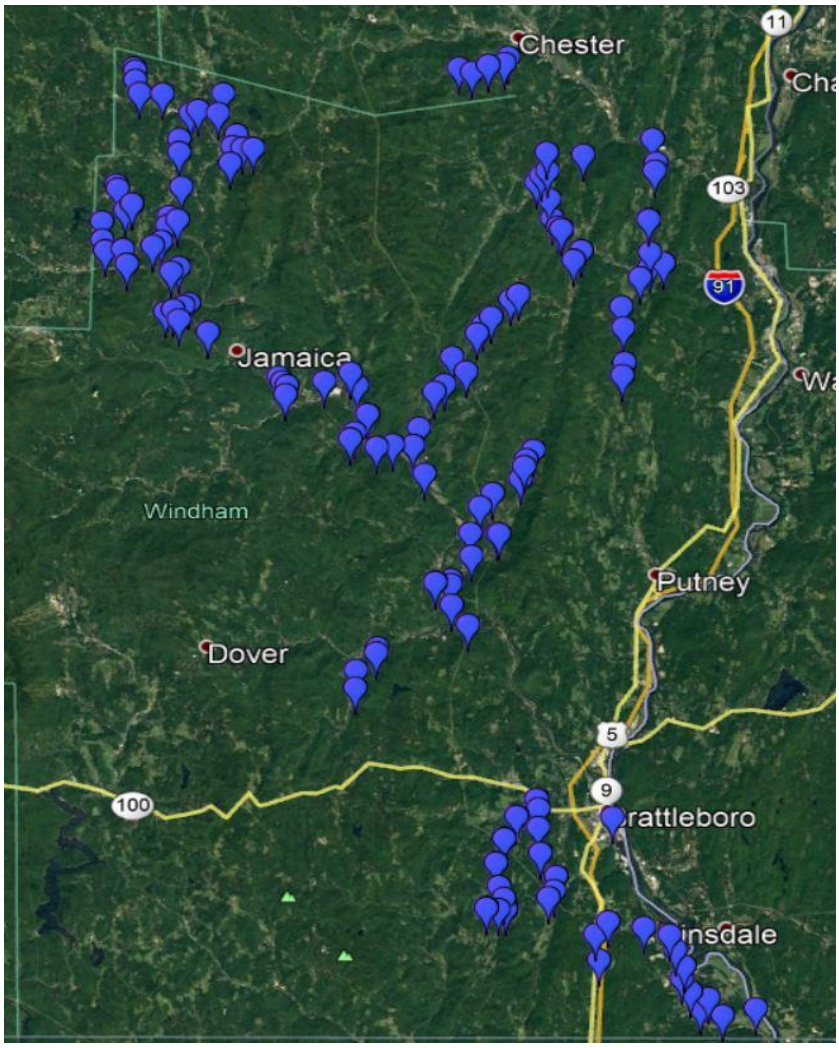
# 2021 Eastern Whip-poor-will Survey: Windham County, Vermont




Points Surveyed in Windham County by VCE Surveyors and Autonomous Recording Units

# Annual Report to the Vermont Fish and Wildlife Department

**August 23, 2021- Report by: Benjamin Fletcher**

VERMONT CENTER FOR ECOSTUDIES
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**Acknowledgements**

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Affixing an automated recording device (ARU) to a tree, overlooking a marshy clearing. Forest edge seen beyond.

## Introduction

*Eastern Whip-poor-will Introduction and Population Trends*

The Eastern Whip-poor-will (*Antrostomus vociferus;* EWPW) is a small bird, between the size of a robin and a crow, in the nightjar family (Caprimulgidae**)** of nocturnal aerial insectivores. These wide-mouthed birds feed primarily on large bodied insects flying under the moonlight in edge habitats across eastern North America. Though visual observations of EWPW are rare due to its camouflaged plumage and nocturnal behavior, EWPW can be reliably detected by its distinctive call. The Whip-poor-will name is onomatopoetic, reflecting the three-syllable vocalization that males of the species continuously repeat on moonlit nights throughout their breeding season which generally occurs late May through early July, with egg-laying timed so that hatching nearly coincides with the full moon phase (Cink 2002).

EWPW require a mosaic of early successional habitat to provide sufficient territory for nesting and nearby hunting activities. Nesting grounds are chosen on forest floors with open understories, and are simple in construction, built as an impression directly in leaf-litter in areas of dry and well-drained soil, such as Pine Barrens and Pine-oak woodlands. Examples of open spaces that can serve as foraging habitat for EWPW include meadows and fields, utility rights-of-way, agricultural areas and recently burned or logged forests (Hunt 2013).

Populations and the geographic range of EWPW have each contracted in Vermont and other New England states due in part to loss of suitable habitat (Sauer et al. 2011). Forest maturation, along with industrial and urban development, have been cited as factors precipitating EWPW decline (Environment Canada 2015). In Vermont, significant early successional habitat is maturing into a more forested state due primarily to farmland abandonment. In addition to reduced habitat availability, EWPW declines have also been associated with declines in large-bodied moths (possibly due to pesticide use), and fatal encounters with cars (COSEWIC 2009).

EWPW numbers fell by 77% between the first (1976-1981) and second (2002-2007) Vermont Breeding Bird Atlas (Renfrew 2013). Other breeding bird atlases (MD, NY, ON, PA) showed an average decline of 54% between their first and second atlases. However, most bird surveys are carried out during the day and may fail to accurately represent populations of nocturnal species. The lack of standardized and consistent nocturnal bird surveys led Dr. Pamela Hunt of New Hampshire Audubon to commence the Northeast Nightjar Survey in 2005, consisting of volunteer nocturnal roadside surveys in four New England states. The survey monitors the three species of nightjars that can be found in New England: The Chuck-will's-widow, Common Nighthawk, and the Eastern Whip-poor-will (which serves as the primary focus). As a result of data collected from the Northeast Nightjar Survey, breeding bird atlas surveys, and decades of anecdotal reports of population decline in Vermont, the EWPW was listed as Threatened in the state in 2011.

Eastern Whip-poor-will. © Laura Gooch CC 2.0

*Origins of Eastern Whip-poor-will Survey*

In 2005, the Northeast Nightjar Survey expanded to Vermont in the form of nocturnal survey routes. Each route began as a series of ten points spaced 0.5 miles apart, with volunteers completing a three-minute count at each point. In 2007, the protocol was updated to its current version, which uses ten six-minute point counts at locations spaced one mile apart (Hunt 2007). Each year, volunteers survey routes within regions containing habitat features considered potentially suitable for EWPW (matrix of field and forest, generally low elevation). These survey routes are loosely based on habitat associations derived from past research in New Hampshire (Hunt 2006) and other data (e.g., Cink 2002, Hunt pers.obs.). These volunteer surveys not only contribute to an understanding of population trends in Vermont, but also contribute to a regional effort to monitor EWPW in the broader northeastern United States.

*Vermont Center for Ecostudies Surveys*

Since 2014, VCE has conducted intensive EWPW surveys in different regions of Vermont, funded in part by the Vermont Fish and Wildlife Department. VCE surveys significantly expand the annual collection of EWPW population data, and enhance population estimates within specific regions. The initial VCE survey (2014) targeted an area of the state where EWPW were thought to exist in relative abundance, around the towns of West Haven and Fair Haven in Rutland county. The subsequent two years (2015,

2016) aimed to survey routes that had been previously monitored by volunteers, but otherwise possessed little past data. From 2016 to 2019, VCE created new routes in areas where few or no EWPW had been previously reported. These routes were designed using the criteria set out by Dr. Pamela Hunt in 2007, and were often supplemented by additional ad-hoc survey points that were selected during in-person scouting efforts. Once established, these routes were surveyed by volunteers as often as possible in subsequent years.

