

Whip-poor-will Territory Mapping at Two New Hampshire Sites



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Executive Summary

Populations of the Whip-poor-will (*Caprimulgus vociferus*) have been declining in eastern North America for decades, and the species has even disappeared from large portions of its former range in the last 20 years. Among the reasons proposed for these declines is the loss of early successional and edge habitat as a result of development or forest maturation. To better understand the potential effects of habitat management on Whip-poor-will populations in New Hampshire, detailed studies were initiated in two high density areas in 2008: Mast Yard State Forest and the Ossipee Pine Barrens.

There were 8-9 Whip-poor-will territories at Mast Yard in 2008 and 2009. In both years, birds were concentrated at the western and eastern portions of the study area. In the west, they used areas of thinned pine, recent clear cuts, and wetlands, while in the east they occupied areas of aspen regeneration, wetlands, and a power line corridor. The remainder of the site, which is dominated by mature pine, was completely unoccupied. These results corroborate those of broad-based studies that have found Whip-poor-wills more common in landscapes with higher proportions of edges or open habitats.

There are significantly fewer data from the Ossipee Pine Barrens, making broad conclusions difficult. However, some areas have significantly higher densities, as evidenced by at least 20 Whip-poor-wills along an abandoned airstrip in 2008. More detailed mapping at a different site in 2009 documented at least 3 birds in a more natural pine barrens habitat, with several additional detections that might represent additional individuals. These data should all be considered preliminary, and it is hoped that more intensive work in the future will better elucidate habitat relationships at Ossipee.

Introduction

The Whip-poor-will (*Caprimulgus vociferus*) is a nocturnal insectivorous bird that breeds in a variety of open forest types in eastern North America. Its populations have declined considerably in the northeastern United States in the last 40 years. Data from the Breeding Bird Survey (Sauer et al. 2008) indicate a significant decline of 2.9% per year for the region, a trend corroborated by numerous anecdotal reports. More recently, several second-generation Breeding Bird Atlases have documented the species' disappearance from 43-77% (average 50%) of blocks occupied during atlases conducted 20-30 years previously (Cadman et al. 2007, McGowan and Corwin 2008, Patuxent Wildlife Research Center 2009, Pennsylvania Breeding Bird Atlas 2009). Due to these declines, the Whip-poor-will is listed as species of concern for all the states and provinces in the Northeast.

Reasons for these declines are poorly understood, but habitat loss on the breeding grounds is commonly proposed as a leading factor. Most available data (Cink 2002, Wilson 2003, Hunt 2006) suggest that Whip-poor-wills need a combination of open areas (e.g., wetlands, fields, forest openings) for foraging and more closed canopy forest for nesting. As a result, they tend to occur where edges and natural disturbance are more prevalent. In much of the northeastern United States, the continued decline of agriculture and – in some areas – forestry have resulted in a net increase in overall forest cover. At the same time, many shrubland habitats are being lost to development, often in the coastal plain and river valleys where Whip-poor-wills were historically more abundant. Thus, even where suitable habitat is less likely to mature (e.g., pine barrens, coastal shrublands), it is being replaced by roads, houses, and other construction. If suitable early successional or edge habitat is declining across the region, it would follow that Whip-poor-will populations would also decline.

There is increasing evidence that certain types of habitat management can benefit Whip-poor-wills. The species occurs disproportionately close to edges in logged pine plantations in North Carolina (Wilson 2003, Wilson and Watts 2008) and uses burned areas relatively soon after treatment in Massachusetts (Garlapow 2007; J. Kelly, pers. comm.). The goal of the present study was thus to collect data on Whip-poor-will use of two managed areas in New Hampshire, one where the dominant treatment is forest management and the other where fire is being used to restore pine barrens. By collecting habitat data at both sites, it may be possible to evaluate which practices are most likely to benefit the species. In the long run, such data can inform “best management practices” that, if applied, would enhance local Whip-poor-will populations and ultimately reduce or reverse the species' ongoing declines.

Study Area and Methods

Whip-poor-will territory mapping was conducted at two New Hampshire sites known to support high densities (Fig. 1). In both 2008 and 2009, the primary study area was the Mast Yard State Forest in Hopkinton and Concord (Fig. 2). Mast Yard and adjoining conservation lands contain over 350 hectares of mixed pine and oak forest along the banks of the Contoocook River.

Dominant species include eastern white pine (*Pinus strobus*), red pine (*P. resinosa*), and northern red oak (*Quercus rubrum*). The site has been subject to limited management in the form of timber harvesting, including a large area in the western portion of the site that was thinned to release pine crowns in the early 1990s. This thinned area presently consists of a partially open pine canopy with extensive brushy undergrowth. Several additional areas were either clear cut or selectively harvested between 1993 and 1996, partially to promote the regeneration of birch (*Betula* sp.) and aspen (*Populus* sp.). These areas are presently in various stages of succession, and include several forest openings. A powerline right-of-way roughly 100 m wide cuts through the eastern portion of the study area. In the New Hampshire Wildlife Action Plan, much of Mast Yard was mapped as potential pitch pine (*Pinus rigida*) habitat, largely due to soil and topography, and there are two small remnant patches of pitch pine at the site.

