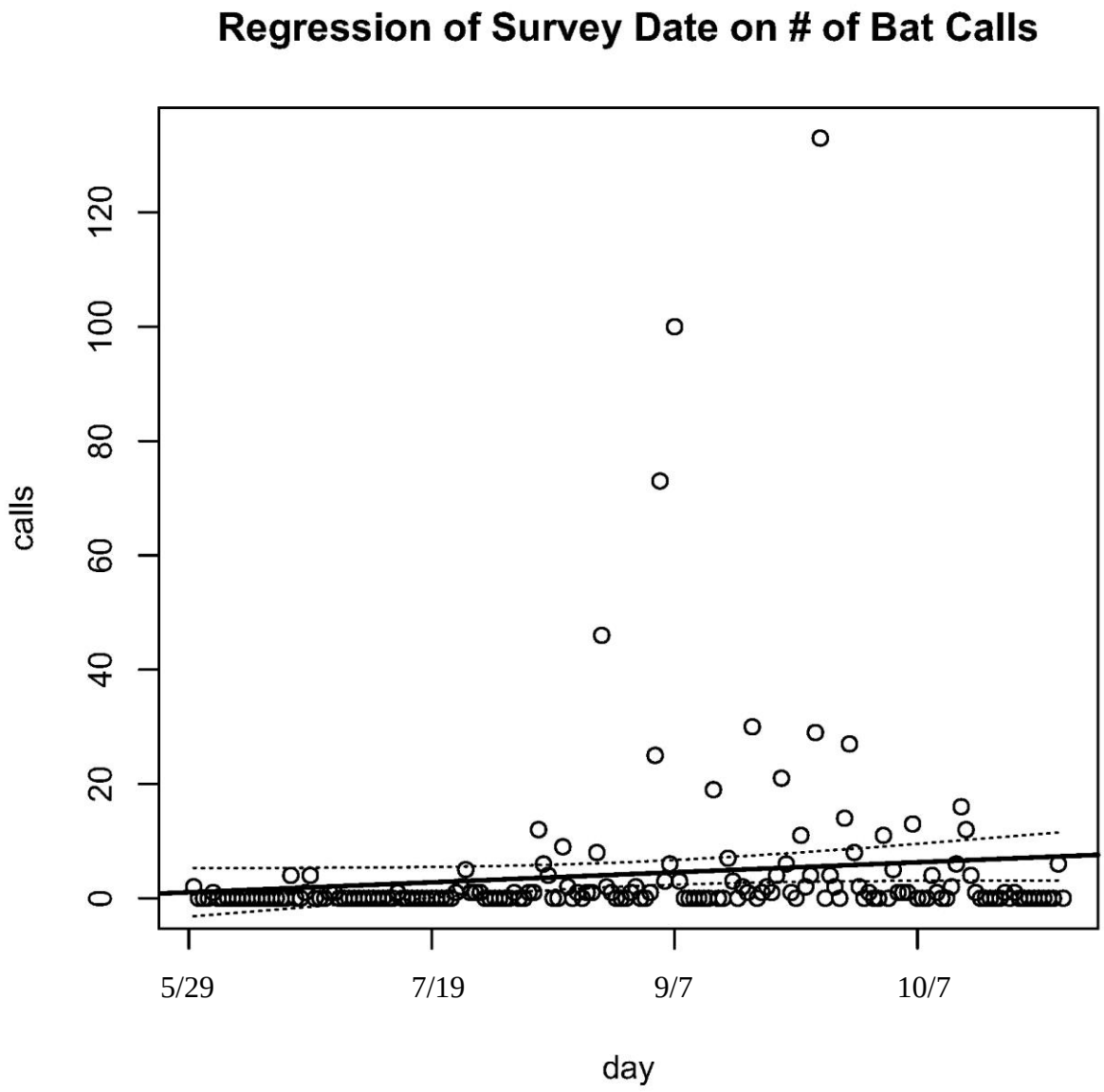


Figure R-10 Linear Regression Illustrating Non-Significant Positive Correlation Between Bat Passes (calls) per Night and Date (r = 0.02, p = 0.09)

Increase in population size after the summer breeding season and coastal/offshore navigation during migration may explain why the majority of encounters with migratory tree bats occur during the fall (Cryan 2003). In addition, increases in bat activity offshore may increase at the end of the summer because females no longer need to return to the roost to nurse young throughout the evening and are able to travel longer distances into the ocean to forage (Pelletier 2013). Short single night spikes in the number of bat passes by the eastern red bat, silver-haired bat, big brown bat, and unidentified high frequency bat in September and October may suggest fall migration pulses across the Lease Area; however, it may also result from an individual bat foraging around the ship during the night so that it could periodically roost and rest on the ship, as has been observed in offshore environments (Thompson et al. 2015).

Bat species recorded may have been in the Lease Area during seasonal migration, nightly foraging, or travel between Long Island and New Jersey using the shortest route. Bat species are thought to forage offshore due to two attributes of open water: lack of obstacles that could remove barriers to insect capture, and temperature stability over large bodies of water, which may remain warmer than nearby land and thus sustain insect activity (Pelletier et al. 2013). Numerous types of insects are present offshore providing foraging opportunities and energy during migration and longer distance travel (Cheng and Birch 1978). Even large-scale insect migrations occur in coastal environments and offshore, which likely affect bat activity rates and would draw bats out into the offshore environment (Russell et al. 1998; Wikelski et al. 2006; Srygley and Dudley 2008). Interestingly, bats offshore of Europe have even been observed gleaning crustaceans off the surface of the ocean (Ahlén et al. 2009).