The 2020 survey year sought to reassess the EWPW population at one long standing route, in the western region of Rutland county (in the towns of West Haven, Fair Haven, Benson, and Poultney, some of which were surveyed in 2014). The 2020 VCE surveys yielded 97 individual EWPW across all points surveyed. In contrast to last year, the 2021 survey year was initiated with a strikingly different objective. Survey efforts this year aimed to thoroughly examine a region with sparse historic data, in Windham county in the southeast corner of the state.

Beginning in 2018, ten SongMeter SM4 Automated Recording Units (ARUs) were introduced to the Eastern Whip-poor-will Survey. The ARUs were used first in 2018 to serve as a back-up observer during route surveys when a VCE surveyor was alone (as opposed to observing alongside an assistant technician). In 2021, the role of the ARUs expanded, to begin data collection at points away (and independent) from survey routes. ARUs were regularly moved to novel supplemental locations during days in the survey window. These ten ARUs significantly expanded the capacity of the Eastern Whip-poor-will Survey to collect audio data, and from previously inaccessible locations (e.g. no safe location for parking at night).

*Volunteers Are Critical to the Eastern Whip-poor-will Survey*

A team of volunteers contributes each year to the Eastern Whip-poor-will Survey, with over 19 serving along 15 survey routes in the 2021 season. Whip-poor-will project volunteers contribute their efforts in primarily three ways: by scouting their assigned or chosen survey route during the day to assist in finding safe parking locations for use during the night time, by going out during the moonlit night to listen for whip-poor-wills along their survey route, and lastly, by helping to record and upload their data in contribution to this project's publicly accessible dataset. Volunteers reliably go out annually to perform single 10-point nighttime surveys at the different established routes throughout the state. Volunteers have been essential since the beginning of EWPW survey activity in Vermont, with some individual volunteers reporting data on their local populations for more than a decade. The Eastern Whip-poor-will Survey volunteer team continues to grow throughout the years (despite a pandemic-induced pause in 2020), to help collect data from an increasing percentage of the state.

Some volunteers also assist in the mapping of potential EWPW habitat within their own locales - for example one volunteer based in Montpelier used Google Earth to compose a map marking extensive potential habitat throughout the Montpelier region. Such contributions facilitate the development of new routes, and so interested individuals have the power to help expand EWPW data collection in regions throughout the state where data collection has been sparse or absent.

Incidental whip-poor-will reports often come to VCE in the form of eBird and iNaturalist submissions, in addition to directly from local residents. If the observers are not familiar with eBird, we encourage them to build a profile with the platform and submit an eBird report with the location, date, and time of the observation (these submissions can ideally include audio recordings).

The Vermont Center for Ecostudies is always looking for new potential volunteers to join the Eastern Whip-poor-will team. We owe a sincere thank you to our volunteers.

An autonomous recording unit attached and locked to a tree, ready to begin recording following sunset. © Ben Fletcher

## 2021 Methods

*Developing Survey Routes in Windham County*

Staff and volunteers survey areas that fit into three general categories: 1) Areas where the species is known to be relatively abundant, 2) Those with viable habitat but lacking in historical data, 3) Areas where whip-poor-wills were thought to have been more abundant in the past.

Routes are designed to include most or all of the following criteria:

1. Well-drained soils, often indicated by quarries, gravel pits and roads.
2. River valleys (low elevation)
3. Habitat mosaic including forested and open lands (e.g. utility rights-of-way, old agricultural fields, meadows)
4. Pine dominant or pine/oak forest
5. Away from development and highly-trafficked roads

The 2021 survey season examined routes near six towns in Windham county. Two of these routes were pre-existing and have past volunteer and VCE data (Brattleboro and Vernon), and four routes were newly created in towns across the county (Brookline, Townshend, Saxtons River, and Londonderry).

Two of the six routes surveyed in 2021 (Brattleboro and Vernon) were established by Dr. Pamela Hunt at the initiation of the Vermont survey activities in 2007. The new routes were developed following the five criteria described above in towns across Windham county. Additionally, extensive ad-hoc surveys were conducted at points in three more Windham towns (Chester, Jamaica, South Newfane) as time allowed. These ad-hoc surveys were selected because of past incidental reports of whip-poor-wills, and by potential habitats identified during in-person scouting.

In order to establish the 10-mile survey routes, potential habitat was identified throughout Windham county using Google Earth. Routes were placed within regions of maximal potential habitat, with the individual 10 points spaced 1.6 km (1 mile) apart. Each survey consisted of six minute point counts conducted at 10 locations along the 10-mile route, labeled 1 through 10 and followed in order. Point locations were adjusted based on access to safe parking, but were moved no further than 0.24 km from the original location.

Roads along the designated survey routes were scouted during the day to locate potential habitat not visible in the satellite imagery, as well as to build familiarity with parking and traffic hazards. Surveyors also used this daylight scouting session to record brief descriptions of habitat composition at each of the survey points along the route.

To prepare for cluster sampling at points where EWPW are detected, supplemental points are designed in relation to each of the 10 original points. Supplemental points are surveyed to assist in the tallying and triangulation of individual whip-poor-wills detected at the original points. Supplemental points are chosen 0.8km (0.5 miles) in each cardinal direction away from original points. Ideally, four supplemental points

can be created and accessed from every original point. Some locations will not have sufficient nearby roads to allow for four supplemental points.

*2021 Survey Routes and Habitat Descriptions*

1. Townshend (Figure 1)

Townshend lies on the edge of the West river, south on Route 30 from the large dam that forms Townshend lake. This route begins at a large bend in the river near East Jamaica village, and follows the river before crossing it via the dam. Numerous small clearings (logging lots, vacant business properties, small disconnected farm fields) line this river-adjacent survey route and represent potential EWPW habitat, in addition to the dam and lake area that was the location of an incidental whip-poor-will report for this town.

2. Londonderry (Figure 2)

The Londonderry route hosts a mosaic of habitat conditions. Initial survey points were located within a large multi-operation agricultural clearing surrounded by pine-dominated mixed forests and variable understory. After this initial location, the route continues for its duration along a forest-lined road broken up by occasional stand-alone clearings, including two narrow (60ft) powerline rights-of-ways. This general pattern of occasional clearings (of all sizes) in the forest continues throughout the route, and leads through areas of substantial development including South Londonderry and Londonderry village.

3. Brookline (Figure 3)

The town of Brookline is a small agricultural community located due west of Putney, and northwest of Brattleboro. The town consists of several broad hills and valleys, where the few roads are bordered by farm fields and other properties which are generally divided by small hardwood forest buffers. There is a large, central patch of mostly undeveloped forest within the Brookline township through which runs a large utility right-of-way. This right-of-way abuts a number of promising but difficult-to-access potential habitats, and warrants further investigation beyond the 10-point route. The patchwork arrangement of the farmland and other properties throughout Brookline creates a mosaic of habitat conditions along this route.

