# *Bat Biological Survey Report Addendum*
# *Spring and Summer 2011*

## *Naval Station Newport*

*Newport, Rhode Island*

***Prepared for:***

**Naval Facilities Engineering Command – Mid Atlantic**
**9742 Maryland Avenue, Bldg. Z-144**
**Norfolk, Virginia 23511**

***By:***

**Tetra Tech, Inc.**
**451 Presumpscot St.**
**Portland, Maine 04103**

***October 2011***

# Table of Contents

**1.0 BAT ACOUSTIC SURVEYS ..... 1**
*1.1* INTRODUCTION ..... 1
*1.2* METHODS ..... 1
*1.3* DATA ANALYSIS ..... 3
*1.4* RESULTS ..... 4
*1.5* DISCUSSION ..... 9
**2.0 REFERENCES ..... 10**

# List of Figures

**Figure 1-1.** Bat detector locations at Naval Station Newport, 2011 ..... 2

# List of Tables

**Table 1-1.** Summary of acoustic monitoring survey effort by detector in the Project Area, 2011. ..... 4
**Table 1-2.** Summary of bat call sequences and species recorded in the Project Area, 2011. ..... 5
**Table 1-3.** Summary of Index of Activity by species recorded in the Project Area, 2011. ..... 6
**Table 1-4.** Summary of bat acoustic monitoring periods and activity levels, 2009–2011 ..... 8

# 1.0 BAT ACOUSTIC SURVEYS

## 1.1 INTRODUCTION

Tetra Tech conducted passive bat acoustic monitoring surveys at the Naval Station Newport Project Area in late fall 2009; in the spring, summer, and fall of 2010; and again in the spring and summer of 2011. The results of these surveys were provided in the *Bird and Bat Biological Survey Report – Winter, Spring, Summer, Fall 2010* (Tetra Tech 2011). An additional series of acoustic monitoring surveys were performed in the spring and late summer of 2011. The purpose of this report is to provide the results of the 2011 supplemental survey effort.

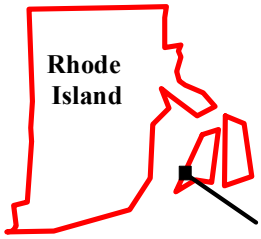
The goals of the 2011 acoustic monitoring study were to assess and quantify bat use of the Project Area and to identify potential for impact to bats associated with building and operating the proposed wind facility. Bat activity was monitored using ultrasonic acoustic recorders (Anabat SD-1, Titley Scientific, Inc.) at three different monitoring stations in the Project Area.

## 1.2 METHODS

Three bat acoustic monitoring stations were established at different heights in the Project Area for the 2011 survey (Figure 1-1). The duration of the deployment period for the three detector stations varied (Table 1-1). Initially, two detectors were deployed at the Tank Farm met tower on March 30, 2011 at a height of 15 meters (m) and 30 m. The two Tank Farm met tower detectors were removed on May 5 and subsequently re-deployed in a new met tower location, the Coastal met tower, on July 8 where they were operational through August 22 (Figure 1-1). The Coastal Met tower detectors were deployed at 15 m and 30 m, respectively. Finally, a stake detector was deployed in the Tank Farm area at a height of 1.5 m; this unit was operational from April 21 through August 22, 2011.

The met tower detectors ('High detector' and 'Low detector') sampled bat activity within the airspace of the proposed Project Area considered to be of highest risk to migratory bats. These detectors were deployed on the guy wires of the two on-site met towers (initially the Tank Farm met tower and later the Coastal met tower) and were suspended at heights approaching the rotor swept zone of the proposed turbine (35 m–130 m). To ensure that the greatest period of bat activity was surveyed, each detector was programmed to begin recording 45 minutes before sunset and to stop recording 45 minutes after sunrise each day.

Each detector station consisted of an Anabat SD-1 bat acoustic detector powered by a 5-watt solar panel and a 12-volt battery encased in a waterproof housing. The housing suspended the Anabat microphone downward. A plastic deflector shield angled at 45 degrees below the microphone facilitated recording of the airspace above and adjacent to the detector. Each detector transmitted data through a cellular data connection each morning after the nightly monitoring period ended.




