Eastern Whip-poor-will Survey

Annual Report to Vermont Fish and Wildlife

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Introduction

The Eastern Whip-poor-will (*Antrostomus vociferus*) is a nocturnal aerial insectivore found in edge habitats across eastern North America. Seldom seen yet well known for its distinctive call, the male Eastern Whip-poor-will (WPW) will call continuously throughout clear, moonlit nights during breeding season (usually late May through early July) (Cink 2002). Habitat requirements for this species are complex and necessitate a mix of open-understory forest, for breeding and rearing young, and large tracts of open land, in order to forage successfully (Hunt 2006). Examples of breeding habitat include forests with dry, nutrient poor soils such as Pine Barrens and Pine-oak Woodlands. Suitable foraging habitats include fields, power-line rights-of-way, agricultural settings, and recently logged or burned areas (Hunt 2013).

Due in part to loss of this composite habitat, the geographic range of WPW has contracted and populations have declined (Sauer et al. 2011). Forest maturation, urbanization, and industrialization have been cited as causal factors in WPW decline (Environment Canada 2015). As agriculture declines and parts of Vermont revert back to their initial, more forested state, early successional habitat necessary to host a robust WPW population is lost. In addition to habitat loss, WPW declines have also been attributed to population declines in large-bodied moths (possibly due to pesticide use), and collisions with cars (COSEWIC 2009).

WPW numbers declined 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 associated data may fail to accurately represent nocturnal bird populations. This lack of standardized and consistent nocturnal bird surveys prompted Pam Hunt of New Hampshire Audubon to commence the Northeast Nightjar Survey in 2007. Now coordinated by the Vermont Center for Ecostudies (VCE), this statewide,

annual survey is carried out by volunteers who survey 17 routes within regions exhibiting habitat characteristics considered potentially suitable for WPWs (low elevation, matrix of field and forest). These surveys suggest changes in the Vermont WPW population and contribute to broader efforts to detect regional changes in the northeastern population. In particular, data from these surveys suggests steep declines in Vermont WPW populations. In 2011, in response to data collected from bird surveys, the Northeast Nightjar Survey, and years of anecdotal accounts of population decline in Vermont, the WPW was listed as Threatened in the state.

In order to better understand habitat requirements of this species and obtain more precise counts, VCE has conducted WPW surveys for the past two summers in different regions of Vermont. These surveys are a first step toward determining where additional survey effort may be focused and providing more thorough population estimates.

Methods

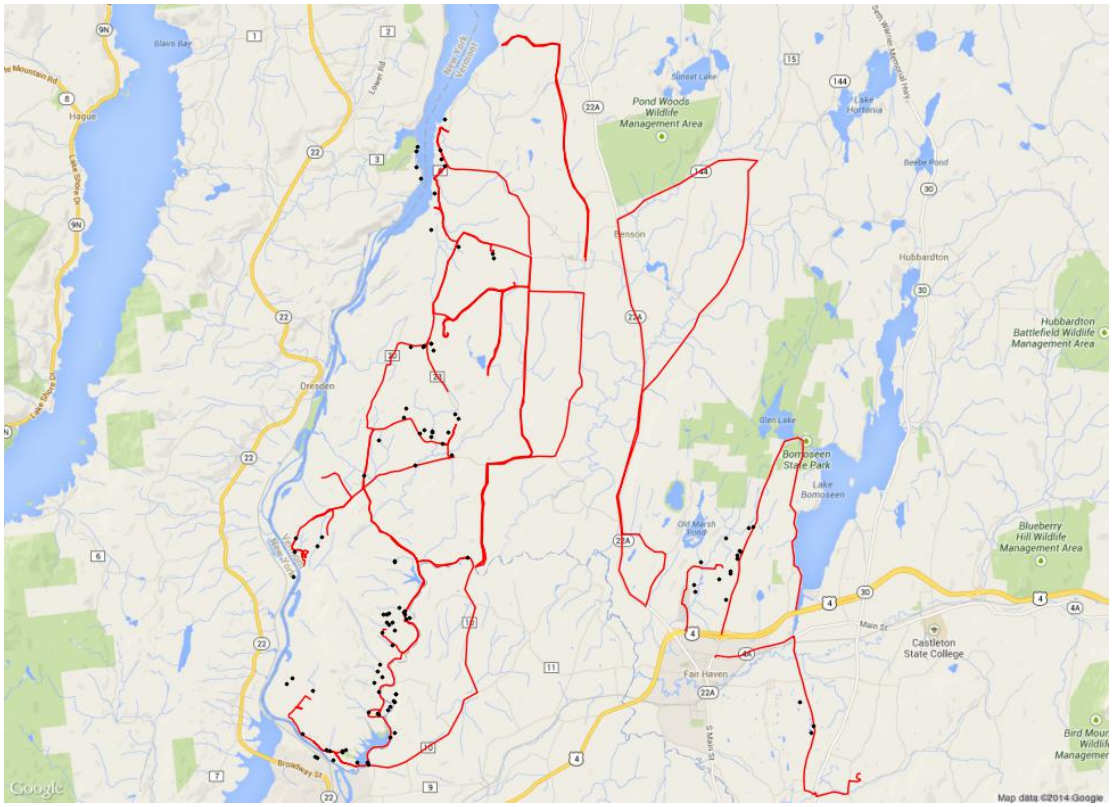
Our objective was to obtain an estimate of the number of WPWs in Vermont by surveying areas where the species is known to be relatively abundant, areas with suitable habitat but from which we have few records, and areas in which we think WPWs may have been more abundant in the past.

2014 Methods

During the 2014 breeding season (11 May to 18 June), we intensively surveyed West Haven, Fair Haven, and surrounding areas. These are areas thought to support healthy WPW populations and are considered “hotspots” in Vermont. Survey areas were not randomly selected and the time spent on any one survey was not constrained. We scouted potential habitat during the day, then surveyed selected areas at night. Potential habitat consisted of any area with relatively open-understory forest adjacent to an open expanse suitable for foraging. Our

focal area was in and around West Haven, beginning with the West Haven annual WPW route (flooded dirt roads surrounding Bald Mountain) and continuing as far north (along the Poultney River to Benson Landing) and east (Fair Haven Airport) as time allowed (Figure 1). Because our objective was to detect as many WPWs as possible, the geographic and temporal span of a survey was dynamic and depended on variables such as weather, detection of WPWs, and calling time. For example, the detection of a calling WPW significantly lengthened time spent surveying in one limited geographic area, as WPWs tend to cluster, but as a result our ability to broaden the geographic span would be constrained for that night. We conducted surveys starting approximately 20 minutes after sunset until approximately 15 minutes before sunrise.