4. Vernon (Figure 4)

Vernon is a primarily flat route that follows the layout of an agricultural community adjacent to both the Connecticut river and Massachusetts state line. Though volunteer surveys have never yielded a whip-poor-will in this area, VCE surveyors in the 2016 year detected two EWPW (on points 4 and 6) on the same night. The 2021 survey failed to locate EWPW along this route despite multiple attempts, including sunset ad-hoc visits to the points at which the birds had been previously heard.

Although this route is largely within populated areas, development is sparse and the habitat is viable for EWPW. Sections of mixed forest frequently border large farms, hay fields, large ponds, gravel pits, a now-defunct industrial site, and the Connecticut river.

5. Saxtons River (Figure 5)

The Saxtons River and Vernon routes are similar in that each initially proceeds through a valley that has mostly been cleared for farmland. Many working farms (pasture, hay, produce) line the first (southbound) section of the route on Pleasant Valley Road, before reaching the village of Saxtons River. This village houses a valuable ad-hoc survey point at the town cemetery, convenient to the established survey route. Beyond the village, the survey route proceeds into a more tightly forested region, still containing (but with smaller, and fewer) various agricultural fields.

6. Brattleboro (Figure 6)

The Brattleboro route begins in Guilford within a sparsely developed village encircled by small mowed fields. This starting point is north of a large undisturbed section of forest, and leads in the opposite direction to a hilly and developed road with consistent residential properties and (primarily mowed) fields. These properties are occasionally interspersed with alternative clearings, including a large powerline right-of-way (over 200ft wide), and open lots from logging operations and assorted business activity. The powerline right-of-way in this route offers exceptional habitat, and though it intersects with accessible roads at two locations, ARUs could be utilized to survey this habitat more extensively than what is possible in nighttime surveys.

The route eventually arrives at a significantly trafficked and developed section of West Brattleboro before it turns back to form a U shape. The road then taken out of West Brattleboro proceeds slightly uphill and into more homogenous and densely forested areas than previous. Mixed use open fields do occur on this road, but at smaller scales and with less frequency than throughout the first half of this route.

*2021 Survey Conditions*

Eastern Whip-poor-will surveys in 2021 were conducted from May 19 through June 2, and from June 17 through July 1. These two separate windows of time include all moon phases with at least 50% illumination (between the First Quarter and Third Quarter moons, in the period between the start of waxing gibbous and end of waning gibbous), when EWPWs are known to vocalize more frequently.
In the initial evenings of the survey window, surveying began 20 - 30 minutes after sunset and continued until the specified endpoint (usually point number 10) as long as the moon was adequately illuminated and weather conditions were suitable. During the waning moon period, when the moon rises after the sun has completely set, sunset surveys could be performed in the time after sunset (20 - 30 minutes following official sunset time) until complete darkness. Regular surveying could then be performed later in the night once the illuminated moon became visible above the horizon, and could proceed until 15 minutes before the official sunrise time.

Note - the period of the last light after sunset (beginning 20 - 30 minutes after official sunset time, proceeding until complete darkness), and the period of the first light before sunrise (ending 15 minutes before official sunrise time), can each be used to survey on any evening or morning within the survey window independent of moonlight.

Surveys were not conducted if conditions were windy (wind speed > 8 mph), cloudy (>50% cloud cover), or rainy.

Each of the six 2021 Windham routes was surveyed twice throughout this survey season. Many nights within the survey window were rendered unusable due to weather conditions, and several surveys were aborted due to sudden shifts in wind or cloud cover. Ideally, first and secondary surveys would be completed within the same lunar cycle to lessen variability in counts that may have resulted from immigration or emigration within the area. All 2021 survey routes were surveyed within the same window except for Townshend (surveyed first May 24 and then June 17). The replicate survey for the Brookline route was similarly punctuated in itself, with points one through six surveyed on June 2 (cut off by sunrise) and the remaining points (seven through ten) surveyed June 17.

*Point-Counts and Cluster Sampling*

Surveyors arrive at the predetermined location, often parking in pull-offs such as snowplow turnarounds, and note both the time and GPS coordinates before exiting the car to record wind speed, cloud cover, and noise data (each assigned a value of 0 - 3, from clear to intense). If wind and/or sky conditions are assessed at level 3, surveyors pause until the assessment is reduced. Passing cars were also counted during the six minutes of surveying to account for potential disturbances.

Surveys at each point consist of a six-minute count, during which observers listen (rotating slowly in order to scan all directions) and record data independent from other observers. Each minute within the six-minute interval is recorded separately, and one observer calls out the mark of each new minute to facilitate data collection in separate columns (for each of the six minutes).

For each point along the route, six columns are present on the data collection form: one for each minute in the six-minute point count. As each new minute is called out by one observer in the party, a "0" is marked in each designated column if no EWPW is heard within that specific minute (habitual, consistent marking "0" when specific birds are not heard within each passing minute assists in keeping track of multiple calling birds over time). If an EWPW is detected within any minute, a "1" is marked within the designated box. If multiple EWPW are detected at a point, an additional six-column row on the form was created for each individual EWPW in order to record the presence or absence of each calling bird within each of the six minutes.

If an EWPW is detected at a minute within a six-minute point count, a compass bearing and qualitative distance assessment (noted as: very close, close, far, very far) are recorded for each individual bird.

For each point at which a whip-poor-will was heard, cluster sampling would then be employed, and so the designated supplemental points (between 0.8 - 1.2 km away) in every cardinal direction from the original point would be surveyed following the same six-minute protocol. Ideally, there would be at least two to three (maximum four) supplemental points for each original point. The distance assessment, compass bearing, and this cluster sampling assist in later mapping efforts to estimate the total number of EWPW within the area, and helps to approximate locations of each calling bird).

Volunteers collect these same data, and volunteer surveys are conducted following this same protocol with six-minute listening sessions at each point along the route. However, volunteers do not conduct cluster sampling, and survey only original route points.

Any EWPW detected are mapped as 1 km line segments from the listening point, drawn in the direction of the bearing given. EWPW are understood to exist at a point along this line, generally informed by the qualitative distance assessment.

*Ad-hoc Survey Locations*

Toward the end of each survey window, ad-hoc surveys were conducted in several areas away from established routes, at locations identified during daytime scouting as possessing suitable habitat. Significant numbers of ad-hoc locations were surveyed in the towns of Chester, Jamaica and South Newfane. These three towns each had incidental EWPW reports on eBird in the past three years. In addition to visiting ad-hoc points, supplemental points were surveyed on multiple occasions despite no detection of EWPW to warrant cluster sampling. Supplemental points are chosen due to their distance relative to the established survey route, while ad-hocs are independent of routes and chosen due to other criteria (e.g. past reports, visual assessment).

*Autonomous Recording Units and Audio Data Analysis*

The 2021 survey season expanded use of the VCE's SongMeter SM4 Autonomous Recording Units (ARUs) to collect additional data throughout the region of interest, Windham county.

Recorders were placed at locations identified during daytime scouting (Table 1), locked and secured to a tree or pillar as near as possible to the promising habitat. ARU locations were selected based on the presence of potential EWPW habitat, as identified during daytime scouting sessions. ARUs can also be valuably placed at locations that cannot be accessed during nighttime roadside surveys, such as private properties. With advanced coordination, outreach to property owners can be performed ahead of time to secure permission for ARU placement in EWPW habitat present on private lands.

For the 2021 survey season, ARU use was limited to public lands. ARUs were secured in each location using a double lock system. A cable lock was secured to each ARU, and affixed to a tree or permanent post in a position that is inconspicuous to car or foot traffic. The weather-proof casing of each ARU was similarly latched using a small lock. ARUs were placed for safe and convenient access, generally attached to medium sized trees one to two feet off the ground, to remain out of eye level and clear of precipitation that might accumulate or splash off of the ground.

