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Northern Saw-whet Owl (Aegolius acadicus) Abundance and Distribution in the Southern Appalachian Mountains of Northeast Tennessee

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ABSTRACT

Northern Saw-whet Owl (*Aegolius acadicus*) Abundance and Distribution in the Southern Appalachian Mountains of Northeast Tennessee

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Little is known about the distribution, abundance, or life histories of the Northern Saw-whet Owl (*Aegolius acadicus*) in the Southern Appalachian Mountains of Northeast Tennessee. This study relied upon the Pennsylvania Protocol of audio playback of a Northern Saw-whet Owl call to monitor for owl presence at various areas above 3,500 feet in elevation. Owls were found at multiple areas in Northeast Tennessee, including Roan Mountain, Unaka Mountain, Rocky Fork, and the Pond Mountain Area. Statistical analysis revealed that these owls were not limited by habitat, showing equal presence in Hardwood habitats along with Spruce and/or Fir habitats. Data also revealed that the owls showed a statistical preference for higher elevations at the surveyed sites. The habitat and elevation preferences, coupled with the locations where owls were detected, allow for a greater understanding of the life histories and population distribution of the Northern Saw-whet Owl in the Southern Appalachian Mountains.

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CHAPTER 1

INTRODUCTION

Background of Northern Saw-whet Owl

While it may seem uncommon to the casual observer, the Northern Saw-whet Owl (*Aegolius acadicus*) is a well-established species in North America. These small owls are common in the forests of the Northern United States and in Southern Canada. Saw-whets can be distinguished by the brown upper parts of their body streaked with white. Similarly, the underside of the bird is white with heavy brown streaking in the feathers. Their facial disk is anchored by golden yellow eyes above a black bill in adults (Peterson 2010). The juvenile owl can be confused with a juvenile Boreal Owl (*Aegolius funereus*). However, the Boreal Owl's range does not extend south of Canada into the Eastern United States, making any perplexing juveniles most likely a Northern Saw-whet Owl (Alsop 2002). One of the most distinguishing features of the owl is its relatively small size. The Saw-whet Owl is one of the smallest owls in North America, comparable to the American Robin (*Turdus migratorius*). It exhibits reverse sexual size dimorphism with females' average weight being 100 grams while the males weigh in at 75 grams. Both sexes measure an approximate length of 20 cm (Carpenter and Carpenter 1993; Cannings 1993).

Saw-whets actively hunt throughout the night. These birds become active approximately one half hour after sunset until one half hour before sunrise. During daylight hours, the owl roosts in tree cavities, trees, and shrubs with thick cover (Forbes and Warner 1974). These owls hunt from low perches, looking for small rodents, birds, or available insects (Alsop 2002). The primarily nocturnal behavior, small size of the owl, and the dense foliage of roosting sites makes

any appearance of a Saw-whet rare to the casual observer. Indeed it is difficult to obtain any substantial record of Northern Saw-whet Owl presence without directly targeting and searching for this species. This secluded nature of owls also creates many difficulties when it comes to the identification of the owl's presence in an area. Compounding the difficulties of locating the Saw-whet Owl is the fact that they restrict calls to the breeding season—late winter into spring. The call is a unique and monotonous "toot-toot-toot" vocalization that can carry upwards of half a mile depending upon surrounding terrain. The singing decreases later in the breeding season after a mate has been attracted to the area (Alsop 2002). While polygyny has been recorded in the Northern Saw-whet Owl, the occurrences of a male raising two clutches with separate females are rare (Marks et al. 1989). Once mating has occurred, the frequent calling becomes more sporadic as the males increase their attention on hunting and providing for their young. Mated males do exhibit a reduced response to soliciting calls making it increasingly difficult to access an owl's presence in a given area. Even with its relative abundance in the north, the solitary nature of the owl leaves much to be learned about the intricacies of the owl's habits and biology (Cannings 1993). New behaviors of Saw-whets are continually being discovered in the void of knowledge that currently exists regarding the species (Boyd 2009).

Breeding Box Usage

The Northern Saw-whet Owl is known to roost and nest in abandoned woodpecker nesting cavities, primarily those of the Pileated Woodpecker (*Dryocopus pileatus*) or the Northern Flicker (*Colaptes auratus*) (Cannings 1993). Saw-whet Owls are forced to compete for these secondary cavity nests with various woodpecker species as well as with Red Squirrels (*Tamiasciurus hudsonicus*) that also use the available cavities (Barb 1995). Saw-whet Owls will

accept artificial nest cavities for the purpose of rearing of chicks when there is a lack of secondary cavity nesting sites. The nesting boxes used for this purpose have the same approximate dimensions as those commonly used for wood ducks (Alsop 2002).

Mark Barb, an East Tennessee State University graduate student, conducted a study in 1995 that involved the placement and monitoring of nesting boxes for Saw-whet Owls placed on trees on Roan Mountain and Unaka Mountain. Thirty-nine nesting boxes were used throughout elevations higher than 3,500 feet on the two mountains. Of these 39 boxes, three confirmed nestings of Saw-whet Owls occurred during the second year of the study (Barb 1995). Similarly, there an ongoing project that incorporates nesting boxes for Saw-whets at Big Bald on the Tennessee/North Carolina border (Big Bald Banding 2011). Of the 28 boxes placed at Big Bald, there has been evidence that two boxes may have been used by Saw-whet Owls for nesting. In both experiments, no results were seen in the first year of the nesting box project. These past experiences show that the Southern Appalachian population of Saw-whet Owls will accept established artificial cavities for nesting.

Northern Saw-whet Owl Range

One solid area of knowledge regarding the Northern Saw-whet Owl is their range (see Figure 1). The Northern Saw-whet Owl can be found as a wintering resident in a majority of the continental United States (Ridgely et al. 2003). They can also be found as a permanent resident along most of the United States and Canadian border, branching southward along the higher conifer zones of the Rocky Mountains and extending from the southeastern edge of Alaska down through the western states of North America into Mexico (Ridgely et al. 2003). Aside from the continuous range, there are two pockets of year-round residency in the Eastern United States.

The first location is in the Allegheny Plateau along the West Virginia border. The second extends through the Southern Appalachian Mountains along the Tennessee and North Carolina border, extending northwards into the southern tip of Virginia. Northern Saw-whet Owls are sympatric with several other owl species throughout this range, notably with Eastern Screech-Owls (*Megascops asio*). There is slight segregation between saw-whets and screech-owls due to habitat preference as the Eastern Screech-Owl prefers a more southern-type forest edge (Swengel 1987a). However the range of the owls does overlap and the two species will respond to vocalizations of the other.

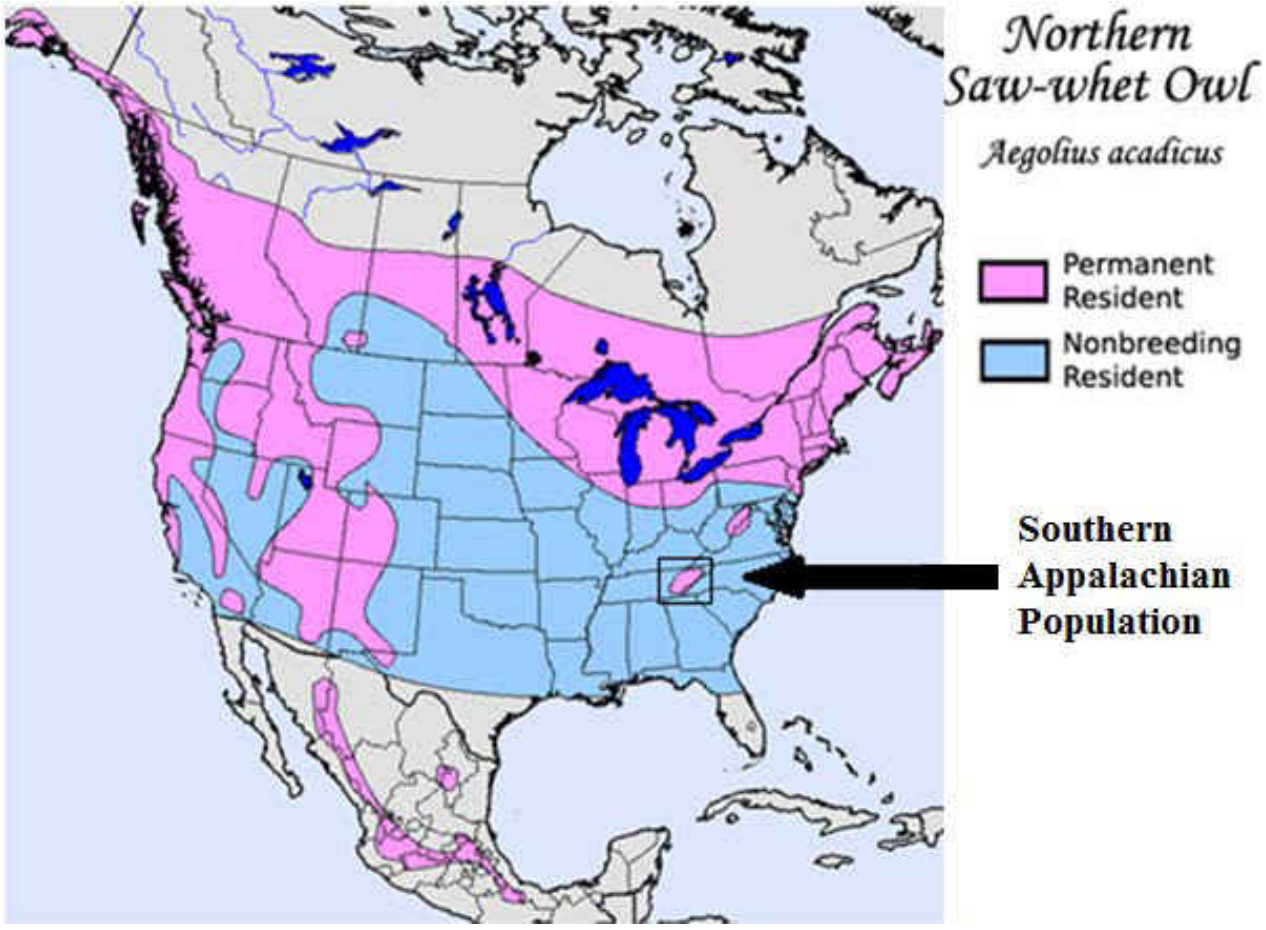

Figure 1. Distribution of the Northern Saw-whet Owl throughout North America (adapted from Ridgley et al. 2003). This figure also indicates the disjunct Southern Appalachian Population.

Southern Appalachian Population

The Southern Appalachian "island" is the southernmost range of the Northern Saw-whet Owl east of the Mississippi River. It has been hypothesized by Tamashiro (1996) that these two islands are the glacial relicts of a time when the Southern Appalachian Mountains mirrored the environment that can be seen in the northern range of Saw-whets today. Indeed, it has been noted that the Saw-whet Owls of this Southern Appalachian disjunct are morphologically distinguishable from the other populations of Saw-whets (Tamashiro 1996). Tamashiro went as far as to hypothesize that the Southern Appalachian Saw-whet might be a genetic reservoir in respect to the other populations of Saw-whet Owls. A recent study also showed migrating Saw-whets flying south to their wintering ground usually avoid the Southern Appalachian Mountain range, preferring to use a corridor along the Atlantic coast (Beckett and Proudfoot 2011). This potential lack of breeding, coupled with Tamashiro's hypothesis of the Southern Appalachian population being a genetic reservoir, leads to an interesting question as to how much importance should be assigned to studying the present owl population in Southern Appalachia.

Even with the interesting queries raised by the Southern Appalachian population of Saw-whets, little research has been conducted on the Southern Appalachian population. A majority of the work published regarding Saw-whet Owls are studies that have occurred in the Northern United States and Canada where these owls are more abundant. This work has shown that Saw-whets accept a wide variety of habitats in the North and Western ends of their range (Cannings 1993). The owls can be found in most woodland habitats and in most forest types throughout their range (Johnson and Anderson 2003). The owls can be found in coniferous forests by riparian zones in the western United States. This preference for coniferous forests is also shown by higher bird density in coniferous forests at moderate elevations and latitudes (Cannings 1993).

The preference for coniferous forests has been associated with the Saw-whet Owls in the Southern Appalachian population. The current consensus among birders in the Southern Appalachian region is that a person must travel to the higher elevations to the Spruce-Fir habitat in order to encounter a Northern Saw-whet Owl during its breeding season (Alsop 1991; McGuiness pers. com.; Somershoe pers. com.). This sentiment seems to be verified as a majority of the encounters with Saw-whets during the early spring months occurs at elevations that exceed 4,500 feet. Almost all of the work conducted on Saw-whet Owls in the Southern Appalachians has been focused on a few areas: namely Unaka Mountain and Roan Mountain on the Tennessee/North Carolina border as well as Grandfather Mountain, Mount Mitchell, the Black Mountains, and the Balsam Mountains of North Carolina (Barb 1995; Cockerel 1997; Milling et al. 1997; Tamashiro 1996; Williams 2003).

The lack of study locations can be partly attributed to the previously mentioned notion that Saw-whet Owls are constrained by their habitat preference. The owls have seemed to limit their breeding range to the spruce-fir habitat through the spruce-fir/upper northern hardwood habitat. Extensive spruce-fir forests of this region are almost exclusively above 1,500 m (5,000 feet) (Simpson et al. 1972). There are also Northern Saw-whet Owls that have been recorded breeding in northern hardwoods with no spruce-fir component (Somershoe pers. com.) A comprehensive study conducted by Milling et al. (1997) found no Saw-whet Owls below 4,000 feet throughout the mountains of North Carolina despite the study focusing over 25% of its time on lower elevation sites.

There have been unconfirmed reports by timber crews of encounters with Northern Saw-whet Owls as low as 3,500 feet in the summer (McGuiness pers. com.). Other sightings of Saw-whets below 3,500 feet are attributed to winter migrations from higher latitudes. One noteworthy

confirmed Northern Saw-whet Owl occurred on 3 May 2014. This bird was identified by Joe McGuinness during the spring bird count of 2014. The bird was located on a gap near the headwaters of Irishman's Branch, a stream located to the east of the city of Unicoi (McGuinness pers. com.). This bird was heard at an elevation of 2,640 feet, almost 900 feet lower than any other confirmed Saw-whet during their breeding season. At the time of this writing, there is still no explanation as to why this owl was in an area that was much lower than expected. Aside from this anomaly, past research supports the idea that during the breeding season, Saw-whets appear to be confined to higher elevations.

Habitat Loss in the Southern Appalachian Mountains

One of the chief concerns for the Southern Appalachian population of Saw-whet Owls is a potential reduction in owl numbers caused by to habitat loss. Indeed, the Southern Appalachian Mountains have historically experienced habitat loss from logging. In the 1950s, the introduction of the balsam woolly adelgid (*Adelges piceae*) led to another risk factor. In the subsequent years, major tracts of conifer woods have been devastated by this insect (USDA 2006). The study of Milling et al. (1997) compared their data collected in mid-1990 with surveys from the 1970s and showed that Saw-whet Owl populations did not seem to be greatly impacted by the adelgid presence. However, it has been over 15 years since the publication of Milling's data. The question arises that the combination of adelgid with factors such as global climate change and air pollution (including habitat loss from ozone and acid rain) has had any effect on the Saw-whet population in Appalachia.

Project Goals

There are worries that the Northern Saw-whet Owl population in the Southern Appalachian Mountains has been declining due to a habitat reduction from logging, climate change, air pollution, and tree deaths from adelgids (Milling et al. 1997; Somershoe pers. com.). There exists a pressing need for more information regarding Saw-whet Owl populations along the entire eastern edge of Tennessee. As shown by the range map, the Southern Appalachian population is one of two disjunct populations in the Eastern United States and this population is the lowest latitude that Northern Saw-whet Owls can be found east of the Mississippi River. This seclusion coupled with the lack of major interactions between the Southern Appalachian population and owls migrating from the north of the range lead to a population that may become more genetically distinct. The possibility that the Southern Appalachian population is a genetic reservoir for Saw-whet Owls motivates the need for more complete information regarding this species in Tennessee.

Due to loss of habitat (from the balsam woolly adelgid and the relegation of conifer tree line to higher elevations due to climate change), less of the Saw-whets' preferred habitat of Spruce and/or Fir and spruce is available to them. In this study I intend to show that the Northern Saw-whet Owl population of the Southern Appalachians is being forced to change its habitat to include the northern hardwood habitat areas overtaking its historical habitat. If no transition away from their reduced habitat is being made, then the owl may be subjected to increased pressures due to higher competition for resources and nesting sites. This project presents information regarding what habitat the Saw-whet Owls are occupying and at what elevations the current Saw-whet Owl population has been detected.

Hypotheses

1. Northern Saw-whet Owls will be present in a multitude of areas in Eastern Tennessee over 3,500 feet in elevation.

In this study I sought to incorporate all accessible and suitable habitats in the Appalachian Mountains of Tennessee to provide a clear picture of Northern Saw-whet Owls and their location throughout the state. In the past, efforts have been made to document this owl's presence in the state of Tennessee. However, these efforts have mainly focused upon searching areas that have had confirmed records of Northern Saw-whet Owls. No effort has yet been made to see the total distribution of Northern Saw-whet Owls throughout suitable areas in Tennessee. By recording all spots surveyed, including those with and without previous evidence of owl presence, this study will indicate the distribution of owls across all survey sites.

2. Northern Saw-whet Owl presence will be influenced more by elevation than by habitat type.

In this study I sought to discover the distribution of Saw-whet Owls throughout the differing habitats along Appalachian Mountains in eastern Tennessee. Past efforts have mainly found owls located in Spruce-Fir or Spruce habitats. However, there have been numerous accounts that also place Saw-whets in Northern Hardwood habitats. Northern Hardwoods with no Spruce or Fir component will be assessed along with the Spruce and/or Fir habitats that have been studied in the past. The Northern Saw-whet Owl distribution among these habitat types will provide information upon the habitat preference of the owl.

CHAPTER 2

MATERIALS AND METHODS

Project Study Area

In light of the fact that most of the previous information gathered has been geographically limited, this project's main purpose was to gather baseline information on the presence of breeding Northern Saw-whet Owls in the mountains of Tennessee. This information will contribute to the understanding of abundance, population size, distribution, and habitat usage of the Southern Appalachian population of Northern Saw-whet Owls.

This study was a part in a statewide survey commissioned by the Tennessee Wildlife Research Agency (TWRA) in order to determine the presence or absence of Northern Saw-whet Owls throughout the state of Tennessee. The study encompassed areas that have already been surveyed, notably Roan Mountain and Unaka Mountain, while also including additional areas in the North and South Cherokee National Forest. A list of these new locations can be found in Table 1 below.

In order to cover such an expanse of land, the overall project was broken into different sections. The South Cherokee National Forest areas were covered by Danielle Floyd at University of Tennessee Chattanooga. My research focused upon the North Cherokee National Forest Areas (areas 1 through 7 in Figure 2 below). This area ran from the Northeastern tip of Tennessee down south through Greene County (indicated by the shaded row in Table 1). The Great Smoky Mountain National Park area was scheduled to be covered by various birding groups in the Great Smoky Mountain area. However, a collaborative effort with these groups was not able to be organized in time for this two-year project.

Table 1: List of areas focused on in research

Areas of Interest	Potential Specific Areas	Counties	Figure 2
North Cherokee National Forest	-Shady Valley Area -Holston Mountain -Pond Mountain Area -Unaka Mountain -Roan Mountain -Rocky Fork	- Johnson - Sullivan/Carter - Carter - Unicoi - Carter - Unicoi	- 1/2/3 - 2 - 4/5 - 5/6 - 5 - 6/7
Great Smoky Mountain National Park	-Suitable elevations	-Cocke, Haywood, Blount, Swain, Sevier	- 8,9,10,11
South Cherokee National Forest	-Whigg Meadow -Cherohala Skyway -Beaver Dam Bald -Wauchessi Mountain -Little and Big Frog Mountain Wilderness Area	- Monroe - Monroe - Monroe - Monroe - Polk	- 12/13 - 12/13 - 12/13 - 12/13 - 14

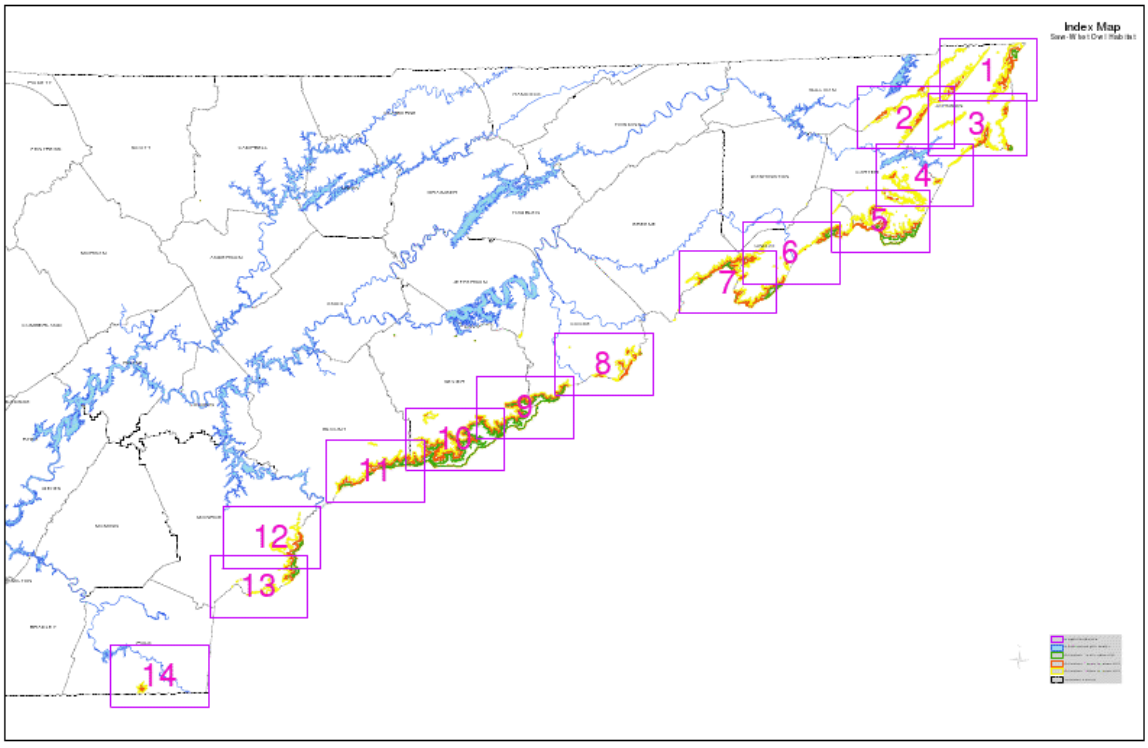

Figure 2: Reference map of East Tennessee areas surveyed (provided by TWRA)

Additional topographic maps for the specific sectors in Figure 2 are located in Appendix A.

GIS and topography maps supplied courtesy of Tennessee Wildlife Resource Agency (TWRA) and the United States Forest Service (USFS) were used to determine areas north of Cocke County, Tennessee, suitable to be surveyed during this project (see Appendix A). The areas that were surveyed encompassed elevations above 3,500 feet. This minimum elevation had been determined because it is the lowest elevation where Northern Saw-whet Owls are expected to be during their breeding season. Milling's study in 1997 found no Saw-whet Owls below 4,000 feet in elevation. Special attention was given to areas above 4,500 feet in elevation during the 2013 field season, while the 2014 field season sought to expand this focus to areas that ranged from 3,500 feet to 4,500 feet.

Nightly surveys were conducted to determine the presence of Northern Saw-whet Owls throughout Tennessee. These surveys were conducted by following the Pennsylvania Protocol of audio playback recording to determine the presence of Saw-whets. Efforts were made to conduct surveys on a vast majority of suitable nights, preferably clear moonlight nights with minimal wind, in all areas that are accessible for researchers.

Pennsylvania Protocol Observation

There are numerous detection methods for Saw-whet Owls. These include listening for calls, locating the whitewash of excrement that indicate a roosting site, searching for pellets, and locating a Saw-whet's cached prey (Swengel 1987a). Given the relative difficulties and unreliability of many of these methods, this project mainly focused on following the Pennsylvania Protocol set forth for by Lanzone and Mulvihill (2006). This protocol focuses on gathering information about the presence of Saw-whet Owls by having the owls respond to a

taped audio lure. This survey technique is similar to the survey procedure used by Milling et al. in 1997.

The Pennsylvania Protocol consists of using audio playback of a set series of Saw-whet Owl calls. The purpose of the audio playing is to elicit a response from any Saw-whet Owls within auditory range, approximately one half mile from the playback's source. This range can be limited by weather conditions as well as geographic features that can limit the range or muffle the call. Before conducting the survey for Saw-whets, information that was recorded for each route included: observer name, date, a code for weather, temperature at the beginning and end of route, wind speed and direction, and lunar phase. At each stop the observer included: the stop number, start time, a GPS reading, the habitat, and any excessive noise that occurred at the time of survey. Of the six areas that were surveyed, the habitat type by stop was categorized into one of three bins: mainly Spruce and Fir present, mainly Northern Hardwood, or an approximately equal mixture of Spruce and/or Fir and deciduous trees. All of this information was recorded in the field on a uniform printed sheet (see Appendix B).