New Hampshire's highest Whip-poor-will densities occur in the vicinity of the Ossipee Pine Barrens (Fig. 3), which historically supported nearly 3000 hectares of pitch pine and scrub oak (*Q. ilicifolia*) habitat. Pitch pine barrens are a globally rare ecosystem, and depend on periodic fire to reduce competing vegetation and promote pitch pine germination. Decades of fire suppression (the last large fire was in 1957) in conjunction with ongoing habitat loss to development have reduced the extent of pitch pine/scrub oak habitat to 1200 hectares. The Ossipee Pine Barrens are currently the focus of extensive conservation efforts by The Nature Conservancy, involving both land protection and the restoration of fire through prescribed burns.

Sites used for Whip-poor-will mapping at Ossipee differed in 2008 and 2009. In 2008, a pilot effort was conducted at an unfinished airstrip in the town of Freedom. The Freedom airstrip is a 2.2 km long and 50-100 m wide cut with a total area of roughly 20 hectares in the town of Freedom. As the name implies, the site was originally intended as a private airstrip, but the project was abandoned in the late 1980s. The airstrip itself is largely non-vegetated sand and gravel, although the forest on either side is a mix of white pine, pitch pine, and northern red oak, with birch and aspen along the edges. It is currently protected as part of the Freedom Town Forest. In 2009 mapping efforts shifted to The Nature Conservancy's "West Branch Preserve," roughly 200 acres of conserved pitch pine/scrub oak along the West Branch in the towns of Madison and Freedom. West Branch is among the sites where The Nature Conservancy is restoring fire to the barrens ecosystem, and roughly 30 acres had been burned prior to the 2009 field season.

Territory mapping employed a modified spot-mapping protocol that will hereafter be referred to as "triangulation mapping." It was based on methodologies piloted in Connecticut and New Hampshire in 2007, and involved simultaneous observations by multiple observers at geo-referenced points. The premise of these surveys is identical to that used in radio telemetry, in that if two independent observers take a compass bearing on a calling bird, the intersection of those bearings should approximate the bird's location on the ground. Unlike radio telemetry however, observers cannot distinguish among individual birds with 100% accuracy, especially at territory boundaries and in high density areas. Analysis of data collected through triangulation mapping is thus more similar to that used for spot-mapping, in that one looks for clusters of locations over time and simultaneous detections of adjacent birds. Because Whip-poor-wills are nocturnal, there are rarely visual cues that can provide information on specific location or distance, which is why

the triangulation component was added to what otherwise would have been a straightforward spot-mapping protocol.

The resulting protocol was as follows. At all three sites in New Hampshire, a series of points were located along existing trails or habitat features (to facilitate navigation in the dark). Initially all points were 250 m apart, with new points at variable distances being added in the course of field work. Ideally, all surveys employed two observers (sometimes more), although there were some occasions at Mast Yard and West Branch when only one observer was present. Surveys were usually conducted during a 1-3 hour period after sunset (a smaller number also took place prior to sunrise), and occurred between mid-May and late July. An effort was made to maximize the number of surveys conducted during each month's "lunar window" as defined by the Northeast Nightjar Survey (Hunt 2007): a period when the moon is at least 50% illuminated and above the horizon.

The two observers stationed themselves at points ranging from 125 to 500 m apart, depending on site configuration, and maintained contact using two-way radios. Once both observers were at their assigned points, they spent a variable amount of time (three minutes suggested) listening for Whip-poor-wills. If any birds were detected, a compass bearing was taken on the approximate origin of the call, and this bearing and the time recorded on a data sheet. Observers also recorded additional information such as perceived distance or location in relation to a habitat edge or landmark. Observers were instructed to track individual birds by giving each a unique numeric identifier during each listening session, and to use this number for repeat observations such as if the bird was perceived to have moved. As much as possible, observers matched up their bird numbering through discussions over their two-way radios.

Once observers were satisfied with the data collected at a given pair of points, they shifted one point along the grid, so that one of the preceding points was still occupied for a second observation period. If there were not birds at a given pair of points, the observers were allowed to continue to a non-overlapping pair. In this manner, the observers continued through the site until it was covered in its entirety or surveys were discontinued because Whip-poor-will activity had declined significantly. When a single observer conducted surveys, they moved as quickly as possible between points while listening to a focal bird in order to obtain a second compass bearing. If a focal bird called continuously while the observer moved, it was assumed to have remained in the same location, since Whip-poor-wills are not known to call while in flight (Cink 2002).

Bird locations were determined by generating lines on a map that corresponded to the compass bearing from any given point. If two simultaneous bearings intersected, this was assumed to be the Whip-poor-will's location. Because estimating the compass direction to a calling bird is sometimes difficult, especially with distant birds, these lines did not always intersect. In such cases, an approximate location was indicated that corresponded to the predominant direction, as informed by other information when available (e.g., estimated distance). The same general rule was applied in situations where there was only a single compass bearing. The latter two location types were coded as "non-triangulated" for purposes of analysis. All locations were assigned to individual birds based on a combination of a) documented

countersinging and b) previous detection patterns. In some cases, a location was shared between adjacent individuals in the absence information that would distinguish between the two.

Whip-poor-will territories were delineated by creating a minimum convex polygon that included all locations assigned to each individual bird. Three polygons were created for each bird, corresponding to: a) a “core territory” including only triangulated locations clearly attributed to that individual, b) an “expanded territory” that also included non-triangulated locations, and c) a “maximum territory” that also included locations that were not resolved between adjacent birds.