In the first survey window (May 19 to June 2), a novel protocol for ARU use was developed which was then employed during the second window (June 17 to July 1): Beginning in the second survey window, ARUs were set to record continuously throughout the night, starting at 30 minutes after the official sunset, and ending 15 minutes before the official sunrise. These recordings are saved to removable SD cards in one-hour intervals, with date and time data incorporated into individual file names. The system of storage used by the device results in many individual audio files. Thousands of audio files were collected

throughout the 2021 survey season (primarily in the second survey window), and 464 individual audio files were ultimately analyzed.

ARUs were placed to record audio at each location for two nights (extended to three nights on occasions of excessive rain) before moving to new placement. Five of the total 10 ARUs were moved each day, and 50 locations were ultimately recorded across the two survey windows. Occasional gaps in transfers arose due to persistent inclement weather.

Audio data were analyzed using the open-source Audacity software in the days following the end of each survey window. Analysis was completed by visually scanning the spectrograms of the recorded audio, listening to particular areas of interest. Using spectrograms from the Macaulay Library of Natural Sounds at Cornell as reference, the default range for spectrogram view in Audacity was set from 1100 to 3300 Hz and the time frame was set to one second intervals. The window size was set to 1024 and the window type was set to Hanning. We listened to all areas displaying activity near the whip-poor-will frequency and interval.

Audio data were analyzed for at least three separate hours each night: one hour beginning 30 minutes after official sunset, one hour after midnight when the moon was visible, one hour ending 15 minutes before official sunrise.

*Volunteer Points*

In addition to the Windham surveys conducted by VCE, volunteers completed similar 10-point surveys at 14 routes throughout the state: Berkshire, Brandon, Concord, Coventry, Fair Haven, Georgia, Hartland, Highgate, Panton, Rutland, Salisbury, Snake Mountain, South Tunbridge, West Haven. These routes were established following the same criteria as VCE survey routes, and are surveyed once each year by volunteers. Volunteers follow the same six-minute survey protocols for data collection as described above for VCE surveys, with the exception that volunteers do not perform cluster sampling at supplemental points upon detection of EWPW.


An automated recording device attached and locked to a tree, ready to begin recording in the last light following sunset. © Ben Fletcher

## Results / Discussion

In the 2021 Eastern Whip-poor-will survey conducted throughout Windham county, zero whip-poor-wills were found in total throughout all official route surveys, ad-hoc surveys, and audio data recorded by ARUs. Volunteers monitoring 14 routes throughout the state together detected 35 EWPW.

### *VCE Survey Results in Windham County*

Throughout the 2021 survey season, VCE surveyors conducted 368 individual six-minute point counts at 184 points located throughout Windham county (this number includes replicate surveys conducted at repeated points). Sixty of these counts were original points contained within the 10-point survey routes that were each visited twice (120 of 184 total points surveyed were original points). Seven of the points surveyed were supplemental points existing in or near established survey routes (7 of 184 total points). Forty points consisted of ad-hoc surveys, conducted at locations selected due to nearby potential EWPW habitat (40 of 184 total points). Remaining points (17 of 184 total points) were original route points visited for ad-hoc surveys independent of full-length surveys.

Surveyors navigated moonlit roads for three hours on average during each night (weather permitting) within the two survey windows (May 19 to June 2, and June 17 to July 1). VCE surveyors listened at different roadside points in Windham county for 2208 minutes (36.8 hours) in total, across all of the 368 point counts conducted.

### *Automated Recording Device (ARU) Results*

SongMeter SM4 Automated Recording Units were located on an ad-hoc basis in regions surrounding the established Windham survey routes, at a total of 50 locations (Table 1) across the two survey windows. Placement was selected by way of visual assessment during vehicle-based scouting sessions. ARUs recorded in each location for an average of two consecutive nights, programmed to record continuously starting 30 minutes after the official sunset, and ending 15 minutes before the official sunrise.

In total, 464 resulting audio files were ultimately scanned - 4 audio files on average combine to compose the 3 different hours that were analyzed from each night. In total, this represents roughly 116 individual nights of recording in total across the 10 ARUs. As three hours from each night were analyzed (one hour beginning 30 minutes after sunset, one hour after midnight with moonlight, one hour ending fifteen minutes before sunrise), the total duration of audio recording that was collected and scanned throughout the 2021 survey season approached 348 hours across the 50 locations, or nearly seven hours on average of analyzed recording per location.

### *Volunteers Evidence Statewide EWPW Populations at Historic Hot-spots*

In the 2021 survey year, a team of 19 dedicated volunteers completed 21 surveys at 14 pre-established routes throughout Vermont. Thirty-five individual EWPW (Table 2) were documented along these 14 routes.

Volunteers are encouraged to conduct surveys with a companion, with each surveyor collecting data independently (helping to explain the difference between number of volunteers and number of routes surveyed). Eighteen of 19 volunteers conducted a single survey in the 2021 season, with the final volunteer conducting three surveys independently. New volunteers are traditionally asked to complete only a single survey per annum.

Volunteer involvement displayed a slight rebound this season from the decline caused by the Covid-19 pandemic. In total through the 2021 season, volunteers spent 1266 minutes (21 hours) listening for EWPW at 141 unique points, to ultimately conduct 211 six-minute point counts. Including transit, surveys and data processing, volunteers each contributed from between 3 and 9.5 hours to the 2021 survey effort.

Sunrise near the end of the first window of the 2021 Eastern Whip-poor-will Survey. Moon seen over a powerline right-of-way. © Ben Fletcher

## Conclusion

*Windham EWPW Count Met Expectations Despite Availability of Viable Habitat*

Despite the introduction of Automated Recording Units to significantly expand survey effort, zero EWPW were detected in Windham county during the 2021 survey season. With the exception of these ARUs, survey protocols were consistent with years past.

While four routes lack past data for comparison, the deficit of EWPW in both the Brattleboro and Vernon routes is consistent with data collected in past volunteer surveys. Notably, in a 2016 survey of the Vernon route completed by VCE staff, two EWPW were detected - the first EWPW detections in the life of this route. VCE surveyors attempted to locate these birds at the reported location but were unable to do so on multiple occasions. These 2016 detections also appear to be an exception to a decade of volunteer surveys through which no EWPW were observed in the Vernon area.

Incidental reports of EWPW do occur most years in Windham county, prior to the EWPW breeding season. These individuals are often still in transit to their ultimate breeding grounds, and so do not remain in their area of detection. Such early season detections are valuable for identifying valuable EWPW habitat, but may ultimately misinform prospects for detections within the survey period. In this 2021 survey, Windham locations with incidental reports of EWPW from recent years were surveyed when possible as ad-hoc locations.

Despite this inability to detect EWPW throughout the Windham surveys, the current EWPW survey protocol is strong, and should be further applied throughout the state of Vermont, particularly in areas lacking in historical data and established routes.

## Future Considerations

*The Volunteer Team is Invaluable and Novel Volunteer Recruitment Recommended*

Volunteer surveying rebounded slightly from 20 routes surveyed in 2020 to 21 routes in 2021. Investment in renewed and expanded volunteer outreach efforts is warranted to expand survey reach, as well as to compensate for any decreases in participation.