Routes throughout areas with suitable elevation were determined based upon the conditions of the roads present. For each route stops were to be within at least 10 meters of a suitable wooded area for Saw-whets. Points upon the road were chosen so that they were clear of any excessive noise interference in the area. Excessive noise was normally regarded as running water or wind that made it too difficult to hear Northern Saw-whet Owls calling in the area. If any point that fell one half mile after the previous point was determined unacceptable, then the next point surveyed was at the next suitable point along the route.

The Pennsylvania Protocol consists of driving along a predetermined mapped route through an area deemed suitable for Saw-whet Owls. Areas were deemed suitable when they met

the criteria of being over 3,500 feet in elevation. These areas, ranging from a Northern Hardwood habitat to a Spruce and/or Fir habitat, were then classified into accessible routes. At approximately half mile intervals along the route, the observers stop the vehicle at a predetermined point. The half mile interval was based off of the male Northern Saw-whet Owls range. These owls are territorial and have a range that is approximately 1 km^2 (Cannings 1993). If a male Northern Saw-whet Owl is detected at a given stop, then any other Saw-whet vocalizations heard at other stops along route can be inferred as another male. At each predetermined point the observer plays a track of Saw-whet Owl vocalizations (courtesy of the Pennsylvania Breeding Bird Atlas) (see Table 2). Throughout the 11-minute track the observers note and document any responses from any owl species on their printed handout sheet. The audio track is transmitted using an mp3 audio player broadcasting the Saw-whet Owl soundtrack using miniature portable speakers. While small, the portable speaker effectively transmits the audio track. Personal experience in the field showed that the track could still be distinguished humans at a distance of up to 0.2 miles away from the source. It can reasonably be inferred that owls could hear the track at distances greater than those a human could hear. All responding bird vocalizations throughout the 11-minute track were recorded.

After playing the Saw-whet Owl soundtrack at a stop, the observer then drove to the next determined point along the route. Here the protocol was repeated. The routes consisted of as many stops that meet the criteria laid out in the section above (conditional on what areas along the route are deemed suitable). At the end of each route all information was then saved to be compiled later. At the end of each breeding season, all the data recorded and information from all the survey sites in Tennessee were included for analysis purposes. This allowed for the analysis to include all the regions surveyed.

In order to gain access to areas where Saw-whet Owls were likely to breed, service roads on mountains were used. Forest service roads at the higher elevation are difficult to maintain. Due to the unstable terrain that constituted a majority of the roads used, a high clearance four-wheel drive vehicle was used, especially in the early part of the breeding season when the possibility of snow in the upper elevation areas to be surveyed was the highest. An effort was made to use a team of at least two people surveying together for the majority of nights. This was done to limit the risks that can be encountered at the sites surveyed as well as to increase the accuracy of identifying any owl responses. A group of undergraduate students and volunteers helped with the placement of nesting boxes and the nightly monitoring of owls.

To ensure that all data collected were uniform, each group surveyed an area using the same methods for attracting Saw-whet Owls and for recording their presence or absence per area (Table 2). By the end of the two-year study period, a wide section of the Southern Appalachian Mountains were covered and surveyed for Saw-whet Owls.

Table 2: A section listing of the different periods that are a part of the Pennsylvania Protocol. (Lanzone and Mulvihill 2006)

Time	Period	Type	Activity
0:00	**1**	**Listen**	**Press play and then Listen**
2:00	**2**		**Calling period**
2:00	2.1	**Playback**	Tape of vocalization (15 seconds)
2:15	2.2	**Listen**	Quiet. Short listening period (25 seconds)
2:40	2.3	**Playback**	Tape of vocalization (15 seconds)
2:55	2.4	**Listen**	Quiet. Short listening period (25 seconds)
3:20	2.5	**Playback**	Tape of vocalization (15 seconds)
3:35	2.6	**Listen**	Quiet. Short listening period (25 seconds)
4:00	2.7	**Playback**	Tape of vocalization (15 seconds)
4:15	2.8	**Listen**	Quiet. Short listening period (25 seconds)
4:40	2.9	**Playback**	Tape of vocalization (15 seconds)
4:55	**3**	**Listen**	**Listen for longer period of 2 minutes**.
6:55	**4**	**Playback**	**Calling period**: Vocalization for 2 minutes (15 seconds of calling followed by 2-second breaks).
9:00	**5**	**Listen**	**Listen** (The final listening period)
11:00	**End**		**Termination of play & listening session**: Fill out remaining sections on the data sheet for that stop, travel to next stop.

Thirteen trips were made into the field in 2013 and are expressed in Table 3. The first year of the field season was limited by unfavorable weather conditions as well as the lack of reliable transportation. This year also focused a majority of effort on surveying high elevation sites found on Roan and Unaka Mountain. The Roan Mountain route began at the Rhododendron gardens above Carver's Gap and continued down the Tennessee side on Highway 143. The Unaka Mountain route ran along the Unaka Mountain Road and Red Fork Road. The Shady Valley Area consisted of two separate areas: McQueen Gap on the west side of the valley and on

Highway 421 along the east side of the valley. The Holston Mountain route ran along Panhandle Road as it followed the ridge leading to Holston High Point.

Table 3: Dates and locations surveyed in 2013

2013 Field Season		
Trip	**Date**	**Location**
1	14 March 2013	Unaka Mountain
2	19 March 2013	Roan Mountain
3	28 March 2013	Shady Valley Area
4	2 April 2013	Unaka Mountain
5	3 April 2013	Roan Mountain
6	8 April 2013	Shady Valley Area
7	9 April 2013	Holston Mountain
8	10 April 2013	Unaka Mountain
9	16 April 2013	Roan Mountain
10	18 April 2013	Unaka Mountain
11	20 April 2013	Unaka Mountain
12	13 September 2013	Roan Mountain
13	20 September 2013	Roan Mountain

The second year of the research project had 27 trips that also included areas not surveyed for during 2013 (see Table 4). This included the low elevation sites of Rocky Fork and the Pond Mountain Area. Rocky Fork's route consisted of the USFS property at the higher elevations of Rocky Fork. The Pond Mountain Area followed Laurel Fork Road, down Little Stony Creek Road until it was below the minimum elevation, and then along Walnut Mountain Road. These areas were added to the previous four sites that were surveyed throughout 2013.

Table 4: Dates and locations surveyed in 2014

	2014 Field Season	
Trip	**Date**	**Location**
1	4 March 2014	Holston Mountain
2	5 March 2014	Shady Valley Area
3	7 March 2014	Roan Mountain
4	8 March 2014	Pond Mountain Area
5	9 March 2014	Shady Valley Area
6	10 March 2014	Holston Mountain
7	11 March 2014	Pond Mountain Area
8	17 March 2014	Holston Mountain
9	18 March 2014	Pond Mountain Area
10	20 March 2014	Shady Valley Area
11	26 March 2014	Rocky Fork
12	27 March 2014	Unaka Mountain
13	30 March 2014	Rocky Fork
14	31 March 2014	Pond Mountain Area
15	1 April 2014	Roan Mountain
16	2 April 2014	Unaka Mountain
17	3 April 2014	Holston Mountain
18	8 April 2014	Rocky Fork
19	9 April 2014	Roan Mountain
20	10 April 2014	Unaka Mountain
21	16 April 2014	Rocky Fork
22	17 April 2014	Pond Mountain Area
23	18 April 2014	Shady Valley Area
24	21 April 2014	Rocky Fork
25	22 April 2014	Roan Mountain
26	23 April 2014	Unaka Mountain
27	29 April 2014	Pond Mountain Area

The stops that were surveyed during both the 2013 and the 2014 field season were then transferred into Google Earth (Google Inc. 2009) for the purpose of creating a visual representation of the different areas that were surveyed. This mapping program was also used to plot the different sites where Northern Saw-whet Owls were found to be present.

Audio Recording Devices

Aside from listening for Saw-Whet Owls along mountain roads, another aspect of the project was to include audio recording devices. The Pennsylvania Protocol for identifying the presence of Saw-whet Owls has an observer only present at each site for less than 15 minutes. By using wildlife acoustic recorders, an observer was able to set the recorder and then collect it at a later date. This was done with the intention to greater coverage at a given site. Three acoustic recorders were loaned to ETSU for this project courtesy of Kevin Hamed from Virginia Highlands Community College. In addition, three other acoustic recorders were purchased before the start of the 2014 field season. These were placed at sites determined according to topography maps provided by the Tennessee Wildlife Resource Agency.

Song Meter™ SM1 and SM2 digital audio field recorders made by Wildlife Acoustics, Inc were used. Both types of boxes had nearly identical casings surrounding the equipment and were painted a dull brown color to better blend in with the trees. The recorders have two external microphones placed on top of the housing unit powered by regular D cell batteries. The recorders were set to record only during hours that the owls were active, from the approximate time of sunset through approximately one half hour before the following morning's sunrise. All the recorded data were stored upon a 32 GB SD/MMC memory card located inside the recorder's casing. Recorders were set to record at a sample rate of 32,000 samples per second. This was chosen as it was the closest setting available to the setting recommended by the Wildlife Acoustics Company for recording high pitched calls like those of the Northern Saw-whet Owl (Song Meter User Manual 2009).

The digital audio information was analyzed by computer to find the Saw-whet Owl vocalization pattern (the monotonous "toot-toot-toot" call). The software used for this project

was Song Scope Software (Wildlife Acoustics 2010). The pattern of owl vocalization is unlike any other animal vocalizations in the area and has a known pitch of approximately 1,100 Hz (mean of 1,104.7, standard deviation of 59.5) (Cannings 1993). A track of a known Northern Saw-whet call was annotated and saved as a "recognizer" in the SongScope program. The section was then used by the program to compare the audio track recorded in the field against the known Northern Saw-whet Owl vocalization. The SongScope software then analyzed the track and marked which sections were most similar to the known vocalization.

Breeding Box Placement

As well as identifying where Northern Saw-Whet Owls are distributed throughout Tennessee, nesting boxes were incorporated into this study. Efforts were made to find the nesting boxes that were placed in a past study by Mark Barb (Barb 1995). Unfortunately, the field notes were inadequate for locating the boxes. Only two of the 39 nesting boxes from a past project were located and were in such disrepair that they had fallen off of their respective trees. New nesting boxes were constructed and placed at the study sites.

These boxes were constructed with the aid of the undergraduate students and with materials provided by TWRA. The boxes were built on the campus of ETSU and were then distributed throughout the study area. When constructing Saw-whet Owl boxes, the following conditions were met. The height of the Saw-whet Owl boxes was approximately 17 inches with floor dimensions that were 8 inch 8 inch squares. Four drainage holes were drilled into the floor of the box. The entrance to the box was a circular hole 3 inches in diameter that was located 10 to 12 inches above the floor of the box. The lid to the boxes was constructed to be angled downward with ventilation holes on each side of the box. The tops were equipped with an

eyehook and latch so that the lids were secured from the wind. Once the boxes were constructed, the tops were waterproofed using Thompson's Water Seal. The final process before placement was to provide two to three inches of sawdust to act as nesting material substrate in the bottom of each box.

Once boxes were constructed, they were hung upon trees located on Roan Mountain and Unaka Mountain. Sites for the boxes were chosen as trees that were at least 50 feet away from any major trails so to reduce human disturbance of any nesting owls. An effort was also made so that boxes were set faced away from any trails to reduce their visibility. Once a suitable tree had been found, a researcher then climbed the tree using a belt and tree spikes similar to those used by utility line repairman. Once in the tree, the boxes were nailed in trees approximately 15 feet from the forest floor. They were placed so that there was at least a 10 foot flyway for the birds so they can enter and exit the box without navigating through obstacles. Each nesting box had its GPS location taken along with a description of its tree. Other information included was a description on how to find the tree from a main road or trail. This was done because the Garmin Rino 530 GPS used was only accurate within +/- 20 feet. The box locations and a description of the area can be found in Appendix B.

The boxes were monitored near the middle of the owl's breeding season to ascertain if any owl was using the site. If it appeared that a squirrel had been using the box, the nesting material placed by the squirrel was removed from the box. The only time that the material was not removed was in the cases where it was possible that a Northern Flying Squirrel (*Glaucomys sabrinus*) was using the box. This information was passed along to the USFS as well as Corinne Diggins, a PhD candidate based out of the Virginia Polytechnic Institute and State University who is currently studying the flying squirrels of the Southern Appalachian Mountains.

CHAPTER 3

RESULTS

Nesting Success in Breeding Boxes

The nesting boxes that were placed for this project were checked for owl presence in 2013 and 2014. Both of the times the boxes were monitoring occurred at least 45 days after the anticipated start of the Northern Saw-whet Owl mating season. An initial monitoring of the boxes in 2013 yielded no presence of owls as well as no indication that the boxes were being used by any other species.

The boxes were monitored again in April of 2014. Box 20 on Roan Mountain showed signs that it was being used by an owl for the purpose of prey caching on 12 April 2014. This stocking of three small rodents agreed with documented behavior that male Saw-whets will cache prey to attract a female to the site (Swengel 1987; Cannings 1993). This box was monitored with tree climbing equipment on 4 May 2014. A female was present in the box and remained until a volunteer began to climb the tree. Once the box had been opened, four newly laid eggs were found in the box (see Appendix C). Another monitoring trip on 29 May 2014 showed that three of the chicks were still present in the nesting box.

Lack of Acoustical Recorder Success

Acoustical monitors were employed in the field at various locations throughout the two field seasons of the project. All the recordings that yielded analyzable data can be found on Table 5 below. The 2013 field season yielded no results that could be successfully analyzed due to corrupted data files and theft of a box. The 2014 field season recorded data was analyzed with

SongScope software after it had been retrieved from the field. Analysis was not able to determine the presence of any Northern Saw-whet Owls on any of the digital recordings that were gathered.

Table 5: Areas surveyed with acoustical recorders

Area Box Located	GPS Coordinates	Dates Box Recorded
Shady Valley	N- 36.509028 W- 81.906056 Elevation- 3500’	5 March– 8 March 2014
Holston	N- 36.44875 W- 82.109361 Elevation- 4193’	10 March- 16 March 2014
Holston	N- 36.435972 W- 82.126222 Elevation- 4205’	10 March- 16 March 2014
Unaka	N- 36.133389 W- 82.305194 Elevation- 4796’	28 March- 1 April 2014
Rocky Fork	N- 36.073083 W- 82.570972 Elevation- 4314’	27 March – 30 March 2014
Rocky Fork	N- 36.073083 W- 82.570972 Elevation- 4314’	31 March – 8 April 2014
Rocky Fork	N- 36.076139 W- 82.566139 Elevation- 4171	31 March – 8 April 2014

Owl Presence as Determined by Pennsylvania Protocol

The most consistent results that were produced came from the Pennsylvania Protocol method of eliciting owl response to an audio track. A complete record of the data gathered during the Pennsylvania Protocol surveys can be found in Appendix D. The 2013 season yielded a total of 107 surveyed stops from a total of 13 trips into the field (see Table 3). The 2014 season yielded an additional 286 surveyed stops during a total of 27 trips into the field (see Table 4). This yielded a total of 393 surveyed stops for the combined two-year research period. A graph

showing a breakdown of stops by location surveyed can be found in Figure 5 below. Throughout these 393 stops, a total of 44 Northern Saw-whet owls were identified. Twenty of the Northern Saw-whet Owl detections came from spontaneous calling, defined as the owls call being detected without being solicited by the audio track. The 44 owls were found on Roan Mountain, on Unaka Mountain, throughout the Pond Mountain Area, and at Rocky Fork. There were no signs of any Northern Saw-whet Owls at either Holston Mountain or the Shady Valley Area. Maps showing the locations of all surveyed sites and the sites that had Saw-whets present are represented below in Figures 3 through 14. Of the 44 Northern Saw-whet Owls that were identified, 12 were located on Roan Mountain, 13 were located at the Pond Mountain Area, 9 were located at Unaka Mountain, and 10 were located at Rocky Fork. This was in addition to a total of 52 Barred Owls (*Strix varia*) that were identified across all the sites. There were no Eastern Screech-Owls (*Megascops asio*), no Great Horned Owls (*Bubu virginianus*), and no Eastern Whip-poor-wills (*Antrostomus vociferus* that were identified above 3,500 feet during either of the years this research project spanned.

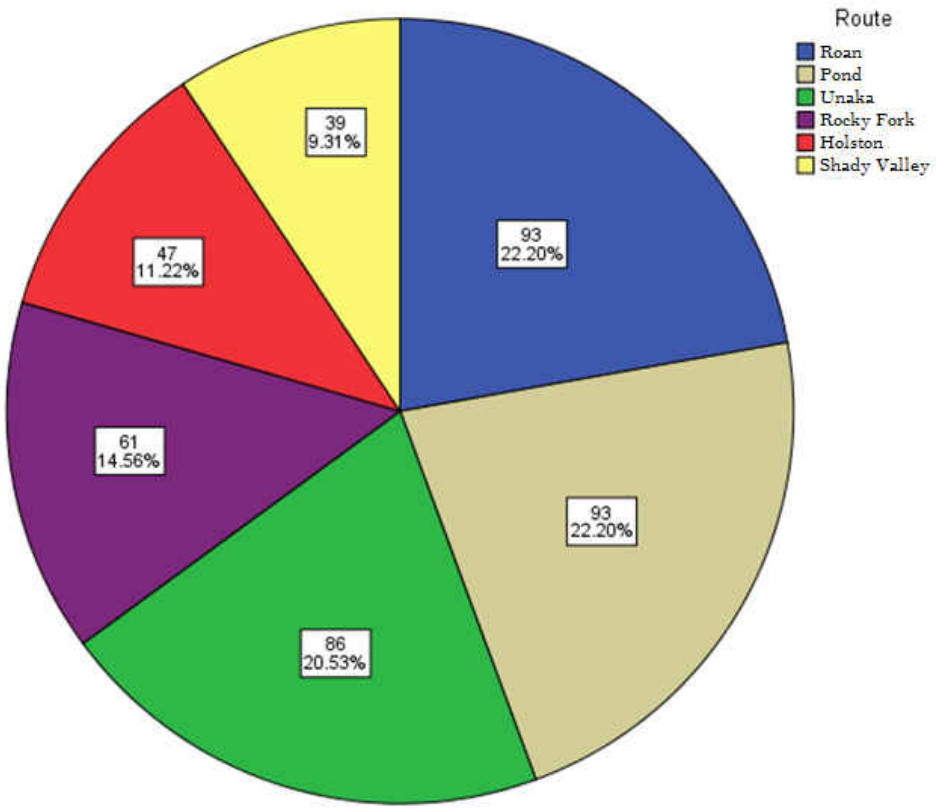

Figure 3: Survey stops by location

Figure 4: Map of survey sites by location

Figure 5: Roan Mountain sites that were surveyed

Figure 6: Roan Mountain sites that had a Northern Saw-whet Owl present

Figure 7: Pond Mountain Area sites that were surveyed

Figure 8: Pond Mountain Area sites that had a Northern Saw-whet Owl present

Figure 9: Unaka Mountain sites that were surveyed

Figure 10: Unaka Mountain sites that had a Northern Saw-whet Owl present

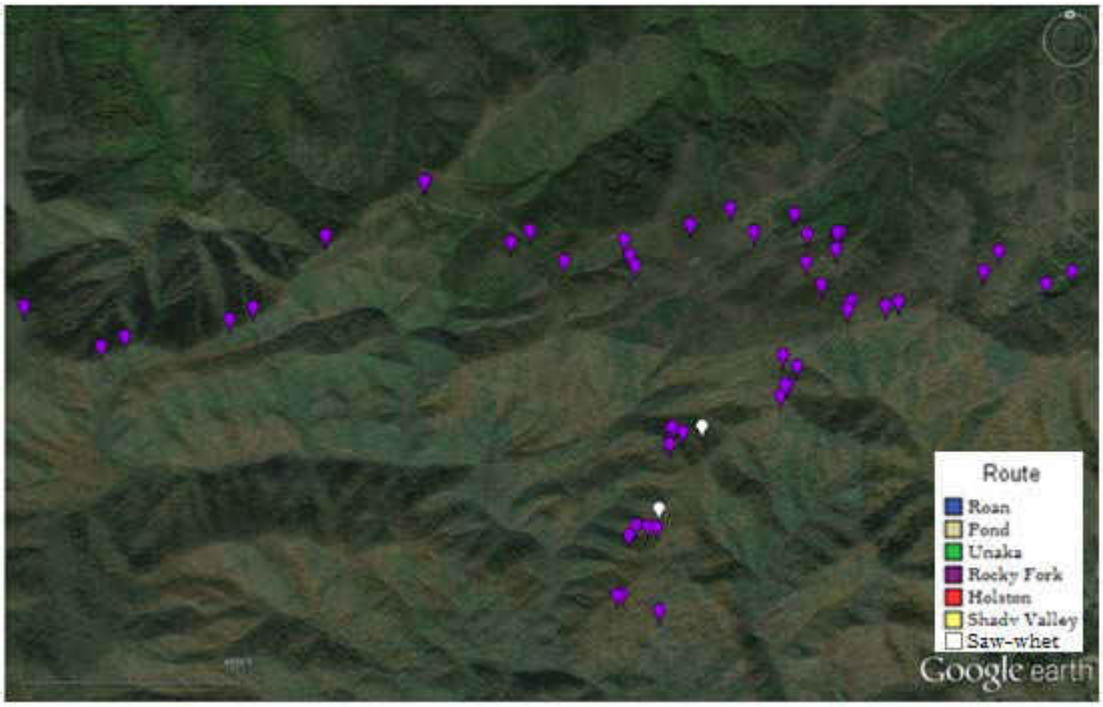

Figure 11: Rocky Fork Area sites that were surveyed

Figure 12: Rocky Fork Area sites that had a Northern Saw-whet Owl present

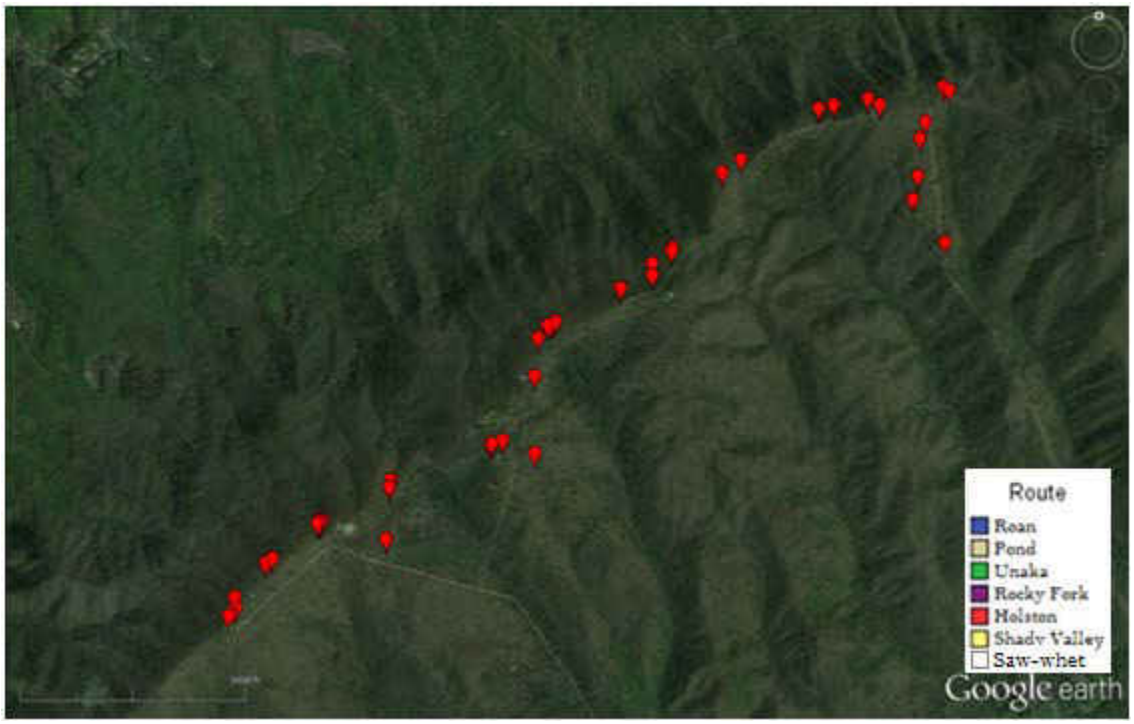

Figure 13: Holston Mountain sites that were surveyed

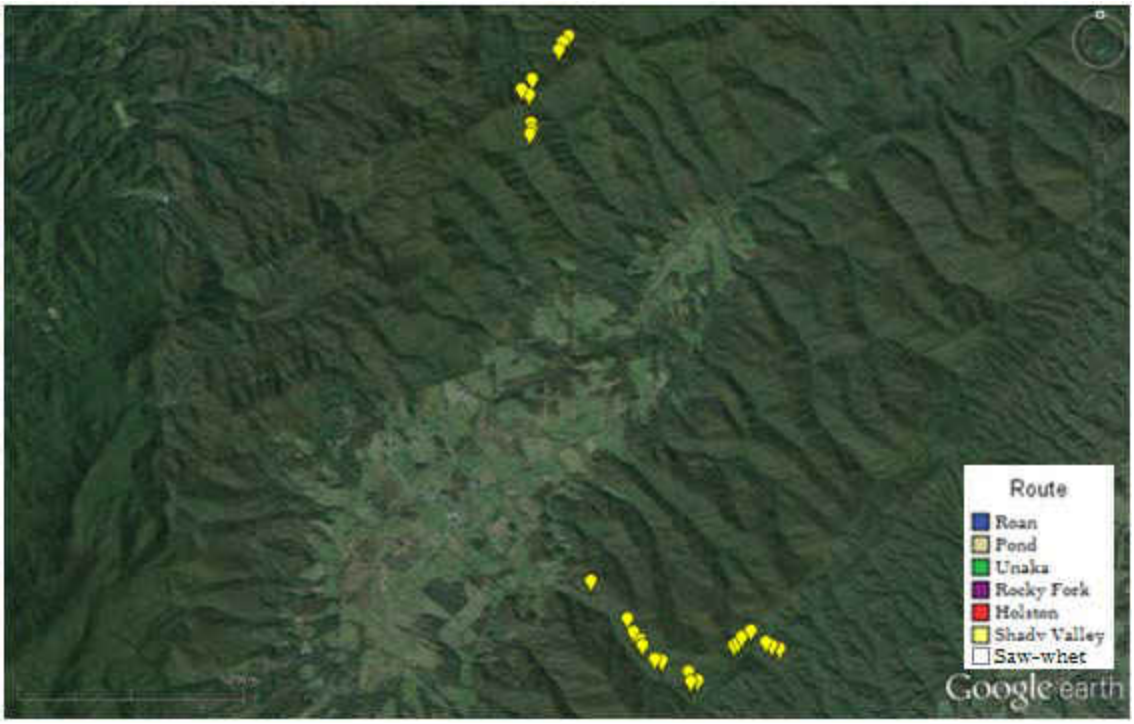

Figure 14: Shady Valley Area sites that were surveyed

Examination of Data Gathered from Pennsylvania Protocol

Of the 44 Northern Saw-whet Owls identified, 12 were located on Roan Mountain, 13 were located at the Pond Mountain Area, 9 were located at Unaka Mountain, and 10 were located at Rocky Fork. A graph showing the locations of the birds recorded can be seen in Figure 15. The count of the different bird codes found in Figure 15 exceeds the number of stops that were done by location. This was caused by situations when one of the surveyed stops would have multiple owls identified at it.