In land-based surveys, bat activity levels are known to be affected by temperature and windspeed. Temperature is generally positively correlated with bat activity (Arnett et al. 2007; Wolbert et al. 2014) and high windspeed negatively correlated with bat activity (Arnett et al. 2007). Johnson et al. (2011) observed that bat activity off the coast of Maryland was positively correlated with temperature and negatively correlated with wind speed. Cryan and Brown (2007) observed that hoary bats only arrived on Farallon Island (28 mi [45 km] offshore of San Francisco) on nights with low wind speeds, and Sjollema (2011) observed bat activity decreasing as windspeed increased offshore of the Atlantic coast from Massachusetts to North Carolina. To date, these trends remain true for most offshore studies; however, several studies have documented bat activity at higher wind speeds offshore, compared to onshore environments (Hatch et al. 2013; Sjollema et al. 2014). This bat activity at higher wind speeds offshore may indicate that bats are forced to fly at higher wind speeds in the offshore environment, or that the species present in the offshore environment (larger bodied species) are less deterred by wind speed. The findings from this study are consistent with our current understanding of bat activity offshore and demonstrate low levels of bat activity within the area proposed for development. This activity is generally comprised of a few species, none of which are federally or state-listed, and is higher during the fall migration period.

R.5 REFERENCES

Ahlén I., H.J. Baagøe, and L. Bach. 2009. Behavior of Scandinavian bats during migration and foraging at sea. Journal of Mammalogy 90:1318-1323.

Arnett, E. B., M. M. P. Huso, D. S. Reynolds, and M. Schirmacher. 2007. Patterns of preconstruction bat activity at a proposed wind facility in northwest Massachusetts. An annual report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA. Available online at: http://batsandwind.org/wp-content/uploads/precon_ma.pdf. Accessed February 2019.

Barbour, R.W. and W.H. Davis. 1969. Bats of America. Lexington. Kentucky University of Kentucky Press.

BCI (Bat Conservation International). 2018. Species profiles. Available online at http://www.batcon.org/index.php/resources/media-education/species-profiles. Accessed December 2018.

Broders, H.G., G.M. Quinn, and G.J. Forbes. 2003. Species status and the spatial and temporal patterns of activity of bats in southwest Nova Scotia, Canada. Northeastern Naturalist 10:383–398.

Buresch, K. 1999. Seasonal pattern of abundance and habitat use by bats on Martha's Vineyard, Massachusetts. M.Sc. Thesis. University of New Hampshire, Durham, NH.

Cheng, L. and M.C. Birch. 1978. Terrestrial insects at sea. Journal of the Marine Biological Association of the United Kingdom 57:995-997.

Cryan, P.M. 2003. Seasonal distribution of migratory tree bats (*Lasiurus* and *Lasionycteris*) in North America. Journal of Mammalogy 84:579–593.

Cryan, P.M. and A. Brown. 2007. Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines. Biological Conservation 139: 1–11. doi:10.1016/j.biocon.2007.05.019.

Dowling, Z., P.R. Sievert, E. Baldwin, L. Johnson, S. von Oettingen, and J. Reichard. 2017. Flight Activity and Offshore Movements of Nano-Tagged Bats on Martha's Vineyard, MA. US Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, Virginia. OCS Study BOEM 2017-054. 39 pp.

Fleming, T.H. and P. Eby. 2003. Ecology of bat migration. In T.H. Kunz and M.B. Fenton (eds.). Bat Ecology. University of Chicago Press, Chicago, Illinois.

Griffin, D.R. 1940. Migrations of New England bats. Bulletin of the Museum of Comparative Zoology 86:217–246.

Hatch, S.K., E.E. Connelly, T.J. Divoll, I.J. Stenhouse, and K.A. Williams. 2013. Offshore Observations of Eastern Red Bats (Lasiurus borealis) in the Mid-Atlantic United States Using Multiple Survey Methods. PLoS ONE 8(12). Available online at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0083803. Accessed December 16, 2019.

Harvey, M.J., J.S. Altenbach, and T.L. Best. 2011. Bats of the United States and Canada. The Johns Hopkins University Press, Baltimore, MD. USA.

Johnson, J.B. and J.E. Gates. 2008. Bats of Assateague Island National Seashore, Maryland. American Midland Naturalist 160:160–170.

Johnson, J.B., J.E. Gates, and N.P. Zegre. 2011. Monitoring seasonal bat activity on a coastal barrier island in Maryland, USA. Environmental Monitoring and Assessment 173:685–699.

Loeb, S.C., T.J. Rodhouse, L.E. Ellison, C.L. Lausen, J.D. Reichard, K.M. Irvine, T.E. Ingersoll, J.T.H. Coleman, W.E. Thogmartin, J.R. Sauer, C.M. Francis, M.L. Bayless, T.R. Stanley, and D.H. Johnson. 2015. A plan for the North American Bat Monitoring Program (NABat). General Technical Report SRS-208. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 112 p.

NJDEP (New Jersey Department of Environmental Protection). 2010. Ocean/Wind Power Ecological Baseline Studies Final Report, January 2008-December 2009. New Jersey Department of Environmental Protection, Office of Science, Trenton, NJ.