Current volunteers have been conducting Eastern Whip-poor-will surveys for more than five years on average, and their observations and familiarity with local EWPW populations are invaluable. Volunteers account for more than half of the annual points surveyed, and are critical to the survey's ability to collect data from across the state in such a short window of time.

Volunteer recruitment efforts in recent years have been sparse, and could be expanded with a low-cost strategy including postings to free online forums such as FrontPorchForum and community listservs.

Community science portals such as eBird and iNaturalist also possess valuable forums - occasional postings are recommended to expand project awareness and facilitate incidental EWPW reports throughout the state.

*Expansion of ARU use as key strategy to increase data collection*

The brevity of the EWPW survey season increases the value of the VCE's 10 Automated Recording Units. These ARUs effectively expand the number of point-counts that surveyors are able to perform on each available night, and devices are able to record for periods of time that far exceed the duration of observations in the Northeast Nightjar Protocol (ARUs can record entire nights, versus the 6 minute observations performed by surveyors). EWPWs have been detected by ARUs even on nights outside of the Northeast Nightjar Protocol, when moon illumination fails to exceed 50% (Clark and Fristrup 2009). Data sets could be expanded in future survey years by the continued use of the ARU methodology implemented this year.

Although ARUs are convenient and effective in the collection of audio data from valuable locations (including those inaccessible at night during survey protocol), they do consume considerable staff and volunteer time: for identifying locations, for placing/retrieving the devices, and for subsequently processing and analyzing audio data. Future use of ARUs can be expanded to individuals other than VCE staff in order to expand volunteer participation and potential EWPW habitat surveyed. Ideal ARU locations often occur in private lands, and so outreach to landowners is a necessary consideration in remotely mapping potential points. Access to software that reduces audio file analysis will be needed in order to limit the amount of person hours spent analyzing data if ARU use increases in the future.

*Expanded Habitat Analysis Recommended*

In addition to the expansion of current survey routes to new Vermont locations following the protocol implemented in 2015, we recommend pursuing an expanded analysis of potential habitat. An analysis of potential habitat that is not limited to the habitats surrounding existing routes, and includes other suitable areas that are currently not addressed in roadside surveys. For example, inclusion of notable powerline right-of-ways, quarries, and zones of logging would facilitate evaluation of how EWPW use these disturbed areas. This could help to further assess the role that disturbed habitat might play in recovery planning.

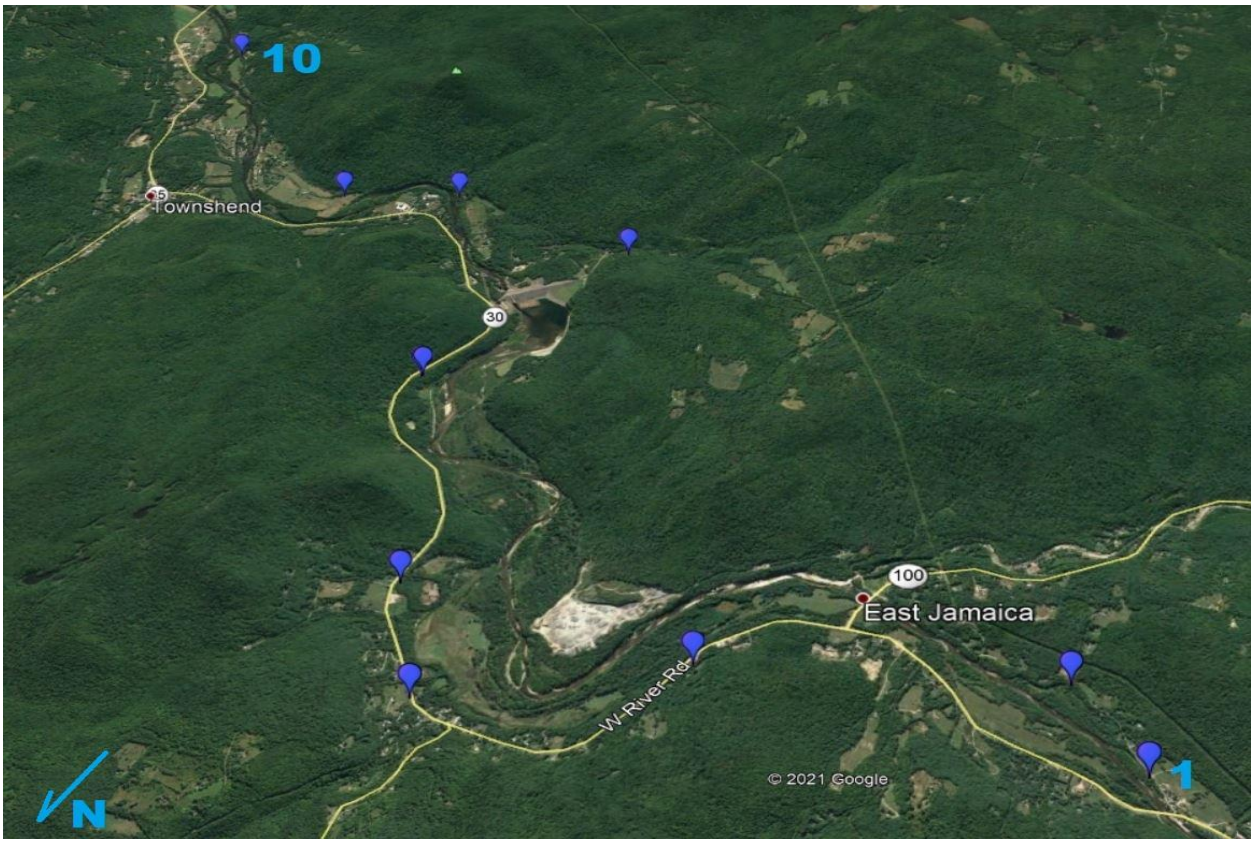
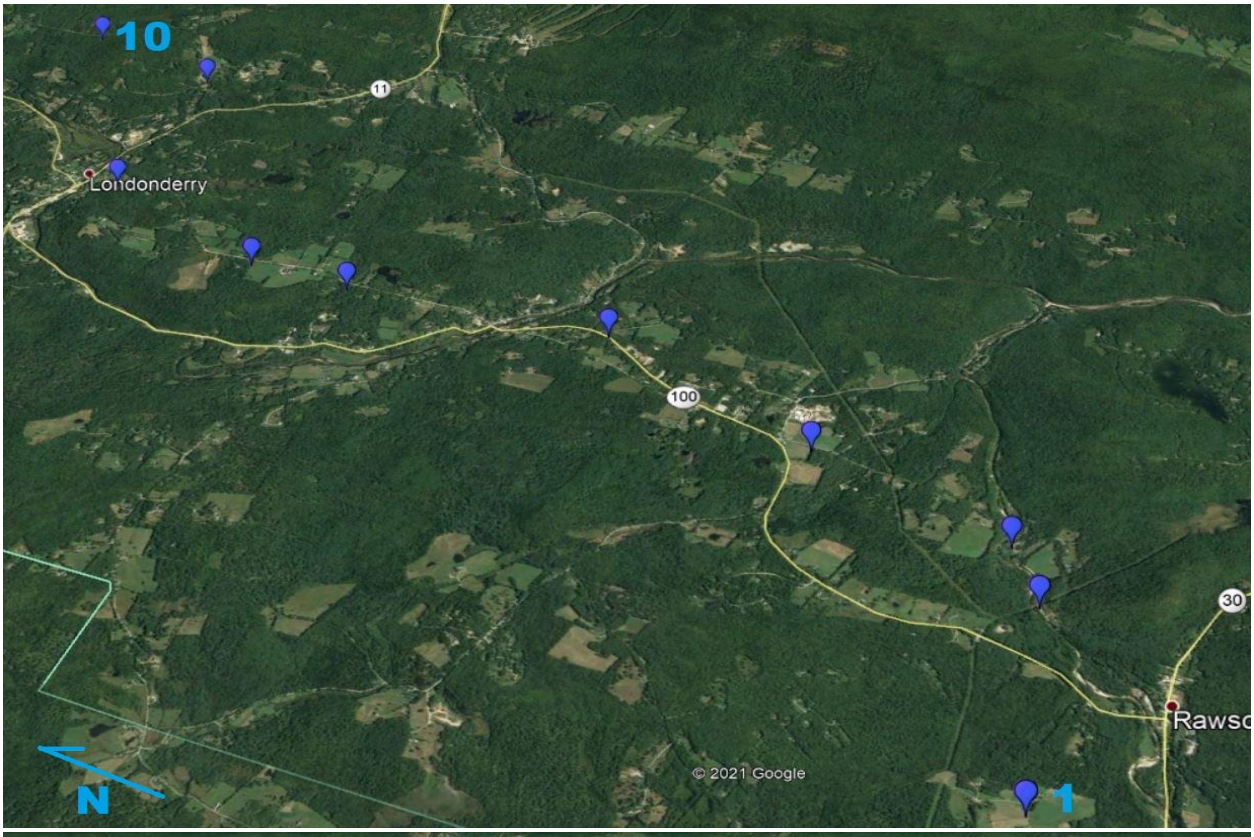