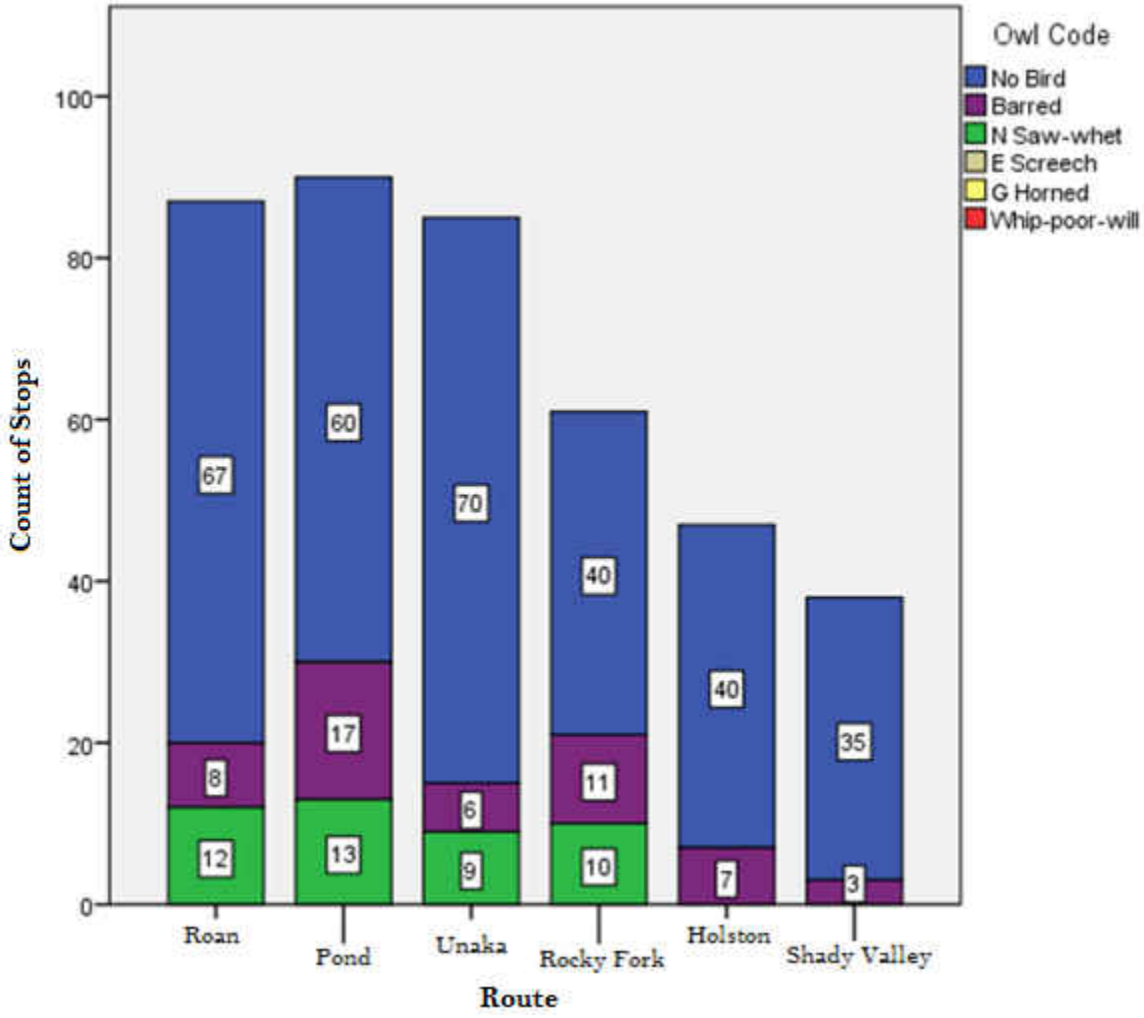

Figure 15: A listing of owls by location surveyed

The habitat concentration varied by the areas surveyed. Figure 16 shows how the different classifications were distributed by location. It should be noted that while the Pond Mountain Area shows some mixed habitat along its route, this was influenced by conifer trees that appear to be planted by local landowners. The Pond Mountain route follows a public road that winds through private land and some of the private land has had conifer trees planted for economic or aesthetic reasons.

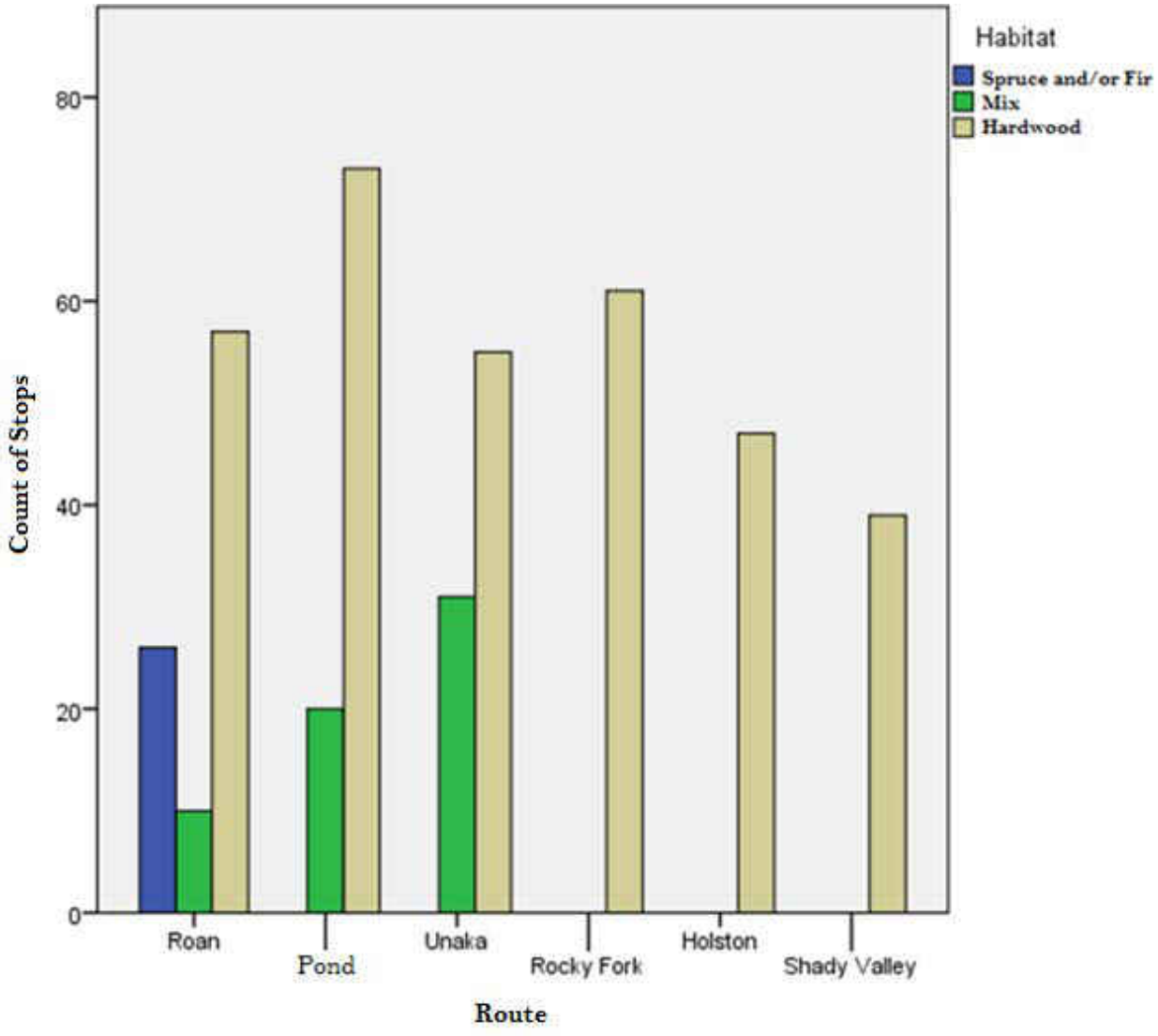

Figure 16: Habitat type frequency by location

The differing habitat types by location can be partially explained by the effect that elevation can have upon habitat. This is shown in Figure 17. The lower elevation sites surveyed had more of a hardwood component while the higher elevation sites surveyed included all three habitat types. This is consistent with the findings of Milling et al. in 1997. Milling also did not find a true Spruce and/or Fir component below 5,000 feet. This finding was supported by this study.

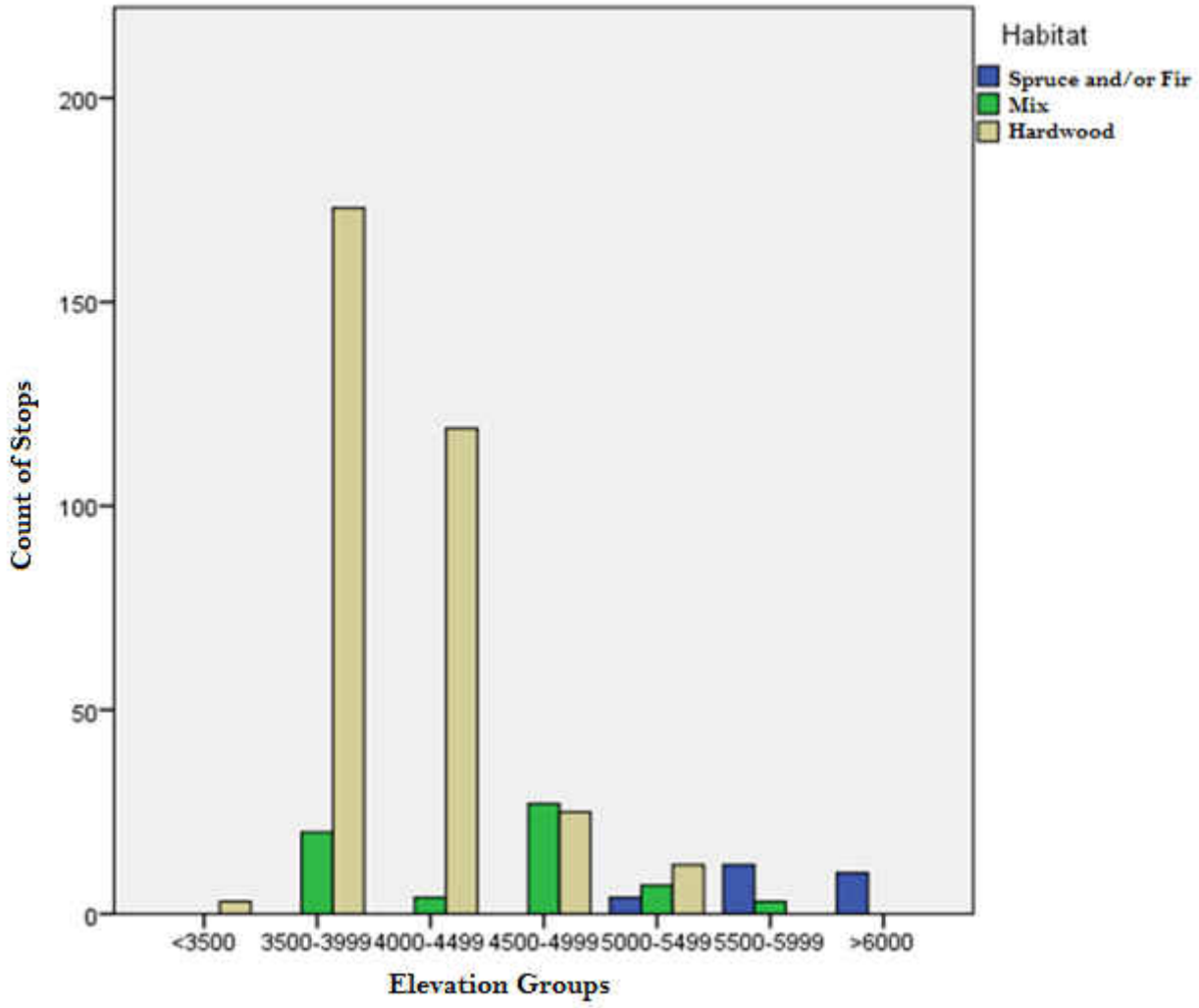

Figure 17: Habitat type by 500 foot elevation group

Northern Saw-whet owls were found throughout all three habitat types during the two-year study period. The current thinking is that while Northern Saw-whet Owls are habitat generalists in the northern part of their range (Cannings 1993), they are habitat specialists on spruce and fir in the Southern Appalachian Population. This study found a majority of the Northern Saw-whet Owls were detected in hardwood habitats instead of the Spruce and/or Fir habitat (as seen in Figure 18).

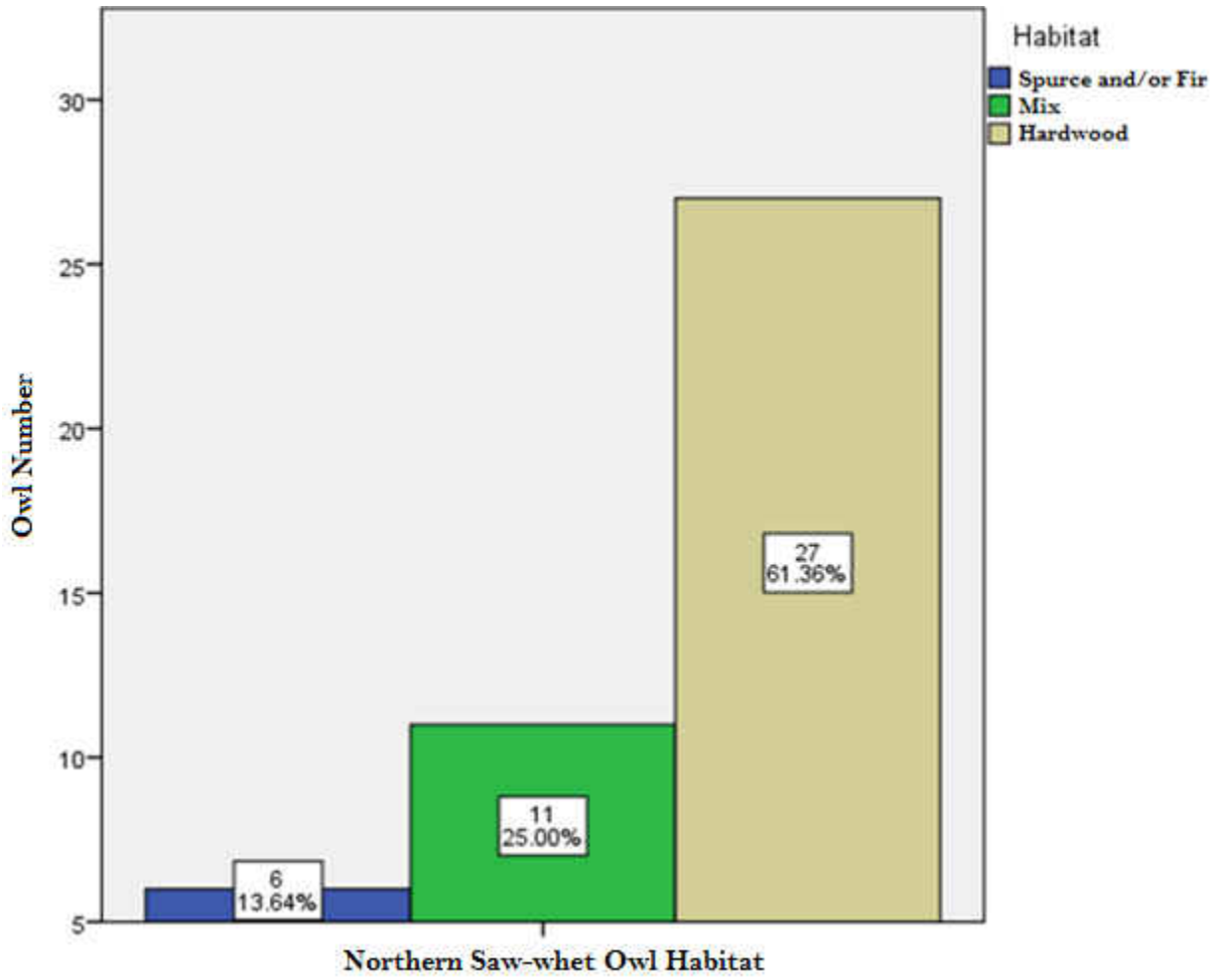

Figure 18: Northern Saw-whet Owl by habitat type

A Chi-Square Test was used on grouping of owls. The chi square statistics test if the owls were evenly distributed across different categories of habitat group (Table 6). The null hypothesis is that the owls would not be found in one categorical type of habitat more or less than the other types.

The expected proportions were calculated from the percentage of locations (Figure 19). It was not possible to survey each of the categories with the same frequency. Categories like hardwood habitats and lower elevations were surveyed more than the other groups. So the groups surveyed more could be expected to yield more owls. To avoid having the expected numbers be the same for all the categories (because they were not monitored with the same frequency), the expected frequencies were calculated from the number of times that each category was surveyed. The proportion of trips to each of the different categories was then used to generate the expected number to take into account that the categories were not surveyed with the same frequency. The expected count was generated by the percentage of times a group was surveyed multiplied by the number of owls that were observed while the observed count came from the data gathered from the field research.

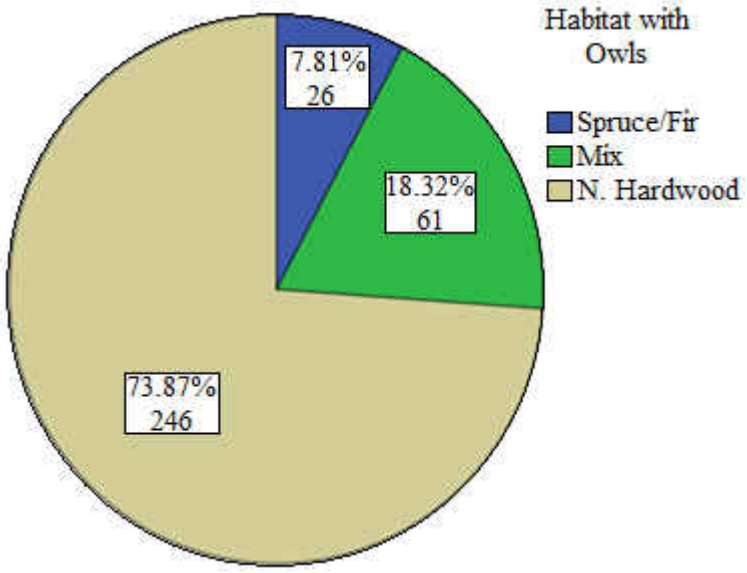

Figure 19: Habitat proportion of the areas surveyed that had Saw-whet presence

Table 6: Chi-Square Analysis on Saw-whet by proportion habitats surveyed

Habitat

	Observed N	Expected N	Residual
Spruce and/or Fir	6	3.4	2.6
Mix	11	8.1	2.9
N. Hardwood	27	32.5	-5.5
Total	44		

Test Statistics

	Habitat
Chi-Square	3.916[a]
Df	2
Asymp. Sig.	.141

a. 1 cells (33.3%) have expected frequencies less than 5. The minimum expected cell frequency is 3.4.

This result indicates that the difference between the observed numbers of owls by habitat type does not significantly differ from the expected numbers. This supports the null hypothesis that Saw-whets had an even distribution across habitats surveyed. This indicates that the Northern Saw-whet Owls detected did not show a statistical preference for habitat type.

Northern Saw-whet Owls were also found across a variety of elevations. This ran opposite of the findings of Milling et al. (1997). In that previous study, only one Northern Saw-whet Owl was heard below 4,500 feet and no Saw-whets were recorded below 4,000 feet throughout the mountains of North Carolina despite those elevations being surveyed over 25% of their study. In this study, a majority of the owls' presence was recorded below 4,500 feet with a large portion falling between 3,500 feet and 4,000 feet (Figure 20 and Figure 21). No owls were

recorded above 6,000 feet or below 3,500 feet but these elevations were only surveyed a combined 13 times throughout the two-year period.