To supplement data collected by triangulation mapping, a radio telemetry component was originally planned for the 2009 breeding season. Unfortunately, a combination of logistical difficulties and poor weather delayed the start of this aspect of the research until mid-June. By this point, birds had apparently become less responsive to audio playback and only a single individual was captured. Continued poor weather precluded additional efforts, and the project was dealt another setback when the radio transmitter fell off the tracked bird after 24 hours. At this point in the season, telemetry efforts for terminated for 2009 and the remaining radios saved for a renewed effort in 2010. The limited data collected for the transmitter-bearing bird are presented where appropriate in the Results.

Habitat data for Mast Yard were derived from a combination of aerial photographs and stand maps provided by the New Hampshire Division of Forests and Lands. In the absence of detailed on-the-ground habitat measurements, cover types were broken into six broad categories as listed and shown on Figure 2. To assess habitat selection by Whip-poor-wills, territories were overlaid on the habitat map and GIS was used to estimate the proportions of each cover type present within each territory.

Results and Discussion

At Mast Yard, surveys were conducted on 20 days in 2008 (13 May to 26 July), for a total of roughly 26.5 hours. Fourteen of these surveys involved at least two observers. In 2009, surveys were conducted 34 times (21 with at least two observers) between 3 May and 31 July, totaling roughly 25.75 hours. The number and dispersion of Whip-poor-will territories at Mast Yard was similar in both years (Figure 4). Territories were clearly clumped at the western and eastern ends of the site, with only occasional detections in the northern and central portions. Although territories averaged slightly larger in 2008 (Table 1), this difference was not statistically significant ($t = 0.28$, $p = 0.39$).

The territory areas reported in Table 1 should be considered minimum estimates, since they are based entirely on the locations of calling birds. Many birds actually use a home range that is significantly larger than the core defended area (e.g., Anich et al. 2009). Estimates of Whip-poor-will home range size based on radio telemetry are highly variable, ranging from an average of 5.1 ha (Cink 2002) to 20-30 ha (Wilson 2003). In the latter study, the largest home ranges were larger than 200 ha. The single male Whip-poor-will fitted with a radio transmitter at Mast Yard was recorded at only six locations before the transmitter fell off. Of these, all but one

were within the territory as delineated by triangulation mapping. The exception was the site where the radio fell off, which was roughly 150 m south of the southernmost known calling location and 300 m south of all other calling locations. The presence of this bird outside its calling-defined territory is consistent with the findings of other researchers (S. Kearney and J. Kelly, unpubl. data), suggesting that Whip-poor-will home ranges are often noticeably larger than the area defined by a male's singing locations.

The habitats found within Whip-poor-will territories in both 2008 and 2009 were not a proportional representation of overall habitat availability at Mast Yard (Table 2, Fig. 5). In particular, although 75% of the study area is characterized as mature pine forest, this habitat comprised only 33-35% of territories (Table 2). In contrast, territories contained higher than expected amounts of all other habitats, especially thinned pine and shrub wetland. The differences between habitat within territories and across the site as a whole was significant in both years (Chi-square = 61.07 in 2008 and 61.248 in 2009, both $p < 0.001$). There was no difference in Whip-poor-will habitat use between the two years (Chi-square = 2.52, $p = 0.995$).

Whip-poor-will's general avoidance of mature pine is probably the reason for the species' absence from the primarily forested northern and central portions of the study area. Selection for open and/or edge habitats at this site is supported by the presence of 1-2 additional territories to the west of Mast Yard in each year, generally adjacent to two open fields (birds not mapped on Fig. 4, but fields are evident). These birds were not included in the analysis because they were not adequately mapped and there were no habitat data available for those areas. However, such habitat preferences fail to explain the absence of Whip-poor-wills from the right-of-way at the northeastern corner of the study area. Although this area was only checked irregularly in both 2008 and 2009, regular surveys immediately to the south would have detected birds if they had been calling there. The species' absence from what appears to be suitable habitat bears further investigation as this project continues.

Sites in the Ossipee Pine Barrens were visited far less frequently than Mast Yard, and as a result it is much more difficult to draw conclusions from the limited data collected. In 2008, the Freedom Airstrip was surveyed five times between 1 June and 16 July with a total accumulated time of 6.75 hours. Based on the data collected, there were between 20 and 25 Whip-poor-will territories at this site, but the infrequency of surveys and trial nature of the protocol preclude an accurate map of their locations (Hunt 2008). It was in part due to the linear nature of the site – which made triangulation difficult – that the project was shifted to the West Branch Preserve in 2009. West Branch was surveyed five times between 21 May and 28 June, for a total time of 5.2 hours, but again there weren't enough data for a comprehensive territory map. At minimum there were three birds, but there were several peripheral and infrequent detections that could not clearly be assigned to individual birds (Figure 5). With the possible exception of a bird detected twice from the northwest portion of the study area, none of the Whip-poor-wills frequented recently burned areas. This may be because the burns are so recent (2007-2008) that understory vegetation has not returned to the point that it provides suitable nesting cover. Continued surveys at this site will allow for more detailed tracking of any colonization of burned areas, as well as shifts in site occupancy following future burns.