Figure 1. Points surveyed during 2014 Whip-poor-will survey. Red lines represent routes traveled. Black dots represent WPW detections. Neither NY birds nor multiple detections of the same bird have been excluded from this map.



2015 Methods

Starting in the summer of 2015, in an effort to produce standardized, replicable surveys, we implemented a set of point-count protocols on routes that had been predetermined by Pamela Hunt during the 2007 Northeast Nightjar Survey. In addition to the new point-count protocols, we employed cluster sampling when a WPW was heard at one of the original points. Since implementation in 2007, volunteers have routinely surveyed most routes for WPWs and other nightjars.

Our surveys were conducted from 25 May through 09 July, on nights with at least 50% moon illumination, during the full moon or waxing and waning gibbous moons, when WPWs are known to call more frequently. We arrived at a predetermined site approximately 30 minutes prior to beginning the survey, to organize ourselves and allow birds to settle. In the evening, surveys started 15 – 20 minutes after sunset and continued through the specified end point, as long as the moon was visible and the weather was suitable. During the waning moon, surveys began after sunset, continued until it was dark, then were delayed varying amounts of time until the moon rose above the horizon. Early morning surveys ended 15 minutes before sunrise and were often used to complete roadside surveys from the previous night or used for ad hoc surveys. We did not conduct surveys if conditions were windy (wind speed > 8 mph), cloudy (> 50% cloud cover), or rainy.

Each survey consisted of point counts at 10 locations along 7 pre-established routes in Hartland, Corinth, Peacham, Concord, Brandon, Salisbury, and Wells. The final route, West Haven, was not surveyed due to rain and flooded roads. Survey locations were each spaced one-mile apart. For all surveys, routes were followed in order, from point 1 to point 10. If there was no safe or quiet parking at a point, the point was moved as far up the road as needed to be safe, but no further than 0.15 mi.

Each point on a given route included a six-minute count, during which time observers listened silently and recorded birds independently. Latitude, longitude,

wind speed, cloud cover, and noise were noted at each point along the route prior to the start of the count. Passing cars were noted during the course of the survey. Individual WPWs were counted in one-minute intervals for six minutes, with a compass bearing and qualitative proximity assessment (‘close’ or ‘distant’) for each WPW. A single bird that was heard singing from two different locations during the same survey was only counted once. If a WPW was heard at one of the 10 original points, a supplemental point survey was completed at least 0.8 km, and no more than 1.2 km away, using the same point-count protocol. Ideally, there would have been 2 - 3 supplemental points available for each original point. However, road conditions and the lack of roads often constrained supplemental counts. For most of the original points at which we heard a WPW, we were only able to access 1 - 2 supplemental points.

When a WPW was documented at a particular point, each observer took bearings to better determine (and potentially triangulate) the location of the individual bird. Supplemental points were often close enough to original points to allow for implementation of triangulation techniques in order to determine if the same WPW was heard in both locations. Because there was no way to gauge exact distance from observer to individual birds, WPWs in close proximity to the observer were mapped at 200 meters, otherwise they were typically mapped out to 800 meters, but no further than 1 km.

We surveyed each route twice, except for the Wells route, which was surveyed once. Repeat surveys were conducted within the same lunar cycle so as to reduce variability in counts that might arise due to immigration or emigration into the survey area. This was true for all surveys except Concord, where the replicate surveys were done during sequential lunar cycles due to excessive cloud cover and lack of moon illumination during the first cycle.

In addition to the surveys conducted by VCE, volunteers completed the following roadside surveys, using the same standard protocols, once during the 2015

breeding season and under suitable weather and lunar conditions (as detailed above): Hartland, Corinth, Brandon, Concord, Underhill, Hinesburg, Fair Haven, Monkton, Salisbury, Peacham, Rutland, Bennington, and Brattleboro.

When time allowed, ad hoc surveys were completed to find WPWs in locations outside the survey routes. Similar to our 2014 methods, we scouted habitat during the day in order to pinpoint suitable locations for ad hoc surveys. These surveys consisted of walking or driving in potential habitat and listening for singing birds. At each site we listened for WPWs for 10 minutes, then proceeded to the next location, which was often determined by detection of a different WPW. If we did not hear a WPW, we proceeded in 0.40 km increments and listened until the survey window closed or unsuitable weather forced us to end the ad hoc survey.

Results and Discussion

2014 Results Summary

During the 2014 breeding season, we conducted 24 surveys and detected 74 individuals (Table 1). Any calling WPWs that may have been physically located in New York State were not counted. In addition, birds that were detected in the same area on different nights or birds that were heard singing from two different locations during the same survey were only counted once. The reported data therefore represent a conservative count.

WPWs were listed as state Threatened based on a primary criterion that the breeding population in the state was less than 300 reproducing females, and a secondary criterion that populations had been consistently declining in the Northeast. Documentation for that listing cited only 3 - 6 breeding pairs in the West Haven area, based on the survey route which was surveyed only 4 times since the launch of the Northeast Nightjar Survey in 2007. Based on conservative extrapolation of data available at that time, the state population was estimated to be approximately 170 -180 females. All population estimates assume one female for every singing male detected, which may be an overestimate.

The 2014 survey yielded notable findings in that we detected more WPWs than previously expected. We assumed that we would have fewer WPW detections in populated farm areas due to an apparent lack of suitable habitat; however, we recorded numerous detections in these areas. The largest number of WPWs found in a single survey (14) was in a rural area east of the original West Haven route that was dominated by dairy farms with relatively low forest cover. Additionally, we were surprised with the frequency with which WPWs were found in clusters. Extensive areas of apparently suitable habitat would sometimes yield no detections but, where birds were detected, we often found several calling males in close proximity to one another.

