Monitoring Songbird Populations at the Pioneer Butte Meadow Restoration Project, Siuslaw National Forest

Survey Design and 2011 Baseline Results

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Introduction

The Siuslaw National Forest (SNF) is planning to conduct habitat restoration activities at a site known as Pioneer Butte on Mary's Peak, Benton County, Oregon. The site includes an abandoned homestead with small scattered openings that probably are remnants of what were once more extensive livestock pastures. However the site has largely become reforested since under SNF management through the encroachment of surrounding Douglas-fir forests. The SNF is planning to remove most conifers on the old homestead and enlarge the existing openings to benefit wildlife that use early successional habitat. Such habitat has become rare on the SNF since the adoption of the Northwest Forest Plan. Conifer removal will result in an expanded opening of approximately 9 ac (3.6 ha) on the site. The City of Corvallis conducted a small meadow restoration in 2010 on lands owned by the City approximately 200 m (656 ft.) from the SNF Pioneer Butte site. This presented an opportunity to collect and examine short-term post-treatment avian data on a meadow site similar to the intended future habitat condition for Pioneer Butte.

The SNF has partnered with the Oregon Wildlife Institute (OWI) for the purpose of collecting baseline diurnal bird community data at Pioneer Butte and to design a monitoring strategy that will facilitate an analysis of bird community responses to habitat restoration practices. However, the small area of the Pioneer Butte site presents a challenging monitoring problem. The most commonly employed avian survey technique is to count bird detections from stations spaced at 250 m along a transect (Ralph et al. 1993). Only 1 or 2 stations could be fitted into a site as small as Pioneer Butte. Many songbird and woodpecker species have territories at least as large as the proposed treatment area. So counts of individuals for any given avian species are likely to be small and interpreting such data is problematic. For example, what is the biological significance of a change from 3 individuals of a species counted one year to 4 individuals the next? Furthermore, determining whether a singing male is within the boundary of the treatment area based only on an aural detection from a point count station is likely to lead to numerous errors.

Avian territory mapping (also called "spot mapping") represents an alternative survey technique that utilizes behavioral observations and recorded positions of birds collected over repeated visits to construct maps of territories established during the breeding season. The method permits relatively precise estimates of population density and is particularly suitable for small study sites or where territories are distributed across patchy habitats (Ralph et al. 1993). Collecting habitat data from within avian territories and comparing it to similar data collected outside of territories can also reveal potential explanations for why a species' occurrence or distribution responds to restoration practices. The method is labor intensive and so cannot be readily applied to all birds that are observed at a forest site. For this monitoring study, I selected three avian indicator species for territory mapping: the dark-eyed junco, hermit warbler, and Pacific wren. All three species are widely distributed in the Oregon Coast Range; establish territories that are typically much smaller than the Pioneer Butte restoration area, and whose habitat relationships have been relatively well studied (Appendix). Given their reported species-habitat relationships, dark-eyed junco populations could be expected to expand as the meadow area at Pioneer Butte increases, hermit warblers would be excluded as canopy cover decreases but may respond to edge effects, and Pacific wrens are likely to be particularly sensitive to coarse woody debris retention and soil disturbance on the site. I did not select birds that are closely associated with grassland or savanna habitats as indicator species because the small size of the meadow (even after restoration) and the conifer forest landscape in which is embedded make it unlikely that such birds will ever occupy the site.

This monitoring survey is designed as a component of an adaptive management strategy specific to the Pioneer Butte habitat restoration project. The goal of the survey to provide SNF land managers site-specific information that will improve their understanding as to whether the restoration effort is satisfying their avian habitat objectives.

Methods

Site Layout

I established a single 200 X 200 m avian sampling plot (total area = 4 ha) at the SNF Pioneer Butte restoration site (hereafter called the "SNF plot") and another plot of the same size at the City of Corvallis Rock Creek Watershed site (hereafter called the "City plot"). The SNF plot was positioned so as to overlay the location of the future meadow restoration according to a map and guidance provided by Cindy McCain, SNF ecologist. The City plot was positioned so as to overlay the meadow created in 2010 and forest immediately surrounding the meadow. Each of these whole plots was divided into 16 50 X 50 M subplots to determine areas of occupancy and/or habitat use within the whole plot (Figure 2).