**Figure 1: Townshend (Above) and Figure 2: Londonderry (Below) Survey Routes**



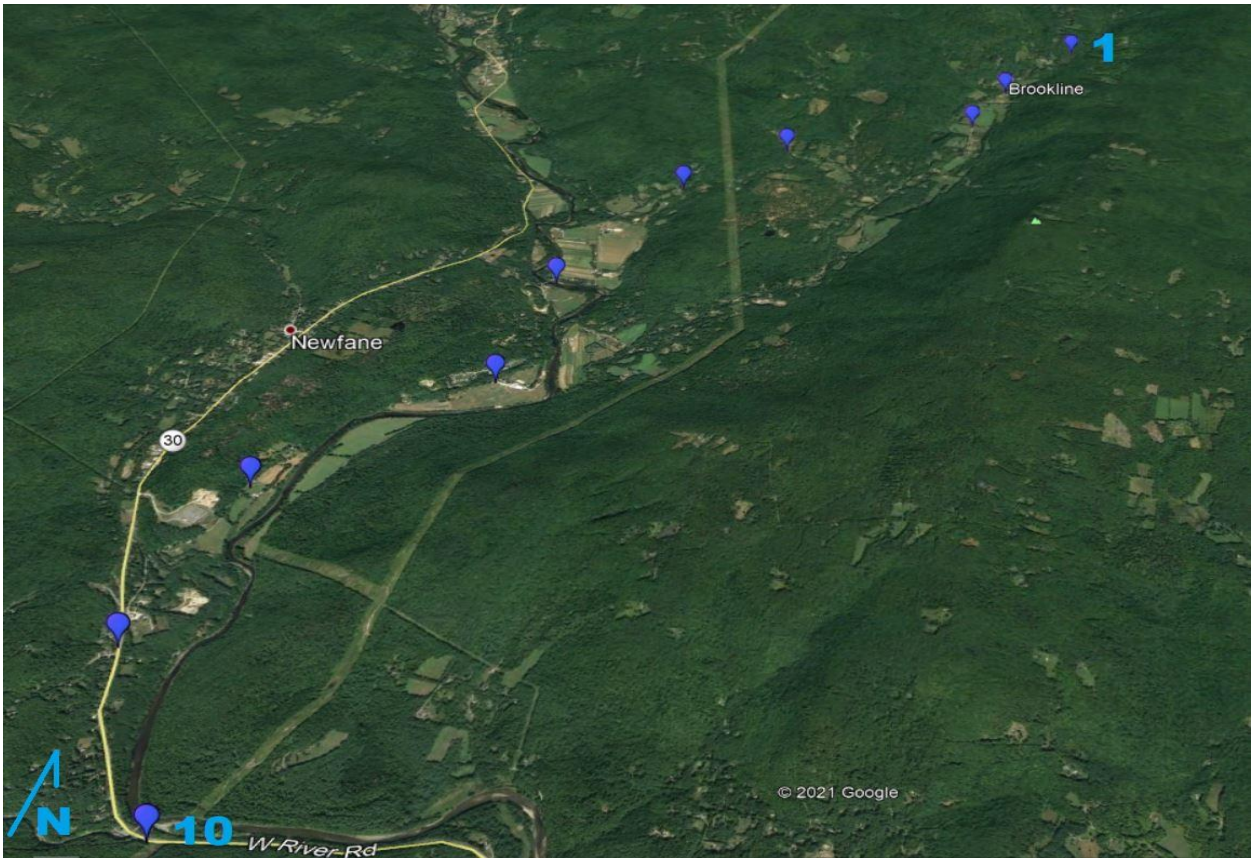
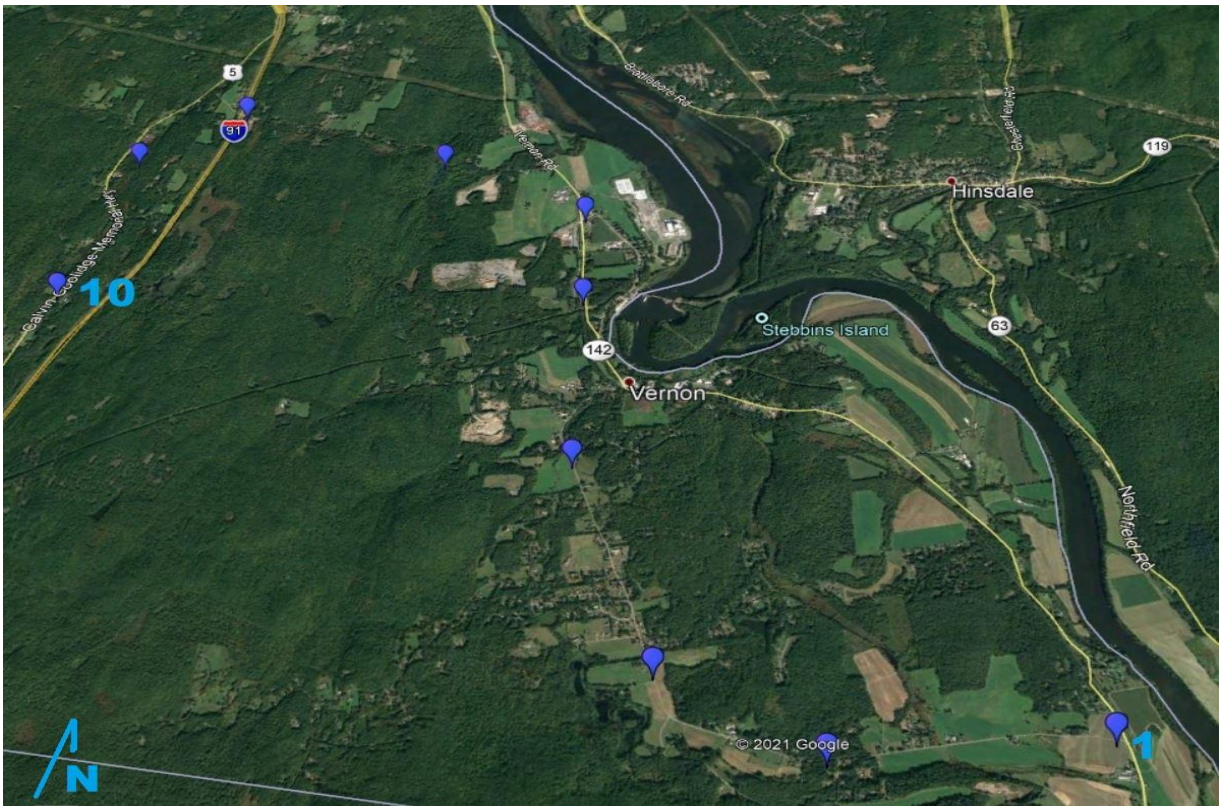