These results corroborate those from studies elsewhere in the species' range, as well as more generalized data from New Hampshire. Using data from roadside survey routes, Hunt (2006) determined that survey points where Whip-poor-wills were detected tended to be in landscapes characterized by relatively low forest cover, and where the non-forested land was open rather than developed. Within the Ossipee Pine Barrens, the presence of pitch pine was also a significant habitat feature in the vicinity of points where Whip-poor-wills were detected (Hunt 2006). A similar study in North Carolina found Whip-poor-wills more likely to occur near forest edges in managed pine plantations, and that most birds were within regenerating versus mature habitat (Wilson and Watts 2008). On Cape Cod, Garlapow (2007) found few differences between occupied and unoccupied sites, although Whip-poor-wills preferred to forage over areas with less ground cover. The lack of clear habitat selection in the latter study may be related to the prevalence of pitch pine/scrub oak communities, and thus relatively little habitat that birds would be likely to avoid.

There is still much to learn about habitat selection by Whip-poor-wills in this portion of the species' range. Data from a managed forest at Mast Yard supports the idea that Whip-poor-wills preferentially settle in areas with a mix of forest and open area. As this project continues into 2010, there will be an opportunity to test this hypothesis more directly, since there was extensive selective cutting on a parcel of private land to the north of the state forest. This area did not receive significant Whip-poor-will use in either 2008 (no detections) or 2009 (two birds late in season), but as the study continues it will be possible to determine whether birds begin to move into the new openings that have been created. The same will be true in the south-central portion of the state forest (between the two territory clusters), where a partial timber harvest is planned for the winter of 2009-2010. In the Ossipee Pine Barrens, there are not presently sufficient data to evaluate habitat relationships at the local scale, but something of a baseline has now been established at the West Branch site. A key need at West Branch is more consistent coverage and thus better data on territory size and dispersion. Given the poor success of radio telemetry in 2009, this component will re-attempted in 2010 with an earlier start date, and probably focus entirely on Mast Yard. After a third year of mapping at that site, especially in light of recent or upcoming timber harvests, it may be possible to draft management recommendations that would result in increased or enhanced habitat for this declining species.

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Table 1. Comparison of three territory measurements for Whip-poor-wills at Mast Yard State Forest, NH.

	Territory Size in hectares (S.E.), by delineation type		
Year (N)	Core	Expanded	Maximum
2008 (9)	3.75 (0.38)	5.49 (0.42)	6.79 (0.46)
2009 (8)	4.94 (0.45)	6.06 (0.43)	6.55 (0.44)

Table 2. General habitat characteristics of Mast Yard State Forest and Whip-poor-will territories in 2008 and 2009.

Habitat Type	Percent of total area in habitat type		
	Mast Yard	WPW 2008	WPW 2009
Mature Pine	74.9	35.1	32.8
Mature Pine Thinned	6.8	21.5	16.6
Young Pine	1.2	4.1	7.4
Young Hardwood	4.0	10.2	14.4
Poorly Vegetated	5.2	5.7	10.6
Shrub Wetland	7.9	23.4	18.3