The populated areas in and around Fair Haven had higher detections than we expected, yet when we surveyed areas considered more suitable for WPWs (Rattlesnake Ridge and surrounding rural farmland), we found none. Because Fair Haven was a secondary focus for this survey effort, more surveys in this area may yield additional WPW detections.

Table 1. Locations of singing WPWs in Fair Haven and West Haven VT in 2014

Date	Time	XCOORD	YCOORD	Date	Time	XCOORD	YCOORD
11-May-14	2042	-73.382851	43.608604	7-Jun-14	2146	-73.388408	43.595251
11-May-14	2042	-73.384956	43.608483	7-Jun-14	2146	-73.387282	43.597235
11-May-14	2042	-73.382702	43.602314	8-Jun-14	350	-73.37782	43.609531
11-May-14	2051	-73.386449	43.605891	8-Jun-14	400	-73.376506	43.609843
11-May-14	2128	-73.37858	43.611357	8-Jun-14	407	-73.377841	43.610644
11-May-14	2138	-73.385952	43.610872	8-Jun-14	415	-73.380042	43.6126
11-May-14	2221	-73.38207	43.625319	10-Jun-14	410	-73.344872	43.706834
12-May-14	346	-73.404776	43.571478	10-Jun-14	412	-73.345268	43.708015
12-May-14	432	-73.407275	43.574159	10-Jun-14	2211	-73.226189	43.578679
12-May-14	449	-73.401201	43.573733	10-Jun-14	2213	-73.225638	43.58069
12-May-14	2119	-73.396	43.570708	10-Jun-14	2220	-73.230683	43.586928
18-May-14	424	-73.410674	43.629272	14-Jun-14	2102	-73.368181	43.714519
19-May-14	156	-73.367795	43.660205	14-Jun-14	2111	-73.367121	43.724424
19-May-14	202	-73.361997	43.659839	15-Jun-14	400	-73.364398	43.733623
19-May-14	214	-73.364106	43.65698	15-Jun-14	400	-73.363158	43.73188
19-May-14	219	-73.36823	43.658625	15-Jun-14	407	-73.365017	43.735988
19-May-14	245	-73.358098	43.663656	15-Jun-14	420	-73.363114	43.744263
19-May-14	305	-73.359284	43.664709	15-Jun-14	436	-73.357884	43.709878
19-May-14	315	-73.370893	43.660525	15-Jun-14	2108	-73.383731	43.58568
19-May-14	316	-73.372726	43.659703	15-Jun-14	2123	-73.38783	43.583792
19-May-14	322	-73.378441	43.663793	15-Jun-14	2131	-73.391472	43.584215
19-May-14	324	-73.377673	43.666406	16-Jun-14	259	-73.39201	43.570783
19-May-14	336	-73.387738	43.657715	16-Jun-14	311	-73.383761	43.577535
19-May-14	348	-73.3933	43.6482	16-Jun-14	2103	-73.256674	43.621824
19-May-14	404	-73.374377	43.651021	16-Jun-14	2122	-73.267601	43.624963
19-May-14	415	-73.360673	43.653711	16-Jun-14	2129	-73.260994	43.620197
6-Jun-14	420	-73.41861	43.63133	16-Jun-14	2139	-73.269955	43.618657
6-Jun-14	441	-73.419348	43.627785	16-Jun-14	2140	-73.269561	43.616844
6-Jun-14	2100	-73.422154	43.591906	17-Jun-14	250	-73.258411	43.614723
6-Jun-14	2111	-73.412505	43.590267	17-Jun-14	304	-73.253841	43.625891
6-Jun-14	2200	-73.416333	43.578389	17-Jun-14	304	-73.254007	43.626872
7-Jun-14	331	-73.3545	43.626167	17-Jun-14	311	-73.25255	43.627653
7-Jun-14	422	-73.375828	43.683051	17-Jun-14	311	-73.253214	43.628014
7-Jun-14	428	-73.371256	43.683048	17-Jun-14	320	-73.258086	43.63147
7-Jun-14	438	-73.368445	43.683928	17-Jun-14	320	-73.249765	43.634021
7-Jun-14	2105	-73.387611	43.589694	17-Jun-14	325	-73.248052	43.634423
7-Jun-14	2114	-73.389553	43.59227				
7-Jun-14	2122	-73.386634	43.59373				

2015 Results and Discussion

The 2015 WPW breeding season was completed using an improved and more systematic protocol. In order to produce standardized, replicable surveys with more reliable results, we conducted surveys on pre-established Northeast Nightjar Survey routes using point counts, which were augmented with cluster sampling using point counts at supplemental points. In addition, we focused our survey efforts over a much larger portion of the state.

Hartland:

The Hartland route was surveyed a total of three times during the 2015 breeding season: once by a volunteer and twice by VCE. For each survey, all 10 points were completed in the span of one night. No WPWs were detected during the volunteer survey (3 June) or the VCE surveys (25 May and 3 June) (Table 2).

From 2006 through 2012, WPWs were detected annually at several points along this route. Many of these points (especially the Hartland Dam (point 1) and a small gravel pit (point 6)) have apparently suitable habitat for breeding WPWs. In the intervening years, however, detections have declined. The 2012 volunteer survey was the last documented WPW detection on the Hartland route.

In addition to the pre-established points, we surveyed five ad hoc points, two on the morning of 26 May, and three on the morning of 4 June. WPWs were detected from all three points during the 4 June survey; however, these points were along the Vermont side of the Connecticut River, with directional and distance estimates almost certainly placing the birds in New Hampshire.

Corinth:

The Corinth route was surveyed a total of three times during the 2015 breeding season: once by a volunteer and twice by VCE. For each survey, all points were completed in the span of one night. VCE's first survey (25 May) yielded no detections (Table 2). However, WPWs were heard during the volunteer survey (3 June), and from point 5 during VCE's second survey (4 June) (Figure 2, Table 2).

Because of the initial detection, we implemented cluster sampling and a second individual was heard at a supplemental point shortly after the first detection. Our one ad hoc area was based on eBird data suggesting WPW presence southwest of our route, but our survey of that area yielded no detections. WPWs were heard at different points along this route during volunteer surveys in 2007, 2008, 2010, and 2013.