Source: ESRI Data and Maps on CD-ROM, 2007

N

0 2,500 5,000 10,000 Feet

0 500 1,000 2,000 Meters

**Figure 1.1. Bat Acoustic Survey Locations Newport, Rhode Island Spring-Summer 2011**

Prepared For: NAVFAC Naval Facilities Engineering Command

Prepared By: TETRA TECH

Date: 10/2011

Z:\projects\100-NEA_T23330.0037_Newport_RI\GIS\MXD\100-NEA_T23330.0037_Newport_Figure_03_20111012.mxd, SMH

## 1.3 DATA ANALYSIS

Potential bat call files were extracted from data files using CFCread© software. CFCread© software screens all data recorded by the bat detector and extracts call files using a filter. To ensure comparability between datasets, the default settings for the CFCread© software were used during the file extraction process. These settings include a maximum time between calls (TBC) of 5 seconds, a minimum pulse fragment line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter, resulting in more noise files and poor quality call sequences retained within the dataset. A call is defined as a single pulse of sound produced by a bat. A call sequence is defined as a combination of two or more pulses recorded in a single call file.

A qualitative visual comparison was made between recorded bat call sequences and established reference libraries of bat calls. This technique allows for relatively accurate identification of bat species (O'Farrell et al. 1999, O'Farrell and Gannon 1999). All call sequences were also run through a series of conservative filters based on call sequence characteristics outlined in Szewczak et al. (2008). A call sequence was considered of suitable quality and duration to be included in data analysis if the individual call pulse(s) exhibited the full spectrum of frequency modulation produced by a bat (i.e., consisted of sharp, distinct lines) with a minimum of five pulses.

Relative abundance, or the magnitude of each species' contribution to recorded activity levels, was obtained by calculating an Index of Activity (IA) modified from Miller (2001). The method is based on the presence/absence of a species' vocalizations within 1-minute time increments. IA was calculated as the sum of minute-increments with a species presence divided by the unit effort (IA = # of minutes/detector-nights * 100). The IA calculation allows for samples with different levels of effort (i.e., different total number of detector-nights) to be accurately compared, thereby reducing the potential bias associated with comparing results from detectors with different study efforts.

## 1.4 RESULTS

### *Summary of Results from 2011*

During the 2011 survey period 284 detector-nights were recorded (∑ number of nights recorded by each detector). The Tank Farm stake detector operated for the longest continuous period (*n* = 122 detector-nights) (Table 1-1). The relative level of bat activity across detectors was variable. The highest activity rates (IA) were recorded at the Tank Farm stake detector (IA = 763.1), indicating a higher concentration of bat activity. Activity during the early spring (March 20–May 5) at the Tank Farm met tower was low, with only a single bat sequence recorded (IA = 2.8). Activity levels at the Coastal met tower detectors during the summer were moderate compared to the Tank Farm stake detector. IA values across all detectors indicate that there was greater bat activity at lower heights above ground level. The low detector (15 m) in the Coastal met tower had nearly twice as much activity as the high detector (30 m), and the Tank Farm stake detector (1 m) had substantially more activity (IA) than the other detectors combined.

**Table 1-1.** Summary of acoustic monitoring survey effort by detector in the Project Area, 2011.

| Detector Location | | Period of Operation | Detector-Nights | Number of Minutes with Activity | Total Number of Call Sequences | Overall Index of Activity (# of Mins Activity/ Detector-Nights)*100 | Pooled Index of Activity |
|---|---|---|---|---|---|---|---|
| **Tank Farm Met Tower** | High | March 30 - May 5, 2011 | 36 | 0 | 1 | *2.8* | 2.8 |
| | Low | March 30 - May 5, 2011 | 36 | 0 | 0 | *0.0* | |
| **Coastal Met Tower** | High | July 8 - August 22, 2011 | 45 | 40 | 69 | *153.3* | 185.6 |
| | Low | July 8 - August 22, 2011 | 45 | 127 | 128 | *284.4* | |
| **Tank Farm Stake** | | April 21 - August 22, 2011 | 122 | 931 | 980 | *763.1* | |
| **Total** | | | **284** | **1098** | **1177** | ***386.6*** | ***386.6*** |

Bat call sequences were identified to the lowest possible taxonomic level (Tables 1-2 and 1-3). A total of 96 percent of recorded calls were identified to species level (*n* = 1,134). Calls were then combined into four 'Known Species Groups' based on similarities in call sequence structure: Low Frequency Species, Middle Frequency Species, Eastern red bat (*Lasiurus borealis*) / Tri-colored bat (*Perimyotis subflavus*), and High Frequency Species (Table 1-2). Call sequences that did not meet the parameters required for species level identification could not be classified to species level (*n* = 125) and consisted of *Myotis* species calls. It is likely that the majority of known species high frequency calls were attributable to little brown bat (*Myotis lucifugus*).