I imported 2009 color imagery, Benton county tax lot boundaries, and a U. S. Forest Service roads layers into a geographic information system (GIS) to create aerial photos and maps of both sites. Using the GIS, I created a vector sampling grid at each of the sites and uploaded the UTM coordinates for each of the subplot corners into a geographic positioning system (GPS). I then used the GPS to locate subplot corners at each site. Where the forest canopy or topography prevented reception of the GPS signal, I used a compass and laser range finder to locate corners using measurements from known positions. All of the corners should be within a 4 m of their true UTM coordinates based on precision estimates recorded by the GPS. Each corner was marked with a wood stake.

Bird Surveys

I conducted bird surveys on 6 visits to the SNF and City plots during the 2011 songbird breeding season (June 2, 6, 9, 17, 20, 23). Observations typically were begun at dawn and continued until all subplots were completed. However, observations on June 20 had to be discontinued before all the subplots could be visited because of heavy rain. I alternated which site was visited first on survey days and varied the pattern I moved through subplots to minimize any bias that survey order or timing might cause in the results.

During each visit, I moved through each of the subplots at a slow walking pace listening for bird songs, calls, and drumming by woodpeckers. Visual observations were made with 8 X 30 binoculars. I remained in each of the subplots long enough to be reasonably certain I had observed all of the birds that were detectable that morning. Subplots with dense vegetation and/or a relatively high number of birds could take as long as 15 minutes while subplots that were mostly meadow might only take 2 minutes. When birds could be visually detected, I attempted to determine whether it was engaged in a behavior that would indicate occupancy of the site, such as territoriality displays or nesting.

For all birds observed within a subplot and below the maximum height of the forest canopy, I recorded the subplot identifier, time of observation, species, sex (if determined), adult or juvenile, count of birds for this observation, and one of 8 behavior classes (Table 1); more than one behavior class were often recorded for a single observation of a bird (or pair of birds). I also recorded the species of birds seen flying above the forest canopy (i.e., "flyovers") or were heard outside the plot as incidental observations.

Table 1. Behavior classes recorded during bird surveys. 2011 Pioneer Butte Avian Monitoring Study. Benton County, Oregon.

Behavior Class	Data Sheet Code	Description
Singing	S	Auditory displays of territoriality or for courting, including drumming by woodpeckers.
Calling	C	Auditory communications to signal position, warning, or begging by a juvenile
Feeding	F	Foraging behaviors
Position Change	P	Position changes were noted when they caused the detection of the bird
Territory Defense	D	Charging toward or fighting with a competitor or potential predator
Nest Building	NB	Carrying nesting materials; nest site preparation
Carrying Food	CF	Carrying food for juveniles or a mate
Other	O	Other significant behaviors not classified above

For the three indicator species, I also recorded notes describing the relative locations of counter-singing males and other intra-specific displays that could be used to delineate territory boundaries. I attempted to visually locate the position of every individual whenever possible. Birds that were outside the plot, but within approximately 100 m of the boundary were noted since it was likely that the territories of some of these birds extended to inside the plot. Bird locations were marked with a strip of plastic flagging bearing a unique identifying number. All flagging was at hung at chest height even when birds were high in the canopy or on observed on the ground.

Territory Mapping

UTM coordinates needed to be determined for each of the indicator species detections so as to permit territory mapping and/or home range estimation. In most cases, a GPS satellite signal could not be obtained directly at positions of the flags because of interference from the forest canopy or topography. In these cases, flag positions were recorded from a known location using a laser rangefinder to estimate distance and a compass to estimate the azimuth. These known locations were either a subplot corner or a control point established in a forest opening. UTM coordinates for the bird locations could be derived by the distance and azimuth estimates from the control point using the following trigonomic functions[1]:

$$UTM\ Bird_{East} = UTM\ Control_{East} + Dist\left[\sin\left(radians(Azm)\right)\right]$$

$$UTM\ Bird_{North} = UTM\ Control_{North} + Dist\left[\cos\left(radians(Azm)\right)\right]$$

Where, *UTM Bird* are the coordinates of the observed bird
UTM Control are the coordinates of the control point
Dist is the estimated distance (m)
Azm is the estimated azimuth (0-360^{o})

[1] Trigonomic functions provided by Hardolf Wasteneys, PhD P.Geo. via ESRI Support Forum post.