NOAA (National Oceanic and Atmospheric Administration). 2018. National Data Buoy Center, Station 44065-New York Harbor Entrance. Available online at: https://www.ndbc.noaa.gov/station_page.php?station=44065. Accessed December 16, 2019.

NYSDEC (New York State Department of Environmental Conservation). 2015a. List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State. New York State Department of Environmental Conservation. Available online at: http://www.dec.ny.gov/animals/7494.html. Accessed December 16, 2019.

NYSDEC. 2015b. New York State Wildlife Action Plan (SWAP) Species of Greatest Conservation Need. Available online at: http://www.dec.ny.gov/animals/7179.html. Accessed December 16, 2019.

NYSDEC. 2019a. Bats of New York. Available online at: https://www.dec.ny.gov/docs/administration_pdf/batsofny.pdf. Accessed February 2019.

NYSDEC. 2019b. Northern Long-Eared Bat. Available online at: https://www.dec.ny.gov/animals/106713.html. Accessed December 2019.

NYSDEC. 2019c. Current and Proposed Status of All Species on Proposed List, October 2019. Available online at: http://www.dec.ny.gov/docs/wildlife_pdf/masterlistpropreg.pdf. Accessed November 2019.

Pelletier, S.K., K. Omland, K.S. Watrous, and T.S. Peterson. 2013. Information Synthesis on the Potential for Bat Interactions with Offshore Wind Facilities – Final Report. U.S. Dept of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study BOEM 2013-01163. 119 pp.

Peterson, T.S., S.K. Pelletier, S.A. Boyden, and K.S. Watrous. 2014. Offshore Acoustic Monitoring of Bats in the Gulf of Main. Northeastern Naturalist: 21(1):86-107.

R Core Team. 2018. R: A language and environment for statistical computing. R Foundation for statistical computing. Vienna, Austria. Available online at: https://www.R-project.org/. Accessed December 16, 2019.

Russell, R.W., M.L. May, K.L. Soltesz, and J.W. Fitzpatrick. 1998. Massive swarm migrations of dragonflies (Odonata) in Eastern North America. The American Midland Naturalist 140:235–342.

Sjollema, A.L. 2011. Bat activity in the vicinity of proposed wind-power facilities along the mid-Atlantic coast. M.Sc. Thesis. Frostburg State University, Frostburg, MD.

Sjollema, A.L., J.E. Gates, R.H. Hildebrand, and J. Sherwell. 2014. Offshore Activity of Bats Along the Mid-Atlantic Coast. Northeastern Naturalist:21(2);154–163. Available online at: ftp://nris.mt.gov/Maxell/Wind_Turbine_Bat_Impacts/Sjollema_2014_Offshore_Bat_Activity_NE Naturalist.pdf. Accessed March 2019.

Solari, S. 2018. *Myotis leibii*. The IUCN Red List of Threatened Species 2018: e.T14172A22055716. Available online at: http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T14172A22055716.en. Accessed March 2019.

Srygley, R.B. and R. Dudley. 2008. Optimal strategies for insects migrating in the flight boundary layer: mechanisms and consequences. Integrative and Comparative Biology 48:119-133.

Thompson, R.H., A.R. Thompson, and R.M. Brigham. 2015. A Flock of Myotis Bats at Sea. Northeastern Naturalist 22(4):N27-N30. Available online at: https://www.researchgate.net/publication/290201818_A_Flock_of_Myotis_Bats_at_Sea. Accessed March 2019.

USFWS. 2011. Indiana bat section 7 and section 10 guidance for wind energy projects; October 26, 2011. Available online at: https://www.fws.gov/midwest/endangered/mammals/inba/pdf/inbaS7and10WindGuidanceFinal26Oct2011.pdf. Accessed April 2019.

USFWS. 2017. Endangered and Threatened Wildlife and Plants; 90-Day Findings for Five Species. Proposed Rule. 82 FR 60362. 50 CFR 17. 60362-60366.

USFWS. 2018. Endangered Species of the United States. Available online at: http://www.fws.gov/endangered/species/us-species.html. Accessed January 2018.

USFWS. 2019a. Indiana Bat Range in Information for Planning and Consultation (IPaC) Online System. Available online at: https://ecos.fws.gov/ipac/. Accessed October 2019.

USFWS 2019b. Environmental Conservation Online System; Indiana Bat (*Myotis sodalis*). Available online at: https://ecos.fws.gov/ecp0/profile/speciesProfile.action?spcode=A000. Accessed December 2019.

USFWS New Jersey Field Office. 2017. New Jersey Municipalities with Hibernation or Maternity Occurrence of Indiana Bat or Northern Long-eared Bat. Available online at: https://www.fws.gov/northeast/njfieldoffice/pdf/battowns.pdf. Last updated April 25, 2017. Accessed December 2019.

USFWS New Jersey Field Office. 2018. Indiana Bat (*Myotis sodalis*). Available online at: https://www.fws.gov/northeast/njfieldoffice/endangered/Ibat.html. Accessed December 2019.

Wikelski, M., D. Moskowitz, J.S. Adelman, J. Cochran, D.S. Wilcove, and M.L. May. 2006. Simple rules guide dragonfly migration. Biology Letters 2:325–329.

Wolbert, S.J., A.S. Zellner, and H.P. Whidden. 2014. Bat Activity, Insect Biomass, and Temperature Along an Elevational Gradient. Northeastern Naturalist 21(1):72-85. Available online at: ftp://nris.mt.gov/Maxell/Wind_Turbine_Bat_Impacts/Wolbertetal_2014_BatActivity_Temperature Insects_NENaturalist.pdf. Accessed February 2019.