Seven species were definitively identified within the recorded call sequences from the 2011 passive monitoring effort. A total of 1,040 calls (88 percent), were attributed to long-distance migratory bats including the hoary bat (*Lasiurus cinereus)*, silver-haired bat (*Lasionycteris noctivagans*), and Eastern red bat. A small number of calls (*n* = 6) were identified as little brown bat, and two northern long-eared bat (*Myotis septentrionalis*) calls were recorded. Tri-colored bat calls comprised 4.5 percent of calls, and 2.8 percent of calls were big brown bat (*Eptesicus fuscus*). The remainder of bat calls were from unknown *Myotis* species.

None of the species documented during the survey period are state listed species of special concern in Rhode Island. In addition, no calls of federally listed bat species were identified during the survey.

**Table 1-2.** Summary of bat call sequences and species recorded in the Project Area, 2011.

| Group | Characteristic Frequencies* | Species | Count of Minutes with Activity | Total Call Sequences |
|---|---|---|---|---|
| **Low Frequency** | 12 – 24 kHz | Hoary bat | 232 | 236 |
| **Middle Frequency** | 24 – 38 kHz | Big brown bat | 36 | 32 |
| | | Silver-haired bat | 677 | 735 |
| **Eastern red / Tri-colored bat** | 44 – 45 kHz | Tri-colored bat | 25 | 54 |
| | | Eastern red bat | 74 | 69 |
| **High Frequency** | 46 – 52 kHz | Northern myotis | 2 | 2 |
| | | Little brown myotis | 6 | 6 |
| | | Unknown *Myotis* species | 47 | 44 |

*** Characteristic frequency (Fc) is generally defined as the frequency of the call pulse at the lowest slope, or the lowest frequency of the consistent frequency modulation sweeps. Fc represents the single most useful parameter for species identification.**

**Table 1-3.** Summary of Index of Activity by species recorded in the Project Area, 2011.

| Detector Location | | Species | | | | | | | | Overall |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Hoary bat | Silver-haired bat | Big brown bat | Eastern red bat | Tri-colored bat | Little brown myotis | Northern long-eared *Myotis* | *Myotis* species | |
| **Tank Farm Met Tower** | High | 0.0 | 0.0 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Low | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Coastal Met Tower** | High | 8.9 | 31.1 | 13.3 | 8.9 | 15.6 | 0.0 | 2.2 | 8.9 | 91.1 |
| | Low | 88.9 | 93.3 | 8.9 | 46.7 | 28.9 | 2.2 | 0.0 | 13.3 | 282.2 |
| **Tank Farm Stake** | | 154.1 | 509.0 | 20.5 | 40.2 | 4.1 | 4.1 | 0.8 | 30.3 | 763.1 |
| **Overall** | | 81.7 | 238.4 | 12.7 | 26.1 | 8.8 | 2.1 | 0.7 | 16.5 | 387.0 |

Relative activity levels for each species and species group across sampling locations were calculated (Table 1-3). Silver-haired bat was the most active single species (IA = 238.4). Hoary bat exhibited the next highest levels of activity (IA = 81.7), followed by Eastern red bat (IA = 26.1). All other species had IA levels of less than 20 (# of minutes / detector-nights*100).

### *Summary of Results from 2009, 2010, and 2011*

A total of 909 detector-nights were recorded at Naval Station Newport during the bat acoustic monitoring surveys, beginning in fall of 2009 and ending August 22, 2011. The initial monitoring period began on October 1 and ended December 10. During the 2009 surveys two detectors were hung from the Coastal met tower, and a single stake detector was deployed near ground level. In 2010 the bat acoustic systems were deployed on April 7 at Bishop Rock and August 13 at the Tank Farm met tower. Bat monitoring in 2010 was curtailed on November 22. The 2011 survey effort began on March 30 with two detectors deployed in the Tank Farm met tower; these detectors were removed on May 5 when the tower was decommissioned. On July 8, 2011 the Coastal met tower was re-installed and two detectors were placed in the guy wire array on July 8. Concurrent with the Tank Farm and Coastal met tower operations in 2011, a stake detector was operational at the Tank Farm from April 21 through August 22, 2011 (Table 1-4).