The resulting bird location coordinates were imported into a geographic information system (GIS) along with the observation data associated with each of the records. Also imported into the GIS were 2009 National Agriculture Imagery Program (NAIP) color orthophography, a SNF transportation geodatabase, a Benton County tax lot shapefile, and shapefiles of the SNF and City survey plots. Once maps of labeled detection locations were prepared, survey records are reviewed to identify the relative positions of males engaged in counter-singing or other territorial displays. Territories boundaries are then defined by the spatial clustering of detections and the locations of territorial males.

Occupancy maps of the SNF and City plots were generated for each of the indicator species as an alternative means for assessing species distribution patterns and a qualitative for examining habitat use. For the purpose of this study, a subplot was determined to be occupied by an indicator species if territorial behaviors or evidence of breeding was observed (i.e., behavior codes S, D, NB, CF) during more than one visit. Maps also indicated a species "present" in a subplot if an individual of the species was observed aural or visually within the boundary of the subplot and below the maximum canopy height during at least one visit.

Results and Discussion

Twenty-seven bird species were detected on the SNF plot during the survey and 21 species were detected on the City plot (Table 2). An additional 6 species were observed flying over or outside the plot boundaries. Two species, the band-tailed pigeon and pileated woodpecker, are listed as state sensitive species (ODFW 2011). However both species are associated with closed canopy forests and woodlands so are unlikely to benefit from the meadow restoration project.

All three of the indicator species selected for the study were detected at the SNF and City plots. However, there were insufficient observations of counter-singing or other territorial behaviors that could be used to delineate territory boundaries. Ralph et al. (1993) recommended a minimum of eight visits during the breeding season to precisely map territories. However spot mapping can be accomplished with fewer visits when the frequency of detections is high (Svensson 1978). Although I was unable to construct maps of territory boundaries, diagrams indicating the presence and occupancy of indicator species on each of the subplots are provided (Figures 1-3) and should be useful for qualitative assessments of species distribution and habitat use on the plot.

There were 12 detections of dark-eyed juncos on or near the SNF plot and 16 detections on or near the City plot. Dark-eyed juncos were found to be present on 3 of the SNF subplots and 4 of the City subplots (Figure 1). None of the subplots met the criterion for determining occupancy by the species. However, there were observations of defense behavior and food-carrying that is suggestive of territoriality and breeding. Anecdotal observations from the survey indicate that most activity by dark-eyed juncos occurred near openings in the forest canopy where the shrub layer was most developed. Dark-eyed juncos also were sighted on woody debris piles in the City plot.

There were 21 detections of hermit warblers on or near the SNF plot and 11 detections on or near the City plot. Three of the SNF subplots met the criterion for occupancy by hermit warblers and the species was present on 3 other SNF subplots (Figure 2). Only 1 of the City plots was occupied by hermit warblers. Except for one observation of an individual foraging in an elderberry, all other detections of hermit warblers were in mid- to upper-canopy positions. The species was absent in the recently thinned area in the City plot suggesting that canopy closure or canopy complexity is important to the species.

Table 2. List of avian species observed on the SNF Pioneer Butte and City of Corvallis plots. 2011

Common Name	Scientific Name	SNF	City	Off Plot
Ruffed Grouse	*Bonasa umbellus*			X
Turkey Vulture	*Cathartes aura*			X
Band tailed Pigeon	*Patagioenas fasciata*	X	X	
Rufous Hummingbird	*Selasphorus rufus*	X		
Northern Flicker	*Colaptes auratus*			X
Pileated Woodpecker	*Dryocopus pileatus*			
Hairy Woodpecker	*Picoides villosus*		X	
Hammond's Flycatcher	*Empidonax hammondii*	X		
Pacific-Slope Flycatcher	*Empidonax difficilis*	X	X	
Western Wood-Pewee	*Contopus sordidulus*	X	X	
Steller's Jay	*Cyanocitta stelleri*	X	X	
Gray Jay	*Perisoreus canadensis*	X	X	
Northern Raven	*Corvus corax*	X		
Chestnut-Backed Chickadee	*Parus rufescens*	X	X	
Brown Creeper	*Certhia americana*	X	X	
Red-Breasted Nuthatch	*Sitta carolinensis*		X	
Pacific Wren	*Troglodytes pacificus*	X	X	
American Robin	*Turdus migratorius*	X	X	
Varied Thrush	*Ixoreus naevius*			X
Hermit Thrush	*Catharus guttatus*	X	X	
Swainson's Thrush	*Catharus ustulatus*	X	X	
Golden-Crowned Kinglet	*Regulus satrapa*	X	X	
Cedar Waxwing	*Bombycilla cedrorum*	X		
Warbling Vireo	*Vireo gilvus*	X		
Hutton's Vireo	*Vireo huttoni*	X		
Cassin's Vireo	*Vireo cassinii*	X		
Orange-Crowned Warbler	*Vermivora celata*	X	X	
Hermit Warbler	*Dendroica occidentalis*	X	X	
Black-Throated Gray Warbler	*Dendroica nigrescens*	X	X	
Wilson's Warbler	*Wilsonia pusilla*	X	X	
Western Tanager	*Piranga ludoviciana*	X	X	
Black-Headed Grosbeak	*Pheucticus melanocephalus*	X	X	
Evening Grosbeak	*Coccothraustes vespertinus*	X		
Purple Finch	*Carpodacus purpureus*			X
Spotted Towee	*Pipilo maculatus*			X
Dark-Eyed Junco	*Junco hyemalis*	X	X	