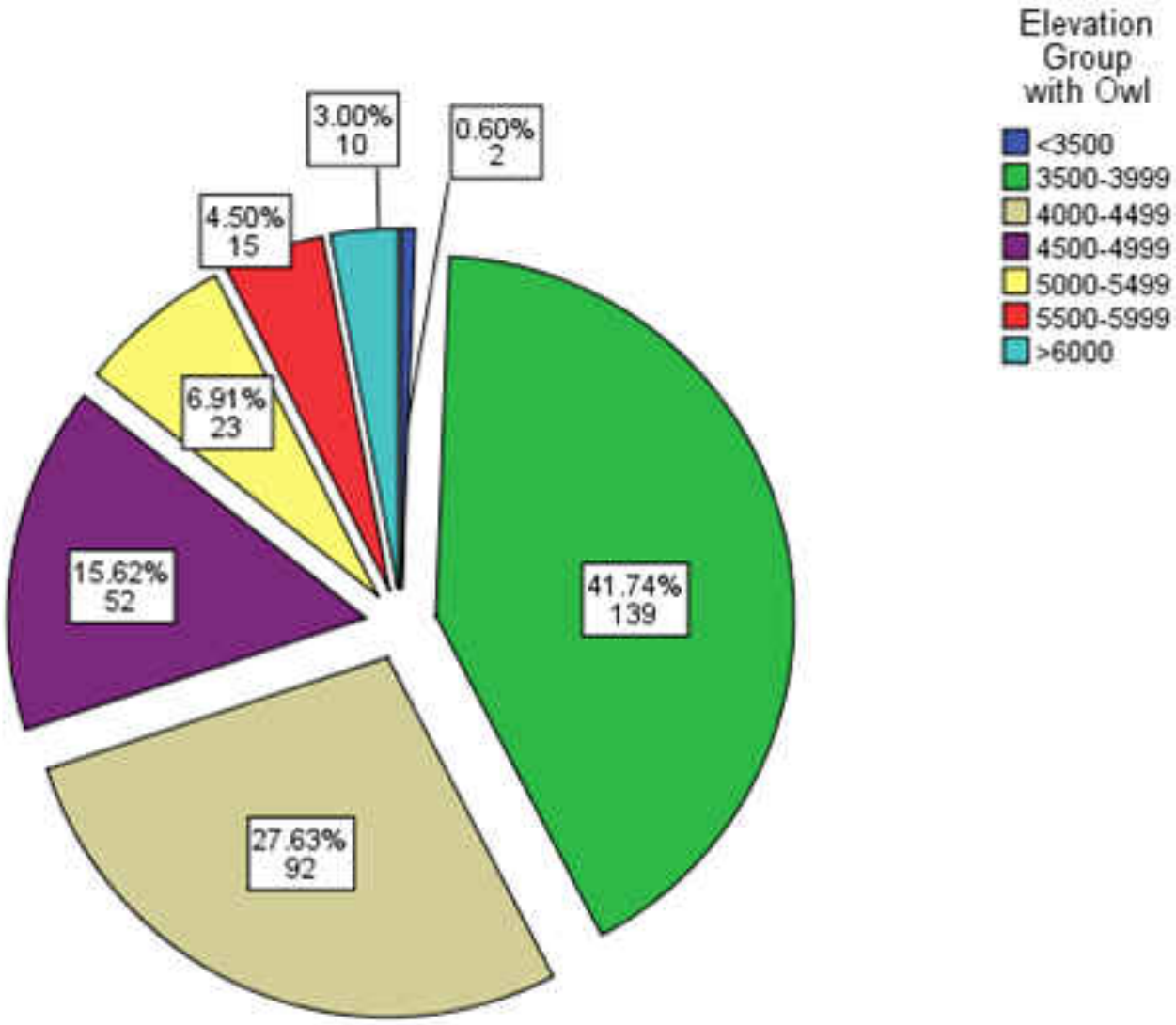

Figure 20: Northern Saw-whet Owl by elevation group

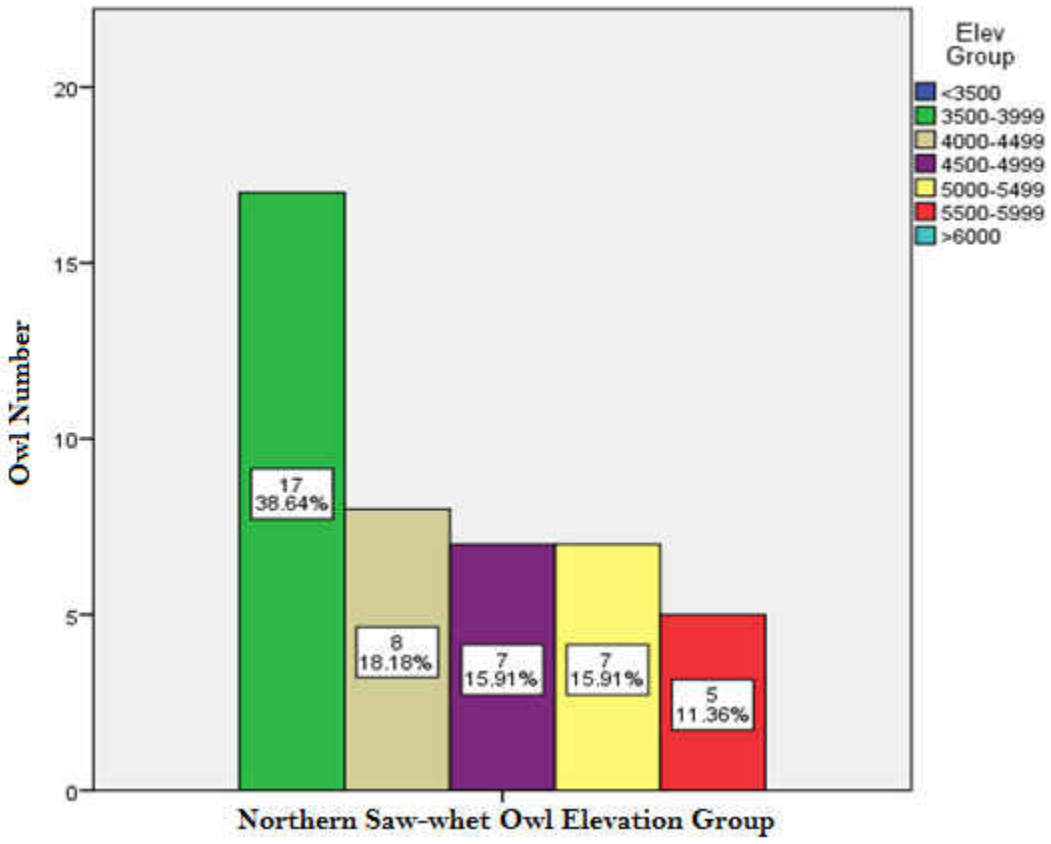

Figure 21: Elevation group proportion of the areas surveyed that had Saw-whet presence

The proportions of the different elevation groups that were surveyed with owls can be found in Figure 20. These proportions were then used to find the expected values in Table 7 below to see if there were any deviations from what was to be expected had there been no influence from the elevation groups.

A Chi-Square Test was again run on the grouping of Northern Saw-whet Owls. The chi square tests were chosen to test if the owls were evenly distributed across different categories of elevation group. The null hypothesis is that the owls are not found in one categorical type of elevation in a different number than the other types. The chi square test should reveal if the Northern Saw-whet Owls show an even distribution across the varying categories.

The expected proportions were calculated from the percentage of elevation groups surveyed that had Northern Saw-whet Owls present (Figure 20). It was not possible to survey each of the elevation groups with the same frequency. The lower elevation categories were surveyed more than the other groups. So the groups surveyed more could be expected to yield more owls. To avoid having the expected numbers be the same for all the categories (because they were not monitored with the same frequency), the expected frequencies were again calculated from the number of times that each category was surveyed. The proportion of trips to each of the different categories was then used to generate the expected number to take into account that the categories were not surveyed with the same frequency. The chi square test was not run on the percentages. Rather the expected count was generated by the percentage of times a group was surveyed multiplied by the number of owls that were observed while the observed count came from the data gathered from the field research. There were no Northern Saw-whet Owls that were recorded at the sites surveyed below 3,500 feet or at the sites surveyed that were above 6,000 feet. This only comprises 3.6% of all the stops that were surveyed.

Table 7: Chi-Square Analysis on Saw-whet by proportion of elevation groups

Elev Group by 500

	Observed N	Expected N	Residual
3500-3999	17	19.1	-2.1
4000-4499	8	12.6	-4.6
4500-4999	7	7.1	-.1
5000-5499	7	3.2	3.8
5500-5999	5	2.1	2.9
Total	44		

Test Statistics

	Elev Group by 500
Chi-Square	10.825[a]
Df	4
Asymp. Sig.	.029

a. 2 cells (40.0%) have expected frequencies less than 5. The minimum expected cell frequency is 2.1.

The results from the Chi-square analysis indicate that the observed number significant deviate from the expected number of owls. This does not support the null hypothesis that the owls can be found in the different elevation groups with the same frequency. It indicates that the lower elevation sites contained fewer owls than were expected while the higher elevation sites contained more owls observed than would be expected if there was an even distribution. This

suggests that the owls may prefer higher elevation because they were found in the higher elevations more than expected.

Another factor that could influence the number of Northern Saw-whet Owls that had been recorded is the time of the breeding season the owl is surveyed. The field season that was used for surveying the owls ran primarily from the start of March through the end of April. This time period was broken into two-week periods. These periods consisted of early March, late March, early April, and late April. The cutoff points were the first of the month and the fifteenth. The number of stops for each two-week period can be found in Figure 22.

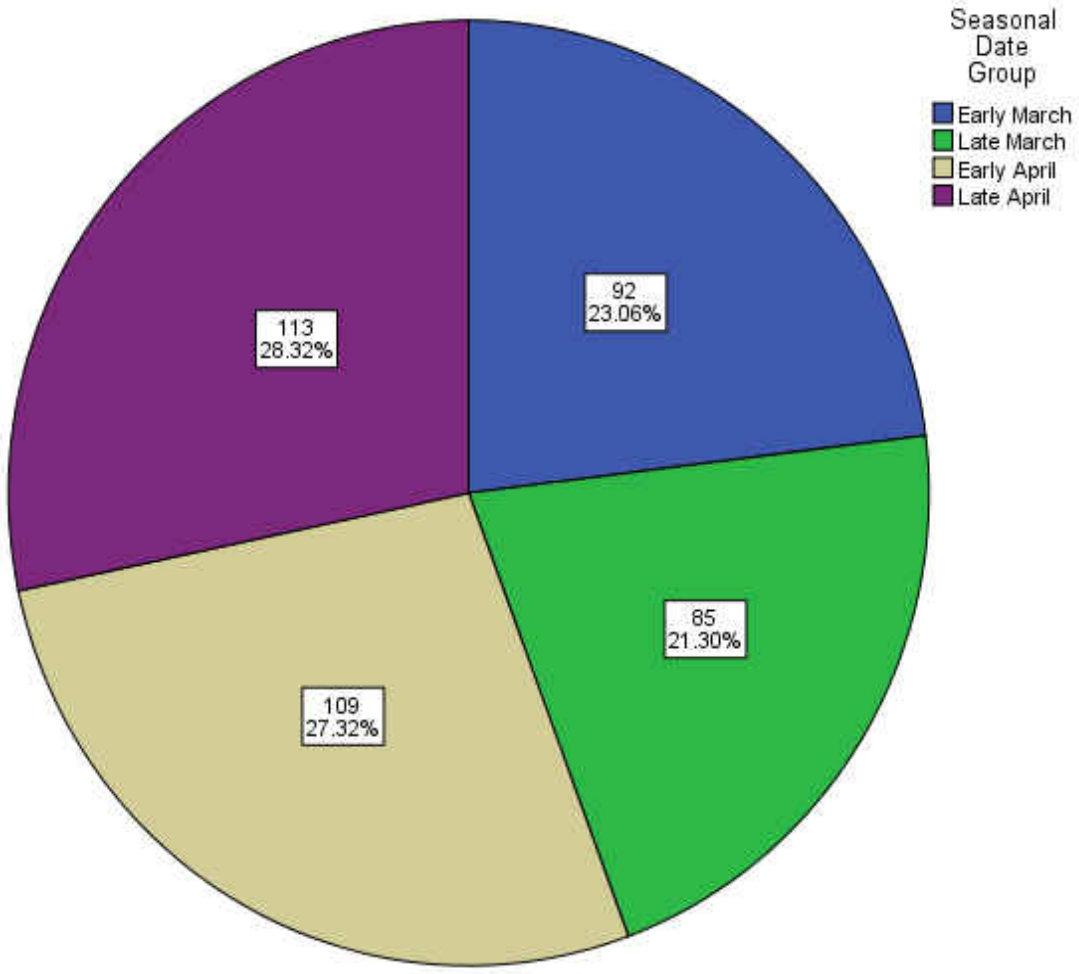

Figure 22: Number of trips by time period during the field season (during breeding season)

Northern Saw-whet Owl presence was recorded throughout the entire length of the field season. This was then set into the categories created by the two week periods from the Start of March through the end of April (Figure 23). There were no Northern Saw-whet Owls identified by the nightly surveys throughout this study during any other time frame.

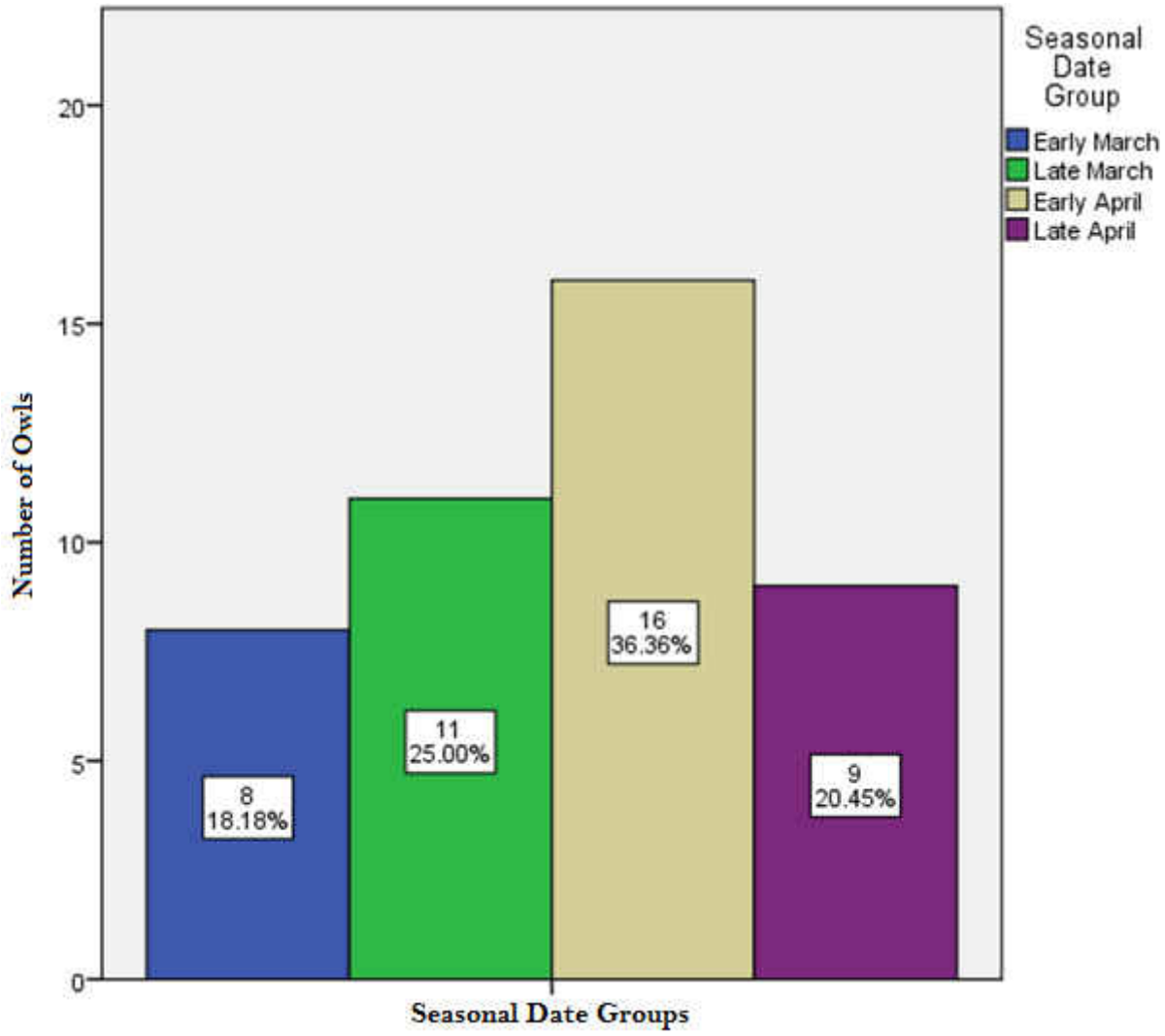

Figure 23: Number of Northern Saw-whet Owls by time period during the field season

A third Chi-Square Test was run on owl presence to see if the owl distribution was equal across the varying time frames described in Figure 22 (see table 8). The expected proportions were calculated from the percentage of date groups surveyed that had Northern Saw-whet Owls

present (Figure 23). As with the previous chi square analysis, it was not possible to survey each of the date groups with the same frequency. To avoid having the expected numbers be the same for all the categories, the expected frequencies were calculated from the number of times that each category was surveyed. The proportion of trips to each of the different categories was then used to generate the expected number to take into account that the categories were not surveyed with the same frequency. The expected count was generated by the percentage of times a group was surveyed multiplied by the number of owls that were observed while the observed count came from the data gathered from the field research. The null hypothesis is that there is no date group that yielded a significantly different number of owls.

Table 8: Chi-Square Analysis on Saw-whet by proportion stops conducted in varying periods

Date Grouping

	Observed N	Expected N	Residual
Early March	8	10.1	-2.1
Late March	11	9.4	1.6
Early April	16	12.0	4.0
Late April	9	12.5	-3.5
Total	44		

Test Statistics

	Date Grouping
Chi-Square	3.015[a]
Df	3
Asymp. Sig.	.389

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.4.

This result indicates that the difference between the observed numbers of owls by date group does not significantly differ from the expected numbers. This supports the null hypothesis that the Saw-whets had an even distribution across date groups surveyed.

While there was no difference in number of Northern Saw-whet Owl by time period, observers could not access some of the higher elevation areas at the start of the field season due to inclement weather. This led to lower elevation sites being surveyed earlier in the field season since they were accessible while the higher elevation sites started being surveyed later in the field season (see Figure 24).

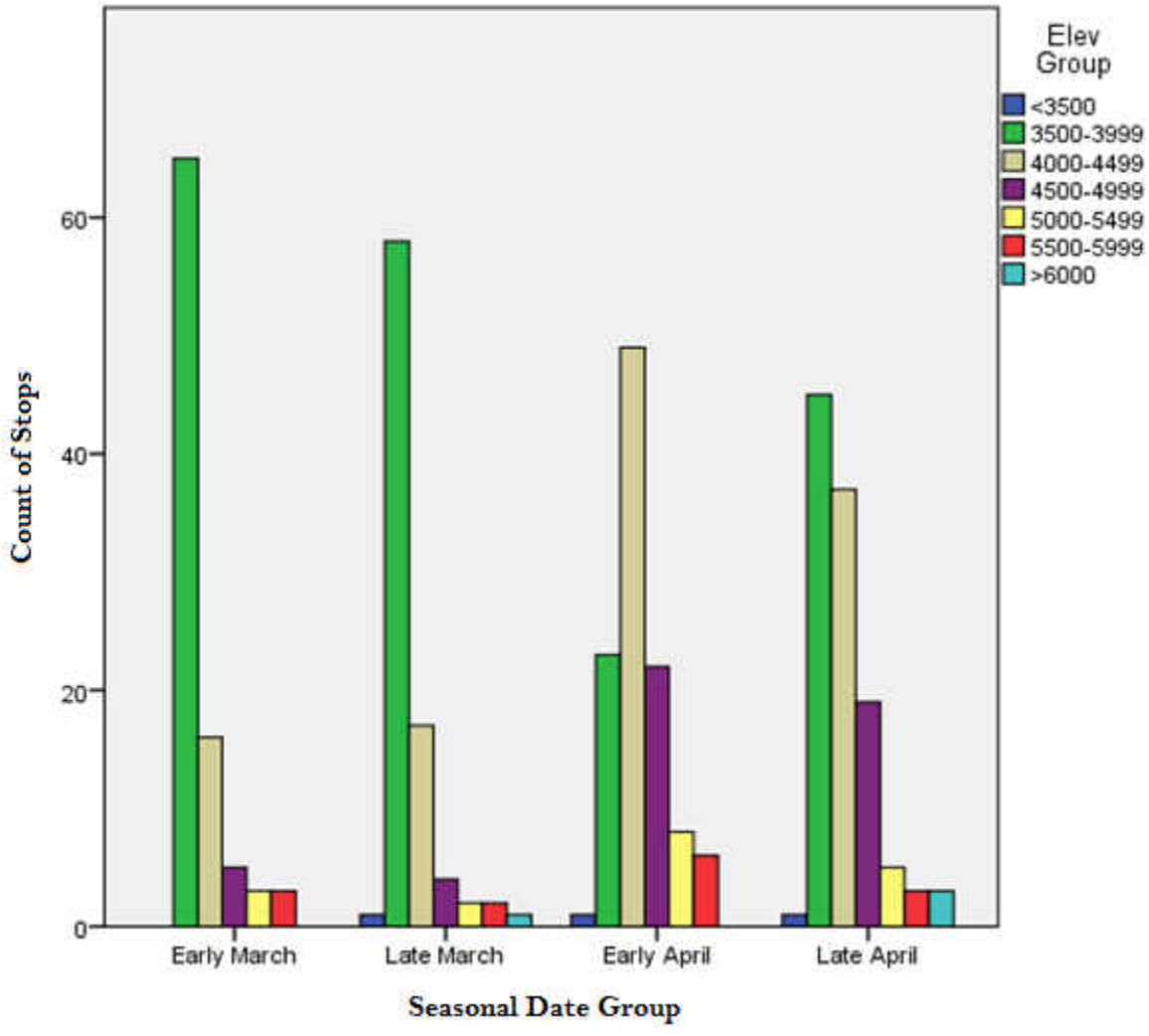

Figure 24: Elevation groups that were surveyed across the different date groups

The difference of the elevations surveyed by date is reflected by the mean elevation of the stops. Figure 25 shows that there is a significant difference between the elevation surveyed in the months of March and April. April's elevations are greater because more of the higher elevation sites became accessible and began to be surveyed for owls.

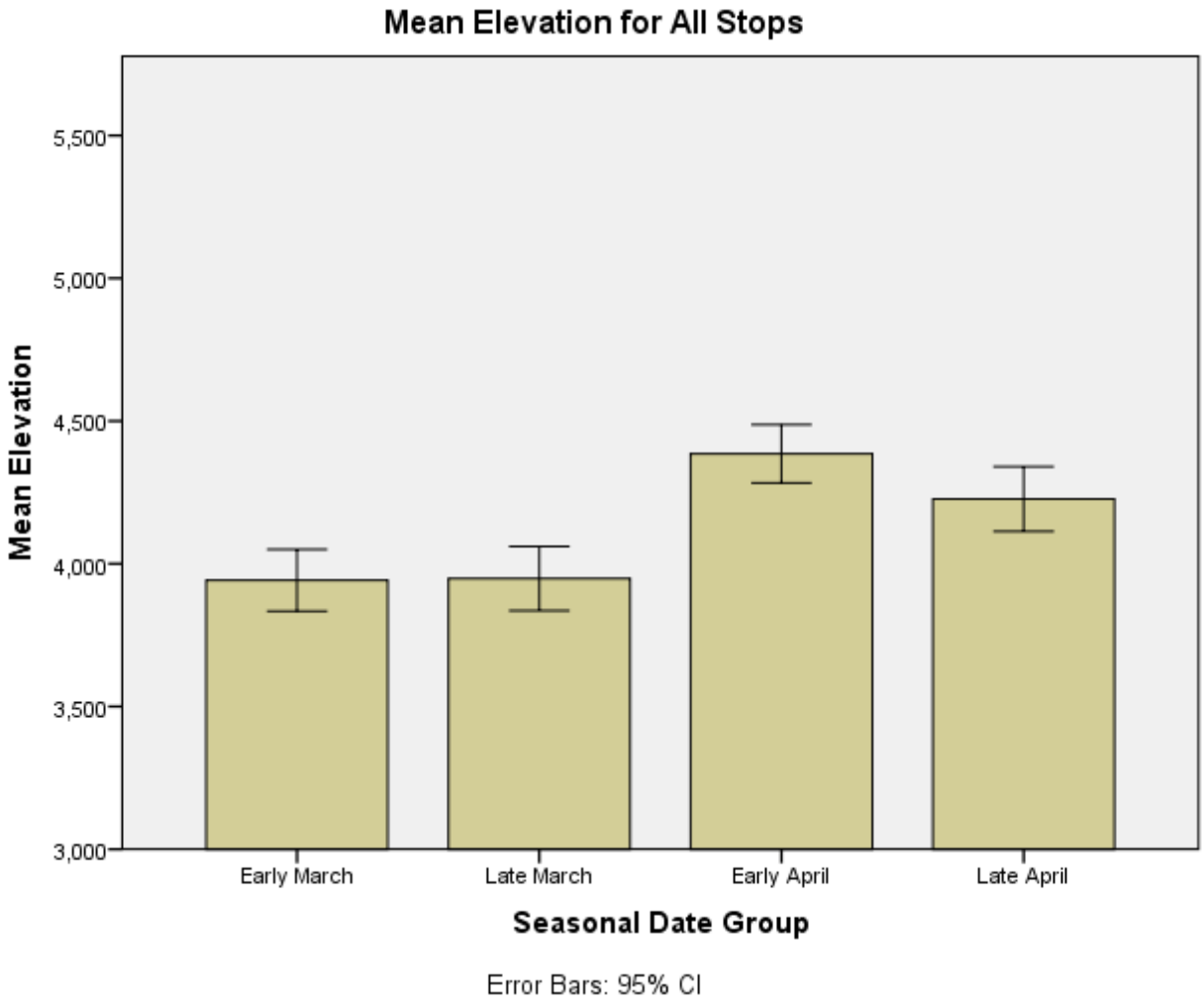

Figure 25: Mean elevation of all stops by the seasonal period

These differences are further corroborated by an independent samples Kruskal-Wallis test. These test results indicate that the distribution of the sites surveyed is not the same across the four seasonal date groups (Table 9 and Table 10).

Table 9: Mean elevation of all sites that were surveyed for Northern Saw-whet Owls

Report

Elevation

Seasonal Date Group	Mean	N	Std. Deviation
Early March	3942.27	91	520.584
Late March	3948.22	85	521.232
Early April	4385.23	109	537.433
Late April	4226.73	113	608.585
Total	4145.62	398	580.897

Table 10: Independent Samples Kruskal-Wallis Test results on all the sites surveyed

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Elevation is the same across categories of Seasonal Date Group.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis

As mentioned above, the surveyed site elevation changed with each date group as more areas became accessible. This change was reflected in the elevations where Saw-whets were found to be present. Figure 26 shows the elevations where Saw-whets were heard. Early in the field season, a majority of the Saw-whets were heard at lower elevations. Later the mean elevation with birds followed the trend of increased surveys of higher elevations (Figure 27).