The total number of recorded call sequences varied across years, with the greatest number of call sequences recorded in 2010, the year when detectors operated for the longest duration. The IA did not vary substantially between years, when the warmest months were sampled. For example IA values were low in 2009 when sampling occurred in October, November, and December. Sampling in 2010 and 2011 included the warmest part of the year, roughly April through August. Bat activity is known to be affected by mean nightly temperatures, presumably because insect prey is more abundant when the ambient air temperature is warmest. Therefore it is not surprising that the IA values for year 2010 and 2011 are more similar then the IA value for 2009.

**Table 1-4.** Summary of bat acoustic monitoring periods and activity levels, 2009–2011.

| Detector Location | | | Period of Operation | Detector-Nights | Number of Minutes with Activity | Total Number of Call Sequences | Overall Index of Activity (# of Mins Activity/ Detector-Nights)*100 | Pooled Index of Activity |
|---|---|---|---|---|---|---|---|---|
| **2009** | | | | | | | | |
| **2009** | **Coastal Met Tower** | **High** | October 1 - December 10, 2009 | 71 | 29 | 36 | *40.8* | 54.4 |
| | | **Low** | October 1 - December 10, 2009 | 71 | 48.2 | 45 | *67.9* | |
| **Bishop Rock** | | | October 1 - December 10, 2009 | 49 | 48.3 | 26 | *98.6* | 98.6 |
| ***2009 Sub-total*** | | | | ***191*** | ***125.5*** | ***107*** | ***65.7*** | ***65.7*** |
| **2010** | | | | | | | | |
| **2010** | **Tank Farm Met Tower** | **High** | August 13 - November 22, 2010 | 102 | 211 | 302 | *206.9* | 284.3 |
| | | **Low** | August 13 - November 22, 2010 | 102 | 369 | 446 | *361.8* | |
| **Bishop Rock** | | | April 7 - November 22, 2010 | 230 | 1123 | 1311 | *488.3* | 488.3 |
| ***2010 Sub-total*** | | | | ***434*** | ***1703*** | ***2059*** | ***392.4*** | ***392.4*** |
| **2011** | | | | | | | | |
| **2011** | **Tank Farm Met Tower** | **High** | March 30 - May 5, 2011 | 36 | 0 | 1 | *2.8* | 2.8 |
| | | **Low** | March 30 - May 5, 2011 | 36 | 0 | 0 | *0.0* | |
| | **Coastal Met Tower** | **High** | July 8 - August 22, 2011 | 45 | 40 | 69 | *153.3* | 185.6 |
| | | **Low** | July 8 - August 22, 2011 | 45 | 127 | 128 | *284.4* | |
| | **Tank Farm Stake** | | April 21 - August 22, 2011 | 122 | 931 | 980 | *763.1* | |
| ***2011 Sub-total*** | | | | ***284*** | ***1098*** | ***1177*** | ***386.6*** | ***386.6*** |

*** (# of Mins Activity/ Detector-Nights)*100**

## *1.5* DISCUSSION

Current research has demonstrated that tree-roosting migratory bat species have been the predominant species found during post-construction mortality studies at operational wind farms in North America (Arnett et al. 2008). Results from these mortality studies show that the three bat species most commonly encountered during ground searches are long-distance migratory bats: Eastern red bat, hoary bat, and silver-haired bat (Kunz et. al 2007, Arnett et al. 2008), all of which were positively identified from recordings during the 2009, 2010, and 2011 survey periods. These species were recorded more frequently than non-migratory *Myotis* species, which demonstrates that the bat community of the Project Area likely consists of a small summer resident population of *Myotis* species, and a population of migratory bats during migration periods.

It is expected that weather conditions, including mean nightly temperature and wind speed, contributed to the patterns of activity recorded by the acoustic detectors. Overall, the highest IA rates were recorded in warm weather periods indicating: (1) increased foraging activity near the detectors due to a rise in mean nightly temperatures (Racey and Swift 1985, O'Donnell 2000, Kusch et al. 2004); (2) increases in food resource concentrations near the detectors; or (3) the area possibly being located in a transit corridor for bats leaving a roost and moving locally to an established area of concentrated food resource. The occurrence of hoary bat, Eastern red bat, and silver-haired bat at the detectors in the spring and fall is almost certainly attributable to migration (Cryan and Veilleux 2007) and is consistent with the migratory strategy of these species (DeGraaf and Yamasaki 2001, Cryan 2003). The presence of migratory tree bat species late in the fall 2009 was not unexpected; especially the comparatively large proportion of Eastern red bat calls in the dataset. Eastern red bat, and to a lesser extent hoary bat and silver-haired bat, are known to migrate along coastal areas, especially during the fall (Cryan 2003, Johnson and Gates 2008). The low levels of bat activity, late in the fall of 2009 and early in the spring of 2011, were likely a result of the low mean nightly temperatures (Racey and Swift 1985).