Most of the habitat on the Corinth route consisted of dirt road surrounded by mixed forest interspersed with open land such as fields, farms, and a large fairground in close proximity our WPW detections on 4 June.

Peacham:

The Peacham route was surveyed a total of three times during the 2015 breeding season: once by a volunteer and twice by VCE. Inclement weather caused us to terminate the first survey after point 6 and finish points 7 - 10 the following morning. Neither the volunteer survey (4 June) nor VCE's first survey (28/29 May) yielded any detections (Table 2). VCE's second survey (6 June) produced one WPW detection in minute six at point 8 (Figure 3, Table 2). Immediately following this detection, we surveyed two supplemental points, the last of which yielded a second detection. However, due to the estimated distance and direction of the second detection, we believe it was the same WPW heard at point 8.
Though interspersed with a small number of farms and open fields, most of the points along this route are on dirt roads surrounded by mixed forest with few openings and so do not appear ideal for WPW. No volunteer surveys of this route have yielded detections.

Concord:

The Concord route, in its entirety, was surveyed three times during the 2015 breeding season: once by a volunteer and twice by VCE. While the volunteer survey (26 May) and VCE's first survey (29 May) were completed in the span of one night, we attempted, but were unable to complete our second survey on 7

June due to excessive cloud cover; we finished the first five points then ended the survey. We returned on 5 July, during the following lunar cycle, and resurveyed the entire route, with all points completed in one night. Several WPWs were detected during the volunteer survey as well as during VCE's first and second complete surveys (Figure 4/4A, Table 2). At least three individual birds were detected on the route at points 8 and 9, with five others heard at various supplemental points, making this the largest congregation of WPWs detected outside of the West Haven area.

Historically, the Concord route has produced multiple WPW detections, especially points 8 and 9. WPWs have been documented along this route every year since it was first surveyed in 2006, with the highest number of detections (5) in 2014. Like most of the routes we surveyed, Leonard Hill Road (which makes up most of the Concord route) is a rural dirt road surrounded by mixed forest. However, it differs from most routes in that it has a power-line right-of-way paralleling its entire length. Power-line rights-of-way may provide WPW habitat, and points 5 - 9, with their miles of adjacent brushy and semi-open right-of-way, appear to consistently support calling WPW.

We heard two WPWs during supplemental point counts, but we believe they were among the WPWs detected during the main route survey.

Brandon:

The Brandon route was surveyed a total of three times during the 2015 breeding season: once by a volunteer and twice by VCE. WPWs were detected during the volunteer survey (29 May) and both VCE surveys (25/26 June and 2 July) (Figure 5, Table 2). All detections on the original route were at points 2 and 3. VCE's first survey was not completed in the span of one night; points 1 - 3 were completed on 25 June, but the rest of the survey was delayed until the night of 26 June due to rain and cloud cover. Despite inclement weather on the 25th, we heard one WPW at point 2, one at point 3, and two others at supplemental points during cluster

sampling. Because point 3 had been surveyed under less than ideal conditions the previous night, we resumed our survey on 26 May beginning with point 3. Two WPWs were detected at point 3 as well as one at a supplemental point that evening, yielding a total of four separate individuals detected during VCE's first complete survey. Three were subsequently heard during VCE's second survey, all on the original route.

In addition to the WPWs heard on the original route and supplemental points, we surveyed several ad hoc points on Hollow Rd. At least three separate individuals were detected in this area.

Interestingly, the habitat around the two points where WPWs were detected on the original route was characterized by swampy habitat as well as a large power-line rights-of-way that extended north, past the original route, and through our ad hoc points (where we heard several WPWs) on Hollow Rd. This provides further evidence that power-line rights-of-way may provide habitat for WPW.

Salisbury:

The Salisbury route was surveyed a total of three times during the 2015 breeding season: once by a volunteer and twice by VCE. All three surveys were completed in the span of one night. WPWs were detected during the volunteer survey (3 June) and VCE's first (29 June) and second (3 July) surveys (Figure 6, Table 2). VCE's initial survey yielded one detection at point 4 and two subsequent detections of separate individuals at supplemental points. Weather began to deteriorate toward the end of the survey, and points 9, 10, and 11 were completed under less than ideal conditions. As a result, we returned the following morning (30 June) to resurvey those points, detecting another WPW at point 10. WPWs were heard during VCE's second survey at points 3, 9, and 10 and one at a supplemental point.

From 2008 through 2014, volunteer surveys have produced several WPW

detections at multiple points along this route, indicating that the Salisbury route has provided and continues to provide appropriate habitat for this species. This route has extensive open areas in the form of swamp, field, and farmland.

Wells:

The Wells route was surveyed once by VCE at the end of 2015 breeding season (6 July). This route is remote and has been surveyed only three times since the implementation of the Northeast Nightjar Survey (2007, 2008, 2009). No WPWs were detected during past volunteer surveys. VCE's survey took place late in the season, around the time most male WPWs have already ceased calling or call only briefly at sunset. Despite the late timing, we heard one WPW calling at point 2, and a separate individual at a supplemental point (Figure 7, Table 2). These late detections indicate potential for a larger WPW population in this area, as does the presence of potentially suitable habitat (slate quarry).

The habitat surrounding the first few points along the Wells route is highly unusual in that it is dominated by miles of slate quarry. Much of this route is developed in one way or another, providing an abundance of open area but few trees compared to other routes.

Conclusion

Given that VCE's 2015 surveys and cluster sampling yielded greater WPW numbers and a more complete assessment of the population status than past survey methods, comparably rigorous surveying protocols in other parts of Vermont are warranted. Unlike past survey efforts, the methods used in 2015 will allow for estimates of abundance and population size that account for imperfect detectability of individuals during surveys. Although the 2015 survey protocol does not yield results directly comparable with the volunteer surveys, patterns of detection of WPW were roughly similar (i.e. birds found on the same routes in mostly the same locations), albeit with fewer WPW detected by volunteers.