There was only 1 detection of a Pacific wren on SNF subplot 15 and two more detections immediately east of the SNF plot boundary (the flag marking one of the detection locations could not found when collecting UTM coordinates, so is not represented on the map; Figure 3). There were 20 detections of Pacific wrens on or near the City plot. The species was present on 5 of the City subplots and subplot 12 met the criterion for occupancy. Most detections of this species were in close proximity to downed logs and piled woody debris that remained after the recent thinning that had occurred east and south of the City plot.

Surprisingly, there was not a single detection of any avian species foraging or engaged in breeding behaviors in the small meadows at either plot. Vegetation heights were generally less than 50 cm (20 in) during the first three visits, so bird detectability was relatively high compared to forest-dominated areas. Therefore it seems unlikely that territorial birds would have been undetected during all 6 visits to the sites. Perhaps the meadows will provide better foraging opportunities for granivorus birds in late summer and fall when seeds of grasses and forbs have matured.

There was a high level of forest bird activity near the edges of meadows where sunlight penetrated the canopy and promoted the development of a diverse shrub layer. Although statistical comparisons between the SNF and City sites are not possible given the case study design of this monitoring survey, the difference in the diversity of the bird communities between the SNF and City plots do not appear to be biologically significant.

Although I was unable to prepare territory maps due to the lack of necessary detections, the shortfall in data was not severe. It's likely that there would have been sufficient observations for mapping had all of the survey effort been directed at the SNF plot. I recommend including two additional visits during the breeding season if both the SNF and City plots are included in future surveys.

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Figures

Figure 1. Locations and behavioral observations of dark-eyed juncos on the SNF Pioneer Butte and City of Corvallis avian survey plots. 2011. 2009 NAIP imagery was taken prior to the meadow restoration completed at the City plot. Inset diagram shows the pattern of species occupancy at each plot.