There is an inherent difficulty in attempting to interpret the number of recorded call sequences as an indication of activity levels; however, detection rates, recorded minutes of activity and IA values do provide a relative measure of bat activity near sampling locations. The limited maximum range of a single Anabat detector (approximately 30 m) makes the characterization of landscape-scale movements, such as migration, difficult to assess. However, a comparative assessment of the results from detectors placed at varying heights in different areas of the Project Area facilitates the characterization of localized bat occurrence and phenology.

The total number of bat call sequences and minutes of activity recorded each night by a given detector may or may not reflect the absolute level of bat activity present in the Project Area, although some studies have suggested that there may be a relationship between the numbers of calls recorded and bat activity levels (Gorresen et al. 2008). The bias in passive acoustic surveys of this type stems from the unknowns associated with recorded call sequences. For example, a single foraging individual may produce a large number of call sequences that are within the range of a given detector set. Conversely, a large number of individual bats may pass the detector set and produce an equally large number of call sequences. It is important to note that the survey results are a sample of bat activity in the airspace surrounding the detectors and are not necessarily indicative of bat activity throughout the entire Project Area. In addition, the variability in sampling effort between years and locations may have diminished the accuracy of comparing activity levels between detector locations. However, by calculating an IA coefficient, a comparison between sampling locations with different levels of effort becomes more valid.

# 2.0 REFERENCES

Arnett, E. B., K. Brown, W. P. Erickson, J. Fiedler, T. H. Henry, G. D. Johnson, J. Kerns, R. R. Kolford, C. P. Nicholson, T. O' Connell, M. Piorkowkski, and R. Tankersley, Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. *Journal of Wildlife Management* 72: 61–78.

Cryan, P. M., and J. P. Veilleux. 2007. Migration and use of autumn, winter and spring roosts by tree bats. In *Bats in Forests: Conservation and Management*, eds. J. P. H. M.J. Lacki, and A. Kurta. Baltimore, MD, The Johns Hopkins University Press**:** 153–176.

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

Gorresen, P.M., A. C. Miles, C. M. Todd, F. J. Bonaccorso and T. J. Weller. 2008. Assessing bat detectability and occupancy with multiple automated echolocation detectors. *Journal of Mammalogy* 89: 11–17.

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

Kunz, T. H., E. B. Arnett, W. P. Erickson, A. R. Hoar, G. D. Johnson, R. P. Larkin, M. D. Strickland, R. W. Thresher, and M. D. Tuttle. 2007. Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. *Frontiers in Ecology and the Environment* 5: 315–324.

Kusch, J., C. Weber, S. Idelberger, and T. Koob. 2004. Foraging habitat preferences of bats in relation to food supply and spatial vegetation structures in a western European low mountain rangeforest. *Folia Zoologica* 53: 113–128.

Miller, B. W. 2001. A method for determining relative activity of free flying bats using a new activity index for acoustic monitoring. *Acta Chiropterologica*, 3:93–105.

O'Donnell, L, C. F. J. 2000. Influence of season, habitat, temperature, and invertebrate availability on nocturnal activity of the New Zealand long-tailed bat (*Chalinolobus tuberculatus*). *New Zealand Journal of Zoology* 27: 207–221.

O'Farrell, M. J., and W. L. Gannon. 1999. A comparison of acoustic versus capture techniques for the inventory of bats. *Journal of Mammalogy* 80: 24–30.

O'Farrell, M. J., B. W. Miller, and W. L. Gannon. 1999. Qualitative identification of free-flying bats using the anabat detector. *Journal of Mammalogy* 80: 11–23.

Racey, P. A., and S. M. Swift. 1985. Feeding ecology of *Pipistrellus pipistrellus* (Chiroptera: Vespertilionidae) during pregnancy and lactation. *Journal of Animal Ecology* 54: 205– 215.

Szewczak, J. M., A. Corcoran, J. P. Kennedy, T. J. Weller, P. C. Orsmbee. 2008. Echolocation call characteristics of Pacific northwest bats. Presented during the proceedings of the Bat Conservation International Acoustic Monitoring Workshop, Tulelake, California.

Tetra Tech, Inc. 2011. Bird and bat biological survey report- Winter, Spring, Summer, and Fall 2010. Naval Station Newport.