**Figure 3: Brookline (Above) and Figure 4: Vernon (Below) Survey Routes**


5
91
119
Hinsdale
10
Stebbins Island
63
142
Vernon
Northfield Rd
© 2021 Google
1
N

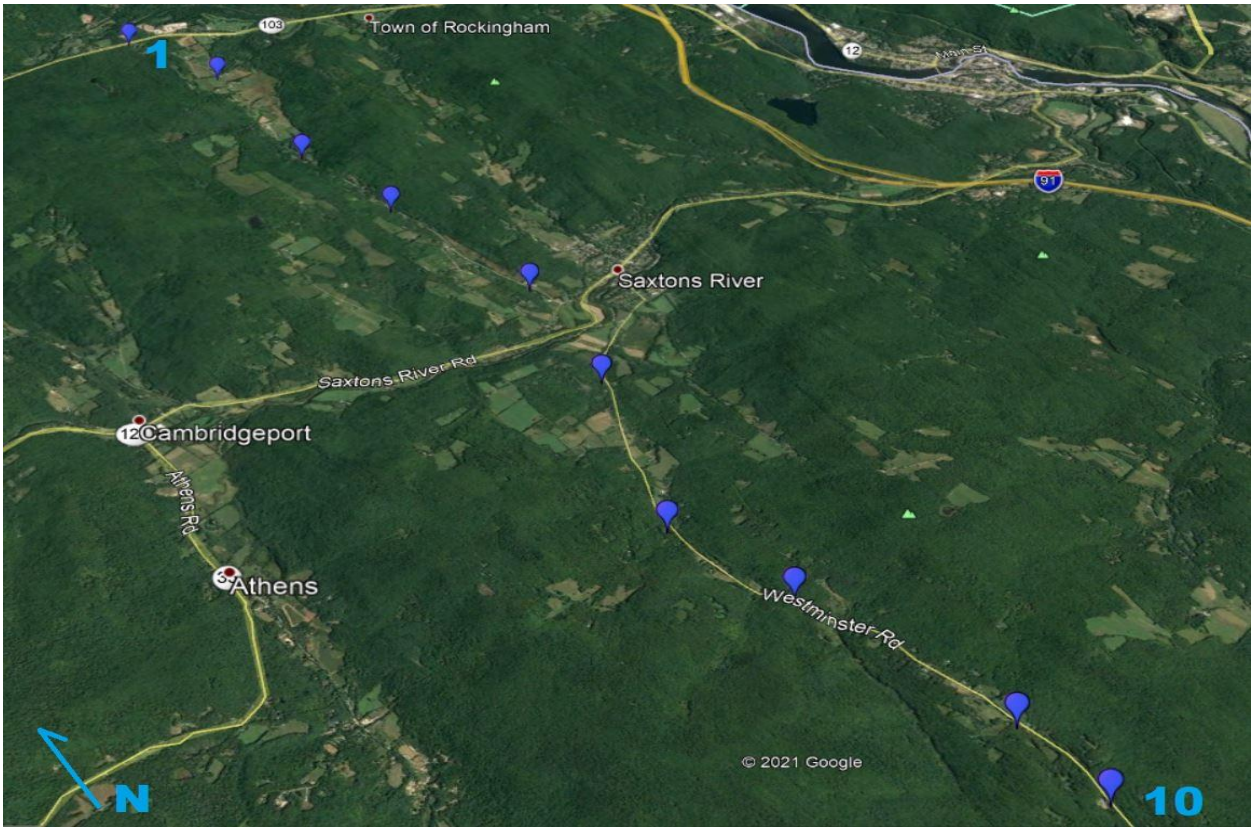

1
103
Town of Rockingham
12
91
Saxtons River
Saxtons River Rd
12
Cambridgeport
Athens Rd
5
Athens
Westminster Rd
© 2021 Google
N
10