In addition to implementing the 2015 survey protocol throughout the state, we also suggest conducting an analysis of habitat use, which would better enable assessment of WPW habitat capacity in Vermont and permit fine-tuning of route designations for regular monitoring. This should include not only analyzing habitat relationships along existing survey routes, but also in other potentially suitable environments that are not well covered by roadside surveys. For example, expanding surveys to include power lines and quarries would allow us to evaluate use of these disturbed areas by WPW and to determine whether they constitute an important source of habitat that might play an important role in recovery efforts.

VCE's recent WPW surveys have been highly constrained due to the limited number of sites and routes that could be surveyed during a short breeding season and under conditions in which WPWs are known to call. To acquire more robust and comprehensive data, more technicians will be required in the field during breeding season. In addition, we suggest evaluating whether automated recording units (e.g., Digby et al. 2013) would allow for a more extensive survey. Automated recording units might prove especially useful in surveying areas that are difficult to access, such as power-line rights-of-way. While the many years of volunteer survey data are invaluable, we have documented a disparity between number of WPWs detected during single volunteer surveys and the number detected during duplicate surveys that employ a cluster sampling methodology. The systematic protocols and methods used during VCE's 2015 survey, if implemented more broadly, would provide better insights into breeding WPW numbers in the state of Vermont.

Table 2. Number and approximate location of WPWs along routes surveyed by VCE. Numbers include cluster sampling.

Route and Visit #	Latitude	Longitude	WHIP #
Hartland 1	-	-	0
Hartland 2	-	-	0
Hartland High #			**0**
Corinth 1	-	-	0
Corinth 2	44.059693	-72.215482	1
Corinth 2	44.050251	-72.213907	2
Corinth High #			**2**
Peacham 1	-	-	0
Peacham 2	44.243456	-72.192846	1
Peacham High #			**1**
Concord 1	44.425782	-71.792974	1
Concord 1	44.430695	-71.792943	2
Concord 1	44.423528	-71.793797	3
Concord 1	44.430991	-71.781550	4
Concord 1	44.422574	-71. 783704	5
Concord 1	44.422985	-71.775230	6
Concord 1	44.420574	-71.774316	7
Concord 1	44.418993	-71.772897	8
Concord 2	44.423089	-71.786413	1
Concord 2	44.423947	-71.773794	2
Concord 2	44.426654	-71.774337	3
Concord High #			**8**
Brandon 1	43.786140	-73.122125	1
Brandon 1	43.801215	-73.115929	2
Brandon 1	43.788824	-73.121915	3
Brandon 1	43.784829	-73. 138725	4

Brandon 2	43.786657	-73.122168	1
Brandon 2	43.788091	-73.124039	2
Brandon 2	43.788782	-73.125589	3
Brandon High #			**4**
Salisbury 1	43.887216	-73.150517	1
Salisbury 1	43.888872	-73.156875	2
Salisbury 1	43.827063	-73.172129	3
Salisbury 1	43.816028	-73.184171	4
Salisbury 2	43.901858	-73.156981	1
Salisbury 2	43.897010	-73.159639	2
Salisbury 2	43.830596	-73.165462	3
Salisbury 2	43.824252	-73.180461	4
Salisbury High #			**4**
Wells 1	43.457483	-73.230098	1
Wells 1	43.461042	-73.238135	2
Wells 2	-	-	-
Wells High #			**2**
Total High #			**20**

Key for Figures 2 – 7

Red pins indicate original points along survey route. Blue flags indicate supplemental points for cluster sampling. “W” indicates approximate location of WPW. Red lines indicate direction and distance from observer to WPW during first survey and blue lines indicate same for second survey. Light blue and light red lines on Brandon map indicate direction and distance from observer to WPW on supplemental points used for ad hoc surveys. Only VCE survey results included.