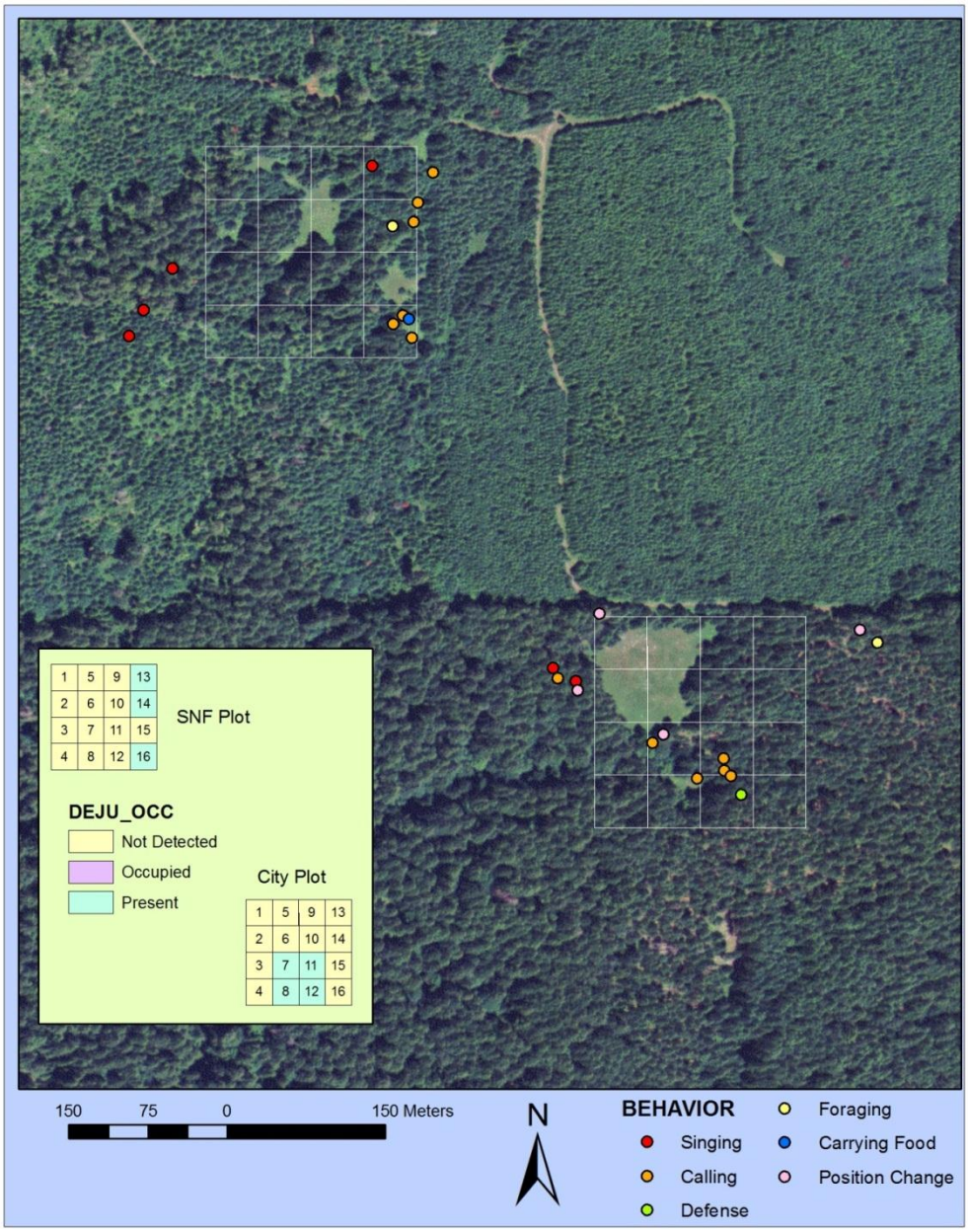


Figure 2. Locations and behavioral observations of hermit warblers on the SNF Pioneer Butte and City of Corvallis avian survey plots. 2011. 2009 NAIP imagery was taken prior to the meadow restoration completed at the City plot. Inset diagram shows the pattern of species occupancy at each plot.