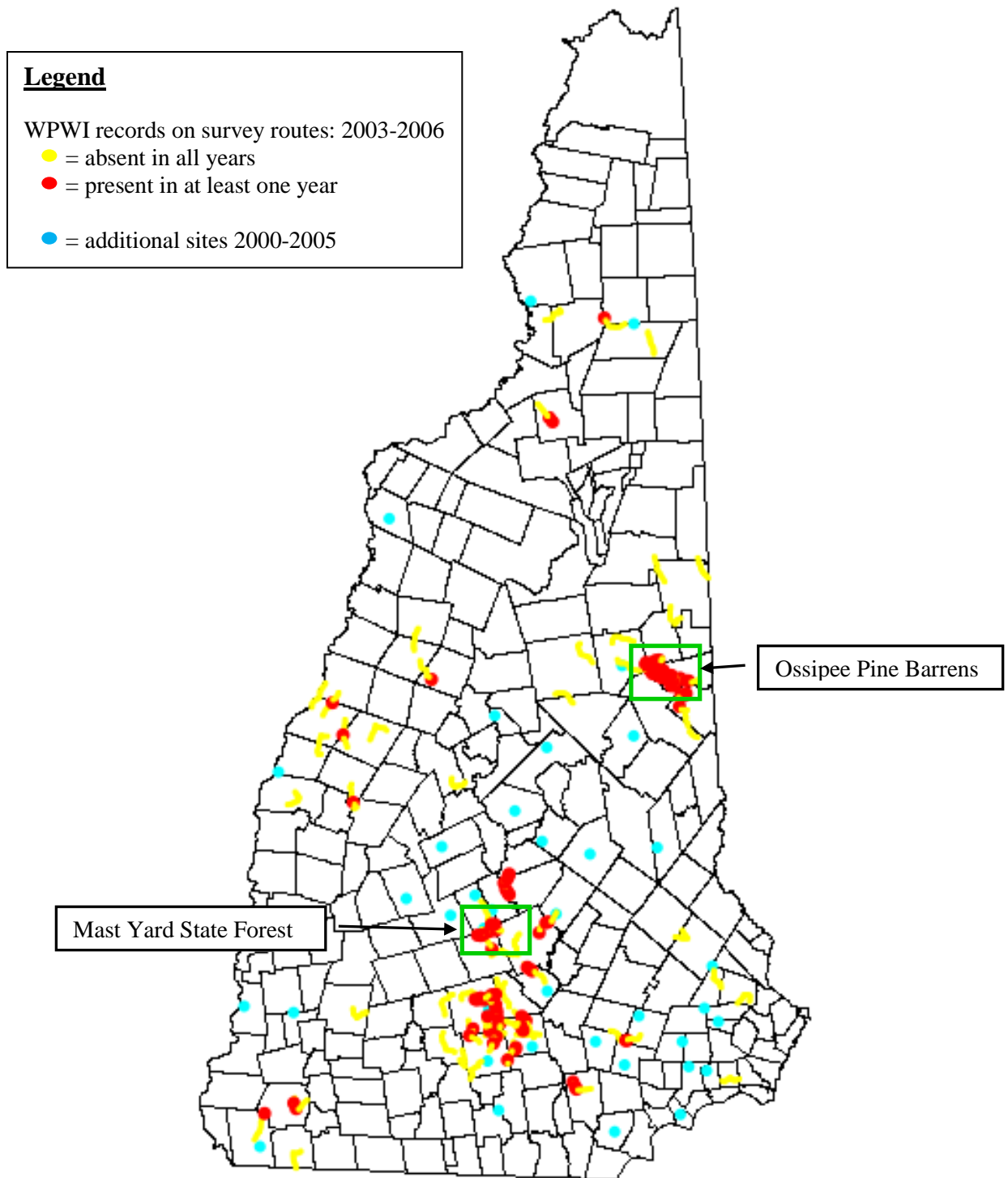


Figure 1. Approximate distribution of Whip-poor-wills in New Hampshire in 2000-2006, based on survey data and anecdotal reports. The two study areas are located within the green boxes.

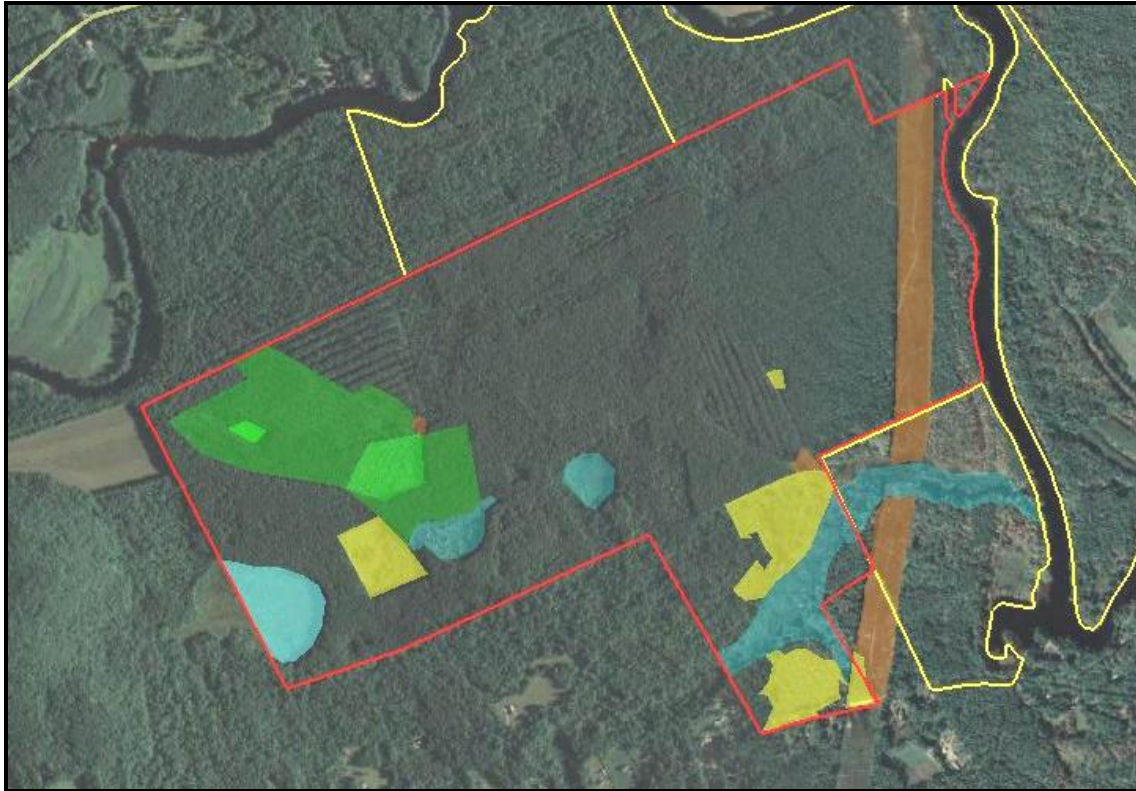


Figure 2. Aerial photograph of Mast Yard State Forest (red outline) and adjacent conservation lands (yellow outlines). Colored shading indicates the locations of habitats mentioned in the text, as follows:

- Not shaded = mature pine forest
- Dark green = thinned pine forest
- Light green = young pine forest
- Yellow = young hardwood forest
- Brown = poorly vegetated (power line right-of-way, log landings)
- Blue = shrub wetlands