Figure 2. Points surveyed and WPW detected, Corinth route

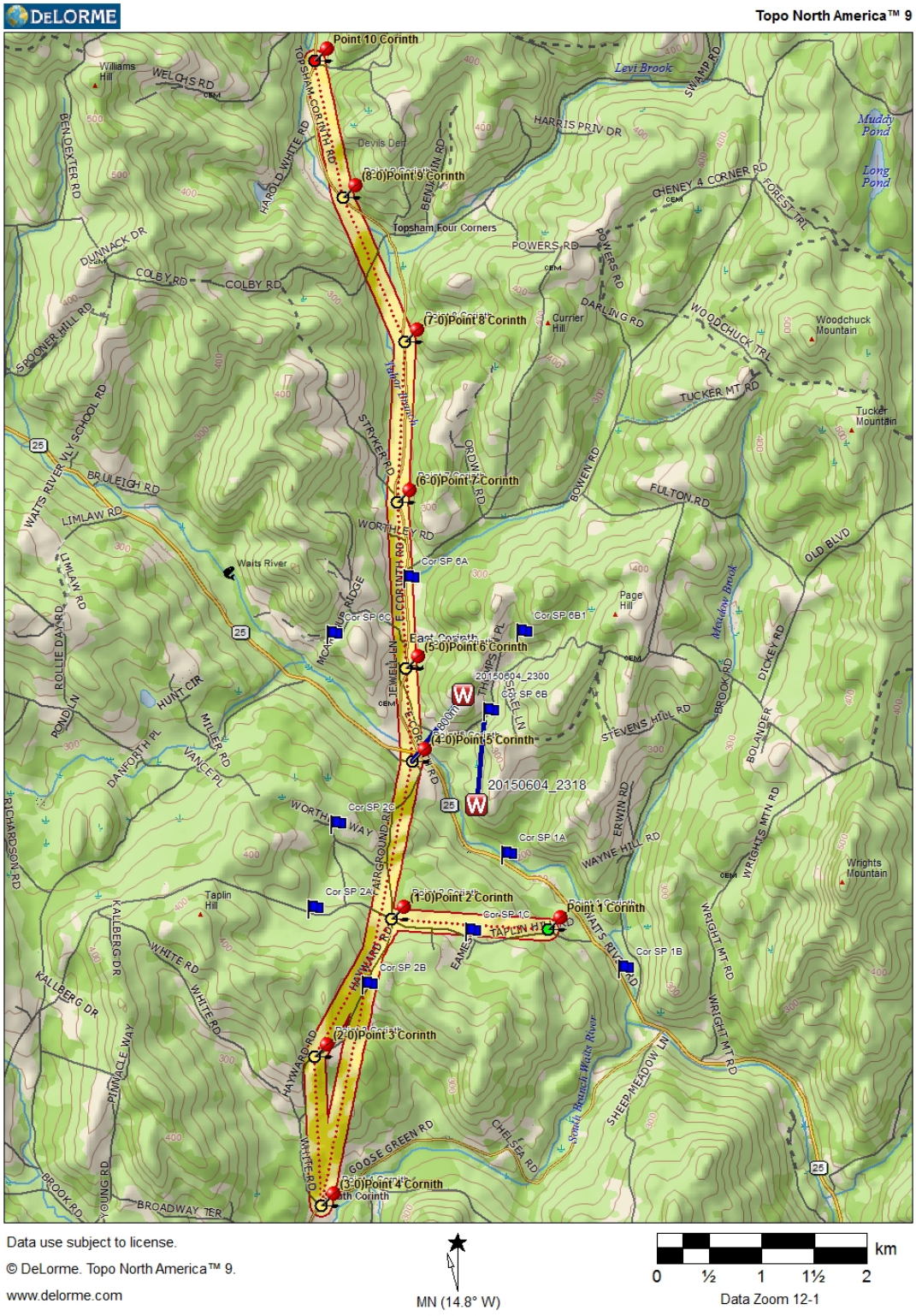


Figure 3. Points surveyed and WPW detected, Peacham route

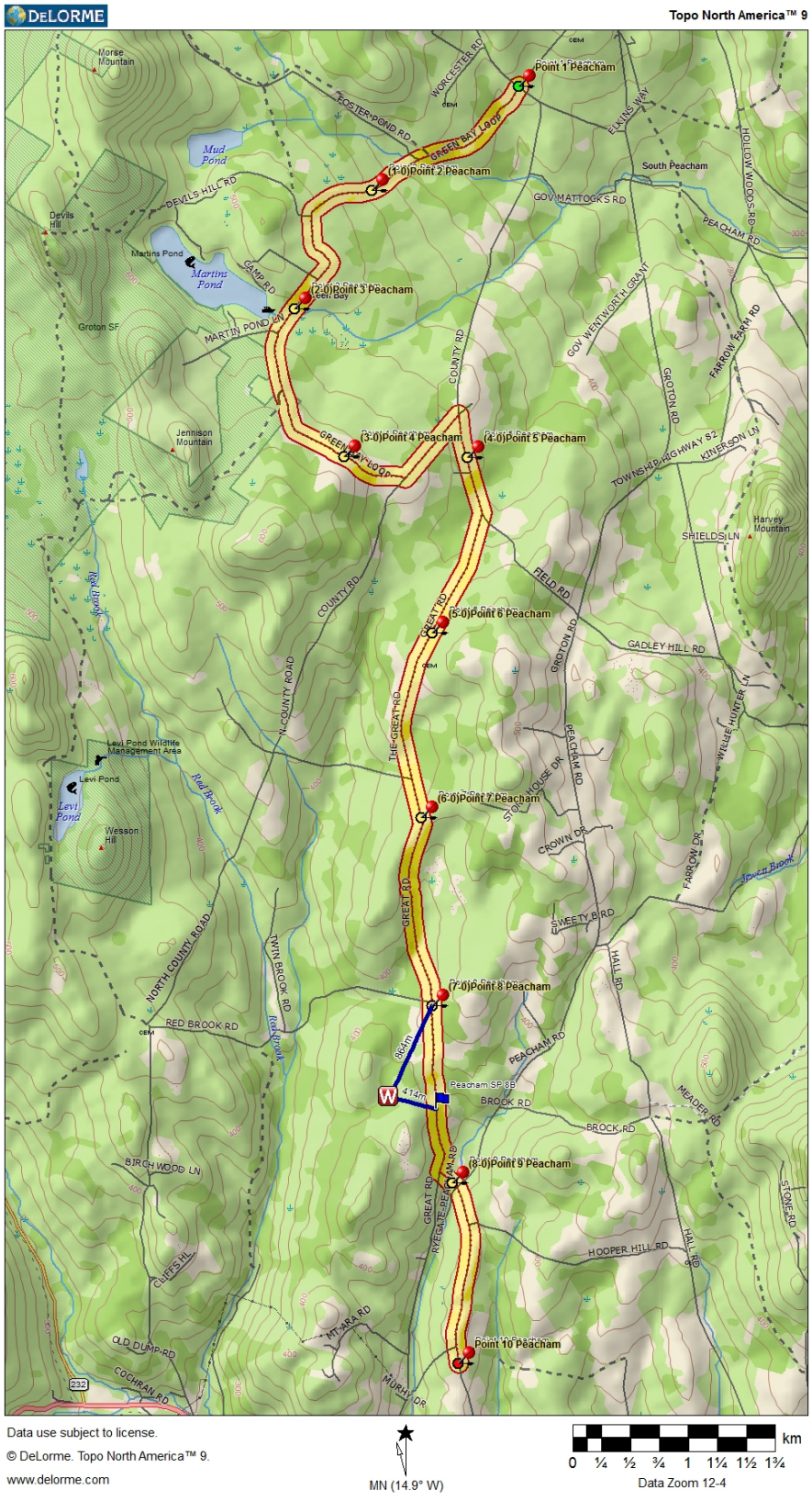