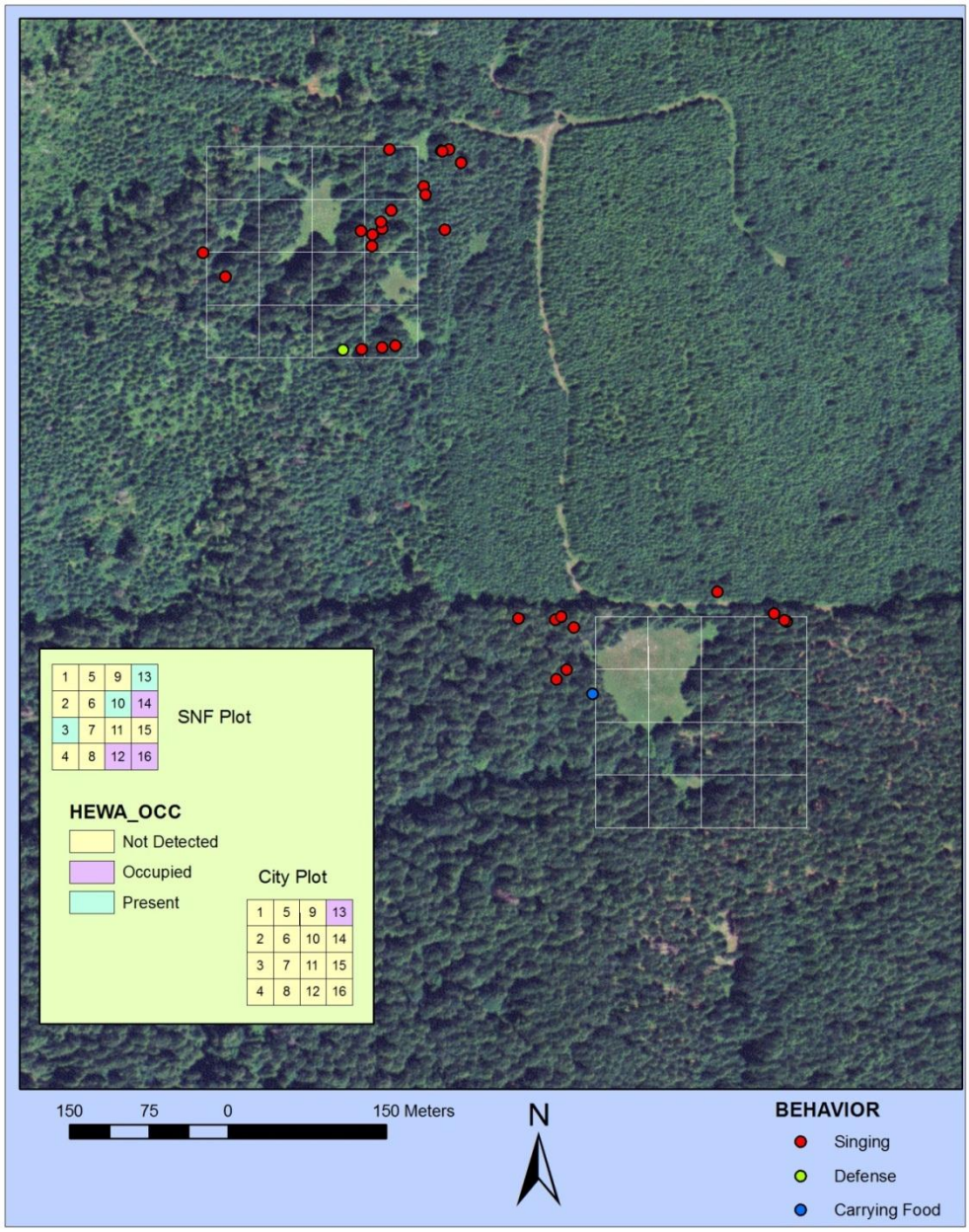
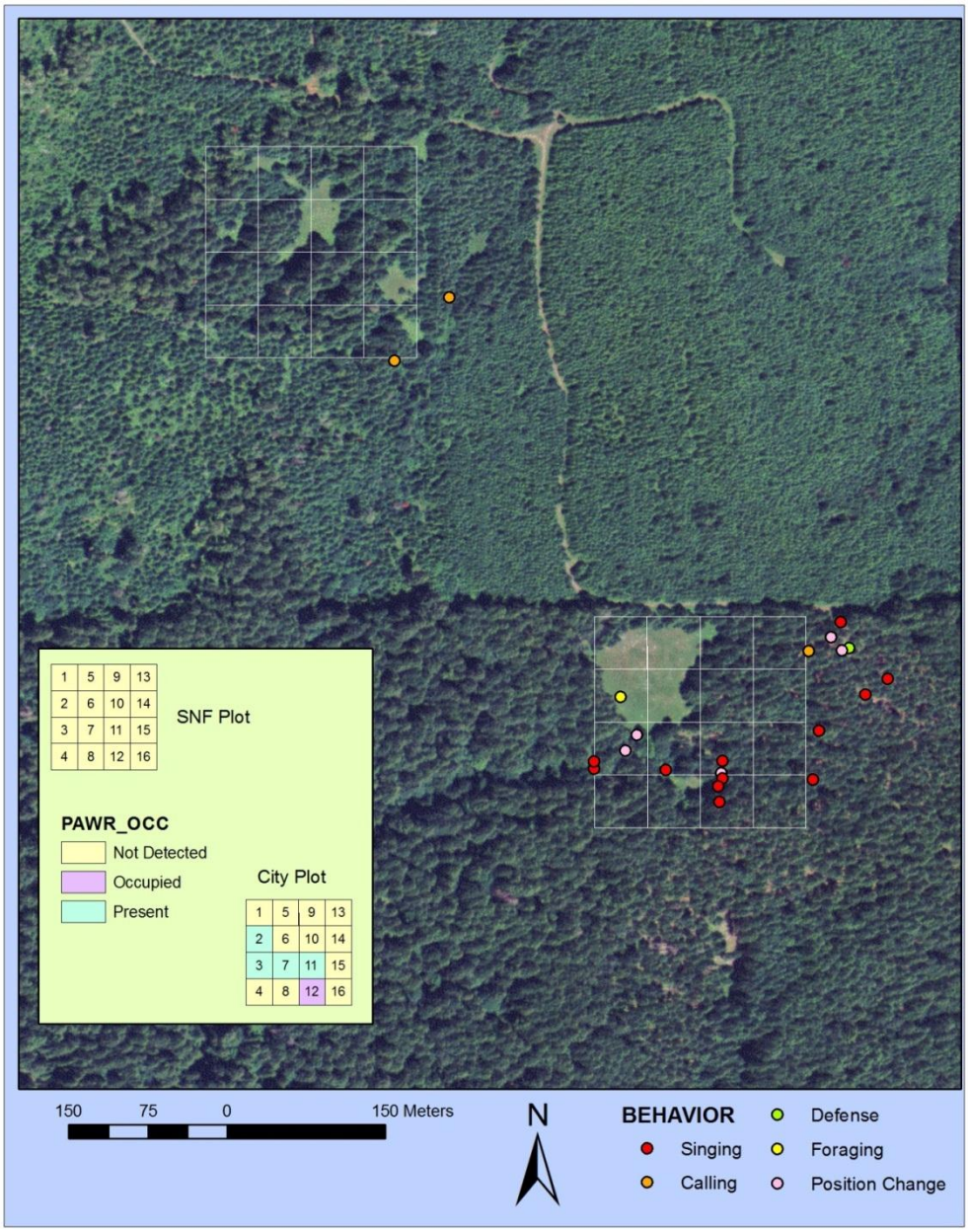