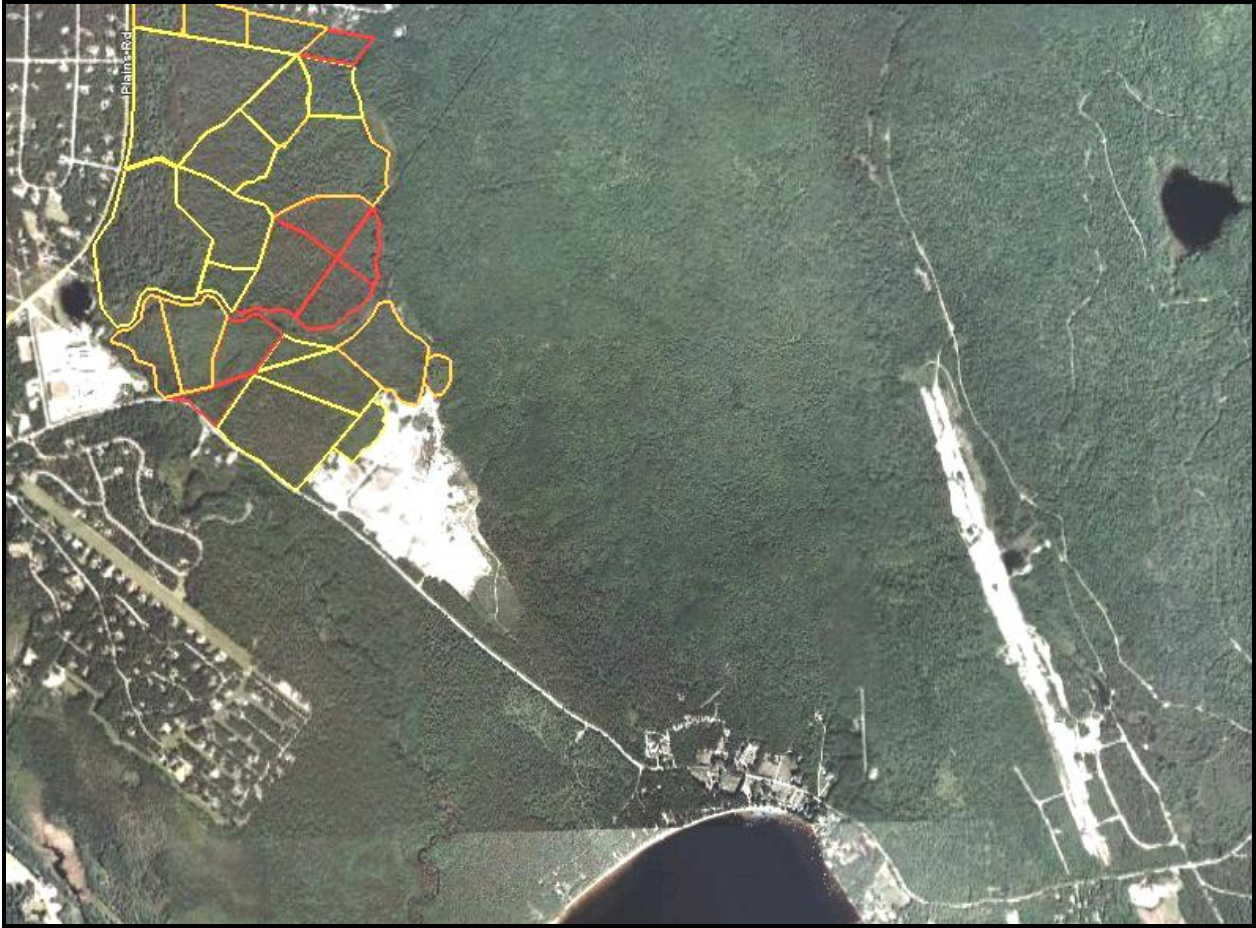


Figure 3. Aerial photograph of a portion of the Ossipee Pine Barrens. The West Branch Preserve is in the northwest, with colored polygons representing burn units. Areas burned in 2007-08 are outlined in red, areas where burns are planned 2009-11 outlined in orange, and other conserved parcels outlined in yellow. The Freedom Airstrip is in the southeast.