Figure 4. Points surveyed and WPW detected, Concord route

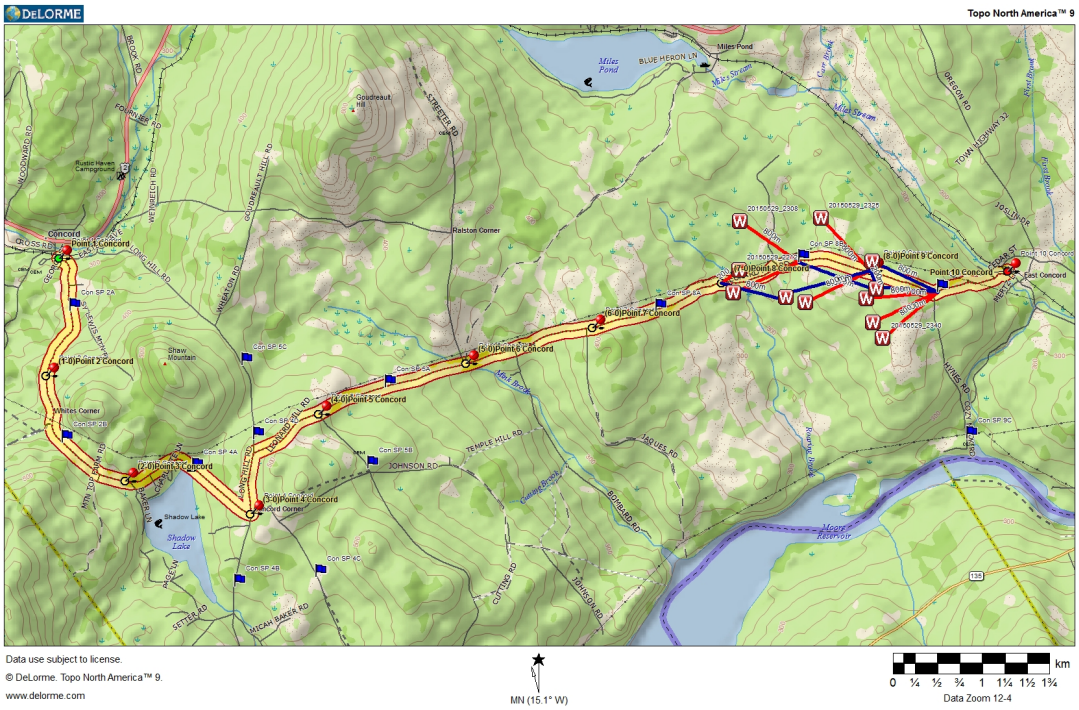


Figure 4A. Points surveyed and WPW detected, Concord route close up of WPW cluster