Figure 3. Locations and behavioral observations of Pacific wrens on the SNF Pioneer Butte and City of Corvallis avian survey plots. 2011. 2009 NAIP imagery was taken prior to the meadow restoration completed at the City plot. Inset diagram shows the pattern of species occupancy at each plot.



Appendix: Indicator Species Accounts

Hermit Warbler

A neotropical migrant arriving in Oregon in April. Hermit warblers are among the most common avian species during summer in western Oregon forests (Janes 2006). Population densities may reach 344 individuals/km^2 (Weins and Nussbaum 1975). The species is usually found in conifer dominated stands but also use conifer-oak ecotone habitat in western Oregon (Morrison 1982). Prefer complex, multi-layered forest canopies (Morrison 1982, Janes 2006). Chambers et al. (1999) reported that hermit warbler abundance decreased when silvicultural treatments such as clearcut or two-story harvesting reduced canopy complexity. In a study of songbird response to low-severity prescribed fire, hermit warbler counts decreased for 6 years following treatment (Bagne and Purcell 2011). Mean territory size in southwest Oregon was reported to be 0.65 ha (n = 8; Janes 2006).

Dark-Eyed Junco

Dark-eyed juncos may be year-round forest residents, or short-distance migrants that overwinter in agricultural areas or cities and move to forests at higher elevations in the summer (Nehls 2006). Dark-eyed juncos are closely associated with forest openings and early-seral forest communities during the breeding season (Mannan and Meslow 1984). Hagar et al. (1996) reported that dark-eyed juncos were more abundant in thinned vs unthinned Douglas-fir forests. The species forages on or near the ground. Nests are typically constructed in a depression on the ground but are occasionally placed in a shrub (Nehls 2006). Territory size is reported to be 0.9 – 1.4 ha (Brown 1985).

Pacific Wren

Previously named the winter wren (*Troglodytes troglodytes*). A resident species associated with moist conifer forests, red alder stands, and Oregon white oak woodlands (Weikel 2006). In McDonald Forest (Benton County, Oregon), the abundance of Pacific wrens decreased following clear-cut harvesting, but not in small (0.2 ha) group selection cuts (Chambers et al. 1999). Two studies in the Oregon Coast Range reported greater abundance of the species in riparian areas than adjacent upslope areas (Hagar 1999, McGarigal and McComb 1995). Downed logs, root wads, and residual woody debris are an important habitat element for Pacific wrens. Of 25 nests found during a study in the Oregon Coast Range, 16 were discovered under logs (Weikel 2006). Territory size ranges between 0.37 – 2.38 ha in British Columbia (Waterhouse 1998).

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