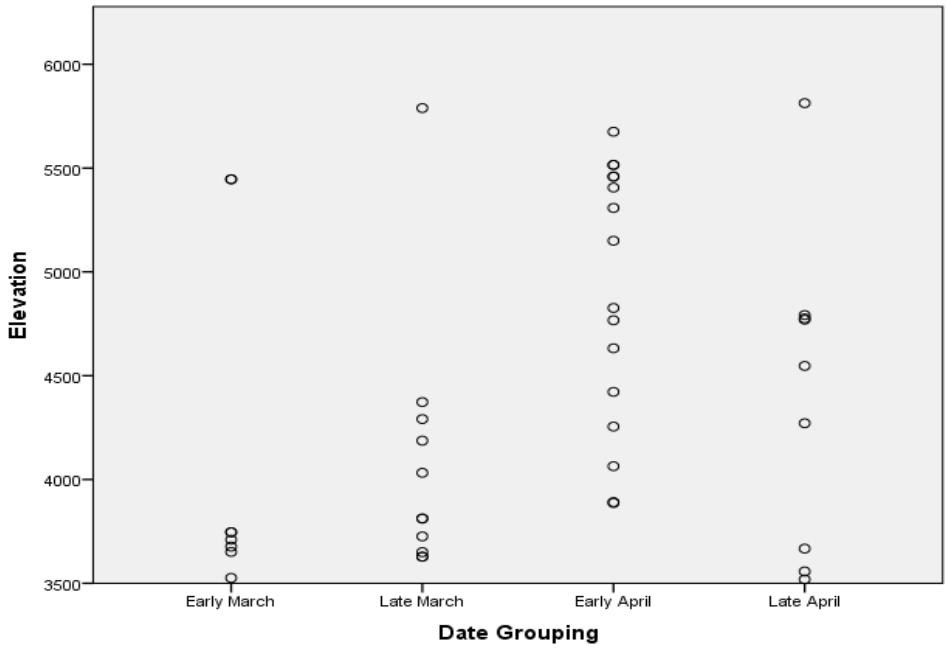

Figure 26: Individual elevations of sites with Northern Saw-whet Owl presence by time period

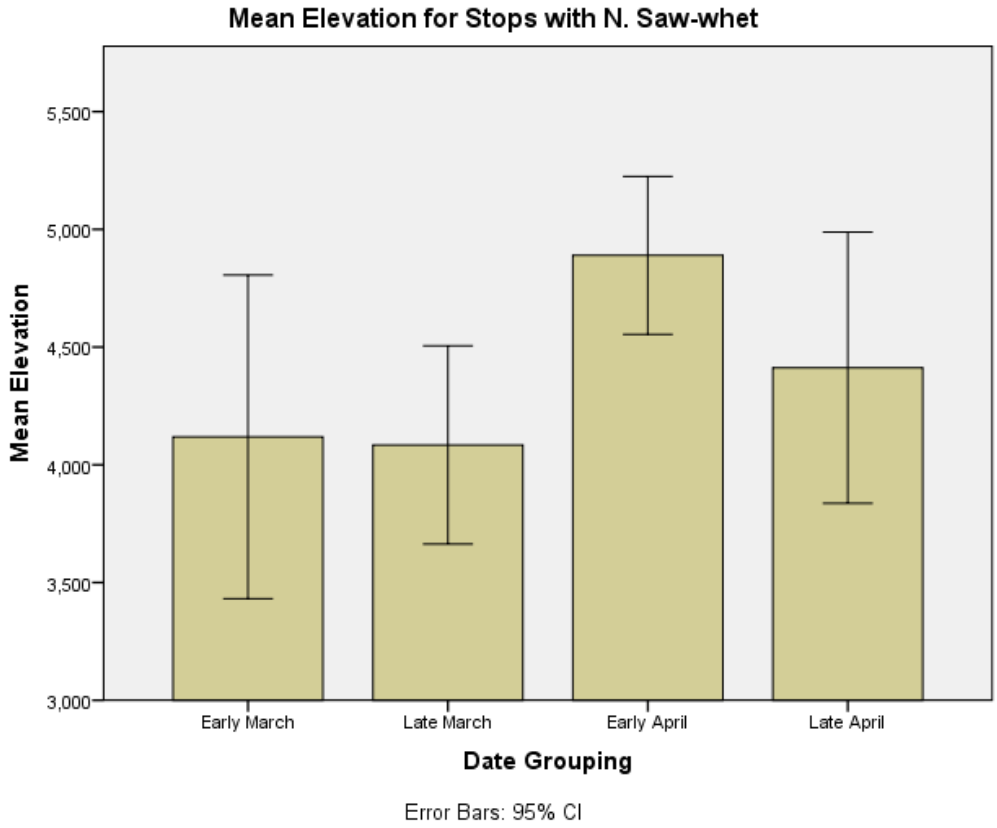

Figure 27: Mean of different elevations for sites with Northern Saw-whet Owl

An independent samples Kruskal-Wallis Test was run to see if there was any difference in the elevations where Northern Saw-whet owls were found (Table 11 and Table 12).

Table 11: Mean of the elevations with Northern Saw-whet Owls by different time period

Report

Elevation

Date Grouping	Mean	N	Std. Deviation
Early March	4118.50	8	822.317
Late March	4084.36	11	626.663
Early April	4889.44	16	629.703
Late April	4412.44	9	749.122
Total	4450.43	44	755.599

Table 12: Results of Kruskal-Wallis test on elevations containing Saw-whets by time period

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Elevation is the same across categories of Seasonal Date Group.	Independent-Samples Kruskal-Wallis Test	.014	Reject the null hypothesis

This test indicated that the distribution of elevation where Northern Saw-whet Owls were found is different across the different time periods. It indicates that the early time frame had lower elevation owls while late had owls at higher elevations. This follows the pattern that was seen by all the sites surveyed.

CHAPTER 4

DISCUSSION

The data show the distribution of Northern Saw-whet Owls throughout the northeastern edge of Tennessee. Owls were found at sites that had been surveyed in the past as well as at sites that had never been actively checked for Northern Saw-whet Owls. For the previous sites, Northern Saw-whet Owls were found at Roan and Unaka mountains. This is consistent with the past studies (Barb 1995; Tamashiro 1996; Cockerel 1997; Milling et al. 1997; Williams 2003) as well as with the current notion of where one should look for the owls. However, the owls were also found at sites where they were not expected to be present. The Pond Mountain Area runs along a ridgeline that stays between 3,500 feet and 4,000 feet. Similarly Rocky Fork stays below 4,500 feet. By having these two new areas surveyed, it now appears that the Northern Saw-whet Owl is indeed present in a multitude of areas above 3,500 feet.

The nightly surveys using the Pennsylvania Protocol were able to successfully locate owls. However this method does not allow for a complete statement as to where the owls are located because an observer is only present at a location for less than 15 minutes. Future work needs to include a more systematic use of acoustical recorders that can record all sounds at a given location for multiple nights. While this project did incorporate such recorders, they were not able to record any owls. It is not clear if this lack of identifiable owls was due to inadequate recorder settings, improper use of analysis software, poor recorder placement on trees that created acoustical shadows, or a lack of vocal owls at chosen locations. Recommendations for future work using acoustical recorders should ensure that the recorders' settings are able to pick up the owl vocalizations and that the analysis software used can identify the calls. Work also needs to be conducted in the field to find the range that the acoustical monitors can cover. This

should allow for a more conclusive statement about the presence or absence of owls at areas beyond what can be generated with nightly surveys alone.

It was hypothesized that habitat would not be the most important indicator of Northern Saw-whet Owl distribution. While owls were found in the Spruce and/or Fir habitats of higher elevations, Rocky Fork is almost exclusively hardwood while the conifer component along the Pond Mountain Area is mostly man-made. Yet both of these areas had substantial Saw-whet presence. Of the 44 Northern Saw-whet Owls, a majority were located in a hardwood habitat (Figure 21). This presence holds true even when the proportion of habitat surveyed is taken into account. While tests show that the owl is found in all three habitat types in roughly the same proportions, it is worth noting that the Southern Appalachian population has been thought to be specifically located in the Spruce and/or Fir habitat. But comparing the habitats of the Northern Saw-whet Owl population in the Southern Appalachian Mountains with the habitats of other populations in northern America, it does not seem that the Southern Appalachian population is any more of a habitat specialist than the other populations found in the northern and the western parts of the owls' range. It would be difficult to generate a specific habitat type to act as an indicator of where the Southern Appalachian owls could be found. While the owls observed in the Spruce-Fir habitat did occur more than was expected, this result is was not significant enough to warrant it as the best indicator of owl presence. So by being consistently found in the Hardwood habitats throughout the study period, this study suggests that the Northern Saw-whet Owl of the Southern Appalachian Mountains may be more of a habitat generalist than was previously thought. This helps substantiate previous anecdotal claims of owls being heard in Northern Hardwoods with no Spruce-Fir component.

A better indicator of Saw-whet presence may be the elevations at which the owls were detected. The Northern Saw-whet Owls detected during this project were not restricted to any one elevation class. Owls were found at elevations that ranged from below 3,500 feet to above 5,500 feet. Despite being at all elevations, it appears that the Northern Saw-whet Owls distribution is affected by elevation. Northern Saw-whet Owls were found at higher elevations more than what the number of trips to that elevation would lead to be expected. Taking into account the number of elevation groups surveyed, this preference indicates Saw-whets significantly prefer higher elevations (Figure 22; Table 9). This supports the idea that these owls can be found more at the higher elevations one would find on Roan or Unaka mountains the higher elevations appear be the best source to find these owls. However, it is important to note that the lower elevation areas should not be discounted. A majority of the Saw-whets detected by this project were found below 4,500 feet (Figure 22). Even with the prevalence of surveys at these lower elevation sites (Figure 23), the owl is not constrained to the higher elevations as most may think. So while there may be a better chance of seeing owls at the higher elevations in Northeastern Tennessee, people seeking the owls should not completely discount the lower elevations they pass through as they seek the owls at the higher elevations.

Birders seeking the Northern Saw-whet Owl should also note that the time of year, ranging from early March through Late April for this project, did not fully account for the detections of the owl. The birds were detected with equal abundance in all of the date groups. One trend involving the date groups that needs to be addressed is the apparent correlation between time of year and the elevation that the owls were found. While the data and the analysis run on the elevation with Northern Saw-whet Owl presence indicated that the owls are likely to move to higher elevations later in the season, this result is most likely an artifact due to the

observers' sampling effort. This trend is due to the higher elevations being inaccessible until after winter's ice and snow had melted.

News that the Northern Saw-whet is more of a generalist may be important for the future of the area's population. Due to the problems this population faces such as logging, climate change, air pollution, and tree deaths from adelgids, it is vital that any species be able to use multiple habitats as their historical habitats are overtaken by warmer climate trees. Being able to use multiple habitats should decrease the pressures due to competition for resources and nesting sites. Over the past 15 years since the publication of Milling's data in 1997, the owl has appeared to inhabit more of a wider swath of habitat. The 1997 publication did not find owls to be lower than 4,000 feet. If anything, this project's findings suggest that owls can be found during the breeding season at 3,500 feet with the potential to be slightly lower. While a change in elevation where owls were found may be a modest finding, it does suggest that the owls can survive as elevations see a shift in habitat.

Finding owls at the new areas (Pond Mountain Area and Rocky Fork) may be beneficial for the conservation of the Southern Appalachian population of Northern Saw-whet Owls. The Pond Mountain Area had a vast majority of its sites located in private landholder's property. This area was the most interesting of the project because it consistently had owls from early March through late April. Likewise, the area was unique because it did not fit the criteria normally listed for breeding Saw-whets: high elevation stands of Spruce and/or Fir trees. While the early March birds may have been migrants heading towards more northern locations, it is very likely that the birds that were still there later in the breeding season had nest sites available. Without a suitable nest site, the male owls move to set up a new territory that would be acceptable for the females. Three calling Northern Saw-whet Owls were recorded on 17 April 2014, well into the breeding

season. Indeed, the area has numerous trees that should be suitable for having cavities that the owls could use for nesting. If this site does hold multiple nesting Saw-whets, it would be prudent to ensure that no major man-made habitat changes occur along that area.

Like the Pond Mountain Area, Rocky Fork was a site that did not fit the normal standard for Northern Saw-whet Owls. This area had a calling Northern Saw-whet Owl on 21 April 2014, still well into the breeding season. This suggests that Rocky Fork may also have owls using the area for breeding. Rocky Fork is similar in habitat composition to the Pond Mountain Area. Rocky Fork is higher in elevation than the Pond Mountain area. But the major difference between the two areas is that Rocky Fork is mainly owned by either the state of Tennessee or the United States Forest Service. There is currently a discussion to put in a campground near the entrance of Rocky Fork. Due to the high number of owls in this location, it may be beneficial to ensure that any disturbance is kept minimal.

Little is still known about the Northern Saw-whet Owl in eastern Tennessee. New information is gathered every year on this population's dynamics, such as an owl being identified at 2,640 feet late during its breeding season, as well as this study's finding that owls may be habitat generalists unlike previously thought. Until more is known about its life history and breeding behaviors, care should be taken to ensure that the population is not put through unwarranted stress. The possibility that the Southern Appalachian population is a genetic reservoir for Saw-whet Owls (Tamashiro 1996) increases the need for more complete information regarding this species in Tennessee. Even though this paper has helped to further the knowledge about the owl's distribution, more research regarding the life histories and population dynamics of this Southern Appalachian population is needed to ensure the presence of this small and reclusive owl.

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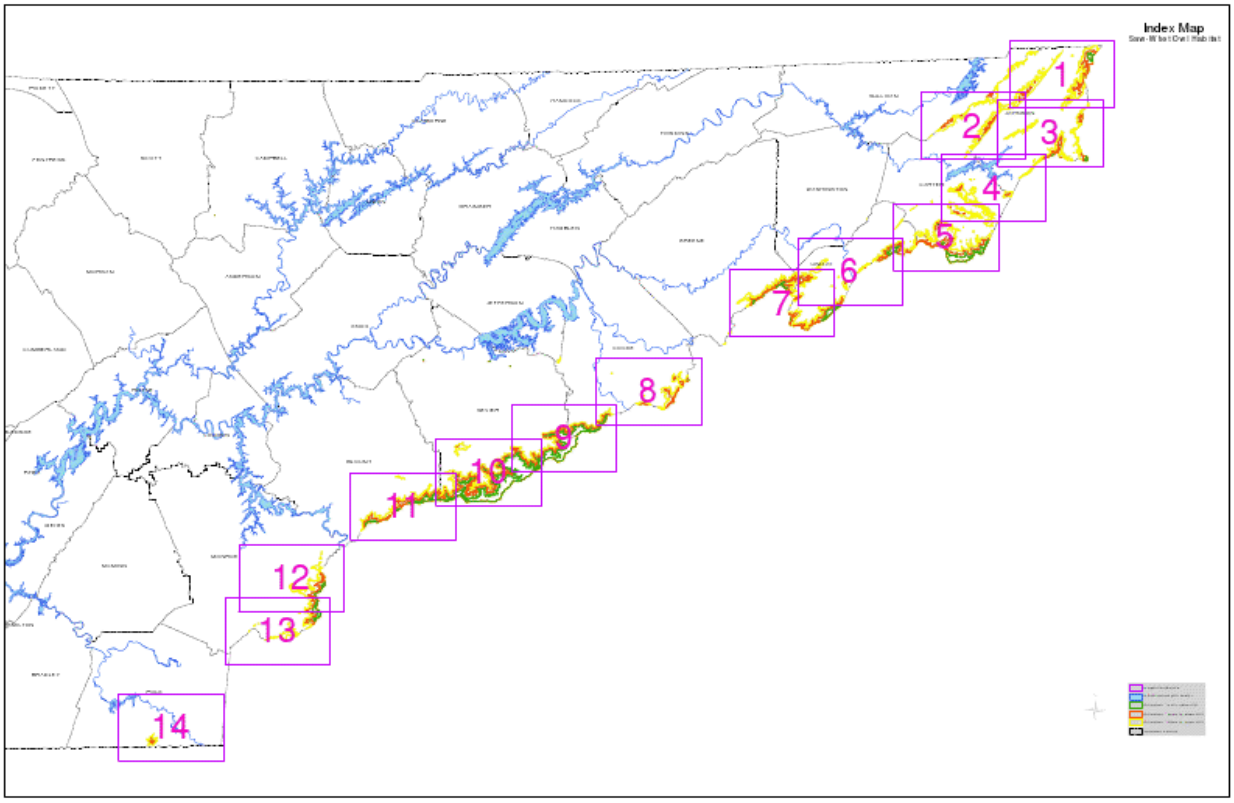
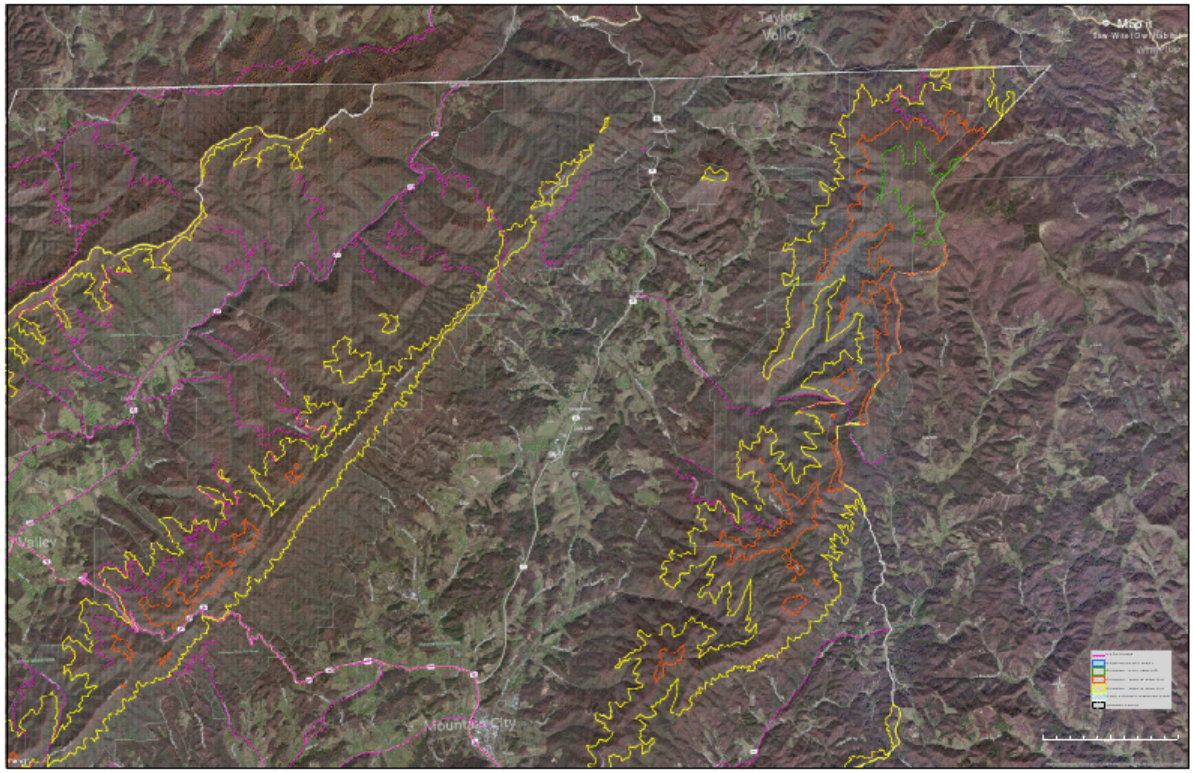
APPENDICES

Appendix A

Area Maps Provided by the GIS Department of the TWRA



Reference map of locations surveyed



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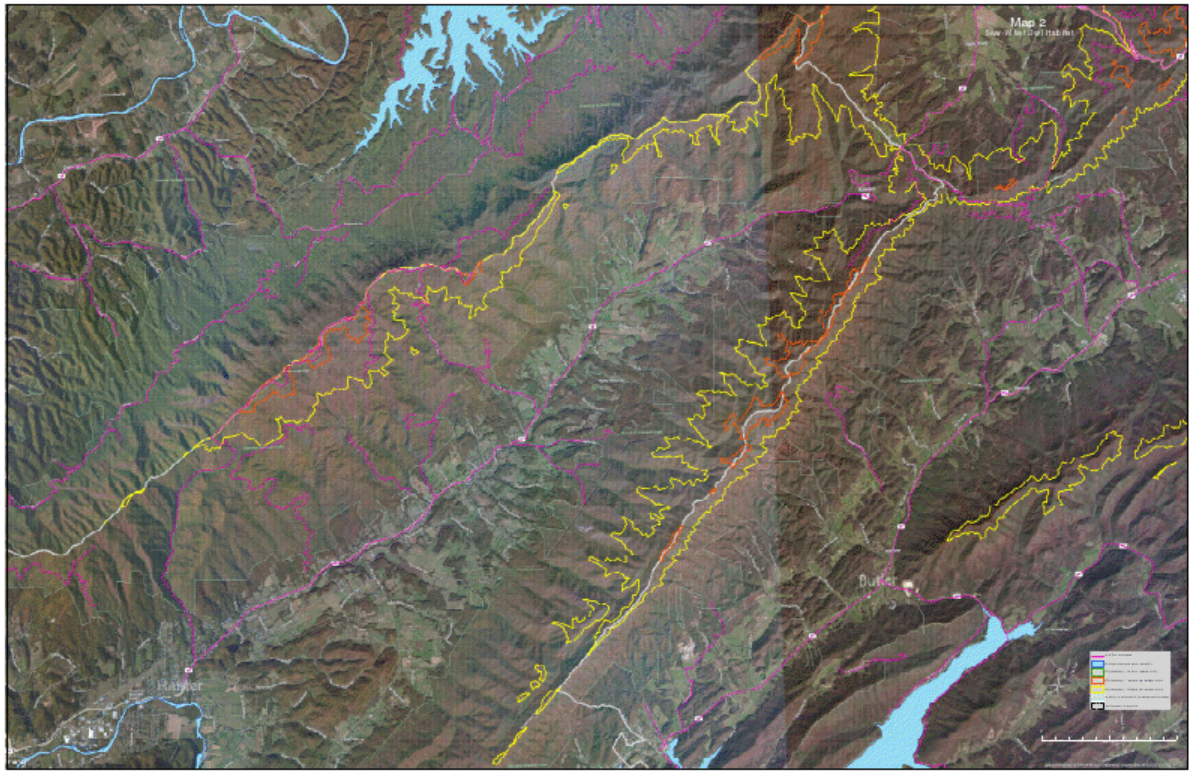

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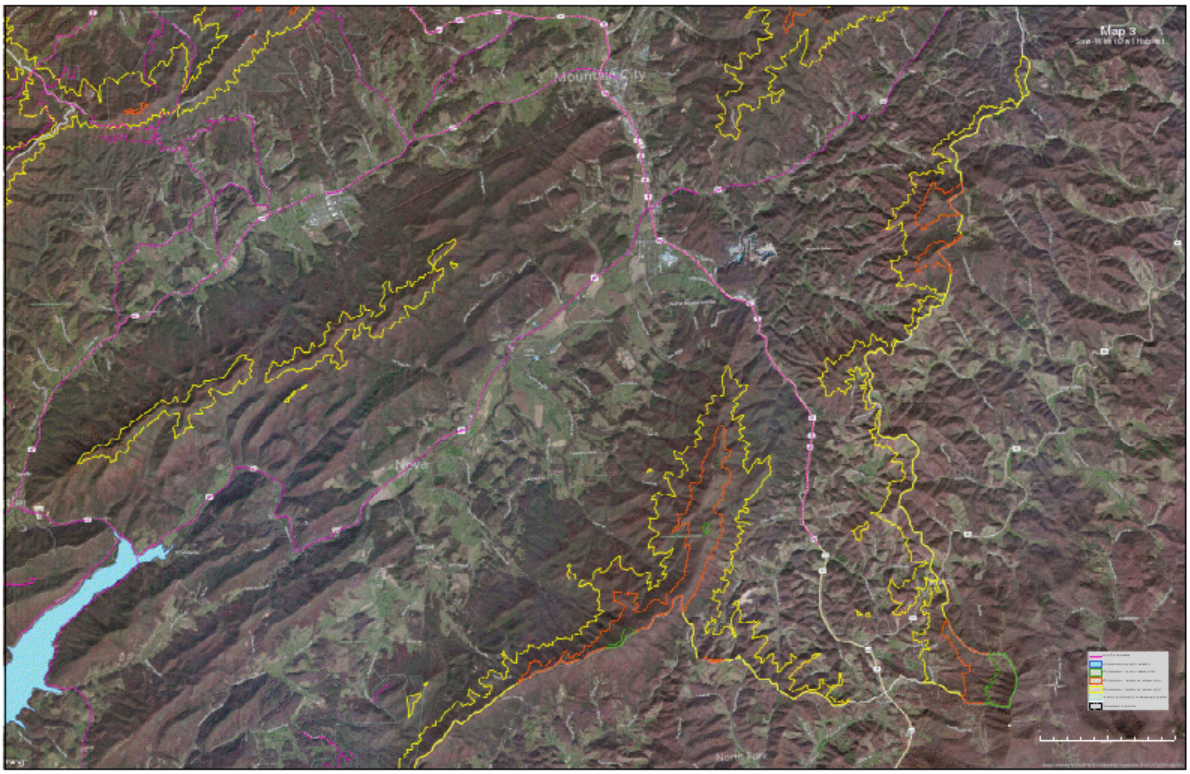