Figure 5. Points surveyed and WPW detected, Brandon route

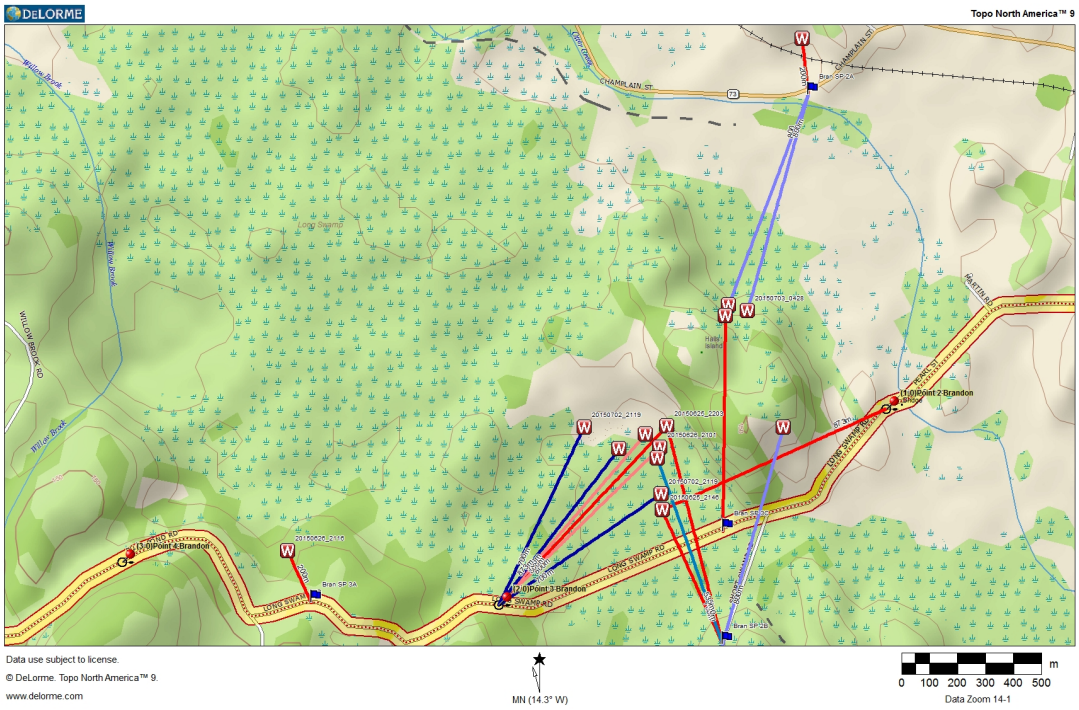


Figure 6. Points surveyed and WPW detected, Salisbury route

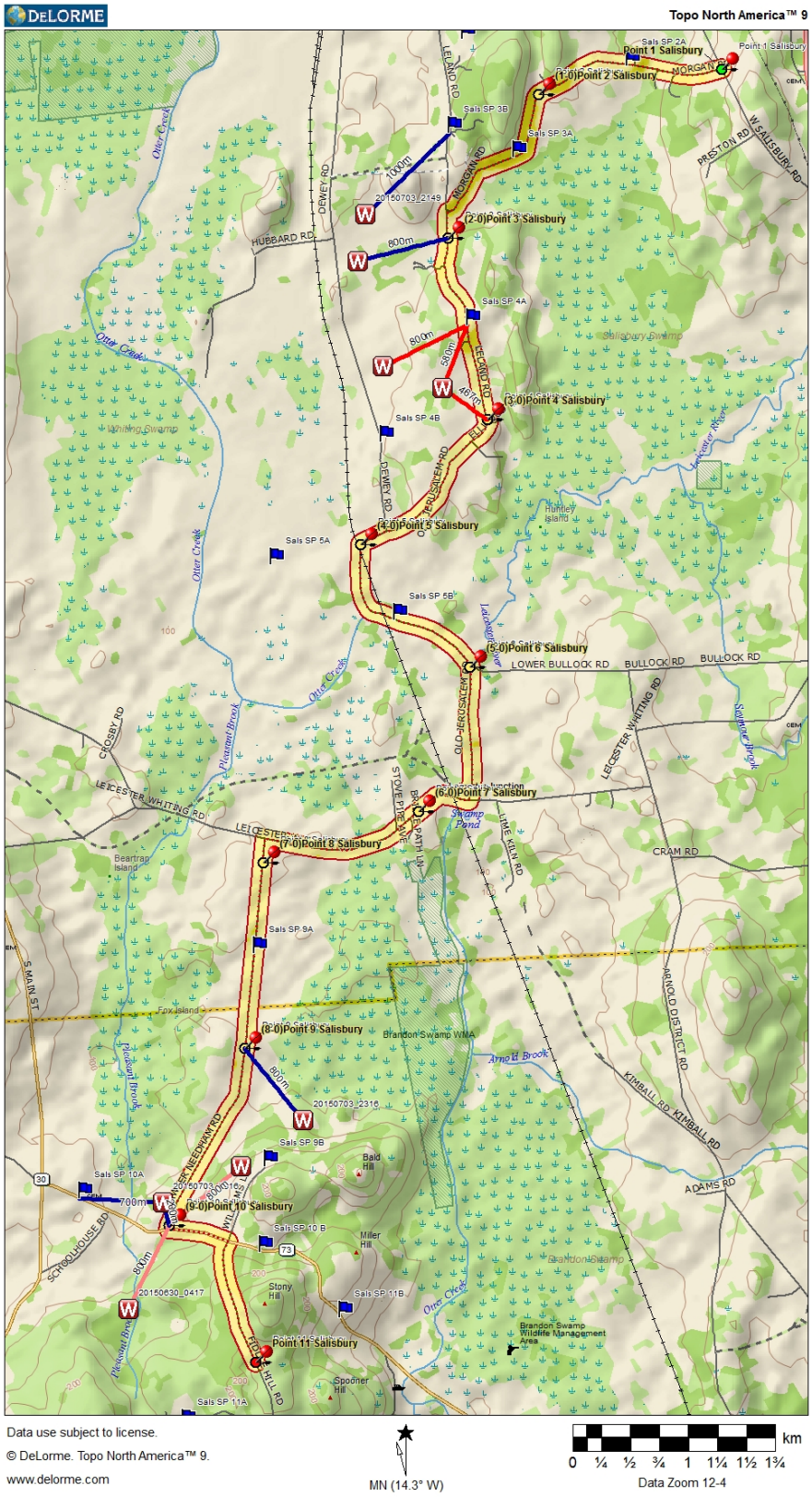
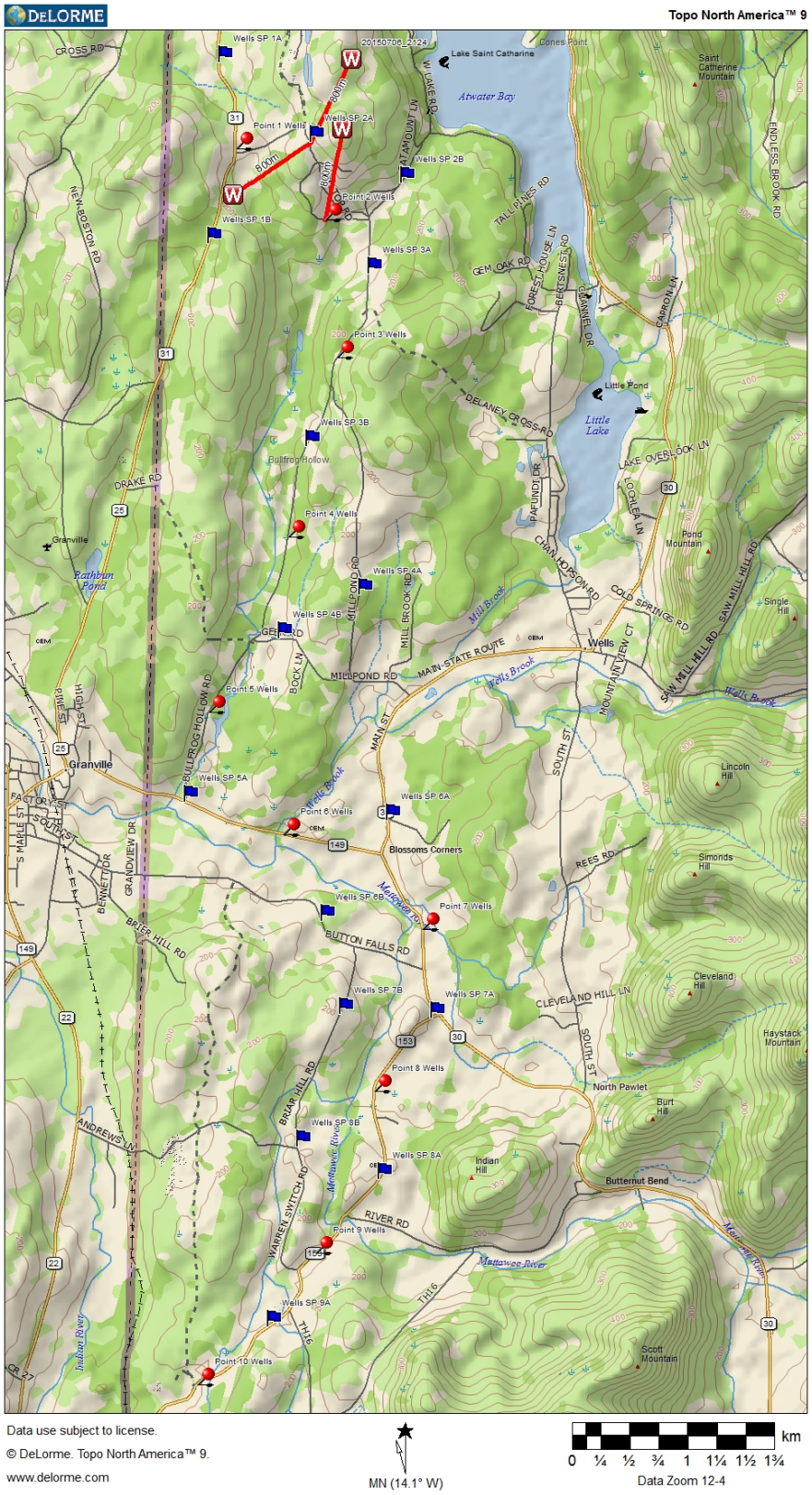


Figure 7. Points surveyed and WPW detected, Wells route



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