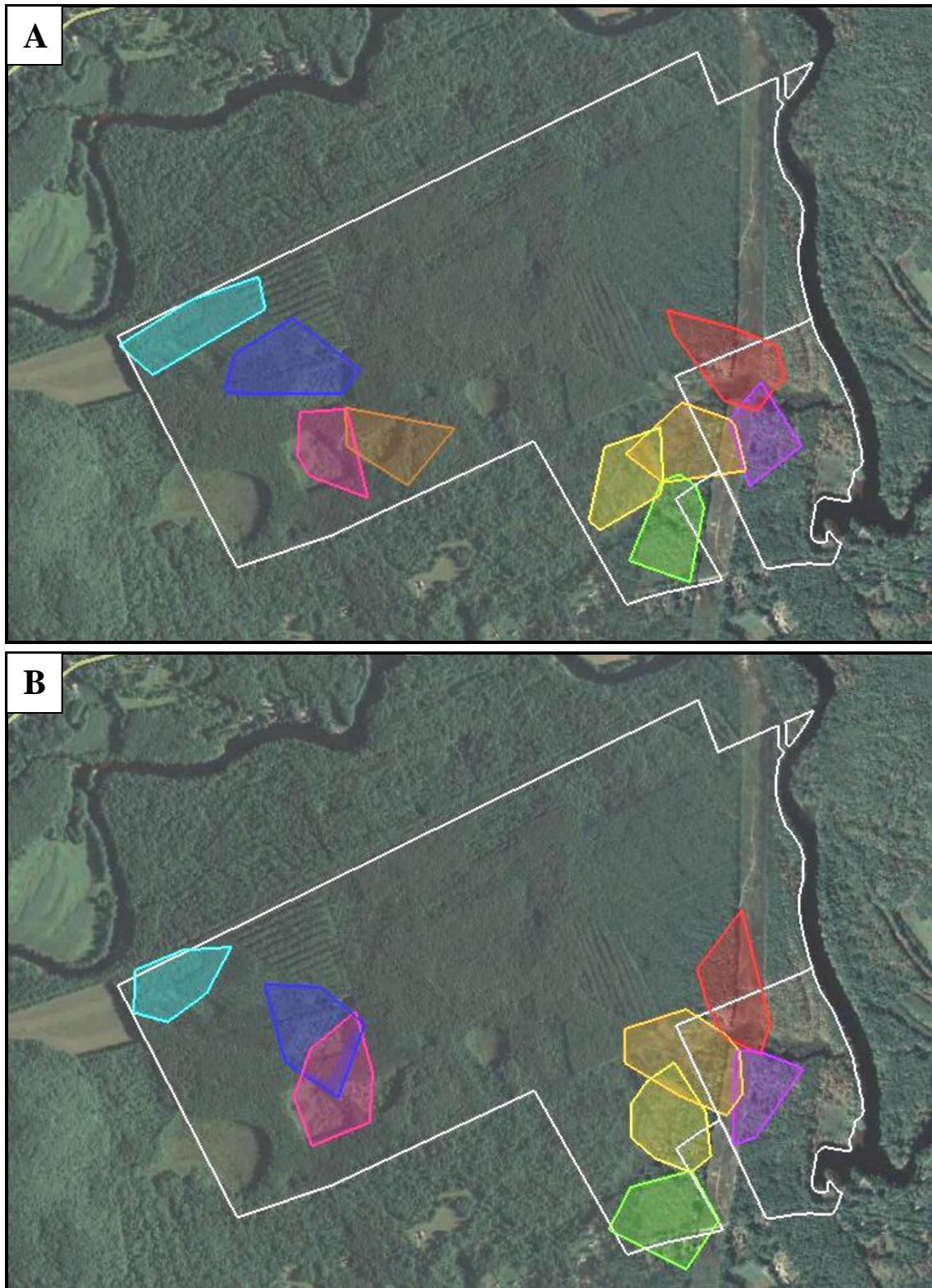


Figure 4. Whip-poor-will territories at the Mast Yard State Forest in A) 2008 and B) 2009. Territories located off the state forest to the west are not shown.