Zimmerman, G.S. 1998. Inventory and habitat use of bats along the central coast of Maine. M.Sc. Thesis. University of Maine, Orono, ME.

ATTACHMENT R-1
EQUIPMENT PHOTOGRAPHS

Image 1 Location of the Bat Detector on the Research Vessel Ocean Researcher

Image 2 Location of the Microphone and SM4 Unit on the Research Vessel Ocean Researcher

ATTACHMENT R-2
EQUIPMENT SPECIFICATION SHEETS

SONG METER SM4BAT ULTRASONIC RECORDER

SPECIFICATIONS

RECORDING TECHNOLOGY:

- Single-channel
- **SM4BAT FS:** 16-bit PCM .wav files or compressed .w4v files
- **SM4BAT ZC:** Zero-Crossing

SAMPLE RATES:

- Full-Spectrum, single-channel;
  192kHz, 256kHz, 384kHz, 500kHz

RUN-TIME:

- **SM4BAT FS:** Up to 450 hours (e.g. 45 10-hour nights), depending on bat activity
- **SM4BAT ZC:** Up to 700 hours (e.g. 70 10-hour nights)
- NOTE: SM4BAT FS and ZC run times can vary by as much as 50% depending on the characteristics of specific brands and models of flash cards, the kind and quality of batteries used (alkaline versus rechargeable), temperature and configuration. We recommend SanDisk brand SDHC/SDXC cards.

POWER OPTIONS:

- Internal power using 4 D-size alkaline or rechargeable NiHM batteries
- External power via optional SM3/SM4 Power Cable

STORAGE:

- 2 SDHC/SDXC flash card slots (class 4 or greater)
  We recommend using SanDisk SDHC/SDXC cards. You can buy them from our store.
- More than 1 terabyte total capacity using 2 512GB SDXC cards

- Compression is available to further increase storage capacity

DIMENSIONS:

- **Height:** 8.6" / 218 mm
- **Width:** 6.0" / 152 mm
- **Depth:** 3.1" / 78 mm

WEIGHT:

- 1.6 lbs / .7 kg without batteries
- 2.9 lbs / 1.3 kg with batteries

ENCLOSURE MATERIAL:

- Polycarbonate

ENCLOSURE ENVIRONMENTAL PROTECTION:

- Fully weatherproof

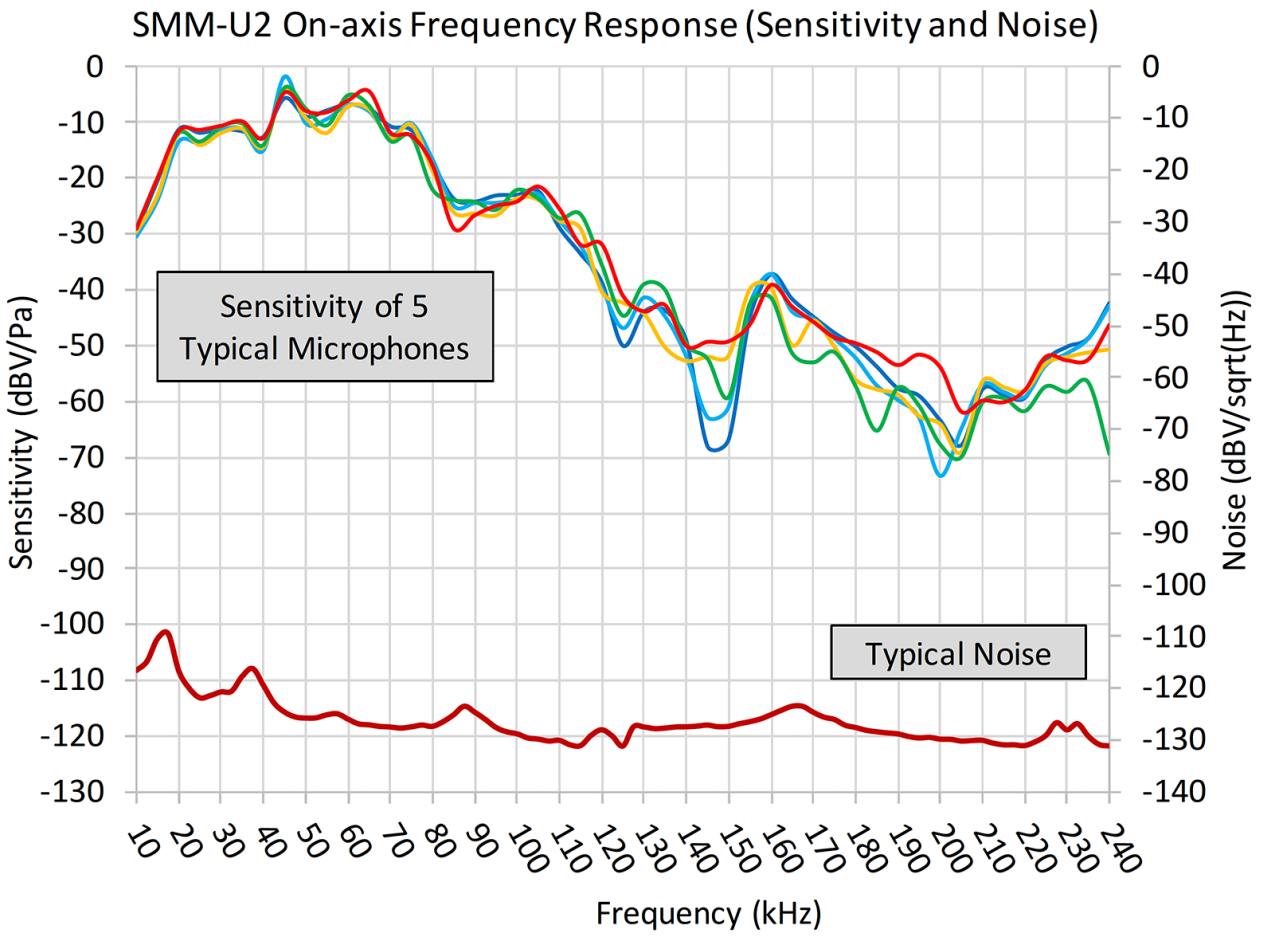
OPERATING TEMPERATURE:

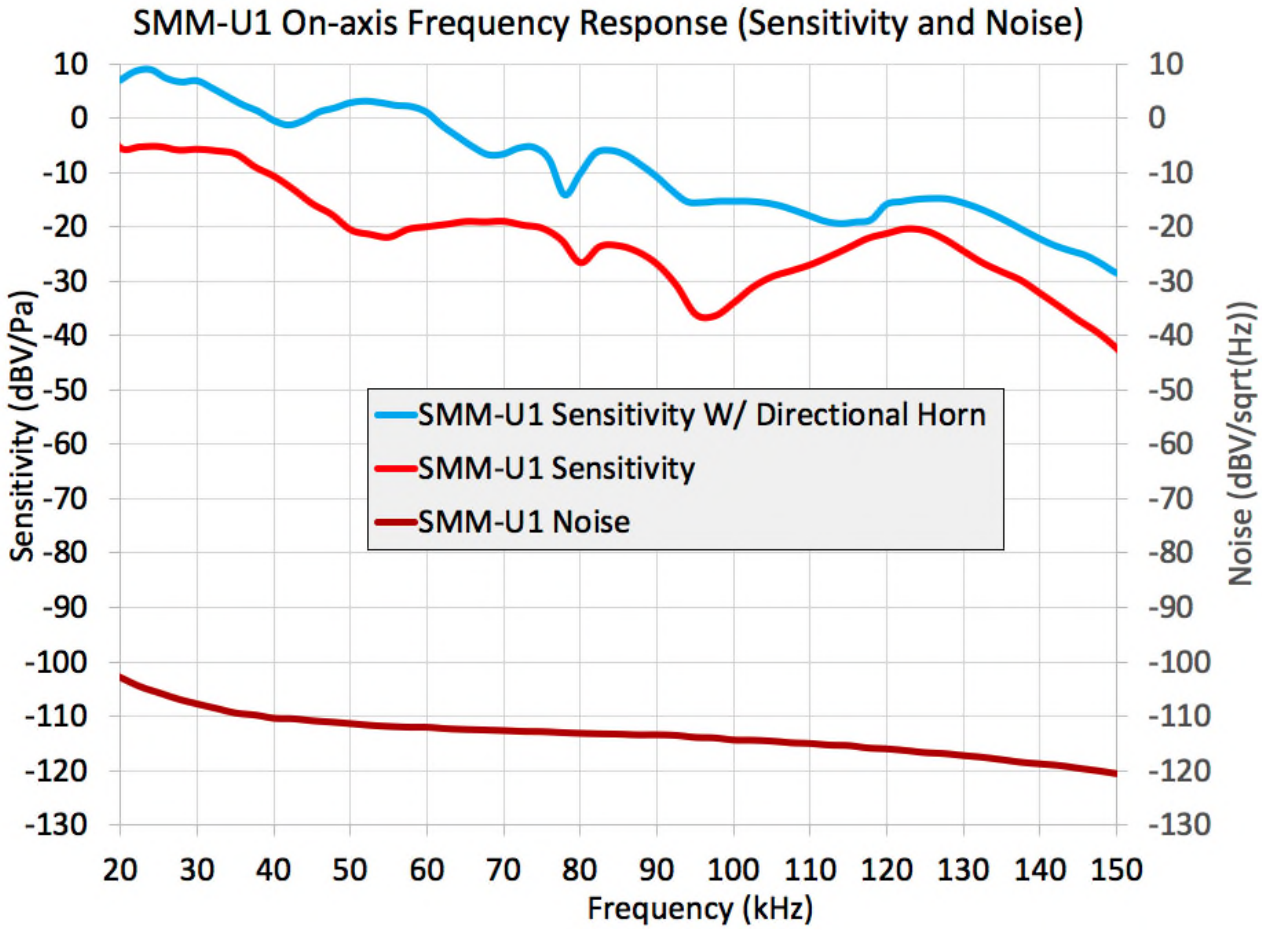
- -4°F to +185°F or -20°C to 85°C

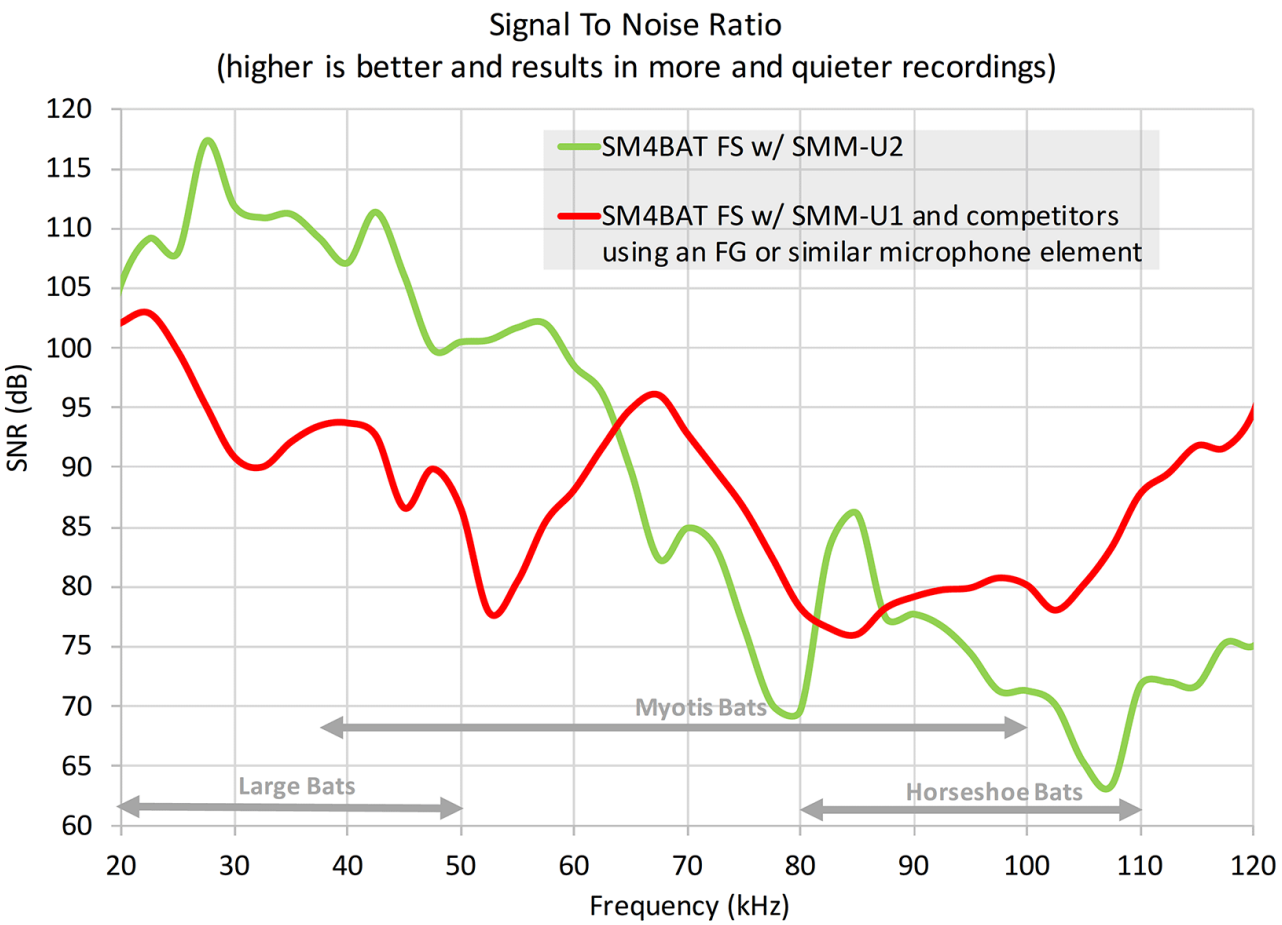
WARRANTY:

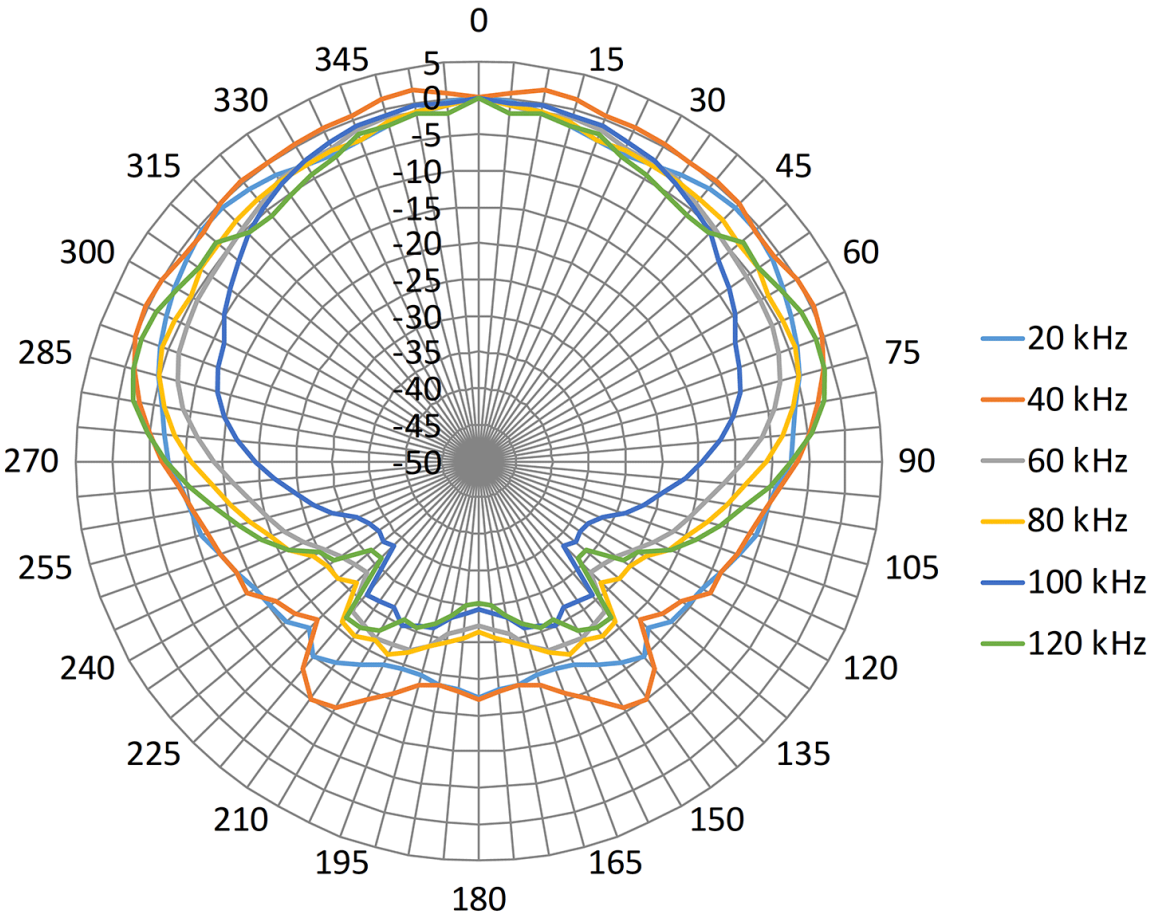
- 3 years

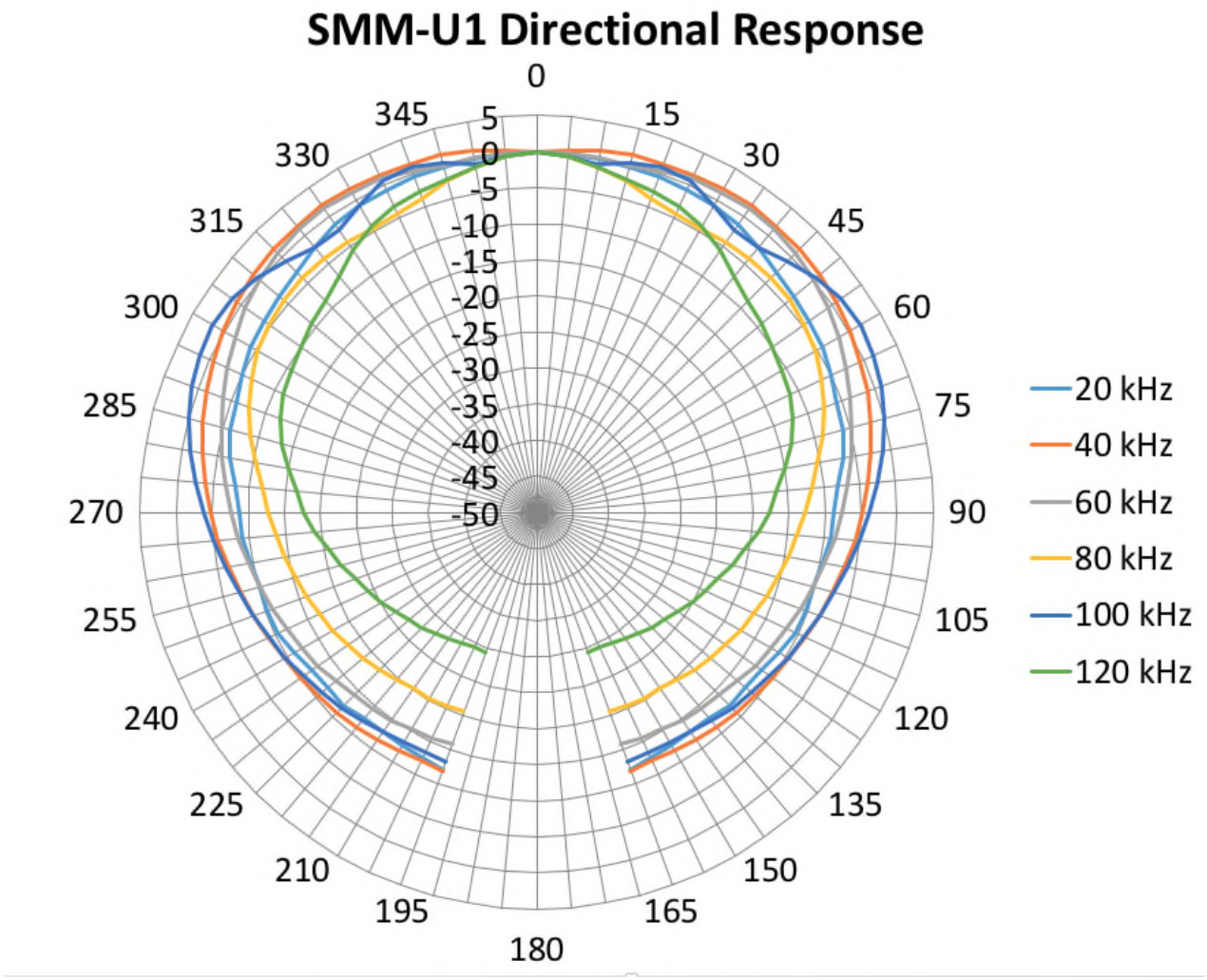
ULTRASONIC MICROPHONE PLOTS

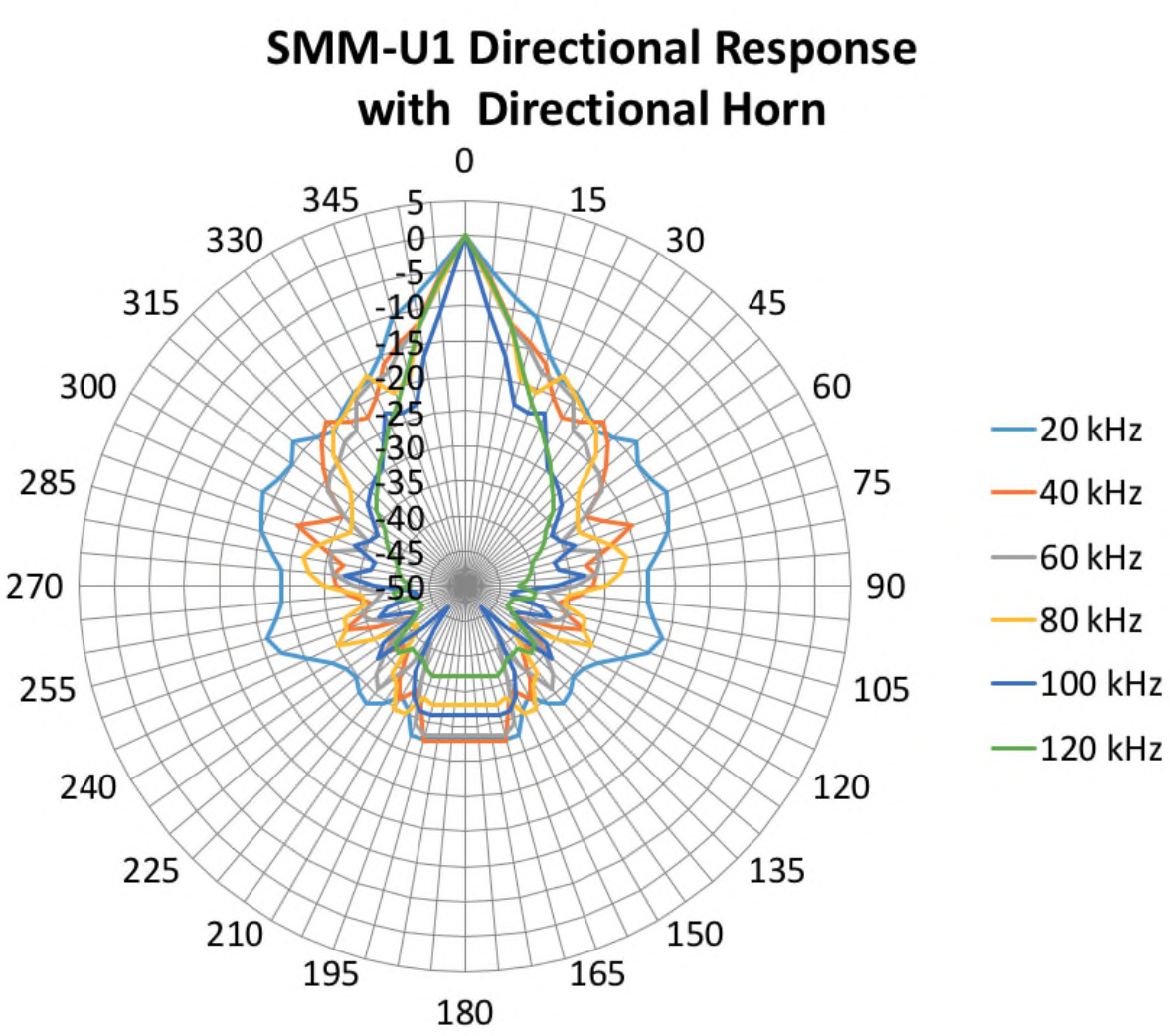

SMM-U2 On-axis Frequency Response (Sensitivity and Noise)
Sensitivity of 5 Typical Microphones
Typical Noise
Sensitivity (dBV/Pa)
Noise (dBV/sqrt(Hz))
Frequency (kHz)


SMM-U1 On-axis Frequency Response (Sensitivity and Noise)
SMM-U1 Sensitivity W/ Directional Horn
SMM-U1 Sensitivity
SMM-U1 Noise
Sensitivity (dBV/Pa)
Noise (dBV/sqrt(Hz))
Frequency (kHz)


Signal To Noise Ratio
(higher is better and results in more and quieter recordings)
SM4BAT FS w/ SMM-U2
SM4BAT FS w/ SMM-U1 and competitors using an FG or similar microphone element
SNR (dB)
120
115
110
105
100
95
90
85
80
75
70
65
60
Myotis Bats
Large Bats
Horseshoe Bats
20
30
40
50
60
70
80
90
100
110
120
Frequency (kHz)


SMM-U2 Directional Response
0
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
300
315
330
345
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
20 kHz
40 kHz
60 kHz
80 kHz
100 kHz
120 kHz


SMM-U1 Directional Response
0
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
300
315
330
345
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
20 kHz
40 kHz
60 kHz
80 kHz
100 kHz
120 kHz



WHICH BAT DETECTOR IS RIGHT FOR YOUR RESEARCH?

Check out our handy comparison chart showing the features and specs of each of our detectors.

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