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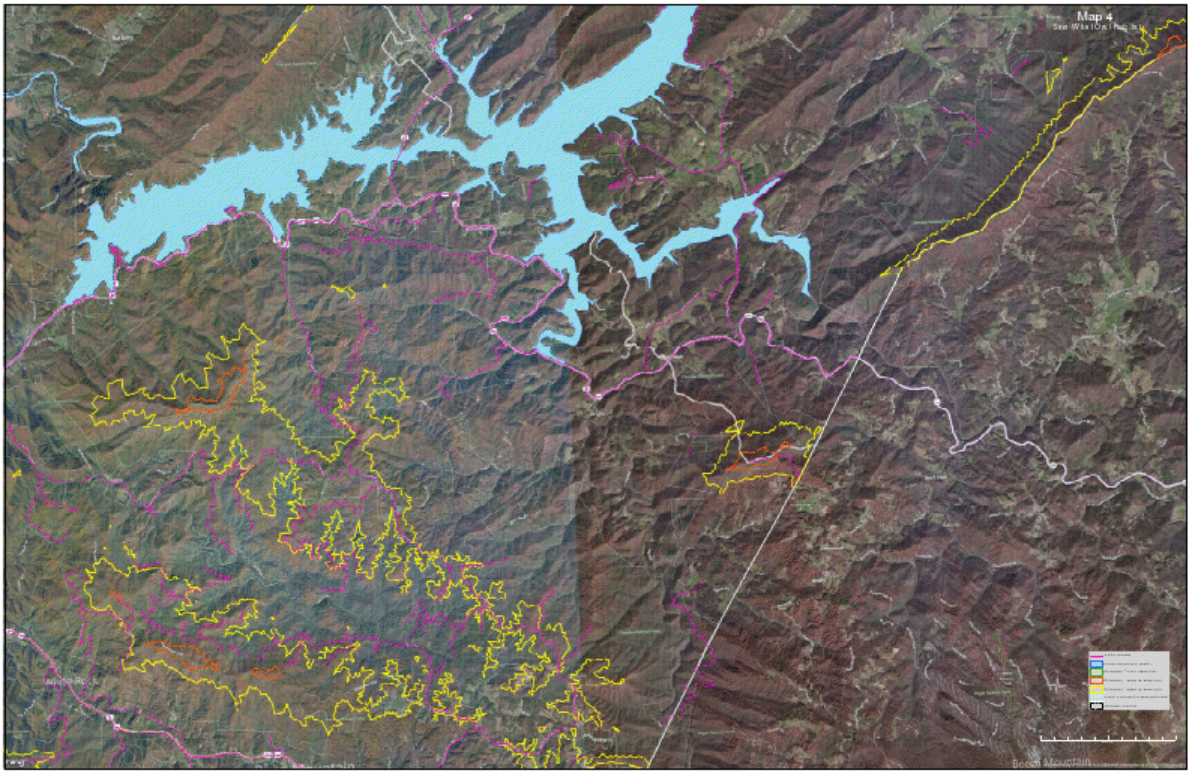

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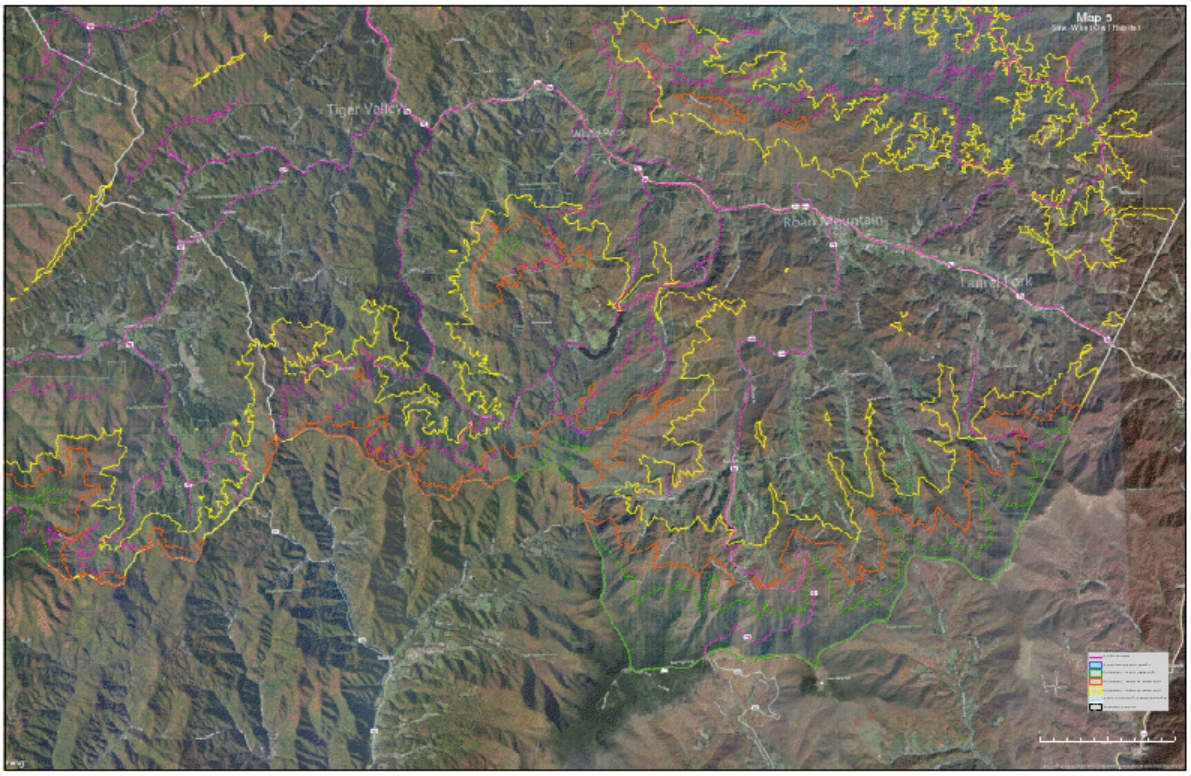

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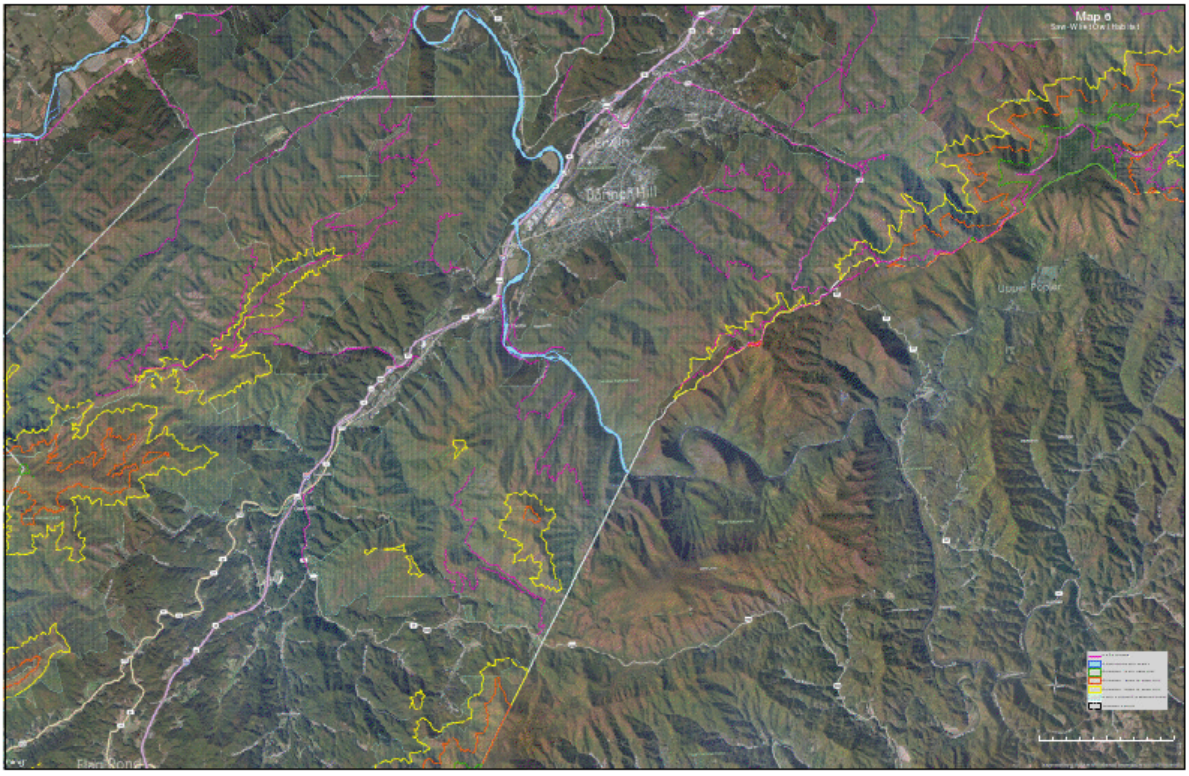

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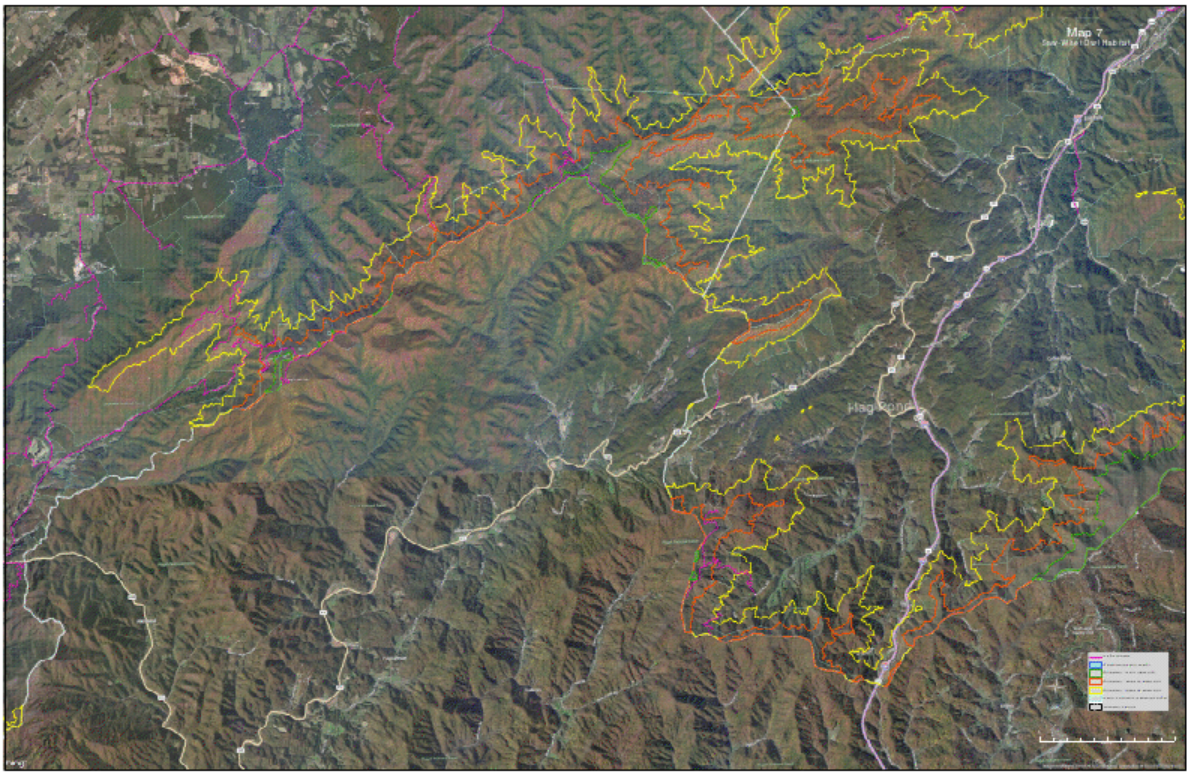


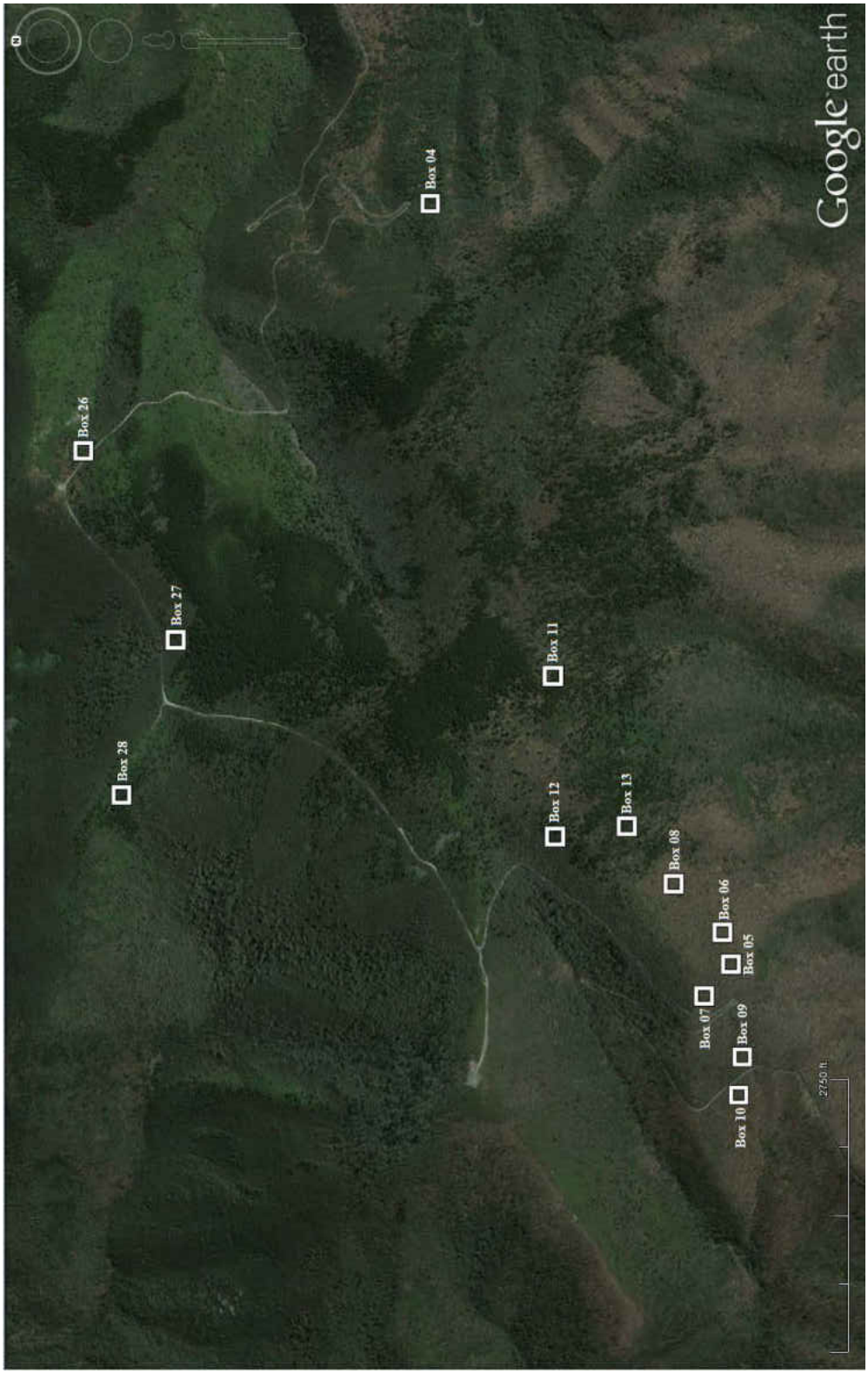
Sector 7

Appendix B

Nesting Box Descriptions and Locations in Northeastern Tennessee

Box **04**-	N 36.135278 W 82.283222 Elevation 4314	Old AT @ switchback on 107 side (front) Located down slope on white pine ~20 ft up Box on downslope side
Box **05**-	N 36.127722 W 82.307333 Elevation 4698	AT @ switchback on Beauty Gap Side (back) Box ~ 100 yards upslope from AT On Hardwood tree in rock field
Box **06**-	N 36.127944 W 82.306333 Elevation 4698	Located to E of box 05 Surrounded by rocks Box on Hardwood tree with thick fork in tree
Box **07**-	N 36.129194 W 82.304806 Elevation 4783	Box to N of box 06 (~.1 mi) Hardwood tree strand E of silver pine Box down slope (E)
Box **08**-	N 36.128389 W 82.308333 Elevation 4750	Box W of Box 05 Box located on E of Hardwood Box on upslope fork Ò↗
Box **09**-	N 36.126583 W 82.310667 Elevation 4301	Box upslope of road on B Gap side Up rock wash at bend right near bottom Upslope on HW to N of wash, tree forks at 30’
Box **10**-	N 36.126583 W 82.312056 Elevation 4163	Located on opposite side of road from Box 09 Down slope on large oak w/ fork @35’ Box on W side – down slope
Box **11 -**	N 36.132306 W 82.298389 Elevation 5129	On AT near peak- past Rhododendron thickets @ Evergreen patch, head to the E Box on Fir tree facing E (down slope)
Box **12**-	N 36.132194 W 82.303278 Elevation 4913	AT after boulders- ~ ¼ mile below 011 After boulders, head W through undergrowth Box on Spruce facing upslope (E)
Box **13**-	N 36.130417 W 82.302972 Elevation 4883	On AT before boulders on trail Box located to E (right when going up), ds On Black Oak tree
Box **26**-	N 36.144000 W 82.291361 Elevation 4688	On main road coming from Unicoi Side ~200 feet before saddle, large Spruce Box on small spruce slightly ds (facing ds)
Box **27**-	N 36.141556 W 82.297278 Elevation 4932	In longest straight-away section of road ~450’ before 2nd pull off Box upslope on beech at edge of rhod
Box **28**-	N 36.143111 W 82.302111 Elevation 4750	2nd pull off, take trail until rocks end (~0.2mi) After last big boulder, turn left and head ds Box is facing upslope on thick spruce tree

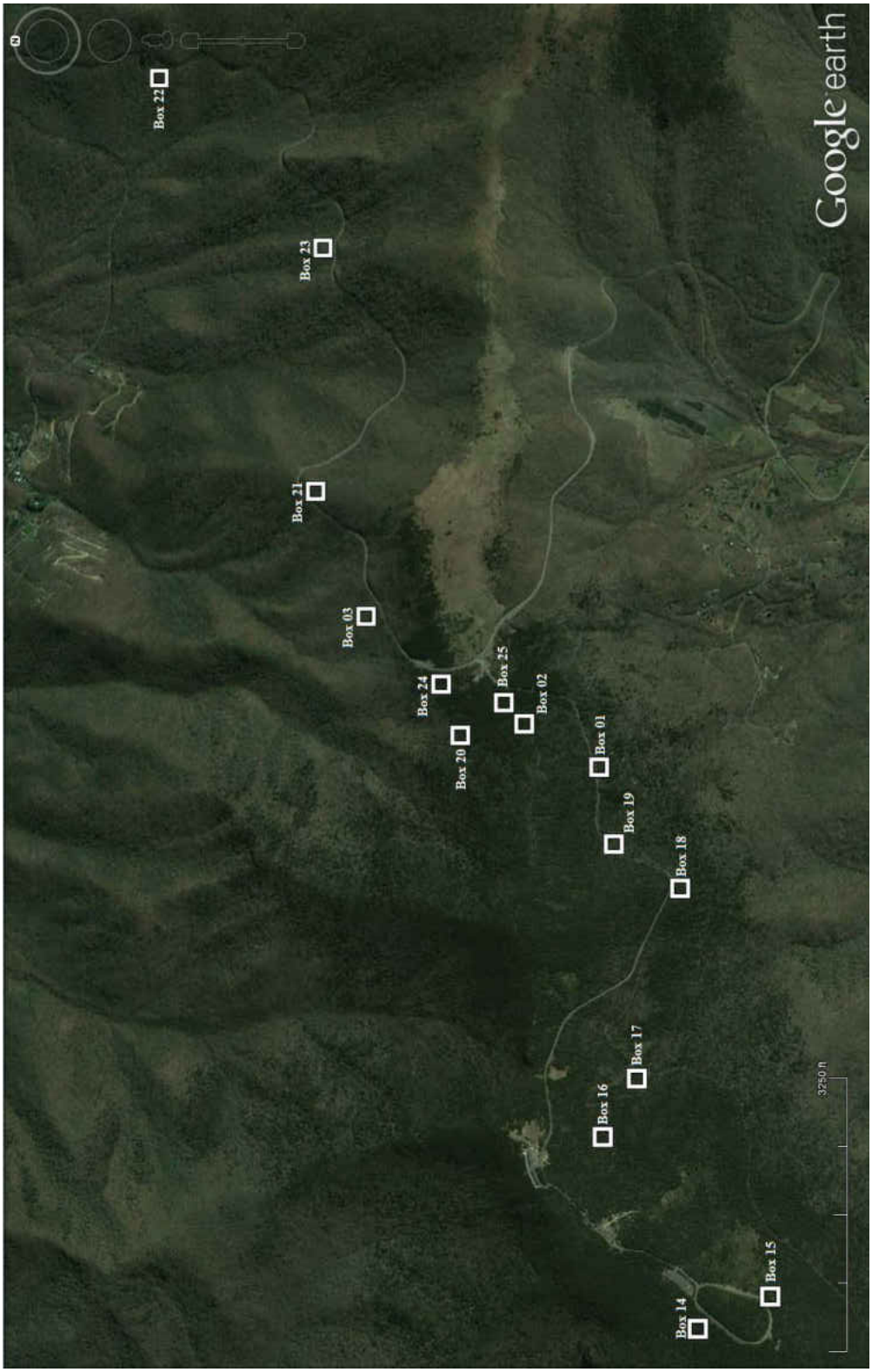
Nesting box locations on Unaka Mountain



Map showing nesting box locations on Unaka Mountain

Box **01**-	N 36.101972 W 82.115111 Elevation 5682	Roan High Knob Gated Road off of 143 ~mile up the road, a large rock on S of road Cedar with box on NW side (visible from road)
Box **02**-	N 36.104694 W 82.113167 Elevation 5708	Trail <1/4 mile up roan road on upslope Go up trail until AT- head upslope ~50 yards Cedar Tree with box on upslope side (W)
Box **03**-	N 36.110472 W 82.108278 Elevation 5262	Box off of Hackline Road (off 143) @ first switchback, box is located down slope Hardwood with box on uphill (E) side
Box **14**-	N 36.098639 W 82.139556 Elevation 6105	Box near Rhod. Gardens, on bus gravel road Back on right circle- large boulder on R Downslope (200')past growth on Fir (NE side)
Box **15**-	N 36.096083 W 82.138139 Elevation 6085	Box on same road as Box 14 on back of loop Culvert on R, go past 10 yards Box down slope through rhod. on Fir (SE side)
Box **16**-	N 36.101972 W 82.13125 Elevation 6003	Gated Rd below top- gravel rd. to pump house ~50 ft south of clearing before stream Box on E side of tree (away from summit)
Box **17**-	N 36.100694 W 82.128861 Elevation 5872	Road 130A- follow gravel until red-roof shed 2nd waterfall (before shed) fir on left of creek Tree 100' from rd, next to stream. Box upslope
Box **18 -**	N 36.099083 W 82.120500 Elevation 5734	Box near gravel turn (high side of gravel end) Box down slope ~40 yds. on Cedar (~10" dbh) Box on down slope side (S)
Box **19**-	N 36.101472 W 82.118528 Elevation 5751	Box b/t box 18 and box 01 @ 3rd culvert, box down slope ~ 100 feet Box on W side of Fir, visible walking towards
Box **20**-	N 36.107000 W 82.113694 Elevation 5613	Parking area- follow AT until upslope curve Go straight, perpendicular to AT's curve After runoff stream, box ~100'from AT on N
Box **21**-	N 36.112333 W 82.102556 Elevation 5347	Coming down TN side of 143 2nd gravel pull off to right (upslope side) Go upslope ~ 75 yards, HW w/ box on E (up)
Box **22**-	N 36.118583 W 82.082361 Elevation 4600	Box on 143 pull off Downslope stands a solitary boulder ~50 SW of boulder is a mossy oak with large Y
Box **23**-	N 36.112167 W 82.090917 Elevation 4943	Off 143 pull off DS of pull off there are 2 large sunken boulder DS of boulders there is a beech (box on NW)
Box **24**-	N 36.107694 W 82.111389 Elevation 5450	Follow AT near outhouse area <u>downslope</u> At 3 plank bridge, go downstream Where 2 streams meet, box on Spruce (East)
Box **25**-	N 36.105417 W 82.112222 Elevation 5600	Follow AT near outhouse area <u>upslope</u> At first bridge, follow stream downslope ~100' Box on Fir, facing back towards outhouse area