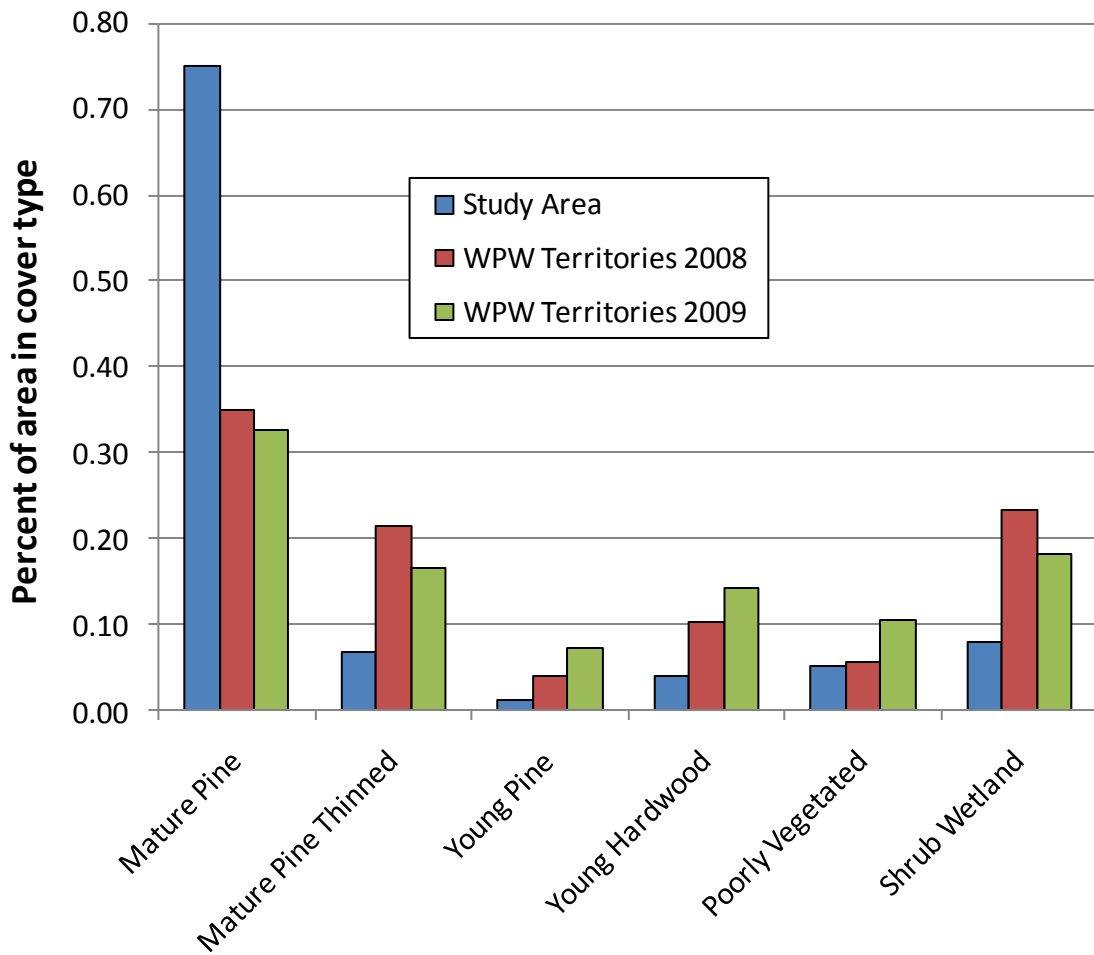


Figure 5. Comparison of habitat types within Whip-poor-will territories with the overall extent of each type within the Mast Yard State Forest as a whole.

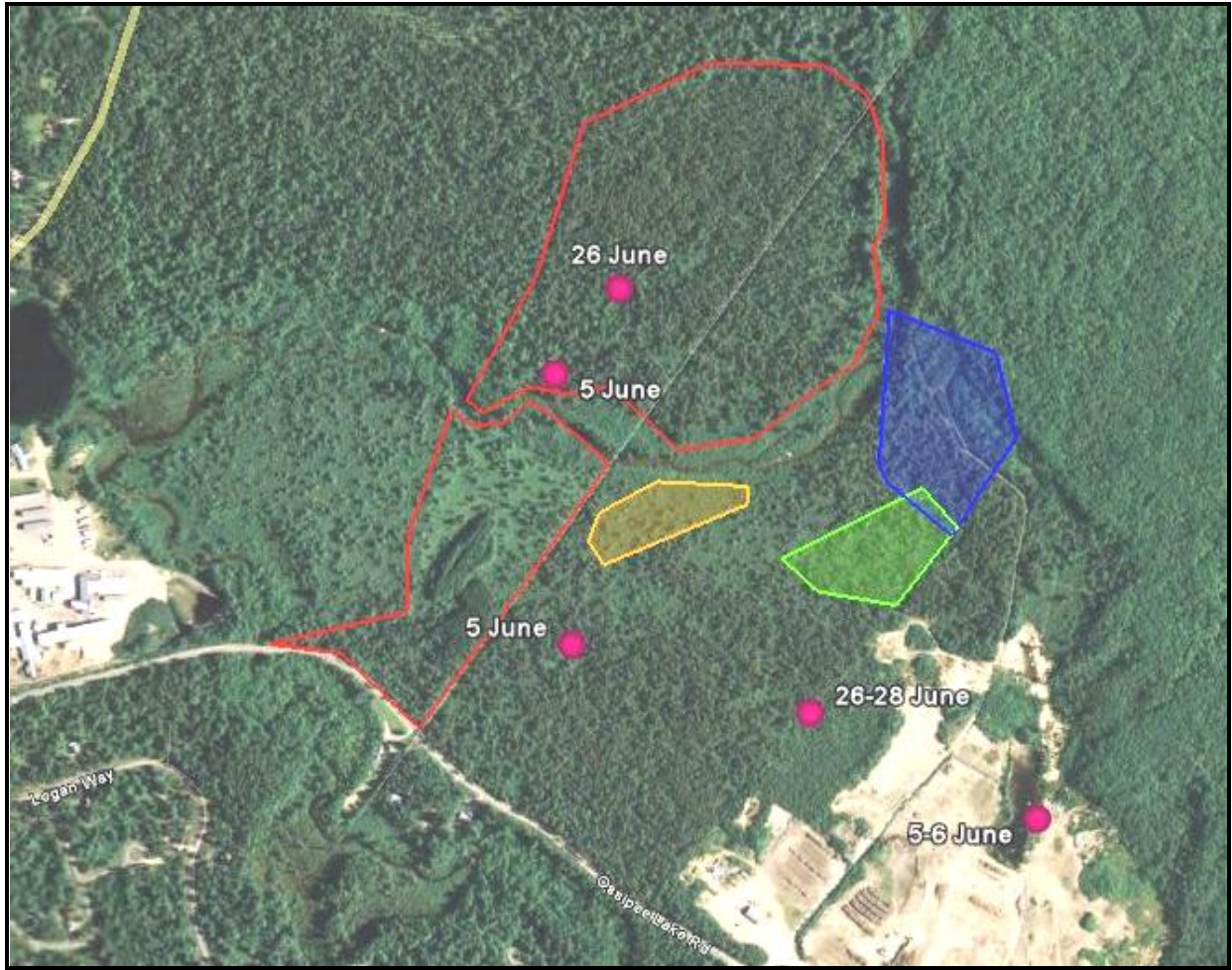


Figure 6. Locations of Whip-poor-will territories (tinted polygons) at the West Branch Preserve (see Figure 3 for site context) in 2009. Pink circles with dates represent locations of birds only detected 1-2 times, and thus not used to delineate territories. Red lines indicate sections of the preserve burned in either 2007 or 2008.