**Figure 5: Saxtons River (Above) and Figure 6: Brattleboro (Below) Survey Routes**

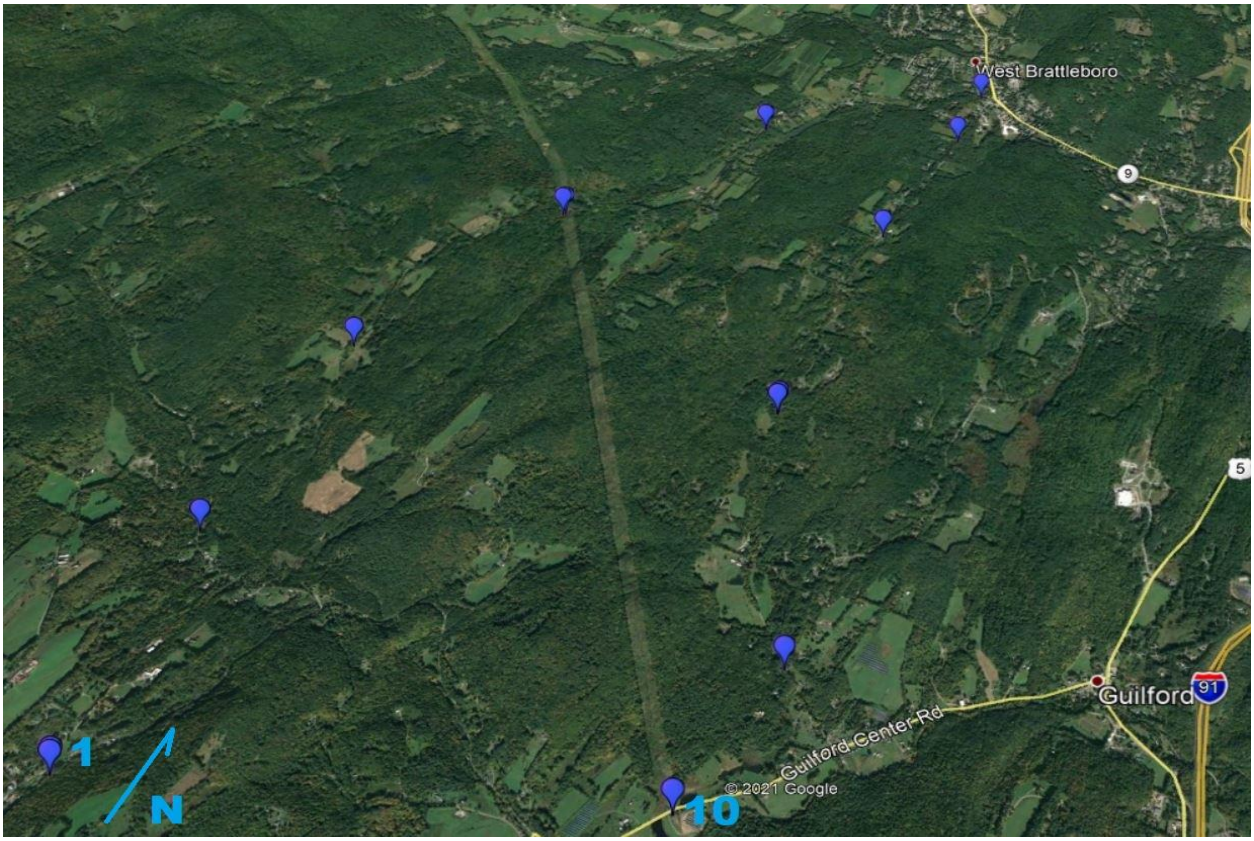


**Table 1: GPS Locations of Automated Recording Unit Placements**

| **ARU #** | Latitude | Longitude | | **ARU #** | Latitude | Longitude |
|---|---|---|---|---|---|---|
| **1** | 42.833227 | -72.622589 | | **26** | 43.18105 | -72.58701 |
| **2** | 42.79713 | -72.63529 | | **27** | 43.18472 | -72.58387 |
| **3** | 42.84488 | -72.61441 | | **28** | 43.18688 | -72.5797 |
| **4** | 42.96905 | -72.65062 | | **29** | 43.19657 | -72.5797 |
| **5** | 42.995166 | -72.619001 | | **30** | 43.19491 | -72.5569 |
| **6** | 42.97044 | -72.65993 | | **31** | 43.14464 | -72.84937 |
| **7** | 43.04332 | -72.67071 | | **32** | 43.15204 | -72.86444 |
| **8** | 43.07901 | -72.75157 | | **33** | 43.15784 | -72.86444 |
| **9** | 43.07221 | -72.74973 | | **34** | 43.16766 | -72.8643 |
| **10** | 43.06063 | -72.69843 | | **35** | 43.17329 | -72.84926 |
| **11** | 43.08161 | -72.63545 | | **36** | 43.2123 | -72.77722 |
| **12** | 43.0895 | -72.64375 | | **37** | 43.20502 | -72.77377 |
| **13** | 43.10595 | -72.62334 | | **38** | 43.20478 | -72.76696 |
| **14** | 43.1015 | -72.62734 | | **39** | 43.19716 | -72.78184 |
| **15** | 43.07505 | -72.64934 | | **40** | 43.20596 | -72.78007 |
| **16** | 43.11007 | -72.61802 | | **41** | 43.17678 | -72.84486 |
| **17** | 43.12174 | -72.6005 | | **42** | 43.17865 | -72.84312 |
| **18** | 43.1443 | -72.56068 | | **43** | 43.18499 | -72.85354 |
| **19** | 43.13929 | -72.56578 | | **44** | 43.18723 | -72.85435 |
| **20** | 43.11916 | -72.56578 | | **45** | 43.19242 | -72.85028 |
| **21** | 43.15571 | -72.57244 | | **46** | 43.23511 | -72.82321 |
| **22** | 43.15109 | -72.57528 | | **47** | 43.24953 | -72.84071 |
| **23** | 43.15701 | -72.57439 | | **48** | 43.24782 | -72.84001 |
| **24** | 43.16145 | -72.57772 | | **49** | 43.24279 | -72.84018 |
| **25** | 43.17162 | -72.57905 | | **50** | 43.23587 | -72.8378 |

**Table 2: GPS Locations of Eastern Whip-poor-will Detected by Volunteers in 2021**

| WPW # | Date | Route | Point ID | Latitude | Longitude |
|---|---|---|---|---|---|
| 1 | 5-19-21 | Brandon | Bran_3 | 43.788407° | -73.126115° |
| 2 | 5-24-21 | Concord | Conc_7 | 44.419114° | -71.827334° |
| 3 | 5-24-21 | Concord | Conc_7 | 44.429186° | -71.814201° |
| 4 | 5-24-21 | Concord | Conc_8 | 44.423122° | -71.807035° |
| 5 | 5-24-21 | Concord | Conc_8 | 44.430689° | -71.803493° |
| 6 | 5-24-21 | Concord | Conc_8 | 44.430867° | -71.786404° |
| 7 | 5-24-21 | Concord | Conc_9 | 44.425824° | -71.789867° |
| 8 | 5-24-21 | Concord | Conc_9 | 44.416823° | -71.777356° |
| 9 | 6-2-21 | West Haven | WeHa_3 | 43.581031° | -73.385659° |
| 10 | 6-2-21 | West Haven | WeHa_4 | 43.575209° | -73.394573° |
| 11 | 6-2-21 | West Haven | WeHa_4 | 43.575209° | -73.394573° |
| 12 | 6-2-21 | West Haven | WeHa_5 | 43.591194° | -73.394308° |
| 13 | 6-2-21 | West Haven | WeHa_5 | 43.600326° | -73.388016° |
| 14 | 6-2-21 | West Haven | WeHa_6 | 43.610802° | -73.375104° |
| 15 | 6-2-21 | West Haven | WeHa_6 | 43.606515° | -73.379461° |
| 16 | 6-2-21 | West Haven | WeHa_6 | 43.606745° | -73.377182° |
| 17 | 6-2-21 | West Haven | WeHa_6 | 43.605949° | -73.372607° |
| 18 | 6-2-21 | West Haven | WeHa_7 | 43.612153° | -73.387364° |
| 19 | 6-2-21 | West Haven | WeHa_7 | 43.620910° | -73.382780° |
| 20 | 6-19-21 | Highgate | High_1 | 44.943018° | -73.093082° |
| 21 | 6-19-21 | Highgate | High_1 | 44.936871° | -73.106347° |
| 22 | 6-19-21 | Highgate | High_1 | 44.939243° | -73.104659° |
| 23 | 6-19-21 | Highgate | High_4 | 44.936844° | -73.104986° |
| 24 | 6-20-21 | Highgate | High_6 | 44.951487° | -73.104607° |
| 25 | 6-20-21 | Highgate | High_7 | 44.950739° | -73.091029° |
| 26 | 6-20-21 | Highgate | High_7 | 44.946782° | -73.091299° |
| 27 | 6-20-21 | South Tunbridge | STun_10 | 43.901455° | -72.526209° |
| 28 | 6-20-21 | South Tunbridge | STun_10 | 43.892267° | -72.513978° |
| 29 | 6-20-21 | Snake Mountain | SnMt_4 | 44.024167° | -73.255462° |
| 30 | 6-20-21 | Snake Mountain | SnMt_4 | 44.043762° | -73.255663° |
| 31 | 6-20-21 | Snake Mountain | SnMt_6 | 44.052745° | -73.259012° |
| 32 | 6-26-21 | Fair Haven | FaHa_2 | 43.581090° | -73.232838° |
| 33 | 6-26-21 | Fair Haven | FaHa_2 | 43.580426° | -73.231933° |
| 34 | 6-26-21 | Fair Haven | FaHa_2 | 43.567557° | -73.233353° |
| 35 | 6-26-21 | Fair Haven | FaHa_3 | 43.563390° | -73.229714° |

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