Nesting box locations on Roan Mountain



Map showing nesting box locations on Roan Mountain

Appendix C

Northern Saw-whet Owls Found on Roan Mountain

Female Northern Saw-whet Owl in nesting box on 4 May 2013

Clutch of Saw-whet Owl eggs seen through box entrance on 4 May 2014

Northern Saw-whet Owl chicks seen on 29 May 2014

Appendix D

The Data Template Used During the Nightly Surveys

Northern Saw-Whet Owl Surveys																								
County	Route/Roads		Observer		Date		Weather		Temperature															
					___/___/20___		Start: End:		Start: End:															
Wind Speed			Wind Direction				Lunar Code (only position will change)																	
Start: End:			Start: End:				Start: End:																	
Shaded columns 1,3 and 5 are quiet periods.																								
Start Time (24 hr)																								
Stop #	1						2						3						4					
Periods	1	2	3	4	5	Total	1	2	3	4	5	Total	1	2	3	4	5	Total	1	2	3	4	5	Total
N Saw-whet Owl																								
E. Screech Owl																								
Barred Owl																								
G. Horned Owl																								
Whip-poor-will																								
Interruptions																								
Excessive Noise																								
Comments																								
Habitat																								
Elevation																								
GPS (deg.dec)																								
NAD83																								
Start Time (24 hr)																								
Stop #	5						6						7						8					
Periods	1	2	3	4	5	Total	1	2	3	4	5	Total	1	2	3	4	5	Total	1	2	3	4	5	Total
N Saw-whet Owl																								
E. Screech Owl																								
Barred Owl																								
G. Horned Owl																								
Whip-poor-will																								
Interruptions																								
Excessive Noise																								
Comments																								
Habitat																								
Elevation																								
GPS (deg.dec)																								
NAD83																								

Appendix E

Key to Codes and Abbreviations Used in Nightly Surveying

Information Gathered	Abbreviation	Code	Description of Code
Weather at start of night	We_S/E	0	Clear with few clouds, 0-10% cloud coverage
		1	Partly cloudy, scattered 10-50%
		2	Cloudy or overcast, 50-100%
		3	Fog or Smoke
		4	Drizzle- No Survey
		5	Rain- No Survey
Temperature at start/end (in F)	T_S/E	0	<1 mph
Estimated wind at start/end	Wi_S/E	1	1-3mph
		2	4-7mph
		3	8-12mph
		4	13-18mph
		5	19-24mph
		6	>25mph
Wind Direction at start/end of protocol	D_S/E		
Phase of moon	M	F	Full
		T	(3/4)
		H	(1/2)
		Q	(1/4)
		N	New
Moon position in sky at start/end	M_S/E	L	Low: 0-30 degrees or 150-180 degrees
		M	Mid: 30-60 degrees or 120-150 degrees
		O	Overhead: 60-120 degrees
		U	Unknown or not visible

Information gathered at each general route assessed during nightly surveys

Information Gathered	Abbreviation	Code	Description of Code
GPS coordinates taken in NAD 83	GPS N/W		
Habitat Type	Habit	SF	Spruce-Fir
		MIX	Mixture
		HW	Northern Hardwood
Species of Bird	Code	0	No bird
		1	Northern Saw-whet Owl
		2	Eastern Screech-Owl
		3	Barred Owl
		4	Great Horned Owl
		5	Eastern Whip-poor-will
Number of Owls	Num		
Period in "Pennsylvania Protocol" audio playback	Per		
Excessive noise	N	1	Wind
		2	Water
		3	Noise
Any interruptions	I	1	Car

Information gathered at individual stops assessed during nightly surveys

Appendix F

Data Gathered from Nightly Surveys

Date	Route	#	Time	N deg.dec	W deg.dec	Habit	Elev	Code	Num	Per	N	I	W_S	E	T_S	E	Wi_S	E	D_S	E	M	M_S	M_E
3/14/2013	Unaka	1	19:35	36.142639	82.289917	SF	4712	0	0	0	0	0	0	0	30	25	0	4	0	NW	Q	L	L
3/14/2013	Unaka	2	19:53	36.144500	82.292639	SF	4650	0	0	0	0	0											
3/14/2013	Unaka	3	20:21	36.139278	82.288500	HW	4543	0	0	0	0	0											
3/14/2013	Unaka	4	20:43	36.135111	82.283722	HW	4394	0	0	0	0	0											
3/14/2013	Unaka	5	21:08	36.138639	82.281639	HW	4248	0	0	0	0	0											
3/14/2013	Unaka	6	21:19	36.138778	82.274083	HW	3950	0	0	0	0	0											
3/14/2013	Unaka	7	21:34	36.137528	82.273000	HW	3776	0	0	0	0	0											
3/14/2013	Unaka	8	21:51	36.133833	82.274389	HW	2667				2												
3/19/2013	Roan	1	20:01	36.103250	82.126167	SF	6033	0	0	0	0	0	0	0	30	30	1	1	W	W	H	O	O
3/19/2013	Roan	2	20:25	36.099528	82.119944	MIX	5789	1	1	1	0	0											
3/19/2013	Roan	3	20:57	36.105167	82.111417	SF	5573	0	0	0	0	0											
3/19/2013	Roan	4	21:10	36.110444	82.106861	HW	5383	0	0	0	0	0											
3/19/2013	Roan	5	21:25	36.109361	82.095778	HW	5123				2												
3/19/2013	Roan	6	21:30	36.115861	82.082056	HW	4789	0	0	0	0	0											
3/19/2013	Roan	7	21:48	36.112278	82.085500	HW	4655	0	0	0	0	0											
3/19/2013	Roan	8	22:02	36.122528	82.084694	HW	4297	0	0	0	0	0											
3/19/2013	Roan	9	21:19	36.124417	82.096139	HW	3815	0	0	0	0	0											
3/19/2013	Roan	10	22:40	36.130056	82.102389	HW	3520	0	0	0	0	0											
3/28/2013	S. Valley	1	20:56	36.573139	81.916750	HW	3809	3	2	1	0	0	0	0	35	30	0	0	0	0	F	L	L
3/28/2013	S. Valley	2	21:22	36.568861	81.915417	HW	3549	0	0	0	0	0											
3/28/2013	S. Valley	3	22:13	36.502500	81.880139	HW	3690	0	0	0	0	1											
3/28/2013	S. Valley	4	22:27	36.497250	81.890278	HW	3776	0	0	0	0	1											
3/28/2013	S. Valley	5	22:42	36.501222	81.897917	HW	3625	0	0	0	0	0											
4/2/2013	Unaka	1	19:51	36.127000	82.311472	HW	4173	0	0	0	0	0	2	2	30	30	2	2	NW	W	H	U	M
4/2/2013	Unaka	2	20:31	36.129972	82.308806	HW	4422	1	1	1	0	0											
4/2/2013	Unaka	3	20:51	36.134028	82.306861	HW	4763	0	0	0	0	0											
4/2/2013	Unaka	4	21:08	36.140306	82.299778	MIX	4812	0	0	0	0	0											
4/2/2013	Unaka	5	21:19	36.144056	82.293806	HW	4724	0	0	0	0	0											
4/2/2013	Unaka	6	21:39	36.141417	82.289611	MIX	4632	1	1	1	0	0											
4/2/2013	Unaka	7	21:58	36.139111	82.285056	HW	4475	0	0	0	0	0											
4/2/2013	Unaka	8	22:14	36.140000	82.283861	HW	4209	0	0	0	0	0											
4/2/2013	Unaka	9	22:28	36.137861	82.275639	HW	4028	0	0	0	0	0											
4/2/2013	Unaka	10	22:41	36.136694	82.274028	HW	3809	0	0	0	0	0											
4/3/2013	Roan	1	20:15	36.100000	82.122056	SF	5869	0	0	0	0	0	2	2	35	30	1	1	W	W	H	U	U
4/3/2013	Roan	2	20:40	36.102167	82.115000	SF	5692	0	0	0	0	0											
4/3/2013	Roan	3	20:58	36.108333	82.110583	SF	5515	1	1	2	0	0											
4/3/2013	Roan	4	21:13	36.112667	82.102778	MIX	5219	0	0	0	0	0											

4/3/2013	Roan	5	21:26	36.109361	82.095917	HW	5150	1	1	1	0	0											
4/3/2013	Roan	6	21:44	36.115806	82.082194	HW	4707	0	0	0	0	0											
4/3/2013	Roan	7	21:59	36.127750	82.086028	HW	4406	0	0	0	0	0											
4/3/2013	Roan	8	22:13	36.121250	82.085194	HW	4110	0	0	0	0	0											
4/8/2013	S. Valley	1	20:58	36.573139	82.916917	HW	3792	0	0	0	0	0	0	0	55	50	1	1	W	W	Q	U	U
4/8/2013	S. Valley	2	21:16	36.568000	81.915333	HW	3556	0	0	0	0	0											
4/8/2013	S. Valley	3	22:04	36.502500	81.880111	HW	3677	0	0	0	0	1											
4/8/2013	S. Valley	4	22:19	36.498778	81.894722	HW	3622	0	0	0	2	0											
4/8/2013	S. Valley	5	22:36	36.502250	81.899083	HW	3536	0	0	0	2	1											
4/9/2013	Holston	1	20:15	36.431833	82.137250	HW	4173	0	0	0	0	0	1	0	63	60	1	5	E	E	N	U	U
4/9/2013	Holston	2	20:29	36.436639	82.131528	HW	4274	3	5	2	0	0											
4/9/2013	Holston	3	20:46	36.438306	82.127000	HW	4123	0	0	0	0	0											
4/9/2013	Holston	4	21:00	36.440583	82.120139	HW	4120	0	0	0	0	0											
4/9/2013	Holston	5	21:14	36.447167	82.116028	HW	4133	0	0	0	0	0											
4/9/2013	Holston	6	21:30	36.451333	82.107861	HW	4087	0	0	0	0	0											
4/9/2013	Holston	7	21:51	36.456417	82.102861	HW	3923	0	0	0	0	0											
4/9/2013	Holston	8	22:04	36.459333	82.095333	HW	3860	0	0	0	0	0											
4/10/2013	Unaka	1	20:52	36.125389	82.311972	HW	4130	0	0	0	0	0	0	0	55	50	1	0	E	0	N	U	U
4/10/2013	Unaka	2	21:08	36.130028	82.308806	HW	4480	0	0	0	0	1											
4/10/2013	Unaka	3	21:27	36.134111	82.306889	SF	4767	1	1	1	0	0											
4/10/2013	Unaka	4	21:41	36.139167	82.299972	SF	4826	0	0	0	0	0											
4/10/2013	Unaka	5	21:53	36.144083	82.293694	MIX	4727	0	0	0	0	0											
4/10/2013	Unaka	6	22:10	36.140972	82.287472	HW	4594	0	0	0	0	0											
4/10/2013	Unaka	7	22:26	36.136056	82.283306	HW	4376	0	0	0	0	0											
4/10/2013	Unaka	8	22:43	36.137583	82.276417	HW	4117	0	0	0	0	0											
4/10/2013	Unaka	9	22:56	36.139556	82.271417	HW	3887	1	1	1	0	0											
4/10/2013	Unaka	10	23:12	36.134056	82.273083	HW	3674	0	0	0	0	0											
4/16/2013	Roan	1	20:20	36.096111	82.139472	SF	6102	0	0	0	0	0	2	2	55	50	1	3	E	S	Q	O	M
4/16/2013	Roan	2	20:33	36.102000	82.135000	SF	6174	0	0	0	0	0											
4/16/2013	Roan	3	20:46	36.103639	82.127333	SF	6072	0	0	0	0	0											
4/16/2013	Roan	4	21:00	36.099417	82.119972	SF	5813	1	1	1	0	0											
4/16/2013	Roan	5	21:20	36.102250	82.114083	SF	5688	0	0	0	0	0											
4/16/2013	Roan	6	21:36	36.108139	82.110583	SF	5433	0	0	0	1	0											
4/16/2013	Roan	7	21:48	36.111000	82.104389	MIX	5357				2												
4/16/2013	Roan	8	21:52	36.109278	82.095861	MIX	5108	0	0	0	0	0											
4/16/2013	Roan	9	22:05	36.115889	82.082028	HW	4753	0	0	0	0	0											
4/16/2013	Roan	10	22:19	36.127694	82.085861	HW	4347	0	0	0	0	0											
4/16/2013	Roan	11	22:32	36.121139	82.085222	HW	4304	0	0	0	0	0											
4/16/2013	Roan	12	22:43	36.124361	82.096028	HW	3923	0	0	0	0	1											
4/16/2013	Roan	13	22:57	36.130083	82.102278	HW	3717	0	0	0	0	0											

4/18/2013	Unaka	1	20:30	36.129861	82.307639	MIX	4678	0	0	0	0	0	1	4	60	66	4	6	SE	SE	H	O	U
4/18/2013	Unaka	2	20:45	36.135306	82.304222	MIX	4806	0	0	0	0	0											
4/18/2013	Unaka	3	21:03	36.142694	82.296056	MIX	4845	0	0	0	0	0											
4/18/2013	Unaka	4	21:20	36.139389	82.286417	HW	4534	0	0	0	0	1											
4/18/2013	Unaka	5	21:36	36.140028	82.283833	HW	4320	0	0	0	0	1											
4/18/2013	Unaka	6	21:51	36.140389	82.270389	HW	3943	0	0	0	0	0											
4/20/2013	Unaka	1	20:33	36.127583	82.308750	HW	4602	0	0	0	0	0	0	0	45	35	1	1	S	S	T	O	O
4/20/2013	Unaka	2	20:47	36.134028	82.306806	MIX	4792	1	1	3	0	0											
								3	1	2	0	0											
4/20/2013	Unaka	3	21:02	36.139472	82.299778	MIX	4826	0	0	0	0	0											
4/20/2013	Unaka	4	21:14	36.143806	82.294083	MIX	4744	0	0	0	0	0											
4/20/2013	Unaka	5	21:28	36.139139	82.288500	MIX	4560	0	0	0	0	0											
4/20/2013	Unaka	6	21:40	36.135694	82.283222	MIX	4370	0	0	0	0	0											
4/20/2013	Unaka	7	21:54	36.140000	82.283861	HW	4271	0	0	0	0	0											
4/20/2013	Unaka	8	22:08	36.139083	82.273250	HW	3996	0	0	0	0	0											
4/20/2013	Unaka	9	22:22	36.136139	82.274083	HW	3795	0	0	0	0	0											
9/13/2013	Roan	1	20:25	36.096139	82.139667	SF	6112				1		1	2	55	60	5	1	W	W	H	M	M
9/13/2013	Roan	2	20:37	36.101972	82.135056	SF	6181	0	0	0	0	1											
9/13/2013	Roan	3	20:51	36.104028	82.129028	SF	6118	0	0	0	0	1											
9/13/2013	Roan	4	21:08	36.106639	82.110556	SF	5505				1												
9/13/2013	Roan	5	21:13	36.110583	82.106778	HW	5416	0	0	0	0	0											
9/13/2013	Roan	6	21:27	36.109361	82.095889	HW	5114	0	0	0	0	1											
9/13/2013	Roan	7	21:43	36.112806	82.084639	HW	4819	0	0	0	0	0											
9/13/2013	Roan	8	21:57	36.129000	82.085583	HW	4471	0	0	0	0	0											
9/13/2013	Roan	9	22:10	36.122556	82.084722	HW	4271	0	0	0	0	1											
9/13/2013	Roan	10	22:23	36.124528	82.096111	HW	3877	0	0	0	0	0											
9/20/2013	Roan	1	19:50	36.096167	82.139750	SF	6151	0	0	0	0	0	3	2	65	60	2	5	N	NW	F	U	L
9/20/2013	Roan	2	20:07	36.102083	82.135028	SF	6190	0	0	0	0	1											
9/20/2013	Roan	3	20:20	36.103944	82.129028	SF	6076	0	0	0	0	0											
9/20/2013	Roan	4	20:39	36.108222	82.110556	SF	5478	0	0	0	0	0											
9/20/2013	Roan	5	20:52	36.112694	82.102778	HW	5328	0	0	0	0	0											
9/20/2013	Roan	6	21:04	36.109333	82.095861	HW	5154	3	1	5	0	0											
9/20/2013	Roan	7	21:19	36.115806	82.082167	HW	4747	3	1	4	0	1											
9/20/2013	Roan	8	21:32	36.127750	82.085944	HW	4412	0	0	0	0	1											
9/20/2013	Roan	9	21:45	36.120917	82.085278	HW	4268	3	2	3	0	0											
9/20/2013	Roan	10	21:54	36.124333	82.096083	HW	3913	0	0	0	0	1											
3/4/2014	Holston	1	18:58	36.432389	82.137333	HW	4215	0	0	0	0	0	2	2	31	28	1	1	W	W	Q	M	O
3/4/2014	Holston	2	19:15	36.436417	82.131667	HW	4291	0	0	0	0	0											
3/4/2014	Holston	3	19:32	36.438333	82.126972	HW	4107	0	0	0	0	0											
3/4/2014	Holston	4	19:48	36.440694	82.120056	HW	4130	3	1	3	0	0											

								3	1	5													
3/4/2014	Holston	5	20:03	36.446417	82.116944	HW	4101	0	0	0	0	0											
3/4/2014	Holston	6	20:21	36.449806	82.10925	HW	4219	0	0	0	0	0											
3/4/2014	Holston	7	20:37	36.4555	82.104417	HW	3930	0	0	0	0	0											
3/4/2014	Holston	8	20:53	36.459222	82.096778	HW	3860	0	0	0	0	0											
3/4/2014	Holston	9	21:08	36.460111	82.08875	HW	3802	3	1	4	0	0											
3/4/2014	Holston	10	21:31	36.455417	82.090778	HW	3699	0	0	0	0	0											
3/5/2014	S. Valley	1	18:18	36.508917	81.905889	HW	3510	0	0	0	0	1	1	1	38	32	1	1	W	W	Q	O	M
3/5/2014	S. Valley	2	18:38	36.503972	81.900028	HW	3599	0	0	0	0	0											
3/5/2014	S. Valley	3	18:53	36.498778	81.895639	HW	3720	0	0	0	0	1											
3/5/2014	S. Valley	4	19:09	36.495917	81.889833	HW	3805	3	1	4	0	0											
3/5/2014	S. Valley	5	19:23	36.500694	81.882917	HW	3772	0	0	0	0	0											
3/5/2014	S. Valley	6	19:38	36.500833	81.877583	HW	3585	0	0	0	0	0											
3/5/2014	S. Valley	7	20:23	36.574472	81.915194	HW	3717	0	0	0	0	0											
3/5/2014	S. Valley	8	20:38	36.579444	81.910222	HW	3520	0	0	0	0	0											
3/5/2014	S. Valley	9	20:59	36.5675	81.915639	HW	3507	0	0	0	0	0											
3/7/2014	Roan	1	18:47	36.100694	82.123667	SF	5910	0	0	0	0	0	2	0	30	31	4	2	W	NW	H	O	O
3/7/2014	Roan	2	19:10	36.102083	82.117306	SF	5744	0	0	0	0	0											
3/7/2014	Roan	3	19:32	36.105806	82.111194	MIX	5537	0	0	0	0	0											
3/7/2014	Roan	4	19:49	36.110639	82.106639	MIX	5446	1	1	1	0	0											
								1	1	5	0	0											
3/7/2014	Roan	5	20:11	36.109306	82.095917	HW	5137	0	0	0	0	0											
3/7/2014	Roan	6	20:28	36.112556	82.084778	HW	4845	3	1	4	0	0											
3/7/2014	Roan	7	20:46	36.124417	82.081361	HW	4618	0	0	0	0	1											
3/7/2014	Roan	8	21:00	36.127667	82.086056	HW	4379	0	0	0	0	1											
3/7/2014	Roan	9	21:14	36.12125	82.08525	HW	4232	0	0	0	0	1											
3/7/2014	Roan	10	21:27	36.122389	82.095361	HW	3950	0	0	0	0	0											
3/7/2014	Roan	11	21:43	36.130306	82.100583	HW	3648	0	0	0	0	0											
3/8/2014	Pond	1	18:39	36.211639	82.000194	MIX	3615	0	0	0	0	0	0	0	44	41	2	1	W	W	H	O	O
3/8/2014	Pond	2	18:52	36.216861	82.003639	MIX	3526	3	1	4	0	0											
3/8/2014	Pond	3	19:05	36.224389	82.005389	HW	3746	1	1	2	0	0											
								1	1	3													
3/8/2014	Pond	4	19:20	36.228194	82.012444	MIX	3566	0	0	0	0	0											
3/8/2014	Pond	5	19:34	36.22975	82.019417	HW	3615	0	0	0	0	0											
3/8/2014	Pond	6	19:47	36.235833	82.025306	HW	3648	3	1	1	0	0											
3/8/2014	Pond	7	20:00	36.241556	82.030111	HW	3677	1	1	3	0	1											
								3	1	1													
								3	3	3													
3/8/2014	Pond	8	20:15	36.244333	82.038056	HW	3707	0	0	0	0	1											
3/8/2014	Pond	9	20:29	36.250639	82.045056	HW	3625	0	0	0	0	0											

3/8/2014	Pond	10	20:43	36.256472	82.045306	HW	3569	0	0	0	0	0											
3/8/2014	Pond	11	20:58	36.261472	82.05075	HW	3779	0	0	0	0	0											
3/8/2014	Pond	12	21:14	36.263639	82.057222	HW	3894	0	0	0	0	0											
3/8/2014	Pond	13	21:29	36.263083	82.064778	HW	3850	0	0	0	0	0											
3/8/2014	Pond	14	21:45	36.266333	82.06975	HW	3612	0	0	0	0	0											
3/8/2014	Pond	15	21:59	36.26825	82.076417	HW	3677	0	0	0	0	0											
3/8/2014	Pond	16	22:13	36.265333	82.082806	HW	3590	0	0	0	0	0											
3/9/2014	S. Valley	1	19:30	36.508833	81.905917	HW	3500	0	0	0	0	0	0	0	46	40	1	3	W	NE	H	O	O
3/9/2014	S. Valley	2	19:55	36.504	81.900028	HW	3556	0	0	0	0	0											
3/9/2014	S. Valley	3	20:13	36.498611	81.894528	HW	3694	0	0	0	0	1											
3/9/2014	S. Valley	4	20:26	36.496139	81.888806	HW	3848	0	0	0	0	1											
3/9/2014	S. Valley	5	20:40	36.501056	81.88225	HW	3799	0	0	0	0	0											
3/9/2014	S. Valley	6	20:54	36.500361	81.876556	HW	3605	0	0	0	0	1											
3/9/2014	S. Valley	7	21:40	36.578333	81.910833	HW	3566	0	0	0	0	0											
3/9/2014	S. Valley	8	21:55	36.5725	81.915694	HW	3658	0	0	0	0	0											
3/10/2014	Holston	1	20:09	36.434528	82.134722	HW	4261	0	0	0	0	0	1	1	45	42	4	4	SW	SW	H	O	O
3/10/2014	Holston	2	20:24	36.435528	82.127139	HW	4176	0	0	0	0	0											
3/10/2014	Holston	3	20:38	36.440139	82.117167	HW	4025	3	1	5	0	0											
3/10/2014	Holston	4	20:55	36.444361	82.117167	HW	4107	0	0	0	0	0											
3/10/2014	Holston	5	21:10	36.449083	82.111389	HW	4183	0	0	0	1	0											
3/10/2014	Holston	6	21:24	36.454056	82.10475	HW	3989	0	0	0	1	0											
3/10/2014	Holston	7	21:38	36.459028	82.097806	HW	3897	0	0	0	1	0											
3/10/2014	Holston	8	21:52	36.460306	82.089167	HW	3828	0	0	0	0	0											
3/10/2014	Holston	9	22:07	36.454139	82.091111	HW	3658	0	0	0	0	0											
3/11/2014	Pond	1	19:35	36.263083	82.0935	MIX	3522	0	0	0	0	0	0	2	57	47	2	1	NW	W	T	O	O
3/11/2014	Pond	2	19:52	36.264778	82.086722	HW	3526	1	1	2	0	1											
3/11/2014	Pond	3	20:08	36.267889	82.079722	HW	3736	3	3	2	0	1											
3/11/2014	Pond	4	20:22	36.266111	82.073972	HW	3651	1	1	3	0	0											
3/11/2014	Pond	5	20:39	36.266	82.067667	HW	3651	0	0	0	0	0											
3/11/2014	Pond	6	20:54	36.262111	82.060472	HW	3920	3	1	4	0	0											
3/11/2014	Pond	7	21:08	36.262278	82.054694	HW	3861	3	1	1	0	0											
3/11/2014	Pond	8	21:22	36.258556	82.047611	HW	3638	0	0	0	0	0											
3/11/2014	Pond	9	21:36	36.253194	82.0445	HW	3644	0	0	0	0	0											
3/11/2014	Pond	10	21:49	36.247028	82.041417	HW	3543	0	0	0	0	0											
3/11/2014	Pond	11	22:03	36.242833	82.033528	HW	3579	0	0	0	0	0											
3/11/2014	Pond	12	22:17	36.238194	82.027361	HW	3618	0	0	0	0	0											
3/11/2014	Pond	13	22:30	36.232222	82.021806	MIX	3526	0	0	0	0	0											
3/11/2014	Pond	14	22:44	36.228167	82.012361	MIX	3572	3	1	1	0	0											
3/11/2014	Pond	15	22:57	36.224278	82.005583	HW	3710	1	1	5	0	0											
3/11/2014	Pond	16	23:12	36.217167	82.003833	MIX	3503	0	0	0	0	0											

3/17/2014	Holston	1	19:40	36.431444	82.137833	HW	4173	0	0	0	0	0	3	2	35	36	2	1	E	E	F	U	U
3/17/2014	Holston	2	19:56	36.436472	82.131472	HW	4402	0	0	0	0	0											
3/17/2014	Holston	3	20:11	36.438667	82.126917	HW	4071	0	0	0	0	0											
3/17/2014	Holston	4	20:25	36.440861	82.119333	HW	4156	0	0	0	0	0											
3/17/2014	Holston	5	20:41	36.447306	82.115778	HW	4074	0	0	0	0	0											
3/17/2014	Holston	6	20:55	36.451111	82.107917	HW	4169	0	0	0	0	0											
3/17/2014	Holston	7	21:11	36.456972	82.10225	HW	3894	0	0	0	0	0											
3/17/2014	Holston	8	21:25	36.459222	82.093639	HW	3956	0	0	0	0	0											
3/17/2014	Holston	9	21:40	36.4575	82.090667	HW	3776	0	0	0	0	0											
3/17/2014	Holston	10	21:54	36.451806	82.088722	HW	3510	3	2	1	0	0											
3/18/2014	Pond	1	19:50	36.265222	82.083167	HW	3664	0	0	0	0	0	1	1	46	35	1	6	E	E	T	U	U
3/18/2014	Pond	2	20:05	36.268556	82.077444	HW	3733	0	0	0	0	0											
3/18/2014	Pond	3	20:20	36.265472	82.071333	HW	3526	3	1	4	0	0											
3/18/2014	Pond	4	20:35	36.264528	82.0655	HW	3704	0	0	0	0	0											
3/18/2014	Pond	5	20:50	36.263694	82.058361	MIX	3858	0	0	0	0	0											
3/18/2014	Pond	6	21:04	36.261528	82.051667	HW	3825	3	1	4	0	0											
3/18/2014	Pond	7	21:19	36.256583	82.0455	HW	3635	0	0	0	0	0											
3/18/2014	Pond	8	21:35	36.250444	82.033778	MIX	3559	0	0	0	0	0											
3/18/2014	Pond	9	21:46	36.245028	82.039222	HW	3510	0	0	0	0	0											
3/18/2014	Pond	10	21:59	36.241417	82.030667	MIX	3658	0	0	0	1	0											
3/18/2014	Pond	11	22:12	36.236167	82.025639	MIX	3677				1												
3/18/2014	Pond	12	22:19	36.230028	82.020028	HW	3569				1												
3/18/2014	Pond	13	22:27	36.226639	82.008667	HW	3664				1												
3/20/2014	S. Valley	1	20:28	36.500389	81.876389	MIX	3559	0	0	0	0	1	1	1	39	35	1	1	S	S	T	U	U
3/20/2014	S. Valley	2	20:44	36.501667	81.881611	HW	3789	0	0	0	0	1											
3/20/2014	S. Valley	3	20:58	36.495889	81.889917	HW	3891	0	0	0	0	1											
3/20/2014	S. Valley	4	21:13	36.500583	81.897639	HW	3648	0	0	0	0	1											
3/20/2014	S. Valley	5	21:27	36.500778	81.899472	HW	3538				2												
3/26/2014	R. Fork	1	19:51	36.079111	82.889111	HW	4137	0	0	0	0	0	0	0	32	29	0	1	0	NW	Q	U	U
3/26/2014	R. Fork	2	20:09	36.075889	82.563222	HW	4291	1	1	3	0	0											
3/26/2014	R. Fork	3	20:26	36.073	82.571028	HW	4373	1	1	5	0	0											
3/26/2014	R. Fork	4	20:52	36.069139	82.57625	HW	4187	1	1	5	0	0											
								3	1	5	0	0											
3/26/2014	R. Fork	5	21:11	36.064556	82.579056	HW	3812	1	1	2	0	0											
								1	1	3													
3/26/2014	R. Fork	6	21:32	36.059639	82.581472	HW	3471	0	0	0	0	0											
3/27/2014	Unaka	1	20:07	36.136083	82.303111	MIX	4826	0	0	0	0	0	1	1	37	37	4	5	N	NW	Q	U	U
3/27/2014	Unaka	2	20:29	36.138944	82.289972	MIX	4612	0	0	0	0	0											
3/27/2014	Unaka	3	20:45	36.135972	82.28325	MIX	4383	0	0	0	0	0											
3/27/2014	Unaka	4	21:12	36.134083	82.276111	HW	3766	0	0	0	0	0											

3/27/2014	Unaka	5	21:28	36.137	82.268611	HW	3550	0	0	0	0	0											
3/30/2014	R. Fork	1	20:11	36.07975	82.566861	HW	3986	0	0	0	0	0	0	0	40	36	2	5	NE	SW	N	U	U
3/30/2014	R. Fork	2	20:25	36.078056	82.569278	HW	4140	0	0	0	0	0											
3/30/2014	R. Fork	3	20:51	36.075472	82.566583	HW	4248	0	0	0	0	0											
3/30/2014	R. Fork	4	21:07	36.071417	82.570667	HW	4330	0	0	0	0	0											
3/30/2014	R. Fork	5	21:25	36.069083	82.578167	HW	4032	1	1	3	0	0											
3/30/2014	R. Fork	6	21:45	36.063528	82.579194	HW	3807	0	0	0	1	0											
3/30/2014	R. Fork	7	22:00	36.059583	82.581861	HW	3513	0	0	0	0	0											
3/31/2014	Pond	1	19:56	36.265	82.086833	HW	3507	0	0	0	2	0	1	1	48	37	1	0	NW	0	N	U	U
3/31/2014	Pond	2	20:13	36.267556	82.079972	HW	3756	0	0	0	0	0											
3/31/2014	Pond	3	20:28	36.266111	82.073222	HW	3608	0	0	0	2	0											
3/31/2014	Pond	4	20:44	36.265528	82.066972	HW	3650	1	1	3	0	0											
								3	1	4													
3/31/2014	Pond	5	20:58	36.262167	82.060556	HW	3940	0	0	0	0	0											
3/31/2014	Pond	6	21:13	36.267639	82.057333	HW	3794	0	0	0	0	0											
3/31/2014	Pond	7	21:28	36.272583	82.054528	HW	3644	0	0	0	0	0											
3/31/2014	Pond	8	21:48	36.261472	82.051139	HW	3769	3	2	3	0	0											
3/31/2014	Pond	9	22:03	36.2565	82.045389	HW	3612	0	0	0	0	0											
3/31/2014	Pond	10	22:18	36.250806	82.045306	MIX	3559	0	0	0	3	0											
3/31/2014	Pond	11	22:33	36.245389	82.039472	HW	3553	0	0	0	0	0											
3/31/2014	Pond	12	22:47	36.241778	82.032472	MIX	3759	3	1	2	0	0											
3/31/2014	Pond	13	23:00	36.237639	82.026833	MIX	3599	0	0	0	0	0											
3/31/2014	Pond	14	23:14	36.231528	82.021417	MIX	3687	3	1	3	0	0											
3/31/2014	Pond	15	23:28	36.227528	82.011861	HW	3628	1	1	1	0	0											
								1	1	3													
								3	1	3													
3/31/2014	Pond	16	23:41	36.223556	82.004917	HW	3726	1	1	1	0	0											
								3	1	2													
3/31/2014	Pond	17	0:00	36.216917	82.003556	MIX	3500	0	0	0	0	0											
3/31/2014	Pond	18	0:14	36.211583	82.000361	HW	3599	0	0	0	3	0											
4/1/2014	Roan	1	20:15	36.10222	82.11481	SF	5675	1	1	1	0	0	0	1	49	50	1	1	W	W	N	L	L
4/1/2014	Roan	2	20:45	36.10813	82.11062	SF	5459	1	1	1	0	0											
								1	1	3													
4/1/2014	Roan	3	20:58	36.11262	82.10275	MIX	5308	1	1	1	0	0											
4/1/2014	Roan	4	21:01	36.10932	82.09581	MIX	5134	0	0	0	2	0											
4/1/2014	Roan	5	21:25	36.11328	82.08606	HW	4871	0	0	0	2	0											
4/1/2014	Roan	6	21:38	36.11850	82.08173	HW	4694	3	1	3	0	0											
4/1/2014	Roan	7	21:51	36.12899	82.08550	HW	4422	3	1	4	0	1											
4/1/2014	Roan	8	22:04	36.12251	82.08481	HW	4340	3	1	2	0	0											
4/1/2014	Roan	9	22:19	36.12430	82.09599	HW	3910	0	0	0	0	0											

4/1/2014	Roan	10	22:32	36.13032	82.10058	HW	3631	0	0	0	0	1											
4/2/2014	Unaka	1	20:04	36.12524	82.31213	HW	4153	0	0	0	0	0	2	1	58	53	1	1	N	W	N	U	M
4/2/2014	Unaka	2	20:18	36.13052	82.30892	HW	4363	0	0	0	2	1											
4/2/2014	Unaka	3	20:31	36.12768	82.30872	HW	4566	3	2	2	0	0											
4/2/2014	Unaka	4	20:45	36.13355	82.30524	MIX	4776	0	0	0	0	0											
4/2/2014	Unaka	5	20:59	36.13723	82.30135	MIX	4826	1	1	2	0	0											
4/2/2014	Unaka	6	21:15	36.14440	82.29258	MIX	4711	0	0	0	0	0											
4/2/2014	Unaka	7	21:28	36.13956	82.28747	MIX	4497	0	0	0	2	0											
4/2/2014	Unaka	8	21:42	36.13725	82.28282	MIX	4294	0	0	0	0	0											
4/2/2014	Unaka	9	21:56	36.13770	82.28004	HW	4205	0	0	0	0	0											
4/2/2014	Unaka	10	22:09	36.13999	82.27127	HW	3982	0	0	0	0	0											
4/2/2014	Unaka	11	22:24	36.13433	82.27514	HW	3809	0	0	0	2	0											
4/2/2014	Unaka	12	22:38	36.13684	82.26987	HW	3580	0	0	0	0	0											
4/3/2014	Holston	1	20:06	36.43136	82.13778	HW	4183	0	0	0	0	0	1	4	60	60	2	3	NW	NW	Q	M	U
4/3/2014	Holston	2	20:20	36.43659	82.13138	HW	4307	0	0	0	0	0											
4/3/2014	Holston	3	20:35	36.43866	82.12687	HW	4097	3	1	2	0	0											
4/3/2014	Holston	4	20:48	36.49083	82.11929	HW	4120	0	0	0	0	0											
4/3/2014	Holston	5	21:02	36.44710	82.11629	HW	4156	0	0	0	0	0											
4/3/2014	Holston	6	21:16	36.45047	82.10923	HW	4179	0	0	0	0	0											
4/3/2014	Holston	7	21:30	36.45623	82.10312	HW	4009	0	0	0	0	0											
4/3/2014	Holston	8	21:44	36.45955	82.09448	HW	3927	0	0	0	0	0											
4/3/2014	Holston	9	21:58	36.45841	82.09029	HW	3733	0	0	0	0	0											
4/8/2014	R. Fork	1	19:59	36.07566	82.62131	HW	4340	0	0	0	0	0	2	2	42	40	2	2	NW	NW	H	O	O
4/8/2014	R. Fork	2	20:14	36.07349	82.61658	HW	4173	0	0	0	0	0											
4/8/2014	R. Fork	3	20:30	36.07496	82.60803	HW	4146	0	0	0	0	0											
4/8/2014	R. Fork	4	20:46	36.07957	82.60153	HW	4104	3	2	4	0	0											
4/8/2014	R. Fork	5	21:01	36.08245	82.59497	HW	4035	0	0	0	0	0											
4/8/2014	R. Fork	6	20:19	36.07924	82.58152	HW	4215	0	0	0	0	0											
4/8/2014	R. Fork	7	21:35	36.07998	82.57722	HW	4429	3	2	2	0	0											
4/8/2014	R. Fork	8	21:52	36.07971	82.57280	HW	4120	0	0	0	0	0											
4/8/2014	R. Fork	9	22:07	36.07970	82.56708	HW	4064	1	1	5	0	0											
4/8/2014	R. Fork	10	22:25	36.07594	82.56632	HW	4255	1	1	2	0	0											
								3	1	4	0	0											
4/8/2014	R. Fork	11	22:40	36.07082	82.57111	HW	4360	0	0	0	0	0											
4/8/2014	R. Fork	12	22:57	36.06815	82.57842	HW	3891	1	1	1	0	0											
4/8/2014	R. Fork	13	23:14	36.06302	82.58105	HW	3628	0	0	0	0	0											
4/8/2014	R. Fork	14	23:31	36.05858	82.57881	HW	3426	0	0	0	0	0											
4/9/2014	Roan	1	20:03	36.10206	82.11529	SF	5708	0	0	0	0	0	1	0	38	40	1	2	NW	N	H	O	O
4/9/2014	Roan	2	20:25	36.10583	82.11126	SF	5515	1	1	1	0	0											
4/9/2014	Roan	3	20:47	36.11052	82.10659	HW	5406	1	1	1	0	0											

4/9/2014	Roan	4	21:01	36.10922	82.09587	HW	5163	0	0	0	2	0											
4/9/2014	Roan	5	21:16	36.11322	82.08605	HW	4780	0	0	0	0	0											
4/9/2014	Roan	6	21:29	36.11845	82.08158	HW	4760	0	0	0	0	0											
4/9/2014	Roan	7	21:43	36.12856	82.08575	HW	4432	0	0	0	0	0											
4/9/2014	Roan	8	21:56	36.12235	82.08474	HW	4340	0	0	0	0	0											
4/9/2014	Roan	9	22:08	36.12226	82.09516	HW	3936	0	0	0	2	0											
4/9/2014	Roan	10	22:22	36.13037	82.10051	HW	3756	0	0	0	0	0											
4/10/2014	Unaka	1	20:05	36.12264	82.31612	HW	4274	0	0	0	0	1	0	0	50	46	0	4	0	SW	T	M	O
4/10/2014	Unaka	2	20:19	36.12811	82.31236	HW	4278	0	0	0	0	1											
4/10/2014	Unaka	3	20:33	36.12848	82.30972	HW	4602	0	0	0	0	0											
4/10/2014	Unaka	4	20:46	36.13197	82.30499	MIX	4753	0	0	0	0	0											
4/10/2014	Unaka	5	21:00	36.13556	82.30398	MIX	4799	0	0	0	1	0											
4/10/2014	Unaka	6	21:15	36.1432	82.29491	MIX	4773	0	0	0	3	0											
4/10/2014	Unaka	7	21:30	36.1391	82.28881	HW	4520	0	0	0	2	0											
4/10/2014	Unaka	8	21:44	36.13581	82.28316	HW	4389	0	0	0	0	0											
4/10/2014	Unaka	9	21:58	36.13783	82.28005	HW	4150	0	0	0	0	0											
4/10/2014	Unaka	10	22:12	36.14056	82.27018	HW	3973	0	0	0	1	0											
4/10/2014	Unaka	11	22:27	36.13398	82.27278	HW	3697	0	0	0	0	0											
4/16/2014	R. Fork	1	20:14	36.07403	82.61501	HW	4123	0	0	0	1	0	1	1	43	36	4	2	S	S	F	U	M
4/16/2014	R. Fork	2	20:30	36.07561	82.60648	HW	4048	0	0	0	1	0											
4/16/2014	R. Fork	3	20:44	36.07999	82.6001	HW	4130	0	0	0	0	0											
4/16/2014	R. Fork	4	21:00	36.08185	82.59357	HW	3913	0	0	0	1	0											
4/16/2014	R. Fork	5	21:16	36.07809	82.58553	HW	4078	0	0	0	0	0											
4/16/2014	R. Fork	6	21:30	36.07782	82.58084	HW	4353	0	0	0	0	0											
4/16/2014	R. Fork	7	21:48	36.07965	82.57283	HW	4114	0	0	0	0	0											
4/16/2014	R. Fork	8	22:04	36.07960	82.56911	HW	3989	0	0	0	0	0											
4/16/2014	R. Fork	9	22:20	36.07680	82.56834	HW	4169	0	0	0	0	0											
4/16/2014	R. Fork	10	22:42	36.00704	82.55221	HW	3996	0	0	0	0	0											
4/16/2014	R. Fork	11	22:58	36.07755	82.55747	HW	4261	0	0	0	0	0											
4/16/2014	R. Fork	12	23:19	36.07145	82.57082	HW	4340	0	0	0	0	0											
4/16/2014	R. Fork	13	23:35	36.06901	82.57833	HW	4022	3	2	2	0	0											
4/16/2014	R. Fork	14	23:52	36.06358	82.58059	HW	3776	0	0	0	0	0											
4/17/2014	Pond	1	20:05	36.26442	82.08438	HW	3527	0	0	0	0	0	1	1	47	39	3	2	SW	W	F	U	L
4/17/2014	Pond	2	20:18	36.26852	82.07967	HW	3704	0	0	0	0	0											
4/17/2014	Pond	3	20:33	36.26628	82.07348	HW	3519	1	1	1	0	0											
4/17/2014	Pond	4	20:47	36.26530	82.06688	HW	3700	0	0	0	0	0											
4/17/2014	Pond	5	21:01	36.26260	82.05975	HW	3849	0	0	0	1	0											
4/17/2014	Pond	6	21:16	36.26855	82.05634	HW	3737	0	0	0	0	0											
4/17/2014	Pond	7	21:31	36.27205	82.05592	HW	3574	0	0	0	0	0											
4/17/2014	Pond	8	21:49	36.26129	82.05077	HW	3754	0	0	0	1	0											

4/17/2014	Pond	9	22:03	36.25534	82.04533	HW	3598	0	0	0	0	0											
4/17/2014	Pond	10	22:18	36.24838	82.04305	HW	3546	0	0	0	0	0											
4/17/2014	Pond	11	22:31	36.24435	82.03608	MIX	3542	0	0	0	0	0											
4/17/2014	Pond	12	22:44	36.24076	82.02858	HW	3641	0	0	0	0	0											
4/17/2014	Pond	13	22:58	36.23477	82.02394	HW	3626	0	0	0	0	0											
4/17/2014	Pond	14	23:11	36.22874	82.01886	MIX	3557	1	1	2	0	0											
4/17/2014	Pond	15	23:26	36.22718	82.01141	HW	3667	1	1	1	0	0											
4/17/2014	Pond	16	23:41	36.22355	82.00485	MIX	3680	0	0	0	1	0											
4/17/2014	Pond	17	23:55	36.21660	82.00303	MIX	3551	0	0	0	0	0											
4/18/2014	S. Valley	1	20:15	36.58018	81.90929	HW	3520	0	0	0	0	0	2	2	49	46	1	1	E	E	F	U	U
4/18/2014	S. Valley	2	20:30	36.57453	81.91529	HW	3704	0	0	0	0	0											
4/18/2014	S. Valley	3	20:44	36.56748	81.91562	HW	3474	3	2	5	0	1											
4/18/2014	S. Valley	4	21:33	36.49991	81.87528	HW	3507	0	0	0	0	1											
4/18/2014	S. Valley	5	21:49	36.50172	81.88165	HW	3720	0	0	0	0	1											
4/18/2014	S. Valley	6	22:02	36.49598	81.88990	HW	3838	0	0	0	0	0											
4/18/2014	S. Valley	7	22:16	36.50056	81.89763	HW	3635	0	0	0	0	1											
4/21/2014	R. Fork	1	20:11	36.07562	82.62131	HW	4324	3	1	1	0	0	2	1	64	53	1	1	SW	SW	T	U	U
4/21/2014	R. Fork	2	20:28	36.07359	82.61655	HW	4160	0	0	0	0	0											
4/21/2014	R. Fork	3	20:42	36.07494	82.60799	HW	4058	0	0	0	0	0											
4/21/2014	R. Fork	4	20:57	36.07949	82.60158	HW	4041	3	1	1	0	0											
4/21/2014	R. Fork	5	21:13	36.08253	82.59481	HW	4009	3	1	2	0	0											
								3	4	2	0	0											
4/21/2014	R. Fork	6	21:27	36..07981	82.58785	HW	4068	0	0	0	2	0											
4/21/2014	R. Fork	7	21:42	36.07841	82.58121	HW	4327	3	2	2	0	0											
4/21/2014	R. Fork	8	21:57	36.08088	82.57451	HW	4340	0	0	0	0	0											
4/21/2014	R. Fork	9	22:12	36.08070	82.57000	HW	4061	0	0	0	0	0											
4/21/2014	R. Fork	10	22:27	36.07880	82.56718	HW	4068	0	0	0	0	0											
4/21/2014	R. Fork	11	22:49	36.07691	82.55297	HW	3989	0	0	0	3	0											
4/21/2014	R. Fork	12	23:04	36.07864	82.55639	HW	4196	0	0	0	0	0											
4/21/2014	R. Fork	13	23:19	36.07568	82.56410	HW	4271	1	1	5	0	0											
4/21/2014	R. Fork	14	23:36	36.07242	82.57005	HW	4330	0	0	0	0	0											
4/21/2014	R. Fork	15	23:52	36.06882	82.57753	HW	4058	3	1	2	0	0											
4/21/2014	R. Fork	16	0:08	36.06358	82.57980	HW	3710	0	0	0	0	0											
4/22/2014	Roan	1	20:08	36.10666	82.11055	MIX	5508				1		2	2	46	46	5	5	N	NW	H	U	U
4/22/2014	Roan	2	20:11	36.11051	82.10673	HW	5380	0	0	0	0	0											
4/22/2014	Roan	3	20:25	36.10934	82.09583	HW	5121				1												
4/22/2014	Roan	4	20:30	36.11329	82.08603	HW	4888	0	0	0	0	0											
4/22/2014	Roan	5	20:44	36.11855	82.08176	HW	4717	0	0	0	0	0											
4/22/2014	Roan	6	20:57	36.12858	82.08577	HW	4455	0	0	0	0	0											
4/22/2014	Roan	7	21:11	36.12259	82.08479	HW	4310	3	1	2	0	0											

4/22/2014	Roan	8	21:25	36.12436	82.09611	HW	3940	0	0	0	0	0										
4/22/2014	Roan	9	21:39	36.13034	82.10054	HW	3687	0	0	0	1	0										
4/23/2014	Unaka	1	20:22	36.121250	82.318280	HW	4261	0	0	0	0	0	1	1	45	40	3	1	W	W	H	U	U
4/23/2014	Unaka	2	20:35	36.126090	82.313360	HW	4166	0	0	0	0	0	0										
4/23/2014	Unaka	3	20:49	36.131080	82.308120	HW	4432	3	1	5	0	0											
4/23/2014	Unaka	4	21:03	36.130380	82.306950	MIX	4688	0	0	0	0	0											
4/23/2014	Unaka	5	21:16	36.134780	82.305190	MIX	4776	1	1	1	0	0											
4/23/2014	Unaka	6	21:29	36.141910	82.299330	MIX	4770	1	1	3	0	0											
4/23/2014	Unaka	7	22:03	36.143470	82.291100	MIX	4714	3	1	1	0	0											
4/23/2014	Unaka	8	22:17	36.139500	82.287220	HW	4547	1	1	1	0	0											
								3	1	5													
4/23/2014	Unaka	9	22:32	36.137390	82.282890	HW	4337	0	0	0	0	0											
4/23/2014	Unaka	10	22:47	36.137120	82.278760	HW	4160	0	0	0	0	0											
4/23/2014	Unaka	11	23:00	36.140580	82.270450	HW	3946	3	1	1	0	0											
4/23/2014	Unaka	12	23:15	36.134300	82.275160	HW	3749	0	0	0	2	1											
4/23/2014	Unaka	13	23:29	36.137110	82.268280	HW	3522	0	0	0	2	0											
4/29/2014	Pond	1	20:18	36.26543	82.08206	HW	3553	0	0	0	0	0	2	2	61	60	2	3	W	W	N	U	U
4/29/2014	Pond	2	20:33	36.26806	82.07689	HW	3651	3	2	2	0	0											
4/29/2014	Pond	3	20:48	36.2651	82.06982	HW	3608	0	0	0	0	0											
4/29/2014	Pond	4	21:02	36.26207	82.06057	HW	3831	0	0	0	1	0											
4/29/2014	Pond	5	21:17	36.26947	82.05495	HW	3625	0	0	0	0	0											
4/29/2014	Pond	6	21:31	36.27307	82.05698	HW	3566	0	0	0	0	0											

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